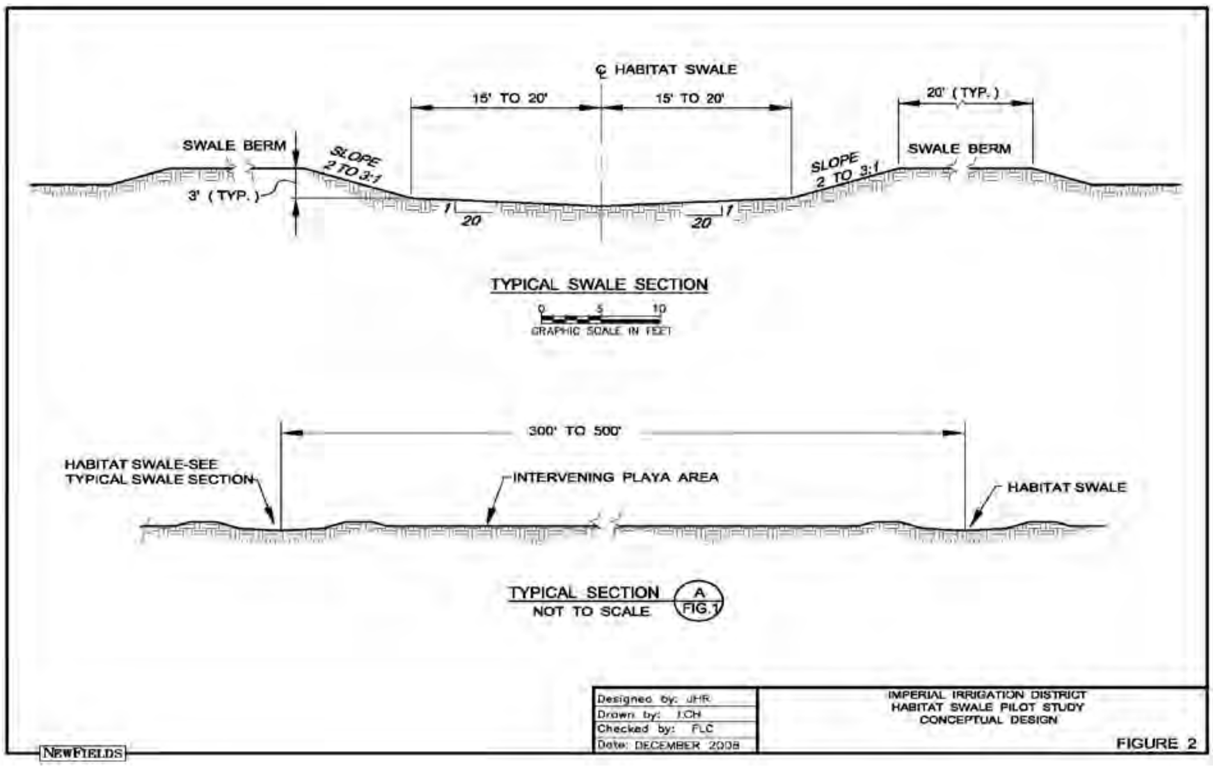
APPENDIX E – DUST CONROL MEASURE DESCRIPTIONS

E.1 Vegetated Swales

Habitat swales are vegetated, earthen channels constructed by raising pairs of parallel berms approximately 60 feet apart, with adjacent pairs of berms spaced 200 to 500 feet from one another (Figure E-1). Habitat swales operate on the principle of interrupting wind fetch (the distance that wind has traveled over an unobstructed area) on a playa, leading to reduced wind velocity at the soil surface and suppression of sand flux and dust emissions in downwind areas. After vegetation is established, swales capture sand and immobilize it beneath the plant community's canopy. A combination of periodic surface wetting, natural crusting, regional reduction in sand motion, and reduced surface wind velocities due to sheltering of areas downwind of the swales results in dust control over the entire swale and inter-swale area.

Figure E-1. Habitat Swale Cross-Section Conceptual Design



E.1.1 Configuration

As described above, swales will consist of parallel berms approximately 60 feet apart. The swales will be designed with a 30- to 40-foot bottom width and four feet total depth. The top width of each earthen side berm will be approximately 20 feet, with the top of the berm approximately two feet above existing grade. The configuration of the swales will be refined during design based on site-specific investigations (i.e., topography, surface erosion potential, primary wind direction) and desired dust control efficiency.

The swales and berms will be constructed from local, on-site materials. The import or borrow of soil, and the disposal of excess fill will be minimized.

Channel lengths and profile gradients will depend on site topography, but in general will be designed so that pulsed irrigation flows can be sustained along the full length of the swale without requiring excessively large and erosive flows at the head end. Given the relatively level topography of the sea floor (and therefore exposed playa in the future), longitudinal profile gradients are expected to be low. The swale cross-section will be sloped toward the center, where there will be a low-flow channel to provide drainage. Swale tailwater will be recycled for other uses or will flow to the Sea. Analysis of soil, wind, and water erosion potential will be conducted during the design phase and will help to determine adequate design criteria.

To achieve regional reductions in sand motion, and thus dust emissions, a network of swales (as described above) will be constructed at intervals of 200 to 500 feet, with traffic avoided to the maximum extent feasible on the intervening playa. A combination of natural crusting, regional reduction in sand motion, and reduced surface wind velocities due to sheltering of areas downwind of the swales will result in dust control over the entire swale and inter-swale area. Final swale spacing will be determined during the design phase as a function of topography, surface erosion potential, primary wind direction, and desired dust control efficiency targets.

E.1.2 Vegetation

Swale cross-sections would mimic natural channels, in which pulsed flow would spread laterally from the cross-section's low point. This favors development of a broad swath of vegetation, ranging from hydrophytic near the centerline to xeric and halophytic along the margins. Plant species will be selected based on suitability for range of the hydrologic regime and saline soil conditions of the site and location along the length of the swale (i.e., wetter conditions on the swale bottom and upstream; drier, more saline conditions on the swale margins and downstream).

In general, species will include sedges, rushes, and similar wetland vegetation located in the bottom and head end of the swale; grasses and other herbaceous species on both sides and downstream reaches of the swale; and shrub species up to the boundaries of anticipated swale seepage. Rhizomatous species should predominate in the swale because they increase the likelihood of re-establishment during long-term maintenance/management without the need for extensive re-planting. Vegetative cover within the swale will be established quickly, with gradual succession to more diverse native species. Stands of vegetation will provide ecological benefits (i.e., microhabitats) similar in character to desert wetlands and xeric native desert vegetation. This vegetation approach tends to discourage (but does not eliminate) establishment of invasive species, such as Tamarisk.

E.1.3 Operation

The swales will be irrigated by pulse irrigation to shorten water's residence/travel time and therefore minimize stagnant water in the swales. During establishment, drain water (inflows to the Sea) would be pulsed through each swale bi-weekly. As vegetation is established, inflows will likely be reduced to a frequency of every few weeks, or longer, as needed to maintain vegetative growth. After establishment, water would be pulsed through each swale 5 to 12 times annually. The timing and duration of the pulses will be a function of inflow availability, soil conditions, and plant irrigation needs. Irrigation frequency and duration will be evaluated during design and the pilot study.

Water flow into each swale will be controlled with slide gates. Open-channel flow will be measured near each gate structure to measure flows entering each swale. The number of swales that can be irrigated simultaneously will be determined by balancing the required flow rate with the available inflow supply. Details regarding flows into the swales, such as amount of flow, cycle times, cutoff time, and other parameters, will be developed during the final design phase.

Tractor and backhoe/excavation (mainly tracked) equipment will be used during construction and operation of the swales and irrigation systems; lighter, wheeled equipment may be employed for planting/maintenance of vegetation. Intermittent tractor and/or backhoe access will be required during the maintenance activities, including, but not limited to, cultivation and weed control. Intermediate access between periods of maintenance will likely be by small utility four-track vehicles.

E.2 Plant Community Enhancement

The central concept of this Dust Control Measure (DCM) is managed enhancement of existing vegetation onto new playa areas. As the Sea recedes, plant communities along the shoreline may naturally expand, especially where freshwater inflows create fresher, shallow groundwater and/or leach salts from newly exposed playa and create more favorable growing conditions (Figure E-2). Species would likely include a mix of sedges, rushes, and similar wetland vegetation located near the wet shoreline; grasses and other herbaceous species near the middle of the landscape; and shrub species in drier areas near and above the historic shoreline. These plant communities can achieve plant cover densities that postpone or eliminate the need for more resource-intensive DCMs.

Figure E-2. Existing Playa Vegetation Would be Expanded and Enhanced Under the Plant Community Enhancement Dust Control Measure

E.2.1 Configuration

The central concept of the vegetation enhancement DCM is enhancement of existing vegetation that can spread onto new playa as the Sea recedes. Configuration of the DCM, selection of vegetative species, and irrigation design will be determined by the existing vegetation and site-specific (landscape position, hydrologic, and salinity) conditions. Species would likely be a mix of sedges, rushes, and similar wetland vegetation located near the wet shoreline; grasses and other herbaceous species near the middle of the landscape; and shrub species in drier areas near and above the historic shoreline. Hydrophytic vegetation would likely line watercourses as they cross the playa.

As the Sea continues to recede, it is anticipated that the species mix (with the right management) will migrate down the playa with the shoreline. Over time, needed vegetation densities may no longer be sustainable in some areas without additional inputs, such as irrigation and/or artificial drainage. At this point, based on monitoring data, sensitive areas would likely be transitioned to another DCM as needed to sustain dust mitigation performance.

E.2.2 Operation

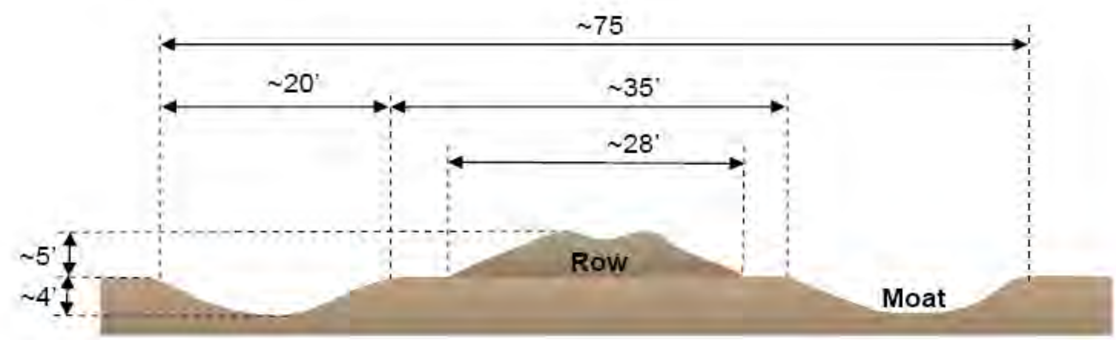
Any combination of flood, pulse, or drip irrigation may be used to meet plant water demand. When needed, fertilizer will be added to irrigation water to stimulate and support vegetative cover levels needed to meet the dust control efficiency requirements. The applied nutrients may include, but are not limited to: nitrogen, phosphorus, and potassium fertilizers, as well as small amounts of micronutrients. Soil and plant tissue will be monitored to determine fertilizer application rates based on plant nutrient needs, and to avoid excess application that might induce off-site migration of applied nutrients.

Tractor and tillage (tracked and/or wheeled) equipment may be used during construction and operation of the DCM, and for planting/maintenance of vegetation. Intermittent tractor and/or backhoe access will be required during the maintenance activities, including, but not limited to, cultivation and weed control. Intermediate access between periods of maintenance will likely be with personal and small utility four-track vehicles.

E.3 Moat and Row

Moat and row consists of an array of earthen berms (rows) flanked on either side by ditches (moats). Figure E-3 is a conceptual cross-section of this type of DCM. Spacing can vary depending on the surface type, the control effectiveness required, and the intensity of adjacent sand sources. Moats control dust by capturing moving soil particles and rows physically shelter the downwind playa by lifting wind velocity profiles, thereby reducing velocity at the soil surface. Moats and rows are constructed to run perpendicular to primary wind vectors. Dust control effectiveness can be enhanced by reducing the distance between rows, increasing the height of the rows, vegetating rows, or using gravel, sand fences, or similar methods to enhance sand capture between rows.

Figure E-3. Conceptual Cross-Section of a Moat and Row Dust Control Measure



E.3.1 Configuration

Moats and rows are generally parallel to one another and spaced at variable intervals so that fetch between rows is conducive to dust control. Spacing can vary depending on the surface type, the control effectiveness required, or exposure to and capture of sand coming from offsite. Previous experience indicates that Moat and Row spacing will generally vary from 250 to 1,000 feet. Spacing of Moat and Row elements is interdependent with cross-section design criteria (e.g., taller elements that shelter longer downwind fetches can be more widely spaced).

E.3.2 Operation

During operation, the Moat and Row array may need to be altered, improved, or maintained to achieve the required level of dust control. The extent, nature, and timing of these operational activities will be determined by monitoring results. Operational activities may include the following:

1. Construction of additional, intermediate moats and rows

2. Repair of existing moats and rows, mainly through excavation of adjacent playa to form new moats, and burial of sand-filled Moat and Row margins with spoil, effectively fattening the original row in the repaired section

3. Addition of sand fences to increase row height or to enclose the site along an unprotected margin

4. Watering of moats or area between Moat and Row elements

5. Irrigation and planting of vegetation on rows or area between Moat and Row elements

6. Gravel armoring along the tops of rows to prevent erosion of the row

E.4 Water-Efficient Vegetation

In this DCM, control is achieved by vegetating playa surfaces with salt- and drought-tolerant species that stabilize and suppress soil and sand movement beneath their canopies. Water-efficient vegetation pilot projects will be conducted to assess the effect of different levels of infrastructure, vegetation density, and vegetation uniformity on dust control efficiency, as well as water use and cost efficiency.

E.4.1 Configuration

Vegetation will be seeded or planted on raised beds 1 to 3 feet high and spaced 5 to 15 feet apart (center-to-center). Previous work on dry, saline playas suggests that the most desirable species for dust control are salt- and drought-tolerant, may be rhizomatous (growth by the spread of underground roots and shoots), and must provide adequate cover even during dormant periods. Saltgrass (*Distichlis spicata*) is a common species, but native shrubs, such as salt bushes (*Atriplex* spp.), greasewood (*Sarcobatus vermiculatus*), and seepweed (*Suaeda moquinii*) may also be used alone or in combination with saltgrass. A mix of native species will provide the needed diversity to maintain adequate cover levels, reduce water demand, and suppress invasive species. Species diversity will also allow better cover within the vegetated areas because different species can occupy different microhabitats. This vegetation approach tends to exclude (but does not eliminate) invasive species, such as Tamarisk.

E.4.2 Operation

Flood, pulse, or drip irrigation will be used to meet plant water demand needs. When needed, fertilizer will be added to irrigation water to stimulate and support adequate vegetative growth and cover levels needed for dust control. The applied nutrients may include, but are not limited to: nitrogen, phosphorus, and potassium fertilizers, as well as small amounts of micronutrients. Soil and plant tissue will be monitored to determine fertilizer application rates based on plant nutrient needs, and to avoid excess application that might induce off-site migration of applied nutrients.

Where soil or groundwater conditions so dictate, drainage improvements will be made to reduce the influence of saline shallow groundwater on the plant root zone. Drainage improvements may include: augmentation of natural drainage by increasing the size (height and width) of the raised beds; excavation of drainage interceptor canals; and/or installation of a subsurface drainage network to maintain an adequate depth of leached and unsaturated soil for plant rooting. Drains will consist of perforated plastic pipes installed in covered trenches and placed between 4 and 10 feet below ground surface. The drains will be enveloped by coarse material (fine gravel or sand) and wrapped in a fabric liner to prevent sediment movement into the perforated pipe, while still allowing for water collection. Final site conditions, design needs, operational inputs, vegetative cover levels, and control efficiency requirements will determine the ultimate mix of infrastructure to achieve dust control.

Tractor and backhoe/excavation (tracked and/or wheeled) equipment will be used during construction and operation of the DCM and irrigation systems, and for planting/maintenance of vegetation. Intermittent tractor and/or backhoe access will be required during the maintenance activities, including, but not limited to, cultivation and weed control. Intermediate access between periods of maintenance will likely be with personal and small utility four-track vehicles.

E.5 Surface Roughening

This DCM consists of roughening the land surface, typically with conventional tillage implements, depending on soil conditions and the target roughness. The roughened surface is less susceptible to erosion due to the lifting of the boundary layer of moving air further above the land surface, and due to the capture of mobile sand within the furrows created by the roughened surface. To maintain control over time, Surface Roughening may need to be repeated periodically as the land surface may be smoothed by erosion, sedimentation, and settling.

E.5.1 Configuration

Where less than 100 percent of the land surface can be tilled to achieve target levels of control, Surface Roughening can be done in blocks or strips that facilitate tillage by minimizing turning, and that avoid traffic on untilled areas to the maximum extent practicable. The long axis of tilled blocks should be oriented perpendicular to the principal wind vectors. Long, uninterrupted fetches across untilled areas should be avoided.

For heavier (more clayey) soils, relatively deep cuts will require substantial draft power and have a relatively narrow working width (per pass), whether soil is turned with a dozer blade or plow. However, resulting roughness is substantial and should not require re-tillage as frequently as lighter soils.

On lighter (sandier) soils (which are rare on the Salton Sea playa), Surface Roughening may be more superficial and may be done with lighter, wider equipment (e.g., a sandfighter). It should therefore proceed more rapidly, but will likely have to be maintained at more frequent intervals.

E.5.2 Operation

Surface Roughening has significant cost and operational advantages over other dust control approaches. Relative to other DCMs, it can be designed and installed at fairly low cost with unspecialized equipment. However, maintenance costs may be significant, depending on the average return time for maintenance and the types of implements used. One of the great strengths of Surface Roughening, where applicable, is its potential for flexible, rapid, and relatively low-cost deployment.

The main challenges of Surface Roughening are the need to adapt the approach to soil conditions and required level of control, and the potentially frequent maintenance activity. It could also be that, as soils dry on the playa, the effectiveness of Surface Roughening may decline, and the cost of adequate control may increase. Over time, Surface Roughening could also potentially become a significant dust source, both due to dust emissions during the tillage operation, and if the roughened surfaces are no longer sufficiently moist and stable to provide control. On the other end of the spectrum, when soils are too moist, it is difficult to achieve the draft power needed to pull or push equipment, and workability of the soil, functioning of equipment, and resulting roughened surface conditions can all be compromised.

E.6 Shallow Flooding

The goal of the Shallow Flood DCM is to provide dust control by maintaining a sufficiently wet surface, thereby reducing saltation and dust emissions. The areal extent of wettingdepends mainly upon the amount of water present on the surface, evaporation rate and lake bed topography, and required control efficiency.

E.6.1 Configuration

Shallow flooding can vary from sheet flow, with , consists of releasing water from arrays of low-flow water outlets spaced at intervals of between 60 and 100 feet along pipelines laid along lake bed contours. The pipelines are spaced between 500 and 800 feet apart. This arrayed configuration of water delivery creates large, very shallow sheets of braided water channels. Water depths in sheet flooded areas are typically at most just a few inches deep. The lower edge of sheet flooded areas has containment berms to capture and pond excess flows. The water slowly flows across the typically very flat lake bed surfaces downhill to tail-water ponds where pumps recirculate the water back to the outlets.

To maximize project water use efficiency, flows to sheet flow areas are regulated at the outlets so that only sufficient water is released to keep the soil wet. Although the quantity of excess water is minimized through system operation, any water that does reach the lower end of the control area is collected and recirculated back through the water delivery system. At the lower end of the sheet flooded areas, or at intermediate locations along lower elevation contours, excess water are collected along collection berms and pumped back up to the outlets to be reused.

Pondflooded areas have water containment berms that allow ponds to be formed that submerge the emissive lake bed areas. These ponds are much deeper than sheet-flooded areas—pond waters are up to four feet deep. The containment berms are typically rock-faced to protect them from wave erosion. Water is usually delivered through one large water inlet per pond. Water is delivered to the pond area until the pond reaches a size and depth sufficient to submerge the required amount of emissive area. Water delivery then ceases until evaporation reduces the pond size to a set minimum.

Non-wetted infrastructure associated with the Shallow Flood DCM includes raised berms, roadways, equipment pads and their associated sloped shoulders. In some cases the shoulders are rock-faced to protect them from wave erosion. Well-traveled roads are typically paved with gravel; less-traveled roads and berms are unpaved. Shallow Flooding requires water transmission, distribution and outlet infrastructure, excess water retention, collection and redistribution infrastructure and the construction of electrical power lines, access roads and water control berms

E.6.2 Operation and Maintenance

Water flows during the dust season will be maintained to provide the required water coverages in substantially evenly distributed standing water or surface-saturated soil. Maintenance activities associated with Shallow Flooding consist of grading, addition of supplemental water outlets, and berming on the control areas to ensure uniform water coverage and prevention of water channeling. Other activities include regular and preventative maintenance of pipeline, valves, pumping equipment, berms, roads and other infrastructure.

E.6.3 Monitoring

The actual wetness coverage for Shallow Flooding areas can be determined using Landsat Satellite Imagery. Satellite imagery is assessed using the Shortwave Infrared band (SWIR) and thresholding to derive a spatial map of standing water and saturated soil surfaces. The following portions of the areas designated for control with Shallow Flooding are exempted from the wetness coverage requirements:

1) Raised berms, roadways and their shoulders necessary to access, operate and maintain the control measure which are otherwise controlled and maintained to render them substantially non-emissive.

2) Raised pads containing vaults, pumping equipment or control equipment necessary for the operation of Shallow Flooding infrastructure which are otherwise controlled and maintained to render them substantially non-emissive.

E.7 Gravel Cover

Gravel Cover forms a non-erodible surface when the size of the gravel is large enough that the wind cannot move the surface. If the gravel surface does not move, it protects finer particles from being emitted from the surface. Gravel and rock coverings have been used successfully to prevent wind erosion from mine tailings in Arizona (Chow and Ono, 1992).

E.7.1 Configuration

A two to four-inch layer of coarse gravel (½ to 1½-inch and larger rocks) laid on the surface of the playa will prevent PM10 emissions by: (a) preventing the formation of efflorescent evaporite salt crusts, because the large pore spaces between the gravel particles disrupt the capillary movement of saline water to the surface where it can evaporate and deposit salts; and (b) creating a surface that has a high threshold wind velocity so that direct movement of the large gravel particles is prevented and the finer particles of the underlying lake bed soils are protected. Gravel Cover is effective on essentially any type of soil surface.

E.7.2 Operation and Maintenance

Once the Gravel Cover has been applied to the playa, limited maintenance would be required to preserve the Gravel Cover. The gravel will be visually monitored to ensure that the Gravel Cover was not filled with sand or dust, or had not been inundated or washed out from flooding. If any of these conditions were observed over large areas, additional gravel will be transported to the playa and applied to the playa surface

E.8 Alternative Land Use

Alternative land use practices can be implemented to cover exposed playa and thus eliminate or significantly mitigate the potential for emissions. Example land use practices include the following:

- **Reclamation of agricultural land.** Portions of exposed playa may be reclaimed for more conventional agricultural activities, such as graminoid forage crops typically grown in the Imperial Valley, or aquaculture crops, such as algae. These crops may be harvested for protein (food) or used as biomass for conversion to energy.

  The development of exposed playa for agriculture will be constrained by irrigation infrastructure, irrigation water availability, and agricultural markets. Certain areas around the southwest quadrant of the Sea have soil types that are suitable for conventional agricultural production of crops. The areas west of the New River delta include soil associations/complexes that are silty clays and various loams. The soils are also considered non-hydric and moderately- to well-drained. Aquaculture farming (i.e., algae and other aquatic vegetation) may be located on exposed playa areas with less suitable soils types. IID will continue evaluating areas around the Sea to evaluate reclamation potential for agricultural activity.

  IID is also evaluating several halophytic plants that might be suitable for crop use in playa areas or other high salt content soils. Vegetating playa with high salt tolerant plants may allow the reclamation of playa areas with less well drained soils and/or soils with higher salt content. IID may also elect to reclaim areas of playa for agricultural purposes or to develop specific crop types that could be used on playa areas without partnering with local entities.

- **Energy Generation Projects.** Energy generation projects that use geothermal and solar resources may also be located on exposed playa. The surface facilities needed to generate energy from these resources could be located on exposed playa and could also, with prior planning and design modification, be co-located with habitat projects.

  Geothermal: The Refined Conceptual Modeling and a New Resource Estimate for the Salton Sea Geothermal Field, Imperial Valley, California (Hulen, et. al. Sept 2002) defined the geothermal resources at the Salton Sea as more extensive than previously thought. The so-called Salton Sea Shallow Thermal Anomaly is mapped from east of the New River delta, through the Alamo River delta area and the Morton Bay/Mullet Island area and along the east side of the Salton Sea to the Imperial Wildlife Area-Wister Unit. The potential geothermal area extends out into the Sea up to three miles in some areas.

Solar: There are two types of solar energy recovery being considered for installation on exposed playa: photovoltaic panel technology and solar gradient ponds. Photovoltaic panel technology is a relatively well proven technology, although it has not been tested on the extreme environment of the Sea playa.

Solar gradient ponds, which extract energy by using solar rays to heat the lower water layer in a stratified impoundment, are being considered as a longer-term (greater than five years) use for the playa. While this technology has been moderately successful in other areas, it has not been tested in the Imperial Valley.

E.9 Species Conservation Habitat and other Habitat-Based Uses

Biological habitat is another type of land use that can cover exposed playa and thus eliminate or significantly mitigate the potential for emissions (analogous to Shallow Flood). Numerous habitat restoration projects are proposed in the Salton Sea area in an effort to sustain the fish and wildlife currently dependent on the Sea. Some of these projects will extend onto areas of the playa that would otherwise be exposed. These projects include, but are not limited to, the following:

- The Species Conservation Habitat Project will be located at the southern end of the Sea and will create up to 3,770 acres of relatively shallow water habitat. Ponds to support fish and wildlife species will be constructed and operated by the CA Department of Fish and Game and supplied with a combination of brackish and saline water, blended to maintain an appropriate salinity range.
- The US Fish and Wildlife Service has proposed development of approximately 700 acres of wading and shore bird habitat in Red Hill Bay in an effort to maintain wetland habitat values on this part of the National Wildlife Refuge.
- There is also potential for the Wister Unit of the Imperial Wildlife Area or the Sonny Bono Salton Sea National Wildlife Refuge Complex to expand habitat onto exposed playa.

Staff Report

2018 State Implementation Plan for the Imperial County 12 µg/m^3 PM2.5 Annual Standard

Release Date: April 27, 2018
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CALIFORNIA AIR RESOURCES BOARD

EEC ORIGINAL PKG

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APPENDICES

EEC ORIGINAL PKG

I. INTRODUCTION

California law specifies that the California Air Resources Board (CARB) is the agency responsible for preparing and submitting state implementation plans (SIPs) to the U.S. Environmental Protection Agency (U.S. EPA). In California, local air districts develop and adopt the SIPs while working cooperatively with CARB. Since the State is ultimately responsible for submitting the SIP to U.S. EPA, CARB reviews and approves all SIPs developed by local air districts. If CARB determines the SIP does not meet the requirements set forth in the federal Clean Air Act (Act), CARB may return the SIP to the local air district to address the deficiencies.

In 2015, a portion of Imperial County was designated nonattainment for the 12.0 $\mu g/m^3$ annual PM2.5 ambient air quality standard (NAAQS or standard) necessitating the need to develop a SIP. This report summarizes CARB's assessment of the Imperial County Air Pollution Control District (District) 2018 PM2.5 SIP for the 12.0 $\mu g/m^3$ annual PM2.5 NAAQS (2018 PM2.5 Plan). The 2018 PM2.5 Plan relies on a special provision in the Act that enables states to prepare a SIP when transport of international pollution inhibits the ability to demonstrate attainment of the PM2.5 standard. The CARB staff reviewed the 2018 PM2.5 Plan developed by the District and determined that it met all applicable Act requirements. CARB staff will continue to work with the District and local community groups to develop additional emission reductions beyond the SIP to protect public health.

On April 24, 2018, the District adopted the 2018 PM2.5 Plan to address the annual 12.0 $\mu g/m^3$ annual PM2.5 standard for the Imperial County PM2.5 nonattainment area. The nonattainment area represents a portion of Imperial County that includes the most populated area of the county, including the cities of Brawley, El Centro, and Calexico. The Act requires the U.S. EPA to designate as nonattainment an area that violates the NAAQS and nearby areas that may contribute to the violation. In establishing the PM2.5 nonattainment area for Imperial County, U.S. EPA recognized the unique features and characteristics of the area and determined the boundaries based on multiple factors including air quality, emissions data, population, local meteorology, and geography/topography. Figure 1 shows the PM2.5 nonattainment area in Imperial County.

As a result of ongoing State and local control programs, PM2.5 air quality has improved throughout Imperial County in recent years. Monitors located in the cities of El Centro and Brawley record PM2.5 design values that are well below the standard. However, the Calexico monitor, located within one mile of the international border with Mexicali, Mexico, remains above the annual standard. Due to its proximity to the international border, Calexico is impacted daily by pollution from Mexicali. The highest PM2.5 concentrations in the Imperial County PM2.5 nonattainment area occur at Calexico in the winter months, typically during stagnant weather conditions when the predominant airflow is from the south. These days often coincide with wintertime holiday celebrations in Mexico where the use of bonfires and refuse burning, along with firework displays, are commonplace.

The Act includes a specific provision for areas located next to an international border that allows states to take into consideration the impacts of cross border transport of pollutants on their attainment status. The 2018 PM2.5 Plan demonstrates that emissions in the Imperial County PM2.5 nonattainment area would be at a level sufficient to attain the annual PM2.5 standard in 2021 absent the impact of emissions from Mexicali, Mexico. Areas impacted by cross border pollution must still comply with requirements in the Act to demonstrate that appropriate actions have been taken to reduce local emissions and their air quality impact. For Imperial County, the SIP must include certain requirements and SIP elements for a moderate nonattainment area.

CARB staff continues to work with the District, U.S. EPA, representatives from Mexico's environmental agencies, and local community groups in efforts to improve air quality along the border region. For example, the Border 2020 Program is a multi-agency cooperative effort to improve environmental conditions, including air quality, along the Calexico-Mexico border. CARB's Heavy Duty Vehicle Inspection Program is another focused effort to improve border air quality. Heavy duty vehicles are periodically inspected at border crossings in Calexico to ensure that these vehicles entering the State meet California's strict vehicle emission standards.

Efforts by the District to enhance the dissemination of information about air quality in Imperial County are ongoing. An air quality and health information website notifies residents by email or cell phone when the levels of air pollutants are forecasted to be unhealthy in Imperial County. Residents may also download the free mobile app (Imperial Valley Air Quality) which sends alerts and notifications of the forecasted and current air quality in the region directly to user's mobile phones. The District also leads a "no burn" campaign that provides radio and television broadcasts to help educate residents in both Imperial County and Mexicali about the air quality impact from open burning. The District will continue these efforts as well as evaluate the potential for additional measures to improve air quality in the region.

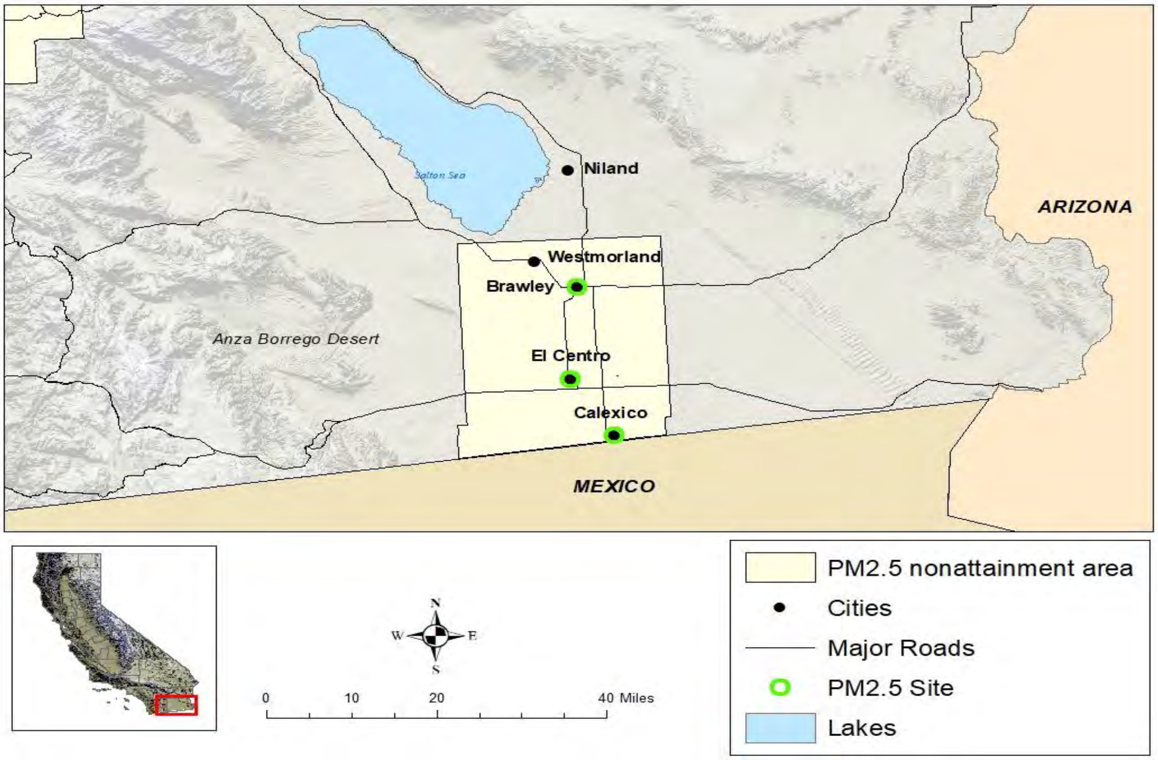
Among the efforts in Imperial County to evaluate emission sources or activities that may potentially contribute to elevated levels of PM2.5 at the community level, the Imperial County Community Air Monitoring Project was launched in 2016. This purpose of this 4-year project is to establish a community air monitoring network for researchers while providing air quality information useful to local residents. The project is coordinated through a collaborative effort by the California Environmental Health Tracking Program with Comite Civico del Valle, a local environmental health advocacy group, and the University of Washington. The monitoring network consists of 40 low-cost air quality sensors that measure PM2.5 and PM10 throughout Imperial County. Although the technology of these air sensors is still evolving and work is on-going to establish the accuracy of their measurements, these sensors enable local residents the ability to collect information on PM levels in their community and provides valuable information on the spatial and temporal variability in air quality in their neighborhoods.

II. BACKGROUND

The Imperial County PM2.5 nonattainment area is an agricultural region located in the southeast corner of California that shares its southern border with Mexicali, Mexico.

Most of the population, commercial activity, and farming operations occur in the PM2.5 nonattainment area, comprising approximately one-fourth the width of the county. The nonattainment area includes the three largest cities in Imperial County - Brawley, El Centro, and Calexico. Each of these cities are similar in size with populations of 25,000 to 43,000 people. A map of Imperial County, the boundaries of the PM2.5 nonattainment area, and the Mexico border area is shown in Figure 1.

Figure 1. Imperial County and the PM2.5 Nonattainment Area



The nonattainment area contains relatively few major industrial sources, with unpaved road dust and fugitive windblown dust emissions representing the largest emission sources. Other significant emission sources in the nonattainment area consist of off-road vehicles, farming operations, and managed burning and disposal.

In contrast, the city of Mexicali, with a population of nearly 700,000, has a large number of industrial, mobile, and area sources. These sources are generally subject to less stringent emission regulations than those in California. As a consequence, emissions from comparable source categories in Mexicali are significantly higher than in the Imperial County PM2.5 nonattainment area for nitrogen oxides (NOx), sulfur oxides (SOx), reactive organic gases (ROG) and ammonia (NH3).

A. Current Air Quality and Trends

The Imperial County nonattainment area is bordered by mountain ranges to the west, east, and southwest. These ranges act as barriers and channel airflow within the Imperial and Mexicali Valleys. Mountain valleys often enhance the formation of temperature inversions and result in little or no mixing of trapped pollutants. This is common in the Imperial Valley, particularly near the international border on nights with light winds. Inversions often occur over multiple days during the winter months resulting in high PM2.5 concentrations. The geography, topography, climate, and similar meteorology throughout the area does not restrict airflow between the Imperial and Mexicali Valleys which results in a shared airshed for the region.

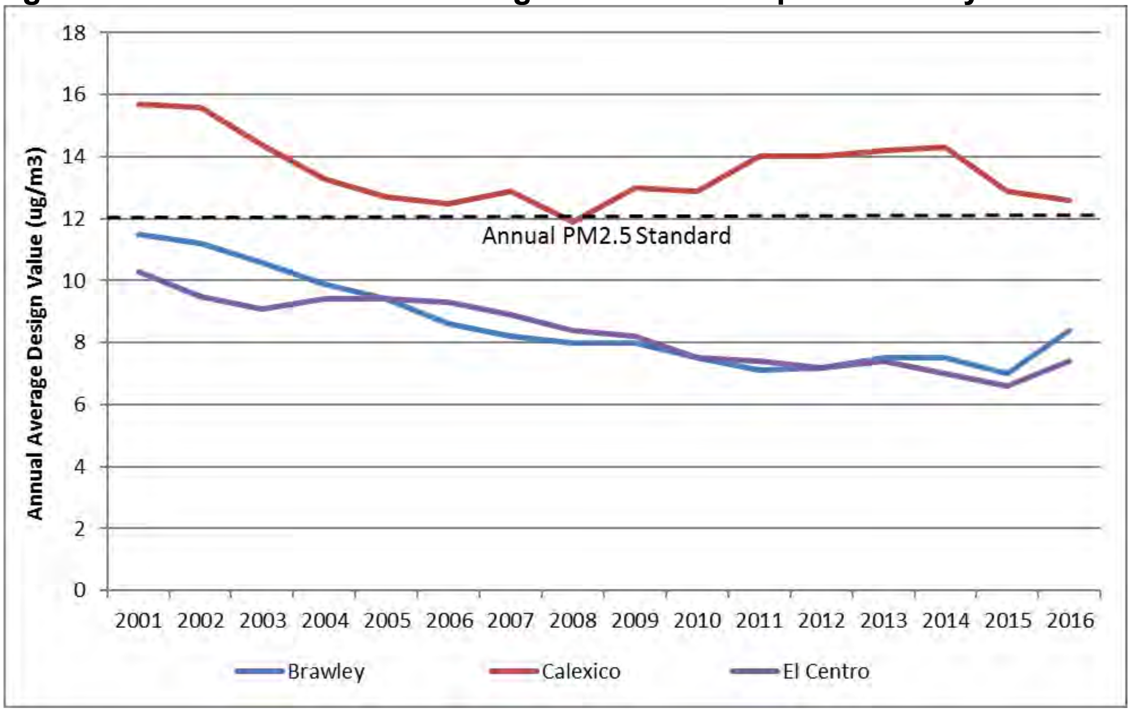
Despite the challenges that Imperial County's geography, topography, meteorology, climate, and proximity to Mexico pose for air quality, the combined efforts of State and local control programs have resulted in improved air quality in the region. The State or Local Air Monitoring Stations (SLAMS) make up the ambient air quality monitoring sites that are operated by State or local agencies for the primary purpose of comparison to the NAAQS. Within the Imperial County PM2.5 nonattainment area, the District operates PM2.5 monitors at stations in Brawley and El Centro, and CARB operates a station in Calexico near the Mexico international border. A map of these monitoring stations is shown in Figure 1. Except for the monitor in Calexico, concentrations recorded at PM2.5 monitors in Imperial County currently comply with the 12.0 $\mu g/m^3$ annual PM2.5 standard.

The metric used for determining if an area attains the PM2.5 standard is called the design value. To reduce year-to-year variability, design values are based on a three-year annual average. In 2016, the Calexico annual PM2.5 design value was 12.6 $\mu g/m^3$, almost twice the design values from monitors located in Brawley and El Centro (7.4 $\mu g/m^3$ and 8.4 $\mu g/m^3$, respectively) (Figure 2). Since the emission sources and magnitudes are similar between Calexico, El Centro, and Brawley, we would assume that the Calexico design value should be in line with the annual design values at El Centro and Brawley, if not for the impact from Mexicali emissions.

Since 2001, air quality in Imperial County has improved. The trend in the PM2.5 annual design value at Calexico has improved significantly over the past few years. In 2001, the annual average at the Calexico monitor was 15.7 $\mu g/m^3$. In 2016, the annual average at Calexico decreased 20 percent to 12.5 $\mu g/m^3$. These reductions are generally due to CARB's mobile source control program and the District's increasingly stringent rules on stationary and area sources, especially on sources of windblown dust.

It is worth noting that the annual design value increased at Calexico from 2011-2014 due to three samples collected in 2011 and 2012 (October 15, 2011, March 31, 2012, and May 25, 2012) being included in the design value calculation. CARB deemed these samples to be invalid and not representative since collocated monitors showed substantially lower concentrations. U.S. EPA requested that these three samples be included as part of the design value calculation. In addition, the El Centro and Brawley design values increased in 2016 due to a few high PM2.5 values caused by wind events that caused the PM2.5 annual average values at these two sites to increase.

Figure 2. 2001-2016 Annual Average DVs for the Imperial County PM2.5 NA



* PM2.5 monitoring began in Imperial County in 1999; 2001 reflects the 1999-2001 design value year.

** The 2015 design value shown above is 12.9 µg/m3 and does not include data from the SPM that was included in 2015 at Calexico. AQS includes data from the SPM in quarters 1 and 4 of 2015, which results in a design value of 13.1 µg/m3.

B. SIP Requirements

The Imperial County PM2.5 nonattainment area was designated as nonattainment by U.S. EPA in 2014, and subsequently classified as moderate in 2015, requiring a SIP submittal by October of 2016. The 2018 PM2.5 Plan was developed under the provisions of section 179B of the Act that allows consideration of the impact of international cross border transport of pollutants. Under this provision, the Act does not require states to develop an attainment strategy addressing pollutants that originate from beyond the United States borders. The 2018 PM2.5 Plan includes a comprehensive technical analysis of these cross border impacts, and a demonstration that the Calexico monitor would have attained the 12.0 µg/m^3 annual PM2.5 standard in 2021, absent these international emissions from Mexicali. The 2018 PM2.5 Plan also addresses Act requirements to demonstrate that appropriate local actions have been taken to reduce emissions and provide ongoing public health protection.

III. CLEAN AIR ACT REQUIREMENTS

The required SIP elements in the 2018 PM2.5 Plan include an emissions inventory of sources in the nonattainment area; Reasonable Available Control Measures/Reasonable Available Control Technology (RACM/RACT) demonstration; Additional Reasonable Measures (ARM); Reasonable Further Progress (RFP); Quantitative Milestones in 2019 and 2022, contingency measures in case the area fails to meet RFP; transportation conformity budgets; and a technical demonstration of cross border impacts.

A. Emission Inventory

An emission inventory consists of a systematic listing of the sources of air pollutants with an estimate of the amount of pollutants from each source and source category over a given period of time. A SIP must contain base year and future year forecasts for all pollutants identified as contributing to PM2.5 concentrations. The base year inventory is an essential element of the plan that forms the basis for all future year projections and establishes the emission levels against which progress in emission reductions will be measured.

U.S. EPA regulations establish general guidelines for selecting an inventory base year. Based on those guidelines, CARB and the District selected 2012 as the base year for the 2018 PM2.5 Plan. In addition to a base year inventory, U.S. EPA regulations require future year inventory projections for specific milestone years. 2019 and 2022 were the inventory years used to address quantitative milestone requirements, and 2021 was the inventory year used to demonstrate attainment of the annual PM2.5 standard. Emission inventories for each of these years were developed for PM2.5, NOx, SOx, ROG and ammonia.

Figures 3 and 4 below show the percent that major source categories contribute to the PM2.5 and NOx emissions in the Imperial County PM2.5 nonattainment area in 2012. Area sources make up over 85 percent of the PM2.5 emissions in the Imperial County PM2.5 nonattainment area, mainly from unpaved road dust, fugitive windblown dust, and managed burning and disposal. More than 85 percent of the NOx emissions in the Imperial County PM2.5 nonattainment area are from mobile sources.

Figure 3. PM2.5 Major Source Categories Percent Contribution (2012)

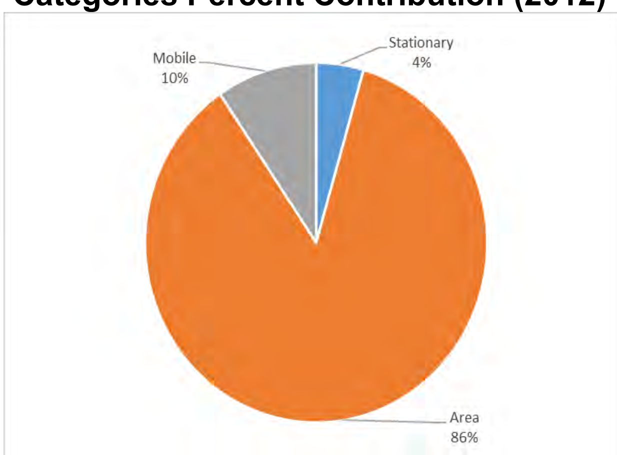
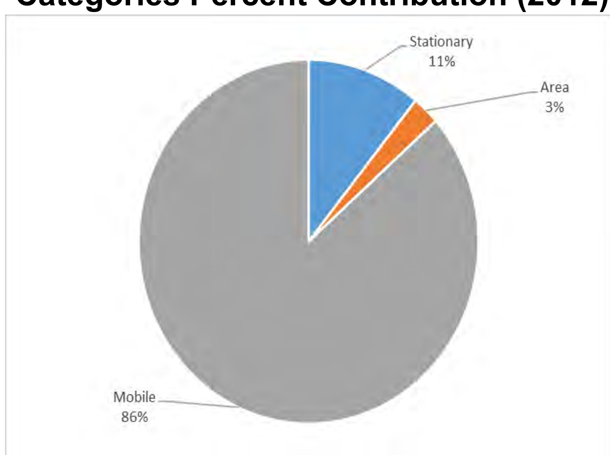


Figure 4. NOx Major Source Categories Percent Contribution (2012)



CARB and the District have developed a comprehensive emissions inventory for the 2018 PM2.5 Plan. The inventory includes a category-by-category review and update using the most recent information available on emissions-generating activities and anticipated population and economic growth in the region. A summary of the emissions inventory along with additional information on the inventory methodologies can be found in Chapter 3 of the District's 2018 PM2.5 Plan.

B. New District Rules

The Act requires that moderate nonattainment areas implement RACM)/RACT for significant emission sources within the nonattainment area. There are currently no major stationary sources of PM2.5 in the Imperial County PM2.5 nonattainment area. However, at the suggestion of the U.S. EPA, the District evaluated the emissions from the top PM2.5 stationary sources in the region and assessed RACT for them. The District determined the stationary sources located within the nonattainment area had a RACT level of control.

For RACM, the District evaluated the adequacy of its control measures on area sources of direct PM2.5 by reviewing the U.S. EPA Office of Air Quality Planning and Standards' Menu of Control Measures (MCM). The MCM is a list that provides a broad set of emission reduction measures for different pollutants and source types. Each control measure was then evaluated against existing District rules that address the same sources. From this analysis, it was determined that the District needed to implement a control measure for New Source Performance Standards (NSPS) for residential wood combustion. Thus, new measures addressing this source are part of the 2018 PM2.5 Plan.

In addition, U.S. EPA guidance requires the District to evaluate additional reasonable measures that could be implemented any time after the four-year period following designation through the end of the sixth calendar year after designation. Based on this guidance, the District identified a control measure to curtail residential wood combustion when 24-hour averaged PM2.5 concentrations are forecasted to exceed 35 $\mu g/m^3$ at Calexico as an ARM. The District also identified ARM related to sources of NOx and NH3 although the 2018 PM2.5 Plan deemed these PM2.5 precursors as not significant. While the comprehensive precursor demonstration has indicated that these PM2.5 precursors do not have a significant impact on PM2.5 levels causing nonattainment in Imperial County, the District is committed to the continued improvement of air quality in the region and thus is presenting rules related to these additional sources and pollutants as part of this 2018 PM2.5 Plan.

Table 1, on the next page, lists the control measures the District plans to pursue followed by a detailed explanation of each ARM measure.

Table 1. District Proposed Control Measures for the 2018 PM2.5 Plan

Measure Type	Measure Title	Adoption Year / Implementation Year	Pollutant	Implementing Agency
RACM	Wood Burning Fireplaces and Wood Burning Heaters – NSPS Certification	2018 / 2019[b]	$PM_{2.5}$	ICAPCD
ARM	Wood Burning Fireplaces and Wood Burning Heaters– Curtailment	2018 / 2020	$PM_{2.5}$	ICAPCD
ARM	Boilers, Steam Generators, and Process Heaters	2019 / 2020	NO_x	ICAPCD
ARM	Biosolids, Animal Manure, and Poultry Litter Composting Operations	2019 / 2020	NH_3	ICAPCD
ARM	Residential Water Heaters	2019 / 2020	NO_x	ICAPCD

Proposed Wood Burning Fireplaces and Wood Burning Heaters Rule-Curtailment

The District is proposing a new rule to implement a control measure that would prohibit/curtail the combustion of wood or solid-fuel products in any wood-burning device in the city of Calexico during a curtailment period. The curtailment period would be defined as any period so declared to the public by the Air Pollution Control Officer when 24-hour averaged PM2.5 levels are forecast to exceed 35 µg/m^3 at the Calexico monitor. This rule would be adopted in or before December 2018 and implementation would begin in 2020. Prior to implementation, the District plans to develop and identify a source of funding for an incentive program for Calexico residents to purchase devices that may operate during mandated curtailment, such as gaseous-fueled devices.

Proposed Boilers, Steam Generators, and Process Heaters Rule

The District is proposing a new rule that will limit NOx emissions from boilers, steam generators, and process heaters rated 0.075 million British thermal units per hour (MMBtu/hr) to less than 5.0 MMBtu/hr. The new rule would affect emissions under the Manufacturing and Industrial and Service and Commercial subcategories, part of the Fuel Combustion Category, in the emission inventory. The new proposed Boiler, Steam Generators, and Process Heaters Rule will limit NOx emissions to less than or equal to 20 parts per million (ppm) of NOx emissions (at 3 percent oxygen [O2] dry). The limit will apply to new and replacement units rated 0.075 MMBtu/hr to less than 5.0 MMBtu/hr. It is estimated the rule would be adopted in the year 2019 and implemented in 2020.

Proposed Biosolids, Animal Manure, and Poultry Litter Composting Operations Rule

The District is proposing a new rule that would regulate biosolids, animal manure, and poultry litter composting operations. Specifically, facilities would be required to follow water management procedures to control ammonia emissions. The new rule would affect emissions under the Composting Solid Waste category in the emissions inventory. Imperial County composting operations largely involve the composting of animal manure, which comes from the county's large confined feedlot operations. It is estimated the rule would be adopted in the year 2019 and implemented in 2020.

Proposed Residential Water Heater Rule

The District is proposing a new rule that would limit NOx emission rates from new residential water heaters rated less than 75,000 Btu/hr. Specifically, the proposed rule would limit NOx emissions to 15 ppm (at 3 percent O2 dry). The new rule would affect emissions classified under the category known as Residential Fuel Combustion – Natural Gas – Water Heater. It is estimated the rule would be adopted in the year 2019 and implemented by January 1, 2020.

C. Quantitative Milestones

SIPs must provide for steady progress in reducing emissions during the years leading to attainment. These interim reductions are known as quantitative milestones. With a base year of 2012, the quantitative milestone years are 2019 and 2022. Emissions are provided in these years for directly-emitted PM2.5 emissions. With already adopted and proposed control measures, PM2.5 emissions are projected to decrease from 2012 to 2021 within the Imperial County PM2.5 nonattainment area. The quantitative milestones for the 2018 PM2.5 Plan involve two new Imperial County rules designed to implement additional control measures and further reduce emissions of PM2.5.

The District plans to adopt a NSPS certification rule that would apply to wood burning fireplaces and wood burning heaters. This rule would require new wood burning fireplaces and wood burning heaters to comply with NSPS certification requirements in effect at the time of installation. The District also plans to adopt a curtailment program for wood burning fireplaces and wood burning heaters which would prohibit residential wood burning in the city of Calexico on days forecasted to exceed 35 $\mu g/m^3$ at the Calexico air monitor. Once these rules are implemented, PM2.5 reductions will occur, leading to decreased PM2.5 concentrations in Calexico. The adoption and implementation of these rules serves as a quantifiable way for measuring progress towards the 2019 and 2022 quantitative milestone requirements.

D. Contingency Measures

Contingency measures are a required element of a nonattainment area SIP and provide additional emission reductions in the event the area fails to meet RFP. If the District fails to meet RFP, within 60 days of U.S. EPA making a determination in the Federal Register the District will lower the curtailment threshold from 35 $\mu g/m^3$ to 30 $\mu g/m^3$ and the curtailment will apply to the entire county when air quality is forecasted to be unhealthy.

The District also commits to lower the applicability threshold for open rural areas subject to District Rule 804 (Open Areas). Currently, District Rule 804 requires dust control on rural areas over three acres. If Imperial fails to meet RFP, the rural area threshold will be lowered to include rural areas down to 1000 square feet. This lowering of the applicability threshold would impose dust controls on an additional 529 rural acres in the Imperial County PM2.5 nonattainment area. The benefits of these two contingency measures collectively exceed the required one year of emission reductions (0.063 tons per day) and follow U.S. EPA's current guidance on contingency measures.

E. Transportation Conformity

Under Section 176(c) of the Act, transportation activities that receive federal funding must ensure that transportation emissions do not interfere with an area's air quality progress. Section 176 of the Act requires that transportation plans, programs, and projects conform to an area's plan before being approved by a metropolitan planning organization. In order for transportation emissions to conform to a plan, the activities must not:

1. Cause or contribute to any new violation of any standard;
2. Increase the frequency or severity of any existing violation of any standard in any area; or
3. Delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

The portion of the total emissions inventory allocated to highway and transit vehicles in the emission inventory is the motor vehicle emissions budget. The 2018 PM2.5 Plan establishes nonattainment area-level on-road mobile exhaust and municipal unpaved road dust emissions. Motor vehicle emission budgets were established for PM2.5 in the baseline year of 2012 and the milestone years of 2019 and 2022 using Southern California Association of Governments (SCAG) motor vehicle activity data and EMFAC2014 (CARB's most current mobile source emission inventory model).

IV. TECHNICAL DEMONSTRATION OF CROSS-BORDER IMPACTS

Section 179B of the Act for international border areas indicates that a SIP "…shall be approved by the Administrator if—(1) [the implementation plan meets all applicable requirements other than the attainment demonstration requirement], and (2) the submitting state establishes…that the implementation plan…would be adequate to attain and maintain the…NAAQS by the attainment date, but for emissions emanating from outside of the United States."[1] U.S. EPA guidance issued in 1994 therefore indicated that those border areas that provide a technical justification of attainment, but for emissions from foreign sources, are relieved of certain planning requirements including development of an attainment demonstration.[2] U.S. EPA guidelines identify the types of information that may be used in evaluating the impact of emissions from outside the U.S. on nonattainment areas. States may use one or more of the identified approaches based on specific circumstances and available data.

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[1] Clean Air Act Amendments of 1990: Public Law 101-549.
[2] See 59 FR 42000-42002 (August 16, 1994).

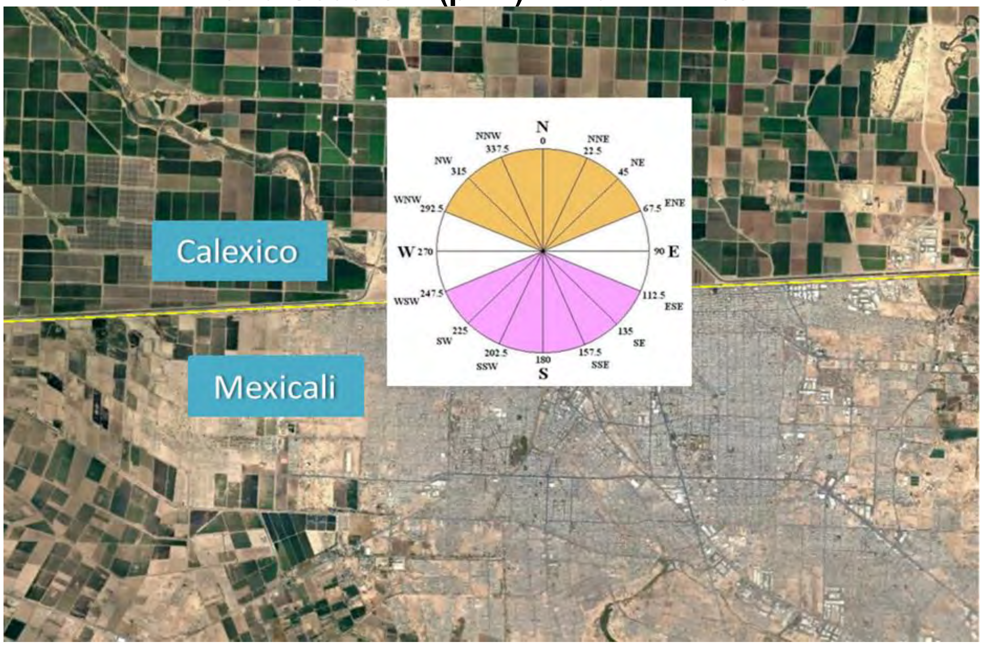
CARB staff examined the available monitoring, emissions, and meteorology data from Calexico, other Imperial County monitoring sites, and Mexicali. Guideline techniques were applied to evaluate the impacts of emissions emanating from Mexicali and Imperial County on attainment of the 12.0 μg/m^3 annual PM2.5 standard.

Staff first compared the area, population, and emissions data for Mexicali and the Imperial County nonattainment area. Mexicali has more than four times the population of the entire nonattainment area and more than 18 times the population of Calexico. Emissions from Mexicali are significantly higher than those in the Imperial County PM2.5 nonattainment area. For example, direct PM2.5 emissions in Mexicali are more than 50 percent higher than the level of direct PM2.5 emissions in the Imperial County PM2.5 nonattainment area, and NOx emissions are more than three times higher than comparable emissions in the Imperial County PM2.5 nonattainment area.

The most recent, verifiable emissions inventory for Mexicali is from 2005 and does not include all of the emissions sources to fairly compare to the emissions in the Imperial County PM2.5 nonattainment area. Windblown dust emissions, for example, are a major source of PM2.5 in the Imperial County PM2.5 nonattainment area but windblown dust and state point source emissions of PM2.5 are missing from the 2005 Mexicali emissions inventory. If windblown dust emissions and state point source emissions in Mexicali were included in the 2005 Mexicali emissions inventory, it is anticipated Mexicali would contribute a much higher share of overall PM2.5 emissions to the total airshed.

Staff also evaluated the relationship between wind direction and the resulting PM2.5 concentrations at Calexico. This analysis paired hourly wind direction data with hourly PM2.5 data to determine what the average PM2.5 impact was from winds that came from the north (Imperial County) versus winds that came from the south (Mexicali) (Figure 5). To determine the appropriate wind direction splits, the compass degrees were split into 16 equal sized bins and assigned as having a northern or southern component. The analysis showed that when the winds came from north, the average PM2.5 concentration measured at Calexico was under the annual PM2.5 standard at 11.7 μg/m^3. However, when the winds came from the south, the average PM2.5 measured concentration at Calexico increased to 20.2 μg/m^3. In addition, winds from the north occurred much more frequently (44 percent) than winds from the south (23 percent) yet the southern winds still had the strongest impact on annual PM2.5 levels at Calexico.

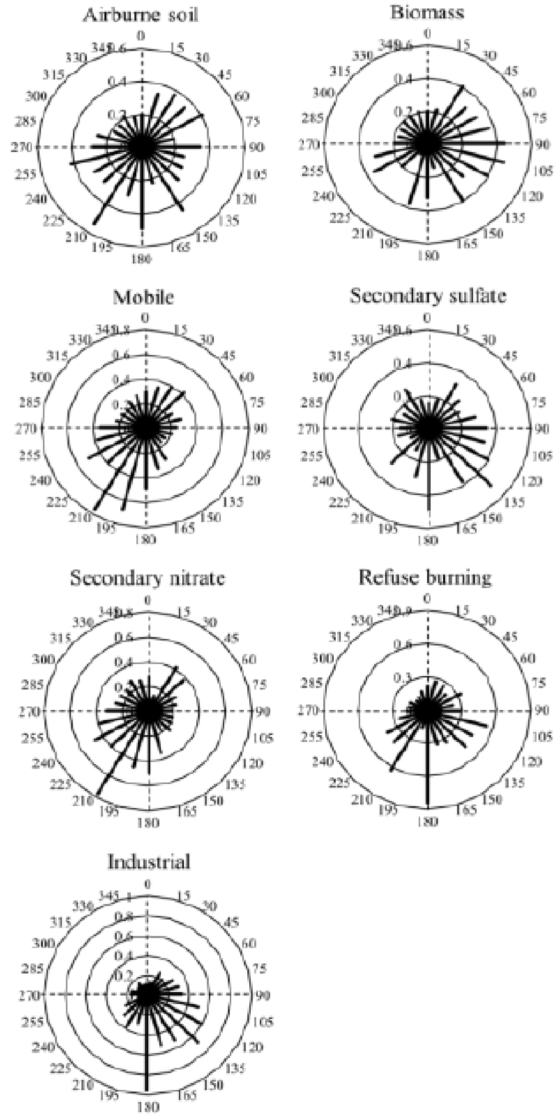
Figure 5. Compass Display of the Northern (orange) and Southern (pink) Wind Bin Arcs



Staff evaluated the chemical composition collected at CARB's Calexico air monitoring site to help identify the type of emissions that result in elevated PM2.5 levels. The chemical composition of the PM2.5 particles at Calexico indicated that combustion, such as produced from motor vehicles or wood and waste burning, is a major source of emissions. The analysis also indicated that elements such as chromium, lead, and zinc, normally measured at very low levels throughout Imperial County and the rest of the State were significantly higher at the Calexico air monitoring site. The potential sources of these elements include the combustion of refuse or other non-biomass materials and industry that does not exist in the Imperial County PM2.5 nonattainment area. Further evaluation of the correlations between wind direction and these source signatures indicated that the origin of these pollutants was south-southeast of the monitoring site in the direction of the border and Mexicali.

Staff conducted various analyses using monitoring data, meteorological conditions, and emissions in the border region to evaluate the impacts of emissions emanating from Mexicali on attainment of the annual PM2.5 standard in Imperial County. Staff assessed Calexico speciation data and conducted a source apportionment analysis which tied speciation data to sources that are present in both the Imperial County PM2.5 nonattainment area and Mexicali. This apportionment method enabled a hypothetical calculation of the annual PM2.5 design value if Mexicali sources were excluded from consideration. This analysis identified seven major sources of pollution (airborne soil, biomass burning, mobile, secondary sulfate, secondary nitrate, refuse burning, and industrial) that impact the Calexico site, with the source direction for the majority of these sources from Mexicali or the border crossing area (Figure 6).

Figure 6. Conditional Probability Function Plots for the Highest 25 Percent of the Source Contributions



Air quality modeling demonstrated that the annual average PM2.5 design value would be 11.7 μg/m^3 at the Calexico PM2.5 monitor in 2021 if emissions from Mexicali were reduced or eliminated. Considered together with air quality data and meteorological influences, the analyses in Appendix A of the 2018 PM2.5 Plan demonstrate that, in 2021, the Imperial County PM2.5 nonattainment area would attain the annual PM2.5 standard of 12.0 μg/m^3 in the absence of emissions from Mexico.

Together with the proximity of Calexico to Mexicali, analysis of the emission inventory for the Imperial County PM2.5 nonattainment area and Mexicali, analysis of the meteorological conditions (wind speed and wind direction) at Calexico, and the chemical composition of samples at Calexico and other monitoring sites, the available evidence supports the international cross-border impact of Mexicali emissions on the Imperial County PM2.5 nonattainment area required under the Act.

V. OTHER CONSIDERATIONS IN IMPERIAL COUNTY

A. Assembly Bill 617

Assembly Bill (AB) 617 (C. Garcia, Chapter 136, Statutes of 2017) provides a new community-focused action framework to improve air quality and reduce exposure to criteria air pollutants and toxic air contaminants in communities most impacted by air pollution. The bill recognizes that while California has seen tremendous improvement in air quality, some communities still suffer greater impacts and will require special attention along with accelerated action. AB 617 builds on the foundation of existing programs, providing additional tools to target actions in communities that bear the greatest burdens. Specifically the legislation sets out a framework that includes:

- Community-level air quality monitoring;
- A State strategy and community emissions reduction programs;
- Expedited schedule for the installation of the cleanest controls on industrial facilities
- Enhanced requirements for the reporting of emissions data including increased penalty provisions for polluters; and
- Grants to local community groups to support active engagement in developing solutions for their communities.

To implement AB 617, CARB has established the Community Air Protection Program (Program). The legislation sets out an ambitious implementation schedule, and CARB must set the overall direction of the Program by October 1, 2018. This includes identifying impacted communities, establishing the criteria for air monitoring and local emissions reduction programs, and developing statewide strategies for reducing emissions. The local air districts also have specific roles and responsibilities and successful implementation will require strong collaboration between CARB and the air districts, as well as with local communities.

B. Agricultural Burning

Imperial County residents have raised concerns about the level of agricultural burning that occurs in Imperial County and the impact it may have on their health. Agricultural burning is a source of PM2.5 emissions that can have localized impacts in the Imperial County PM2.5 nonattainment area. After crops are harvested, the fields and stubble are burned to prepare for the next planting. This burning helps prevent the spread of plant diseases and controls weeds and other pests. Title 17 of the California Code of Regulations (Title 17) provides agricultural and prescribed burning guidelines for each area in California with the goal of minimizing public health impacts. Title 17 specifically requires the District to have rules in place that minimize smoke from agricultural burning.[3] Title 17 also identifies the meteorological criteria for regulation of agricultural and prescribed burning by air basin in order to minimize smoke impacts.

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[3] *Smoke Management Guidelines for Agricultural and Prescribed Burning*. Title 17 of the California Code of Regulations, Subchapter 2, March 14, 2001.

On a daily basis, the District reviews meteorological reports from various airport operators, the National Weather Service, State fire agencies, and CARB to help determine whether the day is a "burn day". Burn/no burn days are declared for the entire county. The District uses a detailed map of Imperial County to ensure that burns are allocated correctly for minimal-to-no smoke impacts on the public. Daily burn authorizations specify the amount, timing, and location of each burn event. The burn authorization system considers the following factors before declaring a burn day: (1) air quality; (2) meteorological conditions expected during burning, including wind speeds and directions at the surface and aloft, and atmospheric stability; (3) types and amounts of materials to be burned; (4) location and timing of materials to be burned; (5) locations of nearby smoke sensitive areas (schools, residential neighborhoods, etc.); and (6) smoke from all burning activities, including burning in neighboring air districts or regions which may affect the District or region.

The District's Rule 701 prohibits agricultural burning on any day declared to be a no-burn day by CARB, a fire control agency, or the District's Air Pollution Control Officer. Residents may report illegal agricultural burning to the District enforcement office. If the burn is deemed to be illegal, the District will conduct an inspection to obtain information on the violation and fines will be assessed on the landowner. Rule 701 also specifies the type of waste material that is allowed for burning, along with appropriate drying times, and the hours when burning may be conducted.

The District's Rule 701 additionally requires that when a burn permit is applied for in which burning is within 1.5 miles of a residential area (three or more contiguous, inhabited dwellings), rural school, or adjacent to heavily traveled roads, an inspector must be present prior to, and at the time of ignition, and must give approval before the burn may be started. In addition, beginning in 2010, as part of the District's Good Neighbor Policy (Policy 37), farmers who conduct burning must notify and advise nearby neighbors (within a half mile) of a potential burn.[4] Overall, agricultural burning has been reduced 75 percent since 2003 in Imperial County.[5]

C. Salton Sea

Imperial County residents have raised concerns about future air quality in Imperial County as Salton Sea water levels decline due to the cessation of mitigation water flows. As the surface level of the Salton Sea drops over the next three decades, the lakebed – or playa – will become exposed and become a potential new source of PM2.5 in the north part of Imperial County. Unless prevented or controlled, windblown PM2.5 could reverse some of the air quality gains proposed in the 2018 PM2.5 Plan. To address this, CARB has been collaborating with other State, as well as federal and local agencies since 2003 in the monitoring, planning, and control of particulate matter (PM) emissions at the Salton Sea.

CARB staff were instrumental in the design and construction of a six-station network of shoreline PM and meteorological monitoring stations at the Salton Sea in 2009. These

[4] *Good Neighbor Policy-Neighbor Notification and Traffic Re-Routing Procedures for Agricultural Burning*. Policy No. 37. https://www.arb.ca.gov/smp/District/imp2010.pdf. April 7, 2010.
[5] Imperial County Air Pollution Control District agricultural burn reports (2003-2017)

stations collect baseline air quality data and serve as an early warning system for changes in exposed playa dust emissivity. The continuous hourly data collected since February 2010 provide a rich database for assessment of air quality impacts and development of mitigation measures by researchers and regulatory agencies alike.

By requirement of the 2003 water transfer agreement, the Imperial Irrigation District (IID) has been the principal agency involved in Salton Sea windblown dust research and control measure testing for the past 15 years. The 2003 water transfer agreement allowed California to reduce diversions from the Colorado River and secure water for population growth in coastal regions, over the next 75 years. The agreement also provided a path for mitigation of adverse environmental impacts resulting from flow reductions to the Salton Sea. Using funds pooled by the water agencies involved in the transfer, IID has retained a team of air quality consultants who participate in control measure research and testing at Owens Lake to conduct similar activities at the Salton Sea. CARB staff is closely reviewing and advising a team of air quality consultants retained by the IID on technical aspects of windblown dust research at the Salton Sea. Research results are shared with the District, the South Coast Air Quality Management District, local environmental justice groups, and the Science and Air Quality Committees of the Governor's Salton Sea Task Force.

Analysis of the collected air quality monitoring data around the Salton Sea has shown that current high PM10 concentrations during high wind events are due to emissions from disturbed soil sources almost due west of communities near the Salton Sea. The windblown dust emissions from the playa will infrequently be transported south to Westmorland and Brawley. Niland, near the southeast corner of the Sea, is downwind of exposed playa during high wind events, but the hourly PM10 peaks recorded on high wind days at Niland and two nearby shoreline stations shows little relationship between the hourly profiles at the three locations.

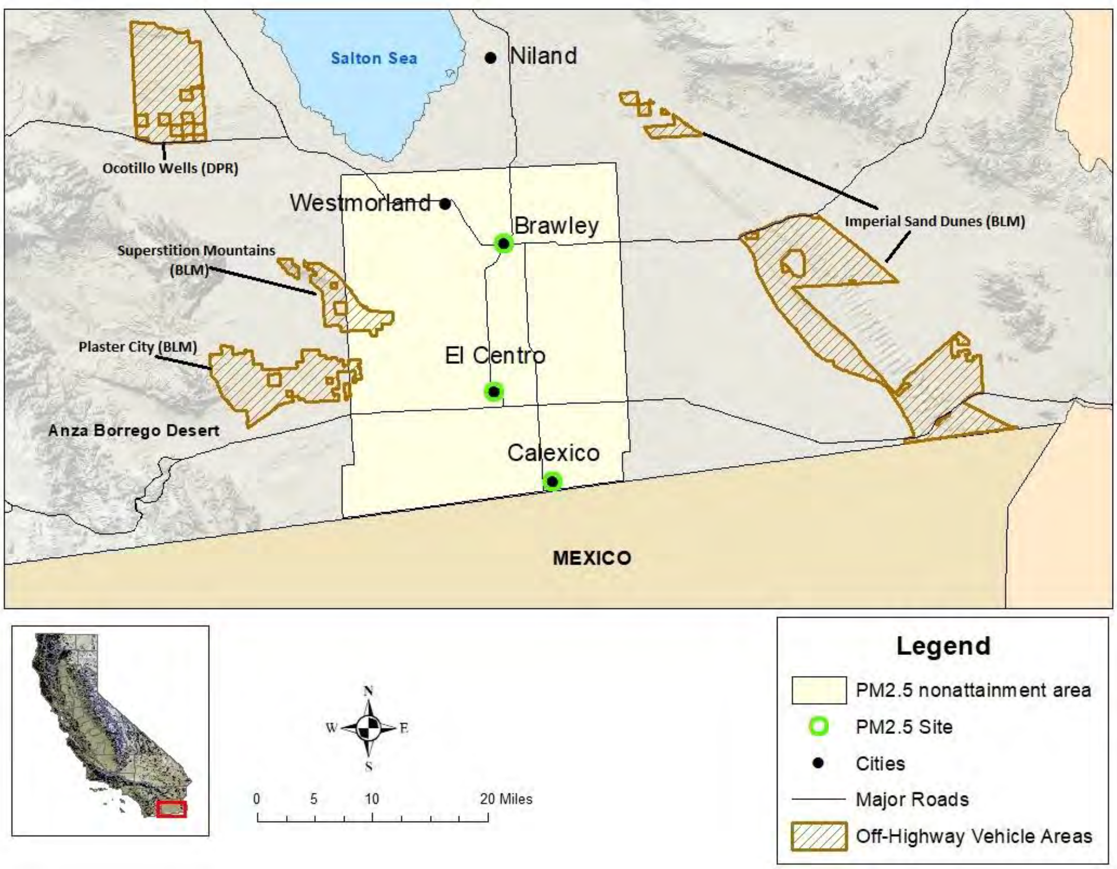
In the past two years, new dust plume visualization systems have been utilized for ongoing analyses of playa emissions. These new systems include 360-degree images recorded during daylight hours at elevated locations at Red Hill Bay and Anza Borrego Desert State Park, as well as captured by new GOES-R geostationary satellites. This system is useful in identifying windblown dust source areas and dust plume density and trajectory. The team of air quality consultants has been researching the design, control effectiveness, and costs of alternative playa dust control measures since 2013. Information from this research includes a three-year lag between the playa first becoming exposed and the onset of windblown dust generation. Addition of the analysis indicates deep tilling can be a near-term control measure that requires the use of no water.

CARB staff will continue collaborative efforts with IID in playa dust control research and testing activities. Staff will also continue to communicate the findings and implications of these research activities to the affected air quality agencies and the many community groups concerned about future Salton Sea emissions. These research activities will help establish the most effective controls to mitigate playa dust.

D. Off-Road Vehicles

Imperial County residents have raised concerns about how off-road recreational vehicles (OHV) impact the PM10 and PM2.5 air quality in Imperial County. PM2.5 emissions from off-road recreational vehicles (OHV) contributes approximately eight percent of the PM2.5 emissions in the Imperial County PM2.5 nonattainment area. The Bureau of Land Management (BLM) and Department of Parks and Recreation (DPR) are the only land managers of OHV-use areas on public lands in Imperial County. BLM and DPR have jurisdiction over five OHV-use areas in Imperial County, totaling over 209,000 acres of land. DPR manages Ocotillo Wells and Heber Dunes which encompass 38,660 and 340 acres, respectively. BLM manages the majority of the OHV-use areas in Imperial County. OHV-use areas under BLM management are the Imperial Sand Dunes, Plaster City, and Superstition Mountain which cover 127,416, 28,240, and 14,723 acres of land in Imperial County, respectively. The Imperial Sand Dunes contain the largest mass of sand dunes in California, covering an area more than 40 miles long and averaging 5 miles in width. Figure 7 displays the OHV areas in relation to the Imperial County PM2.5 nonattainment area.

Figure 7. OHV Areas in Imperial County



The District Rule 800 (General Requirements for Control of Fine Particulate Matter) includes requirements for OHV areas. Under Rule 800, BLM and DPR must submit a Dust Control Plan (DCP) to the District for review and approval that lays out the controls on these OHV use areas. After District comments are incorporated into the DCP, the

District shall transmit the DCP to CARB and U.S. EPA for 45-day review and comment. BLM and DPR must implement all final DCP elements within six months of submittal and update the DCP every two calendar years. The DCP must include a summary of the total miles of paved and unpaved roads with 50 or more average vehicle trips per day, including the length and level of usage of each road. The DCP must also explain the plans for control of PM10 emissions from these roads. From June 15-August 15, BLM and DPR are required to submit a separate DCP to the District for approval in order to hold off-road events and/or competitions. The DCP shall include specific fugitive dust control measures and demonstrate that all control measures, including the requirements of Rule 800, can be implemented and enforced.

BLM and DPR are required to submit a recreational DCP to the District when off-road events and/or competitions take place. On each day of an off-road event and/or competition, in which 50 average vehicle daily trips per day will occur on an unpaved road segment or unpaved traffic area, BLM and DPR shall limit the visible dust emissions to 20 percent opacity and comply with the requirements of a stabilized unpaved road by application of various dust control measures (i.e., watering, restricting access, speed limit restriction, chemical dust suppressants).

During holiday weekends with increased OHV activity, BLM and DPR control road dust on the main entry roads by water application. In addition, a 15 mile per hour speed limit is enforced and posted on these aggregate roads. To deter illegal motorized recreation, route markers and signage identifying restricted use areas are maintained. BLM law enforcement rangers actively patrol illegal off-roading in undesignated areas to deter off-route illegal recreational use on these lands and will issue citations when illegal use is found. In addition, if any new OHV use areas are established within Imperial County that have PM10 emissions of 70 tons per year or above, the public agency must demonstrate in a federal- and/or state-required environmental assessment that these emissions would not cause or contribute to any new violations of any PM10 NAAQS in the area.

BLM and DPR have submitted complete DCP in 2013 and 2016 to the District that outline the measures they have taken and will continue to take to reduce PM10 emissions from OHV areas in the County. These DCP have been approved by the District and the requirements of Rule 800 will continue to be enforced by the District on these OHV use areas.

VI. COLLABORATIVE EFFORTS IN THE BORDER REGION

A. Mexico

Border 2020

The District, CARB, and the U.S. EPA are working together with Mexican federal, state, and local air quality agencies on many fronts to identify and implement programs that will improve air quality in the border region. In 2012, the U.S. and Mexico signed the Border 2020 Program, which is a joint effort between U.S. EPA, Secretariat of Environment and Natural Resources (SEMARNAT), Baja California’s Environmental

Protection Agency (SPA), CARB, the District, and other agencies to improve the border environment by cleaning the air, water, hazardous waste generators, and ensuring emergency preparedness along the U.S.-Mexico border region.

The Border 2020 Program includes the Imperial-Mexicali Air Quality Task Force (AQTF). The AQTF was organized to address issues unique to the border region known as the Mexicali/Imperial air shed, and focuses on reducing air pollution in this area. AQTF membership includes representatives from federal, state and local governments from both sides of the border, as well as representatives from academia, environmental organizations, and the general public. The AQTF meets quarterly, alternating between Imperial County and Mexicali.

The first goal of the Border 2020 Program is to reduce air pollution in the border communities. Emissions from electrical generation and other industrial sources, unpaved roads, diesel trucks, buses and cars, including those idling for long periods of time at ports-of-entry, are significant contributors to the poor air quality along the border. It is important that strategies and solutions to address air pollution along the border are developed and implemented with active participation from the community, as well as local, state, and federal authorities.

- Objective 1: By 2020, in accordance with the North American Free Trade Agreement (NAFTA), promote the reduction of the number of vehicles operating in the border region that do not comply with the respective vehicle emissions standards, and reduce vehicle emissions at ports-of-entry through anti-idling and other feasible reduction measures;
- Objective 2: By 2020, reduce pollutant emissions in order to approach attainment of respective national ambient air quality standards in the Imperial County/Mexicali airshed (and other areas);
- Objective 3: By 2018, maintain effective air monitoring networks and provide real-time access to air quality data in California/Baja California;
- Objective 4: By 2015, support completion of climate action plans in each of the six northern Mexican Border States (as appropriate), and build the necessary capacity to guarantee sustained implementation; and
- Objective 5: By 2020, reduce emissions and associated impacts through energy efficiency and/or alternative/renewable energy projects.

Following is a brief summary of some of the projects in which the District, in conjunction with the AQTF, CARB and U.S. EPA, participated in to address or evaluate emissions at the border and educate the communities on the impact of air pollution in this region.

Mexicali and Imperial County Educational Media Campaign

Elevated PM2.5 levels at the Calexico monitoring station occur during the months of December and January. It is during these months when continual stagnant conditions with light winds dominate the airshed. These conditions, coupled with the tradition in Mexicali of burning wood, tires, etc. for warmth during cold nights, lead to violations of the PM2.5 standards in Calexico.

The U.S. EPA, and the Border Environmental Cooperation Commission (BECC), the District and the Imperial Valley-Mexicali AQTF, through the Border 2020 program, have been funding a “no burn” radio and television Environmental Educational Media Campaign (Campaign) to help educate the Mexicali community concerning the impacts from open burning on the regional air quality and public health. The Campaign encourages a “no burn” mentality and promotes awareness for the wellbeing of the region’s health and environment. The District is the lead agency for this Campaign, and the Secretariat of the State of Baja California is focused on the media portion of the project. The objectives of the radio and television Campaign are to:

- Educate the community regarding the status of air quality in the region and the consequences of open burning of tires, wood, fireworks, etc.;
- Educate young adults with the goal of creating environmental advocates who care for and respect the environment;
- Raise public awareness around the serious consequences of open burning of tires, wood, fireworks, etc. on regional air quality;
- Work towards creating a “no burn” mentality; and
- Improve community leadership involvement.

The Campaign is focused on days that are likely to violate the federal health standard for air quality, traditionally during the holiday season in December and January. Therefore, the media transmissions are aired in phases to capture the periods of highest pollution. There are three audience profiles the Campaign targets: children in kindergarten to sixth grade, young adults in junior high to high school, and the general public. The first step of the Campaign targeted the education of the health and air quality impacts resulting from the burning of fireworks, tires, and wood. The affected community can then begin to understand the long-term harm that will continue should these cultural traditional practices not change.

The District started implementing this Campaign in 2011. The Campaign media advertisements are broadcast on the television and radio, and the District is committed to yearly implementation, as funding allows. The Campaign has opened many avenues of communication with Mexicali’s community and it carries tremendous power to educate all audiences.

Mexicali Monitoring (2016-2018)

To better understand emissions occurring in Mexicali and impacting air quality on both sides of the border, CARB and officials from Baja California received U.S. EPA funding to conduct PM2.5 monitoring beginning in 2016 at two sites in Mexicali (UABC and COBACH) including chemical speciation. This bi-national, monitoring effort began in April of 2016 and will run through April of 2018. This study will produce high quality information on PM2.5 air quality and likely sources in Mexicali. The District is working closely with counterparts in Mexico to develop and implement emission reduction strategies and projects that will improve the air quality in the Mexicali-Imperial region.

At the end of the two years, the monitoring equipment will be donated to the Secretary of Environmental Protection of the State of Baja California. The Secretary of

Environmental Protection will monitor for PM2.5 at Cobach and UABC but speciation will not be continued since the laboratory infrastructure to support analyzing speciated PM2.5 data is not available. CARB will analyze all of the air quality data from this project to assess the main PM2.5 sources and locations of pollution impacting the communities in Mexicali and Calexico.

California-Mexico Memorandum of Understanding

In 2014, the California-Mexico Memorandum of Understanding (MOU) was signed to enhance the cooperation on climate change and the environment between the State of California and the Ministry of Environment and Natural Resources and the National Forestry Commission of the United Mexican States.[6] The MOU establishes actions related to environmental issues such as climate change, human and environmental health, air quality, wildfires, and transportation between California and Mexico.
In addition to other efforts in the MOU, to improve the air quality in these areas, the MOU seeks to: reduce emissions of criteria pollutants, and toxic air contaminants; Increase the cooperation related to air quality along the border, including air quality monitoring, audits of air quality monitoring equipment, the use of specialized equipment and, exchange of technical and policy information on air quality; support new and expanded markets for clean and efficient energy technologies in the industrial, electricity and transportation sectors; reduce vehicle emissions though strengthening vehicle standards, setting common standards, and supporting green freight initiatives; and strengthen technical and institutional capabilities on fire management.

U.S. EPA, CARB, SEMARNAT, SPA, the District, and many other organizations and the public are working together to meet the goals of the MOU to better the air quality in California and Mexico.

Program to Improve Air Quality in Mexicali 2011-2020 (ProAire)

The ProAire program represents a collaborative effort between the federal, State, and municipal governments in Mexico, along with industry and local communities to improve the quality of life in Mexicali and to reduce the risk of exposure to air pollution. This program identifies agricultural burning, paved and unpaved roads, and power generation as the main sources of direct PM2.5 emissions in Mexicali. The program includes the following actions to reduce air emissions in Mexicali:

- Regulating agricultural burning and developing a diagnosis of the current state of agricultural burning in Mexicali in order to establish the meteorological and size conditions under which agricultural burning can be allowed;
- Establishing a model to incentivize reduction of agricultural burning and identifying other alternatives to agricultural burning;

[6] 2014, July 28. Memorandum of Understanding to Enhance Cooperation on Climate Change and the Environment Between the State of California of the United States of America and the Ministry of Environment and Natural Resources and the National Forestry Commission of the United Mexican States. Retrieved from: https://www.gov.ca.gov/wp-content/uploads/2017/09/7.28_Climate_MOU_Eng.pdf.

- Developing a strategy to reduce particulate emissions from paved and unpaved roads; and
- Establishing agreements with power generation facilities to evaluate the significance of their air emissions on air quality and public health and to identify new actions to reduce and control their air emissions.

As outlined in the programs above, the District has been and will continue to work cooperatively with counterparts from U.S. EPA, CARB, and Mexico to develop emission reductions strategies and projects for air quality improvement at the border and to provide public information and education to border residents.

B. District

Web-Based Air Quality and Health Information Center

The District and CARB, in cooperation with the U.S. EPA, operate a web-based air quality and health information center for Imperial County (available at: http://www.imperialvalleyair.org). Through this project, the community is able to take advantage of the real-time air quality data collected by CARB and District-operated monitoring stations, including data for ozone and particulate matter (PM2.5 and PM10). The website allows residents to sign up to receive email, text, or push notifications (via the Imperial Valley Air Quality mobile app) when air quality in the region reaches unhealthy levels. Features of the mobile app include a forecast discussion with related weather information, an explanation of the Air Quality Index (AQI), a "locate me" GPS-based notification, and an identification of the cities where air monitoring stations are located. The overall purpose of this project is to enable schools and after-school programs, as well as other residents and groups in the county, to make informed choices to reduce their exposure to air pollutants. The projects enable them to prepare to use prescribed treatments, such as inhalers, when air pollution reaches levels that could adversely affect their asthma or other respiratory ailments.

AQI Advertisement Campaign

Asthma is a common health issue in Imperial County, with education in daily air quality conditions being a great need for the community. In order to promote air quality awareness and protection, the District established an AQI Advertisement Campaign with the purpose of educating and alerting the community of the daily particulate risk levels. The campaign serves as a visual communication method by utilizing a marquee at a highly trafficked area of the county, the Imperial Valley Mall. The campaign also utilizes local radio and television stations which display and discuss the AQI alerts. The District received funding to contract with Entravision/Univision, a local high–rated and frequently-viewed television station. Viewers will be informed of the air quality forecast, the current AQI, and the AQI website. This information is broadcast twice a day during the morning and evening news. This contract also includes an agreement with a high-rated radio station which announces the AQI, air quality forecast, and Imperial County AQI website three times a day.

Vehicle Idling Emissions Study at Calexico East and Calexico West Ports of Entry (POE)

Reducing emissions of PM and NOx from idling vehicles at the Calexico East and Calexico West Ports of Entry (POE) is one of the most important air quality challenges facing the Imperial County and Mexicali region. Even with new vehicle tailpipe emission standards taking effect over the next decade, millions of vehicles at the border will continue to emit large amounts of NOx, PM, and air toxics, which contribute to serious public health problems in the region.

It is important to understand the impacts and to evaluate the amount of air emissions generated by idling vehicles at the Calexico East and Calexico West POE. On behalf of the AQTF, in 2014, the District was selected as a grantee by BECC to study border idling. The District hired a consulting firm to develop an analysis with two essential elements. The first element was to determine the vehicle idling impacts at both POE. The second element, crucial to any air quality improvement program, was the identification of emission reduction strategies that U.S.-Mexican planning agencies could implement at both POE to reduce impacts on the general population. Estimating emissions from idling vehicles and identifying potential control strategies can be helpful in securing organizational support for federal, State, and local governments on both sides of the border. Overall, this project estimated PM and NOx emissions from northbound idling vehicles waiting at the two POE and identified emission reduction strategies (with accompanying PM and NOx reductions) that U.S. and Mexican planning agencies could implement at the POE.

The first phase of this study focused on the collection of real-world data to better characterize and understand the emissions associated with and causes of border crossing delays at the POE. The second and third phases of this study focused on estimating seasonal emissions of PM2.5, ROG, and NOx at the POE under existing (2014) conditions and assuming several strategies to reduce those emissions. In addition, to analyze existing conditions and an idealized no POE delay scenario, seven emission reduction scenarios were studied:

- Phase 1 of the Calexico West POE reconstruction project;
- Phase 2 of the Calexico West POE reconstruction project;
- Use of California fuel in Mexicali;
- A reduction in empty general-purpose truck trips;
- Replacing 10 percent of general-purpose truck trips to FAST truck trips;
- Streamlining commercial crossing by combining the Aduanas and U.S. Customs and Border Protection (CBP) primary inspections; and
- The Section 559 Proposal to expand the Calexico East POE.

The results indicate that border delay accounts for about 63 percent of the ROG emissions, 46 percent of the NOx emissions, and 53 percent of the PM2.5 emissions from northbound vehicles crossing into the United States on an annual basis. The emissions associated with border delay are equivalent to the TOG (Total Organic Gases which ROG is a subset of) emissions from 2,700 passenger vehicles in Imperial County, the NOx emissions from 4,400 passenger vehicles in Imperial County, and the PM2.5

emissions from 3,450 passenger vehicles in Imperial County. These results provide a sense of the number of privately owned vehicles in Imperial County that would need to be removed from the vehicle fleet in order to achieve the same air quality emissions benefit as addressing border delays.

C. Community

CARB has been involved with the Environmental Group Comité Cívico del Valle Inc. (CCV) on their community monitoring effort which consists of 40 low-cost air quality sensors that measure PM2.5 and PM10 throughout Imperial County. One of these sensors have been collocated with the Calexico station to compare to the regulatory PM2.5 and PM10 measurements. This aides CCV in validating their sensor data as well as to fine tune their calibration algorithm for this monitoring effort. CARB and CCV partnered together to take a proactive role in promoting community science to assess local air quality. The partnership consists of a $160,000 contract to evaluate and improve the performance of CCV's existing community-led air monitoring network in Imperial Valley.

Other efforts to help assist community efforts have also taken place. In support of the CARB/Department of Pesticide Regulation pesticide study, CCV ran a pesticide field sampling site. CARB staff trained CCV on pesticide sampling in February of 2018 to help out with this effort. CARB also performed an EBAM PM2.5 collocation study in the spring 2016 (5 schools plus border crossing) with Dylos PM sensors to verify the Dylos calibration algorithm.

VII. ENVIRONMENTAL IMPACTS

The California Environmental Quality Act (CEQA) requires that State and local agency projects be assessed for potential environmental impacts. An air quality plan is a "project" that is potentially subject to CEQA requirements. The District found that the 2018 PM2.5 Plan will not result in any potentially significant adverse effects on the environment and released a Negative Declaration on March 11, 2018, which was certified at a public hearing on April 24, 2018.

CARB has determined that its review and approval of the 2018 PM2.5 Plan submitted by the District for inclusion in the California SIP is a ministerial activity by CARB for purposes of CEQA (14 CCR § 15268). A "ministerial" decision is one that involves fixed standards or objective measurements, and the agency has no discretion to shape the activity in response to environmental concerns (14 CCR § 15369; *San Diego Navy Broadway Complex Coalition v. City of San Diego* (2010) 185 Cal.App.4th 924, 934).

VIII. RECOMMENDATION

CARB staff recommends that the Board approve the Imperial County PM2.5 nonattainment area's 2018 PM2.5 Plan as a revision to the California SIP including the technical analysis of the impacts of international transport demonstrating the Imperial

County PM2.5 nonattainment area will attain the 12.0 µg/m^3 annual PM2.5 standard in 2021 absent the impact of these international emissions.

INTERNATIONAL

Designation: D1557 – 12$^{\varepsilon 1}$

Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))[1]

This standard is issued under the fixed designation D1557; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

ε^1 NOTE—Editorially corrected variable for Eq A1.2 in July 2015.

1. Scope*

1.1 These test methods cover laboratory compaction methods used to determine the relationship between molding water content and dry unit weight of soils (compaction curve) compacted in a 4- or 6-in. (101.6- or 152.4-mm) diameter mold with a 10.00-lbf. (44.48-N) rammer dropped from a height of 18.00 in. (457.2 mm) producing a compactive effort of 56 000 ft-lbf/ft^3 (2700 kN-m/m^3).

NOTE 1—The equipment and procedures are the same as proposed by the U.S. Corps of Engineers in 1945. The modified effort test (see 3.1.3) is sometimes referred to as the Modified Proctor Compaction Test.

1.1.1 Soils and soil-aggregate mixtures are to be regarded as natural occurring fine- or coarse-grained soils, or composites or mixtures of natural soils, or mixtures of natural and processed soils or aggregates such as gravel or crushed rock. Hereafter referred to as either soil or material.

1.2 These test methods apply only to soils (materials) that have 30 % or less by mass of their particles retained on the ¾-in. (19.0-mm) sieve and have not been previously compacted in the laboratory; that is, do not reuse compacted soil.

1.2.1 For relationships between unit weights and molding water contents of soils with 30 % or less by weight of material retained on the ¾-in. (19.0-mm) sieve to unit weights and molding water contents of the fraction passing the ¾-in. (19.0-mm) sieve, see Practice D4718.

1.3 Three alternative methods are provided. The method used shall be as indicated in the specification for the material being tested. If no method is specified, the choice should be based on the material gradation.

1.3.1 *Method A:*

1.3.1.1 *Mold*—4-in. (101.6-mm) diameter.

1.3.1.2 *Material*—Passing No. 4 (4.75-mm) sieve.

1.3.1.3 *Layers*—Five.

1.3.1.4 *Blows per layer*—25.

1.3.1.5 *Usage*—May be used if 25 % or less by mass of the material is retained on the No. 4 (4.75-mm) sieve. However, if 5 to 25 % by mass of the material is retained on the No. 4 (4.75-mm) sieve, Method A can be used but oversize corrections will be required (See 1.4) and there are no advantages to using Method A in this case.

1.3.1.6 *Other Use*—If this gradation requirement cannot be met, then Methods B or C may be used.

1.3.2 *Method B:*

1.3.2.1 *Mold*—4-in. (101.6-mm) diameter.

1.3.2.2 *Material*—Passing ⅜-in. (9.5-mm) sieve.

1.3.2.3 *Layers*—Five.

1.3.2.4 *Blows per layer*—25.

1.3.2.5 *Usage*—May be used if 25 % or less by mass of the material is retained on the ⅜-in. (9.5-mm) sieve. However, if 5 to 25 % of the material is retained on the ⅜-in. (9.5-mm) sieve, Method B can be used but oversize corrections will be required (See 1.4). In this case, the only advantages to using Method B rather than Method C are that a smaller amount of sample is needed and the smaller mold is easier to use.

1.3.2.6 *Other Usage*—If this gradation requirement cannot be met, then Method C may be used.

1.3.3 *Method C:*

1.3.3.1 *Mold*—6-in. (152.4-mm) diameter.

1.3.3.2 *Material*—Passing ¾-in. (19.0-mm) sieve.

1.3.3.3 *Layers*—Five.

1.3.3.4 *Blows per layer*—56.

1.3.3.5 *Usage*—May be used if 30 % or less (see 1.4) by mass of the material is retained on the ¾-in. (19.0-mm) sieve.

1.3.4 The 6-in. (152.4-mm) diameter mold shall not be used with Method A or B.

NOTE 2—Results have been found to vary slightly when a material is tested at the same compactive effort in different size molds, with the

[1] These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.03 on Texture, Plasticity and Density Characteristics of Soils.

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***A Summary of Changes section appears at the end of this standard**

smaller mold size typically yielding larger values of unit weight and density (1).[2]

1.4 If the test specimen contains more than 5 % by mass of oversize fraction (coarse fraction) and the material will not be included in the test, corrections must be made to the unit weight and molding water content of the test specimen or to the appropriate field in-place unit weight (or density) test specimen using Practice D4718.

1.5 This test method will generally produce a well-defined maximum dry unit weight for non-free draining soils. If this test method is used for free-draining soils the maximum unit weight may not be well defined, and can be less than obtained using Test Methods D4253.

1.6 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by these test methods.

1.6.1 For purposes of comparing measured or calculated value(s) with specified limits, the measured or calculated value(s) shall be rounded to the nearest decimal or significant digits in the specified limits.

1.6.2 The procedures used to specify how data are collected/recorded or calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analytical methods for engineering design.

1.7 The values in inch-pound units are to be regarded as the standard. The values stated in SI units are provided for information only, except for units of mass. The units for mass are given in SI units only, g or kg.

1.7.1 It is common practice in the engineering profession to concurrently use pounds to represent both a unit of mass (lbm) and a force (lbf). This implicitly combines two separate systems of units; that is, the absolute system and the gravitational system. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. These test methods have been written using the gravitational system of units when dealing with the inch-pound system. In this system, the pound (lbf) represents a unit of force (weight). However, the use of balances or scales recording pounds of mass (lbm) or the recording of density in lbm/ft^3 shall not be regarded as a nonconformance with this standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.9 **Warning**—Mercury has been designated by EPA and many state agencies as a hazardous material that can cause central nervous system, kidney, and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website (http://www.epa.gov/mercury/faq.htm) for additional information. Users should be aware that selling mercury or mercury containing products or both into your state may be prohibited by state law.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C127 Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
D653 Terminology Relating to Soil, Rock, and Contained Fluids
D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3))
D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
D2168 Practices for Calibration of Laboratory Mechanical-Rammer Soil Compactors
D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4220 Practices for Preserving and Transporting Soil Samples
D4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
D4718 Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing
D4914 Test Methods for Density and Unit Weight of Soil and Rock in Place by the Sand Replacement Method in a Test Pit
D5030 Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit
D6026 Practice for Using Significant Digits in Geotechnical Data
D6913 Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

[2] The boldface numbers in parentheses refer to the list of references at the end of this standard.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
E319 Practice for the Evaluation of Single-Pan Mechanical Balances
IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System

3. Terminology

3.1 *Definitions:*

3.1.1 See Terminology D653 for general definitions.

3.1.2 *molding water content, n*—the water content of the soil (material) specimen in the mold after it has been reconstituted and compacted.

3.1.3 *modified effort*—in compaction testing, the term for the 56 000 ft-lbf/ft^3 (2700 kN-m/m^3) compactive effort applied by the equipment and methods of this test.

3.1.4 *modified maximum dry unit weight, $\gamma_{d,max}$ (lbf/ft^3 (kN/m^3))*—in compaction testing, the maximum value defined by the compaction curve for a compaction test using modified effort.

3.1.5 *modified optimum water content, w_{opt} (%)*—in compaction testing, the water content at which the soil can be compacted to the maximum dry unit weight using modified compactive effort.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *oversize fraction (coarse fraction), P_C (%)*—the portion of total specimen not used in performing the compaction test; it may be the portion of total specimen retained on the No. 4 (4.75-mm) sieve in Method A, ⅜-in. (9.5-mm) sieve in Method B, or ¾-in. (19.0-mm) sieve in Method C.

3.2.2 *test fraction (finer fraction), P_F (%)*—the portion of the total specimen used in performing the compaction test; it may be fraction passing the No. 4 (4.75-mm) sieve in Method A, passing the ⅜-in. (9.5-mm) sieve in Method B, or passing the ¾-in. (19.0-mm) sieve in Method C.

4. Summary of Test Method

4.1 A soil at a selected molding water content is placed in five layers into a mold of given dimensions, with each layer compacted by 25 or 56 blows of a 10.00-lbf (44.48-N) rammer dropped from a distance of 18.00 in. (457.2 mm), subjecting the soil to a total compactive effort of about 56 000 ft-lbf/ft^3 (2700 kN-m/m^3). The resulting dry unit weight is determined. The procedure is repeated for a sufficient number of molding water contents to establish a relationship between the dry unit weight and the molding water content for the soil. This data, when plotted, represent a curvilinear relationship known as the compaction curve. The values of optimum water content and modified maximum dry unit weight are determined from the compaction curve.

5. Significance and Use

5.1 Soil placed as engineering fill (embankments, foundation pads, road bases) is compacted to a dense state to obtain satisfactory engineering properties such as shear strength, compressibility, or permeability. In addition, foundation soils are often compacted to improve their engineering properties. Laboratory compaction tests provide the basis for determining the percent compaction and molding water content needed to achieve the required engineering properties, and for controlling construction to assure that the required compaction and water contents are achieved.

NOTE 3—The degree of soil compaction required to achieve the desired engineering properties is often specified as a percentage of the modified maximum dry unit weight as determined using this test method. If the required degree of compaction is substantially less than the modified maximum dry unit weight using this test method, it may be practicable for testing to be performed using Test Method D698 and to specify the degree of compaction as a percentage of the standard maximum dry unit weight. Since more energy is applied for compaction using this test method, the soil particles are more closely packed than when D698 is used. The general overall result is a higher maximum dry unit weight, lower optimum moisture content, greater shear strength, greater stiffness, lower compressibility, lower air voids, and decreased permeability. However, for highly compacted fine-grained soils, absorption of water may result in swelling, with reduced shear strength and increased compressibility, reducing the benefits of the increased effort used for compaction (2). Use of D698, on the other hand, allows compaction using less effort and generally at a higher optimum moisture content. The compacted soil may be less brittle, more flexible, more permeable, and less subject to effects of swelling and shrinking. In many applications, building or construction codes may direct which test method, D698 or this one, should be used when specifying the comparison of laboratory test results to the degree of compaction of the in-place soil in the field.

5.2 During design of an engineered fill, testing performed to determine shear, consolidation, permeability, or other properties requires test specimens to be prepared by compacting the soil at a prescribed molding water content to obtain a predetermined unit weight. It is common practice to first determine the optimum water content (w_{opt}) and maximum dry unit weight (γ_{dmax}) by means of a compaction test. Test specimens are compacted at a selected molding water content (w), either wet or dry of optimum (w_{opt}) or at optimum (w_{opt}), and at a selected dry unit weight related to a percentage of maximum dry unit weight (γ_{dmax}). The selection of molding water content (w), either wet or dry of optimum (w_{opt}) or at optimum (w_{opt}) and the dry unit weight (γ_{dmax}) may be based on past experience, or a range of values may be investigated to determine the necessary percent of compaction.

5.3 Experience indicates that the methods outlined in 5.2 or the construction control aspects discussed in 5.1 are extremely difficult to implement or yield erroneous results when dealing with some soils. The following subsections describe typical problem soils, the problems encountered when dealing with such soils and possible solutions for these problems.

5.3.1 *Oversize Fraction*—Soils containing more than 30 % oversize fraction (material retained on the ¾-in. (19-mm) sieve) are a problem. For such soils, there is no ASTM test method to control their compaction and very few laboratories are equipped to determine the laboratory maximum unit weight (density) of such soils (USDI Bureau of Reclamation, Denver, CO and U.S. Army Corps of Engineers, Vicksburg, MS). Although Test Methods D4914 and D5030 determine the "field" dry unit weight of such soils, they are difficult and expensive to perform.

5.3.1.1 One method to design and control the compaction of such soils is to use a test fill to determine the required degree of compaction and the method to obtain that compaction. Then use a method specification to control the compaction. Components of a method specification typically contain the type and size of compaction equipment to be used, the lift thickness, acceptable range of molding water content, and number of passes.

NOTE 4—Success in executing the compaction control of an earthwork project, especially when a method specification is used, is highly dependent upon the quality and experience of the contractor and inspector.

5.3.1.2 Another method is to apply the use of density correction factors developed by the USDI Bureau of Reclamation (3,4) and U.S. Corps of Engineers (5). These correction factors may be applied for soils containing up to about 50 to 70 % oversize fraction. Both agencies use a different term for these density correction factors. The USDI Bureau of Reclamation uses *D* ratio (or *D* – VALUE), while the U.S. Corps of Engineers uses Density Interference Coefficient (I_c).

5.3.1.3 The use of the replacement technique (Test Method D1557–78, Method D), in which the oversize fraction is replaced with a finer fraction, is inappropriate to determine the maximum dry unit weight, γ_{dmax}, of soils containing oversize fractions (5).

5.3.2 *Degradation*—Soils containing particles that degrade during compaction are a problem, especially when more degradation occurs during laboratory compaction than field compaction, the typical case. Degradation typically occurs during the compaction of a granular-residual soil or aggregate. When degradation occurs, the maximum dry-unit weight increases (1) so that the resulting laboratory maximum value is not representative of field conditions. Often, in these cases, the maximum dry unit weight is impossible to achieve in the field.

5.3.2.1 Again for soils subject to degradation, the use of test fills and method specifications may help. Use of replacement techniques is not correct.

5.3.3 *Gap Graded*—Gap-graded soils (soils containing many large particles with limited small particles) are a problem because the compacted soil will have larger voids than usual. To handle these large voids, standard test methods (laboratory or field) typically have to be modified using engineering judgement.

NOTE 5—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

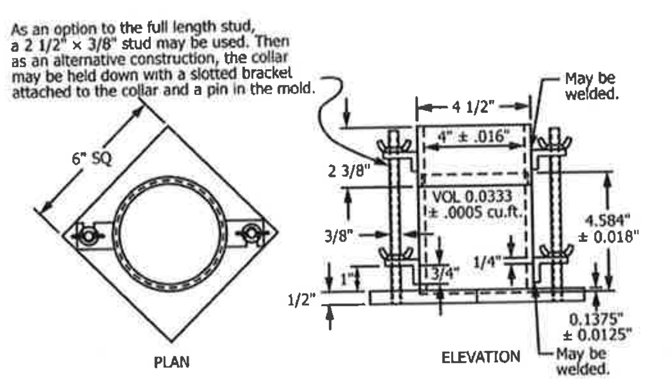
6. Apparatus

6.1 *Mold Assembly*—The molds shall be cylindrical in shape, made of rigid metal and be within the capacity and dimensions indicated in 6.1.1 or 6.1.2 and Fig. 1 and Fig. 2. See also Table 1. The walls of the mold may be solid, split, or tapered. The "split" type may consist of two half-round sections, or a section of pipe split along one element, which can be securely locked together to form a cylinder meeting the requirements of this section. The "tapered" type shall have an internal diameter taper that is uniform and not more than 0.200 in./ft (16.7 mm/m) of mold height. Each mold shall have a base plate and an extension collar assembly, both made of rigid metal and constructed so they can be securely attached and easily detached from the mold. The extension collar assembly shall have a height extending above the top of the mold of at least 2.0 in. (51 mm) which may include an upper section that flares out to form a funnel, provided there is at least a 0.75-in. (19-mm) straight cylindrical section beneath it. The extension collar shall align with the inside of the mold. The bottom of the base plate and bottom of the centrally recessed area that accepts the cylindrical mold shall be planar within ±0.005 in. (±0.1 mm).

6.1.1 *Mold, 4 in.*—A mold having a 4.000 ± 0.016-in. (101.6 ± 0.4-mm) average inside diameter, a height of 4.584 ± 0.018 in. (116.4 ± 0.5 mm) and a volume of 0.0333 ± 0.0005 ft^3 (943.0 ± 14.0 cm^3). A mold assembly having the minimum required features is shown in Fig. 1.

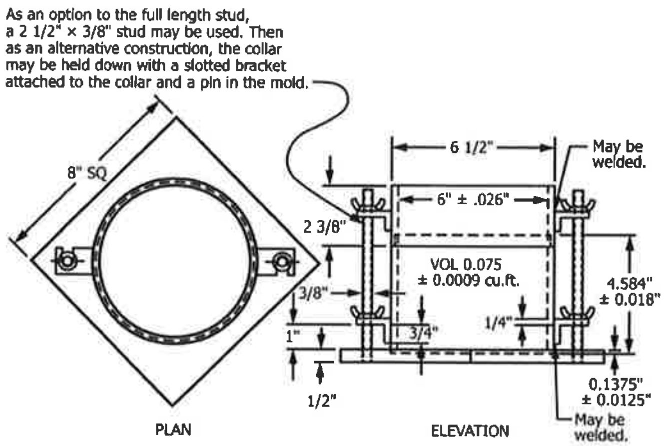
6.1.2 *Mold, 6 in.*—A mold having a 6.000 ± 0.026-in. (152.4 ± 0.7-mm) average inside diameter, a height of 4.584 ± 0.018 in. (116.4 ± 0.5 mm), and a volume of 0.0750 ± 0.0009 ft^3 (2124 ± 25 cm^3). A mold assembly having the minimum required features is shown in Fig. 2.

6.2 *Rammer*—A rammer, either manually operated as described further in 6.2.1 or mechanically operated as described in 6.2.2. The rammer shall fall freely through a distance of 18.00 ± 0.05 in. (457.2 ± 1.3 mm) from the surface of the specimen. The weight of the rammer shall be 10.00 ± 0.02 lbf



NOTE 1—See Table 1 for SI equivalents.

FIG. 1 Cylindrical Mold, 4.0-in.



NOTE 1—See Table 1 for SI equivalents.

FIG. 2 Cylindrical Mold, 6.0-in.

TABLE 1 SI Equivalents for Figs. 1 and 2

in.	mm
0.016	0.41
0.026	0.66
0.032	0.81
0.028	0.71
½	12.70
2⅜	60.33
2½	63.50
2⅝	66.70
4	101.60
4½	114.30
4.584	116.43
4¾	120.60
6	152.40
6½	165.10
6⅝	168.30
6¾	171.40
8¼	208.60
ft^3	cm^3
1⁄30 (0.0333)	943
0.0005	14
1⁄13.333 (0.0750)	2,124
0.0011	31

(44.48 ± 0.09 N, or mass of 4.5364 ± 0.009 kg), except that the weight of the mechanical rammers may be adjusted as described in Practices D2168 (see Note 6). The striking face of the rammer shall be planar and circular, except as noted in 6.2.2.1, with a diameter when new of 2.000 ± 0.005 in. (50.80 ± 0.13 mm). The rammer shall be replaced if the striking face becomes worn or bellied to the extent that the diameter exceeds 2.000 ± 0.01 in. (50.80 ± 0.25 mm).

NOTE 6—It is a common and acceptable practice to determine the weight of the rammer using either a kilogram or pound balance and assume 1 lbf is equivalent to 0.4536 kg, 1 lbf is equivalent to 1 lbm, or 1 N is equivalent to 0.2248 lbf or 0.1020 kg.

6.2.1 *Manual Rammer*—The rammer shall be equipped with a guide sleeve that has sufficient clearance that the free fall of the rammer shaft and head is not restricted. The guide sleeve shall have at least four vent holes at each end (eight holes total) located with centers ¾ ± 1⁄16 in. (19 ± 2 mm) from each end and spaced 90° apart. The minimum diameter of the vent holes shall be ⅜ in. (9.5 mm). Additional holes or slots may be incorporated in the guide sleeve.

6.2.2 *Mechanical Rammer-Circular Face*—The rammer shall operate mechanically in such a manner as to provide uniform and complete coverage of the specimen surface. There shall be 0.10 ± 0.03-in. (2.5 ± 0.8-mm) clearance between the rammer and the inside surface of the mold at its smallest diameter. The mechanical rammer shall meet the standardization/calibration requirements of Practices D2168. The mechanical rammer shall be equipped with a positive mechanical means to support the rammer when not in operation.

6.2.2.1 *Mechanical Rammer-Sector Face*—The sector face can be used with the 6.0-in. (152.4-mm) mold, as an alternative to the circular face mechanical rammer described in 6.2.2. The striking face shall have the shape of a sector of a circle of radius equal to 2.90 ± 0.02 in. (73.7 ± 0.5 mm) and an area about the same as the circular face (see 6.2). The rammer shall operate in such a manner that the vertex of the sector is positioned at the center of the specimen and follow the compaction pattern given in Fig. 3(b).

6.3 *Sample Extruder (optional)*—A jack, with frame or other device adapted for the purpose of extruding compacted specimens from the mold.

6.4 *Balance*—A Class GP5 balance meeting the requirements of Specification D4753 for a balance of 1-g readability. If the water content of the compacted specimens is determined using a representative portion of the specimen, rather than the whole specimen, and if the representative portion is less than 1000 g, a Class GP2 balance having a 0.1-g readability is needed in order to comply with Test Methods D2216 requirements for determining water content to 0.1 %.

NOTE 7—Use of a balance having an equivalent capacity and a readability of 0.002 lbm as an alternative to a class GP5 balance should not be regarded as nonconformance to this standard.

6.5 *Drying Oven*—Thermostatically controlled oven, capable of maintaining a uniform temperature of 230 ± 9°F (110 ± 5°C) throughout the drying chamber. These requirements typically require the use of a forced-draft type oven. Preferably the oven should be vented outside the building.

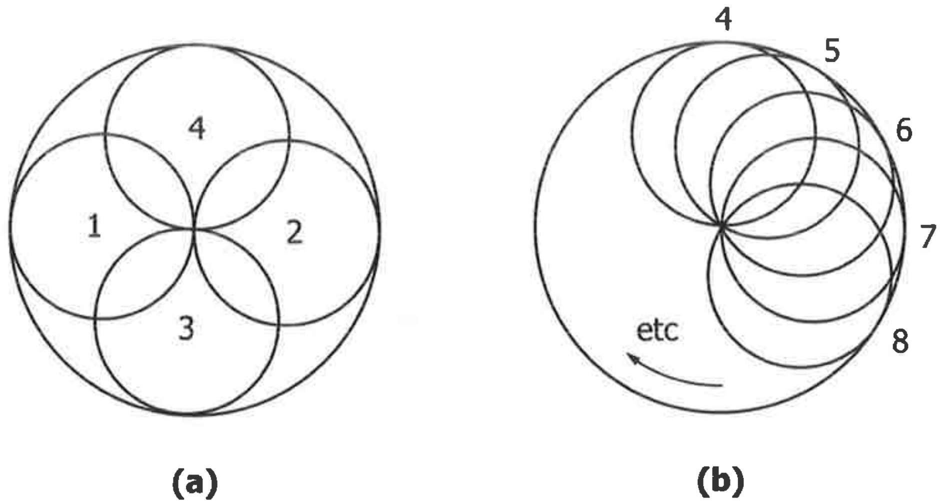


FIG. 3 Rammer Pattern for Compaction in 4-in. (101.6-mm) Mold

6.6 *Straightedge*—A stiff metal straightedge of any convenient length but not less than 10 in. (250 mm). The total length of the straightedge shall be machined straight to a tolerance of ±0.005 in. (±0.1 mm). The scraping edge shall be beveled if it is thicker than ⅛ in. (3 mm).

6.7 *Sieves*—¾ in. (19.0 mm), ⅜ in. (9.5 mm), and No. 4 (4.75 mm), conforming to the requirements of Specification E11.

6.8 *Mixing Tools*—Miscellaneous tools such as mixing pan, spoon, trowel, spatula, spray device (to add water evenly), and (preferably, but optional) a suitable mechanical device for thoroughly mixing the subspecimen of soil with increments of water.

7. Standardization/Calibration

7.1 Perform standardizations before initial use, after repairs or other occurrences that might affect the test results, at intervals not exceeding 1000 test specimens, or annually, whichever occurs first, for the following apparatus:

7.1.1 *Balance*—Evaluate in accordance with Specification D4753 or Practice E319.

7.1.2 *Molds*—Determine the volume as described in Annex A1.

7.1.3 *Manual Rammer*—Verify the free fall distance, rammer weight, and rammer face are in accordance with 6.2. Verify the guide sleeve requirements in accordance with 6.2.1.

7.1.4 *Mechanical Rammer*—Verify and adjust if necessary that the mechanical rammer in accordance with Practices D2168. In addition, the clearance between the rammer and the inside surface of the mold shall be verified in accordance with 6.2.2.

8. Test Specimen

8.1 The minimum test specimen (test fraction) mass for Methods A and B is about 16 kg, and for Method C is about 29 kg of dry soil. Therefore, the field sample (see Practices D4220 for practices of preserving and transporting soil samples) should have a moist mass of at least 23 kg and 45 kg, respectively. Greater masses would be required if the oversize fraction is large (see 10.2 or 10.3) or an additional molding water content is taken during compaction of each point (see 10.4.1).

8.2 If gradation data is not available, estimate the percentage of material (by mass) retained on the No. 4 (4.75-mm), ⅜-in. (9.5-mm), or ¾-in. (19.0-mm) sieve as appropriate for selecting Method A, B, or C, respectively. If it appears the percentage retained of interest is close to the allowable value for a given Method (A, B, or C), then either:

8.2.1 Select a Method that allows a higher percentage retained (B or C).

8.2.2 Using the sieve size designated for the Method of interest, process the specimen in accordance with 10.2 or 10.3 herein. This determines the percentage of material retained for that method. If the percentage retained is acceptable, proceed. If the percentage retained is not acceptable, go to Method B or C using the next larger sieve size.

8.2.3 Determine percentage retained values using a representative portion from the total sample, and performing a simplified or complete gradation analysis using the sieve(s) of interest and Test Method D6913 or C136. It is only necessary to calculate the retained percentage(s) for the sieve or sieves for which information is desired.

9. Preparation of Apparatus

9.1 Select the proper compaction mold(s), collar, and base plate in accordance with the Method (A, B, or C) being used. Check that the volume of the mold is known and whether the volume was determined with or without the base plate. Also, check that the mold is free of nicks or dents, and that the mold will fit together properly with the collar and base plate.

9.2 Check that the manual or mechanical rammer assembly is in good working condition and that parts are not loose or worn. Make any necessary adjustments or repairs. If adjustments or repairs are made, the rammer must be restandardized.

10. Procedure

10.1 *Soils:*

10.1.1 Do not reuse soil that has been previously compacted in the laboratory. The reuse of previously compacted soil yields a significantly greater maximum dry unit weight (**1**).

10.1.2 When using this test method for soils containing hydrated halloysite, or in which past experience indicates that results will be altered by air-drying, use the moist preparation method (see Section 10.2). In referee testing, each laboratory has to use the same method of preparation, either moist (preferred) or air-dried.

10.1.3 Prepare the soil specimens for testing in accordance with 10.2 (preferred) or with 10.3.

10.2 *Moist Preparation Method (preferred)*—Without previously drying the sample/specimen, process it over a No. 4 (4.75-mm), ⅜-in. (9.5-mm), or ¾-in. (19.0-mm) sieve, depending on the Method (A, B, or C) being used or required as covered in 8.2. For additional processing details, see Test Method D6913. Determine and record the mass of both the retained and passing portions (oversize fraction and test fraction, respectively) to the nearest g. Oven dry the oversize fraction and determine and record its dry mass to the nearest g. If it appears more than 0.5 % of the total dry mass of the specimen is adhering to the oversize fraction, wash that fraction. Then determine and record its oven dry mass to the nearest g. Determine and record the water content of the processed soil (test fraction). Using that water content, determine and record the oven dry mass of the test fraction to the nearest g. Based on these oven dry masses, the percent oversize fraction, P_C, and test fraction, P_F, shall be determined and recorded, unless a gradation analysis has already been performed. See Section 11 on Calculations.

10.2.1 From the test fraction, select and prepare at least four (preferably five) subspecimens having molding water contents such that they bracket the estimated optimum water content. A subspecimen having a molding water content close to optimum should be prepared first by trial additions or removals of water and mixing (see Note 8). Select molding water contents for the rest of the subspecimens to provide at least two subspecimens wet and two subspecimens dry of optimum, and molding water contents varying by about 2 %. At least two molding water contents are necessary on the wet and dry side of optimum to define the dry-unit-weight compaction curve (see 10.5). Some soils with very high optimum water content or a relatively flat compaction curve may require larger molding water content increments to obtain a well-defined maximum dry unit weight. Molding water content increments should not exceed about 4 %.

NOTE 8—With practice it is usually possible to visually judge a point near optimum water content. Typically, cohesive soils at the optimum water content can be squeezed into a lump that barely sticks together when hand pressure is released, but will break cleanly into two sections when "bent." They tend to crumble at molding water contents dry of optimum; they tend to stick together in a sticky cohesive mass wet of optimum. For cohesive soils, the optimum water content is typically slightly less than the plastic limit. For cohesionless soils, the optimum water content is typically close to zero or at the point where bleeding occurs.

10.2.2 Thoroughly mix the test fraction, then using a scoop select representative soil for each subspecimen (compaction point). Select about 2.3 kg when using Method A or B, or about 5.9 kg for Method C. Test Method D6913 section on Specimen and Annex A2 give additional details on obtaining representative soil using this procedure and the reason it is the preferred method. To obtain the subspecimen's molding water contents selected in 10.2.1, add or remove the required amounts of water as follows: To add water, spray it into the soil during mixing; to remove water, allow the soil to dry in air at ambient temperature or in a drying apparatus such that the temperature of the sample does not exceed 140°F (60°C). Mix the soil frequently during drying to facilitate an even water content distribution. Thoroughly mix each subspecimen to facilitate even distribution of water throughout and then place in a separate covered container to stand (cure) in accordance with Table 2 prior to compaction. For selecting a standing time, the soil may be classified using Practice D2487, Practice D2488 or data on other samples from the same material source. For referee testing, classification shall be by Practice D2487.

10.3 *Dry Preparation Method*—If the sample/specimen is too damp to be friable, reduce the water content by air drying until the material is friable. Drying may be in air or by the use of drying apparatus such that the temperature of the sample does not exceed 140°F (60°C). Thoroughly break up the aggregations in such a manner as to avoid breaking individual particles. Process the material over the appropriate sieve: No. 4 (4.75 mm), ⅜ in. (9.5 mm), or ¾ in. (19.0 mm). When preparing the material by passing over the ¾-in. sieve for compaction in the 6-in. mold, break up aggregations sufficiently to at least pass the ⅜ in. sieve in order to facilitate the distribution of water throughout the soil in later mixing. Determine and record the water content of the test fraction and all masses covered in 10.2, as applicable to determine the percent oversize fraction, P_C, and test fraction, P_F.

10.3.1 From the test fraction, select and prepare at least four (preferably five) subspecimens in accordance with 10.2.1 and 10.2.2, except for the following: Use either a mechanical splitting or quartering process to obtain the subspecimens. As stated in Test Method D6913, both of these processes will yield non-uniform subspecimens compared to the moist procedure. Typically, only the addition of water to each subspecimen will be required.

10.4 *Compaction*—After standing (curing), if required, each subspecimen (compaction point) shall be compacted as follows:

10.4.1 Determine and record the mass of the mold or mold and base plate, see 10.4.7.

10.4.2 Assemble and secure the mold and collar to the base plate. Check the alignment of the inner wall of the mold and mold extension collar. Adjust if necessary. The mold shall rest without wobbling/rocking on a uniform rigid foundation, such as provided by a cylinder or cube of concrete with a weight or

TABLE 2 Required Standing Times of Moisturized Specimens

Classification	Minimum Standing Time, h
GW, GP, SW, SP	no requirement
GM, SM	3
All other soils	16

mass of not less than 200 lb or 91 kg, respectively. Secure the base plate to the rigid foundation. The method of attachment to the rigid foundation shall allow easy removal of the assembled mold, collar and base plate after compaction is completed.

10.4.2.1 During the compaction procedure, it is advantageous but not required to determine the water content of each subspecimen immediately prior to compaction. This provides a check on the molding water content determined for each compaction point and the magnitude of bleeding. See 10.4.9. However, more soil will have to be selected for each subspecimen than stated in 10.2.2.

10.4.3 Compact the soil in five layers. After compaction, each layer should be approximately equal in thickness and the final layer shall extend slightly into the collar. Prior to compaction, place the loose soil into the mold and spread into a layer of uniform thickness. Lightly tamp the soil prior to compaction until it is not in a fluffy or loose state, using either the manual rammer or a cylinder approximately 2 in. (50 mm) in diameter. Following compaction of each of the first four layers, any soil that has not been compacted, such as adjacent to the mold walls, or extends above the compacted surface (up the mold walls) shall be trimmed. The trimmed soil shall be discarded. A knife or other suitable device may be used. The total amount of soil used shall be such that the fifth compacted layer slightly extends into the collar, but does not extend more than approximately ¼ in. (6 mm) above the top of the mold. If the fifth layer does extend above this limit, then the compaction point shall be discarded. In addition, the compaction point shall be discarded when the last blow on the rammer for the fifth layer results in the bottom of the rammer extending below the top of the compaction mold, unless the soil is pliable enough that this surface can easily be forced above the top of the compaction mold during trimming. See Note 9.

10.4.4 Compact each layer with 25 blows for the 4-in. (101.6-mm) mold or with 56 blows for the 6-in. (152.4-mm) mold. The manual rammer shall be used for referee testing.

10.4.5 In operating the manual rammer, take care to avoid lifting the guide sleeve during the rammer upstroke. Hold the guide sleeve steady and within 5° of vertical. Apply the blows at a uniform rate of about 25 blows/min and in such a manner as to provide complete, uniform coverage of the specimen surface. When using a 4-in. (101.6-mm) mold and manual rammer, follow the blow pattern given in Fig. 3(a) and Fig. 3(b) while for a mechanical rammer, follow the pattern in Fig. 3(b). When using a 6-in. (152.4-mm) mold and manual rammer, follow the blow pattern given in Fig. 4 up to the 9th blow, then systematically around the mold (Fig. 3(b)) and in the middle. When using a 6-in. (152.4-mm) mold and a mechanical rammer equipped with a sector face, the mechanical rammer shall be designed to follow the compaction pattern given in Fig. 3(b). When using a 6-in. (152.4-mm) mold and a mechanical rammer equipped with a circular face, the mechanical rammer shall be designed to distribute the blows uniformly over the surface of the specimen. If the surface of the compacted soil becomes highly uneven (see Note 9) then adjust the pattern to follow the logic given in Fig. 3(a) or Fig. 4. This will most likely void the use of a mechanical rammer for such compaction points.

NOTE 9—When compacting specimens wetter than optimum water content, uneven compacted surfaces can occur and operator judgment is required as to the average height of the specimen and rammer pattern during compaction.

10.4.6 Following compaction of the last layer, remove the collar and base plate (except as noted in 10.4.7) from the mold. A knife may be used to trim the soil adjacent to the collar to loosen the soil from the collar before removal to avoid disrupting the soil below the top of the mold. In addition, to prevent/reduce soil sticking to the collar or base plate, rotate them before removal.

10.4.7 Carefully trim the compacted specimen even with the top of the mold by means of the straightedge scraped across the top of the mold to form a plane surface even with the top of the

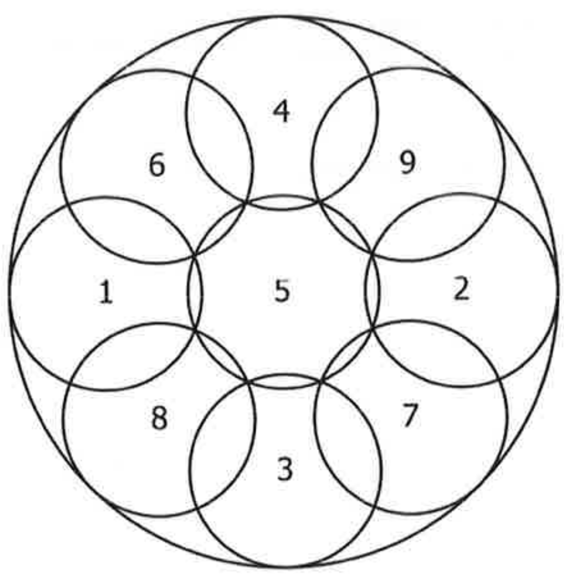


FIG. 4 Rammer Pattern for Compaction in 6-in. (152.4-mm) Mold

mold. Initial trimming of the specimen above the top of the mold with a knife may prevent tearing out soil below the top of the mold. Fill any holes in either surface with unused or trimmed soil from the specimen, press in with the fingers, and again scrape the straightedge across the top of the mold. If gravel size particles are encountered, trim around them or remove them, whichever is the easiest and reduces the disturbance of the compacted soil. The estimated volume of particles above the surface of the compacted soil and holes in that surface shall be equal. Fill in remaining holes as mentioned above. Repeat the appropriate preceding operations on the bottom of the specimen when the mold volume was determined without the base plate. For very wet or dry soils, soil or water may be lost if the base plate is removed. For these situations, leave the base plate attached to the mold. When the base plate is left attached, the volume of the mold must be calibrated with the base plate attached to the mold rather than a plastic or glass plate as noted in Annex A1 (A1.4.1).

10.4.8 Determine and record the mass of the specimen and mold to the nearest g. When the base plate is left attached, determine and record the mass of the specimen, mold and base plate to the nearest g.

10.4.9 Remove the material from the mold. Obtain a specimen for molding water content by using either the whole specimen (preferred method) or a representative portion. When the entire specimen is used, break it up to facilitate drying. Otherwise, obtain a representative portion of the five layers, removing enough material from the specimen to report the water content to 0.1 %. The mass of the representative portion of soil shall conform to the requirements of Table 1, Method B, of Test Methods D2216. Determine the molding water content in accordance with Test Method D2216.

10.5 Following compaction of the last specimen, compare the wet unit weights to ensure that a desired pattern of obtaining data on each side of the optimum water content will be attained for the dry-unit-weight compaction curve. Plotting the wet unit weight and molding water content of each compacted specimen can be an aid in making the above evaluation. If the desired pattern is not obtained, additional compacted specimens will be required. Generally, for experienced plotters of compaction curves, one compaction point wet of the optimum water content is adequate to define the maximum wet unit weight. See 11.2.

11. Calculation and Plotting (Compaction Curve)

11.1 *Fraction Percentages*—If gradation data from Test Method D6913 is not available, calculate the dry mass of the test fraction, percentage of oversize fraction, and test fraction as covered below and using the data from 10.2 or 10.3:

11.1.1 *Test Fraction*—Determine the dry mass of the test fraction as follows:

$$M_{d,tf} = \frac{M_{m,tf}}{1 + \frac{w_{tf}}{100}} \quad (1)$$

where:

$M_{d,tf}$ = dry mass of test fraction, nearest g or 0.001 kg,
$M_{m,tf}$ = moist mass of test fraction, nearest g or 0.001 kg, and
w_{tf} = water content of test fraction, nearest 0.1 %.

11.1.2 *Oversize Fraction Percentage*—Determine the oversize (coarse) fraction percentage as follows:

$$P_C = \frac{M_{d,of}}{M_{d,of} + M_{d,tf}} \quad (2)$$

where:

P_C = percentage of oversize (coarse) fraction, nearest %,
$M_{d,of}$ = dry mass of oversize fraction, nearest g or 0.001 kg.

11.1.3 *Test Fraction Percentage*—Determine the test (finer) fraction percentage as follows:

$$P_F = 100 - P_C \quad (3)$$

where:

P_F = percentage of test (finer) fraction, nearest %

11.2 *Density and Unit Weight*—Calculate the molding water content, moist density, dry density, and dry unit weight of each compacted specimen as explained below.

11.2.1 *Molding Water Content, w*—Calculate in accordance with Test Method D2216 to nearest 0.1 %.

11.2.2 *Density and Unit Weights*—Calculate the moist (total) density (Eq 4), the dry density (Eq 5), and then the dry unit weight (Eq 6) as follows:

11.2.2.1 *Moist Density:*

$$\rho_m = K \times \frac{(M_t - M_{md})}{V} \quad (4)$$

where:

ρ_m = moist density of compacted subspecimen (compaction point), four significant digits, g/cm³ or kg/m³,
M_t = mass of moist soil in mold and mold, nearest g,
M_{md} = mass of compaction mold, nearest g,
V = volume of compaction mold, cm³ or m³ (see Annex A1), and
K = conversion constant, depending on density units and volume units. Use 1 for g/cm³ and volume in cm³. Use 1000 for g/cm³ and volume in m³. Use 0.001 for kg/cm³ and volume in m³. Use 1000 for kg/m³ and volume in cm³.

11.2.2.2 *Dry Density:*

$$\rho_d = \frac{\rho_m}{1 + \frac{w}{100}} \quad (5)$$

where:

ρ_d = dry density of compaction point, four significant digits, g/cm³ or kg/m³, and
w = molding water content of compaction point, nearest 0.1 %.

11.2.2.3 *Dry Unit Weight:*

$$\gamma_d = K_1 \times \rho_d \quad (6)$$

in lbf/ft³, or,

$$\gamma_d = K_2 \times \rho_d \quad (7)$$

in kN/m³,

where:

γ_d = dry unit weight of compacted specimen, four significant digits, in lbf/ft^3 or kN/m^3,

K_1 = conversion constant, depending on density units. Use 62.428 for density in g/cm^3, or use 0.062428 for density in kg/m^3,

K_2 = conversion constant, depending on density units. Use 9.8066 for density in g/cm^3, or use 0.0098066 for density in kg/m^3.

11.3 *Compaction Curve*—Plot the dry unit weight and molding water content values, the saturation curve (see 11.3.2), and draw the compaction curve as a smooth curve through the points (see example, Fig. 5). For each point on the compaction curve, calculate, record, and plot dry unit weight to the nearest 0.1 lbf/ft^3 (0.02 kN/m^3) and molding water content to the nearest 0.1 %. From the compaction curve, determine the compaction results: optimum water content, to nearest 0.1 % and maximum dry unit weight, to the nearest 0.1 lbf/ft^3 (0.02 kN/m^3). If more than 5 % by mass of oversize material was removed from the sample/specimen, calculate the corrected optimum water content and maximum dry unit weight of the total material using Practice D4718. This correction may be made to the appropriate field in-place density test specimen rather than to the laboratory compaction results.

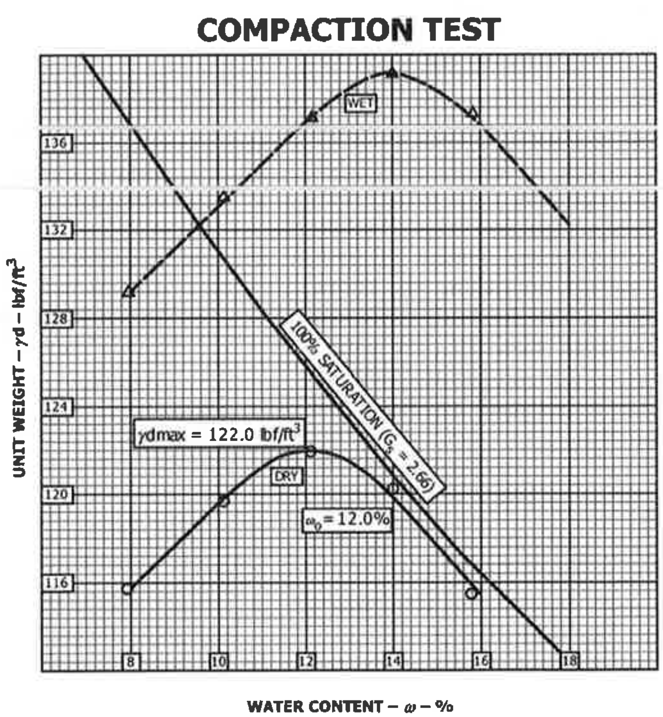
11.3.1 In these plots, the scale sensitivities should remain the same, that is, the change in molding water content or dry unit weight per division is constant between plots. Typically, the change in dry unit weight per division is twice that of molding water content's (2 lbf/ft^3 to 1 % *w* per major division). Therefore, any change in the shape of the compaction curve is a result of testing different material, not the plotting scale. However, a one to one ratio should be used for soils have a relatively flat compaction curve (see 10.2.1), such as highly plastic soils or relatively free draining ones up to the point of bleeding.

11.3.1.1 The shape of the compaction curve on the wet side on optimum should typically follow that of the saturation curve. The shape of the compaction curve on the dry side of optimum may be relatively flat or up and down when testing some soils, such as relatively free draining ones or plastic soils prepared using the moist procedure and having molding water contents close to or less than the shrinkage limit.

11.3.2 Plot the 100 % saturation curve, based on either an estimated or a measured specific gravity. Values of water content for the condition of 100 % saturation can be calculated as explained in 11.4 (see example, Fig. 5).

NOTE 10—The 100 % saturation curve is an aid in drawing the compaction curve. For soils containing more than about 10 % fines and molding water contents well above optimum, the two curves generally become roughly parallel with the wet side of the compaction curve between 92 % to 95 % saturation. Theoretically, the compaction curve cannot plot to the right of the 100 % saturation curve. If it does, there is an error in specific gravity, in measurements, in calculations, in testing, or in plotting. The 100 % saturation curve is sometimes referred to as the zero air voids curve or the complete saturation curve.

11.4 *Saturation Points*—To calculate points for plotting the 100 % saturation curve or zero air voids curve, select values of



NOTE 1—Wet Unit Weights are usually not plotted. They are plotted here for informational purposes only. Also notice that the compaction points may not all lie exactly on the compaction curve.

FIG. 5 Example Compaction Curve Plotting

dry unit weight, calculate corresponding values of water content corresponding to the condition of 100 % saturation as follows:

$$w_{sat} = \frac{(\gamma_w)(G_s) - \gamma_d}{(\gamma_d)(G_s)} \times 100 \quad (8)$$

where:

w_{sat} = water content for complete saturation, nearest 0.1 %,
γ_w = unit weight of water, 62.32 lbf/ft^3 (9.789 kN/m^3) at 20°C,
γ_d = dry unit weight of soil, lbf/ft^3 (kN/m^3), three significant digits, and
G_s = specific gravity of soil (estimated or measured), to nearest 0.01 value, see 11.4.1.

11.4.1 Specific gravity may be estimated for the test fraction based on test data from other soils having the same soil classification and source or experience. Otherwise, a specific gravity test (Test Method C127, Test Method D854, or both) is necessary.

12. Report: Data Sheet(s)/Form(s)

12.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s), as described below, is covered in Section 1.6.

12.2 The data sheet(s)/form(s) shall contain as a minimum the following information:

12.2.1 Method used (A, B, or C).

12.2.2 Preparation method used (moist or dry).

12.2.3 As-received water content, if determined, nearest 1 %.

12.2.4 Modified optimum water content, Mod-w_{opt} to nearest 0.1 %.

12.2.5 Modified maximum (optimum) dry unit weight, Mod-$\gamma_{d,max}$ nearest 0.1 lbf/ft^3 or 0.02 kN/m^3.

12.2.6 Type of rammer (manual or mechanical).

12.2.7 Soil sieve data when applicable for selection of Method (A, B, or C) used.

12.2.8 Description of sample used in test (as a minimum, color and group name and symbol), by Practice D2488, or classification by Test Method D2487.

12.2.9 Specific gravity and method of determination, nearest 0.01 value.

12.2.10 Identification of sample used in test, for example, project number/name, location, depth, and the like.

12.2.11 Compaction curve plot showing compaction points used to establish compaction curve, and 100 % saturation curve, value or point of maximum dry unit weight and optimum water content.

12.2.12 Percentages for the fractions retained (P_C) and passing (P_F) the sieve used in Method A, B, or C, nearest 1 %. In addition, if compaction data (Mod-w_{opt} and Mod-$\gamma_{d,max}$) are corrected for the oversize fraction, include that data.

NOTE 11—The Data Sheet(s)/Form requirements in Section 12 are not intended as requirements for reporting final test results to the requesting agency. The requirements apply to testing records for measurements, for intermediate calculations and for compaction points used to plot the compaction curve. It has been attempted in this test method to determine all measurements and calculations to four significant figures. The purpose is to ensure that precision is not lost due to rounding prior to plotting the compaction curve and that data sheets and forms retained by the laboratory contain that same degree of precision.

13. Precision and Bias[4]

13.1 *Precision*—Criteria for judging the acceptability of maximum unit weight and optimum water content results obtained by this method are given in Table 3.

13.1.1 *Single-Operator Precision (Repeatability)*—The figures in Column 2 of Table 3 are the standard deviations that have been found to be appropriate for the conditions of test described in Column 1. Two results obtained in the same laboratory, by the same operator using the same equipment, in the shortest practical period of time, should not be considered suspect unless the difference in the two results exceeds the values given in Table 3, Column 3.

13.1.2 *Multilaboratory Precision (Reproducibility)*—The figures in Column 2 of Table 3 are the standard deviations that have been found to be appropriate for the conditions of test described in Column 1. Two results submitted by two different operators testing the same material in different laboratories shall not be considered suspect unless the difference in the two results exceeds the values given in Table 3, Column 3.

13.2 *Bias*—It is not possible to present information on bias because there is no other method of determining the values of modified maximum unit weight and modified optimum water content.

14. Keywords

14.1 compaction characteristics; density; impact compaction using modified effort; laboratory tests; modified proctor test; moisture-density curves; soil compaction

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D18-1017.

TABLE 3 Precision Estimates

Conditions of Test and Test Property	Standard Deviation (1s)^A	Acceptable Range of Two Test Results (d2s)^A
Single Operator Precision:		
Maximum Unit Weight (lbf/ft ^{3})	0.6	1.8
Optimum Water Content (percent)	0.4	1.0
Multilaboratory Precision:		
Maximum Unit Weight (lbf/ft ^{3})	1.6	4.4
Optimum Water Content (percent)	0.7	2.1

^{A}These numbers represent, respectively, the (1s) and (d2s) limits as described in Practice C670 for Preparing Precision and Bias Statements for Test Methods for Construction Materials.

NOTE 1—The precision estimates given in Table 3 are based on the analysis of test results from three pairs of AMRL proficiency samples. The data analyzed consisted of results from 144 to 253 laboratories for each of the three pairs of samples. The analysis included two classifications of fine grained soil (group symbol CL): lean clay with sand and sandy lean clay. Average maximum unit weights ranged from 125.8 lbf/ft^3 to 132.6 lbf/ft^3. Average optimum water contents ranged from 8.0 percent to 10.4 percent.

ANNEX

(Mandatory Information)

A1. VOLUME OF COMPACTION MOLD

A1.1 Scope

A1.1.1 This annex describes the method for determining the volume of a compaction mold.

A1.1.2 The volume is determined by two methods, a water-filled method and a linear-measurement method.

A1.1.3 The water filling method for the 4-in. (106.5-mm) mold, when using a balance readable to nearest g, does not yield four significant figures for its volume, just three. Based on Practice D6026, this limits the density/unit weight determinations previously presented from four to three significant figures. To prevent this limitation, the water filling method has been adjusted from that presented in early versions of this test method.

A1.2 Apparatus

A1.2.1 In addition to the apparatus listed in Section 6, the following items are required:

A1.2.1.1 *Vernier or Dial Caliper,* having a measuring range of at least 0 to 6 in. (0 to 150 mm) and readable to at least 0.001 in. (0.02 mm).

A1.2.1.2 *Inside Micrometer (optional),* having a measuring range of at least 2 to 12 in. (50 to 300 mm) and readable to at least 0.001 in. (0.02 mm).

A1.2.1.3 *Depth Micrometer (optional),* having a measuring range of at least 0 to 6 in. (0 to 150 mm) and readable to at least 0.001 in. (0.02 mm).

A1.2.1.4 *Plastic or Glass Plates*—Two plastic or glass plates about 8 in. by 8 in. by ¼ in. thick (200 mm by 200 mm by 6 mm).

A1.2.1.5 *Thermometer or other Thermometric Device,* having a readability of 0.1°C and a maximum permissible error of 0.5°C.

A1.2.1.6 *Stopcock Grease* or similar sealant.

A1.2.1.7 *Distilled Water or De-ionized Water*—Either type of water may be used to fill the mold when determining the mold volume using the water-filling method. Distilled water or de-ionized water may be purchased and is available in most grocery stores. In the procedure for the water-filling method, distilled water, or de-ionized water, is referred to as water.

A1.2.1.8 *Miscellaneous equipment*—Bulb syringe, towels, etc.

A1.3 Precautions

A1.3.1 Perform this method in an area isolated from drafts or extreme temperature fluctuations.

A1.4 Procedure

A1.4.1 *Water-Filling Method:*

A1.4.1.1 Lightly grease the bottom of the compaction mold and place it on one of the plastic or glass plates. Lightly grease the top of the mold. Be careful not to get grease on the inside of the mold. If it is necessary to use the base plate, as noted in 10.4.7, place the greased mold onto the base plate and secure with the locking studs.

A1.4.1.2 Determine the mass of the greased mold and both plastic or glass plates to the nearest 1 g and record, M_{mp}. When the base plate is being used in lieu of the bottom plastic or glass plate determine the mass of the mold, base plate and a single plastic or glass plate to be used on top of the mold to the nearest 1 g and record.

A1.4.1.3 Place the mold and the bottom plate on a firm, level surface and fill the mold with water to slightly above its rim.

A1.4.1.4 Slide the second plate over the top surface of the mold so that the mold remains completely filled with water and air bubbles are not entrapped. Add or remove water as necessary with a bulb syringe.

A1.4.1.5 Completely dry any excess water from the outside of the mold and plates.

A1.4.1.6 Determine the mass of the mold, plates and water and record to the nearest 1 g, $M_{mp,w}$.

A1.4.1.7 Determine the temperature of the water in the mold to the nearest 0.1°C and record. Determine and record the density of water from the table given in D854 or as follows:

$$\rho_{w,c} = 1.00034038 - (7.77 \times 10^{-6}) \times T - (4.95 \times 10^{-6}) \times T^2 \qquad (A1.1)$$

where:

$\rho_{w,c}$ = density of water, nearest 0.00001 g/cm^3, and
T = calibration test temperature, nearest 0.1°C.

A1.4.1.8 Calculate the mass of water in the mold by subtracting the mass determined in A1.4.1.2 from the mass determined in A1.4.1.6.

A1.4.1.9 Calculate the volume of water by dividing the mass of water by the density of water. Record this volume to the nearest 0.1 cm^3 for the 4-in.(101.6-mm) mold or nearest 1 cm^3 for the 6-in. (152.4-mm) mold. To determine the volume of the mold in m^3, multiply the volume in cm^3 by 1 × 10^{-6}. Record this volume, as prescribed.

A1.4.1.10 If the water-filling method is being used to determine the mold's volume and checked by linear measurement method, repeat this volume determination (A1.4.1.3 – A1.4.1.9) and determine and record the average value, V_w, as prescribed.

A1.4.2 *Linear Measurement Method:*

A1.4.2.1 Using either the vernier caliper or the inside micrometer (preferable), measure the inside diameter (ID) of the mold six times at the top of the mold and six times at the bottom of the mold spacing each of the six top and bottom measurements equally around the inside circumference of the mold. Record the values to the nearest 0.001 in. (0.02 mm). Determine and record the average ID to the nearest 0.001 in.

(0.02 mm), d_{avg}. Verify that this ID is within specified tolerances, 4.000 ± 0.016 in. (101.6 ± 0.4 mm); if not, discard the mold.

A1.4.2.2 Using the vernier caliper or depth micrometer (preferably), measure the inside height of the mold to the base plate. In these measurements, make three or more measurements equally spaced around the inside circumference of the mold, and preferably one in the center of the mold, but not required (use the straightedge to facilitate the latter measurement and correct the measurement for the thickness of the straightedge). Record these values to the nearest 0.001 in. (0.02 mm). Determine and record the average of these height measurements to the nearest 0.001 in. (0.02 mm), h_{avg}. Verify that this height is within specified tolerances, 4.584 ± 0.018 in. (116.4 ± 0.5 mm); if not, discard the mold.

A1.4.2.3 Calculate the volume of the mold to four significant digits in cm^3 as follows:

$$V_{lm} = K_3 \frac{\pi \times h_{avg} \times (d_{avg})^2}{4} \quad (A1.2)$$

where:

V_{lm} = volume of mold by linear measurements, to four significant digits, cm^3,
K_3 = constant to convert measurements made in inch (in.) or mm. Use 16.387 for measurements in inches. Use 10^{-3} for measurements in mm.
π = 3.14159,
h_{avg} = average height, in. (mm), and
d_{avg} = average of the top and bottom diameters, in. (mm).

If the volume in m^3 is required, then multiply the above value by 10^{-6}.

A1.5 Comparison of Results and Standardized Volume of Mold

A1.5.1 The volume obtained by either method should be within the volume tolerance requirements of 6.1.1 and 6.1.2, using either or cm^3 or ft^3. To convert cm^3 to ft^3, divide cm^3 by 28 317, record to the nearest 0.0001 ft^3.

A1.5.2 The difference between the two methods should not exceed 0.5 % of the nominal volume of the mold, cm^3 or ft^3.

A1.5.3 Repeat the determination of volume which is most suspect, or both, if these criteria are not met.

A1.5.4 Failure to obtain satisfactory agreement between the two methods, even after several trials, is an indication that the mold is badly deformed and should be replaced.

A1.5.5 Use the volume of the mold determined using the water-filling method or linear method, or average of both methods as the standardized volume for calculating the moist density (see 11.2.2.1). This value (*V*) in cm^3 or m^3 shall have four significant digits. The use of a volume in ft^3, along with masses in lbm shall not be regarded as a nonconformance with this standard.

REFERENCES

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(2) Head, K. H., *Manual of Soil Laboratory Testing: Volume 1 Soil Classification and Compaction Tests*, Pentech Press, London, Second Edition, 1992, p. 313.

(3) *Earth Manual*, United States Bureau of Reclamation, Part 1, Third Edition, 1998, pp. 255-260.

(4) *Earth Manual*, United States Bureau of Reclamation, Part 2, Third Edition, 1990.

(5) Torrey, V.H., and Donaghe, R.T., "Compaction Control of Earth-Rock Mixtures: A New Approach," *Geotechnical Testing Journal*, GTJODJ, Vol 17, No 3, September 1994, pp. 371-386.

SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to these test methods since the last issue, D1557–09, that may impact the use of these test methods. (Approved May 1, 2012)

(1) Revised 6.2.2.1 and 10.4.5.

(2) Added a mercury caveat in the Scope.

California Ambient Air Quality Standards

California Ambient Air Quality Standards (CAAQS)

CATEGORIES

Topics Health, Air Pollution, Air Quality Monitoring

Programs Outdoor Air Quality Standards, Community Air Protection Program ,

Type Fact Sheet

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Hundreds of scientific studies published over the past 50 years point to the harmful effects of air pollution. Air pollution harms people's health, damages agricultural crops, forests, ornamental and native plants, and creates the haze that reduces visibility. Ambient air quality standards are designed to prevent these impacts on health and the environment.

What is a California ambient air quality standard?

Ambient air quality standards (AAQS) define clean air, and are established to protect the health of the most sensitive groups in our communities. An air quality standard defines the maximum amount of a pollutant averaged over a specified period of time that can be present in outdoor air without any harmful effects on people or the environment. In 1959 California enacted legislation requiring the state Department of Public Health to establish air quality standards and necessary controls for motor vehicle emissions. California law continues to mandate California ambient air quality standards (CAAQS), which are often more stringent than national standards. Learn more about our brief history of standard setting in California.

How are California ambient air quality standards developed?

Air quality standard setting in California commences with a critical review of all relevant peer reviewed scientific literature. The Office of Environmental Health Hazard Assessment (OEHHA) uses the review of health literature to develop a recommendation for the standard. The recommendation can be for no change, or can recommend a new standard. The review, including the OEHHA recommendation, is summarized in a document called the draft Initial Statement of Reasons (ISOR), which is released for comment by the public, and also for public peer review by the Air Quality Advisory Committee (AQAC). AQAC members are appointed by the President of the University of California for their expertise in the range of subjects covered in the ISOR, including health, exposure, air quality monitoring, atmospheric chemistry and physics, and effects on plants, trees, materials, and ecosystems. The Committee provides written comments on the draft ISOR. ARB staff next revises the ISOR based on comments from AQAC and the public. The revised ISOR is then released for a 45-day public comment period prior to consideration by the Board at a regularly scheduled Board hearing.

When were California ambient air quality standards last updated?

In June of 2002, the Air Resources Board adopted revisions to the PM10 standard and established a new PM2.5 annual standard. The new standards became effective in June 2003. Visit our web page for more information regarding the PM and Sulfates Standards Review.

Subsequently, staff reviewed the published scientific literature on ground-level ozone and nitrogen dioxide and the Air Resources Board adopted revisions to the standards for these two pollutants. Revised standards for ozone and nitrogen dioxide went into effect on May 17, 2006 and March 20, 2008, respectively. Please follow these links for more information about the Ozone Standard Review and the Nitrogen Dioxide Standards Review.

What are the health and environmental effects of the air pollutants for which there are California ambient air quality standards?

Although there is some variability among the health effects of the CAAQS pollutants, each has been linked to multiple adverse health effects including, among others, premature death, hospitalizations and emergency department visits for exacerbated chronic disease, and increased symptoms such as coughing and wheezing.

Below is the list of pollutants for which CAAQS were established and more information on the health and environmental effects specific to each pollutant.

- Particulate Matter (PM10 and PM2.5)
- Ozone (O_3)
- Nitrogen Dioxide (NO_2)
- Sulfate
- Carbon Monoxide (CO)
- Sulfur Dioxide (SO_2)
- Visibility Reducing Particles
- Lead
- Hydrogen Sulfide (H_2S)
- Vinyl Chloride

Download the PDF for more information on the current levels and averaging times for each California ambient air quality standard.

CAAQS vs. NAAQS

In 1959 the California Legislature directed the State Department of Public Health to develop CAAQS. The original CAAQS were established in 1962. The Air Resources Board was created by the legislature in 1967, and the CAAQS that had been set by the Department of Public Health were subsequently adopted by the Air Resources Board (ARB) in 1969. Thus, the CAAQS predate the national ambient air quality standards (NAAQS) set by the U.S. Environmental Protection Agency (U.S. EPA), which was created in 1970, and issued its first NAAQS in 1971. California law continues to mandate CAAQS, although attainment of the NAAQS has precedence over attainment of the CAAQS due to federal penalties for failure to meet federal attainment deadlines.

Attainment of Air Quality Standards

California law does not require that CAAQS be met by specified dates as is the case with NAAQS. Rather, it requires incremental progress toward attainment.

Additional Information

- View state and federal designation maps showing which geographical areas of California meet the NAAQS and/or CAAQS

- California's State Implementation Plans and State Maintenance Plans for NAAQS
- An overview of the NAAQS

RELATED RESOURCES

Mobile Monitoring Research Studies

Verification Procedure: Installers & Distributors

Car & Bus Exposure Studies

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California Governor
Gavin Newsom

Secretary for Environmental Protection
Jared Blumenfeld

Chair, California Air Resources Board
Mary D. Nichols

Inhalable Particulate Matter and Health (PM2.5 and PM10)

CATEGORIES

Topics Health, Air Pollution, Indoor Air Quality & Exposure

Programs Outdoor Air Quality Standards, Exposure

Type Information

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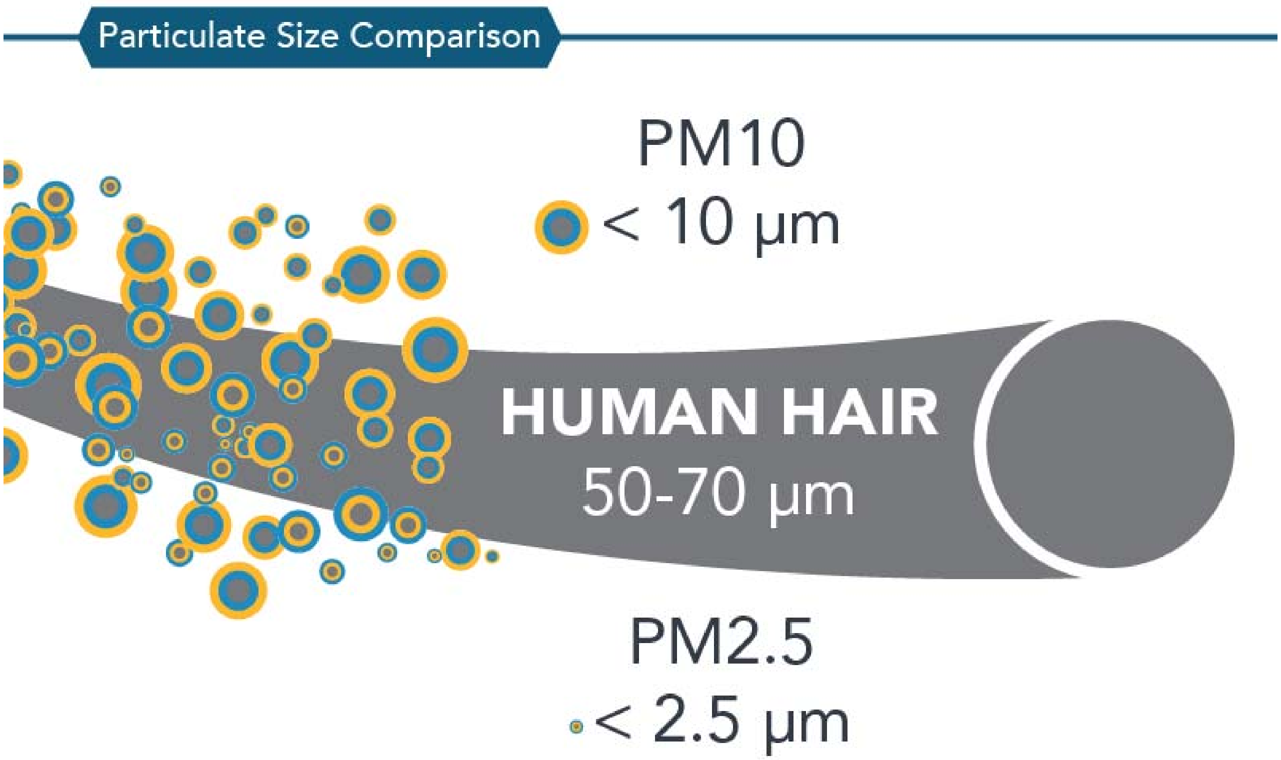
What is Particulate Matter?

Airborne particulate matter (PM) is not a single pollutant, but rather is a mixture of many chemical species. It is a complex mixture of solids and aerosols composed of small droplets of liquid, dry solid fragments, and solid cores with liquid coatings. Particles vary widely in size, shape and chemical composition, and may contain inorganic ions, metallic compounds, elemental carbon, organic compounds, and compounds from the earth's crust. Particles are defined by their diameter for air quality regulatory purposes. Those with a diameter of 10 microns or less (PM10) are inhalable into the lungs and can induce adverse health effects. Fine particulate matter is defined as particles that are 2.5 microns or less in diameter (PM2.5). Therefore, PM2.5 comprises a portion of PM10.

What is the Difference Between PM10 and PM2.5?

PM10 and PM2.5 often derive from different emissions sources, and also have different chemical compositions. Emissions from combustion of gasoline, oil, diesel fuel or wood produce much of the PM2.5 pollution found in outdoor air, as well as a significant proportion of PM10. PM10 also includes dust from construction sites, landfills and agriculture, wildfires and brush/waste burning, industrial sources, wind-blown dust from open lands, pollen and fragments of bacteria.

PM may be either directly emitted from sources (primary particles) or formed in the atmosphere through chemical reactions of gases (secondary particles) such as sulfur dioxide (SO_2), nitrogen oxides (NO_X), and certain organic compounds. These organic compounds can be emitted by both natural sources, such as trees and vegetation, as well as from man-made (anthropogenic) sources, such as industrial processes and motor vehicle exhaust. The relative sizes of PM10 and PM2.5 particles are compared in the figure below.



Why is CARB Concerned about PM10 and PM2.5?

CARB is concerned about air-borne particles because of their effects on the health of Californians and the environment. Both PM2.5 and PM10 can be inhaled, with some depositing throughout the airways, though the locations of particle deposition in the lung depend on particle size. PM2.5 is more likely to travel into and deposit on the surface of the deeper parts of the lung, while PM10 is more likely to deposit on the surfaces of the larger airways of the upper region of the lung. Particles deposited on the lung surface can induce tissue damage, and lung inflammation.

What Kinds of Harmful Effects Can Particulate Matter Cause?

A number of adverse health impacts have been associated with exposure to both PM2.5 and PM10. For PM2.5, short-term exposures (up to 24-hours duration) have been associated with premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, respiratory symptoms, and restricted activity days. These adverse health effects have been reported primarily in infants, children, and older adults with preexisting heart or lung diseases. In addition, of all of the common air pollutants, PM2.5 is associated with the greatest proportion of adverse health effects related to air pollution, both in the United States and world-wide based on the World Health Organization's Global Burden of Disease Project.

Short-term exposures to PM10 have been associated primarily with worsening of respiratory diseases, including asthma and chronic obstructive pulmonary disease (COPD), leading to hospitalization and emergency department visits.

Long-term (months to years) exposure to PM2.5 has been linked to premature death, particularly in people who have chronic heart or lung diseases, and reduced lung function growth in children. The effects of long-term exposure to PM10 are less clear, although several studies suggest a link between long-term PM10 exposure and respiratory mortality. The International Agency for Research on Cancer (IARC) published a review in 2015 that concluded that particulate matter in outdoor air pollution causes lung cancer.

Diesel PM: A special class of particulates. The solid material in diesel exhaust is known as diesel particulate matter (DPM). More than 90% of DPM is less than 1 µm in diameter (about 1/70th the diameter of a human hair), and thus is a subset of PM2.5. More Information

Who is at the Greatest Risk from Exposure to Particulate Matter?

Research points to older adults with chronic heart or lung disease, children and asthmatics as the groups most likely to experience adverse health effects with exposure to PM10 and PM2.5. Also, children and infants are susceptible to harm from inhaling pollutants such as PM because they inhale more air per pound of body weight than do adults - they breathe faster, spend more time outdoors and have smaller body sizes. In addition, children's immature immune systems may cause them to be more susceptible to PM than healthy adults.

Research from the CARB-initiated Children's Health Study found that children living in communities with high levels of PM2.5 had slower lung growth, and had smaller lungs at age 18 compared to children who lived in communities with low PM2.5 levels.

CARB used the U.S. EPA's risk assessment methodology to conduct an assessment of premature mortality associated with exposure to PM2.5 (California Air Resources Board 2010). An update to this analysis using ambient air quality data from 2014-2016 indicated that PM2.5 exposure contributes to 5,400 (uncertainty range of 4,200 – 6,700) premature deaths due to cardiopulmonary causes per year in California. In addition, PM2.5 contributes to about 2,800 hospitalizations for cardiovascular and respiratory diseases (uncertainty range 350 – 5,100), and about 6,700 emergency room visits for asthma (uncertainty range 4,200 – 9,300) each year in California.

How Does Particulate Matter Affect the Environment?

Particulate matter has been shown in many scientific studies to reduce visibility, and also to adversely affect climate, ecosystems and materials. PM, primarily PM2.5, affects visibility by altering the way light is absorbed and scattered in the atmosphere. With reference to climate change, some constituents of the ambient PM mixture promote climate warming (e.g., black carbon), while others have a cooling influence (e.g., nitrate and sulfate), and so ambient PM has both climate warming and cooling properties. PM can adversely affect ecosystems, including plants, soil and water through deposition of PM and its subsequent uptake by plants or its deposition into water where it can affect water quality and clarity. The metal and organic compounds in PM have the greatest potential to alter plant growth and yield. PM deposition on surfaces leads to soiling of materials.

Is Particulate Matter a Problem Indoors?

Some of the particulate matter found indoors originates from the outdoors, especially PM2.5. These particles enter indoor spaces through doors, windows, and "leakiness" in building structures. Particles can also originate from indoor sources. Particles of indoor origin include components derived from biological sources, many of which are known allergens, such as pollens, mold spores, dust mites and cockroaches. Indoor activities generate particles, as well, including smoking tobacco, cooking and burning wood, candles or incense. Particles also can form indoors from complex reactions of gaseous pollutants emitted from such sources as household cleaning products and air fresheners.

What are the Ambient Air Quality Standards for Particulate Matter?

Ambient air quality standards define the maximum amount of pollutant that can be present in outdoor air without harming human health. In 2002, after an extensive review of the scientific literature, the Board adopted a new annual average standard for PM2.5 ppm, and retained the existing annual and 24-hour standard average standards for PM10. The national annual average PM2.5 standard was most recently revised in 2012 following an exhaustive review of new literature pointed to evidence for increased risk of premature mortality at lower PM2.5 concentrations than the existing standard. The 2012 review resulted in retention of the existing 24-hour average PM2.5 and PM10 standards.

	PM2.5		**PM10**	
	Annual Average	**24-Hour Average**	**Annual Average**	**24-Hour Average**
National Ambient Air Quality Standard	12 µg/m^3	35 µg/m^3	None	150 µg/m^3
California Ambient Air Quality Standard	12 µg/m^3	None	20 µg/m^3	50 µg/m^3

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Vinyl Chloride & Health

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What is vinyl chloride?

Vinyl chloride (chloroethene), a chlorinated hydrocarbon, is a colorless gas with a mild, sweet odor. Most vinyl chloride is used in the process of making polyvinyl chloride (PVC) plastic and vinyl products, thus may be emitted from industrial processes. Vinyl chloride has been detected near landfills, sewage treatment plants, and hazardous waste sites, due to microbial breakdown of chlorinated solvents, although levels above the standard have not been measured in California since the 1970's. Today, vinyl chloride exposure is primarily an occupational concern.

History of the vinyl chloride Ambient Air Quality Standard

The ambient air quality standard for vinyl chloride is unique among the California Ambient Air Quality Standards (CAAQS) in that it addressed a localized exposure risk, rather than a statewide risk. The standard for vinyl chloride was set in 1978 to address elevated cancer risk in three areas of California that were adjacent to industrial facilities that emitted vinyl chloride from their production processes. The level of the standard, 0.010 ppm as a 24 hour average was chosen because it was the lowest level that could be reliably measured at the time the standard was promulgated, and could thus function as an enforceable exposure limit.

Vinyl chloride is the only pollutant that has a CAAQS and is also listed as a toxic air contaminant because of its carcinogenicity. The Air Toxics Program, which lists and regulates cancer causing pollutants, had not yet been established at the time CARB determined there was a need to control vinyl chloride emissions. Consequently, CARB used the CAAQS process because it was the only means available at that time to regulate vinyl chloride emissions. Then in 1990, the Board identified vinyl chloride as a toxic air contaminant under the recently established Air Toxics Program, and established a cancer unit risk factor. As a carcinogen, no level of exposure to vinyl chloride is considered as being completely safe and without risk. Although the vinyl chloride CAAQS remains in force, current regulatory efforts are under CARB's Air Toxics Program.

What kinds of harmful effects can vinyl chloride cause?

Short-term exposure to high levels (10 ppm or above) of vinyl chloride in air causes central nervous system effects, such as dizziness, drowsiness, and headaches. The primary non-cancer health effect of long-term exposure to vinyl chloride through inhalation or oral exposure is liver damage. Inhalation exposure to vinyl chloride has been shown to increase the risk of angiosarcoma, a rare form of liver cancer in humans. Current Occupational Safety and Health Administration (OSHA) regulations allow occupational exposures of up to an 8-hour average of 1 ppm vinyl chloride.

There is little information available on possible environmental effects of vinyl chloride.

Who is at the greatest risk from exposure to vinyl chloride?

Most health data on vinyl chloride relate to carcinogenicity. Thus, the people most at risk are those who have long-term exposure to elevated levels. Today, this is more likely to occur in occupational or industrial settings. Control methodologies currently applied to industrial facilities prevent emissions to the ambient air.

Is vinyl chloride a problem indoors?

Outside of occupational and industrial settings, there are no known indoor sources of vinyl chloride emissions.

What is the Ambient Air Quality Standard for vinyl chloride?

	24-Hour Average
National Ambient Air Quality Standard	None
California Ambient Air Quality Standard	0.01 ppm

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What is hydrogen sulfide?

Hydrogen sulfide (H_2S) is a colorless gas with the odor of rotten eggs. The most common sources of H_2S emissions are oil and natural gas extraction and processing, and natural emissions from geothermal fields. It is also formed during bacterial decomposition of human and animal wastes, and is present in emissions from sewage treatment facilities and landfills. Industrial sources include petrochemical plants, coke oven plants, and kraft paper mills.

Why does CARB focus on hydrogen sulfide?

The odor of H_2S is extremely strong and foul, and it can induce tearing of the eyes and symptoms related to overstimulation of the sense of smell, including headache, nausea, or vomiting. The odor of H_2S is detectable at a very low level. On a population basis, the average odor detection threshold is about 0.03 to 0.05 ppm, although some individuals can detect H_2S at lower concentrations. Additional health effects have only been reported with exposures greater than 50 ppm (eye irritation), considerably higher than the odor threshold based standard. Exposure to even higher levels of H_2S (over 300 ppm) can induce serious adverse health effects, although these exposures are typically only encountered in occupational or industrial accident situations. H_2S is regulated as a nuisance based on its odor detection level. If the standard were based on adverse health effects, it would be set at a much higher level.

Who is at the greatest risk from exposure to hydrogen sulfide?

There are insufficient data available to determine whether or not some groups are at greater risk than others. A few studies suggest that asthmatics may be at increased risk of exacerbation of their asthma symptoms.

How does hydrogen sulfide affect the environment?

H_2S is a key participant in the global sulfur cycle. It is oxidized in the atmosphere to SO_2, which can then be converted to sulfate through three different chemical pathways. H_2S is somewhat soluble in water, resulting in formation of sulfhydric acid, which is corrosive to metals, and contributes to acidic deposition to soil and water. Additional information on the environmental effects of sulfur dioxide and sulfate can be found on the fact sheets for these two pollutants. H_2S is not a climate change gas, although because H_2S is converted in the atmosphere to sulfate, it contributes to the cooling influence provided by atmospheric sulfate.

Is hydrogen sulfide a problem indoors?

H_2S is rarely a problem indoors. There are few indoor emission sources of H_2S. Detection of H_2S indoors is generally related to spoiling and decomposition of some foodstuffs. Caution: odorants, which have an odor similar to H_2S, are added to natural gas as an aid to gas leak detection. If the odor of H_2S is present in your home, the local gas company should be notified and asked to investigate whether or not there is a gas leak.

What is the Ambient Air Quality Standard for hydrogen sulfide?

The H_2S standard was adopted for the purpose of odor control. The current standard, 0.03 ppm for a one hour average, was adopted by CARB in 1969. The California Department of Public Health reviewed the scientific literature in 1981 and concluded that the existing standard was adequate. Consequently, CARB did not undertake regulatory action on the standard. The standard has not been changed since it was first adopted.

	1-Hour Average
National Ambient Air Quality Standard	None
California Ambient Air Quality Standard	0.03 ppm

The U.S. Environmental Protection Agency has not established a standard for H_2S; however, the U. S. Occupational Safety and Health Administration has set an 8-hr average occupational standard of 20 ppm.

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What is lead?

Lead is a relatively soft and chemically resistant metal. Lead forms compounds with both organic and inorganic substances. As an air pollutant, lead is present in small particles.

Why do CARB and U.S. EPA focus on lead?

It has been known for many years that lead can accumulate in the body, especially in the bones, and that a variety of adverse health effects can develop if the amount of lead in the body is sufficiently high. At the time the ambient air quality standard for lead was promulgated ambient air was the source of a significant portion of people's total lead exposure due to emissions from motor vehicles that ran on leaded gasoline. The Air Resources Board adopted an ambient air quality standard for lead to protect the public from these adverse health effects. In 1976 CARB passed a regulation that led to a phase-out of lead in gasoline over several years. Since 1993 lead has been regulated under the Toxic Air Contaminant Program, although the state ambient air quality standard remains in force.

What are the sources of lead in ambient air?

In the past, motor vehicle exhaust was the major source of lead emissions to the air. Since lead has been removed from gasoline air emissions of lead from the transportation sector, and particularly the automotive sector, have greatly declined. However, because it was emitted in large amounts from vehicles when leaded gasoline was used, lead is present in many soils (especially urban soils) and can get resuspended into the air. The major sources of lead emissions today are ore and metals processing, particularly lead smelters, and piston-engine aircraft operating on leaded aviation gasoline. Other stationary sources include waste incinerators, utilities, and lead-acid battery manufacturers.

What kinds of harmful effects can lead cause?

Once taken into the body, the blood carries lead throughout the body and it is deposited in the bones where it accumulates. Because lead is only slowly excreted, exposures to small amounts of lead from a variety of sources can accumulate to harmful levels. Lead can adversely affect multiple organ systems of the body and people of every age group. Young children are particularly at risk of lead poisoning. They are usually exposed to lead through the normal hand-to mouth behavior that occurs through crawling or playing on the floor, and putting their hands, toys, and other items in their mouths. In children, adverse health effects of lead exposure are often irreversible and include brain damage and mental retardation. Lead poisoning is often unrecognized in children, and if undetected, it may result in behavioral problems, reduced intelligence, anemia, and liver or kidney damage.

Lead is also harmful to adults. Excessive lead exposure in adults is most often the related to exposure in occupational settings or to unsafe home renovation procedures. Lead poisoning can cause reproductive problems in men and women, high blood pressure, kidney disease, digestive problems, nerve disorders, memory and concentration problems, and muscle and joint pain. There is also evidence that lead exposure can result in cancer in adults. If a pregnant woman is exposed to elevated levels of lead, it can cross the placenta into the baby's blood, increasing risk of adverse developmental effects, particularly in the brain and nervous system.

Who is at the greatest risk from exposure to lead?

Infants and young children are especially sensitive to even low levels of lead, which may contribute to behavioral problems, learning deficits and lowered IQ.

How does lead affect the environment?

Lead is persistent in the environment and accumulates in soils and sediments through deposition from air sources, direct discharge of waste streams to water bodies, mining, and erosion. Ecosystems near point sources of lead demonstrate a wide range of adverse effects including losses in biodiversity, changes in community composition, decreased growth and reproductive rates in plants and animals, and neurological effects in vertebrates.

Is lead a problem indoors?

The main source of lead pollution indoors is lead-based paint, which could arise, for example, from paint flecks or chips or sanding during home renovations. In these cases, the particles are generally too large to be inhaled. Instead, exposure is primarily through ingestion. Young children are at greatest risk in this case due to hand-to-mouth transfer of paint flecks or sanded paint that are then swallowed. This can lead to an elevated level of lead in the body, increasing risk of neurological, behavioral, and learning deficits. Care should be exercised when renovating older homes to prevent inhalation or ingestion of lead-based paint residue.

What are the Ambient Air Quality Standards for lead?

	30-Day Average	**Rolling 3-Month Average**
National Ambient Air Quality Standard	None	0.15 $\mu g/m^3$
California Ambient Air Quality Standard	1.5 $\mu g/m^3$	None

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What is carbon monoxide?

Carbon monoxide (CO) is a colorless, odorless gas. It results from the incomplete combustion of carbon-containing fuels such as natural gas, gasoline, or wood, and is emitted by a wide variety of combustion sources, including motor vehicles, power plants, wildfires, and incinerators. Nationally and, particularly in urban areas, the majority of outdoor CO emissions to ambient air come from mobile sources. Carbon monoxide can also be formed through photochemical reactions in the atmosphere from methane and non-methane hydrocarbons, other volatile organic hydrocarbons in the atmosphere, and organic molecules in surface waters and soils. There are also a number of indoor sources of CO that contribute to total exposure.

Why do CARB and U.S. EPA focus on carbon monoxide?

Air quality regulators are concerned about air pollutants which may reasonably be anticipated to endanger public health and welfare. There is substantial evidence that CO can adversely affect health, participate in atmospheric chemical reactions that result in formation of ozone air pollution, and contribute to climate change.

What kinds of harmful effects can carbon monoxide cause?

Carbon monoxide is harmful because it binds to hemoglobin in the blood, reducing the ability of blood to carry oxygen. This interferes with oxygen delivery to the body's organs. The most common effects of CO exposure are fatigue, headaches, confusion, and dizziness due to inadequate oxygen delivery to the brain. For people with cardiovascular disease, short-term CO exposure can further reduce their body's already compromised ability to respond to the increased oxygen demands of exercise, exertion, or stress. Inadequate oxygen delivery to the heart muscle leads to chest pain and decreased exercise tolerance. Unborn babies whose mothers experience high levels of CO exposure during pregnancy are at risk of adverse developmental effects.

Who is at the greatest risk from exposure to carbon monoxide?

Unborn babies, infants, elderly people, and people with anemia or with a history of heart or respiratory disease are most likely to experience health effects with exposure to elevated levels of CO.

How does carbon monoxide affect the environment?

U.S. EPA conducted an extensive literature search as part of the review of the National Ambient Air Quality Standard for Carbon Monoxide that was completed in 2011, and did not identify any evidence for ecological effects of CO at levels at or near ambient. Consequently, there is no secondary (welfare) standard for CO.

CO contributes indirectly to climate change because it participates in chemical reactions in the atmosphere that produce ozone, which is a climate change gas. CO also has a weak direct effect on climate. For these reasons, CO is classified as a short-lived climate forcing agent, prompting CO emission reductions to be considered as a possible strategy to mitigate effects of global warming.

Is carbon monoxide a problem indoors?

Indoor CO levels can be considerably higher than outdoors. There are a number of potential sources of CO indoors, including gas stoves, malfunctioning or improperly vented gas appliances (i.e., water heaters, furnaces, clothes dryers), space heaters, fireplaces, tobacco smoke, and car or truck exhaust that enters from attached garages.

> WARNING
>
> During the cold season CO poisoning cases tend to increase. These are most often related to elevated indoor CO levels resulting from use of improperly vented space heaters and use of gas ranges to heat the house. Over 400 people die each year in the U.S., due to CO poisoning. Of these, 13 to 36 individuals have died each year since 2000 from non-fire-related CO poisoning in California. Because of the health risk of CO poisoning, California has mandated installation of CO detectors in all housing units in the state.

What is the Ambient Air Quality Standard for carbon monoxide?

	1-Hour Average	8-Hour Average
National Ambient Air Quality Standard	35 ppm	9 ppm
California Ambient Air Quality Standard	20 ppm	9.0 ppm

Additional Information

- Carbon monoxide in the home

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Ozone & Health

Health Effects of Ozone

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What is ozone (O_3)?

Ozone, an important component of smog, is a highly reactive and unstable gas capable of damaging living cells, such as those present in the linings of the human lungs. This pollutant forms in the atmosphere through complex reactions between chemicals directly emitted from vehicles, industrial plants, consumer products and many other sources. Ozone is a powerful oxidant – its actions can be compared to household bleach, which can kill living cells (such as germs or human skin cells) upon contact. It forms in greater quantities on hot, sunny, calm days. In metropolitan areas of California, ozone concentrations frequently exceed existing health-protective standards in the summertime.

Where does ozone come from?

Ozone is formed in the atmosphere through chemical reactions between pollutants emitted from vehicles, factories and other industrial sources, fossil fuels, combustion, consumer products, evaporation of paints, and many other sources. Hydrocarbons and nitrogen oxide gases react in the presence of sunlight to form ozone. Hot, sunny, and calm weather promotes ozone formation. Ozone has a very characteristic pungent odor, and it can sometimes be detected after lightning strikes or during electrical discharges. Individual humans vary in their ability to smell ozone; some people can smell it at levels as low as 0.05 ppm.

What is the difference between ground-level and stratospheric ozone?

The ozone that CARB regulates as an air pollutant is produced close to the ground level, where people live, exercise and breathe. A layer of ozone high up in the atmosphere is called stratospheric ozone. This layer, far away from where people live, reduces the amount of ultraviolet light entering the earth's atmosphere. Without the protection of the stratospheric ozone layer, plant and animal life would be seriously harmed.

Why do CARB and U.S. EPA focus on ozone?

Air quality regulators are concerned about ozone pollution because of its effects on public health and the environment. Ozone can damage the tissues of the respiratory tract, causing inflammation and irritation, and result in symptoms such as coughing, chest tightness and worsening of asthma symptoms. In addition, ozone causes substantial damage to crops, forests and native plants. Ozone can also damage materials such as rubber and plastics.

What kinds of harmful effects can ozone cause?

Inhalation of ozone causes inflammation and irritation of the tissues lining human airways, causing and worsening a variety of symptoms. Exposure to ozone can reduce the volume of air that the lungs breathe in and cause shortness of breath. Ozone in sufficient doses increases the permeability of lung cells, rendering them more susceptible to toxins and microorganisms. The occurrence and severity of health effects from ozone exposure vary widely among individuals, even when the dose and the duration of exposure are the same.

Who is at the greatest risk from exposure to ozone?

Research shows adults and children who spend more time outdoors participating in vigorous physical activities are at greater risk from the harmful health effects of ozone exposure. While there are relatively few studies of ozone’s effects on children, the available studies show that children are no more or less likely to suffer harmful effects than adults. However, there are a number of reasons why children may be more susceptible to ozone and other pollutants. Children and teens spend nearly twice as much time outdoors and engaged in vigorous activities as adults. Children breathe more rapidly than adults and inhale more pollution per pound of their body weight than adults. Also, children are less likely than adults to notice their own symptoms and avoid harmful exposures. Further research may be able to better distinguish between health effects in children and adults.

Children, adolescents and adults who exercise or work outdoors, where ozone concentrations are the highest, are at the greatest risk of harm from this pollutant.

How does ozone affect the environment?

Ozone's effect on plant life

Ozone exposure reduces the overall productivity of plants, damaging cells and causing destruction of leaf tissue. As a result, ozone exposure reduces the plants’ ability to photosynthesize and produce their own food. Plants respond by growing more leaves thereby reducing the amounts of stored carbohydrates in roots and stems. This weakens plants, making them susceptible to disease, pests, cold and drought. Ozone also reduces crop and timber yields, resulting in millions of dollars in economic losses. Additionally, ozone disturbs the stability of ecosystems, leading to sensitive species dying out. Furthermore, ozone exposure reduces the production of roots, seeds, fruit and other plant constituents, reducing the amount of food available for wildlife.

Ozone’s effect on materials

Ozone can cause substantial damage to a variety of materials such as rubber, plastics, fabrics, paint and metals. Exposure to ozone progressively damages both the functional and aesthetic qualities of materials and products, and shortens their life spans. Damage from ozone exposure can result in significant economic losses as a result of the increased costs of maintenance, upkeep and replacement of these materials.

Is ozone a problem indoors?

Ozone reacts with surfaces as it penetrates the indoor environment, usually resulting in lower levels indoors than outdoors. However, levels of ozone indoors can approach outdoor levels when windows or doors are open. Moreover, equipment such as photocopiers, laser printers and certain air purifiers can emit ozone indoors as well. Air purifiers that purposely emit ozone, called ozone generators, should not be used in occupied spaces as they can emit unsafe levels of ozone. Once inside, ozone can cause harmful health effects and damage materials, depending on its concentration.

> **CAUTION REGARDING OZONE GENERATORS**
>
> The Air Resources Board and the California Department of Health Services advise the public not to use ozone generators in homes or offices. These devices are often marketed for the purposes of aiding allergy sufferers, but actually emit harmful ozone gas.

What are the Ambient Air Quality Standards for ozone?

In 2005, after an extensive review of the scientific literature, CARB approved an eight-hour standard for ozone of 0.070 ppm and retained the one-hour 0.09 ppm standard previously established in 1987. Evidence from the reviewed studies indicates that significant harmful health effects could occur among both adults and children if exposed to levels above these standards. On October 1, 2015, the U.S. EPA lowered the national eight-hour standard from 0.075 ppm to 0.070 ppm.

	1-Hour Average	Annual Average
National Ambient Air Quality Standard	--	0.070 ppm*

California Ambient Air Quality Standard	0.09 ppm*	0.070 ppm*

* A part per million (ppm) refers to one part of a substance dissolved into a million parts of another substance.

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What is nitrogen dioxide (NO_2)?

Nitrogen Dioxide (NO_2) is a pungent gas that, along with fine airborne particulate matter, contributes to the reddish-brown haze characteristic of smoggy air in California. NO_2 is comprised of one atom of nitrogen and two atoms of oxygen, and is a gas at ambient temperatures. It has a pungent smell, and is brownish red in color. NO_2 is a member of a family of chemicals comprised of nitrogen and oxygen that are collectively known as nitrogen oxides. The two most prevalent nitrogen oxides are NO_2 and nitric oxide (NO), and the combination is often referred to as NO_X.

Where does nitrogen dioxide come from?

Although NO_2 can be directly emitted from combustion sources, much of the NO_2 in the ambient air is formed in the atmosphere through reactions between nitric oxide (NO) and other air pollutants that require the presence of sunlight (photochemical reactions). NO_2 contributes to formation of several other air pollutants, including ozone (O_3), nitric acid (HNO_3), and nitrate (NO_3^-) -containing particles that also form through photochemical reactions. NO_2 levels in air vary with direct emission levels, as well as with changing atmospheric conditions, particularly the amount of sunlight.

Why do CARB and U.S. EPA focus on nitrogen dioxide?

Air quality regulators have selected NO_2 as the marker for controlling ambient levels of NO_X for several reasons. Much of the information on oxides of nitrogen is specifically for NO_2. This includes information on the distribution in air, human exposure and dose, and health effects. There is only limited information for NO and NO_X, as well as large uncertainty in relating health effects to NO or NO_X exposure. In addition, emissions of NO_2 are highly correlated with those of other oxides of nitrogen and with several other traffic-related pollutants. Consequently, control measures that reduce emissions of NO_2 will also reduce emissions of other NO_X species, as well. NO_2 is an important precursor of anthropogenic O_3, and it is the key agent in the formation of several airborne toxic substances, including nitric acid (HNO_3), fine particles, peroxyacetyl nitrate, nitrosamines, and nitro-polycyclic aromatic hydrocarbons (nitro-PAHs).

It should be noted that the California ambient air quality standard is specifically for NO_2, while the national ambient air quality standard is for NO_X as a group, with NO_2 the marker for determining attainment. In both cases, however, the intent is to control NO_X emissions as a group.

What kinds of harmful effects can nitrogen dioxide cause?

A large body of health science literature indicates that exposure to NO_2 can induce adverse health effects. The strongest health evidence, and the health basis for the ambient air quality standard for NO_2, is results from controlled human exposure studies that show that NO_2 exposure can intensify responses to allergens in allergic asthmatics. In addition, a number of epidemiological studies have demonstrated associations between NO_2 exposure and premature death, cardiopulmonary effects, decreased lung function growth in children, respiratory symptoms, emergency room visits for asthma, and intensified allergic responses.

Who is at the greatest risk from exposure to nitrogen dioxide?

Infants and children are particularly at risk because they have disproportionately higher exposure to NO_2 than adults due to their greater breathing rate for their body weight and their typically greater outdoor exposure duration. Several studies have shown that long-term NO_2 exposure during childhood, the period of rapid lung growth, can lead to smaller lungs at maturity in children with higher compared to lower levels of exposure. In addition, children with asthma have a greater degree of airway responsiveness compared with adult asthmatics. In adults, the greatest risk is to people who have chronic respiratory diseases, such as asthma and chronic obstructive pulmonary disease.

How does nitrogen dioxide affect the environment?

With few exceptions, NO_2 can injure vegetation, including trees, forests and crops. This has only been reported when the cumulative duration of exposures was at least 0.2 ppm for 100 hours or longer during the growing season. Also, NO_2 can contribute to the reduction of visibility both directly, by selectively absorbing the shorter blue wavelengths of visible light, and indirectly by contributing to the formation of nitrate aerosol haze that decreases visibility.

Is nitrogen dioxide a problem indoors?

Indoor levels of NO_2 are determined primarily by the presence of NO_2-emitting appliances, the indoor-outdoor air exchange rate, (i.e., whether or not windows are open), and the effects of season. Gas stoves and space heaters are the most common indoor sources of NO_2 emissions. Other possible sources include improperly vented furnaces, water heaters, and clothes dryers. Winter levels are typically higher than those in summer, due to greater use of gas appliances in winter, and reduced use of windows for ventilation.

What are the Ambient Air Quality Standards for nitrogen dioxide?

Ambient air quality standards define the maximum amount of pollutant that can be present in outdoor air without harming human health. In 2007, after an extensive review of the scientific literature, the Board lowered the state one-hour standard for NO_2 to 0.18 ppm and retained the annual average standard of 0.030 ppm based on evidence for adverse health effects at the level of the existing one-hour standard. The national standard was more recently revised in 2010 following an exhaustive review of new literature pointed to evidence for adverse effects in asthmatics at lower NO_2 concentrations than the existing national standard.

	1-Hour Average	Annual Average
National Ambient Air Quality Standard	0.100 ppm*	0.053 ppm
California Ambient Air Quality Standard	0.18 ppm	0.030 ppm

* The official level of the 1-hour NO_2 standard is 100 ppb, equal to 0.100ppm, which is shown here for the purpose of clearer comparison to the other standards.

RELATED RESOURCES

Mobile Monitoring Research Studies

Verification Procedure: Installers & Distributors

California Portable Classrooms Study

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California

Secretary for

Chair, California

Sulfate & Health

CATEGORIES

Topics Health, Air Pollution

Programs Outdoor Air Quality Standards, Exposure

Type Information

CONTACT

Research Division

Email research@arb.ca.gov

Phone (916) 445-0753

What are sulfates?

Sulfates are a family of chemicals that contain the fully oxidized ionic form of sulfur (SO_4^{2-}), in combination with metal and/or hydrogen ions. In California, emissions of sulfur-containing compounds occur primarily from the combustion of petroleum-derived fuels (e.g., gasoline and diesel fuel) that contain sulfur. A small amount of sulfate is directly emitted from combustion of sulfur-containing fuels, but most ambient sulfate is formed in the atmosphere. First, emitted sulfur in the fuel is oxidized to sulfur dioxide (SO_2) during the combustion process and subsequently converted to sulfate particulate matter through chemical reactions in the atmosphere. Thus, sulfates are a sub-fraction of ambient particulate matter. The conversion of SO_2 to sulfates takes place comparatively rapidly and completely in urban areas of California due to regional meteorological characteristics.

Why does CARB focus on sulfates?

Sulfates can be a significant portion of fine particulate matter (particles that are equal to or less than 2.5 microns in diameter, called PM2.5), and they can induce a wide range of adverse health effects, as described below. In addition, sulfates contribute to acidification of surface water and soil, and contribute to acid rain and fog that damage ecosystems, forests and plants. Because sulfates are light colored, they reflect energy from sunlight back into space. This means that sulfates have a cooling influence on climate change.

What kinds of harmful effects can sulfates cause?

Sulfate particles are part of PM2.5, and so they have health effects similar to those from exposure to PM2.5. These include reduced lung function, aggravated asthmatic symptoms, and increased risk of emergency department visits, hospitalizations, and death in people who have chronic heart or lung diseases.

Who is at the greatest risk from exposure to sulfates?

Groups having higher risk of experiencing adverse health effects with sulfates exposure include children, asthmatics, and older adults who have chronic heart or lung diseases.

How do sulfates affect the environment?

Sulfates are particularly effective in degrading visibility by scattering light before it reaches an observer. This light scattering reduces visual clarity, mutes colors, and reduces the distance one can see. Sulfate particles are usually acidic and when dissolved in water they form sulfuric acid. Deposition of this sulfuric acid is usually through acid rain or snow, which damages a variety of ecosystems and materials. Acid rain can increase the acidity of waterways and lakes, inhibiting fertility, growth, and development of fish and other aquatic species, strip aluminum from the soil and alter essential nutrient availability to trees and plants, thereby inhibiting tree and plant growth. Acid rain can also physically damage tree leaves and needles so that they have reduced capacity for photosynthesis. Dry deposition of acidic sulfates can cause acid damage to buildings, paint, metals and stone that leads to premature deterioration.

Are sulfates a problem indoors?

There are no significant sulfates emissions sources indoors. Indoor sulfate levels are related to infiltration of sulfate from outdoor air.

What is the Ambient Air Quality Standard for sulfates?

	24-Hour Average

EEC ORIGINAL PKG

	24-Hour Average
National Ambient Air Quality Standard	None
California Ambient Air Quality Standard	25 µg/m^3

Additional Information

- CARB's acid deposition research program
- U.S. EPA information on acid rain

RELATED RESOURCES

Mobile Monitoring Research Studies

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California

Secretary for

Chair, California

Governor	Environmental Protection	Air Resources Board
Gavin Newsom	**Jared Blumenfeld**	**Mary D. Nichols**

Sulfur Dioxide & Health

CATEGORIES

Topics Health, Air Pollution

Programs Outdoor Air Quality Standards, Exposure

Type Information

CONTACT

Research Division

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Phone (916) 445-0753

What is sulfur dioxide (SO_2)?

Sulfur dioxide (SO_2) is comprised of one atom of sulfur and two atoms of oxygen, and is a gas at ambient temperatures. It has a pungent, irritating odor. SO_2 is a member of a family of chemicals comprised of sulfur and oxygen that are collectively known as sulfur oxides (SO_X).

Where does sulfur dioxide come from?

SO_X, including SO_2, are emitted when sulfur-containing fuel is burned. Some examples of sources include motor vehicles, locomotives, ships, and off-road diesel equipment that are operated with fuels that contain high levels of sulfur. In addition, SO_2 and the other SO_X are emitted from some industrial processes, such as natural gas and petroleum extraction, oil refining, and metal processing. They are also released during volcanic activity and from geothermal fields.

Why do CARB and U.S. EPA focus on sulfur dioxide as a marker for sulfur oxides?

SO_2 is the most prevalent species of gaseous SO_X in the atmosphere, with other species not present at concentrations relevant for human exposures. Because of this, most health studies have focused on SO_2. Many human and animal exposure studies, as well as epidemiological studies, have reported adverse health effects specifically attributable to SO_2 exposure. For this reason SO_2 is used as the indicator for the group of gaseous SO_X. However, it should be noted that emissions of the SO_X family of air pollutants are involved in a number of chemical reactions in the atmosphere where they are transformed into acids and particulate sulfates, and these pollutants can also contribute to adverse human health and environmental effects. Because the various SO_X species arise from the same sources, control measures that focus on SO_2 also reduce emissions of the other SO_X species.

It should be noted that the California ambient air quality standard is specifically for SO_2 while the national ambient air quality standard is for SO_X as a group, with SO_2 the marker for determining attainment. In both cases, however, the intent is to control SO_X emissions as a group.

What kinds of harmful effects can sulfur dioxide cause?

Controlled human exposure and epidemiological studies show that children and adults with asthma are more likely to experience adverse responses with SO_2 exposure, compared with the non-asthmatic population. Effects at levels near the one-hour standard are those of asthma exacerbation, including bronchoconstriction accompanied by symptoms of respiratory irritation such as wheezing, shortness of breath and chest tightness, especially during exercise or physical activity. Also, exposure at elevated levels of SO_2 (above 1 ppm) results in increased incidence of pulmonary symptoms and disease, decreased pulmonary function, and increased risk of mortality. The elderly and people with cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) are most likely to experience these adverse effects.

How does sulfur dioxide affect the environment?

SO_2 deposition, along with that of other SO_X, species, contributes to soil and surface water acidification and acid rain. This acidification causes a variety of effects that harm susceptible aquatic and terrestrial ecosystems, including slower growth and injury to forests and localized extinction of fish and other aquatic species. SO_2 deposition also promotes chemical reactions that facilitate the accumulation of mercury in water and soil. This can lead to elevated mercury levels in food, which in turn increases risk of adverse health effects in human populations due to mercury ingestion.

Is sulfur dioxide a problem indoors?

The level of SO_2 indoors is largely driven by outdoor concentrations, and is typically lower that outdoors levels. The only known significant indoor source of SO_2 in the U.S. is unvented kerosene heaters, although this is not a common means of indoor heating in most of the country.

What are the Ambient Air Quality Standards for sulfur dioxide?

	1-Hour Average	24-Hour Average	Annual Average
National Ambient Air Quality Standard (SO_X with SO_2 as the marker)	0.075 ppm	0.14 ppm	0.030 ppm
California Ambient Air Quality Standard (SO_2)	0.25 ppm	0.04 ppm	None

RELATED RESOURCES

Mobile Monitoring Research Studies

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Car & Bus Exposure Studies

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Mary D. Nichols

Visibility-Reducing Particles & Health

CATEGORIES

Topics Health, Air Pollution

Programs Outdoor Air Quality Standards, Exposure

Type Information

CONTACT

Research Division

Email research@arb.ca.gov

Phone (916) 445-0753

What are visibility-reducing particles?

Particulate matter (PM) pollution impacts the environment by decreasing visibility (haze). These particles vary greatly in shape, size and chemical composition, and come from a variety of natural and manmade sources. Some haze-causing particles are directly emitted to the air such as windblown dust and soot. Others are formed in the air from the chemical transformation of gaseous pollutants (e.g., sulfates, nitrates, organic carbon particles) which are the major constituents of fine PM. These fine particles, caused largely by combustion of fuel, can travel hundreds of miles causing visibility impairment.

How do particles reduce visibility?

Visibility reduction is probably the most apparent symptom of air pollution. Visibility degradation is caused by the absorption and scattering of light by particles and gases in the atmosphere before it reaches the observer. As the number of fine particles increases, more light is absorbed and scattered, resulting in less clarity, color, and visual range. Light absorption by gases and particles is sometimes the cause of discolorations in the atmosphere but usually does not contribute very significantly to visibility degradation. Scattering by particulates impairs visibility much more readily. Particles that are the most effective at reducing visibility (per unit aerosol mass) have diameters in the range of 0.1-1.0 µm. Some types of particles such as sulfates scatter more light, particularly during humid conditions. Visibility standards are based on extinction coefficients, which is a measure of the light attenuation due to both absorption and scattering.

What are the health effects of visibility-reducing particles?

Haze not only impacts visibility, but some haze-causing pollutants have been linked to serious health problems and environmental damage as well. Exposure to particles up to 2.5 (PM2.5) and 10 microns (PM10) in diameter in the ambient air can contribute to a broad range of adverse health effects, including premature death, hospitalizations and emergency department visits for worsened heart and lung diseases. These effects are described in CARB's webpage for PM2.5 and PM10.

What is the purpose of the Ambient Air Quality Standard for visibility-reducing particles?

The Ambient Air Quality Standard for visibility-reducing particles is intended to limit the frequency and severity of visibility impairment due to regional haze, which is largely caused by ambient particles. The visibility standard is unique among the California ambient air quality standards in that it is not based on health effects, but rather on what is termed a welfare effect. Welfare effects indirectly impact the public through effects that are not related to health, for example reduced visibility, and damage to materials, plants, forests, and ecosystems. Haze also has economic consequences. Each year, millions of visitors travel to our national parks and wilderness areas. Haze affecting these areas obscures the spectacular views the public expects to experience. Over time, this could lead to fewer visitors or shorter visits.

What are the standards for visibility-reducing particles?

Secondary standards set limits to protect public welfare, including protection against decreased visibility. Originally, the State visibility standard was based on the distance a person could see, 10 miles in most of the State, and 30 miles at Lake Tahoe. In 1989, CARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are "extinction of 0.23 per kilometer" and "extinction of 0.07 per kilometer" for the statewide and Lake Tahoe Air Basin standards, respectively.

Regional Haze Program

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SciName	ComName	TaxonGrou	ElmCode	FedList	CalList	GRank	SRank	RPlantRank	OthrStatus
Chaenactis	Peirson's p	Dicots	PDAST2004	None	None	G5T2	S2	1B.3	BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Ditaxis clar	glandular d	Dicots	PDEUP080I	None	None	G3G4	S2	2B.2	
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Icteria vire	yellow-bre	Birds	ABPBX2401	None	None	G5	S3		CDFW_SSC
Toxostoma	Crissal thra	Birds	ABPBK0609	None	None	G5	S3		BLM_S-Sen
Accipiter co	Cooper's ha	Birds	ABNKC1204	None	None	G5	S4		CDFW_WL-
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2		
Gelochelido	gull-billed t	Birds	ABNNM080	None	None	G5	S1		CDFW_SSC
Gelochelido	gull-billed t	Birds	ABNNM080	None	None	G5	S1		CDFW_SSC
Crucifixion	Crucifixion	Woodland	CTT75200C	None	None	G3	S1.2		
Astragalus	Peirson's m	Dicots	PDFAB0F53	Threatenec	Endangere	G3G4T1	S1	1B.2	SB_RSABG-
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Helianthus	Algodones	Dicots	PDAST4N02	None	Endangere	G4T2T3	S1	1B.2	BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Palafoxia a	giant spani	Dicots	PDAST6T01	None	None	G5T3?	S2	1B.3	BLM_S-Sen
Castela em	Emory's cru	Dicots	PDSIM0303	None	None	G3G4	S2S3	2B.2	SB_RSABG-
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Athene cur	burrowing	Birds	ABNSB1001	None	None	G4	S3		BLM_S-Sen
Cylindropu	Munz's cho	Dicots	PDCAC0D0	None	None	G3	S1	1B.3	BLM_S-Sen
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4	4.3	
Rallus obsc	Yuma Ridgw	Birds	ABNME050	Endangere	Threatenec	G5T3	S1S2		CDFW_FP-I
Ipomopsis	Baja Califor	Dicots	PDPLM060	None	None	G3?	SH	2B.1	SB_RSABG-

Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Cylindropu	Munz's chc	Dicots	PDCAC0D0	None	None	G3	S1	1B.3	BLM_S-Sen
Pilostyles t	Thurber's p	Dicots	PDRAF010:	None	None	G5	S4	4.3	
Coccyzus a	western ye	Birds	ABNRB020	Threatene	Endangere	G5T2T3	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatene	G3G4T1	S1		BLM_S-Sen
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Falco mexi	prairie falc	Birds	ABNKD060	None	None	G5	S4		CDFW_WL-
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Laterallus j	California b	Birds	ABNME030	None	Threatene	G3G4T1	S1		BLM_S-Sen
Icteria vire	yellow-bre	Birds	ABPBX240:	None	None	G5	S3		CDFW_SSC
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Sonoran Cc	Sonoran Cc	Riparian	CTT61810C	None	None	G2	S1.1		
Castela em	Emory's cru	Dicots	PDSIM030:	None	None	G3G4	S2S3	2B.2	SB_RSABG-
Castela em	Emory's cru	Dicots	PDSIM030:	None	None	G3G4	S2S3	2B.2	SB_RSABG-
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Astragalus	Harwood's	Dicots	PDFAB0F4	None	None	G5T4	S2	2B.2	SB_RSABG-
Hulsea me	Mexican hu	Dicots	PDAST4Z0	None	None	G3G4	S1	2B.3	SB_RSABG-
Koeberlinia	slender-spi	Dicots	PDCPP050:	None	None	G4T4?	S2	2B.2	
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Myiarchus	brown-cres	Birds	ABPAE430	None	None	G5	S3		CDFW_WL-
Toxostoma	Le Conte's	Birds	ABPBK061(	None	None	G4	S3		BLM_S-Sen
Pilostyles t	Thurber's p	Dicots	PDRAF010:	None	None	G5	S4	4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF010:	None	None	G5	S4	4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF010:	None	None	G5	S4	4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF010:	None	None	G5	S4	4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF010:	None	None	G5	S4	4.3	
Ovis canad	desert bigh	Mammals	AMALE040	None	None	G4T4	S3		BLM_S-Sen
Ovis canad	desert bigh	Mammals	AMALE040	None	None	G4T4	S3		BLM_S-Sen
Ovis canad	desert bigh	Mammals	AMALE040	None	None	G4T4	S3		BLM_S-Sen
Ovis canad	Peninsular	Mammals	AMALE040	Endangere	Threatene	G4T3Q	S1		CDFW_FP-I
Ovis canad	Peninsular	Mammals	AMALE040	Endangere	Threatene	G4T3Q	S1		CDFW_FP-I
Piranga rub	summer ta	Birds	ABPBX450:	None	None	G5	S1		CDFW_SSC
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Icteria vire	yellow-bre	Birds	ABPBX240:	None	None	G5	S3		CDFW_SSC
Polioptila n	black-tailed	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Myiarchus	brown-cres	Birds	ABPAE430	None	None	G5	S3		CDFW_WL-
Myiarchus	brown-cres	Birds	ABPAE430	None	None	G5	S3		CDFW_WL-
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatene	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatene	Endangere	G5T2T3	S1		BLM_S-Sen
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I

Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene(	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene(	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene(	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene(	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene(	G5T3	S1S2		CDFW_FP-I
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene(	Threatene(	G3	S2S3		IUCN_VU-V
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xylorhiza o	Orcutt's wo	Dicots	PDASTA10	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA10	None	None	G3?	S2	1B.2	BLM_S-Sen
Mesquite B	Mesquite B	Riparian	CTT61820(	None	None	G3	S2.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810(	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810(	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810(	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810(	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810(	None	None	G2	S1.1		
Transmont	Transmont	Marsh	CTT52320(	None	None	G3	S2.1		
Palafoxia a	giant spani	Dicots	PDAST6T01	None	None	G5T3?	S2	1B.3	BLM_S-Sen
Palafoxia a	giant spani	Dicots	PDAST6T01	None	None	G5T3?	S2	1B.3	BLM_S-Sen
Palafoxia a	giant spani	Dicots	PDAST6T01	None	None	G5T3?	S2	1B.3	BLM_S-Sen
Nemacaulis	slender cot	Dicots	PDPGN0G0	None	None	G3G4T3?	S2	2B.2	
Xylorhiza o	Orcutt's wo	Dicots	PDASTA10	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA10	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA10	None	None	G3?	S2	1B.2	BLM_S-Sen
Astragalus	Harwood's	Dicots	PDFAB0F4	None	None	G5T4	S2	2B.2	SB_RSABG-
Astragalus	Harwood's	Dicots	PDFAB0F4	None	None	G5T4	S2	2B.2	SB_RSABG-
Castela em	Emory's cru	Dicots	PDSIM030	None	None	G3G4	S2S3	2B.2	SB_RSABG-
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Castela em	Emory's cru	Dicots	PDSIM030	None	None	G3G4	S2S3	2B.2	SB_RSABG-
Bursera mi	little-leaf e	Dicots	PDBUR010	None	None	G4	S2	2B.3	SB_RSABG-
Antrozous	pallid bat	Mammals	AMACC10(	None	None	G5	S3		BLM_S-Sen
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC10(	None	None	G5	S3		BLM_S-Sen
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Selaginella	desert spik	Ferns	PPSEL010G	None	None	G4	S2S3	2B.2	
Koeberlinia	slender-spi	Dicots	PDCPP050	None	None	G4T4?	S2	2B.2	

Koeberlinia	slender-spi	Dicots	PDCPP0501	None	None	G4T4?	S2	2B.2		
Koeberlinia	slender-spi	Dicots	PDCPP0501	None	None	G4T4?	S2	2B.2		
Koeberlinia	slender-spi	Dicots	PDCPP0501	None	None	G4T4?	S2	2B.2		
Koeberlinia	slender-spi	Dicots	PDCPP0501	None	None	G4T4?	S2	2B.2		
Opuntia wi	Wiggins' ch	Dicots	PDCAC0D1	None	None	G3?Q	S1?		3.3	
Opuntia wi	Wiggins' ch	Dicots	PDCAC0D1	None	None	G3?Q	S1?		3.3	
Stabilized a	Stabilized a	Dune	CTT22200C	None	None	G4	S3.2			
Active Dese	Active Dese	Dune	CTT22100C	None	None	G4	S2.2			
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Pilostyles t	Thurber's p	Dicots	PDRAF0101	None	None	G5	S4		4.3	
Gelochelid	gull-billed t	Birds	ABNNM08C	None	None	G5	S1			CDFW_SSC
Gelochelid	gull-billed t	Birds	ABNNM08C	None	None	G5	S1			CDFW_SSC
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2			BLM_S-Sen
Nama sten	mud nama	Dicots	PDHYD0A0	None	None	G4G5	S1S2	2B.2		
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			
Pseudocota	Andrew's d	Insects	IICOL3702C	None	None	G1	S1			

Pseudocot:	Andrew's d	Insects	IICOL3702(	None	None	G1	S1		
Pseudocot:	Andrew's d	Insects	IICOL3702(	None	None	G1	S1		
Pseudocot:	Andrew's d	Insects	IICOL3702(	None	None	G1	S1		
Pseudocot:	Andrew's d	Insects	IICOL3702(	None	None	G1	S1		
Pseudocot:	Andrew's d	Insects	IICOL3702(	None	None	G1	S1		
Pseudocot:	Andrew's d	Insects	IICOL3702(	None	None	G1	S1		
Pseudocot:	Andrew's d	Insects	IICOL3702(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala h	Hardy's du	Insects	IICOL3006(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Anomala c:	Carlson's d	Insects	IICOL3005(	None	None	G1	S1		
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2		
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2		
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2		
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2		
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2		

EEC ORIGINAL PKG

Sigmodon	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Koeberlinia	slender-spi	Dicots	PDCPP050	None	None	G4T4?	S2	2B.2	
Corynorhin	Townsend'	Mammals	AMACC080	None	None	G3G4	S2		BLM_S-Sen
Corynorhin	Townsend'	Mammals	AMACC080	None	None	G3G4	S2		BLM_S-Sen
Corynorhin	Townsend'	Mammals	AMACC080	None	None	G3G4	S2		BLM_S-Sen
Corynorhin	Townsend'	Mammals	AMACC080	None	None	G3G4	S2		BLM_S-Sen
Piranga ru	summer ta	Birds	ABPBX450	None	None	G5	S1		CDFW_SSC
Piranga ru	summer ta	Birds	ABPBX450	None	None	G5	S1		CDFW_SSC
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Crissal thra	Birds	ABPBK060	None	None	G5	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Junco hyen	gray-heade	Birds	ABPBXA50	None	None	G5T5	S1		CDFW_WL-
Setophaga	Sonoran ye	Birds	ABPBX030	None	None	G5T2T3	S2		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Icteria vire	yellow-bre	Birds	ABPBX240	None	None	G5	S3		CDFW_SSC
Setophaga	yellow war	Birds	ABPBX030	None	None	G5	S3S4		CDFW_SSC
Setophaga	yellow war	Birds	ABPBX030	None	None	G5	S3S4		CDFW_SSC
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen

Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Polioptila n	black-tailec	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Myiarchus	brown-cres	Birds	ABPAE430	None	None	G5	S3		CDFW_WL-
Myiarchus	brown-cres	Birds	ABPAE430	None	None	G5	S3		CDFW_WL-
Myiarchus	brown-cres	Birds	ABPAE430	None	None	G5	S3		CDFW_WL-
Pyrocephal	vermilion f	Birds	ABPAE360	None	None	G5	S2S3		CDFW_SSC
Pyrocephal	vermilion f	Birds	ABPAE360	None	None	G5	S2S3		CDFW_SSC
Pyrocephal	vermilion f	Birds	ABPAE360	None	None	G5	S2S3		CDFW_SSC
Pyrocephal	vermilion f	Birds	ABPAE360	None	None	G5	S2S3		CDFW_SSC
Colaptes ch	gilded flick	Birds	ABNYF100	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041	None	Endangere	G5	S1		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Micrathene	elf owl	Birds	ABNSB090	None	Endangere	G5	S1		BLM_S-Sen
Asio flamm	short-earec	Birds	ABNSB130	None	None	G5	S3		CDFW_SSC
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatenec	Endangere	G5T2T3	S1		BLM_S-Sen
Rynchops n	black skimr	Birds	ABNNM14	None	None	G5	S2		CDFW_SSC
Rynchops n	black skimr	Birds	ABNNM14	None	None	G5	S2		CDFW_SSC
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatenec	G3G4T1	S1		BLM_S-Sen
Rallus obsc	Yuma Ridgy	Birds	ABNME050	Endangere	Threatenec	G5T3	S1S2		CDFW_FP-I

Rallus obsc	Yuma Ridg	Birds	ABNME05C	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05C	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05C	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05C	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05C	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05C	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Ardea alba	great egret	Birds	ABNGA040	None	None	G5	S4		CDF_S-Sen
Ardea herc	great blue	Birds	ABNGA040	None	None	G5	S4		CDF_S-Sen
Ardea herc	great blue	Birds	ABNGA040	None	None	G5	S4		CDF_S-Sen
Ardea herc	great blue	Birds	ABNGA040	None	None	G5	S4		CDF_S-Sen
Falco mexi	prairie falc	Birds	ABNKD060	None	None	G5	S4		CDFW_WL-
Falco mexi	prairie falc	Birds	ABNKD060	None	None	G5	S4		CDFW_WL-
Falco mexi	prairie falc	Birds	ABNKD060	None	None	G5	S4		CDFW_WL-
Falco mexi	prairie falc	Birds	ABNKD060	None	None	G5	S4		CDFW_WL-
Falco mexi	prairie falc	Birds	ABNKD060	None	None	G5	S4		CDFW_WL-
Laterallus j	California b	Birds	ABNME03C	None	Threatene	G3G4T1	S1		BLM_S-Sen
Accipiter cc	Cooper's ha	Birds	ABNKC120	None	None	G5	S4		CDFW_WL-
Accipiter cc	Cooper's ha	Birds	ABNKC120	None	None	G5	S4		CDFW_WL-
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Coleonyx s	barefoot ge	Reptiles	ARACD010	None	Threatene	G4	S1		BLM_S-Sen
Coleonyx s	barefoot ge	Reptiles	ARACD010	None	Threatene	G4	S1		BLM_S-Sen
Coleonyx s	barefoot ge	Reptiles	ARACD010	None	Threatene	G4	S1		BLM_S-Sen
Coleonyx s	barefoot ge	Reptiles	ARACD010	None	Threatene	G4	S1		BLM_S-Sen
Coleonyx s	barefoot ge	Reptiles	ARACD010	None	Threatene	G4	S1		BLM_S-Sen

Icteria virei	yellow-brea	Birds	ABPBX2401	None	None	G5	S3		CDFW_SSC
Piranga rub	summer ta	Birds	ABPBX4503	None	None	G5	S1		CDFW_SSC
Cyprinodon	desert pup	Fish	AFCNB0200	Endangere	Endangere	G1	S1		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Ptychochei	Colorado p	Fish	AFCJB3502	Endangere	Endangere	G1	SX		CDFW_FP-F
Desert Fan	Desert Fan	Riparian	CTT62300C	None	None	G3	S3.2		
Desert Fan	Desert Fan	Riparian	CTT62300C	None	None	G3	S3.2		
Desert Fan	Desert Fan	Riparian	CTT62300C	None	None	G3	S3.2		
Desert Fan	Desert Fan	Riparian	CTT62300C	None	None	G3	S3.2		
Desert Fan	Desert Fan	Riparian	CTT62300C	None	None	G3	S3.2		
Sonoran Co	Sonoran Co	Riparian	CTT61810C	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810C	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810C	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810C	None	None	G2	S1.1		
Sonoran Co	Sonoran Co	Riparian	CTT61810C	None	None	G2	S1.1		
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Piranga rub	summer ta	Birds	ABPBX4503	None	None	G5	S1		CDFW_SSC
Myiarchus	brown-cres	Birds	ABPAE4308	None	None	G5	S3		CDFW_WL-
Polioptila n	black-tailed	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Icteria virei	yellow-brea	Birds	ABPBX2401	None	None	G5	S3		CDFW_SSC
Polioptila n	black-tailed	Birds	ABPBJ0803	None	None	G5	S3S4		CDFW_WL-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Carnegiea g	saguaro	Dicots	PDCAC1201	None	None	G5	S1	2B.2	SB_RSABG-
Carnegiea g	saguaro	Dicots	PDCAC1201	None	None	G5	S1	2B.2	SB_RSABG-
Carnegiea g	saguaro	Dicots	PDCAC1201	None	None	G5	S1	2B.2	SB_RSABG-
Carnegiea g	saguaro	Dicots	PDCAC1201	None	None	G5	S1	2B.2	SB_RSABG-
Carnegiea g	saguaro	Dicots	PDCAC1201	None	None	G5	S1	2B.2	SB_RSABG-
Eucnide ru	annual rocl	Dicots	PDLOA0201	None	None	G3	S1	2B.2	
Eucnide ru	annual rocl	Dicots	PDLOA0201	None	None	G3	S1	2B.2	
Eucnide ru	annual rocl	Dicots	PDLOA0201	None	None	G3	S1	2B.2	
Eucnide ru	annual rocl	Dicots	PDLOA0201	None	None	G3	S1	2B.2	
Geraea visc	sticky gera	Dicots	PDAST4202	None	None	G2G3	S2	2B.2	SB_RSABG-
Herissantia	curly heriss	Dicots	PDMAL0F0	None	None	G5	S1	2B.3	
Ipomopsis	slender-lea	Dicots	PDPLM060	None	None	G4	S2	2B.3	SB_RSABG-
Ipomopsis	slender-lea	Dicots	PDPLM060	None	None	G4	S2	2B.3	SB_RSABG-

Lycium par	Parish's de:	Dicots	PDSOL0G0I	None	None	G4	S1	2B.3	
Mentzelia I	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Mentzelia I	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Malperia te	brown turk	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turk	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turk	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turk	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Rynchops r	black skimr	Birds	ABNNM14(	None	None	G5	S2		CDFW_SSC
Hydroprog	Caspian ter	Birds	ABNNM08(	None	None	G5	S4		IUCN_LC-Le
Gelochelid	gull-billed t	Birds	ABNNM08(	None	None	G5	S1		CDFW_SSC
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Myotis cilic	western sn	Mammals	AMACC011	None	None	G5	S3		BLM_S-Sen
Sigmodon a	Colorado R	Mammals	AMAFF070	None	None	G5T2T3	S1S2		CDFW_SSC
Scaphiopus	Couch's spa	Amphibian	AAABF010	None	None	G5	S2		BLM_S-Sen
Incilius alva	Sonoran de	Amphibian	AAABB010	None	None	G5	SH		CDFW_SSC
Incilius alva	Sonoran de	Amphibian	AAABB010	None	None	G5	SH		CDFW_SSC
Incilius alva	Sonoran de	Amphibian	AAABB010	None	None	G5	SH		CDFW_SSC
Incilius alva	Sonoran de	Amphibian	AAABB010	None	None	G5	SH		CDFW_SSC
Incilius alva	Sonoran de	Amphibian	AAABB010	None	None	G5	SH		CDFW_SSC
Abronia vil	chaparral s	Dicots	PDNYC010I	None	None	G5T2?	S2	1B.1	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Eryngium a	San Diego l	Dicots	PDAPI0Z04	Endangere	Endangere	G5T1	S1	1B.1	SB_CRES-Sa
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1		AFS_EN-En

Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Plegadis ch	white-face	Birds	ABNGE020	None	None	G5	S3S4		CDFW_WL-
Myotis yun	Yuma myo	Mammals	AMACC010	None	None	G5	S4		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Plegadis ch	white-face	Birds	ABNGE020	None	None	G5	S3S4		CDFW_WL-
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK061	None	None	G4	S3		BLM_S-Sen
Falco colun	merlin	Birds	ABNKD060	None	None	G5	S3S4		CDFW_WL-
Falco colun	merlin	Birds	ABNKD060	None	None	G5	S3S4		CDFW_WL-
Falco colun	merlin	Birds	ABNKD060	None	None	G5	S3S4		CDFW_WL-
Buteo rega	ferruginou	Birds	ABNKC191	None	None	G4	S3S4		CDFW_WL-
Buteo rega	ferruginou	Birds	ABNKC191	None	None	G4	S3S4		CDFW_WL-
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Euphorbia	flat-seedec	Dicots	PDEUP0D1	None	None	G3	S1	1B.2	SB_RSABG-
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Vireo bellii	least Bell's	Birds	ABPBW011	Endangere	Endangere	G5T2	S2		IUCN_NT-N
Nemacauli	slender cot	Dicots	PDPGN0G0	None	None	G3G4T3?	S2	2B.2	
Senna cove	Cove's cass	Dicots	PDFAB491	None	None	G5	S3	2B.2	SB_RSABG-
Vireo bellii	Arizona be	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Vireo bellii	Arizona be	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Vireo bellii	Arizona be	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Taxidea ta	American b	Mammals	AMAJF040	None	None	G5	S3		CDFW_SSC

Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-U
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Taxidea tax	American b	Mammals	AMAJF0401	None	None	G5	S3		CDFW_SSC
Anomala h	Hardy's du	Insects	IICOL3006C	None	None	G1	S1		
Anomala ca	Carlson's d	Insects	IICOL3005C	None	None	G1	S1		
Anomala ca	Carlson's d	Insects	IICOL3005C	None	None	G1	S1		
Anomala ca	Carlson's d	Insects	IICOL3005C	None	None	G1	S1		
Anomala ca	Carlson's d	Insects	IICOL3005C	None	None	G1	S1		
Anomala ca	Carlson's d	Insects	IICOL3005C	None	None	G1	S1		
Anomala ca	Carlson's d	Insects	IICOL3005C	None	None	G1	S1		
Oliarces cla	cheesewee	Insects	IINEU04010	None	None	G1G3	S2		
Onychomy	southern g	Mammals	AMAFF060	None	None	G5T3	S3		CDFW_SSC
Colubrina c	Las Animas	Dicots	PDRHA050	None	None	G4	S2S3	2B.3	SB_RSABG-
Colubrina c	Las Animas	Dicots	PDRHA050	None	None	G4	S2S3	2B.3	SB_RSABG-
Colubrina c	Las Animas	Dicots	PDRHA050	None	None	G4	S2S3	2B.3	SB_RSABG-
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Lasiurus xa	western ye	Mammals	AMACC05C	None	None	G5	S3		CDFW_SSC
Puma conc	Yuma mou	Mammals	AMAJH040	None	None	G5T1T2Q	S1		CDFW_SSC
Nyctinomo	big free-tai	Mammals	AMACD04C	None	None	G5	S3		CDFW_SSC
Myotis occ	Arizona My	Mammals	AMACC011	None	None	G4	S1		CDFW_SSC
Chaetodipu	pallid San D	Mammals	AMAFD05C	None	None	G5T34	S3S4		CDFW_SSC
Chaetodipu	pallid San D	Mammals	AMAFD05C	None	None	G5T34	S3S4		CDFW_SSC
Chaetodipu	pallid San D	Mammals	AMAFD05C	None	None	G5T34	S3S4		CDFW_SSC
Oreothlypis	Lucy's warb	Birds	ABPBX0109	None	None	G5	S2S3		BLM_S-Sen
Melitta cali	California r	Insects	IIHYM7401	None	None	G4?	S2?		
Melitta cali	California r	Insects	IIHYM7401	None	None	G4?	S2?		
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Calliandra e	pink fairy-d	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra e	pink fairy-d	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra e	pink fairy-d	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-

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Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen

Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Lupinus alb	Mountain S	Dicots	PDFAB2B1.	None	None	G4T2	S2	1B.3	BLM_S-Sen
Cyprinodon	desert pup	Fish	AFCNB0200	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB0200	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB0200	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodon	desert pup	Fish	AFCNB0200	Endangere	Endangere	G1	S1		AFS_EN-En
Ptychochei	Colorado p	Fish	AFCJB3502	Endangere	Endangere	G1	SX		CDFW_FP-I
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF0415	None	Endangere	G5	S1		BLM_S-Sen
Scaphiopus	Couch's spa	Amphibian	AAABF0102	None	None	G5	S2		BLM_S-Sen
Lithobates	lowland leo	Amphibian	AAABH012	None	None	G4	SX		BLM_S-Sen
Lithobates	lowland leo	Amphibian	AAABH012	None	None	G4	SX		BLM_S-Sen
Lithobates	lowland leo	Amphibian	AAABH012	None	None	G4	SX		BLM_S-Sen
Lithobates	lowland leo	Amphibian	AAABH012	None	None	G4	SX		BLM_S-Sen
Lithobates	lowland leo	Amphibian	AAABH012	None	None	G4	SX		BLM_S-Sen
Lithobates	lowland leo	Amphibian	AAABH012	None	None	G4	SX		BLM_S-Sen
Lepismado	Algodones	Insects	IICOLX1110	None	None	G1	S1		
Empidonax	southweste	Birds	ABPAE3304	Endangere	Endangere	G5T2	S1		NABCI_RW
Empidonax	southweste	Birds	ABPAE3304	Endangere	Endangere	G5T2	S1		NABCI_RW
Empidonax	southweste	Birds	ABPAE3304	Endangere	Endangere	G5T2	S1		NABCI_RW
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen

Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Myotis veli	cave myoti	Mammals	AMACC010	None	None	G5	S1		BLM_S-Sen
Larus califc	California g	Birds	ABNNM03:	None	None	G5	S4		CDFW_WL-
Nyctinomo	pocketed fi	Mammals	AMACD040	None	None	G4	S3		CDFW_SSC
Nyctinomo	pocketed fi	Mammals	AMACD040	None	None	G4	S3		CDFW_SSC
Lasiurus cir	hoary bat	Mammals	AMACC050	None	None	G5	S4		IUCN_LC-Le
Lasiurus cir	hoary bat	Mammals	AMACC050	None	None	G5	S4		IUCN_LC-Le
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Nyctinomo	pocketed fi	Mammals	AMACD040	None	None	G4	S3		CDFW_SSC
Myotis yun	Yuma myot	Mammals	AMACC010	None	None	G5	S4		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Nyctinomo	pocketed fi	Mammals	AMACD040	None	None	G4	S3		CDFW_SSC
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Antrozous	pallid bat	Mammals	AMACC100	None	None	G5	S3		BLM_S-Sen
Nyctinomo	pocketed fi	Mammals	AMACD040	None	None	G4	S3		CDFW_SSC
Eumops pe	western ma	Mammals	AMACD020	None	None	G5T4	S3S4		BLM_S-Sen
Imperata b	California s	Monocots	PMPOA3D0	None	None	G4	S3	2B.1	SB_RSABG-
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Sigmodon		Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon		Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon		Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon		Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Perognathu	Palm Sprin	Mammals	AMAFD010	None	None	G5T2	S2		BLM_S-Sen
Sigmodon		Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Pyrocephal	vermilion f	Birds	ABPAE360:	None	None	G5	S2S3		CDFW_SSC
Pyrocephal	vermilion f	Birds	ABPAE360:	None	None	G5	S2S3		CDFW_SSC
Pyrocephal	vermilion f	Birds	ABPAE360:	None	None	G5	S2S3		CDFW_SSC
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Falco colun	merlin	Birds	ABNKD060	None	None	G5	S3S4		CDFW_WL-
Falco colun	merlin	Birds	ABNKD060	None	None	G5	S3S4		CDFW_WL-
Falco colun	merlin	Birds	ABNKD060	None	None	G5	S3S4		CDFW_WL-
Heloderma	banded Gil	Reptiles	ARACE010:	None	None	G4T4	S1		BLM_S-Sen
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-

Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Teucrium c	dwarf gern	Dicots	PDLAM200	None	None	G4G5T3T4	S2	2B.2	
Teucrium c	dwarf gern	Dicots	PDLAM200	None	None	G4G5T3T4	S2	2B.2	
Abronia vil	chaparral s	Dicots	PDNYC010	None	None	G5T2?	S2	1B.1	BLM_S-Sen
Chylismia a	sand eveni	Dicots	PDONA030	None	None	G4?	S2S3	2B.2	
Chylismia a	sand eveni	Dicots	PDONA030	None	None	G4?	S2S3	2B.2	
Chylismia a	sand eveni	Dicots	PDONA030	None	None	G4?	S2S3	2B.2	
Chylismia a	sand eveni	Dicots	PDONA030	None	None	G4?	S2S3	2B.2	
Chylismia a	sand eveni	Dicots	PDONA030	None	None	G4?	S2S3	2B.2	
Chylismia a	sand eveni	Dicots	PDONA030	None	None	G4?	S2S3	2B.2	
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Hymenoxys	bitter hym	Dicots	PDAST530	None	None	G5	S2	2B.1	
Hymenoxys	bitter hym	Dicots	PDAST530	None	None	G5	S2	2B.1	
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V

Scaphiopus	Couch's spa	Amphibian	AAABF010	None	None	G5	S2		BLM_S-Sen
Lithobates	northern le	Amphibian	AAABH011	None	None	G5	S2		CDFW_SSC
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Pelecanus	California b	Birds	ABNFC010	Delisted	Delisted	G4T3T4	S3		BLM_S-Sen
Pelecanus	California b	Birds	ABNFC010	Delisted	Delisted	G4T3T4	S3		BLM_S-Sen
Pelecanus	California b	Birds	ABNFC010	Delisted	Delisted	G4T3T4	S3		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen

Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Laterallus j	California k	Birds	ABNME030	None	Threatene	G3G4T1	S1		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Ixobrychus	least bitter	Birds	ABNGA020	None	None	G4G5	S2		CDFW_SSC
Ixobrychus	least bitter	Birds	ABNGA020	None	None	G4G5	S2		CDFW_SSC
Ixobrychus	least bitter	Birds	ABNGA020	None	None	G4G5	S2		CDFW_SSC
Ixobrychus	least bitter	Birds	ABNGA020	None	None	G4G5	S2		CDFW_SSC
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Astragalus	Harwood's	Dicots	PDFAB0F4	None	None	G5T4	S2	2B.2	SB_RSABG-
Astragalus	Harwood's	Dicots	PDFAB0F4	None	None	G5T4	S2	2B.2	SB_RSABG-

Astragalus	Harwood's	Dicots	PDFAB0F4!	None	None	G5T4	S2	2B.2	SB_RSABG-
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Astragalus	Harwood's	Dicots	PDFAB0F4!	None	None	G5T4	S2	2B.2	SB_RSABG-
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Astragalus	Harwood's	Dicots	PDFAB0F4!	None	None	G5T4	S2	2B.2	SB_RSABG-
Chaenactis	Peirson's p	Dicots	PDAST200	None	None	G5T2	S2	1B.3	BLM_S-Sen
Chaenactis	Peirson's p	Dicots	PDAST200	None	None	G5T2	S2	1B.3	BLM_S-Sen
Chaenactis	Peirson's p	Dicots	PDAST200	None	None	G5T2	S2	1B.3	BLM_S-Sen
Chaenactis	Peirson's p	Dicots	PDAST200	None	None	G5T2	S2	1B.3	BLM_S-Sen
Chaenactis	Peirson's p	Dicots	PDAST200	None	None	G5T2	S2	1B.3	BLM_S-Sen
Chaenactis	Peirson's p	Dicots	PDAST200	None	None	G5T2	S2	1B.3	BLM_S-Sen
Palafoxia a	giant spani	Dicots	PDAST6T01	None	None	G5T3?	S2	1B.3	BLM_S-Sen
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Salvia grea	Orocopia s	Dicots	PDLAM1S0	None	None	G2G3	S2S3	1B.3	BLM_S-Sen
Salvia grea	Orocopia s	Dicots	PDLAM1S0	None	None	G2G3	S2S3	1B.3	BLM_S-Sen
Ditaxis clar	glandular c	Dicots	PDEUP080I	None	None	G3G4	S2	2B.2	
Ditaxis clar	glandular c	Dicots	PDEUP080I	None	None	G3G4	S2	2B.2	
Ditaxis clar	glandular c	Dicots	PDEUP080I	None	None	G3G4	S2	2B.2	
Ditaxis clar	glandular c	Dicots	PDEUP080I	None	None	G3G4	S2	2B.2	
Pseudocot	Andrew's d	Insects	IICOL3702	None	None	G1	S1		
Pseudocot	Andrew's d	Insects	IICOL3702	None	None	G1	S1		
Mentzelia	Darlington'	Dicots	PDLOA031I	None	None	G5	S2	2B.2	SB_RSABG-
Mentzelia	Darlington'	Dicots	PDLOA031I	None	None	G5	S2	2B.2	SB_RSABG-
Lycium par	Parish's de	Dicots	PDSOL0G0I	None	None	G4	S1	2B.3	
Ditaxis clar	glandular c	Dicots	PDEUP080I	None	None	G3G4	S2	2B.2	
Ditaxis clar	glandular c	Dicots	PDEUP080I	None	None	G3G4	S2	2B.2	
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed I	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Symphyotr	San Bernar	Dicots	PDASTE80	None	None	G2	S2	1B.2	SB_CRES-S
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Matelea pa	spear-leaf	Dicots	PDASC0A0.	None	None	G5	S3	2B.3	USFS_S-Se
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1		AFS_EN-En
Streptanth	southern je	Dicots	PDBRA2G0	None	None	G3	S3	1B.3	BLM_S-Sen
Mentzelia	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Xylorhiza o	Orcutt's wo	Dicots	PDASTA10	None	None	G3?	S2	1B.2	BLM_S-Sen

Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Xylorhiza o	Orcutt's wo	Dicots	PDASTA104	None	None	G3?	S2	1B.2	BLM_S-Sen
Digitaria ca	Arizona cot	Monocots	PMPOA270	None	None	G5T5	S2	2B.3	
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra (	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Pholistoma	Arizona ph	Dicots	PDHYD0D0	None	None	G5T4?	S3	2B.3	SB_RSABG-
Pholistoma	Arizona ph	Dicots	PDHYD0D0	None	None	G5T4?	S3	2B.3	SB_RSABG-
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen

Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Astragalus	Harwood's	Dicots	PDFAB0F4(	None	None	G5T4	S2	2B.2	SB_RSABG-
Astragalus	Harwood's	Dicots	PDFAB0F4(	None	None	G5T4	S2	2B.2	SB_RSABG-
Astragalus	Harwood's	Dicots	PDFAB0F4(	None	None	G5T4	S2	2B.2	SB_RSABG-
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen

Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Nama sten	mud nama	Dicots	PDHYD0A0	None	None	G4G5	S1S2	2B.2	
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Nama sten	mud nama	Dicots	PDHYD0A0	None	None	G4G5	S1S2	2B.2	
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Ayenia con	California a	Dicots	PDSTE0102	None	None	G4	S3	2B.3	SB_RSABG-
Euphorbia	Arizona spı	Dicots	PDEUP0D0	None	None	G5	S3	2B.3	
Melanerpe	Gila woodp	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen

Lanius ludc	loggerhead	Birds	ABPBR010:	None	None	G4	S4		CDFW_SSC
Lanius ludc	loggerhead	Birds	ABPBR010:	None	None	G4	S4		CDFW_SSC
Lanius ludc	loggerhead	Birds	ABPBR010:	None	None	G4	S4		CDFW_SSC
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Sigmodon I	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Macrotus c	California l	Mammals	AMACB010	None	None	G4	S3		BLM_S-Sen
Bursera mi	little-leaf e	Dicots	PDBUR010	None	None	G4	S2	2B.3	SB_RSABG-
Ixobrychus	least bitter	Birds	ABNGA020	None	None	G4G5	S2		CDFW_SSC
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen

Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Cyprinodor	desert pup	Fish	AFCNB020(	Endangere	Endangere	G1	S1	AFS_EN-En
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3	BLM_S-Sen

Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Sigmodon l	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Sigmodon l	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Phrynosom	flat-tailed l	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Sigmodon l	Yuma hispi	Mammals	AMAFF070	None	None	G5T2T3	S2		CDFW_SSC
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-V
Koeberlinia	slender-spi	Dicots	PDCPP050:	None	None	G4T4?	S2	2B.2	
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100:	None	None	G4	S3		BLM_S-Sen

Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Koeberlinia	slender-spi	Dicots	PDCPP050	None	None	G4T4?	S2	2B.2	
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatene	G5T3	S1S2		CDFW_FP-I
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatene	Threatene	G3	S2S3	IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatenec	G5T3	S1S2	CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatenec	G5T3	S1S2	CDFW_FP-I
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatenec	Threatenec	G3	S2S3	IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene	G5T3	S1S2	CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene	G5T3	S1S2	CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene	G5T3	S1S2	CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME05(	Endangere	Threatene	G5T3	S1S2	CDFW_FP-I
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatene	Threatene	G3	S2S3	IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF0101	Threatened	Threatened	G3	S2S3	IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatened	G5T3	S1S2	CDFW_FP-I
Rallus obsc	Yuma Ridg	Birds	ABNME050	Endangere	Threatened	G5T3	S1S2	CDFW_FP-I
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3	IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Pseudoron	Deep Cany	Dicots	PDSCR2R0:	None	None	G4G5	S1	2B.3	
Astragalus	Harwood's	Dicots	PDFAB0F49	None	None	G5T4	S2	2B.2	SB_RSABG-
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\
Gopherus a	desert tort	Reptiles	ARAAF010:	Threatenec	Threatenec	G3	S2S3		IUCN_VU-\

Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Calliandra c	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra c	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V

Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatened	Threatened	G3	S2S3		IUCN_VU-V
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Mentzelia p	Darlington'	Dicots	PDLOA031	None	None	G5	S2	2B.2	SB_RSABG-
Astragalus	gravel milk	Dicots	PDFAB0F7	None	None	G4G5	S2	2B.2	
Astragalus	gravel milk	Dicots	PDFAB0F7	None	None	G4G5	S2	2B.2	
Astragalus	gravel milk	Dicots	PDFAB0F7	None	None	G4G5	S2	2B.2	
Astragalus	gravel milk	Dicots	PDFAB0F7	None	None	G4G5	S2	2B.2	
Astragalus	gravel milk	Dicots	PDFAB0F7	None	None	G4G5	S2	2B.2	
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Acmispon h	pygmy lotu	Dicots	PDFAB2A0	None	None	G3	S3	1B.3	SB_USDA-U
Acmispon h	pygmy lotu	Dicots	PDFAB2A0	None	None	G3	S3	1B.3	SB_USDA-U
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain p	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Mentzelia t	spiny-hair b	Dicots	PDLOA031	None	None	G4	S2	2B.1	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	

Lycium par	Parish's de:	Dicots	PDSOL0G0I	None	None	G4	S1	2B.3	
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Linanthus r	Jacumba M	Dicots	PDPLM041	None	None	G2T1	S1	1B.1	BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Charadrius	mountain ţ	Birds	ABNNB031	None	None	G3	S2S3		BLM_S-Sen
Crotalus ru	red-diamoı	Reptiles	ARADE020!	None	None	G4	S3		CDFW_SSC
Crotalus ru	red-diamoı	Reptiles	ARADE020!	None	None	G4	S3		CDFW_SSC
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodţ	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatene	Endangere	G5T2T3	S1		BLM_S-Sen
Laterallus j	California k	Birds	ABNME03C	None	Threatene	G3G4T1	S1		BLM_S-Sen
Laterallus j	California k	Birds	ABNME03C	None	Threatene	G3G4T1	S1		BLM_S-Sen
Laterallus j	California k	Birds	ABNME03C	None	Threatene	G3G4T1	S1		BLM_S-Sen
Colaptes cl	gilded flick	Birds	ABNYF100	None	Endangere	G5	S1		BLM_S-Sen
Colaptes cl	gilded flick	Birds	ABNYF100	None	Endangere	G5	S1		BLM_S-Sen
Colaptes cl	gilded flick	Birds	ABNYF100	None	Endangere	G5	S1		BLM_S-Sen
Colaptes cl	gilded flick	Birds	ABNYF100	None	Endangere	G5	S1		BLM_S-Sen
Micrathene	elf owl	Birds	ABNSB090	None	Endangere	G5	S1		BLM_S-Sen
Penstemor	desert bea	Dicots	PDSCR1L56	None	None	G4G5T4	S3	2B.2	
Penstemor	desert bea	Dicots	PDSCR1L56	None	None	G4G5T4	S3	2B.2	
Penstemor	desert bea	Dicots	PDSCR1L56	None	None	G4G5T4	S3	2B.2	
Micrathene	elf owl	Birds	ABNSB090	None	Endangere	G5	S1		BLM_S-Sen
Colaptes cl	gilded flick	Birds	ABNYF100	None	Endangere	G5	S1		BLM_S-Sen
Colaptes cl	gilded flick	Birds	ABNYF100	None	Endangere	G5	S1		BLM_S-Sen
Micrathene	elf owl	Birds	ABNSB090	None	Endangere	G5	S1		BLM_S-Sen

Micrathene	elf owl	Birds	ABNSB090:	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Melanerpe	Gila woodp	Birds	ABNYF041!	None	Endangere	G5	S1		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Vireo bellii	Arizona bel	Birds	ABPBW011	None	Endangere	G5T4	S1S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Empidonax	southweste	Birds	ABPAE3304	Endangere	Endangere	G5T2	S1		NABCI_RW
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Empidonax	southweste	Birds	ABPAE3304	Endangere	Endangere	G5T2	S1		NABCI_RW
Empidonax	southweste	Birds	ABPAE3304	Endangere	Endangere	G5T2	S1		NABCI_RW
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Empidonax	southweste	Birds	ABPAE3304	Endangere	Endangere	G5T2	S1		NABCI_RW
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Pelecanus	California b	Birds	ABNFC010:	Delisted	Delisted	G4T3T4	S3		BLM_S-Sen
Laterallus j	California b	Birds	ABNME030	None	Threatened	G3G4T1	S1		BLM_S-Sen
Pelecanus	California b	Birds	ABNFC010:	Delisted	Delisted	G4T3T4	S3		BLM_S-Sen
Pelecanus	California b	Birds	ABNFC010:	Delisted	Delisted	G4T3T4	S3		BLM_S-Sen
Micrathene	elf owl	Birds	ABNSB090:	None	Endangere	G5	S1		BLM_S-Sen

Charadrius	western sn	Birds	ABNNB030	Threatened	None	G3T3	S2S3		CDFW_SSC
Charadrius	western sn	Birds	ABNNB030	Threatened	None	G3T3	S2S3		CDFW_SSC
Malperia te	brown turk	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Malperia te	brown turk	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Malperia te	brown turk	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Xylorhiza o	Orcutt's wc	Dicots	PDASTA10	None	None	G3?	S2	1B.2	BLM_S-Sen
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Acmispon h	pygmy lotu	Dicots	PDFAB2A0I	None	None	G3	S3	1B.3	SB_USDA-L
Pholistoma	Arizona ph	Dicots	PDHYD0D0	None	None	G5T4?	S3	2B.3	SB_RSABG-
Pholistoma	Arizona ph	Dicots	PDHYD0D0	None	None	G5T4?	S3	2B.3	SB_RSABG-
Pholistoma	Arizona ph	Dicots	PDHYD0D0	None	None	G5T4?	S3	2B.3	SB_RSABG-
Mentzelia h	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Linanthus r	Jacumba M	Dicots	PDPLM041	None	None	G2T1	S1	1B.1	BLM_S-Sen
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Aquila chry	golden eag	Birds	ABNKC220	None	None	G5	S3		BLM_S-Sen
Ipomopsis	slender-lea	Dicots	PDPLM060	None	None	G4	S2	2B.3	SB_RSABG-
Ipomopsis	slender-lea	Dicots	PDPLM060	None	None	G4	S2	2B.3	SB_RSABG-
Selaginella	desert spik	Ferns	PPSEL010G	None	None	G4	S2S3	2B.2	
Aquila chry	golden eag	Birds	ABNKC220	None	None	G5	S3		BLM_S-Sen
Castela em	Emory's cru	Dicots	PDSIM0303	None	None	G3G4	S2S3	2B.2	SB_RSABG-
Haliaeetus	bald eagle	Birds	ABNKC100	Delisted	Endangere	G5	S3		BLM_S-Sen
Gila elegan	bonytail	Fish	AFCJB1310	Endangere	Endangere	G1	SH		AFS_EN-En
Gila elegan	bonytail	Fish	AFCJB1310	Endangere	Endangere	G1	SH		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En

Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Xyrauchen	razorback s	Fish	AFCJC1101	Endangere	Endangere	G1	S1S2		AFS_EN-En
Toxostoma	Crissal thra	Birds	ABPBK0609	None	None	G5	S3		BLM_S-Sen
Toxostoma	Le Conte's	Birds	ABPBK0610	None	None	G4	S3		BLM_S-Sen
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Toxostoma	Le Conte's	Birds	ABPBK0610	None	None	G4	S3		BLM_S-Sen
Falco mexi	prairie falc	Birds	ABNKD060	None	None	G5	S4		CDFW_WL-
Acmispon l	pygmy lotu	Dicots	PDFAB2A0	None	None	G3	S3	1B.3	SB_USDA-U
Panicum hi	roughstalk	Monocots	PMPOA4K1	None	None	G5T5	S2	2B.1	SB_RSABG-
Panicum hi	roughstalk	Monocots	PMPOA4K1	None	None	G5T5	S2	2B.1	SB_RSABG-
Panicum hi	roughstalk	Monocots	PMPOA4K1	None	None	G5T5	S2	2B.1	SB_RSABG-
Lupinus alb	Mountain S	Dicots	PDFAB2B1	None	None	G4T2	S2	1B.3	BLM_S-Sen
Kinosterno	Sonoran m	Reptiles	ARAAE010	None	None	G4	SH		CDFW_SSC
Kinosterno	Sonoran m	Reptiles	ARAAE010	None	None	G4	SH		CDFW_SSC
Kinosterno	Sonoran m	Reptiles	ARAAE010	None	None	G4	SH		CDFW_SSC
Chylismia a	sand eveni	Dicots	PDONA030	None	None	G4?	S2S3	2B.2	
Acmispon l	pygmy lotu	Dicots	PDFAB2A0	None	None	G3	S3	1B.3	SB_USDA-U
Kinosterno	Sonoran m	Reptiles	ARAAE010	None	None	G4	SH		CDFW_SSC
Kinosterno	Sonoran m	Reptiles	ARAAE010	None	None	G4	SH		CDFW_SSC
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Corynorhin	Townsend'	Mammals	AMACC080	None	None	G3G4	S2		BLM_S-Sen
Corynorhin	Townsend'	Mammals	AMACC080	None	None	G3G4	S2		BLM_S-Sen
Corynorhin	Townsend'	Mammals	AMACC080	None	None	G3G4	S2		BLM_S-Sen
Palafoxia a	giant spani	Dicots	PDAST6T01	None	None	G5T3?	S2	1B.3	BLM_S-Sen
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Calliandra	pink fairy-c	Dicots	PDFAB0N0	None	None	G5	S3	2B.3	SB_RSABG-
Castela em	Emory's cru	Dicots	PDSIM030	None	None	G3G4	S2S3	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Euphorbia	Abrams' sp	Dicots	PDEUP0D0	None	None	G4	S2	2B.2	SB_RSABG-
Ditaxis clar	glandular d	Dicots	PDEUP080	None	None	G3G4	S2	2B.2	
Ditaxis clar	glandular d	Dicots	PDEUP080	None	None	G3G4	S2	2B.2	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Lycium par	Parish's de	Dicots	PDSOL0G0	None	None	G4	S1	2B.3	
Malperia te	brown turb	Dicots	PDAST6701	None	None	G4?	S2?	2B.3	SB_RSABG-
Panicum hi	roughstalk	Monocots	PMPOA4K1	None	None	G5T5	S2	2B.1	SB_RSABG-
Bursera mi	little-leaf e	Dicots	PDBUR010	None	None	G4	S2	2B.3	SB_RSABG-
Pholisma s	sand food	Dicots	PDLNN020	None	None	G2	S2	1B.2	BLM_S-Sen
Coccyzus a	western ye	Birds	ABNRB020	Threatene	Endangere	G5T2T3	S1		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen

Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen

Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Bombus cr	Crotch bun	Insects	IIHYM2448	None	Candidate	G3G4	S1S2	
Bombus oc	western bu	Insects	IIHYM2425	None	Candidate	G2G3	S1	USFS_S-Se
Athene cur	burrowing	Birds	ABNSB1001	None	None	G4	S3	BLM_S-Sen
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2	
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2	
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2	
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2	
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2	
Neotoma a	Colorado V	Mammals	AMAFF080	None	None	G5T3T4	S1S2	
Perognathu	Palm Sprin	Mammals	AMAFD010	None	None	G5T2	S2	BLM_S-Sen
Perognathu	Palm Sprin	Mammals	AMAFD010	None	None	G5T2	S2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF1204	None	None	G3	S2	BLM_S-Sen
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1	AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1	AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1	AFS_EN-En
Cyprinodor	desert pup	Fish	AFCNB020	Endangere	Endangere	G1	S1	AFS_EN-En
Coleonyx s	barefoot g	Reptiles	ARACD010	None	Threatene	G4	S1	BLM_S-Sen

Toxostoma	Le Conte's	Birds	ABPBK061(	None	None	G4	S3		BLM_S-Sen
Coleonyx s	barefoot g	Reptiles	ARACD010	None	Threatene	G4	S1		BLM_S-Sen
Arizona ele	California g	Reptiles	ARADB010	None	None	G5T2	S2		CDFW_SSC
Arizona ele	California g	Reptiles	ARADB010	None	None	G5T2	S2		CDFW_SSC
Laterallus j	California b	Birds	ABNME03(	None	Threatene	G3G4T1	S1		BLM_S-Sen
Heloderma	banded Gil	Reptiles	ARACE010	None	None	G4T4	S1		BLM_S-Sen
Laterallus j	California b	Birds	ABNME03(	None	Threatene	G3G4T1	S1		BLM_S-Sen
Heloderma	banded Gil	Reptiles	ARACE010	None	None	G4T4	S1		BLM_S-Sen
Petalonyx l	narrow-lea	Dicots	PDLOA040	None	None	G4	S3?	2B.3	
Petalonyx l	narrow-lea	Dicots	PDLOA040	None	None	G4	S3?	2B.3	
Petalonyx l	narrow-lea	Dicots	PDLOA040	None	None	G4	S3?	2B.3	
Petalonyx l	narrow-lea	Dicots	PDLOA040	None	None	G4	S3?	2B.3	
Petalonyx l	narrow-lea	Dicots	PDLOA040	None	None	G4	S3?	2B.3	
Petalonyx l	narrow-lea	Dicots	PDLOA040	None	None	G4	S3?	2B.3	
Laterallus j	California b	Birds	ABNME03(	None	Threatene	G3G4T1	S1		BLM_S-Sen
Athene cur	burrowing	Birds	ABNSB100	None	None	G4	S3		BLM_S-Sen
Selaginella	desert spik	Ferns	PPSEL010G	None	None	G4	S2S3	2B.2	
Mentzelia l	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Mentzelia l	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Mentzelia l	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Mentzelia l	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Mentzelia l	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Mentzelia l	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Mentzelia l	hairy stickl	Dicots	PDLOA030I	None	None	G4?	S3	2B.3	SB_RSABG-
Galium ang	Borrego be	Dicots	PDRUB0N0	None	Rare	G5T3?	S3?	1B.3	BLM_S-Sen
Eriastrum h	Harwood's	Dicots	PDPLM030	None	None	G2	S2	1B.2	BLM_S-Sen
Cylindropu	Munz's cho	Dicots	PDCAC0D0	None	None	G3	S1	1B.3	BLM_S-Sen
Cylindropu	Munz's cho	Dicots	PDCAC0D0	None	None	G3	S1	1B.3	BLM_S-Sen
Cylindropu	Munz's cho	Dicots	PDCAC0D0	None	None	G3	S1	1B.3	BLM_S-Sen
Cylindropu	Munz's cho	Dicots	PDCAC0D0	None	None	G3	S1	1B.3	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Tidestromi	Eliasson's v	Dicots	PDAMA0J0	None	None	G5	S2	2B.2	
Gopherus a	desert tort	Reptiles	ARAAF010	Threatene	Threatene	G3	S2S3		IUCN_VU-V
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Taxidea tax	American b	Mammals	AMAJF040	None	None	G5	S3		CDFW_SSC
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Uma notat	Colorado D	Reptiles	ARACF150	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Croton wig	Wiggins' cr	Dicots	PDEUP0H1	None	Rare	G2G3	S2	2B.2	BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Carnegiea g	saguaro	Dicots	PDCAC120	None	None	G5	S1	2B.2	SB_RSABG-
Phrynosom	flat-tailed h	Reptiles	ARACF120	None	None	G3	S2		BLM_S-Sen
Agrilus har	Harenus je	Insects	IICOLV006(	None	None	G1G2	S1S2		

Cyclocepha	Wandae du	Insects	IICOL3302(	None	None	G1G2	S1S2
Apiocera w	Glamis san	Insects	IIDIP54020	None	None	G1G2	S1S2
Efferia mac	Glamis rob	Insects	IIDIP07040	None	None	G1G2	S1S2
Euparagia u	Algodones	Insects	IIHYMBC01	None	None	G1G2	S1S2
Microbemb	Algodones	Insects	IIHYM9001	None	None	G1G2	S1S2
Perdita alg	Algodones	Insects	IIHYM0113	None	None	G1G2	S1S2

OccNumbe	EOndx	Mapndx	ElmDate	SiteDate	Sensitive	OccRank	Presence	Accuracy	AccuracyOı
1	387	34623	19350420	19350420	N	U-Unknowı	Presumed ı	Circular fea	90
12	3601	33091	19980105	19980105	N	B-Good	Presumed ı	Specific bo	10
15	3602	33094	19920504	19920504	N	B-Good	Presumed ı	Circular fea	50
13	3603	33092	199901XX	199901XX	N	A-Excellent	Presumed ı	Specific bo	10
14	3604	33093	19931214	19931214	N	B-Good	Presumed ı	Circular fea	50
16	3605	33095	19960703	19960703	N	B-Good	Presumed ı	Circular fea	50
17	3606	33096	20060115	20060115	N	B-Good	Presumed ı	Specific bo	10
18	3607	33097	19921012	19921012	N	B-Good	Presumed ı	Circular fea	50
33	4091	26363	19950112	19950112	N	B-Good	Presumed ı	Specific bo	10
32	4092	26362	19950112	19950112	N	B-Good	Presumed ı	Specific bo	10
3	4093	26366	19930703	19930703	N	U-Unknowı	Presumed ı	Circular fea	90
5	4094	26365	19931211	19931211	N	U-Unknowı	Presumed ı	Circular fea	70
4	4095	26334	19930628	19930628	N	U-Unknowı	Presumed ı	Circular fea	60
11	4123	30609	19960630	19960630	N	A-Excellent	Presumed ı	Specific bo	10
40	4888	30148	19910516	19910516	N	U-Unknowı	Presumed ı	Non-specif	30
41	4889	30147	19910510	19910510	N	U-Unknowı	Presumed ı	Non-specif	30
48	4970	26220	19910604	19910604	N	U-Unknowı	Presumed ı	Non-specif	30
43	4971	26225	20050811	20061016	N	D-Poor	Presumed ı	Non-specif	30
44	4972	26224	19910604	20061016	N	U-Unknowı	Presumed ı	Non-specif	30
45	4973	26223	19910604	19910604	N	U-Unknowı	Presumed ı	Specific bo	10
47	4974	26221	19910604	19910604	N	U-Unknowı	Presumed ı	Specific bo	10
46	4975	26222	19910604	20061016	N	U-Unknowı	Presumed ı	Non-specif	30
1	5532	35287	19780315	19780315	N	U-Unknowı	Presumed ı	Circular fea	90
65	5664	6674	19450602	19450602	N	U-Unknowı	Presumed ı	Circular fea	90
15	5665	6674	19450603	19450603	N	U-Unknowı	Presumed ı	Circular fea	90
5	5666	6674	19170112	19170112	N	U-Unknowı	Presumed ı	Circular fea	90
7	5667	6674	19491212	19491212	N	U-Unknowı	Presumed ı	Circular fea	90
1	5668	6674	19170117	19170117	N	U-Unknowı	Presumed ı	Circular fea	90
5	5966	75962	199408XX	199408XX	N	D-Poor	Presumed ı	Circular fea	50
3	5967	6266	199408XX	199408XX	N	A-Excellent	Presumed ı	Specific bo	20
1	6460	24620	19920412	19920412	N	A-Excellent	Presumed ı	Specific bo	20
1	6539	71505	20180418	20180418	N	B-Good	Presumed ı	Specific bo	20
11	6540	76078	2000XXXX	2000XXXX	N	U-Unknowı	Presumed ı	Specific bo	20
1	6541	76052	20180418	20180418	N	B-Good	Presumed ı	Specific bo	20
2	6543	76077	20190222	20190222	N	B-Good	Presumed ı	Specific bo	20
1	6544	77872	20130420	20130420	N	U-Unknowı	Presumed ı	Specific bo	20
17	6783	24779	19891105	20110308	N	X-None	Possibly Ex	Specific bo	10
66	6829	26201	19910607	19910607	N	U-Unknowı	Presumed ı	Non-specif	30
65	6830	26202	19910607	19910607	N	U-Unknowı	Presumed ı	Non-specif	30
67	8060	26200	19910607	20061013	N	U-Unknowı	Presumed ı	Specific bo	10
68	8061	26199	20081021	20081021	N	D-Poor	Presumed ı	Specific bo	10
107	12220	17289	19901211	19901211	N	C-Fair	Presumed ı	Circular fea	50
3	12381	6387	20170301	20170301	N	U-Unknowı	Presumed ı	Non-specif	30
21	12383	6117	19850702	19850702	N	A-Excellent	Presumed ı	Specific bo	20
14	12440	6715	20090530	20090530	N	B-Good	Presumed ı	Specific bo	20
1	12599	6156	1987XXXX	2004XXXX	N	U-Unknowı	Presumed ı	Circular fea	50

74	12720	26195	20050805	20061012	N	D-Poor	Presumed I	Non-specif	30
5	12782	6480	1981XXXX	1981XXXX	N	U-Unknow	Presumed I	Non-specif	30
13	12783	6000	1983XXXX	1983XXXX	N	U-Unknow	Presumed I	Non-specif	30
44	13010	16018	19770726	20100629	N	C-Fair	Presumed I	Non-specif	30
2	13038	6364	19750513	198904XX	N	U-Unknow	Presumed I	Circular fea	50
17	13041	6440	20080422	20080508	N	U-Unknow	Presumed I	Non-specif	30
9	13042	6599	20100527	20100527	N	U-Unknow	Presumed I	Circular fea	90
166	13073	6475	19770529	19770529	Y	U-Unknow	Presumed I	Circular fea	50
9	13138	6717	197303XX	1981XXXX	N	U-Unknow	Presumed I	Circular fea	90
86	13176	76169	20050717	20060619	N	D-Poor	Presumed I	Non-specif	30
23	13341	6637	19870504	19870504	N	B-Good	Presumed I	Specific bo	20
75	13476	26196	20060713	20081018	N	D-Poor	Presumed I	Non-specif	30
7	13564	6606	19830815	19870112	N	X-None	Extirpated	Circular fea	50
2	13787	17008	20090318	20090318	N	B-Good	Presumed I	Non-specif	30
1	13788	6058	20131018	20131018	N	D-Poor	Presumed I	Specific bo	20
32	14018	6562	20020609	20020609	N	A-Excellent	Presumed I	Circular fea	40
33	14019	23027	20130428	20130428	N	U-Unknow	Presumed I	Circular fea	60
34	14020	6544	19790427	19800620	N	U-Unknow	Presumed I	Non-specif	30
2	14141	6054	19220401	19220401	N	U-Unknow	Presumed I	Circular fea	90
1	14143	28131	19700412	19700412	N	U-Unknow	Presumed I	Circular fea	90
4	14144	6628	19850415	20101226	N	X-None	Possibly Ex	Specific bo	20
2	14242	85577	20110611	20110611	N	U-Unknow	Presumed I	Non-specif	30
1	14243	28322	19830715	19830715	N	U-Unknow	Presumed I	Specific bo	20
36	14248	6054	19090327	19090327	N	U-Unknow	Presumed I	Circular fea	90
30	14283	6169	19850701	19850701	N	U-Unknow	Presumed I	Non-specif	30
28	14284	6165	19850701	19850701	N	U-Unknow	Presumed I	Specific bo	20
22	14285	6129	19850702	19850702	N	U-Unknow	Presumed I	Specific bo	20
27	14286	6172	19850701	19850701	N	U-Unknow	Presumed I	Non-specif	30
16	14289	6036	1983XXXX	1983XXXX	N	U-Unknow	Presumed I	Specific bo	20
46	14487	6497	1986XXXX	1986XXXX	N	U-Unknow	Presumed I	Specific bo	20
38	14492	6591	1986XXXX	1986XXXX	N	U-Unknow	Presumed I	Specific bo	20
37	14493	6351	1986XXXX	1986XXXX	N	U-Unknow	Presumed I	Specific bo	20
5	14520	6007	1986XXXX	1986XXXX	N	U-Unknow	Presumed I	Specific bo	20
1	14522	5874	2016XXXX	2016XXXX	N	B-Good	Presumed I	Specific bo	20
8	14634	6637	19830715	19860602	N	U-Unknow	Presumed I	Specific bo	20
39	14635	6637	19870405	19870405	N	C-Fair	Presumed I	Specific bo	20
6	14640	6682	19860623	198608XX	N	U-Unknow	Presumed I	Specific bo	20
52	14667	6682	19860603	198608XX	N	U-Unknow	Presumed I	Specific bo	20
1	14684	6637	19770727	19860622	N	U-Unknow	Presumed I	Specific bo	20
17	14685	6682	19860603	198608XX	N	U-Unknow	Presumed I	Specific bo	20
2	14691	6637	19860622	19860622	N	U-Unknow	Presumed I	Specific bo	20
23	14698	53056	20030712	20030712	N	U-Unknow	Presumed I	Non-specif	30
3	14703	6637	2009XXXX	2009XXXX	N	A-Excellent	Presumed I	Specific bo	20
127	14707	6682	19860623	198608XX	N	U-Unknow	Presumed I	Specific bo	20
51	14712	85618	20120720	20130707	N	C-Fair	Presumed I	Specific bo	20
33	14734	6268	20070315	20070522	N	B-Good	Presumed I	Non-specif	30
31	14736	77093	20090603	20090603	N	C-Fair	Presumed I	Non-specif	30

20	14738	6638	2005XXXX	2005XXXX	N	U-Unknow	Presumed	Non-specif	30
16	14739	6716	20090602	20090602	N	C-Fair	Presumed	Non-specif	30
15	14740	6626	2005XXXX	2005XXXX	N	U-Unknow	Presumed	Non-specif	30
7	14741	28321	20080527	20080527	N	U-Unknow	Presumed	Non-specif	30
10	14742	6578	2005XXXX	2005XXXX	N	U-Unknow	Presumed	Specific bo	20
59	14777	6137	20000710	20000710	N	U-Unknow	Presumed	Non-specif	30
61	14778	6122	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
28	14779	6438	20140520	20140520	N	U-Unknow	Presumed	Non-specif	30
1	14781	6154	20130620	20130620	N	B-Good	Presumed	Non-specif	30
4	14803	6371	1987XXXX	1987XXXX	N	B-Good	Presumed	Specific bo	20
2	14829	6065	19940518	19940518	N	B-Good	Presumed	Specific bo	20
4	14841	6586	1977XXXX	1977XXXX	N	U-Unknow	Presumed	Specific bo	20
2	15221	5966	1983XXXX	1983XXXX	N	U-Unknow	Presumed	Specific bo	20
22	15223	6010	1983XXXX	1983XXXX	N	U-Unknow	Presumed	Specific bo	20
6	15569	5917	19851228	19851228	N	U-Unknow	Presumed	Specific bo	20
17	15576	6682	19870111	19870111	N	C-Fair	Presumed	Specific bo	20
13	15579	6697	198501XX	198501XX	N	U-Unknow	Presumed	Specific bo	20
6	15583	6710	19830714	19830714	N	D-Poor	Presumed	Specific bo	20
5	15585	6601	1983XXXX	19870110	N	X-None	Extirpated	Specific bo	20
2	15586	6625	19870111	19870111	N	C-Fair	Presumed	Specific bo	20
9	16087	6061	19800412	19800412	N	U-Unknow	Presumed	Specific bo	20
50	16471	6595	19410303	19410303	N	U-Unknow	Presumed	Non-specif	30
53	16472	46724	19310315	19310315	N	U-Unknow	Presumed	Non-specif	30
54	16476	6410	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Non-specif	30
11	16506	26102	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	90
24	16541	5994	19400127	19400127	N	U-Unknow	Presumed	Non-specif	30
15	16543	6001	1978XXXX	1978XXXX	N	U-Unknow	Presumed	Circular fea	50
16	16546	5978	1978XXXX	1978XXXX	N	U-Unknow	Presumed	Circular fea	40
1	17711	28142	20080320	20080320	N	U-Unknow	Presumed	Non-specif	30
7	17831	28137	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	50
15	18572	6125	19560603	19560603	N	U-Unknow	Presumed	Circular fea	90
1	18573	6428	19820425	19820425	N	U-Unknow	Presumed	Specific bo	20
16	18574	6086	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Non-specif	30
11	18586	5991	19860324	19860324	N	C-Fair	Presumed	Circular fea	50
21	18838	66500	19980613	19980613	N	B-Good	Presumed	Circular fea	70
44	19068	6006	19850422	19850422	N	U-Unknow	Presumed	Circular fea	40
43	19069	5980	20010316	20010316	N	U-Unknow	Presumed	Circular fea	40
20	19226	30609	19960630	19960630	N	A-Excellent	Presumed	Specific bo	10
70	20585	26198	20080413	20090417	N	D-Poor	Presumed	Non-specif	30
71	20586	26192	20060713	20060713	N	U-Unknow	Presumed	Non-specif	30
73	20588	26194	20080712	20090416	N	D-Poor	Presumed	Non-specif	30
72	20590	26193	19910614	19910614	N	U-Unknow	Presumed	Non-specif	30
69	20593	26197	19910515	19910515	N	U-Unknow	Presumed	Non-specif	30
39	20595	30145	20090426	20090426	N	D-Poor	Presumed	Circular fea	50
49	20596	30171	20080112	20081017	N	D-Poor	Presumed	Specific bo	20
1	20674	35229	19220408	19220408	N	U-Unknow	Presumed	Circular fea	90
7	20837	6404	19890927	19890927	N	U-Unknow	Presumed	Circular fea	50

8	20838	6430	198XXXXX	198XXXXX	N		U-Unknow	Presumed	Non-specif	30
3	20839	6377	198XXXXX	198XXXXX	N		U-Unknow	Presumed	Circular fea	60
5	20840	82529	198XXXXX	198XXXXX	N		U-Unknow	Presumed	Non-specif	30
1	20841	6469	198003XX	198003XX	N		U-Unknow	Presumed	Non-specif	30
5	21458	78123	19370219	19370219	N		U-Unknow	Presumed	Circular fea	90
6	21459	78124	1980XXXX	1980XXXX	N		U-Unknow	Presumed	Non-specif	30
3	21461	20105	193XXXXX	193XXXXX	N		U-Unknow	Presumed	Non-specif	30
2	21464	20105	193XXXXX	193XXXXX	N		U-Unknow	Presumed	Non-specif	30
34	21534	6133	19850701	19850701	N		U-Unknow	Presumed	Circular fea	50
31	21537	6167	19850701	19850701	N		U-Unknow	Presumed	Specific bo	20
29	21538	6188	19850701	19850701	N		U-Unknow	Presumed	Circular fea	50
26	21539	6077	XXXXXXXX	XXXXXXXX	N		U-Unknow	Presumed	Circular fea	50
25	21540	6134	XXXXXXXX	XXXXXXXX	N		U-Unknow	Presumed	Circular fea	50
24	21541	6115	XXXXXXXX	XXXXXXXX	N		U-Unknow	Presumed	Circular fea	50
23	21542	6092	XXXXXXXX	XXXXXXXX	N		U-Unknow	Presumed	Circular fea	40
19	21544	6104	19850702	19850702	N		U-Unknow	Presumed	Specific bo	20
15	21547	6014	1983XXXX	1983XXXX	N		U-Unknow	Presumed	Specific bo	20
9	21550	6082	19570324	19570324	N		U-Unknow	Presumed	Non-specif	30
5	21553	5989	19650127	19650127	N		U-Unknow	Presumed	Non-specif	30
7	21554	6156	19660305	19660305	N		U-Unknow	Presumed	Circular fea	50
4	21555	6075	19670324	19670324	N		U-Unknow	Presumed	Circular fea	50
2	21556	6119	19631129	19631129	N		U-Unknow	Presumed	Circular fea	50
1	21558	6097	19670324	19670324	N		U-Unknow	Presumed	Circular fea	40
1	21970	22124	199206XX	199206XX	N		C-Fair	Presumed	Circular fea	50
2	22120	22125	199408XX	199408XX	N		C-Fair	Presumed	Circular fea	50
39	22417	6564	19470726	19470726	N		U-Unknow	Presumed	Circular fea	60
1	22627	27990	XXXXXXXX	XXXXXXXX	N		U-Unknow	Presumed	Circular fea	90
27	22685	6502	197904XX	197904XX	N		U-Unknow	Presumed	Circular fea	50
26	22686	6496	19790410	19790410	N		U-Unknow	Presumed	Circular fea	50
25	22687	6490	19790414	19790414	N		U-Unknow	Presumed	Circular fea	50
24	22688	6488	19790414	19790414	N		U-Unknow	Presumed	Circular fea	50
23	22689	6476	19790413	19790413	N		U-Unknow	Presumed	Circular fea	50
22	22690	6494	19790414	19790414	N		U-Unknow	Presumed	Circular fea	50
21	22691	6427	19790418	19790418	N		U-Unknow	Presumed	Circular fea	50
20	22692	6495	19790410	19790410	N		U-Unknow	Presumed	Circular fea	50
19	22693	6486	19790414	19790414	N		U-Unknow	Presumed	Circular fea	50
18	22694	6484	19790414	19790414	N		U-Unknow	Presumed	Circular fea	50
17	22695	6479	19790414	19790414	N		U-Unknow	Presumed	Circular fea	50
16	22696	17492	19790412	19790412	N		U-Unknow	Presumed	Circular fea	50
15	22697	6540	19790412	19790412	N		U-Unknow	Presumed	Circular fea	50
14	22698	6397	19790418	19790418	N		U-Unknow	Presumed	Circular fea	50
13	22699	6530	19790412	19790412	N		U-Unknow	Presumed	Circular fea	50
12	22700	6510	19790412	19790412	N		U-Unknow	Presumed	Circular fea	50
11	22701	6520	19790412	19790412	N		U-Unknow	Presumed	Circular fea	50
10	22702	6504	19790410	19790410	N		U-Unknow	Presumed	Circular fea	50
9	22703	6511	19790420	19790420	N		U-Unknow	Presumed	Circular fea	50
8	22704	6402	19790418	19790418	N		U-Unknow	Presumed	Circular fea	50

7	22705	6431	19790419	19790419	N	U-Unknow	Presumed I	Circular fea		50
6	22706	6409	19790419	19790419	N	U-Unknow	Presumed I	Circular fea		50
5	22707	6478	19790413	19790413	N	U-Unknow	Presumed I	Circular fea		50
4	22708	6489	19790410	19790410	N	U-Unknow	Presumed I	Circular fea		50
3	22709	6483	19790413	19790413	N	U-Unknow	Presumed I	Circular fea		50
2	22710	6491	19790410	19790410	N	U-Unknow	Presumed I	Circular fea		50
1	22711	6481	19790413	19790413	N	U-Unknow	Presumed I	Circular fea		50
15	22751	6409	19790419	19790419	N	U-Unknow	Presumed I	Circular fea		50
16	22752	6511	19790420	19790420	N	U-Unknow	Presumed I	Circular fea		50
14	22753	6431	19790419	19790419	N	U-Unknow	Presumed I	Circular fea		50
13	22754	6434	19790418	19790418	N	U-Unknow	Presumed I	Circular fea		50
12	22755	6427	19790418	19790418	N	U-Unknow	Presumed I	Circular fea		50
11	22756	6397	19790418	19790418	N	U-Unknow	Presumed I	Circular fea		50
10	22757	6473	19790417	19790417	N	U-Unknow	Presumed I	Circular fea		50
9	22758	6452	19790415	19790415	N	U-Unknow	Presumed I	Circular fea		50
8	22759	6489	19790610	19790610	N	U-Unknow	Presumed I	Circular fea		50
7	22760	6491	19790410	19790410	N	U-Unknow	Presumed I	Circular fea		50
6	22761	6510	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
5	22762	6540	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
4	22763	6530	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
3	22764	6520	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
2	22765	6502	197904XX	197904XX	N	U-Unknow	Presumed I	Circular fea		50
1	22766	6483	19790413	19790413	N	U-Unknow	Presumed I	Circular fea		50
17	22767	6439	19790419	19790419	N	U-Unknow	Presumed I	Circular fea		50
16	22768	6409	19790419	19790419	N	U-Unknow	Presumed I	Circular fea		50
15	22769	6431	19790419	19790419	N	U-Unknow	Presumed I	Circular fea		50
14	22770	6434	19790418	19790418	N	U-Unknow	Presumed I	Circular fea		50
13	22771	6427	19790418	19790418	N	U-Unknow	Presumed I	Circular fea		50
12	22772	6397	19790418	19790418	N	U-Unknow	Presumed I	Circular fea		50
11	22773	6460	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
10	22774	6513	19790416	19790416	N	U-Unknow	Presumed I	Circular fea		90
9	22775	6473	19790417	19790417	N	U-Unknow	Presumed I	Circular fea		50
8	22776	6452	19790415	19790415	N	U-Unknow	Presumed I	Circular fea		50
7	22777	6489	19790410	19790410	N	U-Unknow	Presumed I	Circular fea		50
6	22778	6491	19790410	19790410	N	U-Unknow	Presumed I	Circular fea		50
5	22779	6510	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
4	22780	6530	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
3	22781	6520	19790412	19790412	N	U-Unknow	Presumed I	Circular fea		50
2	22782	6502	197904XX	197904XX	N	U-Unknow	Presumed I	Circular fea		50
1	22783	6483	19790413	19790413	N	U-Unknow	Presumed I	Circular fea		50
42	22827	30146	19910614	19910614	N	U-Unknow	Presumed I	Non-specif		30
23	23791	6696	19100421	19100421	N	U-Unknow	Presumed I	Circular fea		90
6	23803	6596	19100512	19100512	N	U-Unknow	Presumed I	Circular fea		90
22	23804	6231	19090508	19090508	N	U-Unknow	Presumed I	Circular fea		90
7	23807	6072	19800207	19800207	N	U-Unknow	Presumed I	Circular fea		50
1	23809	6691	19401227	19401227	N	U-Unknow	Presumed I	Non-specif		30
9	23810	5970	19581106	19581106	N	U-Unknow	Presumed I	Circular fea		50

3	23815	59733	19100503	19100503	N	U-Unknow	Presumed I	Non-specif	30
6	24258	6424	19890926	19890926	N	U-Unknow	Presumed I	Non-specif	30
23	24321	6571	191911XX	191911XX	N	U-Unknow	Presumed I	Circular fea	90
5	24335	6622	19430301	19430301	N	U-Unknow	Presumed I	Circular fea	50
1	24337	6676	19210506	19210506	N	U-Unknow	Presumed I	Non-specif	30
2	24338	6712	19180514	1991XXXX	N	U-Unknow	Presumed I	Circular fea	50
20	24385	6613	19860621	19860621	N	U-Unknow	Presumed I	Circular fea	50
7	24390	6701	19160519	19160519	N	U-Unknow	Presumed I	Circular fea	90
47	24395	6541	19770607	19770607	N	U-Unknow	Presumed I	Circular fea	90
44	24398	6555	19770607	19770607	N	U-Unknow	Presumed I	Circular fea	50
42	24401	16014	19870421	19870421	N	C-Fair	Presumed I	Circular fea	90
38	24403	6587	19860621	19860621	N	U-Unknow	Presumed I	Non-specif	30
40	24404	16017	19860623	19860623	N	U-Unknow	Presumed I	Circular fea	90
18	24406	6299	19101225	19101225	N	U-Unknow	Presumed I	Circular fea	90
21	24410	6273	19691004	19691004	N	U-Unknow	Presumed I	Circular fea	90
19	24411	6701	19160401	19160401	N	U-Unknow	Presumed I	Circular fea	90
8	24413	6191	19521128	19521128	N	U-Unknow	Presumed I	Circular fea	90
9	24417	6647	19711209	19711209	N	U-Unknow	Presumed I	Circular fea	90
10	24421	28885	19250101	19250101	N	U-Unknow	Presumed I	Circular fea	90
7	24422	6262	19481023	19481023	N	U-Unknow	Presumed I	Circular fea	90
88	24493	6541	19770607	19770607	N	U-Unknow	Presumed I	Circular fea	90
85	24498	6555	19770607	19770607	N	U-Unknow	Presumed I	Circular fea	50
81	24501	6470	19750405	19750405	N	U-Unknow	Presumed I	Circular fea	90
75	24504	6095	19330514	19330514	N	U-Unknow	Presumed I	Circular fea	90
33	24524	6163	19520914	19520914	N	U-Unknow	Presumed I	Circular fea	90
37	24525	6076	19090331	19090331	N	U-Unknow	Presumed I	Circular fea	90
34	24531	6063	19331127	19331127	N	U-Unknow	Presumed I	Circular fea	90
35	24533	6550	18960316	18960316	N	U-Unknow	Presumed I	Circular fea	90
32	24534	6074	19331208	19331208	N	U-Unknow	Presumed I	Circular fea	90
22	24546	5999	19340122	19340122	N	U-Unknow	Presumed I	Circular fea	90
9	24667	6256	19570209	19570209	N	U-Unknow	Presumed I	Circular fea	50
3	24802	6701	19160510	19160510	N	U-Unknow	Presumed I	Circular fea	90
68	24859	6607	19870505	19870505	N	B-Good	Presumed I	Circular fea	50
61	24865	6600	19870505	19870505	N	B-Good	Presumed I	Circular fea	90
60	24866	6624	19870503	19870503	N	B-Good	Presumed I	Circular fea	50
59	24868	6593	19870505	19870505	N	B-Good	Presumed I	Circular fea	90
51	24873	16017	19860623	19860623	N	U-Unknow	Presumed I	Circular fea	90
50	24875	6587	19860621	19860621	N	U-Unknow	Presumed I	Non-specif	30
49	24877	6592	19860604	198608XX	N	U-Unknow	Presumed I	Circular fea	50
19	24887	6177	19600508	19600508	N	U-Unknow	Presumed I	Circular fea	60
18	24891	6258	19610507	19610507	N	U-Unknow	Presumed I	Circular fea	90
14	24898	6701	19300429	19300429	N	U-Unknow	Presumed I	Circular fea	90
32	24911	6328	19210508	19210508	N	U-Unknow	Presumed I	Circular fea	90
28	24915	6282	19521004	19521004	N	U-Unknow	Presumed I	Circular fea	90
12	24922	6583	19100402	19100402	N	U-Unknow	Presumed I	Circular fea	90
3	24924	6709	20110706	20110706	N	U-Unknow	Presumed I	Circular fea	50
6	24925	59733	19100430	19100430	N	U-Unknow	Presumed I	Non-specif	30

5	24928	6701	19100427	19100427	N	U-Unknow	Presumed	Circular fea	90
31	25005	6541	19770607	19770607	N	U-Unknow	Presumed	Circular fea	90
28	25007	6555	19770607	19770607	N	U-Unknow	Presumed	Circular fea	50
7	25014	6273	19681014	19681014	N	U-Unknow	Presumed	Circular fea	90
8	25015	6301	19220402	19220402	N	U-Unknow	Presumed	Circular fea	90
4	25018	6568	19711206	19711206	N	U-Unknow	Presumed	Circular fea	90
12	25021	6701	19160407	19160407	N	U-Unknow	Presumed	Circular fea	90
6	25022	6262	19480314	19480314	N	U-Unknow	Presumed	Circular fea	90
3	25024	6571	19360322	19360322	N	U-Unknow	Presumed	Circular fea	90
20	25260	16017	19860623	19860623	N	U-Unknow	Presumed	Circular fea	90
19	25261	6587	19860621	19860621	N	U-Unknow	Presumed	Non-specif	30
16	25262	6592	19830715	198308XX	N	U-Unknow	Presumed	Circular fea	50
28	25269	6717	19640605	19640605	N	U-Unknow	Presumed	Circular fea	90
1	25278	6701	19160425	19160425	N	U-Unknow	Presumed	Circular fea	90
13	25279	6583	19100402	19100402	N	U-Unknow	Presumed	Circular fea	90
12	25285	59733	19100502	19100502	N	U-Unknow	Presumed	Non-specif	30
3	25376	6701	19301231	19301231	N	U-Unknow	Presumed	Circular fea	90
26	25401	6590	19870410	19870410	N	C-Fair	Presumed	Circular fea	50
24	25403	6644	19870418	19870418	N	B-Good	Presumed	Circular fea	50
22	25404	85627	20110621	20110621	N	U-Unknow	Presumed	Non-specif	30
20	25405	6592	19860604	198608XX	N	U-Unknow	Presumed	Circular fea	50
21	25406	6587	19860621	19860621	N	C-Fair	Presumed	Non-specif	30
43	25467	6189	20060704	20060704	N	U-Unknow	Presumed	Specific bo	20
44	25468	6267	19830331	19830331	N	U-Unknow	Presumed	Circular fea	90
12	25492	16014	19870409	200905XX	N	C-Fair	Presumed	Circular fea	90
2	25539	6262	19560222	19560222	N	U-Unknow	Presumed	Circular fea	90
155	25556	6587	19860621	19860621	N	U-Unknow	Presumed	Non-specif	30
126	25576	6606	19830815	19830815	N	U-Unknow	Presumed	Circular fea	50
125	25577	77723	20090804	20100719	N	D-Poor	Presumed	Non-specif	30
103	25579	6602	19770728	20100622	N	U-Unknow	Presumed	Circular fea	80
50	25600	6616	19770728	19770728	N	U-Unknow	Presumed	Circular fea	50
49	25601	6608	19770804	19770804	N	U-Unknow	Presumed	Non-specif	30
47	25602	6620	19770805	20010801	N	U-Unknow	Presumed	Non-specif	30
48	25603	6604	19770805	19770805	N	U-Unknow	Presumed	Circular fea	50
46	25605	6700	19860623	20010801	N	U-Unknow	Presumed	Circular fea	60
43	25607	6618	XXXXXXXX	19770726	N	U-Unknow	Presumed	Circular fea	50
1	25776	6198	19750712	19750712	N	U-Unknow	Presumed	Circular fea	90
2	25778	6266	19730815	19730815	N	U-Unknow	Presumed	Specific bo	20
72	25791	6627	19720422	19720422	N	U-Unknow	Presumed	Circular fea	50
17	25811	6352	19750514	198904XX	N	U-Unknow	Presumed	Circular fea	50
15	25815	6353	19750514	198904XX	N	U-Unknow	Presumed	Non-specif	30
13	25818	6398	19750512	198904XX	N	U-Unknow	Presumed	Circular fea	60
7	25819	6379	19750513	198904XX	N	U-Unknow	Presumed	Circular fea	50
5	25822	6372	19750513	198904XX	N	U-Unknow	Presumed	Circular fea	50
3	25824	6370	198404XX	198404XX	N	U-Unknow	Presumed	Circular fea	60
1	25825	6390	19750515	198904XX	N	U-Unknow	Presumed	Non-specif	30
37	25892	6360	19870518	19870518	N	U-Unknow	Presumed	Circular fea	50

32	25895	6249	1978XXXX	1978XXXX	N	U-Unknow	Presumed	Circular fea	40
30	25897	6308	2000XXXX	2000XXXX	N	U-Unknow	Presumed	Non-specif	30
21	25902	83076	2005XXXX	2005XXXX	N	U-Unknow	Presumed	Non-specif	30
18	25904	6417	19820520	19820520	N	U-Unknow	Presumed	Circular fea	90
19	25905	6199	2000XXXX	2000XXXX	N	U-Unknow	Presumed	Circular fea	90
11	25906	6579	1985XXXX	1985XXXX	N	U-Unknow	Presumed	Non-specif	30
5	25944	6597	19870410	19870410	N	U-Unknow	Presumed	Circular fea	50
9	25972	6597	19870410	19870410	N	U-Unknow	Presumed	Circular fea	50
6	25974	6679	19870405	19870405	N	U-Unknow	Presumed	Circular fea	50
5	25976	6675	19870405	19870405	N	U-Unknow	Presumed	Circular fea	50
411	26015	5988	19760605	19760605	Y	U-Unknow	Presumed	Circular fea	60
408	26018	5983	19760622	19760622	Y	U-Unknow	Presumed	Circular fea	90
167	26242	83856	197403XX	197403XX	Y	U-Unknow	Presumed	Circular fea	60
164	26245	6614	19770531	19770531	Y	U-Unknow	Presumed	Circular fea	50
44	26445	72661	1980XXXX	1980XXXX	Y	U-Unknow	Presumed	Circular fea	70
85	26532	76190	20120703	20120703	N	B-Good	Presumed	Non-specif	30
8	27350	6701	19100429	19100429	N	U-Unknow	Presumed	Circular fea	90
6	27358	6670	19100503	19100503	N	U-Unknow	Presumed	Circular fea	90
63	27915	6121	20000710	20000710	N	U-Unknow	Presumed	Non-specif	30
62	27917	6090	19790517	19840626	N	U-Unknow	Presumed	Non-specif	30
57	27918	6471	19690506	19690506	N	U-Unknow	Presumed	Circular fea	90
52	27919	5995	20080507	20080507	N	B-Good	Presumed	Specific bo	10
60	27920	6450	19790703	19790703	N	U-Unknow	Presumed	Circular fea	90
58	27921	6296	19710514	19710514	N	X-None	Possibly Ex	Circular fea	50
48	27924	6374	19280722	19280722	N	X-None	Possibly Ex	Circular fea	90
56	27925	6072	19380420	19380420	N	U-Unknow	Presumed	Circular fea	50
41	27926	6064	20120326	20120326	N	U-Unknow	Presumed	Non-specif	30
51	27927	6241	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	90
43	27928	6251	19331130	19331130	N	X-None	Possibly Ex	Circular fea	90
31	27929	6507	19790503	19790503	N	U-Unknow	Presumed	Circular fea	90
49	27930	6432	20070524	20070524	N	U-Unknow	Presumed	Non-specif	30
37	27932	6045	197806XX	197806XX	N	U-Unknow	Presumed	Specific bo	20
36	27933	6405	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
23	27934	6139	19950828	19950828	N	C-Fair	Presumed	Circular fea	60
21	27936	6080	20141001	20141001	N	B-Good	Presumed	Specific bo	20
19	27937	6085	19790522	19790522	N	U-Unknow	Presumed	Circular fea	60
22	27941	6046	20060802	20060802	N	B-Good	Presumed	Specific bo	20
20	27942	6048	20020723	20020723	N	B-Good	Presumed	Specific bo	10
27	27945	6493	19790502	19790502	N	U-Unknow	Presumed	Circular fea	90
5	27948	6068	19790519	19790519	N	U-Unknow	Presumed	Non-specif	30
8	27951	6057	19790508	19790508	N	U-Unknow	Presumed	Non-specif	30
9	27954	6022	19790607	19790607	N	U-Unknow	Presumed	Circular fea	90
6	28151	5996	20010605	20010605	Y	U-Unknow	Presumed	Circular fea	60
1	28152	6017	19760106	19760106	Y	U-Unknow	Presumed	Circular fea	70
3	28156	72537	19761009	19761009	Y	U-Unknow	Presumed	Circular fea	60
5	28157	6030	19870605	19870605	Y	U-Unknow	Presumed	Circular fea	90
2	28160	6028	19760102	19760102	Y	U-Unknow	Presumed	Circular fea	70

38	28484	28322	19870502	19870502	N	B-Good	Presumed	Specific bo	20
14	28485	28322	19830601	19830601	N	U-Unknow	Presumed	Specific bo	20
19	28606	6570	1975XXXX	1975XXXX	N	X-None	Extirpated	Circular fea	50
11	28612	6598	19750612	1981XXXX	N	U-Unknow	Presumed	Circular fea	50
16	28613	6317	1974XXXX	1974XXXX	N	U-Unknow	Presumed	Circular fea	90
1	28614	88450	200407XX	200407XX	N	U-Unknow	Presumed	Specific bo	20
1	28647	6705	1910XXXX	1910XXXX	N	U-Unknow	Presumed	Circular fea	50
24	28864	5987	197709XX	197709XX	N	U-Unknow	Presumed	Circular fea	90
25	28865	5992	194607XX	194607XX	N	U-Unknow	Presumed	Circular fea	90
26	28866	6008	194607XX	194607XX	N	U-Unknow	Presumed	Circular fea	90
23	28867	5997	197709XX	197709XX	N	U-Unknow	Presumed	Circular fea	50
18	28870	5973	197709XX	19801111	N	U-Unknow	Presumed	Circular fea	90
18	28889	6612	19870111	19870111	N	C-Fair	Presumed	Circular fea	50
16	28890	6618	19870112	19870112	N	C-Fair	Presumed	Circular fea	50
3	28894	6639	19870111	19870111	N	D-Poor	Presumed	Circular fea	50
4	28895	6693	1983XXXX	198511XX	N	X-None	Extirpated	Circular fea	50
1	28896	6698	198511XX	198511XX	N	U-Unknow	Presumed	Circular fea	50
1	29377	85699	19500324	19500324	N	U-Unknow	Presumed	Circular fea	90
5	29449	85546	201107XX	201107XX	N	C-Fair	Presumed	Non-specif	30
10	29450	28321	19770804	19770804	N	U-Unknow	Presumed	Non-specif	30
4	29451	28321	19770804	19770804	N	U-Unknow	Presumed	Non-specif	30
2	29452	28321	19770804	19770804	N	U-Unknow	Presumed	Non-specif	30
25	29453	28321	19770804	19770804	N	U-Unknow	Presumed	Non-specif	30
11	29454	28322	19770726	19770726	N	U-Unknow	Presumed	Specific bo	20
1	31273	36276	1990XXXX	1990XXXX	N	U-Unknow	Presumed	Non-specif	30
3	31275	36278	19580320	20130310	N	U-Unknow	Presumed	Non-specif	30
5	31279	36282	19870110	19870110	N	U-Unknow	Presumed	Non-specif	30
2	31280	36283	19790429	19790429	N	U-Unknow	Presumed	Non-specif	30
6	31281	36284	19320405	19320405	N	U-Unknow	Presumed	Circular fea	70
4	31282	36285	19640412	19640412	N	U-Unknow	Presumed	Non-specif	30
7	31283	36286	19761110	19761110	N	U-Unknow	Presumed	Circular fea	90
9	31284	36287	20120330	20120330	N	C-Fair	Presumed	Specific bo	20
10	31285	36288	19620318	19620318	N	U-Unknow	Presumed	Circular fea	90
8	31288	36291	19870414	19870414	N	U-Unknow	Presumed	Non-specif	30
1	31381	36384	20130309	20130309	N	D-Poor	Presumed	Specific bo	20
2	31382	36385	19840614	19840614	N	U-Unknow	Presumed	Circular fea	90
3	31383	84075	20110427	20110427	N	B-Good	Presumed	Specific bo	10
4	31384	36387	19840614	19840614	N	U-Unknow	Presumed	Circular fea	90
5	31385	36388	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	90
4	31729	6034	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	90
5	31730	6029	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	90
6	31731	36734	19780510	20110213	N	U-Unknow	Presumed	Circular fea	70
3	31732	36735	19560129	20090316	N	U-Unknow	Presumed	Circular fea	90
7	31814	A8232	20150506	20150506	N	C-Fair	Presumed	Specific bo	10
1	31899	35229	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	90
1	31999	81359	19620419	19620419	N	U-Unknow	Presumed	Circular fea	60
3	32001	81354	20030511	20030511	N	U-Unknow	Presumed	Non-specif	30

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1	32018	78478	19860309	19860309	N	U-Unknow	Presumed I	Non-specif	30
1	32022	37025	19610304	19610304	N	U-Unknow	Presumed I	Circular fea	90
2	32023	35229	19270416	19270416	N	U-Unknow	Presumed I	Circular fea	90
2	32034	37037	19920308	19920308	N	U-Unknow	Presumed I	Circular fea	100
3	32035	6029	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Circular fea	90
5	32037	78478	19860309	19860309	N	U-Unknow	Presumed I	Non-specif	30
7	32039	37042	19260410	19260410	N	U-Unknow	Presumed I	Circular fea	100
76	32918	37911	19860619	19860619	N	U-Unknow	Presumed I	Specific bo	20
20	34095	39088	19870408	19870825	N	B-Good	Presumed I	Specific bo	10
22	34099	39092	19870409	19870826	N	B-Good	Presumed I	Non-specif	30
23	34102	39095	19870406	19870416	N	B-Good	Presumed I	Non-specif	30
65	34612	39610	20020806	20020806	N	B-Good	Presumed I	Circular fea	40
73	34660	6054	19150814	19150814	N	U-Unknow	Presumed I	Circular fea	90
76	34667	6059	20150331	20150331	N	U-Unknow	Presumed I	Specific bo	10
77	34673	39671	19660521	19660521	N	U-Unknow	Presumed I	Non-specif	30
78	34685	39683	19840517	19840517	N	U-Unknow	Presumed I	Non-specif	30
79	34692	39690	19840517	19840517	N	U-Unknow	Presumed I	Non-specif	30
4	35257	40255	199808XX	199808XX	N	C-Fair	Presumed I	Circular fea	50
3	35258	40255	199808XX	199808XX	N	C-Fair	Presumed I	Circular fea	50
6	35259	40255	199808XX	199808XX	N	C-Fair	Presumed I	Circular fea	50
26	40808	26333	199901XX	199901XX	N	B-Good	Presumed I	Circular fea	60
27	40809	26334	199901XX	199901XX	N	B-Good	Presumed I	Circular fea	60
4	40812	30609	199307XX	19930704	N	A-Excellent	Presumed I	Specific bo	10
2	41031	6571	19100403	19100403	N	U-Unknow	Presumed I	Circular fea	90
2	42999	42999	19890813	19890813	N	U-Unknow	Presumed I	Circular fea	40
1	43419	43419	19160513	19160513	N	X-None	Possibly Ex	Circular fea	90
2	43446	6374	19120601	19120601	N	X-None	Possibly Ex	Circular fea	90
3	43447	43447	19120618	19120618	N	X-None	Possibly Ex	Circular fea	90
5	43449	43449	19500722	19500722	N	X-None	Possibly Ex	Circular fea	90
6	43450	43450	19100411	19100411	N	U-Unknow	Presumed I	Non-specif	30
1	45033	6328	19121019	19121019	N	U-Unknow	Presumed I	Circular fea	90
29	45395	36087	20090310	20090310	N	U-Unknow	Presumed I	Specific bo	10
1	45963	6328	19030725	19030725	N	U-Unknow	Presumed I	Circular fea	90
3	45965	45965	190406XX	190406XX	N	U-Unknow	Presumed I	Circular fea	70
4	45966	6299	19121016	19121016	N	X-None	Possibly Ex	Circular fea	90
6	45968	80483	19121019	19121019	N	U-Unknow	Presumed I	Circular fea	90
2	46437	46437	20180422	20180422	N	B-Good	Presumed I	Specific bo	20
12	46458	6550	190205XX	190205XX	N	U-Unknow	Presumed I	Circular fea	90
26	46503	43447	1915XXXX	1915XXXX	N	U-Unknow	Presumed I	Circular fea	90
27	46513	46513	19810427	19810427	N	U-Unknow	Presumed I	Non-specif	30
46	46673	46673	19800624	19800624	N	U-Unknow	Presumed I	Non-specif	30
50	46714	46714	1986XXXX	1986XXXX	N	U-Unknow	Presumed I	Non-specif	30
53	46724	46724	19540411	19540411	N	U-Unknow	Presumed I	Non-specif	30
5	46958	35229	191704XX	191704XX	N	U-Unknow	Presumed I	Circular fea	90
81	47082	47082	20010629	20010629	N	C-Fair	Presumed I	Circular fea	40
82	47471	47471	20020611	20020611	N	A-Excellent	Presumed I	Circular fea	50
78	47478	47478	20090416	20090416	N	D-Poor	Presumed I	Non-specif	30

83	47785	47785	20140925	20140925	N	B-Good	Presumed	Specific bo	20
84	47786	47786	20030410	20030410	N	B-Good	Presumed	Specific bo	20
17	48050	48050	1997XXXX	1997XXXX	N	U-Unknow	Presumed	Non-specif	30
12	48233	48233	200205XX	200205XX	N	U-Unknow	Presumed	Specific bo	20
85	48639	48639	20020728	20020728	N	A-Excellent	Presumed	Non-specif	30
86	48648	48648	20020714	20020714	N	D-Poor	Presumed	Specific bo	10
476	49011	49011	20020612	20020612	N	C-Fair	Presumed	Specific bo	10
21	49015	6196	1980XXXX	1980XXXX	N	U-Unknow	Presumed	Specific bo	20
523	49108	49108	1994XXXX	1994XXXX	N	U-Unknow	Presumed	Non-specif	30
526	49116	49116	19910401	19910401	N	A-Excellent	Presumed	Circular fea	60
532	49153	49153	19910328	19910328	N	B-Good	Presumed	Circular fea	40
533	49169	49169	19910401	19910401	N	A-Excellent	Presumed	Circular fea	50
534	49174	49174	19910401	19910401	N	A-Excellent	Presumed	Circular fea	50
535	49175	49175	19910419	19910419	N	A-Excellent	Presumed	Circular fea	40
87	49915	49915	20020608	20020608	N	A-Excellent	Presumed	Non-specif	30
88	49919	49919	20020610	20020610	N	A-Excellent	Presumed	Non-specif	30
89	49935	49935	20020529	20020529	N	A-Excellent	Presumed	Circular fea	40
38	50339	50339	1987XXXX	1987XXXX	N	U-Unknow	Presumed	Circular fea	60
568	51255	51255	19090405	19090405	N	U-Unknow	Presumed	Circular fea	50
576	51268	51268	19340530	19340530	N	U-Unknow	Presumed	Circular fea	90
578	51270	51270	19340418	19340418	N	U-Unknow	Presumed	Circular fea	90
583	51277	51277	19910419	19910419	N	A-Excellent	Presumed	Circular fea	40
595	51578	51578	20030602	20030602	N	A-Excellent	Presumed	Specific bo	20
596	51584	51584	20030602	20030602	N	A-Excellent	Presumed	Specific bo	10
597	51609	51609	20070627	20070627	N	A-Excellent	Presumed	Specific bo	20
598	51610	51610	20030603	20030603	N	A-Excellent	Presumed	Specific bo	10
599	51611	51611	20070627	20070627	N	A-Excellent	Presumed	Specific bo	20
600	51612	51612	20030603	20030603	N	A-Excellent	Presumed	Specific bo	20
601	51615	51615	20030603	20030603	N	A-Excellent	Presumed	Specific bo	20
602	51617	51617	20030603	20030603	N	A-Excellent	Presumed	Specific bo	10
180	52940	52940	20021214	20021214	N	U-Unknow	Presumed	Specific bo	10
1	52941	52941	20021208	20021208	N	U-Unknow	Presumed	Specific bo	10
2	52942	52942	20031022	20031022	N	U-Unknow	Presumed	Specific bo	10
3	52943	52943	20030124	20030124	N	U-Unknow	Presumed	Specific bo	10
7	52944	52944	20030122	20030122	N	U-Unknow	Presumed	Specific bo	10
8	52945	52945	20030122	20030122	N	U-Unknow	Presumed	Specific bo	10
21	54020	54020	20010121	20010121	N	B-Good	Presumed	Non-specif	30
4	54053	54053	1987XXXX	1987XXXX	N	U-Unknow	Presumed	Circular fea	90
36	54343	54343	20110102	20110102	N	U-Unknow	Presumed	Non-specif	30
241	54437	54437	20030530	20030530	N	C-Fair	Presumed	Non-specif	30
12	55248	6436	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Non-specif	30
14	55314	6388	19251222	19251222	N	U-Unknow	Presumed	Circular fea	90
16	55943	55927	20100620	20100620	N	C-Fair	Presumed	Specific bo	20
17	55944	55928	20030506	20030506	N	C-Fair	Presumed	Circular fea	60
18	55945	55929	19950516	19950516	N	C-Fair	Presumed	Circular fea	40
5	56582	56566	19340103	19340103	N	U-Unknow	Presumed	Circular fea	90
139	56817	56801	19110405	19110405	N	U-Unknow	Presumed	Circular fea	90

140	56820	6708	19310201	19310201	N	U-Unknow	Presumed I	Circular fea	90
141	56826	6273	19370510	19370510	N	U-Unknow	Presumed I	Circular fea	90
142	56827	56811	19400108	19400108	N	U-Unknow	Presumed I	Circular fea	100
206	56978	56962	19141216	19141216	N	U-Unknow	Presumed I	Circular fea	90
1	57060	84356	19360303	19360303	N	U-Unknow	Presumed I	Non-specif	30
253	57309	57293	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Circular fea	100
254	57310	57294	19150116	19150116	N	U-Unknow	Presumed I	Circular fea	100
258	57376	6328	19220814	19220814	N	U-Unknow	Presumed I	Circular fea	90
267	57420	57404	19690505	19690505	N	U-Unknow	Presumed I	Circular fea	90
276	57472	6674	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Circular fea	90
277	57473	57457	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Circular fea	90
278	57475	57459	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Circular fea	90
17	58315	58279	19700423	19700423	N	U-Unknow	Presumed I	Circular fea	50
18	58319	58279	19720916	19720916	N	U-Unknow	Presumed I	Circular fea	50
19	58320	58284	19720227	19720227	N	U-Unknow	Presumed I	Circular fea	50
20	58321	58285	19720409	19720409	N	U-Unknow	Presumed I	Circular fea	90
21	58322	58286	19730504	19730504	N	U-Unknow	Presumed I	Circular fea	50
22	58323	58287	19720310	19720310	N	U-Unknow	Presumed I	Circular fea	50
23	58324	58288	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Circular fea	90
6	58341	58305	19830501	19830501	N	U-Unknow	Presumed I	Specific bo	20
23	58512	36817	19740117	19740117	N	U-Unknow	Presumed I	Circular fea	90
1	58539	58503	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Circular fea	90
2	58540	58504	19870412	19870412	N	U-Unknow	Presumed I	Circular fea	50
5	58545	58509	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Non-specif	30
1	58840	6299	19990907	19990907	N	U-Unknow	Presumed I	Circular fea	90
2	58841	6328	19770812	19770812	N	U-Unknow	Presumed I	Circular fea	90
3	58844	58808	19990825	19990825	N	U-Unknow	Presumed I	Circular fea	90
4	58845	45965	19850617	19850617	N	U-Unknow	Presumed I	Circular fea	70
5	58848	58812	19770425	19770425	N	U-Unknow	Presumed I	Circular fea	90
6	58854	6374	19931018	19931018	N	U-Unknow	Presumed I	Circular fea	90
7	58855	58819	19920723	19920723	N	U-Unknow	Presumed I	Circular fea	90
8	58856	6262	19940725	19940725	N	U-Unknow	Presumed I	Circular fea	90
2	59191	57293	19091115	19091115	N	U-Unknow	Presumed I	Circular fea	100
2	59560	58808	19870331	19870331	N	U-Unknow	Presumed I	Circular fea	90
3	59769	59733	19100504	19100504	N	U-Unknow	Presumed I	Non-specif	30
12	60409	36817	20020102	20020102	N	U-Unknow	Presumed I	Circular fea	90
13	60410	35229	19381218	19381218	N	U-Unknow	Presumed I	Circular fea	90
36	60484	60448	19571027	19571027	N	U-Unknow	Presumed I	Circular fea	90
2	61682	16014	19100412	19100412	N	U-Unknow	Presumed I	Circular fea	90
2	61718	6262	19490406	19490406	N	U-Unknow	Presumed I	Circular fea	90
3	61721	58279	19720304	19720304	N	U-Unknow	Presumed I	Circular fea	50
10	61842	61806	20100424	20100424	N	U-Unknow	Presumed I	Non-specif	30
90	61988	61952	20060817	20060817	N	B-Good	Presumed I	Specific bo	20
91	61992	61956	20060821	20060821	N	B-Good	Presumed I	Specific bo	20
13	62054	62018	19910410	19910410	N	U-Unknow	Presumed I	Circular fea	90
14	62056	62020	20010326	20010326	N	C-Fair	Presumed I	Specific bo	10
15	62057	62021	20010326	20010326	N	B-Good	Presumed I	Specific bo	20

16	62059	62023	20130310	20130310	N	B-Good	Presumed	Specific bo	20
17	62060	62024	20010326	20010326	N	C-Fair	Presumed	Specific bo	10
18	62061	62025	20010326	20010326	N	C-Fair	Presumed	Specific bo	10
19	62064	62028	20010326	20010326	N	B-Good	Presumed	Specific bo	20
20	62066	62030	20010326	20010326	N	C-Fair	Presumed	Specific bo	10
21	62068	62032	20010326	20010326	N	A-Excellent	Presumed	Specific bo	20
22	62075	62039	20010326	20010326	N	B-Good	Presumed	Specific bo	20
23	62081	62045	19780411	19780411	N	U-Unknow	Presumed	Non-specif	30
24	62082	62046	20010326	20010326	N	C-Fair	Presumed	Specific bo	20
25	62084	62048	20010326	20010326	N	B-Good	Presumed	Specific bo	20
92	62089	62053	20020624	20020624	N	B-Good	Presumed	Specific bo	10
93	62091	62055	20020619	20020619	N	B-Good	Presumed	Specific bo	10
94	62093	62057	20020625	20020625	N	B-Good	Presumed	Specific bo	10
26	62099	62063	20010326	20010326	N	C-Fair	Presumed	Specific bo	20
95	62100	62064	20060901	20060901	N	B-Good	Presumed	Specific bo	20
27	62101	62065	20010326	20010326	N	B-Good	Presumed	Specific bo	20
28	62104	62068	20010326	20010326	N	B-Good	Presumed	Specific bo	20
29	62105	62069	20010326	20010326	N	D-Poor	Presumed	Specific bo	10
96	62108	62072	20080519	20080519	N	B-Good	Presumed	Specific bo	20
97	62110	62074	20020910	20020910	N	B-Good	Presumed	Specific bo	10
98	62113	62077	20020910	20020910	N	B-Good	Presumed	Specific bo	10
30	62127	62091	20010326	20010326	N	C-Fair	Presumed	Specific bo	20
99	62128	62092	20020612	20020612	N	B-Good	Presumed	Specific bo	10
100	62129	62093	20020702	20020702	N	B-Good	Presumed	Specific bo	10
101	62130	62094	20021122	20021122	N	B-Good	Presumed	Specific bo	10
31	62134	62098	19780430	20130310	N	U-Unknow	Presumed	Non-specif	30
32	62135	84074	20130504	20130504	N	A-Excellent	Presumed	Specific bo	10
34	62137	78220	19990409	19990409	N	U-Unknow	Presumed	Non-specif	30
103	62141	62105	20020705	20020705	N	B-Good	Presumed	Specific bo	10
104	62142	62106	20020821	20020821	N	B-Good	Presumed	Specific bo	10
105	62144	62108	20040623	20040623	N	B-Good	Presumed	Specific bo	10
106	62145	62109	20050812	20050812	N	B-Good	Presumed	Specific bo	20
107	62148	62112	20030825	20050825	N	B-Good	Presumed	Specific bo	10
108	62150	62114	20060913	20060913	N	B-Good	Presumed	Specific bo	20
109	62437	62400	20080516	20080516	N	B-Good	Presumed	Specific bo	10
110	62445	62408	20040608	20040608	N	B-Good	Presumed	Specific bo	10
111	62446	62409	20040608	20040608	N	B-Good	Presumed	Specific bo	10
112	62449	62412	20070808	20070808	N	B-Good	Presumed	Specific bo	20
113	62494	62457	20030512	20030512	N	B-Good	Presumed	Specific bo	20
114	62501	62464	20020403	20020403	N	B-Good	Presumed	Specific bo	10
115	62504	62467	20040121	20040121	N	B-Good	Presumed	Specific bo	10
116	62505	62468	20050701	20050701	N	B-Good	Presumed	Specific bo	20
118	62508	62471	20040511	20040511	N	B-Good	Presumed	Specific bo	10
119	62509	62472	20140506	20140506	N	B-Good	Presumed	Specific bo	10
120	62510	62473	20030404	20030404	N	B-Good	Presumed	Specific bo	10
121	62515	62478	20050805	20050805	N	B-Good	Presumed	Specific bo	20
122	62516	62479	20030827	20030827	N	B-Good	Presumed	Specific bo	10

123	62522	62485	20080516	20080516	N	B-Good	Presumed	Specific bo	20
124	62527	62490	20031014	20031014	N	B-Good	Presumed	Specific bo	10
125	62528	62491	20060822	20060822	N	B-Good	Presumed	Specific bo	20
126	62529	62492	20020613	20020613	N	B-Good	Presumed	Specific bo	20
127	62538	62501	20020823	20020823	N	B-Good	Presumed	Specific bo	10
128	62540	62503	20060815	20060815	N	B-Good	Presumed	Specific bo	20
129	62545	62508	20050722	20050722	N	B-Good	Presumed	Specific bo	20
130	62546	62509	20060608	20060608	N	B-Good	Presumed	Specific bo	20
131	62547	62510	20141002	20141002	N	A-Excellent	Presumed	Specific bo	20
132	62549	62512	20020513	20020513	N	B-Good	Presumed	Specific bo	10
133	62552	62515	20040526	20040526	N	A-Excellent	Presumed	Specific bo	10
134	62553	62516	20040716	20040716	N	A-Excellent	Presumed	Specific bo	10
135	62566	62529	20040312	20040312	N	A-Excellent	Presumed	Specific bo	10
136	62571	62534	20050714	20050714	N	B-Good	Presumed	Specific bo	20
45	62597	62560	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Non-specif	30
79	62628	62591	20081016	20081016	N	D-Poor	Presumed	Non-specif	30
80	62629	62592	20090109	20090109	N	D-Poor	Presumed	Non-specif	30
81	62630	62593	20090419	20090419	N	D-Poor	Presumed	Non-specif	30
82	62631	62594	2012XXXX	2012XXXX	N	D-Poor	Presumed	Non-specif	30
2	62825	6583	19100410	19100410	N	U-Unknow	Presumed	Circular fea	90
31	62979	62925	20110712	20110712	N	C-Fair	Presumed	Specific bo	20
29	63374	63282	20010121	20010121	N	D-Poor	Presumed	Specific bo	10
30	63376	63284	20020309	20020309	N	C-Fair	Presumed	Specific bo	10
31	63377	63285	20020309	20020309	N	A-Excellent	Presumed	Circular fea	40
32	63378	63286	20020309	20020309	N	A-Excellent	Presumed	Circular fea	40
33	63379	63287	20020309	20020309	N	B-Good	Presumed	Circular fea	40
34	63380	63288	20010330	20010330	N	B-Good	Presumed	Circular fea	40
35	63381	63289	20031206	20031206	N	U-Unknow	Presumed	Circular fea	40
3	63614	63522	20020701	20020701	N	D-Poor	Presumed	Specific bo	10
1	64290	6072	19390524	19390524	N	X-None	Extirpated	Circular fea	50
2	64292	64197	19381227	19381227	N	X-None	Extirpated	Non-specif	30
3	64293	64198	19490712	19490712	N	X-None	Extirpated	Circular fea	60
4	64294	64199	19400118	19400118	N	X-None	Extirpated	Circular fea	60
5	64296	6231	19090506	19090506	N	X-None	Extirpated	Circular fea	90
7	64300	64205	19291218	19291218	N	X-None	Extirpated	Circular fea	90
1	64374	64295	19860723	19860723	N	U-Unknow	Presumed	Circular fea	50
49	66318	66236	19960629	19960629	N	U-Unknow	Presumed	Non-specif	30
50	66319	66237	20040615	20040615	N	U-Unknow	Presumed	Non-specif	30
51	66320	66238	20100602	20100602	N	U-Unknow	Presumed	Non-specif	30
49	66376	6328	19961007	19961007	N	U-Unknow	Presumed	Circular fea	90
50	66377	66293	19291216	19291216	N	U-Unknow	Presumed	Non-specif	30
153	66612	58285	19770501	19770501	N	U-Unknow	Presumed	Circular fea	90
154	66613	66497	19461121	19461121	N	U-Unknow	Presumed	Circular fea	60
155	66614	6571	19191021	19191021	N	U-Unknow	Presumed	Circular fea	90
156	66615	66499	19670512	19670512	N	U-Unknow	Presumed	Circular fea	90
317	66798	66655	20060605	20060605	N	U-Unknow	Presumed	Non-specif	30
31	68474	66655	20060125	20060125	N	U-Unknow	Presumed	Non-specif	30

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32	68475	68316	20060116	20060116	N	U-Unknow	Presumed	Circular fea	50
10	68553	68363	20060605	20060605	N	U-Unknow	Presumed	Non-specif	30
8	68700	25147	19990615	19990615	N	U-Unknow	Presumed	Circular fea	50
12	68713	68460	19890422	19890422	N	U-Unknow	Presumed	Specific bo	10
13	68714	6328	19951003	19951003	N	U-Unknow	Presumed	Circular fea	90
30	68787	68460	19890422	19890422	N	U-Unknow	Presumed	Specific bo	10
31	68788	6571	19360322	19360322	N	U-Unknow	Presumed	Circular fea	90
199	69217	68739	19970611	19970611	N	U-Unknow	Presumed	Non-specif	30
38	69218	68739	19970611	19970611	N	U-Unknow	Presumed	Non-specif	30
124	69223	33091	19980105	19980105	N	U-Unknow	Presumed	Specific bo	10
40	69287	68784	19990117	19990117	N	U-Unknow	Presumed	Circular fea	40
212	69290	30609	19940911	19940911	N	U-Unknow	Presumed	Specific bo	10
213	69292	68787	19940910	19940910	N	U-Unknow	Presumed	Circular fea	40
353	69293	68787	19940910	19940910	N	U-Unknow	Presumed	Circular fea	40
354	69294	68788	19940705	19940705	N	U-Unknow	Presumed	Specific bo	10
41	69295	68788	19941216	19941216	N	U-Unknow	Presumed	Specific bo	10
214	69296	68788	19941216	19941216	N	U-Unknow	Presumed	Specific bo	10
45	69297	68788	19941216	19941216	N	U-Unknow	Presumed	Specific bo	10
42	69298	68789	19940912	19940912	N	U-Unknow	Presumed	Circular fea	40
355	69299	68790	19940704	19940704	N	U-Unknow	Presumed	Circular fea	40
46	69300	68791	19940705	19940705	N	U-Unknow	Presumed	Circular fea	40
215	69301	68791	19940910	19940910	N	U-Unknow	Presumed	Circular fea	40
1	69816	69048	19630605	19630605	N	U-Unknow	Presumed	Circular fea	90
922	70041	69261	20070104	20070104	N	D-Poor	Presumed	Specific bo	10
925	70043	69263	20061121	20061121	N	B-Good	Presumed	Specific bo	20
4	71425	70521	20071010	20071010	N	U-Unknow	Presumed	Specific bo	10
2	71426	70522	20071010	20071010	N	U-Unknow	Presumed	Specific bo	10
6	71427	70523	20071012	20071012	N	U-Unknow	Presumed	Specific bo	10
7	71428	70524	20090424	20090424	N	U-Unknow	Presumed	Specific bo	20
10	71429	70525	20070921	20070921	N	U-Unknow	Presumed	Specific bo	10
8	71628	81822	20071015	20071015	N	U-Unknow	Presumed	Specific bo	10
33	71631	56801	19090406	19090406	N	U-Unknow	Presumed	Circular fea	90
2	71632	6674	19160513	19160513	N	U-Unknow	Presumed	Circular fea	90
35	71633	6568	19170406	19170406	N	U-Unknow	Presumed	Circular fea	90
1004	71840	70858	20060620	20060620	N	A-Excellent	Presumed	Specific bo	20
1005	71842	70860	20051102	20051102	N	A-Excellent	Presumed	Specific bo	20
1006	71843	70863	20051102	20051102	N	A-Excellent	Presumed	Specific bo	10
1007	71846	70865	20051102	20051102	N	A-Excellent	Presumed	Specific bo	10
1008	71847	70867	20070123	20070123	N	D-Poor	Presumed	Specific bo	10
1009	71854	70876	19941123	19941123	N	U-Unknow	Presumed	Non-specif	30
23	72743	71873	20070120	20070120	N	B-Good	Presumed	Circular fea	40
24	72746	71874	20070115	20070115	N	A-Excellent	Presumed	Circular fea	40
25	72749	71875	20070701	20070701	N	A-Excellent	Presumed	Circular fea	40
5	73102	72140	196406XX	196406XX	N	U-Unknow	Presumed	Circular fea	50
35	73122	72157	19700406	19700406	N	U-Unknow	Presumed	Circular fea	90
36	73124	72158	19890324	19890324	N	U-Unknow	Presumed	Non-specif	30
37	73125	37037	19700301	19700301	N	U-Unknow	Presumed	Circular fea	100

38	73127	72161	20130304	20130304	N	U-Unknow	Presumed	Specific bo	10
1211	73170	72228	200702XX	200702XX	N	A-Excellent	Presumed	Circular fea	40
1212	73171	72229	200702XX	200702XX	N	A-Excellent	Presumed	Circular fea	40
1213	73172	72230	20070510	20070510	N	A-Excellent	Presumed	Specific bo	20
1214	73173	72231	200702XX	200702XX	N	A-Excellent	Presumed	Circular fea	40
1215	73174	72232	200702XX	200702XX	N	A-Excellent	Presumed	Circular fea	40
1216	73175	72233	20070120	20070120	N	A-Excellent	Presumed	Non-specif	30
1217	73177	72235	20070120	20070120	N	A-Excellent	Presumed	Non-specif	30
1218	73179	72237	20070120	20070120	N	A-Excellent	Presumed	Circular fea	40
1219	73180	72238	20070120	20070120	N	A-Excellent	Presumed	Circular fea	40
1220	73182	72240	20070120	20070120	N	A-Excellent	Presumed	Circular fea	40
1	73260	17008	XXXXXXXX	20131018	N	U-Unknow	Presumed	Non-specif	30
2	73262	72302	19860308	20131018	N	U-Unknow	Presumed	Non-specif	30
43	73348	72386	19490317	19490317	N	U-Unknow	Presumed	Circular fea	90
1	73551	72721	19320406	19320406	N	U-Unknow	Presumed	Circular fea	90
2	73555	36286	19761110	19761110	N	U-Unknow	Presumed	Circular fea	90
3	73558	84102	20110307	20110307	N	A-Excellent	Presumed	Specific bo	10
4	73566	72736	19580218	19580218	N	U-Unknow	Presumed	Circular fea	90
5	73567	72737	19580301	19580301	N	U-Unknow	Presumed	Non-specif	30
6	73568	6388	19410321	19410321	N	U-Unknow	Presumed	Circular fea	90
150	73765	72878	20050427	20050427	N	B-Good	Presumed	Specific bo	20
151	73777	72879	20050508	20050508	N	B-Good	Presumed	Specific bo	20
152	73779	72883	20010405	20010405	N	A-Excellent	Presumed	Specific bo	20
153	73782	72884	20050427	20050427	N	B-Good	Presumed	Specific bo	20
154	73783	72885	20010405	20010405	N	A-Excellent	Presumed	Specific bo	20
157	73790	72888	20050427	20050427	N	B-Good	Presumed	Specific bo	10
158	73796	72889	20020621	20020621	N	B-Good	Presumed	Circular fea	40
159	73812	72894	20050703	20050703	N	B-Good	Presumed	Specific bo	20
161	73826	72907	20020525	20020525	N	B-Good	Presumed	Circular fea	40
162	73829	72911	20020523	20020523	N	B-Good	Presumed	Circular fea	40
164	73845	72931	20100324	20100324	N	A-Excellent	Presumed	Specific bo	20
165	73860	72948	20010330	20010330	N	A-Excellent	Presumed	Specific bo	20
166	73880	72967	20050427	20050427	N	A-Excellent	Presumed	Specific bo	20
167	73893	72979	20050106	20050106	N	C-Fair	Presumed	Circular fea	40
168	73903	72990	20050123	20050123	N	U-Unknow	Presumed	Specific bo	10
1	74003	73074	19280422	19280422	N	U-Unknow	Presumed	Circular fea	90
2	74006	6571	19410528	19410528	N	U-Unknow	Presumed	Circular fea	90
193	74016	73085	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
194	74017	73086	20070503	20070503	N	U-Unknow	Presumed	Specific bo	20
219	74060	73129	20050427	20050427	N	A-Excellent	Presumed	Specific bo	20
220	74061	73130	20010406	20010406	N	A-Excellent	Presumed	Specific bo	20
221	74062	73131	20010406	20010406	N	A-Excellent	Presumed	Specific bo	20
223	74085	73153	20010331	20010331	N	A-Excellent	Presumed	Specific bo	20
224	74089	73156	20010330	20010330	N	A-Excellent	Presumed	Specific bo	20
225	74096	73166	20010407	20010407	N	B-Good	Presumed	Specific bo	20
226	74097	73167	20010329	20010329	N	B-Good	Presumed	Specific bo	20
227	74099	73168	20010407	20010407	N	A-Excellent	Presumed	Specific bo	20

5	74526	73558	20070201	20070201	N	B-Good	Presumed I	Specific bo	10
8	74659	58808	19290415	19290415	N	U-Unknow	Presumed I	Circular fea	90
4	76607	75585	20040806	20040806	N	U-Unknow	Presumed I	Specific bo	20
5	76623	75601	20030929	20030929	N	U-Unknow	Presumed I	Specific bo	20
6	76624	75603	20030623	20030623	N	U-Unknow	Presumed I	Specific bo	20
7	76625	75604	20030930	20030930	N	U-Unknow	Presumed I	Specific bo	20
8	76627	75606	20030930	20030930	N	U-Unknow	Presumed I	Specific bo	20
9	76631	75608	20030930	20030930	N	U-Unknow	Presumed I	Specific bo	20
19	76957	75952	19960716	2004XXXX	N	U-Unknow	Presumed I	Circular fea	60
20	76966	6266	199612XX	2006XXXX	N	U-Unknow	Presumed I	Specific bo	20
21	76968	75962	199703XX	2006XXXX	N	U-Unknow	Presumed I	Circular fea	50
138	76974	75969	20050630	20050630	N	U-Unknow	Presumed I	Specific bo	20
198	77014	76014	20090521	20090521	N	B-Good	Presumed I	Non-specif	30
203	77033	76032	20080716	20080716	N	U-Unknow	Presumed I	Specific bo	10
204	77034	76033	20040505	20040505	N	C-Fair	Presumed I	Specific bo	10
207	77049	76048	20090521	20090701	N	B-Good	Presumed I	Circular fea	40
208	77050	76049	20060505	20060505	N	B-Good	Presumed I	Specific bo	20
209	77051	76050	20060417	20060417	N	B-Good	Presumed I	Specific bo	10
37	77067	76079	19790419	19790419	N	U-Unknow	Presumed I	Circular fea	70
38	77074	76081	20020715	20020715	N	U-Unknow	Presumed I	Non-specif	30
39	77075	76082	197706XX	197706XX	N	U-Unknow	Presumed I	Circular fea	60
40	77076	76083	19860308	19860308	N	U-Unknow	Presumed I	Non-specif	30
222	77142	76151	20000703	20000703	N	U-Unknow	Presumed I	Non-specif	30
224	77149	76156	20050413	20090617	N	U-Unknow	Presumed I	Circular fea	40
225	77150	76157	20050423	20090617	N	U-Unknow	Presumed I	Circular fea	40
226	77152	76159	20050515	20090617	N	U-Unknow	Presumed I	Non-specif	30
227	77154	76161	20010415	20010415	N	U-Unknow	Presumed I	Non-specif	30
228	77155	76163	20080508	20080508	N	U-Unknow	Presumed I	Non-specif	30
229	77159	76170	20090429	20090622	N	U-Unknow	Presumed I	Non-specif	30
230	77160	76171	20090602	20090630	N	U-Unknow	Presumed I	Non-specif	30
231	77169	76180	20090513	20090701	N	U-Unknow	Presumed I	Non-specif	30
232	77170	76181	20000424	20000424	N	U-Unknow	Presumed I	Circular fea	40
233	77172	76182	20090409	20090701	N	U-Unknow	Presumed I	Non-specif	30
141	77263	76300	20060808	20060808	N	U-Unknow	Presumed I	Specific bo	10
143	77290	76312	20050929	20050929	N	B-Good	Presumed I	Specific bo	10
144	77306	76327	20060823	20060823	N	U-Unknow	Presumed I	Specific bo	20
145	77310	76332	20060814	20060814	N	U-Unknow	Presumed I	Specific bo	20
146	77312	76334	20060907	20060907	N	B-Good	Presumed I	Specific bo	20
147	77322	76337	20060621	20060621	N	U-Unknow	Presumed I	Specific bo	10
148	77323	76338	20060621	20060621	N	U-Unknow	Presumed I	Specific bo	10
149	77337	76369	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	10
150	77338	76370	20060821	20060821	N	U-Unknow	Presumed I	Specific bo	10
151	77340	76371	20060825	20060825	N	U-Unknow	Presumed I	Specific bo	10
152	77341	76378	20060626	20060626	N	U-Unknow	Presumed I	Specific bo	10
153	77342	76379	20060817	20060817	N	U-Unknow	Presumed I	Specific bo	10
154	77370	76412	20060622	20060622	N	U-Unknow	Presumed I	Specific bo	10
155	77372	76415	20060619	20060619	N	U-Unknow	Presumed I	Specific bo	10

156	77373	76416	20060620	20060620	N	U-Unknow	Presumed	Specific bo	20
157	77374	76417	20060718	20060718	N	B-Good	Presumed	Specific bo	10
158	77376	76421	20070502	20070502	N	B-Good	Presumed	Specific bo	20
159	77379	76423	20060718	20060718	N	B-Good	Presumed	Specific bo	10
160	77382	76426	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
161	77386	76429	20060831	20060831	N	U-Unknow	Presumed	Specific bo	10
163	77394	76445	20060613	20060613	N	B-Good	Presumed	Specific bo	20
164	77398	76447	20070516	20070516	N	U-Unknow	Presumed	Specific bo	20
165	77405	76458	20060622	20060622	N	B-Good	Presumed	Specific bo	20
166	77413	76463	20080514	20080514	N	B-Good	Presumed	Specific bo	20
171	77445	76497	20140919	20140919	N	U-Unknow	Presumed	Specific bo	20
173	77451	76504	20060605	20060605	N	U-Unknow	Presumed	Specific bo	10
174	77453	76505	20060606	20060606	N	U-Unknow	Presumed	Specific bo	10
175	77466	76520	20060828	20060828	N	U-Unknow	Presumed	Specific bo	10
176	77473	76528	20060906	20060906	N	U-Unknow	Presumed	Specific bo	10
177	77476	76531	20060830	20060830	N	U-Unknow	Presumed	Specific bo	10
178	77479	76534	20060912	20060912	N	U-Unknow	Presumed	Specific bo	10
179	77485	76538	20060629	20060629	N	B-Good	Presumed	Specific bo	10
180	77490	76544	20060906	20060906	N	U-Unknow	Presumed	Specific bo	20
181	77635	76689	20060804	20060804	N	U-Unknow	Presumed	Specific bo	10
182	77643	76696	20050825	20050825	N	U-Unknow	Presumed	Specific bo	10
10	77657	76711	20080516	20080516	N	U-Unknow	Presumed	Specific bo	20
273	77671	76720	20090720	20090720	N	U-Unknow	Presumed	Specific bo	10
183	77727	76784	20080520	20080520	N	U-Unknow	Presumed	Specific bo	20
185	77733	76790	20070803	20070803	N	U-Unknow	Presumed	Specific bo	10
187	77778	76837	20070514	20070514	N	U-Unknow	Presumed	Specific bo	10
188	77780	76840	20071003	20071003	N	U-Unknow	Presumed	Specific bo	10
39	77868	76909	20070315	20070522	N	B-Good	Presumed	Specific bo	10
5	77918	76977	20060420	20060420	N	B-Good	Presumed	Specific bo	20
7	77921	76979	20060505	20060505	N	B-Good	Presumed	Specific bo	20
8	77922	76980	20090417	20090417	N	B-Good	Presumed	Specific bo	10
9	77923	76982	20060417	20060417	N	B-Good	Presumed	Specific bo	10
40	77999	77057	20060525	20090701	N	D-Poor	Presumed	Specific bo	20
41	78014	77071	20050407	20050407	N	U-Unknow	Presumed	Specific bo	20
42	78028	77086	20090603	20090603	N	B-Good	Presumed	Specific bo	20
43	78043	77099	20090604	20090604	N	B-Good	Presumed	Specific bo	20
44	78046	77101	20090604	20090604	N	B-Good	Presumed	Specific bo	20
45	78050	77103	20090605	20090605	N	B-Good	Presumed	Specific bo	20
46	78054	77106	20090608	20090608	N	B-Good	Presumed	Specific bo	20
47	78160	77241	20060513	20060513	N	U-Unknow	Presumed	Specific bo	20
189	78561	77640	20110627	20110627	N	B-Good	Presumed	Specific bo	20
191	78588	6262	19290512	19290512	N	U-Unknow	Presumed	Circular fea	90
194	78595	77695	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed	Circular fea	90
195	78596	77696	19300427	19300427	N	U-Unknow	Presumed	Circular fea	90
199	78616	77718	19820521	19820521	N	U-Unknow	Presumed	Circular fea	70
22	78618	77731	19400126	19400126	N	U-Unknow	Presumed	Circular fea	70
25	78622	37043	19140406	19140406	N	U-Unknow	Presumed	Circular fea	90

26	78624	77734	20050310	20050310	N	U-Unknow	Presumed	Non-specif	30
203	78643	77726	20010517	20010517	N	U-Unknow	Presumed	Circular fea	50
42	78644	35229	19310314	20120325	N	U-Unknow	Presumed	Circular fea	90
205	78648	77730	1941XXXX	1941XXXX	N	U-Unknow	Presumed	Circular fea	90
207	78650	77746	1982XXXX	1982XXXX	N	U-Unknow	Presumed	Circular fea	90
208	78651	77751	1982XXXX	1982XXXX	N	U-Unknow	Presumed	Circular fea	70
43	78652	77752	19850310	19850310	N	U-Unknow	Presumed	Circular fea	70
5	78716	77819	20050322	20050322	N	U-Unknow	Presumed	Non-specif	30
6	78720	77824	20080326	20080326	N	B-Good	Presumed	Specific bo	10
7	78721	77825	20050414	20050414	N	U-Unknow	Presumed	Circular fea	60
8	78722	77827	20080409	20080409	N	U-Unknow	Presumed	Non-specif	30
9	78724	77829	20080410	20080410	N	U-Unknow	Presumed	Non-specif	30
10	78731	77836	20080408	20080408	N	U-Unknow	Presumed	Non-specif	30
55	78800	77904	19380324	19380324	N	U-Unknow	Presumed	Non-specif	30
211	78921	78036	20010511	20010511	N	U-Unknow	Presumed	Non-specif	30
212	78924	78040	20010514	20010514	N	U-Unknow	Presumed	Specific bo	10
54	78958	78079	19370531	19370531	N	U-Unknow	Presumed	Non-specif	30
55	78959	78080	19810521	19810521	N	U-Unknow	Presumed	Circular fea	80
56	78960	78081	191605XX	191605XX	N	U-Unknow	Presumed	Non-specif	30
213	79026	78135	20060626	20060626	N	U-Unknow	Presumed	Non-specif	30
32	79071	78171	1980XXXX	1980XXXX	N	U-Unknow	Presumed	Circular fea	90
35	79083	78180	19900630	19900630	N	U-Unknow	Presumed	Circular fea	50
9	79112	78216	19771125	20130309	N	U-Unknow	Presumed	Non-specif	30
10	79114	78217	19780430	19780430	N	U-Unknow	Presumed	Circular fea	60
11	79116	78219	19891231	19891231	N	U-Unknow	Presumed	Non-specif	30
12	79119	78220	19990409	19990409	N	U-Unknow	Presumed	Non-specif	30
28	79348	78428	19770416	19770416	N	U-Unknow	Presumed	Circular fea	50
29	79349	78429	20060401	20060401	N	U-Unknow	Presumed	Circular fea	50
1	79384	62099	20110307	20110307	N	A-Excellent	Presumed	Specific bo	10
2	79385	78460	19910512	19910512	N	U-Unknow	Presumed	Non-specif	30
5	79404	78480	19760826	19760826	N	U-Unknow	Presumed	Non-specif	30
14	79407	93883	20130310	20130310	N	C-Fair	Presumed	Specific bo	10
15	79408	78487	19720330	19720330	N	U-Unknow	Presumed	Non-specif	30
215	79414	78488	20090521	20090521	N	U-Unknow	Presumed	Specific bo	20
216	79415	78494	20090519	20090519	N	U-Unknow	Presumed	Specific bo	20
217	79416	78495	20090520	20090520	N	U-Unknow	Presumed	Specific bo	10
47	79586	78679	18750818	18750818	N	U-Unknow	Presumed	Circular fea	60
83	79611	78661	20090419	20090419	N	D-Poor	Presumed	Non-specif	30
84	79619	78663	20090424	20090424	N	D-Poor	Presumed	Specific bo	10
15	79624	78664	20150327	20150327	N	U-Unknow	Presumed	Specific bo	20
85	79634	78666	20080714	20090421	N	D-Poor	Presumed	Non-specif	30
86	79635	78668	20090419	20090419	N	D-Poor	Presumed	Non-specif	30
87	79637	78670	20060410	20061016	N	D-Poor	Presumed	Non-specif	30
88	79639	78672	20070907	20070907	N	B-Good	Presumed	Non-specif	30
21	79703	5984	19970528	19970528	N	U-Unknow	Presumed	Circular fea	50
20	79731	26102	20100428	20100428	N	U-Unknow	Presumed	Circular fea	90
32	79785	78841	19830329	19830329	N	U-Unknow	Presumed	Circular fea	70

37	79790	78844	19830212	19830212	N	U-Unknow	Presumed	Circular fea	60
38	79791	78845	19830220	19830220	N	U-Unknow	Presumed	Non-specif	30
39	79795	78906	20090311	20090311	N	U-Unknow	Presumed	Specific bo	10
40	79805	78907	20090311	20090311	N	U-Unknow	Presumed	Specific bo	10
41	79806	78910	20090312	20090312	N	U-Unknow	Presumed	Specific bo	10
42	79807	78911	20080410	20080410	N	U-Unknow	Presumed	Specific bo	20
43	79808	78913	20080409	20080409	N	U-Unknow	Presumed	Specific bo	10
44	79809	78915	20090327	20090327	N	U-Unknow	Presumed	Specific bo	10
46	79842	78917	20080408	20080408	N	U-Unknow	Presumed	Specific bo	10
47	79843	78919	20090326	20090326	N	U-Unknow	Presumed	Specific bo	10
48	79844	78920	20080425	20080425	N	U-Unknow	Presumed	Specific bo	10
49	79845	78922	20080326	20080326	N	C-Fair	Presumed	Specific bo	10
50	79846	78924	20090323	20090323	N	U-Unknow	Presumed	Specific bo	10
51	79851	78925	20110227	20110227	N	B-Good	Presumed	Specific bo	20
52	79852	78926	20090323	20090323	N	U-Unknow	Presumed	Specific bo	10
53	79853	78927	20090309	20090309	N	U-Unknow	Presumed	Specific bo	10
62	79911	78950	19850324	19850324	N	U-Unknow	Presumed	Non-specif	30
3	80022	6674	19391013	19391013	N	U-Unknow	Presumed	Circular fea	90
41	80034	35229	19270417	19270417	N	U-Unknow	Presumed	Circular fea	90
42	80052	79087	19830219	19830219	N	U-Unknow	Presumed	Circular fea	90
42	80349	79366	19980322	19980322	N	U-Unknow	Presumed	Circular fea	40
43	80350	79367	20090128	20090128	N	U-Unknow	Presumed	Specific bo	10
44	80351	79368	20021227	20021227	N	U-Unknow	Presumed	Circular fea	40
45	80352	79369	195903XX	195903XX	N	U-Unknow	Presumed	Circular fea	70
46	80356	79373	1987XXXX	1987XXXX	N	D-Poor	Presumed	Non-specif	30
41	80410	79435	19780410	19780410	N	U-Unknow	Presumed	Circular fea	60
42	80414	79438	19860206	19860206	N	U-Unknow	Presumed	Circular fea	60
5	80548	87205	20120325	20120325	N	U-Unknow	Presumed	Specific bo	10
6	80549	79570	20080312	20080312	N	U-Unknow	Presumed	Circular fea	50
1285	80595	79608	20070626	20070626	N	U-Unknow	Presumed	Specific bo	20
1286	80598	79609	20070626	20070626	N	U-Unknow	Presumed	Specific bo	20
1287	80599	79610	20070626	20070626	N	U-Unknow	Presumed	Specific bo	20
1288	80601	79614	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1289	80602	79615	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1290	80604	79616	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1297	80703	79711	20060626	20060626	N	U-Unknow	Presumed	Specific bo	20
1298	80707	79712	20060626	20060626	N	U-Unknow	Presumed	Specific bo	10
1299	80708	79713	20060626	20060626	N	U-Unknow	Presumed	Specific bo	10
1300	80709	79714	20060626	20060626	N	U-Unknow	Presumed	Specific bo	10
1301	80725	79730	20060620	20060620	N	U-Unknow	Presumed	Specific bo	10
1302	80727	79732	20060620	20060620	N	U-Unknow	Presumed	Specific bo	20
1303	80728	79733	20060621	20060621	N	U-Unknow	Presumed	Specific bo	10
1304	80729	79734	20060621	20060621	N	U-Unknow	Presumed	Specific bo	20
1305	80730	79736	20060621	20060621	N	U-Unknow	Presumed	Specific bo	20
1306	80731	79740	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1307	80735	79741	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1308	80737	79742	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20

1309	80739	79745	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1310	80741	79746	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1311	80742	79748	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1312	80746	79753	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1313	80747	79754	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1314	80749	79756	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1315	80750	79757	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1316	80751	79758	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1317	80752	79759	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1318	80754	79763	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1319	80758	79765	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1320	80759	79766	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1321	80777	79774	20060715	20060715	N	U-Unknow	Presumed	Specific bo	20
1322	80778	79782	20060715	20060715	N	U-Unknow	Presumed	Specific bo	20
1323	80780	79787	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1324	80781	79789	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1325	80782	79790	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1326	80785	79793	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1327	80786	79794	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1328	80787	79795	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1329	80789	79796	20060715	20060715	N	U-Unknow	Presumed	Specific bo	20
1330	80790	79797	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
91	80892	79938	20100406	20100406	N	U-Unknow	Presumed	Specific bo	20
92	80893	79939	20100407	20100407	N	U-Unknow	Presumed	Specific bo	10
93	80894	79940	20100413	20100413	N	U-Unknow	Presumed	Specific bo	10
1421	81171	80185	20070508	20070508	N	U-Unknow	Presumed	Specific bo	20
1422	81173	80187	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
1423	81175	80189	20070508	20070508	N	U-Unknow	Presumed	Circular fea	40
1424	81179	80195	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1425	81182	80197	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1426	81183	80198	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1427	81184	80199	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1428	81185	80200	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1429	81187	80202	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1430	81189	80203	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1431	81191	80204	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1432	81193	80207	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1433	81195	80208	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1434	81198	80213	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1435	81200	80216	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1436	81207	80219	20060702	20060702	N	U-Unknow	Presumed	Specific bo	20
1437	81208	80220	20060702	20060702	N	U-Unknow	Presumed	Specific bo	10
1438	81209	80221	20060702	20060702	N	U-Unknow	Presumed	Specific bo	20
1439	81210	80222	20060702	20060702	N	U-Unknow	Presumed	Specific bo	20
1441	81240	80254	20060702	20060702	N	U-Unknow	Presumed	Specific bo	10
1442	81241	80255	20060702	20060702	N	U-Unknow	Presumed	Specific bo	10
1443	81243	80256	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10

1444	81248	80258	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1445	81249	80259	20060702	20060702	N	U-Unknow	Presumed	Specific bo	10
1446	81251	80261	20060702	20060702	N	U-Unknow	Presumed	Specific bo	10
1447	81259	80269	20060702	20060702	N	U-Unknow	Presumed	Specific bo	20
1448	81260	80271	20060702	20060702	N	U-Unknow	Presumed	Specific bo	20
1449	81261	80272	20060702	20060702	N	U-Unknow	Presumed	Specific bo	20
1450	81262	80273	20060702	20060702	N	U-Unknow	Presumed	Specific bo	10
1451	81263	80274	20060702	20060702	N	U-Unknow	Presumed	Specific bo	10
1452	81264	80275	20060706	20060706	N	U-Unknow	Presumed	Specific bo	20
1453	81266	80276	20060705	20060705	N	U-Unknow	Presumed	Specific bo	20
1454	81267	80277	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
1455	81268	80278	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
1456	81269	80279	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
1457	81271	80281	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
1459	81274	80284	20060706	20060706	N	U-Unknow	Presumed	Specific bo	10
1460	81276	80286	20060706	20060706	N	U-Unknow	Presumed	Specific bo	20
1461	81278	80287	20060706	20060706	N	U-Unknow	Presumed	Specific bo	20
1463	81284	80293	20060704	20060704	N	U-Unknow	Presumed	Specific bo	10
1464	81287	80295	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1465	81288	80296	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1466	81290	80297	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1467	81291	80298	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1468	81292	80299	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1469	81293	80300	20060629	20060629	N	U-Unknow	Presumed	Specific bo	10
1470	81295	80306	20060703	20060703	N	U-Unknow	Presumed	Specific bo	10
1471	81296	80307	20060703	20060703	N	U-Unknow	Presumed	Specific bo	20
1472	81299	80309	20060705	20060705	N	U-Unknow	Presumed	Specific bo	20
1473	81300	80311	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
1474	81301	80312	20060705	20060705	N	U-Unknow	Presumed	Specific bo	20
1475	81313	80324	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
18	81316	80341	19030401	19030401	N	X-None	Possibly Ex	Circular fea	90
1476	81318	80327	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
1477	81324	80330	20060705	20060705	N	U-Unknow	Presumed	Specific bo	20
1478	81326	80333	20060705	20060705	N	U-Unknow	Presumed	Specific bo	10
1479	81328	80335	20060707	20060707	N	U-Unknow	Presumed	Specific bo	10
1480	81329	80339	20070509	20070509	N	U-Unknow	Presumed	Specific bo	20
1481	81330	80340	20070509	20070509	N	U-Unknow	Presumed	Specific bo	10
1482	81331	80342	20070509	20070509	N	U-Unknow	Presumed	Specific bo	20
1483	81332	80344	20070510	20070510	N	U-Unknow	Presumed	Specific bo	20
1484	81333	80345	20070510	20070510	N	U-Unknow	Presumed	Specific bo	10
1485	81334	80346	20070510	20070510	N	U-Unknow	Presumed	Specific bo	10
22	81337	80350	19010327	19010327	N	X-None	Extirpated	Circular fea	90
1486	81350	80364	20060525	20060525	N	U-Unknow	Presumed	Specific bo	10
50	81567	80568	19370406	19370406	N	U-Unknow	Presumed	Circular fea	90
6	81651	80652	19970131	19970131	N	U-Unknow	Presumed	Circular fea	70
36	81717	80714	20110703	20110703	N	U-Unknow	Presumed	Non-specif	30
37	81721	6602	20100722	20100722	N	U-Unknow	Presumed	Circular fea	80

28	81880	80901	20070512	20070512	N	B-Good	Presumed I	Circular fea	40
29	81883	80903	20050523	20050523	N	D-Poor	Presumed I	Specific bo	10
30	81895	80907	20050612	20050612	N	B-Good	Presumed I	Specific bo	10
1592	81975	80984	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1593	81976	80985	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1594	81977	80986	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1595	81978	80987	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1596	81982	80993	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	20
1597	81985	80995	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	20
1598	81986	80997	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1599	81996	81010	20060629	20060629	N	U-Unknow	Presumed I	Specific bo	10
9	82245	81266	20081007	20081007	N	U-Unknow	Presumed I	Specific bo	10
10	82246	81267	20081008	20081008	N	U-Unknow	Presumed I	Specific bo	10
11	82247	81268	20081008	20081008	N	U-Unknow	Presumed I	Specific bo	10
12	82248	81269	20081008	20081008	N	U-Unknow	Presumed I	Specific bo	10
13	82249	81270	20081013	20081013	N	U-Unknow	Presumed I	Specific bo	10
14	82250	81271	20081014	20081014	N	U-Unknow	Presumed I	Specific bo	10
15	82251	81272	20081014	20081014	N	U-Unknow	Presumed I	Specific bo	10
16	82252	81273	20081013	20081013	N	U-Unknow	Presumed I	Specific bo	10
17	82253	81274	20081006	20081006	N	U-Unknow	Presumed I	Specific bo	10
18	82254	81275	20090424	20090424	N	U-Unknow	Presumed I	Specific bo	10
20	82256	81262	20080405	20080405	N	U-Unknow	Presumed I	Specific bo	20
21	82274	81290	20090423	20090423	N	U-Unknow	Presumed I	Specific bo	10
46	82343	6550	19441123	19441123	N	U-Unknow	Presumed I	Circular fea	90
15	82356	81377	1941XXXX	1941XXXX	N	U-Unknow	Presumed I	Circular fea	90
10	82468	81490	20060505	20060505	N	U-Unknow	Presumed I	Specific bo	20
1642	82532	81565	20090310	20090310	N	C-Fair	Presumed I	Specific bo	10
1643	82533	81566	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1644	82534	81567	20090310	20090310	N	C-Fair	Presumed I	Specific bo	10
1645	82535	81568	20090310	20090310	N	C-Fair	Presumed I	Specific bo	10
1646	82537	81570	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1647	82538	81571	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1648	82539	81572	20090310	20090310	N	C-Fair	Presumed I	Specific bo	10
1649	82540	81573	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1650	82541	81574	20090310	20090310	N	C-Fair	Presumed I	Specific bo	10
1651	82542	81575	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1652	82543	81576	20090310	20090310	N	C-Fair	Presumed I	Specific bo	10
1653	82544	81577	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1654	82545	81578	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1655	82546	81579	20090310	20090310	N	C-Fair	Presumed I	Specific bo	20
1665	82582	81613	2008XXXX	20080508	N	B-Good	Presumed I	Specific bo	10
1666	82583	81614	20070605	20070605	N	B-Good	Presumed I	Specific bo	10
1667	82584	81615	2008XXXX	20080508	N	U-Unknow	Presumed I	Specific bo	10
1668	82586	81616	2008XXXX	2008XXXX	N	U-Unknow	Presumed I	Specific bo	20
1669	82587	81618	2008XXXX	20080508	N	U-Unknow	Presumed I	Specific bo	10
1670	82588	81619	2008XXXX	20080508	N	U-Unknow	Presumed I	Specific bo	10
1671	82589	81620	2008XXXX	20080508	N	U-Unknow	Presumed I	Specific bo	10

1672	82590	81621	2008XXXX	20080508	N	U-Unknow	Presumed	Specific bo	10
1673	82592	81622	2008XXXX	20080508	N	U-Unknow	Presumed	Specific bo	10
1674	82593	81624	2008XXXX	20080508	N	U-Unknow	Presumed	Specific bo	10
1675	82600	81630	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1676	82602	81632	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1677	82603	81633	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1678	82606	81636	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1679	82611	81640	20070627	20070627	N	U-Unknow	Presumed	Specific bo	10
1680	82612	81641	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1681	82613	81643	20070627	20070627	N	U-Unknow	Presumed	Specific bo	20
1682	82614	81644	20060715	20060715	N	U-Unknow	Presumed	Circular fea	40
1683	82621	81650	20060715	20060715	N	U-Unknow	Presumed	Circular fea	40
1684	82629	81657	20060715	20060715	N	U-Unknow	Presumed	Circular fea	40
1685	82638	81666	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1686	82639	81668	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1687	82640	81670	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1688	82642	81671	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1689	82643	81672	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1690	82644	81674	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1691	82645	81675	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1692	82646	81676	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1693	82647	81677	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1694	82650	81679	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1695	82652	81680	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1696	82654	81682	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
1697	82655	81683	20070602	20070602	N	U-Unknow	Presumed	Specific bo	10
1698	82656	81686	20070602	20070602	N	U-Unknow	Presumed	Specific bo	20
89	82657	81687	19900511	19900511	N	U-Unknow	Presumed	Non-specif	30
1699	82664	81695	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1700	82666	81697	20060712	20060712	N	U-Unknow	Presumed	Specific bo	10
1701	82669	81701	20060712	20060712	N	U-Unknow	Presumed	Specific bo	20
1702	82672	81705	20060712	20060712	N	U-Unknow	Presumed	Specific bo	10
1703	82676	81707	20060712	20060712	N	U-Unknow	Presumed	Specific bo	10
1704	82677	81708	20060712	20060712	N	U-Unknow	Presumed	Specific bo	20
1705	82678	81709	20060712	20060712	N	U-Unknow	Presumed	Specific bo	10
1706	82679	81710	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1707	82681	81711	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1708	82682	81713	20060715	20060715	N	U-Unknow	Presumed	Specific bo	10
1709	82685	81715	20060713	20060713	N	U-Unknow	Presumed	Specific bo	20
1710	82686	81716	20060713	20060713	N	U-Unknow	Presumed	Specific bo	10
1711	82687	81718	20060713	20060713	N	U-Unknow	Presumed	Specific bo	20
1712	82688	81719	20060713	20060713	N	U-Unknow	Presumed	Specific bo	10
1713	82689	81720	20060712	20060712	N	U-Unknow	Presumed	Specific bo	20
1714	82692	81723	20060713	20060713	N	U-Unknow	Presumed	Specific bo	20
1715	82693	81724	20060713	20060713	N	U-Unknow	Presumed	Specific bo	20
1716	82694	81725	20060713	20060713	N	U-Unknow	Presumed	Specific bo	10
1717	82695	81726	20060713	20060713	N	U-Unknow	Presumed	Specific bo	20

1718	82696	81727	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	20
1719	82697	81728	20060715	20060715	N	U-Unknow	Presumed I	Specific bo	20
1720	82698	81729	20060715	20060715	N	U-Unknow	Presumed I	Specific bo	20
1721	82699	81731	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	20
22	82700	81730	19300131	19300131	N	U-Unknow	Presumed I	Circular fea	90
1722	82701	81732	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	20
1723	82702	81733	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	10
1724	82703	81734	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	20
1725	82704	81735	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	10
1726	82705	81736	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	10
23	82706	81738	20080404	20080404	N	U-Unknow	Presumed I	Specific bo	20
1727	82707	81737	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	10
1728	82708	81739	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	10
1729	82709	81740	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	20
1730	82710	81741	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	20
1731	82711	81742	20060713	20060713	N	U-Unknow	Presumed I	Specific bo	10
1732	82712	81743	20060715	20060715	N	U-Unknow	Presumed I	Specific bo	20
1733	82713	81744	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	20
1734	82714	81745	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	20
1735	82715	81746	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	10
1736	82716	81747	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	10
1737	82717	81748	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	20
1738	82719	81749	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	10
1739	82722	81750	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	20
1740	82723	81751	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	20
1741	82724	81752	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	10
1742	82725	81756	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	10
1743	82726	81757	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	10
1744	82727	81758	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	20
1745	82734	81765	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	20
1746	82735	81767	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	20
1747	82739	81769	20070609	20070609	N	U-Unknow	Presumed I	Specific bo	20
1748	82740	81771	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	10
1749	82741	81772	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	20
218	82788	6328	196905XX	196905XX	N	X-None	Possibly Ex	Circular fea	90
19	82798	81825	19310128	19310128	N	U-Unknow	Presumed I	Circular fea	90
1840	83042	82054	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1841	83043	82055	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	20
1842	83044	82056	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	20
1843	83045	82057	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1844	83046	82058	20070602	20070602	N	U-Unknow	Presumed I	Specific bo	10
1845	83048	82060	20070615	20070615	N	U-Unknow	Presumed I	Specific bo	20
294	83131	82148	19880319	19880319	N	U-Unknow	Presumed I	Circular fea	60
12	83240	82233	20110410	20110410	N	B-Good	Presumed I	Specific bo	20
1847	83337	82284	20060706	20060706	N	U-Unknow	Presumed I	Specific bo	20
1848	83341	82328	20060310	20060310	N	U-Unknow	Presumed I	Specific bo	20
1849	83344	82330	20060310	20060310	N	U-Unknow	Presumed I	Specific bo	10

1850	83345	82331	20060317	20060317	N	U-Unknow	Presumed	Specific bo	10
419	83532	82723	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
2	83548	82537	198003XX	198003XX	N	U-Unknow	Presumed	Non-specif	30
48	83677	82675	19980518	19980518	N	C-Fair	Presumed	Specific bo	20
50	83688	82686	19910507	19910507	N	U-Unknow	Presumed	Non-specif	30
420	83713	82725	20010423	20010423	N	U-Unknow	Presumed	Specific bo	10
421	83723	82726	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
422	83724	82727	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
423	83725	82764	20040507	20040507	N	U-Unknow	Presumed	Specific bo	20
424	83726	82728	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
425	83727	82765	20070501	20100330	N	U-Unknow	Presumed	Specific bo	20
426	83728	82729	20070501	20070501	N	U-Unknow	Presumed	Specific bo	10
427	83729	82730	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
428	83730	82731	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
429	83731	82766	20070501	20070501	N	U-Unknow	Presumed	Specific bo	20
430	83732	82767	20070501	20070501	N	U-Unknow	Presumed	Specific bo	20
431	83733	82769	20070501	20080510	N	U-Unknow	Presumed	Specific bo	20
432	83734	82733	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
433	83736	82734	20100323	20100323	N	U-Unknow	Presumed	Specific bo	10
434	83737	82770	20080510	20080510	N	U-Unknow	Presumed	Specific bo	20
435	83739	82735	20040506	20040506	N	U-Unknow	Presumed	Specific bo	10
436	83740	82736	20040506	20040506	N	U-Unknow	Presumed	Specific bo	10
437	83741	82737	20010423	20010423	N	U-Unknow	Presumed	Specific bo	10
438	83742	82738	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
439	83743	82739	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
440	83744	82740	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
441	83745	82743	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
443	83746	82744	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
444	83747	82745	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
442	83748	82771	20050424	20050324	N	U-Unknow	Presumed	Specific bo	20
445	83749	82746	20010423	20010423	N	U-Unknow	Presumed	Specific bo	10
446	83750	82772	20040504	20040504	N	U-Unknow	Presumed	Specific bo	20
447	83751	82747	20010330	20010330	N	A-Excellent	Presumed	Specific bo	10
448	83752	82748	20040506	20040506	N	U-Unknow	Presumed	Specific bo	10
450	83753	82750	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
452	83754	82751	20070429	20070429	N	U-Unknow	Presumed	Specific bo	10
453	83755	82752	20070430	20070430	N	U-Unknow	Presumed	Specific bo	10
454	83756	82753	20050424	20050424	N	U-Unknow	Presumed	Specific bo	10
455	83757	82755	20050424	20050424	N	U-Unknow	Presumed	Specific bo	10
456	83758	82756	20050423	20050423	N	U-Unknow	Presumed	Specific bo	10
457	83759	82757	20050423	20050423	N	U-Unknow	Presumed	Specific bo	10
459	83760	82759	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
460	83761	82773	20100323	20100323	N	U-Unknow	Presumed	Specific bo	20
461	83762	82774	20040410	20040410	N	U-Unknow	Presumed	Specific bo	20
462	83763	82775	20040410	20040410	N	U-Unknow	Presumed	Specific bo	20
463	83764	82760	20050424	20050424	N	U-Unknow	Presumed	Specific bo	10
464	83765	82761	20100323	20100323	N	U-Unknow	Presumed	Specific bo	10

465	83766	82762	20050424	20050424	N	U-Unknow	Presumed	Specific bo	10
466	83767	82763	20070430	20070430	N	U-Unknow	Presumed	Specific bo	10
449	83768	82749	20010329	20010329	N	B-Good	Presumed	Specific bo	10
451	83769	84168	20070330	20070330	N	U-Unknow	Presumed	Specific bo	20
458	83770	82758	20010329	20010329	N	B-Good	Presumed	Specific bo	10
467	83784	82786	20010406	20010406	N	A-Excellent	Presumed	Specific bo	10
468	83785	82788	20010406	20010406	N	B-Good	Presumed	Specific bo	20
469	83786	82790	20010406	20010406	N	A-Excellent	Presumed	Specific bo	10
470	83787	82791	20010403	20010403	N	B-Good	Presumed	Specific bo	10
471	83788	82792	20100330	20100330	N	U-Unknow	Presumed	Specific bo	10
472	83789	82793	20080510	20080510	N	U-Unknow	Presumed	Specific bo	20
473	83790	82794	20070429	20070429	N	U-Unknow	Presumed	Specific bo	10
474	83791	82795	20100330	20100330	N	U-Unknow	Presumed	Specific bo	10
475	83792	82796	20070430	20070430	N	U-Unknow	Presumed	Specific bo	10
476	83793	82797	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
477	83794	82798	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
478	83795	82799	20010405	20010405	N	A-Excellent	Presumed	Specific bo	10
479	83796	82800	20010405	20010405	N	A-Excellent	Presumed	Specific bo	20
480	83797	82801	20030508	20030508	N	U-Unknow	Presumed	Specific bo	20
481	83798	82802	20030508	20030508	N	U-Unknow	Presumed	Specific bo	10
482	83799	82803	20020507	20020507	N	U-Unknow	Presumed	Specific bo	10
483	83800	82804	20050423	20050423	N	U-Unknow	Presumed	Specific bo	10
484	83801	82805	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
485	83802	82806	20050508	20050508	N	U-Unknow	Presumed	Specific bo	10
486	83803	82807	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
487	83804	82808	20050508	20050508	N	U-Unknow	Presumed	Specific bo	10
488	83805	82809	20050508	20050508	N	U-Unknow	Presumed	Specific bo	10
489	83806	82810	20100402	20100402	N	U-Unknow	Presumed	Specific bo	10
490	83807	82811	20040502	20040502	N	U-Unknow	Presumed	Specific bo	10
492	83815	82815	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
493	83816	82816	20010423	20010423	N	U-Unknow	Presumed	Specific bo	10
494	83817	82817	20050424	20050424	N	U-Unknow	Presumed	Specific bo	10
495	83818	82818	20050508	20050508	N	U-Unknow	Presumed	Specific bo	10
496	83819	82819	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
497	83820	82821	20010331	20010331	N	A-Excellent	Presumed	Specific bo	10
498	83821	82822	20050508	20050508	N	U-Unknow	Presumed	Specific bo	10
499	83822	82823	20070430	20070430	N	U-Unknow	Presumed	Specific bo	20
500	83823	82824	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
501	83824	82825	20010331	20010331	N	A-Excellent	Presumed	Specific bo	10
502	83825	82826	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
503	83826	82827	20050423	20050423	N	U-Unknow	Presumed	Specific bo	20
504	83827	82828	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
505	83828	82829	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
506	83829	82830	20040502	20040502	N	U-Unknow	Presumed	Specific bo	10
507	83830	82831	20040502	20040502	N	U-Unknow	Presumed	Specific bo	10
508	83831	82832	20010330	20010330	N	A-Excellent	Presumed	Specific bo	10
509	83832	82833	20050424	20050424	N	U-Unknow	Presumed	Specific bo	20

510	83833	82834	20040502	20040502	N	U-Unknow	Presumed	Specific bo	10
511	83834	82835	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
512	83835	82836	20050424	20050424	N	U-Unknow	Presumed	Specific bo	10
513	83836	82837	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
514	83837	82839	20040503	20040503	N	U-Unknow	Presumed	Specific bo	10
515	83838	82840	20040503	20040503	N	U-Unknow	Presumed	Specific bo	20
516	83839	82841	20010330	20010330	N	B-Good	Presumed	Specific bo	10
517	83840	82842	20010330	20010330	N	A-Excellent	Presumed	Specific bo	20
518	83875	82876	20040502	20040502	N	U-Unknow	Presumed	Specific bo	10
519	83876	82877	20040502	20040502	N	U-Unknow	Presumed	Specific bo	10
520	83877	82878	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
521	83878	82879	20070430	20070430	N	U-Unknow	Presumed	Specific bo	10
522	83879	82880	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
523	83880	82881	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
524	83881	82882	20030512	20030512	N	U-Unknow	Presumed	Specific bo	10
525	83882	82883	20100324	20100324	N	U-Unknow	Presumed	Specific bo	10
526	83883	82884	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
527	83884	82885	20030523	20030523	N	U-Unknow	Presumed	Specific bo	20
528	83885	82886	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
529	83886	82887	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
530	83887	82888	20070429	20070429	N	U-Unknow	Presumed	Specific bo	20
534	83891	82893	20070430	20070430	N	U-Unknow	Presumed	Specific bo	10
535	83892	82894	20040506	20040506	N	U-Unknow	Presumed	Specific bo	10
545	83933	82911	19821207	19821207	N	U-Unknow	Presumed	Non-specif	30
566	83958	82942	20070505	20070505	N	U-Unknow	Presumed	Specific bo	10
567	83959	82943	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
568	83960	82944	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
569	83961	82945	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
570	83962	82946	20070504	20070504	N	U-Unknow	Presumed	Specific bo	20
571	83963	82947	20010427	20010427	N	U-Unknow	Presumed	Specific bo	10
572	83964	82948	20010515	20010515	N	U-Unknow	Presumed	Specific bo	10
573	83965	82949	20010515	20010515	N	U-Unknow	Presumed	Specific bo	10
574	83966	82950	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
575	83967	82952	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
576	83968	82953	20050510	20050510	N	U-Unknow	Presumed	Specific bo	10
577	83969	82954	20040410	20040410	N	U-Unknow	Presumed	Specific bo	10
578	83970	82955	20010427	20010427	N	U-Unknow	Presumed	Specific bo	10
579	83971	82956	20100328	20100328	N	U-Unknow	Presumed	Specific bo	10
580	83972	82957	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
581	83973	82958	20040411	20040411	N	U-Unknow	Presumed	Specific bo	10
582	83974	82959	20010428	20010428	N	U-Unknow	Presumed	Specific bo	10
590	83982	82971	20050510	20050510	N	U-Unknow	Presumed	Specific bo	10
591	83983	82972	20100401	20100401	N	U-Unknow	Presumed	Specific bo	10
592	83984	82973	20100510	20100510	N	U-Unknow	Presumed	Specific bo	10
593	83985	82974	20050509	20050509	N	U-Unknow	Presumed	Specific bo	20
594	83986	82975	20020519	20020519	N	U-Unknow	Presumed	Specific bo	10
595	83987	82976	20050509	20050509	N	U-Unknow	Presumed	Specific bo	10

596	83988	82977	20100403	20100403	N	U-Unknow	Presumed	Specific bo	10
597	83989	82978	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
598	83990	82979	20010505	20010505	N	U-Unknow	Presumed	Specific bo	10
636	84062	83071	20080319	20080319	N	U-Unknow	Presumed	Specific bo	20
55	84082	83086	2005XXXX	2005XXXX	N	U-Unknow	Presumed	Non-specif	30
56	84096	83103	2005XXXX	2005XXXX	N	U-Unknow	Presumed	Specific bo	20
637	84107	83111	20010424	20010424	N	U-Unknow	Presumed	Specific bo	10
638	84108	83112	20070501	20070501	N	U-Unknow	Presumed	Specific bo	10
639	84109	83113	20010423	20010423	N	U-Unknow	Presumed	Specific bo	10
640	84110	83114	20070501	20070501	N	U-Unknow	Presumed	Specific bo	10
641	84111	83115	20020519	20020519	N	U-Unknow	Presumed	Specific bo	20
642	84112	83116	20050528	20050528	N	U-Unknow	Presumed	Specific bo	10
643	84113	83117	20010424	20010424	N	U-Unknow	Presumed	Specific bo	10
644	84114	83118	20020519	20020519	N	U-Unknow	Presumed	Specific bo	20
645	84115	83119	20020519	20020519	N	U-Unknow	Presumed	Specific bo	10
646	84116	83120	20030509	20030509	N	U-Unknow	Presumed	Specific bo	10
647	84117	83121	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
648	84118	83122	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
649	84119	83123	20030509	20030509	N	U-Unknow	Presumed	Specific bo	20
650	84120	83124	20030509	20030509	N	U-Unknow	Presumed	Specific bo	20
651	84121	83125	20090602	20090602	N	U-Unknow	Presumed	Specific bo	20
652	84122	83126	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
653	84123	83127	20030509	20030509	N	U-Unknow	Presumed	Specific bo	10
654	84124	83128	20100329	20100329	N	U-Unknow	Presumed	Specific bo	10
655	84125	83129	20050528	20050528	N	U-Unknow	Presumed	Specific bo	10
656	84126	83130	20020519	20020519	N	U-Unknow	Presumed	Specific bo	10
657	84127	83131	20090602	20090602	N	U-Unknow	Presumed	Specific bo	10
658	84128	83132	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
659	84129	83133	20070502	20070502	N	U-Unknow	Presumed	Specific bo	20
660	84133	83145	20030509	20030509	N	U-Unknow	Presumed	Specific bo	10
661	84134	83146	20100324	20100324	N	U-Unknow	Presumed	Specific bo	10
662	84135	83147	20070501	20070501	N	U-Unknow	Presumed	Specific bo	10
663	84136	83148	20010424	20010424	N	U-Unknow	Presumed	Specific bo	10
664	84137	83150	20030509	20030509	N	U-Unknow	Presumed	Specific bo	10
665	84138	83151	20070501	20070501	N	U-Unknow	Presumed	Specific bo	10
666	84139	83152	20070501	20070501	N	U-Unknow	Presumed	Specific bo	10
667	84140	83153	20070502	20070502	N	U-Unknow	Presumed	Specific bo	20
668	84141	83154	20030509	20030509	N	U-Unknow	Presumed	Specific bo	10
669	84142	83155	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
670	84143	83156	20070501	20070501	N	U-Unknow	Presumed	Specific bo	10
671	84144	83157	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
672	84145	83158	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
673	84146	83159	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
674	84147	83160	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
675	84149	83161	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
676	84150	83162	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
677	84151	83163	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10

678	84152	83165	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
679	84153	83166	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
680	84154	83167	20040507	20040507	N	U-Unknow	Presumed	Specific bo	20
681	84155	83168	20050508	20050508	N	U-Unknow	Presumed	Specific bo	10
682	84156	83169	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
683	84157	83170	20050508	20050508	N	U-Unknow	Presumed	Specific bo	10
684	84158	83171	20040507	20040507	N	U-Unknow	Presumed	Specific bo	20
57	84168	83177	2005XXXX	2005XXXX	N	U-Unknow	Presumed	Circular fea	70
58	84183	83183	20070518	20070518	N	U-Unknow	Presumed	Specific bo	20
59	84186	6374	1987XXXX	1990XXXX	N	U-Unknow	Presumed	Circular fea	90
60	84189	83193	20070707	20070707	N	U-Unknow	Presumed	Specific bo	20
685	84200	83199	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
686	84201	83200	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
687	84202	83201	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
688	84203	83202	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
689	84204	83203	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
690	84205	83204	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
691	84206	83205	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
692	84207	83206	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
693	84208	83207	20090602	20090602	N	U-Unknow	Presumed	Specific bo	10
694	84209	83208	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
695	84210	83209	20090602	20090602	N	U-Unknow	Presumed	Specific bo	10
696	84211	83210	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
697	84212	83211	20100330	20100330	N	U-Unknow	Presumed	Specific bo	10
698	84213	83214	20090603	20090603	N	U-Unknow	Presumed	Specific bo	10
699	84214	83216	20100326	20100326	N	U-Unknow	Presumed	Specific bo	20
700	84215	83217	20100326	20100326	N	U-Unknow	Presumed	Specific bo	10
701	84216	83218	20090603	20090603	N	U-Unknow	Presumed	Specific bo	10
702	84217	83219	20020516	20030510	N	U-Unknow	Presumed	Specific bo	20
703	84218	83220	20100326	20100326	N	U-Unknow	Presumed	Specific bo	10
704	84219	83221	20100326	20100326	N	U-Unknow	Presumed	Specific bo	10
705	84220	83222	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
706	84221	83223	20030509	20030509	N	U-Unknow	Presumed	Specific bo	20
707	84222	83224	20090602	20090602	N	U-Unknow	Presumed	Specific bo	10
708	84223	83225	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
709	84224	83226	20100326	20100326	N	U-Unknow	Presumed	Specific bo	20
710	84225	83227	20100326	20100326	N	U-Unknow	Presumed	Specific bo	10
711	84226	83228	20100326	20100326	N	U-Unknow	Presumed	Specific bo	10
712	84227	83236	20020516	20070502	N	U-Unknow	Presumed	Specific bo	20
713	84241	83235	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
714	84242	83237	20030509	20030509	N	U-Unknow	Presumed	Specific bo	10
715	84243	83238	20030509	20030509	N	U-Unknow	Presumed	Specific bo	20
716	84244	83239	20070502	20070502	N	U-Unknow	Presumed	Specific bo	10
717	84245	83240	20010426	20010426	N	U-Unknow	Presumed	Specific bo	20
718	84246	83241	20050528	20050528	N	U-Unknow	Presumed	Specific bo	10
719	84247	83242	20030510	20030510	N	U-Unknow	Presumed	Specific bo	10
720	84248	83243	20030509	20030509	N	U-Unknow	Presumed	Specific bo	10

721	84249	83244	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
722	84250	83246	20070503	20070503	N	U-Unknow	Presumed	Specific bo	20
723	84251	83247	20070503	20070503	N	U-Unknow	Presumed	Specific bo	10
724	84252	83249	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
725	84253	83250	20020517	20030509	N	U-Unknow	Presumed	Specific bo	20
726	84254	83251	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
727	84255	83264	20090603	20090603	N	U-Unknow	Presumed	Specific bo	10
728	84256	83266	20090603	20090603	N	U-Unknow	Presumed	Specific bo	20
729	84257	83267	20100325	20100325	N	U-Unknow	Presumed	Specific bo	10
730	84258	83268	20020518	20020518	N	U-Unknow	Presumed	Specific bo	10
731	84259	83269	20080511	20080511	N	U-Unknow	Presumed	Specific bo	10
732	84260	83270	20020516	20020516	N	U-Unknow	Presumed	Specific bo	10
733	84269	83271	20020516	20030510	N	U-Unknow	Presumed	Specific bo	20
734	84270	83273	20030510	20030510	N	U-Unknow	Presumed	Specific bo	10
735	84271	83274	20100325	20100325	N	U-Unknow	Presumed	Specific bo	20
736	84272	83275	20030510	20030510	N	U-Unknow	Presumed	Specific bo	20
737	84273	83276	20010425	20010425	N	U-Unknow	Presumed	Specific bo	10
738	84274	83278	20050529	20050529	N	U-Unknow	Presumed	Specific bo	10
739	84275	83279	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
740	84276	83280	20100325	20100325	N	U-Unknow	Presumed	Specific bo	10
741	84277	83281	20030510	20030510	N	U-Unknow	Presumed	Specific bo	10
742	84278	83282	20010426	20010426	N	U-Unknow	Presumed	Specific bo	10
743	84281	83283	20100325	20100325	N	U-Unknow	Presumed	Specific bo	10
744	84282	83284	20090602	20090602	N	U-Unknow	Presumed	Specific bo	10
745	84283	83285	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
746	84284	83286	20030511	20040508	N	U-Unknow	Presumed	Specific bo	20
747	84285	83287	20070502	20070502	N	U-Unknow	Presumed	Specific bo	20
748	84286	83288	20020516	20020516	N	U-Unknow	Presumed	Specific bo	10
749	84287	83289	20020516	20020516	N	U-Unknow	Presumed	Specific bo	10
750	84288	83290	20100325	20100325	N	U-Unknow	Presumed	Specific bo	20
751	84289	83291	20030511	20030511	N	U-Unknow	Presumed	Specific bo	20
752	84290	83292	20030511	20030511	N	U-Unknow	Presumed	Specific bo	20
753	84291	83294	20020518	20020518	N	U-Unknow	Presumed	Specific bo	10
754	84292	83295	20050529	20050529	N	U-Unknow	Presumed	Specific bo	20
755	84293	83296	20010426	20010426	N	U-Unknow	Presumed	Specific bo	20
756	84294	83297	20090604	20090604	N	U-Unknow	Presumed	Specific bo	20
757	84320	83984	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
758	84321	83315	20050529	20050529	N	U-Unknow	Presumed	Specific bo	10
759	84322	83316	20090604	20090604	N	U-Unknow	Presumed	Specific bo	20
760	84323	83317	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
761	84324	83318	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
762	84325	83319	20090602	20090602	N	U-Unknow	Presumed	Specific bo	10
763	84326	83320	20090602	20090602	N	U-Unknow	Presumed	Specific bo	10
764	84327	83322	20010427	20010427	N	U-Unknow	Presumed	Specific bo	10
765	84328	83323	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
766	84329	83324	20070503	20070503	N	U-Unknow	Presumed	Specific bo	10
767	84330	83325	20010426	20010426	N	U-Unknow	Presumed	Specific bo	10

768	84331	83326	20080512	20080512	N	U-Unknow	Presumed	Specific bo	10
769	84332	83327	20070503	20070503	N	U-Unknow	Presumed	Specific bo	10
770	84333	83328	20080511	20080511	N	U-Unknow	Presumed	Specific bo	10
771	84334	83329	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
49	84436	6674	19210521	19210521	N	U-Unknow	Presumed	Circular fea	90
61	84487	83650	2000XXXX	2000XXXX	N	U-Unknow	Presumed	Circular fea	90
772	84897	83865	20070503	20070503	N	U-Unknow	Presumed	Specific bo	20
773	84898	83866	20010426	20010426	N	U-Unknow	Presumed	Specific bo	10
774	84899	83867	20030510	20030510	N	U-Unknow	Presumed	Specific bo	10
775	84900	83868	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
776	84901	83869	20040508	20040508	N	U-Unknow	Presumed	Specific bo	20
777	84902	83870	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
778	84903	83871	20010426	20010426	N	U-Unknow	Presumed	Specific bo	10
779	84904	83872	20070503	20070503	N	U-Unknow	Presumed	Specific bo	10
780	84905	83873	20100325	20100325	N	U-Unknow	Presumed	Specific bo	10
781	84906	83874	20100325	20100325	N	U-Unknow	Presumed	Specific bo	10
782	84907	83875	20030510	20030510	N	U-Unknow	Presumed	Specific bo	10
783	84908	83876	20050529	20050529	N	U-Unknow	Presumed	Specific bo	20
784	84909	83877	20070503	20070503	N	U-Unknow	Presumed	Specific bo	20
785	84910	83878	20020517	20020517	N	U-Unknow	Presumed	Specific bo	10
786	84911	83879	20070503	20070503	N	U-Unknow	Presumed	Specific bo	20
787	84912	83880	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
788	84913	83881	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
789	84914	83882	20090603	20090603	N	U-Unknow	Presumed	Specific bo	10
790	84915	83883	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
791	84916	83884	20080511	20080511	N	U-Unknow	Presumed	Specific bo	20
792	84917	83885	20080511	20080511	N	U-Unknow	Presumed	Specific bo	20
793	84918	83886	20080511	20080511	N	U-Unknow	Presumed	Specific bo	10
794	84919	83887	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
795	84920	83888	20100325	20100325	N	U-Unknow	Presumed	Specific bo	20
796	84921	83889	20040508	20040508	N	U-Unknow	Presumed	Specific bo	20
797	84922	83890	20100325	20100325	N	U-Unknow	Presumed	Specific bo	20
798	84933	83901	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
799	84934	83902	20010427	20010427	N	U-Unknow	Presumed	Specific bo	10
800	84935	83904	20010427	20010427	N	U-Unknow	Presumed	Specific bo	10
801	84936	83905	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
802	84937	83906	20030511	20030511	N	U-Unknow	Presumed	Specific bo	10
803	84938	83907	20020518	20020518	N	U-Unknow	Presumed	Specific bo	20
804	84940	83908	20030511	20030511	N	U-Unknow	Presumed	Specific bo	20
805	84941	83909	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
806	84942	83910	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
807	84943	83911	20090604	20090604	N	U-Unknow	Presumed	Specific bo	10
808	84944	83912	20080511	20080511	N	U-Unknow	Presumed	Specific bo	10
809	84945	83913	20030511	20030511	N	U-Unknow	Presumed	Specific bo	10
810	84946	83914	20030511	20030511	N	U-Unknow	Presumed	Specific bo	20
811	84947	83915	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
812	84948	83916	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10

813	84949	83917	20050529	20050529	N	U-Unknow	Presumed	Specific bo	20
814	84950	83918	20030511	20030511	N	U-Unknow	Presumed	Specific bo	10
815	84951	83919	20050529	20050529	N	U-Unknow	Presumed	Specific bo	10
816	84952	83921	20100327	20100327	N	U-Unknow	Presumed	Specific bo	10
817	84953	83922	20100325	20100325	N	U-Unknow	Presumed	Specific bo	20
818	84954	83924	20100325	20100325	N	U-Unknow	Presumed	Specific bo	20
819	84955	83925	20050529	20050529	N	U-Unknow	Presumed	Specific bo	10
820	84956	83926	20050529	20050529	N	U-Unknow	Presumed	Specific bo	10
821	84957	83927	20010515	20010515	N	U-Unknow	Presumed	Specific bo	20
822	84958	83928	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
823	84959	83929	20010427	20010427	N	U-Unknow	Presumed	Specific bo	10
824	84978	83953	20070504	20070504	N	U-Unknow	Presumed	Specific bo	10
825	84979	83954	20040508	20040508	N	U-Unknow	Presumed	Specific bo	20
826	84980	83955	20040508	20070504	N	U-Unknow	Presumed	Specific bo	20
827	84981	83956	20090603	20090603	N	U-Unknow	Presumed	Specific bo	10
828	84982	83958	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
829	84983	83960	20050529	20050529	N	U-Unknow	Presumed	Specific bo	10
830	84984	83961	20040411	20040411	N	U-Unknow	Presumed	Specific bo	20
831	84985	83962	20100327	20100327	N	U-Unknow	Presumed	Specific bo	10
832	84986	83983	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
833	84987	83968	20050529	20050529	N	U-Unknow	Presumed	Specific bo	20
834	84988	83969	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
835	84989	83970	20100327	20100327	N	U-Unknow	Presumed	Specific bo	10
836	84990	83971	20100327	20100327	N	U-Unknow	Presumed	Specific bo	20
837	84992	83972	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
838	84993	83974	20010427	20010427	N	U-Unknow	Presumed	Specific bo	10
839	84994	83975	20080512	20080512	N	U-Unknow	Presumed	Specific bo	10
840	84995	83976	20010514	20010514	N	U-Unknow	Presumed	Specific bo	10
841	84996	83977	20010514	20010514	N	U-Unknow	Presumed	Specific bo	20
842	84997	83978	20010514	20010514	N	U-Unknow	Presumed	Specific bo	10
843	84998	83979	20010514	20010514	N	U-Unknow	Presumed	Specific bo	20
844	84999	83980	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
845	85000	83981	20040509	20040509	N	U-Unknow	Presumed	Specific bo	10
846	85001	83982	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
847	85003	83963	20040508	20040508	N	U-Unknow	Presumed	Specific bo	10
2	85004	83949	20110225	20110225	N	U-Unknow	Presumed	Non-specif	30
98	85034	83995	19620404	19620404	N	U-Unknow	Presumed	Circular fea	90
848	85035	83997	20070508	20070508	N	U-Unknow	Presumed	Specific bo	20
849	85036	83998	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
850	85037	83999	20040508	20040508	N	U-Unknow	Presumed	Specific bo	20
851	85039	84000	20040509	20040509	N	U-Unknow	Presumed	Specific bo	10
852	85040	84001	20040509	20040509	N	U-Unknow	Presumed	Specific bo	10
853	85041	84002	20010514	20010514	N	U-Unknow	Presumed	Specific bo	10
854	85042	84003	20040508	20040508	N	U-Unknow	Presumed	Specific bo	20
855	85043	84004	20040509	20040509	N	U-Unknow	Presumed	Specific bo	10
856	85044	84005	20010515	20010515	N	U-Unknow	Presumed	Specific bo	10
857	85045	84006	20010515	20010515	N	U-Unknow	Presumed	Specific bo	20

858	85046	84007	20030511	20030511	N	U-Unknow	Presumed	Specific bo	10
859	85047	84008	20040507	20040507	N	U-Unknow	Presumed	Specific bo	10
860	85048	84009	20070508	20070508	N	U-Unknow	Presumed	Specific bo	20
861	85049	84010	20040411	20040411	N	U-Unknow	Presumed	Specific bo	20
862	85050	84011	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
863	85051	84012	20100327	20100327	N	U-Unknow	Presumed	Specific bo	20
864	85052	84013	20070508	20070508	N	U-Unknow	Presumed	Specific bo	20
865	85053	84014	20100327	20100327	N	U-Unknow	Presumed	Specific bo	20
866	85054	84015	20070508	20070508	N	U-Unknow	Presumed	Specific bo	20
867	85055	84016	20070508	20070508	N	U-Unknow	Presumed	Specific bo	20
868	85056	84017	20100403	20100403	N	U-Unknow	Presumed	Specific bo	20
869	85057	84018	20070508	20070508	N	U-Unknow	Presumed	Specific bo	20
870	85058	84019	20100403	20100403	N	U-Unknow	Presumed	Specific bo	20
871	85059	84020	20070508	20070508	N	U-Unknow	Presumed	Specific bo	10
872	85060	84021	20090606	20090606	N	U-Unknow	Presumed	Specific bo	20
873	85061	84022	20040509	20040509	N	U-Unknow	Presumed	Specific bo	10
874	85062	84023	20010505	20010505	N	U-Unknow	Presumed	Specific bo	10
875	85063	84024	20040509	20040509	N	U-Unknow	Presumed	Specific bo	20
876	85069	84033	20050427	20050427	N	U-Unknow	Presumed	Specific bo	10
877	85070	84034	20050427	20050427	N	B-Good	Presumed	Specific bo	10
878	85071	84035	20010404	20010404	N	B-Good	Presumed	Specific bo	10
879	85078	84045	20050427	20050427	N	U-Unknow	Presumed	Specific bo	10
890	85079	84047	20050427	20050427	N	U-Unknow	Presumed	Specific bo	20
880	85080	84046	20050427	20050427	N	U-Unknow	Presumed	Specific bo	20
881	85081	84048	20050427	20050427	N	U-Unknow	Presumed	Specific bo	20
882	85082	84049	20050427	20050427	N	U-Unknow	Presumed	Specific bo	10
884	85083	84052	20050427	20050427	N	U-Unknow	Presumed	Specific bo	10
885	85084	84053	20050427	20050427	N	U-Unknow	Presumed	Specific bo	10
886	85085	84054	20050427	20050427	N	U-Unknow	Presumed	Specific bo	20
888	85086	84056	20050427	20050427	N	U-Unknow	Presumed	Specific bo	20
883	85089	84051	20050423	20050423	N	U-Unknow	Presumed	Specific bo	10
887	85090	84055	20040306	20050427	N	U-Unknow	Presumed	Specific bo	10
889	85091	84057	20010328	20010328	N	C-Fair	Presumed	Specific bo	10
891	85092	84058	20010327	20010327	N	C-Fair	Presumed	Specific bo	10
892	85093	84059	20010327	20010327	N	C-Fair	Presumed	Specific bo	10
47	85105	84075	20110308	20110308	N	B-Good	Presumed	Specific bo	10
48	85106	84076	20110308	20110308	N	A-Excellent	Presumed	Specific bo	10
895	85107	84077	20010403	20010403	N	B-Good	Presumed	Specific bo	10
896	85109	84079	20050427	20050427	N	U-Unknow	Presumed	Specific bo	10
897	85111	84081	20050427	20050427	N	A-Excellent	Presumed	Specific bo	20
899	85135	84138	20111021	20111021	N	U-Unknow	Presumed	Specific bo	10
900	85159	84131	20020528	20020528	N	B-Good	Presumed	Specific bo	10
901	85160	84132	20050427	20050427	N	A-Excellent	Presumed	Specific bo	20
902	85161	84133	20050509	20050509	N	A-Excellent	Presumed	Specific bo	20
903	85162	84134	20050427	20050427	N	A-Excellent	Presumed	Specific bo	20
904	85163	84135	20100324	20100324	N	A-Excellent	Presumed	Specific bo	20
905	85164	84136	20050417	20050417	N	A-Excellent	Presumed	Specific bo	20

906	85165	84137	20010404	20010404	N	U-Unknow	Presumed	Specific bo	10
907	85166	82233	2009XXXX	2009XXXX	N	B-Good	Presumed	Specific bo	20
43	85173	84148	20051012	20051012	N	U-Unknow	Presumed	Specific bo	20
44	85174	84149	20100413	20100413	N	C-Fair	Presumed	Circular fea	40
45	85228	84206	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Circular fea	60
11	85266	84241	20100429	20100429	N	C-Fair	Presumed	Specific bo	10
12	85271	84247	20100324	20100324	N	U-Unknow	Presumed	Circular fea	40
13	85272	84248	20100429	20100429	N	C-Fair	Presumed	Specific bo	10
14	85273	84249	20100429	20100429	N	C-Fair	Presumed	Specific bo	20
15	85274	84250	20100429	20100429	N	C-Fair	Presumed	Specific bo	20
16	85275	84251	20100510	20100510	N	D-Poor	Presumed	Specific bo	20
17	85276	84252	20100429	20100429	N	C-Fair	Presumed	Specific bo	10
18	85277	84253	20100325	20100325	N	U-Unknow	Presumed	Circular fea	40
19	85278	84254	19980308	19980308	N	U-Unknow	Presumed	Non-specif	30
20	85279	84255	20110225	20110225	N	A-Excellent	Presumed	Specific bo	10
21	85280	84256	20110224	20110224	N	B-Good	Presumed	Specific bo	10
10	85289	64295	19600413	19600413	N	U-Unknow	Presumed	Circular fea	50
1	85298	6328	19020113	19020113	N	U-Unknow	Presumed	Circular fea	90
2	85299	84274	19610305	19610305	N	U-Unknow	Presumed	Circular fea	90
5	85304	84276	19620311	19620311	N	U-Unknow	Presumed	Circular fea	70
6	85305	84277	19800410	19800410	N	U-Unknow	Presumed	Circular fea	90
11	85325	43419	19060426	19060426	N	U-Unknow	Presumed	Circular fea	90
57	85331	84304	20100423	20100423	N	U-Unknow	Presumed	Circular fea	50
6	85392	84361	19930319	19930319	N	U-Unknow	Presumed	Circular fea	90
7	85393	84362	20110225	20110225	N	B-Good	Presumed	Specific bo	10
35	85620	84623	20080619	20080619	N	U-Unknow	Presumed	Specific bo	10
36	85622	84624	20080527	20080527	N	U-Unknow	Presumed	Specific bo	10
46	85766	85885	20110226	20110226	N	U-Unknow	Presumed	Circular fea	90
69	85848	84816	20100116	20100116	N	U-Unknow	Presumed	Circular fea	70
70	85849	84817	20080218	20080218	N	U-Unknow	Presumed	Non-specif	30
71	85850	84818	20110109	20110109	N	U-Unknow	Presumed	Circular fea	50
73	85852	84819	20110123	20110123	N	U-Unknow	Presumed	Non-specif	30
74	85853	84820	20111126	20111126	N	U-Unknow	Presumed	Non-specif	30
76	85855	84822	20100206	20100206	N	U-Unknow	Presumed	Non-specif	30
77	85856	6262	20070120	20070120	N	U-Unknow	Presumed	Circular fea	90
78	85857	84823	20110306	20110306	N	U-Unknow	Presumed	Circular fea	70
79	85858	84824	20101118	20101118	N	U-Unknow	Presumed	Circular fea	50
13	85995	35229	19280415	19280415	N	U-Unknow	Presumed	Circular fea	90
6	85999	84963	20100511	20100511	N	C-Fair	Presumed	Specific bo	20
7	86000	84964	20100511	20100511	N	D-Poor	Presumed	Specific bo	20
8	86001	84965	20101118	20101118	N	D-Poor	Presumed	Specific bo	20
9	86002	84966	20101116	20101116	N	D-Poor	Presumed	Specific bo	20
10	86003	84967	20100510	20100510	N	D-Poor	Presumed	Specific bo	20
11	86004	84968	20101116	20101116	N	D-Poor	Presumed	Specific bo	20
12	86005	84969	20101116	20101116	N	D-Poor	Presumed	Specific bo	20
13	86006	84970	20100510	20100510	N	D-Poor	Presumed	Specific bo	20
14	86007	84971	20100402	20100402	N	D-Poor	Presumed	Specific bo	20

15	86008	84972	19660319	19660319	N	U-Unknow	Presumed	Non-specif	30
80	86036	85110	20061123	20061123	N	U-Unknow	Presumed	Circular fea	60
81	86038	85111	20100308	20100308	N	U-Unknow	Presumed	Non-specif	30
82	86039	85130	20070120	20070120	N	U-Unknow	Presumed	Circular fea	90
83	86040	85112	20110209	20110209	N	U-Unknow	Presumed	Circular fea	60
84	86041	85113	20070120	20070120	N	U-Unknow	Presumed	Circular fea	90
85	86042	85114	20110226	20110226	N	U-Unknow	Presumed	Non-specif	30
1	86045	85009	20120412	20120412	N	C-Fair	Presumed	Specific bo	20
86	86135	85115	20110130	20110130	N	U-Unknow	Presumed	Non-specif	30
87	86137	85878	20041214	20041214	N	U-Unknow	Presumed	Circular fea	90
90	86143	85120	20091222	20091222	N	U-Unknow	Presumed	Non-specif	30
88	86161	85132	20090215	20090215	N	U-Unknow	Presumed	Circular fea	90
89	86164	85139	20081230	20081230	N	U-Unknow	Presumed	Circular fea	90
119	86265	85250	20110917	20110917	N	B-Good	Presumed	Specific bo	20
113	86281	85261	20100720	20100720	N	A-Excellent	Presumed	Specific bo	20
39	86532	85512	2009XXXX	2009XXXX	N	U-Unknow	Presumed	Non-specif	30
40	86533	6696	2009XXXX	2009XXXX	N	U-Unknow	Presumed	Circular fea	90
42	86586	6262	19460411	19460411	N	U-Unknow	Presumed	Circular fea	90
43	86587	6299	19551221	19551221	N	U-Unknow	Presumed	Circular fea	90
44	86600	6647	19100503	19100503	N	U-Unknow	Presumed	Circular fea	90
46	86602	28885	2009XXXX	2009XXXX	N	U-Unknow	Presumed	Circular fea	90
45	86603	85578	2009XXXX	2009XXXX	N	U-Unknow	Presumed	Circular fea	50
47	86608	6571	19400417	19400417	N	U-Unknow	Presumed	Circular fea	90
48	86612	85582	19160123	19160123	N	U-Unknow	Presumed	Circular fea	90
49	86615	85584	19430614	19430614	N	U-Unknow	Presumed	Circular fea	90
54	86644	85611	19770804	19770804	N	U-Unknow	Presumed	Circular fea	90
38	86656	85584	19100512	19100512	N	U-Unknow	Presumed	Circular fea	90
55	86657	85626	19360111	19360111	N	U-Unknow	Presumed	Circular fea	90
56	86677	85651	19390203	19390203	N	U-Unknow	Presumed	Circular fea	90
59	86726	85697	19100331	19100331	N	U-Unknow	Presumed	Circular fea	90
60	86727	85698	19100406	19100406	N	U-Unknow	Presumed	Circular fea	90
179	86778	85751	19770805	19770805	N	U-Unknow	Presumed	Non-specif	30
275	86822	85789	2007XXXX	20120309	N	D-Poor	Presumed	Circular fea	40
279	86830	84821	198904XX	20000623	N	D-Poor	Presumed	Circular fea	70
280	86835	85801	198904XX	198904XX	N	U-Unknow	Presumed	Circular fea	50
2	86839	6674	19300619	19300619	N	U-Unknow	Presumed	Circular fea	90
10	86840	57457	19311231	19311231	N	U-Unknow	Presumed	Circular fea	90
11	86841	81730	19130127	19130127	N	U-Unknow	Presumed	Circular fea	90
1	86843	6717	19210601	19210601	N	U-Unknow	Presumed	Circular fea	90
13	86850	6717	19100423	19980516	N	X-None	Possibly Ex	Circular fea	90
1	86859	6674	191905XX	191905XX	N	U-Unknow	Presumed	Circular fea	90
2	86861	85831	19850308	19850308	N	U-Unknow	Presumed	Circular fea	100
3	86869	85835	19850311	19850311	N	U-Unknow	Presumed	Circular fea	80
15	86907	6674	19160505	19780520	N	X-None	Possibly Ex	Circular fea	90
9	86910	85808	20080722	20080722	N	U-Unknow	Presumed	Specific bo	10
12	86911	86142	20080619	20080619	N	U-Unknow	Presumed	Specific bo	10
17	86920	55928	20000715	200905XX	N	U-Unknow	Presumed	Circular fea	60

18	86921	85884	19970619	20010715	N	U-Unknow	Presumed	Circular fea	60
62	86970	85938	19500202	19500202	N	U-Unknow	Presumed	Circular fea	90
63	86974	85941	19491008	19491008	N	U-Unknow	Presumed	Circular fea	90
221	87036	86004	20020531	20020531	N	U-Unknow	Presumed	Specific bo	10
223	87041	86008	20020518	20020518	N	U-Unknow	Presumed	Specific bo	20
224	87045	86012	20020516	20020516	N	U-Unknow	Presumed	Specific bo	20
226	87048	86016	20020514	20020514	N	U-Unknow	Presumed	Specific bo	10
227	87049	86017	20020514	20020514	N	U-Unknow	Presumed	Specific bo	10
228	87051	86018	20010626	20010626	N	U-Unknow	Presumed	Specific bo	10
229	87057	86025	20020511	20020511	N	U-Unknow	Presumed	Specific bo	10
40	87063	6696	19100419	19100419	N	U-Unknow	Presumed	Circular fea	90
230	87074	86041	20050928	20050928	N	U-Unknow	Presumed	Specific bo	10
231	87075	86042	20020904	20020904	N	B-Good	Presumed	Specific bo	10
41	87077	85651	19100424	19100424	N	U-Unknow	Presumed	Circular fea	90
232	87078	86044	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
67	87089	86064	20070624	20070624	N	U-Unknow	Presumed	Specific bo	20
238	87092	86057	19800523	19800523	N	U-Unknow	Presumed	Circular fea	60
69	87094	6602	20100602	20100602	N	U-Unknow	Presumed	Circular fea	80
70	87095	86066	20100604	20100604	N	U-Unknow	Presumed	Circular fea	40
247	87111	86074	20110630	20110630	N	C-Fair	Presumed	Specific bo	10
248	87112	86075	20110801	20110801	N	U-Unknow	Presumed	Specific bo	20
249	87113	86077	20110617	20110617	N	B-Good	Presumed	Specific bo	10
250	87117	86078	20110819	20110819	N	B-Good	Presumed	Specific bo	10
251	87118	86082	20180712	20180712	N	C-Fair	Presumed	Non-specif	30
252	87119	86083	20150608	20150608	N	B-Good	Presumed	Specific bo	20
253	87120	86084	20171007	20171007	N	D-Poor	Presumed	Specific bo	20
255	87122	86086	20150505	20150505	N	U-Unknow	Presumed	Specific bo	20
259	87126	86090	19940517	19940517	N	U-Unknow	Presumed	Circular fea	70
75	87223	80714	20100608	20100608	N	U-Unknow	Presumed	Non-specif	30
262	87284	86241	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Non-specif	30
263	87286	86243	2010XXXX	2010XXXX	N	U-Unknow	Presumed	Non-specif	30
265	87288	86245	20070605	20070605	N	B-Good	Presumed	Specific bo	10
266	87289	86246	2007XXXX	2007XXXX	N	B-Good	Presumed	Specific bo	10
272	87295	86252	20100505	20100505	N	U-Unknow	Presumed	Specific bo	10
274	87297	86254	20110725	20110725	N	C-Fair	Presumed	Specific bo	20
275	87298	86255	20110725	20110725	N	B-Good	Presumed	Non-specif	30
277	87300	86257	20110725	20110725	N	C-Fair	Presumed	Specific bo	20
278	87302	86258	20010724	20010724	N	B-Good	Presumed	Specific bo	10
279	87303	86259	20100617	20100617	N	U-Unknow	Presumed	Specific bo	20
280	87304	86260	20101110	20101110	N	U-Unknow	Presumed	Specific bo	10
281	87307	86263	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	50
281	87456	86419	20110421	20110513	N	U-Unknow	Presumed	Circular fea	50
22	87457	86421	19990816	2004XXXX	N	U-Unknow	Presumed	Non-specif	30
282	87458	86420	20110421	20110513	N	U-Unknow	Presumed	Non-specif	30
23	87459	86422	19990816	2004XXXX	N	U-Unknow	Presumed	Non-specif	30
24	87460	86423	19990816	2004XXXX	N	U-Unknow	Presumed	Non-specif	30
20	87471	6701	19160505	19980516	N	C-Fair	Presumed	Circular fea	90

139	87523	86421	19990816	19991115	N	U-Unknow	Presumed I	Non-specif	30
140	87524	86475	19990816	19991115	N	U-Unknow	Presumed I	Non-specif	30
25	87581	86573	20120324	20120324	N	A-Excellent	Presumed I	Specific bo	10
26	87582	86575	20120324	20120324	N	C-Fair	Presumed I	Specific bo	10
28	87874	86909	20120911	20120911	N	B-Good	Presumed I	Specific bo	10
29	87875	86910	20120912	20120912	N	B-Good	Presumed I	Specific bo	10
49	87923	86962	19850309	19850309	N	U-Unknow	Presumed I	Non-specif	30
50	87924	86971	188104XX	188104XX	N	U-Unknow	Presumed I	Circular fea	90
51	87926	86972	20120330	20120330	N	B-Good	Presumed I	Specific bo	10
28	88026	87066	20120425	20120425	N	U-Unknow	Presumed I	Specific bo	10
66	88065	87066	20120425	20120425	N	U-Unknow	Presumed I	Specific bo	10
16	88155	79087	19670513	19670513	N	U-Unknow	Presumed I	Circular fea	90
51	88164	87200	20120324	20120324	N	D-Poor	Presumed I	Specific bo	10
17	88165	87200	20120324	20120324	N	U-Unknow	Presumed I	Specific bo	10
18	88166	87204	20120323	20120323	N	U-Unknow	Presumed I	Specific bo	10
19	88169	87205	20120325	20120325	N	U-Unknow	Presumed I	Specific bo	10
20	88170	87202	20120323	20120323	N	U-Unknow	Presumed I	Specific bo	10
21	88171	87206	20120424	20120424	N	U-Unknow	Presumed I	Specific bo	10
52	88172	87202	20120323	20120323	N	C-Fair	Presumed I	Specific bo	10
22	88173	87214	20120424	20120424	N	U-Unknow	Presumed I	Specific bo	10
53	88178	87206	20120424	20120424	N	C-Fair	Presumed I	Specific bo	10
54	88179	87214	20120424	20120424	N	B-Good	Presumed I	Specific bo	10
27	88190	87224	19920521	19920521	N	U-Unknow	Presumed I	Non-specif	30
18	88192	87204	20120323	20120323	N	U-Unknow	Presumed I	Specific bo	10
19	88193	87202	20120323	20120323	N	U-Unknow	Presumed I	Specific bo	10
20	88194	87214	20120424	20120424	N	U-Unknow	Presumed I	Specific bo	10
21	88267	87204	20120323	20120323	N	D-Poor	Presumed I	Specific bo	10
35	88316	87329	20120903	20120903	N	C-Fair	Presumed I	Specific bo	10
2	88329	87344	20120412	20120412	N	U-Unknow	Presumed I	Specific bo	10
43	88330	87345	20120903	20120903	N	B-Good	Presumed I	Specific bo	10
44	88331	87346	20120903	20120903	N	B-Good	Presumed I	Specific bo	10
45	88332	87347	20120905	20120905	N	D-Poor	Presumed I	Circular fea	40
49	88337	87351	20120905	20120905	N	D-Poor	Presumed I	Specific bo	10
50	88338	87352	20120905	20120905	N	C-Fair	Presumed I	Specific bo	10
213	88389	87399	20110221	20110221	N	U-Unknow	Presumed I	Specific bo	10
19	88401	87206	20120424	20120424	N	U-Unknow	Presumed I	Specific bo	10
20	88402	87214	20120424	20120424	N	U-Unknow	Presumed I	Specific bo	10
37	88441	87204	20120323	20120323	N	U-Unknow	Presumed I	Specific bo	10
264	88534	87560	XXXXXXXX	XXXXXXXX	N	U-Unknow	Presumed I	Specific bo	10
48	88728	85831	20090302	20090302	N	U-Unknow	Presumed I	Circular fea	100
351	89089	88071	19861211	19861211	N	C-Fair	Presumed I	Circular fea	50
2	89171	88149	2004XXXX	2004XXXX	N	B-Good	Presumed I	Specific bo	20
3	89394	88383	19100405	19100405	N	X-None	Possibly Ex	Non-specif	30
29	89443	88149	2004XXXX	2004XXXX	N	U-Unknow	Presumed I	Specific bo	20
30	89461	88452	19941201	19941201	N	U-Unknow	Presumed I	Specific bo	20
31	89489	88478	19580430	19580430	N	U-Unknow	Presumed I	Specific bo	20
32	89490	88479	19561231	19561231	N	U-Unknow	Presumed I	Circular fea	90

34	89492	88481	19491216	19491216	N	U-Unknow	Presumed	Non-specif	30
35	89493	88483	19500405	19500405	N	U-Unknow	Presumed	Circular fea	70
37	89508	88498	19510103	19510103	N	U-Unknow	Presumed	Circular fea	90
33	89515	88504	19450514	19450514	N	U-Unknow	Presumed	Non-specif	30
66	89534	88525	20120820	20120820	N	U-Unknow	Presumed	Specific bo	10
232	89633	88618	20120503	20120503	N	U-Unknow	Presumed	Circular fea	40
88	89758	88744	20121111	20121111	N	C-Fair	Presumed	Specific bo	10
925	89881	88871	20010327	20010327	N	C-Fair	Presumed	Specific bo	10
926	89884	88875	20110525	20110525	N	U-Unknow	Presumed	Specific bo	10
245	89931	88924	20020309	20020309	N	B-Good	Presumed	Non-specif	30
498	89935	88926	19770605	19770605	Y	U-Unknow	Presumed	Circular fea	60
28	90130	89126	20121117	20121117	N	C-Fair	Presumed	Specific bo	10
1	91951	27990	19121021	19121021	N	U-Unknow	Presumed	Circular fea	90
2	91952	90910	19990815	19990815	N	U-Unknow	Presumed	Circular fea	90
3	91953	90911	20121111	20121111	N	U-Unknow	Presumed	Non-specif	30
58	92467	91358	20130324	20130324	N	U-Unknow	Presumed	Specific bo	20
1	92514	6674	19410518	19410518	N	X-None	Extirpated	Circular fea	90
2	92518	91456	19411130	19411130	N	X-None	Extirpated	Circular fea	90
3	92520	6571	19170407	19170407	N	X-None	Extirpated	Circular fea	90
12	92731	86971	18810325	18810325	N	U-Unknow	Presumed	Circular fea	90
29	92759	91684	20130317	20130317	N	B-Good	Presumed	Specific bo	10
4	92796	27990	191204XX	191204XX	N	X-None	Possibly Ex	Circular fea	90
5	92800	28885	19760415	19760415	N	X-None	Possibly Ex	Circular fea	90
58	93049	91975	20100526	20100526	N	U-Unknow	Presumed	Specific bo	10
251	93050	91977	19180514	19180514	N	U-Unknow	Presumed	Circular fea	90
252	93061	91986	19470528	19470528	N	U-Unknow	Presumed	Circular fea	40
253	93064	81730	19281113	19281113	N	U-Unknow	Presumed	Circular fea	90
56	93647	92503	20020302	20020302	N	U-Unknow	Presumed	Specific bo	10
52	94710	93577	20130310	20130310	N	B-Good	Presumed	Specific bo	10
53	94711	93578	20130310	20130310	N	B-Good	Presumed	Specific bo	10
54	94712	93579	19280601	19280601	N	U-Unknow	Presumed	Non-specif	30
53	94753	93622	20121115	20121115	N	D-Poor	Presumed	Specific bo	10
90	94813	93668	20131018	20131018	N	B-Good	Presumed	Specific bo	10
91	94815	93671	20131018	20131018	N	A-Excellent	Presumed	Specific bo	10
20	95016	93889	20130310	20130310	N	C-Fair	Presumed	Specific bo	10
21	95020	93894	20130309	20130309	N	C-Fair	Presumed	Specific bo	10
16	95058	93945	20131018	20131018	N	B-Good	Presumed	Specific bo	10
17	95059	87200	20130324	20130324	N	U-Unknow	Presumed	Specific bo	10
20	95064	93959	19850306	19850306	N	U-Unknow	Presumed	Non-specif	30
29	95175	94053	20130317	20130317	N	B-Good	Presumed	Specific bo	10
13	95739	93671	20131018	20131018	N	A-Excellent	Presumed	Specific bo	10
18	96849	95715	20110412	20110412	N	U-Unknow	Presumed	Specific bo	10
59	97267	96112	20150322	20150322	N	A-Excellent	Presumed	Specific bo	20
216	97491	96328	1998XXXX	1998XXXX	N	U-Unknow	Presumed	Non-specif	30
282	97605	96438	20140531	20140531	N	D-Poor	Presumed	Specific bo	10
283	97606	96439	20081003	20081003	N	U-Unknow	Presumed	Specific bo	10
284	97608	96440	20110127	20110127	N	U-Unknow	Presumed	Specific bo	10

285	97609	96442	20100529	20100529	N	U-Unknow	Presumed	Specific bo	10
286	97627	96449	19840627	19840627	N	U-Unknow	Presumed	Circular fea	50
287	97628	96450	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Non-specif	30
288	97629	96451	20120911	20120911	N	U-Unknow	Presumed	Specific bo	10
289	97635	96453	1985XXXX	1985XXXX	N	U-Unknow	Presumed	Non-specif	30
290	97647	96471	20000716	20000716	N	U-Unknow	Presumed	Non-specif	30
291	97671	96501	20000712	20000712	N	U-Unknow	Presumed	Circular fea	40
292	97672	96502	20000715	20000715	N	U-Unknow	Presumed	Non-specif	30
293	97673	96503	20140813	20140813	N	C-Fair	Presumed	Specific bo	10
294	97676	96506	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	40
295	97681	96511	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	50
296	97683	96513	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	50
297	97685	96516	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	50
298	97688	96519	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Non-specif	30
299	97699	96526	19330604	19330604	N	U-Unknow	Presumed	Circular fea	90
300	97704	96529	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	50
301	97715	96541	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Non-specif	30
302	97717	96542	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	50
303	97720	96544	20130314	20130314	N	U-Unknow	Presumed	Specific bo	10
304	97722	96546	20130318	20130318	N	U-Unknow	Presumed	Specific bo	10
305	97723	96547	20140428	20140428	N	U-Unknow	Presumed	Circular fea	50
306	97724	96548	20100819	20100819	N	U-Unknow	Presumed	Specific bo	10
307	97729	96551	19360410	19360410	N	U-Unknow	Presumed	Circular fea	90
308	97730	96553	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Circular fea	50
309	97732	96555	2001XXXX	2001XXXX	N	U-Unknow	Presumed	Non-specif	30
310	97734	96556	19790429	19790429	N	U-Unknow	Presumed	Non-specif	30
311	97736	96558	20140428	20140428	N	U-Unknow	Presumed	Specific bo	10
312	97752	96576	20030720	20030720	N	U-Unknow	Presumed	Specific bo	20
313	97763	96585	20020823	20020823	N	U-Unknow	Presumed	Circular fea	40
314	97765	96587	19930805	19930805	N	U-Unknow	Presumed	Non-specif	30
315	97767	96589	19930806	19930806	N	U-Unknow	Presumed	Non-specif	30
316	97770	96593	20020823	20020823	N	U-Unknow	Presumed	Circular fea	40
317	97778	96601	20020823	20020823	N	U-Unknow	Presumed	Non-specif	30
318	97779	96602	20020823	20020823	N	U-Unknow	Presumed	Circular fea	40
319	97781	96603	20030627	20030627	N	U-Unknow	Presumed	Non-specif	30
320	97782	96605	20020823	20020823	N	U-Unknow	Presumed	Circular fea	40
321	97784	96607	20020823	20020823	N	U-Unknow	Presumed	Circular fea	40
322	97785	96608	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
323	97786	96609	20020823	20020823	N	U-Unknow	Presumed	Circular fea	40
324	97787	96611	20120910	20120910	N	U-Unknow	Presumed	Specific bo	10
326	97795	96618	20120615	20120615	N	B-Good	Presumed	Specific bo	10
327	97815	96626	20000706	20000706	N	U-Unknow	Presumed	Circular fea	40
328	97818	96630	20000706	20000706	N	U-Unknow	Presumed	Circular fea	40
329	97820	96633	19870624	19870624	N	U-Unknow	Presumed	Non-specif	30
330	97827	96638	20030828	20030828	N	U-Unknow	Presumed	Specific bo	20
331	97829	96645	20030820	20030820	N	U-Unknow	Presumed	Specific bo	10
332	97830	96648	19870624	19870624	N	U-Unknow	Presumed	Non-specif	30

333	97834	96653	2010XXXX	2010XXXX	N	U-Unknow	Presumed	Circular fea	60
334	97835	96654	19870624	19870624	N	U-Unknow	Presumed	Non-specif	30
335	97844	96661	20000710	20000710	N	U-Unknow	Presumed	Non-specif	30
336	97849	96668	20000709	20000709	N	U-Unknow	Presumed	Non-specif	30
337	97851	96670	20090715	20090715	N	U-Unknow	Presumed	Non-specif	30
338	97852	96671	19790423	19790423	N	U-Unknow	Presumed	Non-specif	30
339	97854	96672	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
340	97857	96676	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
341	97861	96680	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
342	97863	96681	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
343	97874	96691	19960809	19960809	N	U-Unknow	Presumed	Circular fea	50
344	97905	96715	199407XX	199407XX	N	U-Unknow	Presumed	Specific bo	10
345	97906	96716	199407XX	199407XX	N	U-Unknow	Presumed	Specific bo	10
348	97953	96748	199407XX	199407XX	N	U-Unknow	Presumed	Specific bo	10
350	97956	96751	199407XX	199407XX	N	U-Unknow	Presumed	Specific bo	10
354	97967	96757	199107XX	199107XX	N	U-Unknow	Presumed	Specific bo	10
355	97969	96759	199407XX	199407XX	N	U-Unknow	Presumed	Specific bo	10
356	98012	96796	19850625	19850625	N	U-Unknow	Presumed	Non-specif	30
358	98103	96878	20150601	20150601	N	U-Unknow	Presumed	Specific bo	20
360	98110	96882	20150601	20150601	N	U-Unknow	Presumed	Specific bo	10
361	98113	96883	20150609	20150609	N	U-Unknow	Presumed	Specific bo	10
382	98193	96954	20150707	20150707	N	D-Poor	Presumed	Specific bo	10
383	98196	96958	20150707	20150707	N	U-Unknow	Presumed	Specific bo	10
387	98265	97026	19590327	19590327	N	U-Unknow	Presumed	Circular fea	90
390	98449	97189	20150723	20150723	N	U-Unknow	Presumed	Specific bo	10
391	98451	97190	20150811	20150811	N	U-Unknow	Presumed	Specific bo	20
392	98452	97192	20150723	20150723	N	U-Unknow	Presumed	Specific bo	10
393	98453	97193	20150805	20150805	N	U-Unknow	Presumed	Specific bo	10
394	98455	97194	20150811	20150811	N	U-Unknow	Presumed	Specific bo	10
346	98599	97330	1993XXXX	1993XXXX	N	U-Unknow	Presumed	Non-specif	30
217	99133	6299	19481029	19481029	N	U-Unknow	Presumed	Circular fea	90
282	100407	58285	19930404	19930404	N	U-Unknow	Presumed	Circular fea	90
1934	100672	99150	20070104	200805XX	N	U-Unknow	Presumed	Specific bo	10
14	101634	A0079	19261223	19261223	N	U-Unknow	Presumed	Circular fea	90
16	101635	6054	19090328	19090328	N	U-Unknow	Presumed	Circular fea	90
18	101651	A0095	19090429	19090429	N	U-Unknow	Presumed	Circular fea	90
19	101656	6571	19140404	19140404	N	U-Unknow	Presumed	Circular fea	90
20	101662	56801	19090410	19090410	N	U-Unknow	Presumed	Circular fea	90
21	101663	6647	19100503	19100503	N	U-Unknow	Presumed	Circular fea	90
18	101736	A0175	20150312	20150312	N	U-Unknow	Presumed	Specific bo	10
19	101738	A0176	20150312	20150312	N	U-Unknow	Presumed	Specific bo	10
379	101848	A0285	20121217	20121217	N	U-Unknow	Presumed	Specific bo	10
91	103387	A1793	20090427	20090427	N	X-None	Extirpated	Non-specif	30
92	103390	A1797	20090108	20090108	N	D-Poor	Presumed	Specific bo	10
93	103391	A1798	20090108	20090108	N	D-Poor	Presumed	Circular fea	40
94	103415	A1820	20080710	20080710	N	D-Poor	Presumed	Specific bo	10
12	103702	A2098	19650412	19650412	Y	U-Unknow	Presumed	Circular fea	70

254	104240	A2649	20090330	20090330	N	U-Unknow	Presumed	Specific bo	10
13	104597	A2976	198XXXXX	198XXXXX	Y	U-Unknow	Presumed	Circular fea	70
192	105275	A3640	20150411	20150411	N	U-Unknow	Presumed	Circular fea	90
163	105485	A3830	19790623	19790623	N	U-Unknow	Presumed	Circular fea	60
338	105641	A3977	19760627	19760627	N	U-Unknow	Presumed	Circular fea	60
9	105725	81730	186XXXXX	186XXXXX	N	U-Unknow	Presumed	Circular fea	90
23	105741	A5571	19470601	19470601	N	U-Unknow	Presumed	Non-specif	30
21	105826	A4149	19740430	19740430	N	U-Unknow	Presumed	Circular fea	90
1	106610	A4917	19580506	19580506	N	U-Unknow	Presumed	Non-specif	30
2	106616	28885	19350416	19350416	N	U-Unknow	Presumed	Circular fea	90
3	106625	A4929	19831111	19831111	N	U-Unknow	Presumed	Non-specif	30
4	106627	78478	19860309	19860309	N	U-Unknow	Presumed	Non-specif	30
5	106628	A4931	19490406	19490406	N	U-Unknow	Presumed	Circular fea	80
11	106648	A4953	20161206	20161206	N	U-Unknow	Presumed	Specific bo	10
290	107309	A5572	20150725	20150725	N	U-Unknow	Presumed	Specific bo	10
2020	108566	A6795	20160630	20160630	N	A-Excellent	Presumed	Specific bo	20
42	110013	A8232	20150506	20150506	N	B-Good	Presumed	Specific bo	10
22	110231	A8441	19740327	19740327	N	U-Unknow	Presumed	Non-specif	30
23	110232	A8442	20150505	20150505	N	A-Excellent	Presumed	Specific bo	10
24	110234	A8444	2010XXXX	2010XXXX	N	U-Unknow	Presumed	Specific bo	20
25	110235	A8445	2010XXXX	2010XXXX	N	U-Unknow	Presumed	Specific bo	10
26	110236	A8446	2011XXXX	2011XXXX	N	U-Unknow	Presumed	Specific bo	20
27	110237	A8447	2011XXXX	2011XXXX	N	U-Unknow	Presumed	Specific bo	10
31	110242	A8452	20170321	20170321	N	U-Unknow	Presumed	Specific bo	10
20	110335	A8232	20150505	20150505	N	C-Fair	Presumed	Specific bo	10
82	111516	A9658	20170321	20170321	N	U-Unknow	Presumed	Specific bo	10
6	111608	A9753	20180504	20180504	N	C-Fair	Presumed	Specific bo	10
7	111609	A9754	20180504	20180504	N	C-Fair	Presumed	Specific bo	10
8	111610	A9755	20170907	20170907	N	A-Excellent	Presumed	Specific bo	20
9	111702	A9838	20170301	20170301	N	U-Unknow	Presumed	Circular fea	50
395	113155	B1260	20170531	20170531	N	U-Unknow	Presumed	Specific bo	20
396	113156	B1261	20170531	20170531	N	U-Unknow	Presumed	Specific bo	10
5	114073	6717	19550716	19550716	N	U-Unknow	Presumed	Circular fea	90
999	114445	B2516	20100124	20100124	N	U-Unknow	Presumed	Circular fea	40
397	114709	B2775	20170831	20170831	N	C-Fair	Presumed	Specific bo	10
13	114712	B2778	20180702	20180702	N	B-Good	Presumed	Non-specif	30
14	114713	B2779	20180616	20180616	N	A-Excellent	Presumed	Non-specif	30
580	114715	B2781	20170721	20170721	N	A-Excellent	Presumed	Specific bo	10
15	114736	B2802	20180601	20180601	N	A-Excellent	Presumed	Non-specif	30
16	114738	B2803	20180725	20180725	N	B-Good	Presumed	Non-specif	30
398	114743	B2809	20170725	20170725	N	B-Good	Presumed	Specific bo	10
46	115014	B3091	19921025	19921025	N	U-Unknow	Presumed	Non-specif	30
399	116586	B3673	20150504	20150504	N	U-Unknow	Presumed	Specific bo	10
400	116588	B3676	20150630	20150630	N	U-Unknow	Presumed	Specific bo	10
20	117170	B4243	20190602	20190602	N	B-Good	Presumed	Specific bo	20
401	117253	B4325	20170314	20170314	N	B-Good	Presumed	Specific bo	10
1	118236	76077	19930701	19930701	N	U-Unknow	Presumed	Specific bo	20

EEC ORIGINAL PKG

1	118239	B5349	197209XX	197209XX	N	U-Unknow	Presumed	Non-specif	30
1	118240	B5349	19820915	19820915	N	U-Unknow	Presumed	Non-specif	30
1	118258	B5349	19880912	19880912	N	U-Unknow	Presumed	Non-specif	30
1	118271	B5349	20080603	20080603	N	U-Unknow	Presumed	Non-specif	30
1	118339	B5349	19881010	19881010	N	U-Unknow	Presumed	Non-specif	30
1	118355	B5349	19720409	19720409	N	U-Unknow	Presumed	Non-specif	30

Trend	OccType	County	Quad	Elevation	Latitude	Longitude	UTM	PLSS	Location
Unknown	Natural/Na	Imperial	Borrego M	10	33.10192	-116.048	Zone-11 N	T12S, R09E	BAILEYS WI
Stable	Natural/Na	Imperial	Bard (3211	275	32.8462	-114.506	Zone-11 N	T15S, R23E	"THREE C D
Unknown	Natural/Na	Imperial	Ogilby (321	560	32.83105	-114.779	Zone-11 N	T15S, R21E	"SOUTH OF
Unknown	Natural/Na	Imperial	Ogilby (321	720	32.83464	-114.78	Zone-11 N	T15S, R21E	"CARGO M
Unknown	Natural/Na	Imperial	Ogilby (321	880	32.8375	-114.775	Zone-11 N	T15S, R21E	"NE OF CAF
Unknown	Natural/Na	Imperial	Ogilby (321	600	32.84153	-114.792	Zone-11 N	T15S, R21E	"PADRE MA
Unknown	Natural/Na	Imperial	Ogilby (321	880	32.8553	-114.765	Zone-11 N	T15S, R21E	"GUADALU
Unknown	Natural/Na	Imperial	Ogilby (321	740	32.85575	-114.786	Zone-11 N	T15S, R21E	"TYBO MIN
Unknown	Natural/Na	Imperial	Coyote We	375	32.7133	-115.965	Zone-11 N	T16.5S, R1(	0.6 MILE S(
Unknown	Natural/Na	Imperial	Coyote We	300	32.71895	-115.959	Zone-11 N	T16.5S, R1(	JUST SOUT
Unknown	Natural/Na	Imperial	Ogilby (321	720	32.83483	-114.779	Zone-11 N	T15S, R21E	CARGO MI
Unknown	Natural/Na	Imperial	Ogilby (321	680	32.87532	-114.816	Zone-11 N	T15S, R20E	CROWN MI
Unknown	Natural/Na	Imperial	Hedges (32	720	32.8846	-114.82	Zone-11 N	T15S, R20E	QUEEN MII
Unknown	Natural/Na	Imperial	Blue Moun	1200	33.12992	-115.06	Zone-11 N	T12S, R18E	"MARY LOD
Unknown	Natural/Na	Imperial	Obsidian B	-230	33.14022	-115.658	Zone-11 N	T12S, R13E	UNNAMED
Unknown	Natural/Na	Imperial	Obsidian B	-230	33.16208	-115.64	Zone-11 N	T12S, R13E	MOUTH OF
Unknown	Natural/Na	Imperial	Frink (3311	-226	33.35546	-115.705	Zone-11 N	T09S, R12E	INSHORE P
Unknown	Natural/Na	Imperial	Wister (331	-230	33.28507	-115.605	Zone-11 N	T10S, R13E	NILAND LA
Unknown	Natural/Na	Imperial	Wister (331	-230	33.29209	-115.611	Zone-11 N	T10S, R13E	INSHORE P
Unknown	Natural/Na	Imperial	Wister (331	-230	33.3018	-115.616	Zone-11 N	T10S, R13E	INSHORE P
Unknown	Natural/Na	Imperial	Wister (331	-230	33.30878	-115.623	Zone-11 N	T10S, R13E	INSHORE P
Unknown	Natural/Na	Imperial	Wister (331	-230	33.30642	-115.618	Zone-11 N	T10S, R13E	MOUTH OF
Unknown	Natural/Na	Imperial	Ogilby (321	550	32.83702	-114.819	Zone-11 N	T15S, R20E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Obsidian B	-235	33.17313	-115.642	Zone-11 N	T11S, R13E	SALTON SE
Unknown	Natural/Na	Imperial	Niland (331	-235	33.22531	-115.609	Zone-11 N	T11S, R13E	MULLET ISI
Unknown	Natural/Na	Imperial	Coyote We	340	32.67256	-115.895	Zone-11 N	T17S, R11E	6 AIR MILE
Fluctuating	Natural/Na	Imperial | I	Grays Well	200	32.90611	-115.061	Zone-11 N	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial | I	Grays Well	220	32.7278	-114.782	Zone-11 N	T16S, R21E	SE CORNER
Stable	Natural/Na	Imperial | I	Grays Well	300	32.92889	-115.075	Zone-11 N	T14S, R18E	ALGODONI
Increasing	Natural/Na	Imperial	Grays Well	300	32.91623	-115.089	Zone-11 N	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial | I	Grays Well NE (32114€		32.92004	-115.064	Zone-11 N	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Mt. Barrow	1120	33.18913	-114.912	Zone-11 N	T11S, R20E	3.5 MILES I
Unknown	Natural/Na	Imperial	Calipatria S	-230	33.10356	-115.693	Zone-11 N	T12S, R12E	INSHORE P
Unknown	Natural/Na	Imperial	Calipatria S	-230	33.11027	-115.683	Zone-11 N	T12S, R12E	INSHORE P
Unknown	Natural/Na	Imperial	Calipatria S	-230	33.0954	-115.718	Zone-11 N	T12S, R12E	TRIFOLIUM
Unknown	Natural/Na	Imperial	Calipatria S	-230	33.09727	-115.727	Zone-11 N	T12S, R12E	TRIFOLIUM
Unknown	Natural/Na	Imperial	El Centro (3	2	32.75997	-115.612	Zone-11 N	T16S, R13E	ALONG THI
Unknown	Natural/Na	Imperial | I	Mt. Barrow	1400	33.29899	-115.219	Zone-11 N	T10S, R17E	CHOCOLAT
Unknown	Natural/Na	Imperial	Kane Spring	150	33.00798	-115.825	Zone-11 N	T13S, R11E	E OF BORR
Unknown	Natural/Na	Imperial | /	Imperial Re	60	32.91126	-114.476	Zone-11 N	T14S, R24E	COLORADC
Unknown	Natural/Na	Imperial	Yuha Basin	110	32.67708	-115.764	Zone-11 N	T17S, R12E	PINTO WAS

Unknown	Natural/Na	Imperial	Kane Spring	-230	33.13949	-115.792	Zone-11 N:	T12S, R11E	SAN FELIPE
Unknown	Natural/Na	Imperial	East of Aco	650	33.10237	-115.057	Zone-11 N:	T12S, R18E	S END CHO
Unknown	Natural/Na	Imperial	Shell Reef (	120	33.22203	-116.042	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial | /	Laguna Dar	160	32.85427	-114.486	Zone-11 N:	T15S, R24E	VICINITY O
Unknown	Natural/Na	Imperial	Iris (33115:	20	33.16121	-115.387	Zone-11 N:	T12S, R15E	W SIDE CO.
Unknown	Natural/Na	Imperial	Midway W	95	32.70512	-115.172	Zone-11 N:	T17S, R18E	ALL AMERI
Unknown	Natural/Na	Imperial | /	Picacho NV	220	33.2618	-114.688	Zone-11 N:	T10S, R22E	VICINITY O
Unknown	Natural/Na	Imperial	Little Chucl	1200					*SENSITIVE
Decreasing	Natural/Na	Imperial | /	Laguna Dar	180	32.88393	-114.471	Zone-11 N:	T15S, R24E	IMPERIAL F
Decreasing	Natural/Na	Imperial	Bard (3211	160	32.83245	-114.544	Zone-11 N:	T15S, R23E	SOUTH SID
Increasing	Natural/Na	Imperial	Picacho (3:	200	33.02259	-114.612	Zone-11 N:	T13S, R22E	PICACHO S
Unknown	Natural/Na	Imperial	Kane Spring	-230	33.12729	-115.781	Zone-11 N:	T12S, R11E	TRIFOLIUM
Unknown	Natural/Na	Imperial | /	Yuma West	120	32.74698	-114.7	Zone-11 N:	T16S, R22E	FORT YUM/
Unknown	Natural/Na	Imperial	Coyote We	340	32.67364	-115.896	Zone-11 N:	T17S, R11E	BLM CRUCI
Unknown	Natural/Na	Imperial	Coyote We	850	32.63938	-115.952	Zone-11 N:	T17S, R10E	SKULL CAN
Unknown	Natural/Na	Imperial	Ogilby (321	240	32.7542	-114.824	Zone-11 N:	T16S, R20E	ABOUT 0.8
Unknown	Natural/Na	Imperial	Ogilby (321	220	32.7574	-114.84	Zone-11 N:	T16S, R20E	INTERSECT
Unknown	Natural/Na	Imperial	Ogilby (321	240	32.77837	-114.853	Zone-11 N:	T16S, R20E	PILOT KNO
Unknown	Natural/Na	Imperial	Coyote We	280	32.73672	-115.964	Zone-11 N:	T16S, R10E	NEAR COY(
Unknown	Natural/Na	Imperial | !	In-ko-pah Gorge (3211		32.69118	-116.101	Zone-11 N:	T17S, R09E	NORTH OF
Unknown	Natural/Na	Imperial	Picacho Pe.	490	32.98063	-114.636	Zone-11 N:	T14S, R22E	IN LITTLE P
Unknown	Natural/Na	Imperial	Laguna Dar	160	32.85548	-114.491	Zone-11 N:	T15S, R24E	BETWEEN /
Unknown	Natural/Na	Imperial | /	Laguna Dar	160	32.85092	-114.484	Zone-11 N:	T15S, R24E	ALONG THE
Unknown	Natural/Na	Imperial	Coyote We	280	32.73672	-115.964	Zone-11 N:	T16S, R10E	COYOTE W
Unknown	Natural/Na	Imperial	Brawley NV	150	32.91593	-115.748	Zone-11 N:	T14S, R12E	1 MILE NOI
Unknown	Natural/Na	Imperial	Brawley NV	140	32.93046	-115.75	Zone-11 N:	T14S, R12E	10.5 MILES
Unknown	Natural/Na	Imperial	Kane Spring	150	33.00989	-115.79	Zone-11 N:	T13S, R11E	E OF BORR
Unknown	Natural/Na	Imperial	Brawley NV	100	32.95168	-115.733	Zone-11 N:	T14S, R12E	ALONG RO.
Unknown	Natural/Na	Imperial	Kane Spring	15	33.233	-115.991	Zone-11 N:	T11S, R09E	ALONG JEE
Unknown	Natural/Na	Imperial	Ninemile Wash (33114		33.13277	-114.99	Zone-11 N:	T12S, R19E	CHOCOLAT
Unknown	Natural/Na	Imperial	Picacho Peak (321148(		33.11536	-114.764	Zone-11 N:	T12S, R21E	PICHACO P
Unknown	Natural/Na	Imperial | I	East of Acolita (33115:		33.31808	-115.309	Zone-11 N:	T10S, R16E	CHOCOLAT
Increasing	Natural/Na	Imperial | I	In-ko-pah (	2000	32.66183	-116.06	Zone-11 N:	T17S, R09E	PINTO/INK
Stable	Natural/Na	Imperial | !	Coyote We	2300	32.6954	-116.093	Zone-11 N:	T17S, R09E	TIERRA BL/
Decreasing	Natural/Na	Imperial	Picacho (3:	195	33.02259	-114.612	Zone-11 N:	T13S, R22E	PICACHO S
Unknown	Natural/Na	Imperial	Picacho (3:	200	33.02259	-114.612	Zone-11 N:	T13S, R22E	PICACHO S
Decreasing	Natural/Na	Imperial	Bard (3211	145	32.82968	-114.539	Zone-11 N:	T15S, R23E	ALL AMERI
Decreasing	Natural/Na	Imperial	Bard (3211	145	32.82968	-114.539	Zone-11 N:	T15S, R23E	ALL AMERI
Decreasing	Natural/Na	Imperial	Picacho (3:	195	33.02259	-114.612	Zone-11 N:	T13S, R22E	PICACHO S
Decreasing	Natural/Na	Imperial	Bard (3211	150	32.82968	-114.539	Zone-11 N:	T15S, R23E	ALL AMERI
Decreasing	Natural/Na	Imperial	Picacho (3:	195	33.02259	-114.612	Zone-11 N:	T13S, R22E	PICACHO S
Decreasing	Natural/Na	Imperial	Bard (3211	145	32.83243	-114.539	Zone-11 N:	T15S, R23E	NORTH & S
Unknown	Natural/Na	Imperial	Picacho (3:	195	33.02259	-114.612	Zone-11 N:	T13S, R22E	PICACHO S
Decreasing	Natural/Na	Imperial	Bard (3211	150	32.82968	-114.539	Zone-11 N:	T15S, R23E	ALL AMERI
Unknown	Natural/Na	Imperial	Picacho (3:	195	33.02331	-114.613	Zone-11 N:	T13S, R22E	VICINITY O
Stable	Natural/Na	Imperial	Niland (331	-215	33.27344	-115.584	Zone-11 N:	T10S, R13E	WISTER UN
Stable	Natural/Na	Imperial	Calipatria S	-235	33.09439	-115.706	Zone-11 N:	T12S, R12E	BRUCHARD

Unknown	Natural/Na	Imperial | /	Picacho (33	190	33.02696	-114.606	Zone-11 N:	T99X, R99X	IMPERIAL N
Stable	Natural/Na	Imperial | /	Laguna Dar	150	32.85535	-114.484	Zone-11 N:	T15S, R24E	COLORADC
Decreasing	Natural/Na	Imperial | /	Yuma East	125	32.73544	-114.659	Zone-11 N:	T16S, R22E	COLORADC
Unknown	Natural/Na	Imperial | /	Picacho NV	200	33.17959	-114.679	Zone-11 N:	T11S, R22E	COLORADC
Fluctuating	Natural/Na	Imperial | /	Cibola (331	220	33.32083	-114.716	Zone-11 N:	T10S, R21E	NORTHERN
Unknown	Natural/Na	Imperial	Brawley NV	150	32.95448	-115.763	Zone-11 N:	T14S, R12E	ALONG HU
Unknown	Natural/Na	Imperial	Yuha Basin	100	32.73324	-115.817	Zone-11 N:	T16S, R11E	SHELL BEDS
Unknown	Natural/Na	Imperial	Glamis SW	100	32.79365	-115.216	Zone-11 N:	T16S, R17E	EAST MESA
Unknown	Natural/Na	Imperial	Mount Sigr	50	32.67531	-115.712	Zone-11 N:	T17S, R12E	FROM US /
Decreasing	Natural/Na	Imperial | I	Quartz Peak (3311417		33.39605	-115.152	Zone-11 N:	T09S, R17E	CHUCKWAI
Fluctuating	Natural/Na	Imperial	Kane Spring	-150	33.1027	-115.904	Zone-11 N:	T12S, R10E	SAN FELIPE
Decreasing	Natural/Na	Imperial | I	Cibola (331	230	33.42004	-114.726	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial | S	Shell Reef (	240	33.23291	-116.096	Zone-11 N:	T11S, R08E	BASIN WAS
Unknown	Natural/Na	Imperial	Shell Reef (	100	33.22885	-116.033	Zone-11 N:	T11S, R09E	BETWEEN /
Unknown	Natural/Na	Imperial | S	Carrizo Mtı	560	32.87009	-116.156	Zone-11 N:	T15S, R08E	CARRIZO V.
Unknown	Natural/Na	Imperial	Bard (3211	145	32.82968	-114.539	Zone-11 N:	T15S, R23E	SOUTH SID
Unknown	Natural/Na	Imperial	Imperial Reservoir (32		32.9915	-114.502	Zone-11 N:	T14S, R24E	NORTH ENI
Decreasing	Natural/Na	Imperial	Laguna Dar	140	32.8514	-114.491	Zone-11 N:	T15S, R24E	JUST EAST
Unknown	Natural/Na	Imperial	Cibola (331	215	33.26573	-114.677	Zone-11 N:	T10S, R22E	NE OF THR
Decreasing	Natural/Na	Imperial	Picacho SW	190	33.03948	-114.65	Zone-11 N:	T13S, R22E	BEND OF R
Unknown	Natural/Na	Imperial	Harpers W	-125	33.09571	-115.936	Zone-11 N:	T12S, R10E	SAN SEBAS
Unknown	Natural/Na	Imperial	Yuma West	230	32.74592	-114.736	Zone-11 N:	T16S, R21E	6 MILES WI
Unknown	Natural/Na	Imperial	Midway W	145	32.70782	-115.016	Zone-11 N:	T17S, R19E	25 MILES V
Unknown	Natural/Na	Imperial	Glamis NW	70	32.97026	-115.256	Zone-11 N:	T14S, R17E	16 MILES E
Unknown	Natural/Na	Imperial	Coyote We	400	32.73846	-115.995	Zone-11 N:	T16S, R09E	NEAR OCOT
Unknown	Natural/Na	Imperial	Carrizo Mtı	400	32.87931	-116.065	Zone-11 N:	T15S, R09E	2 MILES EA
Unknown	Natural/Na	Imperial	Carrizo Mtı	1000	32.94865	-116.056	Zone-11 N:	T14S, R09E	RED ROCK
Unknown	Natural/Na	Imperial	Carrizo Mtı	430	32.87899	-116.093	Zone-11 N:	T15S, R09E	CARRIZO IN
Unknown	Natural/Na	Imperial	Ogilby (321	240	32.76411	-114.837	Zone-11 N:	T16S, R20E	VICINITY O
Unknown	Natural/Na	Imperial	Kane Spring	-156	33.18648	-115.854	Zone-11 N:	T11S, R11E	1 MILE WE:
Unknown	Natural/Na	Imperial	Yuha Basin	290	32.67335	-115.831	Zone-11 N:	T17S, R11E	YUHA CUT-
Unknown	Natural/Na	Imperial	Glamis NW	83	32.94116	-115.234	Zone-11 N:	T14S, R17E	N PORTION
Unknown	Natural/Na	Imperial	Coyote We	400	32.65658	-115.882	Zone-11 N:	T17S, R11E	APPROXIM
Unknown	Natural/Na	Imperial	In-ko-pah (	1950	32.67528	-116.075	Zone-11 N:	T17S, R09E	ALONG THI
Unknown	Natural/Na	Imperial	Ogilby (321	720	32.881	-114.823	Zone-11 N:	T15S, R20E	TUMCO W/
Unknown	Natural/Na	Imperial	In-ko-pah (	1840	32.67177	-116.058	Zone-11 N:	T17S, R09E	IN MYER V/
Unknown	Natural/Na	Imperial	In-ko-pah (	3640	32.63744	-116.098	Zone-11 N:	T18S, R09E	ALONG SM
Unknown	Natural/Na	Imperial	Blue Moun	1200	33.12992	-115.06	Zone-11 N:	T12S, R18E	"MARY LOI
Unknown	Natural/Na	Imperial	Calipatria S	-230	33.10046	-115.752	Zone-11 N:	T12S, R12E	POE LATER
Unknown	Natural/Na	Imperial	Kane Spring	-230	33.15708	-115.805	Zone-11 N:	T12S, R11E	TRIFOLIUM
Unknown	Natural/Na	Imperial	Kane Spring	-230	33.14731	-115.795	Zone-11 N:	T12S, R11E	TRIFOLIUM
Unknown	Natural/Na	Imperial	Kane Spring	-230	33.15494	-115.796	Zone-11 N:	T12S, R11E	INSHORE P
Unknown	Natural/Na	Imperial	Kane Spring	-230	33.10962	-115.758	Zone-11 N:	T12S, R12E	DRAINS BET
Unknown	Natural/Na	Imperial	Obsidian B	-225	33.17074	-115.632	Zone-11 N:	T11S, R13E	MOUTH OF
Unknown	Natural/Na	Imperial	Niland (331	-230	33.1764	-115.624	Zone-11 N:	T11S, R13E	VAIL LATER
Unknown	Natural/Na	Imperial | S	In-ko-pah (	2950	32.67397	-116.106	Zone-11 N:	T17S, R08E	MOUNTAIN
Unknown	Natural/Na	Imperial	Lion Head I	1200	33.26836	-115.264	Zone-11 N:	T10S, R16E	OLD RANCH

Unknown	Natural/Na	Imperial	Pegleg Well (3311532)		33.34367	-115.206	Zone-11 N:	T09S, R17E	SALVATION
Unknown	Natural/Na	Imperial	Lion Head I	900	33.30732	-115.353	Zone-11 N:	T10S, R16E	LION HEAD
Unknown	Natural/Na	Imperial	Lion Head Mtn. (3311!		33.35417	-115.324	Zone-11 N:	T09S, R16E	BEAL WELL
Unknown	Natural/Na	Imperial	Blue Mountain (33115		33.17089	-115.07	Zone-11 N:	T11S, R18E	AERIAL GU
Unknown	Natural/Na	Imperial | /	Cibola (331	225	33.37676	-114.722	Zone-11 N:	T09S, R21E	ABOUT 4 M
Unknown	Natural/Na	Imperial	Harpers W	100	33.09739	-115.935	Zone-11 N:	T12S, R10E	VICINITY O
Unknown	Natural/Na	Imperial	Kane Sprin	150	33.19378	-115.885	Zone-11 N:	T11S, R10E	"BARCHAN
Unknown	Natural/Na	Imperial	Kane Sprin	150	33.19378	-115.885	Zone-11 N:	T11S, R10E	"BARCHAN
Unknown	Natural/Na	Imperial	Superstitio	160	32.92615	-115.794	Zone-11 N:	T14S, R11E	2.5 AIR MIL
Unknown	Natural/Na	Imperial	Brawley NV	150	32.90439	-115.746	Zone-11 N:	T14S, R12E	NORTH OF
Unknown	Natural/Na	Imperial	Brawley NV	50	32.91893	-115.715	Zone-11 N:	T14S, R12E	3.5 MILES S
Unknown	Natural/Na	Imperial	Kane Sprin	22	33.17725	-115.891	Zone-11 N:	T11S, R10E	6 MILES NV
Unknown	Natural/Na	Imperial	Kane Sprin	-148	33.08966	-115.787	Zone-11 N:	T12S, R11E	APPROX 1.:
Unknown	Natural/Na	Imperial	Kane Sprin	-150	33.09365	-115.824	Zone-11 N:	T12S, R11E	APPROXIM
Unknown	Natural/Na	Imperial	Kane Sprin	-155	33.10814	-115.854	Zone-11 N:	T12S, R11E	APPROXIM
Unknown	Natural/Na	Imperial	Superstitio	220	32.97558	-115.842	Zone-11 N:	T14S, R11E	0.25 MILE \
Unknown	Natural/Na	Imperial	Shell Reef (	110	33.15337	-116.032	Zone-11 N:	T12S, R09E	BETWEEN S
Unknown	Natural/Na	Imperial	Painted Go	165	32.78571	-115.888	Zone-11 N:	T16S, R10E	2 MI W OF
Unknown	Natural/Na	Imperial	Carrizo Mtı	800	32.77076	-116.079	Zone-11 N:	T16S, R09E	ALONG CO
Unknown	Natural/Na	Imperial	Yuha Basin	110	32.67708	-115.764	Zone-11 N:	T17S, R12E	PINTO WAS
Unknown	Natural/Na	Imperial	Harpers W	-90	33.12699	-115.895	Zone-11 N:	T12S, R10E	APPROX 1C
Unknown	Natural/Na	Imperial	Kane Sprin	-180	33.10606	-115.82	Zone-11 N:	T12S, R11E	0.8 MI SE C
Unknown	Natural/Na	Imperial	Kane Sprin	-180	33.11651	-115.851	Zone-11 N:	T12S, R11E	0.6-0.7 MIL
Unknown	Natural/Na	Imperial	Kane Sprin	-230	33.1427	-115.785	Zone-11 N:	T12S, R11E	JUST NORT
Unknown	Natural/Na	Imperial	Niland (331	-235	33.20074	-115.591	Zone-11 N:	T11S, R13E	JUST NORT
Unknown	Natural/Na	Imperial	Grays Well	253	32.75401	-114.802	Zone-11 N:	T16S, R21E	ALONG I-8,
Unknown	Natural/Na	Imperial | /	Yuma East (3211465) |		32.73269	-114.633	Zone-11 N:	T16S, R22E	YUMA, COI
Unknown	Natural/Na	Imperial	Clyde (321	390	32.92059	-114.989	Zone-11 N:	T14S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Clyde (321	390	32.92559	-114.997	Zone-11 N:	T14S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	400	32.9042	-115.014	Zone-11 N:	T14S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	400	32.89865	-115.02	Zone-11 N:	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	300	32.94198	-115.058	Zone-11 N:	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	300	32.88754	-115.011	Zone-11 N:	T15S, R19E	ALGODDOI
Unknown	Natural/Na	Imperial	Acolita (33	200	33.05558	-115.232	Zone-11 N:	T13S, R17E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	400	32.87809	-115.004	Zone-11 N:	T15S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	350	32.88614	-115.029	Zone-11 N:	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	400	32.91031	-115.03	Zone-11 N:	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32	360	32.92833	-115.043	Zone-11 N:	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Cactus (32	200	32.79	-114.926	Zone-11 N:	T16S, R20E	ALGODONI
Unknown	Natural/Na	Imperial	Ogilby (321	200	32.75699	-114.861	Zone-11 N:	T16S, R20E	ALGODONI
Unknown	Natural/Na	Imperial	Amos (331	225	33.09809	-115.292	Zone-11 N:	T12S, R16E	ALGODONI
Unknown	Natural/Na	Imperial	Cactus (32	280	32.81309	-114.9	Zone-11 N:	T15S, R20E	ALGODONI
Unknown	Natural/Na	Imperial	Cactus (32	300	32.81531	-114.946	Zone-11 N:	T15S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Cactus (32	300	32.83238	-114.915	Zone-11 N:	T15S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Clyde (321	330	32.89587	-114.977	Zone-11 N:	T14S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Cactus (32	350	32.86697	-114.942	Zone-11 N:	T15S, R19E	ALGODONI
Unknown	Natural/Na	Imperial	Amos (331	210	33.1178	-115.275	Zone-11 N:	T12S, R16E	ALGODONI

Unknown	Natural/Na	Imperial	Acolita (33	250	33.07507	-115.212	Zone-11 N:	T12S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Amos (331	220	33.10752	-115.264	Zone-11 N:	T12S, R16E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	320	32.95182	-115.05	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	350	32.9324	-115.013	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	340	32.95121	-115.034	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	360	32.92253	-115.012	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	340	32.96364	-115.038	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Amos (331	220	33.10752	-115.264	Zone-11 N:	T12S, R16E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	340	32.86697	-114.942	Zone-11 N:	T15S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Acolita (33	250	33.07507	-115.212	Zone-11 N:	T12S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Acolita (33	175	33.00352	-115.192	Zone-11 N:	T13S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Acolita (33	200	33.05558	-115.232	Zone-11 N:	T13S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Amos (331	240	33.09809	-115.292	Zone-11 N:	T12S, R16E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis SE (	200	32.86225	-115.067	Zone-11 N:	T15S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	280	32.91558	-115.119	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	400	32.9324	-115.013	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	360	32.92253	-115.012	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	300	32.81531	-114.946	Zone-11 N:	T15S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Ogilby (321	205	32.75699	-114.861	Zone-11 N:	T16S, R20E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	280	32.81309	-114.9	Zone-11 N:	T15S, R20E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	310	32.83238	-114.915	Zone-11 N:	T15S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Clyde (321:	380	32.92059	-114.989	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	340	32.95121	-115.034	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Acolita (33	260	33.04141	-115.162	Zone-11 N:	T13S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Amos (331	220	33.10752	-115.264	Zone-11 N:	T12S, R16E	ALGODONE
Unknown	Natural/Na	Imperial	Acolita (33	250	33.07507	-115.212	Zone-11 N:	T12S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Acolita (33	180	33.00352	-115.192	Zone-11 N:	T13S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Acolita (33	200	33.05558	-115.232	Zone-11 N:	T13S, R17E	ALGODONE
Unknown	Natural/Na	Imperial	Amos (331	220	33.09809	-115.292	Zone-11 N:	T12S, R16E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis SE (	115	32.83642	-115.114	Zone-11 N:	T15S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	160	32.78837	-114.937	Zone-11 N:	T16S, R20E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis SE (	200	32.86225	-115.067	Zone-11 N:	T15S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	280	32.91558	-115.119	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	390	32.9324	-115.013	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	360	32.92253	-115.012	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	300	32.81531	-114.946	Zone-11 N:	T15S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	280	32.81309	-114.9	Zone-11 N:	T15S, R20E	ALGODONE
Unknown	Natural/Na	Imperial	Cactus (32:	300	32.83238	-114.915	Zone-11 N:	T15S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Clyde (321:	380	32.92059	-114.989	Zone-11 N:	T14S, R19E	ALGODONE
Unknown	Natural/Na	Imperial	Glamis (32:	340	32.95121	-115.034	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Obsidian Bı	-230	33.16224	-115.649	Zone-11 N:	T11S, R13E	VAIL LATER
Unknown	Natural/Na	Imperial | /	Imperial Re	190	33.00531	-114.502	Zone-11 N:	T13S, R24E	VICINITY O
Unknown	Natural/Na	Imperial	Yuma West	180	32.73188	-114.743	Zone-11 N:	T16S, R21E	PILOT KNO
Unknown	Natural/Na	Imperial	Seeley (321	-49	32.84726	-115.67	Zone-11 N:	T15S, R13E	6 MI W IMI
Unknown	Natural/Na	Imperial	Harpers W	-120	33.09648	-115.906	Zone-11 N:	T12S, R10E	VICINITY O
Unknown	Natural/Na	Imperial | /	Bard (3211	150	32.81121	-114.538	Zone-11 N:	T15S, R23E	2 TO 3 MI N
Unknown	Natural/Na	Imperial | :	Carrizo Mtı	440	32.87588	-116.101	Zone-11 N:	T15S, R09E	OLD CARRI:

Unknown	Natural/Na	Imperial | /	Yuma East	140	32.77133	-114.531	Zone-11 N:	T16S, R23E	ABOUT 5 M
Unknown	Natural/Na	Imperial	Pegleg Wel	1320	33.29255	-115.191	Zone-11 N:	T10S, R17E	SALVATION
Unknown	Natural/Na	Imperial | I	Palo Verde	230	33.43201	-114.736	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial	Picacho Pe	680	32.96216	-114.644	Zone-11 N:	T14S, R22E	PICACHO M
Unknown	Natural/Na	Imperial	Bard (3211	140	32.82248	-114.552	Zone-11 N:	T15S, R23E	2 MILES NO
Unknown	Natural/Na	Imperial	Imperial Re	400	32.89031	-114.482	Zone-11 N:	T15S, R24E	SENATOR M
Decreasing	Natural/Na	Imperial | /	Picacho SW	200	33.04766	-114.672	Zone-11 N:	T13S, R22E	JUST S OF H
Unknown	Natural/Na	Imperial | /	Laguna Dar	200	32.82892	-114.506	Zone-11 N:	T15S, R23E	POTHOLES.
Unknown	Natural/Na	Imperial	Hedges (32	620	32.93336	-114.852	Zone-11 N:	T14S, R20E	INDIAN WA
Unknown	Natural/Na	Imperial	Palo Verde	506	33.28753	-114.812	Zone-11 N:	T10S, R21E	MILPITAS V
Unknown	Natural/Na	Imperial | /	Picacho NV	220	33.23939	-114.687	Zone-11 N:	T11S, R22E	WALTERS C
Unknown	Natural/Na	Imperial	Cibola (331	225	33.33242	-114.71	Zone-11 N:	T10S, R21E	BETWEEN I
Unknown	Natural/Na	Imperial | /	Imperial Re	195	32.98307	-114.499	Zone-11 N:	T14S, R24E	FERGUSON
Unknown	Natural/Na	Imperial	Brawley (3:	-120	32.98392	-115.525	Zone-11 N:	T13S, R14E	BRAWLEY.
Unknown	Natural/Na	Imperial	Niland (331	-230	33.19475	-115.592	Zone-11 N:	T11S, R13E	WEST PONI
Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	POTHOLES,
Unknown	Natural/Na	Imperial	Calipatria S	-160	33.04142	-115.705	Zone-11 N:	T13S, R12E	5 MI W OF
Unknown	Natural/Na	Imperial	Bard (3211	135	32.77059	-114.587	Zone-11 N:	T16S, R23E	3 MILES EN
Unknown	Natural/Na	Imperial | /	Laguna Dar	-153	32.82561	-114.497	Zone-11 N:	T15S, R24E	LAGUNA DA
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	WESTMORI
Unknown	Natural/Na	Imperial	Hedges (32	620	32.93336	-114.852	Zone-11 N:	T14S, R20E	INDIAN WA
Unknown	Natural/Na	Imperial	Palo Verde	506	33.28753	-114.812	Zone-11 N:	T10S, R21E	MILPITAS V
Unknown	Natural/Na	Imperial	Glamis (32:	335	32.95226	-115.074	Zone-11 N:	T14S, R18E	THREE MI S
Unknown	Natural/Na	Imperial	Plaster City	100	32.79227	-115.86	Zone-11 N:	T16S, R11E	PLASTER CI
Unknown	Natural/Na	Imperial	Obsidian B	-235	33.14364	-115.739	Zone-11 N:	T12S, R12E	10 MI NW \
Unknown	Natural/Na	Imperial	Coyote We	420	32.69005	-115.908	Zone-11 N:	T17S, R10E	5 MILE SE C
Unknown	Natural/Na	Imperial	Kane Spring NW (3311		33.18003	-115.922	Zone-11 N:	T11S, R10E	7 MILES NE
Unknown	Natural/Na	Imperial	Ogilby (321	360	32.81754	-114.841	Zone-11 N:	T15S, R20E	OGILBY.
Unknown	Natural/Na	Imperial	Kane Sprin	-25	33.15782	-115.895	Zone-11 N:	T12S, R10E	5 MI NE KA
Unknown	Natural/Na	Imperial	Seventeen	280	33.2992	-116.045	Zone-11 N:	T10S, R09E	CORAL REE
Unknown	Natural/Na	Imperial	Westmorla	-160	33.0317	-115.625	Zone-11 N:	T13S, R13E	WESTMORI
Unknown	Natural/Na	Imperial | /	Laguna Dar	200	32.82892	-114.506	Zone-11 N:	T15S, R23E	POTHOLES,
Increasing	Natural/Na	Imperial	Picacho SW	190	33.06197	-114.684	Zone-11 N:	T13S, R22E	MOUTH OF
Increasing	Natural/Na	Imperial | /	Picacho SW	190	33.08296	-114.691	Zone-11 N:	T12S, R22E	UNNAMED
Increasing	Natural/Na	Imperial	Picacho SW	200	33.03059	-114.638	Zone-11 N:	T13S, R22E	TAYLOR LA
Increasing	Natural/Na	Imperial | /	Picacho SW	240	33.08448	-114.712	Zone-11 N:	T12S, R21E	MOUTH OF
Unknown	Natural/Na	Imperial | /	Imperial Re	195	32.98307	-114.499	Zone-11 N:	T14S, R24E	FERGUSON
Unknown	Natural/Na	Imperial	Cibola (331	225	33.33242	-114.71	Zone-11 N:	T10S, R21E	BETWEEN I
Decreasing	Natural/Na	Imperial | /	Cibola (331	230	33.35789	-114.7	Zone-11 N:	T09S, R21E	CIBOLA RE\
Unknown	Natural/Na	Imperial	Frink (3311	-220	33.35145	-115.73	Zone-11 N:	T09S, R12E	BOMBAY B
Unknown	Natural/Na	Imperial	Wister (33:	-199	33.31892	-115.612	Zone-11 N:	T10S, R13E	7 MI NW N
Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	POTHOLES.
Unknown	Natural/Na	Imperial | I	Calexico (3	10	32.66977	-115.496	Zone-11 N:	T17S, R14E	CALEXICO.
Unknown	Natural/Na	Imperial	Niland (331	-220	33.23864	-115.572	Zone-11 N:	T11S, R13E	3 MI W OF
Unknown	Natural/Na	Imperial | /	Cibola (331	230	33.34733	-114.714	Zone-11 N:	T09S, R21E	COLORADC
Unknown	Natural/Na	Imperial	Laguna Dar	160	32.85932	-114.49	Zone-11 N:	T15S, R24E	JUST E OF I
Unknown	Natural/Na	Imperial | /	Yuma East	140	32.77133	-114.531	Zone-11 N:	T16S, R23E	4 MILES DC

EEC ORIGINAL PKG

Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	POTHOLES.
Unknown	Natural/Na	Imperial	Hedges (32	620	32.93336	-114.852	Zone-11 N:	T14S, R20E	INDIAN WA
Unknown	Natural/Na	Imperial	Palo Verde	506	33.28753	-114.812	Zone-11 N:	T10S, R21E	MILPITAS V
Unknown	Natural/Na	Imperial	Niland (331	-200	33.19475	-115.592	Zone-11 N:	T11S, R13E	WEST PONI
Unknown	Natural/Na	Imperial	Wiest (331	-180	33.12947	-115.513	Zone-11 N:	T12S, R14E	CALIPATRIA
Unknown	Natural/Na	Imperial	Palo Verde	235	33.41585	-114.75	Zone-11 N:	T09S, R21E	1.5 MI SW (
Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	POTHOLES.
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	WESTMORI
Unknown	Natural/Na	Imperial | I	Palo Verde	230	33.43201	-114.736	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial | /	Imperial Re	195	32.98307	-114.499	Zone-11 N:	T14S, R24E	FERGUSON
Unknown	Natural/Na	Imperial	Cibola (331	225	33.33242	-114.71	Zone-11 N:	T10S, R21E	BETWEEN I
Unknown	Natural/Na	Imperial | /	Cibola (331	230	33.35789	-114.7	Zone-11 N:	T09S, R21E	CIBOLA REV
Unknown	Natural/Na	Imperial | /	Laguna Dar	200	32.88393	-114.471	Zone-11 N:	T15S, R24E	IMPERIAL D
Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	POTHOLES.
Unknown	Natural/Na	Imperial | /	Cibola (331	230	33.34733	-114.714	Zone-11 N:	T09S, R21E	COLORADC
Unknown	Natural/Na	Imperial | /	Yuma East	140	32.77133	-114.531	Zone-11 N:	T16S, R23E	4 MILES BE
Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	IN THE VICI
Unknown	Natural/Na	Imperial	Cibola (331	230	33.35643	-114.716	Zone-11 N:	T09S, R21E	ASU REVEG
Unknown	Natural/Na	Imperial	Bard (3211	140	32.80754	-114.592	Zone-11 N:	T15S, R23E	ALONG THE
Unknown	Natural/Na	Imperial	Imperial Re	195	32.98003	-114.502	Zone-11 N:	T14S, R24E	FERGUSON
Decreasing	Natural/Na	Imperial | /	Cibola (331	230	33.35789	-114.7	Zone-11 N:	T09S, R21E	CIBOLA REV
Unknown	Natural/Na	Imperial	Cibola (331	225	33.33242	-114.71	Zone-11 N:	T10S, R21E	BETWEEN I
Unknown	Natural/Na	Imperial	Calipatria S	-200	33.06609	-115.704	Zone-11 N:	T13S, R12E	ALONG VEI
Unknown	Natural/Na	Imperial	Westmorla	185	33.08919	-115.614	Zone-11 N:	T12S, R13E	ALONG GEI
Unknown	Natural/Na	Imperial | /	Picacho NV	220	33.23939	-114.687	Zone-11 N:	T11S, R22E	WALTERS (
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	WESTMORI
Unknown	Natural/Na	Imperial	Cibola (331	225	33.33242	-114.71	Zone-11 N:	T10S, R21E	BETWEEN I
Unknown	Natural/Na	Imperial | /	Yuma West	120	32.74698	-114.7	Zone-11 N:	T16S, R22E	LOWER RES
Unknown	Natural/Na	Imperial	Cibola (331	230	33.35921	-114.702	Zone-11 N:	T09S, R21E	"EUCALYPT
Unknown	Natural/Na	Imperial | /	Picacho NV	215	33.2549	-114.69	Zone-11 N:	T11S, R22E	VICINITY O
Unknown	Natural/Na	Imperial | /	Palo Verde	245	33.42538	-114.634	Zone-11 N:	T09S, R22E	0.6 MILE SC
Unknown	Natural/Na	Imperial | /	Picacho NV	210	33.1706	-114.682	Zone-11 N:	T11S, R22E	ALONG CO
Unknown	Natural/Na	Imperial | /	Picacho SW (3311416)		33.04708	-114.645	Zone-11 N:	T13S, R22E	ALONG CO
Unknown	Natural/Na	Imperial	Picacho NV	210	33.21586	-114.679	Zone-11 N:	T11S, R22E	NEAR GILM
Decreasing	Natural/Na	Imperial | /	Imperial Re	200	32.97114	-114.494	Zone-11 N:	T14S, R24E	SOUTHERN
Unknown	Natural/Na	Imperial | /	Yuma West	125	32.73559	-114.662	Zone-11 N:	T16S, R22E	1.7 MILES V
Unknown	Natural/Na	Imperial	Calipatria S	-220	33.12364	-115.693	Zone-11 N:	T12S, R12E	EIGHT MI N
Unknown	Natural/Na	Imperial	Niland (331	-190	33.22531	-115.609	Zone-11 N:	T11S, R13E	MULLET ISL
Unknown	Natural/Na	Imperial	Yuma West	120	32.74698	-114.647	Zone-11 N:	T16S, R22E	WEST PONI
Unknown	Natural/Na	Imperial	Iris (33115:	90	33.2193	-115.417	Zone-11 N:	T11S, R15E	W SIDE OF
Unknown	Natural/Na	Imperial	Iris (33115:	80	33.20224	-115.413	Zone-11 N:	T11S, R15E	W SIDE OF
Unknown	Natural/Na	Imperial	Amos (331	100	33.0889	-115.296	Zone-11 N:	T12S, R16E	W SIDE CO.
Unknown	Natural/Na	Imperial	Tortuga (3:	50	33.13364	-115.359	Zone-11 N:	T12S, R15E	MAMMOTI
Unknown	Natural/Na	Imperial	Tortuga (3:	60	33.14737	-115.365	Zone-11 N:	T12S, R15E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Tortuga (3:	60	33.1603	-115.373	Zone-11 N:	T12S, R15E	E SIDE OF H
Unknown	Natural/Na	Imperial	Amos (331	60	33.11928	-115.338	Zone-11 N:	T12S, R16E	AREA BETV
Unknown	Natural/Na	Imperial	Alamorio (:	100	32.92932	-115.421	Zone-11 N:	T14S, R15E	HOLTVILLE

Unknown	Natural/Na	Imperial	Niland (331	235	33.18329	-115.623	Zone-11 N:	T11S, R13E	ROCK HILL,
Unknown	Natural/Na	Imperial	Wiest (331	170	33.07481	-115.509	Zone-11 N:	T13S, R14E	RAMER & F
Unknown	Natural/Na	Imperial | /	Picacho SW	190	33.09642	-114.71	Zone-11 N:	T12S, R21E	COLORADC
Unknown	Natural/Na	Imperial	Bonds Corr	40	32.69837	-115.271	Zone-11 N:	T17S, R17E	ALL AMERI
Unknown	Natural/Na	Imperial	Seeley (321	80	32.82064	-115.703	Zone-11 N:	T15S, R12E	NEW RIVEF
Unknown	Natural/Na	Imperial | /	Palo Verde	230	33.40328	-114.727	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial	Palo Verde	240	33.42541	-114.685	Zone-11 N:	T09S, R22E	2.5 MI E OF
Unknown	Natural/Na	Imperial	Palo Verde	240	33.42541	-114.685	Zone-11 N:	T09S, R22E	2.5 MI E OF
Unknown	Natural/Na	Imperial	Bard (3211	160	32.83281	-114.544	Zone-11 N:	T15S, R23E	ALL AMERI
Unknown	Natural/Na	Imperial	Bard (3211	150	32.82642	-114.551	Zone-11 N:	T15S, R23E	ALL AMERI
Unknown	Natural/Na	Imperial	In-ko-pah (	3900					*SENSITIVE
Unknown	Natural/Na	Imperial	Borrego M	700					*SENSITIVE
Unknown	Natural/Na	Imperial	In-ko-pah (	3200					*SENSITIVE
Unknown	Natural/Na	Imperial	Picacho Pe	1100					*SENSITIVE
Unknown	Natural/Na	Imperial	Carrizo Mt	1800					*SENSITIVE
Unknown	Natural/Na	Imperial	Imperial Re	195	32.98264	-114.499	Zone-11 N:	T14S, R24E	VICINITY O
Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	ENCOMPAS
Unknown	Natural/Na	Imperial	Bard (3211	135	32.79004	-114.566	Zone-11 N:	T16S, R23E	5 MI NE OF
Unknown	Natural/Na	Imperial	Superstitio	200	32.97705	-115.827	Zone-11 N:	T14S, R11E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Coyote We	400	32.66492	-115.895	Zone-11 N:	T17S, R11E	N AND S OI
Unknown	Natural/Na	Imperial	Glamis (32	360	33.00507	-115.07	Zone-11 N:	T13S, R18E	GLAMIS, AI
Unknown	Natural/Na	Imperial	Shell Reef (	77	33.14048	-116.07	Zone-11 N:	T12S, R09E	0.6 MILE W
Unknown	Natural/Na	Imperial	Glamis SE (	115	32.77392	-115.132	Zone-11 N:	T16S, R18E	EAST MESA
Unknown	Natural/Na	Imperial	Brawley (3	-110	32.97893	-115.54	Zone-11 N:	T13S, R14E	100 YARDS
Unknown	Natural/Na	Imperial	Holtville Ea	-15	32.81449	-115.382	Zone-11 N:	T15S, R15E	HOLTVILLE
Unknown	Natural/Na	Imperial	Harpers W	-120	33.09648	-115.906	Zone-11 N:	T12S, R10E	HARPERS V
Unknown	Natural/Na	Imperial	Painted Go	180	32.79176	-115.919	Zone-11 N:	T16S, R10E	COYOTE W
Unknown	Natural/Na	Imperial	Seeley (321	60	32.86643	-115.649	Zone-11 N:	T15S, R13E	WIENERT R
Unknown	Natural/Na	Imperial	Heber (321	-15	32.6781	-115.642	Zone-11 N:	T17S, R13E	MOUNT SI
Unknown	Natural/Na	Imperial	Grays Well	155	32.74448	-114.964	Zone-11 N:	T16S, R19E	EAST MESA
Unknown	Natural/Na	Imperial	Glamis NW	100	32.96883	-115.221	Zone-11 N:	T14S, R17E	ALONG HIG
Unknown	Natural/Na	Imperial	Harpers W	-70	33.09275	-115.974	Zone-11 N:	T12S, R10E	ALONG SAI
Unknown	Natural/Na	Imperial	Holtville NI	30	32.90665	-115.286	Zone-11 N:	T14S, R16E	NEAR HIGH
Unknown	Natural/Na	Imperial	Durmid (33	-30	33.39221	-115.763	Zone-11 N:	T09S, R12E	RANGE RO
Unknown	Natural/Na	Imperial	Kane Spring	-90	33.1349	-115.891	Zone-11 N:	T12S, R10E	ABOUT 2 M
Unknown	Natural/Na	Imperial	Kane Spring	-110	33.15495	-115.866	Zone-11 N:	T12S, R11E	HWY 86, AI
Unknown	Natural/Na	Imperial	Kane Spring	50	33.14484	-115.973	Zone-11 N:	T12S, R10E	1.3 MILES I
Unknown	Natural/Na	Imperial	Kane Spring	40	33.12859	-115.977	Zone-11 N:	T12S, R10E	ALONG PO
Unknown	Natural/Na	Imperial	Cactus (32	300	32.81865	-115.015	Zone-11 N:	T15S, R19E	EAST OF CC
Unknown	Natural/Na	Imperial	Painted Go	200	32.86359	-115.925	Zone-11 N:	T15S, R10E	WEST MES
Unknown	Natural/Na	Imperial	Plaster City	70	32.97174	-115.943	Zone-11 N:	T14S, R10E	CARRIZO W
Unknown	Natural/Na	Imperial	Carrizo Mt	600	32.91115	-116.025	Zone-11 N:	T14S, R09E	SW OF FISH
Unknown	Natural/Na	Imperial	In-ko-pah (	1900					*SENSITIVE
Unknown	Natural/Na	Imperial	In-ko-pah (	1500					*SENSITIVE
Unknown	Natural/Na	Imperial	In-ko-pah (	1400					*SENSITIVE
Unknown	Natural/Na	Imperial	Painted Go	1600					*SENSITIVE
Unknown	Natural/Na	Imperial	In-ko-pah (	1500					*SENSITIVE

Unknown	Natural/Na	Imperial | /	Laguna Dar	160	32.85092	-114.484	Zone-11 N:	T15S, R24E	ALONG THE
Unknown	Natural/Na	Imperial | /	Laguna Dar	160	32.85092	-114.484	Zone-11 N:	T15S, R24E	ALONG THE
Unknown	Refugium;	Imperial	Buzzards P	600	33.19105	-114.758	Zone-11 N:	T11S, R21E	ARROWEED
Decreasing	Natural/Na	Imperial | /	Picacho NV	200	33.23939	-114.687	Zone-11 N:	T11S, R22E	WALTERS C
Decreasing	Natural/Na	Imperial	Iris (33115:	60	33.2453	-115.486	Zone-11 N:	T11S, R14E	EAST HIGH
Unknown	Natural/Na	Imperial	Imperial Re	300	32.90869	-114.482	Zone-11 N:	T14S, R24E	SENATOR V
Unknown	Natural/Na	Imperial	Laguna Dar	120	32.82587	-114.499	Zone-11 N:	T15S, R24E	IMMEDIATI
Unknown	Natural/Na	Imperial	In-ko-pah (	2680	32.65535	-116.085	Zone-11 N:	T17S, R09E	JUNIPER SF
Unknown	Natural/Na	Imperial	In-ko-pah (	3100	32.64255	-116.079	Zone-11 N:	T17S, R09E	MESQUITE
Unknown	Natural/Na	Imperial | I	In-ko-pah (	2740	32.63503	-116.056	Zone-11 N:	T18S, R09E	BOUNDARY
Unknown	Natural/Na	Imperial	In-ko-pah (	1880	32.66572	-116.075	Zone-11 N:	T17S, R09E	MORTERO
Unknown	Natural/Na	Imperial | S	Oasis (331:	200	33.40696	-116.082	Zone-11 N:	T09S, R09E	STEINS RES
Unknown	Natural/Na	Imperial | /	Picacho SW	190	33.03753	-114.673	Zone-11 N:	T13S, R22E	CARRIZO W
Unknown	Natural/Na	Imperial | /	Yuma West	120	32.73559	-114.662	Zone-11 N:	T16S, R22E	BETWEEN (
Decreasing	Natural/Na	Imperial | /	Picacho (33	190	33.02337	-114.596	Zone-11 N:	T13S, R23E	SOUTH SIDI
Unknown	Natural/Na	Imperial | /	Red Hill SW	190	33.00947	-114.504	Zone-11 N:	T13S, R23E	NORTH OF
Unknown	Natural/Na	Imperial	Imperial Re	180	32.98197	-114.501	Zone-11 N:	T14S, R24E	FERGUSON
Unknown	Natural/Na	Imperial | /	Bard (3211	140	32.78916	-114.534	Zone-11 N:	T16S, R23E	WEST SIDE
Unknown	Natural/Na	Imperial	Picacho NV	210	33.20412	-114.682	Zone-11 N:	T11S, R22E	WALKER LA
Unknown	Natural/Na	Imperial | /	Picacho NV	200	33.17959	-114.679	Zone-11 N:	T11S, R22E	COLORADO
Unknown	Natural/Na	Imperial | /	Picacho NV	200	33.17959	-114.679	Zone-11 N:	T11S, R22E	ALONG THE
Unknown	Natural/Na	Imperial | /	Picacho NV	200	33.17959	-114.679	Zone-11 N:	T11S, R22E	ALONG THE
Unknown	Natural/Na	Imperial | /	Picacho NV	200	33.17959	-114.679	Zone-11 N:	T11S, R22E	COLORADO
Unknown	Natural/Na	Imperial | /	Laguna Dar	160	32.85092	-114.484	Zone-11 N:	T15S, R24E	ALONG THE
Unknown	Natural/Na	Imperial	Ogilby (321	1000	32.8501	-114.789	Zone-11 N:	T15S, R21E	VICINITY O
Unknown	Natural/Na	Imperial	Ogilby (321	499	32.8674	-114.839	Zone-11 N:	T15S, R20E	3.5 MILES I
Unknown	Natural/Na	Imperial	Picacho Pe	720	32.9507	-114.786	Zone-11 N:	T14S, R21E	IN WASHES
Unknown	Natural/Na	Imperial	Ogilby (321	390	32.84061	-114.87	Zone-11 N:	T15S, R20E	ALONG RAI
Unknown	Natural/Na	Imperial	Ogilby (3211477) | He		32.8806	-114.816	Zone-11 N:	T15S, R20E	NEAR TUM
Unknown	Natural/Na	Imperial	Cactus (32:	400	32.86211	-114.889	Zone-11 N:	T15S, R20E	4.2 MILES I
Unknown	Natural/Na	Imperial	Quartz Pea	1000	33.05875	-114.789	Zone-11 N:	T13S, R21E	JULIAN WA
Unknown	Natural/Na	Imperial	Ninemile W	1000	33.12877	-114.882	Zone-11 N:	T12S, R20E	EAST OF BU
Unknown	Natural/Na	Imperial	Ninemile W	600	33.04581	-115.006	Zone-11 N:	T13S, R19E	5 MILES NC
Unknown	Natural/Na	Imperial	Quartz Pea	1000	33.00222	-114.781	Zone-11 N:	T13S, R21E	INDIAN PAS
Unknown	Natural/Na	Imperial	Laguna Dar	180	32.86992	-114.489	Zone-11 N:	T15S, R24E	APPROXIM
Unknown	Natural/Na	Imperial	Picacho NV	520	33.22867	-114.756	Zone-11 N:	T11S, R21E	>2 MILES E
Unknown	Natural/Na	Imperial	Mt. Barrow	1070	33.15555	-114.899	Zone-11 N:	T12S, R20E	WEST OF 4
Unknown	Natural/Na	Imperial	Palo Verde	1000	33.36363	-114.848	Zone-11 N:	T09S, R20E	NEAR FLAT
Unknown	Natural/Na	Imperial	Palo Verde	1500	33.33232	-114.776	Zone-11 N:	T10S, R21E	VICINITY O
Unknown	Natural/Na	Imperial	Coyote Wells (3211568		32.65694	-116.014	Zone-11 N:	T17S, R09E	DAVIES VAI
Unknown	Natural/Na	Imperial	Painted Gorge (32115:		32.83169	-116.016	Zone-11 N:	T15S, R09E	EASTERN S
Unknown	Natural/Na	Imperial	Carrizo Mtı	1000	32.79338	-116.026	Zone-11 N:	T16S, R09E	FOSSIL CAN
Unknown	Natural/Na	Imperial	Painted Gorge (32115:		32.80931	-115.984	Zone-11 N:	T16S, R10E	PAINTED G
Unknown	Natural/Na	Imperial	In-ko-pah (	4250	32.62181	-116.094	Zone-11 N:	T18S, R09E	AROUND T
Unknown	Natural/Na	Imperial | S	In-ko-pah (	2300	32.67397	-116.106	Zone-11 N:	T17S, R08E	MOUNTAIN
Unknown	Natural/Na	Imperial | S	In-ko-pah Gorge (3211		32.65897	-116.101	Zone-11 N:	T17S, R09E	DESERT TO
Unknown	Natural/Na	Imperial | S	In-ko-pah (	3600	32.64003	-116.099	Zone-11 N:	T17S, R09E	ON THE GR

Unknown	Natural/Na	Imperial	Carrizo Mtı	1000	32.79475	-116.024	Zone-11 N:	T16S, R09E	FOSSIL CAN
Unknown	Natural/Na	Imperial	Heber (321	-20	32.70862	-115.64	Zone-11 N:	T17S, R13E	2 MILES NC
Unknown	Natural/Na	Imperial | !	In-ko-pah (	2300	32.67397	-116.106	Zone-11 N:	T17S, R08E	MOUNTAIN
Unknown	Natural/Na	Imperial | I	Mount Sigr	200	32.65791	-115.77	Zone-11 N:	T17S, R12E	SOUTH OF
Unknown	Natural/Na	Imperial	Painted Go	1800	32.83169	-116.016	Zone-11 N:	T15S, R09E	EASTERN SI
Unknown	Natural/Na	Imperial	Carrizo Mtı	1000	32.79475	-116.024	Zone-11 N:	T16S, R09E	FOSSIL CAN
Unknown	Natural/Na	Imperial	Plaster City	1200	32.9724	-116.01	Zone-11 N:	T14S, R09E	FISH MOUI
Unknown	Natural/Na	Imperial	Niland (331	-226	33.18537	-115.597	Zone-11 N:	T11S, R13E	VAIL 3 DRA
Decreasing	Introduced	Imperial | /	Palo Verde	240	33.41279	-114.697	Zone-11 N:	T09S, R22E	OXBOW PC
Decreasing	Introduced	Imperial	Picacho NV	205	33.13788	-114.692	Zone-11 N:	T12S, R22E	COLORADC
Unknown	Introduced	Imperial | /	Picacho (33	190	33.02704	-114.587	Zone-11 N:	T13S, R23E	COLORADC
Unknown	Natural/Na	Imperial	Harpers W	-31	33.12564	-115.942	Zone-11 N:	T12S, R10E	HIGHWAY
Unknown	Natural/Na	Imperial	Coyote We	280	32.73672	-115.964	Zone-11 N:	T16S, R10E	COYOTE W
Unknown	Natural/Na	Imperial	Harpers W	60	33.11431	-115.943	Zone-11 N:	T12S, R10E	5.1 AIR MIL
Unknown	Natural/Na	Imperial	Frink (3311	-170	33.36006	-115.73	Zone-11 N:	T09S, R12E	1 MILE NOI
Unknown	Natural/Na	Imperial	Grays Well	155	32.70911	-114.948	Zone-11 N:	T16S, R20E	WHERE HIC
Unknown	Natural/Na	Imperial	Grays Well	200	32.74057	-114.847	Zone-11 N:	T16S, R20E	WHERE HIC
Unknown	Natural/Na	Imperial	Niland (331	-230	33.1818	-115.621	Zone-11 N:	T11S, R13E	JUST SE OF
Unknown	Natural/Na	Imperial	Niland (331	-230	33.1818	-115.621	Zone-11 N:	T11S, R13E	JUST SE OF
Unknown	Natural/Na	Imperial	Niland (331	-230	33.1818	-115.621	Zone-11 N:	T11S, R13E	JUST SE OF
Unknown	Natural/Na	Imperial	Hedges (32	700	32.88266	-114.827	Zone-11 N:	T15S, R20E	MESQUITE
Unknown	Natural/Na	Imperial	Hedges (32	720	32.8846	-114.82	Zone-11 N:	T15S, R20E	(GOLDEN) (
Unknown	Natural/Na	Imperial	Blue Moun	1200	33.12992	-115.06	Zone-11 N:	T12S, R18E	"MARY LOI
Unknown	Natural/Na	Imperial | I	Palo Verde	230	33.43201	-114.736	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial	Palo Verde	230	33.42237	-114.732	Zone-11 N:	T09S, R21E	0.75 MILE N
Unknown	Natural/Na	Imperial	Niland (331	-125	33.24069	-115.518	Zone-11 N:	T11S, R14E	NILAND.
Unknown	Natural/Na	Imperial	Holtville Ea	-15	32.81449	-115.382	Zone-11 N:	T15S, R15E	HOLTVILLE.
Unknown	Natural/Na	Imperial	Holtville W	-45	32.80251	-115.447	Zone-11 N:	T15S, R15E	MELOLAND
Unknown	Natural/Na	Imperial	Bard (3211	140	32.77645	-114.637	Zone-11 N:	T16S, R22E	THREE MILI
Unknown	Natural/Na	Imperial | /	Picacho NV	220	33.23966	-114.687	Zone-11 N:	T11S, R22E	COLORADC
Unknown	Natural/Na	Imperial | I	Calexico (3	10	32.66977	-115.496	Zone-11 N:	T17S, R14E	SALTON BA
Unknown	Natural/Na	Imperial	Seventeen	500	33.28721	-116.069	Zone-11 N:	T10S, R09E	PALM WAS
Unknown	Natural/Na	Imperial | I	Calexico (3211564) | H		32.66977	-115.496	Zone-11 N:	T17S, R14E	NEAR CALE
Unknown	Natural/Na	Imperial	Heber (3211565)		32.73088	-115.53	Zone-11 N:	T16S, R14E	HEBER, IMI
Unknown	Natural/Na	Imperial	Brawley (3:	-120	32.98392	-115.525	Zone-11 N:	T13S, R14E	BRAWLEY,
Unknown	Natural/Na	Imperial	Bonds Corr	-2	32.73302	-115.365	Zone-11 N:	T16S, R16E	OLD BEACH
Unknown	Natural/Na	Imperial	Grays Well	300	32.88668	-115.045	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Ogilby (321	400	32.81754	-114.841	Zone-11 N:	T15S, R20E	OGILBY, NE
Unknown	Natural/Na	Imperial	Holtville West (321157		32.80251	-115.447	Zone-11 N:	T15S, R15E	MELOLAND
Unknown	Natural/Na	Imperial	Glamis (32:	300	32.99414	-115.101	Zone-11 N:	T13S, R18E	1.7 MILES \
Unknown	Natural/Na	Imperial	Tortuga (3:	220	33.16323	-115.325	Zone-11 N:	T11S, R16E	SOUTH OF
Unknown	Natural/Na	Imperial	Kane Sprin	150	33.09668	-115.831	Zone-11 N:	T12S, R11E	SOUTH OF
Unknown	Natural/Na	Imperial	Midway W	140	32.70782	-115.016	Zone-11 N:	T17S, R19E	25 MILES V
Unknown	Natural/Na	Imperial | !	In-ko-pah Gorge (3211		32.67397	-116.106	Zone-11 N:	T17S, R08E	MOUNTAIN
Unknown	Natural/Na	Imperial	Painted Go	200	32.77485	-115.941	Zone-11 N:	T16S, R10E	COYOTE W
Unknown	Natural/Na	Imperial	Grays Well	220	32.73514	-114.797	Zone-11 N:	T16S, R21E	PILOT KNO
Unknown	Natural/Na	Imperial	Kane Sprin	-200	33.11131	-115.768	Zone-11 N:	T12S, R12E	TRIFOLIUM

Unknown	Natural/Na	Imperial	Shell Reef (	180	33.19057	-116.057	Zone-11 N:	T11S, R09E	BETWEEN S
Unknown	Natural/Na	Imperial	Kane Spring	42	33.18732	-115.987	Zone-11 N:	T11S, R09E	2.25 MILES
Unknown	Natural/Na	Imperial | I	Durmid (33	-220	33.46954	-115.979	Zone-11 N:	T08S, R10E	NORTH ENI
Unknown	Natural/Na	Imperial | /	Palo Verde (3311446)		33.41324	-114.658	Zone-11 N:	T09S, R22E	CIBOLA BRI
Unknown	Natural/Na	Imperial	Grays Well	210	32.72007	-114.774	Zone-11 N:	T16S, R21E	PILOT KNO
Unknown	Natural/Na	Imperial	Glamis (32:	265	32.9108	-115.112	Zone-11 N:	T14S, R18E	WEST SIDE
Unknown	Natural/Na	Imperial	Grays Well	200	32.72301	-114.779	Zone-11 N:	T16S, R21E	PILOT KNOI
Unknown	Natural/Na	Imperial	Calipatria S	-235	33.11146	-115.697	Zone-11 N:	T12S, R12E	SOUTHERN
Unknown	Natural/Na	Imperial	Calexico (3	20	32.69576	-115.414	Zone-11 N:	T17S, R15E	ALONG JAS
Unknown	Natural/Na	Imperial	Heber (321	-20	32.7408	-115.573	Zone-11 N:	T16S, R13E	0.3 MILE W
Unknown	Natural/Na	Imperial	Brawley NV	-50	32.88524	-115.684	Zone-11 N:	T15S, R12E	0.1 MILE EA
Unknown	Natural/Na	Imperial	Heber (321	-20	32.74509	-115.591	Zone-11 N:	T16S, R13E	200 FEET E.
Unknown	Natural/Na	Imperial	Heber (321	-20	32.7379	-115.6	Zone-11 N:	T16S, R13E	200' EAST C
Unknown	Natural/Na	Imperial	Calexico (3	-35	32.69949	-115.395	Zone-11 N:	T17S, R15E	0.1 MILE SC
Unknown	Natural/Na	Imperial	Grays Well	200	32.72972	-114.791	Zone-11 N:	T16S, R21E	PILOT KNO
Unknown	Natural/Na	Imperial	Grays Well	200	32.74686	-114.815	Zone-11 N:	T16S, R20E	ABOUT 2.5
Unknown	Natural/Na	Imperial	Ogilby (321	220	32.75725	-114.828	Zone-11 N:	T16S, R20E	0.5 MILE ES
Unknown	Natural/Na	Imperial	Wister (33:	-130	33.31407	-115.579	Zone-11 N:	T10S, R13E	1.4 MILES E
Unknown	Natural/Na	Imperial	El Centro (:	-29	32.79239	-115.606	Zone-11 N:	T16S, R13E	SILSBEE, AE
Unknown	Natural/Na	Imperial	Holtville W	-25	32.78034	-115.433	Zone-11 N:	T16S, R15E	7 MILES EA
Unknown	Natural/Na	Imperial	Westmorla	-175	33.07037	-115.577	Zone-11 N:	T13S, R13E	3.5 MILES N
Unknown	Natural/Na	Imperial	Heber (321	-15	32.72508	-115.543	Zone-11 N:	T16S, R14E	SOUTH OF
Unknown	Natural/Na	Imperial	Seeley (321	25	32.75155	-115.634	Zone-11 N:	T16S, R13E	JUST SOUT
Unknown	Natural/Na	Imperial	Mount Sigr	-20	32.70905	-115.64	Zone-11 N:	T16S, R13E	BROCKMAN
Unknown	Natural/Na	Imperial	Mount Sigr	-20	32.70973	-115.631	Zone-11 N:	T16S, R13E	NORTH SID
Unknown	Natural/Na	Imperial	Heber (321	-20	32.71789	-115.621	Zone-11 N:	T16S, R13E	WEST SIDE
Unknown	Natural/Na	Imperial	Heber (321	-10	32.71028	-115.62	Zone-11 N:	T16S, R13E	EAST SIDE (
Unknown	Natural/Na	Imperial	El Centro (:	-55	32.85481	-115.617	Zone-11 N:	T15S, R13E	NORTH SID
Unknown	Natural/Na	Imperial	El Centro (:	-60	32.85469	-115.609	Zone-11 N:	T15S, R13E	NORTH SID
Unknown	Natural/Na	Imperial	El Centro (:	-60	32.85885	-115.621	Zone-11 N:	T15S, R13E	EAST SIDE (
Unknown	Natural/Na	Imperial	Acolita (33	260	33.04784	-115.158	Zone-11 N:	T13S, R17.!	EAST SIDE (
Unknown	Natural/Na	Imperial	Acolita (33	260	33.04841	-115.162	Zone-11 N:	T13S, R17E	EAST SIDE (
Unknown	Natural/Na	Imperial	Acolita (33	240	33.03168	-115.177	Zone-11 N:	T13S, R17E	EAST SIDE (
Unknown	Natural/Na	Imperial	Amos (331	235	33.09079	-115.253	Zone-11 N:	T12S, R16E	EAST SIDE (
Unknown	Natural/Na	Imperial	Alamorio (:	-100	32.94856	-115.406	Zone-11 N:	T14S, R15E	ALONG STA
Unknown	Natural/Na	Imperial	Holtville W	-40	32.79964	-115.474	Zone-11 N:	T15S, R14E	NEXT TO M
Unknown	Natural/Na	Imperial	Westmorla	-140	33.01865	-115.606	Zone-11 N:	T13S, R13E	NEAR INTE
Unknown	Natural/Na	Imperial	Superstitio	200	32.95758	-115.83	Zone-11 N:	T14S, R11E	SUPERSTITI
Unknown	Natural/Na	Imperial	Calipatria S	-225	33.15332	-115.637	Zone-11 N:	T12S, R13E	ALONG THI
Unknown	Natural/Na	Imperial | !	Carrizo Mtı	450	32.87613	-116.112	Zone-11 N:	T15S, R08E	THE GENEF
Unknown	Natural/Na	Imperial	Cactus (3211478) | Cly		32.97808	-115.13	Zone-11 N:	T13S, R17.!	ALGODONE
Unknown	Natural/Na	Imperial	Lion Head Mtn. (33115		33.33752	-115.331	Zone-11 N:	T10S, R16E	BEALS WEL
Unknown	Natural/Na	Imperial	Imperial Re	190	32.9784	-114.5	Zone-11 N:	T14S, R24E	EAST SIDE (
Unknown	Natural/Na	Imperial | /	Picacho (3:	200	33.02351	-114.615	Zone-11 N:	T13S, R22E	CONFLUEN
Unknown	Natural/Na	Imperial	Picacho SW	200	33.02597	-114.634	Zone-11 N:	T13S, R22E	IMMEDIAT
Unknown	Natural/Na	Imperial	Laguna Dar	160	32.85034	-114.493	Zone-11 N:	T15S, R24E	2 MILES AB
Unknown	Natural/Na	Imperial	Heber (321	-21	32.75942	-115.638	Zone-11 N:	T16S, R13E	SILSBEE.

EEC ORIGINAL PKG

Unknown	Natural/Na	Imperial	Imperial Re	300	32.90809	-114.49	Zone-11 N:	T14S, R24E	5 MILES NO
Unknown	Natural/Na	Imperial	Niland (331	-225	33.19475	-115.592	Zone-11 N:	T11S, R13E	ALAMO DU
Unknown	Natural/Na	Imperial | I	West of Palo Verde Pe		33.3821	-114.994	Zone-11 N:	T09S, R19E	13 MI W PA
Unknown	Natural/Na	Imperial | I	Palo Verde	230	33.43647	-114.735	Zone-11 N:	T08S, R21E	PALO VERD
Unknown	Natural/Na	Imperial | S	In-ko-pah (	2800	32.65978	-116.099	Zone-11 N:	T17S, R09E	MOUNTAIN
Unknown	Natural/Na	Imperial | A	Picacho SW (3311416)		33.18	-114.7	Zone-11 N:	T11S, R22E	20 MILES N
Unknown	Natural/Na	Imperial | I	Wiley Well (3311448)		33.492	-114.992	Zone-11 N:	T08S, R19E	18 MILES W
Unknown	Natural/Na	Imperial | I	Calexico (3	0	32.66977	-115.496	Zone-11 N:	T17S, R14E	CALEXICO.
Unknown	Natural/Na	Imperial	Coyote We	360	32.73718	-115.909	Zone-11 N:	T16S, R10E	OCOTILLO,
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N:	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211	200	32.83176	-114.547	Zone-11 N:	T15S, R23E	3 MILES NO
Unknown	Natural/Na	Imperial	Araz (3211	320	32.79131	-114.655	Zone-11 N:	T16S, R22E	6 MILES WI
Unknown	Natural/Na	Imperial	East of Aco	100	33.02148	-115.117	Zone-11 N:	T13S, R18E	3 MILES NW
Unknown	Natural/Na	Imperial	East of Aco	100	33.02148	-115.117	Zone-11 N:	T13S, R18E	3 MILES NW
Unknown	Natural/Na	Imperial	East of Aco	300	33.01297	-115.104	Zone-11 N:	T13S, R18E	2 MILES NW
Unknown	Natural/Na	Imperial	Glamis (32	300	32.99335	-115.08	Zone-11 N:	T13S, R18E	GLAMIS TO
Unknown	Natural/Na	Imperial	Glamis (32	250	32.99548	-115.108	Zone-11 N:	T13S, R18E	2 MILES WI
Unknown	Natural/Na	Imperial	East of Aco	200	33.02662	-115.125	Zone-11 N:	T13S, R17.5	3.5 MILES N
Unknown	Natural/Na	Imperial	Glamis NW	100	33.0006	-115.263	Zone-11 N:	T13S, R17E	10.7 MILES
Unknown	Natural/Na	Imperial	Quartz Pea	1600	33.07914	-114.847	Zone-11 N:	T12S, R20E	BLACK MOU
Unknown	Natural/Na	Imperial | S	In-ko-pah (	3400	32.63483	-116.093	Zone-11 N:	T18S, R09E	VICINITY OI
Unknown	Natural/Na	Imperial	Little Picac	40	32.9758	-114.632	Zone-11 N:	T14S, R22E	LITTLE PICA
Unknown	Natural/Na	Imperial	Quartz Pea	900	33.02503	-114.767	Zone-11 N:	T13S, R21E	GAVILAN W
Unknown	Natural/Na	Imperial	Pegleg Wel	1600	33.39863	-115.165	Zone-11 N:	T09S, R17E	SOUTH OF
Unknown	Natural/Na	Imperial	Brawley (3	-120	32.98392	-115.525	Zone-11 N:	T13S, R14E	BRAWLEY.
Unknown	Natural/Na	Imperial | I	Calexico (3	10	32.66977	-115.496	Zone-11 N:	T17S, R14E	CALEXICO.
Unknown	Natural/Na	Imperial	El Centro (3	-40	32.79162	-115.563	Zone-11 N:	T16S, R14E	EL CENTRO
Unknown	Natural/Na	Imperial	Heber (321	-10	32.73088	-115.53	Zone-11 N:	T16S, R14E	HEBER, IMI
Unknown	Natural/Na	Imperial	El Centro (3	-25	32.7651	-115.607	Zone-11 N:	T16S, R13E	LOCATED A
Unknown	Natural/Na	Imperial	Holtville Ea	-15	32.81449	-115.382	Zone-11 N:	T15S, R15E	HOLTVILLE.
Unknown	Natural/Na	Imperial	El Centro (3	-50	32.84768	-115.569	Zone-11 N:	T15S, R14E	CITY OF IM
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	WESTMOR
Unknown	Natural/Na	Imperial | A	Picacho SW (3311416)		33.18	-114.7	Zone-11 N:	T11S, R22E	20 MILES N
Unknown	Natural/Na	Imperial	El Centro (3	-40	32.79162	-115.563	Zone-11 N:	T16S, R14E	EL CENTRO
Unknown	Natural/Na	Imperial | A	Yuma East	125	32.77133	-114.531	Zone-11 N:	T16S, R23E	ABOUT 4 M
Unknown	Natural/Na	Imperial | S	In-ko-pah (	3400	32.63483	-116.093	Zone-11 N:	T18S, R09E	VICINITY O
Unknown	Natural/Na	Imperial | S	In-ko-pah (	2700	32.67397	-116.106	Zone-11 N:	T17S, R08E	MOUNTAIN
Unknown	Natural/Na	Imperial | I	Thumb Pea	650	33.43519	-114.892	Zone-11 N:	T08S, R20E	IN THE MU
Unknown	Natural/Na	Imperial | A	Picacho NV	220	33.23939	-114.687	Zone-11 N:	T11S, R22E	VICINITY O
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	WESTMORI
Unknown	Natural/Na	Imperial	East of Aco	100	33.02148	-115.117	Zone-11 N:	T13S, R18E	3 MILES NW
Unknown	Natural/Na	Imperial	Painted Go	500	32.81632	-115.973	Zone-11 N:	T15S, R10E	PAINTED G
Unknown	Natural/Na	Imperial	Kane Sprin	-10	33.21186	-115.991	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Kane Sprin	-30	33.21037	-115.98	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Hedges (32	800	32.9791	-114.781	Zone-11 N:	T14S, R21E	IN AND AD.
Unknown	Natural/Na	Imperial	Hedges (32	545	32.9017	-114.865	Zone-11 N:	T14S, R20E	1.4 AIR MIL
Unknown	Natural/Na	Imperial	Hedges (32	540	32.89262	-114.855	Zone-11 N:	T15S, R20E	ABOUT 0.7

Unknown	Natural/Na	Imperial	Hedges (32	560	32.88196	-114.841	Zone-11 N:	T15S, R20E	0.7 AIR MIL
Unknown	Natural/Na	Imperial	Hedges (32	605	32.89612	-114.842	Zone-11 N:	T14S, R20E	1.3 MILES I
Unknown	Natural/Na	Imperial	Hedges (32	615	32.90317	-114.844	Zone-11 N:	T14S, R20E	1.8 AIR MIL
Unknown	Natural/Na	Imperial	Hedges (3211487)		32.92013	-114.85	Zone-11 N:	T14S, R20E	SOUTH OF
Unknown	Natural/Na	Imperial	Hedges (32	650	32.95455	-114.858	Zone-11 N:	T14S, R20E	NORTH OF
Unknown	Natural/Na	Imperial	Hedges (32	690	32.96358	-114.861	Zone-11 N:	T14S, R20E	6.3 AIR MIL
Unknown	Natural/Na	Imperial	Quartz Pea	785	33.01246	-114.875	Zone-11 N:	T13S, R20E	5.8 AIR MIL
Unknown	Natural/Na	Imperial	Ninemile W	1040	33.09684	-114.902	Zone-11 N:	T12S, R20E	20 MILES N
Unknown	Natural/Na	Imperial	Ninemile W	725	33.00126	-114.902	Zone-11 N:	T13S, R20E	9.8 AIR MIL
Unknown	Natural/Na	Imperial	Ninemile W	775	33.02064	-114.903	Zone-11 N:	T13S, R20E	9.8 AIR MIL
Unknown	Natural/Na	Imperial	Kane Spring	-48	33.21351	-115.972	Zone-11 N:	T11S, R10E	ALONG TUI
Unknown	Natural/Na	Imperial	Kane Spring	-113	33.22905	-115.949	Zone-11 N:	T11S, R10E	ALONG TUI
Unknown	Natural/Na	Imperial	Kane Spring	-73	33.22209	-115.94	Zone-11 N:	T11S, R10E	0.3 MI NOF
Unknown	Natural/Na	Imperial	Ninemile W	805	33.02894	-114.904	Zone-11 N:	T13S, R20E	3.8 AIR MIL
Unknown	Natural/Na	Imperial	Kane Spring	83	33.17752	-115.945	Zone-11 N:	T11S, R10E	CAMPBELL
Unknown	Natural/Na	Imperial	Ninemile W	850	33.04496	-114.904	Zone-11 N:	T13S, R20E	5.3 AIR MIL
Unknown	Natural/Na	Imperial	Ninemile W	900	33.05235	-114.902	Zone-11 N:	T13S, R20E	3.5 AIR MIL
Unknown	Natural/Na	Imperial	Buzzards P	980	33.17467	-114.875	Zone-11 N:	T11S, R20E	2.3 AIR MIL
Unknown	Natural/Na	Imperial	Kane Spring	100	33.18354	-115.914	Zone-11 N:	T11S, R10E	SE CAMPBE
Unknown	Natural/Na	Imperial	Kane Spring	48	33.1653	-115.903	Zone-11 N:	T11S, R10E	2.7 MI N O
Unknown	Natural/Na	Imperial	Kane Spring	34	33.15601	-115.913	Zone-11 N:	T12S, R10E	2 MI N OF S
Unknown	Natural/Na	Imperial	Hedges (32	710	32.97726	-114.865	Zone-11 N:	T14S, R20E	ALONG WE
Unknown	Natural/Na	Imperial	Kane Spring	138	33.14547	-115.948	Zone-11 N:	T12S, R10E	1.3 MI N O
Unknown	Natural/Na	Imperial	Kane Spring	21	33.14546	-115.917	Zone-11 N:	T12S, R10E	1.3 MI N O
Unknown	Natural/Na	Imperial	Kane Spring	-34	33.14213	-115.904	Zone-11 N:	T12S, R10E	1.1 MI N O
Unknown	Natural/Na	Imperial	Ogilby (321	400	32.8326	-114.838	Zone-11 N:	T15S, R20E	IN WASH O
Unknown	Natural/Na	Imperial	Ninemile W	1200	33.12533	-114.909	Zone-11 N:	T12S, R20E	IMPERIAL C
Unknown	Natural/Na	Imperial	Chuckwalla	1650	33.42183	-115.18	Zone-11 N:	T09S, R17E	WASH NEA
Unknown	Natural/Na	Imperial	Kane Spring	-76	33.12585	-115.906	Zone-11 N:	T12S, R10E	ALONG STA
Unknown	Natural/Na	Imperial	Kane Spring	-57	33.12586	-115.925	Zone-11 N:	T12S, R10E	ALONG STA
Unknown	Natural/Na	Imperial	Kane Spring	-32	33.20614	-115.972	Zone-11 N:	T11S, R10E	ALONG TUI
Unknown	Natural/Na	Imperial	Kane Spring	130	33.16013	-115.954	Zone-11 N:	T12S, R10E	6.1 MILES V
Unknown	Natural/Na	Imperial	Kane Spring	90	33.1805	-115.909	Zone-11 N:	T11S, R10E	3.8 MI N O
Unknown	Natural/Na	Imperial	Kane Spring	0	33.13409	-115.921	Zone-11 N:	T12S, R10E	SAN FELIPE
Unknown	Natural/Na	Imperial	Kane Spring	-90	33.22332	-115.958	Zone-11 N:	T11S, R10E	ALONG TUI
Unknown	Natural/Na	Imperial	Kane Spring	74	33.15188	-115.966	Zone-11 N:	T12S, R10E	2.5 MI EAS
Unknown	Natural/Na	Imperial	Kane Spring	74	33.15535	-115.953	Zone-11 N:	T12S, R10E	3.2 MI EAS
Unknown	Natural/Na	Imperial	Kane Spring	-50	33.13947	-115.9	Zone-11 N:	T12S, R10E	SAN FELIPE
Unknown	Natural/Na	Imperial	Kane Spring	5	33.19602	-115.978	Zone-11 N:	T11S, R10E	ABOUT 0.5
Unknown	Natural/Na	Imperial	Kane Spring	59	33.18768	-115.98	Zone-11 N:	T11S, R09E	4 MI SW OI
Unknown	Natural/Na	Imperial	Kane Spring	66	33.18358	-115.991	Zone-11 N:	T11S, R09E	4.5 MI SW
Unknown	Natural/Na	Imperial	Kane Spring	177	33.16476	-115.991	Zone-11 N:	T11S, R09E	TARANTUL
Unknown	Natural/Na	Imperial	Kane Spring	21	33.13624	-115.991	Zone-11 N:	T12S, R09E	0.2 MI EAS
Unknown	Natural/Na	Imperial	Kane Spring	44	33.13718	-115.985	Zone-11 N:	T12S, R09E	1 MILE NOI
Unknown	Natural/Na	Imperial	Shell Reef (	179	33.22408	-116.069	Zone-11 N:	T11S, R09E	JUST SOUT
Unknown	Natural/Na	Imperial	Shell Reef (	150	33.22762	-116.057	Zone-11 N:	T11S, R09E	FROM TULI
Unknown	Natural/Na	Imperial	Shell Reef (	99	33.21993	-116.045	Zone-11 N:	T11S, R09E	SOUTH OF

Unknown	Natural/Na	Imperial	Shell Reef (	75	33.22239	-116.033	Zone-11 N:	T11S, R09E	JUST NORT
Unknown	Natural/Na	Imperial	Shell Reef (	78	33.21781	-116.035	Zone-11 N:	T11S, R09E	SOUTH OF
Unknown	Natural/Na	Imperial	Shell Reef (	48	33.21985	-116.019	Zone-11 N:	T11S, R09E	ALONG/NC
Unknown	Natural/Na	Imperial	Shell Reef (	40	33.21707	-116.012	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Shell Reef (	68	33.19533	-116.01	Zone-11 N:	T11S, R09E	ABOUT MII
Unknown	Natural/Na	Imperial	Shell Reef (	55	33.19836	-116.007	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Shell Reef (	120	33.18221	-116.035	Zone-11 N:	T11S, R09E	TARANTUL
Unknown	Natural/Na	Imperial	Shell Reef (	100	33.16242	-116.01	Zone-11 N:	T11S, R09E	9.3 AIR MIL
Unknown	Natural/Na	Imperial	Shell Reef (	35	33.13148	-116.009	Zone-11 N:	T12S, R09E	0.4 MILE N
Unknown	Natural/Na	Imperial	Shell Reef (	80	33.14914	-116.029	Zone-11 N:	T12S, R09E	1.6 MILES I
Unknown	Natural/Na	Imperial	Shell Reef (	61	33.13202	-116.036	Zone-11 N:	T12S, R09E	ALONG JEE
Unknown	Natural/Na	Imperial	Borrego M	25	33.1257	-116.017	Zone-11 N:	T12S, R09E	ALONG HW
Unknown	Natural/Na	Imperial	Shell Reef (	91	33.15063	-116.075	Zone-11 N:	T12S, R09E	1.4 MILES I
Unknown	Natural/Na	Imperial	Shell Reef (	120	33.14871	-116.05	Zone-11 N:	T12S, R09E	1.6 MI N O
Unknown	Natural/Na	Imperial | S	In-ko-pah Gorge (3211		32.64938	-116.11	Zone-11 N:	T17S, R08E	IN-KOH-PA
Unknown	Natural/Na	Imperial	Wister (33:	-224	33.27814	-115.602	Zone-11 N:	T10S, R13E	Z LATERAL
Unknown	Natural/Na	Imperial	Calipatria S	-225	33.09863	-115.735	Zone-11 N:	T12S, R12E	TRIFOLIUM
Unknown	Natural/Na	Imperial	Calipatria S	-222	33.09583	-115.692	Zone-11 N:	T12S, R12E	TRIFOLIUM
Unknown	Natural/Na	Imperial	Niland (331	-222	33.20572	-115.588	Zone-11 N:	T11S, R13E	O LATERAL
Unknown	Natural/Na	Imperial | A	Cibola (331	230	33.34733	-114.714	Zone-11 N:	T09S, R21E	COLORADC
Unknown	Natural/Na	Imperial	Kane Spring	-50	33.21664	-115.974	Zone-11 N:	T11S, R10E	TULE WASH
Unknown	Natural/Na	Imperial	Brawley (3:	-104	32.98103	-115.554	Zone-11 N:	T13S, R14E	EAST OF TH
Unknown	Natural/Na	Imperial	Hedges (32	537	32.90071	-114.863	Zone-11 N:	T14S, R20E	UNNAMED
Unknown	Natural/Na	Imperial	Ninemile W	945	33.07672	-114.894	Zone-11 N:	T12S, R20E	WASH BET\
Unknown	Natural/Na	Imperial	Ninemile W	1045	33.10116	-114.888	Zone-11 N:	T12S, R20E	WASH EAST
Unknown	Natural/Na	Imperial	Thumb Pea	282	33.42841	-114.762	Zone-11 N:	T09S, R21E	SAND WAS
Unknown	Natural/Na	Imperial	Buzzards Peak (331142		33.20311	-114.867	Zone-11 N:	T11S, R20E	BRAIDED W
Unknown	Natural/Na	Imperial	Clyde (321:	366	32.92479	-114.991	Zone-11 N:	T14S, R19E	EASTERN EI
Unknown	Natural/Na	Imperial	Palo Verde	238	33.39347	-114.748	Zone-11 N:	T09S, R21E	ALONG NO
Unknown	Natural/Na	Imperial	Harpers Well (3311518		33.09648	-115.906	Zone-11 N:	T12S, R10E	HARPERS V
Unknown	Natural/Na	Imperial	Harpers W	-115	33.09881	-115.929	Zone-11 N:	T12S, R10E	SAN FELIPE
Unknown	Natural/Na	Imperial | A	Laguna Dar	180	32.87889	-114.472	Zone-11 N:	T15S, R24E	0.6 MILE W
Unknown	Natural/Na	Imperial	Niland (331	-163	33.25451	-115.54	Zone-11 N:	T10S, R14E	VICINITY O
Unknown	Natural/Na	Imperial	Seeley (321	-49	32.84726	-115.67	Zone-11 N:	T15S, R13E	6 MILES WI
Unknown	Natural/Na	Imperial	Picacho NV	525	33.14004	-114.721	Zone-11 N:	T12S, R21E	VICINITY O
Unknown	Natural/Na	Imperial	Glamis NW	110	32.97156	-115.187	Zone-11 N:	T13S, R17E	7.2 MILES \
Unknown	Natural/Na	Imperial	Picacho NV	220	33.16163	-114.683	Zone-11 N:	T12S, R22E	COLORADC
Unknown	Natural/Na	Imperial	Picacho SW	200	33.02673	-114.635	Zone-11 N:	T13S, R22E	COLORADC
Unknown	Natural/Na	Imperial	Picacho NV	210	33.20277	-114.684	Zone-11 N:	T11S, R22E	IN THE VICI
Unknown	Natural/Na	Imperial | I	Calexico (3	5	32.66977	-115.496	Zone-11 N:	T17S, R14E	CALEXICO.
Unknown	Natural/Na	Imperial | A	Picacho SW	200	33.12595	-114.699	Zone-11 N:	T99X, R99X	24 MI S OF
Unknown	Natural/Na	Imperial	Glamis (32:	300	32.99335	-115.08	Zone-11 N:	T13S, R18E	1 MI W OF
Unknown	Natural/Na	Imperial	Kane Spring	-180	33.11182	-115.838	Zone-11 N:	T12S, R11E	KANE SPRII
Unknown	Natural/Na	Imperial | I	Palo Verde	230	33.43201	-114.736	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial | A	Picacho NV	210	33.21003	-114.678	Zone-11 N:	T11S, R22E	15 MI SOU
Unknown	Natural/Na	Imperial	Hedges (32	780	32.89976	-114.826	Zone-11 N:	T14S, R20E	MINES IN T
Unknown	Natural/Na	Imperial	Hedges (32	780	32.89976	-114.826	Zone-11 N:	T14S, R20E	CARGO MU

EEC ORIGINAL PKG

Unknown	Natural/Na	Imperial	Buzzards P	750	33.21128	-114.767	Zone-11 N:	T11S, R21E	BARREN M
Unknown	Natural/Na	Imperial	Hedges (32	820	32.90686	-114.826	Zone-11 N:	T14S, R20E	CARGO MU
Unknown	Natural/Na	Imperial	Obsidian B	-235	33.17506	-115.641	Zone-11 N:	T11S, R13E	SALTON SE
Unknown	Natural/Na	Imperial	Lion Head I	1360	33.33771	-115.33	Zone-11 N:	T10S, R16E	BEAL WELL
Unknown	Natural/Na	Imperial | I	Calexico (3	5	32.66977	-115.496	Zone-11 N:	T17S, R14E	CALEXICO.
Unknown	Natural/Na	Imperial	Lion Head I	1360	33.33771	-115.33	Zone-11 N:	T10S, R16E	BEAL WELL
Unknown	Natural/Na	Imperial | I	Palo Verde (3311446)		33.43201	-114.736	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial	Hedges (32	800	32.98877	-114.792	Zone-11 N:	T13S, R21E	ABOUT 6 M
Unknown	Natural/Na	Imperial	Hedges (32	800	32.98877	-114.792	Zone-11 N:	T13S, R21E	ABOUT 6 M
Unknown	Natural/Na	Imperial	Bard (3211	275	32.8462	-114.506	Zone-11 N:	T15S, R23E	PICACHO M
Unknown	Natural/Na	Imperial	Ogilby (321	740	32.86227	-114.77	Zone-11 N:	T15S, R21E	AMERICAN
Unknown	Natural/Na	Imperial	Blue Moun	1200	33.12992	-115.06	Zone-11 N:	T12S, R18E	CHOCOLAT
Unknown	Natural/Na	Imperial	Iris Wash (:	790	33.36806	-115.453	Zone-11 N:	T09S, R15E	CHOCOLAT
Unknown	Natural/Na	Imperial	Iris Wash (:	790	33.36806	-115.453	Zone-11 N:	T09S, R15E	CHOCOLAT
Unknown	Natural/Na	Imperial	Lion Head I	950	33.30837	-115.358	Zone-11 N:	T10S, R15E	CHOCOLAT
Unknown	Natural/Na	Imperial	Lion Head I	950	33.30837	-115.358	Zone-11 N:	T10S, R15E	CHOCOLAT
Unknown	Natural/Na	Imperial	Lion Head I	950	33.30837	-115.358	Zone-11 N:	T10S, R15E	CHOCOLAT
Unknown	Natural/Na	Imperial	Lion Head I	950	33.30837	-115.358	Zone-11 N:	T10S, R15E	CHOCOLAT
Unknown	Natural/Na	Imperial	Ninemile W	1170	33.0872	-114.935	Zone-11 N:	T12S, R19E	CHOCOLAT
Unknown	Natural/Na	Imperial	Lion Head I	1180	33.26578	-115.265	Zone-11 N:	T10S, R16E	CHOCOLAT
Unknown	Natural/Na	Imperial	Iris Wash (:	90	33.29305	-115.495	Zone-11 N:	T10S, R14E	CHOCOLAT
Unknown	Natural/Na	Imperial	Iris Wash (:	90	33.29305	-115.495	Zone-11 N:	T10S, R14E	CHOCOLAT
Unknown	Natural/Na	Imperial	Heber (321	10	32.68835	-115.597	Zone-11 N:	T17S, R13E	WISTARIA :
Unknown	Natural/Na	Imperial	El Centro (:	-30	32.77256	-115.561	Zone-11 N:	T16S, R14E	EL CENTRO
Unknown	Natural/Na	Imperial	Holtville W	-20	32.75243	-115.502	Zone-11 N:	T16S, R14E	SE OF EL CE
Unknown	Natural/Na	Imperial	Midway W	90	32.70502	-115.211	Zone-11 N:	T17S, R17E	SOUTH SID
Unknown	Natural/Na	Imperial	Holtville Ea	26	32.81554	-115.283	Zone-11 N:	T15S, R16E	WEST SIDE
Unknown	Natural/Na	Imperial	Midway W	85	32.70124	-115.183	Zone-11 N:	T17S, R17E	0.25 MILE S
Unknown	Natural/Na	Imperial	Holtville Ea	85	32.87464	-115.297	Zone-11 N:	T15S, R16E	ALONG HO
Unknown	Natural/Na	Imperial	Brawley NV	1920	32.96531	-115.675	Zone-11 N:	T14S, R13E	0.35 MILE S
Unknown	Natural/Na	Imperial	Yuma West	130	32.7324	-114.716	Zone-11 N:	T16S, R21E	ALONG ALA
Unknown	Natural/Na	Imperial	Heber (321	-21	32.75942	-115.638	Zone-11 N:	T16S, R13E	SILSBEE.
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N:	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Palo Verde	250	33.41585	-114.75	Zone-11 N:	T09S, R21E	ABOUT 2 M
Unknown	Natural/Na	Imperial	El Centro (:	-20	32.75799	-115.556	Zone-11 N:	T16S, R14E	0.8 MI NNE
Unknown	Natural/Na	Imperial	El Centro (:	30	32.7637	-115.554	Zone-11 N:	T16S, R14E	EL CENTRO
Unknown	Natural/Na	Imperial	El Centro (:	30	32.78036	-115.586	Zone-11 N:	T16S, R13E	EL CENTRO
Unknown	Natural/Na	Imperial	El Centro (:	30	32.78193	-115.594	Zone-11 N:	T16S, R13E	EL CENTRO
Unknown	Natural/Na	Imperial	Calexico (3	0	32.70918	-115.5	Zone-11 N:	T16S, R14E	NW CORNE
Unknown	Natural/Na	Imperial	El Centro (:	-40	32.80033	-115.54	Zone-11 N:	T15S, R14E	EL CENTRO
Unknown	Natural/Na	Imperial	Iris (33115:	-95	33.23498	-115.493	Zone-11 N:	T11S, R14E	ALONG UN
Unknown	Natural/Na	Imperial	Wister (33:	-190	33.28364	-115.577	Zone-11 N:	T10S, R13E	ALONG UN
Unknown	Natural/Na	Imperial	Wister (33:	-190	33.29466	-115.586	Zone-11 N:	T10S, R13E	ALONG UN
Unknown	Natural/Na	Imperial	Imperial Re	200	32.88341	-114.469	Zone-11 N:	T15S, R24E	IMPERIAL D
Unknown	Natural/Na	Imperial	Ogilby (321	360	32.81682	-114.789	Zone-11 N:	T15S, R21E	3 MILES EA
Unknown	Natural/Na	Imperial	In-ko-pah (	1300	32.63562	-116.016	Zone-11 N:	T18S, R09E	PINTO CAN
Unknown	Natural/Na	Imperial | I	Mount Sigr	984	32.65791	-115.77	Zone-11 N:	T17S, R12E	PINTO WAS

Unknown	Natural/Na	Imperial	Hedges (32	640	32.91583	-114.837	Zone-11 N:	T14S, R20E	ON BLM RD
Unknown	Natural/Na	Imperial	Wister (33:	-190	33.32789	-115.613	Zone-11 N:	T10S, R13E	8.40 MI NW
Unknown	Natural/Na	Imperial	Wister (33:	-190	33.27536	-115.57	Zone-11 N:	T10S, R13E	4.20 MI NW
Unknown	Natural/Na	Imperial	Wister (33:	-190	33.25633	-115.538	Zone-11 N:	T10S, R14E	AT BM 168
Unknown	Natural/Na	Imperial	Niland (331	-190	33.25137	-115.531	Zone-11 N:	T10S, R14E	1.30 MI NW
Unknown	Natural/Na	Imperial	Niland (331	-190	33.24874	-115.525	Zone-11 N:	T11S, R14E	0.90 MI NW
Unknown	Natural/Na	Imperial	Iris (33115:	-100	33.2369	-115.497	Zone-11 N:	T11S, R14E	ABOUT 1.0
Unknown	Natural/Na	Imperial	Iris (33115:	-100	33.22156	-115.464	Zone-11 N:	T11S, R14E	3.1 MI SW (
Unknown	Natural/Na	Imperial	Iris (33115:	-15	33.21425	-115.447	Zone-11 N:	T11S, R15E	4.1 MI SW (
Unknown	Natural/Na	Imperial	Iris (33115:	-15	33.21128	-115.441	Zone-11 N:	T11S, R15E	4.5 MI SW (
Unknown	Natural/Na	Imperial	Acolita (33	280	33.04224	-115.139	Zone-11 N:	T13S, R17.!	5.0 MI NW
Unknown	Natural/Na	Imperial	Coyote We	340	32.67364	-115.896	Zone-11 N:	T17S, R11E	BLM CRUCI
Unknown	Natural/Na	Imperial	Coyote We	830	32.64039	-115.95	Zone-11 N:	T17S, R10E	SKULL VALI
Unknown	Natural/Na	Imperial	Seeley (321	-41	32.79372	-115.691	Zone-11 N:	T16S, R12E	SEELEY.
Unknown	Natural/Na	Imperial	Picacho SW (3311416)		33.04594	-114.688	Zone-11 N:	T13S, R22E	SANDY WA
Unknown	Natural/Na	Imperial	Quartz Pea	1000	33.05875	-114.789	Zone-11 N:	T13S, R21E	JULIAN WA
Unknown	Natural/Na	Imperial	Mt. Barrow	1385	33.13107	-114.949	Zone-11 N:	T12S, R19E	AT THE WE
Unknown	Natural/Na	Imperial	Palo Verde	850	33.3242	-114.778	Zone-11 N:	T10S, R21E	9.5 MILES S
Unknown	Natural/Na	Imperial	Cibola (3311436) | Pal		33.29252	-114.753	Zone-11 N:	T10S, R21E	10.5 MILES
Unknown	Natural/Na	Imperial	Lion Head Mtn. (33115		33.33752	-115.331	Zone-11 N:	T10S, R16E	BEAL WELL
Unknown	Natural/Na	Imperial	Hedges (32	550	32.91613	-114.878	Zone-11 N:	T14S, R20E	ALONG PIP
Unknown	Natural/Na	Imperial	Ninemile W	1050	33.09941	-114.889	Zone-11 N:	T12S, R20E	1.5 MI NE (
Unknown	Natural/Na	Imperial	Quartz Pea	820	33.02118	-114.878	Zone-11 N:	T13S, R20E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Ninemile W	910	33.05999	-114.9	Zone-11 N:	T13S, R20E	2 MI SE OF
Unknown	Natural/Na	Imperial	Ninemile W	860	33.04415	-114.885	Zone-11 N:	T13S, R20E	3.17 MI SE
Unknown	Natural/Na	Imperial	Ninemile W	800	33.02731	-114.904	Zone-11 N:	T13S, R20E	EAST SIDE (
Unknown	Natural/Na	Imperial	Buzzards P	876	33.20611	-114.855	Zone-11 N:	T11S, R20E	EAST SIDE (
Unknown	Natural/Na	Imperial	Buzzards P	1010	33.14886	-114.871	Zone-11 N:	T12S, R20E	ABOUT 0.5
Unknown	Natural/Na	Imperial	Clyde (321:	560	32.94062	-114.887	Zone-11 N:	T14S, R20E	ROAD BETV
Unknown	Natural/Na	Imperial	Clyde (321:	635	32.97366	-114.896	Zone-11 N:	T14S, R20E	WEST SIDE
Unknown	Natural/Na	Imperial	Buzzards P	940	33.183	-114.871	Zone-11 N:	T11S, R20E	VICINITY O
Unknown	Natural/Na	Imperial	Buzzards P	840	33.2142	-114.861	Zone-11 N:	T11S, R20E	JUST SOUT
Unknown	Natural/Na	Imperial	Ninemile W	970	33.08061	-114.893	Zone-11 N:	T12S, R20E	1 MI E OF H
Unknown	Natural/Na	Imperial	Pegleg Wel	1540	33.37444	-115.178	Zone-11 N:	T09S, R17E	SOUTH SIDI
Unknown	Natural/Na	Imperial	Hedges (32	685	32.9578	-114.838	Zone-11 N:	T14S, R20E	WEST SIDE
Unknown	Natural/Na	Imperial	Cibola (3311436)		33.3504	-114.708	Zone-11 N:	T09S, R21E	6 MILES SO
Unknown	Natural/Na	Imperial | I	Palo Verde	350	33.43201	-114.736	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial	Pegleg Wel	1860	33.25472	-115.188	Zone-11 N:	T10S, R17E	2.6 MI EAS
Unknown	Natural/Na	Imperial	Pegleg Wel	1380	33.3053	-115.196	Zone-11 N:	T10S, R17E	4.0 MI NE (
Unknown	Natural/Na	Imperial	Hedges (32	550	32.88189	-114.845	Zone-11 N:	T15S, R20E	ABOUT 0.7
Unknown	Natural/Na	Imperial	Hedges (32	615	32.92644	-114.851	Zone-11 N:	T14S, R20E	INDIAN WA
Unknown	Natural/Na	Imperial	Hedges (32	630	32.94817	-114.858	Zone-11 N:	T14S, R20E	0.9 MILE N
Unknown	Natural/Na	Imperial	Buzzards P	960	33.17928	-114.874	Zone-11 N:	T11S, R20E	2.50 MI S C
Unknown	Natural/Na	Imperial	Buzzards P	720	33.23708	-114.842	Zone-11 N:	T11S, R20E	1.5 MI NNE
Unknown	Natural/Na	Imperial	Buzzards P	670	33.24861	-114.832	Zone-11 N:	T11S, R20E	2.5 MI NE (
Unknown	Natural/Na	Imperial	Palo Verde	580	33.26036	-114.815	Zone-11 N:	T10S, R20E	4 MI NE OF
Unknown	Natural/Na	Imperial	Palo Verde	490	33.27637	-114.8	Zone-11 N:	T10S, R21E	4 MI SSW C

Unknown	Natural/Na	Imperial	Wister (331	-180	33.26487	-115.56	Zone-11 N:	T10S, R14E	ABOUT 3.0
Unknown	Transplant	Imperial	El Centro (3	-40	32.79162	-115.563	Zone-11 N:	T16S, R14E	EL CENTRO
Unknown	Natural/Na	Imperial	Mount Sigr	70	32.68881	-115.742	Zone-11 N:	T17S, R12E	PINTO WAS
Unknown	Natural/Na	Imperial	Yuha Basin	242	32.64654	-115.836	Zone-11 N:	T17S, R11E	PINTO WAS
Unknown	Natural/Na	Imperial	Glamis SE (	143	32.79207	-115.063	Zone-11 N:	T16S, R18E	GLAMIS SA
Unknown	Natural/Na	Imperial	Plaster City	75	32.94662	-115.881	Zone-11 N:	T14S, R11E	WEST MES.
Unknown	Natural/Na	Imperial	Plaster City	87	32.95932	-115.918	Zone-11 N:	T14S, R10E	WEST MES.
Unknown	Natural/Na	Imperial	Plaster City	78	32.94522	-115.89	Zone-11 N:	T14S, R10E	WEST MES.
Unknown	Natural/Na	Imperial	Niland (331	-231	33.20812	-115.615	Zone-11 N:	T11S, R13E	JUST NW O
Decreasing	Natural/Na	Imperial	Niland (331	-200	33.22531	-115.609	Zone-11 N:	T11S, R13E	MULLET ISI
Decreasing	Natural/Na	Imperial	Obsidian B	-217	33.17313	-115.642	Zone-11 N:	T11S, R13E	OBSIDIAN I
Unknown	Natural/Na	Imperial	Harpers W	20	33.12566	-115.985	Zone-11 N:	T12S, R09E	ALONG STA
Unknown	Natural/Na	Imperial | /	Imperial Re	190	32.89945	-114.471	Zone-11 N:	T15S, R24E	WEST SIDE
Unknown	Natural/Na	Imperial	Picacho SW	220	33.11346	-114.705	Zone-11 N:	T12S, R21E	POND/MAI
Unknown	Natural/Na	Imperial	Harpers W	-115	33.09857	-115.928	Zone-11 N:	T12S, R10E	SAN FELIPE
Unknown	Natural/Na	Imperial	Imperial Re	190	32.97182	-114.472	Zone-11 N:	T14S, R24E	CALIFORNI.
Unknown	Natural/Na	Imperial	Imperial Re	190	32.96479	-114.471	Zone-11 N:	T14S, R24E	CA SIDE OF
Unknown	Natural/Na	Imperial	Imperial Re	190	32.95556	-114.473	Zone-11 N:	T14S, R24E	CA SIDE OF
Unknown	Natural/Na	Imperial | I	Grays Well	150	32.70949	-114.978	Zone-11 N:	T16S, R19E	SOUTH POI
Unknown	Natural/Na	Imperial	Grays Well	200	32.75652	-114.836	Zone-11 N:	T16S, R20E	SE END OF
Unknown	Natural/Na	Imperial	Clyde (321	400	32.9089	-114.965	Zone-11 N:	T14S, R19E	EAST SIDE (
Unknown	Natural/Na	Imperial	Tortuga (33	89	33.15105	-115.359	Zone-11 N:	T12S, R15E	EAST MESA
Unknown	Natural/Na	Imperial	Frink NW (:	-115	33.41701	-115.693	Zone-11 N:	T09S, R12E	ABOUT 0.5
Unknown	Natural/Na	Imperial	Obsidian B	-230	33.16947	-115.631	Zone-11 N:	T11S, R13E	ABOUT 0.4
Unknown	Natural/Na	Imperial	Calipatria S	-220	33.08433	-115.704	Zone-11 N:	T12S, R12E	ABOUT 0.9
Unknown	Natural/Na	Imperial	Calipatria S	-220	33.10442	-115.684	Zone-11 N:	T12S, R12E	MARSH WE
Unknown	Natural/Na	Imperial	Seeley (321	-100	32.81508	-115.714	Zone-11 N:	T15S, R12E	VICINITY O
Unknown	Natural/Na	Imperial	Midway W	95	32.70459	-115.173	Zone-11 N:	T17S, R17E	VICINITY O
Unknown	Natural/Na	Imperial	Laguna Dar	170	32.85724	-114.493	Zone-11 N:	T15S, R24E	EAST SHOR
Unknown	Natural/Na	Imperial	Laguna Dar	170	32.87652	-114.482	Zone-11 N:	T15S, R24E	GENERAL A
Unknown	Natural/Na	Imperial	Imperial Re	240	32.90208	-114.485	Zone-11 N:	T15S, R24E	WEST OF S
Unknown	Natural/Na	Imperial | /	Imperial Re	180	32.9292	-114.48	Zone-11 N:	T14S, R24E	COLORADC
Unknown	Natural/Na	Imperial | /	Imperial Re	180	32.94577	-114.479	Zone-11 N:	T14S, R24E	COLORADC
Unknown	Natural/Na	Imperial	Seventeen	145	33.25336	-116.05	Zone-11 N:	T10S, R09E	NORTH FOI
Unknown	Natural/Na	Imperial	Shell Reef (	130	33.18636	-116.044	Zone-11 N:	T11S, R09E	TARANTUL
Unknown	Natural/Na	Imperial	Shell Reef (	124	33.19985	-116.015	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Shell Reef (	45	33.2099	-116.008	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Shell Reef (	59	33.20888	-116.014	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Shell Reef (	140	33.18617	-116.01	Zone-11 N:	T11S, R09E	VICINITY O
Unknown	Natural/Na	Imperial	Shell Reef (	143	33.18717	-116.05	Zone-11 N:	T11S, R09E	TARANTUL
Unknown	Natural/Na	Imperial	Kane Sprin	-77	33.22932	-115.955	Zone-11 N:	T11S, R10E	ABOUT 0.2
Unknown	Natural/Na	Imperial	Shell Reef (	23	33.22567	-116.003	Zone-11 N:	T11S, R09E	NORTH OF
Unknown	Natural/Na	Imperial	Kane Sprin	21	33.22104	-116.001	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Kane Sprin	-30	33.21038	-115.975	Zone-11 N:	T11S, R10E	TULE WASH
Unknown	Natural/Na	Imperial	Kane Sprin	46	33.19257	-115.991	Zone-11 N:	T11S, R09E	TULE WASH
Unknown	Natural/Na	Imperial	Kane Sprin	23	33.19199	-115.976	Zone-11 N:	T11S, R10E	TULE WASH
Unknown	Natural/Na	Imperial	Kane Sprin	150	33.18309	-115.977	Zone-11 N:	T11S, R10E	TULE WASH

Unknown	Natural/Na	Imperial	Kane Spring	150	33.17814	-115.983	Zone-11 N:	T11S, R09E	8.1 MILES I
Unknown	Natural/Na	Imperial	Kane Spring	55	33.18384	-115.96	Zone-11 N:	T11S, R10E	SOUTHERN
Unknown	Natural/Na	Imperial	Kane Spring	70	33.18586	-115.967	Zone-11 N:	T11S, R10E	SOUTHERN
Unknown	Natural/Na	Imperial	Kane Spring	12	33.19347	-115.956	Zone-11 N:	T11S, R10E	TULE/CAM
Unknown	Natural/Na	Imperial	Kane Spring	4	33.19538	-115.951	Zone-11 N:	T11S, R10E	CAMPBELL
Unknown	Natural/Na	Imperial	Kane Spring	169	33.16824	-115.964	Zone-11 N:	T11S, R10E	TULE/CAM
Unknown	Natural/Na	Imperial	Kane Spring	175	33.17119	-115.976	Zone-11 N:	T11S, R10E	E SIDE OF F
Unknown	Natural/Na	Imperial	Kane Spring	83	33.18123	-115.997	Zone-11 N:	T11S, R09E	SOUTHERN
Unknown	Natural/Na	Imperial	Shell Reef (	100	33.18264	-116.003	Zone-11 N:	T11S, R09E	SOUTHERN
Unknown	Natural/Na	Imperial	Shell Reef (	100	33.17565	-116.024	Zone-11 N:	T11S, R09E	10 TO 11 M
Unknown	Natural/Na	Imperial	Shell Reef (	80	33.15166	-116.006	Zone-11 N:	T12S, R09E	8.9 MILES V
Unknown	Natural/Na	Imperial	Shell Reef (	60	33.14526	-116.012	Zone-11 N:	T12S, R09E	TARANTUL
Unknown	Natural/Na	Imperial	Kane Spring	20	33.13258	-115.992	Zone-11 N:	T12S, R09E	TARANTUL
Unknown	Natural/Na	Imperial	Kane Spring	-8	33.14243	-115.909	Zone-11 N:	T12S, R10E	2.7 MI NOF
Unknown	Natural/Na	Imperial	Kane Spring	-42	33.13413	-115.9	Zone-11 N:	T12S, R10E	NORTH OF
Unknown	Natural/Na	Imperial	Kane Spring	-144	33.13118	-115.872	Zone-11 N:	T12S, R11E	NORTH OF
Unknown	Natural/Na	Imperial	Kane Spring	86	33.17462	-115.904	Zone-11 N:	T11S, R10E	SOUTHEAS
Unknown	Natural/Na	Imperial	Kane Spring	15	33.17507	-115.89	Zone-11 N:	T11S, R10E	JUST SOUT
Unknown	Natural/Na	Imperial	Kane Spring	10	33.16002	-115.897	Zone-11 N:	T12S, R10E	3.3 MILES I
Unknown	Natural/Na	Imperial	Seventeen	78	33.26211	-116.024	Zone-11 N:	T10S, R09E	ARROYO SA
Unknown	Natural/Na	Imperial	Shell Reef (	121	33.17177	-116.044	Zone-11 N:	T11S, R09E	WEST TARA
Unknown	Natural/Na	Imperial	Kane Spring	62	33.1854	-115.966	Zone-11 N:	T11S, R10E	0.5 ESE OF
Unknown	Natural/Na	Imperial	Picacho (33	200	33.02489	-114.612	Zone-11 N:	T13S, R22E	VICINITY O
Unknown	Natural/Na	Imperial	Shell Reef (	66	33.13923	-116.055	Zone-11 N:	T12S, R09E	SAN FELIPE
Unknown	Natural/Na	Imperial	Kane Spring	-30	33.20429	-115.932	Zone-11 N:	T11S, R10E	EAST OF CA
Unknown	Natural/Na	Imperial	Kane Spring	41	33.18088	-115.901	Zone-11 N:	T11S, R10E	SOUTHEAS
Unknown	Natural/Na	Imperial	Kane Spring	-20	33.2032	-115.974	Zone-11 N:	T11S, R10E	ALONG TUI
Unknown	Natural/Na	Imperial	Frink (3311	-191	33.37396	-115.684	Zone-11 N:	T09S, R12E	ALONG STA
Unknown	Natural/Na	Imperial	Imperial Re	191	32.90427	-114.465	Zone-11 N:	T15S, R24E	EAST OF SC
Unknown	Natural/Na	Imperial	Imperial Re	180	32.96957	-114.47	Zone-11 N:	T14S, R24E	SOUTH OF
Unknown	Natural/Na	Imperial	Imperial Re	189	32.94707	-114.475	Zone-11 N:	T14S, R24E	CALIFORNI
Unknown	Natural/Na	Imperial	Imperial Re	194	32.94034	-114.481	Zone-11 N:	T14S, R24E	CALIFORNI
Fluctuating	Natural/Na	Imperial	Imperial Re	273	32.90168	-114.484	Zone-11 N:	T15S, R24E	HURRICAN
Unknown	Natural/Na	Imperial	Bard (3211	154	32.83237	-114.542	Zone-11 N:	T15S, R23E	MISSION W
Stable	Natural/Na	Imperial	Calipatria S	-215	33.08289	-115.71	Zone-11 N:	T12S, R12E	ALONG VEI
Fluctuating	Natural/Na	Imperial	Niland (331	-220	33.1754	-115.625	Zone-11 N:	T11S, R13E	ROCK HILL
Stable	Natural/Na	Imperial	Niland (331	-224	33.18054	-115.616	Zone-11 N:	T11S, R13E	HEADQUAI
Stable	Natural/Na	Imperial	Niland (331	-219	33.18556	-115.589	Zone-11 N:	T11S, R13E	HAZARD 6
Stable	Natural/Na	Imperial	Niland (331	-221	33.19626	-115.583	Zone-11 N:	T11S, R13E	HAZARD 1C
Unknown	Natural/Na	Imperial	Obsidian Bu	-221	33.16942	-115.631	Zone-11 N:	T11S, R13E	MCKINDRY
Unknown	Natural/Na	Imperial	Yuha Basin	15	32.74563	-115.785	Zone-11 N:	T16S, R11E	WEST MESA
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	WESTMOR
Unknown	Natural/Na	Imperial	Carrizo Mtı	1149	32.81335	-116.033	Zone-11 N:	T15S, R09E	COYOTE M
Unknown	Natural/Na	Imperial	Grays Well	200	32.73237	-114.903	Zone-11 N:	T16S, R20E	VICINITY O
Unknown	Natural/Na	Imperial	In-ko-pah (	562	32.74805	-116.029	Zone-11 N:	T16S, R09E	VICINITY O
Unknown	Natural/Na	Imperial	Carrizo Mtı	400	32.88063	-116.048	Zone-11 N:	T15S, R09E	3 MILES EA
Unknown	Natural/Na	Imperial | S	Carrizo Mtn. NE (3211		33.00477	-116.114	Zone-11 N:	T13S, R08E	NEAR SPLIT

EEC ORIGINAL PKG

Unknown	Natural/Na	Imperial	Wister (33:	95	33.32862	-115.541	Zone-11 N:	T10S, R14E	COACHELL/
Unknown	Natural/Na	Imperial	Kane Sprin;	-100	33.17695	-115.857	Zone-11 N:	T11S, R11E	3.5 MILES I
Unknown	Natural/Na	Imperial | !	In-ko-pah Gorge (3211		32.67397	-116.106	Zone-11 N:	T17S, R08E	BASE OF M
Unknown	Natural/Na	Imperial | /	Yuma East	130	32.73659	-114.628	Zone-11 N:	T16S, R22E	AREA OF W
Unknown	Natural/Na	Imperial | !	Carrizo Mtı	996	32.79353	-116.108	Zone-11 N:	T16S, R08E	ALONG THI
Unknown	Natural/Na	Imperial	Coyote We	400	32.75465	-116.003	Zone-11 N:	T16S, R09E	VICINITY O
Unknown	Natural/Na	Imperial	Yuma West	250	32.74686	-114.755	Zone-11 N:	T16S, R21E	I-8 AT JUN(
Unknown	Natural/Na	Imperial	Seventeen	230	33.288	-116.058	Zone-11 N:	T10S, R09E	IN VICINITY
Unknown	Natural/Na	Imperial	Seventeen	62	33.28949	-116.043	Zone-11 N:	T10S, R09E	NORTHERN
Unknown	Natural/Na	Imperial	Seventeen	66	33.29924	-116.022	Zone-11 N:	T10S, R09E	CORAL WA
Unknown	Natural/Na	Imperial	Seventeen	100	33.31203	-116.03	Zone-11 N:	T10S, R09E	GRAVE WA
Unknown	Natural/Na	Imperial | !	Seventeen	180	33.32218	-116.068	Zone-11 N:	T10S, R09E	BIG WASH,
Unknown	Natural/Na	Imperial | !	Seventeen	550	33.30473	-116.076	Zone-11 N:	T10S, R09E	GRAVE WA
Unknown	Natural/Na	Imperial	Grays Well	150	32.70818	-114.973	Zone-11 N:	T17S, R19E	22 MILES V
Unknown	Natural/Na	Imperial	Shell Reef (	160	33.19501	-116.046	Zone-11 N:	T11S, R09E	E SIDE OF T
Unknown	Natural/Na	Imperial	Kane Sprin;	73	33.15533	-115.977	Zone-11 N:	T12S, R10E	ALONG PO
Unknown	Natural/Na	Imperial	Holtville Ea	25	32.77114	-115.28	Zone-11 N:	T16S, R16E	7 MILES E (
Unknown	Natural/Na	Imperial	Holtville Ea	0	32.87658	-115.293	Zone-11 N:	T15S, R16E	POMELO C.
Unknown	Natural/Na	Imperial	Glamis NW	100	32.97034	-115.228	Zone-11 N:	T13S, R17E	ABOUT 20
Unknown	Natural/Na	Imperial	Kane Sprin;	30	33.1369	-115.999	Zone-11 N:	T12S, R09E	ALONG TAI
Unknown	Natural/Na	Imperial	Frink (3311	-150	33.37087	-115.743	Zone-11 N:	T09S, R12E	EAST OF BE
Unknown	Natural/Na	Imperial	Frink NW (:	98	33.38421	-115.636	Zone-11 N:	T09S, R13E	N OF FRINK
Unknown	Natural/Na	Imperial	Picacho Pe.	200	32.9257	-114.642	Zone-11 N:	T14S, R22E	ABOUT 15
Unknown	Natural/Na	Imperial	Iris (33115:	150	33.2201	-115.397	Zone-11 N:	T11S, R15E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Little Picacl	480	32.95768	-114.543	Zone-11 N:	T14S, R23E	FERGUSON
Unknown	Natural/Na	Imperial	Chuckwalla	1650	33.42183	-115.18	Zone-11 N:	T09S, R17E	WASH NEA
Unknown	Natural/Na	Imperial	Glamis (32:	435	32.9249	-115.071	Zone-11 N:	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Glamis (32:	357	32.9842	-115.051	Zone-11 N:	T14S, R18E	ALGODONI
Unknown	Natural/Na	Imperial	Mt. Barrow	1372	33.13111	-114.949	Zone-11 N:	T12S, R19E	AT THE WE
Unknown	Natural/Na	Imperial	Cibola (331	230	33.37117	-114.706	Zone-11 N:	T09S, R21E	CIBOLA NA
Unknown	Natural/Na	Imperial	In-ko-pah (	1860	32.69382	-116.087	Zone-11 N:	T17S, R09E	IN-KO-PAH
Unknown	Natural/Na	Imperial	Picacho (3:	178	33.0254	-114.623	Zone-11 N:	T13S, R22E	ALONG THI
Unknown	Natural/Na	Imperial	Picacho SW (3311416)		33.02797	-114.736	Zone-11 N:	T13S, R21E	GAVILAN V
Unknown	Natural/Na	Imperial	Seventeen	121	33.28954	-116.03	Zone-11 N:	T10S, R09E	PALM WAS
Unknown	Natural/Na	Imperial	Seventeen	355	33.28849	-116.073	Zone-11 N:	T10S, R09E	NORTH FOI
Unknown	Natural/Na	Imperial	Seventeen	78	33.28394	-116.015	Zone-11 N:	T10S, R09E	N SIDE OF /
Unknown	Natural/Na	Imperial | !	In-ko-pah Gorge (3211		32.67054	-116.104	Zone-11 N:	T17S, R09E	LARKENS (L
Unknown	Natural/Na	Imperial	Calipatria S	-223	33.09011	-115.701	Zone-11 N:	T12S, R12E	TRIFOLIUM
Unknown	Natural/Na	Imperial	Niland (331	-224	33.24915	-115.59	Zone-11 N:	T11S, R13E	U LATERAL
Unknown	Natural/Na	Imperial	In-ko-pah (	2250	32.66996	-116.101	Zone-11 N:	T17S, R09E	MOUNTAIN
Unknown	Natural/Na	Imperial	Niland (331	-221	33.24191	-115.585	Zone-11 N:	T11S, R13E	T DRAIN, JU
Unknown	Natural/Na	Imperial	Obsidian B	-225	33.14846	-115.65	Zone-11 N:	T12S, R13E	LACK & LIN
Unknown	Natural/Na	Imperial	Wister (33:	-222	33.29983	-115.609	Zone-11 N:	T10S, R13E	NILAND LA
Unknown	Natural/Na	Imperial	Frink (3311	-191	33.37362	-115.684	Zone-11 N:	T09S, R12E	TRIBUTARY
Unknown	Natural/Na	Imperial	In-ko-pah (	3700	32.6349	-116.092	Zone-11 N:	T18S, R09E	SMUGGLER
Unknown	Natural/Na	Imperial	Coyote Wells (321156		32.73846	-115.995	Zone-11 N:	T16S, R09E	OCOTILLO.
Unknown	Natural/Na	Imperial	Carrizo Mtı	722	32.82858	-116.04	Zone-11 N:	T15S, R09E	CARRIZO M

Unknown	Natural/Na	Imperial | S	Seventeen	500	33.35034	-116.081	Zone-11 N:	T09S, R09E	WONDERS
Unknown	Natural/Na	Imperial	Seventeen	50	33.34565	-116.06	Zone-11 N:	T09S, R09E	SOUTH OF
Unknown	Natural/Na	Imperial	Seventeen	370	33.32945	-116.059	Zone-11 N:	T10S, R09E	VERBENA V
Unknown	Natural/Na	Imperial	Seventeen	80	33.32832	-116.038	Zone-11 N:	T10S, R09E	VERBENA V
Unknown	Natural/Na	Imperial	Seventeen	40	33.3313	-116.03	Zone-11 N:	T10S, R09E	VERBENA V
Unknown	Natural/Na	Imperial	Seventeen	300	33.31391	-116.066	Zone-11 N:	T10S, R09E	IN BIG WAS
Unknown	Natural/Na	Imperial	Seventeen	100	33.31085	-116.036	Zone-11 N:	T10S, R09E	GRAVE WA
Unknown	Natural/Na	Imperial	Seventeen	20	33.32167	-116.02	Zone-11 N:	T10S, R09E	BIG WASH;
Unknown	Natural/Na	Imperial	Seventeen	420	33.30556	-116.068	Zone-11 N:	T10S, R09E	SMALL ARR
Unknown	Natural/Na	Imperial	Seventeen	120	33.29693	-116.031	Zone-11 N:	T10S, R09E	CORAL WA
Unknown	Natural/Na	Imperial	Seventeen	40	33.30138	-116.01	Zone-11 N:	T10S, R09E	CORAL WA
Unknown	Natural/Na	Imperial	Seventeen	140	33.28731	-116.035	Zone-11 N:	T10S, R09E	NORTHERN
Unknown	Natural/Na	Imperial	Seventeen	400	33.27972	-116.063	Zone-11 N:	T10S, R09E	NORTH SID
Unknown	Natural/Na	Imperial	Seventeen	250	33.27029	-116.035	Zone-11 N:	T10S, R09E	ALONG BO
Unknown	Natural/Na	Imperial	Seventeen	100	33.27083	-116.006	Zone-11 N:	T10S, R09E	AMEROSA
Unknown	Natural/Na	Imperial	Seventeen	100	33.28889	-116.023	Zone-11 N:	T10S, R09E	PALM WAS
Unknown	Natural/Na	Imperial	Seventeen	200	33.27873	-116.075	Zone-11 N:	T10S, R09E	ALONG HW
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N:	T16S, R23E	U.S. YUMA
Unknown	Natural/Na	Imperial | S	In-ko-pah (	3000	32.67397	-116.106	Zone-11 N:	T17S, R08E	SUMMIT O
Unknown	Natural/Na	Imperial	Coyote We	600	32.72922	-116.016	Zone-11 N:	T16S, R09E	BASE OF M
Unknown	Natural/Na	Imperial	Hedges (32	787	32.92112	-114.828	Zone-11 N:	T14S, R20E	APPROXIM
Unknown	Natural/Na	Imperial	Clyde (321	600	32.98191	-114.911	Zone-11 N:	T14S, R20E	APPROXIM.
Unknown	Natural/Na	Imperial	Quartz Pea	1100	33.10389	-114.857	Zone-11 N:	T12S, R20E	BLACK MO
Unknown	Natural/Na	Imperial	Buzzards P	800	33.21673	-114.862	Zone-11 N:	T11S, R20E	MIDWAY W
Decreasing	Natural/Na	Imperial	Ninemile W	800	33.05931	-114.971	Zone-11 N:	T13S, R19E	VCR MININ
Unknown	Natural/Na	Imperial	Bard (3211	180	32.80031	-114.619	Zone-11 N:	T16S, R22E	PICACHO V
Unknown	Natural/Na	Imperial	Araz (3211	500	32.83313	-114.686	Zone-11 N:	T15S, R22E	JUST WEST
Unknown	Natural/Na	Imperial	In-ko-pah (	2174	32.67724	-116.09	Zone-11 N:	T17S, R09E	BETWEEN
Unknown	Natural/Na	Imperial | S	In-ko-pah (	3044	32.64828	-116.108	Zone-11 N:	T17S, R08E	0.13 MILES
Unknown	Natural/Na	Imperial	Bonds Corr	40	32.67668	-115.372	Zone-11 N:	T17S, R16E	0.1 MI W C
Unknown	Natural/Na	Imperial	Bonds Corr	30	32.69147	-115.358	Zone-11 N:	T17S, R16E	0.25 MI SW
Unknown	Natural/Na	Imperial	Bonds Corr	30	32.70627	-115.364	Zone-11 N:	T17S, R16E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Mount Sigr	-10	32.68875	-115.665	Zone-11 N:	T17S, R13E	0.75 MILE I
Unknown	Natural/Na	Imperial	Heber (321	-10	32.68141	-115.622	Zone-11 N:	T17S, R13E	0.2 MI NNV
Unknown	Natural/Na	Imperial	Heber (321	-10	32.68886	-115.615	Zone-11 N:	T17S, R13E	0.6 MI SE K
Unknown	Natural/Na	Imperial	Holtville Ea	20	32.76333	-115.286	Zone-11 N:	T16S, R16E	W SIDE OF
Unknown	Natural/Na	Imperial	Holtville Ea	20	32.77015	-115.291	Zone-11 N:	T16S, R16E	0.4 MI SW
Unknown	Natural/Na	Imperial	Holtville Ea	35	32.78968	-115.289	Zone-11 N:	T16S, R16E	0.6 MI NNE
Unknown	Natural/Na	Imperial	Holtville Ea	20	32.79677	-115.291	Zone-11 N:	T15S, R16E	0.8 MI SE N
Unknown	Natural/Na	Imperial	El Centro (3	-30	32.78072	-115.547	Zone-11 N:	T16S, R14E	0.3 MI SE S
Unknown	Natural/Na	Imperial	El Centro (3	-30	32.76186	-115.543	Zone-11 N:	T16S, R14E	0.5 MI E HV
Unknown	Natural/Na	Imperial	El Centro (3	-30	32.77307	-115.556	Zone-11 N:	T16S, R14E	JUST S OF I
Unknown	Natural/Na	Imperial	El Centro (3	-30	32.77281	-115.523	Zone-11 N:	T16S, R14E	JUST S OF I
Unknown	Natural/Na	Imperial	El Centro (3	-25	32.76207	-115.526	Zone-11 N:	T16S, R14E	E SIDE OF H
Unknown	Natural/Na	Imperial	Holtville NE	-60	32.95993	-115.373	Zone-11 N:	T14S, R15E	S OF GRIFF
Unknown	Natural/Na	Imperial	Holtville NE	-50	32.96002	-115.364	Zone-11 N:	T14S, R16E	JUST S OF (
Unknown	Natural/Na	Imperial	Holtville NE	-40	32.96015	-115.35	Zone-11 N:	T14S, R16E	JUST S OF (

Unknown	Natural/Na	Imperial	Holtville NE	-30	32.96009	-115.344	Zone-11 N:	T14S, R16E	JUST N & S
Unknown	Natural/Na	Imperial	Holtville NE	-20	32.96022	-115.338	Zone-11 N:	T14S, R16E	ALONG GRI
Unknown	Natural/Na	Imperial	Holtville NE	0	32.9603	-115.315	Zone-11 N:	T14S, R16E	ALONG GRI
Unknown	Natural/Na	Imperial	Holtville NE	0	32.96012	-115.307	Zone-11 N:	T14S, R16E	S OF GRIFF
Unknown	Natural/Na	Imperial	Holtville NE	0	32.96173	-115.302	Zone-11 N:	T14S, R16E	0.1 MI N O
Unknown	Natural/Na	Imperial	Holtville NE	0	32.96742	-115.307	Zone-11 N:	T14S, R16E	ALONG STF
Unknown	Natural/Na	Imperial	Holtville NE	0	32.96762	-115.317	Zone-11 N:	T14S, R16E	ALONG STF
Unknown	Natural/Na	Imperial	Holtville NE	-10	32.96751	-115.324	Zone-11 N:	T14S, R16E	AT INTERSE
Unknown	Natural/Na	Imperial	Holtville NE	-20	32.96747	-115.329	Zone-11 N:	T14S, R16E	ALONG STF
Unknown	Natural/Na	Imperial	Holtville NE	-20	32.9677	-115.338	Zone-11 N:	T14S, R16E	ALONG STF
Unknown	Natural/Na	Imperial	Holtville NE	-30	32.96791	-115.344	Zone-11 N:	T14S, R16E	AREA OF ST
Unknown	Natural/Na	Imperial	Holtville NE	-30	32.96752	-115.349	Zone-11 N:	T14S, R16E	ALONG STF
Unknown	Natural/Na	Imperial	Holtville NE	-50	32.96742	-115.357	Zone-11 N:	T14S, R16E	AREA ALON
Unknown	Natural/Na	Imperial	Holtville NE	-50	32.96727	-115.367	Zone-11 N:	T14S, R15E	JUST EAST
Unknown	Natural/Na	Imperial	Holtville NE	0	32.97452	-115.321	Zone-11 N:	T13S, R16E	ALONG HW
Unknown	Natural/Na	Imperial	Holtville NE	0	32.97456	-115.316	Zone-11 N:	T13S, R16E	ALONG HW
Unknown	Natural/Na	Imperial	Holtville NE	0	32.9748	-115.311	Zone-11 N:	T13S, R16E	ALONG HW
Unknown	Natural/Na	Imperial	Holtville NE	5	32.97459	-115.302	Zone-11 N:	T13S, R16E	ALONG HW
Unknown	Natural/Na	Imperial	Holtville NE	-30	32.95311	-115.344	Zone-11 N:	T14S, R16E	N SIDE OF
Unknown	Natural/Na	Imperial	Holtville NE	-50	32.95279	-115.36	Zone-11 N:	T14S, R16E	ALONG GO
Unknown	Natural/Na	Imperial	Holtville NE	-60	32.94537	-115.371	Zone-11 N:	T14S, R15E	S SIDE OF N
Unknown	Natural/Na	Imperial	Holtville NE	-50	32.9455	-115.363	Zone-11 N:	T14S, R16E	ALONG NO
Unknown	Natural/Na	Imperial	Coyote We	300	32.75026	-115.925	Zone-11 N:	T16S, R10E	APPROXIM
Unknown	Natural/Na	Imperial	Coyote We	300	32.75065	-115.916	Zone-11 N:	T16S, R10E	APPROXIM
Unknown	Natural/Na	Imperial	Painted Go	300	32.76228	-115.881	Zone-11 N:	T16S, R11E	APPROXIM
Unknown	Natural/Na	Imperial	Amos (331	-10	33.03836	-115.337	Zone-11 N:	T13S, R16E	ALONG IRV
Unknown	Natural/Na	Imperial	Amos (331	-10	33.02995	-115.334	Zone-11 N:	T13S, R16E	250 METEF
Unknown	Natural/Na	Imperial	Amos (331	-10	33.02499	-115.331	Zone-11 N:	T13S, R16E	0.5 MI SE C
Unknown	Natural/Na	Imperial	Wiest (331	-90	33.00087	-115.4	Zone-11 N:	T13S, R15E	ALONG SHA
Unknown	Natural/Na	Imperial	Wiest (331	-100	33.00086	-115.418	Zone-11 N:	T13S, R15E	ALONG SHA
Unknown	Natural/Na	Imperial	Wiest (331	-120	33.00088	-115.437	Zone-11 N:	T13S, R15E	ALONG SHA
Unknown	Natural/Na	Imperial	Wiest (331	-120	33.00809	-115.43	Zone-11 N:	T13S, R15E	0.4 MI W C
Unknown	Natural/Na	Imperial	Wiest (331	-100	33.0081	-115.414	Zone-11 N:	T13S, R15E	ALONG FAI
Unknown	Natural/Na	Imperial	Wiest (331	-100	33.00811	-115.405	Zone-11 N:	T13S, R15E	ALONG FAI
Unknown	Natural/Na	Imperial	Wiest (331	-90	33.0081	-115.397	Zone-11 N:	T13S, R15E	ALONG FAI
Unknown	Natural/Na	Imperial	Wiest (331	-120	33.01532	-115.414	Zone-11 N:	T13S, R15E	0.1 MI W C
Unknown	Natural/Na	Imperial	Wiest (331	-120	33.01537	-115.435	Zone-11 N:	T13S, R15E	0.8 MI E OI
Unknown	Natural/Na	Imperial	Wiest (331	-130	33.0153	-115.447	Zone-11 N:	T13S, R15E	ALONG S SI
Unknown	Natural/Na	Imperial	Wiest (331	-130	33.02256	-115.446	Zone-11 N:	T13S, R15E	ALONG THI
Unknown	Natural/Na	Imperial	Westmorla	-205	33.12333	-115.622	Zone-11 N:	T12S, R13E	ALONG E SI
Unknown	Natural/Na	Imperial	Calipatria S	-170	33.04303	-115.665	Zone-11 N:	T13S, R13E	ALONG HO
Unknown	Natural/Na	Imperial	Calipatria S	-180	33.05046	-115.665	Zone-11 N:	T13S, R13E	ALONG HO
Unknown	Natural/Na	Imperial	Calipatria S	-180	33.05798	-115.665	Zone-11 N:	T13S, R13E	ALONG HO
Unknown	Natural/Na	Imperial	Calipatria S	-190	33.07497	-115.663	Zone-11 N:	T13S, R13E	ALONG HO
Unknown	Natural/Na	Imperial	Calipatria S	-200	33.08603	-115.665	Zone-11 N:	T12S, R13E	ALONG E SI
Unknown	Natural/Na	Imperial	Calipatria S	-210	33.09925	-115.666	Zone-11 N:	T12S, R13E	ALONG TRI
Unknown	Natural/Na	Imperial	Bonds Corr	30	32.69863	-115.358	Zone-11 N:	T17S, R16E	0.9 MI ENE

Unknown	Natural/Na	Imperial	Calipatria S	-220	33.12445	-115.648	Zone-11 N:	T12S, R13E	ALONG LAC
Unknown	Natural/Na	Imperial	Calipatria S	-220	33.10034	-115.673	Zone-11 N:	T12S, R12E	0.4 MI S OF
Unknown	Natural/Na	Imperial	Calipatria S	-210	33.08952	-115.674	Zone-11 N:	T12S, R12E	1 MI WSW
Unknown	Natural/Na	Imperial	Calipatria S	-190	33.06574	-115.673	Zone-11 N:	T13S, R13E	ALONG PEL
Unknown	Natural/Na	Imperial	Calipatria S	-190	33.05514	-115.673	Zone-11 N:	T13S, R13E	0.2 MI N O
Unknown	Natural/Na	Imperial	Calipatria S	-180	33.04565	-115.673	Zone-11 N:	T13S, R13E	0.6 MI N O
Unknown	Natural/Na	Imperial	Calipatria S	-180	33.04111	-115.673	Zone-11 N:	T13S, R13E	0.25 MI N (
Unknown	Natural/Na	Imperial	Calipatria S	-170	33.03433	-115.676	Zone-11 N:	T13S, R13E	0.2 ROAD M
Unknown	Natural/Na	Imperial	Calipatria S	-210	33.08574	-115.683	Zone-11 N:	T12S, R12E	0.7 MI N O
Unknown	Natural/Na	Imperial	Calipatria S	-200	33.0732	-115.681	Zone-11 N:	T13S, R12E	WALKER RI
Unknown	Natural/Na	Imperial	Calipatria S	-190	33.0629	-115.682	Zone-11 N:	T13S, R12E	1.7 MI N SF
Unknown	Natural/Na	Imperial	Calipatria S	-190	33.04878	-115.682	Zone-11 N:	T13S, R12E	0.8 MI N SF
Unknown	Natural/Na	Imperial	Calipatria S	-180	33.03963	-115.682	Zone-11 N:	T13S, R12E	0.1 MI N SF
Unknown	Natural/Na	Imperial	Calipatria S	-170	33.03028	-115.684	Zone-11 N:	T13S, R12E	0.7 MI SE B
Unknown	Natural/Na	Imperial	Calipatria S	-200	33.07023	-115.693	Zone-11 N:	T13S, R12E	0.3 MI S OF
Unknown	Natural/Na	Imperial	Calipatria S	-190	33.05617	-115.69	Zone-11 N:	T13S, R12E	1.4 MI N O
Unknown	Natural/Na	Imperial	Calipatria S	-220	33.08186	-115.701	Zone-11 N:	T12S, R12E	ALONG TRI
Unknown	Natural/Na	Imperial	Calipatria S	-170	33.04516	-115.703	Zone-11 N:	T13S, R12E	0.5 AIR MIL
Unknown	Natural/Na	Imperial	Obsidian B	-220	33.13295	-115.648	Zone-11 N:	T12S, R13E	JUST E OF L
Unknown	Natural/Na	Imperial	Obsidian B	-220	33.14103	-115.639	Zone-11 N:	T12S, R13E	0.5 MI N O
Unknown	Natural/Na	Imperial	Obsidian B	-210	33.14543	-115.631	Zone-11 N:	T12S, R13E	JUST S OF \
Unknown	Natural/Na	Imperial	Obsidian B	-210	33.13631	-115.631	Zone-11 N:	T12S, R13E	1.3 MI SE B
Unknown	Natural/Na	Imperial	Obsidian B	-210	33.12916	-115.631	Zone-11 N:	T12S, R13E	ALONG SE\
Unknown	Natural/Na	Imperial	Niland (331	-200	33.12815	-115.614	Zone-11 N:	T12S, R13E	JUST E OF (
Unknown	Natural/Na	Imperial	Wiest (331	-90	33.12572	-115.403	Zone-11 N:	T12S, R15E	ALONG E W
Unknown	Natural/Na	Imperial	Wiest (331	-130	33.12574	-115.438	Zone-11 N:	T12S, R15E	ALONG E W
Unknown	Natural/Na	Imperial	Iris (33115:	-130	33.13295	-115.445	Zone-11 N:	T12S, R15E	ALONG YOI
Unknown	Natural/Na	Imperial	Iris (33115:	-120	33.13292	-115.431	Zone-11 N:	T12S, R15E	ALONG YOI
Unknown	Natural/Na	Imperial	Iris (33115:	-110	33.1329	-115.421	Zone-11 N:	T12S, R15E	ALONG YOI
Unknown	Natural/Na	Imperial	Iris (33115:	-100	33.13293	-115.414	Zone-11 N:	T12S, R15E	ALONG YOI
Unknown	Natural/Na	Imperial	Seeley (3211576)		32.78099	-115.689	Zone-11 N:	T16S, R12E	BLUE LAKE,
Unknown	Natural/Na	Imperial	Iris (33115:	-100	33.14036	-115.415	Zone-11 N:	T12S, R15E	ALONG WII
Unknown	Natural/Na	Imperial	Iris (33115:	-100	33.14034	-115.429	Zone-11 N:	T12S, R15E	ALONG WII
Unknown	Natural/Na	Imperial	Iris (33115:	-130	33.14015	-115.443	Zone-11 N:	T12S, R15E	ALONG WII
Unknown	Natural/Na	Imperial	Iris (33115:	-120	33.14745	-115.435	Zone-11 N:	T12S, R15E	ALONG W I
Unknown	Natural/Na	Imperial	Wister (33:	-70	33.29282	-115.538	Zone-11 N:	T10S, R14E	ALONG WII
Unknown	Natural/Na	Imperial	Wister (33:	-80	33.27882	-115.532	Zone-11 N:	T10S, R14E	0.9 MI SE E
Unknown	Natural/Na	Imperial	Wister (33:	-120	33.27129	-115.537	Zone-11 N:	T10S, R14E	1.1 MI SSE
Unknown	Natural/Na	Imperial	Wister (33:	-90	33.26369	-115.522	Zone-11 N:	T10S, R14E	0.7 MI WES
Unknown	Natural/Na	Imperial	Wister (33:	-110	33.26304	-115.528	Zone-11 N:	T10S, R14E	JUST S OF L
Unknown	Natural/Na	Imperial	Wister (33:	-110	33.25651	-115.523	Zone-11 N:	T10S, R14E	ABOUT 0.5
Unknown	Natural/Na	Imperial	Plaster City (3211577)		32.78215	-115.773	Zone-11 N:	T16S, R12E	DIAMOND
Unknown	Natural/Na	Imperial	Truckhaver	-130	33.27974	-115.952	Zone-11 N:	T10S, R10E	0.7 MI E SR
Unknown	Natural/Na	Imperial | I	Oasis (331:	200	33.41645	-116.098	Zone-11 N:	T09S, R08E	EXTREME N
Unknown	Natural/Na	Imperial | S	In-ko-pah (	2952	32.64344	-116.109	Zone-11 N:	T17S, R08E	SOUTH OF
Unknown	Natural/Na	Imperial	Picacho SW	220	33.11315	-114.706	Zone-11 N:	T12S, R21E	VELIAN WA
Unknown	Natural/Na	Imperial | /	Picacho NV	220	33.2549	-114.69	Zone-11 N:	T11S, R22E	THREE FIN(

EEC ORIGINAL PKG

Unknown	Natural/Na	Imperial	Iris (33115:	82	33.19193	-115.397	Zone-11 N:	T11S, R15E	ALONG RAI
Unknown	Natural/Na	Imperial	Cibola (331	238	33.31423	-114.732	Zone-11 N:	T10S, R21E	JUST NW D
Unknown	Natural/Na	Imperial	Palo Verde	245	33.41606	-114.749	Zone-11 N:	T09S, R21E	JUST W OF
Unknown	Natural/Na	Imperial	Wiest (331	-90	33.01535	-115.394	Zone-11 N:	T13S, R15E	ALONG THI
Unknown	Natural/Na	Imperial	Wiest (331	-80	33.01533	-115.385	Zone-11 N:	T13S, R15E	ALONG THI
Unknown	Natural/Na	Imperial	Amos (331	-70	33.02279	-115.376	Zone-11 N:	T13S, R15E	ALONG THI
Unknown	Natural/Na	Imperial	Wiest (331	-80	33.00084	-115.387	Zone-11 N:	T13S, R15E	ALONG THI
Unknown	Natural/Na	Imperial	Wiest (331	-70	33.00084	-115.382	Zone-11 N:	T13S, R15E	ALONG THI
Unknown	Natural/Na	Imperial	Amos (331	-60	33.00808	-115.372	Zone-11 N:	T13S, R15E	S SIDE OF F
Unknown	Natural/Na	Imperial	Amos (331	-60	33.01536	-115.374	Zone-11 N:	T13S, R15E	S SIDE OF J
Unknown	Natural/Na	Imperial	Niland (331	-220	33.17474	-115.614	Zone-11 N:	T11S, R13E	JUST SSE O
Unknown	Natural/Na	Imperial	Mount Sigr	-10	32.71374	-115.688	Zone-11 N:	T16.5S, R1:	ON WESTSI
Unknown	Natural/Na	Imperial	Seeley (321	-60	32.79813	-115.737	Zone-11 N:	T16S, R12E	VICINITY O
Unknown	Natural/Na	Imperial	Seeley (321	-60	32.84222	-115.738	Zone-11 N:	T15S, R12E	IN THE VICI
Unknown	Natural/Na	Imperial	Plaster City	-40	32.83399	-115.754	Zone-11 N:	T15S, R12E	ALONG THI
Unknown	Natural/Na	Imperial	Wister (33:	-130	33.27779	-115.545	Zone-11 N:	T10S, R14E	VICINITY O
Unknown	Natural/Na	Imperial	Calipatria S	-200	33.06911	-115.717	Zone-11 N:	T13S, R12E	ALONG TRI
Unknown	Natural/Na	Imperial	Calipatria S	-210	33.09735	-115.667	Zone-11 N:	T12S, R12E	ALONG TRI
Unknown	Natural/Na	Imperial	Niland (331	-220	33.18768	-115.588	Zone-11 N:	T11S, R13E	ALONG VAI
Unknown	Natural/Na	Imperial	El Centro (:	-50	32.818	-115.518	Zone-11 N:	T15S, R14E	JCT OF ALD
Unknown	Natural/Na	Imperial	Amos (331	-10	33.05972	-115.341	Zone-11 N:	T13S, R16E	JUST S OF M
Unknown	Natural/Na	Imperial	Laguna Dar	160	32.87106	-114.477	Zone-11 N:	T15S, R24E	JUST N ANI
Unknown	Natural/Na	Imperial	Seeley (321	-40	32.77211	-115.744	Zone-11 N:	T16S, R12E	ALONG THI
Unknown	Natural/Na	Imperial	Ogilby (321	360	32.81754	-114.841	Zone-11 N:	T15S, R20E	OGILBY.
Unknown	Natural/Na	Imperial | S	Borrego Mountain SE (		33.02988	-116.093	Zone-11 N:	T13S, R09E	ACROSS FR
Unknown	Natural/Na	Imperial	Imperial Re	190	32.95316	-114.473	Zone-11 N:	T14S, R24E	CA SIDE OF
Unknown	Natural/Na	Imperial	El Centro (:	-40	32.80668	-115.518	Zone-11 N:	T15S, R14E	ALONG E SI
Unknown	Natural/Na	Imperial	El Centro (:	-50	32.82291	-115.518	Zone-11 N:	T15S, R14E	ALONG CO
Unknown	Natural/Na	Imperial	El Centro (:	-60	32.83269	-115.518	Zone-11 N:	T15S, R14E	ALONG CO
Unknown	Natural/Na	Imperial	El Centro (:	-60	32.83653	-115.519	Zone-11 N:	T15S, R14E	ALONG CO
Unknown	Natural/Na	Imperial	El Centro (:	-120	32.87383	-115.518	Zone-11 N:	T15S, R14E	ALONG WE
Unknown	Natural/Na	Imperial	El Centro (:	-120	32.87034	-115.51	Zone-11 N:	T15S, R14E	ALONG HW
Unknown	Natural/Na	Imperial	Brawley (3:	-140	32.91428	-115.511	Zone-11 N:	T14S, R14E	JUST NNW
Unknown	Natural/Na	Imperial	Brawley (3:	-130	32.93117	-115.51	Zone-11 N:	T14S, R14E	ALONG SR
Unknown	Natural/Na	Imperial	Brawley (3:	-120	32.96513	-115.509	Zone-11 N:	T14S, R14E	ALONG SR
Unknown	Natural/Na	Imperial	Brawley (3:	-120	32.97395	-115.509	Zone-11 N:	T13S, R14E	ALONG SR
Unknown	Natural/Na	Imperial	Westmorla	-140	33.01285	-115.509	Zone-11 N:	T13S, R14E	E SIDE OF E
Unknown	Natural/Na	Imperial	Westmorla	-150	33.03982	-115.509	Zone-11 N:	T13S, R14E	ALONG BES
Unknown	Natural/Na	Imperial	Westmorla	-160	33.06264	-115.511	Zone-11 N:	T13S, R14E	ALONG KEI
Unknown	Natural/Na	Imperial	Westmorla	-160	33.089	-115.509	Zone-11 N:	T12S, R14E	JUST SE KEI
Unknown	Natural/Na	Imperial	Plaster City	-10	32.78524	-115.793	Zone-11 N:	T16S, R11E	0.4 MI SSE
Unknown	Natural/Na	Imperial	Yuha Basin	20	32.74447	-115.785	Zone-11 N:	T16S, R11E	ABOUT 2 M
Unknown	Natural/Na	Imperial	Plaster City	50	32.77902	-115.833	Zone-11 N:	T16S, R11E	ABOUT 1.8
Unknown	Natural/Na	Imperial	Plaster City	50	32.769	-115.818	Zone-11 N:	T16S, R11E	1 MI W OF
Unknown	Natural/Na	Imperial	Plaster City	40	32.76871	-115.809	Zone-11 N:	T16S, R11E	0.5 MI W C
Unknown	Natural/Na	Imperial	Plaster City	252	32.75728	-115.871	Zone-11 N:	T16S, R11E	2.5 MI SSW
Unknown	Natural/Na	Imperial	Yuha Basin	40	32.74945	-115.799	Zone-11 N:	T16S, R11E	1.3 MI S OF

Unknown	Natural/Na	Imperial	Plaster City	30	32.78827	-115.827	Zone-11 N:	T16S, R11E	ABOUT 1.9
Unknown	Natural/Na	Imperial	Plaster City	30	32.77973	-115.822	Zone-11 N:	T16S, R11E	1.5 MI NW
Unknown	Natural/Na	Imperial	Plaster City	180	32.77319	-115.865	Zone-11 N:	T16S, R11E	1.3 MI SSW
Unknown	Natural/Na	Imperial	Holtville NE	-40	32.94569	-115.351	Zone-11 N:	T14S, R16E	ALONG NO
Unknown	Natural/Na	Imperial	Holtville NE	-30	32.94572	-115.342	Zone-11 N:	T14S, R16E	ALONG NO
Unknown	Natural/Na	Imperial	Holtville NE	-15	32.94565	-115.327	Zone-11 N:	T14S, R16E	ALONG NO
Unknown	Natural/Na	Imperial	Holtville NE	0	32.94545	-115.304	Zone-11 N:	T14S, R16E	ALONG NO
Unknown	Natural/Na	Imperial	Holtville NE	0	32.93839	-115.306	Zone-11 N:	T14S, R16E	ALONG HA
Unknown	Natural/Na	Imperial	Holtville NE	-20	32.93835	-115.335	Zone-11 N:	T14S, R16E	ALONG HA
Unknown	Natural/Na	Imperial	Holtville NE	-40	32.93826	-115.349	Zone-11 N:	T14S, R16E	ALONG HA
Unknown	Natural/Na	Imperial	Holtville NE	-40	32.93389	-115.353	Zone-11 N:	T14S, R16E	ABOUT 1.6
Unknown	Natural/Na	Imperial	Holtville NE	-50	32.93389	-115.369	Zone-11 N:	T14S, R15E	ABOUT 0.3
Unknown	Natural/Na	Imperial	Holtville NE	-50	32.93492	-115.375	Zone-11 N:	T14S, R15E	ABOUT 0.4
Unknown	Natural/Na	Imperial	Alamorio (:	-120	32.99368	-115.444	Zone-11 N:	T13S, R15E	ALONG O'E
Unknown	Natural/Na	Imperial	Alamorio (:	-110	32.99372	-115.427	Zone-11 N:	T13S, R15E	ALONG O E
Unknown	Natural/Na	Imperial	Alamorio (:	-100	32.99363	-115.419	Zone-11 N:	T13S, R15E	ALONG O'E
Unknown	Natural/Na	Imperial	Alamorio (:	-90	32.99361	-115.407	Zone-11 N:	T13S, R15E	ALONG O'E
Unknown	Natural/Na	Imperial	Alamorio (:	-70	32.99363	-115.388	Zone-11 N:	T13S, R15E	ALONG O E
Unknown	Natural/Na	Imperial	Alamorio (:	-70	32.98643	-115.382	Zone-11 N:	T13S, R15E	ALONG TAI
Unknown	Natural/Na	Imperial	Alamorio (:	-80	32.98644	-115.397	Zone-11 N:	T13S, R15E	ALONG TAI
Unknown	Natural/Na	Imperial	Alamorio (:	-100	32.98637	-115.418	Zone-11 N:	T13S, R15E	ALONG TAI
Unknown	Natural/Na	Imperial	Alamorio (:	-110	32.98642	-115.427	Zone-11 N:	T13S, R15E	ALONG TAI
Unknown	Natural/Na	Imperial	Alamorio (:	-110	32.9864	-115.436	Zone-11 N:	T13S, R15E	ALONG TAI
Unknown	Natural/Na	Imperial	Alamorio (:	-120	32.98647	-115.442	Zone-11 N:	T13S, R15E	ALONG TAI
Unknown	Natural/Na	Imperial	Alamorio (:	-90	32.98175	-115.412	Zone-11 N:	T13S, R15E	ALONG SILI
Unknown	Natural/Na	Imperial	Alamorio (:	-80	32.98175	-115.397	Zone-11 N:	T13S, R15E	ALONG SILI
Unknown	Natural/Na	Imperial	Holtville NE	-70	32.98171	-115.384	Zone-11 N:	T13S, R15E	ALONG SILI
Unknown	Natural/Na	Imperial	Kane Spring	-118	33.16533	-115.828	Zone-11 N:	T11S, R11E	SAN FELIPE
Unknown	Natural/Na	Imperial	Alamorio (:	-80	32.97423	-115.394	Zone-11 N:	T13S, R15E	ALONG HW
Unknown	Natural/Na	Imperial	Alamorio (:	-80	32.9742	-115.399	Zone-11 N:	T13S, R15E	ALONG HW
Unknown	Natural/Na	Imperial	Alamorio (:	-110	32.97437	-115.44	Zone-11 N:	T13S, R15E	ALONG HW
Unknown	Natural/Na	Imperial	Alamorio (:	-110	32.96721	-115.438	Zone-11 N:	T14S, R15E	ALONG STF
Unknown	Natural/Na	Imperial	Alamorio (:	-100	32.9676	-115.426	Zone-11 N:	T14S, R15E	ALONG STF
Unknown	Natural/Na	Imperial	Alamorio (:	-100	32.96711	-115.417	Zone-11 N:	T14S, R15E	ALONG STF
Unknown	Natural/Na	Imperial	Alamorio (:	-80	32.96708	-115.399	Zone-11 N:	T14S, R15E	ALONG STF
Unknown	Natural/Na	Imperial	Alamorio (:	-70	32.96732	-115.391	Zone-11 N:	T14S, R15E	ALONG STF
Unknown	Natural/Na	Imperial	Holtville NE	-60	32.96745	-115.376	Zone-11 N:	T14S, R15E	ALONG STF
Unknown	Natural/Na	Imperial	Alamorio (:	-70	32.96008	-115.386	Zone-11 N:	T14S, R15E	ALONG GRI
Unknown	Natural/Na	Imperial	Alamorio (:	-80	32.96006	-115.4	Zone-11 N:	T14S, R15E	ALONG GRI
Unknown	Natural/Na	Imperial	Alamorio (:	-90	32.95988	-115.407	Zone-11 N:	T14S, R15E	ALONG GRI
Unknown	Natural/Na	Imperial	Alamorio (:	-90	32.95993	-115.416	Zone-11 N:	T14S, R15E	ALONG GRI
Unknown	Natural/Na	Imperial	Alamorio (:	-100	32.95981	-115.423	Zone-11 N:	T14S, R15E	ALONG GRI
Unknown	Natural/Na	Imperial	Alamorio (:	-120	32.96041	-115.448	Zone-11 N:	T14S, R15E	ALONG WII
Unknown	Natural/Na	Imperial	Alamorio (:	-110	32.9529	-115.443	Zone-11 N:	T14S, R15E	ALONG GO
Unknown	Natural/Na	Imperial	Alamorio (:	-110	32.95278	-115.432	Zone-11 N:	T14S, R15E	ALONG GO
Unknown	Natural/Na	Imperial	Alamorio (:	-100	32.95281	-115.426	Zone-11 N:	T14S, R15E	ALONG GO
Unknown	Natural/Na	Imperial	Alamorio (:	-90	32.95289	-115.413	Zone-11 N:	T14S, R15E	ALONG GO

Unknown	Natural/Na	Imperial	Alamorio (3	-80	32.95288	-115.399	Zone-11 N:	T14S, R15E	ALONG GO
Unknown	Natural/Na	Imperial	Alamorio (3	-70	32.95341	-115.38	Zone-11 N:	T14S, R15E	ALONG GO
Unknown	Natural/Na	Imperial	Alamorio (3	-70	32.94554	-115.388	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial	Alamorio (3	-80	32.94559	-115.401	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial | /	Yuma East	200	32.73172	-114.616	Zone-11 N:	T16S, R22E	FORT YUM.
Unknown	Natural/Na	Imperial	Alamorio (3	-90	32.94561	-115.41	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial	Alamorio (3	-90	32.94551	-115.419	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial	Alamorio (3	-100	32.94557	-115.424	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial	Alamorio (3	-100	32.94555	-115.43	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.94553	-115.435	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial	Bard (3211	160	32.81796	-114.521	Zone-11 N:	T15S, R23E	JUST NE OF
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.9455	-115.44	Zone-11 N:	T14S, R15E	ALONG NO
Unknown	Natural/Na	Imperial	Alamorio (3	-115	32.93614	-115.449	Zone-11 N:	T14S, R15E	ALONG WI
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.93779	-115.437	Zone-11 N:	T14S, R15E	ALONG HA
Unknown	Natural/Na	Imperial	Alamorio (3	-90	32.93802	-115.413	Zone-11 N:	T14S, R15E	ALONG HA
Unknown	Natural/Na	Imperial	Alamorio (3	-80	32.93809	-115.403	Zone-11 N:	T14S, R15E	ALONG HA
Unknown	Natural/Na	Imperial	Alamorio (3	-80	32.93574	-115.396	Zone-11 N:	T14S, R15E	ALONG AN
Unknown	Natural/Na	Imperial	Alamorio (3	-100	32.92365	-115.425	Zone-11 N:	T14S, R15E	ALONG FIN
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.92366	-115.443	Zone-11 N:	T14S, R15E	ALONG FIN
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.91647	-115.448	Zone-11 N:	T14S, R15E	ALONG E K
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.91648	-115.442	Zone-11 N:	T14S, R15E	ALONG E K
Unknown	Natural/Na	Imperial	Alamorio (3	-100	32.91649	-115.428	Zone-11 N:	T14S, R15E	ALONG E K
Unknown	Natural/Na	Imperial	Alamorio (3	-90	32.91642	-115.416	Zone-11 N:	T14S, R15E	ALONG E K
Unknown	Natural/Na	Imperial	Alamorio (3	-90	32.90936	-115.414	Zone-11 N:	T14S, R15E	ALONG CO
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.90921	-115.436	Zone-11 N:	T14S, R15E	ALONG CO
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.90919	-115.443	Zone-11 N:	T14S, R15E	ALONG CO
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.89952	-115.449	Zone-11 N:	T14S, R15E	0.5 MI WS\
Unknown	Natural/Na	Imperial	Alamorio (3	-110	32.90198	-115.444	Zone-11 N:	T14S, R15E	ALONG BO
Unknown	Natural/Na	Imperial	Alamorio (3	-100	32.90202	-115.434	Zone-11 N:	T14S, R15E	ALONG BO
Unknown	Natural/Na	Imperial	Alamorio (3	-80	32.90202	-115.418	Zone-11 N:	T14S, R15E	ALONG BO
Unknown	Natural/Na	Imperial	Alamorio (3	-80	32.90199	-115.41	Zone-11 N:	T14S, R15E	ALONG BO
Unknown	Natural/Na	Imperial	Alamorio (3	-70	32.90204	-115.394	Zone-11 N:	T14S, R15E	ALONG BO
Unknown	Natural/Na	Imperial	Alamorio (3	-60	32.89482	-115.384	Zone-11 N:	T14S, R15E	ALONG TO
Unknown	Natural/Na	Imperial	Alamorio (3	-90	32.89474	-115.418	Zone-11 N:	T14S, R15E	ALONG TO
Unknown	Natural/Na	Imperial | I	Calexico (3	0	32.66977	-115.496	Zone-11 N:	T17S, R14E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211	405	32.8619	-114.556	Zone-11 N:	T15S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Holtville NI	-60	32.98203	-115.369	Zone-11 N:	T13S, R15E	ABOUT 2.5
Unknown	Natural/Na	Imperial	Holtville NI	-50	32.98202	-115.362	Zone-11 N:	T13S, R16E	ABOUT 2.7
Unknown	Natural/Na	Imperial	Holtville NI	-30	32.98196	-115.35	Zone-11 N:	T13S, R16E	ABOUT 3.5
Unknown	Natural/Na	Imperial	Holtville NI	-20	32.98198	-115.339	Zone-11 N:	T13S, R16E	ABOUT 3.9
Unknown	Natural/Na	Imperial	Holtville NI	0	32.98197	-115.318	Zone-11 N:	T13S, R16E	ALONG SILI
Unknown	Natural/Na	Imperial	Alamorio (3	-100	32.89473	-115.435	Zone-11 N:	T14S, R15E	ALONG TO
Unknown	Natural/Na	Imperial	Ogilby (321	660	32.85935	-114.787	Zone-11 N:	T15S, R21E	AMERICAN
Unknown	Natural/Na	Imperial	Chuckwalla	1740	33.41464	-115.194	Zone-11 N:	T09S, R17E	1 AIR MILE
Unknown	Natural/Na	Imperial	Calipatria S	-200	33.07509	-115.697	Zone-11 N:	T12S, R12E	ALONG WA
Unknown	Natural/Na	Imperial	Niland (331	-220	33.16974	-115.626	Zone-11 N:	T11S, R13E	ALONG MC
Unknown	Natural/Na	Imperial	Niland (331	-220	33.1801	-115.616	Zone-11 N:	T11S, R13E	0.25 MI NN

Unknown	Natural/Na	Imperial	Niland (331	-220	33.18395	-115.586	Zone-11 N:	T11S, R13E	0.5 MI NNE
Unknown	Natural/Na	Imperial	Mt. Barrow	1310	33.18553	-114.96	Zone-11 N:	T11S, R19E	0.8 MI E OF
Unknown	Natural/Na	Imperial	Mammoth Wash (331:		33.18541	-115.17	Zone-11 N:	T11S, R17E	AERIAL GU
Unknown	Natural/Na	Imperial	Bonds Corr	18	32.68075	-115.37	Zone-11 N:	T17S, R16E	0.3 MI N O
Unknown	Natural/Na	Imperial	Bard (3211	125	32.75711	-114.589	Zone-11 N:	T16S, R23E	S END OF H
Unknown	Natural/Na	Imperial	Mt. Barrow	1190	33.20909	-114.978	Zone-11 N:	T11S, R19E	4.5 MI NNW
Unknown	Natural/Na	Imperial	Mt. Barrow	1155	33.20582	-114.965	Zone-11 N:	T11S, R19E	4 MI NNW
Unknown	Natural/Na	Imperial	Mt. Barrow	1135	33.21279	-114.964	Zone-11 N:	T11S, R19E	4.5 MI NNW
Unknown	Natural/Na	Imperial	Mt. Barrow	1075	33.2129	-114.956	Zone-11 N:	T11S, R19E	4.5 MI N O
Unknown	Natural/Na	Imperial	Mt. Barrow	1110	33.21833	-114.965	Zone-11 N:	T11S, R19E	5 MI NNW
Unknown	Natural/Na	Imperial	Mt. Barrow	1070	33.2209	-114.961	Zone-11 N:	T11S, R19E	5 MI N OF I
Unknown	Natural/Na	Imperial	Mt. Barrow	1070	33.22453	-114.962	Zone-11 N:	T11S, R19E	5 MI NNW
Unknown	Natural/Na	Imperial	Mt. Barrow	1040	33.22666	-114.958	Zone-11 N:	T11S, R19E	5.5 MI N O
Unknown	Natural/Na	Imperial	Mt. Barrow	1085	33.21061	-114.946	Zone-11 N:	T11S, R19E	4 MI N OF I
Unknown	Natural/Na	Imperial	Mt. Barrow	1030	33.22511	-114.943	Zone-11 N:	T11S, R19E	5 MI N OF I
Unknown	Natural/Na	Imperial	Mt. Barrow	995	33.23112	-114.947	Zone-11 N:	T11S, R19E	5.5 MI N O
Unknown	Natural/Na	Imperial	Mt. Barrow	1010	33.20843	-114.915	Zone-11 N:	T11S, R20E	3.5 MI WSW
Unknown	Natural/Na	Imperial	Mt. Barrow	1010	33.21245	-114.921	Zone-11 N:	T11S, R19E	4 MI W OF
Unknown	Natural/Na	Imperial	Mt. Barrow	940	33.22743	-114.915	Zone-11 N:	T11S, R20E	3.5 MI W C
Unknown	Natural/Na	Imperial	Mt. Barrow	960	33.23197	-114.927	Zone-11 N:	T11S, R19E	4.5 MI W C
Unknown	Natural/Na	Imperial	West of Pa	940	33.26971	-114.973	Zone-11 N:	T10S, R19E	7.5 MI WN
Unknown	Natural/Na	Imperial	West of Pa	940	33.26196	-114.959	Zone-11 N:	T10S, R19E	7 MI WNW
Unknown	Natural/Na	Imperial	West of Pa	950	33.25554	-114.955	Zone-11 N:	T10S, R19E	6.5 MI WN
Unknown	Natural/Na	Imperial	West of Pa	900	33.26083	-114.94	Zone-11 N:	T10S, R19E	6 MI WNW
Unknown	Natural/Na	Imperial	West of Pa	760	33.27486	-114.907	Zone-11 N:	T10S, R20E	5 MI NW O
Unknown	Natural/Na	Imperial	West of Pa	850	33.275	-114.939	Zone-11 N:	T10S, R19E	6 MI NW O
Unknown	Natural/Na	Imperial	West of Pa	800	33.26265	-114.906	Zone-11 N:	T10S, R20E	4.5 MI NW
Unknown	Natural/Na	Imperial	West of Pa	810	33.2513	-114.899	Zone-11 N:	T11S, R20E	3.5 MI NW
Unknown	Natural/Na	Imperial	Mt. Barrow	800	33.23808	-114.879	Zone-11 N:	T11S, R20E	2 MI NW O
Unknown	Natural/Na	Imperial	West of Pa	800	33.25793	-114.902	Zone-11 N:	T10S, R20E	4 MI NW O
Unknown	Natural/Na	Imperial	Buzzards P	610	33.24582	-114.805	Zone-11 N:	T11S, R21E	3.5 MI NE (
Unknown	Natural/Na	Imperial	Buzzards P	730	33.24274	-114.854	Zone-11 N:	T11S, R20E	1.5 MI N O
Unknown	Natural/Na	Imperial	Buzzards P	700	33.24013	-114.839	Zone-11 N:	T11S, R20E	1.5 MI NNE
Unknown	Natural/Na	Imperial	Buzzards P	710	33.24465	-114.845	Zone-11 N:	T11S, R20E	2 MI NNE C
Unknown	Natural/Na	Imperial	Palo Verde	470	33.27121	-114.785	Zone-11 N:	T10S, R21E	4 MI S OF F
Unknown	Natural/Na	Imperial	Buzzards P	730	33.25006	-114.866	Zone-11 N:	T11S, R20E	2.5 MI NNW
Unknown	Natural/Na	Imperial	Palo Verde	660	33.2609	-114.852	Zone-11 N:	T10S, R20E	3 MI N OF I
Unknown	Natural/Na	Imperial	Palo Verde	640	33.25855	-114.834	Zone-11 N:	T10S, R20E	3 MI NNE C
Unknown	Natural/Na	Imperial	Palo Verde	600	33.26286	-114.824	Zone-11 N:	T10S, R20E	3.5 MI NNE
Unknown	Natural/Na	Imperial	Palo Verde	590	33.26868	-114.828	Zone-11 N:	T10S, R20E	4 MI NNE C
Unknown	Natural/Na	Imperial	Palo Verde	570	33.26869	-114.819	Zone-11 N:	T10S, R20E	4 MI NNE C
Unknown	Natural/Na	Imperial	Palo Verde	690	33.26498	-114.867	Zone-11 N:	T10S, R20E	3 MI NNW
Unknown	Natural/Na	Imperial	Palo Verde	690	33.26157	-114.865	Zone-11 N:	T10S, R20E	3.5 MI NNW
Unknown	Natural/Na	Imperial	Palo Verde	620	33.27166	-114.846	Zone-11 N:	T10S, R20E	3.5 MI N O
Unknown	Natural/Na	Imperial	Palo Verde	600	33.27156	-114.833	Zone-11 N:	T10S, R20E	4 MI NNE C
Unknown	Natural/Na	Imperial	Palo Verde	540	33.27949	-114.823	Zone-11 N:	T10S, R20E	4.5 MI SW
Unknown	Natural/Na	Imperial	Palo Verde	580	33.28728	-114.858	Zone-11 N:	T10S, R20E	4.5 MI N O

Unknown	Natural/Na	Imperial	Palo Verde	580	33.28616	-114.852	Zone-11 N:	T10S, R20E	4.5 MI N O
Unknown	Natural/Na	Imperial	Palo Verde	590	33.28203	-114.845	Zone-11 N:	T10S, R20E	4.5 MI N O
Unknown	Natural/Na	Imperial	Palo Verde	530	33.26741	-114.806	Zone-11 N:	T10S, R21E	4.5 MI SSW
Unknown	Natural/Na	Imperial	Palo Verde	430	33.28196	-114.776	Zone-11 N:	T10S, R21E	AT MILPITA
Unknown	Natural/Na	Imperial	Palo Verde	450	33.28027	-114.791	Zone-11 N:	T10S, R21E	3.5 MI S OF
Unknown	Natural/Na	Imperial	Hedges (32	620	32.90674	-114.846	Zone-11 N:	T14S, R20E	0.9 MI WSW
Unknown	Natural/Na	Imperial	Hedges (32	700	32.96234	-114.861	Zone-11 N:	T14S, R20E	6 MI NNW
Unknown	Natural/Na	Imperial	Hedges (32	650	32.95293	-114.855	Zone-11 N:	T14S, R20E	5.5 MI NNW
Unknown	Natural/Na	Imperial	Clyde (321	690	32.9962	-114.897	Zone-11 N:	T13S, R20E	7.5 MI SSW
Unknown	Natural/Na	Imperial	Clyde (321	660	32.99216	-114.918	Zone-11 N:	T13S, R19E	8.5 MI SW
Unknown	Natural/Na	Imperial	Clyde (321	590	32.97523	-114.932	Zone-11 N:	T14S, R19E	8.5 MI E OF
Unknown	Natural/Na	Imperial	Clyde (321	560	32.97579	-114.953	Zone-11 N:	T14S, R19E	7 MI E OF C
Unknown	Natural/Na	Imperial	Clyde (321	600	32.99112	-114.953	Zone-11 N:	T13S, R19E	7 MI E OF C
Unknown	Natural/Na	Imperial	Quartz Pea	1140	33.05861	-114.862	Zone-11 N:	T13S, R20E	3 MI SW OI
Unknown	Natural/Na	Imperial	Quartz Pea	1150	33.06308	-114.868	Zone-11 N:	T13S, R20E	3 MI SW OI
Unknown	Natural/Na	Imperial	Quartz Pea	930	33.0461	-114.868	Zone-11 N:	T13S, R20E	4 MI SW OI
Unknown	Natural/Na	Imperial	Ninemile W	910	33.05425	-114.883	Zone-11 N:	T13S, R20E	4.5 MI SW
Unknown	Natural/Na	Imperial	Ninemile W	920	33.06087	-114.886	Zone-11 N:	T13S, R20E	3.5 MI S OF
Unknown	Natural/Na	Imperial	Ninemile W	860	33.05221	-114.917	Zone-11 N:	T13S, R19E	6 MI WSW
Unknown	Natural/Na	Imperial	Ninemile W	860	33.05223	-114.929	Zone-11 N:	T13S, R19E	7 MI WSW
Unknown	Natural/Na	Imperial	Ninemile W	840	33.05224	-114.936	Zone-11 N:	T13S, R19E	7 MI WSW
Unknown	Natural/Na	Imperial	Ninemile W	820	33.04892	-114.946	Zone-11 N:	T13S, R19E	7 MI S OF N
Unknown	Natural/Na	Imperial	Quartz Pea	1100	33.10442	-114.874	Zone-11 N:	T12S, R20E	3.5 MI WN
Unknown	Natural/Na	Imperial	Ninemile W	1070	33.09668	-114.911	Zone-11 N:	T12S, R20E	5 MI SSE O
Unknown	Natural/Na	Imperial	Quartz Pea	1110	33.12095	-114.872	Zone-11 N:	T12S, R20E	3.5 MI NW
Unknown	Natural/Na	Imperial	Ninemile W	1110	33.11686	-114.892	Zone-11 N:	T12S, R20E	4 MI SE OF
Unknown	Natural/Na	Imperial	Ninemile W	1180	33.1168	-114.91	Zone-11 N:	T12S, R20E	3 MI SE OF
Unknown	Natural/Na	Imperial	Ninemile W	1330	33.10903	-114.918	Zone-11 N:	T12S, R20E	3.5 MI SSE
Unknown	Natural/Na	Imperial	Buzzards Pe	1120	33.15107	-114.856	Zone-11 N:	T12S, R20E	5 MI NNW
Unknown	Natural/Na	Imperial	Mt. Barrow	1090	33.14812	-114.892	Zone-11 N:	T12S, R20E	3 MI E OF N
Unknown	Natural/Na	Imperial	Mt. Barrow	1160	33.1346	-114.904	Zone-11 N:	T12S, R20E	2.5 MI ESE
Unknown	Natural/Na	Imperial	Mt. Barrow	1150	33.13935	-114.905	Zone-11 N:	T12S, R20E	2.5 MI ESE
Unknown	Natural/Na	Imperial	Mt. Barrow	1170	33.14133	-114.91	Zone-11 N:	T12S, R20E	2 MI ESE O
Unknown	Natural/Na	Imperial	Mt. Barrow	1220	33.14557	-114.919	Zone-11 N:	T12S, R20E	1.5 MI E OF
Unknown	Natural/Na	Imperial	Mt. Barrow	1010	33.15946	-114.878	Zone-11 N:	T12S, R20E	4 MI ENE C
Unknown	Natural/Na	Imperial	Mt. Barrow	1080	33.15833	-114.896	Zone-11 N:	T12S, R20E	3 MI ENE C
Unknown	Natural/Na	Imperial	Mt. Barrow	1100	33.15492	-114.901	Zone-11 N:	T12S, R20E	2.5 MI E OF
Unknown	Natural/Na	Imperial	Mt. Barrow	1160	33.1574	-114.919	Zone-11 N:	T12S, R20E	1.5 MI ENE
Unknown	Natural/Na	Imperial	Mt. Barrow	990	33.16337	-114.878	Zone-11 N:	T12S, R20E	4 MI ENE C
Unknown	Natural/Na	Imperial	Mt. Barrow	1040	33.16615	-114.892	Zone-11 N:	T11S, R20E	3.5 MI ENE
Unknown	Natural/Na	Imperial	Mt. Barrow	1070	33.166	-114.899	Zone-11 N:	T11S, R20E	3 MI ENE C
Unknown	Natural/Na	Imperial	Mt. Barrow	1110	33.16536	-114.911	Zone-11 N:	T11S, R20E	2 MI ENE C
Unknown	Natural/Na	Imperial	Mt. Barrow	1200	33.16463	-114.918	Zone-11 N:	T11S, R20E	2 MI NE OF
Unknown	Natural/Na	Imperial	Buzzards Pe	1000	33.18919	-114.855	Zone-11 N:	T11S, R20E	6 MI ENE C
Unknown	Natural/Na	Imperial	Buzzards Pe	810	33.18514	-114.866	Zone-11 N:	T11S, R20E	5 MI NE OF
Unknown	Natural/Na	Imperial	Buzzards Pe	920	33.19799	-114.868	Zone-11 N:	T11S, R20E	5 MI NE - E
Unknown	Natural/Na	Imperial	Mt. Barrow	980	33.18276	-114.882	Zone-11 N:	T11S, R20E	4.5 MI NE C

Unknown	Natural/Na	Imperial	Mt. Barrow	970	33.18688	-114.885	Zone-11 N:	T11S, R20E	1.3 MI ESE
Unknown	Natural/Na	Imperial	Mt. Barrow	1030	33.17495	-114.892	Zone-11 N:	T11S, R20E	3.5 MI ENE
Unknown	Natural/Na	Imperial	Mt. Barrow	1100	33.17223	-114.903	Zone-11 N:	T11S, R20E	3 MI NE OF
Unknown	Natural/Na	Imperial	Mt. Barrow	1140	33.17909	-114.914	Zone-11 N:	T11S, R20E	2.5 MI NE (
Unknown	Natural/Na	Imperial	Mt. Barrow	1180	33.1735	-114.923	Zone-11 N:	T11S, R19E	2 MI NE OF
Unknown	Natural/Na	Imperial	Mt. Barrow	1140	33.18282	-114.923	Zone-11 N:	T11S, R19E	2.5 MI NNE
Unknown	Natural/Na	Imperial	Buzzards P	790	33.22132	-114.858	Zone-11 N:	T11S, R20E	0.4 MI NE (
Unknown	Natural/Na	Imperial	Buzzards P	860	33.20581	-114.867	Zone-11 N:	T11S, R20E	0.8 MI SSW
Unknown	Natural/Na	Imperial	Palo Verde	720	33.32755	-114.869	Zone-11 N:	T10S, R20E	MILPITAS V
Unknown	Natural/Na	Imperial	West of Pa	700	33.33008	-114.89	Zone-11 N:	T10S, R20E	MILPITAS V
Unknown	Natural/Na	Imperial	West of Pa	780	33.32922	-114.956	Zone-11 N:	T10S, R19E	IN THE VICI
Unknown	Natural/Na	Imperial	West of Pa	780	33.33269	-114.958	Zone-11 N:	T10S, R19E	IN THE VICI
Unknown	Natural/Na	Imperial	West of Pa	790	33.32984	-114.961	Zone-11 N:	T10S, R19E	IN THE VICI
Unknown	Natural/Na	Imperial	West of Pa	700	33.34162	-114.897	Zone-11 N:	T09S, R20E	IN THE VICI
Unknown	Natural/Na	Imperial	West of Pa	700	33.34311	-114.905	Zone-11 N:	T09S, R20E	5 MI SSW (
Unknown	Natural/Na	Imperial	West of Pa	720	33.34517	-114.921	Zone-11 N:	T09S, R19E	5 MI SW OI
Unknown	Natural/Na	Imperial	West of Pa	750	33.3408	-114.942	Zone-11 N:	T10S, R19E	4 MI SE OF
Unknown	Natural/Na	Imperial	West of Pa	730	33.34959	-114.902	Zone-11 N:	T09S, R20E	VICINITY O
Unknown	Natural/Na	Imperial	West of Pa	760	33.3558	-114.928	Zone-11 N:	T09S, R19E	VICINITY O
Unknown	Natural/Na	Imperial	West of Pa	770	33.35952	-114.928	Zone-11 N:	T09S, R19E	VICINITY O
Unknown	Natural/Na	Imperial	West of Pa	810	33.35805	-114.965	Zone-11 N:	T09S, R19E	2.5 MI SE C
Unknown	Natural/Na	Imperial	Wiley Well	900	33.40496	-114.984	Zone-11 N:	T09S, R19E	1.5 MI N O
Unknown	Natural/Na	Imperial	Wiley Well	850	33.41853	-114.971	Zone-11 N:	T09S, R19E	2.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1300	33.37246	-115.135	Zone-11 N:	T09S, R18E	JUST N OF /
Unknown	Natural/Na	Imperial	Little Mule	1240	33.36881	-115.119	Zone-11 N:	T09S, R18E	6 MI SSE O
Unknown	Natural/Na	Imperial	Chuckwalla	1320	33.38014	-115.131	Zone-11 N:	T09S, R18E	5 MI S OF (
Unknown	Natural/Na	Imperial	Little Chucl	1290	33.38001	-115.122	Zone-11 N:	T09S, R18E	5 MI SSE O
Unknown	Natural/Na	Imperial	Little Chucl	1290	33.3881	-115.116	Zone-11 N:	T09S, R18E	4.5 MI SSE
Unknown	Natural/Na	Imperial	Chuckwalla	1410	33.38404	-115.149	Zone-11 N:	T09S, R17E	5 MI S OF (
Unknown	Natural/Na	Imperial	Chuckwalla	1390	33.39457	-115.137	Zone-11 N:	T09S, R17E	4 MI S OF (
Unknown	Natural/Na	Imperial	Chuckwalla	1360	33.39431	-115.13	Zone-11 N:	T09S, R18E	4 MI S OF (
Unknown	Natural/Na	Imperial	Chuckwalla	1370	33.39801	-115.13	Zone-11 N:	T09S, R18E	3.5 MI S OF
Unknown	Natural/Na	Imperial	Chuckwalla	1570	33.39575	-115.17	Zone-11 N:	T09S, R17E	4.5 MI SSW
Unknown	Natural/Na	Imperial	Chuckwalla	1520	33.39559	-115.161	Zone-11 N:	T09S, R17E	4 MI SSW (
Unknown	Natural/Na	Imperial	Chuckwalla	1560	33.4004	-115.166	Zone-11 N:	T09S, R17E	4 MI SSW (
Unknown	Natural/Na	Imperial	Chuckwalla	1530	33.40341	-115.159	Zone-11 N:	T09S, R17E	2 MI SE OF
Unknown	Natural/Na	Imperial	Chuckwalla	1550	33.41257	-115.158	Zone-11 N:	T09S, R17E	1.8 MI ESE
Unknown	Natural/Na	Imperial	Little Chucl	1360	33.38712	-115.068	Zone-11 N:	T09S, R18E	4 MILES W
Unknown	Natural/Na	Imperial	Little Chucl	1310	33.39608	-115.061	Zone-11 N:	T09S, R18E	4.5 MILES \
Unknown	Natural/Na	Imperial	Little Chucl	1230	33.40056	-115.093	Zone-11 N:	T09S, R18E	5 MILES W
Unknown	Natural/Na	Imperial	Little Chucl	1210	33.41116	-115.068	Zone-11 N:	T09S, R18E	4.5 MILES E
Unknown	Natural/Na	Imperial	Chuckwalla	1700	33.42087	-115.184	Zone-11 N:	T09S, R17E	AT RAINEY
Unknown	Natural/Na	Imperial	Chuckwalla	1760	33.4182	-115.194	Zone-11 N:	T09S, R17E	ABOUT 0.5
Unknown	Natural/Na	Imperial	Chuckwalla	1830	33.42006	-115.207	Zone-11 N:	T09S, R17E	ABOUT 1.2
Unknown	Natural/Na	Imperial	Chuckwalla	1590	33.41596	-115.238	Zone-11 N:	T09S, R17E	3 MI WSW
Unknown	Natural/Na	Imperial	Chuckwalla	1970	33.41501	-115.243	Zone-11 N:	T09S, R17E	3.2 MI WS\
Unknown	Natural/Na	Imperial	Chuckwalla	2000	33.42098	-115.244	Zone-11 N:	T09S, R16E	3.2 MI W C

EEC ORIGINAL PKG

Unknown	Natural/Na	Imperial	Augustine I	2040	33.41964	-115.255	Zone-11 N:	T09S, R16E	3.8 MI W C
Unknown	Natural/Na	Imperial	Augustine I	2000	33.42501	-115.262	Zone-11 N:	T09S, R16E	ABOUT 2 M
Unknown	Natural/Na	Imperial | I	Augustine I	2120	33.42851	-115.268	Zone-11 N:	T08S, R16E	ABOUT 2 M
Unknown	Natural/Na	Imperial	Yuma West	260	32.74848	-114.743	Zone-11 N:	T16S, R21E	ALONG S P.
Unknown	Natural/Na	Imperial | /	Imperial Re	185	33.02577	-114.519	Zone-11 N:	T13S, R23E	IMPERIAL N
Unknown	Natural/Na	Imperial | /	Yuma East	120	32.75808	-114.528	Zone-11 N:	T16S, R23E	COLORADO
Unknown	Natural/Na	Imperial	Blue Moun	1200	33.21882	-115.016	Zone-11 N:	T11S, R19E	5.5 MI ESE
Unknown	Natural/Na	Imperial	Blue Moun	1180	33.22531	-115.013	Zone-11 N:	T11S, R19E	5.5 MI E BL
Unknown	Natural/Na	Imperial	Blue Moun	1150	33.2328	-115.016	Zone-11 N:	T11S, R19E	5.5 MI E OF
Unknown	Natural/Na	Imperial	Blue Moun	1150	33.22519	-115.003	Zone-11 N:	T11S, R19E	6 MI NW O
Unknown	Natural/Na	Imperial	Mt. Barrow	1000	33.23546	-114.994	Zone-11 N:	T11S, R19E	6.5 MI NNV
Unknown	Natural/Na	Imperial	West of Pa	1050	33.25335	-114.996	Zone-11 N:	T10S, R19E	6.5 MI E OF
Unknown	Natural/Na	Imperial	Blue Moun	1060	33.24985	-115.002	Zone-11 N:	T11S, R19E	6 MI E OF E
Unknown	Natural/Na	Imperial	Little Mule	1060	33.25484	-115.01	Zone-11 N:	T10S, R19E	6 MI E OF E
Unknown	Natural/Na	Imperial	Little Mule	1050	33.25896	-115.015	Zone-11 N:	T10S, R19E	5.5 MI ENE
Unknown	Natural/Na	Imperial	Little Mule	1040	33.26378	-115.016	Zone-11 N:	T10S, R19E	5.5 MI ENE
Unknown	Natural/Na	Imperial	Blue Moun	1420	33.2019	-115.069	Zone-11 N:	T11S, R18E	3.5 MI SE C
Unknown	Natural/Na	Imperial	Blue Moun	1370	33.20688	-115.063	Zone-11 N:	T11S, R18E	3.5 MI SE C
Unknown	Natural/Na	Imperial	Blue Moun	1300	33.21621	-115.056	Zone-11 N:	T11S, R18E	3.5 MI ESE
Unknown	Natural/Na	Imperial	Blue Moun	1280	33.22009	-115.054	Zone-11 N:	T11S, R18E	3.5 MI ESE
Unknown	Natural/Na	Imperial	Blue Moun	1220	33.22975	-115.051	Zone-11 N:	T11S, R18E	3.5 MI ESE
Unknown	Natural/Na	Imperial	Blue Moun	1200	33.23716	-115.051	Zone-11 N:	T11S, R18E	3.5 MI E OF
Unknown	Natural/Na	Imperial	Blue Moun	1170	33.23724	-115.039	Zone-11 N:	T11S, R18E	4 MI E OF E
Unknown	Natural/Na	Imperial	Blue Moun	1140	33.24082	-115.029	Zone-11 N:	T11S, R18E	4.5 MI E OF
Unknown	Natural/Na	Imperial	Blue Moun	1150	33.2451	-115.042	Zone-11 N:	T11S, R18E	3.5 MI E OF
Unknown	Natural/Na	Imperial	Blue Moun	1130	33.24615	-115.033	Zone-11 N:	T11S, R18E	4.5 MI E OF
Unknown	Natural/Na	Imperial	Blue Moun	1400	33.21357	-115.084	Zone-11 N:	T11S, R18E	2.5 MI ESE
Unknown	Natural/Na	Imperial	Blue Moun	1360	33.21546	-115.075	Zone-11 N:	T11S, R18E	3 MI ESE O
Unknown	Natural/Na	Imperial	Blue Moun	1170	33.25121	-115.058	Zone-11 N:	T11S, R18E	3 MI ENE C
Unknown	Natural/Na	Imperial	Little Mule	990	33.27154	-115.005	Zone-11 N:	T10S, R19E	6 MI ENE C
Unknown	Natural/Na	Imperial	West of Pa	900	33.29095	-114.988	Zone-11 N:	T10S, R19E	6.5 MI S OF
Unknown	Natural/Na	Imperial	Little Mule	920	33.29411	-115.005	Zone-11 N:	T10S, R19E	6.5 MI S OF
Unknown	Natural/Na	Imperial	Little Mule	930	33.29725	-115.014	Zone-11 N:	T10S, R19E	6 MI S OF T
Unknown	Natural/Na	Imperial	Little Mule	900	33.3056	-115.004	Zone-11 N:	T10S, R19E	5.5 MI S OF
Unknown	Natural/Na	Imperial	Little Mule	1100	33.26417	-115.052	Zone-11 N:	T10S, R18E	3.5 MI NE (
Unknown	Natural/Na	Imperial	Little Mule	1120	33.26421	-115.06	Zone-11 N:	T10S, R18E	2.8 MI NE (
Unknown	Natural/Na	Imperial	Little Mule	1110	33.27099	-115.074	Zone-11 N:	T10S, R18E	2.5 MI NE (
Unknown	Natural/Na	Imperial	Little Mule	1090	33.27444	-115.07	Zone-11 N:	T10S, R18E	3 MI NE OF
Unknown	Natural/Na	Imperial	Little Mule	1080	33.27457	-115.065	Zone-11 N:	T10S, R18E	3.25 MI NE
Unknown	Natural/Na	Imperial	Little Mule	1030	33.29137	-115.057	Zone-11 N:	T10S, R18E	4.25 MI NE
Unknown	Natural/Na	Imperial	Little Mule	1140	33.30411	-115.094	Zone-11 N:	T10S, R18E	4.25 MI N (
Unknown	Natural/Na	Imperial	Little Mule	990	33.32301	-115.049	Zone-11 N:	T10S, R18E	5.5 MI SW
Unknown	Natural/Na	Imperial	Little Mule	1060	33.32212	-115.079	Zone-11 N:	T10S, R18E	5.5 MI NNE
Unknown	Natural/Na	Imperial	Little Mule	1160	33.32801	-115.082	Zone-11 N:	T10S, R18E	6 MI NNE C
Unknown	Natural/Na	Imperial	Little Mule	1200	33.33044	-115.102	Zone-11 N:	T10S, R18E	6 MI N OF I
Unknown	Natural/Na	Imperial	Little Mule	1180	33.32578	-115.105	Zone-11 N:	T10S, R18E	VICINITY O
Unknown	Natural/Na	Imperial	Little Mule	1080	33.3489	-115.061	Zone-11 N:	T09S, R18E	4.5 MI WS\

Unknown	Natural/Na	Imperial	Little Mule	980	33.33629	-115.041	Zone-11 N:	T10S, R18E	4.5 MI SW
Unknown	Natural/Na	Imperial	Little Mule	960	33.3365	-115.036	Zone-11 N:	T10S, R18E	4 MI SW OI
Unknown	Natural/Na	Imperial	Little Mule	980	33.34256	-115.034	Zone-11 N:	T09S, R18E	4 MI SW OI
Unknown	Natural/Na	Imperial	Little Mule	960	33.34312	-115.029	Zone-11 N:	T09S, R18E	3.5 MI SW
Unknown	Natural/Na	Imperial	Little Mule	1010	33.35238	-115.033	Zone-11 N:	T09S, R18E	3.5 MI SW
Unknown	Natural/Na	Imperial	Little Mule	940	33.34275	-115.023	Zone-11 N:	T09S, R19E	3.5 MI SSW
Unknown	Natural/Na	Imperial	Little Mule	960	33.35688	-115.019	Zone-11 N:	T09S, R19E	2.5 MI SW
Unknown	Natural/Na	Imperial	Niland (331	-222	33.19892	-115.605	Zone-11 N:	T11S, R13E	ALAMO RIV
Unknown	Natural/Na	Imperial	Seeley (321	-40	32.76544	-115.711	Zone-11 N:	T16S, R12E	MARSH AR
Unknown	Natural/Na	Imperial	Holtville Ea	-15	32.81449	-115.382	Zone-11 N:	T15S, R15E	VICINITY O
Unknown	Natural/Na	Imperial	Wister (331	-85	33.29276	-115.545	Zone-11 N:	T10S, R14E	DRAINS AL
Unknown	Natural/Na	Imperial	Blue Moun	1520	33.20729	-115.108	Zone-11 N:	T11S, R18E	2.5 MI S OF
Unknown	Natural/Na	Imperial	Blue Moun	1480	33.21325	-115.108	Zone-11 N:	T11S, R18E	2 MI S OF E
Unknown	Natural/Na	Imperial	Blue Moun	1380	33.22666	-115.098	Zone-11 N:	T11S, R18E	1.5 MI SSE
Unknown	Natural/Na	Imperial	Blue Moun	1460	33.23428	-115.106	Zone-11 N:	T11S, R18E	0.5 MI SW
Unknown	Natural/Na	Imperial	Blue Moun	1240	33.24558	-115.081	Zone-11 N:	T11S, R18E	1.5 MI E OF
Unknown	Natural/Na	Imperial	Blue Moun	1220	33.2494	-115.086	Zone-11 N:	T11S, R18E	1.5 MI ENE
Unknown	Natural/Na	Imperial	Little Mule	1210	33.25586	-115.097	Zone-11 N:	T10S, R18E	1 MI ENE C
Unknown	Natural/Na	Imperial	Little Mule	1180	33.25679	-115.083	Zone-11 N:	T10S, R18E	2 MI NE OF
Unknown	Natural/Na	Imperial	Little Mule	1140	33.26476	-115.079	Zone-11 N:	T10S, R18E	2.5 MI NE (
Unknown	Natural/Na	Imperial	Little Mule	1180	33.26069	-115.092	Zone-11 N:	T10S, R18E	1.5 MI NE (
Unknown	Natural/Na	Imperial	Little Mule	1180	33.26498	-115.096	Zone-11 N:	T10S, R18E	1.5 MI N O
Unknown	Natural/Na	Imperial	Little Mule	1220	33.2651	-115.106	Zone-11 N:	T10S, R18E	1.5 MI N O
Unknown	Natural/Na	Imperial	Little Mule	1220	33.2691	-115.107	Zone-11 N:	T10S, R18E	1.5 MI N O
Unknown	Natural/Na	Imperial	Mammoth	1540	33.23038	-115.165	Zone-11 N:	T11S, R17E	3.75 MI WS
Unknown	Natural/Na	Imperial	Mammoth	1560	33.23246	-115.181	Zone-11 N:	T11S, R17E	3.5 MI ESE
Unknown	Natural/Na	Imperial	Mammoth	1560	33.23448	-115.205	Zone-11 N:	T11S, R17E	2.5 MI SE C
Unknown	Natural/Na	Imperial	Mammoth	1490	33.24077	-115.197	Zone-11 N:	T11S, R17E	2.5 MI ESE
Unknown	Natural/Na	Imperial	Mammoth	1530	33.24404	-115.211	Zone-11 N:	T11S, R17E	1.5 MI SE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1430	33.25629	-115.226	Zone-11 N:	T10S, R17E	IN THE VICI
Unknown	Natural/Na	Imperial	Pegleg Wel	1430	33.2557	-115.235	Zone-11 N:	T10S, R17E	IN THE VICI
Unknown	Natural/Na	Imperial	Mammoth	1460	33.24745	-115.188	Zone-11 N:	T11S, R17E	2.5 MI ESE
Unknown	Natural/Na	Imperial	Pegleg Wel	1460	33.25379	-115.199	Zone-11 N:	T10S, R17E	2 MI E OF F
Unknown	Natural/Na	Imperial	Pegleg Wel	1400	33.27086	-115.215	Zone-11 N:	T10S, R17E	1.5 MI NE (
Unknown	Natural/Na	Imperial	Pegleg Wel	1400	33.27001	-115.22	Zone-11 N:	T10S, R17E	1 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1390	33.26899	-115.23	Zone-11 N:	T10S, R17E	0.8 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1320	33.26821	-115.235	Zone-11 N:	T10S, R17E	0.75 MI NN
Unknown	Natural/Na	Imperial	Pegleg Wel	1300	33.28056	-115.241	Zone-11 N:	T10S, R17E	1.5 MI NNV
Unknown	Natural/Na	Imperial	Pegleg Wel	1410	33.26278	-115.191	Zone-11 N:	T10S, R17E	2.5 MI E OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1400	33.26659	-115.19	Zone-11 N:	T10S, R17E	2.5 MI ENE
Unknown	Natural/Na	Imperial	Pegleg Wel	1390	33.27004	-115.194	Zone-11 N:	T10S, R17E	2.5 MI ENE
Unknown	Natural/Na	Imperial	Pegleg Wel	1330	33.27225	-115.2	Zone-11 N:	T10S, R17E	2.25 MI EN
Unknown	Natural/Na	Imperial	Pegleg Wel	1380	33.27445	-115.205	Zone-11 N:	T10S, R17E	2 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1350	33.27869	-115.221	Zone-11 N:	T10S, R17E	1.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1350	33.25975	-115.144	Zone-11 N:	T10S, R17E	2.5 MI WN
Unknown	Natural/Na	Imperial	Pegleg Wel	1360	33.26873	-115.17	Zone-11 N:	T10S, R17E	3.5 MI ENE
Unknown	Natural/Na	Imperial	Pegleg Wel	1360	33.27711	-115.19	Zone-11 N:	T10S, R17E	3 MI ENE C

Unknown	Natural/Na	Imperial	Pegleg Wel	1340	33.28654	-115.219	Zone-11 N:	T10S, R17E	2 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1360	33.29102	-115.22	Zone-11 N:	T10S, R17E	2.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1370	33.28817	-115.21	Zone-11 N:	T10S, R17E	2.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1390	33.29485	-115.211	Zone-11 N:	T10S, R17E	3 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1360	33.29435	-115.202	Zone-11 N:	T10S, R17E	3 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1385	33.30049	-115.203	Zone-11 N:	T10S, R17E	3.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1360	33.30783	-115.187	Zone-11 N:	T10S, R17E	4.5 MI NE (
Unknown	Natural/Na	Imperial	Pegleg Wel	1430	33.30231	-115.219	Zone-11 N:	T10S, R17E	3 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1430	33.30491	-115.212	Zone-11 N:	T10S, R17E	3.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1440	33.31017	-115.211	Zone-11 N:	T10S, R17E	4 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1420	33.31686	-115.196	Zone-11 N:	T10S, R17E	4.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1320	33.27225	-115.152	Zone-11 N:	T10S, R17E	3 MI NW O
Unknown	Natural/Na	Imperial	Pegleg Wel	1310	33.27198	-115.147	Zone-11 N:	T10S, R17E	3 MI NW O
Unknown	Natural/Na	Imperial	Pegleg Wel	1280	33.27833	-115.145	Zone-11 N:	T10S, R17E	3 MI NW O
Unknown	Natural/Na	Imperial	Pegleg Wel	1260	33.28464	-115.145	Zone-11 N:	T10S, R17E	3.5 MI NW
Unknown	Natural/Na	Imperial	Pegleg Wel	1240	33.2873	-115.137	Zone-11 N:	T10S, R17E	3 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1200	33.29553	-115.13	Zone-11 N:	T10S, R18E	3.5 MI NNV
Unknown	Natural/Na	Imperial	Little Mule	1170	33.30272	-115.119	Zone-11 N:	T10S, R18E	4 MI NNW
Unknown	Natural/Na	Imperial	Little Mule	1200	33.30436	-115.107	Zone-11 N:	T10S, R18E	4 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1310	33.28415	-115.166	Zone-11 N:	T10S, R17E	4.5 MI NW
Unknown	Natural/Na	Imperial	Pegleg Wel	1280	33.29043	-115.161	Zone-11 N:	T10S, R17E	4.5 MI NW
Unknown	Natural/Na	Imperial	Pegleg Wel	1250	33.29729	-115.152	Zone-11 N:	T10S, R17E	4.5 MI NW
Unknown	Natural/Na	Imperial	Pegleg Wel	1210	33.303	-115.141	Zone-11 N:	T10S, R17E	4.5 MI NNV
Unknown	Natural/Na	Imperial	Pegleg Wel	1240	33.30889	-115.151	Zone-11 N:	T10S, R17E	5 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1190	33.3108	-115.134	Zone-11 N:	T10S, R18E	5 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1290	33.30539	-115.169	Zone-11 N:	T10S, R17E	5 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1300	33.29931	-115.173	Zone-11 N:	T10S, R17E	4.5 MI NE (
Unknown	Natural/Na	Imperial	Pegleg Wel	1330	33.30066	-115.181	Zone-11 N:	T10S, R17E	4 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1340	33.30518	-115.181	Zone-11 N:	T10S, R17E	4.5 MI NE (
Unknown	Natural/Na	Imperial	Pegleg Wel	1320	33.30924	-115.174	Zone-11 N:	T10S, R17E	5 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1340	33.31493	-115.177	Zone-11 N:	T10S, R17E	5 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1350	33.31962	-115.176	Zone-11 N:	T10S, R17E	5.5 MI NE (
Unknown	Natural/Na	Imperial	Pegleg Wel	1320	33.32152	-115.167	Zone-11 N:	T10S, R17E	6 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1340	33.32634	-115.167	Zone-11 N:	T10S, R17E	6 MI NE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1340	33.3318	-115.168	Zone-11 N:	T10S, R17E	6.5 MI NE (
Unknown	Natural/Na	Imperial	Pegleg Wel	1370	33.33092	-115.173	Zone-11 N:	T10S, R17E	6 MI NNE C
Unknown	Natural/Na	Imperial	Lion Head I	1600	33.30823	-115.288	Zone-11 N:	T10S, R16E	4.5 MI NW
Unknown	Natural/Na	Imperial	Pegleg Wel	1290	33.3263	-115.158	Zone-11 N:	T10S, R17E	6.5 MI NNV
Unknown	Natural/Na	Imperial	Pegleg Wel	1260	33.32281	-115.151	Zone-11 N:	T10S, R17E	6 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1220	33.323	-115.141	Zone-11 N:	T10S, R17E	5.5 MI NNV
Unknown	Natural/Na	Imperial	Pegleg Wel	1230	33.32899	-115.141	Zone-11 N:	T10S, R17E	6 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1210	33.33078	-115.134	Zone-11 N:	T10S, R18E	6 MI NNW
Unknown	Natural/Na	Imperial	Little Mule	1170	33.33074	-115.126	Zone-11 N:	T10S, R18E	6 MI NNW
Unknown	Natural/Na	Imperial	Little Mule	1170	33.33663	-115.122	Zone-11 N:	T10S, R18E	6.5 MI N O
Unknown	Natural/Na	Imperial	Lion Head I	1290	33.2801	-115.255	Zone-11 N:	T10S, R16E	2 MI NW O
Unknown	Natural/Na	Imperial	Lion Head I	1280	33.27912	-115.264	Zone-11 N:	T10S, R16E	2.5 MI NW
Unknown	Natural/Na	Imperial	Lion Head I	1690	33.2882	-115.269	Zone-11 N:	T10S, R16E	3 MI NW O

Unknown	Natural/Na	Imperial	Lion Head I	1370	33.28961	-115.278	Zone-11 N:	T10S, R16E	3.5 MI NW
Unknown	Natural/Na	Imperial	Lion Head I	1450	33.29373	-115.277	Zone-11 N:	T10S, R16E	3.5 MI NW
Unknown	Natural/Na	Imperial	Lion Head I	1440	33.2952	-115.285	Zone-11 N:	T10S, R16E	4 MI NW O
Unknown	Natural/Na	Imperial	Lion Head I	1450	33.31521	-115.286	Zone-11 N:	T10S, R16E	5 MI NW O
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N:	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Frink (3311	-225	33.35533	-115.699	Zone-11 N:	T09S, R12E	MARSH AR
Unknown	Natural/Na	Imperial	Pegleg Wel	1390	33.2941	-115.239	Zone-11 N:	T10S, R17E	2.5 MI N O
Unknown	Natural/Na	Imperial	Pegleg Wel	1390	33.29491	-115.245	Zone-11 N:	T10S, R16E	2.5 MI NNV
Unknown	Natural/Na	Imperial	Pegleg Wel	1370	33.2907	-115.251	Zone-11 N:	T10S, R16E	2.5 MI NNV
Unknown	Natural/Na	Imperial	Lion Head I	1400	33.29528	-115.252	Zone-11 N:	T10S, R16E	3 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1430	33.29963	-115.245	Zone-11 N:	T10S, R16E	3 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1450	33.30279	-115.25	Zone-11 N:	T10S, R16E	3.5 MI NNV
Unknown	Natural/Na	Imperial	Lion Head I	1440	33.29878	-115.26	Zone-11 N:	T10S, R16E	3.5 MI NNV
Unknown	Natural/Na	Imperial	Lion Head I	1530	33.3056	-115.268	Zone-11 N:	T10S, R16E	4 MI NW O
Unknown	Natural/Na	Imperial	Pegleg Wel	1450	33.30507	-115.227	Zone-11 N:	T10S, R17E	3.5 MI N O
Unknown	Natural/Na	Imperial	Pegleg Wel	1460	33.30506	-115.232	Zone-11 N:	T10S, R17E	3.5 MI N O
Unknown	Natural/Na	Imperial	Pegleg Wel	1470	33.30863	-115.23	Zone-11 N:	T10S, R17E	3.5 MI N O
Unknown	Natural/Na	Imperial	Pegleg Wel	1490	33.31575	-115.222	Zone-11 N:	T10S, R17E	4 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1550	33.31481	-115.255	Zone-11 N:	T10S, R16E	4 MI NNW
Unknown	Natural/Na	Imperial	Pegleg Wel	1570	33.32007	-115.241	Zone-11 N:	T10S, R17E	4.5 MI N O
Unknown	Natural/Na	Imperial	Pegleg Wel	1600	33.32402	-115.247	Zone-11 N:	T10S, R16E	4.5 MI NNV
Unknown	Natural/Na	Imperial	Lion Head I	1610	33.32255	-115.267	Zone-11 N:	T10S, R16E	5 MI NNW
Unknown	Natural/Na	Imperial	Lion Head I	1640	33.32751	-115.257	Zone-11 N:	T10S, R16E	5 MI NNW
Unknown	Natural/Na	Imperial	Lion Head I	1720	33.33652	-115.264	Zone-11 N:	T10S, R16E	5 MI SSE O
Unknown	Natural/Na	Imperial	Lion Head I	1700	33.33695	-115.257	Zone-11 N:	T10S, R16E	5 MI SSE O
Unknown	Natural/Na	Imperial	Pegleg Wel	1430	33.33306	-115.186	Zone-11 N:	T10S, R17E	6 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1450	33.32598	-115.195	Zone-11 N:	T10S, R17E	5 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1470	33.32338	-115.202	Zone-11 N:	T10S, R17E	5 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1500	33.32409	-115.212	Zone-11 N:	T10S, R17E	4.5 MI N O
Unknown	Natural/Na	Imperial	Pegleg Wel	1540	33.32657	-115.219	Zone-11 N:	T10S, R17E	5 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1560	33.32753	-115.227	Zone-11 N:	T10S, R17E	5 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1570	33.33232	-115.229	Zone-11 N:	T10S, R17E	5 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1400	33.36094	-115.162	Zone-11 N:	T09S, R17E	8 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1370	33.35632	-115.159	Zone-11 N:	T09S, R17E	8 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1390	33.3555	-115.163	Zone-11 N:	T09S, R17E	8 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1370	33.35033	-115.164	Zone-11 N:	T09S, R17E	7.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1310	33.3443	-115.154	Zone-11 N:	T09S, R17E	7.5 MI NE (
Unknown	Natural/Na	Imperial	Pegleg Wel	1350	33.34738	-115.159	Zone-11 N:	T09S, R17E	7.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1360	33.34304	-115.165	Zone-11 N:	T09S, R17E	7 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1410	33.34295	-115.176	Zone-11 N:	T09S, R17E	6.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1450	33.34725	-115.18	Zone-11 N:	T09S, R17E	7 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1440	33.34284	-115.182	Zone-11 N:	T09S, R17E	6.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1470	33.34266	-115.187	Zone-11 N:	T09S, R17E	6.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1530	33.344	-115.199	Zone-11 N:	T09S, R17E	6.5 MI NNE
Unknown	Natural/Na	Imperial	Pegleg Wel	1520	33.35196	-115.192	Zone-11 N:	T09S, R17E	7 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1570	33.37281	-115.187	Zone-11 N:	T09S, R17E	6.5 MI ESE
Unknown	Natural/Na	Imperial	Chuckwalla	1590	33.3779	-115.185	Zone-11 N:	T09S, R17E	6.5 MI ESE

Unknown	Natural/Na	Imperial	Pegleg Wel	1540	33.33356	-115.213	Zone-11 N:	T10S, R17E	5.5 MI N O
Unknown	Natural/Na	Imperial	Pegleg Wel	1540	33.34017	-115.206	Zone-11 N:	T10S, R17E	6 MI NNE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1570	33.34124	-115.213	Zone-11 N:	T09S, R17E	6 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1640	33.34288	-115.229	Zone-11 N:	T09S, R17E	6 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1610	33.34478	-115.218	Zone-11 N:	T09S, R17E	6 MI N OF I
Unknown	Natural/Na	Imperial	Pegleg Wel	1620	33.35003	-115.215	Zone-11 N:	T09S, R17E	6 MI SE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1700	33.36057	-115.227	Zone-11 N:	T09S, R17E	5 MI SE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1650	33.35996	-115.214	Zone-11 N:	T09S, R17E	5.5 MI ESE
Unknown	Natural/Na	Imperial	Pegleg Wel	1700	33.36646	-115.219	Zone-11 N:	T09S, R17E	5 MI ESE O
Unknown	Natural/Na	Imperial	Pegleg Wel	1710	33.37446	-115.213	Zone-11 N:	T09S, R17E	5 MI ESE O
Unknown	Natural/Na	Imperial	Chuckwalla	1690	33.37742	-115.208	Zone-11 N:	T09S, R17E	5.5 MI ESE
Unknown	Natural/Na	Imperial	Pegleg Wel	1680	33.34345	-115.238	Zone-11 N:	T09S, R17E	5.5 MI SE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1720	33.34845	-115.243	Zone-11 N:	T09S, R16E	5 MI SE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1730	33.35244	-115.241	Zone-11 N:	T09S, R17E	5 MI SE OF
Unknown	Natural/Na	Imperial	Pegleg Wel	1740	33.3515	-115.248	Zone-11 N:	T09S, R16E	4.5 MI SE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1770	33.36512	-115.239	Zone-11 N:	T09S, R17E	4.5 MI SE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1760	33.3719	-115.23	Zone-11 N:	T09S, R17E	4.5 MI ESE
Unknown	Natural/Na	Imperial	Chuckwalla	1760	33.37604	-115.227	Zone-11 N:	T09S, R17E	4.5 MI ESE
Unknown	Natural/Na	Imperial	Chuckwalla	1810	33.38092	-115.231	Zone-11 N:	T09S, R17E	4 MI ESE O
Unknown	Natural/Na	Imperial	Lion Head I	1860	33.37255	-115.3	Zone-11 N:	T09S, R16E	2.5 MI S OF
Unknown	Natural/Na	Imperial	Lion Head I	1880	33.36678	-115.263	Zone-11 N:	T09S, R16E	3.5 MI SE C
Unknown	Natural/Na	Imperial	Pegleg Wel	1840	33.37314	-115.247	Zone-11 N:	T09S, R16E	3.5 MI SE C
Unknown	Natural/Na	Imperial	Augustine I	1910	33.3781	-115.263	Zone-11 N:	T09S, R16E	2.5 MI SE C
Unknown	Natural/Na	Imperial	Augustine I	2060	33.38342	-115.263	Zone-11 N:	T09S, R16E	2.5 MI SE C
Unknown	Natural/Na	Imperial	Augustine I	1880	33.38287	-115.253	Zone-11 N:	T09S, R16E	3 MI ESE O
Unknown	Natural/Na	Imperial	Augustine I	1990	33.39046	-115.266	Zone-11 N:	T09S, R16E	2 MI ESE O
Unknown	Natural/Na	Imperial	Augustine I	2080	33.39121	-115.284	Zone-11 N:	T09S, R16E	1 MI SSE O
Unknown	Natural/Na	Imperial	Lion Head I	1570	33.33543	-115.314	Zone-11 N:	T10S, R16E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Lion Head I	1520	33.34651	-115.313	Zone-11 N:	T09S, R16E	ABOUT 1.2
Unknown	Natural/Na	Imperial	Lion Head I	1480	33.35037	-115.327	Zone-11 N:	T09S, R16E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Lion Head I	1510	33.3539	-115.324	Zone-11 N:	T09S, R16E	ABOUT 1.2
Unknown	Natural/Na	Imperial	Lion Head I	1580	33.35328	-115.309	Zone-11 N:	T09S, R16E	ABOUT 1.6
Unknown	Natural/Na	Imperial	Lion Head I	1680	33.36618	-115.308	Zone-11 N:	T09S, R16E	ABOUT 2.3
Unknown	Natural/Na	Imperial	Lion Head I	1740	33.37251	-115.306	Zone-11 N:	T09S, R16E	2.5 MI SSW
Unknown	Natural/Na	Imperial	Lion Head I	1840	33.35879	-115.266	Zone-11 N:	T09S, R16E	3.5 MI SSE
Unknown	Natural/Na	Imperial | S	Carrizo Mtı	900	32.79361	-116.112	Zone-11 N:	T16S, R08E	MORTERO
Unknown	Natural/Na	Imperial	Painted Gorge (321157		32.7802	-116.001	Zone-11 N:	T16S, R09E	SOUTH OF
Unknown	Natural/Na	Imperial	Augustine I	1860	33.38594	-115.31	Zone-11 N:	T09S, R16E	1.5 MI SW
Unknown	Natural/Na	Imperial	Augustine I	1850	33.38737	-115.316	Zone-11 N:	T09S, R16E	2 MI SW OI
Unknown	Natural/Na	Imperial	Augustine I	1930	33.39513	-115.317	Zone-11 N:	T09S, R16E	1.5 MI SSW
Unknown	Natural/Na	Imperial	Augustine I	2080	33.3937	-115.297	Zone-11 N:	T09S, R16E	ABOUT 1.2
Unknown	Natural/Na	Imperial	Augustine I	2060	33.3974	-115.297	Zone-11 N:	T09S, R16E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Augustine I	1980	33.39833	-115.309	Zone-11 N:	T09S, R16E	1 MI SW OI
Unknown	Natural/Na	Imperial	Augustine I	1990	33.40292	-115.314	Zone-11 N:	T09S, R16E	1 MI WSW
Unknown	Natural/Na	Imperial	Augustine I	2070	33.40864	-115.321	Zone-11 N:	T09S, R16E	1.5 MI W C
Unknown	Natural/Na	Imperial	Augustine I	2200	33.4152	-115.312	Zone-11 N:	T09S, R16E	1 MI WNW
Unknown	Natural/Na	Imperial	Chuckwalla	1720	33.40112	-115.197	Zone-11 N:	T09S, R17E	ABOUT 1.6

Unknown	Natural/Na	Imperial	Chuckwalla	1690	33.3916	-115.197	Zone-11 N:	T09S, R17E	ABOUT 2 M
Unknown	Natural/Na	Imperial	Chuckwalla	1760	33.38837	-115.212	Zone-11 N:	T09S, R17E	2.7 MI SW
Unknown	Natural/Na	Imperial	Chuckwalla	1920	33.40077	-115.24	Zone-11 N:	T09S, R17E	4 MI E OF S
Unknown	Natural/Na	Imperial	Chuckwalla	1890	33.40319	-115.227	Zone-11 N:	T09S, R17E	2.5 MI SW
Unknown	Natural/Na	Imperial	Chuckwalla	1940	33.40094	-115.247	Zone-11 N:	T09S, R16E	2.5 MI E OF
Unknown	Natural/Na	Imperial	Chuckwalla	1900	33.39162	-115.247	Zone-11 N:	T09S, R16E	3 MI ESE O
Unknown	Natural/Na	Imperial	Augustine I	200	33.40342	-115.263	Zone-11 N:	T09S, R16E	1.5 MI E OF
Unknown	Natural/Na	Imperial	Augustine I	1990	33.40881	-115.253	Zone-11 N:	T09S, R16E	2.5 MI E OF
Unknown	Natural/Na	Imperial	Augustine I	2020	33.40847	-115.262	Zone-11 N:	T09S, R16E	2 MI E OF S
Unknown	Natural/Na	Imperial	Augustine I	2040	33.41306	-115.262	Zone-11 N:	T09S, R16E	2 MI E OF S
Unknown	Natural/Na	Imperial	Augustine I	2050	33.40143	-115.277	Zone-11 N:	T09S, R16E	1 MI ESE O
Unknown	Natural/Na	Imperial	Augustine I	2100	33.40618	-115.283	Zone-11 N:	T09S, R16E	IN THE VICI
Unknown	Natural/Na	Imperial	Augustine I	2170	33.42045	-115.285	Zone-11 N:	T09S, R16E	1 MI NNE C
Unknown	Natural/Na	Imperial	Augustine I	2230	33.42412	-115.298	Zone-11 N:	T09S, R16E	1 MI NNW
Unknown	Natural/Na	Imperial | I	Augustine I	2240	33.42822	-115.296	Zone-11 N:	T09S, R16E	1.5 MI N O
Unknown	Natural/Na	Imperial | I	Augustine I	2280	33.42821	-115.304	Zone-11 N:	T09S, R16E	1.5 MI NNE
Unknown	Natural/Na	Imperial	Augustine I	2290	33.42698	-115.308	Zone-11 N:	T09S, R16E	1.5 MI NNE
Unknown	Natural/Na	Imperial | I	Augustine I	2320	33.42958	-115.312	Zone-11 N:	T08S, R16E	2 MI NNE C
Unknown	Natural/Na	Imperial	Ogilby (321	470	32.85686	-114.839	Zone-11 N:	T15S, R20E	1 MI SSW C
Unknown	Natural/Na	Imperial	Ogilby (321	490	32.86414	-114.839	Zone-11 N:	T15S, R20E	1 MI SSW C
Unknown	Natural/Na	Imperial	Hedges (32	540	32.88853	-114.848	Zone-11 N:	T15S, R20E	1.5 MI WN
Unknown	Natural/Na	Imperial	Clyde (321	580	32.94573	-114.89	Zone-11 N:	T14S, R20E	6 MI NW O
Unknown	Natural/Na	Imperial	Clyde (321	600	32.9569	-114.895	Zone-11 N:	T14S, R20E	WEST SIDE
Unknown	Natural/Na	Imperial	Clyde (321	620	32.9681	-114.894	Zone-11 N:	T14S, R20E	ALONG OG
Unknown	Natural/Na	Imperial	Clyde (321	660	32.98398	-114.897	Zone-11 N:	T14S, R20E	ALONG OG
Unknown	Natural/Na	Imperial	Clyde (321	670	32.98876	-114.9	Zone-11 N:	T13S, R20E	EAST SIDE (
Unknown	Natural/Na	Imperial	Buzzards P	1000	33.17407	-114.864	Zone-11 N:	T11S, R20E	VICINITY O
Unknown	Natural/Na	Imperial	Buzzards P	950	33.18606	-114.861	Zone-11 N:	T11S, R20E	2.7 MI ESE
Unknown	Natural/Na	Imperial	Buzzards P	860	33.21376	-114.853	Zone-11 N:	T11S, R20E	JUST E OF E
Unknown	Natural/Na	Imperial	Buzzards P	630	33.2476	-114.818	Zone-11 N:	T11S, R20E	3 MI NE OF
Unknown	Natural/Na	Imperial	Ninemile W	980	33.07559	-114.927	Zone-11 N:	T12S, R19E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Buzzards P	780	33.22822	-114.845	Zone-11 N:	T11S, R20E	ABOUT 0.8
Unknown	Natural/Na	Imperial	Cibola (331	350	33.3391	-114.726	Zone-11 N:	T10S, R21E	ABOUT 2 M
Unknown	Natural/Na	Imperial	Cibola (331	260	33.36499	-114.733	Zone-11 N:	T09S, R21E	0.5 MI NW
Unknown	Natural/Na	Imperial	Cibola (331	250	33.37198	-114.738	Zone-11 N:	T09S, R21E	1 MI NW O
Unknown	Natural/Na	Imperial	Mt. Barrow	1070	33.15555	-114.899	Zone-11 N:	T12S, R20E	WEST OF 4
Unknown	Natural/Na	Imperial	Mt. Barrow	1336	33.12946	-114.95	Zone-11 N:	T12S, R19E	OFF A TRAI
Unknown	Natural/Na	Imperial	Clyde (321	560	32.93231	-114.886	Zone-11 N:	T14S, R20E	6 MI NW O
Unknown	Natural/Na	Imperial	Ninemile W	790	33.02234	-114.906	Zone-11 N:	T13S, R20E	EAST SIDE (
Unknown	Natural/Na	Imperial	Ninemile W	1030	33.09312	-114.889	Zone-11 N:	T12S, R20E	1.5 MI NE (
Unknown	Transplant	Imperial	In-ko-pah (	1770	32.6997	-116.068	Zone-11 N:	T17S, R09E	IN-KO PAH
Unknown	Natural/Na	Imperial	Ninemile W	830	33.04311	-114.913	Zone-11 N:	T13S, R20E	ON OGILBY
Unknown	Natural/Na	Imperial	Ninemile W	850	33.04694	-114.906	Zone-11 N:	T13S, R20E	EAST SIDE (
Unknown	Natural/Na	Imperial	Ninemile W	930	33.07042	-114.895	Zone-11 N:	T13S, R20E	1.5 MI SE C
Unknown	Natural/Na	Imperial	Ninemile W	1100	33.12105	-114.884	Zone-11 N:	T12S, R20E	E SIDE OF E
Unknown	Natural/Na	Imperial	Buzzards P	1060	33.14821	-114.879	Zone-11 N:	T12S, R20E	VICINITY O
Unknown	Natural/Na	Imperial	Buzzards P	780	33.22859	-114.851	Zone-11 N:	T11S, R20E	JUST N OF

Unknown	Natural/Na	Imperial	Ogilby (321	450	32.84778	-114.841	Zone-11 N:	T15S, R20E	2 MI N OF (
Unknown	Natural/Na	Imperial	Chuckwalla	1740	33.41464	-115.194	Zone-11 N:	T09S, R17E	1 MILE SW
Unknown	Natural/Na	Imperial	Grays Well	200	32.74501	-114.855	Zone-11 N:	T16S, R20E	ALONG THI
Unknown	Natural/Na	Imperial	Plaster City	0	32.79061	-115.802	Zone-11 N:	T16S, R11E	ALONG EV/
Unknown	Natural/Na	Imperial | I	Grays Well	155	32.70815	-114.942	Zone-11 N:	T17S, R20E	SE END OF
Unknown	Natural/Na	Imperial	Coyote We	300	32.74931	-115.924	Zone-11 N:	T16S, R10E	NORTH SID
Unknown	Natural/Na	Imperial	Coyote We	550	32.71186	-115.989	Zone-11 N:	T16.5S, R9.	APPROXIM
Unknown	Natural/Na	Imperial	Plaster City	150	32.76538	-115.849	Zone-11 N:	T16S, R11E	APPROXIM
Unknown	Natural/Na	Imperial	Plaster City	75	32.764	-115.829	Zone-11 N:	T16S, R11E	NORTH SID
Unknown	Natural/Na	Imperial	Plaster City	50	32.7696	-115.817	Zone-11 N:	T16S, R11E	APPROXIM
Unknown	Natural/Na	Imperial	Plaster City	0	32.75576	-115.777	Zone-11 N:	T16S, R12E	APPROXIM
Unknown	Natural/Na	Imperial	Painted Go	320	32.75093	-115.914	Zone-11 N:	T16S, R10E	NORTH SID
Unknown	Natural/Na	Imperial	In-ko-pah (	700	32.7114	-116.007	Zone-11 N:	T16.5S, R0!	APPROXIM
Unknown	Natural/Na	Imperial	Carrizo Mtı	1200	32.80854	-116.075	Zone-11 N:	T16S, R09E	DOMELANI
Unknown	Natural/Na	Imperial	Carrizo Mtı	849	32.7879	-116.042	Zone-11 N:	T16S, R09E	SMALL CAN
Unknown	Natural/Na	Imperial	Carrizo Mtı	443	32.77875	-116.014	Zone-11 N:	T16S, R09E	MOUTH OF
Unknown	Natural/Na	Imperial	Glamis NW	300	32.97156	-115.187	Zone-11 N:	T13S, R17E	7 MILES WI
Unknown	Natural/Na	Imperial | I	Calexico (3211564) | H		32.66977	-115.496	Zone-11 N:	T17S, R14E	CALEXICO.
Unknown	Natural/Na	Imperial	Mount Sigr	0	32.7088	-115.754	Zone-11 N:	T17S, R12E	2.0 MILES I
Unknown	Natural/Na	Imperial	Kane Spring	-200	33.12405	-115.855	Zone-11 N:	T12S, R11E	SAN FELIPE
Unknown	Natural/Na	Imperial	Harpers W	-70	33.10382	-115.939	Zone-11 N:	T12S, R10E	0-2 KM N C
Unknown	Natural/Na	Imperial	Niland (3311525) | Wi		33.24069	-115.518	Zone-11 N:	T11S, R14E	IMPERIAL J
Unknown	Natural/Na	Imperial	Glamis NW	100	32.94769	-115.241	Zone-11 N:	T14S, R17E	SOUTH OF
Unknown	Natural/Na	Imperial	Coyote We	900	32.67937	-116.008	Zone-11 N:	T17S, R10E	4 MILES SS'
Unknown	Natural/Na	Imperial	In-ko-pah (	1731	32.69751	-116.083	Zone-11 N:	T17S, R09E	WEST SIDE
Unknown	Natural/Na	Imperial	Picacho NV	220	33.25048	-114.693	Zone-11 N:	T11S, R22E	IN THE VICI
Unknown	Natural/Na	Imperial	Picacho NV	210	33.16161	-114.68	Zone-11 N:	T12S, R22E	ALONG THI
Unknown	Natural/Na	Imperial	Westmorla	-180	33.13276	-115.545	Zone-11 N:	T12S, R14E	ENGLISH RI
Unknown	Natural/Na	Imperial	Seeley (321	-70	32.76588	-115.702	Zone-11 N:	T16S, R12E	FIG LAGOO
Unknown	Natural/Na	Imperial	Mount Sigr	-30	32.74597	-115.695	Zone-11 N:	T16S, R12E	IN THE VICI
Unknown	Natural/Na	Imperial	Brawley N\	-50	32.88983	-115.675	Zone-11 N:	T14S, R13E	IN THE VICI
Unknown	Natural/Na	Imperial	Alamorio (:	-130	32.96493	-115.48	Zone-11 N:	T14S, R14E	IN THE VICI
Unknown	Natural/Na	Imperial	Wiest (331	-170	33.0705	-115.503	Zone-11 N:	T13S, R14E	IN THE VICI
Unknown	Natural/Na	Imperial	Westmorla	-150	33.04443	-115.553	Zone-11 N:	T13S, R14E	ALONG RU
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	IN THE VICI
Unknown	Natural/Na	Imperial	Calipatria S	-160	33.02492	-115.65	Zone-11 N:	T13S, R13E	IN THE VICI
Unknown	Natural/Na	Imperial	Calipatria S	-180	33.0518	-115.647	Zone-11 N:	T13S, R13E	IN THE VICI
Unknown	Natural/Na	Imperial | !	In-ko-pah (	3000	32.67397	-116.106	Zone-11 N:	T17S, R08E	MOUNTAIN
Unknown	Natural/Na	Imperial	Mount Sigr	30	32.65332	-115.684	Zone-11 N:	T17S, R13E	WEST MES.
Unknown	Natural/Na	Imperial	Mount Sigr	40	32.67845	-115.708	Zone-11 N:	T17S, R12E	WEST MES.
Unknown	Natural/Na	Imperial	Mount Sigr	-5	32.69953	-115.696	Zone-11 N:	T17S, R12E	WEST MES.
Unknown	Natural/Na	Imperial	Yuha Basin	0	32.74129	-115.772	Zone-11 N:	T16S, R12E	WEST MES.
Unknown	Natural/Na	Imperial	Yuha Basin	0	32.74892	-115.783	Zone-11 N:	T16S, R11E	WEST MES.
Unknown	Natural/Na	Imperial	Plaster City	20	32.75151	-115.791	Zone-11 N:	T16S, R11E	WEST MES.
Unknown	Natural/Na	Imperial	Plaster City	10	32.75454	-115.787	Zone-11 N:	T16S, R11E	WEST MES.
Unknown	Natural/Na	Imperial	Plaster City	-10	32.75557	-115.778	Zone-11 N:	T16S, R12E	WEST MES.
Unknown	Natural/Na	Imperial	Plaster City	10	32.77601	-115.801	Zone-11 N:	T16S, R11E	WEST MES.

Unknown	Natural/Na	Imperial	Plaster City (3211577)		32.79105	-115.839	Zone-11 N:	T16S, R11E	1 MILE EAS
Unknown	Natural/Na	Imperial	Calipatria S	-210	33.11534	-115.642	Zone-11 N:	T12S, R13E	IN THE VICI
Unknown	Natural/Na	Imperial	Wiest (331	-140	33.11152	-115.449	Zone-11 N:	T12S, R15E	ALONG HW
Unknown	Natural/Na	Imperial	Wiest (331	-100	33.10221	-115.405	Zone-11 N:	T12S, R15E	VICINITY O
Unknown	Natural/Na	Imperial	Niland (331	-210	33.1475	-115.617	Zone-11 N:	T12S, R13E	IN THE VICI
Unknown	Natural/Na	Imperial	Niland (331	-200	33.16974	-115.59	Zone-11 N:	T11S, R13E	ALONG HA'
Unknown	Natural/Na	Imperial	Tortuga (3:	-160	33.15481	-115.484	Zone-11 N:	T12S, R14E	AGRICULTU
Unknown	Natural/Na	Imperial	In-ko-pah (	1275	32.72916	-116.1	Zone-11 N:	T16S, R09E	PALM CAN'
Unknown	Natural/Na	Imperial	Niland (331	-200	33.17721	-115.545	Zone-11 N:	T11S, R14E	VICINITY O
Unknown	Natural/Na	Imperial	Iris (33115:	-140	33.22835	-115.513	Zone-11 N:	T11S, R14E	VICINITY O
Unknown	Natural/Na	Imperial	Niland (331	-180	33.16953	-115.519	Zone-11 N:	T11S, R14E	ALONG HW
Unknown	Natural/Na	Imperial	Kane Sprin	-190	33.22316	-115.86	Zone-11 N:	T11S, R11E	IN THE VICI
Unknown	Natural/Na	Imperial | I	Durmid (33	-200	33.4131	-115.819	Zone-11 N:	T09S, R11E	ABOUT 1.3
Unknown	Natural/Na	Imperial	In-ko-pah (	1800	32.70066	-116.066	Zone-11 N:	T17S, R09E	IN-KO-PAH
Unknown	Natural/Na	Imperial	In-ko-pah (	1200	32.7053	-116.053	Zone-11 N:	T17S, R09E	IN-KO-PAH
Unknown	Natural/Na	Imperial | /	Yuma West	120	32.73224	-114.644	Zone-11 N:	T16S, R22E	S BANK OF
Unknown	Natural/Na	Imperial | /	Imperial Re	190	33.00531	-114.502	Zone-11 N:	T13S, R24E	VICINITY O
Unknown	Natural/Na	Imperial	Westmorla	-160	33.03509	-115.62	Zone-11 N:	T13S, R13E	WESTMOR
Unknown	Natural/Na	Imperial	Brawley (3:	-120	32.98392	-115.525	Zone-11 N:	T13S, R14E	BRAWLEY.
Unknown	Natural/Na	Imperial	Bard (3211	130	32.77059	-114.587	Zone-11 N:	T16S, R23E	HAUGHTEL
Unknown	Natural/Na	Imperial | /	Laguna Dar	140	32.82561	-114.497	Zone-11 N:	T15S, R24E	VICINITY O
Unknown	Natural/Na	Imperial	Laguna Dar	180	32.86831	-114.486	Zone-11 N:	T15S, R24E	W SIDE ALL
Unknown	Natural/Na	Imperial | I	Palo Verde	235	33.43201	-114.736	Zone-11 N:	T09S, R21E	VICINITY O
Unknown	Natural/Na	Imperial	Palo Verde	240	33.40866	-114.702	Zone-11 N:	T09S, R22E	ON COLOR.
Unknown	Natural/Na	Imperial | /	Yuma West	130	32.72955	-114.717	Zone-11 N:	T16S, R21E	COLORADC
Unknown	Natural/Na	Imperial	Picacho NV	200	33.14415	-114.687	Zone-11 N:	T12S, R22E	LIGHTHOU:
Unknown	Natural/Na	Imperial | /	Yuma West	120	32.72955	-114.717	Zone-11 N:	T16S, R21E	ALONG THI
Unknown	Natural/Na	Imperial | /	Cibola (331	220	33.29406	-114.728	Zone-11 N:	T10S, R21E	COLORADC
Unknown	Natural/Na	Imperial | /	Imperial Re	180	32.8951	-114.465	Zone-11 N:	T15S, R24E	COLORADC
Unknown	Natural/Na	Imperial | I	Mule Wash	240	33.43435	-114.628	Zone-11 N:	T08S, R22E	COLORADC
Unknown	Natural/Na	Imperial | /	Picacho NV	210	33.17988	-114.674	Zone-11 N:	T99X, R99X	EAST SIDE (
Unknown	Natural/Na	Imperial | /	Picacho (3:	195	33.02479	-114.598	Zone-11 N:	T13S, R23E	ABOUT 0.7
Unknown	Natural/Na	Imperial	Wister (33:	-200	33.30095	-115.592	Zone-11 N:	T10S, R13E	NILAND LA'
Unknown	Natural/Na	Imperial	Wiest (331	-170	33.05734	-115.5	Zone-11 N:	T13S, R14E	IN THE VICI
Unknown	Natural/Na	Imperial	Frink NW (:	50	33.41028	-115.667	Zone-11 N:	T09S, R12E	COACHELL/
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N:	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211	190	32.83176	-114.547	Zone-11 N:	T15S, R23E	ALONG THI
Unknown	Natural/Na	Imperial | /	Yuma East	200	32.73172	-114.616	Zone-11 N:	T16S, R22E	FORT YUM.
Unknown	Natural/Na	Imperial | /	Laguna Dar	160	32.88393	-114.471	Zone-11 N:	T15S, R24E	1 MI SW OI
Unknown	Natural/Na	Imperial | /	Laguna Dar	180	32.88393	-114.471	Zone-11 N:	T15S, R24E	VICINITY O
Unknown	Natural/Na	Imperial	Bard (3211475)		32.78948	-114.554	Zone-11 N:	T16S, R23E	BARD, FOR
Unknown	Natural/Na	Imperial	Cibola (331	689	33.35361	-114.83	Zone-11 N:	T09S, R20E	PALO VERE
Unknown	Natural/Na	Imperial	Picacho Pe.	1000	32.96143	-114.674	Zone-11 N:	T14S, R22E	SOUTHWE:
Unknown	Natural/Na	Imperial	Bard (3211	135	32.78948	-114.554	Zone-11 N:	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Picacho SW	220	33.11172	-114.706	Zone-11 N:	T12S, R21E	ALONG THI
Unknown	Natural/Na	Imperial	Cibola (331	220	33.25481	-114.689	Zone-11 N:	T11S, R22E	VICINITY O
Unknown	Natural/Na	Imperial | /	Picacho (3:	140	33.02351	-114.615	Zone-11 N:	T13S, R22E	VICINITY O

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Unknown	Natural/Na	Imperial	Picacho SW	200	33.02943	-114.637	Zone-11 N:	T13S, R22E	VICINITY O
Unknown	Natural/Na	Imperial	Niland (331	-220	33.14777	-115.623	Zone-11 N:	T12S, R13E	SE SALTON
Unknown	Natural/Na	Imperial	Calipatria S	-210	33.08282	-115.693	Zone-11 N:	T12S, R12E	SE SALTON
Unknown	Natural/Na	Imperial	Shell Reef (	270	33.19777	-116.068	Zone-11 N:	T11S, R09E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Shell Reef (	100	33.17118	-116.006	Zone-11 N:	T11S, R09E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Shell Reef (	80	33.1452	-116.006	Zone-11 N:	T12S, R09E	8.9 MILES \
Unknown	Natural/Na	Imperial	Shell Reef (	80	33.14527	-116.061	Zone-11 N:	T12S, R09E	ALONG SAI
Unknown	Natural/Na	Imperial	Shell Reef (	80	33.14726	-116.067	Zone-11 N:	T12S, R09E	NEAR SAN
Unknown	Natural/Na	Imperial	Kane Spring	110	33.1784	-115.993	Zone-11 N:	T11S, R09E	ABOUT 0.3
Unknown	Natural/Na	Imperial	Kane Spring	90	33.15931	-115.977	Zone-11 N:	T12S, R10E	POLE LINE
Unknown	Natural/Na	Imperial | /	Imperial Re	190	33.00531	-114.502	Zone-11 N:	T13S, R24E	VICINITY O
Unknown	Natural/Na	Imperial	Kane Spring	50	33.13417	-115.979	Zone-11 N:	T12S, R09E	POLE LINE
Unknown	Natural/Na	Imperial	Kane Spring	-10	33.12578	-115.962	Zone-11 N:	T12S, R10E	STATE HIGI
Unknown	Natural/Na	Imperial | /	Imperial Re	180	32.8951	-114.465	Zone-11 N:	T15S, R24E	COLORADC
Unknown	Natural/Na	Imperial	Plaster City	130	32.90684	-115.916	Zone-11 N:	T14S, R10E	ABOUT 5.5
Unknown	Natural/Na	Imperial	Wister (331	-60	33.29867	-115.543	Zone-11 N:	T10S, R14E	ALONG THI
Unknown	Natural/Na	Imperial | S	Shell Reef (	140	33.18275	-116.085	Zone-11 N:	T11S, R08E	VICINITY O
Unknown	Natural/Na	Imperial | /	Picacho NV	220	33.2549	-114.69	Zone-11 N:	T11S, R22E	IN THE VICI
Unknown	Natural/Na	Imperial	Laguna Dar	160	32.8605	-114.489	Zone-11 N:	T15S, R24E	E SIDE OF A
Unknown	Natural/Na	Imperial	Painted Go	320	32.78444	-115.967	Zone-11 N:	T16S, R10E	ABOUT 3.1
Unknown	Natural/Na	Imperial	Painted Go	150	32.79113	-115.882	Zone-11 N:	T16S, R11E	E SIDE OF F
Unknown	Natural/Na	Imperial	Plaster City	100	32.77871	-115.857	Zone-11 N:	T16S, R11E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Plaster City	90	32.76995	-115.84	Zone-11 N:	T16S, R11E	ABOUT 1.9
Unknown	Natural/Na	Imperial	Mount Sigr	0	32.74052	-115.767	Zone-11 N:	T16S, R12E	FROM ABO
Unknown	Natural/Na	Imperial	Plaster City	30	32.76492	-115.8	Zone-11 N:	T16S, R11E	ABOUT 0.2
Unknown	Natural/Na	Imperial	Plaster City	0	32.76342	-115.785	Zone-11 N:	T16S, R11E	FROM 0.3 I
Unknown	Natural/Na	Imperial	Plaster City	-10	32.77833	-115.791	Zone-11 N:	T16S, R11E	ABOUT 0.7
Unknown	Natural/Na	Imperial	Kane Spring	-160	33.11198	-115.882	Zone-11 N:	T12S, R10E	ALONG SAI
Unknown	Natural/Na	Imperial	Picacho SW	220	33.11315	-114.706	Zone-11 N:	T12S, R21E	ALONG PAI
Unknown	Natural/Na	Imperial	Mount Sigr	100	32.68347	-115.757	Zone-11 N:	T17S, R12E	0.2 TO 0.6
Unknown	Natural/Na	Imperial	Yuha Basin	150	32.66625	-115.782	Zone-11 N:	T17S, R12E	5 TO 6 MIL
Unknown	Natural/Na	Imperial	Plaster City	50	32.7867	-115.839	Zone-11 N:	T16S, R11E	ABOUT 1 M
Unknown	Natural/Na	Imperial	Plaster City	40	32.77361	-115.82	Zone-11 N:	T16S, R11E	ABOUT 1.2
Unknown	Natural/Na	Imperial	Mount Sigr	0	32.71894	-115.711	Zone-11 N:	T16.5S, R1:	WEST MES/
Unknown	Natural/Na	Imperial	Mount Sigr	30	32.7016	-115.721	Zone-11 N:	T17S, R12E	ABOUT 2 M
Unknown	Natural/Na	Imperial	Mount Sigr	60	32.70414	-115.735	Zone-11 N:	T17S, R12E	ABOUT 3 M
Unknown	Natural/Na	Imperial	Mount Sigr	90	32.69516	-115.751	Zone-11 N:	T17S, R12E	ABOUT 3.4
Unknown	Natural/Na	Imperial	Mount Sigr	120	32.66606	-115.729	Zone-11 N:	T17S, R12E	ABOUT 2.3
Unknown	Natural/Na	Imperial	Mount Sigr	50	32.66075	-115.688	Zone-11 N:	T17S, R13E	ABOUT 1.2
Unknown	Natural/Na	Imperial	Mount Sigr	15	32.66338	-115.683	Zone-11 N:	T17S, R13E	ABOUT 1.2
Unknown	Natural/Na	Imperial	Glamis SW	50	32.76858	-115.246	Zone-11 N:	T16S, R17E	0.6 MILE N
Unknown	Natural/Na	Imperial	Wister (331	-220	33.28187	-115.604	Zone-11 N:	T10S, R13E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Kane Spring	-230	33.32851	-115.941	Zone-11 N:	T10S, R10E	ABOUT 20
Unknown	Natural/Na	Imperial	Wister (331	-210	33.25738	-115.576	Zone-11 N:	T10S, R13E	GENERAL A
Unknown	Natural/Na	Imperial	Calipatria S	-230	33.12004	-115.766	Zone-11 N:	T12S, R12E	SOUTHERN
Unknown	Natural/Na	Imperial	Niland (331	-230	33.25491	-115.599	Zone-11 N:	T10S, R13E	ABOUT 8 M
Unknown	Natural/Na	Imperial | /	Laguna Dar	300	32.82892	-114.506	Zone-11 N:	T15S, R23E	VICINITY O

Unknown	Natural/Na	Imperial	Kane Sprin	-230	33.32851	-115.941	Zone-11 N	T10S, R10E	DESERT SH
Unknown	Natural/Na	Imperial	Niland (331	-230	33.30582	-115.622	Zone-11 N	T10S, R13E	BOMBAY B
Unknown	Natural/Na	Imperial	Coyote We	958	32.65599	-115.944	Zone-11 N	T17S, R10E	APPROXIM
Unknown	Natural/Na	Imperial	Coyote We	670	32.65901	-115.939	Zone-11 N	T17S, R10E	APPROXIM
Unknown	Natural/Na	Imperial	Harpers W	-65	33.07985	-115.976	Zone-11 N	T12S, R10E	ALONG N S
Unknown	Natural/Na	Imperial	Harpers W	-148	33.10185	-115.91	Zone-11 N	T12S, R10E	SOUTH ED
Unknown	Natural/Na	Imperial	Hedges (32	800	32.90129	-114.817	Zone-11 N	T14S, R20E	ENTRENCH
Unknown	Natural/Na	Imperial	East of Acolita (33115		33.02188	-115.108	Zone-11 N	T13S, R18E	MESQUITE
Unknown	Natural/Na	Imperial	Buzzards P	1011	33.14771	-114.869	Zone-11 N	T12S, R20E	APPROX 0.
Unknown	Natural/Na	Imperial	Carrizo Mt	1030	32.79656	-116.054	Zone-11 N	T16S, R09E	UNNAMED
Unknown	Natural/Na	Imperial	Carrizo Mt	1030	32.79656	-116.054	Zone-11 N	T16S, R09E	CANYON A
Unknown	Natural/Na	Imperial	Coyote We	600	32.72922	-116.016	Zone-11 N	T16S, R09E	APPROXIM
Unknown	Natural/Na	Imperial	In-ko-pah (	1290	32.72894	-116.099	Zone-11 N	T16S, R09E	PALM CAN
Unknown	Natural/Na	Imperial	In-ko-pah (	1290	32.72894	-116.099	Zone-11 N	T16S, R09E	PALM CAN
Unknown	Natural/Na	Imperial	In-ko-pah (	1639	32.68607	-116.058	Zone-11 N	T17S, R09E	NARROW (
Unknown	Natural/Na	Imperial	In-ko-pah (	2174	32.67724	-116.09	Zone-11 N	T17S, R09E	BETWEEN
Unknown	Natural/Na	Imperial	In-ko-pah (	1909	32.66615	-116.077	Zone-11 N	T17S, R09E	ALONG BO
Unknown	Natural/Na	Imperial	In-ko-pah (	3636	32.63122	-116.088	Zone-11 N	T18S, R09E	0.4 AIR MIL
Unknown	Natural/Na	Imperial	In-ko-pah (	1910	32.66615	-116.077	Zone-11 N	T17S, R09E	ALONG BO
Unknown	Natural/Na	Imperial	In-ko-pah (	4200	32.6234	-116.098	Zone-11 N	T18S, R09E	0.4 AIR MIL
Unknown	Natural/Na	Imperial	In-ko-pah (	3636	32.63122	-116.088	Zone-11 N	T18S, R09E	0.4 AIR MIL
Unknown	Natural/Na	Imperial	In-ko-pah (	4200	32.6234	-116.098	Zone-11 N	T18S, R09E	0.4 AIR MIL
Unknown	Natural/Na	Imperial |	In-ko-pah (	3100	32.64215	-116.106	Zone-11 N	T17S, R08E	IN-KO-PAH
Unknown	Natural/Na	Imperial	In-ko-pah (	1639	32.68607	-116.058	Zone-11 N	T17S, R09E	NARROW (
Unknown	Natural/Na	Imperial	In-ko-pah (	1909	32.66615	-116.077	Zone-11 N	T17S, R09E	ALONG BO
Unknown	Natural/Na	Imperial	In-ko-pah (	4201	32.6234	-116.098	Zone-11 N	T18S, R09E	0.4 AIR MIL
Unknown	Natural/Na	Imperial	In-ko-pah (	1639	32.68607	-116.058	Zone-11 N	T17S, R09E	NARROW (
Unknown	Natural/Na	Imperial	Cibola (331	240	33.34658	-114.723	Zone-11 N	T09S, R21E	ALONG HIG
Unknown	Natural/Na	Imperial	In-ko-pah (	1130	32.73641	-116.089	Zone-11 N	T16S, R09E	PALM CAN
Unknown	Natural/Na	Imperial	Amos (331	220	33.1247	-115.276	Zone-11 N	T12S, R16E	APPROXIM
Unknown	Natural/Na	Imperial	Tortuga (3	220	33.13166	-115.28	Zone-11 N	T12S, R16E	APPROXIM
Unknown	Natural/Na	Imperial	Harpers W	0	33.1259	-115.998	Zone-11 N	T12S, R09E	ALONG HIG
Unknown	Natural/Na	Imperial	Shell Reef (	55	33.12964	-116.07	Zone-11 N	T12S, R09E	APPROXIM
Unknown	Natural/Na	Imperial	Shell Reef (	40	33.12636	-116.045	Zone-11 N	T12S, R09E	JUST EAST
Unknown	Natural/Na	Imperial	Carrizo Mt	1640	32.82455	-116.01	Zone-11 N	T15S, R09E	ABOUT 0.3
Unknown	Natural/Na	Imperial	In-ko-pah (	3636	32.63122	-116.088	Zone-11 N	T18S, R09E	0.4 AIR MIL
Unknown	Natural/Na	Imperial	In-ko-pah (	4200	32.6234	-116.098	Zone-11 N	T18S, R09E	0.4 AIR MIL
Unknown	Natural/Na	Imperial	In-ko-pah (	1639	32.68607	-116.058	Zone-11 N	T17S, R09E	NARROW (
Unknown	Natural/Na	Imperial	Buzzards P	1210	33.1544	-114.856	Zone-11 N	T12S, R20E	ABOUT 0.9
Unknown	Natural/Na	Imperial	Cibola (3311436) | Pal		33.35361	-114.83	Zone-11 N	T09S, R20E	PALO VERD
Unknown	Natural/Na	Imperial |	Picacho SW	200	33.09	-114.709	Zone-11 N	T12S, R21E	MOUTH OF
Stable	Introduced	Imperial |	Cibola (331	223	33.33481	-114.702	Zone-11 N	T99X, R99X	ISOLATED F
Unknown	Natural/Na	Imperial |	Cibola (331	225	33.31908	-114.717	Zone-11 N	T10S, R21E	COLORADO
Unknown	Introduced	Imperial |	Cibola (331	223	33.33481	-114.702	Zone-11 N	T99X, R99X	ISOLATED F
Unknown	Natural/Na	Imperial	Wister (33	-60	33.27616	-115.525	Zone-11 N	T10S, R14E	GALLEANO
Unknown	Natural/Na	Imperial	Westmorla	-174	33.07752	-115.512	Zone-11 N	T12S, R14E	RAMER LA
Unknown	Natural/Na	Imperial	Frink (3311	-230	33.3533	-115.713	Zone-11 N	T09S, R12E	BOMBAY B

Unknown	Natural/Na	Imperial	Niland (331	-228	33.19666	-115.59	Zone-11 N:	T11S, R13E	VICINITY O
Unknown	Natural/Na	Imperial | /	Laguna Dar	142	32.8255	-114.501	Zone-11 N:	T15S, R24E	VICINITY O
Unknown	Natural/Na	Imperial | I	Oasis (331:	-200	33.4257	-116.054	Zone-11 N:	T09S, R09E	TRAVERTIN
Unknown	Natural/Na	Imperial	Westmorla	-205	33.118	-115.563	Zone-11 N:	T12S, R13E	BRANDT RI
Unknown	Natural/Na	Imperial | I	Thumb Pea	363	33.43335	-114.795	Zone-11 N:	T09S, R21E	ABOUT 3.5
Unknown	Natural/Na	Imperial | I	Thumb Pea	326	33.43431	-114.776	Zone-11 N:	T08S, R21E	ABOUT 2.5
Unknown	Natural/Na	Imperial	Amos (331	200	33.11666	-115.276	Zone-11 N:	T12S, R16E	5.6 AIR MIL
Unknown	Natural/Na	Imperial	Thumb Pea	256	33.42337	-114.757	Zone-11 N:	T09S, R21E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Thumb Pea	390	33.42833	-114.795	Zone-11 N:	T09S, R21E	ABOUT 3.6
Unknown	Natural/Na	Imperial	Palo Verde	258	33.42799	-114.761	Zone-11 N:	T09S, R21E	ABOUT 1.6
Unknown	Natural/Na	Imperial	Thumb Pea	1300					*SENSITIVE
Unknown	Natural/Na	Imperial	In-ko-pah (	1370	32.69458	-116.054	Zone-11 N:	T17S, R09E	CANYON BI
Unknown	Natural/Na	Imperial | /	Yuma East (3211465) |		32.73269	-114.633	Zone-11 N:	T16S, R22E	SANDBARS
Unknown	Natural/Na	Imperial	Clyde (321:	380	32.94363	-115	Zone-11 N:	T14S, R19E	APPROXIM
Unknown	Natural/Na	Imperial	Amos (331	197	33.11116	-115.286	Zone-11 N:	T12S, R16E	N SECTION
Unknown	Natural/Na	Imperial	In-ko-pah (	1370	32.69457	-116.054	Zone-11 N:	T17S, R09E	APPROX 1.:
Unknown	Natural/Na	Imperial	Bard (3211	140	32.78948	-114.554	Zone-11 N:	T16S, R23E	VICINITY O
Unknown	Natural/Na	Imperial	Bonds Corr	40	32.69396	-115.293	Zone-11 N:	T17S, R16E	VICINITY O
Unknown	Natural/Na	Imperial | I	Palo Verde	240	33.43201	-114.736	Zone-11 N:	T09S, R21E	VICINITY O
Unknown	Natural/Na	Imperial	East of Acolita (33115:		33.02188	-115.108	Zone-11 N:	T13S, R18E	MESQUITE
Unknown	Natural/Na	Imperial	In-ko-pah (	1339	32.7104	-116.077	Zone-11 N:	T17S, R09E	FOOT OF D
Unknown	Natural/Na	Imperial | /	Yuma East	120	32.73269	-114.633	Zone-11 N:	T16S, R22E	RIVER BAN
Unknown	Natural/Na	Imperial | /	Laguna Dar	140	32.82561	-114.497	Zone-11 N:	T15S, R24E	LAGUNA D/
Unknown	Natural/Na	Imperial	Glamis NW	250	32.98615	-115.173	Zone-11 N:	T13S, R17E	0.7 MILE N
Unknown	Natural/Na	Imperial	Imperial Re	355	32.91597	-114.506	Zone-11 N:	T14S, R23E	ABOUT 3.3
Unknown	Natural/Na	Imperial	Hedges (32	830	32.8809	-114.816	Zone-11 N:	T15S, R20E	ABOUT 1.4
Unknown	Natural/Na	Imperial | /	Yuma East	200	32.73172	-114.616	Zone-11 N:	T16S, R22E	FORT YUM/
Unknown	Natural/Na	Imperial	Ogilby (321	310	32.81475	-114.847	Zone-11 N:	T15S, R20E	IMPERIAL I
Unknown	Natural/Na	Imperial	Ninemile W	1000	33.08507	-114.914	Zone-11 N:	T12S, R20E	JUST WEST
Unknown	Natural/Na	Imperial	Ninemile W	885	33.05949	-114.915	Zone-11 N:	T13S, R20E	ALONG OG
Unknown	Natural/Na	Imperial	Mammoth Wash (331:		33.20676	-115.247	Zone-11 N:	T11S, R16E	MAMMOU
Unknown	Natural/Na	Imperial	Chuckwalla	1676	33.41369	-115.181	Zone-11 N:	T09S, R17E	1 KM SE OI
Unknown	Natural/Na	Imperial	Coyote We	344	32.66973	-115.891	Zone-11 N:	T17S, R11E	CRUCIFIXIC
Unknown	Natural/Na	Imperial	Coyote We	838	32.64073	-115.953	Zone-11 N:	T17S, R10E	SKULL VALI
Unknown	Natural/Na	Imperial	Picacho Pe.	343	32.99878	-114.629	Zone-11 N:	T13S, R22E	IN THE VICI
Unknown	Natural/Na	Imperial	Picacho Pe.	422	32.98674	-114.63	Zone-11 N:	T13.5S, R2:	ARRASTRA
Unknown	Natural/Na	Imperial	Coyote We	720	32.65658	-115.938	Zone-11 N:	T17S, R10E	UNNAMED
Unknown	Natural/Na	Imperial	In-ko-pah (	1330	32.72894	-116.099	Zone-11 N:	T16S, R09E	PALM CAN'
Unknown	Natural/Na	Imperial	Wiley Well (3311448)		33.42044	-114.904	Zone-11 N:	T09S, R20E	5.1 MILES S
Unknown	Natural/Na	Imperial	Painted Go	686	32.82221	-115.991	Zone-11 N:	T15S, R09E	ROCKY HILI
Unknown	Natural/Na	Imperial	Coyote We	838	32.64073	-115.953	Zone-11 N:	T17S, R10E	SKULL VALI
Unknown	Natural/Na	Imperial	In-ko-pah (	1330	32.69964	-116.059	Zone-11 N:	T17S, R09E	ALONG EAS
Unknown	Natural/Na	Imperial	Amos (331	75	33.01732	-115.302	Zone-11 N:	T13S, R16E	SOUTH OF
Unknown	Natural/Na	Imperial | /	Picacho NV	210	33.19577	-114.678	Zone-11 N:	T11S, R22E	SOUTHEAS'
Unknown	Natural/Na	Imperial	Borrego M	100	33.03991	-116.062	Zone-11 N:	T13S, R09E	ALONG RO.
Unknown	Natural/Na	Imperial	Borrego M	60	33.04176	-116.042	Zone-11 N:	T13S, R09E	3.3 MI EAS'
Unknown	Natural/Na	Imperial	Borrego M	70	33.03613	-116.048	Zone-11 N:	T13S, R09E	ALONG RO.

Unknown	Natural/Na	Imperial	Coyote We	290	32.74348	-115.933	Zone-11 N:	T16S, R10E	0.2 MILE S(
Unknown	Natural/Na	Imperial	Yuha Basin	60	32.7283	-115.768	Zone-11 N:	T16S, R12E	3.1 AIR MIL
Unknown	Natural/Na	Imperial	Yuha Basin	50	32.72327	-115.758	Zone-11 N:	T16.5S, R1:	3.4-3.8 AIR
Unknown	Natural/Na	Imperial	Mount Sigr	45	32.70889	-115.73	Zone-11 N:	T17S, R12E	3.9 AIR MIL
Unknown	Natural/Na	Imperial	Mount Sigr	70	32.6627	-115.7	Zone-11 N:	T17S, R12E	1.5 TO 2 M
Unknown	Natural/Na	Imperial	Amos (331	90	33.04333	-115.284	Zone-11 N:	T13S, R16E	7.5 AIR MIL
Unknown	Natural/Na	Imperial	Glamis NW	75	32.95287	-115.245	Zone-11 N:	T14S, R17E	3.8 AIR MIL
Unknown	Natural/Na	Imperial	Glamis NW	90	32.94391	-115.227	Zone-11 N:	T14S, R17E	3.1 AIR MIL
Unknown	Natural/Na	Imperial	Durmid (33	-150	33.37846	-115.775	Zone-11 N:	T09S, R11E	0.8 MILE N
Unknown	Natural/Na	Imperial	Yuha Basin	100	32.70465	-115.771	Zone-11 N:	T17S, R12E	4.7 AIR MIL
Unknown	Natural/Na	Imperial	Glamis SW	115	32.7912	-115.149	Zone-11 N:	T16S, R18E	7.4 AIR MIL
Unknown	Natural/Na	Imperial	Glamis SE (	120	32.84192	-115.101	Zone-11 N:	T15S, R18E	12.8 AIR M
Unknown	Natural/Na	Imperial	Glamis SE (	120	32.82814	-115.101	Zone-11 N:	T15S, R18E	12.1 AIR M
Unknown	Natural/Na	Imperial	Glamis SE (	125	32.77457	-115.108	Zone-11 N:	T16S, R18E	ABOUT 4.3
Unknown	Natural/Na	Imperial	Midway W	100	32.713	-115.184	Zone-11 N:	T16S, R17E	ABOUT 6 M
Unknown	Natural/Na	Imperial	Midway W	100	32.74982	-115.181	Zone-11 N:	T16S, R17E	0.6 MILE N
Unknown	Natural/Na	Imperial	Glamis SW	100	32.79829	-115.177	Zone-11 N:	T15S, R17E	ABOUT 6.4
Unknown	Natural/Na	Imperial	Glamis SW	100	32.82176	-115.175	Zone-11 N:	T15S, R17E	7.2 MILES I
Unknown	Natural/Na	Imperial	Midway W	85	32.70124	-115.215	Zone-11 N:	T17S, R17E	0.3 MILE S(
Unknown	Natural/Na	Imperial	Midway W	80	32.69449	-115.219	Zone-11 N:	T17S, R17E	0.8 MILE S(
Unknown	Natural/Na	Imperial	Midway W	115	32.73271	-115.155	Zone-11 N:	T16S, R18E	NEAR INTE
Unknown	Natural/Na	Imperial	Midway W	125	32.71535	-115.102	Zone-11 N:	T16S, R18E	NEAR INTE
Unknown	Natural/Na	Imperial	Midway W	125	32.71094	-115.083	Zone-11 N:	T16S, R18E	VICINITY O
Unknown	Natural/Na	Imperial	Midway W	120	32.7508	-115.11	Zone-11 N:	T16S, R18E	3.0 MILES I
Unknown	Natural/Na	Imperial	Midway W	140	32.73882	-115.057	Zone-11 N:	T16S, R19E	ABOUT 2.6
Unknown	Natural/Na	Imperial	Midway W	140	32.7309	-115.032	Zone-11 N:	T16S, R19E	ABOUT 3.5
Unknown	Natural/Na	Imperial	Midway W	130	32.70947	-115.04	Zone-11 N:	T16S, R19E	2.9 MILES E
Unknown	Natural/Na	Imperial	Yuha Basin	190	32.65374	-115.795	Zone-11 N:	T17S, R12E	PINTO WAS
Unknown	Natural/Na	Imperial	Mount Sigr	45	32.7136	-115.739	Zone-11 N:	T16.5S, R1:	4.5 AIR MIL
Unknown	Natural/Na	Imperial	Mount Sigr	-10	32.71607	-115.703	Zone-11 N:	T16.5S, R1:	WEST MES.
Unknown	Natural/Na	Imperial	Mount Sigr	0	32.67114	-115.685	Zone-11 N:	T17S, R13E	SW OF POI
Unknown	Natural/Na	Imperial	Mount Sigr	70	32.6883	-115.743	Zone-11 N:	T17S, R12E	0.7 MILE N
Unknown	Natural/Na	Imperial	Yuha Basin	200	32.6462	-115.797	Zone-11 N:	T17S, R12E	YUHA DESE
Unknown	Natural/Na	Imperial	Yuha Basin	180	32.6525	-115.787	Zone-11 N:	T17S, R12E	JUST SE OF
Unknown	Natural/Na	Imperial	Yuha Basin	200	32.65072	-115.822	Zone-11 N:	T17S, R11E	PINTO WAS
Unknown	Natural/Na	Imperial	Yuha Basin	75	32.7208	-115.781	Zone-11 N:	T16.5S, R1:	6.9 AIR MIL
Unknown	Natural/Na	Imperial	Yuha Basin	200	32.7358	-115.847	Zone-11 N:	T16S, R11E	5.0 AIR MIL
Unknown	Natural/Na	Imperial	Coyote We	350	32.7015	-115.894	Zone-11 N:	T17S, R11E	YUHA DESE
Unknown	Natural/Na	Imperial	Yuha Basin	350	32.6658	-115.869	Zone-11 N:	T17S, R11E	YUHA DESE
Unknown	Natural/Na	Imperial	Yuha Basin	130	32.68528	-115.768	Zone-11 N:	T17S, R12E	0.5 MILE N
Unknown	Natural/Na	Imperial	Painted Go	300	32.76449	-115.973	Zone-11 N:	T16S, R10E	0.4 MILE N
Unknown	Natural/Na	Imperial	Plaster City	80	32.85088	-115.85	Zone-11 N:	T15S, R11E	4.1 MILES I
Unknown	Natural/Na	Imperial	Plaster City	80	32.8691	-115.836	Zone-11 N:	T15S, R11E	5.5 MILES I
Unknown	Natural/Na	Imperial	Plaster City	65	32.87767	-115.822	Zone-11 N:	T15S, R11E	6 MILES NN
Unknown	Natural/Na	Imperial	Superstitio	60	32.89237	-115.809	Zone-11 N:	T15S, R11E	4.4 MILES S
Unknown	Natural/Na	Imperial	Superstitio	100	32.93088	-115.818	Zone-11 N:	T14S, R11E	1.7 MILES S
Unknown	Natural/Na	Imperial	Superstitio	80	32.92116	-115.875	Zone-11 N:	T14S, R11E	ABOUT 4 M

EEC ORIGINAL PKG

Unknown	Natural/Na	Imperial	Superstitio	75	32.9461	-115.863	Zone-11 N:	T14S, R11E	ABOUT 2.3
Unknown	Natural/Na	Imperial	Plaster City	70	32.96464	-115.89	Zone-11 N:	T14S, R10E	ABOUT 3 M
Unknown	Natural/Na	Imperial	Superstitio	220	32.97172	-115.807	Zone-11 N:	T14S, R11E	NORTH SID
Unknown	Natural/Na	Imperial	Brawley NV	150	32.96751	-115.754	Zone-11 N:	T14S, R12E	NORTH OF
Unknown	Natural/Na	Imperial	Brawley NV	70	32.94022	-115.713	Zone-11 N:	T14S, R12E	NEAR HUFF
Unknown	Natural/Na	Imperial	Superstitio	300	32.93591	-115.788	Zone-11 N:	T14S, R11E	SE EDGE OI
Unknown	Natural/Na	Imperial	Kane Spring	150	33.03066	-115.821	Zone-11 N:	T13S, R11E	SUPERSTITI
Unknown	Natural/Na	Imperial	Superstitio	100	32.99523	-115.857	Zone-11 N:	T13S, R11E	ABOUT 3 M
Unknown	Natural/Na	Imperial	Plaster City	120	32.93652	-115.943	Zone-11 N:	T14S, R10E	ABOUT 7 M
Unknown	Natural/Na	Imperial	Plaster City	180	32.90713	-115.96	Zone-11 N:	T14S, R10E	ABOUT 8.5
Unknown	Natural/Na	Imperial	Kane Spring	-200	33.19841	-115.848	Zone-11 N:	T11S, R11E	5.0 MILES N
Unknown	Natural/Na	Imperial	Kane Spring	5	33.2199	-115.994	Zone-11 N:	T11S, R09E	3.7 MI WSV
Unknown	Natural/Na	Imperial	Shell Reef (	30	33.2164	-116.003	Zone-11 N:	T11S, R09E	4.2 MILES V
Unknown	Natural/Na	Imperial	Shell Reef (	130	33.17955	-116.076	Zone-11 N:	T11S, R09E	0.5 MILE ES
Unknown	Natural/Na	Imperial	Shell Reef (	120	33.1763	-116.068	Zone-11 N:	T11S, R09E	1.0 MILE ES
Unknown	Natural/Na	Imperial | S	Shell Reef (	100	33.15518	-116.081	Zone-11 N:	T12S, R09E	1.8 MILES S
Unknown	Natural/Na	Imperial	Shell Reef (	70	33.13448	-116.075	Zone-11 N:	T12S, R09E	0.3 MILE N
Unknown	Natural/Na	Imperial	Plaster City	100	32.86477	-115.856	Zone-11 N:	T15S, R11E	ABOUT 5 M
Unknown	Natural/Na	Imperial	Plaster City	10	32.77563	-115.805	Zone-11 N:	T16S, R11E	0.6 MILE N
Unknown	Natural/Na	Imperial	Plaster City	-30	32.77573	-115.776	Zone-11 N:	T16S, R12E	0.25 MILE I
Unknown	Natural/Na	Imperial	Plaster City	-10	32.7742	-115.787	Zone-11 N:	T16S, R11E	0.9 MILE EI
Unknown	Natural/Na	Imperial	Harpers W	-15	33.11306	-115.995	Zone-11 N:	T12S, R09E	0.9 MILE SC
Unknown	Natural/Na	Imperial	Borrego M	-25	33.09722	-116.022	Zone-11 N:	T12S, R09E	0.7 MILE N
Unknown	Natural/Na	Imperial	Midway W	85	32.7505	-115.215	Zone-11 N:	T16S, R17E	ABOUT 10.
Unknown	Natural/Na	Imperial	Harpers W	0	33.12548	-116.001	Zone-11 N:	T12S, R09E	SOUTH SID
Unknown	Natural/Na	Imperial	Borrego M	-30	33.11038	-116.005	Zone-11 N:	T12S, R09E	NE OF SAN
Unknown	Natural/Na	Imperial	Borrego M	-15	33.1075	-116.022	Zone-11 N:	T12S, R09E	ALONG SAN
Unknown	Natural/Na	Imperial	Borrego M	-30	33.10317	-116.01	Zone-11 N:	T12S, R09E	NEAR SAN
Unknown	Natural/Na	Imperial	Borrego M	-40	33.09722	-116.005	Zone-11 N:	T12S, R09E	SOUTH OF
Unknown	Natural/Na	Imperial	Glamis SW	100	32.84651	-115.187	Zone-11 N:	T15S, R17E	ABOUT 2 M
Unknown	Natural/Na	Imperial	Brawley (3:	-120	32.98392	-115.525	Zone-11 N:	T13S, R14E	BRAWLEY.
Unknown	Natural/Na	Imperial	Glamis (32:	300	32.99335	-115.08	Zone-11 N:	T13S, R18E	GLAMIS SA
Unknown	Natural/Na	Imperial	Truckhaver	-200	33.27046	-115.9	Zone-11 N:	T10S, R10E	ABOUT 1.6
Unknown	Natural/Na	Imperial | S	Carrizo Mtı	455	32.87596	-116.104	Zone-11 N:	T15S, R08E	CARRIZO C
Unknown	Natural/Na	Imperial	Coyote We	280	32.73672	-115.964	Zone-11 N:	T16S, R10E	COYOTE W
Unknown	Natural/Na	Imperial	Harpers W	-114	33.09514	-115.913	Zone-11 N:	T12S, R10E	VICINITY O
Unknown	Natural/Na	Imperial | I	Palo Verde	230	33.43201	-114.736	Zone-11 N:	T09S, R21E	PALO VERD
Unknown	Natural/Na	Imperial	Heber (321	-21	32.75942	-115.638	Zone-11 N:	T16S, R13E	SILSBEE.
Unknown	Natural/Na	Imperial	Bard (3211	135	32.77059	-114.587	Zone-11 N:	T16S, R23E	ABOUT 5 M
Unknown	Natural/Na	Imperial	Shell Reef (	75	33.22307	-116.033	Zone-11 N:	T11S, R09E	NORTH OF
Unknown	Natural/Na	Imperial	Seventeen	377	33.27156	-116.057	Zone-11 N:	T10S, R09E	SOUTH OF
Unknown	Natural/Na	Imperial	Painted Go	360	32.76575	-115.99	Zone-11 N:	T16S, R09E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Niland (331	-223	33.20941	-115.583	Zone-11 N:	T11S, R13E	EXPERIMEN
Unknown	Natural/Na	Imperial	Niland (331	-224	33.2233	-115.585	Zone-11 N:	T11S, R13E	DRAIN Q, A
Unknown	Natural/Na	Imperial	Wister (33:	-224	33.2637	-115.593	Zone-11 N:	T10S, R13E	W LATERAL
Unknown	Natural/Na	Imperial	Calipatria S	-218	33.10287	-115.685	Zone-11 N:	T12S, R12E	TRIFOLIUM
Unknown	Natural/Na	Imperial	Coyote We	600					*SENSITIVE

Unknown	Natural/Na	Imperial	Niland (331	-227	33.17665	-115.619	Zone-11 N:	T11S, R13E	W SINCLAII
Unknown	Natural/Na	Imperial | !	In-ko-pah (	2500					*SENSITIVE
Unknown	Natural/Na	Imperial | !	In-ko-pah (	2495	32.66797	-116.106	Zone-11 N:	T17S, R09E	ROADWAY:
Unknown	Natural/Na	Imperial | !	In-ko-pah (	3152	32.6416	-116.105	Zone-11 N:	T17S, R09E	IN THE VICI
Unknown	Natural/Na	Imperial | !	Carrizo Mtı	454	32.87461	-116.106	Zone-11 N:	T15S, R08E	ALONG CAI
Unknown	Natural/Na	Imperial | /	Yuma East	200	32.73172	-114.616	Zone-11 N:	T16S, R22E	FORT YUM/
Unknown	Natural/Na	Imperial	Niland (331	-220	33.18549	-115.582	Zone-11 N:	T11S, R13E	VICINITY O
Unknown	Natural/Na	Imperial	Quartz Pea	1000	33.03448	-114.837	Zone-11 N:	T13S, R20E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Yuma West	120	32.74995	-114.697	Zone-11 N:	T16S, R22E	3.6 MILES \
Unknown	Natural/Na	Imperial | /	Laguna Dar	160	32.82561	-114.497	Zone-11 N:	T15S, R24E	NORTH OF
Unknown	Natural/Na	Imperial	Picacho Pe.	1000	32.94491	-114.634	Zone-11 N:	T14S, R22E	MILKWEED
Unknown	Natural/Na	Imperial	Carrizo Mtı	1000	32.79475	-116.024	Zone-11 N:	T16S, R09E	FOSSIL CAN
Unknown	Natural/Na	Imperial | I	Frink NW (:	200	33.43162	-115.68	Zone-11 N:	T08S, R12E	CANYON B
Unknown	Natural/Na	Imperial	Carrizo Mtı	1640	32.9983	-116.095	Zone-11 N:	T13S, R09E	PEAK 1.2 A
Unknown	Natural/Na	Imperial	Niland (331	-185	33.20645	-115.526	Zone-11 N:	T11S, R14E	MANAGED
Unknown	Natural/Na	Imperial	Bonds Corr	37	32.72172	-115.289	Zone-11 N:	T16S, R16E	BETWEEN I
Unknown	Natural/Na	Imperial	In-ko-pah (	4250	32.62181	-116.094	Zone-11 N:	T18S, R09E	AROUND T
Unknown	Natural/Na	Imperial	In-ko-pah (	900	32.70437	-116.019	Zone-11 N:	T17S, R09E	3 AIRLINE I
Unknown	Natural/Na	Imperial	In-ko-pah (	1390	32.69267	-116.055	Zone-11 N:	T17S, R09E	APPROXIM
Unknown	Natural/Na	Imperial	In-ko-pah (	1400	32.71377	-116.082	Zone-11 N:	T17S, R09E	WEST SIDE
Unknown	Natural/Na	Imperial	In-ko-pah (	1230	32.71874	-116.074	Zone-11 N:	T17S, R09E	WEST SIDE
Unknown	Natural/Na	Imperial	In-ko-pah (	950	32.73029	-116.05	Zone-11 N:	T16S, R09E	SOUTH SID
Unknown	Natural/Na	Imperial	Carrizo Mtı	780	32.75646	-116.061	Zone-11 N:	T16S, R09E	APPROXIM
Unknown	Natural/Na	Imperial	Borrego M	200	33.04668	-116.098	Zone-11 N:	T13S, R09E	SPLIT MOU
Unknown	Natural/Na	Imperial	In-ko-pah (	4250	32.62181	-116.094	Zone-11 N:	T18S, R09E	AROUND T
Unknown	Natural/Na	Imperial	Borrego M	60	33.03417	-116.039	Zone-11 N:	T13S, R09E	NORTH ED
Unknown	Natural/Na	Imperial	Acolita (33	275	33.08554	-115.209	Zone-11 N:	T12S, R17E	NORTH AL(
Unknown	Natural/Na	Imperial	Tortuga (3:	240	33.1324	-115.274	Zone-11 N:	T12S, R16E	IMPERIAL S
Unknown	Natural/Na	Imperial	Little Mule	960	33.31739	-115.039	Zone-11 N:	T10S, R18E	SMOKETRE
Unknown	Natural/Na	Imperial	Little Chucl	1360	33.4003	-115.127	Zone-11 N:	T09S, R18E	SOUTH OF
Unknown	Natural/Na	Imperial	Kane Sprin	-157	33.10877	-115.86	Zone-11 N:	T12S, R11E	FROM ABO
Unknown	Natural/Na	Imperial	Kane Sprin	-137	33.10706	-115.872	Zone-11 N:	T12S, R11E	ABOUT 1.6
Unknown	Natural/Na	Imperial | /	Laguna Dam (3211474		32.88393	-114.471	Zone-11 N:	T15S, R24E	WASTE GR
Unknown	Transplant	Imperial	Coyote We	983	32.68026	-116.001	Zone-11 N:	T17S, R10E	DAVIES VAI
Unknown	Natural/Na	Imperial	Glamis NW	191	32.95953	-115.166	Zone-11 N:	T14S, R17E	GECKO RD,
Unknown	Natural/Na	Imperial	Superstitio	75	32.94413	-115.863	Zone-11 N:	T14S, R11E	SW OF SUP
Unknown	Natural/Na	Imperial	Glamis SW	77	32.78983	-115.224	Zone-11 N:	T16S, R17E	EAST MESA
Unknown	Natural/Na	Imperial	Superstitio	143	32.95165	-115.753	Zone-11 N:	T14S, R12E	ALONG UN
Unknown	Natural/Na	Imperial	Yuha Basin	150	32.66176	-115.779	Zone-11 N:	T17S, R12E	PINTO WA:
Unknown	Natural/Na	Imperial	Brawley N\	135	32.95302	-115.75	Zone-11 N:	T14S, R12E	NORTH SID
Unknown	Natural/Na	Imperial	Brawley N\	31	32.92399	-115.699	Zone-11 N:	T14S, R12E	IMLER RD /
Unknown	Natural/Na	Imperial	Yuma East	164	32.73851	-114.638	Zone-11 N:	T16S, R22E	ALONG WII
Unknown	Natural/Na	Imperial	Tortuga (3:	143	33.14817	-115.334	Zone-11 N:	T12S, R16E	ABOUT 0.7
Unknown	Natural/Na	Imperial	Frink NW (:	-120	33.40874	-115.742	Zone-11 N:	T09S, R12E	ABOUT 3.0
Unknown	Natural/Na	Imperial	Palo Verde	960	33.33422	-114.816	Zone-11 N:	T10S, R20E	0.4 KM SOI
Unknown	Natural/Na	Imperial	In-ko-pah (	723	32.73975	-116.042	Zone-11 N:	T16S, R09E	ABOUT 1.5
Unknown	Natural/Na	Imperial	Grays Well	300	32.91623	-115.089	Zone-11 N:	T14S, R18E	ALGODONI

Unknown	Natural/Na	Imperial	Grays Well	250	32.90558	-115.055	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Grays Well	250	32.90558	-115.055	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Grays Well	250	32.90558	-115.055	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Grays Well	250	32.90558	-115.055	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Grays Well	250	32.90558	-115.055	Zone-11 N:	T14S, R18E	ALGODONE
Unknown	Natural/Na	Imperial	Grays Well	250	32.90558	-115.055	Zone-11 N:	T14S, R18E	ALGODONE

LocDetails	Ecological	ThreatList	Threat	General	OwnerMgt	LastUpdate	KeyQuad	UTMZone	UTME
ELL, BETWEEN HARPER WELL AND BORREGO S				ONLY SOUI	UNKNOWN	########	Borrego Mo	11	588863
ONE OF TH	HABITAT C	Recreation	POSSIBLE T	6 ADULT FE	BLM	########	Bard (3211	11	733439
CARGO MI	HABITAT C	Mining | O	POSSIBLE T	3 INDIVIDU	BLM	########	Ogilby (321	11	707905
THIS MINE	HABITAT C	Mining | O	POSSIBLE T	132 INDIVS	BLM	########	Ogilby (321	11	707835
RGO MINE,"	HABITAT CONSISTS OF CREOSOTE			1 ADULT O	BLM	########	Ogilby (321	11	708291
ONE PORTI	HABITAT C	Mining | O	POSSIBLE T	ROOST SITI	BLM	########	Ogilby (321	11	706624
2006 OBSE	HABITAT C	Mining | O	POSSIBLE T	10 FEMALE	BLM	########	Ogilby (321	11	709123
INCLUDES I	HABITAT C	Mining | O	POSSIBLE T	HISTORIC S	BLM	########	Ogilby (321	11	707137
LOCATED II	HABITAT C	Mining	THREATEN	ONE PAIR (	UNKNOWN	########	Coyote We	11	596958
LOCATED II	HABITAT C	Mining	THREATEN	ONE PAIR (	UNKNOWN	########	Coyote We	11	597586
NE, IN JACK	HABITAT CONSISTS OF CREOSOTE			MINE SITE	BLM	########	Ogilby (321	11	707853
INE, IN TUN	HABITAT CONSISTS OF CREOSOTE			MASTIFF B	BLM	########	Hedges (32	11	704305
SITE: LARG	HABITAT CONSISTS OF CREOSOTE			TWO MAST	BLM	########	Hedges (32	11	703890
THIS SITE II	HABITAT SI	Landfill | R	POSSIBLE D	1 INDIV, 1	DOD-CHOC	########	Blue Moun	11	680957
AGRICULTU	SLOW FLOV	Biocides | I	THREATS IN	1 PUPFISH	PVT-IMPER	########	Obsidian Bu	11	625200
VAIL LATEI	SHALLOW A	Biocides | I	THREATS IN	26 PUPFISH	PVT-IMPER	########	Obsidian Bu	11	626791
OOL ABOUT	AN INSHOR	Non-native	THREATS IN	24 PUPFISH	UNKNOWN	########	Frink (3311	11	620475
POOL AT TI	A SHALLOV	Biocides | I	THREATS IN	3 PUPFISH	PVT-IMPER	########	Wister (331	11	629935
OOL AT THE	AN INSHOR	Biocides | I	MOSQUITO	1 PUPFISH,	PVT-IMPER	########	Wister (331	11	629333
OOL 0.1 MI	A LARGE IN	Non-native	POSSIBLY T	9 PUPFISH	UNKNOWN	########	Wister (331	11	628842
OOL ABOUT	A LONG, ELONGATED INSHORE PC			30 PUPFISH	UNKNOWN	########	Wister (331	11	628182
THE NILAN	SLOW MOVING, MURKY WATER V			19 PUPFISH	PVT-IMPER	########	Wister (331	11	628629
OBSERVED GROWING IN LOWER FAN OF DRY				50-100 PLA	UNKNOWN	########	Ogilby (321	11	704098
MAPPED G	FROM AIR PHOTOS (1992-2010) A			GAINES NC	UNKNOWN	########	Bard (3211	11	729107
LOCALE STATED AS "BARD."				SDNHM #3	UNKNOWN	########	Bard (3211	11	729107
LOCALE STATED AS "BARD."				UCLA MUS	UNKNOWN	########	Bard (3211	11	729107
LOCALE STATED AS "BARD."				SDNHM #3	UNKNOWN	########	Bard (3211	11	729107
LOCALE STATED AS "BARD."				UCLA #E14	UNKNOWN	########	Bard (3211	11	729107
A, NW EDG	NEST SITE I	Other | Re	MAIN THRE	ESTIMATED	PVT-IMPER	########	Obsidian Bu	11	626655
COLONY ES	SUBSTRATE	Recreation	MAIN THRE	ESTIMATED	PVT-IMPER	########	Niland (331	11	629644
SINGLE POI	FLAT DOMI	Road/trail (	THIS AREA	THIS SURR	BLM-ACEC	########	Coyote We	11	603595
LARGE POL	SAND DUN	ORV activit	ORV USE. E	PLANTS OB	BLM	########	Glamis (32	11	681328
JUST W OF	SAND DUN	ORV activit	OHV USE.	BETWEEN I	BLM	########	Grays Well	11	707824
SCATTERED	SAND DUN	ORV activit	OHV USE, E	POP #S FOI	BLM	########	Glamis (32	11	680006
SCATTERED	SAND DUN	ORV activit	OHV USE G	EO #2 & #1	BLM	########	Glamis (32	11	678720
SCATTERED	SAND DUN	ORV activit	ORV USE.	>3,000 PLA	BLM	########	Glamis (32	11	681072
WITHIN TH	ON SPARSE	ORV activit	AREA IS HE	ONE PLANT	BLM	########	Mt. Barrow	11	694641
OOL SOUTH	INSHORE P	Non-native	THREATS IN	IN 1978, 38	USFWS-SO	########	Calipatria S	11	621955
OOL WEST (	INSHORE P	Non-native	THREATS IN	IN 1978, 38	UNKNOWN	########	Calipatria S	11	622898
DRAIN 1 O	WIDE, FAIR	Biocides | I	THREATS IN	9 PUPFISH	USFWS-SO	########	Calipatria S	11	619648
2.5 MILES I	1991: STOF	Biocides | I	THREATS IN	2 CAPTURE	BLM	########	Calipatria S	11	618831
8 OWLS OE	ALFALFA FI	Road/trail (	POTENTIAL THREATS F		PVT-IMPER	########	El Centro (3	11	629988
MAPPED A	OBSERVED	Military op	SOME COL(	20-30 PLAN	DOD-NAVY	########	Pegleg Wel	11	665824
ALONG WA	PLANTS IN	Military op	POSSIBLE D	AREA MAY	USBOR	########	Kane Spring	11	609767
1969-70: FI	STATIONS \	Recreation	EXCESSIVE	AREA CONS	USFWS-IMI	########	Imperial Re	11	736079
SH, IMMEDI	IN SONORAN CREOSOTE BUSH SCI			2 PLANTS F	BLM	########	Yuha Basin	11	615851

EEC ORIGINAL PKG

MOUTH OF	AGRICULTU	Non-native	NON-NATIV	5 PUPFISH	UNKNOWN	########	Kane Spring	11	612688
MAPPED ACCORDING TO A 1983 E			FEW DISTU	RECORDED	DOD-CHOC	########	East of Aco	11	681321
MAPPED A	PARASITIC ON DALEA EMORYI. CREOSOTE BU				BLM	########	Shell Reef (	11	589309
MAPPED G	HABITAT DESCRIBED A		INVASIVE S	5 COLLECTI	USBOR, BLI	########	Laguna Dar	11	735251
MAPPED A	HABITAT TYPE LISTED AS CATTAILS			2 RESPONDE	BLM, UNKN	########	Iris (331152	11	650444
ALL AMERI	HABITAT AREA IS THE MARSHY AR			9 RAILS DE	BLM	########	Midway W	11	671321
CIBOLA DIV	SITE SURROUNDED A DREDGED BA			THE MARSI	USFWS-CIB	########	Cibola (331	11	715395
PLEASE CONTACT THE CALIFORNIA NATURAL DIVERSITY DATABASE,						########	Little Chucl	0	
ONE FISH (2170 GRAMS) NETTED IN 1973. A 1				RECRUITM	BLM	########	Imperial Re	11	736636
1986: GENI	CATTAIL M	Agriculture	POSSIBLE T	1 DETECTE	BLM, OTHE	########	Bard (3211	11	729893
OBS IN 197	SALT CEDAR, MESQUIT		FLOODING & PROLON		DPR-PICAC	########	Picacho (33	11	723001
AG DRAIN (	UNIFORML	Non-native	NON-NATIV	6 PUPFISH	PVT-IMPER	########	Kane Spring	11	613718
A-QUECHAN	EXTIRPATED. FORMERLY DOMINA			OWNED BY	BIA-YUMA	########	Yuma West	11	715496
MAPPED B	ON NON-A	ORV activit	AREA FENC	APPROXIM	BLM	########	Coyote We	11	603506
MAPPED B	AN OPEN, S	ORV activit	OHV, HEAV	DATE OBSE	BLM	########	Coyote We	11	598300
1979: LOCA	CREOSOTE	ORV activit	OHV TRAFF	1 LIZARD A	BLM	########	Ogilby (321	11	703835
MAPPED TO	DUNE HABITAT.			1 COLLECTI	BLM	########	Ogilby (321	11	702395
SDNHM LO	1980: CREOSOTE AND BURSAGE V			SDNHM #5	BLM	########	Ogilby (321	11	701038
OTE WELLS, COLORADO DESERT.				ONLY SOUI	UNKNOWN	########	Coyote We	11	597024
EXACT LOCATION UNKNOWN. MAPPED AS BE				MAIN SOUI	UNKNOWN	########	In-ko-pah (	11	584265
MAPPED B	ALONG SAN	Mining	ENTIRE ARI	2 PLANTS S	BLM-EL CEI	########	Picacho Pe	11	720952
1977 SURV	PRIMARILY	Altered flo	RECENT (19	UP TO 3 DE	BLM	########	Laguna Dar	11	734758
E COLORAD	PRIMARILY	Altered flo	FLOODING	12+ INDIVI	BLM, USBC	########	Laguna Dar	11	735447
ELL.				MVZ SPECI	UNKNOWN	########	Coyote We	11	597024
MAPPED IN	PLANTS GR	Military op	IN AREA IN	50-90 SEEN	DOD-NAVY	########	Brawley NV	11	617091
3 COLONIE	PLANTS ON	Military op	MILITARY E	IN AREA IN	DOD-NAVY	########	Brawley NV	11	616851
MAPPED A	PLANTS IN	Military op	POSSIBLE D	AREA MAY	USBOR	########	Kane Spring	11	613018
MAPPED V	PLANTS FO	Military op	POSSIBLE N	IN AREA IN	DOD-NAVY	########	Brawley NV	11	618386
MAPPED A	PARASITIC ON DALEA EMORYI. CR			EO 17 LUM	BLM-EL CEI	########	Kane Spring	11	594025
SHEEP CONCENTRATE AT THE NORTHERN ENI				POPULATIC	DOD-CHOC	########	Blue Moun	11	687539
EAKS.				POPULATIC	BLM	########	Quartz Pea	11	708582
SHEEP CON	SHEEP ARE	Other	BURRO CO	POPULATIC	DOD-CHOC	########	Iris Pass (3	11	657443
TRANSIENT INDIVIDUALS IN TIERRA BLANCO,				POPULATIC	BLM, PVT	########	In-ko-pah (	11	588155
RECOVERY	AREA OF U	Other | Ve	MORTALIT	POPULATIC	DPR-ANZA-	########	In-ko-pah (	11	585035
NOT OBS D	SALT CEDAR, MESQUITE, WILLOW			MIX W/SAI	DPR-PICAC	########	Picacho (33	11	723001
TATE RECRE	SALT CEDAR, MESQUIT		SOME DIST	TWO INDIV	DPR-PICAC	########	Picacho (33	11	723001
CAN CANAL	SCATTERED, MATURE COTTONWC			ONE OBS D	BIA-FORT Y	########	Bard (3211	11	730387
ONE MALE	SCATTEREI	Agriculture	SURROUNDED BY SALT		BIA-FORT Y	########	Bard (3211	11	730387
TATE RECRE	SALT CEDAR, MESQUITE, AND WIL			NONE OBSI	DPR-PICAC	########	Picacho (33	11	723001
CAN CANAL	HABITAT IS SCATTEREI		SALT CEDA	FOUR OBSI	BIA-FORT Y	########	Bard (3211	11	730387
TATE RECRE	HABITAT IS SALT CEDA		FLOODING	OBSERVATI	DPR-PICAC	########	Picacho (33	11	723001
1986: OBSI	1986: SCAT	Non-native	BURROS US	FOUR OBSI	USBOR	########	Bard (3211	11	730351
1938 COLLI	SOME COT	Altered flo	FLOODING	UP TO 3 DE	DPR-PICAC	########	Picacho (33	11	723001
CAN CANAL	HABITAT IS SCATTERED, MATURE			PAIR OF CU	BIA-FORT Y	########	Bard (3211	11	730387
MAPPED TO	SMALL HAE	Recreation	CAMPING /	0 DETECTE	DPR-PICAC	########	Picacho (33	11	722961
WILDLIFE A	1989: HABI	Altered flo	POSSIBLE T	86 IN 1974	DFG-IMPEF	########	Wister (331	11	631826
MOUTH OF	FRESH WA	Altered flo	DECLINE DI	THE AREA I	USFWS-SOI	########	Calipatria S	11	620743

IMPERIAL [	THIS AREA HAS CONSISTENTLY SU			MARSH AR	USFWS-IMI	########	Picacho (33	11	723564
LAGUAN D	RAILS KNO'	Altered flo	1985: HABI	MARSHES /	BLM	########	Laguna Dar	11	735414
YUMA DIVI	1990: WITH	Altered flo	1984: FLOC	MARSH AR	BLM, USBC	########	Yuma West	11	719330
IMPERIAL [	RAILS HAVE BEEN CONSISTENTLY I			MARSH AR	USFWS-IMI	########	Picacho NV	11	716389
MARSH AR	MARSH FROM MITCHELL'S CAMP			DETECTED	USFWS-CIB	########	Cibola (331	11	712621
1979 AND :	MAINLY HA	ORV activit	OHV TRESF	1 LIZARD D	DOD-NAVY	########	Superstitio	11	615647
1979 DETECTION LOCATION GIVEN AS T16S R				1 LIZARD O	BLM	########	Yuha Basin	11	610819
1952 LOCA	1984: VEGETATION DC		SOME SECT	2 COLLECTI	BLM	########	Glamis SW	11	667066
MAPPED A	CREOSOTE	Developme	DISTURBAN	3 FOUND II	BLM	########	Mount Sigr	11	620797
1 OF 4 PRII	AREA COVE	Developme	INCREASING OFF-ROAI		BLM, PVT, :	########	Iris Wash (:	11	671839
FROM SAN	ONLY NATI	Non-native	TAMARISK,	CAS #1170	BLM, PVT,	########	Harpers W	11	602271
1910 DETE	HABITAT CONSISTED OF EXPANSI\			GRINNELL (	USBOR, PV	########	Palo Verde	11	711449
MAPPED BY CNDDB A(		ORV activit	IN AREA OI	MAJORITY	DPR-ANZA-	########	Shell Reef (	11	584228
MAPPED B'	IN THE WASHES, ON GRAVELLY TE			SITE BASEC	DPR-OCOTI	########	Shell Reef (	11	590089
AREA IS M/	EXTENSIVE	ORV activit	ORVS USE !	SEE WWW.	DPR-ANZA-	########	Sweeney P	11	579006
E OF ALL AI	MATURE POPULUS FRI		SITE MAY H	SEE WWW.	BIA-FORT Y	########	Bard (3211	11	730387
D OF FERGL	COTTONWOOD-WILLOW TYPE;<1(			SEE WWW.	USFWS-IMI	########	Imperial Re	11	733400
SURVIVING	MOSTLY DEAD OR SENESCENT PO			SITE IS OW	USBOR	########	Laguna Dar	11	734817
SITE NOW I	FORMERLY ISOLATED STANDS OF			SEE WWW.	UNKNOWN	########	Cibola (331	11	716414
STANDS AF	IN 1983, SALIX GOODDINGII W/VE			SEE WWW.	DPR-PICAC	########	Picacho SW	11	719425
THE MARSI	SCIRPUS OI	ORV activit	LIGHT GRA	THIS AREA	BLM-ACEC,	########	Harpers W	11	599245
MAPPED B'	IN SAND.			ONLY SOUI	UNKNOWN	########	Yuma West	11	712159
MAPPED B'	ON SAND HILLS.			ONLY SOUI	BLM	########	Midway W	11	685952
MAPPED BY CNDDB AS BEST GUESS ABOUT 1(				ONLY SOUI	BLM	########	Holtville NI	11	662988
TILLO.	GROWING IN SANDY, MESQUITE H			ONLY SOUI	UNKNOWN	########	Coyote We	11	594207
MAPPED B'	ALKALINE FLAT.			ONLY SOUI	DPR-ANZA-	########	Carrizo Mti	11	587423
MAPPED B'	SMALL WA	ORV activit	IN AREA OI	SITE BASEC	STATE LAN	########	Carrizo Mti	11	588200
NORTH OF	BARREN, S/	ORV activit	IN AREA OI	SITE BASEC	DPR-ANZA-	########	Carrizo Mti	11	584798
MAPPED B'	SPARSE CREOSOTE BUSH SCRUB V			SITE BASEC	BLM	########	Ogilby (321	11	702645
MAPPED AT THE EAST END OF SMALL DUNE S				ONLY SOUI	UNKNOWN	########	Kane Sprin	11	606864
OFF APPROXIMATELY 11.5 MILES WEST OF M(				SITE BASEC	UNKNOWN	########	Yuha Basin	11	609570
TARGET AF	LONGITUD	Non-native	MILITARY E	105 FLOWE	DOD-NAVY	########	Glamis NW	11	665058
MAPPED BY CNDDB AS BEST GUESS ALONG TI				ONLY SOUI	BLM	########	Coyote We	11	604841
MAPPED A	ON ROCKY GRANITIC SLOPE WITH			ONE PLANT	BLM	########	In-ko-pah (	11	586702
INCLUDES (	HABITAT SI	Mining	THREATEN	1 M COLL 1	BLM	########	Hedges (32	11	703630
ALLEY; APPF	IN SANDY SOIL.			FEWER TH/	BLM-EL CEI	########	In-ko-pah (	11	588362
UGGLERS C	ON MID-SLOPE OF STEEP ROCKY H			FEWER TH/	PVT	########	In-ko-pah (	11	584648
THE WORK	HABITAT SI	Landfill | R	POSSIBLE D	5 OBS & 4 I	DOD-CHOC	########	Blue Moun	11	680957
WHERE PO	1991: FAIR	Non-native	NON-NATIV	11 CAPTUR	PVT-IMPER	########	Kane Sprin	11	616421
23 NORTH	AGRICULTURAL DRAIN WITH A FIF			2 PUPFISH	PVT-IMPER	########	Kane Sprin	11	611454
WHERE TRI	1991: DRAI	Non-native	POSSIBLY T	13 CAUGHT	UNKNOWN	########	Kane Sprin	11	612422
OOL IMMEI	INSHORE P	Non-native	POSSIBLY T	UNKNOWN	UNKNOWN	########	Kane Sprin	11	612316
TWEEN BAF	SOFT, MUD	Biocides | I	THREATS IN	ON 5/15/9	UNKNOWN	########	Kane Sprin	11	615836
MAPPED T(	POND FED	Biocides | I	COMPETITI	18 PUPFISH	PVT-IMP IR	########	Obsidian B	11	627597
SOUTH OF	POND & A(	Non-native	POSSIBLY T	ONE PUPFI	USFWS-SOI	########	Niland (331	11	628308
COLLECTED AT 900 METERS (ABOUT 2950 FEE				MAIN SOUI	UNKNOWN	########	In-ko-pah (	11	583784
TWO 1989	ALONG A WASH. ASSOCIATED WIT			BETTER MA	DOD-CHOC	########	Lion Head I	11	661699

MAPPED BY CNDDB AS BEST GUESS ALONG P.				SITE BASED	DOD-CHOC	########	Pegleg Wel	11	666925
MAPPED B	THIS PLANT COMPRISES APPROXII			THERE IS A	DOD-CHOC	########	Lion Head I	11	653303
MAPPED BY CNDDB AS BEST GUESS ALONG M				SITE BASED	DOD-CHOC	########	Lion Head I	11	655960
MAPPED B	IN A CREOSOTE BUSH SCRUB COM			MAIN SOU	DOD-CHOC	########	Blue Moun	11	679918
MAPPED B	ROCKY HILLSIDE.			PHYSICAL D	UNKNOWN	########	Palo Verde	11	711932
MAPPED BY CNDDB BASED ON A 1986 BLM M				25 OR FEW	BLM	########	Harpers W	11	599348
BOUNDARY	CRESCENT DUNES W/H		UNKNOWN	SEE WWW.	DOD, BLM,	########	Kane Spring	11	603917
BOUNDARY	CRESCENTIC DUNES W		UNSURE SI	SEE WWW.	DOD, BLM,	########	Kane Spring	11	603917
MAPPED IN	ON DALEA	Military op	IN AREA IN	6 PLANTS S	DOD-NAVY	########	Superstitio	11	612766
MAPPED A	PLANTS GR	Military op	IN AREA IN	FEWER THA	DOD-NAVY	########	Brawley NV	11	617306
MAPPED IN	PLANTS GR	Military op	IN AREA IN	<100 PLAN	DOD-NAVY	########	Brawley NV	11	620127
MAPPED AT CORNER OF SECTIONS 25, 26, 35				UNKNOWN	BLM-EL CE	########	Kane Spring	11	603408
MAPPED AS PER OLECH MAP AT CORNER OF I				UNKNOWN	BLM-EL CE	########	Kane Spring	11	613157
MAPPED SITE BASED ON MAP FROM LILIAN C				UNKNOWN	BLM-EL CE	########	Kane Spring	11	609702
MAPPED AS PER MAP FROM OLECH IN SW 1/				UNKNOWN	BLM-EL CE	########	Kane Spring	11	606900
2 COLONIE	ON DALEA	Military op	MILITARY E	100+ PLAN	DOD-NAVY	########	Superstitio	11	608195
2 COLONIE	PARASITIC ON DALEA EMORYI. CR			TWO POPU	BLM	########	Shell Reef (	11	590310
PLASTER CI	PARASITIC ON DALEA EMORYI. DESERT WASH				BLM	########	Painted Go	11	604147
NORTH SID	PARASITIC ON DALEA EMORYI. CREOSOTE BU				BLM-EL CE	########	Carrizo Mtn	11	586224
POPULATIO	PARASITIC ON DALEA EMORYI.			COLLECTIO	BLM	########	Yuha Basin	11	615851
MAPPED IN	PARASITIC ON DALEA EMORYI.				BLM-EL CE	########	Kane Spring	11	603104
COLLECTIO	PARASITIC ON DALEA EMORYI. OPEN SANDY I				BLM-EL CE	########	Kane Spring	11	610071
MAPPED IN	PARASITIC IN DALEA EMORYI. SAN			WITHIN TH	BLM	########	Kane Spring	11	607157
THE NESTIN	THE ERODE	Altered flo	POTENTIAL	TERNS WEI	UNKNOWN	########	Kane Spring	11	613325
COLONY SI	HABITAT C	Other	POTENTIAL	MORTON E	PVT-IMPER	########	Niland (331	11	631349
COULD NOT LOCATE PROVIDED LOCALITY "SP				SDMNH SP	UNKNOWN	########	Ogilby (321	11	705959
MAPPED ALONG THE CALIFORNIA SIDE OF TH				SITE BASED	UNKNOWN	########	Yuma West	11	721786
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Clyde (321	11	688031
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Clyde (321	11	687265
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	685778
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	685193
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	681517
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	686099
ENDEMIC T	FLIGHT ACTIVITY 10-30 MINUTES ,			ADULTS SW	BLM	########	Acolita (33	11	665098
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	686691
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	684413
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	684206
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Glamis (32	11	682935
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Cactus (32	11	694226
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Ogilby (321	11	700427
ENDEMIC T	FLIGHT ACTIVITY 10-30 MINUTES ,			ADULTS SW	BLM	########	Amos (331	11	659420
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Cactus (32	11	696607
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Cactus (32	11	692337
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Cactus (32	11	695118
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Clyde (321	11	689252
ENDEMIC T	FLIGHT ACTIVITY 10-3(		OHVS. THE ADULTS SW		BLM	########	Cactus (32	11	692536
ENDEMIC T	FLIGHT ACTIVITY 10-30 MINUTES ,			ADULTS SW	BLM	########	Amos (331	11	660913

ENDEMIC T	FLIGHT ACTIVITY 10-30 MINUTES A	ADULTS SW	BLM	########	Acolita (33	11	666867
ENDEMIC T	FLIGHT ACTIVITY 10-30 MINUTES A	ADULTS SW	BLM	########	Amos (331	11	661950
ENDEMIC T	FLIGHT ACTIVITY 10-30	OHVS. THE ADULTS SW	BLM	########	Glamis (32	11	682306
ENDEMIC T	FLIGHT ACTIVITY 10-30	OHVS. THE ADULTS SW	BLM	########	Glamis (32	11	685728
ENDEMIC T	FLIGHT ACTIVITY 10-30	OHVS. THE ADULTS SW	BLM	########	Glamis (32	11	683799
ENDEMIC T	FLIGHT ACTIVITY 10-30	OHVS. THE ADULTS SW	BLM	########	Glamis (32	11	685896
ENDEMIC T	FLIGHT ACTIVITY 10-30	OHVS. THE ADULTS SW	BLM	########	Glamis (32	11	683343
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS	6 SPECIME	BLM	########	Amos (331	11	661950
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Cactus (32	11	692536
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS	8 SPECIME	BLM	########	Acolita (33	11	666867
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Acolita (33	11	668929
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Acolita (33	11	665098
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Amos (331	11	659420
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Glamis SE (	11	680875
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Glamis (32	11	675903
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS	6 SPECIME	BLM	########	Glamis (32	11	685728
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Glamis (32	11	685896
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Cactus (32	11	692337
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Ogilby (321	11	700427
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Cactus (32	11	696607
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Cactus (32	11	695118
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS	56 SPECIM	BLM	########	Clyde (321	11	688031
ES DUNE SY	NO KNOWN HOST PLANT. ADULTS HAVE BEE		BLM	########	Glamis (32	11	683799
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Acolita (33	11	671584
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Amos (331	11	661950
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Acolita (33	11	666867
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Acolita (33	11	668929
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Acolita (33	11	665098
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Amos (331	11	659420
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Glamis SE (	11	676532
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Cactus (32	11	693149
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Glamis SE (	11	680875
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Glamis (32	11	675903
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Glamis (32	11	685728
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Glamis (32	11	685896
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Cactus (32	11	692337
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Cactus (32	11	696607
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Cactus (32	11	695118
ES DUNE SY	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Clyde (321	11	688031
ES DUNES S	VIRTUALLY NOTHING IS KNOWN A	FOR YEARS	BLM	########	Glamis (32	11	683799
AL 6 DRAIN	AGRICULTU Biocides | I	THREATS IN 2 PUPFISH	PVT-IMPER	########	Obsidian B	11	625995
SPECIMEN LOCATION STATED AS "8 MI BELOW		1 MALE CO	USFWS	########	Picacho (33	11	733380
SDMNH RECORD GIVES LOCATION ONLY AS "I		SDMNH #1	BLM, UNKN	########	Yuma West	11	711453
PERIAL.		MVZ #7173	UNKNOWN	########	Seeley (321	11	624462
MVZ #161983 GIVES LOCATION AS "0.5 MI W		SDMNH #1	UNKNOWN	########	Harpers W	11	602064
MAPPED TO GEOREFERENCED COORDINATES		2 COLLECTI	UNKNOWN	########	Bard (3211	11	730522
ZO STAGE STATION.		CSULB #30	UNKNOWN	########	Carrizo Mt	11	584088

EEC ORIGINAL PKG

1ILES NORTHEAST OF YUMA, ALONG THE COL(			3 FEMALES	UNKNOWN	########	Bard (3211	11	731265
TWO 1989	ALLUVIAL FAN BESIDE A WASH. A!		SEEN IN 19	DOD-CHOC	########	Pegleg Wel	11	668413
EXACT LOCATION UNKNOWN. MAPPED IN TH			1 FEMALE (	PVT-SDGE,	########	Palo Verde	11	710433
MAPPED TO PROVIDED LOCALITY PICACHO M			1 MALE CO	UNKNOWN	########	Picacho Pe.	11	720171
MAPPED APPROXIMATELY TO "2 MI N OF BAI			SPECIMEN	UNKNOWN	########	Bard (3211	11	729175
MAPPED T(	KNOWN MATERNITY COLONY AT !		#6712 UCL.	BLM, UNKN	########	Imperial Re	11	735554
ONE ADUL	2-3 ACRES OF MATURE WILLOWS.		GREAT BLU	USFWS-IMI	########	Picacho SW	11	717344
			UCLA SPEC	BLM, BIA-F	########	Bard (3211	11	733478
ASH, AT HWY S-34, APPROX 12.5 MI N OF I-80 ,			NESTING B	BLM	########	Hedges (32	11	700809
NESTING BIRDS OBS DURING SUMMER 1977 STUDY; ESTI				BLM	########	Palo Verde	11	703782
3 INDIVIDU	160 ACRE S	ORV activit	MODERATE ORV USE.	UNKNOWN	########	Picacho NW	11	715543
MAPPED T(	MESQUITE WOODLAND W/SOME		ONE OBSEI	USFWS-CIB	########	Cibola (331	11	713108
LAKE, COLORADO RIVER.		THREATS F	TWO OBS I	USFWS-IMI	########	Imperial Re	11	733750
			UCLA SPEC	UNKNOWN	########	Brawley (3.	11	637820
D, IMPERIAL VALLEY, 9.5 MI SW OF NILAND.			#S-4510 SB	DFG-IMPEF	########	Niland (331	11	631199
4 MILES NORTHEAST OF BARD.				BLM, BIA-F	########	Bard (3211	11	733478
WESTMORELAND.			#S-1949 SB	UNKNOWN	########	Calipatria S	11	620895
ON THE MAP, THE NAME OF THE LAKE AT THI			CAS SPECIN	UNKNOWN	########	Bard (3211	11	726046
AM.			UCLA SPEC	UNKNOWN	########	Laguna Dar	11	734306
LAND.			#S-706 SBC	UNKNOWN	########	Westmorla	11	628845
ASH, AT HWY S-34, APPROX 12.5 MI N OF I-80 ,			NESTING B	BLM	########	Hedges (32	11	700809
VASH, 2 MI W OF HWY 78 ON ARMY ROAD, AT			NESTING B	BLM	########	Palo Verde	11	703782
ONE YOUN	DESERT HABITAT - PALO VERDE AI		EO FROM N	UNKNOWN	########	Glamis (32:	11	680042
TY.			EGG SET FF	UNKNOWN	########	Plaster City	11	606770
WESTMORELAND. (SOUTHERN PORTION OF TI			SBCM SPEC	UNKNOWN	########	Obsidian Bu	11	617568
COYOTE WELL.			EGG SET. A	BLM	########	Coyote We	11	602361
OF KANE SPRINGS.			LACM SPEC	UNKNOWN	########	Kane Spring	11	600504
			CAS SPECIN	UNKNOWN	########	Ogilby (321	11	702138
NE SPRING.			LACM SPEC	UNKNOWN	########	Kane Spring	11	603017
F, COACHELLA VALLEY. (IN THE HILLS BETWEE			LACM SPEC	UNKNOWN	########	Seventeen	11	588884
LAND.			SBCM #5-2	UNKNOWN	########	Westmorla	11	628432
3 MI NE OF BARD.			UCLA SPEC	BLM, BIA-F	########	Bard (3211	11	733478
10 INDIVID	SITE PROBABLY USED FOR BREEDING. SALT CI			DPR-PICAC	########	Picacho SW	11	716186
4 INDIVIDU	PROBABLY	Other	BURROW DAMAGE; M	USFWS-IMI	########	Picacho SW	11	715509
5 INDIVIDU	GOOD HAB	ORV activit	ORV ACTIVITY.	DPR-PICAC	########	Picacho SW	11	720596
5 INDIVIDU	SCATTEREI	ORV activity		DFG-COLOI	########	Picacho SW	11	713564
SIX OBS IN	MESQUITE/	Non-native	THREATS FROM INUNI	USFWS-IMI	########	Imperial Re	11	733750
MAPPED T(	MESQUITE WOODLAND W/SOME		4 OBSERVE	USFWS-CIB	########	Cibola (331	11	713108
3 OBS DUR	9 YEAR OLD, SMALL REVEG PLOT OF COTTON'			USBOR	########	Cibola (331	11	713993
EACH, SALTON SEA.			SBCM #S-2	UNKNOWN	########	Frink (3311	11	618166
ILAND.			SBCM #S-3	UNKNOWN	########	Wister (33:	11	629204
			SDMNH #1	BLM, BIA-F	########	Bard (3211	11	733478
			UCLA #J64!	UNKNOWN	########	Calexico (3	11	641015
NILAND.			SBCM #2-1	UNKNOWN	########	Niland (331	11	632998
MAPPED W	HABITAT CONSISTED OF EXPANSI\		GRINNELL I	UNKNOWN	########	Cibola (331	11	712695
1980 DATA	HABITAT INCLUDED A	MANY COV	1 SINGING	USBOR	########	Laguna Dar	11	734878
)WNSTREAM OF POTHOLES ON COLORADO RI			FROM BLM	UNKNOWN	########	Bard (3211	11	731265

				FROM BLM	BLM, BIA-F	########	Bard (3211	11	733478
ASH, AT HWY S-34, APPROX 12.5 MI N OF I-80 ,				NESTING B	BLM	########	Hedges (32	11	700809
VASH, 2 MI W OF HWY 78 ON ARMY ROAD, AT				NESTING B	BLM	########	Palo Verde	11	703782
D, IMPERIAL WATERFOWL MANAGEMENT ARI				SBCM SPEC	DFG-IMPEF	########	Niland (331	11	631199
A.				LACM SPEC	UNKNOWN	########	Niland (331	11	638682
OF PALO VERDE.				CAS SPECIN	BLM, UNKN	########	Palo Verde	11	709193
				WFVZ EGG	BLM, BIA-F	########	Bard (3211	11	733478
LAND.				SBCM SPEC	UNKNOWN	########	Westmorla	11	628845
'E.				WFVZ EGG	PVT-SDGE,	########	Palo Verde	11	710433
LAKE, COL(	HABITAT IS A SMALL, Y		THREATS F	TWO OBSE	USFWS-IMI	########	Imperial Re	11	733750
MAPPED T(	HABITAT DESCRIBED AS MESQUIT			ONE OBSEI	USFWS-CIB	########	Cibola (331	11	713108
/EGETATIOI	HABITAT IS A 9-YEAR-OLD, SMALL			2-5 INDIVII	USBOR	########	Cibola (331	11	713993
DAM, S OF CHOCOLATE MOUNTAINS.				MVZ SPECI	BLM	########	Imperial Re	11	736636
				5 SPECIMEI	BLM, BIA-F	########	Bard (3211	11	733478
MAPPED W	HABITAT CONSISTED OF EXPANSIV			GRINNELL I	UNKNOWN	########	Cibola (331	11	712695
MVZ LOCATION GIVEN AS "COLORADO RIVER				MVZ BIRD ;	UNKNOWN	########	Bard (3211	11	731265
MAPPED TO LOCATION DESCRIBED AS "POTH				7 MALES, 3	BLM, BIA-F	########	Bard (3211	11	733478
;ETATION SI	HABITAT CONSISTS OF COTTONW			UNKNOWN	USBOR	########	Cibola (331	11	712494
E ALL AMER	HABITAT C(	ORV activit	THREATS IN	1-2 INDIVII	BIA-FORT Y	########	Bard (3211	11	725444
MAPPED T(	1986: YOU	Non-native	THREATS F	4 DETECTEI	USFWS-IMI	########	Little Picacl	11	733473
/EGETATIOI	HABITAT IS A 9-YEAR-OLD, SMALL			ONE PAIR (	USBOR	########	Cibola (331	11	713993
MAPPED T(	HABITAT DESCRIBED AS MESQUIT			1 DETECTEI	USFWS-CIB	########	Cibola (331	11	713108
ARTIFICIAL OWLS NEST IN THE DIRT BANKS O				AT LEAST 2	PVT, USFW	########	Calipatria S	11	620978
NTRY RD, SW OF CALIPATRIA.				AT LEAST A	UNKNOWN	########	Westmorla	11	629360
MAPPED T(	GOOD QUA	Developme	HEAVY ORV	3 ADULTS I	USFWS-CIB	########	Picacho NV	11	715543
LAND.				CSULB #15!	UNKNOWN	########	Westmorla	11	628845
MAPPED T(	HABITAT DESCRIBED AS MESQUIT			ONE OBSEI	USFWS-CIB	########	Cibola (331	11	713108
SERVATION	HABITAT CONSISTS OF NO IMMED			ONE INDIV	BIA-YUMA	########	Yuma West	11	715496
ABOUT 1.1	MARGINAL	Vehicle col	VISIBLE DIS	PRESENT 1'	USBOR, US	########	Cibola (331	11	713832
MAPPED G	AREA IMMEDIATELY SURROUNDIN			ONE POSSI	PVT, USFW	########	Cibola (331	11	715209
DUTH OF 38TH STREET COUNTY PARK, CIBOLA				SITE CR13 (	BLM	########	Palo Verde	11	720012
MAPPED B'	DENSE RIPARIAN WILLOW GROVE			10 CUCKOO(	USFWS-IMI	########	Picacho NV	11	716168
MAPPED BY CNDDB ACCORDING TO MULTIPL				8 CUCKOO!	DPR-PICAC	########	Picacho SW	11	719881
IORES LANDING TRAILER PARK, CIBOLA DIVISI(				SITE CR16 (	PVT	########	Picacho NV	11	716354
1977: MAP	BIRD DETE(	Non-native	INUNDATI(	1 BIRD, PO!	BLM, UNKN	########	Imperial Re	11	734213
WEST OF W	HABITAT CONSISTS OF WILLOWS \			SITE CR23 (	USBOR	########	Yuma West	11	719064
IW OF WES'	HABITAT IS RIVER DELTA SHORELII			ADULTS AN	UNKNOWN	########	Calipatria S	11	621923
LAND.	HABITAT IS ALKALI MUDFLAT ON /			TWO EGGS	PVT-IMPER	########	Niland (331	11	629644
D NEAR WINTERHAVEN.				MANY HEA	UNKNOWN	########	Yuma West	11	720494
MAPPED T(	HABITAT T'	Altered flo(	POSSIBLE II	2 RESPONE	UNKNOWN	########	Iris (33115:	11	647517
MAPPED T(	HABITAT TYPE DESCRIBED AS "CA'			5 RESPONE	UNKNOWN	########	Iris (33115:	11	647942
MAPPED A	POSSIBLE IMPACTS TO HYDROLO(			3 RESPONE	BLM	########	Amos (331	11	659048
MAPPED T(	DESCRIBED	Agriculture	POSSIBLY T	TWO RESP(	BLM, UNKN	########	Tortuga (3:	11	653109
MAPPED T(	HABITAT T'	Agriculture	AIR PHOTO	ONE RESPC	BLM, UNKN	########	Tortuga (3:	11	652507
MAPPED T(	HABITAT T'	Agriculture	SOUTHEAS'	TWO RESP(	BLM, UNKN	########	Tortuga (3:	11	651683
MAPPED T(	HABITAT TYPE DESCRIBED AS "CA'			2 DETECTEI	BLM, UNKN	########	Amos (331	11	655079
MAIN DRAIN, AROUND HWY 115, APPROX 7 N				FOUR DUE'	UNKNOWN	########	Alamorio (3	11	647660

MAPPED TO POW85U0002 MPA FOR 1978 SU 2 RAILS EST	USFWS-SO	########	Niland (331	11	628344
IMPERIAL WILDLIFE AREA DIVISION. 1974 & 1 86 DETECT	DFG-IMPEF	########	Westmorla	11	639180
IMPERIAL D RAILS HAVE BEEN CONSISTENTLY I MARSH AR	USFWS-IMI	########	Picacho SW	11	713683
CAN CANAL; JUST ACROSS AND E OF INFLOW (5 YUMA CL	USBOR	########	Bonds Corr	11	662116
2000: NEW RIVER, CURTIS RD. MAPPED TO P(RAILS RESP	UNKNOWN	########	Seeley (321	11	621398
CIBOLA DIV A MANAGEMENT PLAN IS BEING F 5 RAILS DE	IMP COUN	########	Palo Verde	11	711421
PALO VERI HABITAT CONSISTS OF AGRICULTU 20 PAIRS O	UNKNOWN	########	Palo Verde	11	715214
PALO VERI HABITAT C(Agriculture AGRICULTU 5 PAIRS OB	UNKNOWN	########	Palo Verde	11	715214
AT LEAST 6 ACTIVE NESTS CONTAINING YOUN 10 ADULTS	UNKNOWN	########	Bard (3211	11	729853
NESTS ARE LOCATED IN TWO COTTONWOOD 10 ADULTS	UNKNOWN	########	Bard (3211	11	729245
PLEASE CONTACT THE CALIFORNIA NATURAL DIVERSITY DATABASE,		########	In-ko-pah (	0	
PLEASE CONTACT THE CALIFORNIA NATURAL DIVERSITY DATABASE,		########	Borrego M(	0	
PLEASE CO NEST LOCATED AT 200-300 FEET IN A GRANITE OUTCROF		########	In-ko-pah (	0	
PLEASE CO POTHOLE NEST LOCATED AT 300 FT, IN A POTHOLE, IN A		########	Picacho Pe	0	
PLEASE CONTACT THE CALIFORNIA NATURAL DIVERSITY DATABASE,		########	Carrizo Mtı	0	
SURVEY AR HABITAT W Non-native MAIN THRE 5 DETECTE	USFWS-IMI	########	Imperial Re	11	733705
SSES LAGUNA DAM AND POTHOLES ALONG CC MVZ #1269	BLM, BIA-F	########	Bard (3211	11	733478
YUMA. MVZ #1269	UNKNOWN	########	Bard (3211	11	727985
DETECTED CREOSOTE BUSH SCRUB. 1 COLLECTI	DOD-NAVY	########	Superstitio	11	609623
MAPPED T(DESERT HORNED LIZARDS & FRIN(1 FLAT-TAII	BLM	########	Coyote We	11	603623
LOCATIONS STATED AS "1 MI N GLAMIS, ALG(MUSEUM S	UNKNOWN	########	East of Aco	11	680295
SDNHM #3 HABITAT C(ORV activit OHV RECRE MUSEUM S	DPR-OCOTI	########	Shell Reef (	11	586777
MAPPED T(DESERT HORNED LIZARDS & FRIN(0 FLAT-TAII	BLM	########	Glamis SW	11	674913
DIRECTIONS IN "LOCATION" FIELD DEVELOPM 1 FEMALE (	UNKNOWN	########	Brawley (3:	11	636400
MAPPED TO SPECIMEN Developme SUITABLE H FEMALE M	UNKNOWN	########	Holtville W	11	651477
LOCALITY STATED AS "HARPER'S WELL". SDNHM CA	UNKNOWN	########	Harpers W(	11	602064
1941 SPECI 2011-2012 ORV activit CONSTRUC SDNHM CA	BLM	########	Painted Go	11	601188
MAPPED TO LOCALITY "10 MI. SW (AIRLINE) (LACM #123	UNKNOWN	########	Seeley (321	11	626384
MAPPED T(MOUNT SI(Agriculture REMOVAL (1 WAS COL	UNKNOWN	########	Mount Sigr	11	627326
ON WEST SIDE OF COACHELLA CANAL, ABOU ONE OBSEF	BLM	########	Grays Well	11	690771
1955-1964 AERIAL IM/ Vehicle col THREAT FR MANY COL	BLM, PVT	########	Glamis NW	11	666210
PLOT 16: S' DOMINANT PLANTS; CRYPTANTH/ 4 OBSERVE	UNKNOWN	########	Harpers W(	11	595733
1978 DETE(DOMINANT PLANTS INCLUDED LA 3 OBSERVE	BLM, UNKN	########	Holtville NE	11	660316
LIZARD SEEN ON DIRT ROAD, SEVERAL SCAT / ONE LIZARI	UNKNOWN	########	Durmid (33	11	615020
1979: EXA(CREOSOTE ORV activit OHV RECRE 1 OBSERVE	DPR, BLM,	########	Kane Spring	11	603458
LIZARD ENCOUNTERED DURING "SECTION SE/ 1 LIZARD O	BLM	########	Kane Spring	11	605741
"PROAD" A 2002-2006 ORV activit OHV RECRE 1 OBS IN T:	DPR-OCOTI	########	Kane Spring	11	595751
EXACT LOC 2002: CRE(ORV activit POSSIBLY T 1 FLAT-TAII	BLM, DPR-(	########	Kane Spring	11	595387
KLAUBER (1939) GAVE LOCALITY OF "20 MILE OBSERVED	BLM	########	Glamis SE (	11	685854
AREA IS PRIMARILY EAST OF THE OLD OVERL/ ONE OBSEF	UNKNOWN	########	Painted Go	11	600543
T14S, R10E, SECTIONS 4 & 9. LOCATION MAPI USNM SPE(	BLM, UNKN	########	Plaster City	11	598766
LOCATION MAPPED ACCORDING TO PROVIDE ONE OBSEF	UNKNOWN	########	Carrizo Mtı	11	591146
PLEASE CO ASSOCIATE Over-collec THREATENED BY POACHING AND		########	In-ko-pah (	0	
PLEASE CONTACT THE ORV activit THREATENED BY COLLECTION (PO		########	In-ko-pah (	0	
PLEASE CONTACT THE ORV activit THREATENED BY POACHING AND		########	In-ko-pah (	0	
PLEASE CO "...TAKEN (ORV activit AREA HAS LONG HISTORY OF USE		########	Carrizo Mtı	0	
PLEASE CONTACT THE ORV activit THREATENED BY POACHING AND		########	In-ko-pah (	0	

E COLORAD	VEGETATIC Altered flo	FLOODING	2 INDIVIDU	BLM, USBC	#########	Laguna Dar	11	735447
E COLORAD	VEGETATION INCLUDES GOODDIN		ONE PAIR (	BLM, USBC	#########	Laguna Dar	11	735447
) SPRING RI	25 PUPFISH TRANSPLANTED FROM SALTON S			DOD-CHOC	#########	Buzzards P	11	708992
ONE 680 G	FISH CAUGHT IN 1975. A SMALL #		A 1981 CDI	USBOR, US	#########	Picacho NV	11	715543
LINE CANAL AND PONDS, NILAND.			SIX CAPTUI	PVT	#########	Iris (33115	11	641050
DOCUMEN	2 COLLECTI Dam/Inunc	DAMS, CH/	7 COLLECTI	USBOR	#########	Imperial Re	11	735478
ELY BELOW	PLENTIFUL.			UNKNOWN	#########	Laguna Dar	11	734110
WASHINGT	UNABLE TO CONVERT TO FLORIST		SEE WWW.	UNKNOWN	#########	In-ko-pah (	11	585764
WASHINGT	SPRING DRY IN SUMMER. UNABLE		SEE WWW.	UNKNOWN	#########	In-ko-pah (	11	586339
WASHINGT	UNABLE TO CONVERT TO FLORIST		SEE WWW.	UNKNOWN	#########	In-ko-pah (	11	588583
WASHINGT	UNABLE TO CONVERT TO FLORIST		SEE WWW.	UNKNOWN	#########	In-ko-pah (	11	586700
66 PALMS (	WASHINGT Non-native	TAMARISK	SEE WWW.	UNKNOWN	#########	Oasis (331	11	585366
U/S, DESER	SMALL BUT DENSE STAND (100% (		SEE WWW.	DPR-PICAC	#########	Picacho SW	11	717311
COLORADO	YOUNG DENSE STAND (APPROX 7		SITE OWNE	USBOR	#########	Yuma West	11	719064
E OF COLOR	SALIX GOODDINGII W/FEW COTT(		SEE WWW.	DPR-PICAC	#########	Picacho (33	11	724533
FERGUSON	DOMINATED BY SALIX GOODDING		SEE WWW.	USFWS-IMI	#########	Picacho (33	11	733211
TYPED FRO	COTTONWOOD-WILLOW TYPE W/		SEE WWW.	USFWS-IMI	#########	Little Picacl	11	733492
MAPPED A	2010 AIR PHOTO SHOWS EXTENSI		3-4 DETECT	UNKNOWN	#########	Bard (3211	11	730916
MAPPED T(	2003: AREA OF OBSERVATION WA		UP TO 3 IN	BLM, USFW	#########	Picacho NV	11	716047
) RIVER FROM WALKER LAKE DOWNSTREAM T			UNKNOWN	USFWS-IMI	#########	Picacho NV	11	716389
E COLORADO RIVER FROM WALKER LAKE DOW			UNKNOWN	USFWS-IMI	#########	Picacho NV	11	716389
E COLORADO RIVER FROM WALKER LAKE TO L			FEWER TH/	USFWS-IMI	#########	Picacho NV	11	716389
) RIVER FROM WALKER LAKE DOWNSTREAM T			UNKNOWN	USFWS-IMI	#########	Picacho NV	11	716389
E COLORADO RIVER BETWEEN LAGUNA AND II			FEWER TH/	BLM, USBC	#########	Laguna Dar	11	735447
E POLYGON	GROWING Mining	MINING AC	W POLYGO	BLM?	#########	Ogilby (321	11	706926
EXACT LOC	GRAVELLY SLOPES AND RUNNEL-II		MAIN SOU	BLM	#########	Ogilby (321	11	702214
ALONG RO.	LOW TOTAL COVER (<5%) IN SMA		FEWER TH/	BLM	#########	Hedges (32	11	706948
NEAR RAILI	ROCKY WASH CHANNEL. CREOSOT		ONLY SOUI	BLM	#########	Ogilby (321	11	699398
EXACT LOC	IN SMALL GULLIES.		SITE KNOW	BLM	#########	Hedges (32	11	704289
MAPPED BY CNDDB AS BEST GUESS ABOUT 4.			SITE BASED	BLM	#########	Cactus (32	11	697500
MAPPED ABOUT 2 MILES EAST OF RADIO FAC			ONLY SOUI	BLM	#########	Quartz Pea	11	706387
MAPPED B	FOUND WI Other	THREATEN	992 PLANT	BLM	#########	Mt. Barrow	11	697546
MAPPED 5	OPEN DESERT.		ONLY SOUI	BLM	#########	East of Aco	11	686212
SS ROAD, 7.	ALONG WATER COURSES WITH OI		MAPPED B.	BLM	#########	Quartz Pea	11	707285
JUST E OF I	SAGUAROS Developme	OHV, TARG	3 LIVING PI	BLM	#########	Laguna Dar	11	734925
SPECIMEN	GROWING IN A DEEP WASH WITH		1 PLANT OI	BLM	#########	Buzzards P	11	709092
MAPPED A	GROWING ORV activit	POSSIBLY T	1 LARGE PL	BLM	#########	Mt. Barrow	11	695965
SPECIMEN	GROWING IN A DESERT PAVEMEN		1 PLANT OI	BLM	#########	Palo Verde	11	700267
SITE MAPP	CREOSOTE BUSH SCRUB. ON ROCKY SUBSTRA			BLM	#########	Palo Verde	11	707012
EXACT LOCATION UNKNOWN. MAPPED BY CN			ONLY SOUI	BLM	#########	In-ko-pah (	11	592422
EXACT LOCATION UNKNOWN. MAPPED BY CN			ONLY SOUI	UNKNOWN	#########	Carrizo Mt	11	592121
INCLUDES /	SONORAN DESERT. ASSOCIATED V		UNKNOWN	BLM	#########	Carrizo Mt	11	591194
EXACT LOC	CREOSOTE ORV activit	OHV, TARG	SITE BASED	BLM	#########	Painted Go	11	595088
MAPPED A	FAIRLY OPE Other | Fo	TRAMPLIN	5 PLANTS S	BLM	#########	In-ko-pah (	11	585041
MAPPED ALONG I-8 IN THE VICINITY OF MOU			APPARENT	DPR-ANZA-	#########	In-ko-pah (	11	583784
EXACT LOC	STEEP ROCKY HILL.		MAIN SOUI	UNKNOWN	#########	In-ko-pah (	11	584322
SCATTERED	SCRUB OAK WOODLAND/CHAPAR		MAIN SOUI	UNKNOWN	#########	In-ko-pah (	11	584524

MAPPED B' STEEP WALLED CANYON WITH SAI		MENTIONE	BLM	########	Carrizo Mtı		11	591377
ON DIRT ROAD.		ONLY SOUI	UNKNOWN	########	Mount Sigr		11	627488
EXACT LOC GRAVELLY SLOPES ON NORTH BAI		PRIMARY S	DPR-ANZA-	########	In-ko-pah (		11	583784
VOLCANIC FLATS SOUTH OF PINTO WASH. EX		OCCURREN	UNKNOWN	########	Yuha Basin		11	615378
LOPE OF CARRIZO MOUNTAIN.		ONLY SOUI	UNKNOWN	########	Carrizo Mtı		11	592121
MAPPED B' STEEP WALLED CANYON WITH SAI		PLANTS MI	BLM	########	Carrizo Mtı		11	591377
UNABLE TC IN SANDY WASH.		ONLY SOUI	UNKNOWN	########	Carrizo Mtı		11	592495
IRRIGATION DRAIN BETWEEN IMPERIAL STAT		TRAPPING	DFG-IMPEF	########	Niland (331		11	630802
ISOLATED : SHORELINE	Non-native	NON-NATI\	19,940 FRY	UNKNOWN	########	Palo Verde	11	714155
BACKWATE SUBSTRATI	Non-native	SPECIES M/	59,461 FRY	USFWS-IMI	########	Picacho NV	11	715312
MEANDERI DEPTH, 0.2	Non-native	NON-NATI\	94,848 FRY	USFWS-IMI	########	Picacho (3:	11	725386
2002 LOCA HABITAT CONSISTS OF CREOSOTE		1 ADULT FI	DPR-OCOTI	########	Kane Sprin		11	598659
LOCATIONS STATED AS: MVZ, "COYOTE WELL		MUSEUM (	UNKNOWN	########	Coyote We		11	597024
MAPPED A CREOSOTE - WHITE BU	SOME OFFI	SDNHM #S	PVT	########	Harpers W		11	598604
FOUND ON SANDY SHOULDER OF HIGHWAY.		MUSEUM S	UNKNOWN	########	Frink (3311		11	618195
SCAT FOUI MOST OF THE HABITAT ALONG TH		ABUNDAN(	BLM	########	Grays Well		11	692376
SCAT FOUI MOST OF THE HABITAT ALONG TH		ABUNDAN(	BLM	########	Grays Well		11	701707
ROCK HILL, HABITAT C	ORV activit	THREATEN	ESTIMATEI	USFWS-SOI	########	Niland (331	11	628583
ROCK HILL, HABITAT C	ORV activit	THREATEN	ESTIMATEI	USFWS-SOI	########	Niland (331	11	628583
ROCK HILL, HABITAT C	ORV activit	THREATEN	ESTIMATEI	USFWS-SOI	########	Niland (331	11	628583
GATED MII HABITAT C	Mining | O	POSSIBLE T	3 BANDED	BLM	########	Hedges (32	11	703297
1990 OBS I HABITAT C	Mining | O	RENEWED	14 BANDEI	BLM	########	Hedges (32	11	703890
THE WORK HABITAT SI	Landfill | R	POSSIBLE I	~125 COUI	DOD-CHOC	########	Blue Moun	11	680957
EXACT LOCATION UNKNOWN. COORDINATES		3 MALE SPI	PVT-SDGE,	########	Palo Verde		11	710433
NORTH OF 1 HABITAT CONSISTS OF A FLOODEI		4 ADULT M	UNKNOWN	########	Palo Verde		11	710881
		COLLECTIO	UNKNOWN	########	Niland (331		11	638042
		ONE FROG	UNKNOWN	########	Holtville W		11	651477
), BETWEEN EL CENTRO AND HOLTVILLE.		TWO FROG	UNKNOWN	########	Holtville W		11	645375
ES NORTH OF WINTERHAVEN.		TWO FROG	UNKNOWN	########	Araz (3211		11	721284
MAPPED IN THE VICINITY OF WALTERS CAMP		ONE FROG	USFWS-CIB	########	Picacho NV		11	715522
EXACT LOCATION UNKNOWN. MAPPED BY CI		ONLY SOUI	UNKNOWN	########	Calexico (3		11	641015
FREEMAN I SANDY ARROYO WITH DESERT PA'		UNCOMM(	DPR-OCOTI	########	Seventeen		11	586673
EXACT LOCATION UNKNOWN. MAPPED BY CI		ONLY SOUI	UNKNOWN	########	Calexico (3		11	641015
MAPPED BY CNDDB AS BEST GUESS AROUND		TYPE LOCA	UNKNOWN	########	Heber (321		11	637770
"STREETS OF BRAWLEY."		ONLY SOUI	UNKNOWN	########	Brawley (3:		11	637820
EXACT LOC OLD BEACH.		ONLY SOUI	UNKNOWN	########	Bonds Corr		11	653162
MAPPED B' MOST COM	ORV activit	ORV ACTIV	SEEN IN 19	BLM	########	Glamis (32:	11	682852
EXACT LOCATION UNKNOWN, MAPPED AS BE		SITE BASEI	UNKNOWN	########	Ogilby (321		11	702138
).		SITE BASEI	UNKNOWN	########	Holtville W		11	645375
EXACT LOC DUNES. GROWING WITH A FEW G		SITE BASEI	BLM	########	Glamis (32:		11	677380
MAPPED IN MOST OF SOUTH HALF OF SW1/4		ONLY SOUI	UNKNOWN	########	Tortuga (3:		11	656207
EXACT LOCATION UNKNOWN. MAPPED FROI		ONLY SOUI	UNKNOWN	########	Kane Sprin		11	609056
EXACT LOCATION UNKNOWN. MAPPED AS BE		ONLY SOUI	UNKNOWN	########	Midway W		11	685952
EXACT LOCATION UNKNOWN. MAPPED BY CI		ONLY SOUI	UNKNOWN	########	In-ko-pah (		11	583784
LOCALITY S HABITAT C	ORV activit	VEHICLES T	29 JUN 20(	UNKNOWN	########	Painted Go	11	599180
4 LIZARDS ' CREOSOTE	ORV activit	OHV AREA,	1 OBSERVE	BLM	########	Grays Well	11	706421
1.7 MI EAS AGRICULTI	Non-native	2001: "...M	10 FOUND	PVT-IMPER	########	Kane Sprin	11	614944

EEC ORIGINAL PKG

CAS LOCAL	DESERT SU	ORV activit	OHV ACTIV	24 DETECT	DPR-OCOTI	########	Shell Reef (	11	587932
WEST OF C	DESERT ERIOGONUM WASH, W/ /			1 ADULT O	DPR-OCOTI	########	Kane Spring	11	594402
) OF SALTON SEA, RIVERSIDE COUNTY.				COLONY A(	UNKNOWN	########	Salton (331	11	594849
NIGHT-ROOST.				UNKNOWN	UNKNOWN	########	Palo Verde	11	717794
9 INDIVIDU	HABITAT C	ORV activit	THREATS IN	1 ADULT O	BLM	########	Grays Well	11	708661
72 BELT TR	HABITAT C	ORV activit	THREATEN	1 JUVENILE	BLM	########	Glamis (32	11	676568
B MESA, 1.6	HABITAT C	ORV activit	THREATS C	1 ADULT O	BLM	########	Grays Well	11	708190
END OF SALTON SEA AT MOUTH OF NEW RIV				1954: 1ST I	USFWS-SOI	########	Calipatria S	11	621609
NO SPECIFIC LOCATIOI		Developme	THREATEN	8 ADULT O	UNKNOWN	########	Calexico (3	11	648700
BURROW IS LOCATED (		Agriculture	THREATEN	1 ADULT AI	UNKNOWN	########	Heber (321	11	633718
BURROW IS	BURROW IS	Agriculture	THREATEN	1 ADULT AI	UNKNOWN	########	Brawley NV	11	623134
BURROW IS	BURROW IS LOCATED ALONG A C/			2 JUVENILE	UNKNOWN	########	Heber (321	11	631973
)F DELIVERY	BURROW IS LOCATED (		THREATEN	2 ADULTS /	UNKNOWN	########	Heber (321	11	631165
)UTH OF SC	BURROW IS LOCATED .		THREATEN	2 ADULTS /	UNKNOWN	########	Calexico (3	11	650436
8 INDIVIDU	HABITAT C	ORV activit	THREATS IN	1 ADULT O	BLM	########	Grays Well	11	707048
6 INDIVIDU	CREOSOTE	ORV activit	PIPELINE C	ONE DEAD	BLM	########	Grays Well	11	704747
SE OF THE JU	CREOSOTE	ORV activit	PIPELINE C	ONE ADULT	BLM	########	Ogilby (321	11	703430
DAVIS ROAD, VICINITY		Other	IN 1987 TH	2 FOUND D	UNKNOWN	########	Wister (331	11	632294
MAPPED AT THE LAT/ LONG COORDINATES G				MVZ EGG S	UNKNOWN	########	El Centro (3	11	630495
ST OF EL CENTRO.				SBCM EGG	UNKNOWN	########	Holtville W	11	646782
NORTHEAST OF WESTMORELAND.				SBCM EGG	UNKNOWN	########	Westmorla	11	632850
BURROW IS	HABITAT SURROUNDIN		POSSIBLE T	1 ADULT O	UNKNOWN	########	Heber (321	11	636564
SITE CONSI	BURROW SITES ARE LOCATED IN /			ON 2 JUN 2	PVT	########	Seeley (321	11	628010
N ROAD AT	BURROW SITES ARE LOCATED IN /			1 ADULT O	UNKNOWN	########	Mount Sign	11	627507
THE S POLY	BURROW SITES ARE SURROUNDEI			8 ADULTS /	PVT	########	Mount Sign	11	628329
BURROW L	BURROW SITES ARE SURROUNDEI			1 ADULT AI	UNKNOWN	########	Heber (321	11	629270
SOUTHERN	SOUTHERN POLYGON: BURROW S			1 ADULT O	UNKNOWN	########	Heber (321	11	629308
BURROWS	BURROW SITES ARE SURROUNDEI			4 ADULTS (	PVT	########	El Centro (3	11	629420
BURROWS	BURROW SITES ARE SURROUNDEI			8 ADULTS /	PVT	########	El Centro (3	11	630204
BURROW L	BURROW SITES ARE SURROUNDEI			2 ADULTS (	PVT	########	El Centro (3	11	629069
)F ALGODO	HABITAT CONSISTS OF PALOVERD			ONE OBSEI	BLM	########	Acolita (33	11	672023
)F ALGODONES DUNES, 0.4 MILE SOUTHWEST				ONE WINTI	BLM	########	Acolita (33	11	671643
)F ALGODONES DUNES, ABOUT 2 MILES SOUT				ONE WINTI	UNKNOWN	########	Acolita (33	11	670272
)F ALGODONES DUNES, ABOUT 1.3 MILES SW				WINTERIN(	UNKNOWN	########	Amos (331	11	663022
ATE ROUTE 115 BETWEEN ORANGE LATERAL D				BIRD OBSEI	UNKNOWN	########	Alamorio (3	11	648981
EADOWS UNION SCHOOL, ALONG ACACIA LA				BIRD OBSEI	UNKNOWN	########	Holtville W	11	642894
FIELD WITH	RECENTLY BURNED HAYFIELD AFT			2001: 1/21	PVT	########	Westmorla	11	630217
EXACT LOCATION UNKNOWN. MAPPED BY CN				SITE BASED	DOD-NAVY	########	Superstitio	11	609382
1970'S DAT	DIKED PONDS, MARSHLANDS, ANI			OBSERVED	USFWS-SOI	########	Obsidian B	11	627151
MAPPED TO	HABITAT C	Non-native	POSSIBLY T	3 ADULTS (	DPR-ANZA-	########	Carrizo Mtı	11	583041
EXACT LOCATION UNKNOWN, SOURCE LISTS :				ONLY SOUI	BLM	########	Glamis NW	11	674697
L, 11 MILES EAST OF NILAND.				ONLY SOUI	DOD-CHOC	########	Lion Head I	11	655367
LOCATION	HABITAT C	Nest parasi	BROWN-HE	2003: AT LI	USFWS-IMI	########	Imperial Re	11	733589
LOCATED B	HABITAT C	Nest parasi	COWBIRDS	2 SINGING	USBOR, DP	########	Picacho (33	11	722779
SE 1/4 OF S	HABITAT C	Other	THREATEN	1 ADULT M	USBOR, DP	########	Picacho SW	11	720987
OVE LAGUNA DAM.				2 MALES A	USBOR, BLI	########	Laguna Dar	11	734620
MAPPED LOCATION CENTERED AT SILSBEE SC				MALE COLL	UNKNOWN	########	Seeley (321	11	627562

LOCATION MAPPED IN THE SENATOR WASH /	FEMALE CC	USBOR	########	Imperial Re	11	734727
LOCATION GIVEN AS "ALAMO DUCK PRESERV	MALE COLL	DFG-IMPEF	########	Niland (331	11	631199
MAPPED ACCORDING TO LAT/LONG GIVEN B'	MVZ #9099	UNKNOWN	########	Wiley Well	11	686567
AREA MAPPED TO INCLUDE PALO VERDE ANE	MVZ #2140	UNKNOWN	########	Palo Verde	11	710576
EXACT LOC STONY DESERT SLOPES.	MAIN SOUI	UNKNOWN	########	In-ko-pah (	11	584496
MAPPED ACCORDING TO LAT/LONG GIVEN B'	MVZ #1060	UNKNOWN	########	Picacho NV	11	714441
MAPPED ACCORDING TO LAT/LONG GIVEN B'	FEMALE CC	UNKNOWN	########	Wiley Well	11	686563
	UNIVERSIT	UNKNOWN	########	Calexico (3	11	641015
LOCATION MAPPED JUST SOUTH OF INTERST/	LACM #673	BLM	########	Coyote We	11	602266
LOCALE STATED AS "BARD."	1 COLLECTI	UNKNOWN	########	Bard (3211	11	729107
LOCATION MAPPED IN VICINITY OF WHERE M	2 COLLECTI	UNKNOWN	########	Bard (3211	11	729610
LOCATION MAPPED NW OF THE JUNCTION O	1 COLLECTI	UNKNOWN	########	Araz (3211	11	719575
V OF GLAMIS.	ORIGINAL I	BLM	########	East of Aco	11	675848
V OF GLAMIS.	ALLOTYPE I	BLM	########	East of Aco	11	675848
V OF GLAMIS.	HOLOTYPE	BLM	########	East of Aco	11	677109
1 MILE WEST OF GLAMIS.	4 MALE PA	BLM	########	Glamis (32	11	679398
EST OF GLAMIS.	259 MALE I	UNKNOWN	########	Glamis (32	11	676732
NW OF GLAMIS.	6 MALE PA	BLM	########	East of Aco	11	675102
WEST OF GLAMIS.	ONE MALE	BLM	########	Amos (331	11	662290
UNTAIN, 21 KM NE OF GLAMIS.	COLLECTIO	BLM	########	Quartz Pea	11	700949
F SMUGGLERS CAVE EAST OF JACUMBA.	ONE MALE	BLM, UNKN	########	In-ko-pah (	11	585106
EXACT LOCATION UNKNOWN. MAPPED BY CN	LOCATION	DPR-PICAC	########	Picacho Pe	11	721330
/ASH, 0.7 R(IN GRANITIC SANDS OF WASH. AS	MENTIONE	UNKNOWN	########	Quartz Pea	11	708556
MAPPED ACCORDING TO THE FOLLOWING T-	LARGE ARE	BLM	########	Chuckwalla	11	670683
EXACT LOCATIONS NOT GIVEN. MAPPED IN TI	COLLECTED	UNKNOWN	########	Brawley (3:	11	637820
EXACT LOCATION UNKNOWN. MAPPED IN TH	ONE FEMA	UNKNOWN	########	Calexico (3	11	641015
EXACT LOCATION NOT GIVEN. MAPPED IN TH	ALL SPECIM	UNKNOWN	########	El Centro (:	11	634594
NON-SPECIFIC LOCALE, THUS MAPPED TO LA'	ONE MALE	UNKNOWN	########	Heber (321	11	637770
MAPPED AT THE LAT-LONG COORDINATES GI	ONE MALE	UNKNOWN	########	El Centro (:	11	630512
EXACT LOCATION UNKNOWN. MAPPED IN TH	ALL MVZ: 1	UNKNOWN	########	Holtville W	11	651477
EXACT LOCATION NOT GIVEN. MAPPED IN TH	2 FEMALE S	UNKNOWN	########	El Centro (:	11	633887
EXACT LOCATION UNKNOWN. MAPPED IN TH	3 MALE SPI	UNKNOWN	########	Westmorla	11	628845
LOCATION NOT SPECIFIC, MAPPED ACCORDIN	ONE MALE	UNKNOWN	########	Picacho NV	11	714441
EXACT LOCATION NOT GIVEN. LOCATION ONI	ONE MALE	UNKNOWN	########	El Centro (:	11	634594
IILES SSW OF POTHOLES ALONG THE COLORAI	1 FEMALE S	UNKNOWN	########	Bard (3211	11	731265
EXACT LOCATION NOT KNOWN. MAPPED IN 1	21 F & 24 N	BLM, UNKN	########	In-ko-pah (	11	585106
EXACT LOCATION NOT KNOWN. MAPPED IN 1	A:1F 12 M/	DPR-ANZA-	########	In-ko-pah (	11	583784
EXACT LOCATION NOT KNOWN. MAPPED AS I	4 FEMALES	UNKNOWN	########	Wiley Well	11	695997
MVZ LOCATION GIVEN AS "20 MI N PACACHC	NEST PLUS	UNKNOWN	########	Picacho NV	11	715543
LAND.	HISTORICA	UNKNOWN	########	Westmorla	11	628845
V OF GLAMIS.	ONE FEMA	BLM	########	East of Aco	11	675848
MAPPED B' SPARSE CREOSOTE BUSH SCRUB II	OCCURREN	BLM	########	Painted Go	11	596171
RAINBOW CREOSOTE ORV activit OHV RECRI	1 OBSERVE	DPR-OCOTI	########	Kane Sprin	11	594037
RAINBOW CREOSOTE ORV activit OHV RECRI	ONE ADUL'	DPR-OCOTI	########	Kane Sprin	11	595022
AROUND 8 DESERT PAVEMENT/DESERT WASI	1991 LARU	BLM	########	Hedges (32	11	707383
IN THE NW STRINGER ' ORV activit THREATEN	10 PLANTS	BLM	########	Hedges (32	11	699726
AIR MILE N FOUND WI ORV activit THREATEN	84 PLANTS	BLM	########	Hedges (32	11	700606

EEC ORIGINAL PKG

IN THE SE 1	OPEN ROCI	ORV activit	THREATEN	91 PLANTS	BLM	########	Hedges (32	11	701986
SOUTH ED(	FOUND WI	ORV activit	THREATEN	2 PLANTS S	BLM	########	Hedges (32	11	701852
NE 1/4 OF I	FOUND WI	ORV activit	THREATEN	5 PLANTS S	BLM	########	Hedges (32	11	701643
EAST EDGE	FOUND WI	ORV activit	THREATEN	56 PLANTS	BLM	########	Hedges (32	11	701088
IN THE SE 1	FOUND WI	ORV activit	THREATEN	5 PLANTS (	BLM	########	Hedges (32	11	700188
NW 1/4 OF	FOUND WI	ORV activit	THREATEN	304 PLANT	BLM	########	Hedges (32	11	699895
SE 1/4 OF S	FOUND WI	ORV activit	THREATEN	36 PLANTS	BLM	########	Quartz Pea	11	698540
MAPPED A	WASH WITH SANDY SOIL ON FLAT			SITE BASED	BLM	########	Ninemile W	11	695822
2 POLYGOI	STRINGER '	ORV activit	THREATEN	13 PLANTS	BLM	########	Ninemile W	11	696030
IN THE SW	FOUND WI	ORV activit	THREATEN	22 PLANTS	BLM	########	Ninemile W	11	695844
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	595782
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	597944
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	598754
EAST OF SIDE OF ROAI		ORV activit	THREATEN	<20 PLANT	BLM	########	Ninemile W	11	695707
SAN FELIPE	HABITAT C	ORV activit	OHV RECRE	1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	598321
.ES ESE OF I	FOUND WI	ORV activit	THREATEN	38 PLANTS	BLM	########	Ninemile W	11	695724
IN THE NE :	FOUND WI	ORV activit	THREATEN	40 PLANTS	BLM	########	Ninemile W	11	695928
EAST SIDE OF ROAD, A		ORV activit	THREATEN	1 PLANT SE	BLM	########	Buzzards P	11	698148
MAPPED A	HABITAT C	ORV activit	OHV RECRE	1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	601278
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	602263
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	601332
IN THE SE 1	STRINGER '	ORV activit	THREATEN	15 PLANTS	BLM	########	Hedges (32	11	699529
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	598112
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	601044
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	602202
EXACT LOC	WASH WOODLAND WITH OLNEYA			1978 LATTI	UNKNOWN	########	Ogilby (321	11	702396
IN WASHES	EDGES OF SMALL WASHES ON RO			180 PLANT	BLM	########	Mt. Barrow	11	695052
MAPPED IN	OPEN, SANDY, ILL-DEFINED WASH			1999 TAYL(	UNKNOWN	########	Chuckwalla	11	669171
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	602097
MAPPED A	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	600306
LOCATION	CREOSOTE SCRUB, TABULAR SANI			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	595818
LOCATION	HABITAT C	ORV activit	OHV RECRE	2 ADULTS (	DPR-OCOTI	########	Kane Sprin	11	597545
LOCATION	HABITAT IN AREA CON		OHV TRACI	2 ADULTS (	DPR-OCOTI	########	Kane Sprin	11	601702
SAN FELIPE	CREOSOTE	ORV activit	OHV RECRE	1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	600640
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	597140
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	596447
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	597612
ALONG FOI	HABITAT CONSISTS OF CREOSOTE			2 ADULTS (	DPR-OCOTI	########	Kane Sprin	11	602603
MAPPED T(	2003: CREOSOTE SCRUB ON SUBS'			1 MALE AD	DPR-OCOTI	########	Kane Sprin	11	595285
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	595053
LOCATION	CREOSOTE SCRUB, AEOLIAN SANI			1 JUVENILE	DPR-OCOTI	########	Kane Sprin	11	594031
LOCATION	HABITAT C	ORV activit	OHV RECRE	8 ADULTS #	DPR-OCOTI	########	Kane Sprin	11	594071
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR-OCOTI	########	Kane Sprin	11	594072
LOCATION	HABITAT C	ORV activit	OHV RECRE	3 ADULTS (	DPR-OCOTI	########	Kane Sprin	11	594686
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR	########	Shell Reef (	11	586791
LOCATION	CREOSOTE	ORV activit	OHV RECRE	1 CAUGHT	DPR-OCOTI	########	Shell Reef (	11	587828
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C	DPR	########	Shell Reef (	11	588996

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ARRAY 16,	2002: MED	ORV activit	OHV RECRE	1 MALE AN	DPR-OCOTI	########	Shell Reef (	11	590126
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C/	DPR	########	Shell Reef (	11	589972
LOCATION	HABITAT C(	ORV activit	OHV RECRE	1 ADULT C/	DPR-OCOTI	########	Shell Reef (	11	591388
MAPPED A	2002: CREC	ORV activit	VEHICLE C(	1 MALE AD	BLM	########	Shell Reef (	11	592050
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C/	DPR-OCOTI	########	Shell Reef (	11	592289
RAINBOW '	CREOSOTE	ORV activit	OHV RECRE	1 ADULT C/	DPR-OCOTI	########	Shell Reef (	11	592512
ALONG THI	HABITAT C(	ORV activit	OHV RECRE	1 ADULT FE	DPR-OCOTI	########	Shell Reef (	11	589980
EXACT LOC	MUD HILLS	ORV activit	POSSIBLY T	1 FEMALE (	DPR-OCOTI	########	Shell Reef (	11	592298
LOCATION	HABITAT CONSISTS OF		OHV TRACI	1 ADULT C/	DPR, BLM	########	Shell Reef (	11	592430
1998 DETE(	CREOSOTE SCRUB, LAK		OHV TRACI	4 LIZARDS (	DPR-OCOTI	########	Shell Reef (	11	590546
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C/	DPR-OCOTI	########	Shell Reef (	11	589896
PLOT 4 IN 1	CREOSOTE SCRUB AND GRAVEL O			3 FLAT-TAII	DPR-OCOTI	########	Shell Reef (	11	591722
LOCATION	HABITAT CONSISTS OF CREOSOTE			1 ADULT C/	DPR-OCOTI	########	Shell Reef (	11	586255
LOCATION	HABITAT C(	ORV activit	OHV RECRE	3 ADULTS (	DPR-OCOTI	########	Shell Reef (	11	588596
MAPPED BY CNDDB AS BEST GUESS AROUND				NOTE IN 2(	SDG COUN	########	In-ko-pah (	11	583470
WHERE Z D	AGRICULTU	Non-native	NON-NATI\	0 FOUND II	PVT-IMPER	########	Wister (331	11	630185
MOUTH OF	AGRICULTU	Non-native	NON-NATI\	UP TO 5 AE	PVT-IMPER	########	Calipatria S	11	618004
WHERE TRI	AGRICULTU	Non-native	NON-NATI\	1 ADULT &	PVT-IMPER	########	Calipatria S	11	622021
WHERE O [	AGRICULTU	Non-native	NON-NATI\	1 ADULT &	PVT-IMPER	########	Niland (331	11	631630
MAPPED W/ RESPECT TO 1951 CIBOLA 15-MI				GRINNELL I	UNKNOWN	########	Cibola (331	11	712695
MAPPED B'	SANDY/SIL'	ORV activit	HEAVY OH\	11 PLANTS	BLM	########	Kane Spring	11	595614
IE NEW RIV	OLD DATE I	Developme	SITE PROP(	THIS HAS B	PVT	########	Brawley (3:	11	635130
WASH SOU	DESERT W/	ORV activit	OFF-ROAD	1 ADULT O	BLM	########	Hedges (32	11	699897
WEEN CHOI	DESERT W/	ORV activit	OFF-ROAD	2 ADULTS (	BLM	########	Ninemile W	11	696606
T OF STATE	DESERT W/	ORV activit	OFF-ROAD	2 ADULTS (	BLM	########	Ninemile W	11	697106
H ABOUT 1.	DESERT W/	ORV activit	OFF-ROAD	1 ADULT O	BLM	########	Thumb Pea	11	708084
/ASH WEST	BRAIDED W	ORV activit	ORV USE A	1 ADULT O	UNKNOWN	########	Buzzards P	11	698832
DGE OF IMI	MICROPHYLL WOODL/		ORV USE A	1 FEMALE (	BLM	########	Clyde (321	11	687852
TOAD FOU	DESERT SCRUB ON HIGH SLOPE RU			1 TOAD FO	BLM	########	Palo Verde	11	709435
SOME MUSEUM LOCATIONS GIVEN AS "WASI				MVZ #2718	UNKNOWN	########	Harpers W	11	602064
MUSEUM I	THIS LOCATION IS WITHIN THE M/			MVZ #2789	UNKNOWN	########	Harpers W	11	599972
BOTH ADULTS AND TADPOLES COLLECTED. M				MVZ #4941	BLM	########	Imperial Re	11	736514
MVZ RECORD GIVES LOCATION AS "1.5 MI W				MVZ #3297	UNKNOWN	########	Wister (331	11	635958
MAPPED ACCORDING TO THE LAT-LONG GIVE				MVZ #1058	UNKNOWN	########	Seeley (321	11	624462
MVZ RECORD GIVES LOCATION AS "20 MI S P/				MVZ #1202	BLM	########	Picacho NV	11	712599
NEST OF GL	COLLECTED BY SWEEPING FLOWE			IN SPITE OI	UNKNOWN	########	Glamis NW	11	669467
GENERAL L	25% GOODDING WILLOW, 30% C(			1 RESIDENT	BLM	########	Picacho NV	11	716042
2004 SURV	40% WILLC	Nest parasi	COWBIRDS	1 RESIDENT	BLM	########	Picacho SW	11	720857
MAPPED T(	DENSE TAN	Nest parasi	COWBIRDS	1 PAIR & 1	BLM	########	Picacho NV	11	715906
				1 MALE SPI	UNKNOWN	########	Calexico (3	11	641015
EXACT LOCATION UNKNOWN. MAPPED ALON				1 MALE SPI	UNKNOWN	########	Picacho NV	11	714692
EXACT LOCATION UNKNOWN. MAPPED IN TH				1 FEMALE S	BLM	########	Glamis (32:	11	679398
MAPPED ACCORDING TO LAT/LONG COORDII				1 MALE & 1	UNKNOWN	########	Kane Spring	11	608456
EXACT LOCATION UNKNOWN. MAPPED IN TH				1 MALE SPI	PVT-SDGE,	########	Palo Verde	11	710433
EXACT LOCATION UNKNOWN. MAPPED IN TH				1 MALE CO	UNKNOWN	########	Picacho NV	11	716397
SHAFT & AI	NIGHT ROOST FOR ANTROZOUS P			6 INDIVIDU	UNKNOWN	########	Hedges (32	11	703327
SHAFT & AI	MATERNITY COLONY FOR MACRO			45 INDIVID	UNKNOWN	########	Hedges (32	11	703327

LOCATION GIVEN AS "TURTLE" MINE IN SECTI				GUANO AN	UNKNOWN	########	Buzzards P	11	708103
SHAFT OMR 13328 IN NW 1/4 OF SECTION 36				1 BAT OBSI	UNKNOWN	########	Hedges (32	11	703316
SMALL, UN	NARROW PENINSULA COMPOSED			40-50 GULI	PVT-IMPER	########	Obsidian B	11	626678
, 13 KM EAST OF SIPHON 10 OF COACHELLA C.				1 MALE SPI	UNKNOWN	########	Lion Head I	11	655418
				1 MALE SPI	UNKNOWN	########	Calexico (3	11	641015
, 13 KM EAST OF SIPHON 10 OF COACHELLA C.				1 MALE SPI	UNKNOWN	########	Lion Head I	11	655418
EXACT LOCATION UNKNOWN. MAPPED AS BE				1 FEMALE S	PVT-SDGE,	########	Palo Verde	11	710433
MAPPED ACCORDING TO T-R-S DATA PROVID				INDIVIDUA	UNKNOWN	########	Hedges (32	11	706316
MAPPED ACCORDING TO T-R-S DATA PROVID				INDIVIDUA	UNKNOWN	########	Hedges (32	11	706316
IOUNTAINS, NORTH OI		Recreation	CLOSE TO \	OUTFLIGHT	BLM	########	Bard (3211	11	733439
BOY MINE. CARGO MUCHACHO MOUNTAINS				MAINLY W	UNKNOWN	########	Ogilby (321	11	708635
MARY LODE MINE #2, WEST ADIT.				A FEW IND	DOD-CHOC	########	Blue Moun	11	680957
MAPPED ACCORDING TO UTM COORDINATES				FORAGING	DOD-CHOC	########	Iris Wash (	11	643950
MAPPED ACCORDING TO UTM COORDINATES				ROOST SITI	DOD-CHOC	########	Iris Wash (	11	643950
MAPPED ACCORDING TO UTM COORDINATES				NIGHT ROC	DOD-CHOC	########	Lion Head I	11	652824
MAPPED ACCORDING TO UTM COORDINATES				ROOST SITI	DOD-CHOC	########	Lion Head I	11	652824
MAPPED ACCORDING TO UTM COORDINATES				FORAGING	DOD-CHOC	########	Lion Head I	11	652824
MAPPED ACCORDING TO UTM COORDINATES				FORAGING	DOD-CHOC	########	Lion Head I	11	652824
MAPPED ACCORDING TO UTM COORDINATES				ROOST SITI	UNKNOWN	########	Ninemile W	11	692695
MAPPED ACCORDING TO UTM COORDINATES				FORAGING	DOD-CHOC	########	Lion Head I	11	661614
MAPPED ACCORDING TO UTM COORDINATES				FORAGING	DOD-CHOC	########	Iris Wash (	11	640100
MAPPED ACCORDING TO UTM COORDINATES				FORAGING	DOD-CHOC	########	Iris Wash (	11	640100
EXACT LOCATION UNKNOWN. CANNOT LOCA				ONLY SOUI	UNKNOWN	########	Heber (321	11	631561
MAPPED A	DISTURBEC	Developme	RESIDENTI/	UNOCCUPI	UNKNOWN	########	El Centro (	11	634766
MAPPED ACCORDING '		Agriculture	FURTHER A	BURROW S	UNKNOWN	########	El Centro (	11	640327
E OF THE AI	HABITAT CONSISTS OF ARROW W			2 ADULT M	PVT-IMPER	########	Midway W	11	667688
OF EAST HI	HABITAT CONSISTS OF TAMARISK			2 NON-REP	PVT-IMPER	########	Holtville Ea	11	660724
SOUTH OF T	HABITAT CONSISTS OF ARROW W			4 NON-REP	PVT-IMPER	########	Midway W	11	670324
MAPPED T(	HABITAT C(	Agriculture	THREATS IN	5 NON-BRE	PVT-IMPER	########	Holtville Ea	11	659318
SOUTH OF T	HABITAT CONSISTS OF CREOSITE E			1 NON-REP	PVT-IMPER	########	Brawley NV	11	623873
1903 USNN	2007 HABITAT CONSISTED OF DEN			2 MALES &	PVT-IMPER	########	Yuma West	11	714045
MAPPED LOCATION CENTERED AT SILSBEE SC				MVZ #8102	UNKNOWN	########	Seeley (321	11	627562
LOCALE STATED AS "BARD."				4 SPECIMEI	UNKNOWN	########	Bard (3211	11	729107
IILES SW OF PALO VERDE.				MVZ #3074	BLM, UNKN	########	Palo Verde	11	709193
THE BURRC	DEVELOPN	Developme	AREA TO TI	A PAIR OF I	PVT	########	El Centro (	11	635233
THE BURRC	DEVELOPN	Developme	AREA TO TI	2 PAIRS OF	PVT	########	El Centro (	11	635408
ON IMPERI	DEVELOPN	Developme	SITE MAY E	A PAIR OF I	UNKNOWN	########	El Centro (	11	632412
ON IMPERI	DEVELOPN	Developme	SITE MAY E	A PAIR OF I	UNKNOWN	########	El Centro (	11	631628
ER OF THE INTERSECTIC		Road/trail (	THREATEN	A BUOW P/	UNKNOWN	########	Calexico (3	11	640613
THE IMPERIAL IRRIGATION DISTRICT MONITO				# OF ACTIV	PVT-IMPER	########	El Centro (	11	636672
MAPPED A	HABITAT DESCRIBED AS DISTURBE			1 OVER-WI	UNKNOWN	########	Iris (33115	11	640388
MAPPED A	HABITAT D	Over-collec	THREATEN	AT LEAST 3	UNKNOWN	########	Wister (33	11	632520
MAPPED A	HABITAT D	Over-collec	THREATEN	AT LEAST 3	UNKNOWN	########	Wister (33	11	631688
EXACT LOCATION UNKNOWN, BUT IT SEEMS I				IN JUN 196	BLM	########	Imperial Re	11	736739
EXACT LOC	LOW DESERT SCRUB, SANDY SOIL.			ONLY SOUI	BLM	########	Ogilby (321	11	706984
MAPPED B'	SMALL POPULATION GROWING IN			ONLY SOUI	UNKNOWN	########	In-ko-pah (	11	592268
EXACT LOCATION UNKNOWN. LOCATION DES				ONLY SOUI	UNKNOWN	########	Yuha Basin	11	615378

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MAPPED A	SPARSELY VEGETATED GRAVELLY			MAIN SOU	BLM	########	Hedges (32	11	702274
V OF NILAN	HABITAT C	Developme	THREATEN	ACTIVE BU	UNION PAC	########	Wister (33	11	629122
V OF NILAN	HABITAT C	Developme	THREATEN	ACTIVE BU	UNION PAC	########	Wister (33	11	633164
BLOCK COD	HABITAT C	Developme	THREATEN	ACTIVE BU	PVT	########	Wister (33	11	636188
V OF NILAN	HABITAT C	Developme	THREATEN	ACTIVE BU	UNION PAC	########	Wister (33	11	636881
V OF NILAN	HABITAT C	Developme	THREATEN	ACTIVE BU	UNION PAC	########	Niland (331	11	637402
MI SW OF I	HABITAT CONSISTS OF DESERT SC			3 ADULTS A	UNION PAC	########	Iris (33115	11	640012
OF NILAND	HABITAT CONSISTS OF DESERT SC			3 ACTIVE B	UNION PAC	########	Iris (33115	11	643151
OF NILAND	HABITAT CONSISTS OF DESERT SC			1ACTIVE BU	UNION PAC	########	Iris (33115	11	644701
OF NILAND	HABITAT CONSISTS OF DESERT SC			1ACTIVE BU	UNION PAC	########	Iris (33115	11	645330
OF GLAMIS	HABITAT CONSISTS OF DESERT SC			1ADULT AT	UNION PAC	########	Acolita (33	11	673771
EXACT LOC	SILTY PLAYA	ORV activit	OHV, TRAF	PLANTS OB	BLM	########	Coyote We	11	603506
MAPPED B	DRIED, MU	ORV activit	OHV, HEAV	OCCURREN	BLM	########	Coyote We	11	598495
EXACT LOC	DRY, OPEN DESERT.			ONLY SOU	UNKNOWN	########	Seeley (321	11	622615
EXACT LOCATION UNKNOWN. MAPPED BY CN				ONLY SOU	UNKNOWN	########	Picacho SW	11	715876
EXACT LOC	GROWING AMONG ROCKS ON A S			ONLY SOU	BLM	########	Quartz Pea	11	706387
MAPPED W	IN ROCKY GRANITIC SLOUTH FACI			37 PLANTS	BLM	########	Mt. Barrow	11	691305
EXACT LOC	ROCKY MOUNTAIN SLOPE.			ONLY SOU	UNKNOWN	########	Palo Verde	11	706867
EXACT LOC	BASE OF CONGLOMERATE CUT AL			ONLY SOU	BLM	########	Palo Verde	11	709213
.	ROCKY STEEP SLOPES.			ONLY SOU	DOD-CHOC	########	Lion Head I	11	655367
MAPPED T	HABITAT C	Developme	POTENTIAL	3-4 APR 20	BLM	########	Clyde (321	11	698390
MAPPED T	HABITAT C	Developme	POTENTIAL	1 TORTOIS	BLM	########	Ninemile W	11	697034
MAPPED T	HABITAT C	ORV activit	POTENTIAL	11" FEMAL	BLM	########	Ninemile W	11	698243
MAPPED T	HABITAT C	Developme	POTENTIAL	A TORTOIS	BLM	########	Ninemile W	11	696032
OF THE INT	CREOSOTE	ORV activit	ORV'S.	3 FEMALES	BLM	########	Ninemile W	11	697515
MAPPED T	ROLLING H	Developme	POTENTIAL	1 OLD AND	BLM	########	Ninemile W	11	695737
MAPPED T	DESERT WA	Developme	PIPELINE C	1 TORTOIS	PVT-SF PAC	########	Buzzards P	11	699921
MAPPED W	HABITAT C	Developme	POTENTIAL	UP TO 5 TC	BLM, PVT-S	########	Buzzards P	11	698542
STATION 3	CREOSOTE	Developme	PIPELINE C	MALE TOR	BLM	########	Clyde (321	11	697509
STATION 3	CREOSOTE	Developme	PIPELINE C	TORTOISE (	BLM	########	Clyde (321	11	696645
MAPPED T	HABITAT C	ORV activit	POTENTIAL	11 INDIVID	BLM	########	Buzzards P	11	698452
MAPPED T	HABITAT C	ORV activit	POTENTIAL	3 TORTOIS	BLM	########	Buzzards P	11	699309
MAPPED T	HABITAT C	Developme	POTENTIAL	1 TORTOIS	BLM	########	Ninemile W	11	696637
E OF ARROY	IRONWOO	Developme	ORVS AND	1 ADULT O	BLM	########	Pegleg Wel	11	669453
OF INDIAN	DESERT PA	ORV activit	ORVS.	1 JUVENILE	BLM	########	Hedges (32	11	702075
EXACT LOCATION UNKNOWN. MAPPED BY CN				ONLY SOU	UNKNOWN	########	Cibola (331	11	713262
EXACT LOC	ALKALI SOIL.			MAIN SOU	UNKNOWN	########	Palo Verde	11	710433
T OF PEGLEG MINE, CHOCOLATE MOUNTAIN A				1 ADULT O	DOD-CHOC	########	Pegleg Wel	11	668815
MAPPED TO PROVIDED COORDINATES.				2 TORTOIS	STATE LAN	########	Pegleg Wel	11	667932
SE QUARTE	HABITAT C	ORV activit	POTENTIAL	10 INCH FE	BLM	########	Hedges (32	11	701613
MAPPED T	HABITAT C	ORV activit	POTENTIAL	10" FEMAL	BLM	########	Hedges (32	11	700920
NEAR CENT	HABITAT C	ORV activit	POTENTIAL	1 TORTOIS	BLM	########	Hedges (32	11	700243
OBSERVATI	DESERT WA	ORV activit	ORV TRAFF	30 MAR 20	BLM	########	Buzzards P	11	698247
MAPPED T	HABITAT C	ORV activit	POTENTIAL	1 ADULT M	BLM	########	Buzzards P	11	701039
NE 1/4 OF	HABITAT C	ORV activit	POTENTIAL	1 MATING	BLM	########	Buzzards P	11	702008
MAPPED T	HABITAT C	ORV activit	POTENTIAL	FEMALE TC	UNKNOWN	########	Palo Verde	11	703489
NEAR CENT	HABITAT C	ORV activit	POTENTIAL	SCAT LESS	BLM	########	Palo Verde	11	704932

MI NW OF	FLOODED [	Developme	CONTINUE	1 ADULT O	UNION PA(	########	Wister (33:	11	634102
LOCATION GIVEN AS, "EL CENTRO, IMPERIAL				2 INDIVIDU	UNKNOWN	########	El Centro (:	11	634594
LOCATION	CREOSOTE SCRUBLAND WITH PAT			1 ADULT O	BLM	########	Mount Sigr	11	617931
LOCATION	CREOSOTE SCRUBLAND WITH PAT			2 ADULTS (	BLM	########	Yuha Basin	11	609152
1.25 MILES	CREOSOTE SCRUBLAND WITH PAT			6 ADULTS (	BLM	########	Glamis SE (	11	681354
JUST NORT	CREOSOTE SCRUBLAND WITH PAT			1 ADULT O	BLM	########	Plaster City	11	604586
SOUTHEAS	CREOSOTE SCRUBLAND WITH PAT			3 ADULTS (	BLM	########	Plaster City	11	601100
SOUTH OF	CREOSOTE SCRUBLAND WITH PAT			5 ADULTS (	BLM	########	Plaster City	11	603749
MAPPED T(	OBS IN LO\	Biocides | I	BOTULISM	3 NESTS W	PVT-IMPER	########	Niland (331	11	629071
MAPPED T(	OBSERVED	Biocides | I	BOTULISM	NEST WITH	PVT-IMPER	########	Niland (331	11	629644
MAPPED T(	OBSERVED	Biocides | I	BOTULISM	5 NESTS OI	PVT-IMPER	########	Obsidian B	11	626655
1978 SPECI	2002: CRE(	Vehicle col	VEHICLE C(	1 DOR OBS	BLM	########	Kane Sprin	11	594654
1969-70: N	2000-1: EN	Other | Re	EXCESSIVE	4-6 DETECT	BLM	########	Imperial Re	11	736593
MAPPED T(	CATTAIL MARSHLAND WITH MATI			1 ADULT DI	USFWS-IMI	########	Picacho SW	11	714110
MAPPED T(	STEEP-SIDE	ORV activit	ORV USE A	1 INDIVIDU	BLM	########	Harpers W	11	600042
2006: ABO	2006: CLRA	Recreation	EXCESSIVE	CALIFORNI	BLM	########	Imperial Re	11	736255
2000: STAT	LEAST BITT	Recreation	EXCESSIVE	NONE DETI	BLM	########	Imperial Re	11	736410
LOCATION	LEAST BITT	Recreation	EXCESSIVE	1 ADULT HI	BLM	########	Imperial Re	11	736192
MAPPED B'	SAND DUNES. ASSOCIATED WITH			ONLY SOUI	BLM	########	Grays Well	11	689479
MAPPED B'	SPARSE DESERT SCRUB ON LOOSE			SITE BASED	BLM	########	Ogilby (321	11	702733
MAPPED ACCORDING		ORV activit	OHV USE.	PLANTS PR	BLM	########	Clyde (321:	11	690287
MAPPED B'	CREOSOTE BUSH SCRUB ON SAND			UNCOMM(	BLM	########	Tortuga (3:	11	653029
1988: "TRII	EMERGENT WETLAND VEGETATIC			4 DETECTEI	UNKNOWN	########	Frink NW (:	11	621565
TRANSECT	EMERGENT WETLAND VEGETATIC			NONE DETI	PVT-IMPER	########	Obsidian B	11	627667
MAPPED T(	EMERGENT WETLAND VEGETATIC			NONE DETI	USFWS-SOI	########	Calipatria S	11	620956
1989: EME	EVENS: AREA BULLDOZED BY USA(			13 DETECT	PVT-IMPER	########	Calipatria S	11	622778
SURVEY ST.	EMERGENT WETLAND VEGETATIC			6 BLACK RA	UNKNOWN	########	Seeley (321	11	620402
1984 & 198	EMERGENT WETLAND VEGETATIC			30-38 DETE	BLM, USBC	########	Midway W	11	671240
1979: BETV	FRESHWATER MARSH WITH EMEF			8+ DETECT	BLM	########	Laguna Dar	11	734619
1969-70: IN	EMERGENT WETLAND VEGETATIC			4-8 DETECT	BLM	########	Imperial Re	11	735564
2000-9 STU	FRESHWATER MARSH WITH EMEF			2+ DETECT	BLM	########	Imperial Re	11	735256
STUDY ARE	EMERGENT WETLAND VEGETATIC			1 DETECTEI	BLM	########	Imperial Re	11	735602
1973-4: "SI	FRESHWATER MARSH WITH EMEF			1 DETECTEI	BLM	########	Imperial Re	11	735718
BADLANDS	SPARSE CREOSOTE AND SALTBUSH			ONE FEMA	DPR-OCOTI	########	Seventeen	11	588498
ALONG WE	CREOSOTE	ORV activit	OHV RECRI	ONE ADUL	DPR-OCOTI	########	Shell Reef (	11	589134
RAINBOW	MUDHILL T	ORV activit	OHV RECRI	TWO FEMA	DPR-OCOTI	########	Shell Reef (	11	591803
LOCATED V	SUBSTRATI	ORV activit	OHV RECRI	TWO INDIV	DPR-OCOTI	########	Shell Reef (	11	592452
RAINBOW	VEGETATIC	ORV activit	OHV RECRI	ONE MALE	DPR-OCOTI	########	Shell Reef (	11	591875
EXACT LOC	2006: CRE(	ORV activit	OHV RECRI	FLAT-TAILE	BLM	########	Shell Reef (	11	592266
PLOT M09.	HEAVY OR(	ORV activit	OHV RECRI	ONE ADUL	DPR-OCOTI	########	Shell Reef (	11	588530
TAB 8 PLOT	HABITAT C	ORV activit	OHV RECRI	ONE OBSEI	DPR-OCOTI	########	Kane Sprin	11	597366
LOCATED V	HABITAT IS	ORV activit	OHV RECRI	ONE OBSEI	DPR-OCOTI	########	Shell Reef (	11	592878
LOCATED V	POGONOMYRMEX PRESENT ON P			ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	593120
TAB 12 PLOT. LOCATED BETWEEN MIDDLE FC				ONE FEMA	DPR-OCOTI	########	Kane Sprin	11	595485
RAINBOW	HABITAT C	ORV activit	OHV RECRI	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	594007
TAB 16 PLC	HABITAT C	ORV activit	OHV RECRI	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	595493
M07 PLOT.	HABITAT C	ORV activit	OHV RECRI	ONE OBSEI	DPR-OCOTI	########	Kane Sprin	11	595369

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VICINITY O	MUDHILL T	ORV activit	OHV RECRE	1 OBSERVE	DPR-OCOTI	########	Kane Sprin	11	594791
LOCATED J	HABITAT C	ORV activit	OHV RECRE	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	596920
SAN FELIPE	MUDHILL, S	ORV activit	OHV RECRE	1 FEMALE (	BLM	########	Kane Sprin	11	596327
LOCATED N	HABITAT C	ORV activit	OHV RECRE	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	597351
TAB15 PLO	HABITAT C	ORV activit	OHV RECRE	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	597758
SAN FELIPE	HABITAT C	ORV activit	OHV RECRE	ONE OBSEF	DPR-OCOTI	########	Kane Sprin	11	596635
VICINITY O	2006: MUD	ORV activit	OHV RECRE	20 CAPTUR	DPR-OCOTI	########	Kane Sprin	11	595491
M19 PLOT.	HABITAT C	ORV activit	OHV RECRE	ONE OBSEF	DPR-OCOTI	########	Kane Sprin	11	593531
BTW SITE I	2006: HABI	ORV activit	OHV RECRE	12 CAPTUR	BLM	########	Shell Reef (	11	592966
1991: LOCA	MUDHILL T	ORV activit	OHV RECRE	1 DETECTE	DPR-OCOTI	########	Shell Reef (	11	591013
1991: DETE	GRAVEL FL	ORV activit	OHV RECRE	1 DEAD LIZ	BLM, DPR-(	########	Shell Reef (	11	592738
2004: EXAC	2006: GRA	ORV activit	OHV RECRE	FLAT-TAILE	DPR-OCOTI	########	Shell Reef (	11	592163
2004: EXAC	2006: SANI	ORV activit	OHV RECRE	FLAT-TAILE	DPR-OCOTI	########	Kane Sprin	11	594003
SAN FELIPE	MUD FLAT	ORV activit	OHV RECRE	ONE FEMA	DPR-OCOTI	########	Kane Sprin	11	601727
SAN FELIPE	14 PLOT. L	ORV activit	OHV RECRE	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	602598
SAN FELIPE	HABITAT C	ORV activit	OHV RECRE	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	605256
SAN FELIPE 11 PLOT. ABOUT 0.7 MILE SSW OI				ONE FEMA	DPR-OCOTI	########	Kane Sprin	11	602186
ON NORTH	HABITAT C	ORV activit	OHV RECRE	ONE ADUL	UNKNOWN	########	Kane Sprin	11	603513
SAN FELIPE	HABITAT C	ORV activit	OHV RECRE	ONE ADUL	DPR-OCOTI	########	Kane Sprin	11	602890
BADLANDS 15 PLOT. 0.7 MILE SSE OF VABM 2				ONE ADUL	DPR-OCOTI	########	Seventeen	11	590905
PLOT 10. LOCATED 0.3 MILE WNW OF CAHUII				ONE INDIV	DPR-OCOTI	########	Shell Reef (	11	589107
SAND DUNES EAST OF POLE LINE ROAD, ALOI				2 MALES C	DPR-OCOTI	########	Kane Sprin	11	596410
SURVEY SIT	MARSH BY THE COLORADO RIVER			1 ADULT H	DPR-PICAC	########	Picacho (33	11	722998
LOCATED ON THE NORTH SIDE OF SAN FELIPE				ONE MALE	DPR-OCOTI	########	Shell Reef (	11	588117
MAPPED ACCORDING TO PROVIDED UTM CO				ONE MALE	DPR-OCOTI	########	Kane Sprin	11	599568
0.3 MILE SOUTH OF BENCHMARK 17/STATE R				ONE FEMA	DPR-OCOTI	########	Kane Sprin	11	602455
1 MILE NORTH OF MCCAIN SPRING. MAPPED				1 FEMALE (	UNKNOWN	########	Kane Sprin	11	595595
MAPPED T(	EMERGENT	Altered flo	CLEARING (	1 PAIR DET	PVT	########	Frink (3311	11	622451
SENATOR W	VEGETATIC	Recreation	EXCESSIVE	NONE SEEN	BLM	########	Imperial Re	11	737088
SET POINTS	VEGETATIC	Recreation	EXCESSIVE	NONE SEEN	BLM	########	Imperial Re	11	736473
CA SIDE OF	VEGETATIC	Recreation	EXCESSIVE	NONE SEEN	BLM	########	Imperial Re	11	736064
CA SIDE OF	VEGETATIC	Recreation	EXCESSIVE	NONE SEEN	BLM	########	Imperial Re	11	735492
SOUTH OF	EMERGENT WETLAND VEGETATIC			1 DETECTE	BLM	########	Imperial Re	11	735306
1991: STOI	EMERGENT WETLAND VEGETATIC			TWO RAILS	BIA-FORT Y	########	Bard (3211	11	730070
1987-2005	EMERGENT WETLAND VEGETATIC			THE AREA W	USFWS-SOI	########	Calipatria S	11	620385
1987-2005	EMERGENT WETLAND VEGETATIC			THE AREA W	USFWS-SOI	########	Niland (331	11	628181
1987-2005	EMERGENT WETLANDS VEGETATI			THE AREA W	USFWS-SOI	########	Niland (331	11	629016
JUST WEST	EMERGENT WETLAND VEGETATIC			184 TOTAL	DFG-IMPEF	########	Niland (331	11	631544
JUST SOUT	EMERGENT WETLAND VEGETATIC			16 DETECT	DFG-IMPEF	########	Niland (331	11	632126
POINTS MK	EMERGENT WETLAND VEGETATIC			8 CLRA RES	PVT-IMP IR	########	Obsidian Bu	11	627653
2007: OBSE	2007: SON(	ORV activit	2011: TRAF	1 FOUND D	BLM	########	Yuha Basin	11	613790
"WESTMORELAND"; "CA WESTMORELAND."				SDNHM CC	UNKNOWN	########	Westmorla	11	628845
LOCATION STATED AS "COYOTE MOUNTAINS.				SDNHM CA	UNKNOWN	########	Carrizo Mtı	11	590518
MAPPED BY CNDDB ACCORDING TO LOCALITY				COLLECTED	BLM	########	Grays Well	11	696547
LOCALITY GIVEN AS "OCOTILLO; CA 1.5 MI W				SDNHM CA	STATE, BLM	########	In-ko-pah (	11	590957
MAPPED BY	ALKALINE WASH.			ONLY SOUI	DPR-ANZA-	########	Carrizo Mtı	11	589089
EXACT LOCATION UNKNOWN. MAPPED BY CI				ONLY SOUI	DPR-ANZA-	########	Borrego M	11	582769

TRANSECT	ADJACENT TO CANAL. WASH WITH		ONLY SOUI	UNKNOWN	########	Wister (331	11	635753
1996 DETE	1996: A GE	Vehicle col	VEHICLE CC	DETECTED	BLM, UNKN	########	Kane Spring	11	606593
MAPPED B	IN SAND.			OCCURREN	UNKNOWN	########	In-ko-pah (	11	583784
CAS LOCALITY STATES "VIC. W. WINTERHAVEI				CALIFORNI	UNKNOWN	########	Yuma West	11	722293
LOCALITY STATES "OCOTILLO, 7.6 MILES NW (				ROYAL ONT	DPR-ANZA-	########	Carrizo Mtn	11	583535
SPECIMEN #13899: LOCALITY STATED AS "OC				ROYAL ONT	BLM, UNKN	########	Carrizo Mtn	11	593437
MAPPED B	SANDY SOIL WITH LARREA AND CI			ONLY SOUI	UNKNOWN	########	Grays Well	11	710370
MAPPED B	AT MARGIN	ORV activit	SLOPES SEV	SEVERAL TI	STATE LAN	########	Seventeen	11	587722
MAPPED IN	SANDY WA	ORV activit	ILLICIT OFF	>100 INDIV	DPR-OCOTI	########	Seventeen	11	589140
JUST SOUT	WASH ON :	ORV activit	ILLEGAL OF	SEVERAL H	DPR-OCOTI	########	Seventeen	11	591098
EXACT LOC	IN ARROYO BOTTOM AND SURRO			MENTIONE	UNKNOWN	########	Seventeen	11	590263
MAPPED B	ARROYO BOTTOM AND SURROUN			MENTIONE	DPR, STATE	########	Seventeen	11	586776
MAPPED B	ROCKY WASH BOUNDED BY MUDS			MENTIONE	STATE LAN	########	Seventeen	11	585990
EXACT LOC	SAND DUNES.			ONLY SOUI	BLM	########	Grays Well	11	689951
LOCATION	2002: BADLANDS HABITAT, COMP			3 MALES A	DPR-OCOTI	########	Shell Reef (	11	588935
JUST EAST OF POLE LINE ROAD. LOCATION GI				MVZ SPECI	DPR-OCOTI	########	Kane Spring	11	595397
EXACT LOCATION UNK		Agriculture	MOST OF T	ONLY SOUI	UNKNOWN	########	Holtville Ea	11	661124
NEAR "GAT	SANDY SOI	Agriculture	AGRICULTU	ONLY SOUI	UNKNOWN	########	Holtville NE	11	659710
E OF THE EAST HIGHLINE. MAPPED BY CNDDE				ONLY SOUI	UNKNOWN	########	Glamis NW	11	665618
2004: EXAC	2006: CREC	ORV activit	OHV RECRE	FLAT-TAILE	DPR-OCOTI	########	Kane Spring	11	593321
NORTH OF	STATE ROAD 111 WHERE IT CURVE			ONLY SOUI	PVT, BLM, :	########	Frink (3311	11	616924
(SPRING, N	IN WASH.			ONLY SOUI	DOD-CHOC	########	Frink NW (:	11	626847
MAPPED B	ALONG WASH IN DESERT WASH S			MAIN SOUI	BLM	########	Picacho Pe	11	720526
MAPPED B	IN SANDY WASH IN CREOSOTE BU			ONLY SOUI	UNKNOWN	########	Iris (33115:	11	649410
ON NORTH	AMONG ROCKS.			UNKNOWN	UNKNOWN	########	Little Picac	11	729633
MAPPED B	IN OPEN, SANDY, ILL-DEFINED WA			ONLY SOUI	UNKNOWN	########	Chuckwalla	11	669171
MAPPED TO THE COORDINATES G		OHVS. THE		TWO COLLI	BLM	########	Glamis (32:	11	680356
LOCATION GIVEN AS "5 MI. S. GLA		OHVS. THE		THREE BEE	BLM	########	Glamis (32:	11	682095
MAPPED W	ROCKY GRANITIC S-FACING SLOPE			56 PLANTS	BLM	########	Mt. Barrow	11	691343
EXACT LOCATION UNKNOWN. MAPPED BY CN				ONLY SOUI	USFWS-CIB	########	Cibola (331	11	713401
WESTBOUI	BOULDER (GRANITE) SLOPE.			ONLY SOUI	BLM	########	In-ko-pah (	11	585576
GROWING	SANDY WA	Foot traffic	TRAMPLIN	3 PLANTS (	DPR-PICAC	########	Picacho (33	11	722048
EXACT LOC	HIGH, ROCKY SLOPE.			ONLY SOUI	UNKNOWN	########	Picacho SW	11	711410
FREEMAN I	SANDY WASH.			ONE SET O	DPR-OCOTI	########	Seventeen	11	590279
JUST NORTH OF CONFLUENCE OF NORTH ANI				TWO MALE	DPR-ANZA-	########	Seventeen	11	586293
1.7 MILES WNW OF CLAY POINT, JUST OUTSII				ONE ADULT	STATE LAN	########	Seventeen	11	591686
EXACT LOCATION UNKNOWN. MAPPED BY CN				ONLY SOUI	UNKNOWN	########	In-ko-pah (	11	583980
WHERE TRI	NOT MUCH	Non-native	NON-NATIV	2 ADULTS &	PVT, USFW	########	Calipatria S	11	621229
U DRAIN LE	SURROUNI	Non-native	NON-NATIV	1 ADULT AI	BLM	########	Niland (331	11	631321
MAPPED A	GRANITIC SUBSTRATE WITH FOUC			NE POLYGC	BLM, PVT	########	In-ko-pah (	11	584321
T DRAIN LE	SURROUNI	Non-native	NON-NATIV	0 FOUND, :	UNKNOWN	########	Niland (331	11	631808
FISH FOUN	NOT MUCH	Non-native	NON-NATIV	FOUR JUVE	PVT-IMPER	########	Obsidian Bi	11	625948
WHERE NIL	FISH FOUN	Non-native	NON-NATIV	1 ADULT TI	DFG, IMPEI	########	Wister (331	11	629492
AT UNION	SHALLOW :	Altered flo	CHANGES I	20 ADULTS	PVT	########	Frink (3311	11	622436
RS CAVE ARI	CHAPARRAL AND DESERT SCRUB I			ONLY SOUI	BLM	########	In-ko-pah (	11	585191
EXACT LOCATION UNKNOWN. MAPPED BY CN				SITE BASED	UNKNOWN	########	Coyote We	11	594207
MAPPED B	GRAVELLY SILT EDGE OF WASH.			ONLY SOUI	BLM	########	Carrizo Mtn	11	589812

EEC ORIGINAL PKG

MAPPED B'	WASH WITH OLNEYA AND ENCELI.	ONLY SOUI	UNKNOWN	########	Seventeen	11	585546
MAPPED B'	ALONG A WASH WITH ENCELIA FA	SITE BASED	UNKNOWN	########	Seventeen	11	587445
FREEMAN I	IN ROCKY ARROYO AND SURROUN	SITE BASED	DPR-OCOTI	########	Seventeen	11	587536
FREEMAN I	IN ROCKY ARROYO AND SURROUN	SITE BASED	STATE LAN	########	Seventeen	11	589553
FREEMAN I	IN SANDY ARROYO AND SURROUN	~5 PLANTS	DPR-OCOTI	########	Seventeen	11	590305
FREEMAN I	IN ARROYO BOTTOM AND SURRO	SITE BASED	DPR, STATE	########	Seventeen	11	586931
FREEMAN I	IN ARROYO BOTTOM AND SURRO	SITE BASED	DPR-OCOTI	########	Seventeen	11	589700
FREEMAN I	IN SANDY ARROYO AND SURROUN	SITE BASED	STATE LAN	########	Seventeen	11	591241
FREEMAN I	IN ARROYO BOTTOM AND SURRO	SITE BASED	STATE LAN	########	Seventeen	11	586757
FREEMAN I	ON DRIED MUD AND SANDY SUBS	SITE BASED	DPR-OCOTI	########	Seventeen	11	590233
FREEMAN I	SANDY LOAM IN WASH OF MESA /	SITE BASED	STATE LAN	########	Seventeen	11	592144
I TRIBUTAR'	DESERT WA ORV activit	OFF-HIGHV	>20 PLANT	DPR-OCOTI ########	Seventeen	11	589856
FREEMAN I	MUD AND COBBLE SUBSTRATES. (	SITE BASED	DPR-OCOTI	########	Seventeen	11	587224
MAPPED A	ROADSIDE Road/trail (ILLEGAL DU	6 PLANTS S	DPR-OCOTI	########	Seventeen	11	589894
FREEMAN I	DESERT PAVEMENT AND MUD/CC	SITE BASED	STATE LAN	########	Seventeen	11	592588
FREEMAN I	SANDY WASHES AND COBBLY MU	SITE BASED	STATE LAN	########	Seventeen	11	591016
MAPPED B'	BARREN SLOPES OF UPLIFTED SED	SITE BASED	DPR-OCOTI	########	Seventeen	11	586172
MAPPED BY CNDDB AS BEST GUESS CENTERE		ONLY SOUI	UNKNOWN	########	Bard (3211	11	729107
EXACT LOC	SANDY SPOTS ON ROCKY SLOPES.	SITE BASED	UNKNOWN	########	In-ko-pah (	11	583784
EXACT LOC	CREOSOTE BUSH SCRUB.	SITE BASED	UNKNOWN	########	In-ko-pah (	11	592183
MAPPED B'	VOLCANIC SUBSTRATES WITH LAR	ONLY SOUI	BLM	########	Hedges (32	11	703112
ATELY 0.9 A	ALLUVIAL SLOPE. NARROW WASH	VERY LOCA	BLM	########	Clyde (321:	11	695158
MAPPED B'	IN WASHES AND ARROYOS GROW	ONLY SOUI	BLM	########	Quartz Pea	11	699949
EXACT LOCATION UNKNOWN. MAPPED BY CN		ONLY SOUI	UNKNOWN	########	Buzzards P	11	699226
MAPPED BY CNDDB AC Mining	MINING AC	SITE BASED	PVT	########	Ninemile W	11	689418
MAPPED B'	SANDY SOIL WITH LARREA, AMBR	ONLY SOUI	UNKNOWN	########	Bard (3211	11	722953
EXACT LOC	IN SHALLOW, SANDY WASH WITH	ONLY SOUI	UNKNOWN	########	Araz (3211	11	716629
MAPPED A	GRANITIC E ORV activit AREA DISTU	UNKNOWN	BLM	########	In-ko-pah (	11	585352
APPROXIM	IN THE BOULDERS. CHAPARRAL W	ONLY SOUI	SDG COUN	########	In-ko-pah (	11	583666
BLOCK COD	UPLAND ELEVATION SUBREGION.	3 BREEDIN	UNKNOWN	########	Bonds Corr	11	652652
BLOCK COD	UPLAND ELEVATION SUBREGION.	1 ADULT O	UNKNOWN	########	Bonds Corr	11	653884
ALONG WE	UPLAND ELEVATION SUBREGION.	1 ADULT EA	UNKNOWN	########	Bonds Corr	11	653366
N OF MT SI	LOWLAND ELEVATION SUBREGIOI	1 ADULT O	UNKNOWN	########	Mount Sigr	11	625122
ALONG W S	LOWLAND ELEVATION SUBREGIOI	1 ADULT O	UNKNOWN	########	Heber (321	11	629214
BLOCK COD	LOWLAND ELEVATION SUBREGIOI	1 ADULT O	UNKNOWN	########	Heber (321	11	629858
ALONG WA	OWLS FOUND AT DRAIN DITCH. A	1 BREEDIN	PVT-IMPER	########	Holtville Ea	11	660553
ON WARRE	CANTALOUPE FIELD AND DRAIN D	1 ADULT O	PVT-IMPER	########	Holtville Ea	11	660075
N OF EAST	ALFALFA AGRICULTURE AND DRAI	1 ADULT O	PVT-IMPER	########	Holtville Ea	11	660197
N OF EAST	ALFALFA AGRICULTURE AND DRAI	1 ADULT O	PVT-IMPER	########	Holtville Ea	11	660045
BLOCK COD	ALFALFA AGRICULTURE AND DRAI	1 BREEDIN	PVT-IMPER	########	El Centro (3	11	636056
BETWEEN I	ALFALFA AGRICULTURE AND DRAI	1 BREEDIN	PVT-IMPER	########	El Centro (3	11	636438
BLOCK COD	ALFALFA AGRICULTURE, DRAIN DI	1 BREEDIN	PVT-IMPER	########	El Centro (3	11	635269
BLOCK COD	ALFALFA AGRICULTURE AND DRAI	1 BREEDIN	PVT-IMPER	########	El Centro (3	11	638328
BLOCK COD	ALFALFA AGRICULTURE AND DRAI	1 BREEDIN	PVT-IMPER	########	El Centro (3	11	638041
ALONG OH	ALFALFA AGRICULTURE IN AREA. I	2 BREEDIN	PVT	########	Holtville NE	11	652090
ALONG OH	ALFALFA AGRICULTURE IN AREA. I	1 BREEDIN	PVT	########	Holtville NE	11	652941
ALONG OH	ALFALFA AGRICULTURE IN AREA. I	3 JUVENILE	PVT	########	Holtville NE	11	654196

BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 JUVENILE	PVT	########	Holtville NI	11	654767
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	655370
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	657485
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	658200
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	658706
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	658218
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	657291
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	656635
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	656164
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 BREEDIN(	UNKNOWN	########	Holtville NI	11	655324
BLOCK COI	ALFALFA AGRICULTURE IN AREA. I			15 JUL 200	PVT	########	Holtville NI	11	654715
ALONG OLI	AREA SURROUNDED BY AGRICULT			2 JUVENILE	PVT	########	Holtville NI	11	654275
ALONG OLI	ALFALFA AGRICULTURE IN AREA. I			3 JUVENILE	PVT	########	Holtville NI	11	653524
ALONG OLI	TILLED FIELD IN AREA. LOWLAND			1 ADULT O	PVT	########	Holtville NI	11	652585
ALONG OR	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	UNKNOWN	########	Holtville NI	11	656911
ALONG OR	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	UNKNOWN	########	Holtville NI	11	657360
ALONG OR	LOWLAND ELEVATION SUBREGIOI			2 ADULTS (	UNKNOWN	########	Holtville NI	11	657832
ALONG OR	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	UNKNOWN	########	Holtville NI	11	658649
ALONG OR.	LOWLAND ELEVATION SUBREGIOI			2 JUVENILE	PVT	########	Holtville NI	11	654759
ALONG OR.	ALFALFA AGRICULTURE IN AREA. I			1 ADULT O	PVT	########	Holtville NI	11	653293
ALONG OX.	TILLED FIELD AT 18 AND ALFALFA			1 ADULT O	PVT	########	Holtville NI	11	652248
ALONG OX.	ALFALFA AGRICULTURE IN AREA. I			1 ADULT O	PVT	########	Holtville NI	11	653055
JUST NORT	SLIGHTLY S	Developme	THREATEN	IN 2010, 24	BLM	########	Painted Go	11	600663
JUST NORT	SLIGHTLY S	Developme	THREATEN	7 PLANTS V	BLM	########	Painted Go	11	601555
BETWEEN (	SLIGHTLY S	Developme	THREATEN	3 PLANTS V	BLM	########	Painted Go	11	604806
MUNYON I	HABITAT TYPE IS AN IRRIGATION (			1 BREEDIN(	PVT	########	Amos (331	11	655314
ALONG MY	HABITAT TYPE IS AN IRRIGATION (			1 ADULT O	PVT	########	Amos (331	11	655578
BLOCK COI	HABITAT TYPE IS LISTED AS IRRIGA			1 ADULT O	PVT	########	Amos (331	11	655870
ALONG MA	LOWLAND ELEVATION SUBREGIOI			2 BREEDIN(	UNKNOWN	########	Wiest (331	11	649433
ALONG MA	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	UNKNOWN	########	Wiest (331	11	647828
ALONG MA	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	PVT	########	Wiest (331	11	645969
ALONG ME	HABITAT TYPE IS LISTED AS FIELD (			1 BREEDIN(	PVT	########	Wiest (331	11	646665
ALONG ME	HABITAT TYPE IS LISTED AS FIELD (			1 BREEDIN(	PVT	########	Wiest (331	11	648117
ALONG ME	HABITAT TYPE IS LISTED AS FIELD (			4 ADULTS (	PVT	########	Wiest (331	11	649021
ALONG ME	HABITAT TYPE IS LISTED AS FIELD (			2 ADULTS (	PVT	########	Wiest (331	11	649720
ALONG MA	HABITAT TYPE IS LISTED AS FIELD ,			2 ADULTS (	PVT	########	Wiest (331	11	648125
ALONG MA	HABITAT TYPE IS LISTED AS FIELD ,			1 BREEDIN(	PVT	########	Wiest (331	11	646196
ALONG MA	HABITAT TYPE IS LISTED AS FIELD (			1 BREEDIN(	PVT	########	Wiest (331	11	645012
ALONG MU	HABITAT TYPE IS LISTED AS FIELD (			1 ADULT O	PVT	########	Wiest (331	11	645142
BLOCK COI	HABITAT TYPE IS LISTED AS IDLE O			1 PAIR OBS	PVT	########	Westmorla	11	628544
BLOCK COI	HABITAT TYPE IS LISTED AS GRAIN			1 ADULT O	PVT	########	Calipatria S	11	624689
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	PVT	########	Calipatria S	11	624681
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	PVT	########	Calipatria S	11	624676
ALONG TRI	LOWLAND ELEVATION SUBREGIOI			10 OWLS C	PVT	########	Calipatria S	11	624830
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	PVT	########	Calipatria S	11	624557
BLOCK COI	LOWLAND ELEVATION SUBREGIOI			1 ADULT O	PVT	########	Calipatria S	11	624491
BLOCK COI	UPLAND ELEVATION SUBREGION.			1 ADULT O	PVT	########	Bonds Corr	11	653918

E OF VAIL 6	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Calipatria S	11	626118
BLOCK COD	HABITAT TYPE LISTED AS GRAIN O	2 ADULTS (	PVT	########	Calipatria S	11	623840
BLOCK COD	HABITAT TYPE LISTED AS DISKED I	2 ADULTS (	PVT	########	Calipatria S	11	623732
BLOCK COD	HABITAT TYPE LISTED AS DISKED F	1 PERCHED	PVT	########	Calipatria S	11	623858
BLOCK COD	HABITAT TYPE LISTED AS GRAIN O	1 ADULT O	PVT	########	Calipatria S	11	623862
BLOCK COD	HABITAT TYPE LISTED AS DISKED I	1 ADULT O	PVT	########	Calipatria S	11	623882
BLOCK COD	HABITAT TYPE LISTED AS DISKED I	1 ADULT O	PVT	########	Calipatria S	11	623880
BLOCK COD	HABITAT TYPE LISTED AS GRAIN O	1 ADULT O	PVT	########	Calipatria S	11	623685
BLOCK COD	HABITAT TYPE LISTED AS GRAIN O	1 BREEDIN	PVT	########	Calipatria S	11	622923
BLOCK 365	HABITAT TYPE LISTED AS GRAIN O	10 UNIQUE	PVT	########	Calipatria S	11	623110
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Calipatria S	11	623056
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Calipatria S	11	623071
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Calipatria S	11	623087
ALONG TRI	LOWLAND ELEVATION SUBREGIOI	4 ADULTS (	PVT	########	Calipatria S	11	622858
BLOCK COD	LOWLAND ELEVATION SUBREGIOI	1 ADULT O	PVT	########	Calipatria S	11	622045
BLOCK COD	LOWLAND ELEVATION SUBREGIOI	1 BREEDIN	PVT	########	Calipatria S	11	622274
ARTIFICIAL	HABITAT TYPE LISTED AS IDLE OR	14 DIFFERE	PVT, USFW	########	Calipatria S	11	621281
BLOCK COD	HABITAT TYPE LISTED AS FIELD CR	1 ADULT O	PVT, USFW	########	Calipatria S	11	621074
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Obsidian B	11	626093
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	2 ADULTS (	PVT	########	Obsidian B	11	626896
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	2 ADULTS (	PVT	########	Obsidian B	11	627702
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Obsidian B	11	627713
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Obsidian B	11	627721
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Niland (331	11	629327
ALONG D D	HABITAT TYPE LISTED AS DRAIN D	2 ADULTS (	PVT	########	Iris (33115	11	648988
ALONG D D	HABITAT TYPE LISTED AS DRAIN D	1 ADULT O	PVT	########	Iris (33115	11	645679
ALONG E D	HABITAT TYPE LISTED AS DRAIN D	1 ADULT O	PVT	########	Iris (33115	11	645061
ALONG E D	HABITAT TYPE LISTED AS DRAIN D	2 ADULTS /	PVT	########	Iris (33115	11	646392
ALONG E D	HABITAT TYPE LISTED AS DRAIN D	2 ADULTS (	PVT	########	Iris (33115	11	647270
ALONG E D	HABITAT TYPE LISTED AS DRAIN D	1 ADULT AI	PVT	########	Iris (33115	11	647922
EXACT LOCATION UNK	Surface wa BLUE LAKE	ONLY SOUI	UNKNOWN	########	Seeley (321	11	622790
ALONG F D	HABITAT TYPE LISTED AS DRAIN D	1 ADULT O	PVT	########	Iris (33115	11	647861
ALONG F D	HABITAT TYPE LISTED AS DRAIN D	1 ADULT O	PVT	########	Iris (33115	11	646566
ALONG F D	HABITAT TYPE LISTED AS DRAIN D	1 ADULT O	PVT	########	Iris (33115	11	645257
ALONG G D	HABITAT TYPE LISTED AS DRAIN D	1 ADULT O	PVT	########	Iris (33115	11	646000
ALONG NIL	HABITAT TYPE LISTED AS IRRIGATI	1 ADULT O	PVT	########	Wister (331	11	636126
JUST NORT	HABITAT TYPE LISTED AS NATURA	2 ADULTS (	PVT	########	Wister (331	11	636725
ALONG Y L	HABITAT TYPE LISTED AS IRRIGATI	2 ADULTS (	PVT	########	Wister (331	11	636218
ALONG W I	HABITAT TYPE LISTED AS IRRIGATI	1 ADULT O	PVT	########	Wister (331	11	637619
BLOCK COD	HABITAT TYPE LISTED AS CEMENT	1 ADULT O	PVT	########	Wister (331	11	637127
BLOCK COD	HABITAT TYPE LISTED AS IDLE OR	1 ADULT O	PVT	########	Wister (331	11	637549
EXACT LOC	SURROUND Surface wa LAKE HAS E	ONLY SOUI	UNKNOWN	########	Plaster City	11	614925
0.1 MI NW	HABITAT TYPE LISTED AS IDLE OR	1 ADULT AI	PVT	########	Truckhaver	11	597579
EXACT LOCATION UNKNOWN. MAPPED BY CI		ONLY SOUI	DPR-ANZA-	########	Oasis (331	11	583884
ALONG RO	TRANSITION BETWEEN DESERT AI	ONLY SOUI	UNKNOWN	########	In-ko-pah (	11	583539
MAPPED A	CATTAIL MARSH WITH MATURE P	UP TO 4 BII	USFWS-IMI	########	Picacho SW	11	714079
MAPPED A	BACKWATER CHANNELS LINED WI	1 DETECTEI	USFWS-CIB	########	Cibola (331	11	715209

LOCATION	DISTURBED DESERT SCRUB & DES			ADULTS SE	BLM	########	Iris (33115	11	649443
ALONG MI	HABITAT CONSISTS OF TAMARISK			PAIR OBSE	USFWS-CIB	########	Cibola (331	11	711156
MAPPED A	HABITAT CONSISTS OF MESQUITE			TWO BREE	PVT	########	Palo Verde	11	709346
ALONG MA	LOWLAND ELEVATION SUBREGIO			1 ADULT O	UNKNOWN	########	Wiest (331	11	650045
ALONG MA	LOWLAND ELEVATION SUBREGIO			2 ADULTS (	UNKNOWN	########	Wiest (331	11	650849
ALONG ML	LOWLAND ELEVATION SUBREGIO			1 ADULT O	UNKNOWN	########	Wiest (331	11	651693
ALONG MA	HABITAT CONSISTS OF GRASS FIEL			2 ADULTS (	UNKNOWN	########	Wiest (331	11	650640
ALONG MA	LOWLAND ELEVATION SUBREGIO			2 ADULTS (	UNKNOWN	########	Wiest (331	11	651168
ALONG ME	HABITAT CONSISTS OF FIELD CRO			2 ADULTS (	UNKNOWN	########	Amos (331	11	652041
ALONG MA	HABITAT CONSISTS OF GRASS FIEL			2 ADULTS (	UNKNOWN	########	Amos (331	11	651861
NEAR BAN	HABITAT CONSISTS OF IDLE OR FA			1 MALE AD	PVT	########	Niland (331	11	629257
MAPPED T	HABITAT C	Waterway	THREATS I	1 ADULT &	PVT-IMPER	########	Mount Sig	11	622985
MAPPED T	HABITAT C	Waterway	THREATS I	2 ADULTS	PVT-IMPER	########	Seeley (321	11	618277
MAPPED T	HABITAT C	Waterway	THREATS I	1 ADULT O	PVT-IMPER	########	Seeley (321	11	618081
MAPPED T	HABITAT C	Waterway	THREATS I	3 ADULTS (	PVT-IMPER	########	Plaster City	11	616613
MAPPED T	HABITAT C	Waterway	THREATS I	3 ADULTS (	PVT-IMPER	########	Wister (33	11	635524
MAPPED T	HABITAT C	Waterway	THREATS I	4 ADULTS	PVT-IMPER	########	Calipatria S	11	619798
MAPPED T	HABITAT C	Waterway	THREATS I	1 ADULT O	PVT-IMPER	########	Calipatria S	11	624426
MAPPED T	HABITAT C	Waterway	THREATS I	1 ADULT O	DFG-IMPE	########	Niland (331	11	631609
MAPPED T	HABITAT C	Waterway	THREATS I	1 ADULT O	PVT-IMPER	########	El Centro (	11	638736
MAPPED T	HABITAT C	Waterway	THREATS I	1 ADULT M	PVT-IMPER	########	Amos (331	11	654925
MAPPED T	HABITAT C	Altered flo	THREATS I	1 NON REP	BLM	########	Laguna Da	11	736057
MAPPED TO PROVIDED COORDINATES.				THE FOLLO	UNKNOWN	########	Seeley (321	11	617605
				2 FEMALES	UNKNOWN	########	Ogilby (321	11	702138
EXACT LOC	EDGE OF WASH.			SITE BASED	UNKNOWN	########	Borrego M	11	584700
COLORADC	STATIONS 106 (NW FEATURE) & 1			1 ADULT H	BLM	########	Imperial Re	11	736257
ALONG E S	VACANT R	Vehicle col	POSSIBLY T	2 OWLS OE	UNKNOWN	########	El Centro (	11	638721
ALONG ALI	VACANT R	Vehicle col	POSSIBLY T	14 ACTIVE	UNKNOWN	########	El Centro (	11	638680
ALONG ALI	VACANT R	Vehicle col	POSSIBLY T	2 OWLS OE	UNKNOWN	########	El Centro (	11	638673
ABOUT 15(	VACANT R	Vehicle col	POSSIBLY T	OWLS OBS	UNKNOWN	########	El Centro (	11	638583
NEAR THE	VACANT R	Vehicle col	POSSIBLY T	3 EAST-FAC	UNKNOWN	########	El Centro (	11	638607
ALONG RO	VACANT R	Vehicle col	POSSIBLY T	20 BURRO	UNKNOWN	########	El Centro (	11	639419
"183 FEET	VACANT R	Vehicle col	POSSIBLY T	3 OWLS OE	UNKNOWN	########	Brawley (3	11	639259
NORTH OF	VACANT R	Vehicle col	POSSIBLY T	10 BURRO	UNKNOWN	########	Brawley (3	11	639310
ALONG THI	VACANT R	Vehicle col	POSSIBLY T	1 NORTH-F	UNKNOWN	########	Brawley (3	11	639340
ALONG THI	VACANT R	Vehicle col	POSSIBLY T	4 ACTIVE B	UNKNOWN	########	Brawley (3	11	639318
E OF BEST	VACANT R	Vehicle col	POSSIBLY T	EAST-FACI	UNKNOWN	########	Westmorla	11	639260
ALONG BES	VACANT R	Vehicle col	POSSIBLY T	5 ACTIVE B	UNKNOWN	########	Westmorla	11	639185
MAPPED T	VACANT R	Vehicle col	POSSIBLY T	6 BURROW	UNKNOWN	########	Westmorla	11	638972
1 BURROW	VACANT R	Vehicle col	POSSIBLY T	2 ACTIVE B	UNKNOWN	########	Westmorla	11	639169
MAPPED T	SONORAN	Developme	THREATEN	1 ADULT O	UNKNOWN	########	Plaster City	11	613035
MAPPED T	SONORAN	Developme	BURROW S	1 DECEASE	BLM	########	Yuha Basin	11	613850
MAPPED TO PROVIDE		Developme	THREATEN	BURROWIN	UNKNOWN	########	Plaster City	11	609328
MAPPED TO PROVIDE		Developme	THREATEN	BURROW V	BLM	########	Plaster City	11	610679
MAPPED TO PROVIDE		Developme	THREATEN	BURROW V	BLM	########	Plaster City	11	611587
MAPPED TO PROVIDE		Developme	THREATEN	BURROW V	BLM	########	Plaster City	11	605760
MAPPED TO PROVIDE		Developme	THREATEN	BURROW V	BLM	########	Yuha Basin	11	612471

MAPPED TO PROVIDEI	Developme	THREATEN	BURROW V	BLM	########	Plaster City	11	609861
MAPPED TO PROVIDEI	Developme	THREATEN	BURROW V	BLM	########	Plaster City	11	610363
MAPPED TO PROVIDEI	Developme	THREATEN	BURROW V	BLM	########	Plaster City	11	606291
ALONG OX.	HABITAT DESCRIBED AS ALFALFA/		2 JUVENILE	PVT	########	Holtville NI	11	654182
ALONG OX.	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	PVT	########	Holtville NI	11	655012
ALONG OX.	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Holtville NI	11	656418
ALONG OX.	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Holtville NI	11	658564
ALONG OLI	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Holtville NI	11	658376
ALONG OLI	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Holtville NI	11	655655
ALONG OLI	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Holtville NI	11	654306
ALONG OR	HABITAT DESCRIBED AS ALFALFA/		1 ADULT O	PVT	########	Holtville NI	11	654025
ALONG OR	HABITAT DESCRIBED AS ALFALFA /		1 JUVENILE	PVT	########	Holtville NI	11	652467
ALONG OR	HABITAT DESCRIBED AS TILLED FIE		1 ADULT O	PVT	########	Holtville NI	11	651945
ALONG MC	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	645329
ALONG MC	LOWLAND ELEVATION SUBREGIOI		2 ADULTS (	UNKNOWN	########	Alamorio (:	11	646934
ALONG MC	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	647742
ALONG MC	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	648871
ALONG MC	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	650574
ALONG OA	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	651185
ALONG OA	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	649756
ALONG OA	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	647835
ALONG OA	LOWLAND ELEVATION SUBREGIOI		2 ADULTS (	UNKNOWN	########	Alamorio (:	11	647019
ALONG OA	LOWLAND ELEVATION SUBREGIOI		2 ADULTS (	UNKNOWN	########	Alamorio (:	11	646122
ALONG OA	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	645603
ALONG OS.	LOWLAND ELEVATION SUBREGIOI		2 ADULTS (	UNKNOWN	########	Alamorio (:	11	648426
ALONG OS.	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	649739
OSAGE DR.	LOWLAND ELEVATION SUBREGIOI		1 ADULT O	UNKNOWN	########	Alamorio (:	11	650990
JUST SSE O	SAILFIN MC	Non-native	NON-NATI\ 13 SPECIM	BLM, OTHE	########	Kane Spring	11	609239
ALONG OR	HABITAT DESCRIBED AS CANAL W		1 ADULT O	PVT	########	Alamorio (:	11	650100
ALONG OR	HABITAT DESCRIBED AS IRRIGATIC		2 JUVENILE	PVT	########	Alamorio (:	11	649607
ALONG OR	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	645801
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	645974
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	647075
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	647957
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	649576
ALONG OLI	HABITAT DESCRIBED AS ALFALFA /		1 JUVENILE	PVT	########	Alamorio (:	11	650410
ALONG OLI	HABITAT DESCRIBED AS ALFALFA /		1 ADULT O	PVT	########	Alamorio (:	11	651782
ALONG OH	HABITAT DESCRIBED AS TILLED FIE		1 JUVENILE	PVT	########	Alamorio (:	11	650867
ALONG OH	HABITAT DESCRIBED AS AN IRRIG/		3 JUVENILE	PVT	########	Alamorio (:	11	649509
ALONG OH	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	648855
ALONG OH	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	648015
ALONG OH	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	647386
ALONG OH	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	645038
ALONG OR.	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	645501
ALONG OR.	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT AI	PVT	########	Alamorio (:	11	646545
ALONG OR.	HABITAT DESCRIBED AS IRRIGATIC		1 ADULT O	PVT	########	Alamorio (:	11	647136
ALONG OR.	HABITAT DESCRIBED AS IRRIGATIC		2 JUVENILE	PVT	########	Alamorio (:	11	648365

ALONG OR.	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT O	PVT		########	Alamorio (:	11	649622
ALONG OR.	HABITAT DESCRIBED AS BERMUD/	1 JUVENILE	PVT		########	Alamorio (:	11	651442
ALONG OX.	HABITAT DESCRIBED AS ALFALFA /	1 JUVENILE	PVT		########	Alamorio (:	11	650711
ALONG OX.	HABITAT DESCRIBED AS IRRIGATIC	2 JUVENILE	PVT		########	Alamorio (:	11	649506
MAPPED GENERALLY TO THE ENTRANCE TO S		USNM SPE(	UNKNOWN		########	Yuma East	11	723447
ALONG OX.	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT AI	PVT		########	Alamorio (:	11	648657
ALONG OX.	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT O	PVT		########	Alamorio (:	11	647817
ALONG OX.	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT O	PVT		########	Alamorio (:	11	647342
ALONG OX.	HABITAT DESCRIBED AS IRRIGATIC	1 JUVENILE	PVT		########	Alamorio (:	11	646789
ALONG OX.	HABITAT DESCRIBED AS IRRIGATIC	3 JUVENILE	PVT		########	Alamorio (:	11	646269
MAPPED T(	HABITAT C(Agriculture	THREATS IN	2 ADULT M	PVT-IMPER	########	Bard (3211	11	732083
ALONG OX.	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT O	PVT		########	Alamorio (:	11	645825
LOCATED E	HABITAT DESCRIBED AS CLOVER A	2 ADULTS (	UNKNOWN		########	Alamorio (:	11	645036
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT &	PVT		########	Alamorio (:	11	646154
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT O	PVT		########	Alamorio (:	11	648391
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC	2 ADULTS (	PVT		########	Alamorio (:	11	649307
ALONG OLI	HABITAT DESCRIBED AS IRRIGATIC	1 ADULT O	PVT		########	Alamorio (:	11	649948
ALONG OC	HABITAT DESCRIBED AS AGRICULT	1 ADULT O	UNKNOWN		########	Alamorio (:	11	647227
ALONG OC	HABITAT DESCRIBED AS AGRICULT	1 ADULT O	UNKNOWN		########	Alamorio (:	11	645625
ALONG OR	HABITAT DESCRIBED AS ALFALFA /	2 ADULTS (	PVT		########	Alamorio (:	11	645146
ALONG OR	LOWLAND ELEVATION SUBREGIOI	1 ADULT O	PVT		########	Alamorio (:	11	645718
ALONG OR	HABITAT DESCRIBED AS ALFALFA /	1 ADULT O	UNKNOWN		########	Alamorio (:	11	646950
ALONG OR	HABITAT DESCRIBED AS ALFALFA /	1 ADULT O	UNKNOWN		########	Alamorio (:	11	648160
ALONG OA	HABITAT DESCRIBED AS ALFALFA /	1 ADULT O	UNKNOWN		########	Alamorio (:	11	648297
ALONG OA	HABITAT DESCRIBED AS HARVESTI	1 ADULT O	PVT		########	Alamorio (:	11	646257
ALONG OA	LOWLAND ELEVATION SUBREGIOI	1 ADULT O	UNKNOWN		########	Alamorio (:	11	645626
ALONG AN	HABITAT DESCRIBED AS A FALLOW	1 ADULT O	UNKNOWN		########	Alamorio (:	11	645070
ALONG OA	HABITAT DESCRIBED AS SUGAR BE	1 ADULT O	UNKNOWN		########	Alamorio (:	11	645560
ALONG OA	HABITAT DESCRIBED AS A CORN F	2 ADULTS (	UNKNOWN		########	Alamorio (:	11	646436
ALONG OA	HABITAT DESCRIBED AS ALFALFA I	1 ADULT O	UNKNOWN		########	Alamorio (:	11	647935
ALONG OA	HABITAT DESCRIBED AS FALLOW F	1 ADULT O	UNKNOWN		########	Alamorio (:	11	648745
ALONG OA	HABITAT DESCRIBED AS ALFALFA I	1 ADULT O	UNKNOWN		########	Alamorio (:	11	650182
ALONG TO'	HABITAT DESCRIBED AS ALFALFA I	1 ADULT O	PVT		########	Alamorio (:	11	651184
ALONG TO'	HABITAT DESCRIBED AS ALFALFA I	1 ADULT O	UNKNOWN		########	Alamorio (:	11	647943
TYPE LOCALITY GIVEN	Developme	CALEXICO I	TYPE SPECI	UNKNOWN	########	Calexico (3	11	641015
MSU SPECIMEN LOCATION STATED AS "5 MI.		BERNARD E	BLM, STATI		########	Bard (3211	11	728713
ALONG OSAGE DRAIN. BLOCK CODE 3650-65(		1 ADULT O	UNKNOWN		########	Holtville NI	11	652385
ALONG OSAGE DRAIN. BLOCK CODE 3650-65(		1 ADULT O	UNKNOWN		########	Holtville NI	11	653101
ALONG OSAGE DRAIN. BLOCK CODE 3650-65(		1 ADULT O	UNKNOWN		########	Holtville NI	11	654178
ALONG OSAGE DRAIN. BLOCK CODE 3650-65(		2 ADULTS (	UNKNOWN		########	Holtville NI	11	655216
ALONG OSAGE DRAIN. BLOCK CODE 3650-65(		1 ADULT O	UNKNOWN		########	Holtville NI	11	657163
ALONG TO'	HABITAT DESCRIBED AS ALFALFA I	1 ADULT O	UNKNOWN		########	Alamorio (:	11	646415
MAPPED T(	HABITAT C(Mining	POSSIBLY T	1 ADULT M	BLM, PVT-E	########	Ogilby (321	11	707119
ON THE NC	GENERALLY Developme	PROPOSED	ABOUT 30	BLM	########	Chuckwalla	11	667889
ARTIFICIAL BURROW #38 (EAST), 39 (CENTER)		7 DIFFEREN	UNKNOWN		########	Calipatria S	11	621588
ARTIFICIAL BURROW #10 (WEST) AND 50 (EA:		3 OWLS CA	PVT, USFW		########	Obsidian B	11	628078
ARTIFICIAL BURROW #07. MAPPED TO PROVI		2 OWLS CA	PVT, USFW		########	Niland (331	11	629024

ARTIFICIAL BURROW #12. MAPPED TO PROVI	2 OWLS CA	DFG-IMPEF	########	Niland (331	11	631790
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Mt. Barrow	11	690192
MAPPED B' IN A CREOSOTE BUSH SCRUB COM	MAIN SOU	DOD-CHOC	########	Mammoth	11	670622
1.4 MI STR SURROUND Agriculture AGRICULTU	1998: TWO	UNKNOWN	########	Bonds Corr	11	652801
STOP NO. 1: S END OF HAUGHTELIN LAKE IN 1	2 RAILS SIG	UNKNOWN	########	Bard (3211	11	725877
MAPPED TO 2001 COORDINATES. 1982 DATA	BURROW A	STATE LAN	########	Mt. Barrow	11	688475
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Mt. Barrow	11	689688
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Mt. Barrow	11	689736
MAPPED TO PROVIDED COORDINATES.	FEMALE (2	DOD-CHOC	########	Mt. Barrow	11	690530
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Mt. Barrow	11	689642
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Mt. Barrow	11	690026
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Mt. Barrow	11	689868
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Mt. Barrow	11	690237
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Mt. Barrow	11	691394
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Mt. Barrow	11	691642
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Mt. Barrow	11	691305
ABOUT 1 MILE NNW OF PAYMASTER MINE. M	MALE TOR	BLM	########	Mt. Barrow	11	694302
ABOUT 1.5 MILES NW OF PAYMASTER MINE.	MALE TOR	UNKNOWN	########	Mt. Barrow	11	693762
MAPPED TO PROVIDED COORDINATES.	1 MALE (27	BLM	########	Mt. Barrow	11	694259
2004 & 2008 DATA MAPPED TO PROVIDED C(	1 BURROW	BLM	########	Mt. Barrow	11	693116
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	BLM	########	West of Pa	11	688798
MAPPED TO PROVIDED COORDINATES.	CARCASS C	BLM	########	West of Pa	11	690111
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	BLM, UNKN	########	West of Pa	11	690503
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	UNKNOWN	########	West of Pa	11	691889
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	BLM	########	West of Pa	11	694937
SMOKETREE VALLEY. MAPPED TO PROVIDED	CARCASS C	BLM	########	West of Pa	11	691959
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	BLM	########	West of Pa	11	695015
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	BLM	########	West of Pa	11	695753
MAPPED TO PROVIDED COORDINATES.	CARCASS C	BLM	########	Mt. Barrow	11	697601
MAPPED TO PROVIDED COORDINATES.	1 FEMALE (	BLM	########	West of Pa	11	695440
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	BLM	########	Buzzards P	11	704515
MAPPED TO PROVIDED COORDINATES.	1 FEMALE	BLM	########	Buzzards P	11	699957
MAPPED T HABITAT C ORV activit THREATS IN	USEABLE L(	BLM	########	Buzzards P	11	701352
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	BLM	########	Buzzards P	11	700817
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	BLM	########	Palo Verde	11	706266
MAPPED TO PROVIDED COORDINATES.	CARCASS C	BLM	########	Palo Verde	11	698779
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	BLM	########	Palo Verde	11	700053
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	BLM	########	Palo Verde	11	701791
MAPPED TO PROVIDED COORDINATES.	MALE TOR	UNKNOWN	########	Palo Verde	11	702727
MAPPED TO PROVIDED COORDINATES.	INTACT CA	BLM	########	Palo Verde	11	702314
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	BLM	########	Palo Verde	11	703108
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	BLM	########	Palo Verde	11	698663
EAST CENTER OF SECTION 33 AND WEST CEN	1 FEMALE /	BLM	########	Palo Verde	11	698857
SW QUARTER OF SECTION 26 AND SE QUARTI	MALE CAR(	BLM	########	Palo Verde	11	700637
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	BLM	########	Palo Verde	11	701786
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	BLM	########	Palo Verde	11	702715
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	BLM	########	Palo Verde	11	699452

EEC ORIGINAL PKG

MAPPED TO PROVIDED COORDINATES.				MALE TOR	BLM	########	Palo Verde	11	700024
MAPPED TO PROVIDED COORDINATES.				TORTOISE (	BLM	########	Palo Verde	11	700640
MAPPED T	HABITAT C	ORV activit	THREATS IN	RECENTLY	BLM	########	Palo Verde	11	704337
MAPPED T	HABITAT C	ORV activit	THREATS IN	CARCASS C	BLM	########	Palo Verde	11	707082
MAPPED T	HABITAT C	ORV activit	THREATS IN	CARCASS C	BLM	########	Palo Verde	11	705758
MAPPED T	HABITAT C	ORV activit	POTENTIAL	2 BURROW	BLM	########	Hedges (32	11	701447
MAPPED T	HABITAT C	ORV activit	POTENTIAL	A 9" LONG	BLM	########	Hedges (32	11	699938
MAPPED T	HABITAT C	ORV activit	POTENTIAL	BURROW V	BLM	########	Hedges (32	11	700475
MAPPED T	HABITAT C	ORV activit	POTENTIAL	ABOUT 1 Y	BLM	########	Clyde (321	11	696468
MAPPED TO PROVIDED COORDINATES.				MALE TOR	UNKNOWN	########	Clyde (321	11	694525
MAPPED TO PROVIDED COORDINATES. ON SE				1 MALE CA	BLM	########	Clyde (321	11	693301
MAPPED TO PROVIDED COORDINATES.				MALE TOR	BLM	########	Clyde (321	11	691293
MAPPED TO PROVIDED COORDINATES.				MALE CAR	BLM	########	Clyde (321	11	691279
MAPPED TO PROVIDED COORDINATES.				FEMALE CA	BLM	########	Quartz Pea	11	699615
MAPPED TO PROVIDED COORDINATES.				TORTOISE (	BLM	########	Quartz Pea	11	699074
MAPPED TO PROVIDED COORDINATES.				TORTOISE (	BLM	########	Quartz Pea	11	699060
MAPPED T	HABITAT C	ORV activit	POTENTIAL	BURROW C	BLM	########	Ninemile W	11	697618
MAPPED T	HABITAT C	ORV activit	POTENTIAL	3 TORTOISE	BLM	########	Ninemile W	11	697400
MAPPED TO PROVIDED COORDINATES.				FEMALE CA	BLM	########	Ninemile W	11	694485
MAPPED TO PROVIDED COORDINATES.				FEMALE CA	BLM	########	Ninemile W	11	693341
MAPPED TO PROVIDED COORDINATES.				MALE TOR	BLM	########	Ninemile W	11	692681
MAPPED TO PROVIDED COORDINATES.				FEMALE IN	BLM	########	Ninemile W	11	691813
MAPPED TO PROVIDED COORDINATES.				FEMALE CA	BLM	########	Quartz Pea	11	698353
NEAR CENTER OF SECTION 30. MAPPED TO PI				TORTOISE (	BLM	########	Ninemile W	11	694988
MAPPED TO PROVIDED COORDINATES.				MALE TOR	STATE LAN	########	Quartz Pea	11	698575
MAPPED TO PROVIDED COORDINATES.				FEMALE TC	BLM	########	Ninemile W	11	696667
MAPPED TO PROVIDED COORDINATES.				INTACT FEI	BLM	########	Ninemile W	11	694975
MAPPED TO PROVIDED COORDINATES.				FEMALE TC	BLM	########	Ninemile W	11	694294
MAPPED TO PROVIDED COORDINATES.				MALE CAR	BLM	########	Buzzards P	11	699933
MAPPED TO PROVIDED COORDINATES.				CARCASS C	BLM	########	Mt. Barrow	11	696577
MAPPED TO PROVIDED COORDINATES.				TORTOISE (	BLM	########	Mt. Barrow	11	695489
MAPPED TO PROVIDED COORDINATES.				INTACT MA	BLM	########	Mt. Barrow	11	695405
NEARLY CENTER OF SECTION 7. MAPPED TO F				INTACT MA	BLM	########	Mt. Barrow	11	694975
MAPPED TO PROVIDED COORDINATES.				MALE TOR	BLM	########	Mt. Barrow	11	694053
MAPPED T	HABITAT C	ORV activit	POTENTIAL	DEEP, RECE	BLM	########	Mt. Barrow	11	697864
MAPPED TO PROVIDED COORDINATES.				INTACT MA	BLM	########	Mt. Barrow	11	696181
MAPPED TO PROVIDED COORDINATES.				2 CARCASS	BLM	########	Mt. Barrow	11	695714
MAPPED TO PROVIDED COORDINATES.				TORTOISE (	BLM	########	Mt. Barrow	11	694045
MAPPED T	HABITAT C	ORV activit	POTENTIAL	11 INCH FE	BLM	########	Mt. Barrow	11	697915
MAPPED TO PROVIDED COORDINATES.				UNKNOWN	BLM	########	Mt. Barrow	11	696585
MAPPED TO PROVIDED COORDINATES.				MALE TOR	BLM	########	Mt. Barrow	11	695925
MAPPED TO PROVIDED COORDINATES.				MALE CAR	BLM	########	Mt. Barrow	11	694822
MAPPED TO PROVIDED COORDINATES.				CARCASS C	BLM	########	Mt. Barrow	11	694147
MAPPED TO PROVIDED COORDINATES.				MALE CAR	BLM	########	Buzzards P	11	699969
MAPPED TO PROVIDED COORDINATES.				MALE TOR	BLM	########	Buzzards P	11	698973
MAPPED T	HABITAT C	ORV activit	POTENTIAL	FRESH SCA	BLM	########	Buzzards P	11	698706
MAPPED TO PROVIDED COORDINATES.				2 FEMALE	BLM	########	Mt. Barrow	11	697469

MAPPED TO PROVIDED COORDINATES.		FEMALE CA	BLM	########	Mt. Barrow	11	697205
MAPPED TO PROVIDED COORDINATES.		FEMALE TC	BLM	########	Mt. Barrow	11	696574
MAPPED TO PROVIDED COORDINATES.		HEALTHY A	BLM	########	Mt. Barrow	11	695561
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM	########	Mt. Barrow	11	694528
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	STATE LAN	########	Mt. Barrow	11	693627
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	UNKNOWN	########	Mt. Barrow	11	693672
MAPPED TO	HABITAT C	ORV activit	POTENTIAL	1 USEABLE	BLM	########	Buzzards P	11	699629
MAPPED TO	HABITAT C	ORV activit	POTENTIAL	4 OBSERVA	BLM	########	Buzzards P	11	698817
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	BLM	########	Palo Verde	11	698326
MAPPED TO PROVIDED COORDINATES.		CARCASS C	BLM	########	West of Pa	11	696418
MAPPED TO PROVIDED COORDINATES.		MALE TOR	BLM, UNKN	########	West of Pa	11	690228
MAPPED TO PROVIDED COORDINATES.		CARCASS C	UNKNOWN	########	West of Pa	11	690016
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	UNKNOWN	########	West of Pa	11	689747
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	BLM	########	West of Pa	11	695675
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM	########	West of Pa	11	694963
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM, UNKN	########	West of Pa	11	693497
ON THE SECTION LINE OF SE SEC 35 AND NE S		TORTOISE (	BLM, UNKN	########	West of Pa	11	691512
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	BLM	########	West of Pa	11	695267
MAPPED TO PROVIDED COORDINATES.		FEMALE TC	UNKNOWN	########	West of Pa	11	692832
MAPPED TO PROVIDED COORDINATES.		CARCASS C	UNKNOWN	########	West of Pa	11	692811
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	UNKNOWN	########	West of Pa	11	689360
NEAR CENTER OF SECTION 9. MAPPED TO PR		MALE CAR	UNKNOWN	########	Wiley Well	11	687498
MAPPED TO PROVIDED COORDINATES.		MALE TOR	UNKNOWN	########	Wiley Well	11	688624
MAPPED TO	HABITAT C	ORV activit	THREATS IN	ON 7 DEC 1	BLM, UNKN	########	Pegleg Wel	11	673539
MAPPED TO PROVIDED COORDINATES.		MALE CAR	BLM	########	Little Mule	11	675018
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	UNKNOWN	########	Chuckwalla	11	673856
MAPPED TO PROVIDED COORDINATES.		CARCASS C	BLM, UNKN	########	Little Chucl	11	674713
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM	########	Little Chucl	11	675198
MAPPED TO PROVIDED COORDINATES.		2 CARCASS	BLM	########	Chuckwalla	11	672182
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM	########	Chuckwalla	11	673296
MAPPED TO PROVIDED COORDINATES.		CARCASS C	BLM	########	Chuckwalla	11	673904
MAPPED TO PROVIDED COORDINATES.		CARCASS C	BLM	########	Chuckwalla	11	673875
MAPPED TO PROVIDED COORDINATES.		FEMALE TC	BLM, UNKN	########	Chuckwalla	11	670178
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	BLM	########	Chuckwalla	11	671018
MAPPED TO PROVIDED COORDINATES.		FEMALE TC	BLM	########	Chuckwalla	11	670562
MAPPED TO PROVIDED COORDINATES.		MALE TOR	BLM	########	Chuckwalla	11	671157
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM	########	Chuckwalla	11	671279
MAPPED TO PROVIDED COORDINATES.		FEMALE TC	UNKNOWN	########	Little Chucl	11	679743
MAPPED TO PROVIDED COORDINATES.		MALE TOR	BLM	########	Little Chucl	11	680349
MAPPED TO PROVIDED COORDINATES.		MALE TOR	UNKNOWN	########	Little Chucl	11	677339
MAPPED TO PROVIDED COORDINATES.		FEMALE TC	BLM	########	Little Chucl	11	679677
MAPPED TO PROVIDED COORDINATES.		FEMALE CA	BLM	########	Chuckwalla	11	668887
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM	########	Chuckwalla	11	667950
MAPPED TO PROVIDED COORDINATES.		TORTOISE (	BLM	########	Chuckwalla	11	666717
MAPPED TO PROVIDED COORDINATES.		2 FEMALE (	BLM	########	Chuckwalla	11	663849
MAPPED TO PROVIDED COORDINATES.		MALE TOR	BLM	########	Chuckwalla	11	663384
MAPPED TO PROVIDED COORDINATES.		MALE TOR	DOD-CHOC	########	Chuckwalla	11	663276

MAPPED TO PROVIDED COORDINATES.			MALE TOR	DOD-CHOC	########	Augustine	11	662252
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Augustine	11	661568
MAPPED TO PROVIDED COORDINATES.			MALE TOR	DOD-CHOC	########	Augustine	11	661047
MAPPED T	HABITAT CONSISTED C	POTENTIAL	BETWEEN :	BLM	########	Yuma West	11	711502
IMPERIAL DIVISION SECTION I. 1969-70: ISLAI			MARSH AR	USFWS-IMI	########	Picacho (33	11	731743
SOUTHERN	1990: WITH	Altered flo	1984: FLOC	MARSH AR	UNKNOWN	########	Bard (3211	11	731613
MAPPED TO PROVIDED COORDINATES.			FEMALE CA	DOD-CHOC	########	Blue Moun	11	684903
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Blue Moun	11	685127
MAPPED TO PROVIDED COORDINATES.			FEMALE CA	DOD-CHOC	########	Blue Moun	11	684879
MAPPED TO PROVIDED COORDINATES.			TORTOISE (	DOD-CHOC	########	Blue Moun	11	686133
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Mt. Barrow	11	686917
MAPPED TO PROVIDED COORDINATES.			TORTOISE (	DOD-CHOC	########	West of Pa	11	686683
MAPPED TO PROVIDED COORDINATES.			TORTOISE (	DOD-CHOC	########	Blue Moun	11	686090
MAPPED TO PROVIDED COORDINATES.			2 MALE CA	DOD-CHOC	########	Little Mule	11	685411
CENTER EAST OF SECTION 31. MAPPED TO PR			CARCASS C	DOD-CHOC	########	Little Mule	11	684885
MAPPED TO PROVIDED COORDINATES.			CARCASS C	DOD-CHOC	########	Little Mule	11	684807
MAPPED TO PROVIDED COORDINATES.			MALE TOR	DOD-CHOC	########	Blue Moun	11	679985
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Blue Moun	11	680553
MAPPED TO PROVIDED COORDINATES.			2 MALE CA	DOD-CHOC	########	Blue Moun	11	681197
MAPPED TO PROVIDED COORDINATES.			2 MALE CA	DOD-CHOC	########	Blue Moun	11	681380
MAPPED TO PROVIDED COORDINATES.			2 MALE CA	DOD-CHOC	########	Blue Moun	11	681572
MAPPED TO PROVIDED COORDINATES.			MALE TOR	DOD-CHOC	########	Blue Moun	11	681611
MAPPED TO PROVIDED COORDINATES.			FEMALE CA	DOD-CHOC	########	Blue Moun	11	682726
MAPPED TO PROVIDED COORDINATES.			MALE TOR	DOD-CHOC	########	Blue Moun	11	683592
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Blue Moun	11	682442
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Blue Moun	11	683269
MAPPED TO PROVIDED COORDINATES.			MALE CAR	STATE LAN	########	Blue Moun	11	678560
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Blue Moun	11	679418
MAPPED TO PROVIDED COORDINATES.			4 CARCASS	DOD-CHOC	########	Little Mule	11	680882
MAPPED TO PROVIDED COORDINATES.			CARCASS C	UNKNOWN	########	Little Mule	11	685795
MAPPED TO PROVIDED COORDINATES.			MALE CAR	UNKNOWN	########	West of Pa	11	687308
MAPPED TO PROVIDED COORDINATES.			CARCASS C	BLM	########	Little Mule	11	685783
MAPPED TO PROVIDED COORDINATES.			CARCASS C	BLM	########	Little Mule	11	684918
MAPPED TO PROVIDED COORDINATES.			CARCASS C	UNKNOWN	########	Little Mule	11	685790
MAPPED TO PROVIDED COORDINATES.			FEMALE CA	DOD-CHOC	########	Little Mule	11	681448
MAPPED TO PROVIDED COORDINATES.			CARCASS C	DOD-CHOC	########	Little Mule	11	680679
MAPPED TO PROVIDED COORDINATES.			TORTOISE (	DOD-CHOC	########	Little Mule	11	679425
NEAR CENTER OF SEC 27. MAPPED TO PROVII			2 MALE CA	DOD-CHOC	########	Little Mule	11	679739
MAPPED TO PROVIDED COORDINATES.			MALE CAR	DOD-CHOC	########	Little Mule	11	680210
MAPPED TO PROVIDED COORDINATES.			FEMALE CA	UNKNOWN	########	Little Mule	11	680954
MAPPED TO PROVIDED COORDINATES.			FEMALE TC	STATE LAN	########	Little Mule	11	677427
MAPPED TO PROVIDED COORDINATES.			FEMALE CA	UNKNOWN	########	Little Mule	11	681559
MAPPED TO PROVIDED COORDINATES.			CARCASS C	BLM, UNKN	########	Little Mule	11	678785
MAPPED TO PROVIDED COORDINATES.			TORTOISE (	BLM	########	Little Mule	11	678543
MAPPED TO PROVIDED COORDINATES.			TORTOISE (	UNKNOWN	########	Little Mule	11	676668
MAPPED TO PROVIDED COORDINATES.			TORTOISE (	UNKNOWN	########	Little Mule	11	676421
MAPPED TO PROVIDED COORDINATES.			CARCASS C	UNKNOWN	########	Little Mule	11	680402

MAPPED TO PROVIDED COORDINATES.	MALE CAR(	UNKNOWN	########	Little Mule	11	682339
MAPPED TO PROVIDED COORDINATES.	CARCASS C	UNKNOWN	########	Little Mule	11	682813
MAPPED TO PROVIDED COORDINATES.	THREE CAR	UNKNOWN	########	Little Mule	11	682975
MAPPED TO PROVIDED COORDINATES.	INTACT CAI	UNKNOWN	########	Little Mule	11	683395
MAPPED TO PROVIDED COORDINATES.	MALE TOR'	UNKNOWN	########	Little Mule	11	682999
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	UNKNOWN	########	Little Mule	11	683998
MAPPED TO PROVIDED COORDINATES.	2 MALE CA	BLM, UNKI	########	Little Mule	11	684309
MVZ SPECIMENS "ALA Other DECLINE DI	7 COLLECTI	PVT-IMPER	########	Niland (331	11	630050
2000: FIG LAGOON. 2007: SITE NAME PS-33 E	ONE DETEC	UNKNOWN	########	Seeley (321	11	620749
"HOLTVILLE - COACHELLA." MAPPED TO THE '	EIGHT DETI	UNKNOWN	########	Holtville W	11	651477
MAPPED T(HEAVY CO\ Developme LIBERTY EN	THREE PAII	UNKNOWN	########	Wister (331	11	635499
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Blue Moun	11	676311
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Blue Moun	11	676318
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Blue Moun	11	677242
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Blue Moun	11	676437
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Blue Moun	11	678739
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Blue Moun	11	678324
MAPPED TO PROVIDED COORDINATES.	UNKNOWN	DOD-CHOC	########	Little Mule	11	677277
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Little Mule	11	678533
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Little Mule	11	678955
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Little Mule	11	677688
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Little Mule	11	677301
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Little Mule	11	676435
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Little Mule	11	676279
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Mammoth	11	670947
MAPPED TO PROVIDED COORDINATES.	2 TORTOISI	DOD-CHOC	########	Mammoth	11	669523
ON SECTION LINE BETWEEN SEC 8 AND SEC 9	FEMALE TC	DOD-CHOC	########	Mammoth	11	667279
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Mammoth	11	667943
MAPPED TO PROVIDED COORDINATES.	MALE (260	DOD-CHOC	########	Mammoth	11	666674
MAPPED TO PROVIDED COORDINATES.	MALE TOR'	DOD-CHOC	########	Pegleg Wel	11	665229
MAPPED TO PROVIDED COORDINATES.	MALE TOR'	DOD-CHOC	########	Pegleg Wel	11	664451
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Mammoth	11	668843
MAPPED TO PROVIDED COORDINATES.	2 TORTOISI	DOD-CHOC	########	Pegleg Wel	11	667745
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	666273
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	665823
MAPPED TO PROVIDED COORDINATES.	2 TORTOISI	DOD-CHOC	########	Pegleg Wel	11	664834
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	664378
MAPPED TO PROVIDED COORDINATES.	MALE TOR'	DOD-CHOC	########	Pegleg Wel	11	663811
MAPPED TO PROVIDED COORDINATES.	1 TORTOISI	DOD-CHOC	########	Pegleg Wel	11	668455
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	668581
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	668167
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	667685
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	667216
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	665711
MAPPED TO PROVIDED COORDINATES. ALMC	MALE CAR(	STATE LAN	########	Pegleg Wel	11	672849
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	670439
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	668550

MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	665816
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	665740
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	666699
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Pegleg Wel	11	666588
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	667441
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	667271
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	668825
MAPPED TO PROVIDED COORDINATES.	3 FEMALE (	DOD-CHOC	########	Pegleg Wel	11	665810
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	666484
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	666579
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	667932
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	672077
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Pegleg Wel	11	672580
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	672775
MAPPED TO PROVIDED COORDINATES.	2 MALE CA	DOD-CHOC	########	Pegleg Wel	11	672755
MAPPED TO PROVIDED COORDINATES. SE QU	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	673456
MAPPED TO PROVIDED COORDINATES. ON SE	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	674089
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Little Mule	11	675084
MAPPED TO PROVIDED COORDINATES. NEAR	MALE TOR	DOD-CHOC	########	Little Mule	11	676244
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	670755
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	671272
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	672108
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	673120
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	672170
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	673755
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	670484
MAPPED TO PROVIDED COORDINATES. VICIN	1 MALE OB	DOD-CHOC	########	Pegleg Wel	11	670092
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	669323
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	669326
MAPPED TO PROVIDED COORDINATES.	5 CARCASS	DOD-CHOC	########	Pegleg Wel	11	669976
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	669676
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	669829
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	670573
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	670632
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	670486
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	670055
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Lion Head I	11	659411
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	671456
MAPPED TO PROVIDED COORDINATES.	4 CARCASS	DOD-CHOC	########	Pegleg Wel	11	672097
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	673033
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	673051
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	673714
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	674423
NEAR ARROYO SECO IN THE LITTLE MULE MO	MALE CAR(	DOD-CHOC	########	Little Mule	11	674775
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Lion Head I	11	662548
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Lion Head I	11	661655
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Lion Head I	11	661144

MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Lion Head I	11	660368
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Lion Head I	11	660440
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Lion Head I	11	659645
MAPPED TO PROVIDED COORDINATES. NEAR	TORTOISE (	DOD-CHOC	########	Lion Head I	11	659518
SPECIMEN DICKEY'S ORIGINAL SPECIES DESCI	THREE ADU	UNKNOWN	########	Bard (3211	11	729107
LOCATION STATED AS "BOMBAY BEACH MAR	THREE DET	USBOR, BLI	########	Frink (3311	11	621074
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Pegleg Wel	11	663998
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	663407
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Lion Head I	11	662821
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Lion Head I	11	662759
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	663412
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Pegleg Wel	11	662903
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Lion Head I	11	662033
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Lion Head I	11	661251
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	665085
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Pegleg Wel	11	664605
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	664824
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	665517
MAPPED TO PROVIDED COORDINATES.	CARCASS F	DOD-CHOC	########	Lion Head I	11	662443
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	663690
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	663122
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Lion Head I	11	661339
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Lion Head I	11	662231
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Lion Head I	11	661554
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Lion Head I	11	662215
MAPPED TO PROVIDED COORDINATES.	2 MALE CA	DOD-CHOC	########	Pegleg Wel	11	668804
MAPPED TO PROVIDED COORDINATES. ONE (	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	667966
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	667314
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	666418
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	665812
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	665005
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Pegleg Wel	11	664851
4 MI NW OF ARROYO SECCO IN THE LITTLE M	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	671025
ABOUT 4 MI WNW OF ARROYO SECCO IN THE	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	671294
ABOUT 4 MI WNW OF ARROYO SECCO IN THE	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	670892
ABOUT 4 MILES WNW OF ARROYO SECCO IN	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	670854
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	671802
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	671285
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	670795
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	669765
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	669387
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	669211
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	668712
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	667641
MAPPED TO PROVIDED COORDINATES.	3 CARCASS	DOD-CHOC	########	Pegleg Wel	11	668215
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	BLM	########	Pegleg Wel	11	668703
NEAR ARROYO SECCO. MAPPED TO PROVIDEI	MALE CAR(	BLM	########	Chuckwalla	11	668861

MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	666310
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	666969
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	666323
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	664833
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	665788
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Pegleg Wel	11	666068
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	665005
MAPPED TO PROVIDED COORDINATES. SW, B	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	666194
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	665664
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	BLM	########	Pegleg Wel	11	666195
MAPPED TO PROVIDED COORDINATES.	CARCASS C	BLM	########	Chuckwalla	11	666709
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Pegleg Wel	11	663967
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Pegleg Wel	11	663454
MAPPED TO PROVIDED COORDINATES.	3 LIVE TOR	DOD-CHOC	########	Pegleg Wel	11	663681
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Pegleg Wel	11	662993
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	DOD-CHOC	########	Pegleg Wel	11	663848
MAPPED TO PROVIDED COORDINATES.	FEMALE TC	UNKNOWN	########	Pegleg Wel	11	664627
MAPPED TO PROVIDED COORDINATES.	2 MALE CA	UNKNOWN	########	Chuckwalla	11	664891
MAPPED TO PROVIDED COORDINATES.	MALE TOR	UNKNOWN	########	Chuckwalla	11	664570
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Lion Head I	11	658133
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Lion Head I	11	661637
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Pegleg Wel	11	663063
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Augustine I	11	661574
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Augustine I	11	661589
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Augustine I	11	662456
MAPPED TO PROVIDED COORDINATES. NW C	FEMALE CA	DOD-CHOC	########	Augustine I	11	661279
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Augustine I	11	659567
MAPPED TO PROVIDED COORDINATES.	MALE TOR	DOD-CHOC	########	Lion Head I	11	656878
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	DOD-CHOC	########	Lion Head I	11	656983
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Lion Head I	11	655708
MAPPED TO PROVIDED COORDINATES.	1 MALE TO	DOD-CHOC	########	Lion Head I	11	655980
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Lion Head I	11	657373
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Lion Head I	11	657384
MAPPED TO PROVIDED COORDINATES.	CARCASS C	DOD-CHOC	########	Lion Head I	11	657621
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Lion Head I	11	661357
EXACT LOC IN ROCKS APPROXIMATELY 40-60	SINGLE PLA	DPR-ANZA-	########	Carrizo Mtı	11	583190
EXACT LOC HILLSIDE WASH.	ONLY SOUI	BLM	########	Painted Go	11	593598
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Augustine I	11	657166
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Augustine I	11	656598
MAPPED TO PROVIDED COORDINATES.	1 TORTOISI	DOD-CHOC	########	Augustine I	11	656523
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Augustine I	11	658373
MAPPED TO PROVIDED COORDINATES.	FEMALE CA	DOD-CHOC	########	Augustine I	11	658338
MAPPED TO PROVIDED COORDINATES.	MALE CAR(	DOD-CHOC	########	Augustine I	11	657298
MAPPED TO PROVIDED COORDINATES.	2 MALE CA	DOD-CHOC	########	Augustine I	11	656789
MAPPED TO PROVIDED COORDINATES.	TORTOISE (	DOD-CHOC	########	Augustine I	11	656131
MAPPED TO PROVIDED COORDINATES. ALMC	TORTOISE (	DOD-CHOC	########	Augustine I	11	656925
MAPPED TO PROVIDED COORDINATES.	2 CARCASS	BLM	########	Chuckwalla	11	667680

NEAR CENTER OF SECTION 16. MAPPED TO PI				FEMALE CA	BLM	########	Chuckwalla	11	667694
MAPPED TO PROVIDED COORDINATES.				CARCASS C	BLM	########	Chuckwalla	11	666258
MAPPED TO PROVIDED COORDINATES.				TORTOISE (	BLM	########	Chuckwalla	11	663630
MAPPED TO PROVIDED COORDINATES.				2 CARCASS	UNKNOWN	########	Chuckwalla	11	664832
MAPPED TO PROVIDED COORDINATES.				CARCASS C	BLM	########	Chuckwalla	11	663009
MAPPED TO PROVIDED COORDINATES.				CARCASS C	UNKNOWN	########	Chuckwalla	11	663076
MAPPED TO PROVIDED COORDINATES.				2 CARCASS	BLM	########	Augustine I	11	661576
MAPPED TO PROVIDED COORDINATES.				CARCASS C	DOD-CHOC	########	Augustine I	11	662407
MAPPED TO PROVIDED COORDINATES.				MALE TOR'	BLM	########	Augustine I	11	661589
MAPPED TO PROVIDED COORDINATES.				MALE CAR(	DOD-CHOC	########	Augustine I	11	661572
MAPPED TO PROVIDED COORDINATES.				MALE CAR(	DOD-CHOC	########	Augustine I	11	660191
MAPPED TO PROVIDED COORDINATES.				3 CARCASS	DOD-CHOC	########	Augustine I	11	659675
NEAR CENTER OF SEC 3. MAPPED TO PROVIDI				1 MALE (25	DOD-CHOC	########	Augustine I	11	659411
MAPPED TO PROVIDED COORDINATES.				CARCASS C	DOD-CHOC	########	Augustine I	11	658230
NE QUARTER OF SEC 4 AND NW QUARTER OF				TORTOISE (	DOD-CHOC	########	Augustine I	11	658398
MAPPED TO PROVIDED COORDINATES.				FEMALE TC	DOD-CHOC	########	Augustine I	11	657703
MAPPED TO PROVIDED COORDINATES.				MALE TOR'	DOD-CHOC	########	Augustine I	11	657298
ALONG COUNTY LINE. MAPPED TO PROVIDED				FEMALE TC	DOD-CHOC	########	Augustine I	11	656900
MAPPED T(	HABITAT C(	Developme	POTENTIAL	3 TORTOISI	BLM	########	Ogilby (321	11	702200
MAPPED T(	HABITAT C(	Developme	POTENTIAL	4 PIECES O	BLM	########	Ogilby (321	11	702226
MAPPED T(	HABITAT C(	ORV activit	POTENTIAL	CARCASS C	BLM	########	Hedges (32	11	701289
NEAR CENT	HABITAT C(	Developme	POTENTIAL	TORTOISE I	BLM	########	Clyde (321	11	697209
MAPPED T(	HABITAT C(	Developme	POTENTIAL	3 TORTOISI	BLM	########	Clyde (321	11	696777
MAPPED T(	HABITAT C(	Developme	POTENTIAL	3 TORTOISI	BLM	########	Clyde (321	11	696781
MAPPED T(	HABITAT C(	Developme	POTENTIAL	2 OLD BUR	BLM	########	Clyde (321	11	696503
MAPPED T(	HABITAT C(	Developme	POTENTIAL	TORTOISE I	BLM	########	Clyde (321	11	696236
MAPPED T(	HABITAT C(	Developme	POTENTIAL	TORTOISE I	BLM	########	Buzzards P	11	699128
MAPPED T(	HABITAT C(	Developme	POTENTIAL	TORTOISE S	BLM	########	Buzzards P	11	699443
MAPPED T(	HABITAT C(	Developme	POTENTIAL	2 TORTOISI	BLM	########	Buzzards P	11	700093
MAPPED T(	HABITAT C(	Developme	POTENTIAL	2 TORTOISI	BLM	########	Buzzards P	11	703313
MAPPED TO PROVIDED COORDINATES.				FEMALE TC	STATE LAN	########	Ninemile W	11	693530
MAPPED T(	HABITAT C(	Developme	POTENTIAL	MALE TOR'	BLM	########	Buzzards P	11	700826
MAPPED T(	HABITAT C(	ORV activit	POTENTIAL	4 PIECES O	BLM	########	Cibola (331	11	711595
MAPPED T(	HABITAT CONSISTED OF OPEN SP/			TORTOISE (	BLM	########	Cibola (331	11	710951
MAPPED T(	HABITAT C(	ORV activit	POTENTIAL	TORTOISE (	BLM	########	Cibola (331	11	710448
MAPPED A	IN SMALL ROCKY WASHES OFF RO			80+ PLANT	BLM	########	Mt. Barrow	11	695965
PLANTS FO	GRANITIC SOIL GROWING WITH O			20+ PLANT	BLM	########	Mt. Barrow	11	691274
MAPPED T(	HABITAT C(	ORV activit	POTENTIAL	FRESH SCA	BLM	########	Clyde (321	11	697657
MAPPED T(	HABITAT CONSISTED C		POTENTIAL	TORTOISE I	BLM	########	Ninemile W	11	695567
MAPPED T(	HABITAT C(	Developme	POTENTIAL	TORTOISE (	BLM	########	Ninemile W	11	697015
MAPPED T(	THOUGHT '	Other	POTENTIAL	TORTOISE (	BLM	########	In-ko-pah (	11	587357
MAPPED T(	HABITAT C(	Developme	POTENTIAL	TORTOISE (	BLM	########	Ninemile W	11	694861
EAST SIDE (	HABITAT C(	Developme	POTENTIAL	3 TORTOISI	BLM	########	Ninemile W	11	695534
MAPPED T(	HABITAT C(	Developme	POTENTIAL	TORTOISE,	BLM	########	Ninemile W	11	696542
MAPPED T(	HABITAT C(	Developme	POTENTIAL	3 TORTOISI	BLM, STATI	########	Ninemile W	11	697434
MAPPED T(	HABITAT C(	Developme	POTENTIAL	9 LIVE, 5 DI	BLM	########	Mt. Barrow	11	697812
MAPPED T(	HABITAT C(	ORV activit	POTENTIAL	3 TORTOISI	BLM	########	Buzzards P	11	700259

MAPPED T(	HABITAT C(	ORV activit	POTENTIAL	FRESH SCA'	BLM	########	Ogilby (321	11	702069
MAPPED T(	HABITAT C(	Developme	POTENTIAL	TORTOISE (	BLM	########	Chuckwalla	11	667889
NE SIDE OF	HERBACEO	ORV activit	SITE DISTU	~12 PLANT	BLM	########	Grays Well	11	700950
ABOUT 60	GROWING	Developme	NEAR OHV	2 MATURE	BLM?	########	Plaster City	11	612182
BETWEEN TRANSMISSION POLES 8191 AND 8				ONLY SOUI	BLM	########	Grays Well	11	692862
MAPPED IN	SONORAN	Developme	THREATEN	2 PLANTS (	BLM	########	Coyote We	11	600809
MAPPED IN	GROWING IN ROCKY SOIL ON A LC			ONLY SOUI	BLM	########	Coyote We	11	594770
NORTH OF	SONORAN	Developme	THREATEN	1 PLANT OI	BLM	########	Plaster City	11	607763
MAPPED IN	SONORAN	Developme	THREATEN	2 PLANTS (	BLM	########	Plaster City	11	609725
NORTH OF	SONORAN	Developme	THREATEN	2 PLANTS (	BLM	########	Plaster City	11	610797
MAPPED IN	CREOSOTE	Developme	THREATEN	2 DEAD PL/	BLM	########	Plaster City	11	614589
MAPPED IN	SONORAN	Developme	THREATEN	3 PLANTS (	BLM	########	Painted Go	11	601698
MAPPED A	GROWING IN ROCKY SOIL ON THE			ONLY SOUI	BLM	########	In-ko-pah (	11	593103
DIRECTION	SILTY, BROWN SOIL (MUDLANDS).			ONLY SOUI	BLM	########	Carrizo Mt	11	586601
MAPPED IN	ROCKY FLA	Non-native	SOME WEE	100+ PLAN	BLM	########	Carrizo Mt	11	589739
MAPPED IN	SANDY GRAVELLY WASH AREA IN			12 PLANTS	BLM	########	Carrizo Mt	11	592384
EXACT LOCATION UNKNOWN. MAPPED AS BE				ONLY SOUI	BLM	########	Glamis NW	11	669467
EXACT LOCATION UNKNOWN. MAPPED BY CN				ONLY SOUI	UNKNOWN	########	Calexico (3	11	641015
LOCALITY (	DRY DESERT WASHES.			ONLY SOUI	BLM	########	Yuha Basin	11	616750
LOCATIONS	GROWING IN SANDY SOIL.			ONLY SOUI	UNKNOWN	########	Kane Spring	11	606854
NEAR 33 D	FLATS AND STABILIZED DUNES, GE			ONLY SOUI	UNKNOWN	########	Harpers W	11	599031
EXACT LOCATION UNKNOWN. MAPPED BY CN				ONLY SOUI	UNKNOWN	########	Niland (331	11	638042
MAPPED T(	LOW SANDY EW TRENDING RIDGE			UNKNOWN	DOD-NAVY	########	Glamis NW	11	664431
EXACT LOCATION UNKNOWN. MAPPED AS BE				ONLY SOUI	BLM	########	In-ko-pah (	11	592980
MAPPED O	IN ROCKY (	Non-native	THREATEN	10+ PLANT	BLM	########	In-ko-pah (	11	585949
MAPPED T(	HABITAT CONSISTED OF "BACKWA			2 INDIVIDU	USFWS-CIB	########	Cibola (331	11	714886
MAPPED T(	HABITAT CONSISTED OF "TAMARI			SINGING M	USFWS-IMI	########	Picacho NV	11	716349
EBIRD OBS	MOUNTAIN PLOVERS LIKELY USE I			50 REPORT	PVT	########	Niland (331	11	635746
MAPPED TO EBIRD COORDINATES & LOCATIC				15 DETECT	UNKNOWN	########	Seeley (321	11	621565
MAPPED TO PROVIDED COORDINATES AND L				ABOUT 80	PVT	########	Mount Sigr	11	622215
MAPPED TO PROVIDED COORDINATES AND L				320 REPOR	PVT	########	Brawley NV	11	623912
MAPPED TO PROVIDED COORDINATES AND L				16 DETECT	PVT	########	Alamorio (3	11	642012
MAPPED TO PROVIDED COORDINATES AND L				3 DETECTE	DFG-IMPEF	########	Westmorla	11	639763
MAPPED TO PROVIDED COORDINATES AND L				A GROUP C	PVT	########	Westmorla	11	635097
EXACT LOCATION UNKNOWN. MAPPED TO PF				2 DETECTE	PVT	########	Westmorla	11	628845
MAPPED TO PROVIDED COORDINATES AND L				3 DETECTE	PVT	########	Calipatria S	11	626113
MAPPED TO PROVIDED COORDINATES AND L				ONE OR M(	PVT	########	Calipatria S	11	626311
EXACT LOC	STONY HILLS.			ONLY SOUI	UNKNOWN	########	In-ko-pah (	11	583784
EAST OF UI	DESERT W/	Developme	POSSIBLY T	4 PLANTS (	BLM	########	Mount Sigr	11	623448
SOUTH OF	CREOSOTE	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Mount Sigr	11	621097
MAPPED B'	DESERT W/	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Mount Sigr	11	622200
MAPPED B'	DESERT W/	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Yuha Basin	11	615064
JUST SOUT	DESERT W/	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Yuha Basin	11	613983
JUST NORT	CREOSOTE	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Plaster City	11	613270
NORTH OF	CREOSOTE	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Plaster City	11	613603
NORTH OF	CREOSOTE	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Plaster City	11	614447
MAPPED B'	CREOSOTE	Developme	POSSIBLY T	1 PLANT OI	BLM	########	Plaster City	11	612304

EXACT LOC	SANDY DESERT.			ONLY SOUI	BLM	########	Plaster City	11	608697
LOCATION STATED AS "BOWLES AND LACK." I				ABOUT 20(	PVT	########	Calipatria S	11	626685
MAPPED T(	EXACT LOCATIONS NOT KNOWN A			903 DETEC	PVT	########	Wiest (331	11	644704
MAPPED T(	MOUNTAIN PLOVERS LIKELY USE I			449 REPOR	PVT	########	Wiest (331	11	648818
MAPPED TO PROVIDED COORDINATES AND L				88 DETECTI	PVT	########	Niland (331	11	629018
MAPPED T(	MOUNTAIN PLOVERS LIKELY USE I			84 REPORT	PVT	########	Niland (331	11	631473
SEVERAL EI	MOUNTAIN PLOVERS LIKELY USE I			46 OBSERV	PVT	########	Iris (33115:	11	641357
3 POLYGOI	LARGE, OPI	Developme	PROPOSED	FEWER TH/	BLM	########	In-ko-pah (	11	584369
EBIRD DETI	MOUNTAIN PLOVERS LIKELY USE I			AT LEAST 1	PVT	########	Niland (331	11	635616
MAPPED T(	MOUNTAIN PLOVERS MORE THAN			AT LEAST C	PVT	########	Niland (331	11	638555
MAPPED T(	MOUNTAIN PLOVERS LIKELY USE I			ONE OR M(	PVT	########	Niland (331	11	638080
MAPPED TO PROVIDED COORDINATES AND L				SINGLE DET	BLM	########	Kane Spring	11	606253
EXACT LOCATION UNKNOWN. MAPPED TO PI				30 DETECTI	DPR-SALTC	########	Durmid (33	11	609786
MAPPED T(	HABITAT D	Developme	POTENTIAL	1 ADULT O	BLM	########	In-ko-pah (	11	587518
NEAR CENT	WASH WIT	Vehicle col	POSSIBLE C	1 ADULT O	BLM	########	In-ko-pah (	11	588747
STATED LO	43 ACRES OF RESTORED RIPARIAN			SPECIMENS	UNKNOWN	########	Yuma West	11	720744
MAPPED A	1910: MATURE WILLOWS, COTTO			UNKNOWN	USFWS, PV	########	Picacho (33	11	733380
MUSEUM SPECIMEN LOCALITY PROVIDED AS				1 MALE AN	UNKNOWN	########	Westmorla	11	628845
EXACT COLLECTION LOCATIONS FOR MUSEUI				STAGER CC	UNKNOWN	########	Brawley (3:	11	637820
MAPPED T(	DESCRIBED AS RIVER BOTTOM WI			AT LEAST 1	UNKNOWN	########	Bard (3211	11	726046
NO EXACT LOCATIONS GIVEN; MUSEUM SPE(				4 COLLECTI	BLM, UNKN	########	Laguna Dar	11	734306
1977 SURVEY BY BOAT FROM IMPERIAL TO L/				1 BIRD DET	BLM	########	Laguna Dar	11	735256
EXACT LOCATION OF MUSEUM SPECIMENS U				WILDER CC	UNKNOWN	########	Palo Verde	11	710433
EXACT LOCATION UNKNOWN; MAPPED TO BI				1 MALE AN	UNKNOWN	########	Palo Verde	11	713695
EXACT LOCATION UNKNOWN; MAPPED TO B(				1 MALE CO	UNKNOWN	########	Yuma West	11	713904
MAPPED TO "20 MI. ABOVE PICACHO" PER GI				GRINNELL I	USFWS	########	Picacho NV	11	715769
MAPPED TO PROVIDED MAP & LOCATION DE				ON 8 MAY	BLM	########	Yuma West	11	713904
EXACT LOCATION UNKNOWN, MAPPED TO BI				1 TAKEN BY	UNKNOWN	########	Cibola (331	11	711587
MAPPED T(	GRINNELL (1910) NOTED MANY S/			1 NEST FOU	BLM, UNKN	########	Imperial Re	11	737081
MAPPED T(	PENINSULA IN LOOP OF RIVER WI			GRINNELL (	BLM, UNKN	########	Palo Verde	11	720535
MAPPED A	LARGE WASH WITH HEAVY GROW			GRINNELL I	USFWS	########	Picacho NV	11	716848
DETECTION	HABITAT CONSISTED OF DENSE W			3 PRESUMI	DPR-PICAC	########	Picacho (33	11	724328
MAPPED T(	HABITAT "OF MARGINAL QUALITY			TWO CALIF	DFG-IMPEF	########	Wister (33:	11	631105
MAPPED G	CONWAY (2007): "HAE		"LAKE IS BU	UP TO 7 HE	DFG-IMPEF	########	Wiest (331	11	640028
MAPPED T(	GENERALLY DESCRIBED AS A SEEP			1-4 DETECT	BLM	########	Frink NW (:	11	623969
MAPPED T(	AREA IS CURRENTLY DEVELOPED /			2 SETS OF !	UNKNOWN	########	Bard (3211	11	729107
MAPPED APPROXIMATELY TO LOCATIONS DE				4 MALES &	UNKNOWN	########	Bard (3211	11	729610
MAPPED TO LOCATIONS DESCRIBED AS "FOR				1 FEMALE (	UNKNOWN	########	Yuma East	11	723447
MAPPED T(	HABITAT CONSISTED OF A BELT OI			NEST OBSE	UNKNOWN	########	Imperial Re	11	736636
1903: SAGI	1903, 1910	Over-collec	EXCESSIVE	2 NESTING	BLM, UNKN	########	Imperial Re	11	736636
EXACT LOCATION UNKNOWN. MAPPED BY CN				ONLY SOUI	UNKNOWN	########	Bard (3211	11	729107
EXACT LOC	NORTH-FACING SLOPES. ASSOCIA			ONLY SOUI	BLM?	########	Palo Verde	11	701929
HILLS ON S	NORTH-FACING ROCKY SLOPE.			ONLY SOUI	BLM	########	Picacho Pe:	11	717408
MAPPED T(	TWO ELF O	Agriculture	DESTRUCTI	TWO BIRDS	UNKNOWN	########	Bard (3211	11	729107
MAPPED T(	HABITAT CONSISTED OF MARSHL/			1 INDIVIDU	USFWS	########	Picacho SW	11	714056
MAPPED T(	HABITAT CONSISTED OF "BACKW/			1 INDIVIDU	USFWS	########	Cibola (331	11	715258
MAPPED G	1997 DETE	Improper b	DISTRUBAI	0 ON 2 SUF	USBOR, DP	########	Picacho (33	11	722779

MCKERNAI	1997 DETECTION IN MIXED SALT (			0 ON 2 SUF	USBOR, DP	########	Picacho SW	11	720678
NO SPECIFIC LOCATION GIVEN FOR MUSEUM				1 FEMALE (	UNKNOWN	########	Niland (331	11	628405
MAPPED TO "WESTMORLAND, 5 MI NW"; EX/				1 MALE CO	UNKNOWN	########	Calipatria S	11	622022
MAPPED TO COORDINATES GIVEN IN 2003 RE				1 MALE CA	DPR-OCOTI	########	Shell Reef (	11	586893
AT OR NEA	MEDIUM LEVELS OF OHV USE. SIT			3 ADULT M	DPR-OCOTI	########	Shell Reef (	11	592711
1991 LOCA	AREA DESCRIBED AS HAVING MED			1 LIZARD D	DPR-OCOTI	########	Shell Reef (	11	592672
MAPPED TO PROVIDED COORDINATES.				1 FEMALE /	BLM	########	Shell Reef (	11	587531
ARRAY 14, TRANSECT 6 IN 2002 SURVEY. MAI				1 ADULT O	DPR-OCOTI	########	Shell Reef (	11	587006
SITE BTW II	DESCRIBED IN 2003 REPORT AS B/			1 ADULT M	DPR-OCOTI	########	Kane Sprin	11	593891
MAPPED TO COORDINATES PROVIDED IN 200				1 ADULT M	BLM	########	Kane Sprin	11	595367
GRINNELL !	ACCORDING TO GRINNELL'S FIELD			A MALE AN	USFWS	########	Picacho (33	11	733380
MAPPED TO PROVIDED COORDINATES.				1 FEMALE (	BLM, DPR-(	########	Kane Sprin	11	595249
EXACT LOC	2002: CREOSOTE SCRUB ON LAKE			1 FLAT-TAII	BLM, UNKN	########	Kane Sprin	11	596847
JUST NORT	NEST FOUND "3.5 FEET UP, ON HC			DURING GI	UNKNOWN	########	Imperial Re	11	737081
EXACT DETECTION LOCATIONS NOT GIVEN; F(				1 FLAT-TAII	BLM	########	Plaster City	11	601389
MAPPED T(	HABITAT C(	Developme	POTENTIAL	2007: 5 GR	UNKNOWN	########	Wister (331	11	635689
EXACT LOC	DOMINANT PERENNIAL IS BURSA(			3 LIZARDS I	DPR-OCOTI	########	Shell Reef (	11	585326
MAPPED A	HABITAT CONSISTED OF A DREDG			2010: 3 INI	USFWS-CIB	########	Cibola (331	11	715209
MAPPED T(	HABITAT CONSISTED OF GOODDIN			2010: 2 INI	BLM	########	Laguna Dar	11	734965
DETECTION	LIZARD FOI	Vehicle col	VEHICLE C(	1 FOUND D	BLM	########	Painted Go	11	596726
MAPPED T(	SONORAN	Vehicle col	VEHICLE TF	1 ADULT FE	BLM	########	Painted Go	11	604671
1930 SPECI	SONORAN	ORV activit	CONSTRUC	COLLECTED	BLM	########	Plaster City	11	607012
MAPPED T(	SPARSE VE(	ORV activit	CONSTRUC	1 ADULT FE	UNKNOWN	########	Plaster City	11	608645
MAPPED T(	SPARSE CR	Developme	VEHICLE TF	1 OBSERVE	BLM	########	Yuha Basin	11	615561
MAPPED A	SPARSELY \	ORV activit	TRAFFIC FR	1 ADULT AI	BLM	########	Plaster City	11	612430
MAPPED A	2010: FALL	Developme	SOLAR PRC	1 FOUND C	BLM, PVT	########	Plaster City	11	613827
MAPPED A	IN 2010 TH	Developme	SOLAR PRC	1 LIZARD D	PVT	########	Plaster City	11	613178
MAPPED T(	TAMARIX AND ATRIPLEX ON HARI			1 MALE OB	BLM, UNKN	########	Harpers W(	11	604319
MAPPED T(	HABITAT CONSISTED OF GOODDIN			1 INDIVIDU	USFWS-IMI	########	Picacho SW	11	714079
SPECIMENS WITH LOC.		ORV activit	BETWEEN :	COLLECTED	BLM	########	Yuha Basin	11	616530
1978-2002	SUBSTRATE IS ROSITAS COARSE/L(			37 DETECT	BLM	########	Yuha Basin	11	614208
DETECTED	2008: SONORAN CREOSOTE BUSH			1 FLAT-TAII	BLM	########	Plaster City	11	608701
DETECTED	2008: SONORAN CREOSOTE BUSH			1 ADULT SE	BLM	########	Plaster City	11	610527
MAPPED U	CREOSOTE BUSH - WHITE BURSA(			1 FLAT-TAII	BLM	########	Mount Sigr	11	620813
EXACT LOC	2011: CRE(	Vehicle col	CONSTRUC	1 FLAT-TAII	BLM	########	Mount Sigr	11	619852
MAPPED T(	CREOSOTE	Vehicle col	CONSTRUC	1 ADULT FE	BLM	########	Mount Sigr	11	618564
MAPPED T(	CREOSOTE	Vehicle col	CONSTRUC	1 FLAT-TAII	BLM	########	Mount Sigr	11	617112
MAPPED T(	CREOSOTE	ORV activit	OHV USE.	1 FLAT-TAII	BLM	########	Mount Sigr	11	619195
MAPPED U	CREOSOTE BUSH - WHITE BURSA(			1 FTHL DET	BLM	########	Mount Sigr	11	622994
MAPPED U	CREOSOTE BUSH - WHITE BURSA(			1 FTHL DET	BLM	########	Mount Sigr	11	623480
MAPPED T(	VEHICLE TRACK DENSITY ASSESSEI			LSU #1556:	BLM	########	Glamis SW	11	664274
LOCATION	WETLAND FIELD ACTIV		POSSIBLE P	1 DETECTEI	PVT-IMPER	########	Wister (331	11	629969
MAPPED T(	FURTHER R	Biocides | I	BOTULISM	BROWN PE	PVT-IMPER	########	Truckhaver	11	598539
LOCATION	WETLAND FIELD ACTIV		POSSIBLE P	1 DETECTEI	DFG-IMPEF	########	Wister (331	11	632599
MAPPED TO POINT RE'		Biocides | I	BOTULISM	BROWN PE	PVT-IMPER	########	Kane Sprin	11	615086
MAPPED TO POINT RE'		Biocides | I	BOTULISM	BROWN PE	PVT-IMPER	########	Wister (331	11	630460
SPECIMEN	CARDIFF (1978) NOTED THAT THE			HUEY AND	UNKNOWN	########	Bard (3211	11	733478

SURVEY DA	OPEN, GEN	Other | Po	POTENTIAL	EGG SETS (	PVT-IMPER	########	Truckhaver		11	598539
SURVEY DA	OPEN, GEN	Other | Po	POTENTIAL	EGG SETS (	UNKNOWN	########	Wister (33:		11	628252
MAPPED B'	GROWING IN A SMALL ROCKY CAI			50 PLANTS	BLM	########	Coyote We		11	599031
MAPPED B'	GROWING	Foot traffic	FOOT TRAF	FEWER THA	BLM	########	Coyote We		11	599535
EAST OF PC	IN CLAY AN	ORV activit	OFF-ROAD	GREATER T	UNKNOWN	########	Harpers W		11	595531
720 METER	CLAY SOIL I	ORV activit	OFF-ROAD	GREATER T	DFG-SAN F	########	Harpers W		11	601664
MAPPED A	ASSOCIATED WITH ASCLEPIAS ALE			ONLY SOUI	UNKNOWN	########	Hedges (32		11	704203
EXACT LOCATION UNKNOWN. MAPPED IN TH				MAIN SOUI	BLM	########	East of Aco		11	676690
MAPPED A	GROWING IN SMALL ROCKY DRAII			60 PLANTS	BLM	########	Buzzards P		11	698766
MAPPED A	SCATTERED IN ROCKY/GRAVELLY \			FEWER THA	BLM	########	Carrizo Mtı		11	588575
ON STEEP (	ROCKY CANYON WITH LARREA TR			OVER 50 PI	BLM	########	Carrizo Mtı		11	588575
COLLECTION LABEL SAYS "...AT CA HIGHWAY				ONLY SOUI	UNKNOWN	########	In-ko-pah (		11	592183
IN THE SW	ROCKY, GR	Developme	THREATEN	3 PLANTS (	BLM	########	In-ko-pah (		11	584396
MAPPED A	LARGE, OPI	Developme	THREATEN	8 PLANTS S	BLM	########	In-ko-pah (		11	584396
MAPPED A	NARROW,	ORV activit	AREA DISTI	35-45 PLAN	BLM	########	In-ko-pah (		11	588299
MAPPED A	ROCKY SLO	ORV activit	AREA DISTI	100+ PLAN	BLM	########	In-ko-pah (		11	585352
IN WASH A	BOULDERY	Foot traffic	AREA DISTI	35+ PLANT	UNKNOWN	########	In-ko-pah (		11	586567
MAPPED A	NARROW,	ORV activit	THREATEN	25+ PLANT	BLM	########	In-ko-pah (		11	585578
IN THE NW	ROCKY SLO	Foot traffic	AREA DISTI	24 PLANTS	UNKNOWN	########	In-ko-pah (		11	586567
MAPPED A	BOULDERY	ORV activit	THREATEN	50+ PLANT	BLM	########	In-ko-pah (		11	584647
IN THE NE :	GRAVELLY	ORV activit	THREATEN	12 PLANTS	BLM	########	In-ko-pah (		11	585578
IN THE NE :	BOULDERY	ORV activit	THREATEN	AROUND 5	BLM	########	In-ko-pah (		11	584647
MAPPED A	SANDY SOIL, SONORAN DESERT S(			ONLY SOUI	UNKNOWN	########	In-ko-pah (		11	583825
MAPPED A	NARROW,	ORV activit	AREA DISTI	UNKNOWN	BLM	########	In-ko-pah (		11	588299
MAPPED A	BOULDERY	Foot traffic	AREA DISTI	6 PLANTS (	UNKNOWN	########	In-ko-pah (		11	586567
MAPPED A	BOULDERY	ORV activit	THREATEN	30-40 PLAN	BLM	########	In-ko-pah (		11	584647
MAPPED A	NARROW,	ORV activit	AREA DISTI	3 PLANTS I	BLM	########	In-ko-pah (		11	588299
ON THE WI	PRIMARILY	Non-native	CYNODON	OVER 1000	BLM	########	Cibola (331		11	711860
NEAR ABAI	LARGE, OPI	Developme	AREA DISTI	TYPE LOCA	BLM	########	In-ko-pah (		11	585382
MAPPED B'	IN LARGE D	ORV activit	IN MAMM(	HUNDREDS	BLM	########	Amos (331		11	660794
MAPPED B'	IN BROAD	ORV activit	IN MAMM(	HUNDREDS	BLM	########	Tortuga (3:		11	660409
NORTH SID	IN A POND	Non-native	INVADED B	230 PLANT	BLM	########	Kane Spring		11	593511
NORTH SID	IN DISTURE	ORV activit	POSSIBLY T	25 PLANTS	BLM	########	Shell Reef (		11	586733
ON THE NC	IN SMALL S	ORV activit	POSSIBLY T	17 PLANTS	DPR-OCOTI	########	Shell Reef (		11	589072
MAPPED T(	ROCK OUTCROP.			NEST DETE	BLM, UNKN	########	Carrizo Mtı		11	592687
IN GRAVEL	NARROW,	ORV activit	THREATEN	7 PLANTS (	BLM	########	In-ko-pah (		11	585578
PLANTS SEI	BOULDERY	ORV activit	THREATEN	APPROXIM	BLM	########	In-ko-pah (		11	584647
MAPPED A	NARROW,	ORV activit	AREA DISTI	6-10 PLANT	BLM	########	In-ko-pah (		11	588299
MAPPED TO PROVIDED COORDINATES. COOR				BREEDING	BLM	########	Buzzards P		11	699980
EXACT LOCATION UNKNOWN. MAPPED AS BE				ONLY SOUI	BLM?	########	Palo Verde		11	701929
MAPPED T(	HABITAT DESCRIBED AS DESERT R			1 ADULT AI	USFWS, DF	########	Picacho SW		11	713820
LOCATION	BONYTAILS	Non-native	POTENTIAL	POND USEI	USFWS-CIB	########	Cibola (331		11	713879
MAPPED W	HABITAT C(	Altered flo(	THREATEN	GRINNELL (	USFWS-CIB	########	Cibola (331		11	712545
LOCATION	DOMINATED BY DENSI		POTENTIAL	POND USEI	USFWS-CIB	########	Cibola (331		11	713879
ALL FISH W	GALLEANO RESERVOIR IS A COMP			3 CAPTURE	UNKNOWN	########	Wister (33:		11	637354
MAPPED TO ENTIRETY OF RAMER LAKE.				1 RAZORBA	DFG-IMPEF	########	Westmorla		11	638930
MAPPED TO AREA NEAR "BOMBAY BEACH" A				1 RAZORBA	DPR-SALTC	########	Frink (3311		11	619775

MAPPED TO LOCATION DESCRIBED AS "NEAR				1 RAZORBA	PVT-IMPER	########	Niland (331	11	631473
MARCH COLLECTION LOCATION WAS "0.125-(				24 RAZORE	BLM, UNKN	########	Bard (3211	11	733944
COLLECTION LOCATION WAS "TRAVERTINE R(				1 RAZORBA	UNKNOWN	########	Oasis (331:	11	587908
COLLECTION LOCATION WAS "ALAMO RIVER,				1 RAZORBA	PVT	########	Westmorla	11	634093
MAPPED T(	GENERAL AREA DESCRIBED AS "C(			2 CRISSAL T	BLM, PVT-S	########	Thumb Pea	11	705021
MAPPED T(	GENERAL A	Developme	THIS AREA	1 LE CONTE	PVT-SDGE,	########	Thumb Pea	11	706718
MAPPED B'	DRY, CRACKED, SILTY DEPRESSION			OVER 40 PI	BLM	########	Amos (331	11	660866
MAPPED T(	HABITAT D	ORV activit	OFF HIGHV	SCUTE "LES	UNKNOWN	########	Thumb Pea	11	708529
MAPPED T(	TOPOGRAPHY: FLAT. SOIL TYPE: P.			1 MALE DE	BLM	########	Thumb Pea	11	705045
MAPPED T(	DESERT W/	ORV activit	POTENTIAL	2 ADULT LE	BLM, UNKN	########	Thumb Pea	11	708122
PLEASE CO	GEOMORPHOLOGY: DOME. SUPPORTING STRUCTURE: S(					########	Thumb Pea	0	
MAPPED B'	ROCKY PLACES IN A GRANITIC BOU			12 PLANTS	BLM	########	In-ko-pah (	11	588641
EXACT LOC	SANDBAR. OPEN SANDY SOIL.			MAIN SOU	UNKNOWN	########	Yuma West	11	721786
EXACT LOC	EAST MARGIN OF DUNES.			ONLY SOUI	BLM	########	Clyde (321:	11	686928
EXACT LOC	SILTY DEPRESSIONS IN MICROPHY			FEWER TH/	BLM	########	Amos (331	11	659888
2 POLYGON	GRANITIC, BOULDERY CANYON W			40+ PLANT	BLM	########	In-ko-pah (	11	588641
LOCALITY S	ACCORDING TO JENNINGS (1983),			1 COLLECTI	UNKNOWN	########	Bard (3211	11	729107
LOCALITY I:	ACCORDING TO JENNINGS (1983),			1 COLLECTI	UNKNOWN	########	Bonds Corr	11	660029
LOCALITY I:	ACCORDING TO JENNINGS (1983),			1 COLLECTI	UNKNOWN	########	Palo Verde	11	710433
EXACT LOCATION UNKNOWN. MAPPED IN TH				ONLY SOUI	BLM	########	East of Aco	11	676690
PLANTS WI	ROCKY/BOULDERY CANYON WITH			APPROXIM	BLM	########	In-ko-pah (	11	586504
SPECIMEN	ACCORDING TO JENNINGS (1983),			VAN DENBI	UNKNOWN	########	Yuma West	11	721786
SPECIMEN	ACCORDING TO JENNINGS (1983),			ONE ADUL	UNKNOWN	########	Laguna Dar	11	734306
MAPPED ACCORDING TO COORDINATES PRO'				UNKNOWN	BLM	########	Glamis NW	11	670676
MAPPED APPROXIMATELY TO LOCALITY STAT				1 COLLECTI	UNKNOWN	########	Little Picacl	11	733257
MAPPED TO LOCALITY STATED AS "TUMCO M				1 MALE CO	UNKNOWN	########	Hedges (32	11	704351
MAPPED GENERALLY TO THE ENTRANCE TO S				1 COLLECTI	UNKNOWN	########	Yuma East	11	723447
MAPPED A	SHALLOW DUNES AND SANDY SOI			ONLY SOUI	UNKNOWN	########	Ogilby (321	11	701564
MAPPED A	SMALL DR/	ORV activit	OHV, GARE	20 PLANTS	BLM	########	Ninemile W	11	694739
MAPPED A	SMALL DR/	ORV activit	OHV, GARE	30-40 PLAN	BLM	########	Ninemile W	11	694701
MAPPED AS BEST GUESS BY CNDDB ALONG T(				ONLY SOUI	UNKNOWN	########	Mammoth	11	663393
LOCALITY (	ALLUVIAL SLOPE NEAR LOW VOLC			ONE SOLIT/	BLM	########	Chuckwalla	11	669152
SCATTEREI	SILTY PLAY.	ORV activit	OHV, TRAF	25-30 PLAN	BLM	########	Coyote We	11	603965
SCATTEREI	LARGE, SIL	ORV activit	OHV, HEAV	GREATER T	BLM	########	Coyote We	11	598226
ON SANDY,	OPEN, ROC	ORV activit	OHV, HIGH	6 LARGE IN	BLM	########	Picacho Pe.	11	721532
ON ROCKY	ROCKY CAN	ORV activit	OHV, HIGH	1 LARGE, R	BLM	########	Picacho Pe.	11	721487
MAPPED B'	ON ROCKY	ORV activit	OHV, HEAV	5 SHRUBS S	BLM	########	Coyote We	11	599602
MAPPED B'	GROWING ON ROCKY OUTCROPPI			TWO SHRU	BLM	########	In-ko-pah (	11	584396
EXACT LOC	ASSOCIATES INCLUDE HILARIA SP.			'COMMON	BLM	########	Wiley Well	11	694871
MAPPED B'	RUGGED R(	ORV activit	OHV, MINI	OVER 50 IN	BLM	########	Painted Go	11	594453
OPEN FLAT	A LARGE SI	ORV activit	OHV, HEAV	APPROXIM	BLM	########	Coyote We	11	598226
NORTHWE:	SONORAN DESERT SCRUB ON GR/			ONLY SOUI	BLM	########	In-ko-pah (	11	588226
MAPPED A	ON LOOSE	ORV activit	OHV.	WEST POLY	BLM, DOD	########	Amos (331	11	658611
MAPPED B'	DENSE RIPARIAN WILLOW GROVE			10 CUCKO(	USFWS-IMI	########	Picacho NV	11	716440
MAPPED T(	CREOSOTE-	ORV activit	OVERUSE E	1 ADULT O	BLM	########	Borrego M(	11	587561
LOCATION	HABITAT DESCRIBED AS CREOSOT			1 JUVENILE	UNKNOWN	########	Borrego M(	11	589411
LOCATION	HABITAT DESCRIBED AS SANDY DE			1 YEARLIN(	UNKNOWN	########	Borrego M(	11	588854

MAPPED T(	HABITAT DESCRIBED AS "SAND DU			1 ADULT O	BLM	########	Coyote We		11	599972
MAPPED T(	LIZARD DET	ORV activit	OHV USE.	1 LIZARD A	BLM	########	Yuha Basin		11	615415
DETECTED	VEHICLE TF	ORV activit	OHV IMPA(	AT LEAST 1	BLM	########	Yuha Basin		11	616389
ALONG AC(	ROCKY ANI	ORV activit	SURVEYOR	1 ADULT F(	BLM	########	Mount Sigr		11	619033
MAPPED TO INCLUDE SPECIFIC LOCATION GI\				1 LIZARD F(	BLM	########	Mount Sigr		11	621912
WITHIN A (	CREOSOTE SCRUB WITH SUBSTRA			1 ADULT FE	DOD	########	Amos (331		11	660250
MAPPED T(	CREOSOTE SCRUB WITH SUBSTRA			1 ADULT M	UNKNOWN	########	Glamis NW		11	664003
MAPPED T(	CREOSOTE SCRUB WITH SUBSTRA			2 ADULT M	UNKNOWN	########	Glamis NW		11	665739
MAPPED T(	MUD HILLS, SAND/GRAVEL FLATS,			1 ADULT O	DPR-SALTC	########	Durmid (33		11	613944
MAPPED T(	VEHICLE TF	ORV activit	OHV IMPA(	AT LEAST 1	BLM	########	Yuha Basin		11	615158
MAPPED T(	VEHICLE TF	ORV activit	OHV IMPA(	AT LEAST 1	BLM	########	Glamis SW		11	673349
MAPPED T(	VEHICLE TF	ORV activit	OHV IMPA(	AT LEAST 1	BLM	########	Glamis SE (		11	677721
MAPPED T(	VEHICLE TF	ORV activit	OHV IMPA(	AT LEAST 1	BLM	########	Glamis SE (		11	677793
MAPPED T(	VEHICLE TF	ORV activit	OHV IMPA(	AT LEAST 3	BLM	########	Glamis SE (		11	677238
MAPPED GENERALLY TO LOCALITY GIVEN FOI				1 COLLECTI	UNKNOWN	########	Midway W		11	670237
1979 & 198	1979 AND 1986 SURVEYORS ASSU			1 LIZARD A	BLM	########	Midway W		11	670392
1993 DETE	2001: VEHICLE TRACK DENSITY AS			1 LIZARD D	BLM	########	Glamis SW		11	670710
MAPPED T(	VEHICLE TRACK DENSITY ASSESSEI			AT LEAST 1	BLM	########	Glamis SW		11	670822
MAPPED T(	ACCESS RO	Road/trail (	VEHICLE C(	1 OLD CAR(	BOR	########	Midway W		11	667359
MAPPED T(	ACCESS RO	Road/trail (	VEHICLE C(	1 CARCASS	BOR	########	Midway W		11	666931
MAPPED T(	SANDY CRE	ORV activit	OHV IMPA(	AT LEAST 1	BLM	########	Midway W		11	672906
MAPPED TO COORDINATES GIVEN FOR 2010				1 COLLECTI	BLM	########	Midway W		11	677856
1936 SPECI	1984 SURVEYORS ASSUMED THE S			1 FLAT-TAII	BLM, USBC	########	Midway W		11	679641
MAPPED T(	VEHICLE TF	ORV activit	OHV IMPA(	AT LEAST 1	BLM	########	Glamis SE (		11	677075
MAPPED T(	VEHICLE TF	ORV activit	OHV IMPA(	1 LIZARD F(	BLM	########	Midway W		11	682017
DETECTION	SURVEYORS PRESUMED THE SCAT			1 LIZARD A	BLM	########	Midway W		11	684415
A 1984 SUI	1984 SURVEYORS ASSUMED THE S			1 ADULT O	USBOR	########	Midway W		11	683753
MAPPED TO PROVIDED COORDINATES.				6 CAUGHT	BLM	########	Yuha Basin		11	612986
MAPPED T(	FLAT, SANDY AREA NEAR ALLUVIA			MARK AND	BLM	########	Mount Sigr		11	618226
LOCATION GIVEN ONLY AS T16.5S R12E SEC 2				1 LIZARD D	BLM, UNKN	########	Mount Sigr		11	621525
LOCATION GIVEN ONLY AS T17S R13E SECTIO				1 LIZARD D	BLM	########	Mount Sigr		11	623319
MAPPED T(	LOWER PINTO WASH. SANDY, SEE			MARK AND	BLM	########	Mount Sigr		11	617866
1993 DETE	2002 PLOT WAS IN FEEDER WASH			1 LIZARD D	BLM	########	Yuha Basin		11	612832
MAPPED T(	SOUTHERN SHOULDER OF PINTO '			MARK AND	BLM	########	Yuha Basin		11	613786
2002: MAP	2002: FLAT	Other	BORDER PA	MARK AND	BLM	########	Yuha Basin		11	610455
MAPPED T(	FLAT, GRAVEL HARDPAN BETWEEI			MARK AND	BLM	########	Yuha Basin		11	614280
MAPPED T(	ROCKY GROUND WITH FEW PEREI			MARK AND	BLM	########	Yuha Basin		11	608012
LOCATION GIVEN AS T17S, R11E, SECTION 6. I				1 LIZARD D	BLM	########	Coyote We		11	603660
MAPPED T(	FINE GRAVEL BEDS AND GRAVEL H			1 FLAT-TAII	BLM	########	Yuha Basin		11	606079
MAPPED T(	SPARSELY \	ORV activit	OHVS, BOR	1 FLAT-TAII	BLM	########	Yuha Basin		11	615493
MAPPED T(	SPARSELY \	Developme	DEVELOPM	2 ADULTS A	BLM	########	Painted Go		11	596180
MAPPED T(	FOUND ON	Military op	MILITARY A	2 LIZARDS I	DOD	########	Plaster City		11	607606
MAPPED T(	FOUND ON	Military op	MILITARY A	1 FEMALE (	DOD	########	Plaster City		11	608899
1978 SPECIMEN FROM		Military op	MILITARY A	1 COLLECTI	DOD	########	Superstitio		11	610172
MAPPED TO GIVEN COORDINATES.				1 LIZARD C.	BLM	########	Superstitio		11	611380
MAPPED TO GIVEN COORDINATES.				1 LIZARD C.	BLM	########	Superstitio		11	610536
LOCATION ONLY GIVEN AS T14S, R11E, SECTI(				1 LIZARD D	BLM	########	Superstitio		11	605225

MAPPED TO LOCATION GIVEN FOR PLOT WM				11 ADULTS	BLM	########	Superstitio	11	606290
1987 LOCATION GIVEN ONLY AS T14S, R10E, S				1 FLAT-TAII	BLM	########	Plaster City	11	603697
MAPPED A	FOUND ON PAVED ROAD.			4 LIZARDS I	DOD	########	Superstitio	11	611440
1990 TO 19	MAINLY HARDPAN SUBSTRATE, TH			284 CAUGH	DOD-NAVY	########	Superstitio	11	616477
DETECTED IN T14S, R1		Vehicle col	TRAFFIC OI	2 LIZARDS ,	DOD	########	Brawley NV	11	620267
LOCATION GIVEN AS T14S, R11E, SECTION 24.				1 LIZARD A	BLM, DOD	########	Superstitio	11	613315
LOCATIONS GIVEN AS T13S, R11E, SECTIONS :				2 LIZARDS '	BLM	########	Kane Spring	11	610056
LOCATION GIVEN AS T13S, R11E, SECTION 32.				1 LIZARD D	BLM	########	Superstitio	11	606772
LOCATION GIVEN AS T14S, R10E, SECTION 21.				1 LIZARD D	BLM	########	Plaster City	11	598781
LOCATION GIVEN AS T14S, R10E, SECTION 32.				1 LIZARD D	BLM	########	Plaster City	11	597226
DETECTION	FOUND ON ROAD THROUGH A LO			1 JUVENILE	UNKNOWN	########	Kane Spring	11	607388
MAPPED TO PROVIDED COORDINATES.				1 ADULT FE	DPR-OCOTI	########	Kane Spring	11	593715
1991 DETECTION WITH LOCATION GIVEN ONI				1 LIZARD D	BLM	########	Shell Reef (	11	592918
MAPPED TO GIVEN COORDINATES FROM 199				1 DETECTEI	DPR-OCOTI	########	Shell Reef (	11	586140
MAPPED TO GIVEN COORDINATES.				3 LIZARDS I	DPR-OCOTI	########	Shell Reef (	11	586845
MAPPED TO PROVIDED COORDINATES.				1 MALE LIZ	DPR-OCOTI	########	Shell Reef (	11	585714
MAPPED TO GIVEN COORDINATES FROM 199				1 LIZARD D	UNKNOWN	########	Shell Reef (	11	586293
LOCATION	SCAT FOUND WAS PRESUMED TO			1 LIZARD A	DOD	########	Plaster City	11	607028
MAPPED T(	RELEASE SI	Developme	SOLAR PRC	1 HEALTHY	BLM	########	Plaster City	11	611958
MAPPED T(	FOUND ON	Developme	SOLAR PRC	1 INJURED	PVT	########	Plaster City	11	614625
MAPPED T(	FOUND UN	Developme	SOLAR PRC	1 MALE AD	PVT	########	Plaster City	11	613593
MAPPED A	CAUGHT AT ACTIVE SC		SOLAR PRC	1 ADULT LI	PVT-SEVILL	########	Harpers W(	11	593738
MAPPED T(	RELOCATION SITE CHARACTERIZEI			1 ADULT LI	BLM	########	Borrego M(	11	591267
MAPPED GENERALLY TO GIVEN LOCALITY, "H(				COLLECTED	UNKNOWN	########	Glamis SW	11	667188
MAPPED T(	OLD AGRIC	Developme	CONSTRUC	1 ADULT C/	BLM, PVT	########	Shell Reef (	11	593183
MAPPED T(	LIZARDS FC	Developme	CONSTRUC	1 LIZARD C.	PVT	########	Borrego M(	11	592836
MAPPED T(	LIZARD CAUGHT ON CONSTRUCTI(			1 LIZARD C.	BLM	########	Borrego M(	11	591256
MAPPED T(	LIZARD CAUGHT IN CONSTRUCTIC			1 LIZARD C.	PVT	########	Borrego M(	11	592418
MAPPED T(	LIZARD CAUGHT IN CONSTRUCTIC			1 LIZARD C.	PVT	########	Borrego M(	11	592874
LOCATION GIVEN AS T15S, R17E, SECTION 14.				1 FLAT-TAII	BLM	########	Glamis SW	11	669693
EXACT LOCATION UNKNOWN. MAPPED BY CN				COLLECTIO	UNKNOWN	########	Brawley (3:	11	637820
EXACT LOCATION UNKNOWN. THE LOCALITY				COLLECTED	BLM	########	Glamis (32:	11	679398
MAPPED T(	DESERT SIN	Vehicle col	TRAFFIC AL	1 ADULT O	UNKNOWN	########	Truckhaver	11	602450
STEPHENS DESCRIBES THIS SITE WELL IN HIS F				TYPE SPECI	DPR-ANZA-	########	Carrizo Mtı	11	583812
ELLS.				1 COLLECTI	UNKNOWN	########	Coyote We	11	597024
LOCATION	BROAD, FLAT VALLEY ONCE A LAR			1 FEMALE ,	DFG, BLM	########	Harpers W(	11	601408
EXACT LOCATION UNKNOWN. MAPPED IN TH				5 COLLECTI	UNKNOWN	########	Palo Verde	11	710433
MAPPED GENERALLY TO HISTORIC SILSBEE SC				1 FEMALE (	UNKNOWN	########	Seeley (321	11	627562
EXACT LOCATION UNKNOWN. MAPPED BASE				ONE COLLE	UNKNOWN	########	Bard (3211	11	726046
MAPPED TO PROVIDED COORDINATES.				1 CAUGHT	DPR-OCOTI	########	Shell Reef (	11	590142
MAPPED TO PROVIDED COORDINATES.				1 CAUGHT	DPR-OCOTI	########	Seventeen	11	587833
MAPPED TO PROVIDED COORDINATES.				1 CAUGHT	BLM	########	Painted Go	11	594632
MAPPED T(	SURROUNI	Other	PONDS WE	POND #3: (	IMPERIAL I	########	Niland (331	11	632025
MAPPED T(	AGRICULTURAL DRAIN TO THE SAI			1 JUVENILE	IMPERIAL I	########	Niland (331	11	631875
MAPPED T(	AGRICULTURAL DRAIN TO THE SAI			NONE FOU	DFG-IMPEF	########	Wister (33:	11	631004
MAPPED T(	AGRICULTU	Non-native	NON-NATI\	NONE FOU	IMPERIAL I	########	Calipatria S	11	622693
PLEASE CO	THIS AREA IS NOW PART OF BLM'S JACUMBA WILDERNE!					########	Coyote We	0	

EEC ORIGINAL PKG

MAPPED T(	DETECTION ON TRAIL IN DESERT S	1 ADULT O	USFWS-SO	########	Niland (331	11	628753
PLEASE CO	SOME OF THE LAND IN THIS AREA	IS MANAGED BY BLM,		########	In-ko-pah (	0	
ACCORDIN	HABITAT WAS ROCKY DESERT MO	2 COLLECTI	UNKNOWN	########	In-ko-pah (	11	583857
NITY OF OL	ACCORDING TO KLAUBER (1946) \	SPECIMENS	UNKNOWN	########	In-ko-pah (	11	583905
MAPPED T(	THE SMALL	Non-native TAMARISK	6-10 DETE(	DPR-ANZA-	########	Carrizo Mtı	11	583665
A, IMPERIAI	THOUGH IT IS NOT ENTIRELY CLEA	W. M. GAB	UNKNOWN	########	Yuma East	11	723447
LOCATIONS	JANUARY COLLECTION WAS FOUN	THOUGH L(	DFG, USFW	########	Niland (331	11	632188
MAPPED G	MUCH OF THE LANDSCAPE WAS D	ONE WAS (	BLM	########	Quartz Pea	11	701990
EXACT LOC	WITH LARREA AND AMBROSIA.	ONLY SOUI	UNKNOWN	########	Yuma West	11	715730
EXACT LOC	WASTE DISTURBED PLACES.	ONLY SOUI	UNKNOWN	########	Laguna Dar	11	734306
EXACT LOC	ROCKY SLOPE, WITH ENCELIA FAR	ONLY SOUI	BLM?	########	Picacho Pe.	11	721225
EXACT LOC	STEEP-WALLED CANYON WITH SA	ONLY SOUI	BLM	########	Carrizo Mtı	11	591377
EXACT LOCATION UNKNOWN. MAPPED AS BE		ONLY SOUI	UNKNOWN	########	Frink NW (:	11	622746
CLOSE TO SUMMIT OF BARREN GYPSUM MOI		ABOUT 5 P	PVT	########	Carrizo Mtı	11	584544
MAPPED T(	THE MANAGED MARSH COMPLEX	ONE WAS [	IMPERIAL I	########	Niland (331	11	637397
MAPPED T(	RIGHT-OF-WAY AND AGRICULTUR	2 ADULTS /	UNKNOWN	########	Bonds Corr	11	660307
MAPPED A	GROWING IN BOULDER CRACKS B	15-30 PLAN	BLM	########	In-ko-pah (	11	585041
MAPPED A	ON COMPACT SANDY SLOPES.	SITE BASED	BLM	########	In-ko-pah (	11	591989
MAPPED A	SANDY DR/ ORV activit OHV, TRAN	70+ PLANT	BLM	########	In-ko-pah (	11	588595
MAPPED A	POPULATIONS OF CYLINDROPUNT	ABOUT 10(	BLM	########	In-ko-pah (	11	586010
MAPPED A	POPULATIONS OF CYLINDROPUNT	15 PLANTS	BLM	########	In-ko-pah (	11	586819
MAPPED A	CREOSOTE ORV activit MINOR THI	DURING 20	BLM	########	In-ko-pah (	11	589057
MAPPED A	CREOSOTE ORV activit MINOR THI	75 PLANTS	BLM	########	Carrizo Mtı	11	588006
MAPPED	ACCORDING TO 2017 MORSE COOR	UNKNOWN	DPR-ANZA-	########	Borrego M(	11	584218
MAPPED A	IN AMONGST BOULDERS. BOULDE	3 SPRAWLI	BLM	########	In-ko-pah (	11	585041
MAPPED	ACCORDING TO 2017 MORSE COOR	UNKNOWN	UNKNOWN	########	Borrego M(	11	589699
MAPPED A	ON THE EDGE OF CREOSOTE SCRU	1 PLANT OI	BLM	########	Acolita (33	11	667204
MAPPED A	DESERT WASH WOODLAND. 5% SI	1 PLANT OI	BLM	########	Tortuga (3:	11	661035
MAPPED A	PRIMARILY DESERT W/ NONE.	48 PLANTS	BLM	########	Little Mule	11	682564
MAPPED B'	DESERT UNICORN PLANTS ALSO A	OBSERVED	UNKNOWN	########	Chuckwalla	11	674212
MAPPED T(	SPARSE CREOSOTE, SALTBUSH AN	3 ADULT FE	UNKNOWN	########	Kane Spring	11	606413
MAPPED T(	DESERT HARDPAN WITH SPARSE (	1 ADULT W	UNKNOWN	########	Kane Spring	11	605274
MAPPED A	WASTE GROUND.	ONLY SOUI	BLM?	########	Imperial Re	11	736636
LEY NEAR I	DESERT WASH. THIS AREA IS ABOI	INTACT, FR	BLM	########	In-ko-pah (	11	593664
MAPPED T(	PRIMARILY ORV activit OHV USE, F	1 JUVENILE	BLM	########	Glamis NW	11	671386
MAPPED T(	CREOSOTE ORV activit OHV USE.	40 DETECT	BLM	########	Superstitio	11	606280
MAPPED T(	CREOSOTE SCRUB ON SANDY SUB	2 ADULTS (	BLM	########	Glamis SW	11	666296
MAPPED T(	ROAD THROUGH CREOSOTE SCRU	1 ADULT O	DOD-NAVY	########	Superstitio	11	616594
MAPPED T(	CREOSOTE SCRUB WITH A FEW P/	15 ADULTS	BLM	########	Yuha Basin	11	614473
MAPPED T(	OPEN CRE(Military op MILITARY L	24 ADULTS	DOD-NAVY	########	Brawley N\	11	616843
MAPPED T(	PAVED PUE Vehicle col VEHICLE ST	1 ADULT M	DOD-NAVY	########	Brawley N\	11	621626
FORT YUM.	ROADSIDES.	ONLY SOUI	BIA-FORT Y	########	Yuma West	11	721345
MAPPED TO PROVIDED COORDINATES.		1 ADULT &	BLM	########	Tortuga (3:	11	655337
MAPPED TO PROVIDED COORDINATES.		1 ADULT M	BLM	########	Frink NW (:	11	616972
MAPPED A	ROOTED BELOW OUTC NONE APP/	SINGLE PL/	BLM	########	Palo Verde	11	703288
MAPPED T(	DETECTED Vehicle col VEHICLE ST	1 ADULT O	BLM	########	In-ko-pah (	11	589728
MAPPED N	FOUND ON ITS LARVAL HOST PLAI	COLLECTIO	BLM	########	Glamis (32:	11	678720

MAPPED NON-SPECIFICALLY ACROSS THE EXT	SPECIMENS	BLM	########	Glamis (32:	11	681857
MAPPED NON-SPECIFICALLY ACROSS THE EXT	THIS SPECII	BLM	########	Glamis (32:	11	681857
MAPPED NON-SPECIFICALLY ACROSS THE EXT	SPECIMENS	BLM	########	Glamis (32:	11	681857
MAPPED NON-SPECIFICALLY ACROSS THE EXT	COLLECTIO	BLM	########	Glamis (32:	11	681857
MAPPED N FOUND ONLY AROUND THE BASES	THIS SPECII	BLM	########	Glamis (32:	11	681857
MAPPED NON-SPECIFICALLY ACROSS THE EXT	COLLECTIO	BLM	########	Glamis (32:	11	681857

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Scientific_Name	Common_Name	Element_Code	Occ_Number	MAPNDX
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	43	6251
Setophaga petechia	yellow warbler	ABPBX03010	32	6328
Athene cunicularia	burrowing owl	ABNSB10010	107	17289
Mentzelia hirsutissima	hairy stickleaf	PDLOA030K0	1	37025
Incilius alvarius	Sonoran desert toad	AAABB01010	3	43447
Abronia villosa var. aurita	chaparral sand-verbena	PDNYC010P1	1	6328
Euphorbia abramsiana	Abrams' spurge	PDEUP0D010	3	45965
Euphorbia abramsiana	Abrams' spurge	PDEUP0D010	1	6328
Pholisma sonorae	sand food	PDLNN02020	26	43447
Athene cunicularia	burrowing owl	ABNSB10010	523	49108
Athene cunicularia	burrowing owl	ABNSB10010	526	49116
Athene cunicularia	burrowing owl	ABNSB10010	533	49169
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Athene cunicularia	burrowing owl	ABNSB10010	568	51255
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Athene cunicularia	burrowing owl	ABNSB10010	596	51584
Athene cunicularia	burrowing owl	ABNSB10010	598	51610
Buteo regalis	ferruginous hawk	ABNKC19120	8	52945
Taxidea taxus	American badger	AMAJF04010	139	56801
Taxidea taxus	American badger	AMAJF04010	258	6328
Lasiurus xanthinus	western yellow bat	AMACC05070	3	58808
Lasiurus xanthinus	western yellow bat	AMACC05070	5	58812
Lasiurus xanthinus	western yellow bat	AMACC05070	7	58819
Lasiurus xanthinus	western yellow bat	AMACC05070	2	6328
Lasiurus xanthinus	western yellow bat	AMACC05070	4	45965
Nyctinomops macrotis	big free-tailed bat	AMACD04020	2	58808
Eumops perotis californicus	western mastiff bat	AMACD02011	49	6328
Nyctinomops femorosaccus	pocketed free-tailed bat	AMACD04010	13	6328
Imperata brevifolia	California satintail	PMPOA3D020	1	69048
Athene cunicularia	burrowing owl	ABNSB10010	922	69261
Athene cunicularia	burrowing owl	ABNSB10010	925	69263
Pyrocephalus rubinus	vermilion flycatcher	ABPAE36010	33	56801
Athene cunicularia	burrowing owl	ABNSB10010	1005	70860
Athene cunicularia	burrowing owl	ABNSB10010	1006	70863
Athene cunicularia	burrowing owl	ABNSB10010	1007	70865
Athene cunicularia	burrowing owl	ABNSB10010	1008	70867
Athene cunicularia	burrowing owl	ABNSB10010	1009	70876
Abronia villosa var. aurita	chaparral sand-verbena	PDNYC010P1	43	72386
Lithobates pipiens	northern leopard frog	AAABH01170	8	58808
Malperia tenuis	brown turbans	PDAST67010	2	37037
Calliandra eriophylla	pink fairy-duster	PDFAB0N040	37	37037
Athene cunicularia	burrowing owl	ABNSB10010	1285	79608
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Athene cunicularia	burrowing owl	ABNSB10010	1290	79616
Athene cunicularia	burrowing owl	ABNSB10010	599	51611
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Athene cunicularia	burrowing owl	ABNSB10010	1302	79732
Athene cunicularia	burrowing owl	ABNSB10010	1303	79733
Athene cunicularia	burrowing owl	ABNSB10010	1304	79734
Athene cunicularia	burrowing owl	ABNSB10010	1305	79736
Nama stenocarpa	mud nama	PDHYD0A0H0	18	80341
Euphorbia abramsiana	Abrams' spurge	PDEUP0D010	6	80483
Sigmodon hispidus eremicus	Yuma hispid cotton rat	AMAFF07013	9	81266
Sigmodon hispidus eremicus	Yuma hispid cotton rat	AMAFF07013	17	81274
Athene cunicularia	burrowing owl	ABNSB10010	1642	81565
Athene cunicularia	burrowing owl	ABNSB10010	1643	81566
Athene cunicularia	burrowing owl	ABNSB10010	1644	81567
Athene cunicularia	burrowing owl	ABNSB10010	1645	81568
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	218	6328
Athene cunicularia	burrowing owl	ABNSB10010	1647	81571
Rallus obsoletus yumanensis	Yuma Ridgway's rail	ABNME0501A	48	82675
Astragalus sabulonum	gravel milk-vetch	PDFAB0F7R0	1	6328
Charadrius montanus	mountain plover	ABNNB03100	69	84816
Charadrius montanus	mountain plover	ABNNB03100	70	84817
Lycium parishii	Parish's desert-thorn	PDSOL0G0D0	6	84963
Lycium parishii	Parish's desert-thorn	PDSOL0G0D0	8	84965
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	279	86259
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	280	86260
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	314	96587
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	315	96589
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	1	6154
Phrynosoma mcallii	flat-tailed horned lizard	ARACF12040	289	96453
Neotoma albigula venusta	Colorado Valley woodrat	AMAFF08031	20	56801

EONDX	Key_Quad_Code	Key_Quad_Name	Key_County_Code	Accuracy
27928	3211566	Mount Signal	IMP	1 mile
24911	3211564	Calexico	IMP	1 mile
12220	3211575	El Centro	IMP	1/5 mile
32022	3211566	Mount Signal	IMP	1 mile
43447	3211574	Holtville West	IMP	1 mile
45033	3211564	Calexico	IMP	1 mile
45965	3211565	Heber	IMP	3/5 mile
45963	3211564	Calexico	IMP	1 mile
46503	3211574	Holtville West	IMP	1 mile
49108	3211564	Calexico	IMP	nonspecific area
49116	3211565	Heber	IMP	2/5 mile
49169	3211565	Heber	IMP	1/5 mile
49174	3211565	Heber	IMP	1/5 mile
49175	3211564	Calexico	IMP	1/10 mile
51255	3211575	El Centro	IMP	1/5 mile
51268	3211574	Holtville West	IMP	1 mile
51277	3211565	Heber	IMP	1/10 mile
51578	3211576	Seeley	IMP	specific area
51584	3211566	Mount Signal	IMP	80 meters
51610	3211565	Heber	IMP	80 meters
52945	3211574	Holtville West	IMP	80 meters
56817	3211576	Seeley	IMP	1 mile
57376	3211564	Calexico	IMP	1 mile
58844	3211575	El Centro	IMP	1 mile
58848	3211575	El Centro	IMP	1 mile
58855	3211575	El Centro	IMP	1 mile
58841	3211564	Calexico	IMP	1 mile
58845	3211565	Heber	IMP	3/5 mile
59560	3211575	El Centro	IMP	1 mile
66376	3211564	Calexico	IMP	1 mile
68714	3211564	Calexico	IMP	1 mile
69816	3211565	Heber	IMP	1 mile
70041	3211575	El Centro	IMP	80 meters
70043	3211575	El Centro	IMP	specific area
71631	3211576	Seeley	IMP	1 mile
71842	3211575	El Centro	IMP	specific area
71843	3211575	El Centro	IMP	80 meters
71846	3211575	El Centro	IMP	80 meters
71847	3211564	Calexico	IMP	80 meters
71854	3211575	El Centro	IMP	nonspecific area
73348	3211576	Seeley	IMP	1 mile
74659	3211575	El Centro	IMP	1 mile
32034	3211567	Yuha Basin	IMP	5 miles
73125	3211567	Yuha Basin	IMP	5 miles
80595	3211563	Bonds Corner	IMP	specific area
80602	3211565	Heber	IMP	80 meters

80604	3211565 Heber	IMP	80 meters
51611	3211565 Heber	IMP	specific area
80601	3211566 Mount Signal	IMP	80 meters
51609	3211566 Mount Signal	IMP	specific area
71840	3211575 El Centro	IMP	specific area
80725	3211575 El Centro	IMP	80 meters
80727	3211575 El Centro	IMP	specific area
80728	3211575 El Centro	IMP	80 meters
80729	3211575 El Centro	IMP	specific area
80730	3211575 El Centro	IMP	specific area
81316	3211576 Seeley	IMP	1 mile
45968	3211563 Bonds Corner	IMP	1 mile
82245	3211566 Mount Signal	IMP	80 meters
82253	3211575 El Centro	IMP	80 meters
82532	3211575 El Centro	IMP	80 meters
82533	3211575 El Centro	IMP	specific area
82534	3211575 El Centro	IMP	80 meters
82535	3211575 El Centro	IMP	80 meters
82788	3211564 Calexico	IMP	1 mile
82538	3211575 El Centro	IMP	specific area
83677	3211563 Bonds Corner	IMP	specific area
85298	3211564 Calexico	IMP	1 mile
85848	3211576 Seeley	IMP	3/5 mile
85849	3211566 Mount Signal	IMP	nonspecific area
85999	3211566 Mount Signal	IMP	specific area
86001	3211566 Mount Signal	IMP	specific area
87303	3211566 Mount Signal	IMP	specific area
87304	3211566 Mount Signal	IMP	80 meters
97765	3211566 Mount Signal	IMP	nonspecific area
97767	3211566 Mount Signal	IMP	nonspecific area
14781	3211566 Mount Signal	IMP	nonspecific area
97635	3211566 Mount Signal	IMP	nonspecific area
101662	3211576 Seeley	IMP	1 mile

Presence	Occ_Type	Occ_Rank	Sensitive	Site_Date
Possibly Extirpated	Natural/Native occurrence	None	N	19331130
Presumed Extant	Natural/Native occurrence	Unknown	N	19210508
Presumed Extant	Natural/Native occurrence	Fair	N	19901211
Presumed Extant	Natural/Native occurrence	Unknown	N	19610304
Possibly Extirpated	Natural/Native occurrence	None	N	19120618
Presumed Extant	Natural/Native occurrence	Unknown	N	19121019
Presumed Extant	Natural/Native occurrence	Unknown	N	190406XX
Presumed Extant	Natural/Native occurrence	Unknown	N	19030725
Presumed Extant	Natural/Native occurrence	Unknown	N	1915XXXX
Presumed Extant	Natural/Native occurrence	Unknown	N	1994XXXX
Presumed Extant	Natural/Native occurrence	Excellent	N	19910401
Presumed Extant	Natural/Native occurrence	Excellent	N	19910401
Presumed Extant	Natural/Native occurrence	Excellent	N	19910401
Presumed Extant	Natural/Native occurrence	Excellent	N	19910419
Presumed Extant	Natural/Native occurrence	Unknown	N	19090405
Presumed Extant	Natural/Native occurrence	Unknown	N	19340530
Presumed Extant	Natural/Native occurrence	Excellent	N	19910419
Presumed Extant	Natural/Native occurrence	Excellent	N	20030602
Presumed Extant	Natural/Native occurrence	Excellent	N	20030602
Presumed Extant	Natural/Native occurrence	Excellent	N	20030603
Presumed Extant	Natural/Native occurrence	Unknown	N	20030122
Presumed Extant	Natural/Native occurrence	Unknown	N	19110405
Presumed Extant	Natural/Native occurrence	Unknown	N	19220814
Presumed Extant	Natural/Native occurrence	Unknown	N	19990825
Presumed Extant	Natural/Native occurrence	Unknown	N	19770425
Presumed Extant	Natural/Native occurrence	Unknown	N	19920723
Presumed Extant	Natural/Native occurrence	Unknown	N	19770812
Presumed Extant	Natural/Native occurrence	Unknown	N	19850617
Presumed Extant	Natural/Native occurrence	Unknown	N	19870331
Presumed Extant	Natural/Native occurrence	Unknown	N	19961007
Presumed Extant	Natural/Native occurrence	Unknown	N	19951003
Presumed Extant	Natural/Native occurrence	Unknown	N	19630605
Presumed Extant	Natural/Native occurrence	Poor	N	20070104
Presumed Extant	Natural/Native occurrence	Good	N	20061121
Presumed Extant	Natural/Native occurrence	Unknown	N	19090406
Presumed Extant	Natural/Native occurrence	Excellent	N	20051102
Presumed Extant	Natural/Native occurrence	Excellent	N	20051102
Presumed Extant	Natural/Native occurrence	Excellent	N	20051102
Presumed Extant	Natural/Native occurrence	Poor	N	20070123
Presumed Extant	Natural/Native occurrence	Unknown	N	19941123
Presumed Extant	Natural/Native occurrence	Unknown	N	19490317
Presumed Extant	Transplant Outside of Native Hab./Range	Unknown	N	19290415
Presumed Extant	Natural/Native occurrence	Unknown	N	19920308
Presumed Extant	Natural/Native occurrence	Unknown	N	19700301
Presumed Extant	Natural/Native occurrence	Unknown	N	20070626
Presumed Extant	Natural/Native occurrence	Unknown	N	20070627

Presumed Extant	Natural/Native occurrence	Unknown	N	20070627
Presumed Extant	Natural/Native occurrence	Excellent	N	20070627
Presumed Extant	Natural/Native occurrence	Unknown	N	20070627
Presumed Extant	Natural/Native occurrence	Excellent	N	20070627
Presumed Extant	Natural/Native occurrence	Excellent	N	20060620
Presumed Extant	Natural/Native occurrence	Unknown	N	20060620
Presumed Extant	Natural/Native occurrence	Unknown	N	20060620
Presumed Extant	Natural/Native occurrence	Unknown	N	20060621
Presumed Extant	Natural/Native occurrence	Unknown	N	20060621
Presumed Extant	Natural/Native occurrence	Unknown	N	20060621
Possibly Extirpated	Natural/Native occurrence	None	N	19030401
Presumed Extant	Natural/Native occurrence	Unknown	N	19121019
Presumed Extant	Natural/Native occurrence	Unknown	N	20081007
Presumed Extant	Natural/Native occurrence	Unknown	N	20081006
Presumed Extant	Natural/Native occurrence	Fair	N	20090310
Presumed Extant	Natural/Native occurrence	Fair	N	20090310
Presumed Extant	Natural/Native occurrence	Fair	N	20090310
Presumed Extant	Natural/Native occurrence	Fair	N	20090310
Possibly Extirpated	Natural/Native occurrence	None	N	196905XX
Presumed Extant	Natural/Native occurrence	Fair	N	20090310
Presumed Extant	Natural/Native occurrence	Fair	N	19980518
Presumed Extant	Natural/Native occurrence	Unknown	N	19020113
Presumed Extant	Natural/Native occurrence	Unknown	N	20100116
Presumed Extant	Natural/Native occurrence	Unknown	N	20080218
Presumed Extant	Natural/Native occurrence	Fair	N	20100511
Presumed Extant	Natural/Native occurrence	Poor	N	20101118
Presumed Extant	Natural/Native occurrence	Unknown	N	20100617
Presumed Extant	Natural/Native occurrence	Unknown	N	20101110
Presumed Extant	Natural/Native occurrence	Unknown	N	19930805
Presumed Extant	Natural/Native occurrence	Unknown	N	19930806
Presumed Extant	Natural/Native occurrence	Good	N	20130620
Presumed Extant	Natural/Native occurrence	Unknown	N	1985XXXX
Presumed Extant	Natural/Native occurrence	Unknown	N	19090410

Elm_Date	Owner_Management	Federal_Status	State_Status	Global_Rank	State_Rank
19331130	UNKNOWN	None	None	G3	S2
19210508	UNKNOWN	None	None	G5	S3S4
19901211	PVT-IMPERIAL IRRIGATION DIST	None	None	G4	S3
19610304	UNKNOWN	None	None	G4?	S3
19120618	UNKNOWN	None	None	G5	SH
19121019	UNKNOWN	None	None	G5T2?	S2
190406XX	UNKNOWN	None	None	G4	S2
19030725	UNKNOWN	None	None	G4	S2
1915XXXX	UNKNOWN	None	None	G2	S2
1994XXXX	UNKNOWN	None	None	G4	S3
19910401	UNKNOWN	None	None	G4	S3
19910401	UNKNOWN	None	None	G4	S3
19910401	UNKNOWN	None	None	G4	S3
19910419	UNKNOWN	None	None	G4	S3
19090405	UNKNOWN	None	None	G4	S3
19340530	UNKNOWN	None	None	G4	S3
19910419	UNKNOWN	None	None	G4	S3
20030602	PVT	None	None	G4	S3
20030602	UNKNOWN	None	None	G4	S3
20030603	UNKNOWN	None	None	G4	S3
20030122	UNKNOWN	None	None	G4	S3S4
19110405	UNKNOWN	None	None	G5	S3
19220814	UNKNOWN	None	None	G5	S3
19990825	UNKNOWN	None	None	G5	S3
19770425	UNKNOWN	None	None	G5	S3
19920723	UNKNOWN	None	None	G5	S3
19770812	UNKNOWN	None	None	G5	S3
19850617	UNKNOWN	None	None	G5	S3
19870331	UNKNOWN	None	None	G5	S3
19961007	UNKNOWN	None	None	G5T4	S3S4
19951003	UNKNOWN	None	None	G4	S3
19630605	UNKNOWN	None	None	G4	S3
20070104	UNKNOWN	None	None	G4	S3
20061121	UNKNOWN	None	None	G4	S3
19090406	UNKNOWN	None	None	G5	S2S3
20051102	PVT	None	None	G4	S3
20051102	UNKNOWN	None	None	G4	S3
20051102	UNKNOWN	None	None	G4	S3
20070123	UNKNOWN	None	None	G4	S3
19941123	PVT-IMPERIAL IRRIGATION DIST	None	None	G4	S3
19490317	UNKNOWN	None	None	G5T2?	S2
19290415	UNKNOWN	None	None	G5	S2
19920308	UNKNOWN	None	None	G4?	S2?
19700301	UNKNOWN	None	None	G5	S3
20070626	UNKNOWN	None	None	G4	S3
20070627	UNKNOWN	None	None	G4	S3

20070627	UNKNOWN	None	None	G4	S3
20070627	UNKNOWN	None	None	G4	S3
20070627	UNKNOWN	None	None	G4	S3
20070627	PVT	None	None	G4	S3
20060620	PVT	None	None	G4	S3
20060620	PVT-IMPERIAL IRRIGATION DIST	None	None	G4	S3
20060620	PVT-IMPERIAL IRRIGATION DIST	None	None	G4	S3
20060621	PVT-IMPERIAL IRRIGATION DIST	None	None	G4	S3
20060621	PVT-IMPERIAL IRRIGATION DIST	None	None	G4	S3
20060621	PVT-IMPERIAL IRRIGATION DIST	None	None	G4	S3
19030401	UNKNOWN	None	None	G4G5	S1S2
19121019	UNKNOWN	None	None	G4	S2
20081007	PVT-IMPERIAL IRRIGATION DIST	None	None	G5T2T3	S2
20081006	PVT-IMPERIAL IRRIGATION DIST	None	None	G5T2T3	S2
20090310	UNKNOWN	None	None	G4	S3
20090310	UNKNOWN	None	None	G4	S3
20090310	UNKNOWN	None	None	G4	S3
20090310	UNKNOWN	None	None	G4	S3
196905XX	UNKNOWN	None	None	G3	S2
20090310	UNKNOWN	None	None	G4	S3
19980518	UNKNOWN	Endangered	Threatened	G5T3	S1S2
19020113	UNKNOWN	None	None	G4G5	S2
20100116	UNKNOWN	None	None	G3	S2S3
20080218	PVT	None	None	G3	S2S3
20100511	BLM	None	None	G4	S1
20101118	BLM	None	None	G4	S1
20100617	BLM	None	None	G3	S2
20101110	BLM	None	None	G3	S2
19930805	BLM; UNKNOWN	None	None	G3	S2
19930806	BLM	None	None	G3	S2
20130620	BLM	None	None	G3	S2
1985XXXX	BLM	None	None	G3	S2
19090410	UNKNOWN	None	None	G5T3T4	S1S2

Rare_Plant_Rank	CDFW_Status	Other_Status	Symbology
	SSC	BLM_S; IUCN_NT	204
	SSC	USFWS_BCC	804
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
2B.3		SB_RSABG; SB_USDA	104
	SSC	IUCN_LC	804
1B.1		BLM_S; SB_RSABG; USFS_S	804
2B.2		SB_RSABG	804
2B.2		SB_RSABG	804
1B.2		BLM_S; SB_RSABG	804
	SSC	BLM_S; IUCN_LC; USFWS_BCC	203
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
	SSC	BLM_S; IUCN_LC; USFWS_BCC	204
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	WL	IUCN_LC; USFWS_BCC	201
	SSC	IUCN_LC	804
	SSC	IUCN_LC	804
	SSC	IUCN_LC; WBWG_H	804
	SSC	IUCN_LC; WBWG_H	204
	SSC	IUCN_LC; WBWG_H	204
	SSC	IUCN_LC; WBWG_H	804
	SSC	IUCN_LC; WBWG_H	804
	SSC	IUCN_LC; WBWG_MH	804
	SSC	BLM_S; WBWG_H	804
	SSC	IUCN_LC; WBWG_M	804
2B.1		SB_RSABG; SB_SBBG; USFS_S	104
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	IUCN_LC	804
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	203
1B.1		BLM_S; SB_RSABG; USFS_S	104
	SSC	IUCN_LC	804
2B.3		SB_RSABG; SB_USDA	804
2B.3		SB_RSABG	804
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201

	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
2B.2			104
2B.2		SB_RSABG	104
	SSC		201
	SSC		201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_LC; USFWS_BCC	201
	SSC	BLM_S; IUCN_NT	804
	SSC	BLM_S; IUCN_LC; USFWS_BCC	202
	FP	NABCI_RWL	202
2B.2			804
	SSC	BLM_S; IUCN_NT; NABCI_RWL; USFWS_BCC	204
	SSC	BLM_S; IUCN_NT; NABCI_RWL; USFWS_BCC	203
2B.3			102
2B.3			102
	SSC	BLM_S; IUCN_NT	202
	SSC	BLM_S; IUCN_NT	201
	SSC	BLM_S; IUCN_NT	203
	SSC	BLM_S; IUCN_NT	203
	SSC	BLM_S; IUCN_NT	203
	SSC	BLM_S; IUCN_NT	203
			804

Taxon_Group
Reptiles
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Amphibians
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Reptiles
Mammals

CALIFORNIA DEPARTMENT OF FISH and WILDLIFE RareFind

Query Summary:
County IS (Imperial)

Print Close

CNDDB Element Query Results

Scientific Name	Common Name	Taxonomic Group	Element Code	Total Occs	Returned Occs	Federal Status	State Status	Global Rank	State Rank	CA Rare Plant Rank	Other Status	Habitats
Abronia villosa var. aurita	chaparral sand-verbena	Dicots	PDNYC010P1	98	2	None	None	G5T2?	S2	1B.1	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden, USFS_S-Sensitive	Chaparral, Coastal scrub, Desert dunes
Accipiter cooperii	Cooper's hawk	Birds	ABNKC12040	118	3	None	None	G5	S4	null	CDFW_WL-Watch List, IUCN_LC-Least Concern	Cismontane woodland, Riparian forest, Riparian woodland, Upper montane coniferous forest
Acmispon haydonii	pygmy lotus	Dicots	PDFAB2A0H0	32	13	None	None	G3	S3	1B.3	SB_USDA-US Dept of Agriculture	Pinon & juniper woodlands, Sonoran desert scrub
Active Desert Dunes	Active Desert Dunes	Dune	CTT22100CA	4	1	None	None	G4	S2.2	null	null	Desert dunes
Agrilus harenus	Harenus jewel beetle	Insects	IICOLV0060	1	1	None	None	G1G2	S1S2	null	null	Desert dunes
Anomala carlsoni	Carlson's dune beetle	Insects	IICOL30050	24	23	None	None	G1	S1	null	null	Desert dunes, Sonoran desert scrub
Anomala hardyorum	Hardy's dune beetle	Insects	IICOL30060	17	17	None	None	G1	S1	null	null	Desert dunes, Sonoran desert scrub
Antrozous pallidus	pallid bat	Mammals	AMACC10010	420	10	None	None	G5	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, USFS_S-Sensitive, WBWG_H-High Priority	Chaparral, Coastal scrub, Desert wash, Great Basin grassland, Great Basin scrub, Mojavean desert scrub, Riparian woodland, Sonoran desert scrub, Upper montane coniferous forest, Valley & foothill grassland
Apiocera warneri	Glamis sand fly	Insects	IIDIP54020	1	1	None	None	G1G2	S1S2	null	null	Desert dunes
Aquila chrysaetos	golden eagle	Birds	ABNKC22010	321	2	None	None	G5	S3	null	BLM_S-Sensitive, CDF_S-Sensitive, CDFW_FP-Fully	Broadleaved upland forest, Cismontane woodland, Coastal prairie, Great Basin grassland, Great Basin scrub, Lower montane coniferous forest, Pinon & juniper woodlands, Upper montane coniferous forest, Valley & foothill grassland

EEC ORIGINAL PKG

											Protected, CDFW_WL-Watch List, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	
Ardea alba	great egret	Birds	ABNGA04040	43	1	None	None	G5	S4	null	CDF_S-Sensitive, IUCN_LC-Least Concern	Brackish marsh, Estuary, Freshwater marsh, Marsh & swamp, Riparian forest, Wetland
Ardea herodias	great blue heron	Birds	ABNGA04010	156	3	None	None	G5	S4	null	CDF_S-Sensitive, IUCN_LC-Least Concern	Brackish marsh, Estuary, Freshwater marsh, Marsh & swamp, Riparian forest, Wetland
Arizona elegans occidentalis	California glossy snake	Reptiles	ARADB01017	260	2	None	None	G5T2	S2	null	CDFW_SSC-Species of Special Concern	null
Asio flammeus	short-eared owl	Birds	ABNSB13040	11	1	None	None	G5	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Great Basin grassland, Marsh & swamp, Meadow & seep, Valley & foothill grassland, Wetland
Astragalus insularis var. harwoodii	Harwood's milk-vetch	Dicots	PDFAB0F491	120	12	None	None	G5T4	S2	2B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Desert dunes, Desert wash, Mojavean desert scrub
Astragalus magdalenae var. peirsonii	Peirson's milk-vetch	Dicots	PDFAB0F532	3	1	Threatened	Endangered	G3G4T1	S1	1B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Desert dunes
Astragalus sabulonum	gravel milk-vetch	Dicots	PDFAB0F7R0	19	5	None	None	G4G5	S2	2B.2	null	Desert dunes, Mojavean desert scrub, Sonoran desert scrub
Athene cunicularia	burrowing owl	Birds	ABNSB10010	1989	262	None	None	G4	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Coastal prairie, Coastal scrub, Great Basin grassland, Great Basin scrub, Mojavean desert scrub, Sonoran desert scrub, Valley & foothill grassland
Ayenia compacta	California ayenia	Dicots	PDSTE01020	74	1	None	None	G4	S3	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden	Desert wash, Mojavean desert scrub, Sonoran desert scrub
Bombus crotchii	Crotch bumble bee	Insects	IIHYM24480	276	1	None	Candidate Endangered	G3G4	S1S2	null	null	null
Bombus occidentalis	western bumble bee	Insects	IIHYM24250	279	1	None	Candidate Endangered	G2G3	S1	null	USFS_S-Sensitive, XERCES_IM-Imperiled	null

Bursera microphylla	little-leaf elephant tree	Dicots	PDBUR01020	18	3	None	None	G4	S2	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden	Desert wash, Sonoran desert scrub
Buteo regalis	ferruginous hawk	Birds	ABNKC19120	107	2	None	None	G4	S3S4	null	CDFW_WL-Watch List, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Great Basin grassland, Great Basin scrub, Pinon & juniper woodlands, Valley & foothill grassland
Calliandra eriophylla	pink fairy-duster	Dicots	PDFAB0N040	53	48	None	None	G5	S3	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden	Sonoran desert scrub
Carnegiea gigantea	saguaro	Dicots	PDCAC12010	30	6	None	None	G5	S1	2B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Sonoran desert scrub
Castela emoryi	Emory's crucifixion-thorn	Dicots	PDSIM03030	55	7	None	None	G3G4	S2S3	2B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Alkali playa, Desert wash, Mojavean desert scrub, Sonoran desert scrub
Chaenactis carphoclinia var. peirsonii	Peirson's pincushion	Dicots	PDAST20042	12	7	None	None	G5T2	S2	1B.3	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Sonoran desert scrub
Chaetodipus fallax pallidus	pallid San Diego pocket mouse	Mammals	AMAFD05032	79	3	None	None	G5T34	S3S4	null	CDFW_SSC-Species of Special Concern	Desert wash, Pinon & juniper woodlands, Sonoran desert scrub
Charadrius alexandrinus nivosus	western snowy plover	Birds	ABNNB03031	138	2	Threatened	None	G3T3	S2S3	null	CDFW_SSC-Species of Special Concern, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Great Basin standing waters, Sand shore, Wetland
Charadrius montanus	mountain plover	Birds	ABNNB03100	90	23	None	None	G3	S2S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_NT-Near Threatened, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Chenopod scrub, Valley & foothill grassland
Chylismia	sand evening-	Dicots	PDONA03020	16	7	None	None	G4?	S2S3	2B.2	null	Sonoran desert scrub

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arenaria	primrose											
Coccyzus americanus occidentalis	western yellow-billed cuckoo	Birds	ABNRB02022	165	16	Threatened	Endangered	G5T2T3	S1	null	BLM_S-Sensitive, NABCI_RWL-Red Watch List, USFS_S-Sensitive, USFWS_BCC-Birds of Conservation Concern	Riparian forest
Colaptes chrysoides	gilded flicker	Birds	ABNYF10040	25	7	None	Endangered	G5	S1	null	BLM_S-Sensitive, IUCN_LC-Least Concern, NABCI_YWL-Yellow Watch List, USFWS_BCC-Birds of Conservation Concern	Riparian forest, Riparian woodland
Coleonyx switaki	barefoot gecko	Reptiles	ARACD01040	13	7	None	Threatened	G4	S1	null	BLM_S-Sensitive, IUCN_LC-Least Concern	Mojavean desert scrub, Sonoran desert scrub
Colubrina californica	Las Animas colubrina	Dicots	PDRHA05030	38	3	None	None	G4	S2S3	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden	Desert wash, Mojavean desert scrub, Sonoran desert scrub
Corynorhinus townsendii	Townsend's big-eared bat	Mammals	AMACC08010	635	7	None	None	G3G4	S2	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, USFS_S-Sensitive, WBWG_H-High Priority	Broadleaved upland forest, Chaparral, Chenopod scrub, Great Basin grassland, Great Basin scrub, Joshua tree woodland, Lower montane coniferous forest, Meadow & seep, Mojavean desert scrub, Riparian forest, Riparian woodland, Sonoran desert scrub, Sonoran thorn woodland, Upper montane coniferous forest, Valley & foothill grassland
Crotalus ruber	red-diamond rattlesnake	Reptiles	ARADE02090	192	2	None	None	G4	S3	null	CDFW_SSC-Species of Special Concern, USFS_S-Sensitive	Chaparral, Mojavean desert scrub, Sonoran desert scrub
Croton wigginsii	Wiggins' croton	Dicots	PDEUP0H140	12	12	None	Rare	G2G3	S2	2B.2	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Desert dunes, Sonoran desert scrub
Crucifixion Thorn Woodland	Crucifixion Thorn Woodland	Woodland	CTT75200CA	2	1	None	None	G3	S1.2	null	null	null
Cyclocephala wandae	Wandae dune beetle	Insects	IICOL33020	1	1	None	None	G1G2	S1S2	null	null	Desert dunes
Cylindropuntia	Munz's cholla	Dicots	PDCAC0D0V0	6	6	None	None	G3	S1	1B.3	BLM_S-	Sonoran desert scrub

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munzii											Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	
Cyprinodon macularius	desert pupfish	Fish	AFCNB02060	74	41	Endangered	Endangered	G1	S1	null	AFS_EN-Endangered, IUCN_VU-Vulnerable	Aquatic, Artificial flowing waters, Artificial standing waters, Colorado River basin flowing waters, Colorado River basin standing waters
Desert Fan Palm Oasis Woodland	Desert Fan Palm Oasis Woodland	Riparian	CTT62300CA	80	5	None	None	G3	S3.2	null	null	Riparian woodland
Digitaria californica var. californica	Arizona cottontop	Monocots	PMPOA27051	3	1	None	None	G5T5	S2	2B.3	null	Mojavean desert scrub, Sonoran desert scrub
Ditaxis claryana	glandular ditaxis	Dicots	PDEUP080L0	26	9	None	None	G3G4	S2	2B.2	null	Desert wash, Mojavean desert scrub, Sonoran desert scrub
Efferia macroxipha	Glamis robberfly	Insects	IIDIP07040	1	1	None	None	G1G2	S1S2	null	null	Desert dunes
Empidonax traillii extimus	southwestern willow flycatcher	Birds	ABPAE33043	70	7	Endangered	Endangered	G5T2	S1	null	NABCI_RWL-Red Watch List	Riparian woodland
Eriastrum harwoodii	Harwood's eriastrum	Dicots	PDPLM030B1	80	1	None	None	G2	S2	1B.2	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden, SB_USDA-US Dept of Agriculture	Desert dunes
Eryngium aristulatum var. parishii	San Diego button-celery	Dicots	PDAPI0Z042	82	1	Endangered	Endangered	G5T1	S1	1B.1	SB_CRES-San Diego Zoo CRES Native Gene Seed Bank, SB_RSABG-Rancho Santa Ana Botanic Garden	Coastal scrub, Valley & foothill grassland, Vernal pool, Wetland
Eucnide rupestris	annual rock-nettle	Dicots	PDLOA02020	6	4	None	None	G3	S1	2B.2	null	Sonoran desert scrub
Eumops perotis californicus	western mastiff bat	Mammals	AMACD02011	296	10	None	None	G5T4	S3S4	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, WBWG_H-High Priority	Chaparral, Cismontane woodland, Coastal scrub, Valley & foothill grassland
Euparagia unidentata	Algodones euparagia	Insects	IIHYMBC010	3	1	None	None	G1G2	S1S2	null	null	Desert dunes
Euphorbia abramsiana	Abrams' spurge	Dicots	PDEUP0D010	109	15	None	None	G4	S2	2B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Mojavean desert scrub, Sonoran desert scrub
Euphorbia arizonica	Arizona spurge	Dicots	PDEUP0D060	11	1	None	None	G5	S3	2B.3	null	Sonoran desert scrub
Euphorbia platysperma	flat-seeded spurge	Dicots	PDEUP0D1X0	3	1	None	None	G3	S1	1B.2	SB_RSABG-Rancho Santa	Desert dunes, Mojavean desert scrub

											Ana Botanic Garden	
Falco columbarius	merlin	Birds	ABNKD06030	37	6	None	None	G5	S3S4	null	CDFW_WL-Watch List, IUCN_LC-Least Concern	Estuary, Great Basin grassland, Valley & foothill grassland
Falco mexicanus	prairie falcon	Birds	ABNKD06090	460	7	None	None	G5	S4	null	CDFW_WL-Watch List, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Great Basin grassland, Great Basin scrub, Mojavean desert scrub, Sonoran desert scrub, Valley & foothill grassland
Galium angustifolium ssp. borregoense	Borrego bedstraw	Dicots	PDRUB0N042	20	1	None	Rare	G5T3?	S3?	1B.3	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Sonoran desert scrub
Gelochelidon nilotica	gull-billed tern	Birds	ABNNM08010	6	5	None	None	G5	S1	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, NABCI_YWL-Yellow Watch List, USFWS_BCC-Birds of Conservation Concern	null
Geraea viscida	sticky geraea	Dicots	PDAST42020	112	1	None	None	G2G3	S2	2B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Chaparral
Gila elegans	bonytail	Fish	AFCJB13100	3	2	Endangered	Endangered	G1	SH	null	AFS_EN-Endangered, IUCN_EN-Endangered	Aquatic, Colorado River basin flowing waters, Colorado River basin standing waters
Gopherus agassizii	desert tortoise	Reptiles	ARAAF01012	970	439	Threatened	Threatened	G3	S2S3	null	IUCN_VU-Vulnerable	Joshua tree woodland, Mojavean desert scrub, Sonoran desert scrub
Haliaeetus leucocephalus	bald eagle	Birds	ABNKC10010	327	1	Delisted	Endangered	G5	S3	null	BLM_S-Sensitive, CDF_S-Sensitive, CDFW_FP-Fully Protected, IUCN_LC-Least Concern, USFS_S-Sensitive, USFWS_BCC-Birds of Conservation Concern	Lower montane coniferous forest, Oldgrowth
Helianthus niveus ssp. tephrodes	Algodones Dunes	Dicots	PDAST4N0Z2	3	1	None	Endangered	G4T2T3	S1	1B.2	BLM_S-Sensitive,	Desert dunes

	sunflower										SB_USDA-US Dept of Agriculture	
Heloderma suspectum cinctum	banded Gila monster	Reptiles	ARACE01011	21	3	None	None	G4T4	S1	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_NT-Near Threatened	Mojavean desert scrub, Riparian scrub, Sonoran desert scrub
Herissantia crispa	curly herissantia	Dicots	PDMAL0F010	2	1	None	None	G5	S1	2B.3	null	Sonoran desert scrub
Hulsea mexicana	Mexican hulsea	Dicots	PDAST4Z050	3	1	None	None	G3G4	S1	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden	Chaparral
Hydroprogne caspia	Caspian tern	Birds	ABNNM08020	3	1	None	None	G5	S4	null	IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	null
Hymenoxys odorata	bitter hymenoxys	Dicots	PDAST530E0	6	2	None	None	G5	S2	2B.1	null	Riparian scrub, Sonoran desert scrub
Icteria virens	yellow-breasted chat	Birds	ABPBX24010	100	15	None	None	G5	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Riparian forest, Riparian scrub, Riparian woodland
Imperata brevifolia	California satintail	Monocots	PMPOA3D020	32	1	None	None	G4	S3	2B.1	SB_RSABG-Rancho Santa Ana Botanic Garden, SB_SBBG-Santa Barbara Botanic Garden, USFS_S-Sensitive	Chaparral, Coastal scrub, Meadow & seep, Mojavean desert scrub, Riparian scrub, Wetland
Incilius alvarius	Sonoran desert toad	Amphibians	AAABB01010	6	5	None	None	G5	SH	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Aquatic, Artificial flowing waters, Desert wash, Wetland
Ipomopsis effusa	Baja California ipomopsis	Dicots	PDPLM060U0	1	1	None	None	G3?	SH	2B.1	SB_RSABG-Rancho Santa Ana Botanic Garden	Chaparral, Desert wash, Sonoran desert scrub
Ipomopsis tenuifolia	slender-leaved ipomopsis	Dicots	PDPLM060J0	17	4	None	None	G4	S2	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden	Chaparral, Pinon & juniper woodlands, Sonoran desert scrub
Ixobrychus exilis	least bittern	Birds	ABNGA02010	10	5	None	None	G4G5	S2	null	CDFW_SSC-Species of Special Concern, IUCN_LC-	Marsh & swamp, Wetland

											Least Concern, USFWS_BCC-Birds of Conservation Concern	
Junco hyemalis caniceps	gray-headed junco	Birds	ABPBXA5021	9	1	None	None	G5T5	S1	null	CDFW_WL-Watch List	Upper montane coniferous forest
Kinosternon sonoriense	Sonoran mud turtle	Reptiles	ARAAE01040	5	5	None	None	G4	SH	null	CDFW_SSC-Species of Special Concern, IUCN_VU-Vulnerable	Colorado River basin flowing waters
Koeberlinia spinosa var. tenuispina	slender-spined all thorn	Dicots	PDCPP05012	12	9	None	None	G4T4?	S2	2B.2	null	Desert wash, Riparian woodland, Sonoran desert scrub
Lanius ludovicianus	loggerhead shrike	Birds	ABPBR01030	110	3	None	None	G4	S4	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Broadleaved upland forest, Desert wash, Joshua tree woodland, Mojavean desert scrub, Pinon & juniper woodlands, Riparian woodland, Sonoran desert scrub
Larus californicus	California gull	Birds	ABNNM03110	8	1	None	None	G5	S4	null	CDFW_WL-Watch List, IUCN_LC-Least Concern	null
Lasiurus cinereus	hoary bat	Mammals	AMACC05030	238	2	None	None	G5	S4	null	IUCN_LC-Least Concern, WBWG_M-Medium Priority	Broadleaved upland forest, Cismontane woodland, Lower montane coniferous forest, North coast coniferous forest
Lasiurus xanthinus	western yellow bat	Mammals	AMACC05070	58	8	None	None	G5	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, WBWG_H-High Priority	Desert wash
Laterallus jamaicensis coturniculus	California black rail	Birds	ABNME03041	303	37	None	Threatened	G3G4T1	S1	null	BLM_S-Sensitive, CDFW_FP-Fully Protected, IUCN_NT-Near Threatened, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Brackish marsh, Freshwater marsh, Marsh & swamp, Salt marsh, Wetland
Lepismadora	Algodones	Insects	IICOLX1110	1	1	None	None	G1	S1	null	null	null

algodones	sand jewel beetle											
Linanthus maculatus ssp. emaculatus	Jacumba Mountains linanthus	Dicots	PDPLM041Y2	5	2	None	None	G2T1	S1	1B.1	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Desert dunes, Sonoran desert scrub
Lithobates pipiens	northern leopard frog	Amphibians	AAABH01170	19	1	None	None	G5	S2	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Freshwater marsh, Great Basin flowing waters, Great Basin standing waters, Marsh & swamp, Wetland
Lithobates yavapaiensis	lowland leopard frog	Amphibians	AAABH01250	7	6	None	None	G4	SX	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	null
Lupinus albifrons var. medius	Mountain Springs bush lupine	Dicots	PDFAB2B1J5	48	10	None	None	G4T2	S2	1B.3	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden, SB_USDA-US Dept of Agriculture	Desert wash, Pinon & juniper woodlands, Sonoran desert scrub
Lycium parishii	Parish's desert-thorn	Dicots	PDSOL0G0D0	21	15	None	None	G4	S1	2B.3	null	Coastal scrub, Sonoran desert scrub
Macrotus californicus	California leaf-nosed bat	Mammals	AMACB01010	46	16	None	None	G4	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, WBWG_H-High Priority	Riparian scrub, Sonoran desert scrub
Malperia tenuis	brown turbans	Dicots	PDAST67010	30	20	None	None	G4?	S2?	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden, SB_USDA-US Dept of Agriculture	Sonoran desert scrub
Matelea parvifolia	spear-leaf matelea	Dicots	PDASC0A0J0	68	1	None	None	G5	S3	2B.3	USFS_S-Sensitive	Mojavean desert scrub, Sonoran desert scrub
Melanerpes uropygialis	Gila woodpecker	Birds	ABNYF04150	62	36	None	Endangered	G5	S1	null	BLM_S-Sensitive, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Riparian forest, Riparian woodland

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Melitta californica	California mellitid bee	Insects	IIHYM74010	5	2	None	None	G4?	S2?	null	null	null
Mentzelia hirsutissima	hairy stickleaf	Dicots	PDLOA030K0	28	11	None	None	G4?	S3	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden, SB_USDA-US Dept of Agriculture	Desert wash, Sonoran desert scrub
Mentzelia puberula	Darlington's blazing star	Dicots	PDLOA031F0	11	3	None	None	G5	S2	2B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Mojavean desert scrub, Sonoran desert scrub
Mentzelia tricuspis	spiny-hair blazing star	Dicots	PDLOA031T0	16	1	None	None	G4	S2	2B.1	null	Mojavean desert scrub
Mesquite Bosque	Mesquite Bosque	Riparian	CTT61820CA	14	1	None	None	G3	S2.1	null	null	Riparian forest
Micrathene whitneyi	elf owl	Birds	ABNSB09010	17	6	None	Endangered	G5	S1	null	BLM_S-Sensitive, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Riparian woodland
Microbembex elegans	Algodones elegant sand wasp	Insects	IIHYM90010	1	1	None	None	G1G2	S1S2	null	null	Desert dunes
Myiarchus tyrannulus	brown-crested flycatcher	Birds	ABPAE43080	18	7	None	None	G5	S3	null	CDFW_WL-Watch List, IUCN_LC-Least Concern	Riparian forest, Riparian woodland
Myotis ciliolabrum	western small-footed myotis	Mammals	AMACC01140	82	1	None	None	G5	S3	null	BLM_S-Sensitive, IUCN_LC-Least Concern, WBWG_M-Medium Priority	null
Myotis occultus	Arizona Myotis	Mammals	AMACC01160	3	1	None	None	G4	S1	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, WBWG_M-Medium Priority	null
Myotis velifer	cave myotis	Mammals	AMACC01050	9	1	None	None	G5	S1	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, WBWG_M-	Riparian scrub, Sonoran desert scrub

											Medium Priority	
Myotis yumanensis	Yuma myotis	Mammals	AMACC01020	265	2	None	None	G5	S4	null	BLM_S-Sensitive, IUCN_LC-Least Concern, WBWG_LM-Low-Medium Priority	Lower montane coniferous forest, Riparian forest, Riparian woodland, Upper montane coniferous forest
Nama stenocarpa	mud nama	Dicots	PDHYD0A0H0	22	3	None	None	G4G5	S1S2	2B.2	null	Marsh & swamp, Wetland
Nemacaulis denudata var. gracilis	slender cottonheads	Dicots	PDPGN0G012	24	2	None	None	G3G4T3?	S2	2B.2	null	Coastal dunes, Desert dunes, Sonoran desert scrub
Neotoma albigula venusta	Colorado Valley woodrat	Mammals	AMAFF08031	22	12	None	None	G5T3T4	S1S2	null	null	Sonoran desert scrub
Nyctinomops femorosaccus	pocketed free-tailed bat	Mammals	AMACD04010	90	5	None	None	G4	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, WBWG_M-Medium Priority	Joshua tree woodland, Pinon & juniper woodlands, Riparian scrub, Sonoran desert scrub
Nyctinomops macrotis	big free-tailed bat	Mammals	AMACD04020	32	1	None	None	G5	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, WBWG_MH-Medium-High Priority	null
Oliarces clara	cheeseweed owlfly (cheeseweed moth lacewing)	Insects	IINEU04010	11	1	None	None	G1G3	S2	null	null	Sonoran desert scrub
Onychomys torridus ramona	southern grasshopper mouse	Mammals	AMAFF06022	28	1	None	None	G5T3	S3	null	CDFW_SSC-Species of Special Concern	Chenopod scrub
Opuntia wigginsii	Wiggins' cholla	Dicots	PDCAC0D1P0	6	2	None	None	G3?Q	S1?	3.3	null	Sonoran desert scrub
Oreothlypis luciae	Lucy's warbler	Birds	ABPBX01090	2	1	None	None	G5	S2S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Riparian woodland
Ovis canadensis nelsoni	desert bighorn sheep	Mammals	AMALE04013	46	3	None	None	G4T4	S3	null	BLM_S-Sensitive,	Alpine, Alpine dwarf scrub, Chaparral, Chenopod scrub, Great Basin scrub, Mojavean desert scrub, Montane dwarf

											CDFW_FP-Fully Protected, USFS_S-Sensitive	scrub, Pinon & juniper woodlands, Riparian woodland, Sonoran desert scrub
Ovis canadensis nelsoni pop. 2	Peninsular bighorn sheep DPS	Mammals	AMALE04012	7	2	Endangered	Threatened	G4T3Q	S1	null	CDFW_FP-Fully Protected	Alpine, Alpine dwarf scrub, Chaparral, Chenopod scrub, Great Basin scrub, Mojavean desert scrub, Montane dwarf scrub, Pinon & juniper woodlands, Riparian woodland, Sonoran desert scrub
Palafoxia arida var. gigantea	giant spanish-needle	Dicots	PDAST6T012	6	6	None	None	G5T3?	S2	1B.3	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Desert dunes
Panicum hirticaule ssp. hirticaule	roughstalk witch grass	Monocots	PMPOA4K170	18	4	None	None	G5T5	S2	2B.1	SB_RSABG-Rancho Santa Ana Botanic Garden	Desert dunes, Joshua tree woodland, Mojavean desert scrub, Sonoran desert scrub
Pelecanus occidentalis californicus	California brown pelican	Birds	ABNFC01021	27	6	Delisted	Delisted	G4T3T4	S3	null	BLM_S-Sensitive, CDFW_FP-Fully Protected, USFS_S-Sensitive	null
Penstemon pseudospectabilis ssp. pseudospectabilis	desert beardtongue	Dicots	PDSCR1L562	25	3	None	None	G4G5T4	S3	2B.2	null	Mojavean desert scrub, Sonoran desert scrub
Perdita algodones	Algodones perdita	Insects	IIHYM01130	1	1	None	None	G1G2	S1S2	null	null	Desert dunes
Perognathus longimembris bangsi	Palm Springs pocket mouse	Mammals	AMAFD01043	30	3	None	None	G5T2	S2	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern	Desert wash, Sonoran desert scrub
Petalonyx linearis	narrow-leaf sandpaper-plant	Dicots	PDLOA04010	26	6	None	None	G4	S3?	2B.3	null	Mojavean desert scrub, Sonoran desert scrub
Pholisma sonorae	sand food	Dicots	PDLNN02020	14	14	None	None	G2	S2	1B.2	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Desert dunes, Sonoran desert scrub
Pholistoma auritum var. arizonicum	Arizona pholistoma	Dicots	PDHYD0D011	23	5	None	None	G5T4?	S3	2B.3	SB_RSABG-Rancho Santa Ana Botanic Garden, SB_USDA-US Dept of Agriculture	Mojavean desert scrub
Phrynosoma mcallii	flat-tailed horned lizard	Reptiles	ARACF12040	340	268	None	None	G3	S2	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_NT-	Desert dunes, Mojavean desert scrub, Sonoran desert scrub

											Near Threatened	
Pilostyles thurberi	Thurber's pilostyles	Dicots	PDRAF01010	26	22	None	None	G5	S4	4.3	null	Sonoran desert scrub
Piranga rubra	summer tanager	Birds	ABPBX45030	21	5	None	None	G5	S1	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Riparian forest
Plegadis chihi	white-faced ibis	Birds	ABNGE02020	20	2	None	None	G5	S3S4	null	CDFW_WL-Watch List, IUCN_LC-Least Concern	Marsh & swamp, Wetland
Polioptila melanura	black-tailed gnatcatcher	Birds	ABPBJ08030	34	13	None	None	G5	S3S4	null	CDFW_WL-Watch List, IUCN_LC-Least Concern	Mojavean desert scrub, Sonoran desert scrub
Pseudocotalpa andrewsi	Andrew's dune scarab beetle	Insects	IICOL37020	29	29	None	None	G1	S1	null	null	Desert dunes, Sonoran desert scrub
Pseudorontium cyathiferum	Deep Canyon snapdragon	Dicots	PDSCR2R010	3	1	None	None	G4G5	S1	2B.3	null	Sonoran desert scrub
Ptychocheilus lucius	Colorado pikeminnow	Fish	AFCJB35020	3	2	Endangered	Endangered	G1	SX	null	CDFW_FP-Fully Protected, IUCN_VU-Vulnerable	Aquatic, Colorado River basin flowing waters
Puma concolor browni	Yuma mountain lion	Mammals	AMAJH04013	1	1	None	None	G5T1T2Q	S1	null	CDFW_SSC-Species of Special Concern	null
Pyrocephalus rubinus	vermilion flycatcher	Birds	ABPAE36010	25	7	None	None	G5	S2S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Marsh & swamp, Riparian forest, Riparian scrub, Riparian woodland, Wetland
Rallus obsoletus yumanensis	Yuma Ridgway's rail	Birds	ABNME0501A	58	37	Endangered	Threatened	G5T3	S1S2	null	CDFW_FP-Fully Protected, NABCI_RWL-Red Watch List	Freshwater marsh, Marsh & swamp, Wetland
Rynchops niger	black skimmer	Birds	ABNNM14010	7	3	None	None	G5	S2	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, NABCI_YWL-Yellow Watch List, USFWS_BCC-Birds of Conservation Concern	Alkali playa, Sand shore
Salvia greatae	Orocopia sage	Dicots	PDLAM1S0P0	25	2	None	None	G2G3	S2S3	1B.3	BLM_S-Sensitive, SB_RSABG-	Desert wash, Mojavean desert scrub, Sonoran desert scrub

											Rancho Santa Ana Botanic Garden	
Scaphiopus couchii	Couch's spadefoot	Amphibians	AAABF01020	6	3	None	None	G5	S2	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	null
Selaginella eremophila	desert spike-moss	Ferns	PPSEL010G0	75	3	None	None	G4	S2S3	2B.2	null	Chaparral, Sonoran desert scrub
Senna covesii	Cove's cassia	Dicots	PDFAB491X0	55	1	None	None	G5	S3	2B.2	SB_RSABG-Rancho Santa Ana Botanic Garden	Desert wash, Sonoran desert scrub
Setophaga petechia	yellow warbler	Birds	ABPBX03010	78	2	None	None	G5	S3S4	null	CDFW_SSC-Species of Special Concern, USFWS_BCC-Birds of Conservation Concern	Riparian forest, Riparian scrub, Riparian woodland
Setophaga petechia sonorana	Sonoran yellow warbler	Birds	ABPBX03017	4	1	None	None	G5T2T3	S2	null	CDFW_SSC-Species of Special Concern, USFWS_BCC-Birds of Conservation Concern	Riparian forest
Sigmodon arizonae plenus	Colorado River cotton rat	Mammals	AMAFF07022	6	1	None	None	G5T2T3	S1S2	null	CDFW_SSC-Species of Special Concern	null
Sigmodon hispidus eremicus	Yuma hispid cotton rat	Mammals	AMAFF07013	23	23	None	None	G5T2T3	S2	null	CDFW_SSC-Species of Special Concern	null
Sonoran Cottonwood Willow Riparian Forest	Sonoran Cottonwood Willow Riparian Forest	Riparian	CTT61810CA	21	11	None	None	G2	S1.1	null	null	Riparian forest
Stabilized and Partially Stabilized Desert Dunes	Stabilized and Partially Stabilized Desert Dunes	Dune	CTT22200CA	3	1	None	None	G4	S3.2	null	null	Desert dunes
Streptanthus campestris	southern jewelflower	Dicots	PDBRA2G0B0	65	1	None	None	G3	S3	1B.3	BLM_S-Sensitive, USFS_S-Sensitive	Chaparral, Lower montane coniferous forest, Pinon & juniper woodlands
Symphyotrichum defoliatum	San Bernardino aster	Dicots	PDASTE80C0	102	1	None	None	G2	S2	1B.2	SB_CRES-San Diego Zoo CRES Native Gene Seed Bank, SB_RSABG-Rancho Santa Ana Botanic	Cismontane woodland, Coastal scrub, Lower montane coniferous forest, Marsh & swamp, Meadow & seep, Valley & foothill grassland

											Garden, USFS_S-Sensitive	
Taxidea taxus	American badger	Mammals	AMAJF04010	592	13	None	None	G5	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Alkali marsh, Alkali playa, Alpine, Alpine dwarf scrub, Bog & fen, Brackish marsh, Broadleaved upland forest, Chaparral, Chenopod scrub, Cismontane woodland, Closed-cone coniferous forest, Coastal bluff scrub, Coastal dunes, Coastal prairie, Coastal scrub, Desert dunes, Desert wash, Freshwater marsh, Great Basin grassland, Great Basin scrub, Interior dunes, Ione formation, Joshua tree woodland, Limestone, Lower montane coniferous forest, Marsh & swamp, Meadow & seep, Mojavean desert scrub, Montane dwarf scrub, North coast coniferous forest, Oldgrowth, Pavement plain, Redwood, Riparian forest, Riparian scrub, Riparian woodland, Salt marsh, Sonoran desert scrub, Sonoran thorn woodland, Ultramafic, Upper montane coniferous forest, Upper Sonoran scrub, Valley & foothill grassland
Teucrium cubense ssp. depressum	dwarf germander	Dicots	PDLAM20032	5	2	None	None	G4G5T3T4	S2	2B.2	null	Alkali playa, Desert dunes, Sonoran desert scrub
Tidestromia eliassoniana	Eliasson's woolly tidestromia	Dicots	PDAMA0J070	5	1	None	None	G5	S2	2B.2	null	Mojavean desert scrub, Sonoran desert scrub
Toxostoma crissale	Crissal thrasher	Birds	ABPBK06090	67	16	None	None	G5	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Riparian woodland
Toxostoma lecontei	Le Conte's thrasher	Birds	ABPBK06100	238	15	None	None	G4	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Desert wash, Mojavean desert scrub, Sonoran desert scrub
Transmontane Alkali Marsh	Transmontane Alkali Marsh	Marsh	CTT52320CA	7	1	None	None	G3	S2.1	null	null	Marsh & swamp, Wetland
Uma notata	Colorado Desert fringe-toed lizard	Reptiles	ARACF15020	16	11	None	None	G3	S2	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_NT-Near Threatened	Desert dunes, Desert wash, Sonoran desert scrub
Vireo bellii arizonae	Arizona bell's vireo	Birds	ABPBW01111	38	12	None	Endangered	G5T4	S1S2	null	BLM_S-Sensitive, IUCN_NT-Near	Riparian forest

											Threatened, USFWS_BCC-Birds of Conservation Concern	
Vireo bellii pusillus	least Bell's vireo	Birds	ABPBW01114	503	1	Endangered	Endangered	G5T2	S2	null	IUCN_NT-Near Threatened, NABCI_YWL-Yellow Watch List	Riparian forest, Riparian scrub, Riparian woodland
Xylorhiza orcuttii	Orcutt's woody-aster	Dicots	PDASTA1040	66	26	None	None	G3?	S2	1B.2	BLM_S-Sensitive, SB_RSABG-Rancho Santa Ana Botanic Garden	Desert wash, Sonoran desert scrub
Xyrauchen texanus	razorback sucker	Fish	AFCJC11010	28	16	Endangered	Endangered	G1	S1S2	null	AFS_EN-Endangered, CDFW_FP-Fully Protected, IUCN_EN-Endangered	Aquatic, Colorado River basin flowing waters

SAFETY AND HEALTH PROTECTION ON THE JOB

State of California
Department of Industrial Relations

California law provides workplace safety and health protections for workers through regulations enforced by the Division of Occupational Safety and Health (Cal/OSHA). This poster explains some basic requirements and procedures to comply with the state's workplace safety and health standards and orders. The law requires that this poster be displayed. Failure to do so could result in a substantial penalty. Cal/OSHA standards can be found at www.dir.ca.gov/samples/search/query.htm.

WHAT AN EMPLOYER MUST DO:

All employers must provide work and workplaces that are safe and healthful. In other words, as an employer, you must follow state laws governing job safety and health. Failure to do so can result in a threat to the life or health of workers, and substantial monetary penalties.

You must display this poster in a conspicuous place where notices to employees are customarily posted so everyone on the job can be aware of basic rights and responsibilities.

You must have a written and effective Injury and Illness Prevention Program (IIPP) meeting the requirements of California Code of Regulations, title 8, section 3203 (www.dir.ca.gov/title8/3203.html).

You must be aware of hazards your employees face on the job and keep records showing that each employee has been trained in the hazards unique to each job assignment.

You must correct any hazardous condition that you know may result in injury to employees. Failure to do so could result in criminal charges, monetary penalties, and even incarceration.

You must notify a local Cal/OSHA district office of any serious injury or illness, or death, occurring on the job. Be sure to do this immediately after calling for emergency help to assist the injured employee. Failure to report a serious injury or illness, or death, within 8 hours can result in a minimum civil penalty of $5,000.

WHAT AN EMPLOYER MUST NEVER DO:

Never permit an employee to do work that violates Cal/OSHA workplace safety and health regulations.

Never permit an employee to be exposed to harmful substances without providing adequate protection.

Never allow an untrained employee to perform hazardous work.

EMPLOYEES HAVE CERTAIN WORKPLACE SAFETY & HEALTH RIGHTS:

As an employee, you (or someone acting for you) have the right to file a confidential complaint and request an inspection of your workplace if you believe conditions there are unsafe or unhealthful. This is done by contacting the local Cal/OSHA district office (see list of offices). Your name is not revealed by Cal/OSHA, unless you request otherwise.

You also have the right to bring unsafe or unhealthful conditions to the attention of the Cal/OSHA investigator inspecting your workplace.

Any employee has the right to refuse to perform work that would violate an occupational safety or health standard or order where such violation would create a real and apparent hazard to the employee or other employees.

You may not be fired or punished in any way for filing a complaint about unsafe or unhealthful working conditions, or for otherwise exercising your rights to a safe and healthful workplace. If you feel that you have been fired or punished for exercising your rights, you may file a complaint about this type of discrimination by contacting the nearest office of the California Department of Industrial Relations, Division of Labor Standards Enforcement (Labor Commissioner's Office) or the San Francisco office of the U.S. Department of Labor, Occupational Safety and Health Administration. (Employees of state or local government agencies may only file these complaints with the California Labor Commissioner's Office.) Consult your local telephone directory for the office nearest you.

EMPLOYEES ALSO HAVE RESPONSIBILITIES:

To keep the workplace and your coworkers safe, you should tell your employer about any hazard that could result in an injury or illness to an employee.
While working, you must always obey state workplace safety and health laws.

SPECIAL RULES APPLY FOR WORK AROUND HAZARDOUS SUBSTANCES:

Employers who use any substance that is listed as a hazardous substance in California Code of Regulations, title 8, section 339 (www.dir.ca.gov/title8/339.html), or is covered by the Hazard Communication standard (www.dir.ca.gov/title8/5194.html) must provide employees information on the hazardous chemicals in their work areas, access to safety data sheets, and training on how to use hazardous chemicals safely.

Employers shall make available on a timely and reasonable basis a safety data sheet on each hazardous substance in the workplace upon request of an employee, an employee's collective bargaining representative, or an employee's physician.

Employees have the right to see and copy their medical records and records of exposure to potentially toxic materials or harmful physical agents.

Employers must allow access by employees or their representatives to accurate records of employee exposures to potentially toxic materials or harmful physical agents, and notify employees of any exposures in concentration or levels exceeding the exposure limits allowed by Cal/OSHA standards.

Any employee or their representative has the right to observe monitoring or measuring of employee exposure to hazards conducted to comply with Cal/OSHA regulations.

WHEN CAL/OSHA COMES TO THE WORKPLACE:

A trained Cal/OSHA safety engineer or industrial hygienist may visit the workplace to make sure your company is obeying workplace safety and health laws.

Inspections are also conducted when an employee files a valid complaint with Cal/OSHA.

Cal/OSHA also goes on-site to the workplace to investigate a serious injury or illness, or fatality.

When an inspection begins, the Cal/OSHA investigator will show official identification.

The employer, or someone the employer chooses, will be given an opportunity to accompany the investigator during the inspection. An authorized representative of the employees will be given the same opportunity. Where there is no authorized employee representative, the investigator will talk to a reasonable number of employees about safety and health conditions at the workplace.

VIOLATIONS, CITATIONS, AND PENALTIES:

If the investigation shows that the employer has violated a safety and health standard or order, Cal/OSHA may issue a citation. Each citation carries a monetary penalty and specifies a date by which the violation must be abated. A notice, which carries no monetary penalty, may be issued in lieu of a citation for certain non-serious violations.

Penalty amounts depend in part on the classification of the violation as regulatory, general, serious, repeat, or willful; and whether the employer failed to abate a previous violation involving the same hazardous condition. Base penalty amounts, penalty adjustment factors, and minimum and maximum penalty amounts are set forth in California Code of Regulations, title 8, section 336 (www.dir.ca.gov/title8/336.html). In addition, a willful violation that causes death or permanent impairment of the body of any employee can result, upon conviction, in a fine of up to $250,000 or imprisonment up to three years, or both, and if the employer is a corporation or limited liability company, the fine may be up to $1.5 million.

The law provides that employers may appeal citations within 15 working days of receipt to the Occupational Safety and Health Appeals Board.

An employer who receives a citation, Order to Take Special Action, or Special Order must post it prominently at or near the place of the violation for three working days, or until the unsafe condition is corrected, whichever is longer, to warn employees of danger that may exist there. Any employee may protest the time allowed for correction of the violation to the Division of Occupational Safety and Health or the Occupational Safety and Health Appeals Board.

HELP IS AVAILABLE:

To learn more about workplace safety rules, you may contact Cal/OSHA Consultation Services for free information, required forms, and publications. You can also contact a local district office of Cal/OSHA. If you prefer, you may retain a competent private consultant, or ask your workers' compensation insurance carrier for guidance in obtaining information.

Call the FREE Worker Information Helpline – (866) 924-9757

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH (CAL/OSHA)

HEADQUARTERS: 1515 Clay Street, Ste. 1901, Oakland, CA 94612 – Telephone (510) 286-7000

District Offices

American Canyon	3419 Broadway St., Ste. H8, American Canyon 94503	(707) 649-3700
Bakersfield	7718 Meany Ave., Bakersfield 93308	(661) 588-6400
Foster City	1065 East Hillsdale Bl., Ste. 110, Foster City 94404	(650) 573-3812
Fremont	39141 Civic Center Dr., Ste. 310, Fremont 94538	(510) 794-2521
Fresno	2550 Mariposa St., Rm. 4000, Fresno 93721	(559) 445-5302
Long Beach	3939 Atlantic Ave., Ste. 212, Long Beach 90807	(562) 506-0810
Los Angeles	320 West Fourth St., Rm. 820, Los Angeles 90013	(213) 576-7451
Modesto	4206 Technology Dr., Ste. 3, Modesto 95356	(209) 545-7310
Monrovia	800 Royal Oaks Dr., Ste. 105, Monrovia 91016	(626) 239-0369
Oakland	1515 Clay St., Ste. 1303, Box 41, Oakland 94612	(510) 622-2916
Redding	381 Hemsted Dr., Redding 96002	(530) 224-4743
Sacramento	2424 ArdenWay, Ste. 160, Sacramento 95825	(916) 263-2800
San Bernardino	464 West Fourth St., Ste. 332, San Bernardino 92401	(909) 383-4321
San Diego	7575 Metropolitan Dr., Ste. 207, San Diego 92108	(619) 767-2280
San Francisco	455 Golden Gate Ave., Rm. 9516, San Francisco 94105	(415) 557-0100
Santa Ana	2 MacArthur Place, Ste. 720, Santa Ana 92707	(714) 558-4451
Van Nuys	6150 Van Nuys Blvd., Ste. 405, Van Nuys 91401	(818) 901-5403

Regional Offices

San Francisco	455Golden Gate Ave., Rm 9516, San Francisco 94102	(415) 557-0300
Sacramento	2424 Arden Way, Ste. 300, Sacramento 95825	(916) 263-2803
Santa Ana	2 MacArthur Place, Ste. 720, Santa Ana 92707	(714) 558-4300
Monrovia	750 Royal Oaks Dr., Ste. 105, Monrovia 91016	(626) 470-9122

Cal OSHA Consultation Services

Field / Area Offices

•Fresno / Central Valley	2550 Mariposa Mall, Rm. 2005 Fresno 93721	(559) 445-6800
•La Palma / Los Angeles / Orange County	1 Centerpointe Dr., Ste. 150 La Palma 90623	(714) 562-5525
•Oakland/ Bay Area	1515 Clay St., Ste 1103 Oakland 94612	(510) 622-2891
•Sacramento / Northern CA	2424 Arden Way, Ste. 410, Sacramento 95825	(916) 263-0704
•San Bernardino	464 West Fourth St., Ste. 339 San Bernardino 92401	(909) 383-4567
•San Diego / Imperial County	7575 Metropolitan Dr., Ste. 204 San Diego 92108	(619) 767-2060
•San Fernando Valley	6150 Van Nuys Blvd., Ste. 307 Van Nuys 91401	(818) 901-5754

Consultation Region Office

•Fresno	2550 Mariposa Mall, Rm. 3014 Fresno 93721	(559) 445-6800

Enforcement of Cal/OSHA workplace safety and health standards is carried out by the Division of Occupational Safety and Health, under the California Department of Industrial Relations, which has primary responsibility for administering the Cal/OSHA program. Safety and health standards are promulgated by the Occupational Safety and Health Standards Board. Anyone desiring to register a complaint alleging inadequacy in the administration of the California Occupational Safety and Health Plan may do so by contacting the San Francisco Regional Office of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor Tel: (415) 625-2547. OSHA monitors the operation of state plans to assure that continued approval is merited. August 2019

EEC ORIGINAL PKG

As required by AB 75 (Strom Martin, Chapter 764, Statutes of 1999), each state agency and large state facility was required to develop an integrated waste management plan by July 1, 2000. The plan was to lay out how the agency or facility would divert at least 25 percent of its solid waste from landfills or transformation facilities by January 1, 2002, and 50 percent by January 1, 2004. Annual reporting on implementation of the plans is also required. These plans (and the annual reports, once submitted) can be reviewed in the State Agency Reporting Center (SARC).

Changes to Reporting Requirements for DAAs Starting January 1, 2015(
As of January 1, 2015 pursuant to AB 2490 (Eggman, Chapter 342, Statutes of 2014) Sections 10 and 15, California district agricultural associations (DAA) are excluded from the definition of “state agency” for purposes of the provisions in Public Resources Code Section 42926 (d). As such, DAAs are no longer required to submit an annual state agency waste management report to CalRecycle’s State Agency Reporting Center (SARC) by May 1 of each year. A full explanation of AB 2490 changes for DAAs is available on the California Legislative Information site.

While AB 2490 exempts DAAs from reporting requirements, each DAA is required to still maintain and monitor its waste diversion programs and activities to ensure adherence to the diversion requirements for State entities under AB 75 (Strom-Martin, Chapter 764, Statutes of 1999), AB 341 (Chesbro, Chapter 476, Statutes of 2011), SB 1016 (Wiggins, Chapter 343, Statutes of 2008), and PRC 42920-42926. See State Agency Laws and Regulations at for more information on diversion and recycled content purchasing requirements.

Any new agency or facility that has not yet completed a plan should contact CalRecycle staff for assistance. The following resources were provided to help agencies and facilities complete their plans.

- **State Agency Model Integrated Waste Management Plan** was drafted by the California Integrated Waste Management Board (now CalRecycle) to assist State agencies with meeting the new requirements.
- ***Conducting a Diversion Study--A Guide for Local Jurisdictions*** (Pub. #311-99-006). Includes volume-to-weight conversion factors for various material types.
- ***Waste Reduction Policies and Procedures for State Agencies*** (Pub. #441-99-017)
- ***Solid Waste Generation, Disposal, and Diversion Measurement Guide for State Agencies and Large State Facilities*** *(Final Draft for Peer Review)* (Pub. #321-00-007)
- **Volume-to-weight conversion factors** (approximate) for recovered materials, as found in Appendix I of *Conducting a Diversion Study: A Guide for California Jurisdictions* (Pub. #311-99-006)

Introduction

- Background
- Benefits of Waste Reduction
- Elements of a Self-Sustaining Waste Reduction Program
- Establishing Departmental Policy and Goals
- Table of Contents

Background

California's Solid Waste Mandates

Assembly Bill 939 (Sher, Chapter 1095, Statutes of 1989) requires every California city and county to divert 50 percent of its waste from landfills by the year 2000. Current law also requires State agencies to institute waste reduction and buy recycled activities to assist local governments in this effort. With less than a year remaining to attain the solid waste diversion goals of AB 939, California has reached a commendable statewide 33 percent waste diversion rate. (Note: As of 2000, the statewide rate was at 42 percent.)

Changes to Reporting Requirements for DAAs Starting January 1, 2015

As of January 1, 2015 pursuant to AB 2490 (Eggman, Chapter 342, Statutes of 2014) Sections 10 and 15, California district agricultural associations (DAA) are excluded from the definition of “state agency” for purposes of those provisions (Food and Agricultural Code Section 4061(a) and PRC Section 42926 (d)). As such, DAAs are no longer required to submit an annual state agency waste management report to CalRecycle’s State Agency Reporting Center (SARC) by May 1 or a State Agency Buy Recycled Campaign report (SABRC) by March 1 of each year for “Calendar Year” reporters or October 31 for “Fiscal Year” reporters. A full explanation of AB 2490 changes for DAAs can be found here.

While AB 2490 exempts DAAs from reporting requirements, CalRecycle still requires each DAA to maintain and monitor its programs and waste diversion activities to ensure adherence to the diversion requirements for State entities under AB 75 (Strom-Martin, Chapter 764, Statutes of 1999), AB 341 (Chesbro, Chapter 476, Statutes of 2011), SB 1016 (Wiggins, Chapter 343, Statutes of 2008), PCC 12153-12217, and PRC 42920-42926. See State Agency Laws and Regulations for more information on diversion and recycled content purchasing requirements.

The Integrated Waste Management Hierarchy

To most efficiently achieve the waste reduction goals of AB 939, the legislature established a hierarchy of waste reduction practices: (1) waste prevention (also referred to as source reduction), (2) recycling and composting, (3) environmentally safe transformation and land disposal. Waste prevention is at the top of this hierarchy because when resources are used efficiently, less waste is created. If waste is not created, it does not need to be recycled or disposed. Waste prevention and reuse activities have been highlighted in this document as the most effective way to save money and resources in State government. However, a comprehensive and integrated approach to waste reduction is suggested including waste prevention, reuse, recycling collection, composting, and recycled-content product procurement activities.

State Government's Role in Reducing Waste
Current law places state waste diversion responsibility on local government. As citizens, State employees have the responsibility to participate and contribute to the diversion activities of the communities in which they live and work. Equally, each State agency has the responsibility to divert waste to further the waste diversion goals of the jurisdiction or regions of the state in which the agency does business. Local governments are subject to fines of up to $10,000 per day if the waste diversion goals are not met. These penalties will ultimately affect all citizens if the State does not do its part in meeting the mandates.

Beyond responsibilities at the local level, the State of California should lead the way in exemplary waste reduction efforts. Although state government is diverse, opportunities exist in each agency to reduce waste. Implementing waste prevention, reuse, recycling, and buying recycled activities within each state agency will provide leadership, responsibility and economic and environmental benefits to the state, its people, business community, and government.

This guidance document provides California State agencies, offices, departments, divisions, boards, commissions, and facilities with a framework to develop and implement waste reduction and recycled-content product procurement policies and programs to:

- Demonstrate State government leadership and responsibility toward meeting the state's solid waste goals.
- Show environmental leadership in conserving natural resources.
- Maximize budget resources through the efficient use of all resources.
- Further compliance with laws requiring state agency waste reduction and buy recycled activities.

Benefits of Waste Reduction

Produces More Efficient Operations and Reduces Costs
The traditional use of the word "waste" means inefficient use of resources. Waste reduction is the efficient use of all resources. It begins with examining how business is conducted, including how materials are used, why individual business processes are performed, and what products are purchased. Efficient operations will minimize waste in materials, labor, and money. Specific benefits to an agency employing a waste reduction program include reduction in energy, water and utility costs; reduction in raw material usage, storage and disposal costs; and decreased printing and postage costs. Waste reduction, in whatever its form, results in direct cost savings for the State of California.

Develops Markets for Recycled Materials
Purchasing recycled-content products creates markets for recycled materials, thereby supporting the manufacturing capacity for those products. The State can make a significant impact on the development of markets for recycled materials by each department meeting or exceeding the purchasing and reporting goals of Public Contract Code (PCC) Sections 12205 (State Agency Buy Recycled Campaign) in each of the 11 product categories (See Procurement: Buying Recycled).

Elements of a Self-Sustaining Waste Reduction Program

Improves an Organization's Environmental Performance
A waste reduction program involves much more than placing recycling bins in common areas. In fact, the term "program" is misleading because it implies doing something "extra." A self-sustaining waste reduction

program is simply a better, more efficient way to do the same thing—conduct business. It is an ongoing process that continually improves an organization's environmental performance. A comprehensive self-sustaining waste reduction program incorporates waste prevention, reuse, recycling, and recycled-content product procurement activities into everyday business. It originates with and is supported through management as an organizational policy. Employees are expected to be familiar with the policies and conduct business in that manner.

Includes Management Support and Employee Input
Management through policies and directives supports a successful waste reduction program; however, it also requires employee involvement. Staff responsible for performing the business functions is best able to identify wasteful practices and recommend areas for improvement. With upper management support, the improvements can be implemented and the waste reduction savings can be realized. This approach to encouraging employee input with the full support of upper management perpetuates employee "buy-in" and helps develop a sustainable waste reduction program.

Establishing Departmental Policies and Goals

Secure Organizational Support
Successful waste reduction requires commitment and support from both the upper management and staff level employees. The ultimate goal in recruiting organizational support is to make waste reduction part of the culture of the workplace. Waste reduction must become inherent to the way business is conducted.

Management must be clear on waste issues and see that the benefits of waste reduction outweigh the costs. It must be understood that it is not a problem to be fixed, it is an ongoing improvement to internal processes.

There are many support materials available through the CalRecycle to help document the benefits of waste reduction and to encourage top management support. See "Encouraging Top Management to Support Waste Reduction Efforts" on page 36 of *Trainers' Manual: Establishing a Waste Reduction Program at Work*, and U.S. EPA WasteWise fact sheet, *Steps for Implementing a Waste Prevention Program*.

Know Your Waste Types
There are two methods to identify waste: waste assessment and analysis of business functions.

Waste Assessment. The traditional method of estimating waste generation, a waste assessment or audit, identifies materials and items that are major contributors to an organization's waste stream. A waste assessment also provides a baseline for measuring the effects of waste reduction practices. Waste assessments can range from visual peeks into garbage cans to more formal retrieval, separation and weighing of disposed materials. For health and safety concerns in an office environment, visual assessments are recommended.

For more information on how to perform a waste assessment, see CalRecycle Pub. #500-94-004, *Reduce, Reuse, Recycle—A Guide for California Business*; CalRecycle Pub # 442-95-070, *Establishing a Waste Reduction Program at Work*; and U.S. EPA's WasteWise fact sheet, *Conducting a Waste Assessment*.

Analysis of Business Functions. Examining major business processes for opportunities to reduce materials, labor or time will produce greater overall cost savings, and reduce waste at the same time.

An example of a business function change that improved efficiency and reduced waste is a change the Fair Political Practices Commission (FPPC) instituted for completion of their Form 700, Statement of Economic Interest. Formerly, hard copies (at 31 pages each) were provided to each State employee required to comply. Each State employee would complete and return the package to FPPC. A majority of the completions required only a signature on the front page, leaving the other 30 pages unused.

The FPPC now provides the Form 700 as a downloadable PDF (portable document format) file that agencies can provide electronically to their employees. Employees access the form electronically and print only pages of the form they need to return to the FPPC, i.e., the signature page, in most cases. By implementing the PDF version of the Form 700, the FPPC realizes savings in several areas: reductions in paper, postage, storage, and labor costs required to manage the volume of paper previously used as well as the reduction in paper waste.

An analysis of business functions to improve efficiencies and reduce waste should be ongoing in any State agency. As part of a waste reduction program, it can provide immediate and measurable results.

Set Waste Reduction Policies and Goals

Waste reduction policies reflect the visions and priorities of the department. Policies should be drafted early in the process of implementing a waste reduction program and formally adopted by the agency. Formal adoption by the agency demonstrates support and commitment. Once adopted, standard operating procedures, new employee orientations, etc. should highlight the waste reduction policies.

Waste reduction goals should be adopted based on the policies of the agency. This can be as part of the policies themselves, or as a separate document. The goals should be for a specified time period, such as one or two years. Setting realistic and measurable goals will ensure success.

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Contact: Recycling Coordinator SARC@calrecycle.ca.gov, (916) 341-6199
Contact: Buy Recycled Campaign SABRC@calrecycle.ca.gov, (916) 341-6199

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Implementing Waste Reduction

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The following outlines the steps to establishing a waste reduction program within a state agency.

Many of these steps are consistent with those used by the private sector. Realizing that "one size does not fit all" in practicing waste reduction, this is a general outline for guidance purposes, mostly pertaining to an office setting.

Each agency should take into consideration the primary business function performed when applying these steps. For instance, the California Department of Corrections, with diverse operations and facilities, would employ different steps in implementing waste reduction than a small office department, such as the Department of Boating and Waterways. Regardless of the size of the organization or the function, there are common components to any successful program.

Designate a Waste Reduction Team and Coordinator
A waste reduction coordinator should be appointed by management to ensure the policies and goals of the department are met. The coordinator should have strong organizational, leadership, and communication skills, and have enthusiasm for waste reduction.

A waste reduction team of staff should be designated to assist the coordinator in implementing and maintaining the program. The team can be voluntary or mandatory; however, voluntary recruitment with team duties included in the staff's duty statement to formalize the efforts results in the most committed team. The size of the team depends on the size of the agency. Representatives from each functional area and level of the agency must be represented.

The waste reduction coordinator and team are responsible for educating, planning, and maintaining the program. The team should meet regularly. The CalRecycle's Waste Reduction Committee meets biweekly to monthly, depending on the items to be discussed. Subcommittees may be formed to address specific action items related to the agency policies and goals.

Develop an Action Plan
An action plan to achieve each established goal should be drafted by the team as a working document. The action plan outlines tasks to be accomplished, staff responsible for each task, and a timeline for completion of each task.

Measure Savings
Measuring savings from waste reduction efforts provides information to help sustain current efforts and improve upon them. Highlighting savings keeps employees and management involved and enthusiastic

about the changes that have been made. Measuring also provides a monitoring system to identify and correct unexpected problems quickly.

It's important to determine the method of measurement early in the program. Whether through a waste audit or through changes to business functions, measuring waste reduction requires establishing a baseline of the materials to be measured.

For more information on measuring savings through waste reduction, see*Measuring the Success of Office Paper Reduction Efforts*, or #442-95-070, *Establishing a Waste Reduction Program at Work*.

Educate/Publicize Results
Once the savings are measured, they can be used to educate staff and management of the goals achieved and the success of the campaign. Education is an ongoing effort. The goal is to have waste reduction become the way daily business is conducted.

Waste Prevention and Reuse

What Is Not Created Does Not Need to Be Destroyed

Waste prevention and reuse, sometimes referred to as source reduction, is preventing or reducing waste during its production rather than managing it after its generation, as in recycling and disposal. Preventing waste means using less material, such as paper, to do the same job. Reusing materials also is a form of waste prevention because materials go further, thereby producing less overall waste.

Waste prevention is accomplished by getting the maximum use of any material before it is recycled or thrown away. It includes replacing disposable materials with reusable materials, eliminating a particular item altogether, repairing or maintaining equipment so it last longer, and using electronic communications instead of paper.

Waste prevention and reuse measures are the first steps in a comprehensive waste reduction program. Successful waste prevention requires creative and analytical thinking first about how a reduction in materials can be accomplished, and then what can be done to reuse the materials that have been used once. Too often only recycling systems are considered rather than reducing and reusing systems.

Successful waste prevention requires making changes to materials that come in as raw materials, supplies, or packaging as opposed to thinking about waste reduction as only trash going out. All materials that are recycled or disposed have been paid for in some way. It is important to consider purchasing practices to see if materials can be moved "upstream" into the waste prevention and reuse categories instead of focusing on recycling as the first and only treatment of materials. By minimizing the volume of raw materials, supplies or packaging used, direct savings are realized.

Case Study
CalRecycle has undertaken a comprehensive waste prevention initiative in its office headquarters. The CalRecycle formed an in-house committee to develop and implement a waste prevention program to reduce waste at the CalRecycle and serve as a model for other public and private sector office settings. Highlights from the first nine months of the program include the following.

White office paper use was reduced by 25 percent by:

- Discouraging avoidable or excess copying and printing

- Encouraging communications via electronic mail.
- Encouraging two-sided copying and printing.
- Making two-sided printing an automatic computer feature.
- Reducing the size of documents.
- Streamlining document review processes.
- Turning one-sided paper into scratch pads.
- Pruning mailing lists.

These efforts are estimated to produce annual savings of:

- 364 cases (3640 reams or 1.8 million sheets) of white paper.
- $16,724 in reduced postage costs.
- $68,370 in photocopying costs.
- $5,500 in reduced printing costs.
- $10,151 in reduced purchasing costs (paper and note pads).

Recycling/Collection

Recycling Is Not Enough
Recycling has traditionally been the first action taken when implementing a waste reduction program. Too often it is the only action implemented. An agency that implements recycling collection programs without implementing the other elements of an integrated system may be lacking the true benefits of waste reduction and resource efficiency. To realize the full cost and resource savings a comprehensive waste reduction program can provide, an agency should first focus on waste prevention and reuse activities. However, recycling is a critical component to an integrated waste management system.

Materials to Collect for Recycling
Before determining what materials to collect for recycling, the agency must first determine what materials are generated in sufficient quantities to support a recycling program. The materials to collect for recycling and the methods used to collect those materials are specific to the organization and site. Current law requires State agencies and facilities to collect office paper, corrugated cardboard, newsprint, beverage containers (as defined in section 14505 of the Public Resources Code [PRC]), waste oil, and any other material at the discretion of the CalRecycle (see Applicable Statutes, next page).

A majority of State agencies will comply with these mandates as they operate in office settings generating these materials. However, State agencies or facilities with specific functions may generate other waste materials in significant quantities sufficient for recycling. For instance, the Department of Transportation generates construction and demolition (C&D) materials in sufficient quantities to support a C&D collection program. (For more information on C&D debris or other special wastes, see Appendix B, Waste Reduction Resources for State Agencies.)

Collection Methods
The methods used to collect, separate, store, and remove recyclables depends on the material types, volume, space availability, and organizational structure to remove the materials. General recycling program options include:

Source Separation. Materials such as white paper, mixed paper, aluminum, glass, plastic, and cardboard are segregated by type into bins where initially discarded. This is the traditional approach to office recycling. Characteristics of a source separated recycling program are:

- Potential high recovery value of recyclables.
- Provides an adequate recovery rate to contribute to State waste diversion goals.
- Provides significant avoided disposal costs for building management (approximately $800 to $1400 per month according to BFI).
- Requires only 5 percent more custodial staff time to handle discarded materials.
- Success (high recovery rate) based on employee education and involvement.

Dry Commingled (unseparated). All dry waste materials are mixed where initially discarded, then compacted, and hauled away for a fee (about 8 percent less than the charge for municipal solid waste or MSW). The materials are mechanically/manually sorted at a transfer station or "clean" materials recovery facility (MRF). Unacceptable materials typically include cafeteria and restroom waste, food/beverages, liquids, pallets, construction debris, and landscape waste. Characteristics of a dry commingled system are:

- Reduced recovery value of recyclables.
- Provides a high recovery rate to contribute to state waste diversion goals.
- Avoided disposal costs for building management depends on fee to haul away dry commingled recyclables vs. MSW.
- Requires minimal additional custodial staff time to handle discarded materials.
- Requires less employee education and involvement to achieve a high recovery rate.

Education is Key to Success

Education is important to the success of any waste reduction program. With recycling collection programs, education is critical. Staff should be trained about the collection system being implemented and how their participation determines the success of the program. This training should include materials being diverted, the proper location to put the recyclables, and clearly identified lists of unacceptable materials. Education increases participation in the program and minimizes contamination of recyclables thereby increasing the volume of recyclables and the overall success of program.

Applicable Statutes

Current law requires each State agency/office to initiate activities for the collection, separation, and recycling of recyclable materials whether in State-owned or -leased facilities in Sacramento, Los Angeles, and San Francisco counties, and in any other area the CalRecycle determines is feasible. With assistance from the CalRecycle, each State agency shall recycle office paper, corrugated cardboard, newsprint, beverage containers (as defined in section 14505 of the PRC), waste oil, and any other material at the discretion of the Board.

Additional Resources

The CalRecycle has a Web site for State agencies, which links to other useful pages within the site, including the following:

For more information on statutes pertaining to the collection and recycling of materials in State offices (PCC Section 12165 (a) and PRC Sections 42560-42562), contact the CalRecycle's Project Recycle staff (See Appendix B).

For more information on office paper recycling, waste assessments, and cost-benefit analysis of office paper recycling, see the many publications available through the CalRecycle's Business Waste Reduction Fact Sheets and Case Studies.

Procurement: Buying Recycled

Completes the Materials "Loop"
Buying recycled-content products (RCP) completes the recycling loop by creating markets for recycled materials to use as feedstock in the manufacturing of recycled-content products. It is the demand side of the recycling equation. A demand for recycled-content products in turn supports recycling collection as the most economical and desirable method of disposal.

Purchasing Power of State Government
The State's role in RCP procurement is twofold. On the one hand, State purchases can definitely be an asset to markets for recycled materials. The State purchases billions of dollars of products each year. State government is the single largest purchasing entity in California. Through this buying power, the State has the ability to create and maintain stable markets for recycled materials.

The second role the State fulfills by purchasing RCPs is that of leadership and an example to other government entities throughout the State as well as the private sector. If the private sector believes that the State is committed to buying RCPs, it too will respond by manufacturing more RCPs and by increasing its own RCP purchases. In this way the State and the private sector create a synergy that will build and sustain markets for recyclable materials.

State Agency Buy Recycled Campaign
Activities pertaining to RCP procurement by State agencies increased considerably with the passage of Assembly Bill 4, (Eastin, Stats. 1989, c. 1094). This statute, added to the Public Contract Code and revised by several subsequent bills, constituted the major components of what has become known as the State Agency Buy Recycled Campaign (SABRC). The current laws require State agencies to:

- Purchase recycled-content products in sufficient quantities to attain the annual goals for specified product categories.
- Report annual purchases of recycled and nonrecycled products in specified product categories.
- Submit plans identifying how the annual goals for recycled-content products will be attained.
- Require contractors to certify, under penalty of perjury, the recycled content of the products they offer to the State.
- Purchase ALL recycled-content products instead of nonrecycled products whenever they are available at no more than the total cost of nonrecycled products, and fitness and quality are comparable.
- Attain the mandated recycled-content product procurement goals regardless of the price differences between recycled- and nonrecycled-content products.

Staff from CalRecycle, with assistance from the Department of General Services (DGS) provide a SABRC manual and training to implement the statutory requirements. As of FY 97/98, 113 out of 133 agencies submitted reports (84 percent) and reported $24,483,218 in RCP purchases.

Elements of a Successful State Agency Buy Recycled Campaign

There are many elements that go into a successful SABRC within any agency. Depending on the size of the institution, the way it is organized, the extent to which purchasing is centralized, and the commitment made to these mandates, each agency's results can vary considerably. The access to computers and software dedicated to purchasing and accounting and the individual staff working on these issues will effect the amount of RCP purchases and the ability of that agency to accurately report those purchases. Based on the experience that CalRecycle staff has gained over the past four years of implementing the SABRC and on comments received from State agencies, the following items have been identified as key elements of a successful buy recycled campaign.

Commitment From the Top

Because of the need for multiple offices to be involved in identifying, purchasing, tracking, and reporting RCPs for an agency, it is often necessary to have a high level manager oversee these activities. Therefore, a critical factor to a successful SABRC is support throughout the levels of management. Middle and upper level support and backup are critical to overcoming hesitation or complacency when it comes to purchasing RCPs rather than non-RCPs. Because staff from several offices may need to be involved in the SABRC activities, a manager must be responsible for communicating the needs to the other managers and for coordinating the efforts of the team.

Dedicated Personnel

Those responsible for the SABRC mandates must purchase RCPs rather than non-RCPs whenever possible. Without personal dedication by the agency coordinator, increased RCP procurement will be very difficult. Much of the time, the responsibilities for the SABRC are simply added to the responsibilities of one particular person. This is often not realistic nor appreciated. At the very least, the SABRC coordinator responsibilities should be those of someone in an appropriate position of authority, overseeing procurement and related administrative functions with an interest in environmental issues.

Internal Communication/Coordination

For most State agencies, attaining the SABRC mandates will require a coordinated effort among multiple branches or offices within an agency. The individual responsible for generating the report may not work in the procurement office. At the very least, a close relationship must exist between the buyers, the users, and those generating the report. It would not be uncommon for another person or office to be responsible for collecting the procurement data during the year, and the users of the products (the copy room, painters, plumbers, vehicle pool, etc.) to also play a part in the process. Each of the people in these positions needs to be part of the team that becomes responsible for attaining the SABRC mandates and generating the report. Full responsibility cannot be placed upon one individual for an agency's compliance with the mandates.

External Information Sharing

Another element that cannot be overlooked is education. Some people have had bad experiences with RCPs in the past or have heard of such experiences from others. RCPs have improved a great deal in recent years with corporate America coming into the manufacturing arena for many product categories. With considerable research and development going into this new generation of RCPs, many of them compare very favorably to, and some are simply better than, non-RCPs with respect to price, quality, and availability. These advancements need to be discussed among buyers and sellers. Buyers need to communicate with suppliers, and a concerted effort must be made by the State as a whole to inform product manufacturers of the preferences for RCPs. Additionally, SABRC contacts representing various agencies need to communicate and share experiences with each other.

Evaluation and Improvement

The final element to a successful SABRC is the ability to analyze past purchases with respect to product performance, price, delivery, and vendor satisfaction, as should be done with all purchases regardless of material content. This type of information will be used to develop a history of RCP procurements.

Analysis of purchases necessitates the development of some type of procurement tracking mechanism. Staff must have a system to gather the information, organize it in a meaningful manner, and be able to manipulate the data by a variety of criteria. Each member of the team—buyers, users, management, and those tracking the purchases—must fully analyze past purchases from each of their particular areas of expertise so that they will lead to more successful future purchases. This will result in establishing "best RCP purchasing practices," prevent some mistakes from being repeated, and should result in feedback for the RCP suppliers on how to improve the RCPs that were not purchased.

Building Green

The Benefits of Green Buildings

A "green" or sustainable building is a structure that is designed, built, renovated, operated, or reused in an ecological and resource efficient manner. Green buildings are designed to meet certain objectives, such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing environmental impacts associated with the production of raw materials and building construction.

Green buildings provide significant savings in energy and operating costs over the life of the building. Cost savings are fully realized when they are incorporated at the conceptual design phase through construction, and with the assistance of an integrated team of professionals. Additionally, building green promotes waste reduction and the efficient use of resources by reusing building products and utilizing recycled-content products, thereby supporting markets for recycled materials.

The State has the opportunity, when planning and constructing new State buildings, to realize the operating cost savings green buildings provide while providing leadership in waste reduction and recycled-content product procurement practices in the construction industry. The CalRecycle, in coordination with CalEPA, is actively working to incorporate sustainable building measures into several developing State building projects to demonstrate the performance and economic success of sustainable construction in the state.

Available Resources

The CalRecycle, with assistance from the City of Santa Monica and Gottfried Technology, Inc. (GTek), is developing a statewide plan for a sustainable building program. The program, now in the conceptual stage, will address the benefits and provide support for sustainable buildings in the State, local, and private sectors.

The CalRecycle develops and distributes educational materials relating to green buildings and provides comments and technical assistance for specific building projects. For more information, visit CalRecycle's green building Web site.

Landscape Materials Management

Waste-Efficient Landscape Maintenance Practices

Landscape sites at State agency facilities and institutions can be maintained in an environmentally sound and cost-effective manner by using responsible landscape management practices that reduce green waste generation, reuse trimmings and prunings on site, and recycle organic products (mulch and compost) back into the landscape. These management practices include:

- Controlled Irrigation—Water just enough to maintain plant health and appearance.
- Precise Fertilization—Only apply precise amounts of necessary plant nutrients.
- Grasscycling—The natural practice of leaving clippings on the lawn when mowing.
- Selective Pruning—Use techniques that result in less green waste and healthier plants.
- On-Site Composting and Mulching—Use site-generated trimmings as feedstock.
- Proper Organic Materials Application—Use products derived from urban green waste.
- Environmentally Beneficial Design—Install low-maintenance, drought-tolerant plants and waste-efficient landscape design features to reduce trimmings and prunings.

Benefits of the "Three Rs" in Landscape Management

Practices that reduce green waste generation produce significant economic and environmental benefits. Direct savings can be realized by reduced maintenance, labor, water and fertilizer cost. Indirect cost benefits include reduced hauling expenses as well as disposal fees and less exposure to workers' compensation claims due to crew injury from lifting heavy loads. On-site management of yard trimmings returns valuable, high-quality nutrients and organic matter to the soil. This encourages healthier, disease and pest resistant plants that improve appearance, prevent erosion, and increase property values.

Using recycled organic materials in landscapes enhances soil fertility and water holding capacity, slows evaporation losses, increases plant drought tolerance, conserves water, and also suppresses the spread of wildfires. Using the environmentally beneficial landscape maintenance practices outlined above will reduce fertilizer and water usage, which in turn reduces toxic runoff that can lead to surface and groundwater pollution.

Case Study

Fountain Circle on the west side of California's State Capitol was selected as a demonstration ground for grasscycling. This was a cooperative effort among the CalRecycle, Department of General Services, the Office of Buildings and Grounds, and the Toro Company, which supplied the mulching mower. This initial demonstration was so well received that DGS/OBG is now converting its entire fleet to grasscycling mowers.

Results of Grasscycling Demo at State Capitol:

- Mowing time reduced by over 50 percent. Bagging and disposal cost eliminated.
- More than 300 pounds of grass clippings per 1000 square feet recycled annually.
- Nitrogen content of recycled clippings reduced fertilization requirements by 25 percent.
- Similar savings in water usage noted.

Available CalRecycle Resources

CalRecycles's organics Web site has sections containing specific information on the practices outlined above, a compost and mulch source list, a section for publications, reports, articles, and fact sheets available for downloading or online ordering and a section on composting regulations.

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Contact: Buy Recycled Campaign SABRC@calrecycle.ca.gov, (916) 341-6199

Appendices

Appendix A: Definitions

Recycled Content Product (RCP) Procurement. The term recycled content product procurement refers to purchasing practices that support markets for recycled materials and minimize environmental impact.

California State Agency. Refers to every State office, department, division, board, commission, or other agency of the State of California.

Waste Reduction. The term waste reduction, as used in this document, refers to the comprehensive efforts of waste prevention, reuse, recycling/collection, and procurement practices.

Appendix B: Waste Reduction Resources for State Government Agencies

General Resources. CalRecycle's resource page for State agencies includes links to pertinent information, including the other programs in this section.

CalRecycle Publications. CalRecycle's online publications catalog provides information on more than 500 CalRecycle publications. Most are available on line or can be downloaded. Hard copies can be ordered via e-mail.

Business Resource Efficiency and Waste Reduction Program. Developed primarily to assist the business community to divert waste, this program provides fact sheets and guides on waste prevention and resource efficiency. Many of the materials are applicable to any office setting and are available to California State agencies. For more information on CalRecycle's Business Assistance resources, please visit our Business Assistance Portal for more information on growing or greening a business.

State Agency Waste Management Manual. The CalRecycle coordinates implementation of waste prevention, reuse, and recycling programs at State-owned and leased buildings and facilities including offices, prisons, youth authority facilities, developmental centers, hospitals, maintenance facilities, and parks.

The Board coordinates and assists State facilities by:

- Managing State recycling contracts.
- Training and advising State employees and recycling coordinators.
- Acting as a liaison between State facilities and recyclers.
- Providing recycling information, supplies, and equipment.
- Gathering and reporting data on materials collected for recycling.

As of January 1999, Project Recycle was coordinating and monitoring programs at more than 1,800 State facilities. During 1998 over 63,000 tons of material were reported collected for recycling from California State facilities.

State Agency Buy Recycled Campaign. The State Agency Buy Recycled Campaign (SABRC) consists of mandates for State agencies to purchase recycled-content products (RCP) in 11 categories ranging from copy paper to steel products. The mandates, located in the Public Contract Code (PCC), require each State agency to submit a Recycled Product Procurement Plan and a Recycled Product Procurement Report annually to CalRecycle. The reports are used to determine compliance with the RCP procurement mandates.

The State Agency Buy Recycled Campaign provides a recycled-content product database for State agencies to assist in procuring recycled-content products, and a guidance document to assist agencies with both procurement and reporting compliance. For more information, visit the SABRC Web site.

Appendix C: Sample Waste Reduction and RCP Procurement Policy Statements

The following are sample waste reduction policies and individual action items to support an agency's steps toward reducing waste. Agencies may need to add, modify, or delete items depending on the particular goals of the organization.

Waste Reduction Policy Statements (General)

1. It is the policy of the (Agency) to assist local government and business in meeting California's waste diversion mandates by practicing waste reduction and recycled content product procurement in all aspects of its internal and external operations.
2. The (Agency) shall continually strive to minimize the generation of waste and support markets for recycled materials through waste prevention, reuse, collection/recycling and composting, and the procurement of recycled content products.
3. The (Agency) recognizes the trust placed in it by the people of California to wisely use resources in the most effective and efficient manner possible so that waste is minimized in all areas of operation, so that procured products contain the maximum amount of recycled content, and so that savings are accounted for and measured.

Waste Prevention Policy Statements and Action Items

The (Agency) shall:

1. Use available information technology to maximize the efficient use of paper.

    1. Set all electronic systems to default double-sided printing, including individual and network software.
    2. Print all documents and communications double-sided.
    3. Use electronic mail and voice mail.
    4. Promote electronic access of agency information and publications to customers via the Internet prior to providing paper copies.

EEC ORIGINAL PKG

2. Review standard documents, templates, and publications for waste reduction opportunities.

    1. Eliminate unnecessary reports and reduce report size.
    2. Use 1/2 sheets of paper for fax cover sheets instead of a full sheet (and use both sides).
    3. Design mailers to avoid use of envelopes.
    4. Proofread documents on screen and preview before printing.
    5. Annually purge and remove duplicate names and out of date entries from mailing lists.

3. Submit internal documents with minor legible handwritten corrections.

4. Utilize a centralized mailing system.

5. Review standard distribution/circulation procedures for waste reduction opportunities

    1. Circulate memos, documents, reports, periodicals, and publications.
    2. Post announcements on bulletin boards or circulate copies.

6. Maximize waste prevention practices in the custodial, maintenance and landscaping practices of state-owned buildings. Contractual arrangements with facility management in leased buildings shall maximize waste prevention in the custodial, maintenance and landscaping practices.

    1. Encourage cafeteria discounts for use of own cup, plate, and utensils.
    2. Encourage use of air dryers or cloth wipes in restrooms instead of paper towels.
    3. Encourage landscape maintenance to implement grasscycling.

Reuse Policy Statements and Action Items

The (Agency) shall:

1. Establish systems that routinely reuse paper and other office supplies.

    1. Reuse paper printed on one side:
        - In fax machines.
        - In copiers for draft copies, except where specifically prohibited by equipment warranties.
        - To make scratch paper and pads through DGS.
    2. Reuse envelopes by placing a label over the old address.
    3. Institute an office "trading post" next to supplies area to reuse office supplies, etc.
    4. Investigate whether local libraries, schools, hospitals, nursing homes, etc. could use old trade journals or magazines.

Employee Education/Outreach Policy Statements and Action Items

The (Agency) shall:

1. Develop an ongoing employee education and outreach campaign.

    1. Use intranet (internal web site) to post in-house waste reduction information (policy, goals, procedures, and accomplishments) for easy reference.
    2. Provide all new employees with an in-house Waste reduction policy orientation.
    3. Conduct employee educational activities on at least a quarterly basis.

2. Become a government member of U.S. EPA's WasteWi$e program to show commitment to waste reduction practices.

3. Ensure all (Agency) documents carry a recycled logo and/or environmental policy statement.

Recycling Collection Policy Statements and Action Items

The (Agency) shall:

1. Work with CalRecycle to set up, implement, or expand collection programs.

2. Utilize CalRecycle collection contracts when feasible.

3. Provide, at a minimum, for collection of the following materials: white paper, newspaper, mixed paper, magazines, plastic, glass, and aluminum.

   1. Provide desktop recycling containers for employees.
   2. Provide clearly labeled recycling bins near copiers, shipping and receiving areas, and in employee eating areas.
   3. Print directly on envelopes rather than using labels to increase envelope recyclability.

4. Periodically increase the level of white paper recycling and correspondingly decrease contaminants in white paper bins.

   1. Don't buy paper that is a contaminant in recycling, e.g., thermal fax paper, glossy/plastic coatings, envelopes with plastic windows, or bright colors (including goldenrod).
   2. Eliminate use of pressure sensitive adhesives.

Recycled Content Product Procurement Policy Statements and Action Items

The (Agency) shall:

1. Buy recycled-content products rather than nonrecycled content products. Quality and availability being comparable, the (Board/Agency) shall:

   1. Buy only white copy/xerographic paper with at least 30 percent postconsumer recycled content.
   2. Purchase the product with the greater recycled content when faced with a choice of two recycled products.
   3. Use recycled-only bids and RCP set-asides to purchase products.

2. Attain the mandated RCP procurement goals.

   1. Appoint SABRC contact.
   2. Require recycled content information for all of the products purchased.
   3. Track all RCP and non-RCP purchases within the product categories.
   4. Annually submit the SABRC procurement report and plan.

Prevention and Reuse Procurement Policy Statements and Action Items

The (Agency) shall:

1. Purchase products that prevent waste.

1. Purchase high-quality, durable products.
2. Purchase photocopiers with a fast, reliable duplex function designed for heavy loads.
3. Purchase refillable pens.

2. Purchase used or reused products at every opportunity.

   1. Purchase reused diskettes.
   2. Reuse disks from software purchases.
   3. Purchase remanufactured toner cartridges.

2. Purchase products with no packaging, less packaging, or reusable packaging.

   1. Purchase products in bulk.
   2. Discuss with suppliers a reduction in the amount of packaging of the products purchased.

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Last updated: October 9, 2018
State Agency Waste Management Programs: https://www.calrecycle.ca.gov/StateAgency/
Contact: Recycling Coordinator SARC@calrecycle.ca.gov, (916) 341-6199
Contact: Buy Recycled Campaign SABRC@calrecycle.ca.gov, (916) 341-6199

Certified Unified Program Agencies (CUPA)

The Enforcement and Emergency Response Division (EERD) administers the technical implementation of the state's Unified Program – a consolidation of six environmental programs at the local level. EERD conducts triennial reviews of Unified Program agencies to ensure their programs are consistent statewide, conform to standards, and deliver quality environmental protection at the local level. EERD oversees the hazardous waste generator and onsite waste treatment surveillance and enforcement program carried out by local Unified Programs. DTSC was certified, effective January 1, 2005, to be the CUPA for Imperial and Trinity Counties.

Guidance

- Permit by Rule Permanent Household Hazardous Waste Collection Facility Inspection Checklist
- Permit by Rule Temporary Household Hazardous Waste Collection Facility Inspection Checklist
- Unified Program Strategic Plan
- Frequently Asked Questions

Forms

- Storage Extension Application for Generators
- UPA Model Application For Corrective Action Delegation Form 1447
- UPA Model Application For Corrective Action Delegation Form 1447 – Interactive
- UPA Model Application For Corrective Action Delegation Form 1447 – Instructions

Reports/Notices – Corrective Action Delegation

Tier 2 Level Implementation and Enforcement of Environmental Assessment and Corrective Action

- **LA County CUPA:** Notice of Approval
- **Merced County CUPA:** Notice of Approval
- **Sacramento County CUPA:** Notice of Approval
- **San Diego County CUPA:** Notice of Approval
- **San Mateo County CUPA:** Notice of Approval
- **Ventura County CUPA:** Notice of Approval

Resources

- Cal CUPA
- U.S. EPA Compliance
- U.S. EPA Enforcement
- U.S. Envirofacts

Unified Program Training

EERD Training

DTSC supports the training needs and activities for the CUPAs, DTSC staff, industry, and the regulated community. EERD staff are members of the Unified Program Trainers Committee which is composed of state and local training coordinators, and addresses CUPA training issues. Through this committee EERD staff worked closely with the CUPAs to assess training needs and plan and coordinate

CUPA training.

- DTSC Calendar
- Training for CUPA Inspectors (CalEPA website)
- California CUPA Forum Training Calendar
- CalEPA Basic Inspector Academy
- CalEPA Environmental Enforcement Training
- SWRCB UST Inspector Training

For regulations regarding the Unified Program Administration and programs, please click on the link for CalEPAs Unified Program Laws and Regulations.

Imperial CUPA Hazardous Materials Release Response Plans and Inventory Program Business Plan

Program Overview

When hazardous materials are improperly handled or stored they can result in a threat to employees, public health, and/or the contamination of the environment. State and Federal Community Right-to-Know laws were passed in 1986. These laws allow public access to information about the types and amounts of chemicals being used at local businesses. The laws also require businesses to plan and prepare for a chemical emergency through the preparation of a Hazardous Materials Inventory and a Hazardous Materials Business Plan that are certified annually. Businesses are inspected at least once every three years by a CUPA inspector to verify compliance with the California Health and Safety Code and California Code of Regulations.

Regulatory Authority

Law: California Health and Safety Code, Chapter 6.95, Article 1, Sections 25500 – 25519
Regulation: California Code of Regulations, Title 19, Division 2, Chapters 4 and 4.1, Sections 2620 – 2671

Who is Subject to the Business Plan Program?

A Business Emergency Response Plan and Inventory is required of any facility which handles hazardous materials or hazardous waste in amounts greater than:

- 55 gallons for liquids
- 500 pounds for solids
- 200 cubic feet for compressed gases

There are exemptions to reporting requirements for certain hazardous materials that allow for storage greater than the above thresholds. Some of these exemptions are:

1. For a solid or liquid hazardous material that is classified as a hazard solely as an irritant or sensitizer, the new reporting quantity is 5,000 pounds and 550 gallons, respectively.

2. For a hazardous material that is a gas, at standard temperature and pressure, and for which the only health and physical hazards are simple asphyxiation and the release of pressure, the new reporting quantity is 1,000 cubic feet. (Reporting of gases in a cryogenic state remains unchanged).

3. There are other compressed gases that do not have to be reported until the 1,000 cubic feet threshold is met, such as carbon dioxide and nonflammable refrigerant gases, as defined in the California Fire Code, that are used in refrigeration systems, even when they don't meet paragraph 2 above.

4. For oil-filled electrical equipment that is not contiguous to an electrical facility, the new reporting quantity for the oil is 1,320 gallons. There are other exemptions your facility may be qualified to use. For more information on these exemptions please contact us.

Please note that if extremely hazardous materials or radiological materials are handled, the business may be subject to this program even if the minimum quantities indicated are not met. For more information you should contact your local CUPA.

Contact Us

DTSC Imperial CUPA Office
627 Wake Avenue
El Centro, California 92243
Phone: (760) 352-0381
Fax: (760) 352-1641

Toll Free Number: 1-866-357-3990

Hazardous Materials Forms and Publications

All CUPA regulated businesses are required to submit business information electronically through the California Environmental Reporting System (CERS). Many of the Unified Program forms are no longer available on our website and instead must be completed online in CERS.

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Unified Program

The Unified Program protects Californians from hazardous waste and hazardous materials by ensuring consistency throughout the state regarding the implementation of administrative requirements, permits, inspections, and enforcement at the local regulatory level. CalEPA oversees the statewide implementation of the Unified Program and its 81 certified local agencies, known as Certified Unified Program Agencies (CUPAs), which apply regulatory standards established by the Governor's Office of Emergency Services (Cal OES), the Department of Toxic Substances Control (DTSC), the Office of the State Fire Marshal (OSFM), the State Water Resources Control Board (State Water Board), and the California Environmental Protection Agency. Read more about the Unified Program.

Electronic Reporting

Effective January 1, 2009, all regulated businesses and local Unified Program Agencies (UPAs) are required to submit Unified Program information electronically, either to the local regulatory agency or to the California Environmental Reporting System (CERS). CERS supports electronic data exchange among businesses, UPAs, state agencies, and U.S. EPA. Read more about Electronic Reporting.

CUPA Performance Evaluations

A periodic performance evaluation of each CUPA is conducted to ensure adequate and effective implementation of the Unified Program by the local agency. Read more about the CUPA performance evaluation process, evaluation schedule, and evaluation results.

State Surcharges

The State Surcharges, paid by all businesses regulated under applicable program elements of the Unified Program, are used to fund the reasonable costs for all State Agencies with Unified Program Responsibilities. CUPAs are responsible for billing and collecting the state surcharges from each regulated business or facility as part of the Single Fee System. **State Surcharges for Unified Program elements are as follows**:

- Oversight: $49.00 per business/facility
- Underground Storage Tank Program: $20.00 per tank
- California Accidental Release Prevention Program: $270.00 per regulated business
- Aboveground Petroleum Storage Act Program: $26.00 per tank facility
- Refinery Safety: Assessed to Refinery Facilities according to the daily barrel capacity (DBC)
  - $45,000 – Tier 1 (equal to or greater than 200,000 DBC)
  - $27,500 – Tier 2 (100,000 to 199,999 DBC)
  - $13,750 – Tier 3 (50,000 to 99,999 DBC)
  - $3,500 – Tier 4 (Less than 50,000 DBC)

Unified Program News

AB 1429: CERS HMBP Annual Certification

Background:
Assembly Bill 1429 of 2019 (Health and Safety Code Chapter 6.95 Article 1, Section 25508) modifies the Hazardous Material Business Plan (HMBP) program by changing the business plan submittal period from annually to once every three years for businesses not subject to EPCRA Tier II reporting requirements or the Aboveground Petroleum Storage Act. AB 1429 also requires these businesses to annually review and certify that the information in the California Environmental Reporting System (CERS) is complete, accurate, and in compliance with EPCRA. An electronic HMBP submittal to CERS satisfies this certification requirement. The businesses who are not subject to the EPCRA or APSA requirements will still be required to submit a complete HMBP every three years.

CERS currently does not have this HMBP certification functionality. CalEPA is currently working to develop the HMBP certification functionality in CERS, which will allow businesses to annually certify that the HMBP information in CERS is complete, accurate, and in compliance with EPCRA.

CERS Solution:
The CERS solution will create the functionality in CERS that will allow a business to certify annually that the information in CERS is complete, accurate, and in compliance with EPCRA in lieu of a complete HMBP submittal in CERS. The primary components of the CERS solution are:

- HMBP Certification Option to User Interface – insert a certification button to allow businesses to certify the HMBP information in CERS is accurate and complete instead of submitting a complete HMBP.
- Determining/Validating HMBP Certification Eligibility – submittal in past 36 months, not subject to EPCRA or APSA, etc.

- Add New Submittal Status "Certified" – The submittal will come in the system as certified and be automatically accepted with no further action required by CUPA.
- Add New Event Types/Notifications for "Certified" Submittals – email notifications, etc.
- Update Affected Reports – to add "certified" submissions.
- Update Windows Services – used for large user print jobs, large submittal, and inventory downloads, etc., to ease the burden on the server.
- Testing certification functionality (internal, external and portal CUPA's) – This will be an ongoing process as the CalEPA IT Team completes sections of the overall update requirements. Subject matter experts and key stakeholders are involved in user acceptance testing for each of the major requirements. The deployment of new features will be created in the CERS test environment as they are completed. When there are testable units of functionality, SMEs and key stakeholders will be asked to participate in testing.
- Deployment in CERS – Once all requirements and functionality are completed, tested, and approved by the Unified Program and stakeholder community, the final solution will be deployed to the CERS production environment. At this point, eligible businesses can certify that the HMBP information in CERS is complete, accurate, and in compliance with EPCRA.

Status:
The Cal EPA IT Team have began development of the Annual HMBP Certification functionality in CERS. Development of each of the major requirements will use an iterative process where subject matter experts and key stakeholders are involved in each development iteration to provide input for the development of each requirement.

Anticipated Completion Date:
Mid-August – Early September 2020

Potential Future Additional Modifications:

- Allow businesses with multiple facilities to certify all qualified facilities at one time, rather than a single facility at a time;
- EDT Tier changes.

CalEPA Denies Imperial County Fire Department CUPA Application,Opens the Opportunity for CUPA Participation

(Posted Aug. 6, 2019)

CalEPA Secretary for Environmental Protection Jared Blumenfeld issued a final notice of denial to the Imperial County Fire Department (ICFD) in response to its application to assume authority as the county's Certified Unified Program Agency (CUPA). The state Department of Toxic Substances Control (DTSC) has served as the CUPA for Imperial County on the public's behalf since 2005 and will continue to do so.

ICFD submitted the application to become the CUPA on Aug. 31, 2018. A public hearing on the matter was held in December 2018. On March 19, Secretary Blumenfeld issued a Notice of Intent to Deny the ICFD application, citing a number of inconsistencies and gaps in the ICFD's plans and capabilities. On May 6, ICFD submitted a revised application and requested a second public hearing. CalEPA and the state agencies that participate in CUPA oversight reviewed then revised the application and CalEPA held a second public hearing July 17.

The Secretary's letter cites several unresolved deficiencies in ICFD's application and notes that DTSC has not withdrawn from its obligations to implement the Unified Program. Applicable laws and regulations do not provide authority to decertify DTSC while it is in good standing. Nonetheless, the Secretary has directed DTSC to work with ICFD to develop a Participating Agency agreement, allowing ICFD to implement the Hazardous Material Business Plan program element of the Unified Program by Dec. 31. A Participating Agency agreement presents an opportunity for ICDF to demonstrate its commitment and capacity to effectively implement the Unified Program, with close oversight by DTSC and CalEPA. There are 24 other local participating agencies now operating within the Unified Program in other counties throughout the state. The CalEPA staff report accompanying the Secreatary's letter contains further recommendations for terms of the agreement.

To learn more, read the Documents on the Imperial County Fire Department CUPA Application.

Resources:

- **CalEPA Regulated Site Portal**
  The CalEPA Regulated Site Portal is a website that combines data about environmentally regulated sites and facilities in California into a single, searchable database and interactive map. The portal was created to provide a more holistic view of regulated activities statewide. By combining data from a variety of state and federal databases, the portal provides an overview of regulated activities across the spectrum of environmental programs for any given location in California. These activities include hazardous materials and waste, state and federal cleanups, impacted ground and surface waters, and toxic materials. The portal combines information from the following databases:
- Cal/OSHA – Inspection and enforcement information reported to federal OSHA
- CERS – The California Environmental Reporting System
- CIWQS – The California Integrated Water Quality System
- EIS – U.S. EPA's Air Emission Inventory System
- EnviroStor – Permitting, enforcement and cleanup activities at hazardous waste facilities and sites with known or suspected contamination
- GeoTracker – Impacted groundwater sites within the state, such as leaking underground storage tanks, cleanup sites, and permitted facilities such as landfills and operating underground storage tank facilities
- SMARTS – The Stormwater Multiple Application and Report Tracking System

- SWIS – The Solid Waste Information System
- TRI – The Toxics Release Inventory

Unified Program Listservs

- Unified Program (General)
- CERS Regulator Users

More about the Unified Program

Certified Unified Program Agencies (CUPAs) and Program Agencies (PAs) throughout the state created a partnership and formed the California CUPA Forum. Together, members of the California CUPA Forum and representatives of local, state and federal agencies established the Unified Program Administration and Advisory Group (UPAAG) to effectively address policy decisions, training and problem solving. The UPAAG's goals and objectives are listed in the UPAAG Strategic Plan (PDF).

The Unified Program consolidates the administration, permit, inspection, and enforcement activities of the following environmental and emergency management programs:

- Aboveground Petroleum Storage Act (APSA) Program
- Area Plans for Hazardous Materials Emergencies
- California Accidental Release Prevention (CalARP) Program
- Hazardous Materials Release Response Plans and Inventories (Business Plans)
- Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statements (HMIS) (California Fire Code)
- Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs
- Underground Storage Tank Program

State agency partners involved in the implementation of the Unified Program are responsible for setting program element standards, working with CalEPA to ensure program consistency and providing technical assistance to CUPAs and PAs. The following state agencies are involved with the Unified Program:

California Environmental Protection Agency (CalEPA) The Secretary of the California Environmental Protection Agency is directly responsible for coordinating and evaluating the administration of the Unified Program and certifying Unified Program Agencies (UPAs). UPAs are accountable for carrying out responsibilities previously handled by approximately 1,300 different state and local agencies.

Department of Toxic Substances Control (DTSC) The Department of Toxic Substances Control evaluates and provides technical assistance for the Hazardous Waste Generator Program, including Onsite Treatment (Tiered Permitting) and the Resource Conservation Recovery Act (RCRA).

Governor's Office of Emergency Services (Cal OES) The Governor's Office of Emergency Services evaluates and provides technical assistance for the Hazardous Material Release Response Plan (Business Plan) Program and the Area Plan Programs, as well as the California Accidental Release Prevention Program.

CAL FIRE- Office of the State Fire Marshal (CAL FIRE-OSFM) The Office of the State Fire Marshal evaluates and provides technical assistance for the Hazardous Material Management Plan (HMMP), the Hazardous Materials Inventory Statement (HMIS) and the Aboveground Petroleum Storage Act (APSA) Programs. The HMMP and HMIS Program are closely tied to the Business Plan Program.

State Water Resources Control Board (State Water Board) The State Water Resources Control Board evaluates and provides technical assistance for the Underground Storage Tank Program.

Unified Program Administration and Advisory Group

Unified Program Strategic Plan 2018-2022

CalEPA
California Environmental Protection Agency

EEC ORIGINAL PKG

EEC ORIGINAL PKG

CalEPA
California Environmental Protection Agency

Unified Program Administration and Advisory Group

Unified Program Strategic Plan 2018-2022

CALIFORNIA CUPA FORUM

Edmund G. Brown Jr.
Governor

Matthew Rodriquez
Secretary for Environmental Protection

EEC ORIGINAL PKG

Executive Summary

In 1993, the Legislature enacted Health and Safety Code Chapter 6.11 directing the Secretary of the California Environmental Protection Agency (CalEPA) to establish, by January 1, 1996, a "unified hazardous waste and hazardous materials management regulatory program" (Unified Program). This year marks the 22nd anniversary of establishment of the Unified Program and the collaboration between CalEPA and the Certified Unified Program Agencies (CUPA) Forum for strategic planning and cooperative problem solving in the field of hazardous material regulation and enforcement. As for prior strategic plans, the collaboration known as the Unified Program Administration and Advisory Group (UPAAG), has developed the 2018-2022 Strategic Plan to:

- Incorporate an update of the previous 2012 Strategic Plan to identify successes, missed opportunities and maintain continuity of efforts.
- Identify key issues and challenges facing the Unified Program as well as gaps or barriers in existing statutes, regulations and program implementation.
- Assess and apply the resources available to key stakeholders to increase the efficacy and functionality of the Unified Program.
- Evaluate the program against new statutory and regulatory requirements.
- Identify and recommend opportunities to align current operations with the goals of an effective organization, including updating statutes and regulations if the Unified Program can evolve to become more effective.

The Unified Program has a unique governance structure. CalEPA oversees the implementation of the six regulatory program elements as a whole, including periodic evaluation and certification of individual CUPAs' performance. State Program Agencies have the responsibility of maintaining regulations, setting program element standards, working with CalEPA to achieve optimal consistency, and providing technical assistance to the CUPAs. CalEPA and the State Program Agencies also work closely with U.S. EPA to ensure harmony with federal environmental requirements. CalEPA has currently certified eighty-one CUPAs and a number of subordinate participating agencies (PAs) to implement the Unified Program at the local level.

UPAAG develops and executes five-year strategic plans, of which this is the fourth, to guide the Unified Program's continuous long-term improvement. Interim reviews and assessments are essential means of monitoring progress and making interim course corrections when warranted. UPAAG typically reviews specific program tasks, action items and assignments at its quarterly meetings. Beginning in 2019, UPAAG will review the Strategic Plan holistically each May to assess the progress of goals and to ensure we are meeting objectives in accordance with agreed-upon priorities and work plans.

Unified Program Overview

The Unified Program protects California's environment and public health from hazardous materials and hazardous waste by ensuring adherence to established regulatory standards throughout the state that are consolidated, coordinated and consistent relative to the implementation and enforcement of environmental and release prevention programs. The following state agencies collaborate with CalEPA in the implementation of the Unified Program and are responsible for setting the standards for each of the six Unified Program elements, indicated with bullets, in table below:

State Program Agencies with Unified Program Responsibilities	Unified Program Element
CalEPA H&SC Sec. 25404 et. seq.	Overall development and administration of the Unified Program, CUPA certifications and CUPA performance evaluation standards
Governor's Office of Emergency Services (Cal OES) H&SC Sec. 25500 et. seq.	Hazardous Materials Release Response Plan (Business Plan) California Accidental Release Prevention (CalARP) Program
Department of Toxic Substances Control (DTSC) H&SC Sec. 25100 et. seq.	Hazardous Waste Management Generators Onsite Hazardous Waste Treatment (Tiered Permitting)
CAL FIRE- Office of the State Fire Marshal (OSFM) CFC Sec. 5001 et. seq., H&SC Sec. 25270 et. seq.	California Fire Code: Hazardous Materials Management Plans (HMMP) Hazardous Materials Inventory Statements (HMIS) Aboveground Petroleum Storage Act (APSA) Program
State Water Resources Control Board (State Water Board) H&SC Sec. 25280 et. seq.	Underground Storage Tank (UST) Program

With CalEPA oversight, local agencies (generally city or county environmental health departments or fire departments) carry out compliance and enforcement of the standards for each Unified Program element. Once certified, these local agencies are referred to as Certified Unified Program Agencies (CUPAs). There are eighty-one CUPAs currently responsible for implementing the Unified Program. Within its local jurisdiction, each CUPA may enter a formal agreement with another local agency, referred to as a Participating Agency (PA), to carry out one or more Unified Program elements. Collectively, CUPAs and PAs are known as Unified Program Agencies (UPAs).

Structure of the Unified Program Administration and Advisory Group (UPAAG)

CalEPA's Unified Program Policy Group (UPPG) and the California CUPA Forum Board (CUPA Forum Board) work in cooperation through the Unified Program Administration and Advisory Group (UPAAG) to achieve common goals as set forth in this Plan and to foster effective working partnerships between local, state, and federal agencies. UPAAG serves at the request of the CalEPA Secretary to provide the opportunity to gather, process, discuss, refine, and develop solutions to issues concerning local and statewide implementation of the Unified Program. Steering Committees and various Workgroups established by UPAAG assist in fulfillment of these responsibilities.

CalEPA's Unified Program Manager chairs UPPG, comprised of managers from each State Program Agency: CalOES, DTSC, OSFM and the State Water Boards. UPPG's purpose is to coordinate Unified Program policy and practice at the State level. UPPG ensures that the latest regulations for all six program elements, and best practices for their implementation, are incorporated into the Unified Program.

CUPA Forum Board provides a single statewide representative organization of CUPAs and PAs to consolidate and improve local Unified Program implementation efforts. The CUPA Forum strives to achieve consistency, consolidation, and coordination in the implementation of the Unified Program in an efficient and effective manner. CUPA Forum Board issue coordinators oversee the efforts of Technical Advisory Groups (TAGs), which primarily address technical issues and develop resolutions to propose to the CUPA Forum. A TAG Strike Team is established when a focused effort is needed to address urgent issues.

UPAAG Vision Statement

State and local agency members collaborate to protect public health and safety from hazardous material and hazardous waste releases, restore and enhance environmental quality, and sustain economic vitality through effective and efficient implementation of the Unified Program.

UPAAG Mission Statement

UPAAG leads the policy oversight and implementation of the Unified Program through development and execution of a strategic plan, and an orderly application of resources to maximize compliance with regulatory program standards. All Unified Program participants at the local, state, and federal level engage in cooperative development of best practices, with a quality of communication that enhances the inclusion of all agency stakeholders. The chart below depicts the relationships between UPPAG, UPPG and CUPA Forum Board.

Opportunities, Challenges, Goals and Objectives

Together as a UPAAG workgroup, UPPG and CUPA Forum Board representatives continuously assess near-term and future needs for further refining and improving statewide implementation of the Unified Program. Based on recent achievements and the assessment of future opportunities, challenges and needs, UPAAG has established the following seven goals to compose the 2018-2022 iteration of the UPAAG Strategic Plan. The Strategic Plan recognizes and details opportunities associated with each goal and provides a framework of objectives and specific, measurable tasks appropriate to meeting the challenges of each goal over the five-year planning horizon.

Priority	Goal
1	Emphasize State and local collaboration and consistency in implementing the Unified Program.
2	Review and enhance the CUPA Performance Evaluation process.
3	Develop and implement methodologies and tools for prioritizing local program implementation based on risk and cumulative impacts to public health and safety.
4	Develop exceptionally trained and skilled Unified Program personnel for employment at state and agencies.
5	Improve the capabilities and functionality of the California Environmental Reporting System (CERS) for current and future needs.
6	Enrich and curate CERS data to make informed decisions that advance the Unified Program goals, objectives and public safety.
7	Minimize and mitigate the impact of local disaster emergency response on essential Unified Program functions at the local level.

Goal 1: Emphasize State and local collaboration and consistency in implementing the Unified Program.

Opportunities and Challenges

There are many government agencies with different regulations and policy frameworks in the Unified Program. Managing the Unified Program efficiently and effectively requires collaboration, communication and consistency.

Objectives

1.1	Maintain a collaborative process to prioritize local, state and federal activities to ensure efficient and effective CUPA planning and program implementation.
1.2	Use CUPA, federal, state and local partnerships to govern the Unified Program effectively.
1.3	Develop and apply improved practices and processes for effective communication.

Objective 1.1: Maintain a collaborative process to prioritize local, state and federal activities to ensure efficient and effective CUPA planning and program implementation.

	Task	Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
1.1.1	Include a standing agenda item to quarterly UPAAG meetings for each State Program Agency and the CUPA Forum Board to report on the status of their top three program priorities. Agenda items include: State Program Agency expectations of CUPAs What State Program Agencies need from CUPAs to implement each priority Impacts identified for each priority What CUPAs need from State Program Agencies to implement each priority	UPAAG Co-Chairs	Quarterly	August 2018	December 2022
1.1.2	Develop and implement a plan to communicate the activity, sequence, and message to the regulated community, industry and other stakeholders (regulated businesses and organizations, consultants, etc.)	UPAAG	8 months	August 2018	March 2019
1.1.3	Monitor and improve communication plans as necessary, as State Program Agencies and CUPAs implement priority activities. Regularly review communication plans to improve coordination for each initiative so that participants understand details of each.	UPAAG	Semi-Annually	August 2019	December 2022

1.1.4	Develop a format for open communication between industry representatives, the regulated community, and regulatory agencies (CUPAs and state agencies) regarding concerns of implementation of the Unified Program. The format should include various methods of communication and media, including those similar to the Industry Roundtable meeting at the Annual Training Conference and the CERS Business User Group.	UPAAG	9 months	April 2019	December 2019
1.1.5	Review the Strategic Plan annually to determine progress for meeting each goal. Dedicate adequate time the day before the May UPAAG meeting each year for review of the Strategic Plan. Lead executive groups or steering committees will provide progress updates on the status of each respective objective and task.	UPAAG	Annually	May 2019	May 2022

Objective 1.2: Use CUPA, federal, state and local partnerships to govern the Unified Program effectively.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
1.2.1	Discuss approaches to achieving best practices with local, state and federal partners as they relate to implementation of each program element.	UPAAG	6 months	August 2018	December 2022
1.2.2	Schedule discussions to identify different understandings and approaches to enforcement based on different CUPA organizational cultures. Discuss how different approaches affect Unified Program partners.	UPAAG	6 months	August 2018	January 2019
1.2.3	Coordinate enforcement approaches that consult, include and inform partnerships.	UPAAG	8 months	August 2018	March 2019
1.2.4	Identify means for easier reference to shared best practices using Unified Program, State Program Agency and CUPA Forum Board websites cooperatively, and continue to present those at training workshops, webinars and conferences.	UPAAG	12 months	August 2018	July 2019
1.2.5	Continue to assess emerging statutes, regulations, technologies, and best practices, and plan for impacts on the Unified Program.	UPAAG	Quarterly	August 2018	December 2022

Objective 1.3: Develop and apply improved practices and processes for effective communication.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
1.3.1	Establish a communication workgroup to review current practices and approaches to communication.	UPAAG	3 months	June 2018	August 2018
1.3.2	Develop a communication plan that addresses how to communicate various information, what sequence, to whom and how. NOTE: For consistency, the Communications Workgroup will consider the DTSC Lean Six Sigma Workgroup recommendations scheduled for completion in July 2018.	Communications Workgroup	9 months	November 2018	July 2019
1.3.3	Disseminate the communication plan widely so all know how to coordinate communication.	Communications Workgroup	3 months	August 2019	October 2019

Goal 2: Review and enhance the CUPA Performance Evaluation process.

Opportunities and Challenges

The process of conducting CUPA Performance Evaluations has undergone various revisions in recent years and each state agency has experienced turnover in evaluation staff, resulting in various levels of experience among the evaluation team. CUPA Performance evaluation guidance documents and tools currently in use need updating and revision, and additional guidance needs to be developed. Establishing improved methods for training and mentoring evaluators will enable a desirable and collaborative approach toward the interaction among CalEPA and each state agency as well as with CUPAs, leading to the implementation of a greater constructive evaluation process.

Objectives

2.1:	Develop a collaborative approach to conducting CUPA Performance Evaluations.
2.2:	Revise the Unified Program Evaluation Manual with an updated set of criteria used by State Program Agencies and CUPAs for performance evaluations.
2.3:	Establish evaluation process training for State Program Agency evaluators and CUPA inspectors.

Objective 2.1: Develop a collaborative approach to conducting CUPA Performance Evaluations.

	Task	Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
2.1.1	Define areas of the performance evaluation process that are resource intensive for state agencies and CUPAs, such as preparation, conduct, response to, and follow-up with deficiency corrective actions.	CalEPA and State Program Agencies	6 months	May 2018	October 2018
2.1.2	Define and clarify the mission and purpose of the performance evaluation process.	CalEPA and State Program Agencies	6 months	May 2018	October 2018
2.1.3	Identify modifications to the current performance evaluation process to improve efficiency and effectiveness.	CalEPA and State Program Agencies	12 months	January 2018	December 2018
2.1.4	Develop practices, procedures and guidance that outlines the current performance evaluation process.	CalEPA and State Program Agencies	6 months	May 2018	October 2018
2.1.5	Develop and implement metrics for measuring success in program elements of the performance evaluation process.	CalEPA and State Program Agencies	3 months	October 2018	December 2018
2.1.7	Define guidelines for information and facility file requests used to conduct CUPA performance evaluations.	CalEPA and State Program Agencies	4 months	August 2018	November 2018
2.1.8	Review, update and revise the following documents to reflect the NEW Evaluation Process: Summary of Findings Report (PRELIMINARY and FINAL) Evaluation Survey for CUPAs CUPA Performance Evaluation Manual Deficiency Library	CalEPA and State Program Agencies	4 months	August 2018	November 2018
2.1.9	Present NEW Evaluation Process to the Evaluation Workgroup.	CalEPA and State Program Agencies	1 month	December 2018	December 2018

2.1.10	Review, update, revise and develop Performance Evaluation guidance documents for CUPAs to reference for improving the existing implementation of the Unified Program, such as: Inspection and Enforcement Plan Self-Audit Various policies and procedures developed by the CUPA to implement Unified Program processes, including: public notification, financial management, data management, etc.	CalEPA and State Program Agencies	Continuous	January 2019	December 2022
2.1.11	Implement the new evaluation process beginning with the 2019 Evaluation Schedule.	CalEPA and State Program Agencies	Continuous	January 2019	December 2022

Objective 2.2: Revise the Unified Program Evaluation Manual with an updated set of criteria used by State Program Agencies and CUPAs for performance evaluations.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
2.2.1	Identify existing CERS reports currently used, including specification of the report parameters.	CalEPA and State Program Agencies	2 months	August 2018	September 2018
2.2.2	Identify the need for any new CERS reports.	CalEPA and State Program Agencies	2 months	August 2018	September 2018
2.2.3	Review and revise existing CERS reports.	CalEPA and State Program Agencies	2 months	October 2018	November 2018
2.2.4	Create new CERS reports as necessary, including specifying the report parameters.	CalEPA IT staff	2 months	October 2018	November 2018
2.2.5	Modify existing CERS reports as necessary, including specifying the report parameters.	CalEPA IT staff	1 month	December 2018	December 2018

Objective 2.3: Establish evaluation process training for State Program Agency evaluators and CUPA inspectors.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
2.3.1	Identify training modules for a training program.	UPPG, CUPA Forum Board	6 months	August 2018	January 2019
2.3.2	Develop training materials for each module.	State Program Agencies, CUPA Forum Board	12 months	February 2019	January 2020
2.3.3	Identify instructors and attendees.	State Program Agencies, CUPA Forum Board	6 months	February 2020	July 2020
2.3.4	Implement the training program.	State Program Agencies, CUPA Forum Board	Continuous	August 2020	December 2022

Goal 3: Develop and implement methodologies and tools for prioritizing local program implementation based on risk and cumulative impacts to public health and safety.

Opportunities and Challenges

Local programs and participating agencies must enforce a wide range of regulations and inspect diverse entities. CUPAs can better serve to protect public health, safety, and the environment by prioritizing activities based on risk or cumulative impacts associated with certain facilities, businesses types, business practices, and industry sectors. Developing and implementing criteria for flexibility in performance-based inspections within mandatory, CUPA-level inspection and enforcement plans is a key component of the Regulatory Performance Initiative.

Objectives

3.1:	Develop overall concept for risk prioritization.
3.2:	Communicate the risk-based inspection concept to key stakeholders to gain support for implementation.
3.3:	Create legislative language to adopt the risk-based inspection concept.

Objective 3.1: Develop overall concept for risk prioritization.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
3.1.1	Develop a clear definition of goals and objectives for the process, including definition of CUPA compliance program prioritization, with respect to effective allocation of inspection and enforcement resources.	UPRPI Workgroup	6 months	May 2018	October 2018
3.1.2	Engage State Program Agencies to review and provide comment on the proposed risk-based inspection concept.	UPRPI Workgroup	2 months	August 2018	September 2018
3.1.3	Develop local agency model programs.	UPRPI Workgroup	6 months	July 2018	December 2018
3.1.4	Survey and report on risk-based programs of other states and agencies	UPRPI Workgroup	6 months	July 2018	December 2018
3.1.5	Develop and submit legislative and regulatory justification for the risk-based inspection concept (UPRPI).	UPRPI Workgroup, UPAAG	3 months	September 2018	November 2018

Objective 3.2: Communicate the risk-based inspection concept to key stakeholders to gain support for implementation.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
3.2.1	Provide outreach regarding the risk-based inspection concept to the public, including environmental groups, environmental justice groups, business groups and the regulated community.	UPRPI Workgroup	3 months	September 2018	November 2018
3.2.2	Consider feedback provided by the public.	UPRPI Workgroup	2 months	December 2018	January 2019
3.2.3	Present UPAAG with any feedback that would likely impact or result in changing the risk-based inspection concept previously approved by UPAAG.	UPRPI Workgroup	1 month	December 2018	December 2018
3.2.4	Make any necessary amendments to the risk-based inspection concept based on feedback provided by the public.	UPRPI Workgroup	4 months	November 2018	February 2019

3.2.5	Obtain UPAAG approval of revisions to the risk-based inspection concept, if any revisions exist.	UPRPI Workgroup	1 month	March 2019	March 2019
3.2.6	Communicate the final risk-based inspection concept (RPI) to key stakeholders (businesses, state executives, and Legislature, labor and community organizations), the regulated community and Unified Program regulating agencies.	UPAAG	3 months	March 2019	May 2019

Objective 3.3: Create legislative language to adopt the risk-based inspection concept.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
3.3.1	Create legislative language for adopting the risk-based inspection concept approved by UPAAG.	Legislative and UPPRI Workgroups	3 months	October 2018	December 2018
3.3.2	Evaluate potential legislative support for an authorizing statute.	CUPA Forum Board	5 months	October 2018	February 2019

Goal 4: Develop exceptionally trained and skilled Unified Program personnel for employment at state and agencies.

Opportunities and Challenges

As experienced personnel retire or leave, CUPAs and State Program Agencies will need trained and skilled staff for ever-more complex enforcement and implementation of Unified Program regulatory requirements. Local CUPA and state agency programs must continuously recruit and train new staff, and provide ongoing training, to provide services that maintain the expected standards of the Unified Program.

Objective

4.1:	Conduct ongoing assessment of the Training Framework.
4.2:	Evaluate the effectiveness and accessibility of various training delivery methods.
4.3:	Develop statewide certification programs for CUPA inspectors and State Program Agency evaluators.
4.4:	Develop a statewide registration program for CUPA personnel.
4.5:	Support the Unified Program training culture.

Objective 4.1: Conduct ongoing assessment of the Training Framework.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
4.1.1	Develop process and determine frequency for reviewing and updating the Training Framework	Training Steering Committee	3 months	August 2018	October 2018
4.1.2	Perform gap analysis to determine if all Knowledge, Skills and Abilities (KSAs) have associated existing courses in the Training Framework.	Training Steering Committee	6 months	October 2018	March 2019
4.1.3	Review statutes and regulations to determine if revisions to the Training Framework are necessary.	Training Steering Committee	Continuous	April 2019	December 2022
4.1.4	Revise the Training Framework.	Training Steering Committee	6 months	July 2019	December 2019
4.1.5	Develop metrics to evaluate the implementation of the Training Framework.	Training Steering Committee	6 months	January 2020	June 2020
4.1.6	Develop a communication/outreach strategy for implementing the Training Framework.	Training Steering Committee	6 months	July 2020	December 2020
4.1.7	Implement the Training Framework	Training Steering Committee	Continuous	January 2021	December 2022

Objective 4.2: Evaluate the effectiveness and accessibility of various training delivery methods.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
4.2.1	Identify existing training delivery methods. The following should be considered: Inspector succession planning/training Implementation of various training delivery methods (classroom training, webinars, videos, etc.) A Mentoring program Joint inspections with U.S. EPA, state agency staff and/or CUPA staff or inspectors where each are given the opportunity to ask questions in the field as inspections are conducted and various issues are encountered	Training Steering Committee	3 months	January 2019	March 2019
4.2.2	Explore new technology for training delivery methods.	Training Steering Committee	3 months	April 2019	June 2019
4.2.3	Determine effectiveness of each training delivery method.	Training Steering Committee	Continuous	July 2019	December 2022
4.2.4	Apply most effective and efficient training delivery methods to Unified Program related training.	Training Steering Committee	3 months	October 2019	December 2019
4.2.5	Implement new training delivery methods.	Training Steering Committee, State Program Agencies, CUPAs	Continuous	January 2020	December 2022

Objective 4.3: Develop statewide certification programs for CUPA inspectors and State Program Agency evaluators.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
4.3.1	Hazardous Materials Certification Workgroup to develop specific criteria for a training certification program.	Hazardous Materials Certification Workgroup (CUPA Forum Board)	12 months	May 2018	April 2019

4.3.2	Provide interpretive outreach to stakeholders (regulated businesses and organizations, consultants, etc.)	CUPA Forum Board	4 months	December 2018	March 2019
4.3.3	Complete the first cycle of the training certification program.	CUPA Forum Board	3 years	July 2018	July 2021

Objective 4.4: Develop a statewide registration program for CUPA personnel.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
4.4.1	Establish a Registration Workgroup to develop specific criteria for the statewide registration program.	UPAAG	1 month	March 2019	March 2019
4.4.2	Develop a statewide registration program.	Registration Workgroup	9 months	May 2019	January 2020
4.4.3	Provide interpretive outreach to stakeholders (regulated businesses and organizations, consultants, etc.)	Registration Workgroup	6 months	January 2020	June 2020
4.4.4	Develop proposed legislation.	Registration Workgroup	10 months	January 2020	October 2020
4.4.5	Consider feedback provided by stakeholders (regulated businesses and organizations, consultants, etc.)	Registration Workgroup	6 months	February 2020	July 2020
4.4.6	Identify, develop and recommend any needed statutory or regulatory language to affect changes.	Registration Workgroup	3 months	October 2020	December 2020

Objective 4.5: Support the Unified Program training culture.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
4.5.1	Expand the "Train the Trainer" program. Explore additional vendors for the "Train the Trainer" program. Enable State Program Agency staff to participate. Conduct the "Train the Trainer" program	CUPA Forum Board	6 months	January 2019	June 2019
4.5.2	Create a commitment and expectations policy for training volunteers to ensure succession planning occurs.	CUPA Forum Board	4 months	September 2018	December 2018
4.5.3	Share the trainer commitment and expectations policy with UPAAG and Training Steering Committee	CUPA Forum Board	4 months	December 2018	March 2019

Goal 5: Improve the capabilities and functionality of the California Environmental Reporting System (CERS) for current and future needs.

Opportunities and Challenges

Electronic reporting systems require significant CUPA and PA resources to maintain functionality. Unified Program Agencies (UPAs) use various database platforms and/or system versions to meet CERS electronic reporting requirements. There may be a more effective and efficient means of meeting current and future requirements to electronically report Unified Program information to CERS, in order to comply with state and national regulatory requirements.

Objectives

5.1:	Examine functionality and efficiency of CERS and local CUPA business processes and database systems.
5.2:	Examine the concept of a CUPA management tool using data from CERS.

Objective 5.1: Examine functionality and efficiency of CERS and local CUPA business processes database systems.

	Task	Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
5.1.1	Business Process Modeling (BPM) document: Assess and document existing business processes and understand process requirements to provide business process improvement opportunities.	Data Steering Committee and CalEPA	18-24 months	December 2018	December 2020
5.1.2	CalEPA, UPAs and State Program Agencies to identify areas for improving business processes, improving the functionality of CERS or for amending the data requirements for electronic reporting as proposed CERS enhancements.	Data Steering Committee and CalEPA	18-24 months	December 2019	December 2021
5.1.3	Explore development of an inspection module or other tool to support enhanced inspection data capture, with the capability of creating outputs for regulating agencies and for regulated businesses.	CUPA Forum Board	12 months	December 2018	December 2019
5.1.4	Plan and make interim improvements to CERS and local reporting databases based on evaluation of CERS functionality and assessment of business processes.	Data Steering Committee and CalEPA	24 months	December 2019 2020	December 2022

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Objective 5.2: Examine the concept of a CUPA management tool using data from CERS.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
5.2.1	Document and implement governance structures to prioritize need of management tool, assess and develop business cases and objectives.	Data Steering Committee	12-18 months	January 2019	June 2020
5.2.2	Document and collaborate with UPAs and State Program Agency data owners to identify, define and development of centralized data warehouse in order to support consistently defined data sets and to support data management tool.	Data Steering Committee	24-36 months	January 2020	January 2023
5.2.3	Propose a funding mechanism for proceeding with the development of the data-management functionality of CERS.	Data Steering Committee	6 months	July 2019	December 2019
5.2.4	Obtain agreement among CalEPA, UPAs and State Program Agencies to develop CERS data-management capabilities in addition to data-reporting capabilities.	Data Steering Committee	6 months	January 2020	June 2020

Goal 6: Enrich and curate CERS data to make informed decisions that advance the Unified Program goals, objectives and public safety.

Opportunities and Challenges

Local programs devote significant resources to collecting data and reporting information to state agencies and other Unified Program partners. Together, all parties must ensure that the information is reliable and valid, and that investment in data collection and analyses are efficient and effective in fulfilling State oversight needs and requirements as well as improving program implementation.

Objectives

6.1:	Develop and implement a process to enrich data quality in the California Environmental Reporting System (CERS).
6.2:	Develop and share analytic methodologies for trend analysis of CERS data.
6.3:	Evaluate the needed enhancements for non-data exchange CUPAs.
6.4:	Promote the use and improve the functionality of the CalEPA Regulated Site Portal website and data services.

Objective 6.1: Develop and implement a process to enrich data quality in the California Environmental Reporting System (CERS).

	Task	Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
6.1.1	Develop a data quality enrichment process.	Data Steering Committee	9 months	January 2019	September 2019
6.1.2	Research applicability of QA/QC methods and standards used by State Program Agencies to verify facility-reported data.	Data Steering Committee	12-18 months	January 2019	June 2020
6.1.3	Define QA/QC methods and standards to ensure CERS data is not duplicated and to identify data entry and transfer errors for data reported directly in CERS by business and regulator users and for data transferred to CERS through Electronic Data Transfer (EDT).	Data Steering Committee	24 months	December 2019	December 2021
6.1.4	Define and recommend a priority for the implementation of data QA/QC methods and standards for UPAs, State Program Agencies and regulated businesses.	Data Steering Committee	12 months	December 2020	December 2021
6.1.5	Define how to apply standards to submittals from businesses to CERS.	Data Steering Committee	12 months	January 2021	December 2021
6.1.6	Define standards that should be applied by CUPAs when reviewing and accepting submittals.	Data Steering Committee	12 months	January 2021	December 2021
6.1.7	Assess ways to reduce data entry errors, i.e.: using linkages or tools to standardize submittal choices.	Data Steering Committee	12 months	January 2022	December 2022

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Objective 6.2: Develop and share analytic methodologies for trend analysis of CERS data.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
6.2.1	Identify Unified Program public, state agency and CUPA needs for trend analysis and define the metrics for analysis. Trend analysis should utilize Unified Program data to demonstrate the success and effectiveness of the implementation of the Unified Program to the public.	Data Steering Committee	6 months	July 2020	December 2020
6.2.2	Research and identify methodologies for conducting trend analysis, including measures to track success of implementation of the Unified Program.	Data Steering Committee	6 months	January 2021	June 2021
6.2.3	Perform and report on trend analysis to support and advance Unified Program efficiency and effectiveness.	Data Steering Committee	12 months	July 2021	June 2022

Objective 6.3: Evaluate the needed enhancements for non-data exchange CUPAs.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
6.3.1	Survey CUPAs not utilizing electronic data transfer (EDT) to determine if additional CERS enhancements are necessary.	Data Steering Committee	9 months	January 2020	September 2020
6.3.2	Review survey responses.	Data Steering Committee	3 months	October 2020	December 2020
6.3.3	Determine actions necessary in response to surveys.	Data Steering Committee	6 months	January 2021	June 2021
6.3.4	Prioritize and develop scope and cost of effort for each new proposed CERS enhancement.	Data Steering Committee and CalEPA	6 months	July 2021	December 2021

6.3.5	Proceed with development of CERS enhancements.	CalEPA and CUPA Data Services Vendors	12 months	January 2022	December 2022
6.3.6	Implement CERS enhancements in production environments.	CalEPA and CUPA Data Services Vendors	Continuous	January 2023	Continuous

Objective 6.4: Promote the use and improve the functionality of the CalEPA Regulated Site Portal website and data services.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
6.4.1	Develop and implement changes to the Regulated Site Portal to improve features and functionality with the incorporation of data from additional environmental databases.	CalEPA	15 months	June 2018	August 2019
6.4.2	Develop and update public outreach material to highlight uses and functionality.	CalEPA	6 months	March 2019	August 2019
6.4.3	Present updated outreach to all stakeholders (consultants, attorneys, regulated businesses, etc.).	Data Steering Committee and CalEPA	24 months	September 2019	September 2021

Goal 7: Minimize and mitigate the impact of local disaster emergency response on essential Unified Program functions at the local level.

Opportunities and Challenges

By statute, UPAs must routinely prepare for local disaster emergency roles and responsibilities, maintain response capabilities, and coordinate regularly with disaster emergency assistance agencies and organizations. In the face of growing disaster response costs and limited state/federal resources to respond to large disasters, CUPAs seek to improve collaboration and training for local mutual aid and disaster assistance. It remains critical for UPAs to ensure the ability to continue to protect environmental health and public safety by maintaining routine Unified Program responsibilities as effectively and efficiently as possible. For both provider and recipient agencies, best practices are necessary to balance response and assistance activities during declared disaster emergencies with continuity of executing Unified Program inspection and enforcement responsibilities as fully as possible.

Objectives

7.1:	Help enable local agencies continue to protect environmental health and public safety and maintain Unified Program implementation effectively and efficiently while conducting disaster recovery or rendering Disaster Emergency Assistance (DEA) to other local agencies.

Objective 7.1: Ensure local agencies are able to continue to protect environmental health and public safety and maintain Unified Program implementation effectively and efficiently while participating in Disaster Emergency Assistance (DEA) for State-declared disasters.

Task		Lead	Estimated Time for Completion	Estimated Start Date	Estimated Completion Date
7.1.1	Develop an evaluation process contingency plan for CUPAs that have experienced response demands to state-declared emergencies during the performance review period.	UPAAG Evaluation Workgroup	6 months	January 2019	June 2019
7.1.2	Identify necessary contingency planning for CUPAs in order to enable each CUPA to continue to perform routine Unified Program implementation amidst the establishment of disaster relief and need for supportive assistance in response to the disaster.	Cal OES and CUPAs	6 months	February 2018	July 2018
7.1.3	Determine if and how a state declared emergency disaster temporarily relieves requirements of regulated businesses in the area during the declared emergency.	CalEPA, CCDEH, CUPAs	12 months	August 2018	July 2019
7.1.4	Identify and develop statutory or regulatory revisions needed to alleviate resource/priority conflicts between Unified Program requirements and local emergency response needs.	UPAAG	24 months	August 2019	July 2021

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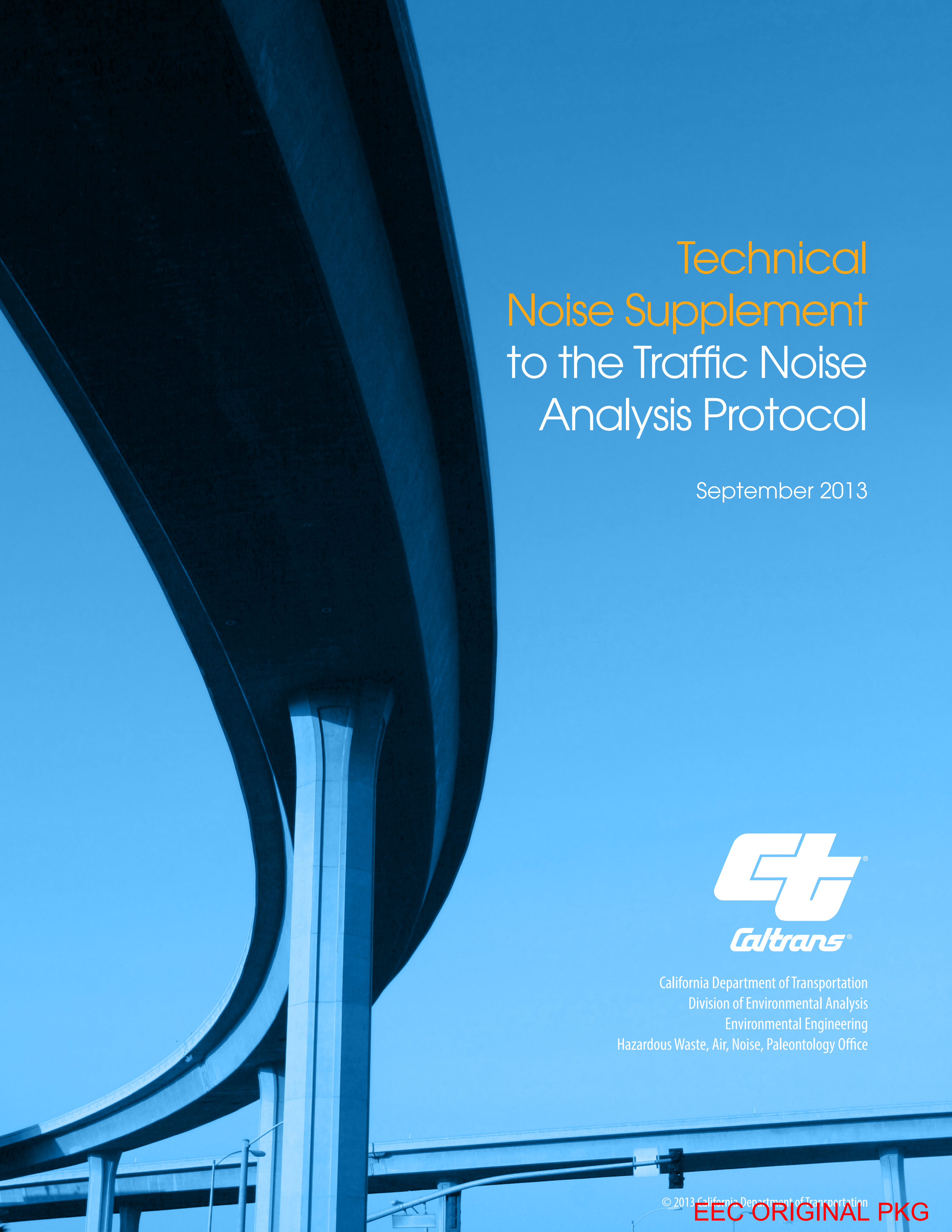

Technical Noise Supplement to the Traffic Noise Analysis Protocol

September 2013

Caltrans

California Department of Transportation
Division of Environmental Analysis
Environmental Engineering
Hazardous Waste, Air, Noise, Paleontology Office

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CALTRANS Technical Report Documentation Page

1. Report No. CT-HWANP-RT-13-069.25.2	2. Type of Report Reference & Guidance	3. Report Phase and Edition Final
4. Title and Subtitle Technical Noise Supplement to the Caltrans Traffic Noise Analysis Protocol A Guide for the Measuring, Modeling, and Abating Highway Operation and Construction Noise Impacts		5. Report Date September 2013
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8. Performing Organization Names and Addresses California Department of Transportation Division of Environmental Analysis Environmental Engineering Hazardous Waste, Air, Noise, & Paleontology Office 1120 N Street, Mail Stop 27 Sacramento CA 95814 http://www.dot.ca.gov/hq/env/noise/index.htm		9. Task Order No. 25 10. Contract No. : 43A0269 – ICF International
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13. Supplementary Notes This document updates and supersedes the Nov 2009 *Technical Noise Supplement.* Refer to the Sept 2013 *Caltrans Highway Traffic Noise Analysis Protocol* for noise-related policy.		14. External Reviewers

15. Abstract
This manual contains Caltrans noise analysis procedures, practices, and other useful technical background information related to the analysis and reporting of highway and construction noise impacts and abatement. It supplements and expands on concepts and procedures referred to in the *Traffic Noise Analysis Protocol*, which in turn is required by federal regulations in 23CFR772. *The contents of this document are not official policy, standard, or regulation*, and are for informational purposes—*unless they are referenced in the Protocol.* Except for some Caltrans-specific methods and procedures, most methods and procedures recommended in this document are in conformance with industry standards and practices. This document can be used as a stand-alone guide for highway noise training purposes or as a reference for technical concepts, methodology, and terminology needed to acquire a basic understanding of highway noise and construction noise-related issues.

16. Key Words Highway noise, highway noise measurement, noise barrier design, traffic noise impact analysis, noise study reports, construction noise.	17. Distribution Statement Available to the general public	18. No. of pages 276

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Technical Noise Supplement to the Caltrans Traffic Noise Analysis Protocol

A Guide for Measuring, Modeling, and Abating Highway Operation and Construction Noise Impacts

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Acronyms and Abbreviations

Δ	change
°F	degrees Farenheit
AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ADT	average daily traffic
ANSI	American National Institute of Standards
B	bels
Caltrans	California Department of Transportation
CFR	Code of Federal Regulations
CNEL	community noise equivalent level
cps	cycles per second
dB	decibels
dB/s	decibels per second
dBA	A-weighted decibels
DGAC	dense-graded asphalt concrete
EWNR	Exterior Wall Noise Rating
FHWA	Federal Highway Administration
ft/s	feet per second
GPS	global positioning system
Guidance Manual	Technical Guidance Manual on the Effects on the Assessment and Mitigation of Hydroacoustic Effects of Pile Driving Sound on Fish
Hz	hertz
I-	Interstate
kHz	kilohertz
km/hr	kilometers per hour
kVA	kilovolt-amperes
L_{dn}	day-night noise level
L_{eq}	equivalent noise level
L_{max}	maximum noise level

m/s	meters per second
mph	miles per hour
N	Newton
N/m^2	Newton per square meter
NAC	noise abatement criteria
NADR	Noise Abatement Decision Report
NIST	National Institute of Standards and Technology
Nm	Newton meter
NRC	noise reduction coefficient
OBSI	on-board sound intensity
OGAC	open-graded aspalt concrete
OSHA	Occupational Safety and Health Administration
PCC	Portland concrete cement
PLD	path length difference
Protocol	Traffic Noise Analysis Protocol
psi	pounds per square inch
pW	picowatt
REMEL	Reference Energy Mean Emission Level
rms	root mean square
SPL	sound pressure level
SR	State Route
STC	Sound Transmission Class
TeNS	Technical Noise Supplement
TL	transmission loss
TNM	Traffic Noise Model
VNTSC	Volpe National Transportation Systems Center
vph	vehicles per hour
W	watts
W/m^2	watts per square meter
$\mu N/m^2$	microNewtons per square meter
μPa	micro Pascals

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- Rudy Hendriks (ICF Jones & Stokes; California Department of Transportation [retired])—principal author
- Bruce Rymer (California Department of Transportation)—technical reviewer
- Jim Andrews (California Department of Transportation)—technical reviewer
- Dave Buehler (ICF International)—technical editor

Dedication:

This edition of the Technical Noise Supplement is dedicated to Rudy Hendriks whose early work substantially contributed to the science of highway acoustics.

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Section 1
Introduction and Overview

1.1 Introduction

This 2013 Technical Noise Supplement (TeNS) to the California Department of Transportation (Caltrans) *Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects* (Protocol) (California Department of Transportation 2011) is an updated version of the 2009 TeNS. This version of the TeNS is compatible with applicable sections of the 2011 Protocol that were prepared in response to changes to Title 23 Part 772 of the Code of Federal Regulations (CFR) which were published in July 2010. The current Protocol was approved by the Federal Highway Administration (FHWA) and became effective on July 13, 2011. Be sure to check for updates to the Protocol.

The purpose of this document is to provide technical background information on transportation-related noise in general and highway traffic noise in particular. It is designed to elaborate on technical concepts and procedures referred to in the Protocol. The contents of the TeNS are for informational purposes; *unless they are referenced in the Protocol, the contents of this document are not official policy, standard, or regulation*. Except for some Caltrans-specific methods and procedures, most methods and procedures recommended in TeNS are in conformance with industry standards and practices.

This document can be used as a stand-alone document for training purposes or as a reference for technical concepts, methodology, and terminology needed to acquire a basic understanding of transportation noise with emphasis on highway traffic noise.

Revisions to this document are listed below.

- Removal of references and discussion relating to traffic noise models that preceded the current FHWA Traffic Noise Model (TNM).

- Abbreviated discussions of several topics such as bioacoustics and quieter pavement that are now covered in more detail in newer technical references.
- Elimination of metric units in accordance with Caltrans current standards. The exception to this is units of pressure that are traditionally expressed in metric units such as micro-pascals.
- Removal of the traffic noise analysis screening procedure which was removed from the Protocol.
- Removal of obsolete information.

The 2009 version of TeNS will remain available on the Caltrans website as a reference for information that has been removed from this edition. The 2009 version of TeNS contains a number of measurement procedures for non-routine noise studies.

1.2 Overview

The TeNS consists of eight sections. Except for Section 1, each covers a specific subject of highway noise. A brief description of the subjects follows.

- Section 1, *Introduction and Overview*, summarizes the subjects covered in the TeNS.
- Section 2, *Basics of Highway Noise*, covers the physics of sound as it pertains to characteristics and propagation of highway noise, effects of noise on humans, and ways of describing noise.
- Section 3, *Measurements and Instrumentation*, provides background information on noise measurements, and discusses various noise-measuring instruments and operating procedures.
- Section 4, *Detailed Analysis for Traffic Noise Impacts*, provides guidance for conducting detailed traffic noise impact analysis studies. This section includes identifying land use, selecting receptors, determining existing noise levels, predicting future noise levels, and determining impacts.
- Section 5, *Detailed Analysis for Noise Barrier Design Considerations*, outlines the major aspects that affect the acoustical design of noise barriers, including the dimensions, location, and material; optimization of noise barriers; possible noise reflections; acoustical design of overlapping noise barriers (to provide maintenance access to areas

behind barriers); and drainage openings in noise barriers. Challenges and cautions associated with noise barrier design are also discussed.

- Section 6, *Noise Study Reports*, discusses the contents of noise study reports.
- Section 7, *Non-Routine Considerations and Issues*, covers non-routine situations involving the effects of noise on distant receptors, use of sound intensity and sound power as tools in characterizing sound sources, pavement noise, noise monitoring for insulating facilities, construction noise, earthborne vibrations, California Occupational Safety and Health Administration (OSHA) noise standards, and effects and abatement of transportation-related noise on marine and wildlife.
- Section 8, *Glossary*, provides terminology and definitions common in transportation noise.
- Appendix A, *References Cited*, provides a listing of literature directly cited or used for reference in the TeNS.

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Section 2
Basics of Highway Noise

The following sections introduce the fundamentals of sound and provide sufficient detail to understand the terminology and basic factors involved in highway traffic noise prediction and analysis. Those who are actively involved in noise analysis are encouraged to seek out more detailed textbooks and reference books to acquire a deeper understanding of the subject.

2.1 Physics of Sound

2.1.1 Sound, Noise, and Acoustics

Sound is a vibratory disturbance created by a moving or vibrating source in the pressure and density of a gaseous or liquid medium or in the elastic strain of a solid that is capable of being detected by the hearing organs. Sound may be thought of as the mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. The medium of primary concern is air. In absence of any other qualifying statements, sound is considered airborne sound, as opposed to structure- or earthborne sound, for example.

Noise is defined as sound that is loud, unpleasant, unexpected, or undesired. It therefore may be classified as a more specific group of sounds. Although the terms *sound* and *noise* are often used synonymously, perceptions of sound and noise are highly subjective.

Sound is actually a process that consists of three components: source, path, and receiver. All three components must be present for sound to exist. Without a source, no sound pressure waves would be produced. Similarly, without a medium, sound pressure waves would not be transmitted. Finally, sound must be received—a hearing organ, sensor, or other object must be present to perceive, register, or be affected by sound. In most situations, there are many different sound sources, paths, and receivers.

In the context of an analysis pursuant to 23 CFR 772 the term *receptor* means a single dwelling unit or the equivalent of a single dwelling unit. A *receiver* is a single point that can represent one receptor or multiple receptors. As an example it is common when modeling traffic noise to use a single receiver in the model to represent multiple receptors. Acoustics is the field of science that deals with the production, propagation, reception, effects, and control of sound. The field is very broad, and transportation-related noise and abatement addresses only a small, specialized part of acoustics.

2.1.2 Speed of Sound

When the surface of an object vibrates in air, it compresses a layer of air as the surface moves outward and produces a rarefied zone as the surface moves inward. This results in a series of high and low air pressure waves (relative to the steady ambient atmospheric pressure) alternating in sympathy with the vibrations. These pressure waves, not the air itself, move away from the source at the speed of sound, approximately 1,126 feet per second (ft/s) in air with a temperature of 68 degrees Fahrenheit (°F). The speed of sound can be calculated from the following formula:

$$c = \sqrt{1.401\left(\frac{P}{\rho}\right)} \qquad \textbf{(2-1)}$$

Where:

c = speed of sound at a given temperature, in ft/s

P = air pressure in pounds per square foot (pounds/ft^2)

ρ = air density in slugs per cubic foot (slugs/ft^3)

1.401 = ratio of the specific heat of air under constant pressure to that of air in a constant volume

For a given air temperature and relative humidity, the ratio P/ρ tends to remain constant in the atmosphere because the density of air will reduce or increase proportionally with changes in pressure. Therefore, the speed of sound in the atmosphere is independent of air pressure. When air temperature changes, ρ changes, but *P* does not. Therefore, the speed of sound is temperature-dependent, as well as somewhat humidity-dependent because humidity affects the density of air. The effects of the latter with regard to the speed of sound, however, can be ignored for the purposes of the TeNS. The fact that the speed of sound changes with altitude has nothing to do with the change in air pressure and is only caused by the change in temperature.

For dry air of 32ºF, ρ is 0.002509 slugs/ft^3. At a standard air pressure of 29.92 inches Hg, pressure is 14.7 pounds per square inch (psi) or 2,118 pounds/ft^2. Using Equation 2-1, the speed of sound for standard pressure and temperature can be calculated as follows:

$$\mathbf{c} = \sqrt{(1.401)(\frac{2{,}118}{0.002509})} = 1{,}087 \text{ ft/s.}$$

From this base value, the variation with temperature is described by the following equation:

$$c = 1051.3\sqrt{1 + \frac{T_f}{459.7}} \text{ ft/s} \qquad \textbf{(2-2)}$$

Where:

c = speed of sound

T_f = temperature in degrees Fahrenheit (include minus sign for less than 0ºF)

The above equations show that the speed of sound increases or decreases as the air temperature increases or decreases, respectively. This phenomenon plays an important role in the atmospheric effects on noise propagation, specifically through the process of refraction, which is discussed in Section 2.1.4.3.

2.1.3 Sound Characteristics

In its most basic form, a continuous sound can be described by its frequency or wavelength (pitch) and amplitude (loudness).

2.1.3.1 Frequency, Wavelength, and Hertz

For a given single pitch, the sound pressure waves are characterized by a sinusoidal periodic (i.e., recurring with regular intervals) wave, as shown in Figure 2-1. The upper curve shows how sound pressure varies above and below the ambient atmospheric pressure with distance at a given time. The lower curve shows how particle velocity varies above 0 (molecules moving right) and below 0 (molecules moving left). Please note that when the pressure fluctuation is at 0, the particle velocity is at its maximum, either in the positive or negative direction; when the pressure is at its positive or negative peak, the particle velocity is at 0. Particle velocity describes the motion of the air molecules in response to the pressure waves. It does not refer to the velocity of the waves, otherwise known as the speed of sound. The distance (λ) between crests of both curves is the wavelength of the sound.

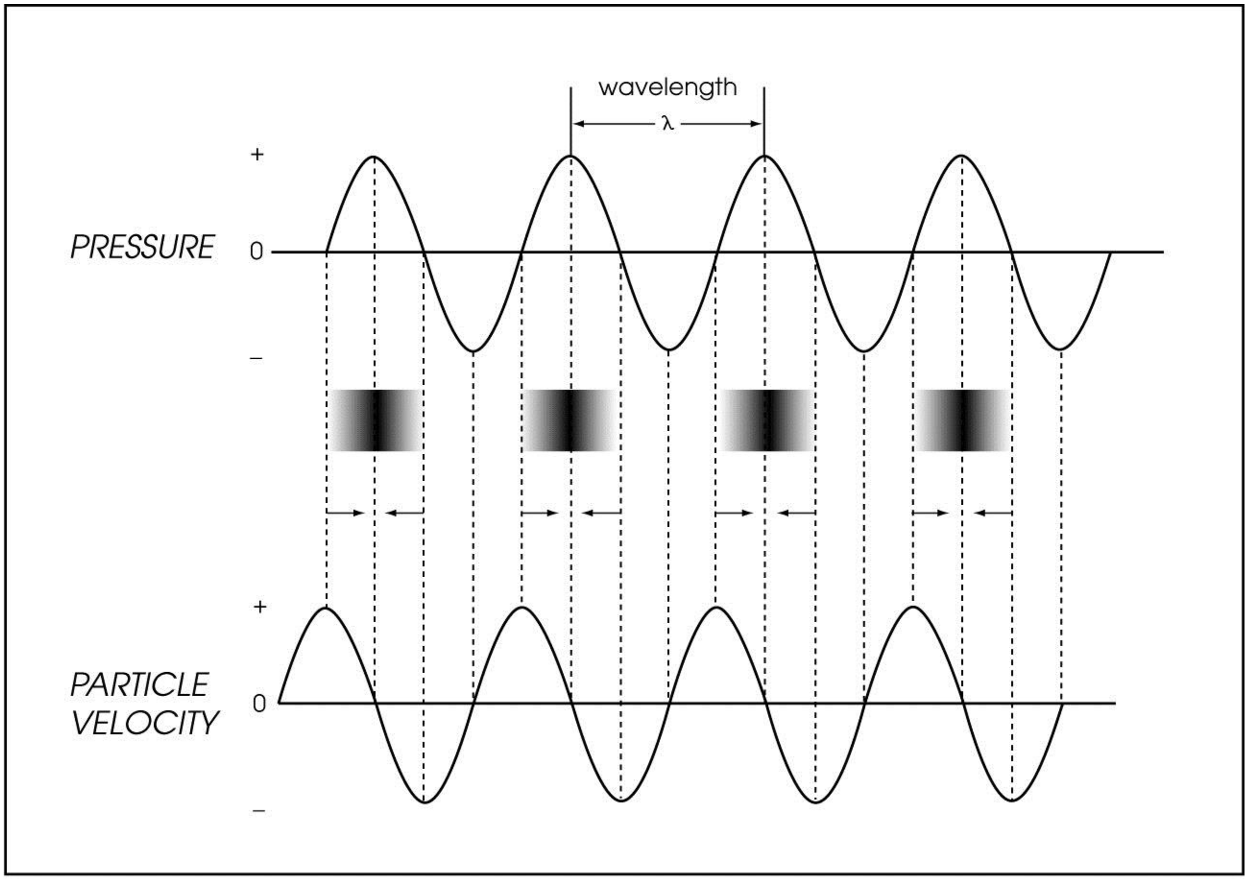


Figure 2-1. Sound Pressure vs. Particle Velocity

The number of times per second that the wave passes from a period of compression through a period of rarefaction and starts another period of compression is referred to as the frequency of the wave (Figure 2-2). Frequency is expressed in cycles per second, or hertz (Hz): 1 Hz equals one cycle per second. High frequencies are sometimes more conveniently expressed in units of kilohertz (kHz) or thousands of hertz. The extreme range of frequencies that can be heard by the healthiest human ears spans from 16 to 20 Hz on the low end to about 20,000 Hz (20 kHz) on the high end. Frequencies are heard as the pitch or tone of sound. High-pitched sounds produce high frequencies, and low-pitched sounds produce low frequencies. Very-low-frequency airborne sound of sufficient amplitude may be felt before it can be heard and is often confused with earthborne vibrations. Sound less than 16 Hz is referred to as infrasound, while high frequency sound above 20,000 Hz is called ultrasound. Both infrasound and ultrasound are not audible to humans, but many animals can hear or sense frequencies extending well into one or both of these regions.

Ultrasound also has various applications in industrial and medical processes, specifically cleaning, imaging, and drilling.

The distance traveled by a sound pressure wave through one complete cycle is referred to as the wavelength. The duration of one cycle is called the period. The period is the inverse of the frequency. For example, the frequency of a series of waves with periods of 0.05 (1/20) second is 20 Hz; a period of 0.001 (1/1000) second is 1,000 Hz or 1 kHz. Although low frequency earthborne vibrations (e.g., earthquakes and swaying of bridges or other structures) often are referred to by period, the term rarely is used in expressing airborne sound characteristics.

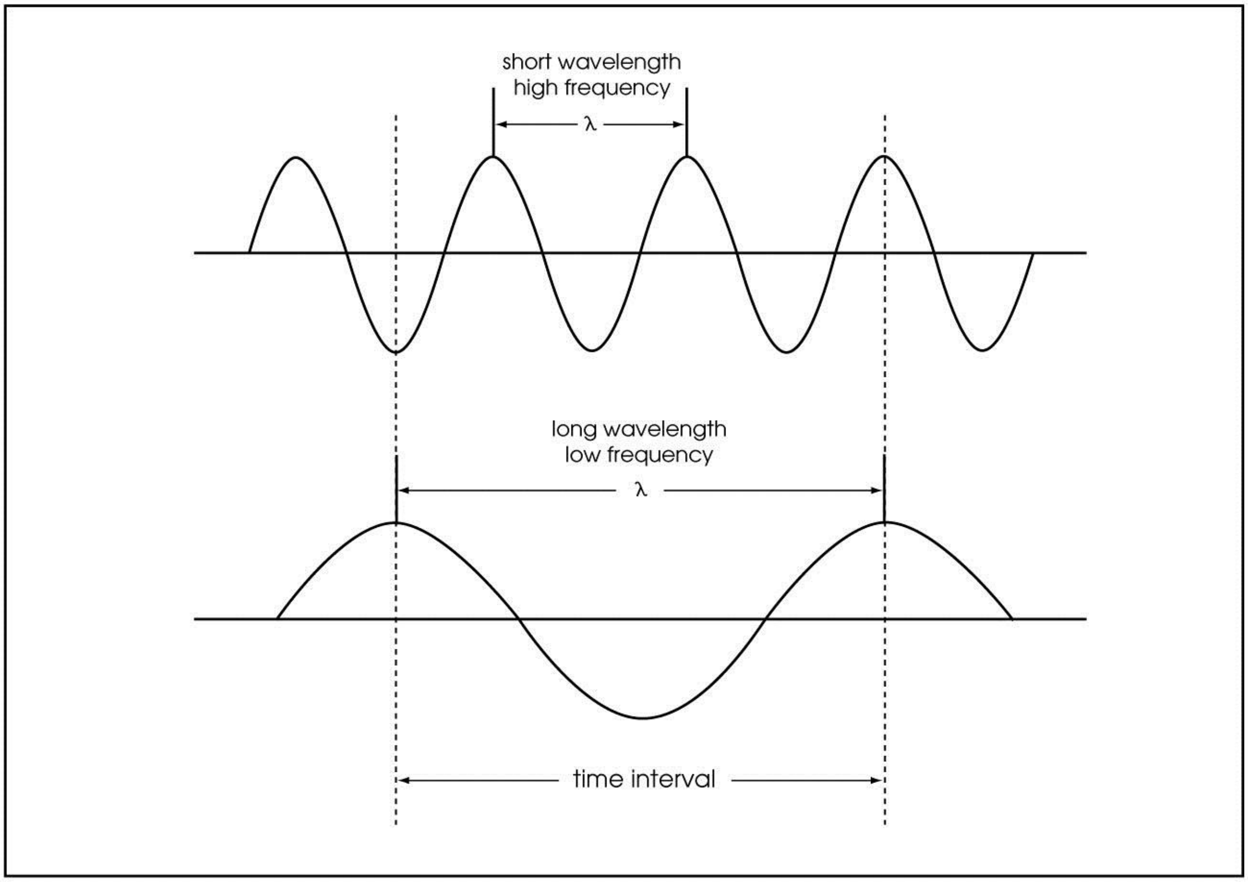


Figure 2-2. Frequency and Wavelength

Figure 2-2 shows that as the frequency of a sound pressure wave increases, its wavelength decreases, and vice versa. The relationship between frequency and wavelength is linked by the speed of sound, as shown in the following equations:

$$\lambda = \frac{c}{f} \quad \textbf{(2-3)}$$

$$f = \frac{c}{\lambda} \quad \textbf{(2-4)}$$

$$c = f\lambda \quad \textbf{(2-5)}$$

Where:

λ = wavelength (feet)

c = speed of sound (1,126.5 ft/s at 68ºF)

f = frequency (Hz)

In these equations, care must be taken to use the same units (distance units in feet and time units in seconds) for wavelength and speed of sound. Although the speed of sound is usually thought of as a constant, it has been shown that it actually varies with temperature. These mathematical relationships hold true for any value of the speed of sound. Frequency normally is generated by mechanical processes at the source (e.g., wheel rotation, back and forth movement of pistons) and therefore is not affected by air temperature. As a result, wavelength usually varies inversely with the speed of sound as the latter varies with temperature.

The relationships between frequency, wavelength, and speed of sound can be visualized easily by using the analogy of a train traveling at a given constant speed. Individual boxcars can be thought of as the sound pressure waves. The speed of the train (and individual boxcars) is analogous to the speed of sound, while the length of each boxcar is the wavelength. The number of boxcars passing a stationary observer each second depicts the frequency (*f*). If the value of the latter is 2, and the speed of the train (*c*) is 68 miles per hour (mph), or 100 ft/s, the length of each boxcar (λ) must be: c/f = 100/2 = 50 feet.

Using Equation 2-3, a table can be developed showing frequency and associated wavelength. Table 2-1 shows the frequency and wavelength relationship at an air temperature of 68ºF.

Table 2-1. Wavelength of Various Frequencies

Frequency (Hz)	Wavelength at 68ºF (Feet)
16	70
31.5	36
63	18
125	9
250	4.5
500	2.3

Frequency (Hz)	Wavelength at 68ºF (Feet)
1,000	1.1
2,000	0.56
4,000	0.28
8,000	0.14
16,000	0.07

The validity of Table 2-1 can be checked by multiplying each frequency by its wavelength, which should equal the speed of sound. Please notice that because of rounding, multiplying frequency and wavelength gives varying results for the speed of sound in air, which for 68ºF should be constant at 1,126.5 ft/s.

Frequency is an important component of noise analysis. Virtually all acoustical phenomena are frequency-dependent, and knowledge of frequency content is essential. Sections 2.1.3.6 and 2.1.3.7 discuss how frequency is considered in sound level measurements and sound analysis.

2.1.3.2 Sound Pressure Levels and Decibels

As indicated in Figure 2-1, the pressures of sound waves continuously change with time or distance and within certain ranges. The ranges of these pressure fluctuations (actually deviations from the ambient air pressure) are referred to as the amplitude of the pressure waves. Whereas the frequency of the sound waves is responsible for the pitch or tone of a sound, the amplitude determines the loudness of the sound. Loudness of sound increases and decreases with the amplitude.

Sound pressures can be measured in units of microNewtons per square meter ($\mu N/m^2$), also called micro Pascals (μPa): 1 μPa is approximately one-hundred-billionth (1/100,000,000,000) of the normal atmospheric pressure. The pressure of a very loud sound may be 200 million μPa, or 10 million times the pressure of the weakest audible sound (20 μPa). Expressing sound levels in terms of μPa would be very cumbersome because of this wide range. Sound pressure levels (SPLs) are described in logarithmic units of ratios of actual sound pressures to a reference pressure squared called bels. To provide a finer resolution, a bel is divided into tenths, or decibels (dB). In its simplest form, SPL in decibels is expressed as follows:

$$\text{Sound pressure level (SPL)} = 10\log_{10}\left(\frac{p_1}{p_0}\right)^2 \text{ dB} \qquad \textbf{(2-6)}$$

Where:

P_1 = sound pressure

P_0 = reference pressure, standardized as 20 μPa

The standardized reference pressure, P_0, of 20 μPa corresponds to the threshold of human hearing. When the actual sound pressure is equal to the reference pressure, the expression results in a sound level of 0 dB:

$$10\log_{10}\left(\frac{p_1}{p_0}\right)^2 = 10\log_{10}(1) = 0 \text{ dB}$$

Please note that 0 dB does not represent an absence of any sound pressure. Instead, it is an extreme value that only those with the most sensitive ears can detect. Therefore, it is possible to refer to sounds as less than 0 dB (negative dB) for sound pressures that are weaker than the threshold of human hearing. For most people, the threshold of hearing is probably close to 10 dB.

2.1.3.3 Root Mean Square and Relative Energy

Figure 2-1 depicted a sinusoidal curve of pressure waves. The values of the pressure waves were constantly changing, increasing to a maximum value above normal air pressure, then decreasing to a minimum value below normal air pressure, in a repetitive fashion. This sinusoidal curve is associated with a single frequency sound, also called a pure tone. Each successive sound pressure wave has the same characteristics as the previous wave. The amplitude characteristics of such a series of simple waves then can be described in various ways, all of which are simply related to each other. The two most common ways to describe the amplitude of the waves is in terms of peak SPL and root mean square (rms) SPL.

Peak SPL simply uses the maximum or peak amplitude (pressure deviation) for the value of P_1 in Equation 2-6. Therefore, peak SPL only uses one value (absolute value of peak pressure deviation) of the continuously changing amplitudes. The rms value of the wave amplitudes (pressure deviations) uses all positive and negative instantaneous amplitudes, not just the peaks. It is derived by squaring the positive and negative instantaneous pressure deviations, adding these together, and dividing the sum by the number of pressure deviations. The result is called the mean square of the pressure deviations; the square root of this mean value is the rms value. Figure 2-3 shows the peak and rms relationship for sinusoidal or single-frequency waves. The rms is 0.707 times the peak value.

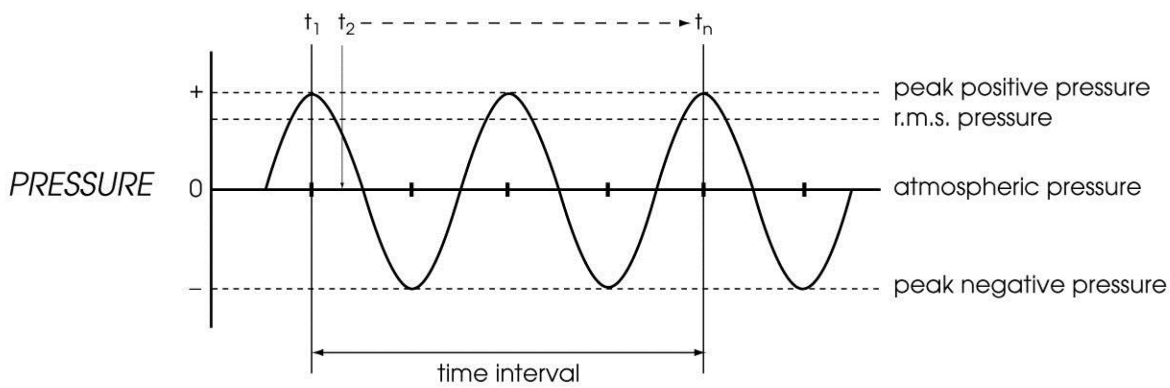


Figure 2-3. Peak and Root Mean Square Sound Pressure

In terms of discrete samples of the pressure deviations, the mathematical expression is as follows:

$$\text{rms} = \sqrt{\left({}_{1}\Sigma^{n}(t_1^2 + t_2^2 + \ldots t_n^2)/n\right)} \qquad \textbf{(2-7)}$$

Where:

$t_1, t_2, \ldots t_n$ = discrete pressure values at times t_1 through t_n above (positive) and below (negative) the local atmospheric pressure

Sound pressures expressed in rms are proportional to the energy contents of the waves and are therefore the most important and often used measure of amplitude. Unless indicated otherwise, all SPLs are expressed as rms values.

2.1.3.4 Relationship between Sound Pressure Level, Relative Energy, Relative Pressure, and Pressure

Table 2-2 shows the relationship between rms SPL, relative sound energy, relative sound pressure, and pressure. Please note that SPL, relative energy, and relative pressure are based on a reference pressure of 20 µPa and by definition are all referenced to 0 dB. The pressure values are the actual rms pressure deviations from local ambient atmospheric pressure.

The most useful relationship is that of SPL (dB) and relative energy. Relative energy is unitless. Table 2-2 shows that for each 10 dB increase in SPL the acoustic energy increases tenfold (e.g., an SPL increase from 60 to 70 dB increases the energy 10 times). Acoustic energy can be thought of as the energy intensity (energy per unit area) of a certain noise source, such as a heavy truck, at a certain distance. For example, if one heavy truck passing by an observer at a given speed and distance produces an SPL of 80 A-weighted decibels (dBA), the SPL of 10 heavy trucks identical to the single truck would be 90 dBA if they all could simultaneously occupy the same space and travel at the same speed and distance from the observer.

Because SPL is computed using $10\log_{10}(P_1/P_2)^2$, the acoustic energy is related to SPL as follows:

$$(P_1/P_2)^2 = 10^{SPL/10} \qquad \textbf{(2-8)}$$

Table 2-2. Relationship between Sound Pressure Level, Relative Energy, Relative Pressure, and Sound Pressure

Sound Pressure Level (dB) $10\log_{10}\left(\frac{p_1}{p_0}\right)^2$	Relative Energy $\left(\frac{p_1}{p_0}\right)^2$	Relative Pressure $\left(\frac{p_1}{p_0}\right)$	Sound Pressure (µPa) (P_1)
200	10^{20}	10^{10}	
154			10^9 (1,000 Pa)
150	10^{15}		
140	10^{14}	10^7	
134			10^8 (100 Pa)
130	10^{13}		
120	10^{12}	10^6	
114			10^7 (10 Pa)
110	10^{11}		
100	10^{10}	10^5	
94			10^6 (1 Pa)
90	10^9		
80	10^8	10^4	
74			10^5 µPa
70	10^7		
60	10^6	10^3	
54			10^4 µPa
50	10^5		
40	10^4	10^2	

Sound Pressure Level (dB) $10\log_{10}\left(\frac{p_1}{p_0}\right)^2$	Relative Energy $\left(\frac{p_1}{p_0}\right)^2$	Relative Pressure $\left(\frac{p_1}{p_0}\right)$	Sound Pressure (μPa) (P_1)
34			10^3 μPa
30	10^3		
20	10^2	10^1	
14			10^2 μPa
10	10^1		
0	**$10^0 = 1$ = Ref.**	**$10^0 = 1$ = Ref.**	**$P_1 = P_0 = 20$** μPa

2.1.3.5 Adding, Subtracting, and Averaging Sound Pressure Levels

Because decibels are logarithmic units, SPL cannot be added or subtracted by ordinary arithmetic means. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB; they would combine to produce 73 dB. The following discussion provides additional explanation of this concept. The SPL from any source observed at a given distance from the source may be expressed as $10\log_{10}(P_1/P_0)^2$ (see Equation 2-6). Therefore, the SPL from two equal sources at the same distance would be calculated as follows:

$$SPL = 10\log_{10} [(P_1/P_0)^2+(P_1/P_0)^2] = 10\log_{10}[2(P_1/P_0)^2]$$

This can be simplified as $10\log_{10}(2) + 10\log_{10}(P_1/P_0)^2$. Because the logarithm of 2 is 0.301, and 10 times that would be 3.01, the sound of two equal sources is 3 dB more than the sound level of one source. The total SPL of the two automobiles therefore would be 70 + 3 = 73 dB.

Adding and Subtracting Equal Sound Pressure Levels

The previous example of adding the noise levels of two cars may be expanded to any number of sources. The previous section described the relationship between decibels and relative energy. The ratio $(P_1/P_0)^2$ is the relative (acoustic) energy portion of the expression SPL = $10\log_{10}(P_1/P_0)^2$, in this case the relative acoustic energy of one source. This must immediately be qualified with the statement that this is not the acoustic power output of the source. Instead, the expression is the relative acoustic energy per unit area received by the observer. It may be stated that N identical automobiles or other noise sources would yield an SPL calculated as follows:

$$SPL_{Total} = SPL_1 + 10\log_{10}(N) \qquad \textbf{(2-9)}$$

Where:

SPL_1 = SPL of one source

N = number of identical sources to be added (must be more than 0)

Example

If one noise source produces 63 dB at a given distance, what would be the noise level of 13 of the same source combined at the same distance?

Solution

$SPL_{Total} = 63 + 10\log_{10}(13) = 63 + 11.1 = 74.1$ dB

Equation 2-9 also may be rewritten as follows. This form is useful for subtracting equal SPLs:

$$SPL_1 = SPL_{Total} - 10\log_{10}(N) \qquad \textbf{(2-10)}$$

Example

The SPL of six equal sources combined is 68 dB at a given distance. What is the noise level produced by one source?

Solution

$SPL_1 = 68$ dB $- 10\log_{10}(6) = 68 - 7.8 = 60.2$ dB

In these examples, adding equal sources actually constituted multiplying one source by the number of sources. Conversely, subtracting equal sources was performed by dividing the total. For the latter, Equation 2-9 could have been written as $SPL_1 = SPL_{Total} + 10\log_{10}(1/N)$. The logarithm of a fraction yields a negative result, so the answers would have been the same.

These exercises are very useful for estimating traffic noise impacts. For example, if one were to ask what the respective SPL increases would be along a highway if existing traffic were doubled, tripled, or quadrupled (assuming traffic mix, distribution, and speeds would not change), a reasonable prediction could be made using Equation 2-9. In this case, N would be the existing traffic (N = 1); N = 2 would be doubling, N = 3 would be tripling, and N = 4 would be quadrupling the existing traffic. Because $10\log_{10}(N)$ in Equation 2-9 represents the increase in SPL, the above values for N would yield +3, +4.8, and +6 dB, respectively.

Similarly, one might ask what the SPL decrease would be if traffic were reduced by a factor of 2, 3, or 4 (i.e., N = 1/2, N = 1/3, and N = 1/4, respectively). Applying $10\log_{10}(N)$ to these values would yield -3, -5, and -6 dB, respectively.

The same problem also may arise in a different form. For example, the traffic flow on a given facility is 5,000 vehicles per hour, and the SPL is 65 dB at a given location next to the facility. One might ask what the expected SPL would be if future traffic increased to 8,000 vehicles per hour. The solution would be:

$$65 + 10\log_{10}(8{,}000/5{,}000) = 65 + 2 = 67 \text{ dB}.$$

Therefore, N may represent an integer, fraction, or ratio. However, N always must be more than 0. Taking the logarithm of 0 or a negative value is not possible.

In Equations 2-9 and 2-10, $10\log_{10}(N)$ was the increase from SPL_1 to SPL_{Total} and equals the change in noise levels from an increase or decrease in equal noise sources. Letting the change in SPLs be referred to as ΔSPL, Equations 2-9 and 2-10 can be rewritten as follows:

$$\Delta SPL = 10\log_{10}(N) \qquad \textbf{(2-11)}$$

This equation is useful for calculating the number of equal source increments (N) that must be added or subtracted to change noise levels by ΔSPL. For example, if it is known that an increase in traffic volumes increases SPL by 7 dB, the factor change in traffic (assuming that traffic mix and speeds did not change) can be calculated as follows:

$7 \text{ dB} = 10\log_{10}(N)$

$0.7 \text{ dB} = \log_{10}(N)$

$10^{0.7} = N$

$N = 5.0$

Therefore, the traffic volume increased by a factor of 5.

Adding and Subtracting Unequal Sound Pressure Levels

If noise sources are not equal or equal noise sources are at different distances, $10\log_{10}(N)$ cannot be used. Instead, SPLs must be added or subtracted individually using the SPL and relative energy relationship in Equation 2-8. If the number of SPLs to be added is N, and SPL_1, SPL_2, and SPL_n represent the first, second, and nth SPL, respectively, the addition is accomplished as follows:

$$SPL_{Total} = 10\log_{10}[10^{SPL_1/10} + 10^{SPL_2/10} + \ldots 10^{SPL_n/10}] \quad \textbf{(2-12)}$$

The above equation is the general equation for adding SPLs. The equation also may be used for subtraction (simply change “+” to “–”). However, the result between the brackets must always be more than 0. For example, determining the total SPL of 82, 75, 88, 68, and 79 dB would use Equation 2-12 as follows:

$$SPL = 10\log_{10}(10^{68/10} + 10^{75/10} + 10^{79/10} + 10^{82/10} + 10^{88/10}) = 89.6 \text{ dB}$$

Adding Sound Pressure Levels Using a Simple Table

When combining sound levels, a table such as the following may be used as an approximation.

Table 2-3. Decibel Addition

When Two Decibel Values Differ by:	Add This Amount to the Higher Value:	Example:
0 or 1 dB	3 dB	70 + 69 = 73 dB
2 or 3 dB	2 dB	74 + 71 = 76 dB
4 to 9 dB	1 dB	66 + 60 = 67 dB
10 dB or more	0 dB	65 + 55 = 65 dB

This table yields results within about 1 dB of the mathematically exact value and can be memorized easily. The table can also be used to add more than two SPLs. First, the list of values should be sorted, from lowest to highest. Then, starting with the lowest values, the first two should be combined, the result should be added to the third value, and so on until only the answer remains. For example, to determine the sum of the sound levels used in the preceding example using Table 2-3, the first step would be to rank the values from low to high: 68, 75, 79, 82, and 88 dB.

Using Table 2-3, the first two noise levels then should be added. The result then would be added to the next noise level, etc., as follows:

68 + 75 = 76,

76 + 79 = 81,

81 + 82 = 85,

85 + 88 = 90 dB

For comparison, using Equation 2-12, total SPL was 89.6 dB.

Two decibel-addition rules are important. First, when adding a noise level to an approximately equal noise level, the total noise level increases 3 dB.

For example, doubling the traffic on a highway would result in an increase of 3 dB. Conversely, reducing traffic by one half would reduce the noise level by 3 dB. Second, when two noise levels are 10 dB or more apart, the lower value does not contribute significantly (less than 0.5 dB) to the total noise level. For example, 60 + 70 dB ≈ 70 dB. This means that if a noise level measured from a source is at least 70 dB, the background noise level (without the target source) must not be more than 60 dB to avoid risking contamination.

Averaging Sound Pressure Levels

There are two ways of averaging SPLs: arithmetic averaging and energy-averaging. Arithmetic averaging is simply averaging the decibel values. For example, the arithmetic average (mean) of 60 and 70 dB is:

$$(60 + 70)/2 = 65 \text{ dB}$$

Energy averaging is averaging of the energy values. Using the previous example, the energy average (mean) of 60 and 70 dB is:

$$10\log[(10^{6.0} + 10^{7.0})/2] = 67.4 \text{ dB}$$

Please notice that the energy average is always equal to or more than the arithmetic average. It is only equal to the arithmetic average if all values are the same. Averaging the values 60, 60, 60, and 60 dB yields equal results of 60 dB in both cases. The following discussion shows some examples of when each method is appropriate.

Energy Averaging

Energy averaging is the most widely used method of averaging noise levels. Sound energy relates directly to the sound source. For example, at a given distance the sound energy from six equal noise sources is three times that of two of the same sources at that same distance. To average the number of sources and calculate the associated noise level, energy averaging should be used. Examples of applications of energy averaging are provided below.

Example 1

To determine the average noise level at a specific receiver along a highway between 6 a.m. and 7 a.m., five 1-hour measurements were taken on random days during that hour. The energy-averaged measurement results were 68, 67, 71, 70, and 71 dB. What is a good estimate of the noise level at that receiver? Because the main reason for the fluctuations in noise levels is probably the differences in source strength (vehicle mix, volumes, and speeds), energy averaging is appropriate. Therefore, the result would be: $10\log[(10^{6.8} + 10^{6.7} + 10^{7.1} + 10^{7.0} + 10^{7.1})/5] = 69.6$ dB, or 70 dB.

Example 2

Another situation is where traffic volumes substantially change during a measurement period. Noise is measured at a location along a highway. Vehicles on that highway are distributed equally, are traveling at the same speed, and are of the same type (e.g., automobiles). Such traffic characteristics would produce a near steady-state noise level. The typical procedure would be to measure the traffic noise for an hour. After 15 minutes, the traffic volume suddenly increases sharply, but speeds remain the same and the vehicles, although closer together, are still equally distributed for the remaining 45 minutes. The noise level during the first 15 minutes was 70 dB and during the last 45 minutes was 75 dB. What was the energy-averaged noise level? Because the time periods were not the same, the energy average must be time-weighted by using the following equation:

$$\text{Energy-averaged noise level} = 10\log[(15 * 10^{7.0} + 45 * 10^{7.5})/60] = 74.2 \text{ dB}$$

In this example, the time was weighted in units of minutes. This also could have been accomplished using fractions of 1 hour, as follows:

$$\text{Energy-averaged noise level} = 10\log[(0.25 * 10^{7.0} + 0.75 * 10^{7.5})/1] = 74.2 \text{ dB}$$

Arithmetic Averaging

Arithmetic averaging is used less frequently, but it is used in situations such as the following. For example, the objective is to measure the noise of a machine with great accuracy. For simplicity, assume that the machine produces a steady noise level, which is expected to be constant, each time the machine is turned on. Because accuracy is of great importance, it is chosen to take repeat measurements with different sound level meters and to calculate the average noise level. In this case, it is appropriate to calculate the arithmetic mean by adding the measured decibel values and dividing by the number of measurements. Because the same source is measured repeatedly, any measured noise fluctuations are mainly from errors inherent in the instrumentation; method of measurement; environmental conditions; and, to a certain extent, source strength. Because the errors are distributed randomly, the expected value of the measurements is the arithmetic mean.

It is also appropriate to use arithmetic means for statistical comparisons of noise levels, or hypothesis testing, whether the noise levels were obtained by energy averaging or arithmetic means. Examples of applications of arithmetic averaging are provided below.

Example 1

In this example the objective is to compare the noise levels from Compressors A and B. It is decided to take five independent noise measurements at 25 feet from each compressor. Between each measurement, the compressors will be shut off and restarted. The following data are collected:

Compressor	Measured Noise Levels (dB)	Arithmetic Average (dB)
A	75, 76, 73, 74, 75	(75+76+73+74+75)/5 = 74.6
B	77, 75, 76, 78, 75	(77+75+76+78+75)/5 = 76.2

In addition, the hypothesis that Compressors A and B emit the same noise can be tested by calculating the standard deviations and using appropriate statistical tests assuming a certain level of significance. However, this is not the subject of discussion in this case.

Example 2

Residents A and B live next to the same highway. Resident A complains about the noise at night, while Resident B does not. One wishes to determine whether the nighttime noise level is higher at Residence A than Residence B. Four hours at night are randomly selected, and simultaneous energy-averaged noise measurements are taken at Residences A and B during the 4 hours. The measurement results are:

Hour	Residence A (dB)	Residence B (dB)
1	65	62
2	62	58
3	63	59
4	66	63
Arithmetic mean	64.0	60.5

The goal is a statistical comparison of noise levels at Residences A and B for the same randomly selected time periods, as well as the same traffic and environmental conditions. Although the 1-hour noise levels represent energy averages for each hour, arithmetic means should be calculated for the statistical comparison, as shown in the preceding measurement results.

The hypothesis that noise levels at Residence A equal noise levels at Residence B can be tested using the standard deviations, as well as the appropriate tests and significance levels. Please note, however, that statistical significance has no relationship to human significance. In this example, the noise level at Residence A is probably significantly higher statistically than at Residence B. In terms of human perception, however, the difference may be barely perceptible.

A good rule to remember is that whenever measurements or calculations must relate to the number of sources or source strength, energy averaging should be used. However, if improving accuracy in measurements or calculations of the same events or making statistical comparisons is the goal, the arithmetic mean is appropriate. Additional details about averaging and time-weighting are addressed in Section 2.2.2.

2.1.3.6 A-Weighting and Noise Levels

SPL alone is not a reliable indicator of loudness. Frequency or pitch also has a substantial effect on how humans respond. While the intensity (energy per unit area) of the sound is a purely physical quantity, loudness or human response depends on the characteristics of the human ear.

Human hearing is limited not only to the range of audible frequencies, but also in the way it perceives the SPL in that range. In general, the healthy human ear is most sensitive to sounds between 1,000 and 5,000 Hz and perceives both higher and lower frequency sounds of the same magnitude with less intensity. To approximate the frequency response of the human ear, a series of SPL adjustments is usually applied to the sound measured by a sound level meter. The adjustments, or weighting network, are frequency-dependent.

The A-scale approximates the frequency response of the average young ear when listening to most everyday sounds. When people make relative judgments of the loudness or annoyance of a sound, their judgments correlate well with the A-scale sound levels of those sounds. There are other weighting networks that have been devised to address high noise levels or other special problems (e.g., B-, C-, D-scales), but these scales rarely, if ever, are used in conjunction with highway traffic noise. Noise levels for traffic noise reports should be reported as dBA. In environmental noise studies, A-weighted SPLs commonly are referred to as noise levels.

Figure 2-4 shows the A-scale weighting network that is normally used to approximate human response. The 0-dB line represents a reference line; the curve represents frequency-dependent attenuations provided by the ear's response. Table 2-4 shows the standardized values (American National Standards Institute 1983). The use of this weighting network is signified by appending an "A" to the SPL as dBA or dB(A).

The A-weighted curve was developed from averaging the statistics of many psychoacoustic tests involving large groups of people with normal hearing in the age group of 18 to 25 years. The internationally standardized curve is used worldwide to address environmental noise and is incorporated in virtually all environmental noise descriptors and standards. Section 2.2.2 addresses the most common descriptors applicable to transportation noise.

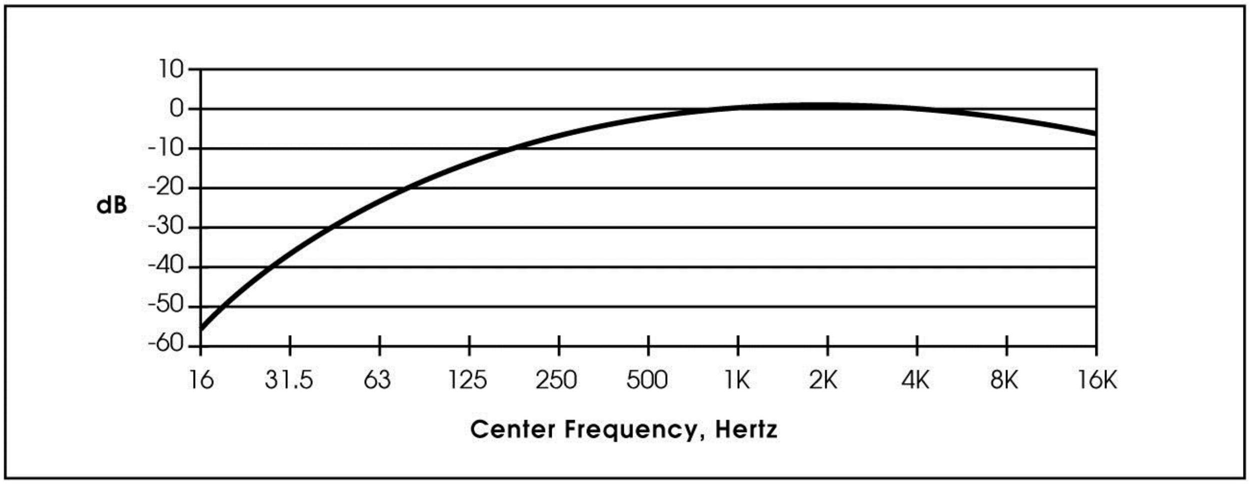


Figure 2-4. A-Weighting Network

Table 2-4. A-Weighting Adjustments for One-Third-Octave Center Frequencies

Frequency (Hz)	A-Weighting (dB)	Frequency (Hz)	A-Weighting (dB)	Frequency (Hz)	A-Weighting (dB)	Frequency (Hz)	A-Weighting (dB)
16	-56.7	100	-19.1	630	-1.9	4,000	+1.0
20	-50.5	125	-16.1	800	-0.8	5,000	+0.5
25	-44.7	160	-13.4	1,000	0	6,300	-0.1
31.5	-39.4	200	-10.9	1,250	+0.6	8,000	-1.1
40	-34.6	250	-8.6	1,600	+1.0	10,000	-2.5
50	-30.6	315	-6.6	2,000	+1.2	12,500	-4.3
63	-26.2	400	-4.8	2,500	+1.3	16,000	-6.6
80	-22.5	500	-3.2	3,150	+1.2	20,000	-9.3

Source: American National Standards Institute 1983.

Sound level meters used for measuring environmental noise have an A-weighting network built in for measuring A-weighted sound levels. This is accomplished through electronic filters, also called band pass filters. Each filter allows the passage of a selected range (band) of frequencies only and attenuates its SPL to modify the frequency response of the sound level meter to about that of the A-weighted curve and the human ear.

A range of noise levels associated with common indoor and outdoor activities is shown in Table 2-5. The decibel scale is open-ended. As discussed, 0 dB or 0 dBA should not be construed as the absence of sound. Instead, it is the generally accepted threshold of the best human hearing. SPLs in negative decibel ranges are inaudible to humans. On the other extreme, the decibel scale can go much higher than shown in Table 2-5. For example, gunshots, explosions, and rocket engines can reach 140 dBA or higher at close range. Noise levels approaching 140 dBA are nearing the threshold of pain. Higher levels can inflict physical damage on such things as structural members of air and spacecraft and related parts. Section 2.2.1.1 discusses the human response to changes in noise levels.

Table 2-5. Typical Noise Levels

Common Outdoor Activities	Noise Level (dBA)	**Common Indoor Activities**
	110	Rock band
Jet flyover at 1,000 feet		
	100	
Gas lawnmower at 3 feet		
	90	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower, 100 feet	**70**	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	**60**	
		Large business office
Quiet urban daytime	**50**	Dishwasher in next room
Quiet urban nighttime	**40**	Theater, large conference room (background)
Quiet suburban nighttime		
	30	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20	
		Broadcast/recording studio
	10	
	0	

2.1.3.7 Octave and One-Third-Octave Bands and Frequency Spectra

Very few sounds are pure tones (i.e., consisting of a single frequency). To represent the complete characteristics of a sound properly, it is necessary to divide the total sound into its frequency components (i.e., determine how much sound [SPL] comes from each of the multiple frequencies that make up the sound). This representation of frequency vs. SPL is called a frequency spectrum. Spectra usually consist of 8- to 10-octave bands, more or less spanning the frequency range of human hearing (20 to 20,000 Hz). Just as with a piano keyboard, an octave represents the frequency interval between a given frequency and twice that frequency. Octave bands are internationally standardized and identified by their "center frequencies" (geometric means).

Because octave bands are rather broad, they are frequently subdivided into thirds to create one-third-octave bands. These are also standardized. For convenience, one-third-octave bands are sometimes numbered from 1 (1.25-Hz one-third-octave center frequency, which cannot be heard by humans) to 43 (20,000-Hz one-third-octave center frequency). Within the extreme range of human hearing there are 30 one-third-octave bands ranging from band 13 (20-Hz one-third-octave center frequency) to band 42 (16,000-Hz one-third-octave center frequency). Table 2-6 shows the ranges of the standardized octave and one-third-octave bands, as well as band numbers.

Frequency spectra are used in many aspects of sound analysis, from studying sound propagation to designing effective noise control measures. Sound is affected by many frequency-dependent physical and environmental factors. Atmospheric conditions, site characteristics, and materials and their dimensions used for sound reduction are some of the most important examples.

Sound propagating through the air is affected by air temperature, humidity, wind and temperature gradients, vicinity and type of ground surface, obstacles, and terrain features. These factors are all frequency-dependent.

The ability of a material to transmit noise depends on the type of material (concrete, wood, glass, etc.) and its thickness. Effectiveness of different materials at transmitting noise depends on the frequency of the noise. See Section 5.1.1 for a discussion of transmission loss and sound transmission class.

Wavelengths serve to determine the effectiveness of noise barriers. Low frequency noise, with its long wavelengths, passes easily around and over a noise barrier with little loss in intensity. For example, a 16-Hz noise with a wavelength of 70 feet will tend to pass over a 16-foot-high noise barrier. Fortunately, A-weighted traffic noise tends to dominate in the 250- to 2,000-Hz range with wavelengths in the range of about 0.6 to 4.5 feet. As discussed later, noise barriers are less effective at lower frequencies and more effective at higher ones.

Table 2-6. Standardized Band Numbers, Center Frequencies, One-Third-Octave and Octave Bands, and Octave Band Ranges

Band	Center Frequency (Hz)	One-Third-Octave Band Range (Hz)	Octave Band Range (Hz)
12	**16**	14.1–17.8	**11.2–22.4**
13	20	17.8–22.4	
14	25	22.4–28.2	
15	**31.5**	28.2–35.5	**22.4–44.7**
16	40	35.5–44.7	
17	50	44.7–56.2	
18	**63**	56.2–70.8	**44.7–89.1**
19	80	70.8–89.1	
20	100	89.1–112	
21	**125**	112–141	**89.1–178**
22	160	141–178	
23	200	178–224	
24	**250**	224–282	**178–355**
25	315	282–355	
26	400	355–447	
27	**500**	447–562	**355–708**
28	630	562–708	
29	800	708–891	
30	**1,000**	891–1,120	**708–1,410**
31	1,250	1,120–1,410	
32	1,600	1,410–1,780	
33	**2,000**	1,780–2,240	**1,410–2,820**
34	2,500	2,240–2,820	
35	3,150	2,820–3,550	
36	**4,000**	3,550–4,470	**2,820–5,620**
37	5,000	4,470–5,620	
38	6,300	5,620–7,080	
39	**8,000**	7,080–8,910	**5,620–11,200**
40	10,000	8,910–11,200	
41	12,500	11,200–14,100	
42	**16,000**	14,100–17,800	**11,200–22,400**

Band	Center Frequency (Hz)	One-Third-Octave Band Range (Hz)	Octave Band Range (Hz)
43	20,000	17,800–22,400	
Source: Harris 1979.			

Figure 2-5 shows a conventional graphical representation of a typical octave-band frequency spectrum. The octave bands are depicted as having the same width, although each successive band should increase by a factor of 2 when expressed linearly in terms of 1-Hz increments.

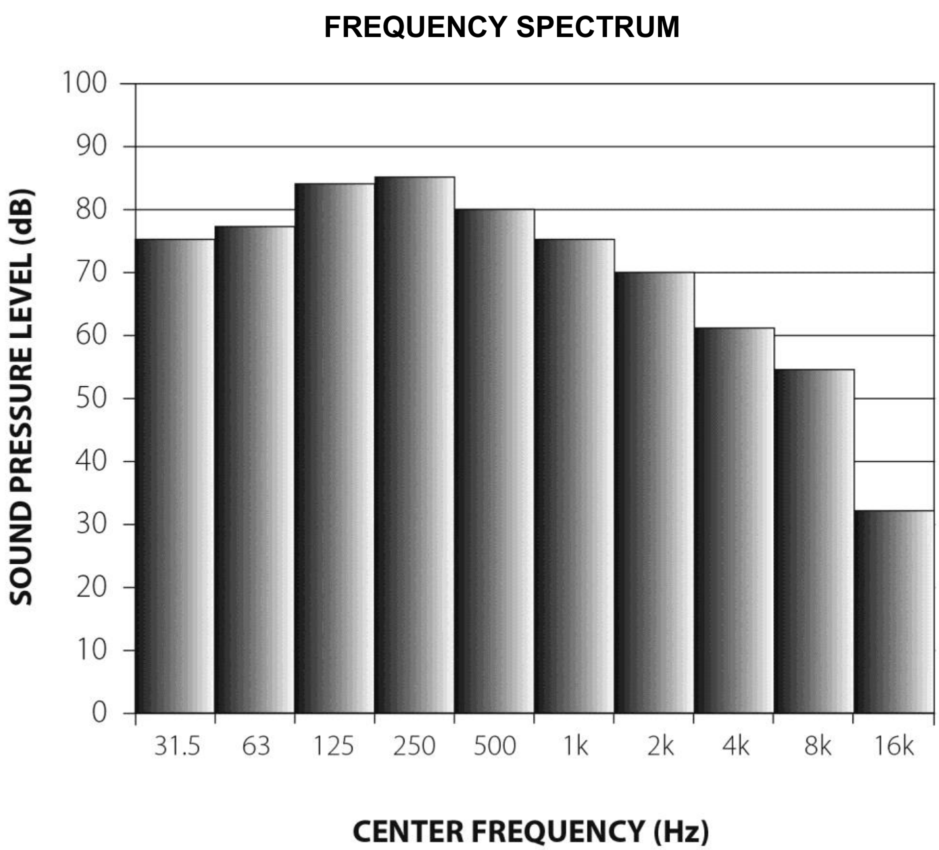


Figure 2-5. Typical Octave Band Frequency Spectrum

A frequency spectrum can also be presented in tabular form. For example, the data used to generate Figure 2-5 is illustrated in tabular form in Table 2-7.

Table 2-7. Tabular Form of Octave Band Spectrum

Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)
31.5	75
63	77
125	84
250	85
500	80
1,000	75
2,000	70
4,000	61
8,000	54
16,000	32
Total sound pressure level = 89 dB	

Often, one is interested in the total noise level, or the summation of all octave bands. Using the data shown in Table 2-8, one may simply add all the SPLs, as was explained in Section 2.1.3.5. The total noise level for the above octave band frequency spectrum is 89 dB.

The same sorts of charts and tables can be compiled from one-third-octave band information. For example, if more detailed one-third-octave information for the above spectrum is available, a one-third-octave band spectrum could be constructed as shown in Figure 2-6 and Table 2-8. Note that the total noise level does not change, and that each subdivision of three one-third-octave bands adds up to the total octave band shown in the previous example.

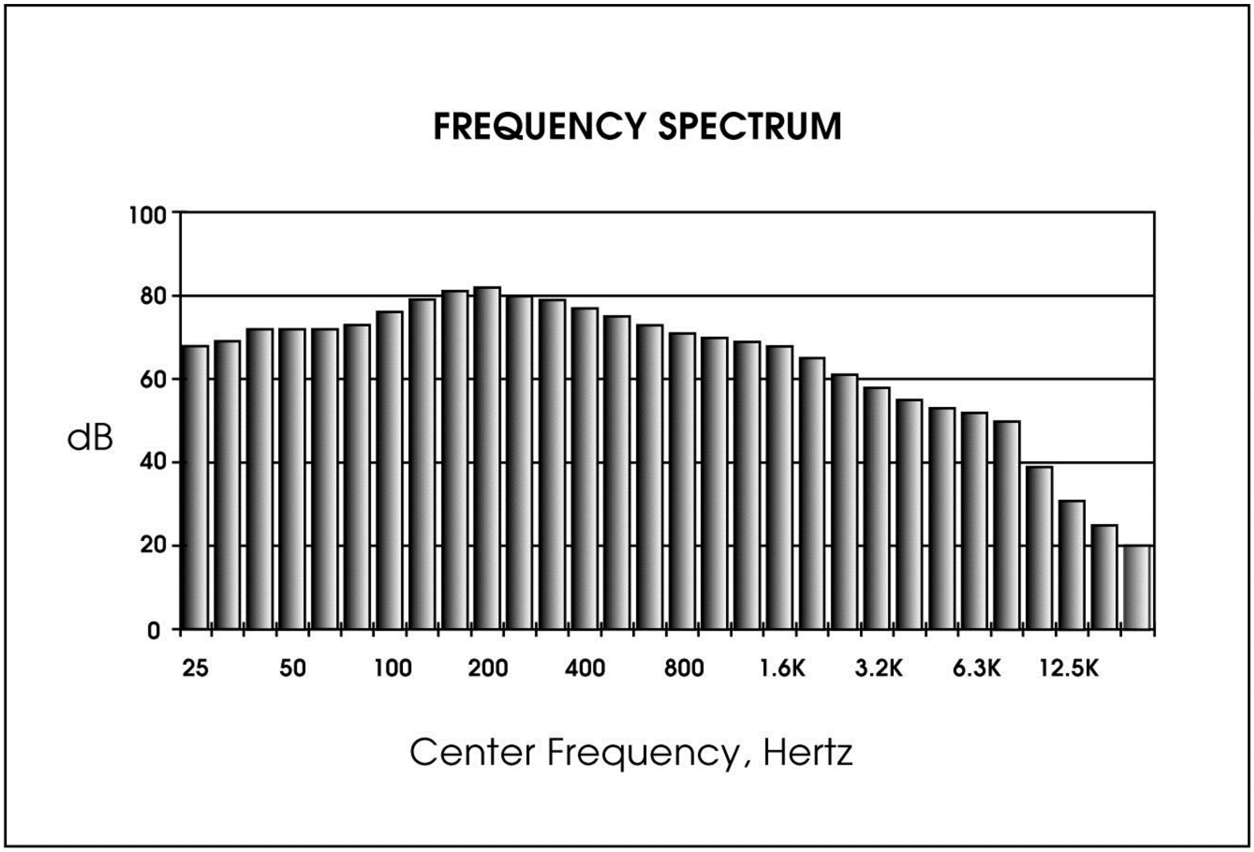


Figure 2-6. Typical One-Third-Octave Band Frequency Spectrum

Frequency spectrums are usually expressed in linear, unweighted SPLs (dB). However, they may also be A-weighted by applying the adjustments from Table 2-4. For example, the data in Table 2-8 can be A-weighted (rounded to nearest dB) as shown in Table 2-9.

Table 2-8. Tabular Form of One-Third Octave Band Spectrum

One-Third-Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)	One-Third-Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)	One-Third-Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)
25	68	**250**	80	2,500	61
31.5	69	315	79	3,200	58
40	72	400	77	**4,000**	55
50	72	**500**	75	5,000	53
63	72	630	73	6,300	52
80	73	800	71	**8,000**	50
100	76	**1,000**	70	10,000	39
125	79	1,250	69	12,500	31
160	81	1,600	68	**16,000**	25

One-Third-Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)	One-Third-Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)	One-Third-Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)
200	82	**2,000**	65	20,000	20
Total sound pressure level = 89 dB					

Table 2-9. Adjusting Linear Octave Band Spectrum to A-Weighted Spectrum

Octave Band Center Frequency (Hz)	Sound Pressure Level (dBA)
31.5	75 – 39 = 36
63	77 – 26 = 51
125	84 – 16 = 68
250	85 – 9 = 76
500	80 – 3 = 77
1,000	75 – 0 = 75
2,000	70 + 1 = 71
4,000	61 + 1 = 62
8,000	54 – 1 = 53
16,000	32 – 7 = 25
Total sound pressure level = 89 dB (linear) and 81.5 dBA	

The total A-weighted noise level is 81.5 dBA, compared with the linear noise level of 89 dB. In other words, the original linear frequency spectrum with a total noise level of 89 dB is perceived as a total A-weighted noise level of 81.5 dBA.

A linear noise level of 89 dB with a different frequency spectrum distribution, could have produced a different A-weighted noise level, either higher or lower. The reverse may also be true. Theoretically, an infinite number of frequency spectrums could produce either the same total linear noise level or the same A-weighted spectrum. This is an important concept because it can help explain a variety of phenomena dealing with noise perception. For example, some evidence suggests that changes in frequencies are sometimes perceived as changes in noise levels, although the total A-weighted noise levels do not change significantly. Section 7 addresses with some of these phenomena.

2.1.3.8 White and Pink Noise

White noise is noise with a special frequency spectrum that has the same amplitude (level) for each frequency interval over the entire audible frequency spectrum. It is often generated in laboratories for calibrating sound level measuring equipment, specifically its frequency response. One might expect that the octave or one-third-octave band spectrum of white noise would be a straight line, but this is not true. Beginning with the lowest audible octave, each subsequent octave spans twice as many frequencies than the previous ones, and therefore contains twice the energy. This corresponds with a 3-dB step increase for each octave band, and 1 dB for each one-third-octave band.

Pink noise, in contrast, is defined as having the same amplitude for each octave band (or one-third-octave band), rather than for each frequency interval. Its octave or one-third-octave band spectrum is truly a straight "level" line over the entire audible spectrum. Therefore, pink noise generators are conveniently used to calibrate octave or one-third-octave band analyzers.

Both white and pink noise sound somewhat like the static heard from a radio that is not tuned to a particular station.

2.1.4 Sound Propagation

From the source to receiver, noise changes both in level and frequency spectrum. The most obvious is the decrease in noise as the distance from the source increases. The manner in which noise reduces with distance depends on the following important factors.

- Geometric spreading from point and line sources.
- Ground absorption.
- Atmospheric effects and refraction.
- Shielding by natural and manmade features, noise barriers, diffraction, and reflection.

2.1.4.1 Geometric Spreading from Point and Line Sources

Sound from a small localized source (approximating a point source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level attenuates or drops off at a rate of

6 dBA for each doubling of the distance (6 dBA/DD). This decrease, resulting from the geometric spreading of the energy over an ever-increasing area, is referred to as the inverse square law. Doubling the distance increases each unit area, represented by squares with sides "a" in Figure 2-7, from a^2 to $4a^2$.

Because the same amount of energy passes through both squares, the energy per unit area at 2D is reduced four times from that at distance D. Therefore, for a point source the energy per unit area is inversely proportional to the square of the distance. Taking $10\log_{10}(1/4)$ results in a 6-dBA/DD reduction. This is the point source attenuation rate for geometric spreading.

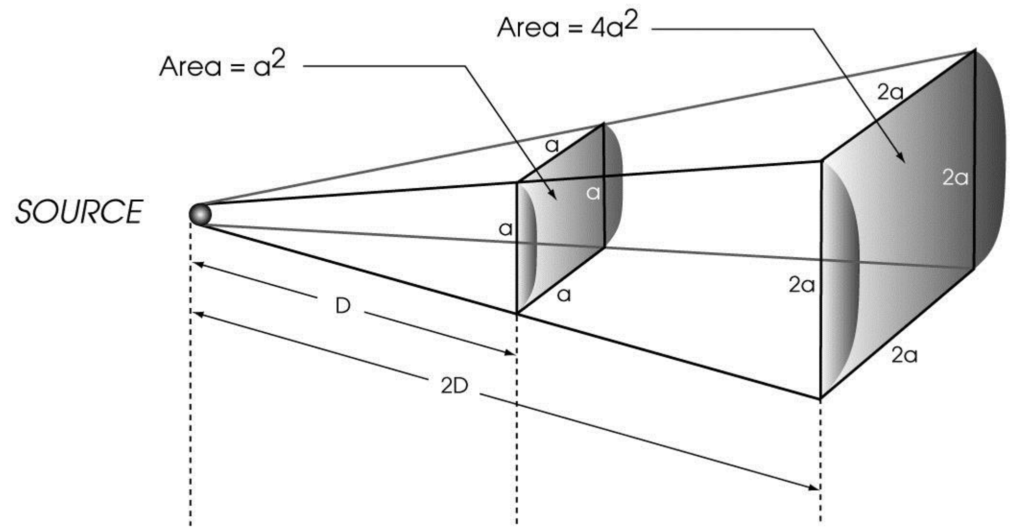


Figure 2-7. Point Source Propagation (Spherical Spreading)

As seen in Figure 2-8, based on the inverse square law the change in noise level between any two distances because of spherical spreading can be found using the following equation:

$$dBA_2 = dBA_1 + 10\log_{10}[(D_1/D_2)]^2 = dBA_1 + 20\log_{10}(D_1/D_2) \qquad \textbf{(2-13)}$$

Where:

dBA_1 = noise level at distance D_1

dBA_2 = noise level at distance D_2

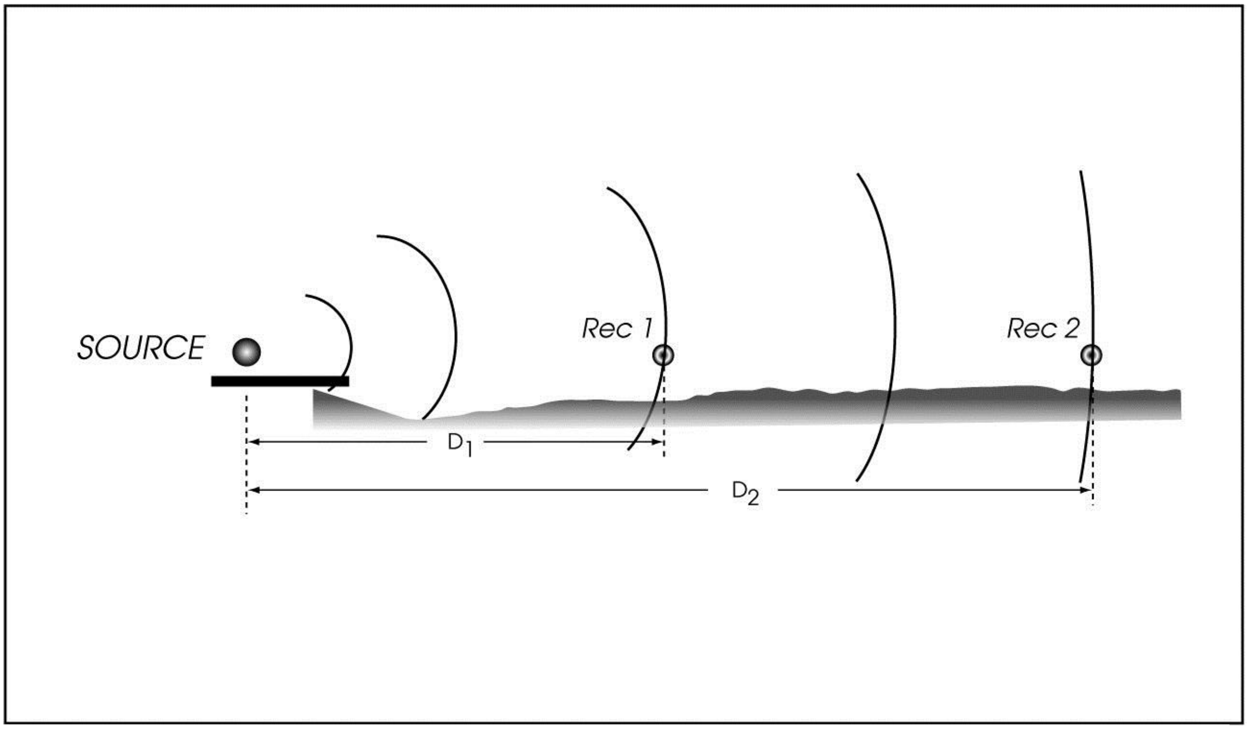


Figure 2-8. Change in Noise Level with Distance from Spherical Spreading

However, highway traffic noise is not a single, stationary point source. The movement of the vehicles makes the source of the sound appear to emanate from a line (line source) rather than a point when viewed over a time interval (Figure 2-9). This results in cylindrical spreading rather than spherical spreading. Because the change in surface area of a cylinder only increases by two times for each doubling of the radius instead of the four times associated with spheres, the change in sound level is 3 dBA/DD. The change in noise levels for a line source at any two different distances from cylindrical spreading is determined using the following equation:

$$dBA_2 = dBA_1 + 10\log_{10} (D_1/D_2) \qquad \textbf{(2-14)}$$

Where:

dBA_1 = noise level at distance D_1 and conventionally the known noise level

dBA_2 = noise level at distance D_2 and conventionally the unknown noise level

Note

The expression $10\log_{10}(D_1/D_2)$ is negative when D_2 is more than D_1 and positive when D_1 is more than D_2. Therefore, the equation automatically accounts for the receiver being farther or closer with respect to the source—$\log_{10}$ of a number less than 1 gives a negative result, $\log_{10}$ of a number more than 1 is positive, and $\log_{10}(1) = 0$.

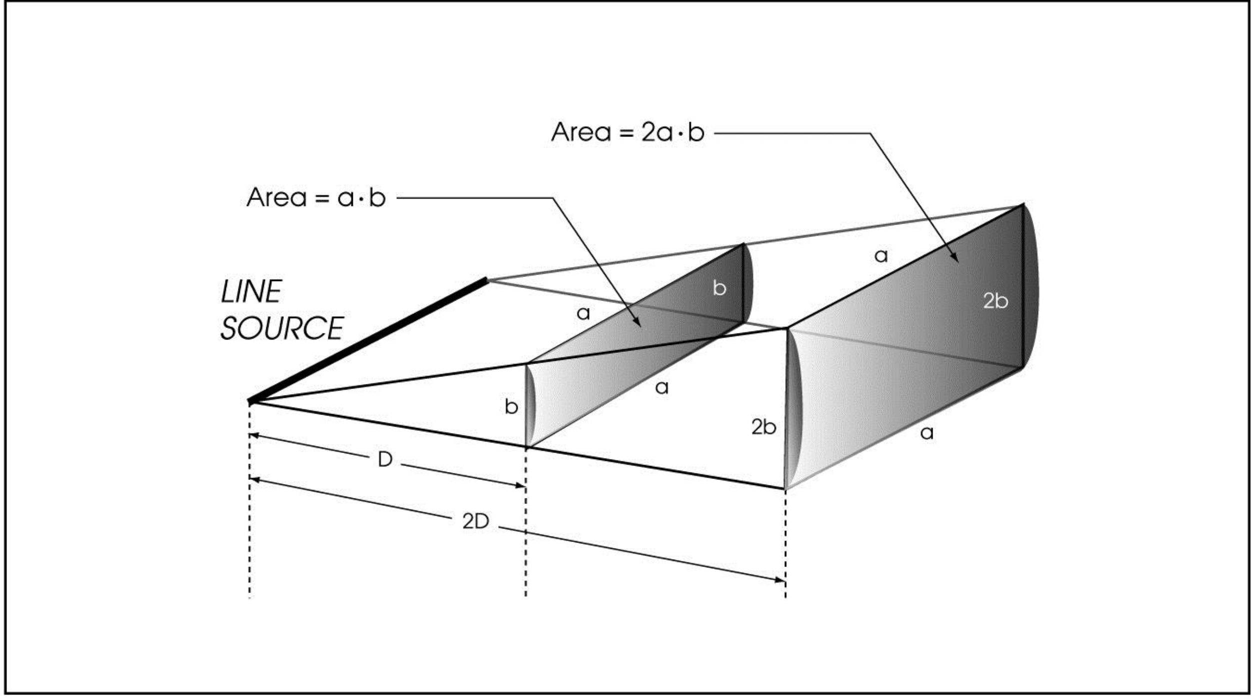


Figure 2-9. Line Source Propagation (Cylindrical Spreading)

2.1.4.2 Ground Absorption

Most often, the noise path between the highway and observer is very close to the ground. Noise attenuation from ground absorption and reflective wave cancellation adds to the attenuation from geometric spreading. Traditionally, this excess attenuation has been expressed in terms of decibels of attenuation per doubling of distance. This approximation is done for simplification only; for distances of less than 200 feet, the prediction results based on this scheme are sufficiently accurate. The sum of the geometric spreading attenuation and excess ground attenuation (if any) is referred to as the attenuation or dropoff rate. For distances of 200 feet or more, the approximation causes excessive inaccuracies in predictions. The amount of excess ground attenuation depends on the height of the noise path and characteristics of the intervening ground or site. In practice, excess ground attenuation may vary from 0 to 8–10 dBA/DD or more. In fact, it varies as the noise path height changes from the source to receiver and with vehicle type because the source heights are different. The complexity of terrain also influences the propagation of sound by potentially increasing the number of ground reflections.

The FHWA TNM is the model that is currently approved by FHWA for use in noise impact studies. The TNM has complex algorithms that directly calculate excess ground attenuation based on ground type and site geometry.

2.1.4.3 Atmospheric Effects and Refraction

Research by Caltrans and others has shown that atmospheric conditions can have a profound effect on noise levels within 200 feet of a highway. Wind has shown to be the most important meteorological factor within approximately 500 feet, while vertical air temperature gradients are more important over longer distances. Other factors such as air temperature, humidity, and turbulence also have significant effects.

Wind

The effects of wind on noise are mostly confined to noise paths close to the ground because of the wind shear phenomenon. Wind shear is caused by the slowing of wind in the vicinity of a ground plane because of surface friction. As the surface roughness of the ground increases, so does the friction between the ground and the air moving over it. As the wind slows with decreasing heights, it creates a sound velocity gradient (because of differential movement of the medium) with respect to the ground. This velocity gradient tends to bend sound waves downward in the same direction of the wind and upward in the opposite direction. The process, called refraction, creates a noise shadow (reduction) upwind of the source and a noise concentration (increase) downwind of the source. Figure 2-10 shows the effects of wind on noise. Wind effects on noise levels along a highway depend very much on wind angle, receiver distance, and site characteristics. A 6-mph cross wind can increase noise levels at 250 feet by about 3 dBA downwind and reduce noise by about the same amount upwind. Present policies and standards ignore the effects of wind on noise levels. Unless wind conditions are specifically identified, noise levels are always assumed to be for zero wind. Noise analyses are also always made for zero-wind conditions.

Wind also has another effect on noise measurements. Wind “rumble” caused by air movement over a microphone of a sound level meter can contaminate noise measurements even if a wind screen is placed over the microphone.

Limited measurements performed by Caltrans in 1987 showed that wind speeds of about 11 mph produce noise levels of about 45 dBA, using a ½-inch microphone with a wind screen. This means that noise measurements below 55 dBA are contaminated by wind speeds of 11 mph or more. A noise level of 55 dBA is about at the low end of the range of noise levels routinely measured near highways for noise analysis. FHWA’s *Measurement of Highway-Related Noise* (1996) recommends that highway noise measurements should not be made at wind speeds above 12 mph. An 11 mph criterion for maximum allowable wind speed for routine highway noise measurements seems reasonable and is therefore recommended. More information concerning wind/microphone contamination is provided in Section 3.

Wind Turbulence

Turbulence also has a scattering effect on noise levels, which is difficult to predict. It appears, however, that turbulence has the greatest effect on noise levels in the vicinity of the source.

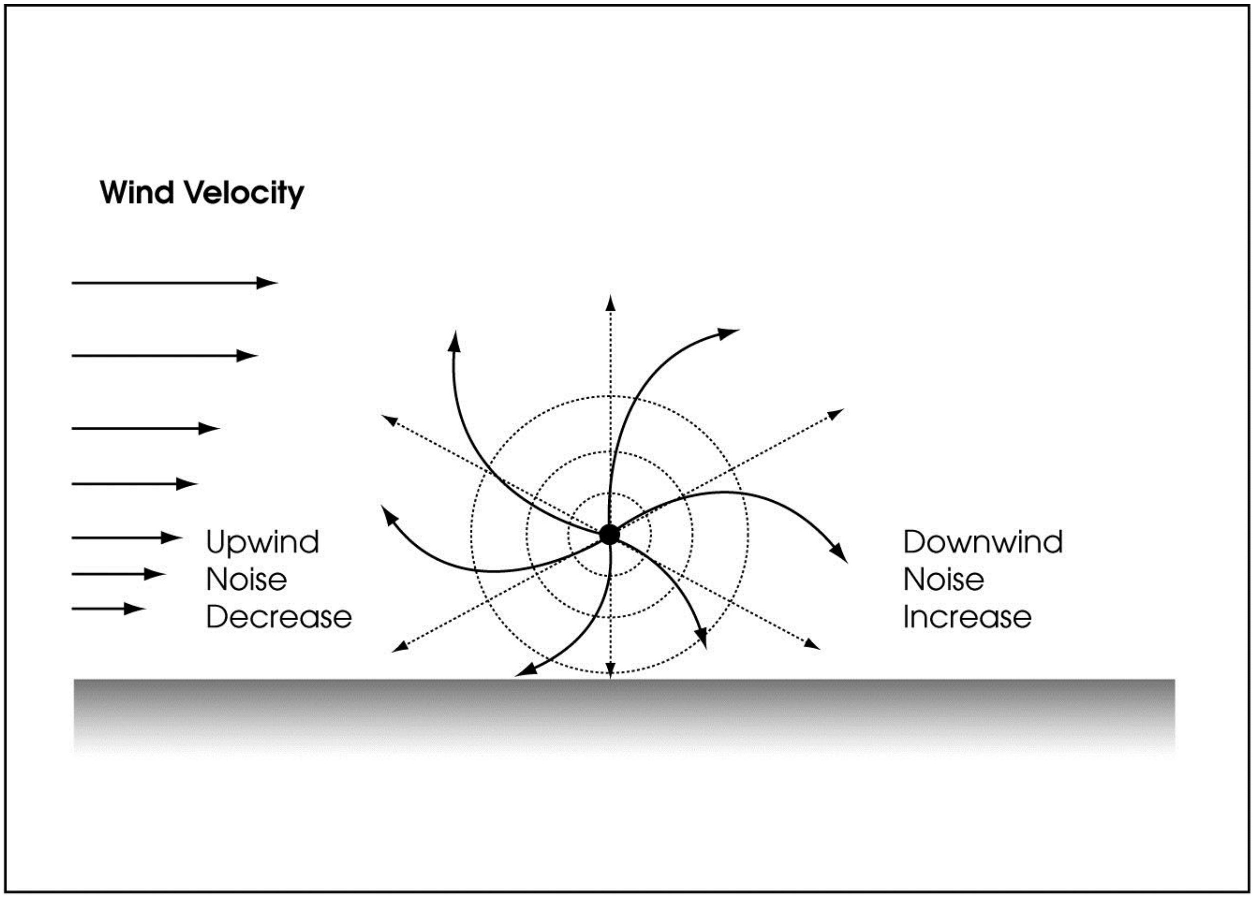


Figure 2-10. Wind Effects on Noise Levels

Temperature Gradients

Figure 2-11 shows the effects of temperature gradients on noise levels. Normally, air temperature decreases with height above the ground. This is called the normal lapse rate, which for dry air is about -5.5ºF per 1,000 feet. Because the speed of sound decreases as air temperature decreases, the resulting temperature gradient creates a sound velocity gradient with height. Slower speeds of sound higher above the ground tend to refract sound waves upward in the same manner as wind shear upwind from the source. The result is a decrease in noise. Under certain stable atmospheric conditions temperature profiles can become inverted (i.e., temperatures increase with height either from the ground up or at some altitude above the ground). This inversion results in speeds of sound that temporarily increase with altitude, causing noise refraction similar to that caused by wind shear downwind from a noise source. Also, once trapped within an elevated inversion layer, noise may be carried over long distances. Both ground and elevated temperature inversions have the effect of propagating noise with less than the usual attenuation rates and therefore increase noise. The effects of vertical temperature gradients are more important over longer distances.

Temperature and Humidity

Molecular absorption in air also reduces noise levels with distance. Although this process only accounts for about 1 dBA per 1,000 feet under average conditions of traffic noise in California, the process can cause significant longer-range effects. Air temperature and humidity affect molecular absorption differently depending on the frequency spectrum and can vary significantly over long distances in a complex manner.

Rain

Wet pavement results in an increase in tire noise and corresponding increase in frequencies of noise at the source. Wet pavement may increase vehicle noise emission levels relative to dry conditions in the range of 0 to 15 dBA (Sandberg and Ejsmont 2002). Because the propagation of noise is frequency-dependent, rain may also affect distance attenuation rates. However, traffic generally slows down during rain, decreasing noise levels and lowering frequencies. When wet, pavement types interact differently with tires than when they are dry. These factors make it very difficult to predict noise levels during rain. Therefore, no noise measurements or predictions should be made under rainy conditions. Noise abatement criteria (NAC) and standards in the FHWA noise regulation (23 CFR 772) are based on completely dry pavement.

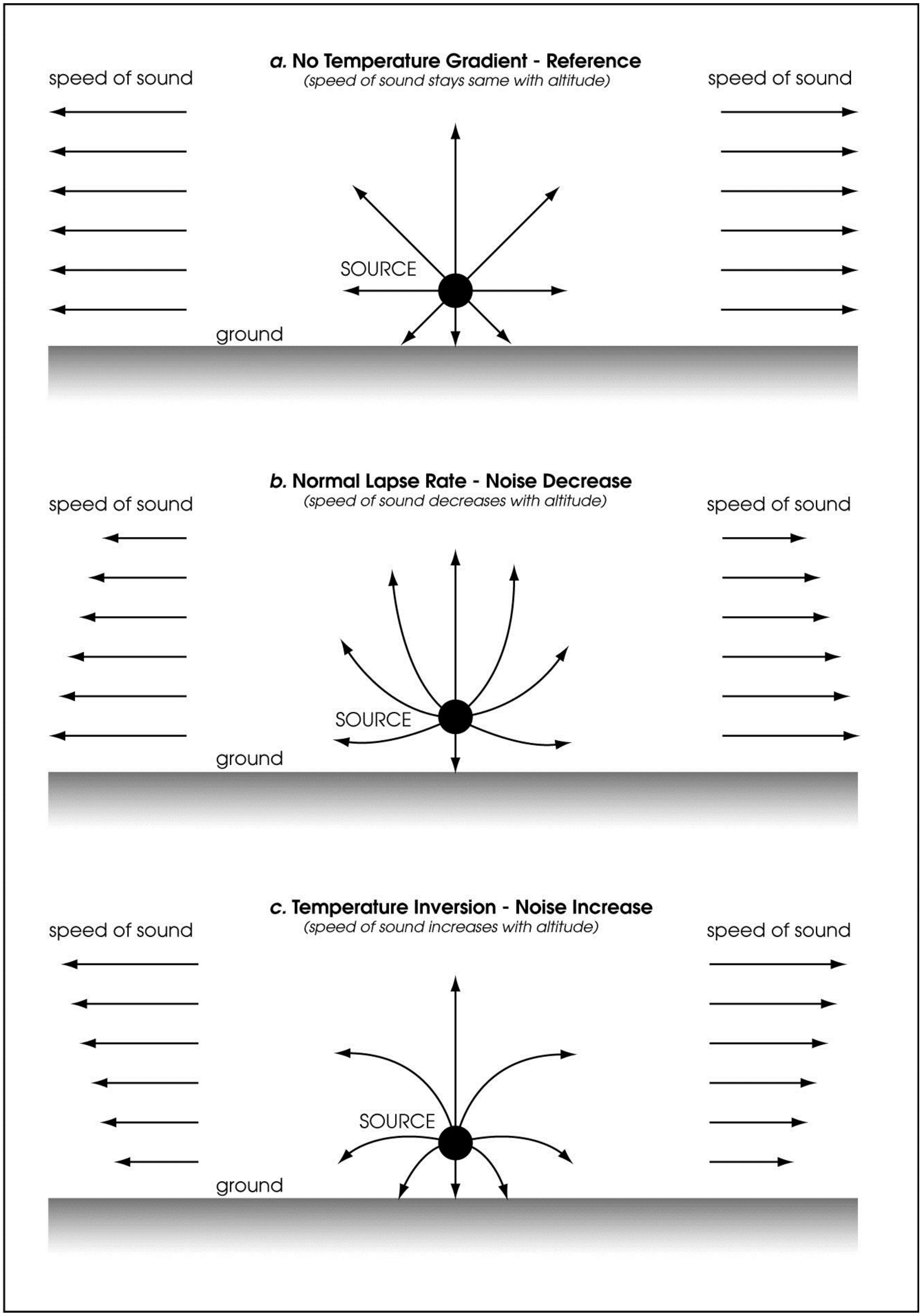


Figure 2-11. Effects of Temperature Gradients on Noise

2.1.4.4 Shielding by Natural and Manmade Features, Noise Barriers, Diffraction, and Reflection

A large object in the path between a noise source and receiver can significantly attenuate noise levels at the receiver. The amount of attenuation provided by this shielding depends on the size of the object and frequencies of the noise levels. Natural terrain features such as hills and manmade features, such as buildings and walls, can significantly alter noise levels. Walls are often used specifically to reduce noise.

Trees and Vegetation

It is uncommon for trees and vegetation to result in a noticeable reduction in noise. A vegetative strip must be very dense and wide for there to be any meaningful shielding effect. A heavily vegetated ground surface may increase ground absorption which can increase attenuation over distance.

Landscaping

Caltrans research (California Department of Transportation 1995) has shown that ordinary landscaping along a highway accounts for less than 1 dBA of reduction. Claims of increases in noise from removal of vegetation along highways are mostly spurred by the sudden visibility of the traffic source. There is evidence of a psychological effect ("out of sight, out of mind") of vegetation on noise.

Buildings

Depending on site geometry, the first row of houses or buildings next to a highway may shield the successive rows. This often occurs where the facility is at-grade or depressed. The amount of noise reduction varies with building sizes, spacing of buildings, and site geometry. Generally, for an at-grade facility in an average residential area where the first row houses cover at least 40% of total area (i.e., no more than 60% spacing), the reduction provided by the first row is reasonably assumed to be 3 dBA, with 1.5 dBA for each additional row. For example, one may expect a 3-dBA noise reduction behind the first row, 4.5 dBA behind the second row, and 6 dBA behind the third row. For houses or buildings spaced tightly (covering about 65% to 90% of the area, with 10% to 35% open space), the first row provides about 5 dBA of reduction. Successive rows still reduce noise by 1.5 dBA per row. However, for the reason discussed in the preceding discussion, the limit is 10 dBA. For these assumptions to be true the first row of houses or buildings must be equal to or higher than the second row, which should be equal to or higher than the third row, etc.

Noise Barriers

Although any natural or manmade feature between source and receiver that reduces noise is technically a noise barrier, the term is generally reserved for a wall or berm specifically constructed for noise reduction. The acoustical design of noise barriers is addressed in Section 5. However, it is appropriate at this time to introduce the acoustical concepts associated with noise barriers. These principles apply loosely to any obstacle between the source and receiver.

As shown in Figure 2-12, when a noise barrier is inserted between a noise source and receiver, the direct noise path along the line of sight between the two is interrupted. Some of the acoustical energy will be transmitted through the barrier material and continue to the source, although at a reduced level. The amount of this reduction depends on the material's mass and rigidity, and is called the transmission loss (TL), which is expressed in decibels. Its mathematical expression is:

$$TL = 10\log_{10}(E_f/E_b) \quad \textbf{(2-15)}$$

Where:

E_f = relative noise energy immediately in front of barrier (source side)

E_b = relative noise energy immediately behind barrier (receiver side)

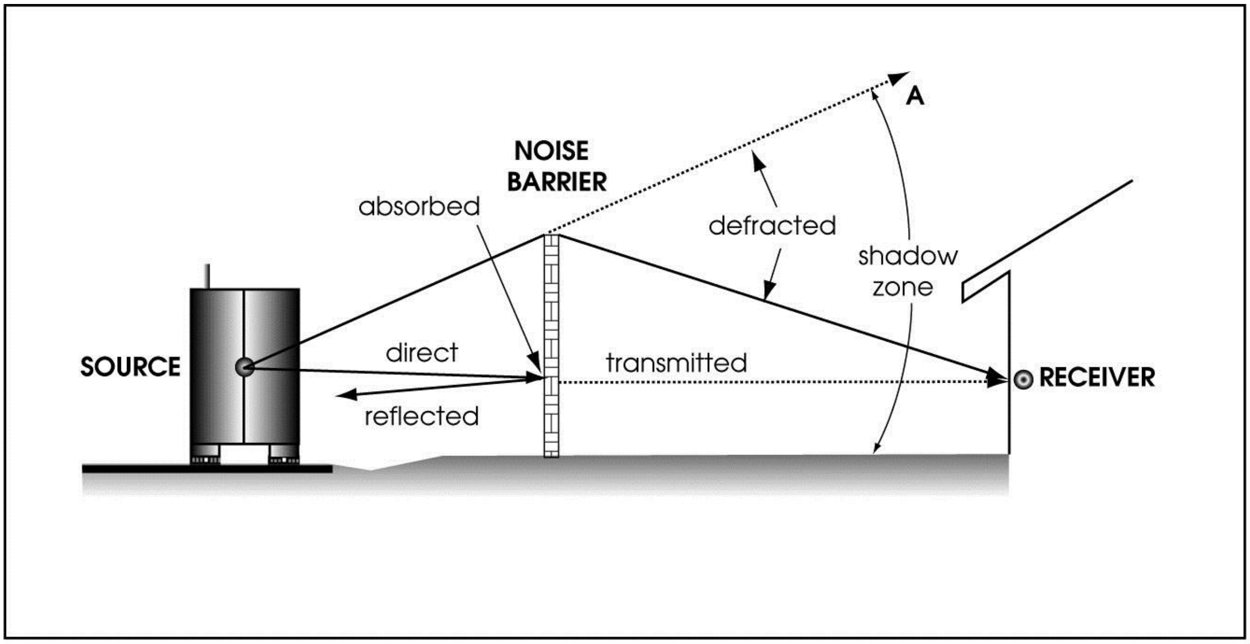


Figure 2-12. Alteration of Sound Paths after Inserting a Noise Barrier between Source and Receiver

Please note that E_f and E_b are relative energies (i.e., energies with reference to the energy of 0 dB [Section 2.1.3.4]). As relative energies, they may be expressed as any ratio (fractional or percentage) that represents their relationship. For example, if 1% of the noise energy striking a barrier is transmitted, TL = $10\log_{10}(100/1)$ = 20 dBA. Most noise barriers have TLs of 30 dBA or more. This means that only 0.1% of the noise energy is transmitted.

The remaining direct noise (usually close to 100%) is either partially or entirely absorbed by the noise barrier material (if sound absorptive) and/or partially or entirely reflected by it (if sound reflective). Whether the barrier is reflective or absorptive depends on its ability to absorb sound energy. A smooth, hard barrier surface, such as masonry or concrete, is considered almost perfectly reflective (i.e., almost all sound striking the barrier is reflected back toward the source and beyond). A barrier surface material that is porous, with many voids, is said to be absorptive (i.e., little or no sound is reflected back). The amount of energy absorbed by a barrier surface material is expressed as an absorption coefficient α, which has a value ranging from 0 (100% reflective) to 1 (100% absorptive). A perfect reflective barrier ($\alpha = 0$) will reflect back virtually all noise energy (assuming a transmission loss of 30 dBA or more) toward the opposite side of a highway. If the difference in path length between the direct and reflected noise paths to the opposite (unprotected) side of a highway is ignored, the maximum expected increase in noise will be 3 dBA.

If one wishes to calculate the noise increase from a partially absorptive wall, Equation 2-15 may be used. E_f is the noise energy striking the barrier, but E_b becomes the energy reflected back. For example, a barrier material with an α of 0.6 absorbs 60% of the direct noise energy and reflects back 40%. To calculate the increase in noise on the opposite side of the highway in this situation, the energy loss from the transformation of the total noise striking the barrier to the reflected noise energy component is $10\log_{10}(100/40)$= 4 dBA. In other words, the energy loss of the reflection is 4 dBA. If the direct noise level of the source at a receiver on the opposite side of the highway is 65 dBA, the reflective component (ignoring the difference in distances traveled) will be 61 dBA. The total noise level at the receiver is the sum of 65 and 61 dBA, slightly less than 66.5 dBA. The reflected noise caused an increase of 1.5 dBA at the receiver.

The transmitted, absorbed, and reflected noise paths shown in Figure 2-12 are variations of the direct noise path. Of these three paths, only transmitted noise reaches the receiver behind the barrier. However, there is one more path—the diffracted path—that reaches the receiver. The diffracted path is actually the most important path. With the barrier in place, sound energy traveling along this path is diffracted downward toward the receiver.

In general, diffraction is characteristic of all wave phenomena, including light, water, and sound waves. It can best be described as the bending of waves around objects. The amount of diffraction depends on the wavelength and size of the object. Low frequency waves with long wavelengths approaching the size of the object are easily diffracted. Higher frequencies with short wavelengths in relation to the size of the object are not as easily diffracted. This explains why light, with its very short wavelengths, casts shadows with fairly sharp, well defined edges between light and dark. Sound waves also “cast a shadow” when they strike an object. However, because of their much longer wavelengths (by at least about six orders of magnitude) the noise shadows are not very well defined and amount to a noise reduction, not an absence of noise.

Because noise consists of many different frequencies that diffract by different amounts, it seems reasonable to expect that the greater the angle of diffraction, the more frequencies will be attenuated. In Figure 2-12, beginning with the top of the shadow zone and going down to the ground surface, the higher frequencies will be attenuated first, then the middle frequencies, and finally the lower ones. Please notice that the top of the shadow zone is defined by the extension of a straight line from the noise source (in this case represented at the noise centroid as a point source) to the top of the barrier. The diffraction angle is defined by the top of the shadow zone and the line from the top of the barrier to receiver. Therefore, the position of the source relative to the top of the barrier determines the extent of the shadow zone and the diffraction angle to the receiver. Similarly, the receiver location relative to the top of the barrier is also important in determining the diffraction angle.

From the previous discussion, three conclusions are clear. First, the diffraction phenomenon depends on three critical locations: source, top of barrier, and receiver. Second, for a given source, top of barrier, and receiver configuration, a barrier is more effective in attenuating higher frequencies than lower frequencies (Figure 2-13). Third, the greater the angle of diffraction, the greater the noise attenuation.

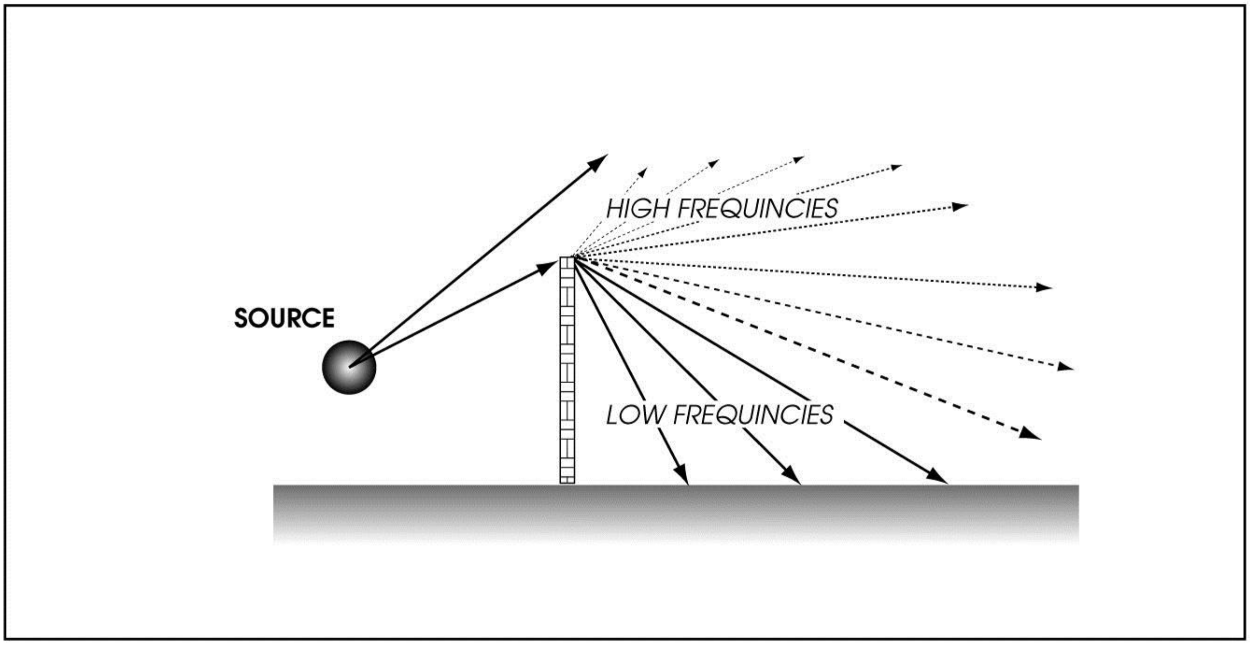


Figure 2-13. Diffraction of Sound Waves

The angle of diffraction is also related to the path length difference (δ) between the direct noise and diffracted noise. Figure 2-14 illustrates the concept of path length difference. A closer examination of this illustration reveals that as the diffraction angle becomes greater, so does δ. The path length difference is defined as $\delta = a + b - c$. If the horizontal distances from the source to receiver and the source to barrier, as well as the differences in elevation between the source, top of barrier, and receiver, are known, *a*, *b*, and *c* can readily be calculated. Assuming that the source in Figure 2-14 is a point source, *a*, *b*, and *c* are calculated as follows:

$$a = \sqrt{[d_1^2 + (h_2 - h_1)^2]}$$

$$b = \sqrt{(d_2^2 + h_2^2)}$$

$$c = \sqrt{(d^2 + h_1^2)}$$

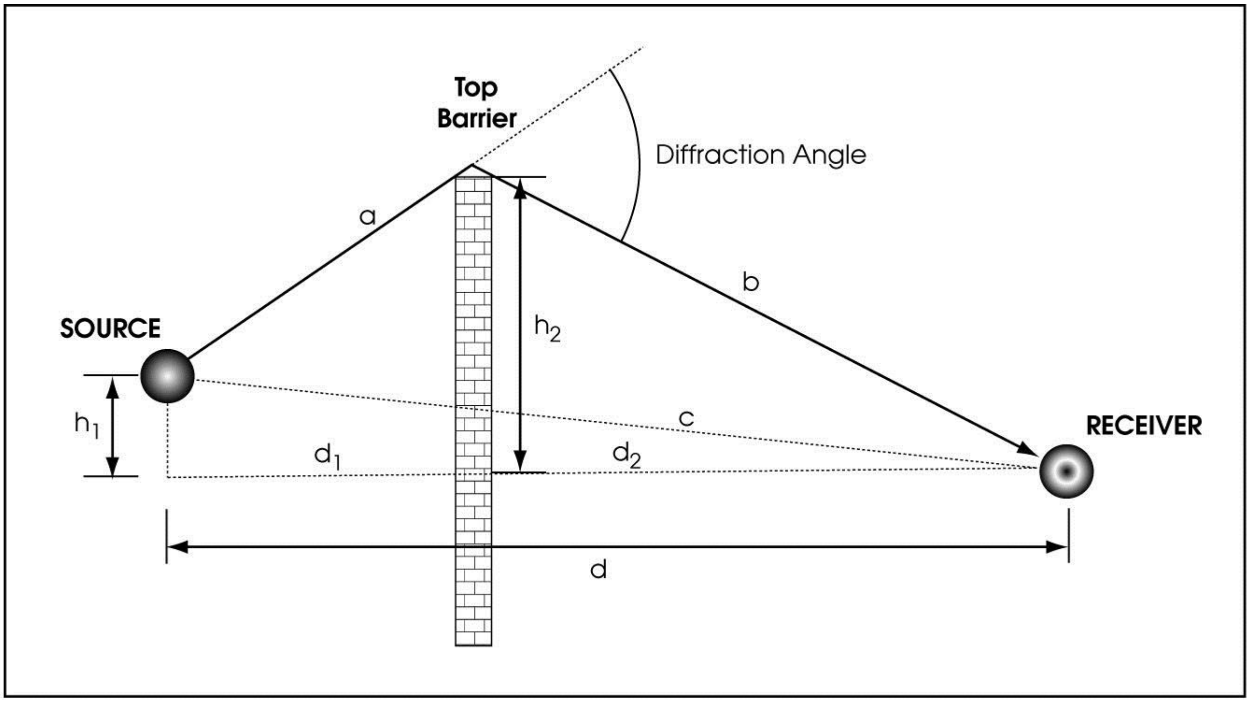


Figure 2-14. Path Length Difference between Direct and Diffracted Noise Paths

Highway noise prediction models use δ in barrier attenuation calculations. Section 5 addresses the subject in greater detail. However, it is appropriate to include the most basic relationship between δ and barrier attenuation through the Fresnel number (N_0). If the source is a line source (e.g., highway traffic) and the barrier is infinitely long, there is an infinite number of path length differences. The path length difference (δ_0) at the perpendicular line to the barrier is then of interest. Mathematically, N_0 is defined as follows:

$$N_0 = 2(\delta_0/\lambda) \qquad \textbf{(2-16)}$$

Where:

N_0 = Fresnel number determined along the perpendicular line between source and receiver (i.e., barrier must be perpendicular to the direct noise path)

δ_0 = δ measured along perpendicular line to barrier

λ = wavelength of sound radiated by source

According to Equation 2-3, $\lambda = c/f$. Therefore, Equation 2-16 may be rewritten as follows:

$$N_0 = 2(f\delta_0/c) \qquad \textbf{(2-17)}$$

Where:

f = frequency of sound radiated by source

c = speed of sound

Please note that these equations relate δ_0 to N_0. If one increases, so does the other, along with barrier attenuation. Similarly, if frequency increases, so will N_0 and barrier attenuation. Figure 2-15 shows the barrier attenuation Δ_B for an infinitely long barrier as a function of 550 Hz. It has been found that the attenuation of the A-weighted SPL of typical traffic is almost identical to the sound attenuation of 55 Hz frequency band. (Federal Highway Administration 1978)

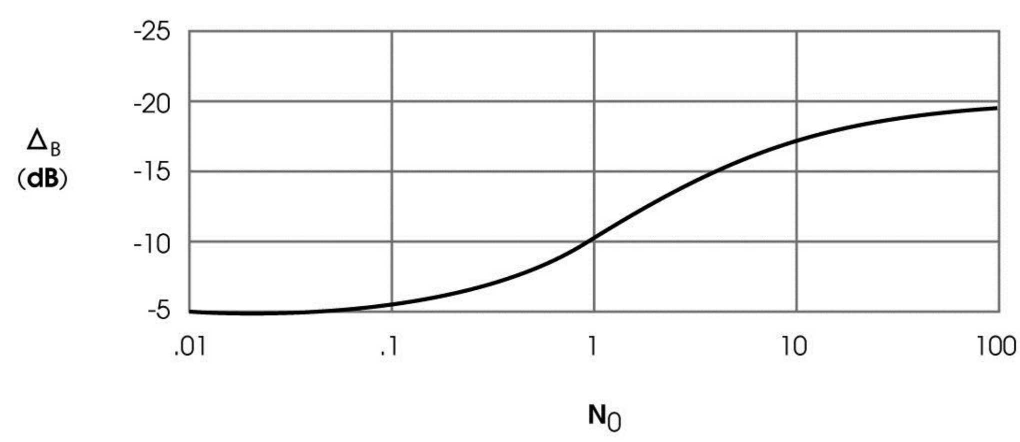


Figure 2-15. Barrier Attenuation (Δ_B) vs. Fresnel Number (N_0) for Infinitely Long Barriers

A barrier can be effective even when it does not completely block the line of sight between the source and the receiver. Figure 2-16 illustrates a special situation where the top of the barrier is just high enough to graze the direct noise path, or line of sight between the source and receiver. In this situation, a noise barrier provides about 5 dBA of attenuation.

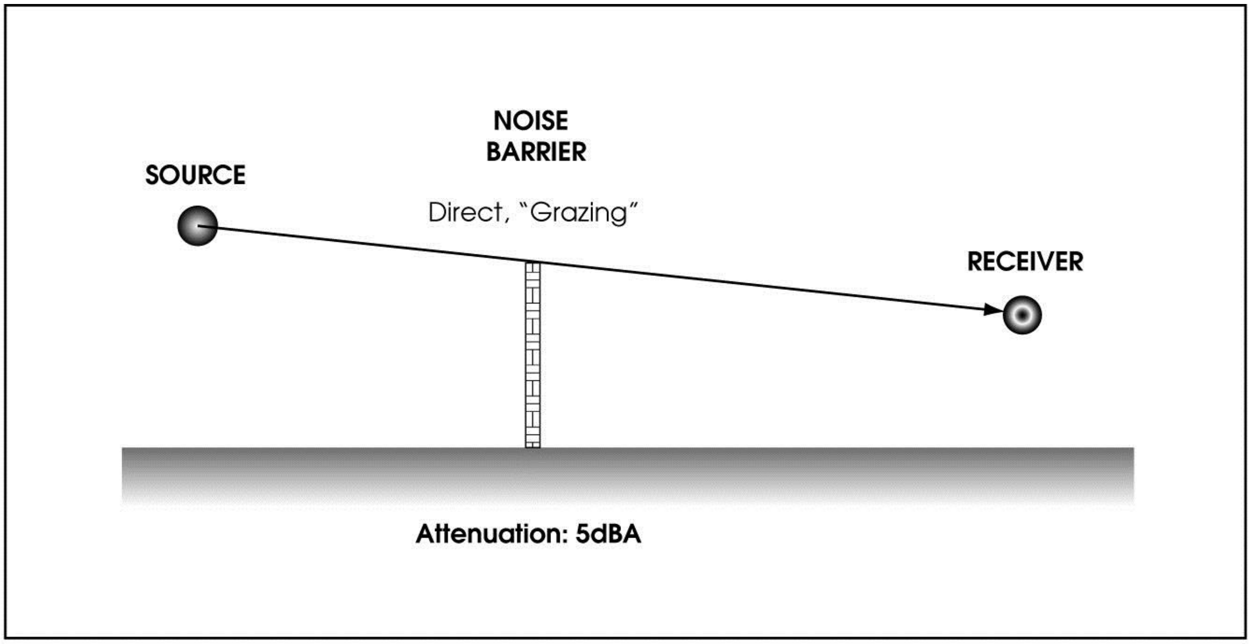


Figure 2-16. Direct Noise Path Grazing Top of Barrier, Resulting in 5 dBA of Attenuation

Another situation, in which the direct noise path is not interrupted but still close to the barrier, will provide some noise attenuation (Figure 2-17). Such negative diffraction (with an associated negative path length difference and Fresnel number) generally occurs when the direct noise path is within 5 feet above the top of the barrier for the average traffic source and receiver distances encountered in near-highway noise environments. The noise attenuation provided by this situation is between 0 and 5 dBA—5 dBA when the noise path approaches the grazing point, and near 0 dBA when it clears the top of the barrier by approximately 5 feet or more.

These principles of barriers apply loosely to terrain features (e.g., berms, low ridges, other significant manmade features). The principles are discussed in more detail in Section 5.

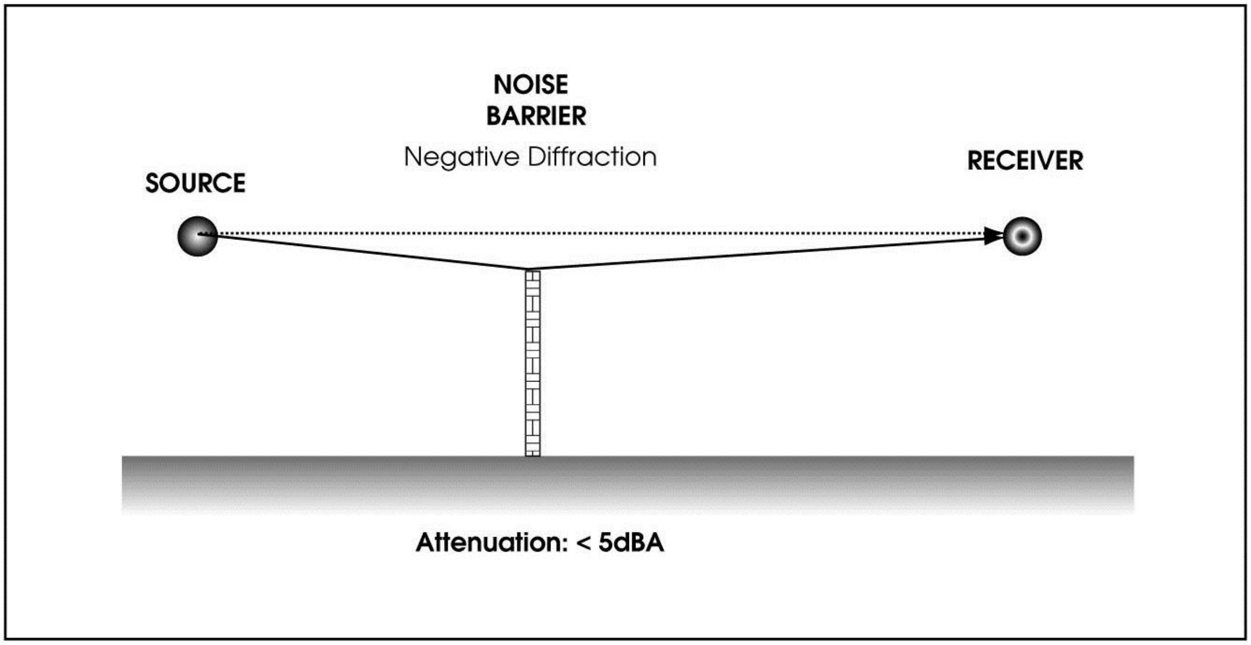


Figure 2-17. Negative Diffraction, Which Provides Some Noise Attenuation

2.2 Effects of Noise and Noise Descriptors

2.2.1 Human Reaction to Sound

People react to sound in a variety of ways. For example, rock music may be pleasant to some people, while for others it may be annoying, constitute a health hazard, or disrupt activities. Human tolerance to noise depends on a variety of acoustical characteristics of the source and environmental characteristics. These factors are briefly discussed below.

- **Noise Level, Variability in Level (Dynamic Range), Duration, Frequency Spectrums, and Time Patterns:** Exposures to very high noise levels can damage hearing. A high level is more objectionable than a low-level noise. For example, intermittent truck peak noise levels are more objectionable than the continuous level of fan noise. Humans have better hearing sensitivities in the high frequency region than the low. This is reflected in the A-scale (Section 2.1.3.6), which deemphasizes the low-frequency sounds. Studies indicate that annoyance or disturbance correlates with the A-scale.
- **Amount of Background Noise Present before Intruding Noise:** People tend to compare an intruding noise with existing background noise. If the new noise is readily identifiable or considerably louder

than the background or ambient, it usually becomes objectionable. One example is an aircraft flying over a residential area.

- **Nature of Work or Living Activity Exposed to Noise Source:** Highway traffic noise might not be disturbing to workers in a factory or office, but it might be annoying or objectionable to people sleeping at home or studying in a library. An automobile horn at 2:00 a.m. is more disturbing than the same noise in traffic at 5:00 p.m.

2.2.1.1 Human Response to Changes in Noise Levels

Under controlled conditions in an acoustics laboratory, the trained healthy human ear is able to discern changes in sound levels of 1 dBA when exposed to steady single-frequency (pure tone) signals in the mid-frequency range. Outside such controlled conditions, the trained ear can detect changes of 2 dBA in normal environmental noise. It is generally accepted that the average healthy ear, however, can barely perceive a noise level change of 3 dBA. If changes to the character (i.e., frequency content) of a sound occur, level changes less than 3 dBA may be noticeable. Individuals who are exposed to continuous traffic noise may also be able to notice small changes in noise levels (i.e., less than 3 dBA).

Earlier, the concept of A-weighting and the reasons for describing noise in terms of dBA were discussed. The human response curve of frequencies in the audible range is simply not linear (i.e., humans do not hear all frequencies equally well).

It appears that the human perception of loudness is also not linear, either in terms of decibels or in terms of acoustical energy. As discussed, there is a mathematical relationship between decibels and relative energy. For example, if one source produces a noise level of 70 dBA, two of the same sources produce 73 dBA, three will produce about 75 dBA, and 10 will produce 80 dBA.

Human perception is complicated by the fact that it has no simple correlation with acoustical energy. Two noise sources do not sound twice as loud as one noise source. Based on studies conducted over the years some approximate relationships between changes in acoustical energy and corresponding human reaction have been charted. Table 2-10 shows the relationship between changes in acoustical energy, dBA, and human perception. The table shows the relationship between changes in dBA (ΔdBA), relative energy with respect to a reference of a ΔdBA of 0 (no change), and average human perception. The factor change in relative energy relates to the change in acoustic energy.

Table 2-10. Relationship between Noise Level Change, Factor Change in Relative Energy, and Perceived Change

Noise Level Change, (dBA)	Change in Relative Energy ($10^{\pm\Delta dBA/10}$)	Perceived Change	
		Perceived Change in Percentage ($[2^{\pm\Delta dBA/10}-1] * 100\%$)	Descriptive Change in Perception
+40	10,000		16 times as loud
+30	1,000		Eight times as loud
+20	100	+300%	Four times as loud
+15	31.6	+183%	
+10	10	+100%	Two times as loud
+9	7.9	+87%	
+8	6.3	+74%	
+7	5.0	+62%	
+6	4.0	+52%	
+5	3.16	+41%	Readily perceptible increase
+4	2.5	+32%	
+3	2.0	+23%	Barely perceptible increase
0	1	0%	Reference (no change)
-3	0.5	-19%	Barely perceptible reduction
-4	0.4	-24%	
-5	0.316	-29%	Readily perceptible reduction
-6	0.25	-34%	
-7	0.20	-38%	
-8	0.16	-43%	
-9	0.13	-46%	
-10	0.10	-50%	One-half as loud
-15	0.0316	-65%	
-20	0.01	-75%	One-quarter as loud
-30	0.001		One-eighth as loud
-40	0.0001		One-sixteenth as loud

Section 2.1.3.3 discusses that the rms value of the sound pressure ratio squared (P_1/P_2) is proportional to the energy content of sound waves (acoustic energy). Human perception is displayed in two columns: percentage and descriptive. The percentage of perceived change is based on the mathematical approximation that the factor change of human perception relates to ΔdBA as follows:

$$\text{Factor Change in Perceived Noise Levels} = 2^{\pm\Delta dBA/10} \quad \textbf{(2-18)}$$

According to this equation, the average human ear perceives a 10-dBA decrease in noise levels as half of the original level ($2^{\pm\Delta dBA/10} = 2^{-10/10} = 0.5$). By subtracting 1 and multiplying by 100, the result will be in terms of a percentage change in perception, where a positive (+) change represents an increase and a negative (-) change a decrease. The descriptive perception column indicates how the percentage change is typically perceived.

2.2.2 Describing Noise

Noise in our daily environment fluctuates over time. Some fluctuations are minor, and some are substantial. Some occur in regular patterns, and others are random. Some noise levels fluctuate rapidly, and others slowly. Some noise levels vary widely, and others are relatively constant. To describe noise levels, one needs to choose the proper noise descriptor or statistic.

2.2.2.1 Time Patterns

Figure 2-18 is a graphical representation of how noise can have different time patterns depending on the source. Shown are noise levels vs. time patterns of four different sources: a fan (a), pile driver (b), single vehicle passby (c), and highway traffic (d).

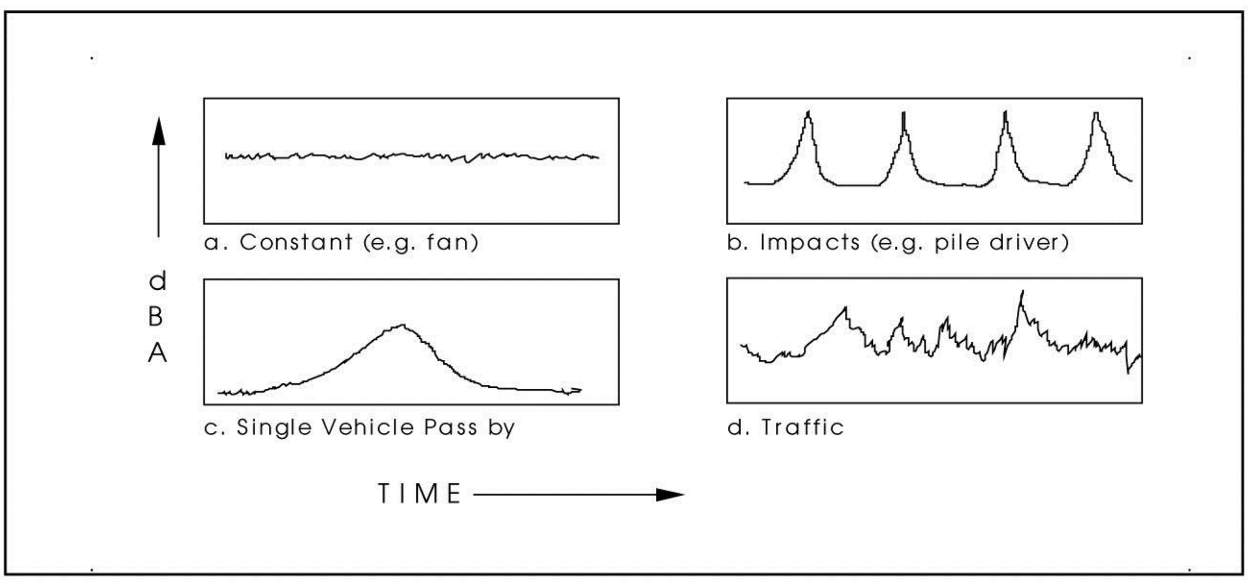


Figure 2-18. Different Noise Level vs. Time Patterns

The simplest noise level time pattern is constant noise, which is essentially a straight, level line. Such a pattern is characteristic of stationary fans, compressors, pumps, and air conditioners. At each instant, the noise level is about the same for a fixed observer. A single measurement taken at random would suffice to describe the noise level at a specific distance. The minimum and maximum noise levels would be nearly the same as the average noise level.

Other noise levels vs. time patterns are more complicated. For example, to describe the pile driving noise, noise samples need to include the instantaneous peaks, or maximum noise levels. In our environment, there are a range of noises of many different patterns in addition to the ones shown in Figure 2-18. The levels may be extremely short in duration, such as a single gunshot (transient noise); intermittent, such as the pile driver; or continuous, such as the fan. Traffic noise along major highways tends to lie somewhere between intermittent and continuous. It is characterized by the somewhat random distribution of vehicles, each of which emits a pattern such as shown for a single vehicle passby.

2.2.2.2 Noise Descriptors

The proper noise descriptor to use in any given situation depends on the nature of the noise source. For example a high amplitude short duration event such as gunshot requires a different descriptor than a constant relatively low amplitude noise source such as traffic. The proper descriptor depends on the spatial distribution of noise sources, duration of the noise event, amount of fluctuation, and time patterns.

Dozens of descriptors and scales have been devised over the years to quantify community noise, aircraft flyovers, traffic noise, industrial noise, speech interference, etc. The descriptors shown in Table 2-11 are those encountered most often in traffic, community, and environmental noise. There are many more descriptors not discussed here. The word “Level,” abbreviated *L*, is frequently used whenever sound is expressed in decibels relative to the reference pressure. Therefore, all the descriptors shown in Table 2-11 have *L* as part of the term.

All Caltrans highway traffic noise analysis should be done in terms of worst noise hour L_{eq}(h) as required under 23 CFR 772. If a noise analysis requires other descriptors to satisfy city or county requirements, see Section 2.2.3 for a discussion of descriptor conversions.

Table 2-11. Common Noise Descriptors

Noise Descriptor	Definition
Maximum noise level (L_{max})	The highest instantaneous noise level during a specified time period. This descriptor is sometimes referred to as "peak (noise) level." The use of term "peak level" should be discouraged because it may be interpreted as a non-rms noise signal (see Section 2.1.3.3 for difference between peak and rms).
Statistical descriptor (L_x)	The noise level exceeded *X* % of a specified time period. The value of *X* is commonly 10 (e.g., L_{10}). Other values such as 50 and 90 are used also.
Equivalent noise level (L_{eq}). Routinely used by Caltrans and FHWA to address the worst noise hour (L_{eq}[h]).	The equivalent steady-state noise level in a stated period of time that would contain the same acoustic energy as the time-varying noise level during the same period
Day-night noise level (L_{dn}). Used commonly for describing community noise levels.	A 24-hour L_{eq} with a "penalty" of 10 dBA added during the night hours (10 p.m. to 7 a.m.) because this time is normally used for sleep
Community noise equivalent level (CNEL). A common community noise descriptor, also used for airport noise.	Same as L_{dn} with an additional penalty of 4.77 dBA (or 10log3), for the hours 7 p.m. to 10 p.m., which are usually reserved for relaxation, television, reading, and conversation
Sound exposure level. Used mainly for aircraft noise, it enables comparing noise created by a loud but fast overflight with that of a quieter but slow overflight.	The acoustical energy during a single noise event, such as an aircraft overflight, compressed into a period of 1 second, expressed in decibels

2.2.2.3 Calculating Noise Descriptors

The following formulae and examples may be used to calculate various noise descriptors from instantaneous noise vs. time data.

Statistical Descriptor

L_x, a statistical descriptor, signifies the noise level that is exceeded *X* % of the time. This descriptor was formerly used in highway noise, before L_{eq}. The most common value of *X* was 10, denoting the level that is exceeded 10% of the time. Therefore, the L_{10} descriptor is used as an example to represent the L_x family of calculations. The following instantaneous noise samples (Table 2-12) shown as a frequency distribution (dBA vs. number of occurrences) serve to illustrate the L_{10} calculation.

Fifty samples were taken at 10-second intervals. To determine L_{10}, identify the five highest values (10% of 50) and then count down five values from the top. The "boundary" of the top 10% is 76 dBA. Therefore, L_{10} lies at 76 dBA. L_{50} would be at 66 dBA (25 occurrences from the top).

Table 2-12. Noise Samples for L_{10} Calculation

Noise Level (dBA)	Occurrences (Sampling Interval of 10 Seconds) (Each *X* Is One Occurrence)							Total Occurrences
80								0
79								0
78	X							1
77	X							1
76	X	X	X					3
75	X	X						2
74	X	X						2
73	X	X						2
72								0
71	X	X	X					3
70	X							1
69	X	X						2
68	X	X	X	X	X			5
67	X	X						2
66	X	X	X	X				4
65	X	X	X	X	X	X	X	7
64	X	X	X	X	X			5
63	X	X	X					3
62	X	X	X					3
61	X	X						2
60	X	X						2
Total samples								**50**

Equivalent Noise Level

L_{eq} is an energy average noise level. L_{eq} is also called an energy-mean noise level. The instant noise levels over a certain time period are energy-averaged by first converting all dBA values to relative energy values. Next, these values are added and the total divided by the number of values. The result is average (relative) energy. The final step is to convert the average energy value back to a decibel level. Equation 2-12 showed the method of adding the energy values. This equation can be expanded to yield L_{eq}:

$$L_{eq} = 10\log_{10}[(10^{SPL_1/10} + 10^{SPL_2/10} + ... 10^{SPL_n/10})/N] \quad \textbf{(2-19)}$$

Where:

SPL_1, SPL_2, SPL_n = first, second, and *n*th noise level

N = number of noise level samples

Example

Calculate L_{eq} of the following noise instantaneous samples, taken at 10-second intervals:

- 10:00:10: 60 dBA
- 10:00:20: 64 dBA
- 10:00:30: 66 dBA
- 10:00:40: 63 dBA
- 10:00:50: 62 dBA
- 10:01:00: 65 dBA

Using Equation 2-19:

$L_{eq} = 10\log_{10}[(10^{60/10}+10^{64/10}+10^{66/10}+10^{63/10}+10^{62/10}+10^{65/10})/6] =$
$10\log_{10}(14235391.3/6) = 63.8$ dBA

Usually, longer time periods are preferred. Using the sampling data in Table 2-12, the following equation can be used to add the dBA levels for each set of equal noise levels:

$$SPL_{Total} = SPL_1 + 10\log_{10}(N) \quad \textbf{(2-20)}$$

Where:

SPL_1 = SPL of one source

N = number of identical noise levels to be added (in this case, number of occurrences of each noise level)

Next, the following equation can be used to add the subtotals:

$$SPL_{Total} = 10\log_{10}(10^{SPL_1/10} + 10^{SPL_2/10} + ... 10^{SPL_n/10}) \quad \textbf{(2-21)}$$

Finally, this amount must be energy-averaged to compute L_{eq}. This may be accomplished using the following equation:

$$L_{eq} = 10\log_{10}(10^{SPL_{Total}/10}/N) \qquad \textbf{(2-22)}$$

Where:

N = total number of samples (in this case, 50)

The calculation procedures are shown in Table 2-13.

Table 2-13. Noise Samples for L_{eq} Calculation

Noise Level (dBA)	Occurrences (N) (from Table 2-12)	Total Noise Levels [dBA + $10\log_{10}(N)$]
80	0	
79	0	
78	1	78
77	1	77
76	3	80.8
75	2	78
74	2	77
73	2	76
72	0	
71	3	75.8
70	1	70
69	2	72
68	5	75
67	2	70
66	4	72
65	7	73.5
64	5	71
63	3	67.8
62	3	66.8
61	2	64
60	2	63
Total	**50**	**87.5**
$L_{eq} = 10\log_{10}[(10^{8.75})/50] = 70.5$ dBA		

Day-Night Noise Level

L_{dn} is actually a 24-hour L_{eq}, or the energy-averaged result of 24 1-hour L_{eq}s, except that the nighttime hours (10 p.m. to 6 a.m.) are assessed a 10-dBA penalty. This penalty attempts to account for the fact that nighttime noise levels are potentially more disturbing than equal daytime noise levels. Mathematically, L_{dn} is expressed as follows:

$$L_{dn} = 10\log_{10}\left[\left(\frac{1}{24}\right)\sum_{i=1}^{24} 10^{L_{eq}(h)_i + W_i/10}\right] \quad \textbf{(2-23)}$$

Where:

$W_i = 0$ for day hours (7 a.m. to 10 p.m.)

$W_i = 10$ for night hours (10 p.m. to 7 a.m.)

$L_{eq}(h)_i = L_{eq}$ for ith hour

To calculate L_{dn} accurately, one must have 24 successive hourly L_{eq} values, representing one typical day. The hourly values between 10 p.m. and 7 a.m. (nine hourly values) must first be weighted by adding 10 dBA. An example is shown in Table 2-14.

The energy average calculated from the nine weighted and 15 unweighted hourly L_{eq} values is the L_{dn}. Once the hourly data is properly weighted, the L_{dn} can be calculated as an L_{eq} (in this case, a weighted 24-hour L_{eq}). Equation 2-19 can be used with the weighted data. The resulting L_{dn} is 65 dBA.

Table 2-14. Noise Samples for L_{dn} Calculations

Begin Hour	L_{eq}(h) (dBA)	Weight (dBA)	Weighted Noise (dBA)
Midnight	54	+10	64
1 a.m.	52	+10	62
2 a.m.	52	+10	62
3 a.m.	50	+10	60
4 a.m.	53	+10	63
5 a.m.	57	+10	67
6 a.m.	62	+10	72
7 a.m.	65	0	65
8 a.m.	63	0	63
9 a.m.	64	0	64
10 a.m.	66	0	66
11 a.m.	66	0	66
Noon	65	0	65
1 p.m.	65	0	65
2 p.m.	63	0	63
3 p.m.	65	0	65
4 p.m.	65	0	65
5 p.m.	63	0	63
6 p.m.	64	0	64
7 p.m.	62	0	62
8 p.m.	60	0	60

Begin Hour	L_{eq}(h) (dBA)	Weight (dBA)	Weighted Noise (dBA)
9 p.m.	58	0	58
10 p.m.	57	+10	67
11 p.m.	55	+10	65

Community Noise Equivalent Level

CNEL is the same as L_{dn} except for an additional weighting of almost 5 dBA for the evening hours between 7 p.m. and 10 p.m. The equation is essentially the same as Equation 2-23, with an additional definition of $W_i = 10\log_{10}(3)$, which is 4.77. Calculations for CNEL are similar to L_{dn}. The result is normally about 0.5 dBA higher than L_{dn} using the same 24-hour data. The equation for the CNEL is as follows:

$$CNEL = 10\log_{10}\left[\left(\frac{1}{24}\right)\sum_{i=1}^{24} 10^{L_{eq}(h)_i + W_i/100}\right] \qquad \textbf{(2-24)}$$

Where:

$W_i = 0$ for day hours (7 a.m. to 7 p.m.)

$W_i = 10\log_{10}(3) = 4.77$ for evening hours (7 p.m. to 10 p.m.)

$W_i = 10$ for night hours (10 p.m. to 7 a.m.)

$L_{eq}(h)_i = L_{eq}$ for the *i*th hour

The 24-hour data used in the L_{dn} example yields a CNEL of 65.4 dBA, compared with an L_{dn} of 65.0 dBA.

Sound Exposure Level

The sound exposure level (SEL) is useful in comparing the acoustical energy of different events involving different source characteristics. For example, the overflight of a slow propeller-driven plane may not be as loud as a jet aircraft. However, the duration of the noise is longer than the duration of the noise from the jet aircraft overflight. SEL makes a noise comparison of both events possible because it combines the effects of time and level. For example, the L_{eq} of a steady noise level will remain unchanged over time. It will be the same whether calculated for a time period of 1 second or 1,000 seconds. The SEL of a steady noise level, however, will keep increasing because all the acoustical energy within a given time period is included in the reference time period of 1 second. Because both values are energy-weighted, they are directly related to each other by time, as shown in the following equations:

$$SEL = L_{eq}(T) + 10\log_{10}(T) \quad \textbf{(2-25)}$$

$$L_{eq}(T) = SEL + 10\log_{10}(1/T) = SEL - 10\log_{10}(T) \quad \textbf{(2-26)}$$

Where:

T = duration of noise level in seconds

Example

L_{eq} of a 65-second aircraft overflight is 70 dBA. What is the SEL?

$SEL = L_{eq}(65) + 10\log_{10}(65) = 70 + 18.1 = 88.1$ dBA

A time period of 1 hour (T = 3,600 seconds) is commonly used for the L_{eq} descriptor when it is applied to criteria in policies and standards. The SEL value accumulated over the 1-hour period can be converted to $L_{eq}(h)$ as follows. $L_{eq}(h) = SEL - 10\log_{10}(3{,}600)$, or 88.1 – 35.6 = 52.5 dBA for the example above. Because a conversion from SEL to $L_{eq}(h)$ always involves subtraction of the constant 35.6 and the following relationships between SEL and $L_{eq}(h)$ always hold true:

$$L_{eq}(h) = SEL - 35.6 \quad \textbf{(2-27)}$$

$$SEL = L_{eq}(h) + 35.6 \quad \textbf{(2-28)}$$

These relationships have many practical applications when one is adding a mixture of SELs and $L_{eq}(h)$s. For example, one wants to calculate the existing worst hour noise level in $L_{eq}(h)$ at a receiver A from the following data.

- Highway noise = 63 dBA, $L_{eq}(h)$
- Two train passbys with SELs of 89 dBA each
- Five aircraft overflights averaging SELs of 93 dBA each

First, all SELs are added:

$$\text{Total SEL} = 10\log_{10}[2(10^{89/10}) + 5(10^{93/10})] = 100.6 \text{ dBA}$$

Next, the SEL is expanded to 1 hour using Equation 2-28:

$$L_{eq}(h) = 100.6 - 35.6 = 65 \text{ dBA}$$

Finally, the $L_{eq}(h)$ of the highway is added:

$$\text{Worst hour noise level at receiver A} = 10\log_{10}(10^{63/10} + 10^{65/10}) = 67.1 \text{ dBA}$$

2.2.3 Conversion between Noise Descriptors

Although Caltrans exclusively uses L_{eq}, there are times that comparisons need to be made with local noise standards, most of which are in terms of L_{dn} or CNEL. If 24-hour traffic and noise data are available, these descriptors can be calculated accurately. However, this information is often not available. The methodologies in this section allow a reasonably accurate conversion of the worst hourly noise level to L_{dn} or CNEL (and vice versa).

Before these conversions are discussed, it should be noted that although these conversions are reasonably accurate, they are only approximate for various reasons. First is the assumption that 24 hourly traffic mixes remain constant and that traffic speeds do not change. Second, the method assumes that the peak hour traffic coincides with the worst-hour L_{eq}, which is often not true. Nevertheless, the methods of conversion discussed may be used if only average daily traffic (ADT) volumes are known and a reasonable estimate can be made of the percentage of peak hour traffic volume of the ADT. Another requirement is a reasonable estimate of the day and night traffic volume split for L_{dn} and day, evening, and night split for CNEL.

The previous section discussed that L_{dn} is defined as an energy-averaged 24-hour L_{eq} with a nighttime penalty of 10 dBA assessed to noise levels between 10 p.m. and 7 a.m. If traffic volumes, speeds, and mixes were to remain constant throughout the entire 24 hours and there were no nighttime penalty, there would be no peak hour and each hourly L_{eq} would equal the 24-hour L_{eq}. Hourly traffic volumes would then be 100/24, or 4.17% of ADT. Peak hour corrections would not be necessary in this case. (Let this be the reference condition.)

To convert peak hour L_{eq} to L_{dn}, at least two corrections must be made to the reference condition. First, one must make a correction for peak hour traffic volumes expressed as a percentage of ADT. Second, one must make a correction for the nighttime penalty of 10 dBA. For CNELs, a third correction needs to be made for the evening hour penalty. For this one must know what fractions of the ADT occur during the day and at night. Depending on the accuracy desired and information available, other corrections can be made for different day/night traffic mixes and speeds; these are not discussed in this section.

The first correction for peak hour can be expressed as:

$$10\log_{10}\frac{4.17}{P}$$

Where:
P = peak hour volume as percent of ADT

The second correction for nighttime penalty of 10 dBA is:

$$10\log_{10}(D + 10N)$$

Where:
D = day fraction of ADT
N = night fraction of ADT
D + N = 1

The following equations are used to convert from peak hour L_{eq} to L_{dn}, and vice versa, respectively:

$$L_{dn} = L_{eq}(h)_{pk} + 10\log_{10}\frac{4.17}{P} + 10\log_{10}(D + 10N) \qquad \textbf{(2-29)}$$

$$L_{eq}(h)_{pk} = L_{dn} - 10\log_{10}\frac{4.17}{P} - 10\log_{10}(D + 10N) \qquad \textbf{(2-30)}$$

Where:
$L_{eq}(h)_{pk}$ = peak hour L_{eq}
P = peak hour volume % of ADT
D = daytime fraction of ADT
N = nighttime fraction of ADT
D + N = 1

Example

Peak hour L_{eq} at a receiver near a freeway is 65.0 dBA. Peak hour traffic is 10% of ADT. Daytime traffic volume is 85% of ADT, and nighttime traffic volume is 15% of ADT. Assume that the day and nighttime heavy truck percentages are equal and traffic speeds do not vary significantly. What is the estimated L_{dn} at the receiver?

$$L_{dn} = 65.0 + 10\log_{10}\frac{4.17}{10} + 10\log_{10}(0.85 + 1.50) = 65.0 + (-3.8) + 3.70 = 64.9 \text{ dBA}$$

Please note that in this example, which is a fairly typical case, L_{dn} is approximately equal to $L_{eq}(h)_{pk}$. The general rule is that L_{dn} is within about 2 dBA of $L_{eq}(h)_{pk}$ under normal traffic conditions.

The following equations are used to convert from peak hour L_{eq} to CNEL, and L_{dn} to peak hour L_{eq}, respectively:

$$CNEL = L_{eq}(h)_{pk} + 10\log_{10}\frac{4.17}{P} + 10\log_{10}(d + 4.77e + 10N) \qquad \textbf{(2-31)}$$

$$L_{eq}(h)_{pk} = CNEL - 10\log_{10}\frac{4.17}{P} - 10\log_{10}(d + 4.77e + 10N) \qquad \textbf{(2-32)}$$

Where:

The variables *d* and *e* are further divisions of *D* shown in L_{dn} to account for day and evening hours. Please note that *d* + *e* = *D* (shown in Equations 2-31 and 2-32). The factor 4.77 comes from $10\log_{10}(3)$, which is the designated penalty for evening hours in the definition of CNEL. Although an evening hour penalty of 5 dBA is often used to calculate CNEL, the correct value is $10\log_{10}(3)$. The difference between using 4.77 and 5 is usually negligible.

Example

Using the data for the previous L_{dn} example and adding a further division of *D* into *d* = 0.80 and *e* = 0.05, the CNEL result using Equation 2-31 is 65.2 dBA, 0.3 dBA more than L_{dn}.

From Equations 2-31 and 2-32, the following equations can be derived in terms of CNEL and L_{dn}:

$$CNEL = L_{dn} + [10\log_{10}(d + 4.77e + 10N) - 10\log_{10}(d + e + 10N)] \qquad \textbf{(2-33)}$$

$$L_{dn} = CNEL - [10\log_{10}(d + 4.77e + 10N) - 10\log_{10}(d + e + 10N)] \qquad \textbf{(2-34)}$$

Example

Using the same example for which L_{dn} was 64.9 dBA, the CNEL in Equation 2-33 yields 65.2 dBA. Please note that CNEL is always larger than L_{dn}.

The values in Table 2-15 can also be used in Equations 2-29 and 2-30. Please notice that the peak hour percentage term of the equation always yields a negative value, while the weighted day/night split always yields a positive value. The difference between the two is the difference between $L_{eq}(h)_{pk}$ and L_{dn}.

Table 2-15. L_{eq}/L_{dn} Conversion Factors

Peak Hour, %	$10\log_{10}(4.17/P)$	Day	Night	$10\log_{10}(D+10N)$
5	-0.8	0.98	0.02	+0.7
6	-1.6	0.95	0.05	+1.6
7	-2.3	0.93	0.07	+2.1
8	-2.8	0.90	0.10	+2.8
9	-3.3	0.88	0.12	+3.2
10	-3.8	0.85	0.15	+3.7
11	-4.2	0.83	0.17	+4.0
12	-4.6	0.80	0.20	+4.5
13	-4.9	0.78	0.22	+4.7
14	-5.3	0.75	0.25	+5.1
15	-5.6	0.73	0.27	+5.4
17	-6.1	0.70	0.30	+5.7
20	-6.8	0.68	0.32	+5.9
		0.65	0.35	+6.2
		0.63	0.37	+6.4
		0.60	0.40	+6.6

Figure 2-19 illustrates the difference between $L_{eq}(h)_{pk}$ and L_{dn}. For example, if *P* is 10% and *D*/*N* = 0.85/0.15, $L_{dn} \approx L_{eq}(h)$.

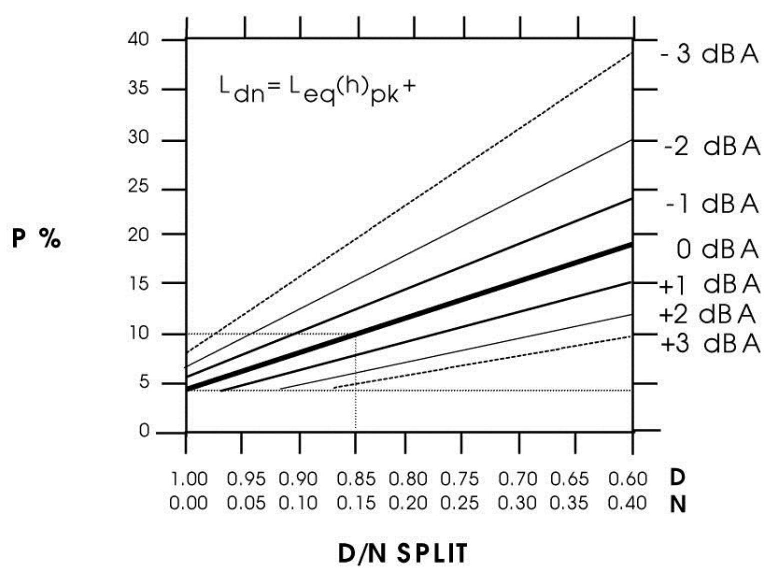


Figure 2-19. Relationship between L_{dn} and $L_{eq}(h)_{pk}$

If CNEL is desired, the L_{dn} to CNEL corrections (Δ) in Table 2-16 may be used. Please note that this table is only calculated for a common day/night volume spilt of 0.85/0.15. Because of the many possible combinations, other tables are not shown. For other D/N splits, use Equation 2-31 or 2-32 to calculate CNEL. This table is intended to be used when only an L_{dn} is given and CNEL is desired.

Table 2-16. L_{dn}/CNEL Corrections (Δ) (Must Be Added to L_{dn} to Obtain CNEL)

D = 0.85		Δ
D	E	(CNEL = L_{dn} + Δ)
0.80	0.05	0.3
0.79	0.06	0.4
0.78	0.07	0.5
0.77	0.08	0.5
0.76	0.09	0.6
0.75	0.10	0.7
0.74	0.11	0.7
0.73	0.12	0.8
0.72	0.13	0.8
0.71	0.14	0.9
0.70	0.15	0.9

D = percentage of traffic in hours 7:00 a.m. to 10:00 p.m.
E = percentage of traffic in hours 7:00 p.m. to 10:00 p.m.
d = percentage of traffic in hours 7:00 a.m. to 7:00 p.m.
D = d + E.

The values shown assume a fixed nighttime fractional traffic contribution of 0.15 (D/N split of 0.85/0.15 for L_{dn}). The remaining daytime traffic contribution of 0.85 is further subdivided into day (*d*) and evening (*E*) hours. In each instance, *d* + E = 0.85.

2.2.4 Negative Effects on Humans

The most obvious negative effects of noise are physical damage to hearing. Other obvious effects are the interference of noise with certain activities, such as sleeping and conversation. Less obvious are the stress effects of noise. A brief discussion of each of the topics follows.

2.2.4.1 Hearing Damage

A person exposed to high noise levels can suffer hearing damage, either gradual or traumatic. These are described as follows.

- **Gradual:** Sustained exposure to moderately high noise levels over a period of time can cause gradual hearing loss. It starts out as a temporary hearing loss, such as immediately after a loud rock concert. The hearing usually restores itself within a few hours after exposure, although not quite to its pre-exposure level. This is also called a temporary threshold shift. Although the permanent deterioration may be negligible, it will become significant after many repetitions of the exposure. At that time, it is considered permanent hearing damage. The primary cause of permanent hearing damage is daily exposure to industrial noise. Transportation noise levels experienced by communities and the general public are normally not high enough to produce hearing damage.
- **Traumatic:** Short, sudden exposure to an extremely high noise level, such as a gunshot or explosion at very close range, can cause a traumatic hearing loss, which is very sudden and can be permanent.

Hearing damage is preventable by reducing the exposure to loud noise. This can be done by quieting the source, shielding the receiver with a barrier, or having the receiver wear proper ear protection. Occupational exposure to noise is controlled at the Federal Level by OSHA and at the state level by the state level by the California Division of Safety and Health. The maximum allowable noise exposure over an 8 hours period is a level of 90 dBA. For each halving of the exposure time, the maximum noise level is allowed to increase 5 dBA. Therefore, the maximum allowable noise exposure (100%) is 90 dBA for 8 hours, 95 dBA for 4 hours, 100 dBA for 2 hours, 105 dBA for 1 hour, 110 dBA for 30 minutes, and 115 dBA for 15 minutes. Dosimeters, worn by workers in noisy environments, can measure noise during the workday in percentages of the maximum daily exposure.

2.2.4.2 Interference with Activities

Activities most affected by noise include rest, relaxation, recreation, study, and communications. Although most interruptions by noise can be considered annoying, some may be considered dangerous, such as the inability to hear warning signals or verbal warnings in noisy industrial situations or situations involving workers next to a noisy freeway. Figure 2-20 gives an estimate of the speech communication that is possible at various noise levels and distances.

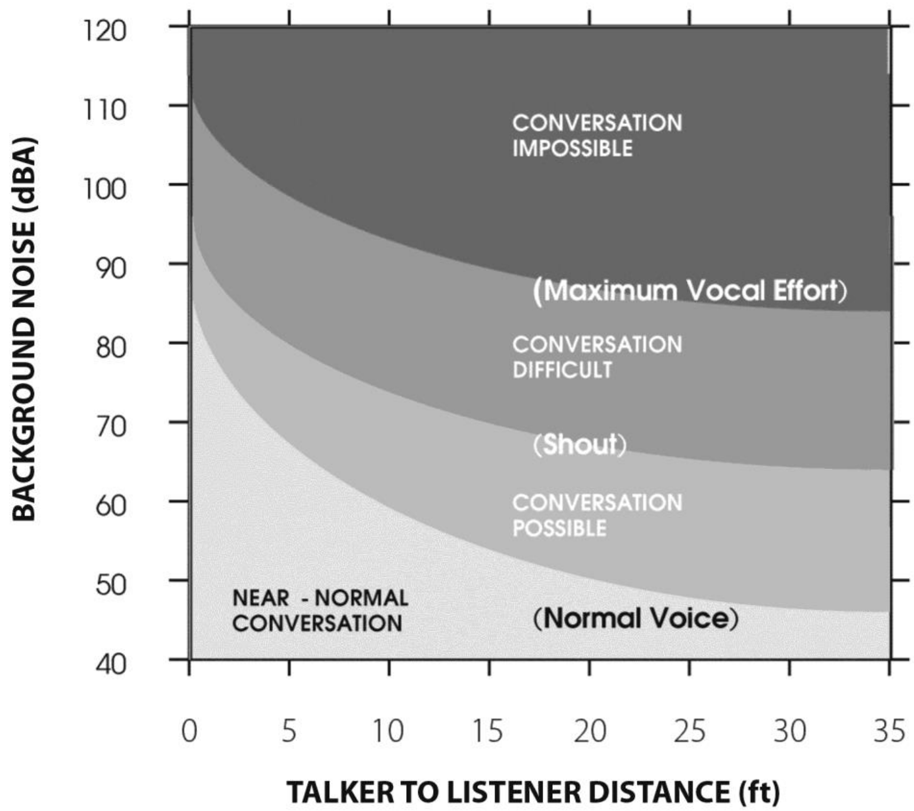


Figure 2-20. Interference of Conversation from Background Noise

For example, if the talker-to-listener distance is about 20 feet, normal conversation can be conducted with the background level at about 50 dBA. If the background level is increased to 60 dBA, the talker must either raise his or her voice or decrease the distance to the listener to about 10 feet.

2.2.4.3 Stress-Related Diseases

There is ample evidence that noise can cause stress in humans and may be responsible for a host of stress-related diseases, such as hypertension, anxiety, and heart disease. Although noise is probably not the sole culprit in these diseases, it can be a contributor. The degree to which noise contributes to stress-related diseases depends on noise frequencies, their bandwidths, noise levels, and time patterns. In general, higher frequencies, pure tones, and fluctuating noise levels tend to be more stressful than lower frequencies, broadband, and constant-level noise.

Section 3
Measurements and Instrumentation

Noise measurements play an important role in noise analysis and acoustical design of noise attenuation for transportation projects. This section addresses recommendations on why, where, when, and how noise measurements should be taken. A brief discussion on available instrumentation is also included. Because of the variety of sound instrumentation, coverage of equipment setup and operational procedures is discussed only at a general level. For additional detail, manufacturers' manuals should be consulted.

The noise analyst should be aware of both the importance and limitations of noise measurements. As with all field work, quality noise measurements are relatively expensive, requiring time, personnel, and equipment. Therefore, the noise analyst should carefully plan the location, time, duration, and number of repetitions of noise measurements before actually taking the measurements. Efforts should be made during the measurements to document location, traffic levels, weather, and other pertinent factors discussed in this section.

The contents of this section represent Caltrans measurement procedures and are consistent with methods described in FHWA's *Measurement of Highway-Related Noise* (1996a).

3.1 Purposes of Noise Measurements

There are five major purposes for measuring transportation noise.

- Determine existing ambient and background noise levels.
- Calibrate noise prediction models.
- Monitor construction noise levels for compliance with standard specifications, special provisions, and local ordinances.
- Evaluate the effectiveness of abatement measures such as noise barriers.
- Perform special studies and research.

Ambient and background noise and model calibration measurements are routinely performed by the Caltrans districts. Construction noise monitoring is also conducted frequently by the districts. Some districts conduct before-and-after noise abatement measurements. Special studies and noise research measurements are done rarely by the districts and are often contracted to consultants with Caltrans oversight.

Where, when, and how noise measurements are performed depends on the purpose of the measurements. The following sections discuss the reasons for the measurements, what they include, and how the results are typically used.

3.1.1 Ambient and Background Noise Levels

Ambient noise levels are all-encompassing noise levels at a given place and time, usually a composite of sounds from all sources near and far, including specific noise sources of interest. Typically, ambient noise levels include highway and community noise levels. Ambient noise levels are measured for the following reasons.

- To assess highway traffic noise impacts for new highway construction or reconstruction projects. Existing ambient noise levels provide a baseline for comparison to predicted future noise levels. The measurements are also used to describe the current noise environment in the area of the proposed project. This information is reported in appropriate environmental documents. Generally, the noise resulting from natural and mechanical sources and human activity considered usually to be present should be included in the measurements.
- To investigate citizens' traffic or construction noise complaints. Noise measurements are usually reported via memorandum to the interested party, with recommendations for further actions or reasons that further actions are not justified.

Background noise is considered to be the total noise in a specific region without the presence of noise sources of interest. Typically, this would be the noise generated within the community without the highway and is usually measured at acoustically representative locations away from the highway where highway noise does not contribute to the total noise level. Background noise levels are routinely measured to determine the feasibility of noise abatement and to ensure that noise reduction goals can be achieved. Noise abatement cannot reduce noise levels below background levels. Section 5.1.6 discusses the importance of background noise levels.

Depending on the situation, noise sources measured may typically include highway traffic, community activity, surface street traffic, trains, and sometimes airplanes (when project is near an airport).

3.1.2 Model Validation/Calibration

Noise measurements near highways or other transportation corridors are routinely used to validate and, if necessary, calibrate the project-specific TNM model by comparing calculated noise levels with actual (measured) noise levels. The calculated levels are modeled results obtained from traffic counts and other parameters recorded during the noise measurements. The difference between calculated and measured noise levels may then be applied to calculated future noise levels, assuming site conditions will not change significantly, or modeled existing noise levels (see Sections 4.3.3 and 4.4). Model calibration can only be performed on projects involving reconstruction of existing highways.

3.1.3 Construction Noise Levels

Construction noise measurements are frequently conducted by districts to check the contractor's compliance with the standard specifications, special provisions, and local ordinances.

3.1.4 Performance of Abatement Measures

Before-and-after abatement measurements can be used to evaluate the performance of noise barriers, building insulation, or other abatement options. The measurements provide a check on the design and construction procedures of the abatement. Although these measurements are occasionally performed by some districts, they are not part of a routine program.

3.1.5 Special Studies and Research

These measurements are usually done by Caltrans headquarters staff and consultants. They may involve district assistance and generally involve noise research projects. Setups are usually complex and include substantial equipment and personnel positioned at many locations for simultaneous noise measurement. The studies generally require more sophisticated equipment and setups than routine noise studies.

3.2 Measurement Locations

The selection of measurement locations requires considerable planning and foresight by the noise analyst. A fine balance must be achieved between sufficient quality locations and the cost in person hours. Good engineering judgment must be exercised in site selection; experience makes this task easier.

Many tools are available in the search for quality noise measurement sites. Preliminary design maps, cross sections, aerial photographs, and field survey data are all helpful sources of information. However, noise measurement sites should only be selected after a thorough field review of the project area.

3.2.1 General Site Recommendations

Some general site requirements common to all outside noise measurement sites are listed below (more detailed considerations are discussed in Section 3.2.2).

- Sites must be clear of major obstructions between the source and receiver unless these are representative of the area of interest. Small reflecting surfaces should be more than 10 feet from the microphone positions. Large reflecting surfaces should be avoided unless they are the subject of study.
- Sites must be free of noise contamination by sources other than sources of interest. Avoid sites located near sources such as barking dogs, lawnmowers, pool pumps, and air conditioners unless it is the express intent of the analyst to measure these sources.
- Sites must be acoustically representative of areas and conditions of interest. They must either be located at or represent locations of human use.
- Sites must not be exposed to prevailing meteorological conditions that are beyond the constraints discussed in this section. For example, in areas with prevailing high wind speeds, sites in open fields should be avoided.

3.2.2 Measurement Site Selection

For the purpose of this document, a distinction will be made between receivers and noise measurement sites. Receivers are all locations or sites of interest in the noise study area. Noise measurement sites are locations where noise levels are measured. Unless an extremely rare situation exists in which a noise measurement site is used for a specialized purpose, all noise measurement sites may be considered receivers. However, not all receivers are noise measurement sites. Additional information on receivers and noise measurement sites can be found in Section 4.3.

For describing existing noise levels at selected receivers, measured noise levels are normally preferred. Restricted access or adverse site conditions may force the selection of noise measurement sites at locations that are physically different from but acoustically equivalent to the intended receivers. In some cases, measurements are not feasible. In such cases, the existing noise levels must be modeled. This can only be accomplished along an existing facility, where traffic data can be collected.

In general, there will be more modeled receivers than noise measurement sites. It is far less expensive to take noise measurements at selected, representative receivers and then model the results for the remaining receivers. Nevertheless, there needs to be an adequate overlap of measurement sites and modeled receivers for model calibration and verification.

Factors that should be considered when selecting noise measurement sites are described in the next three sections.

3.2.2.1 Site Selection by Purpose of Measurement

Noise measurement sites should be selected according to the purpose of the measurement. For example, if the objective is to determine noise impacts of a highway project, sites should be selected in areas that will be exposed to the highest noise levels generated by the highway after completion of the project. The sites should also represent areas of human use. Conversely, if the objective is to measure background community noise levels, the sites should be located in areas that represent the community without influence from the highway. These measurements are often necessary for acoustical noise barrier design and to document pre-project noise levels at distant receivers. Past controversies concerning reported increases in noise levels at distant receivers attributed to noise barriers could have been readily resolved if sufficient background noise measurements had been obtained prior to the project being built. (Refer to Section 3.1.1 for more information on background noise levels).

Classroom noise measurements (Street and Highways Code Section 216) or receivers lacking outside human use require both inside and outside noise measurements in rooms with worst noise exposures from the highway. Measurements should generally be made at a point in a room, hall, or auditorium where people would be affected by infiltrating noise from the sources of interest. These points are typically desks, chairs, or beds near windows. Several sensitive points may need to be tested, and the results averaged. No measurements should be made within 3 to 4 feet of a wall. It is also important to take measurements in the room in its typical furnished condition. If windows are normally open, measurements should be taken with windows open and closed. Devices such as fans, ventilation, clocks, appliances, and telephones should be turned off. People should vacate the room or be extremely quiet.

Model calibration measurements usually require sites to be near the highway, preferably at receivers or acoustical equivalents to the receivers (see Section 4.4 for additional details). Sites for construction noise monitoring are dictated by standard specifications, special provisions, and local ordinances, which detail maximum allowable noise levels at a reference distance (e.g., L_{max} of 86 dBA at 50 feet) and other requirements.

Before-and-after measurements for evaluations of noise barriers and other abatement options, as well as measurements for special studies or research, are non-routine and require a detailed experimental design. Coordination with Caltrans Headquarters staff is advisable.

3.2.2.2 Site Selection by Acoustical Equivalence

Noise measurement sites should be representative of the areas of interest. Representativeness in this case means *acoustical equivalence*. The concept of acoustical equivalence incorporates equivalences in noise sources, distances from these sources, topography, and other pertinent parameters.

The area under study may need to be divided into sub-areas in which acoustical equivalence can generally be maintained. Sub-area boundaries must be estimated by one or more of the previously mentioned acoustical parameters. Also, in cases where measurements are being taken for more than one purpose, separate sub-areas may be defined by each purpose. The areas of interest may vary in size. For example, noise abatement for a school may cover only the school itself, while a noise study for a large freeway project may range from a large area to many sub-areas.

The number of measurement sites selected within each area or sub-area under study depends on the area's size, number of receivers, and remaining variations in acoustical parameters. If sub-areas are carefully selected, the number of measurement sites can be minimized. The minimum number of sites recommended for each area or sub-area is two.

Figure 3-1 shows an example of receiver and noise measurement site selections for an at-grade freeway widening and noise barrier project. Alternate noise measurement sites to be used if the selected receivers are not accessible or otherwise not suitable for noise measurement locations are shown also. Only sites near the freeway are shown. Background noise measurement sites would typically be off the map, farther from the freeway. Actual site selection would depend on field reviews and more information not shown on the map.

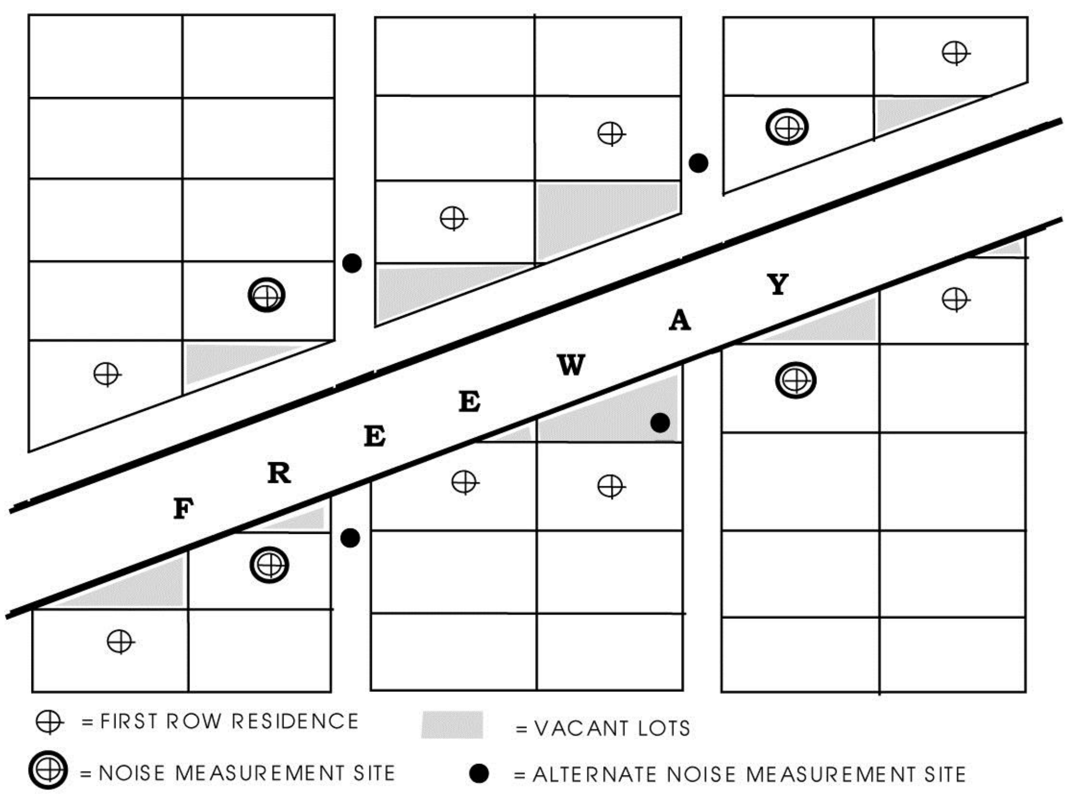


Figure 3-1. Typical Measurement Site Locations

3.2.2.3 Site Selection by Geometry

In addition to being an important consideration in determining acoustical equivalence, topography (site geometry) plays an important role in determining locations of worst exposure to highway noise. Receivers located farther from a highway may be exposed to higher noise levels, depending on the geometry of a site. One typical example is a highway on a high embankment, where the first-tier receivers may be partially shielded by the top of the fill. Unshielded second- or third-tier receivers may then be exposed to higher noise levels even though they are farther from the source. This concept is shown in Figure 3-2. Another common situation involves a receiver close to the source, shielded by the top of a highway embankment, and an unshielded receiver farther from the source. The attenuation provided by the embankment is often more than the distance effect, resulting in higher noise levels at the farther receiver.

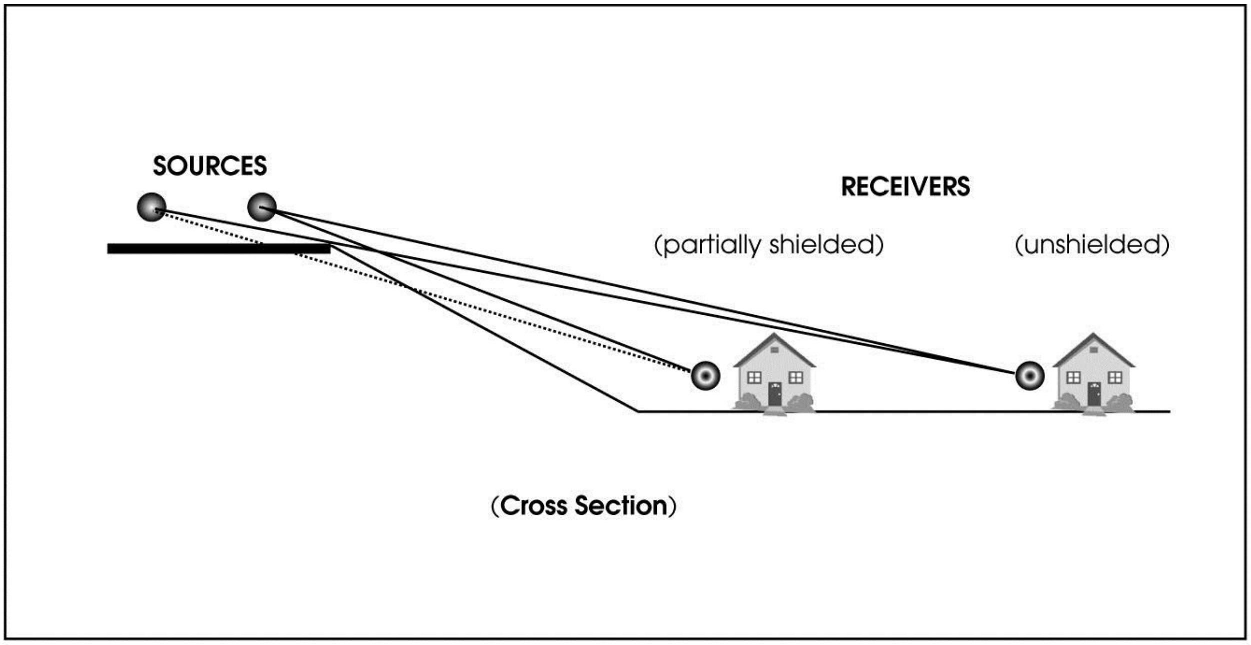


Figure 3-2. Typical Noise Measurement Site Locations

Figure 3-3 illustrates another example of the effects of site geometry on the selection of highest noise exposure. The unshielded Receiver 1 shows a higher noise level than Receiver 2 even though the latter is closer to the freeway. Other examples can be generated in which the nature of terrain and natural or artificial obstructions cause noise levels at receivers closer to the source to be lower than those farther away. This concept is an important consideration in impact analysis, where interest usually focuses on the noisiest locations.

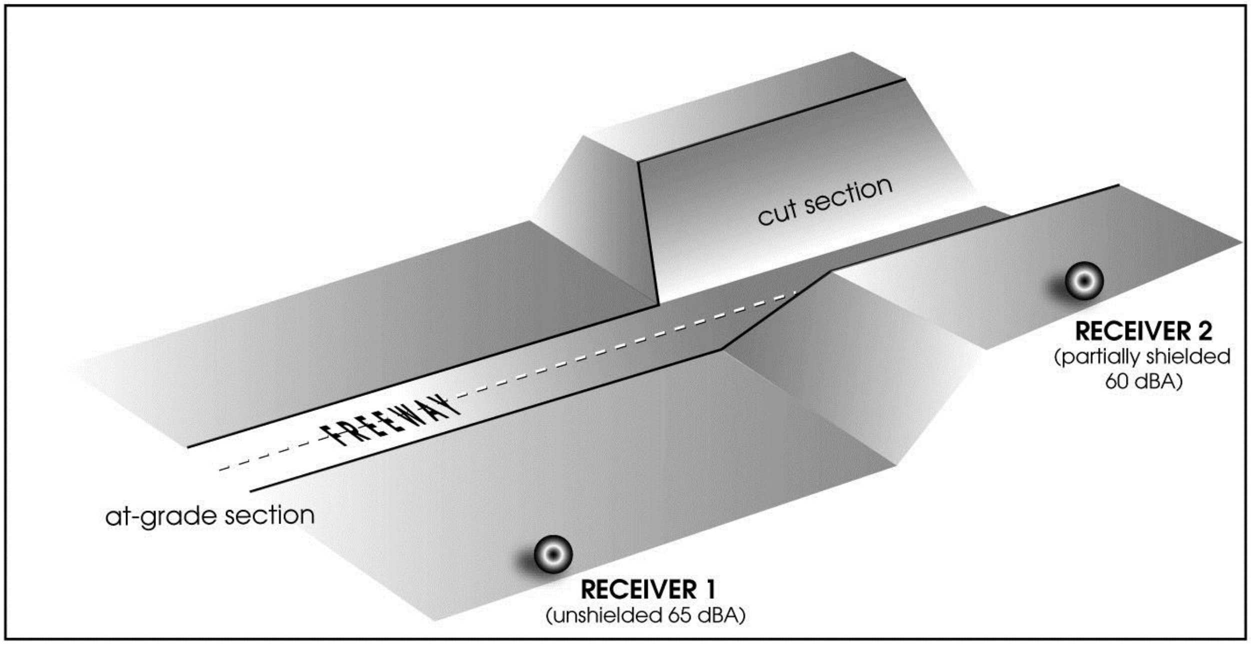


Figure 3-3. Receiver Partially Shielded by Top of Cut vs. Unshielded Receiver

3.3 Measuring Times, Duration, and Number of Repetitions

3.3.1 Measuring Times

23 CFR 772 requires that traffic characteristics that yield the worst hourly traffic noise impact on a regular basis be used for predicting noise levels and assessing noise impacts. Therefore, if the purpose of the noise measurements is to determine a future noise impact by comparing predicted noise with measured noise, the measurements must reflect the highest existing hourly noise level that occurs regularly. In some cases, weekly or seasonal variations need to be considered. In recreational areas, weekend traffic may be higher than on weekdays and may be heavily influenced by season, depending on the type of recreation. Measurements made for retrofit noise barrier projects also require noise measurements during the highest traffic noise hour.

The noise impact analysis for classrooms, under the provisions of the Streets and Highways Code Section 216, requires noise measurements to be made “at appropriate times during regular school hours” and sets an indoor noise limit of 52 dBA, L_{eq}(h), from freeway sources. Therefore, noise measurements for schools qualifying for school noise abatement under Section 216 need to be made during the noisiest traffic hour during school hours. Noise from school children often exceeds traffic noise levels. To avoid contaminated measurements, it is often necessary to vacate classrooms for the duration of the measurements or to take measurements during vacation breaks.

Noise measurements for model calibration do not need to be made during the worst noise hour, but it is desirable to have about the same estimated traffic mix (e.g., heavy truck percentages of the total volume) and speeds as during the noisiest hour. Accurate traffic counts and meteorological observations (see Section 3.6) must be made during these measurements.

Noise monitoring for background community noise levels should be done during the expected time of the highest noise level from the highway even though the measurements are taken at sites far enough removed from an existing highway that they will not be contaminated by it. This should be done because the background levels will later be added to predicted near-highway noise levels.

Noise monitoring for investigating citizen complaints may need to be done at a time to which the parties mutually agree. Frequently, these measurements are taken before or after normal working hours, as dictated by the nature of the complaint.

Construction monitoring is performed during operation of the equipment to be monitored. This may require night work on some construction projects.

Unless other times are of specific interest, before-and-after noise abatement (e.g., noise barrier) measurements to verify noise abatement performance should be done during the noisiest hour. Noise barriers are designed for noisiest hour traffic characteristics, which probably include highest truck percentages, and to minimize contamination by background noise. Traffic should be counted during these measurements. If before-and-after traffic conditions differ, measurements should be normalized or adjusted to the same conditions of traffic (see Section 3.3.1.2).

The nature of special studies and research projects dictates the appropriate times for those measurements.

3.3.1.1 Noisiest Hour for Highway Traffic

The peak traffic hour is generally not the noisiest hour. During rush hour traffic, vehicle speeds and heavy truck volumes are often low. Free-flowing traffic conditions just before or after rush hour often yield higher noise levels. Preliminary noise measurements at various times of the day are sometimes necessary to determine the noisiest hour. If accurate traffic counts and speeds for various time periods are available, the noisiest hour may be determined by using TNM. Experience based on previous studies may also be valuable in determining the noisiest hour for a particular facility.

3.3.1.2 Adjusting Other-Than-Noisiest Hour

For the sake of efficiency, highway traffic noise measurements are often not made when the highest hourly traffic noise levels occur. These measurements may be adjusted upward to noisiest hour levels by using TNM. To make the adjustments, traffic must be counted and speeds determined simultaneously with the noise measurements. The following procedure must be followed.

1. During each measurement, take noise measurements and count traffic simultaneously. Although lane-by-lane traffic counts yield the most accurate results, it is usually sufficient to count traffic by direction (e.g., east- and westbound). Separate vehicles into the five vehicle groups used by the model (autos, medium trucks, heavy trucks, buses, and motorcycles). Obtain average traffic speeds (both directions). These may be obtained by radar or driving a test vehicle through the project area at the prevailing traffic speed.
2. Expand vehicle counts for the measurement period to hourly values (e.g., if the measurement period was 15 minutes, multiply the vehicles counted in each group by 4). Section 3.3.2 discusses duration of measurement as a function of hourly vehicle volumes.
3. Enter the hourly traffic volumes and speeds from steps 1 and 2 into TNM. Also include the proper roadway and receiver geometry and site parameters. Run the model.
4. Enter the traffic volumes and speeds associated with the noisiest hour and the same roadway and receiver geometry and site parameters as used in step 3. Run the model.
5. Subtract results of step 3 from step 4. The step 4 results should always be larger than step 3.
6. Add the differences obtained in step 5 to the noise measurements of step 1.

Example

Measured noise level in step 1, L_{eq} = 66 dBA

Calculated for step 1 conditions (step 3) = 67 dBA

Calculated for noisiest hour (step 4) = 69 dBA

Difference (step 5) = 2 dBA

Measured noise level adjusted to noisiest hour (step 6) = 66 + 2 = 68 dBA

If 24-hour monitoring equipment is available, a histogram of 24 hourly noise measurements may be developed for an existing freeway. This information may then be used to adjust an off-peak hour noise level at any location along the freeway to a noisiest hour noise level. However, steps must be taken to reduce the chance of noise contamination from non-traffic sources. If hourly noise relationships are in agreement between the two monitors, there is reasonable assurance that neither was contaminated. There is, however, no assurance that regional contamination such as frequent aircraft flyovers did not take place. As such, measurements with remote noise monitoring equipment must be approached with extreme caution and only with at least some familiarity of nearby noise sources.

3.3.2 Measurement Duration

A noise measurement representing an hourly L_{eq} does not need to last the entire hour. As long as noise levels do not change significantly, a shorter time period will usually be sufficient to represent the entire hour of interest. The recommended length of measurements depends on how much the noise levels fluctuate—the higher the fluctuations, the longer the measurement must be. Vehicle spacing and differences in vehicle types are responsible for fluctuating noise levels. These fluctuations decline as traffic densities increase. Highway noise also becomes more constant as the distance from the highway increases because the rate of distance change between a moving vehicle and a receiver diminishes. The durations in Table 3-1 are recommended for highway traffic noise measurements as a function of number of vehicles per hour (vph) per lane.

Table 3-1. Suggested Measurement Durations

Traffic Volume	Vehicles per Hour per Lane	Duration (Minutes)
High	>1,000	10
Medium	500–1,000	15–20
Low	<500	20–30

Most sound level meters automatically integrate and digitally display cumulative L_{eq}. Near the beginning of each measurement period, the displays fluctuate considerably. However, after more data are collected, they tend to stabilize. The time necessary to stabilize depends on the amount of noise fluctuation. A measurement may be terminated when the range of the fluctuation in displayed L_{eq} is less than 0.5 dBA. However, measurements can be lengthened if necessary.

3.3.3 Number of Measurement Repetitions

Noise measurements taken at a specific site tend to vary. The most common causes of these variations are listed below.

- Change in traffic volumes, speeds, and/or mixes.
- Contamination from non-traffic noise sources, such as barking dogs, aircraft, nearby construction, and landscaping and road maintenance activities.
- Change in weather (e.g., wind speed, wind direction, temperature, and humidity).
- Changes in site conditions.
- Instrument, operator, or calibration error.
- Malfunctioning instruments.

Because of these potential variables and errors that may occur during a measurement, it is strongly recommended that a time-averaged measurement (e.g., the L_{eq} descriptor) be repeated at least once at each site. This procedure will reduce the chances of undetected errors. There are exceptions to this recommendation, however. Whenever three or more noise measurements are made in the same general area, simultaneously or in relatively rapid succession, one measurement at each site may be sufficient if the sites are acoustically equivalent (see Section 3.2.2.2). However, to determine whether a measurement at a particular site is acceptable, the measurement should be compared to those at the other sites and subjected to the same criteria for repeat measurements discussed later in this section.

The recommended minimum of two measurements should be taken independently (using two different setups and separate calibrations). However, the operator is not precluded from taking more than one measurement per setup and calibration. In fact, if time permits, multiple measurements during each setup are encouraged to improve accuracy. To save time concurrent measurements may be made at a single position with two separate instrument setups.

Repeat measurements should be compared with the original measurements under the same conditions of traffic, meteorology, and site. Noise contamination, instrument malfunction, operator error, or any other anomalies in the measurements can then readily be detected. To ensure that conditions are the same for all measurements, traffic counts and some basic meteorological measurements should be made during the noise measurements (see Sections 3.3.4 and 3.6). If the repeat measurements are not in reasonable agreement with the original measurements, additional measurement repetitions are recommended. For routine measurements, such as determining ambient noise levels or calibrating noise prediction models, the above-recommended minimum of two measurements normalized for differences in traffic mix and volumes should agree within 2 dBA. If more than one measurement is taken per setup, the mean noise levels for the two setups should agree within 2 dBA. Repetitive measurements for each setup should then be within about 1 dBA of the mean noise level of the setup.

The above criteria have been set empirically from many years of field experience with a variety of sound level meters approved for transportation noise measurements (American National Institute of Standards [ANSI] S1.4 1983, Types 1 and 2). Some examples illustrating these criteria are listed below and were purposely selected to show the extreme allowable limits. Usually, better agreement between setups and within setups can be expected. Examples 1 to 3 assume that all meteorological conditions, traffic conditions, and site conditions are the same throughout all measurements.

Example 1

Measurement 1

Setup 1: 74.5 dBA, L_{eq}

Setup 2: 76.5 dBA, L_{eq}

Mean: 75.5 dBA, L_{eq}

Conclusion: Measurements are acceptable because they agree by 2 dBA.

Example 2

Measurement 1

Setup 1: 69 dBA, L_{eq}

Setup 2: 71 dBA, L_{eq}

Measurement 2

Setup 1: 67 dBA, L_{eq}

Setup 2: 69 dBA, L_{eq}

Mean

Setup 1: 68 dBA, L_{eq}

Setup 2: 70 dBA, L_{eq}

Overall: 69 dBA, L_{eq}

Conclusion: Measurements are acceptable because they agree by 2 dBA and measurements within each setup are within about 1 dBA of the setups' mean.

Example 3

Measurement 1

Setup 1: 61.6 dBA, L_{eq}

Setup 2: 58.6 dBA, L_{eq}

Measurement 2

Setup 1: 59.6 dBA, L_{eq}

Setup 2: –

Mean

Setup 1: 60.6 dBA, L_{eq}

Setup 2: 58.6 dBA, L_{eq}

Overall Mean: 59.9 dBA, L_{eq} (round to 60)

Conclusion: Measurements are acceptable.

Examples 1 to 3 indicate that as long as the agreement criteria between the two setups and within each setup are met, all measurements can be averaged together. Examples 4 and 5 illustrate the process if the setups do not agree by 2 dBA.

Example 4

Measurement 1

Setup 1: 65.3 dBA, L_{eq}

Setup 2: 68.0 dBA, L_{eq}

Conclusion: Measurements are not acceptable; difference of more than 2 dBA).

After the second measurement, a decision should be made to either take another measurement during Setup 2 or break the setup and take a measurement for a new Setup 3. Either method will be acceptable, although if the decision is to take another measurement during Setup 2, and the agreement criteria still cannot be met, it is recommended to break Setup 2 and perform additional measurements with Setup 3. If agreement is reached between Setups 2 and 3, Setup 1 should be eliminated, as illustrated in Example 5:

Example 5

Measurement 1

Setup 1: 65.3 dBA, L_{eq}

Setup 2: 68.0 dBA, L_{eq}

Setup 3: 69.0 dBA, L_{eq}

Measurement 2

Setup 1: –

Setup 2: 68.5 dBA, L_{eq}

Setup 3: –

Mean

Setups 2 and 3: 68.5 dBA, L_{eq}

Conclusion: Setup 2 and 3 measurements are acceptable.

If Setup 3 measurement would have agreed with both Setups 1 and 2 (e.g., 67.0 instead of 69.0), another decision would have to be made, such as one of the following.

- Use Setups 1 and 3.
- Use Setups 2 and 3.
- Use the average of all three setups (all measurements).

The safest approach would be to use the average of all measurements unless there would be a good reason to eliminate one setup.

These examples illustrate some extreme cases; many other combinations are possible. Most measurements will show better agreement. The examples are intended to show how the recommended criteria may be applied in general. The analyst may need to rely more on individual judgment and experience in more complicated situations.

In some cases, more accuracy is required than the criteria allow. These cases apply mostly to special studies or research. However, they may also be applied to a few key noise measurement sites on a large project for the purpose of accurate model calibration. In these cases, a 95% confidence interval for the mean of several measurements (using a minimum of two setups) can be calculated. The 95% confidence interval should be specified to be no more than about 1 dBA. Table 3-2 shows the maximum allowable standard deviations (S_{max}) as a function of the number of samples (measurements). Although the table is calculated for up to 10 measurements, the criterion can be met by five or fewer measurements in most cases. A scientific calculator with statistical functions is essential when making calculations in the field.

Table 3-2. Maximum Allowable Standard Deviations for a 95% Confidence Interval for Mean Measurement of about 1 dBA

Number of Measurements	Maximum Allowable Standard Deviations
2	0.11
3	0.40
4	0.63
5	0.81
6	0.95
7	1.08
8	1.20
9	1.30
10	1.40

Example

Measurement 1

Setup 1: 67.8 dBA, L_{eq}

Setup 2: 68.7 dBA, L_{eq}

Measurement 2

Setup 1: 66.9 dBA, L_{eq}

Setup 2: 67.9 dBA, L_{eq}

Measurement 3

Setup 1: –

Setup 2: 67.8 dBA, L_{eq}

Standard Deviation (Maximum)

Setups 1 and 2: 0.73 (0.63)

Setups 1 to 3: 0.64 (0.81)

Mean

Setups 1 to 3: 67.8 dBA, L_{eq} (round to 68)

Conclusion: Use Setups 1 to 3 (five measurements).

The preceding examples assume that the previously mentioned site, traffic, and meteorological conditions remain the same during all measurements. Site conditions and contamination from other noise sources can be controlled by careful site selection. Noise contamination from intermittent sources can further be controlled by pausing the instruments during the contamination or by marking and editing recorded data.

Operator error and instrument malfunction usually cause larger errors that are easily detected. Instrument error is a function of equipment brand, type, and calibration. Instrument records of calibration, repair, performance, manufacturers' manuals, and accuracy standards (discussed later in Section 3.7) will give a good estimate of instrument error.

The next section addresses a method of normalizing noise measurements made under different traffic conditions. Meteorological limits for comparisons of noise measurements will be discussed in Section 3.6.

3.3.4 Normalizing Measurements for Differences in Traffic Mixes and Volumes

Before applying the criteria discussed in Section 3.3.3, repeated measurements must be adjusted for differences in traffic mix and volume. The effects of traffic differences can be calculated by the noise prediction models and compared with the actual differences in the measurements. However, a simple method to normalize measurements for differences in traffic mixes and volumes has been developed for optional use in the field.

This method involves field calculations that with practice can be carried out in a few minutes with a log function calculator as demonstrated in the discussion below. The repeated measurements are field-adjusted for the same traffic conditions as the first measurement. The adjusted (normalized) measurements may then be compared directly according to the criteria in Section 3.3.3.

The obvious advantage of using this method is that it may eliminate the need to return to the same site at a later date if repetition criteria are not met. However, as with most simplified methods, there are certain limitations to the use of this procedure. The method should not be used in the following cases.

- Average traffic speeds are not the same for each measurement. This is difficult to verify, but under free-flow conditions at a specific location, speeds generally will be constant.
- Truck speeds are significantly different (more than 5 mph) from auto speeds or truck percentages are significantly different (more than doubled).
- Speeds cannot be determined within 5 mph.

- The ratio of distances from the receiver to the centerline of the far (directional) lane group and the receiver to the centerline of the near (directional) lane group is more than 2:1. For most eight-lane urban freeways, this means that the receiver should not be closer than 45 feet from the edge of the traveled way.
- The directional split of traffic is different by more than 20% for each vehicle group between measurements. For example, if the directional split between heavy trucks during the first measurement is 60/40 and 80/20 or 40/60 during the next measurement, the method would be valid. However, a second split of 85/15 or 35/65 means that the method would be inaccurate. This criterion is usually met.

The method uses the concept of equivalent vehicles (V_E), which equates medium and heavy trucks to an acoustically equivalent number of autos. Based on the TNM Reference Energy Mean Emission Levels (REMELs) (Federal Highway Administration 1996b), one heavy truck traveling at 55 mph makes as much noise as approximately 10 autos cruising at the same speed. A medium truck at 55 mph is acoustically equivalent to approximately four autos passing at the same speed. These relationships are speed-dependent and the same for the maximum noise level (L_{max}) and time-averaged noise levels (L_{eq}).

The relationships do not consider source heights and may not be used if the path from the source to the measurement site is intercepted by a barrier or natural terrain feature. Table 3-3 shows V_E for speeds from35 to 70 mph in 5-mph increments, based on the FHWA TNM REMELs for baseline conditions.

Table 3-3. Equivalent Vehicles Based on Federal Highway Administration Traffic Noise Model Reference Energy Mean Emission Levels

	Equivalent Vehicles		
Speed (mph)	1 Heavy Truck	1 Medium Truck	1 Automobile
35	19.1	7.1	1
40	15.1	5.8	1
45	12.9	5.0	1
50	11.5	4.5	1
55	10.4	4.1	1
60	9.6	3.7	1
65	8.9	3.5	1
70	8.3	3.2	1

Note: Based on FHWA TNM REMELs and vehicle definitions in Federal Highway Administration 1996a and 1996b (also see Section 4.5.2).

The following is an example of calculating V_E using Table 3-3.

Given

In 15 minutes, the following traffic was counted: 76 heavy trucks, 34 medium trucks, and 789 autos. Average traffic speed was 55 mph.

Solution

76 heavy trucks = 76 x 10.4 = 790 V_E

34 medium trucks = 34 x 4.1 = 139 V_E

789 autos = 789 x 1 = 789 V_E

Total = 1,718 V_E

To normalize a noise measurement for one traffic count to another noise measurement for a different traffic count, the following procedure should be followed:

1. $L_{eq}(1)$ is the first noise measurement, which is used as the reference measurement. Convert the traffic count for $L_{eq}(1)$ to V_E, which is designated $V_E(1)$.
2. $L_{eq}(2)$ is the second noise measurement, which is to be normalized. Convert the traffic count for $L_{eq}(2)$ to $V_E = V_E(2)$.
3. *c* is the correction to be applied to $L_{eq}(2)$ for normalization to the traffic of $L_{eq}(1)$. The equation to compute *c* is $10\log_{10}[V_E(1)/V_E(2)]$. Note that *c* may be negative or positive.
4. $L_{eq}(2N)$ is the normalized $L_{eq}(2)$. The equation to compute $L_{eq}(2N)$ is $L_{eq}(2) + c$.
5. $L_{eq}(2N)$ may be directly compared to $L_{eq}(1)$ in the field to determine whether the agreement criteria discussed in Section 3.3.3 are met. If more than two measurements are made, the same procedure can be used for subsequent measurements. The same reference measurement must be used throughout the procedure.

Following is an example for determining in the field whether three 15-minute measurements for different traffic conditions meet the agreement criteria in Section 3.3.3 (for convenience the measurements have been numbered consecutively regardless of setup):

Given

		15-Minute L_{eq}					
Measurement	Setup	dBA	Heavy Trucks	Medium Trucks	Autos	Speed (mph)	Equivalent Vehicles (V_E)
1	1	74.4	100	50	1,275	55	2,520
2	1	75.5	150	100	850	55	2,820
3	2	74.0	60	30	1,700	55	2,447

Correction Calculations (Using Table 3-3)

Correction *c* for $L_{eq}(2) = 10\log_{10}\left(\frac{V_E(1)}{V_E(2)}\right) = 10\log_{10}\left(\frac{2{,}520}{2{,}820}\right) = -0.5$

$L_{eq}(2N) = L_{eq}(2) + c = 75.5 - 0.5 = 75.0$ dBA

Correction *c* for $L_{eq}(3) = 10\log_{10}\left(\frac{2{,}520}{2{,}447}\right) = 0.2$

$L_{eq}(3N) = 74.0 + 0.2 = 74.1$ dBA

Normalized Data Using Table 3-3

Measurement	Setup	Normalized L_{eq} (dBA)
1	1	74.4
2	1	75.0
3	2	74.1

Further examination indicates that the agreement criteria of Section 3.3.3 are met, and no further measurements are necessary. Please note that the normalized data are only used to determine agreement between measurements. The actual measurements and traffic counts may be used in later calculations as follows.

Average Energy of Measurements

74.5 dBA (report as 75 dBA)

Average 15-Minute Traffic Counts

Mean Heavy Trucks = $\left(\frac{100 + 150 + 60}{3}\right) = 103.3$

Mean Medium Trucks = $\left(\frac{50 + 100 + 30}{3}\right) = 60.0$

Mean Autos = $\left(\frac{1275 + 850 + 1700}{3}\right) = 1{,}275.0$

Expand Average 15-Minute Traffic Counts to 1 Hour

Mean Heavy Trucks = 103.3 x 4 = 413

Mean Medium Trucks = 60.0 x 4 = 240

Mean Autos = 1,275.0 x 4 = 5,100

The expanded average traffic counts may be used in the prediction model to calculate the noise level. The result may be compared to the energy-averaged measurement. Section 4.4 explains how this comparison may be used for "calibrating" the prediction model.

An alternative more detailed approach to normalization is contained in American Association of State Highway and Transportation Officials (AASHTO) Draft Standard TP 99-12 (American Association of State Highway and Transportation Officials 2011).

3.3.5 Classroom Noise Measurements

These measurements meet the requirements of the California Streets and Highways Code Section 216 which is discussed in the Protocol. Under these provisions:

> [t]he noise level produced by traffic on, or by construction of, a state freeway shall be measured in the classrooms, libraries, multipurpose rooms, and spaces used for pupil personnel services of a public or private elementary or secondary school if the rooms or spaces are being used for the purpose for which they were constructed and they were constructed under any of the following circumstances: …

Section 216 lists all of these circumstances and should be consulted to determine applicability of these measurements. For convenience, the rooms mentioned above will be referred to as “classrooms” in this section.

Determining a project’s traffic noise impacts on classroom interiors under Section 216 requires taking noise measurements inside the classroom. Please note that Section 216 requires that all measurements “be made at appropriate times during regular school hours and shall not include noise from other sources that exceed the maximum permitted by law.” The noise of vehicles that exceed the maximum allowable level in the California Vehicle Code (L_{max} of 90 dBA at 50 feet for vehicles traveling more than 45 mph) should be excluded. Because this is difficult, however, the requirement is ignored. It is customary to take outside and inside noise levels to determine building insertion loss. This information is useful when noise abatement is necessary.

If the project involves a reconstruction of an existing freeway, simultaneous traffic noise measurements may be taken inside and outside the classroom. Microphones should be placed as shown in Figures 3-4 and 3-5.

Figure 3-4 shows the preferred setup where microphone 1 (Mic. 1) should be placed outside the classroom at approximately the same distance from the freeway as the center of the classroom. Care must be taken to place the microphone far enough away from the building to avoid significant shielding by the corner of the building. This can be accomplished by maintaining at least a 70º angle between a perpendicular line to the freeway and a line to the corner of the building. Mic. 2 should be placed in the center of the classroom.

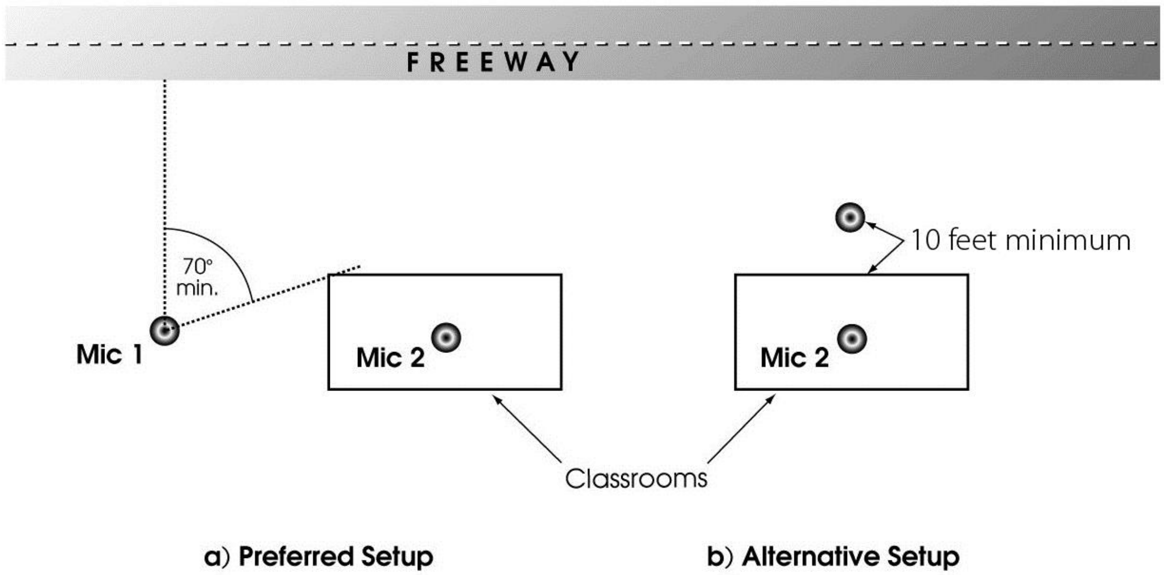


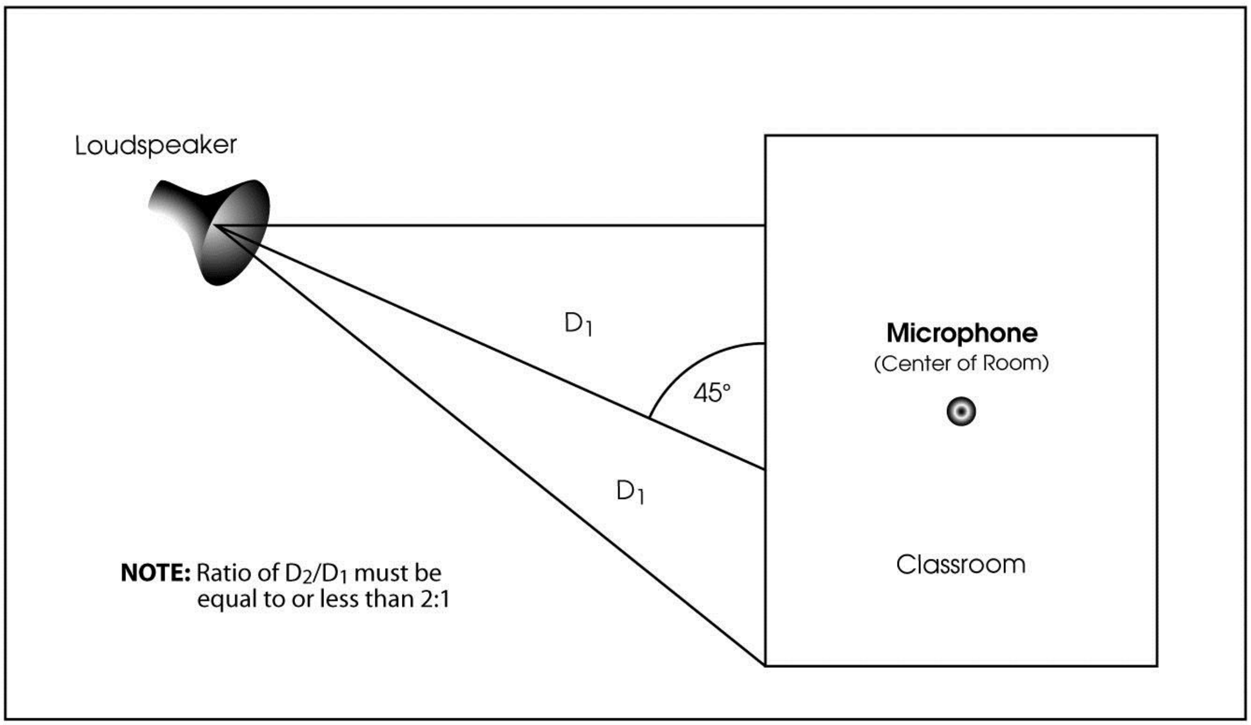
Figure 3-4. Classroom Noise Measurements (Reconstruction of Existing Freeway)

Figure 3-5 shows an alternate setup to be used if the setup shown in Figure 3-4 is not possible. Mic. 1 should be positioned at least 10 feet from the building to avoid noise reflections from the building. The disadvantage of this setup is that Mic. 1 and Mic. 2 are not equal distances from the freeway. If Mic. 1 is 200 feet or more from the freeway, the effects of unequal distances can usually be ignored. Assuming a 33-by-33-foot classroom, the error would be 0.5 dBA or less. Between 65 and 200 feet, a distance reduction of 1 dBA would have to be applied to Mic. 1 to normalize Mic. 1 to Mic. 2. If the distance from Mic. 1 to the freeway is less than 65 feet, a larger adjustment will be necessary. TNM may be used to calculate the adjustments.

If the classrooms are not air-conditioned and rely on open windows or doors for ventilation, simultaneous measurements should be made with doors and windows open and closed. The noise insertion loss provided by the building under these conditions is useful for predicting inside classroom noise levels and for choosing noise abatement options if needed. For instance, if a classroom interior is not expected to meet the inside classroom noise criterion with the windows and doors open, but will meet the criterion with them closed, noise abatement considered may include adding air conditioning.

If the project is on a new alignment or construction noise will be the dominant noise source, there is no existing traffic source that can be used to measure building attenuation. In that case, it is appropriate to use an artificial noise source to quantify building insertion loss (Figure 3-5).

Acceptable choices of an artificial source would be traffic noise audio recordings or an electronically generated noise spectrum that approximates typical traffic noise. This spectrum should be linear, from 31.5 to 500 Hz, and decrease at 6 dB per octave from 500 to 4,000 Hz. Amplification should be sufficient to produce A-weighted sound levels at least 10 dBA greater than background noise levels at exterior and interior microphone locations. A commercial-quality loudspeaker should be used with directional characteristics such that a 2,000-Hz signal measured at 45° from perpendicular to the face of the speaker is no more than 6 dB less than the level measured at the same distance on the perpendicular axis. The sound level output must be kept constant for inside and outside measurements.



Source)

The loudspeaker is a point source. To account for all the possible angles of incidence provided by a line source and to avoid reflections from the building face, the speaker should be positioned as shown in Figure 3-5 for the indoor noise measurements.

Placing the speaker and microphone so that there is a direct line of sight between them through an open door or window should be avoided. If possible, additional measurements at 15º, 30º, and 60º should be taken and the results averaged. If only one angle is used, it should be 45º.

Once the indoor measurements are completed, outdoor measurements must be taken. For the outdoor noise measurements, the distance between the speaker to the outdoor microphone should be the same as the distance between the speaker and the indoor microphone. The sound level output of the artificial source must be the same for both indoor and outdoor measurements. The difference between the measured outdoor sound level and the indoor sound level indicates the sound level reduction provided by the building shell.

Section 7.4 discusses methods for evaluating interior noise for Activity Category D land use facilities (schools, hospitals, libraries, etc.). Under the 2011 revision to 23 CFR 772 interior noise abatement for residences is no longer a federally fundable form of noise abatement.

3.4 Instrumentation

The instruments used for measuring or recording noise include a range of manufacturers, models, types, accessories, degrees of accuracy, prices, and levels of sophistication. It is not the intent of this section to discuss all details of noise instruments or to endorse certain manufacturers. Informative catalogs are available from all major manufacturers to help in deciding what equipment to purchase, and sales representatives are usually very helpful in demonstrating the equipment. Once purchased, user manuals will be useful, ready references for specific operating procedures. It is strongly recommended that Caltrans Headquarters staff be consulted before purchasing noise instrumentation.

This section will address general features common to most instruments. The categories discussed are sound level meters, recording devices, frequency analyzers, acoustical calibrators, and meteorological and other non-noise-related equipment.

3.4.1 Sound Level Meters

ANSI has established requirements for sound level meter accuracy in standard ANSI S1.4-1983 (Revision of S1.4-1973) and ANSI S1.4N-1985 Amendment to ANSI S1.4-1983. The standard defines three basic types of sound level meters.

- Type 0: Laboratory Standard (primarily designed for laboratory use).
- Type 1: Precision (field use).
- Type 2: General Purpose (field use).

The expected total allowable error for a Type 1 sound level meter in the field is about 1.5 dB; for a Type 2 sound level meter in the field, the allowable error is about 2.3 dB. These expected values of total allowable errors apply to an instrument selected at random. These errors may be reduced for a specific instrument through careful calibration and adjustment.

For each sound level meter type, the standard requires three frequency weightings (A, B, and C) and two response settings (slow and fast). In addition, the standard permits other optional features in a sound level meter, such as impulse and peak measuring capabilities and wide ranges for the display of sound levels. All sound level meters used by Caltrans or its contractors shall be of any type described above (Types 0, 1, 2, with A-weighting). The type must be marked on the meter by the manufacturer. Although sound level meters are available in a variety of configurations, they all have the following general components.

- **Microphone System (Microphone and Preamplifier):** The microphone converts air pressure fluctuations into an electrical signal that is measured by instrumentation such as the sound level meter or a third-octave band spectrum analyzer. Most microphones can be detached from the body of the meter and connected to an extension cable. To satisfy a Type 0 or 1 requirement, the microphone may need to be separated from the meter body.

  Microphones come in various diameters. The 0.5-inch-diameter microphone is used most commonly. The air condenser microphone (most common) consists of a membrane and back plate separated by an air gap. The width of the air gap fluctuates as the membrane vibrates in a sound field, thereby changing the capacitance. Microphones of sound level meters complying with the type standards are omni-directional, have a flat frequency response, and are sensitive over a wide range of frequencies.

  A compatible preamplifier, usually manufactured as part of the microphone system, should always be used. A preamplifier provides high-input impedance and constant low-noise amplification over a wide frequency range. Depending on the type of microphone, a preamplifier may also provide a polarization voltage to the microphone.

- **Wind Screen:** A spherically or cylindrically shaped screen, generally made of open-celled polyurethane. When placed over the microphone, it reduces wind noise (see Section 3.6). The wind screen should always be used, even in absence of wind, because it helps to protect the microphone against dust or mishaps.

- **Root Mean Square Detector:** Converts peak-to-peak signals to a rms signal. This measure is derived by squaring the signal at each instant, obtaining the average (mean) of the squared values, and taking the square root of this average.
- **Amplifier:** Amplifies the electrical signal.
- **Frequency Weighting Filters (A to C):** These filters are required by ANSI S1.4-1983 and ANSI S1.4-1985. The A-weighting is used internationally for environmental noise measurements (including transportation noise).
- **Slow or Fast Response Switch:** Refers to time-averaging characteristics of the sound level meter. On the slow setting, the averaging of sound levels takes place over 1-second increments. On the fast setting, the averaging time is 0.125 second. On a real-time display (digital or analog), the sound level fluctuations are easier to read on the slow setting. The fast setting, however, gives a better resolution of instantaneous sound levels.
- **Range Setting:** Allows setting of the correct range of sound levels to be measured.
- **Digital Display:** Displays instantaneous noise levels or integrated averages. Digital displays often have multi-function switches that allow the user to view various noise descriptors such as L_{eq} and L_{max}.
- **Battery Check Switch:** Allows user to check battery voltage.
- **Output:** For various recording devices.
- **Power On/Off Switch**.

Many sound level meters also have pause switches to interrupt data sampling, preset time switches that allow sampling over a predesignated time period, reset switches for starting a new sampling period, and other features.

3.4.2 Data Recording and Analysis

Professional sound level meters typically can log measured sound levels in the form of the various sound level descriptors including those described in Table 2-12. These logged values can then be downloaded to a computer for analysis using a computer spreadsheet or other analysis software.

Professional sound level meters will typically have an audio output that can be connected to an external audio recorder for recording the audio signal from the meter. Handheld solid state digital audio recorders are typically used as an external recording device. Recorders should be high-quality professional recorders with flat frequency response and high signal-to-noise ratios. Once the signal is recorded a digital signal analyzer can then be used to analyze the recorded signal using octave, one-third octave, or narrow band signal analysis equipment. Digital signal analyzers can be dedicated stand-alone units, computer software programs, or built into the sound level meter. Some sound level meters also have the ability to directly capture digital audio recordings.

3.4.3 Acoustical Calibrators

Acoustical calibrators are used to calibrate the sound level meter/recorder system in the field. The calibrator fits over the top of the microphone. Care must be taken that the microphone is properly seated in the calibrator cavity. When activated, the calibrator emits an audio signal at a reference frequency and decibel level. Most calibrators have a reference level of 94 dB or 114 dB at 1,000 Hz. Modern sound level meters generally maintain calibration within about ±0.2 dB. If field calibration values fall outside this deviation, the meter should be checked and calibrated by a laboratory accredited to perform calibrations on specified instruments.

Acoustical calibrators and sound level meters should be periodically certified for proper calibration by an appropriate certified acoustic lab.

3.4.4 Meteorological and Other Non-Noise-Related Equipment

Basic meteorological data including wind speed, wind direction, temperature, and relative humidity should be collected concurrently with most noise measurements.

An anemometer is an instrument used to measure wind speed. For general-purpose measurements at relatively close distances to a noise source, i.e., within about 100 feet, a hand-held, wind-cup anemometer and an empirically observed estimation of wind direction are sufficient to document wind conditions. For all types of measurements, the anemometer should be located at a relatively exposed position and at an elevation approximately equal to that of the highest receiver position.

Other recommended equipment includes a radar gun to measure traffic speeds, tape measures, survey levels (or hand levels), and rods to survey the site and document microphone positions with reference to landmarks, as well as watches or stopwatches to time the measurements. Portable radios or cell phones may be helpful to maintain contact with traffic counting personnel and other field personnel. Traffic count logging equipment is also very useful. Traffic can be counted and classified in real time in the field or recorded with a video camera for subsequent counting and classification.

3.5 Noise Measurement Procedures

This section addresses general procedures for routine noise measurements. Manufacturers' manuals should be consulted for operating each specific instrument. The following procedures are common to all routine Caltrans noise measurements.

3.5.1 Instrumentation Setup

The sound level meter microphone should be placed 5 feet above the ground and at least 10 feet from reflecting surfaces such as buildings, walls, parked vehicles, and billboards. Operators should be careful not to shield the microphone with their bodies during the measurements. Other obstructions between microphone and noise source should be avoided unless they are representative of the region of interest.

If the microphone is not separated from the sound level meter body, the sound level meter should be supported on a tripod. If the microphone is separated, it should be placed on a tripod or other stand.

When meteorological equipment is set up, thermometers should be in the shade, and the anemometer should have good exposure to representative winds.

3.5.2 Field Calibration

Acoustical calibrators are described under Section 3.4.3. Some calibrators provide a choice of several frequency settings. If the calibrator offers these choices, 1,000 Hz should be used for calibration. The sound level meter/recorder system can then be adjusted to this level. The procedures in manufacturers' user manuals should be followed.

The sound level meter/recorder system should be calibrated before and after each setup. If several measurements are made during the same setup, calibration may also be checked between measurements. For routine measurements, if the reading differs by less than 0.5 dB from the reference level (C_R) indicated on the calibrator, the sound level meter/recorder system does not need to be adjusted. If the reading deviates by 0.5 dB or more, or if measurements are part of a special study in which extreme accuracy is required, the sound level meter/recorder system should be adjusted within 0.1 dB of the reference level.

If the final calibration (C_F) of the acoustic instrumentation differs from the initial calibration (C_I) by 1 dB or more, all data measured with the system between the calibrations should be discarded and repeated. The instrumentation and connections should be checked thoroughly before repeating the measurements. If the final calibration is less than 1 dB from the initial calibration, all data measured with that system between the calibrations should be adjusted as follows:

$$\text{Data Adjustment} = C_R – [(C_I + C_F\}/2)] \qquad \textbf{(3-1)}$$

Example

C_R = 94.2 dB

C_I = 94.4 dB

C_F = 94.6 dB

Data Adjustment = 94.2 – [(94.4 + 94.6)/2] = -0.3 dB

All data measured in between the two calibrations should be reduced by 0.3 dB (e.g., a measurement of 66.7 dBA would become 66.4 dBA). For routine measurements, it is customary to round off and report the final adjusted value to the nearest decibel; for example, 66.4 dBA would be reported as 66 dBA, and 66.5 dBA would be reported as 67 dBA.

The field calibration procedure is described below.

1. Adequate start-up of instruments should be allowed before calibration (at least 1 minute or as specified in the manufacturer's manual). The

analyst should check that all proper connections have been made and that batteries are fresh or adequately charged.

2. The calibrator should be placed carefully over the microphone and properly seated. Touching the calibrator during calibration should be avoided.
3. If necessary make calibration adjustments as indicated in the manufacturer's user manual.

3.5.3 Measurements

Following calibration of equipment, a wind screen should be placed over the microphone. The frequency weighting should be set on "A." The proper response setting should be set at "fast" or "slow." "Slow" is typically used for traffic noise measurements. The desired sampling time, sampling interval, and noise descriptor should be selected.

During the noise measurements, any noise contamination, such as barking dogs, local traffic, lawnmowers, train passbys and aircraft, should be noted. If the sound level meter is equipped with a "pause" or "standby" switch or button, the measurement should be temporarily interrupted until the noise contamination ceases. Notes on the start time and duration of the contaminating event should be taken.

Talking during measurements should be avoided. Curious bystanders will often ask the operator about the monitoring. A possible way to avoid talking near the microphone is to stand 25 to 50 feet from it, which is far enough not to contaminate the measurement but close enough to watch the setup.

If highway noise measurements are taken, traffic should be counted simultaneously with the noise measurements. At a minimum, directional traffic should be counted separately. Traffic counts by lane are best but often not practical because they are too labor-intensive. Traffic should be divided into heavy trucks, medium trucks, autos, buses, and motorcycles as defined in TNM. Definitions of these vehicle types are addressed in Section 4. Average speeds for each vehicle group and direction should be estimated using a radar gun (if available) or test runs with a vehicle in the flow of traffic during the noise measurements.

Wind speed and direction, temperature, humidity, and sky conditions (i.e., clear, partly cloudy, overcast, fog, or haze) should be observed and documented.

After the last measurement of the setup, the equipment should be recalibrated before power is turned off. Also, if the power is interrupted during or between measurements, the instruments need to be recalibrated before additional measurements are taken. The procedure for calibration and necessary data adjustment was discussed in Section 3.5.2.

3.5.4 Documentation

Measurement data should be carefully recorded. If the data are read from a display and hand-copied on a form, the readings should be checked and confirmed by another person if possible. It is recommended that blank data logging and collection forms be printed in advance for noise data, meteorological data, traffic counts, and site data. The forms can easily be designed for various types of measurements or specific studies using word processing or spreadsheet software. Specifically, the following items should be documented:

- **Noise Measurement Sites:** A sketch should be made showing the microphone location in relation to natural or artificial landmarks. Distances should be shown to the nearest foot to such features as building corners, trees, street signs, curbs, and fences. Enough detail should be included on the sketch to enable anyone to reoccupy, at a later date, the three-dimensional (including height above ground) position of the microphone within 1 foot horizontally and 0.5 foot vertically. Accurate three-dimensional relationships between source and site should be shown. Cross sections should be obtained from accurate maps or field surveys. Sites should be located on maps showing all receivers used in the noise analysis. Global positioning system (GPS) coordinates should be noted at each position. Photo documentation is also recommended. Many digital cameras and smart phones are capable of taking pictures that are automatically geo-tagged. The district, county, route number, and post mile of the site should be included.
- **Noise Measurements:** All instruments used for the noise measurements should be recorded, including manufacturer, model number, and serial number. Also important are the calibrator make, model, serial number, reference level, frequency, and last calibration date. Names of instrument operators and persons recording the data should be shown. Pre- and post-calibration data should be shown. Site number, date, time, length of measurement, noise descriptor, pertinent settings on the sound level meter/recorder system, and noise data should be recorded. Remarks, notes of contamination, or anything that might have a possible effect on the measurement results should be included.

- **Meteorological Conditions:** Prevailing wind direction and speed during the noise measurements, temperature, relative humidity, and sky conditions should be noted. Approximate height, and location of measurements should be indicated. Date, time, site number, and name of observer should be shown also.
- **Traffic Counts:** The number of vehicles broken down by classification should be shown. It is important to indicate the location of traffic counts, number of lanes or lane groups counted, direction, length of time, time, district, county, route, post mile, names of personnel, and counts and speeds.

Care must be taken so that enough information to make necessary cross references between noise measurements, traffic counts, weather, and site information can be made later if necessary.

3.6 Meteorological Constraints on Noise Measurements

Meteorological conditions can affect noise measurements in several ways. At an ambient noise level of 40 to 45 dBA, wind speeds of more than 11 mph may begin to contaminate noise measurements with a rumbling noise because of frictional forces on a microphone covered with a wind screen. Without the screen, the effect would be present at a much lower wind speed.

Extremes in temperature and relative humidity affect critical components of sound level meters. For example, during conditions of high humidity, water condensation can form on the vibrating microphone membrane, causing a "popping" sound that can contaminate noise measurements.

Rain or snow on highway pavement can alter the levels and the frequencies of tire and pavement noise, causing it to vary in unpredictable ways from levels on dry pavements, on which vehicle noise source characteristics are based. Pavement should be dry when taking measurements. Refraction caused by wind shear or temperature gradients near the ground surface will also alter noise levels. The effects of refraction are discussed in Section 2.1.4.3. When noise levels are compared to determine the effects of a transportation project on the noise environment or to evaluate the effectiveness of a noise abatement measure, the before and after noise levels should be conducted under equivalent meteorological conditions.

The following sections include listings of meteorological constraints on noise measurements and equivalent meteorological conditions.

3.6.1 Meteorological Criteria

Noise measurements should not be made when one or more of the following meteorological conditions exist.

- Wind speeds are more than 11 mph for routine highway noise measurements.
- Manufacturers' recommendations for acceptable temperature and humidity ranges for instrument operation are exceeded. Typically, these ranges are from 14 to 122°F for temperature and 5 to 90% for relative humidity. Heavy fog conditions usually exceed 90% relative humidity.
- There are rain, snow, or wet pavement conditions. All reported highway noise levels are assumed valid for dry pavements only.

3.6.2 Equivalent Meteorological Conditions

Wind can significantly alter noise levels. Wind effects are caused by refraction (bending) of the noise rays because of wind shear near the ground. Noise rays are bent upward upwind and downward downwind from the source, resulting in a noise decrease upwind and increase downwind from a source.

Studies by Caltrans and others have shown that this wind effect can affect noise measurements significantly even at relatively close distances to noise sources. Section 3.3.3 indicates that to compare noise measurements for agreement, all site, traffic, and meteorological conditions must be the same.

Noise measurement comparisons can therefore only be made for similar meteorological conditions. ANSI S12.8 - 1998 "Methods for Determination of Insertion Loss of Outdoor Noise Barriers" recommends that meteorological equivalence be based on wind, temperature, and cloud cover. The following criteria are recommended for atmospheric equivalence average wind velocities from the source position to the receiver position. In the case of highway noise, the wind component of interest is perpendicular to the highway. The standards recommended by ANSI may be used to define meteorological equivalency for the purposes of comparing noise levels for agreement with Section 3.3.3 or any time before and after noise measurements are performed on noise barriers.

3.6.2.1 Equivalent Wind Conditions

Wind conditions are equivalent for noise measurements if the following conditions exist.

- The wind class (Table 3-4) remains unchanged.
- The vector components of the average wind velocity from the source to receiver (perpendicular to the highway) do not differ by more than a certain limit.

This limit depends on the accuracy desired and the distance from the source to receiver. To keep the measurement accuracy due to atmospheric wind conditions to within about 1 dB, this limit should be 2.2 mph for distances less than 230 feet. If it is desired to keep this accuracy within about 0.5 dB for the same distance, the measurements to be compared should each be repeated at least four times. The 2.2 mph limit does not apply to the "calm" condition. By convention, the perpendicular wind component blowing from the highway to receiver (microphone position) is positive, while the same component blowing from the receiver to highway is negative.

Table 3-4. Classes of Wind Conditions

Wind Class	Vector Component of Wind Velocity, mph
Upwind	-2.2 to -11
Calm	-2.2 to +2.2
Downwind	+2.2 to +11

For example, two measurements may be compared when their respective wind components are 0 and -2.2 mph, -2.2 and -4.4mph, or -5.5 and -7.7 mph, but not when their respective components are 1.1 mph and 3.3 mph, because of the change in wind class. For the purposes of comparison with the results from the FHWA TNM, which has no provisions for wind inputs and therefore predicts noise levels for calm (no wind) conditions, the perpendicular wind component needs to be between -2.2 and +2.2 mph.

Please note that the actual wind velocity (direction and speed) needs to be resolved into two components, with directions parallel and perpendicular to the highway. Then, only the perpendicular component is considered (as long as the actual wind speed does not exceed 11 mph, any wind velocity may be resolved in this manner). The component of wind velocity for a given set of acoustical measurements should be determined as follows.

- Monitoring wind velocity (speed and direction) throughout any period of acoustical measurements.

- Noting the average speed and direction.
- Computing from these averages the vector component of wind velocity from the source to receiver (perpendicular to the highway).

3.6.2.2 Equivalent Temperature and Cloud Cover

Measurements to be compared (e.g., before or after noise barrier measurements or repeat measurements) should be made for the same class of cloud cover, as determined from Table 3-5, and with the average air temperatures within 25°F of each other.

Table 3-5. Cloud Cover Classes

Class	Description
1	Heavily overcast.
2	Lightly overcast, either with continuous sun or sun obscured intermittently by clouds 20 to 80% of the time.
3	Sunny, with sun essentially unobscured by clouds at least 80% of the time.
4	Clear night, with less than 50% cloud cover.
5	Overcast night, with 50% or more cloud cover.

3.6.2.3 Equivalent Humidity

Although there are no strict guidelines for equivalence of humidity, an attempt should be made to pair measurements for similar conditions of humidity. For example, comparisons of measurements made under extremely dry conditions (e.g., less than 25%) with those made during humid conditions (e.g., more than 75%) should be avoided.

3.7 Quality Assurance

All sound level meters and acoustical calibrators should be periodically calibrated by the manufacturer, or by a laboratory accredited to perform calibrations on specified instruments. All calibrations should be traceable to the National Institute of Standards and Technology (NIST) in Washington, DC. For legal purposes instrument manuals and calibration and repair records should be kept on file in the office of the responsible party (e.g., District office, headquarters environmental unit). Historical data on the instrument performance may be useful in determining the reliability and accuracy of the equipment.

Section 4

Detailed Analysis for Traffic Noise Impacts

This section discusses the procedure for conducting a detailed analysis of traffic noise impacts. These procedures comply with analysis requirements of 23 CFR 772 and are consistent with standard acoustical practices.

4.1 Gathering Information

The first step in a technical noise analysis is to determine the level of detail necessary for the study, which depends on the size and nature of the project. Generally, as the size of the project, the complexity of terrain, and the population density increase, so does the amount of information and level of effort needed for an adequate noise analysis.

For the analysis, it is necessary to obtain adequate information and mapping showing project alternatives and their spatial relationships to potentially noise-sensitive areas. A "no build" alternative should be included. Early in the project, final design details usually are not available, and additional analyses may need to be performed as more details are introduced. Topographical information may also be limited in early stages of project design. Field reviews, recent aerial photographs, and online geographic data may be necessary to augment information shown on preliminary maps. Design-year traffic information for all project alternatives is also required for the analysis. Traffic count data for all state highways is available for downloading from the Caltrans website at:

http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm

4.2 Identifying Existing and Future Land Use and Applicable Noise Abatement Criteria

Existing and reasonably expected future activities on all lands that may be affected by noise from the highway must be identified (see the Protocol for details on how various land use types are addressed). Existing activities, developed lands, and undeveloped lands which have been permitted for development that may be affected by noise from the highway must be identified. Land development is considered to be permitted on the date that the land use (subdivision, residences, schools, churches, hospitals, libraries, etc.) has received all final discretionary approvals from the local agency with jurisdiction, generally the date that the building permit or vesting tentative map is issued. This information is essential to determine which NAC apply for determining traffic noise impacts. The NAC are shown in Table 4-1.

Table 4-1. Activity Categories and Noise Abatement Criteria (23 CFR 772)

Activity Category	Activity $L_{eq}[h]$[a]	Evaluation Location	Description of Activities
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[b]	67	Exterior	Residential.
C[b]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in Activity Categories A–D or F.
F			Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G			Undeveloped lands that are not permitted for development of a specific use.

[a] The $L_{eq}(h)$ activity criteria values are for impact determination only and are not design standards for noise abatement measures. All values are A-weighted decibels (dBA).

[b] Includes undeveloped lands permitted for this activity category.

23 CFR 772 requires that a minimum of one receiver be placed in all areas within a project area that are associated with Activity Categories A, B, C, D, and G. Undeveloped Activity Category

G areas are included because FHWA wants to provide a record of predicted future noise levels to local agencies so that these noise levels can be considered in future land use planning.

If there are no exterior use areas at an Activity Category E use it is not necessary to include a receiver in that area. Similarly, it is not necessary to include a receiver at an Activity Category F use. Receivers are not required for these areas because these uses are already developed and it is not necessary to inform local planning agencies about future noise levels in these areas.

4.3 Determining Existing Noise Levels

Existing noise levels may be determined at discrete locations in the project area by actual noise measurement (see Section 3) or using the TNM (see Section 4.5.1). The latter is usually the case. This section discusses how to select these locations, the methods used to determine existing noise levels, and how to “calibrate” the noise prediction model with measurements where appropriate.

4.3.1 Selecting Noise Receivers and Noise Measurement Sites

For the purposes of noise analysis, a noise receiver is any location included in the noise analysis. A noise measurement site is a location where noise measurements are taken to determine existing noise levels, and verify or calibrate the noise prediction model. Receivers and noise measurement sites may or may not coincide. Normally, there are more receivers than noise measurement sites. It is far less expensive to model (calculate) noise levels for receivers than to take noise measurements in the field. If the project involves the reconstruction of an existing facility, existing noise levels are measured at representative receivers and compared with modeled results for the conditions observed during the measurement. The difference between modeled and measured results may then be applied to the results for modeled future conditions. This process, called model calibration, is fully described in Section 4.4.

4.3.1.1 Receptors and Receivers

In the context of a 23 CFR 772 analysis the term *receptor* means a single dwelling unit or the equivalent of a single dwelling unit. A *receiver* is a single point in a noise model that can represent one receptor or multiple receptors. Within the identified land use activity categories adjacent to the project, there are typically numerous noise receptors that need to be analyzed for future noise impacts or benefits from noise abatement under consideration. It is not reasonable or possible to examine these factors at all receptors. Therefore, modeling receivers should be carefully selected to accurately represent one or more receptor locations. Some general recommendations for selecting receivers are listed below.

- Although noise impacts must be evaluated at all developed land uses, receiver locations should focus on areas of frequent human use (defined in the Protocol glossary).
- The TNM has been validated at distances within 500 feet of the highway. Receptors that are located beyond 500 feet from the project area do not need to be considered for analysis unless there is a reasonable expectation that noise impacts would extend beyond that boundary. This may require engineering judgment and supplemental noise measurements to determine impacts.
- Generally select receivers in locations that are receiving or are expected to receive the highest noise levels over the period covered by the analysis. Because in most cases impacts will be at receivers closest to the highway, most receivers should be in the first row of residences relative to the project alternative. Some common exceptions include the following.
  - Projects where realignment would move the noise sources toward receptors other than those adjacent to the existing alignment.
  - Projects involving geometry where the first row of homes is partially shielded and second-row homes actually may receive higher noise levels (e.g., roadways on high embankments).
  - Areas near the ends of proposed barriers where second- or third-row receptor sites may be needed to better define the barrier limits.
  - Projects that involve widening where additional right-of-way requirements may clear the first row of residences and turn the second row into the first.
- A noise measurement site should coincide with a modeling receiver whenever possible. However, this often may not be the case. The selected receiver location may not be a good or accessible location for setting up a sound level meter. In that case, a noise measurement site that is acoustically representative of the receiver should be selected in a more accessible location.
- Other noise-sensitive locations, such as libraries, churches, hospitals, and schools, should be included.
- Receivers that are acoustically equivalent of the area of concern should be chosen. The concept of acoustical equivalence incorporates equivalencies in noise sources (traffic), highway cross sections,

distance from the highway, topography of intervening terrain, shielding, and other pertinent factors. The region under study may need to be subdivided into subregions in which acoustical equivalence generally can be maintained. One or more of the previously mentioned acoustical factors should dictate boundaries of each subregion. The size of subregions may vary depending on the scope of the project.

- A minimum of two receivers should be selected for each acoustically equivalent region or subregion. The actual number necessary to define noise impacts depends not only on the type of project, but also on such influences as complexity of the highway profile and variability of the surrounding terrain. A highway with a straight grade or very shallow vertical curves in a relatively flat area with tract-type residential development that parallels the highway may need only a few receivers to adequately define the noise impacts. However, a project involving a major freeway that includes interchanges, cuts and fills in an area of rolling terrain, and non-tract mixed residential and commercial development is likely to need more receivers.
- Receivers are placed 5 feet above the ground elevation, unless dictated by unusual circumstances, special studies, or other requirements. Exceptions would include placing a receiver 5 feet above a wooden deck of a house situated on a steep slope, instead of 5 feet above the ground. Similar situations might be encountered where residential living areas are built above garages, where second-story levels would be more logical receiver locations.
- Noise should be evaluated at second-story elevations or at higher elevations in the case of multistory buildings when there are exterior areas of frequent human use at the higher elevations that could benefit from noise reduction. Examples include large patios or decks that are the primary outdoor use area in an apartment complex. Clearly, it will not be feasible or reasonable to construct a wall that protects a receiver location several stories above a freeway. There may, however, be situations where an upper story of a building is at the same elevation as the highway (i.e., the highway is on a fill section). In this case, it may be both feasible and reasonable to build a wall to reduce noise at the upper stories.
- To determine the number of benefited receptors (defined in the Protocol glossary), it is usually necessary to include receivers in the first, second, and third rows of residences (or beyond in some cases) in the noise analysis.

4.3.1.2 Noise Measurement Sites

The selection of noise measurement locations requires planning and foresight by the noise analyst. A fine balance should be achieved between a sufficient number of quality locations and the cost and availability of resources. Preliminary design maps, cross sections, aerial photographs, and field survey data are all helpful sources of information for selecting noise measurement sites, but the sites should be selected only after a thorough field review of the project area. Some recommended site characteristics common to all outside noise measurement sites are listed below.

- Sites should be clear of major obstructions. Reflecting surfaces such as walls of residences should be more than 10 feet from the microphone positions.
- Sites should be free of noise contamination by sources other than those of interest. Sites located near barking dogs, lawn mowers, pool pumps, air conditioners, etc. should be avoided unless it is the express intent to measure noise from these sources.
- Sites should be acoustically representative of areas and conditions of interest. They should either be located at or represent locations of frequent human use.

In addition to these general requirements, the selection of noise measurement sites is governed by the same general guidelines as those for selection of receivers in Section 4.3.1.1. Of particular importance is the concept of acoustical equivalence for representativeness of the area of concern. More detailed considerations are discussed in Section 3.2.

4.3.2 Measuring Existing Noise Levels

When possible, existing noise levels should be determined by field measurements. As with all field work, quality noise measurements are relatively expensive, requiring time, personnel and equipment. The noise analyst should carefully plan the locations, times, duration, and number of repetitions of the measurements before taking the measurements. Meteorological and other environmental conditions can significantly affect noise measurements. Particular attention should be given to the meteorological and environmental constraints described in the Section 3.6.

In the noise analysis for a project, the noise measurements are used to determine existing ambient and background noise levels, and to calibrate the noise prediction model when appropriate. Section 3 provides details of noise measurement methods.

4.3.3 Modeling Existing Noise Levels

Noise levels near existing facilities can also be determined by modeling. Although measurements are preferred, adverse environmental conditions, construction, unavailability of good measurement sites, or lack of time may make it necessary to calculate existing noise levels using TNM. However, this can only be done in areas where a defined highway source exists with minimal influence from traffic on other roads in the area or other contaminating noise sources.

Often, a combination of measurements and modeling at various receivers is used to determine existing noise levels. In addition to the measurement sites, additional receivers are modeled to establish better resolution of existing noise levels. Measurements are used in a process called model validation and calibration, which is discussed in the following section. This process can be applied to the additional modeled receivers for determining existing noise levels at a greater resolution. Model validation and calibration ensure that existing noise levels at the measured and modeled receptors are in reasonable agreement.

4.4 Validating/Calibrating the Prediction Model

The main purpose of modeling is to predict future noise levels. The computer model (TNM) and procedures used to predict future noise levels are discussed in Section 4.5. However, as mentioned in Section 4.3, TNM also can be used for modeling existing noise levels where measurements are not possible or undesirable because of lack of access or local environmental conditions. In both cases, the model should be validated with measurements and calibrated if necessary. This section, which discusses the model validation/calibration procedures that rely on measurements and modeling, should be used with Section 4.5. However, for convenience, all information needed except for running the model is contained in this section.

TNM cannot account for all the variables present in the real world. It uses relatively simple algorithms to approximate physical processes that are complex in nature. TNM for projects involving existing roadways should always be validated for accuracy by comparing measured sound levels to modeled sound levels using traffic data collected during the measurement. If modeled sound levels do not match measured sound levels within ±3 dB the model parameters should be reviewed and adjusted if necessary to ensure that they accurately represent actual site conditions. If the measurements and model results are still not in agreement, the model should be calibrated.

This section discusses the model calibration process. Section 4.4.1 addresses model calibrations that are routinely performed by Caltrans. The procedures for these are straightforward but rely on sound judgment and place a heavy burden on quality noise measurements.

4.4.1 Routine Model Calibration

4.4.1.1 Introduction

The purpose of model calibration is to fine-tune the prediction model to actual site conditions that are not adequately accounted for by the model. In general, model calibrations are recommended if the site conditions, highway alignment, and profile in the design year relative to existing conditions are not expected to change significantly.

Model calibration is defined as the process of adjusting calculated future noise levels by algebraically adding a calibration constant derived from the difference between measured and calculated noise levels at representative sites. The difference—calibration constant, K-constant, or K—is defined as measured noise level M minus calculated noise level C, or $K = M - C$. Please note that K is positive when M is greater than C, and K is negative when M is less than C. In this section, a distinction will be made between calculated and predicted noise levels as follows:

- Calculated noise levels (existing or future) are the results of the model.
- Predicted noise levels are adjusted or calibrated calculated values.

4.4.1.2 Limitations

Highways constructed along new alignments and profiles do not lend themselves to model calibration. The site before project construction does not include the new highway. Ambient noise levels are generated by typical community noise sources, such as lawn mowers, air conditioners, and barking dogs, which cannot be modeled with TNM.

Highway reconstruction projects that significantly alter alignments and profiles of an existing highway are also poor candidates for model calibration. However, predictions of future noise levels for simple highway widening projects, design of retrofit noise barriers, or other improvements that do not significantly change highway alignment or profile are good candidates for model calibration as long as other site conditions do not change.

4.4.1.3 Pertinent Site Conditions

To determine whether the model can be calibrated successfully, the site conditions that are allowed to change between the present and the expected life of the project should be examined first. For this purpose, site conditions should be divided into two groups:

- **Group 1:** Site conditions that can be accounted for by the model, which include the following.
  - Traffic mix, speeds, and volumes.
  - Noise dropoff rates, terrain conditions, ground types, and distances.
  - Opaque barriers (noise transmission through barrier material may be ignored [i.e., high transmission loss]).
  - Roadway and barrier segment adjustments.
  - Receptor locations.
  - Grade corrections.
  - Pavement type.

  Note that FHWA policy requires the use of the “average” pavement type for design year traffic noise predictions. Alternative pavement types such as dense-graded asphaltic concrete (DGAC), Portland cement concrete (PCC), and open-graded asphaltic concrete (OGAC) can be used in the model validation process if actual existing pavements are one of these types of alternative pavements.

- **Group 2:** Site conditions that cannot be accounted for by the model and therefore are ignored, although they affect the local noise environment. These include the following.
  - Non-typical vehicle noise populations such as farm equipment, recreational vehicles, or vehicles with studded snow tires or aggressive tread (i.e., designed for mud and snow conditions).
  - Transparent shielding (noise transmission through material is significant [i.e., low transmission loss], and such materials include wood fences with shrinkage gaps [noise leaks] and areas of heavy brush or trees).
  - Reflections off nearby buildings and structures.
  - Meteorological conditions.

For the purposes of model validation and calibration, Group 1 site conditions are allowed to change somewhat. The degree to which conditions can change is a judgment call and is discussed further in

Section 4.4.1.5. Group 2 site conditions, however, are not allowed to change. These conditions affect noise levels to an unknown extent but are ignored by the model. As long as they remain constant during the entire analysis period, they may be corrected for with *K*. If they change at some point in the future, however, *K* also must change by an unknown amount, and model calibration becomes invalid.

Some cautions and challenges associated with Groups 1 and 2 site conditions are discussed in Section 4.4.1.5. First, however, the calibration procedures will be explained.

4.4.1.4 Procedures

The actual mechanics of model calibration are fairly straightforward.

1. Select locations along the existing highway that are representative of the area of interest.
2. Take noise measurements at these locations and count traffic, preferably during the peak noise hour. If this is not possible, select any other time during which traffic mix and speeds (not necessarily volumes) are roughly similar to the noisiest time. This may be estimated. Typically, this condition occurs during daytime whenever traffic is free-flowing.
3. Calculate the noise levels with the prediction model using the traffic counts (expanded to 1 hour), site geometry, and any other pertinent existing features.
4. Compare measured and calculated noise levels. If these values differ by more than 3 dB check traffic data and model parameters to ensure they represent actual site conditions. If the values continue to differ by more than 3 dB then calibrate the model using the difference. The difference, *K*, is determined as follows:

$$K = \text{Measured} - \text{Calculated, or } K = M - C \quad \textbf{(4-1)}$$

Add K to the future calculated noise levels to obtain predicted noise levels *P*:

$$P = C + K \quad \textbf{(4-2)}$$

The following illustrates the mechanics of the calibration procedure with some typical values.

Example

Existing Noise Levels (L_{eq}[h], dBA)	Future Noise Levels (L_{eq}[h], dBA)
73 (C_1)	75 (C_2)
70 (M)	? (P_1)

$K = M - C_1 = 70 - 73 = -3$ dBA

$P_1 = C_2 + K = 75 + (-3) = 72$ dBA

The predicted future noise level is 72 dBA. In essence, although the model calculated the future noise level to be 75 dBA, it is expected that the actual future noise level will be 72 dBA, possibly because of the inability of the model to account for existing obstacles or other site features that attenuate noise.

4.4.1.5 Cautions and Challenges

Section 4.4.1.3 indicated that Group 1 conditions (those conditions that can be accounted for in the model) are allowed to vary. Experience has shown that significant changes in traffic volumes, speeds, and mix, as well as shielding by barriers more than 6 feet high and segment adjustments within the range normally encountered, can be accounted for adequately by the model. The main problem areas in Group 1 site conditions pertaining to model calibrations are differences in source-to-receiver distances and low barriers.

First, distances should be considered. No model can satisfy all conditions encountered in the real world. Therefore, *K* tends to be at least somewhat distance-dependent. This has two major implications for the calibration process.

- Source-to-receiver distances, their relative heights, and the groundcover between them should not change significantly during the analysis period. Slight changes in distances (e.g., from widening projects) or even slight changes in profile or receiver height are permissible. Also, the differences between ground effects before and after construction of a noise barrier appear to be adequate in the model.
- Receivers need to be selected for several representative distances to include the effects of propagation inaccuracies in *K*. Each receiver may have a different *K*. The user must decide on their radius of influence and whether to group some *K*'s together (if they are close enough). This is clearly a matter of judgment based on experience.

The second Group 1 challenge relates to attenuation from low ground features or barriers. Although it is Caltrans' policy to build barriers that are at least 6 feet high, it is possible that the existing condition includes a low rise in terrain, a hinge point, or a low barrier. Because these features will result in some degree of attenuation, it is important to include these low ground features or barriers in the model if calibration is going to be conducted. Meteorology is one of the major challenges in Group 2 site conditions. The effects of wind speed and direction or temperature inversions on noise levels at a receiver can be substantial, even at relatively short distances from a highway. (Refer to Section 2.1.4.3 for more details on these effects.) Because the prediction model does not take weather into consideration, noise measurements should be taken under calm wind conditions. Strong temperature inversion conditions should be avoided as well. Temperature inversion conditions can occur during warm summer and fall months with cool morning conditions. Section 3.6 discussed the criteria for identifying calm winds. Any attempt to calibrate the model for a prevailing wind condition is only valid for that condition. Noise standards, however, are not linked to weather.

Finally, noise contamination from other sources not considered by the model cannot be corrected by model calibration, as illustrated in the following hypothetical case. In this case, at a calibration site, the existing measured noise level is 68 dBA. This freeway noise level is contaminated by nearby surface streets and other neighborhood noises and the freeway contribution and background noise cannot be separated from the measurement. It is not known that the freeway traffic and background noise contribute 65 dBA each, for a total of 68 dBA. The existing noise level from the freeway was calculated to be 65 dBA, which happens to agree with the actual freeway contribution. There is no reason to believe that the background noise will change in the future. Therefore, the model is incorrectly calibrated. The calculated future noise level is 70 dBA. However, the predicted future level must be determined. This problem is outlined below.

Existing Noise Levels	**Future Noise Levels**
Freeway: 65 dBA (unknown)	Freeway: 70 dBA (unknown)
Background: 65 dBA (unknown)	Background: 65 dBA (unknown)
Total: 68 dBA (measured)	Total: 71 dBA (actual)
Freeway: 65 dBA (calculated)	Freeway: 70 dBA (calculated)
K = M – C = 68 – 65 = 3	Freeway: ? dBA (predicted)

Predicted Freeway

$$P = C + K = 70 + 3 = 73 \text{ dBA}$$

(Compared with 71 dBA actual)

In this situation, the calibration process caused an overprediction of 2 dBA, although the background remained the same during the analysis period. Therefore, background noise high enough to contaminate the noise measurements cannot be considered a Group 1 or 2 site condition. In short, it represents a site condition that precludes the use of model calibration.

Noise measurement sites should be carefully selected to eliminate as many Group 2 site conditions as possible and to avoid any contamination. Contamination occurs when the sound level of an undesired noise source is within 10 dBA of the noise source of interest. A quick check for contamination can be performed by viewing the instantaneous sound level on a sound level meter. If the meter responds at all to fluctuations of the undesired source, the noise level likely will be contaminated.

4.4.1.6 Tolerances

Model accuracy is usually sufficient when the difference between measured and model sound levels is less than 3 dB. Because of the inherent uncertainties in the measurements and calibration procedures, model calibration should not be attempted when calculated and measured noise levels agree within 1 dBA. If there is great confidence in the accuracy and representativeness of the measurements, calibration may be attempted when calculated noise levels are within 2 dBA of the measured values. Differences of 3 to 4 dBA may routinely be calibrated unless the validity of the measurements is in serious doubt. Differences of 5 dBA or more should be approached with caution. The analyst should retake measurements, look for obvious causes for the differences (e.g., weather, pavement conditions, obstructions, reflections), check traffic and other model input parameters (and remember to expand traffic counted during the noise measurement to 1 hour), and confirm that the traffic speeds are accurate. If differences of 5 dBA or more still exist after confirming the measurements and input parameters, the decision about whether to calibrate the model should be made after determining whether any of the responsible Group 2 site conditions will change during the project life.

4.4.1.7 Common Dilemmas

The following hypothetical cases present some common dilemmas the noise analyst may need to resolve when selecting model calibration sites. In one case, a receiver was selected in a backyard abutting a freeway right-of-way. The only obstacle between the receiver and the freeway is a 6-foot-high wood fence running parallel to the freeway. The fence boards are standard ½ - by 6-inch boards with shrinkage gaps between them. The question is whether this receiver should be used for model calibration measurements.

There is no clear-cut answer. If the fence is new and expected to remain in good condition for about the next 20 years and no noise barrier is planned, this probably would be a good representative location to measure existing noise levels and predict model-calibrated future noise levels for all the backyards bordering the right-of-way.

In another case, the predicted (calibrated) noise level at this receiver is high enough to qualify for a noise wall. Before the wall is constructed, the existing fence provides transparent shielding, a Group 2 site condition. After the wall is constructed, however, any effect from the fence will be eliminated, regardless of whether the fence remains (i.e., the effects of a Group 2 site condition change). In this case, the location would be a bad choice for model calibration.

In many cases, it is uncertain whether noise levels are high enough to justify noise barriers until the noise is measured. There are also no assurances of the longevity of wooden backyard fences. In the preceding case (and for wooden privacy fences in general), it is good policy to pick for calibration purposes locations on the freeway side of the fence or on a side street that dead-ends at the freeway right-of-way. Similar situations may exist in areas of heavy shrubs or dense woods.

Shielding by a solid barrier such as by a masonry block wall of at least 6 feet in height, can be adequately addressed by the model and does not represent a problem in the calibration process.

4.5 Predicting Future Noise Levels

After determining the existing noise levels, future noise levels are predicted for all project alternatives under study for the analysis period. This information is needed to determine whether any of the alternatives are predicted to result in traffic noise impacts. The traffic noise prediction procedures are specified in 23 CFR 772. FHWA requires that all new project noise studies be evaluated using the federally approved TNM. An exception to this requirement may occur for a reevaluation noise study of a project that was originally analyzed using an earlier noise model. Any decision to use an earlier noise model should be reviewed and approved by Caltrans headquarters noise staff. Refer to the 2009 version of TeNS for a detailed discussion of previous noise models.

4.5.1 FHWA TNM Overview

The FHWA TNM was released on March 30, 1998. FHWA mandated that all new federal-aid highway projects that begin after January 15, 2006, be evaluated using TNM. TNM Version 2.5 is the current version as of the publishing of this document. *Federal Highway Administration Traffic Noise Model* and *FHWA TNM* are a registered copyright and trademark. This provides FHWA with the exclusive right to use these names. The copyright and trademark encompass the user's guide, technical manual, software source, and executable codes.

The following sections provide a brief overview of TNM. For detailed information, the technical manual and user's guide should be consulted. Refer to the following FHWA website for current information and guidance on TNM:

http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/tnm_v25

Additional detailed technical guidance from FHWA is available at the following website:

http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/

4.5.1.1 TNM Reference Energy Mean Emission Levels

TNM computes highway traffic noise at nearby receivers and aids in the design of noise barriers. The noise sources include an entirely new database of 1994–1995 REMELs that is detailed in *Development of National Reference Energy Mean Emission Levels for the FHWA Traffic Noise Model (FHWA TNM), Version 1.0* (Fleming et al. 1995). The database includes speed-dependent emission levels for constant speeds on level roadways from idle to 80 mph, for the following vehicle types.

- **Automobiles:** all vehicles having two axels and four tires—designated primarily for transportation of nine or fewer passengers, i.e., automobiles, or for transportation of cargo, i.e., light trucks. Generally with gross vehicle weight less than 9,900 pounds.
- **Medium Trucks:** all cargo vehicles with two axles and six tires—generally gross vehicle weight is greater than 9,900 pounds but less than 26,400 pounds.
- **Heavy Trucks:** all cargo vehicles with three or more axles—generally with gross vehicle weight greater than 26,400 pounds.

- **Buses:** all vehicles having two or three axles and designed for transportation of nine or more passengers.
- **Motorcycles:** all vehicles with two or three tires with an open-air driver/passenger compartment.

TNM contains the following pavement types.

- DGAC.
- PCC.
- OGAC.
- Average: a combination of both DGAC and PCC pavements which is comprised of, on average, approximately 75% DGAC pavement and 25% PCC pavement.

TNM defaults to *average* for pavement type. The use of any other pavement type must be substantiated and approved by FHWA. Therefore, unless definite knowledge is available on the pavement type and condition and its noise-generating characteristics, no adjustments should be made for pavement type in the prediction of highway traffic noise levels.

In addition, the database includes data for the following.

- Vehicles on grades.
- Three different pavements (DGAC, OGAC, and PCC).
- Accelerating vehicles.
- Acoustic energy apportioned to two subsource heights above the pavement (0 feet and 5 feet for all vehicles, except for heavy trucks, where the subsource heights are 0 feet and 12 feet).
- Data stored in one-third-octave bands.

The TNM Baseline REMEL curves shown in Figure 4-1 were plotted from the following TNM Baseline equations:

$$\text{Speed} = 0 \text{ (idle)}: L(s_i) = 10\log_{10}(10^{C/10}) \quad \textbf{(4-3)}$$

$$L(s_i) = C \quad \textbf{(4-4)}$$

$$\text{Speed} > 0\text{: } L(s_i) = 10\log_{10}[(0.6214s_i)^{A/10} + 10^{B/10} + 10^{C/10}] \quad \textbf{(4-5)}$$

Where:

$L(s_i)$ = REMEL for vehicle type *i* at speed *s* in kilometers per hour

s_i = speed of vehicle type *i* in kilometers per hour

A, B, C are constants for each vehicle type, shown below (Table 4-2)

Note: For speeds in miles per hour omit 0.6214 in Equation 4-5.

Table 4-2. TNM Constants for Vehicle Types

	Constants		
Vehicle Type	A	B	C
Autos	41.740807	1.148546	50.128316
Medium trucks (two axles, dual wheels)	33.918713	20.591046	68.002978
Heavy trucks (three axles)	35.879850	21.019665	74.298135

Note: Baseline REMELs = REMELs for the following conditions.

- Average pavement (average for all pavements in the study, including PCC, DGAC, and OGAC).
- Level roadways (grades of 1.5% or less).
- Constant-flow traffic.
- A-weighted, total noise level at 50 feet.

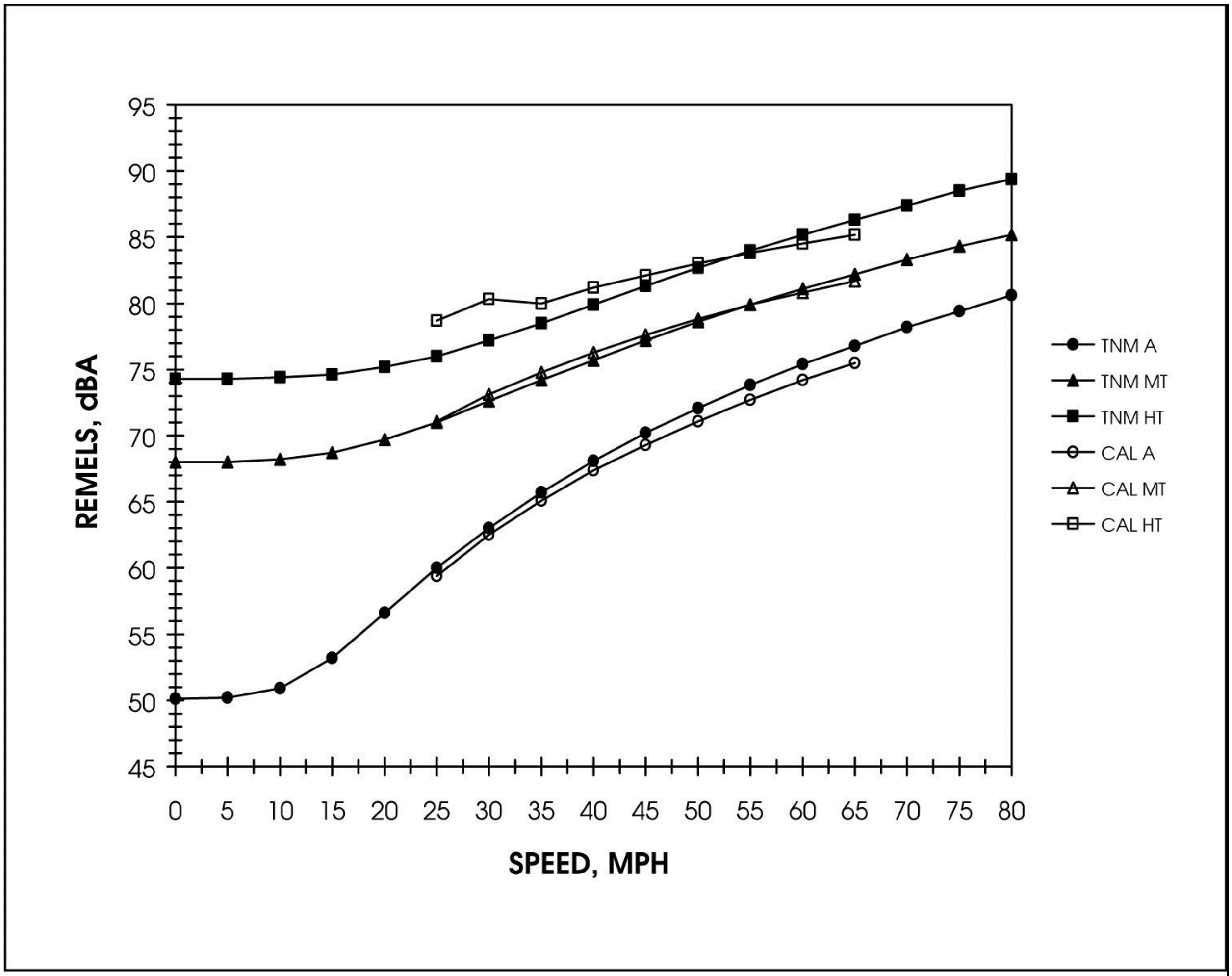


Figure 4-1. A-Weighted Baseline FHWA TNM REMEL Curves

4.5.1.2 Noise Level Computations

TNM calculations of noise levels include the following components.

- Three noise descriptors (L_{eq}[h], L_{dn}, and CNEL—see Section 2.2.2.2).
- Capability of inserting traffic control devices, including traffic signals, stop signs, tollbooths, and on-ramp start points (the TNM calculates vehicle speeds and emission levels, and noise levels accordingly).
- Computations performed in one-third-octave bands for greater accuracy (not visible to users).
- Noise contours if specified.

Roadways and roadway segments define noise source locations (x-y-z coordinates). Hourly traffic volumes determine the noise characteristics of the source.

4.5.1.3 Propagation, Shielding, and Ground Effects

The TNM incorporates sound propagation and shielding (e.g., noise barriers) algorithms, which are based on research of sound propagation over different ground types, atmospheric absorption, and shielding effects of noise barriers (including earth berms), ground, buildings, and trees. However, the TNM does not include the effects of atmospheric refraction, such as varying wind speed and direction or temperature gradients. TNM propagation algorithms assume neutral atmospheric conditions (zero wind speed, isothermal atmosphere). The propagation algorithms can use the following user input information.

- Terrain lines (x-y-z coordinates) define ground location. Source and receiver heights above the ground are important in noise propagation.
- Ground zones (x-y-z coordinates) define perimeters of selected ground types. Ground type may be selected from: a ground-type menu (e.g., lawn, field grass, pavement), specified default, or user input flow resistivity (if known).
- Berms may be defined with user-selectable heights, top widths, and side slopes. They are computed as if they are terrain lines.
- Rows of buildings (x-y-z coordinates) with percentage of area shielded relative to the roadways may be input to calculate additional attenuation.
- Tree zones (x-y-z coordinates) may be included for additional attenuation calculations if appropriate.

The propagation algorithms also include double diffraction. The net diffraction effect is computed from the most effective pair of barriers, berms, or ground points that intercept the source-to-receiver line of sight.

4.5.1.4 Parallel Barrier Analysis

TNM calculates the noise reduction provided by a barrier placed between a roadway and a receiver. If another barrier is placed on the opposite side of the roadway there is potential for multiple reflections between the two barriers to degrade the noise reduction provided by the original barrier at the receiver. (See Section 5.1.7.4 for a detailed discussion of this issue.)

TNM cannot directly calculate the degradation in barrier performance caused by parallel barriers. There is however a separate two-dimensional module in the program that can calculate the degradation caused by multiple reflections at a single receiver for a given parallel barrier configuration. This degradation, expressed in dB, is then applied to the TNM model results for that receiver.

4.6 Comparing Results with Appropriate Criteria

After the predicted noise levels (including model calibration, if appropriate) have been determined, they should be compared with the appropriate impact criteria in the Protocol. Examination of traffic noise impacts includes comparing the following for each project alternative when appropriate.

- Predicted noise levels with existing noise levels (for “substantial increase” impacts).
- Predicted noise levels with the appropriate NAC (for “approach or exceed” impacts).
- Predicted noise level of classroom interior with 52 dBA-L_{eq}(h) (as required by California Street and Highways code).

4.7 Evaluating Noise Abatement Options

If traffic noise impacts have been identified, noise abatement must be considered. Noise abatement measures may include those listed in the Protocol. These potential measures are based on avoiding impacts, interrupting noise paths, or protecting selected receptors. If the project alternative locations are flexible, alignments and profiles can be selected to avoid sensitive receptors or reduce the noise impacts. Most often, highway alignments and profiles are selected based on other overriding factors. The construction of noise barriers is usually the most common noise abatement option available. The consideration of noise abatement described in the Protocol requires at a minimum a preliminary design of the abatement. Section 5 provides guidance on the design considerations of noise barriers.

Section 5
Noise Barrier Design Considerations

The primary function of highway noise barriers is to shield receivers from excessive noise generated by highway traffic. Although there are other strategies for attenuating transportation-related noise, noise barriers are the most common noise attenuation option used by Caltrans.

Many factors need to be considered in the proper design of noise barriers. First, barriers must be acoustically adequate. They must reduce the noise as described by policies or standards. Acoustical design considerations include barrier material, locations, dimensions, shapes, and background noise levels. Acoustical considerations, however, are not the only factors leading to proper design of noise barriers.

A second set of design considerations, collectively labeled non-acoustical design considerations, is equally important. Noise barriers can have secondary effects related to security in surrounding areas, aesthetics, community continuity, and other non-acoustical factors. With appropriate planning and design these potential effects from noise barriers can be reduced or avoided.

The current edition of the *Highway Design Manual* Chapter 1100 should be consulted for specific noise barrier design criteria. Because these may change in the future, the discussion in this section will focus on general applications and consequences of the design criteria, not on the criteria themselves. The Caltrans Headquarters Division of Environmental Analysis should be consulted for the latest status.

The acoustical and non-acoustical design considerations in this section conform to the *FHWA Highway Noise Barrier Design Handbook* (Fleming et al. 2011).

5.1 Acoustical Design Considerations

The FHWA TNM described in Section 4 is used for determining proper heights and lengths of noise barriers. The models assume that the noise barriers do not transmit any sound through the barrier. Only the noise diffracted by the barrier and any unshielded segments are considered. Therefore, the material of the barrier must be sufficiently dense or thick to ensure that the sound transmission through the barrier will not contribute to the total noise level calculated by the model at the receiver.

The material, location, dimensions, and shape of a noise barrier all affect its acoustical performance. The various effects associated with these factors are discussed in Sections 2 and 4.5.

Figure 5-1 is a simplified sketch showing what happens to vehicle noise when a noise barrier is placed between the source and receiver. The original straight path from the source to receiver is now interrupted by the barrier. Depending on the barrier material and surface treatment, a portion of the original noise energy is reflected or scattered back toward the source. Another portion is absorbed by the material of the barrier, and another is transmitted through the barrier. The reflected (scattered) and absorbed noise paths never reach the receiver.

The transmitted noise continues on to the receiver with a loss of acoustical energy (redirected and some converted into heat). The common logarithm of energy ratios of the noise in front of the barrier and behind the barrier, expressed in decibels, is the TL. The TL of a barrier depends on the barrier material, primarily its weight, and the frequency spectrum of the noise source.

The transmitted noise is not the only noise from the source reaching the receiver. The straight line noise path from the source to the top of the barrier, originally destined in the direction of “A” without the barrier, now is diffracted downward toward the receiver (Figure 5-2). This process also results in a loss of acoustical energy.

Therefore, the receiver is exposed to both the transmitted and diffracted noise. Whereas the transmitted noise only depends on barrier material properties, the diffracted noise depends on the location, shape, and dimensions of the barrier. These factors will be discussed in the following sections.

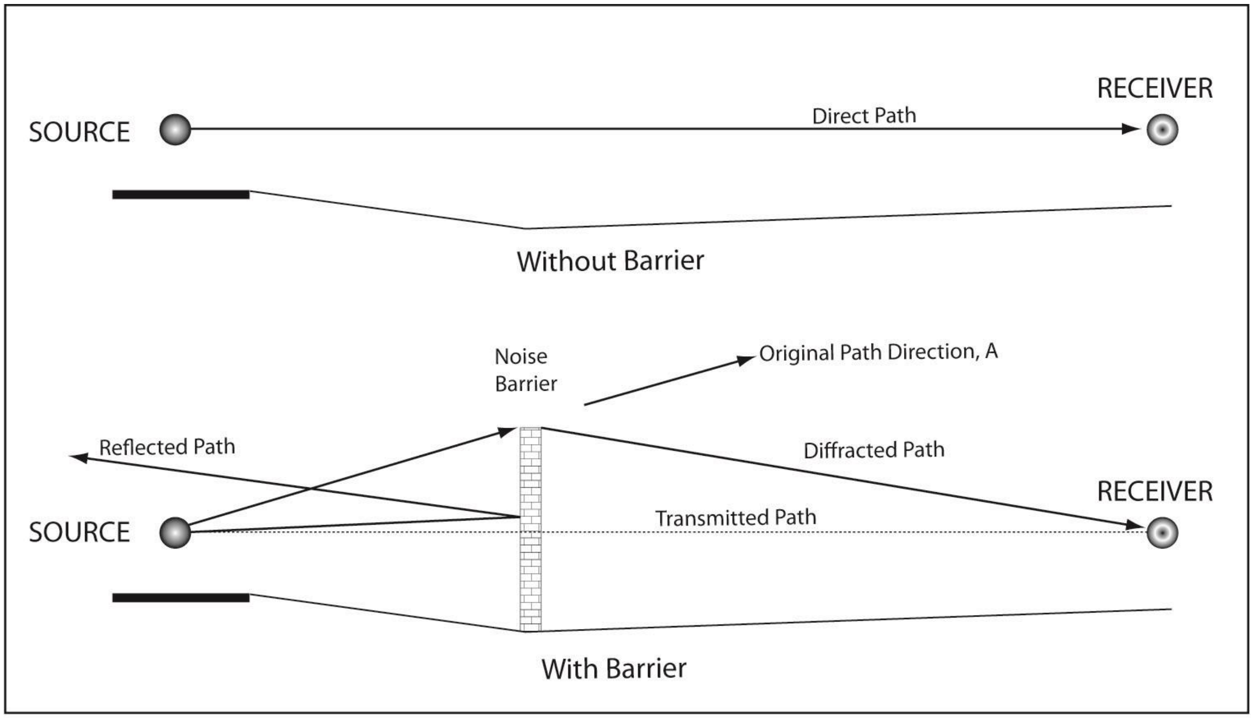


Figure 5-1. Alteration of Noise Paths by a Noise Barrier

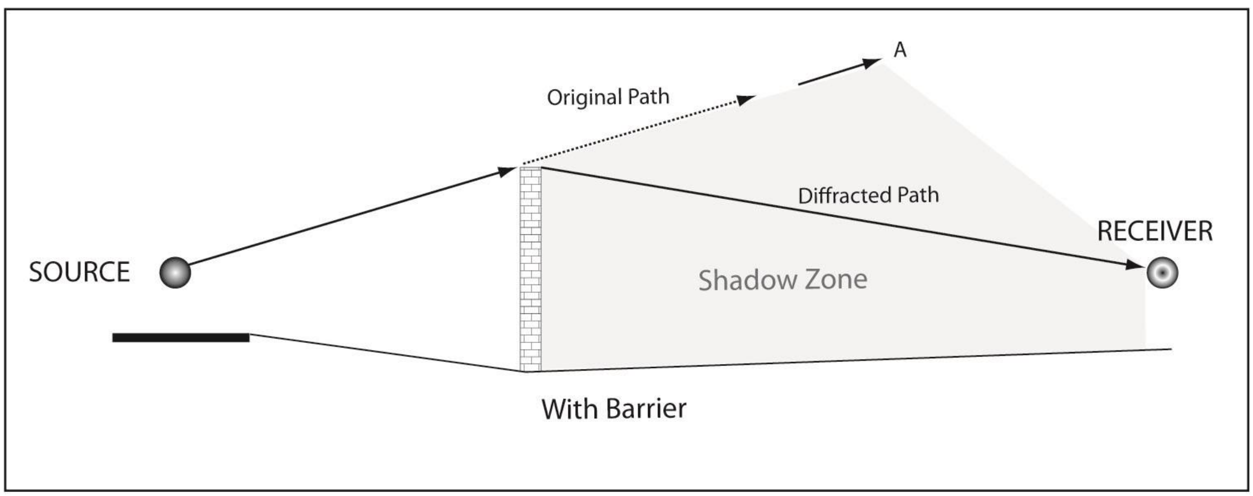


Figure 5-2. Barrier Diffraction

5.1.1 Barrier Material and Transmission Loss

For acoustical purposes, any material may be used for a barrier between a noise source and a noise receiver as long as it has a TL of at least 10 dBA more than the desired noise reduction. This ensures that the only noise path to be considered in the acoustical design of a noise barrier is the diffracted noise path. For example, if a noise barrier is designed to reduce the noise level at a receiver by 8 dBA, the TL of the barrier must be at least 18 dBA. The transmitted noise may then be ignored because the diffracted noise is at least 10 dBA more.

As a general rule, any material weighing 4 pounds per square foot or more has a transmission loss of at least 20 dBA. Such material would be adequate for a noise reduction of at least 10 dBA due to diffraction. Please note that this weight can be attained by a variety of material types. The denser a material is, the thinner it may be. TL also depends on the stiffness of the barrier material and frequency of the source.

In general the maximum noise reduction that can be achieved from a barrier is about 20 dBA for thin screens (walls) and 23 dBA for berms. Therefore, a material that has a TL of 33 dBA (23 + 10) or more would be adequate for a noise barrier in most situations.

Table 5-1 gives approximate TL values for some common materials, tested for typical A-weighted traffic frequency spectra. They may be used as a rough guide in acoustical design of noise barriers. For accurate values, material test reports by accredited laboratories should be consulted. These product specifications can usually be provided by the manufacturer.

Table 5-1. Approximate Transmission Loss Values for Common Materials

Material	Thickness (Inches)	Weight (Pounds per Square Foot)	Transmission Loss (dBA)
Concrete block, 8 by 8 by 16 inches, light weight	8	31	34
Dense concrete	4	50	40
Light concrete	6	50	39
Light concrete	4	33	36
Steel, 18 gage	0.050	2.00	25
Steel, 20 gage	0.0375	1.50	22
Steel, 22 gage	0.0312	1.25	20
Steel, 24 gage	0.025	1.00	18
Aluminum, sheet	0.0625	0.9	23
Aluminum, sheet	0.125	1.8	25
Aluminum, sheet	0.25	3.5	27
Wood, fir	0.5	1.7	18
Wood, fir	1	3.3	21
Wood, fir	2	6.7	24

Material	Thickness (Inches)	Weight (Pounds per Square Foot)	Transmission Loss (dBA)
Plywood	0.5	1.7	20
Plywood	1	3.3	23
Glass, safety	0.125	1.6	22
Plexiglas	0.25	1.5	22

Table 5-1 assumes no openings or gaps in the barrier material. However, some materials such as wood are prone to develop openings or gaps because of shrinkage, warping, splitting, or weathering. These openings decrease the TL values. The TL of a barrier material with openings can be calculated if the ratio of area of openings to total barrier area and TL of the material are known. The following formula can be used to calculate the transmission loss with the openings (TL_o):

$$TL_o = TL - 10\log_{10}(A_o * 10^{TL/10} + A_c) \quad \textbf{(5-1)}$$

Where:

TL_o = transmission loss of material with openings

TL = transmission loss of material without openings

A_o = area of openings as a fraction of the total area of the barrier

A_c = area of closed portion as a fraction of the total area of the barrier = $1 - A_o$

This method of calculation assumes that the openings or gaps are distributed uniformly over the surface of a barrier. For example, a barrier made of 2-inch-thick fir planks has openings that make up about 5% of the total area and are about equally distributed. The transmission loss of the material with these gaps can then be determined. From Table 5-1, the TL for 2-inch fir is 24 dBA. A_o is 5%, or 0.05; A_c is 1 – 0.05 = 0.95. Therefore:

$$TL_o = 24 - 10\log_{10}(0.05 * 10^{2.4} + 0.95) = \textbf{12.7, or about 13 dBA}$$

The reduced TL could affect the barrier’s performance. For example, it is assumed that before the barrier the noise level was 75 dBA and the intention was to reduce noise levels by 10 dBA (i.e., the diffracted noise was to be 65 dBA, and the transmitted noise was to be 75 – 24 = 51 dBA). The total noise level would have been 65 + 51 = 65 dBA. With the gaps, however, the transmitted noise is now 75 – 13 = 62 dBA, and the total noise level is 65 + 62 = 66.8 dBA. The effectiveness of the barrier is reduced by almost 2 dBA. Instead of a designed noise reduction of 10 dBA, an actual noise reduction of only 8 dBA will be realized in this case.

Properly treated materials will reduce or eliminate noise leakage. For example, lumber should be treated with preservatives that provide proper penetration and do not interfere with any protective coatings (e.g., paint) to be applied later. The wood also should have a low moisture content, requiring kiln drying after waterborne preservatives have been used. Wood planks should have tongue-and-groove deep enough to allow for shrinkage without gaps to maintain a high TL. Such tongue-and-groove is usually non-standard.

Several other ratings are used to express the ability of materials in specific construction configurations to resist sound transmission. Two of these are the Sound Transmission Class (STC) and Exterior Wall Noise Rating (EWNR). Both are most often used in conjunction with indoor acoustics.

STC is universally accepted by architects and engineers. The rating uses a standard contour against which the TL values in one-third-octave bands are compared in the frequency range between 125 and 4,000 Hz. The standard contour is moved up or down relative to the test curve until the sum of the differences between them is 32 dB or less, and the maximum difference at each one-third-octave center frequency is no more than 8 dB. The STC is the TL value of the standard contour at the 500-Hz center frequency.

The disadvantage of this rating scheme is that it is designed to rate noise reductions in frequencies of normal office and speech noises, not for the lower frequencies of highway traffic noise. The STC can still be used as a rough guide, but it should be pointed out that for frequencies of average traffic conditions, the STC is 5 to 10 dBA more than the TL. For example, material with an STC rating of 35 has a TL of about 25 to 30 dBA for traffic noise.

The EWNR rating scheme is different from the STC in that it uses a standard contour developed from typical highway noise frequencies. Therefore, it agrees closely with the A-weighted TL for traffic noise. The FHWA *Highway Traffic Noise: Analysis and Abatement Guidance* (Federal Highway Administration 2011) provides further useful information for calculating outdoor to indoor traffic noise reductions.

5.1.2 Barrier Location

The previous section indicated that by selecting materials with sufficient TL, noise transmitted through a barrier may be ignored because its contribution to the total noise level is negligible. The only remaining noise of concern is diffracted noise. Sections 2 and 4 discuss the basics of diffraction and barrier attenuation. The principal factor determining barrier attenuation is the Fresnel number, which is related to the path length difference (PLD) between the original straight line path between the source and receiver (source–receiver) and the diffracted path, described by the source, to top of the barrier, to the receiver (source–top of barrier–receiver). The greater this difference, the greater the barrier attenuation, to a limit of 20 dB for walls and 23 dB for berms. Figure 5-3 shows the PLD concept.

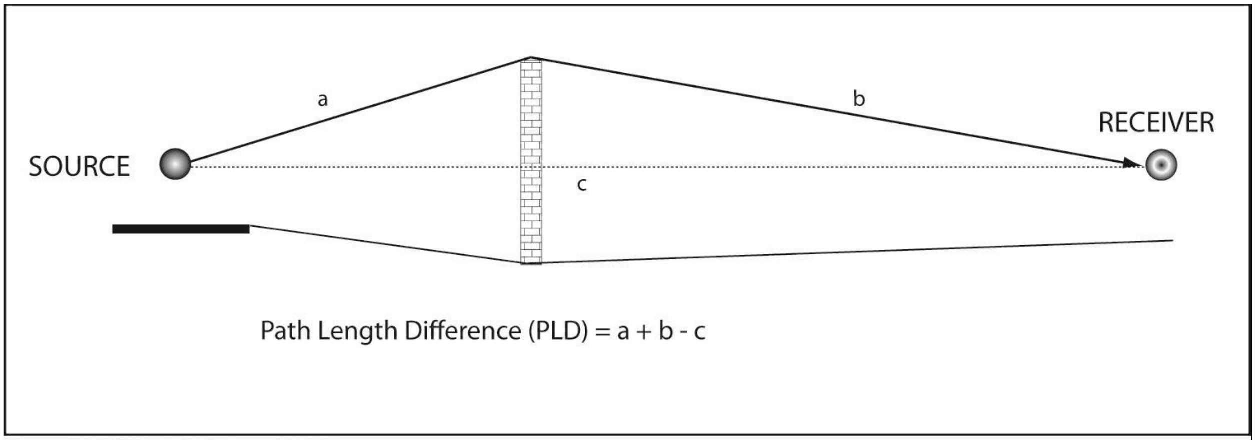


Figure 5-3. Path Length Difference

In level, at-grade roadway-receiver cross sections, a noise barrier of a given height provides greater barrier attenuation when it is placed either close to the source or close to the receiver. The least effective location would be about halfway between the source and receiver. Figure 5-4 shows these situations for two source heights (autos and heavy trucks). Location *b* gives the lowest barrier attenuations for a given barrier height.

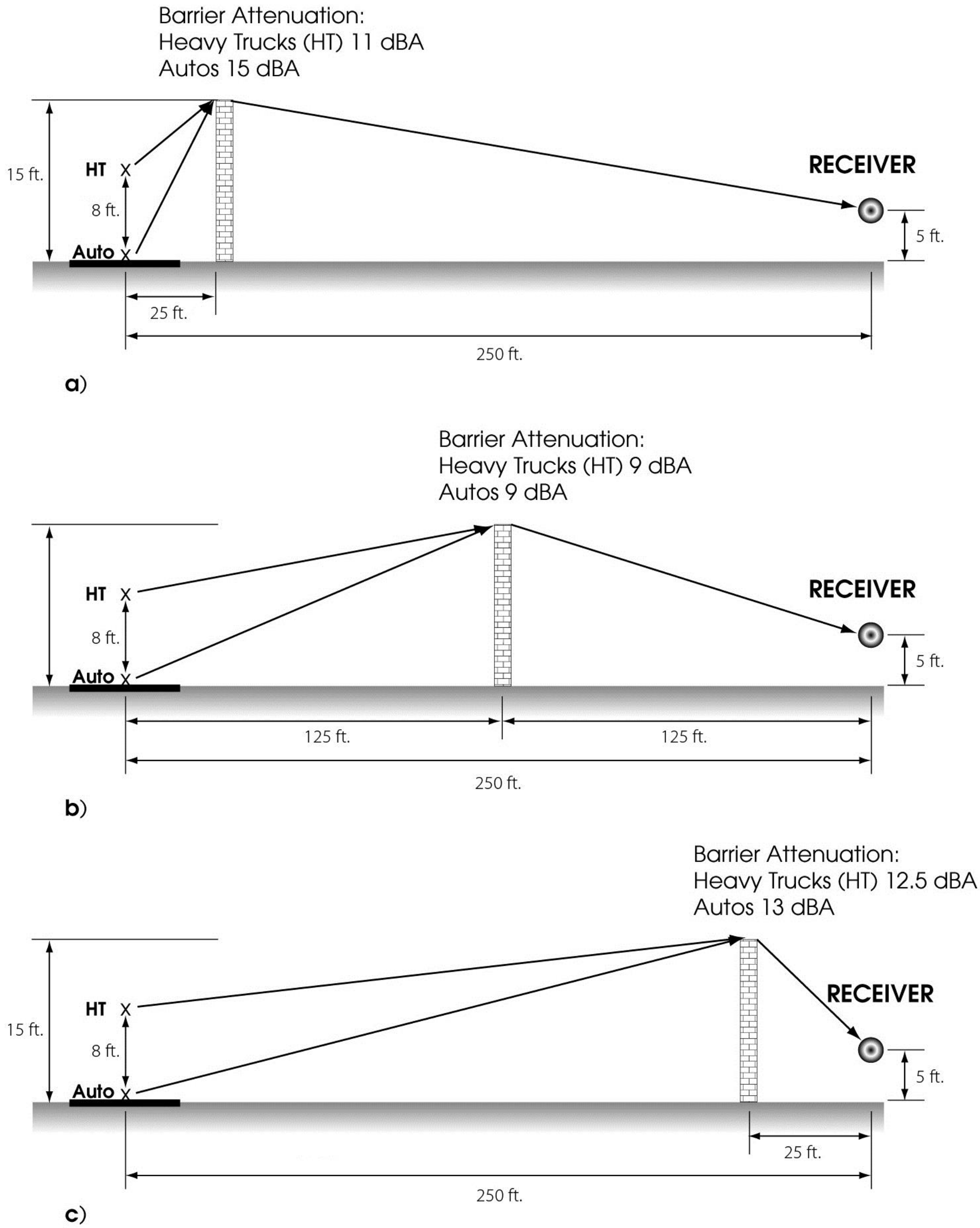


Figure 5-4. Barrier Attenuation as a Function of Location (At-Grade Highway)—Barrier Attenuation is Least When Barrier is Located Halfway between the Source and Receiver *b*; the Best Locations are Near the Source *a* or Receiver *c*

In depressed highway sections, the barrier is most effective near the receiver on top of the cut (Figure 5-5). Please note that the without-barrier path is generally not a straight path between the source and receiver. The top of cut is already a fairly effective noise barrier. The PLD in this case is the difference between the paths described by source–top of barrier–receiver line, and source–top of cut–receiver line. The barrier attenuation is then calculated from the difference in barrier attenuation provided by the top of cut and top of the noise barrier.

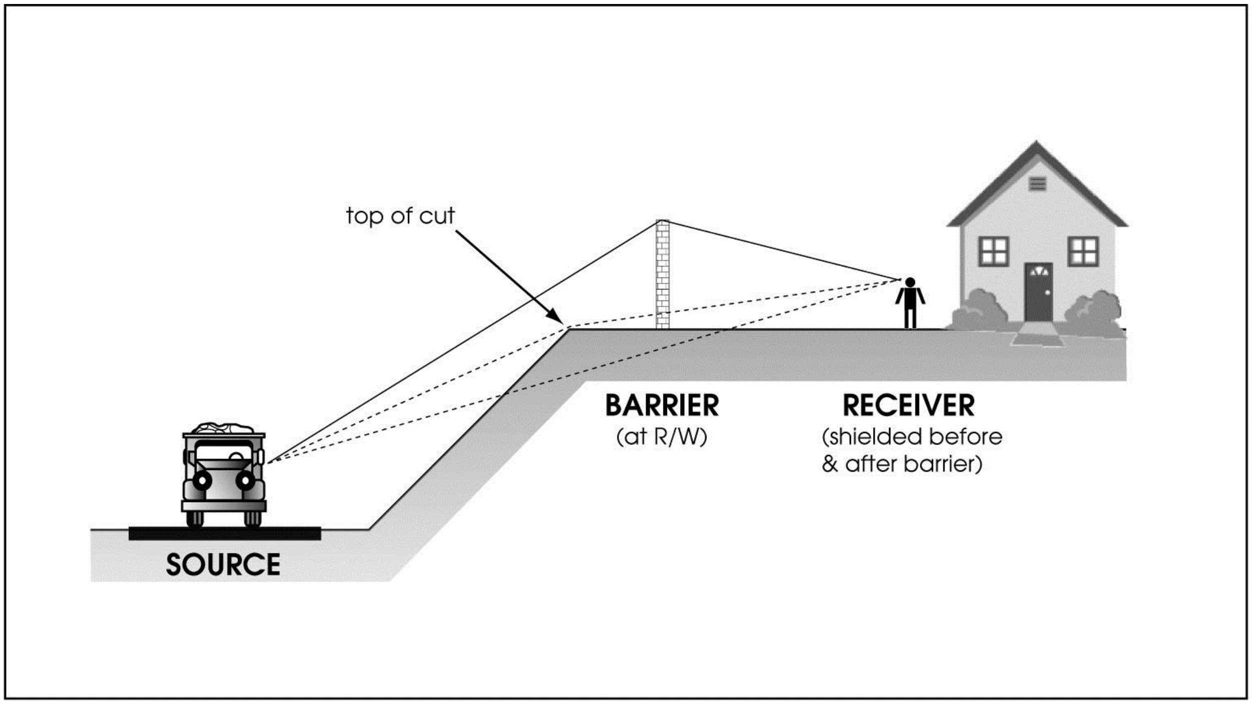


Figure 5-5. Typical Barrier Location for Depressed Highways

Because the attenuation per incremental increase in barrier height diminishes with the effective height of a barrier (see Section 5.1.3), this difference may be small. Noise barriers at the top of depressed highway sections are generally not very effective in reducing noise because the top-of-cut of the cut section by itself may already be providing substantial noise reduction.

The most effective location of noise barriers along highways on fills is on top of the embankment (Figure 5-6). Any attempt to place the barrier closer to the receivers will result in a higher barrier for the same or less attenuation. The same is true for elevated highways on structures. The most effective barrier location from an acoustical standpoint is on top of the structure.

The preceding discussions point out that the most acoustically effective location for a noise barrier depends on the source-to-receiver geometry. In most cases, the choices are fairly obvious. To recap the simplest situations:

- **Highway at Grade:** barrier location near the edge of shoulder or at the right-of-way (barrier is close to the noise source).
- **Highway in Depressed Section:** barrier at the right-of-way (barrier is close to the receiver).
- **Elevated Highway on Embankment or Structure:** barrier near edge of shoulder (barrier is close to the noise source).

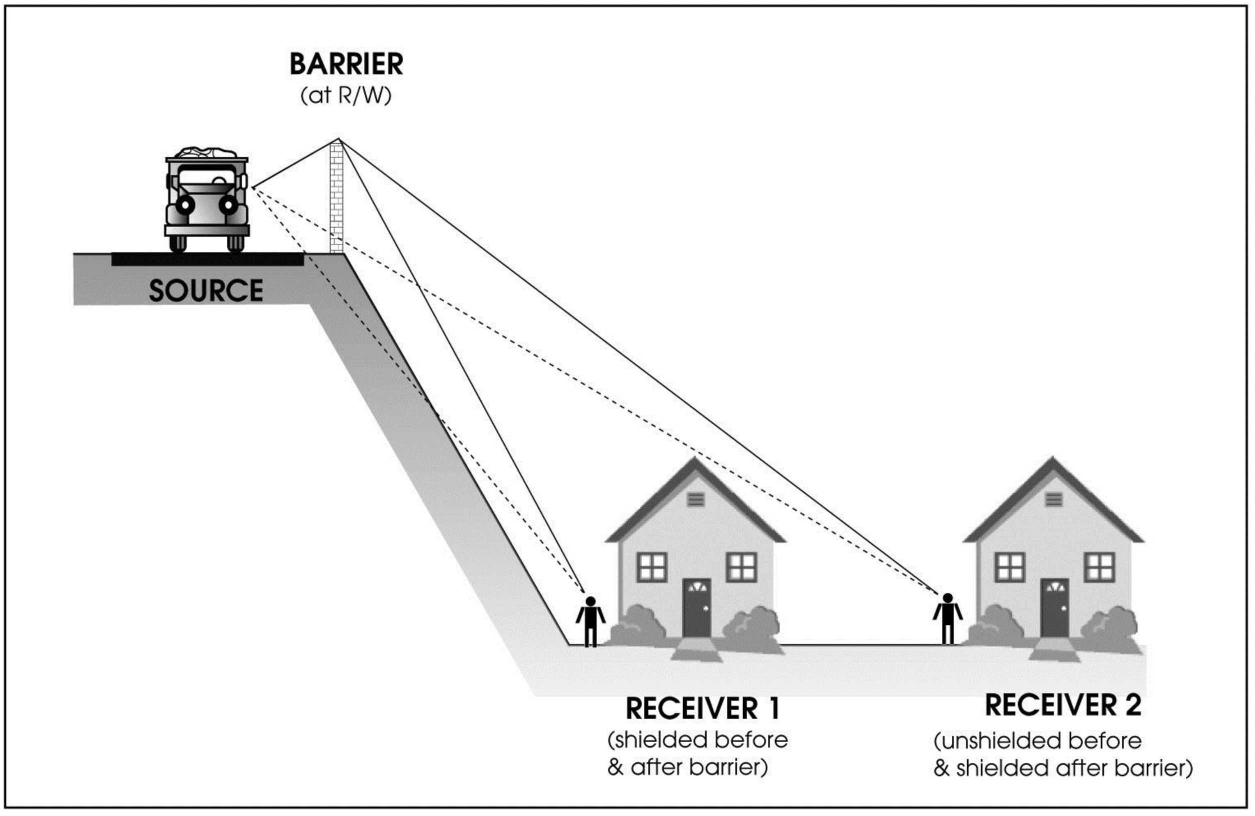


Figure 5-6. Typical Barrier Location for Elevated Highways

In some cases, however, the choices are not as simple. In more complex highway/receiver geometries, the best locations from an acoustical standpoint may need to be determined by using TNM for several barrier location alternatives.

Transitions between cuts and fills, ramps, and interchanges are some examples of cases that need careful consideration. Figures 5-7 to 5-9 show typical noise barrier locations in some of these transitional areas. Barrier overlaps are often necessary in these cases (Figures 5-7 and 5-8).

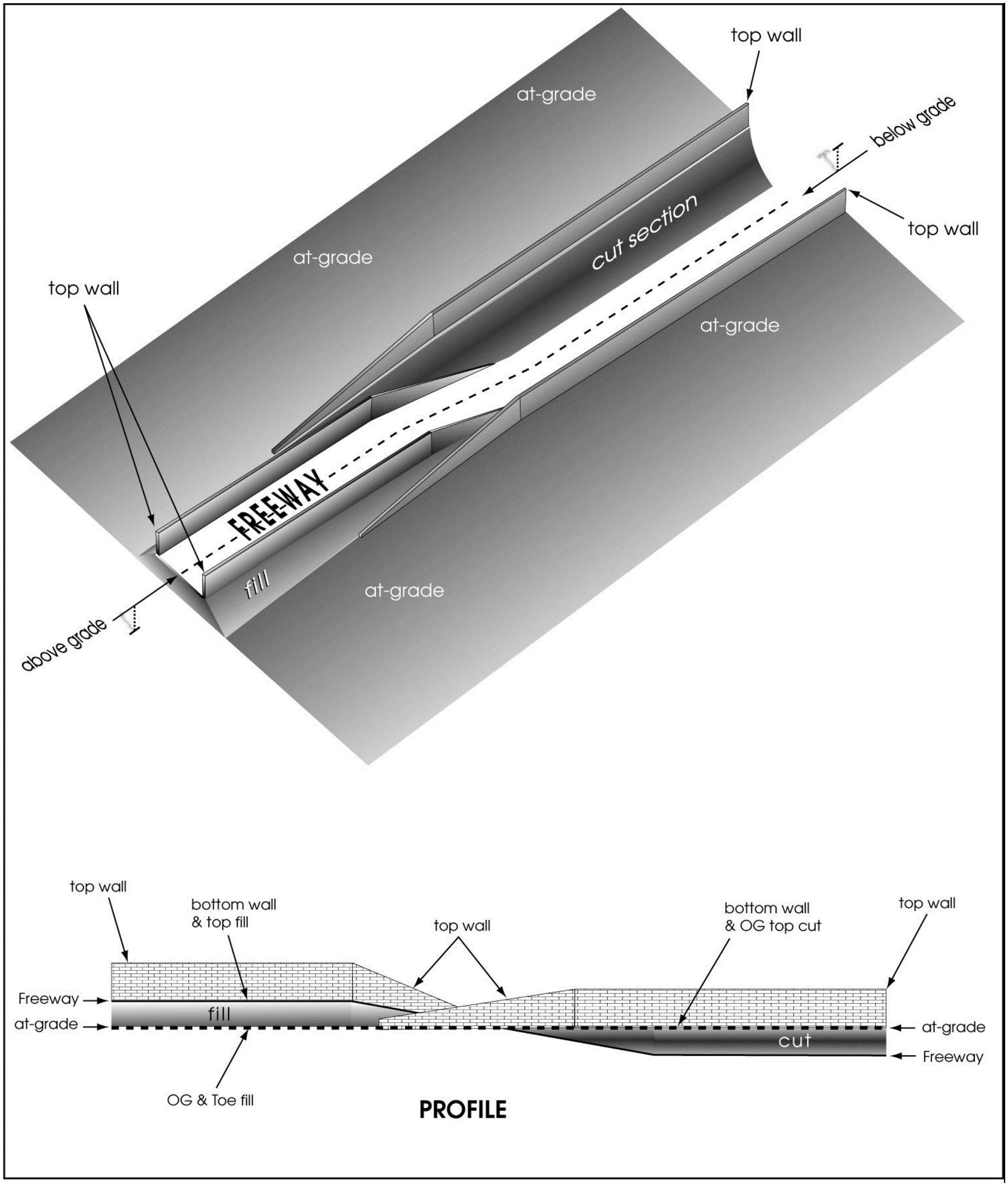


Figure 5-7. Barriers for Cut and Fill Transitions

One of the more common reasons for barrier overlaps is to provide maintenance access to the areas within the right-of-way that are on the receiver side of noise barriers (Figure 5-7). This will be discussed in more detail in the maintenance consideration portion of this section.

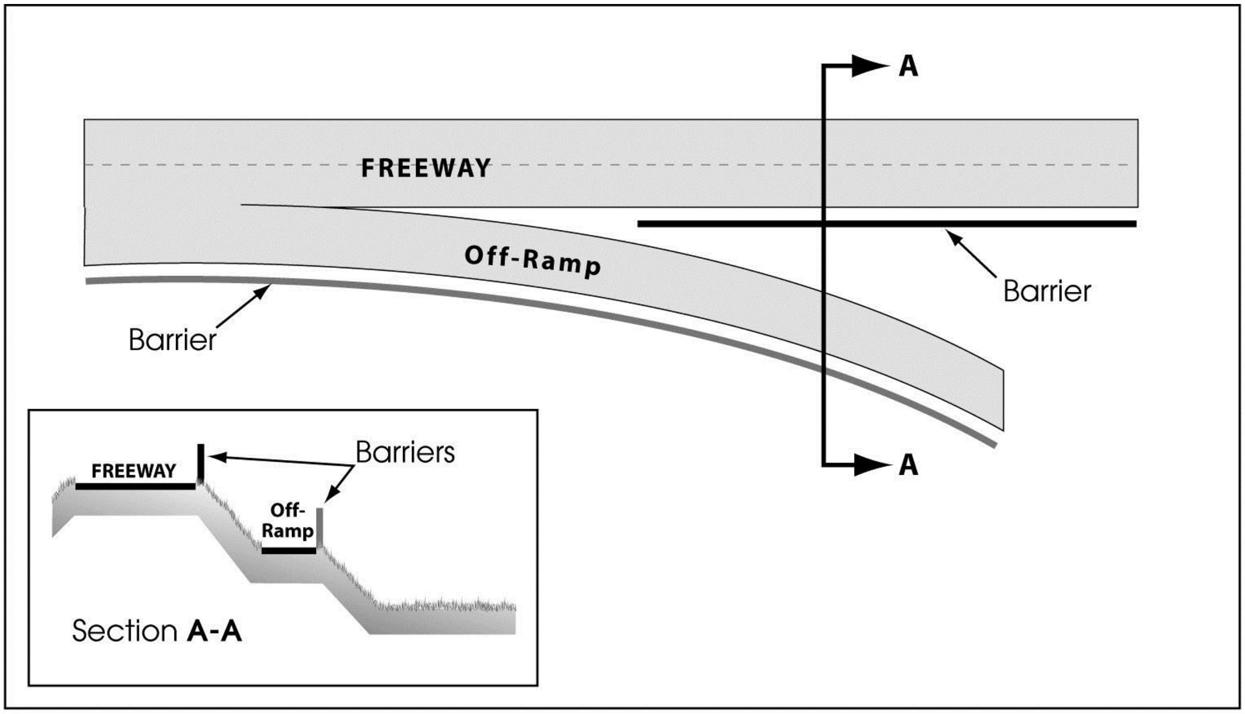


Figure 5-8. Barriers for Highway on Fill with Off-Ramp

Restrictions on lateral clearances, sight distances, and other safety considerations may also dictate final noise barrier locations. The current version of the Caltrans *Highway Design Manual* should always be consulted before finalizing alternate noise barrier alignments.

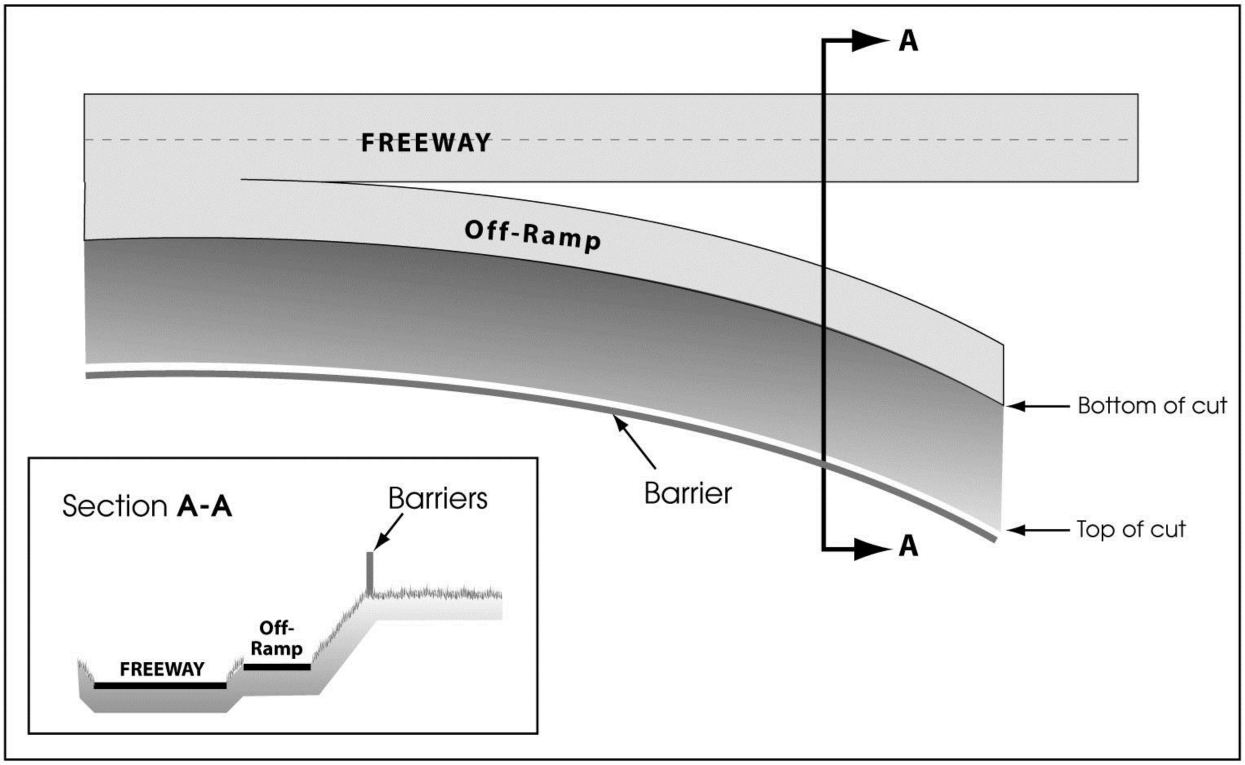


Figure 5-9. Barriers for Highway in Cut with Off-Ramp

5.1.3 Barrier Dimensions

Noise barrier dimensions depend largely on the freeway geometry, topography of the surrounding terrain, location of the noise barrier, and size of the area to be shielded by the barrier. Barrier attenuation depends on the path length difference between the direct (before-barrier) and diffracted (after-barrier) noise paths. Figure 5-3 reviews the concept. Because the location of the bottom of the barrier is not part of the triangle, the highway geometry and terrain topography determine how high the barrier should be for a given barrier attenuation. Figure 5-10 illustrates this concept.

Similarly, the length of the barrier is governed by the extent of the area to be shielded and the site geometry and topography (Figure 5-11).

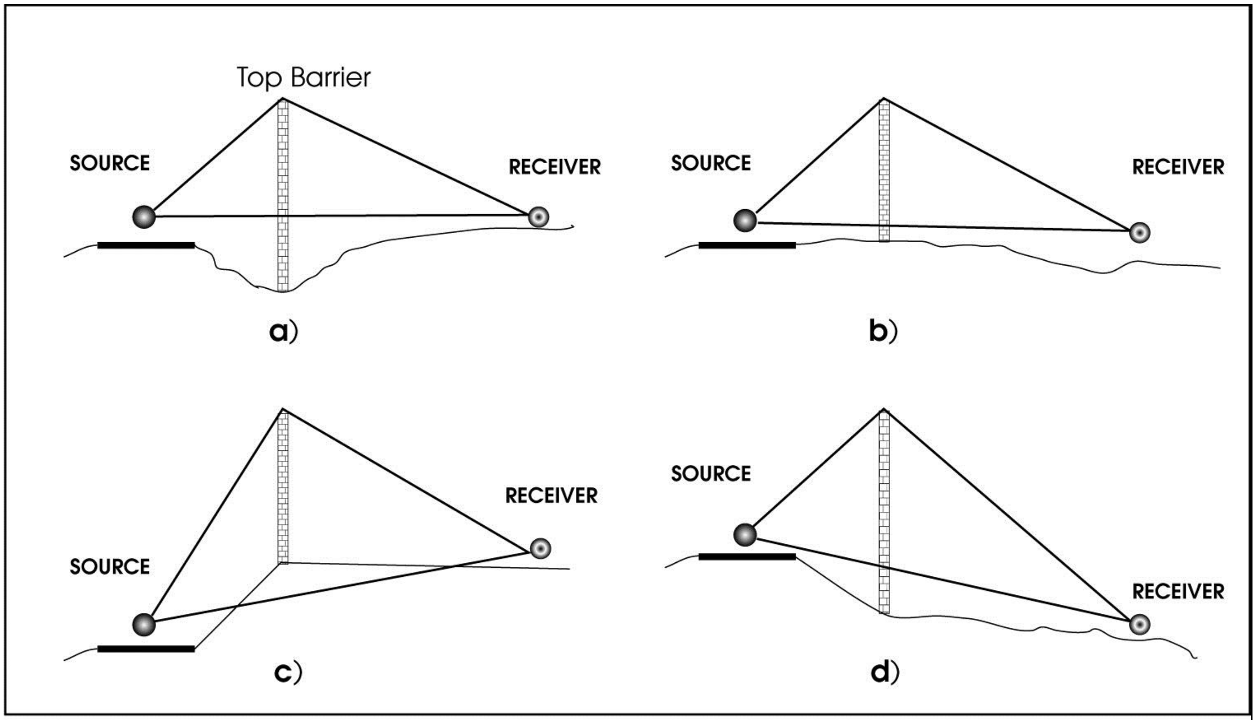


Figure 5-10. Actual Noise Barrier Height Depends on Site Geometry and Terrain Topography (Same Barrier Attenuation for *a*, *b*, *c*, and *d*)

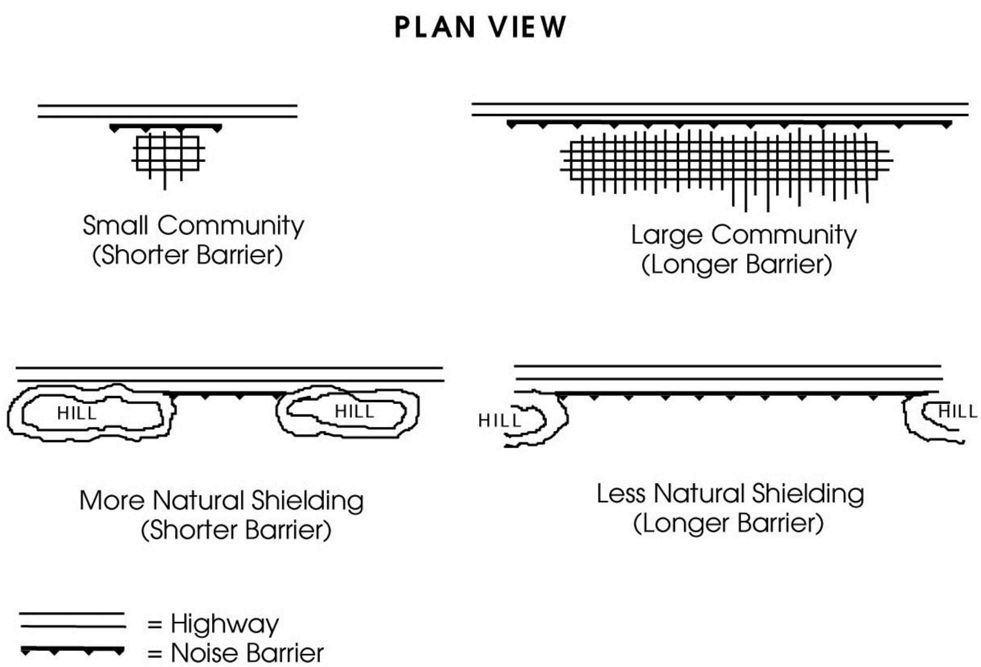


Figure 5-11. Noise Barrier Length Depends on Size of the Area to be Shielded and Site Geometry and Topography

5.1.3.1 Height

Barrier height generally has the most direct influence on the effectiveness of a noise barrier. Figure 5-3 reviews the PLD concept. An increase in height of a noise barrier will result in a greater PLD and therefore greater noise attenuation. This increase in noise attenuation is not linear with the increase in height.

Figure 5-12 shows the barrier attenuation as a function of wall height at a 5-foot-high receiver, 50 feet behind a soundwall located along the right-of-way of a typical urban at-grade eight-lane freeway. The traffic consists of 10% heavy trucks, 5% medium trucks, and 85% autos. Attenuations are plotted for wall heights from 6 to 16 feet, representing minimum and maximum heights identified in the Caltrans *Highway Design Manual* Chapter 1100. Also shown is the height at which the line of sight between an 11.5-foot truck stack and a 5-foot-high receiver is intercepted by the wall. For this particular highway/barrier/receiver geometry, the intercept height is 9 feet and the associated attenuation is 7.5 dB.

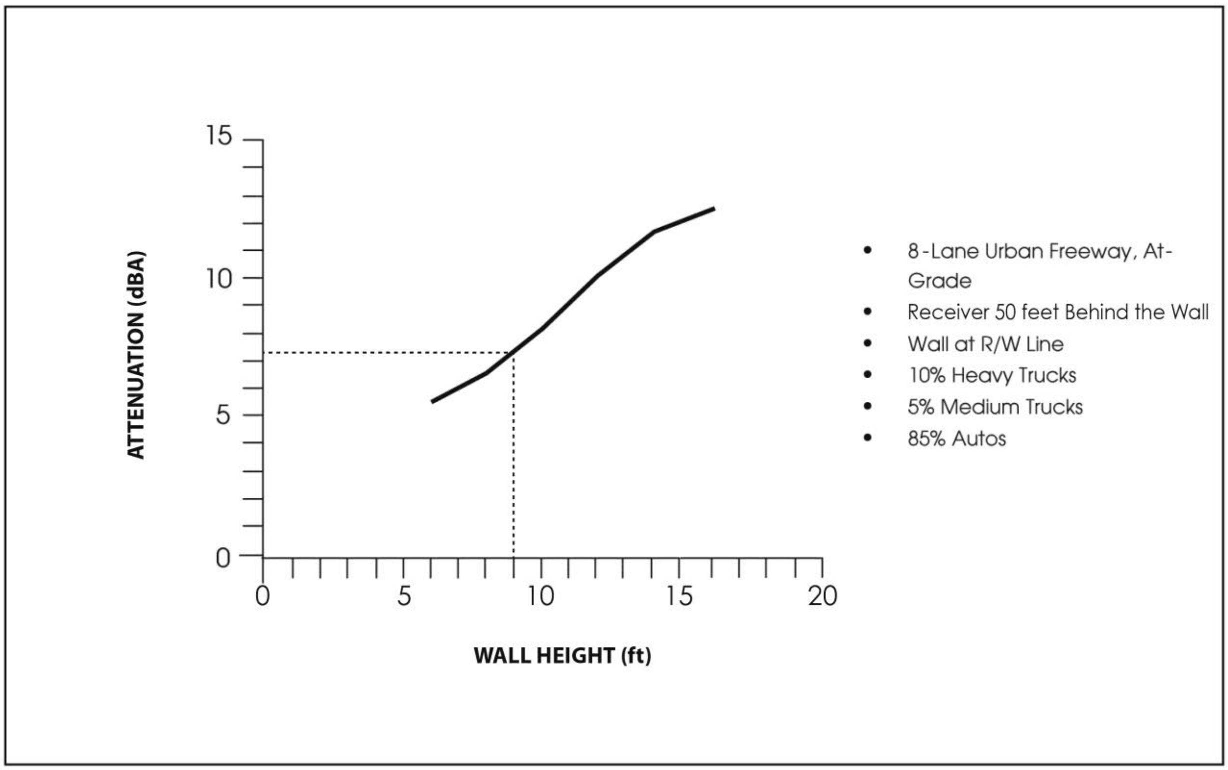


Figure 5-12. Soundwall Attenuation vs. Height for At-Grade Freeway

Please note that in this case the change in attenuation per incremental change in wall height is highest between wall heights of 9 and 11 feet, at 0.9 dBA per 1 foot. Above and below this range, the values are lower.

Once the optimum height has been reached, any further increases in noise barrier height results in diminishing returns in effectiveness. Higher barriers are often necessary to meet design goals.

Noise barriers along depressed freeways are less effective than those along at-grade freeways. In deep cuts, the receiver often is already effectively shielded by the tops of cuts. In some cases, this top-of-cut shielding may not reduce noise levels enough to satisfy barrier design criteria, and an additional barrier behind the top of cut may be necessary to achieve further noise reductions.

When designing such a barrier, the designer should recognize that the without-barrier or before-barrier condition includes the shielding of the existing top of cut. Because of the diminishing-returns effect, a barrier of a given height along a depressed freeway will generally be less effective than a barrier of the same height in an at-grade situation. The diminishing-returns effect, however, is not the only factor to consider.

In general a berm is more effective in reducing noise than a wall of the same height because of additional diffraction, ground absorption, and path length effects. The top of cut associated with a depressed freeway essentially acts like a berm in terms of noise attenuation. Figure 5-13 shows the barrier attenuation vs. height plots for a receiver 50 feet behind a barrier located on the right-of-way of a typical urban eight-lane freeway in a 25-foot-deep depressed section. The traffic mix is the same as that for Figure 5-12, described above. Two attenuation curves are shown.

The upper curve represents attenuation differences between a wall (after-construction condition) and the top of cut (before-construction condition) in which the latter is treated as an existing wall. Such a condition would exist if a soundwall were built on top of an existing retaining wall (i.e., the top of cut would be the top of retaining wall).

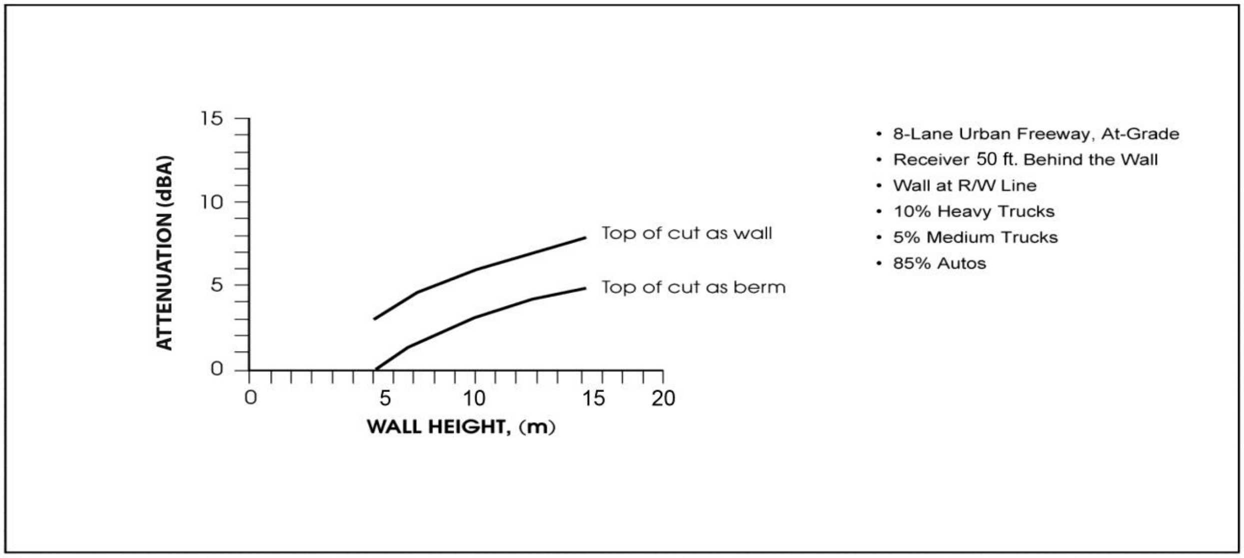


Figure 5-13. Soundwall Attenuation vs. Height for 25-Foot Depressed Freeway

Both the before and after conditions would then involve a wall. Likewise, if the before-and-after-conditions consist of berms (built at or near the top of cut), the upper curve also would be a correct representation. The lower curve consists of attenuation differences between a soundwall and the existing top of cut, with the latter treated as a berm. The additional 3-dBA attenuation provided by the before condition is eliminated by the wall, making it less effective.

A similar phenomenon may also be encountered when freeways are built on embankments. Receivers located near the top of fill may be fully or partially shielded from traffic by the top of fill or hinge point. For these receivers, a wall built on top of the embankment may be less effective than for receivers located farther from the freeway.

The above discussions illustrate the importance of noise source, barrier, and receiver relationships in designing effective noise barriers. These geometries not only affect the barrier attenuation, but also noise propagation in many cases. Section 2.1.4 discusses hard- and soft-site characteristics. The excess noise attenuation provided by a soft site is caused by the noise path's proximity to a noise-absorbing ground surface. If a noise barrier is constructed between a source and receiver, the diffracted noise path is lifted higher off the ground, causing less noise absorption by the ground and a lower rate of noise attenuation with distance. Figure 5-14 illustrates this concept.

In "a," the before-barrier situation shows a noise attenuation rate of 4.5 dBA per doubling of distance. In "b," the after-barrier attenuation is 3 dBA per doubling of distance. The lower attenuation rate reduces the barrier's effectiveness.

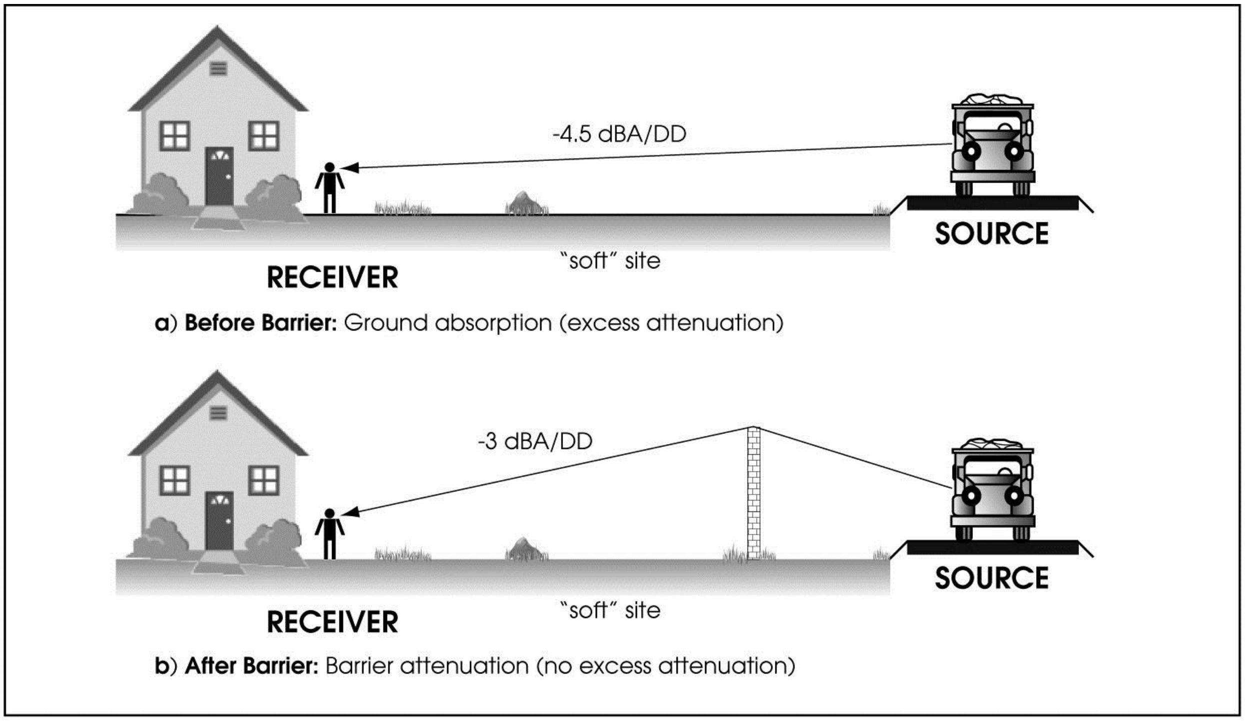


Figure 5-14. Loss of Soft-Site Characteristics from Constructing a Noise Barrier

The potential of a barrier to be less effective than indicated by barrier attenuation alone gave rise to the term insertion loss. Section 5.1.5 discusses the difference between barrier attenuation and insertion loss in detail. The insertion loss of a barrier is the net noise reduction provided by a barrier at a receiver. It includes barrier attenuation and before- and after-barrier differences in noise propagation characteristics (i.e., it is the actual noise reduction caused by inserting a noise barrier between source and receiver). A measured insertion loss is usually referred to as field insertion loss.

Finally, another height consideration in the acoustical design of noise barriers is Caltrans guidance to break the line of sight between an 11.5-foot-high truck exhaust stack and 5-foot-high receiver in the first row of houses. This guideline, detailed in *Highway Design Manual* Chapter 1100, is intended to reduce the visual and noise intrusiveness of truck exhaust stacks at the first-line receivers.

Barrier heights determined by TNM often satisfy the acoustical requirements without shielding high truck exhaust stacks. Although such barriers may reduce noise levels sufficiently to meet feasibility and design goal requirement, they have generated complaints from the public in the past when truck stacks were visible. The line of sight break criterion occasionally governs the height of a noise barrier.

The 11.5-foot height used for truck stacks was determined to be the average (50th-percentile) height of truck stacks in a 1979 District 7 study, including 1,000 heavy trucks measured at a truck inspection station along I-5. This means that the line-of-sight break will shield first-line receivers from the exhaust stacks of about half of the trucks on the highways.

The 11.5-foot dimension is not related to the noise source heights used for heavy trucks in TNM and therefore should not be used for noise predictions. Determining the line-of-sight break is a separate process from predicting noise and is completed with the line-of-sight module in TNM. Generally, it is desirable to calculate and plot the break profile along the barrier alignment before the acoustical design of the noise barrier. . If more than one barrier alignment is under consideration, the line-of-sight break must be calculated for each alignment alternative.

The line-of-sight break height depends on the three-dimensional locations of the 11.5-foot truck stack, receiver, and bottom of the barrier (interface between barrier and ground). To calculate the height for a certain source, barrier, and receiver combination, the designer needs to determine the critical truck stack lane, which is the lane in which the 11.5-foot truck stack creates the highest line-of-sight break. Figure 5-15 shows a quick method of determining which lane is critical. If the receiver is located above a baseline drawn through far- and near-lane truck stacks, the far lane is critical. If the receiver is located below this line, the near lane is critical. When the receiver is on the line, either lane is critical. Please note that the line does not need to be horizontal or level.

Highway Design Manual Chapter 1100 does not give guidance on whether the entire barrier or only a portion of the barrier should break the line of sight for a certain receiver. On one extreme, a series of line-of-sight intercepts can be calculated from one receiver, covering the entire barrier. On the other extreme, only one intercept can be calculated using a perpendicular line from the receiver to the barrier or highway. In the absence of an official policy, it is recommended that a distance of 2D left and right along the centerline of the critical lane, measured from a perpendicular line from the receiver to the lane, be used (where D = the distance from receiver to the lane). Also, it is recommended that the portion of the barrier evaluated be further constrained by a maximum distance from receiver to truck stack (D_t) of 500 feet. Figure 5-16 shows the recommended constraints.

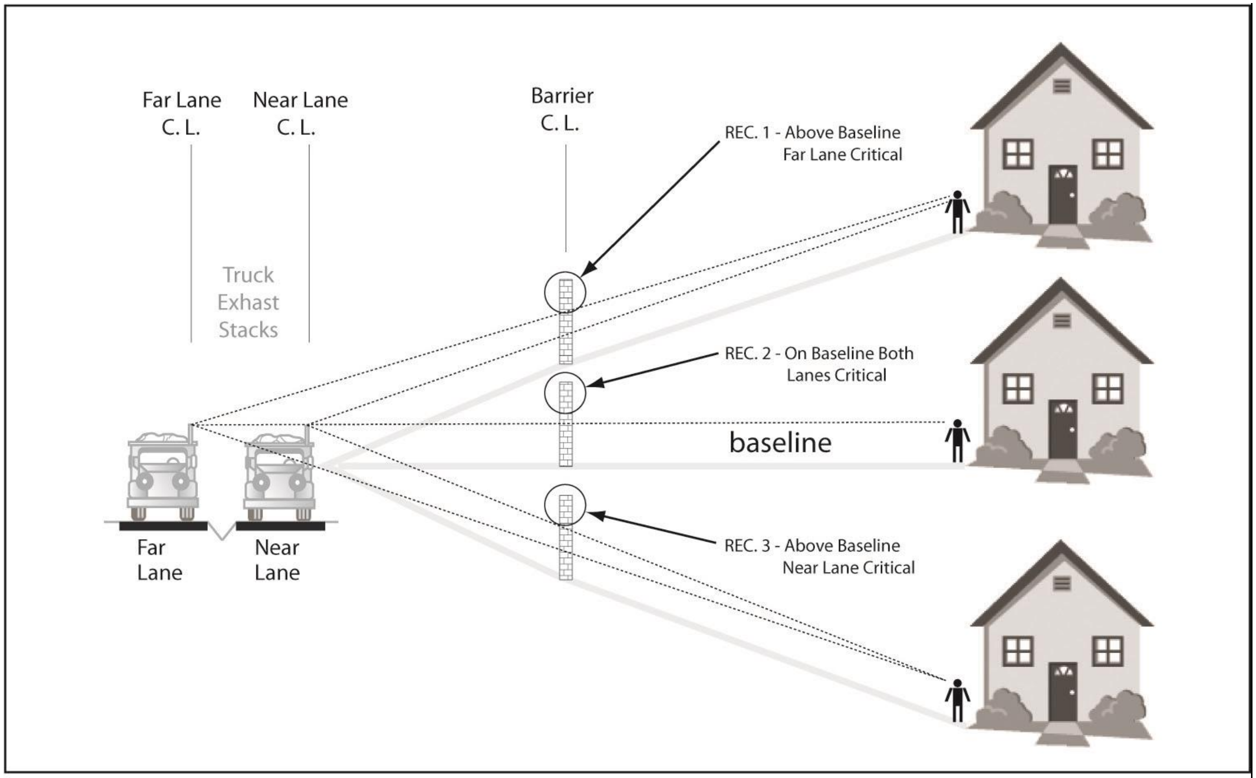


Figure 5-15. Determination of Critical Lane for Line-of-Sight Height

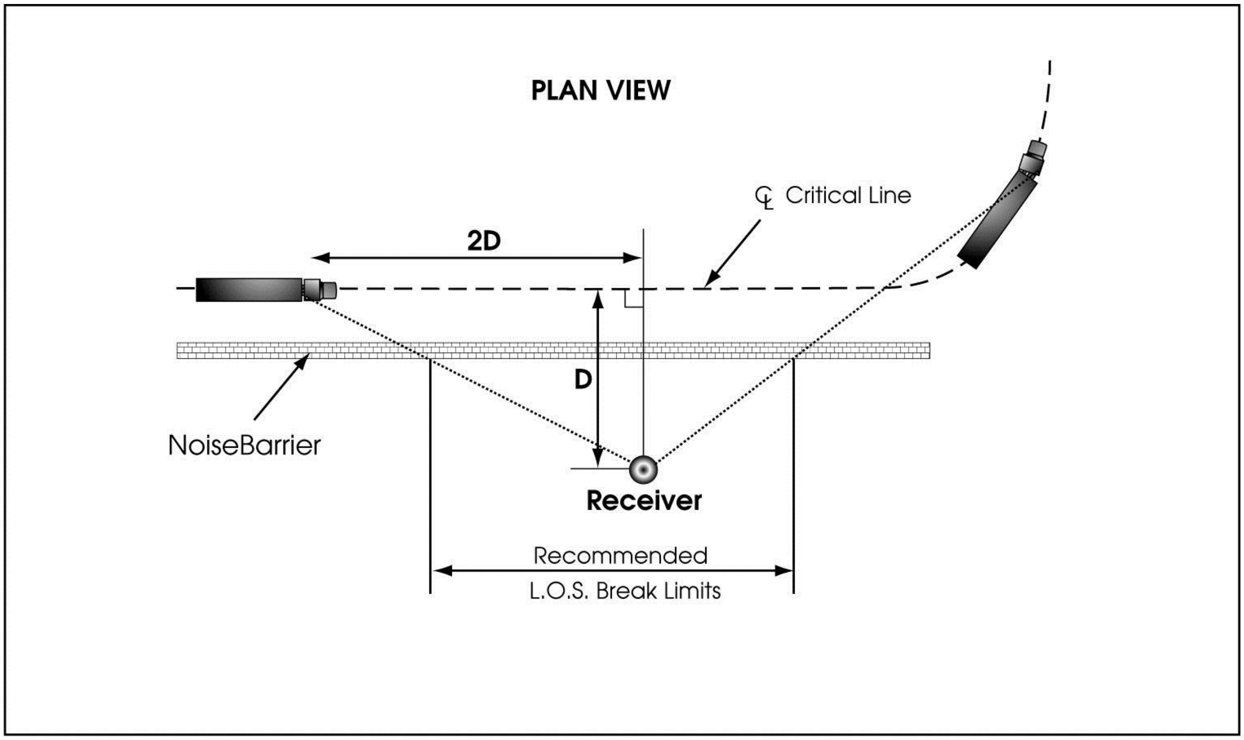


Figure 5-16. Recommended Line-of-Sight Break Limits

5.1.3.2 Length

A noise barrier should be sufficiently long to protect the end receivers (see Figure 5-17). If the barrier is not long enough, the exposed roadway segment will contribute a significant portion of noise energy received and sharply reduce the effectiveness of the barrier. For example, if a barrier ends at the receiver, half of the roadway is exposed, and the noise reduction by the barrier is 3 dBA or less.

As a general rule, a noise barrier should extend at least 4D beyond the last receiver (where D = the perpendicular distance from barrier to receiver) (see Figure 5-18). The "4D rule," however, should be considered a starting point, and the FHWA TNM should be used to precisely locate the end of the barrier. Often, the critical end receivers are not in the first row of homes, but several rows farther from the highway (see Figure 5-17). As the barrier-to-receiver distance increases, highway noise becomes lower, but the barrier segment angle is also reduced, making a potential noise barrier less effective. The FHWA TNM is needed to resolve these opposing factors.

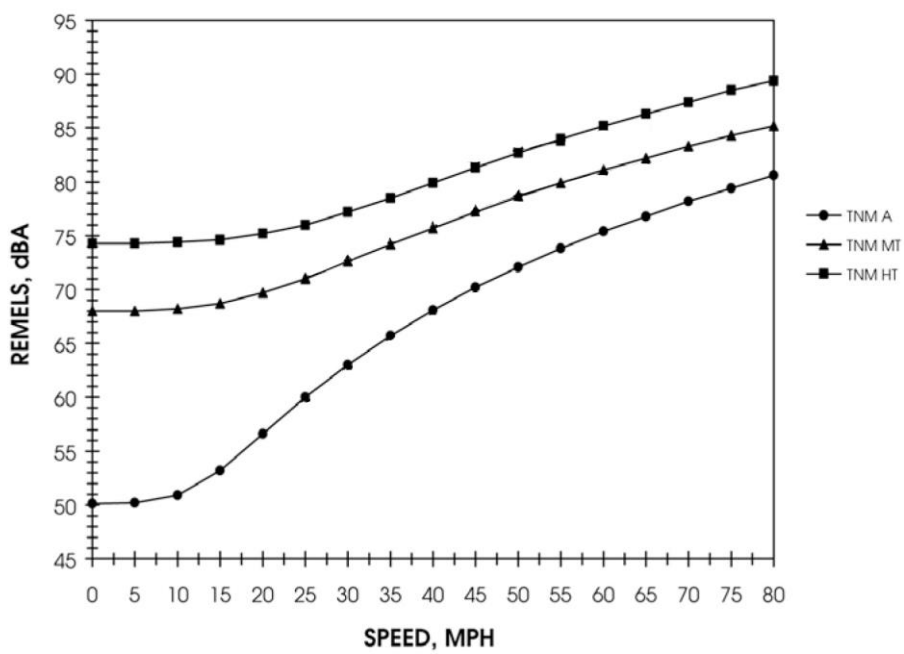


Figure 5-17. Barrier Extended Far Enough to Protect End Receivers

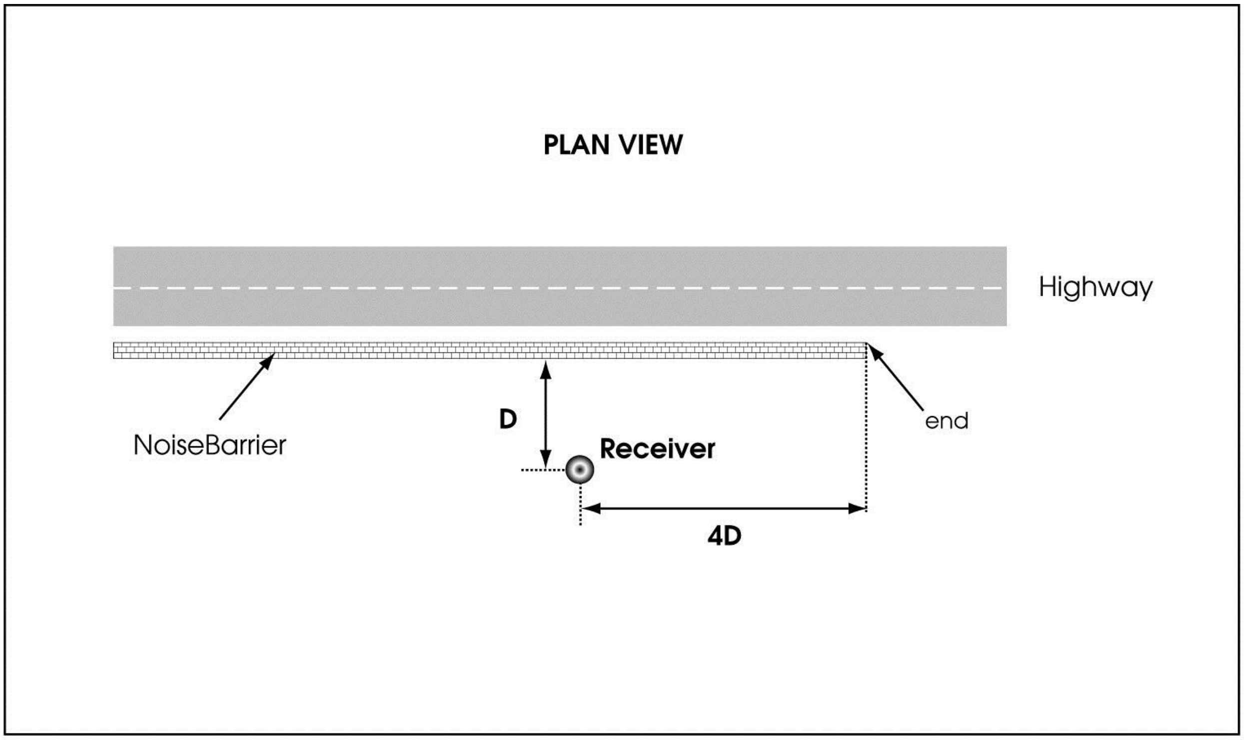


Figure 5-18. 4D Rule

Another way of addressing end receivers is shown in Figure 5-19. The barrier is “hooked” around the critical receivers. The obvious advantage of this design is the shorter barrier length compared to the normal barrier extension. The disadvantage is the need for legal agreements between Caltrans and the private property owners concerning construction easements, barrier maintenance, and responsibilities.

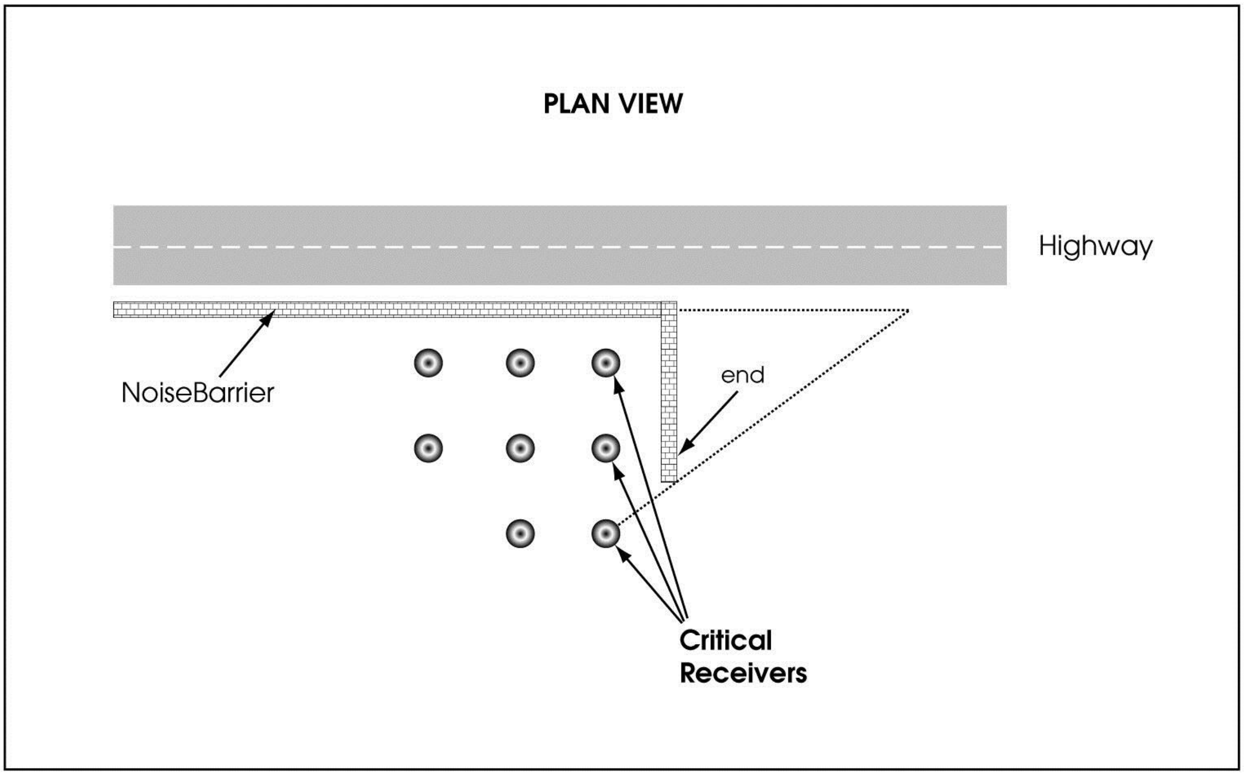


Figure 5-19. Barrier Wrapped around End Receivers, an Effective Alternative

5.1.4 Barrier Shape

Section 4.5.1 indicates that the FHWA TNM distinguishes between two noise barrier shapes: thin screen (wedge) and earth berm. Figure 5-20 shows representations of the two barrier shapes.

Given the same site cross section, distance between source and receiver, and barrier height, a berm allows greater barrier attenuation than the thin screen (wedge), such as a soundwall. In general the actual extra attenuation associated with a berm is somewhere between 1 and 3 dBA.

There are several probable causes for the extra 3-dBA attenuation for a berm. The flat top of the berm allows a double diffraction, resulting in a longer path-length difference. Also, the noise path is closer to the ground (berm surface) than for a thin screen, allowing more ground absorption.

Other barrier shapes have been researched, including “T-tops,” “Y-tops,” pear-shaped tops, and curved walls. Given the same total wall height, these do little to improve barrier attenuation, usually only about 1 or 2 dBA at most. Figure 5-21 shows some different shapes. The added cost of constructing and complexity of these shapes usually does not justify the small acoustical benefit.

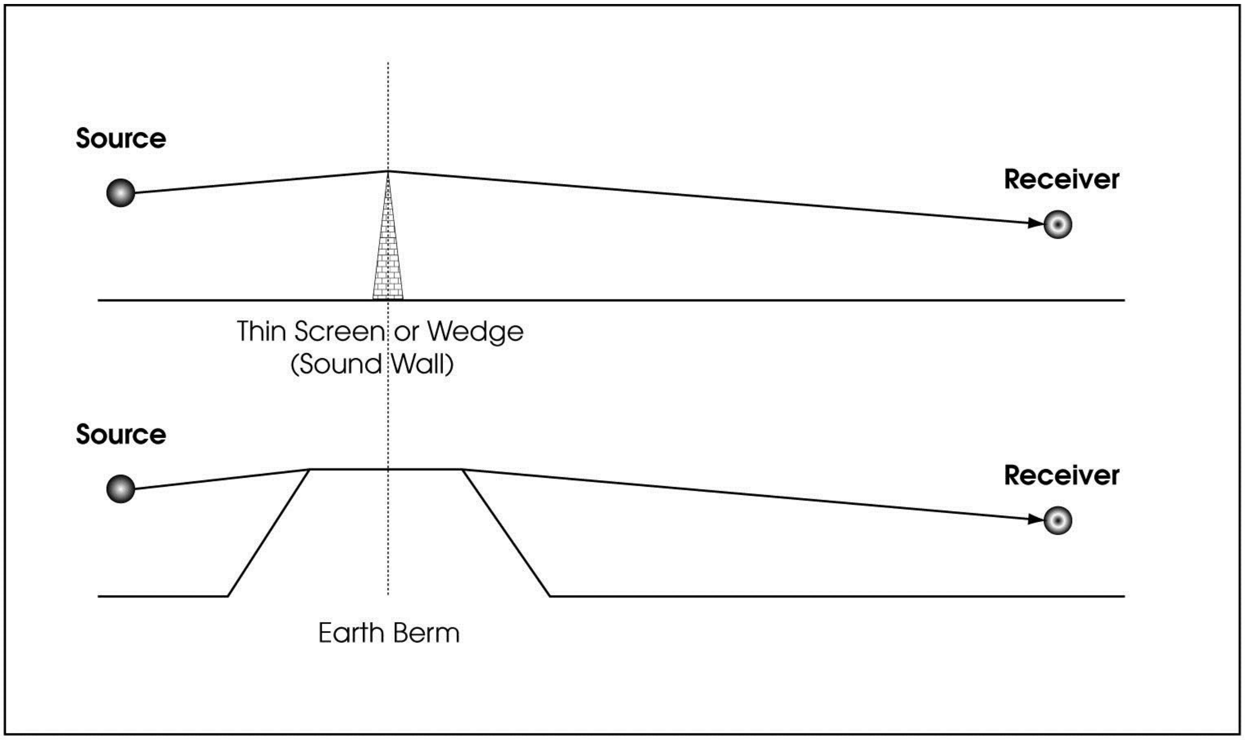


Figure 5-20. Thin Screen vs. Berm (Berm Gives More Barrier Attenuation)

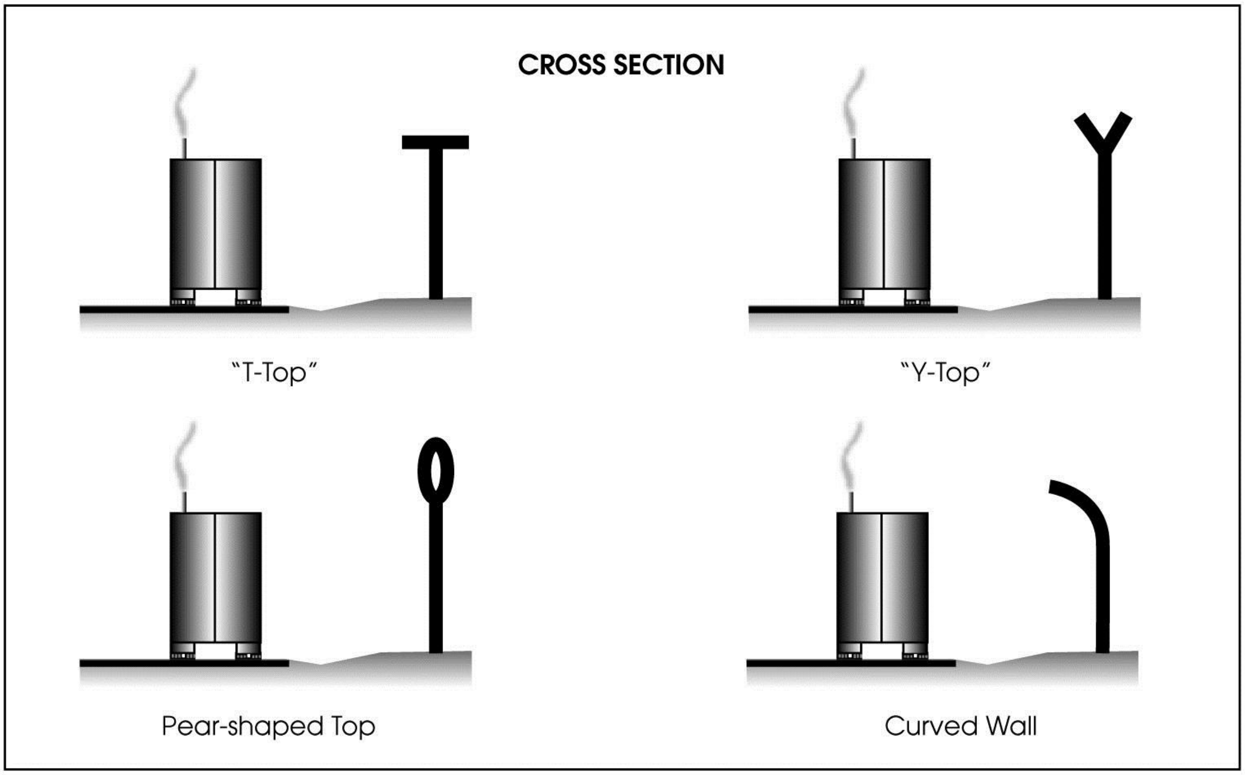


Figure 5-21. Various Wall Shapes (Minimal Benefit for Extra Cost)

There is also a question of jeopardizing safety with any overhang, especially when the barrier is constructed near the edge of the shoulder.

5.1.5 Barrier Insertion Loss vs. Attenuation

In simple terms, barrier insertion loss is the difference in noise levels before and after a barrier is constructed. It accounts for barrier attenuation, contributions from unshielded roadway segments, changes in dropoff rates, and interaction with existing barriers (e.g., reflections or additional shielding).

Figure 5-22 illustrates the difference between barrier insertion loss and attenuation. Barrier attenuation only accounts for noise attenuated from noise barrier diffraction, integrated over the length of the noise barrier. Barrier insertion loss is the net noise reduction and includes barrier attenuation, changes in noise path heights and associated changes in ground effects, flanking noise, and other noise sources. When designing noise barriers, barrier insertion loss is the primary factor of interest.

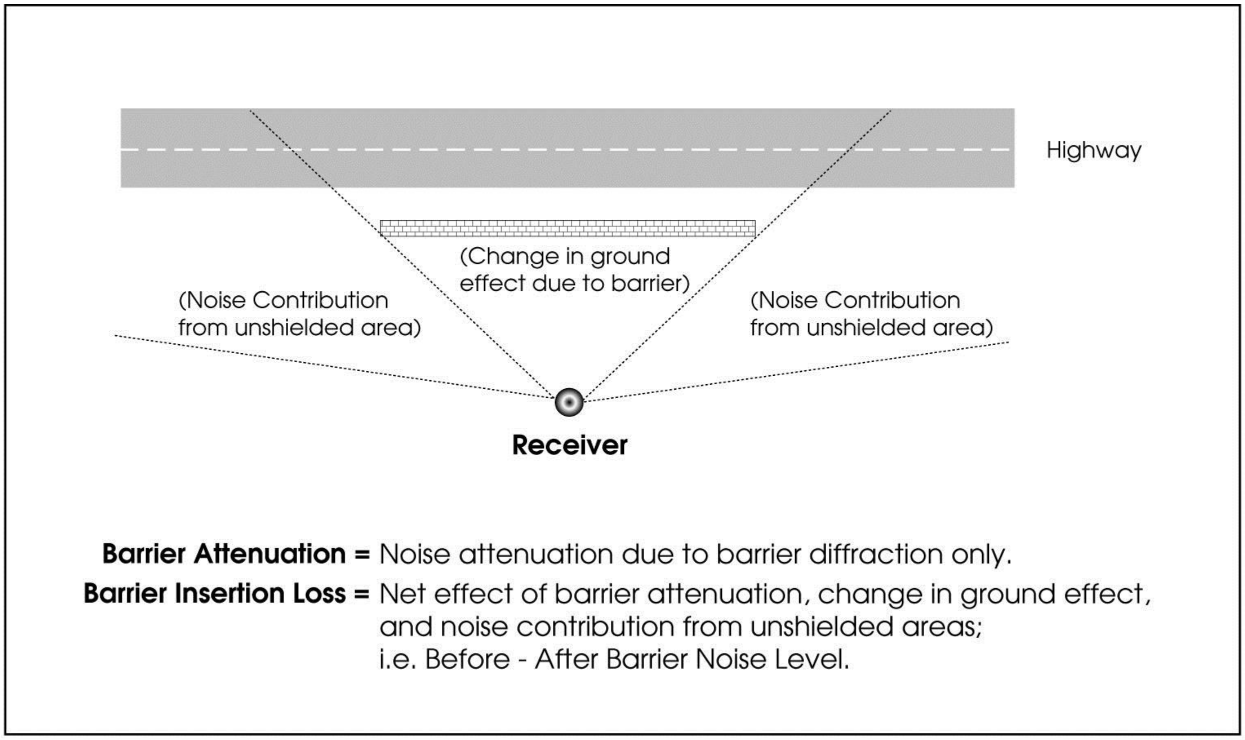


Figure 5-22. Barrier Insertion Loss vs. Attenuation

5.1.6 Background Noise Levels

One important factor to be considered but often overlooked in noise barrier design is the background noise level within a community. A noise barrier cannot reduce noise levels below the noise level generated by local traffic on surface streets. For instance, if the background level (without the highway) is 65 dBA at the target receivers, and a proposed project will raise this level to 68 dBA, a noise barrier will not be able to reduce the noise level to less than 65 dBA. Therefore, the community background noise level always should be added into the predicted noise levels and considered in the noise abatement design process. Only if it is obvious that the background noise from local sources will not influence the noise barrier's insertion loss (i.e., is at least 10 dBA less than the predicted noise level with the noise barrier) can the background noise be ignored.

The following is an example of how background noise levels can influence noise barrier calculations.

<u>Given</u>

Background noise level: 60 dBA at receivers

New facility (without background): 68 dBA at receivers

Total predicted: 69 dBA at receivers

The goal of this exercise is to design a noise barrier that will reduce the total noise level at the receiver by at least 5 dBA. The model predicts traffic noise levels without the background noise level. However, the background noise level should be accounted for in the total noise attenuation. Therefore, the predicted noise level needed to reduce the total predicted noise level at the receiver to 64 dBA must be calculated.

<u>Calculation</u>

If the barrier reduces the noise from the new facility by 5 dB the facility noise level would be 64 dBA. When the background noise is considered the resulting sound level would be 65 dBA (60 dBA + 64 dBA). This is only a 4 dB reduction from the total predicted noise level of 69 dBA. Additional attenuation is needed to provide at least 5 dB of noise reduction relative to the total predicted noise level.

The goal is for the background sound level plus the new facility noise level behind the barrier to be 64 dBA (5 dBA below the total predicted noise level of 69).

background (B) + new facility noise level behind barrier (N) = 64 dBA

$$B + N = 64 \text{ dBA}$$

$$60 + N = 64 \text{ dBA}$$

$$N = 64 – 60$$

$$N = 10\log(10^{(64/10)} – 10^{(60/10)}$$

$$N = 61.8 \approx 62 \text{ dBA.}$$

Therefore the barrier must provide a total noise reduction of 7 dB and result in a noise level of 62 dBA behind the barrier for the net noise reduction to be at least 5 dBA.

5.1.7 Reflected Noise and Noise Barriers

5.1.7.1 Noise Reflection

The reflection of noise from barriers can be a source of concern for residences in the vicinity of a barrier. A barrier that reduces noise at receivers on one side of the highway could potentially alter the noise at receivers on the other side. The complex nature of noise barrier reflections, difficulties in measuring them, and controversy surrounding the significance of their impacts deserve detailed discussion.

More noise barriers have been constructed in California than in any other state, in many different configurations of alignment, profile, and height. These barriers are located along one or both sides of highways of different widths; along ramps, connectors, and interchanges; and in urban, suburban, and, rural regions under varying traffic conditions. The receivers for which they were designed are located in many different types of terrain, topography, and climate. The combinations and permutations associated with the vast variety of conditions inevitably increase the possibility of creating controversies over the extent of noise reflections by barriers. Therefore, it is only natural that noise reflection issues are on the rise in California, especially because almost all noise barriers here are made of noise-reflective material with hard, smooth surfaces, such as masonry and concrete. In most cases, the noise increases from reflections are so small that most people do not notice them. The people who do perceive increases in noise are usually suddenly made aware of freeway noise by an event that triggers that awareness (e.g., construction of the noise barrier). Measured increases from noise reflections of more than 2 dBA have never been measured by Caltrans, but claims of 10 and even 20 dBA increases have been made occasionally.

Many complaints of large increases in noise came from residents living far from the highway and were actually from changes in meteorology. Atmospheric refraction from wind shear and temperature gradients can account for 10- to 15-dBA variations when the same sources are measured from distances of approximately 1 to 2 miles. To measure the effects of noise reflections, before- and after-barrier noise measurements need to be carefully matched by wind speed, wind direction, temperature gradients, air temperature, humidity, and sky cover. Likewise, if a person perceives a noticeable increase in noise levels from a reflective noise barrier, he or she must be able to compare it mentally with a before-barrier condition that included the same meteorology. Of course, this process is very unreliable. The effects of noise barriers on distant receivers are discussed in Section 7.

This section addresses various aspects of noise reflection concerns in detail. The following classifications of reflective noise with respect to noise barriers and other structures will be discussed.

- Single barriers (on one side of the highway).
- Parallel barriers (on both sides of the highway).
- Structures and canyon effects.

Compared with reflections measured under similar conditions, results of theoretically modeled noise reflections normally show higher values. This overprediction of reflection models has been attributed to the inability of models to accurately account for all the variables, such as interactions with atmospheric effects and the unknown degree to which traffic streams interfere with reflections.

Reflective noise is not peculiar to noise barriers. Retaining walls and other structures reflect noise in the same manner as noise barriers. The principles discussed in this section can be applied to reflective barriers, reflective retaining walls, or any other smooth, continuous, hard surfaces.

5.1.7.2 Single Barriers

Simple Terrain

Figure 5-23 is the simplest two-dimensional representation of single-barrier reflections. The presence of a reflective barrier on the opposite side of an at-grade highway essentially doubles the acoustic energy at the receiver. In addition to the direct noise ray “d,” the barrier reflects a noise ray “r” of roughly the same acoustic energy (actually, “r” is longer than “d” and will result in slightly less acoustical energy). Theoretically, only one reflective ray reaches the receiver because the angle of incidence equals the angle of reflection (both depicted as θ in Figure 5-23). Therefore, even if they are equal, “r” and “d” cause a doubling of energy that increases the noise level by 3 dB at the receiver.

Figure 5-24 shows that for an infinite line source and noise barrier the reflections are also an infinite line source. At each point along the highway, there is only one reflection ray that reaches the receiver and for which the angle of incidence equals the angle of reflection.

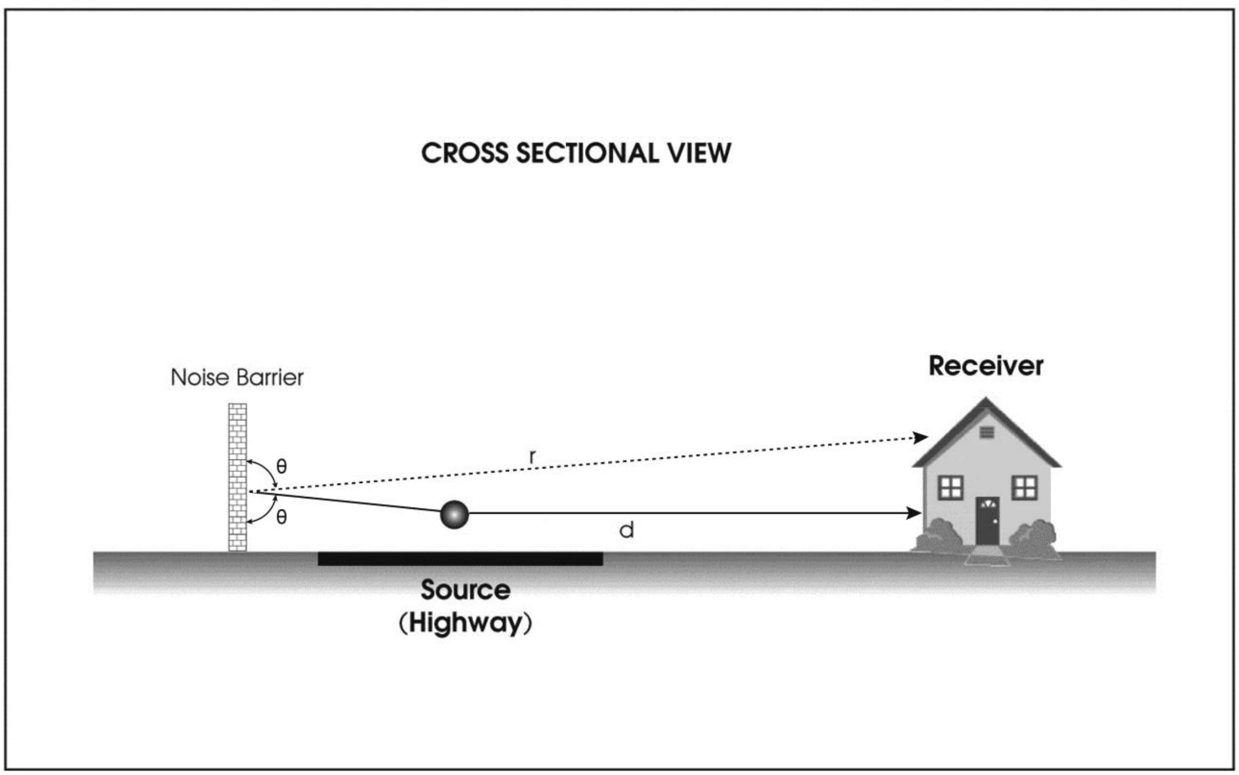


Figure 5-23. Single-Barrier Reflection (Simplest Representation)

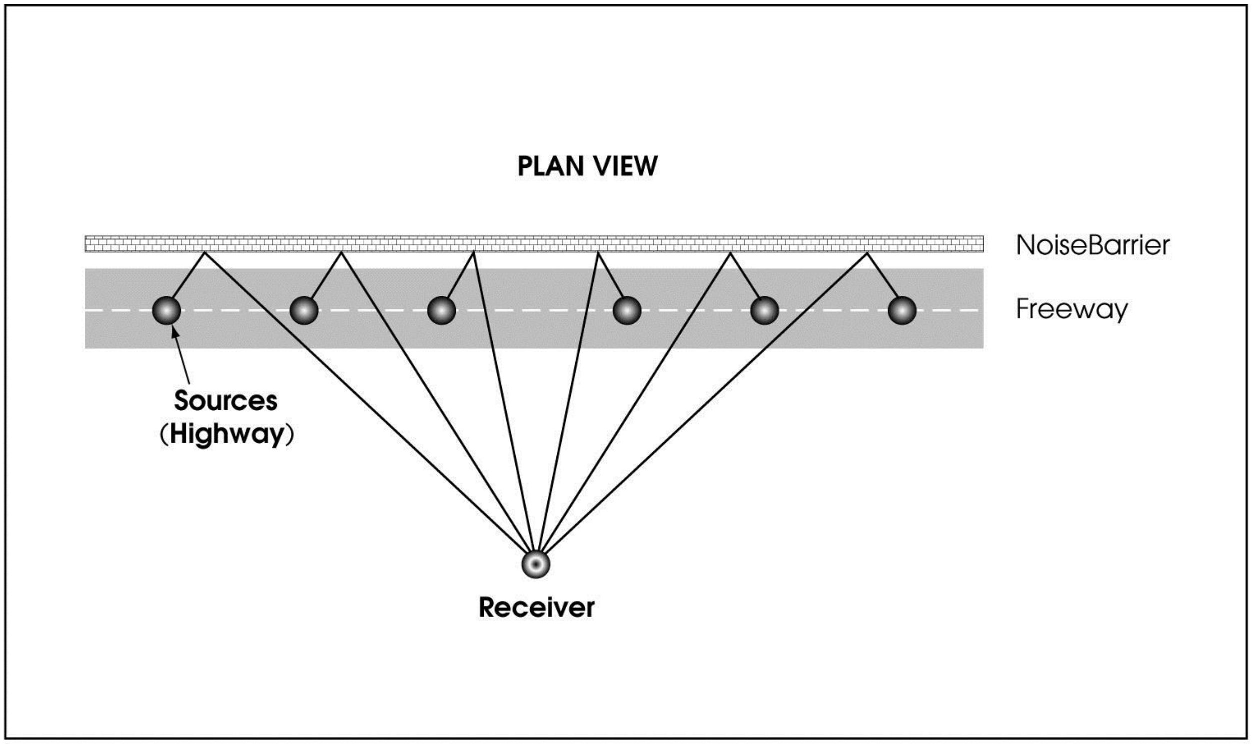


Figure 5-24. Single-Barrier Reflections (Infinite Line Source and Noise Barrier)

Figure 5-25 is a more realistic depiction, which includes pavement reflections. Please note, however, that a noise barrier on the opposite side still increases the noise level by 3 dB, although the before and after noise levels are 3 dB higher (because of pavement reflections) than in Figures 5-23 and 5-24. In plan view, the pavement reflections would also be shown to be a line source. The reflection point R_1 (Figure 5-25) may fall off the pavement on absorptive ground, reducing the before-barrier noise levels at the receiver. The pavement reflection point R_2, however, which is significant only after building the barrier, usually will be on the pavement. Therefore, the difference between before- and after-barrier noise levels could in theory slightly exceed 3 dBA.

The effects of single-barrier reflections are distance-dependent. At distant receivers, the ratios of direct/reflected noise path lengths and those for near- and far-lane distances approach 1. When this is the case, contributions of direct and reflected noise from each lane contribute roughly the same energy (there will always remain a slight loss of acoustical energy because of imperfect reflections). The result would be an increase that approaches 3 dBA for distant receivers. For receivers close to the highway, however, the distance ratios become less than 1, and the noise at the receiver is dominated by direct noise from the near lanes. The result is less contribution from reflected noise.

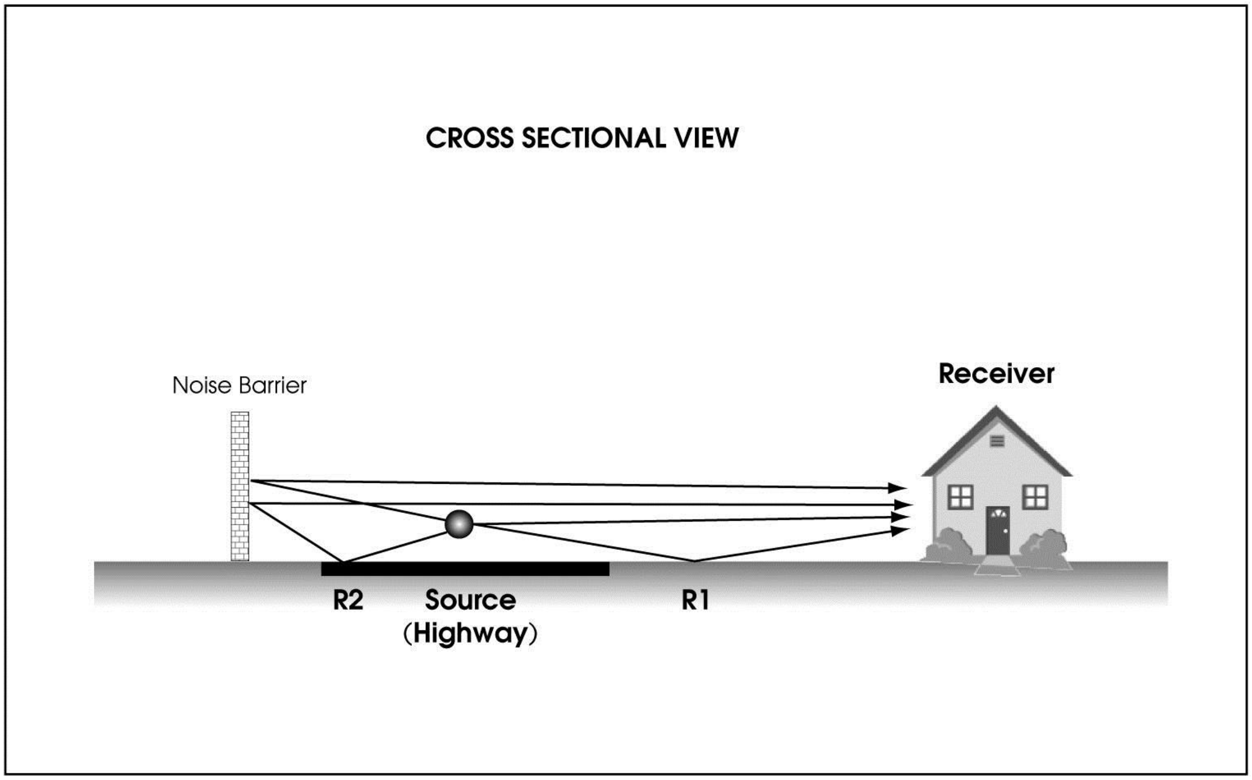


Figure 5-25. Single-Barrier Reflection (More Accurate Representation)

Figure 5-26 shows the distance dependency of the noise increases from barrier reflections for a typical eight-lane at-grade freeway. At 50 feet from the edge of the traveled way, the increase is only 1.3 dBA, at 200 feet it is 2.0 dBA, and at 400 feet it is 2.4 dBA. The increases were calculated assuming equal noise source distributions in the near and far (eastbound and westbound) lanes and hard-site propagation.

Real-world situations are far more complicated than shown in Figures 5-23 to 5-26. The noise sources are distributed over the width of the highway, the paths of the barrier noise reflections are always longer than the direct noise paths, reflective barriers are not perfect reflectors, and the traffic stream likely interferes with the reflections. Because of these factors, reflected noise contributions are less than those of direct noise and seldom increase noise levels by more than 1 or 2 dB.

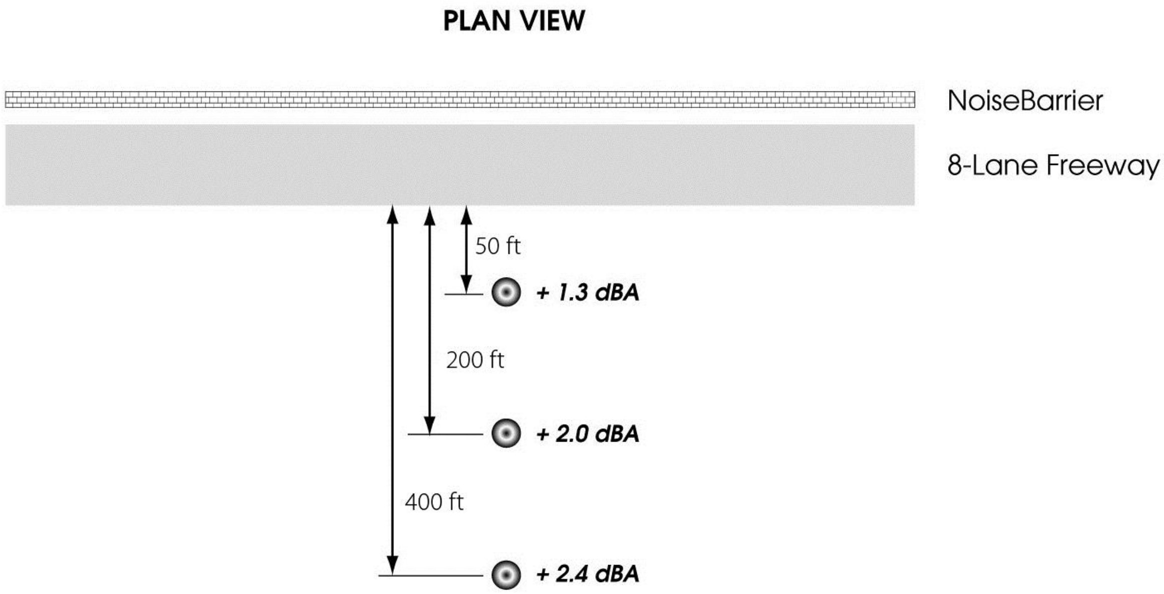


Figure 5-26. Noise Increases from Single-Barrier Reflections

Complex Terrain

In more complex terrain there are instances when single-barrier reflected noise could increase noise levels perceptibly at a receiver. One such case is shown in Figure 5-27, which depicts a receiver that is effectively shielded by terrain or the top of a depressed highway cut. If a noise barrier or retaining wall were constructed on the opposite side of the highway, unshielded reflected noise ray “r” could contain significantly more acoustical energy than the shielded direct ray “d,” causing a noticeable increase in noise at the receiver. However, real-world situations are far more complex than illustrated. Some of the noise sources or noise paths may be shielded, while others may not. In general, if most of the traffic cannot be seen from the receiver while most of the noise barrier is visible, it is possible that the barrier noticeably increased noise levels at the receiver.

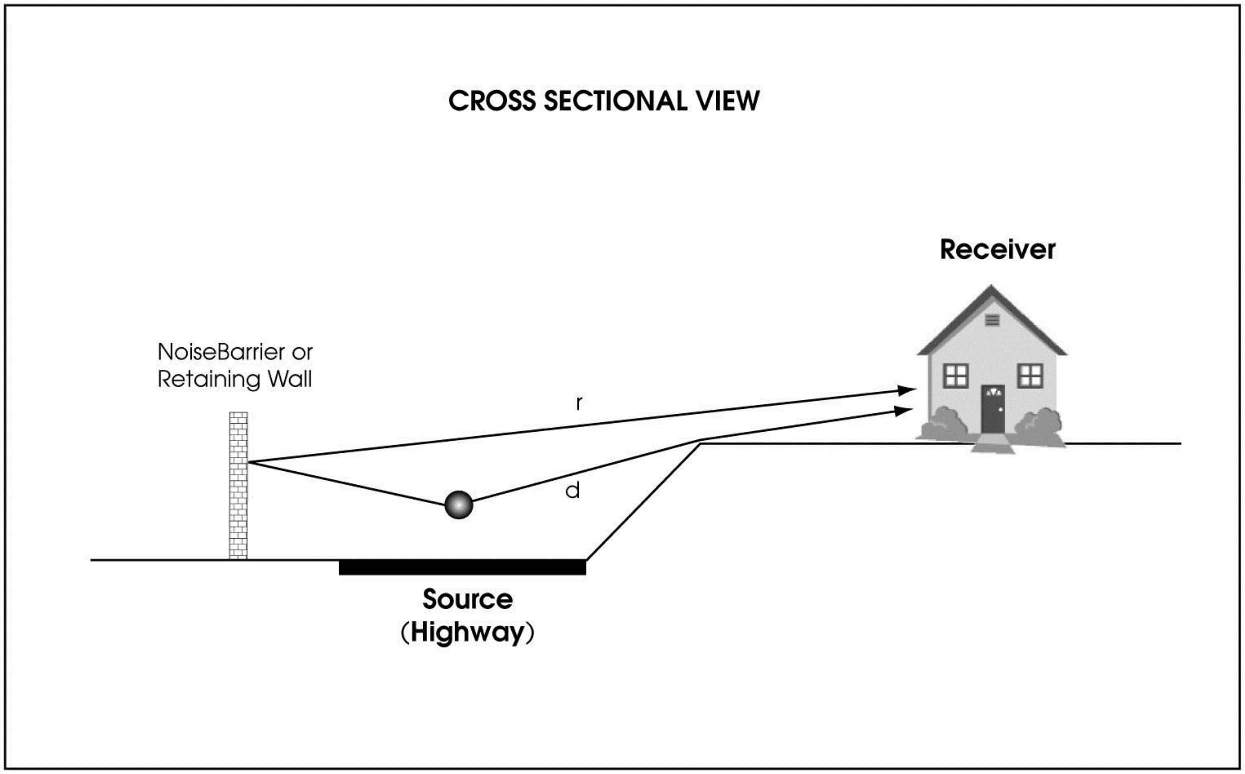


Figure 5-27. Single-Barrier Reflection (Direct Noise Shielded, Reflected Noise Not Shielded)

Reflections off single barriers located at the top of cut (Figure 5-28) generally are directed over a 5-foot-high receiver on the opposite side and therefore are usually not a concern for low receivers. However, higher receivers— the second floor of a residence or receivers located on a higher hill behind the front receivers—still may be affected by the reflections if the direct noise is shielded.

Situations depicted in Figures 5-27 and 5-28 (high receivers only) may increase noise levels by 3 to 5 dBA, depending on the angle of reflections and the height and length of the reflective barrier.

Single barriers on the top of fills (Figure 5-29) generally do not present any reflection issues. The reflected noise ray is usually well above the receiver.

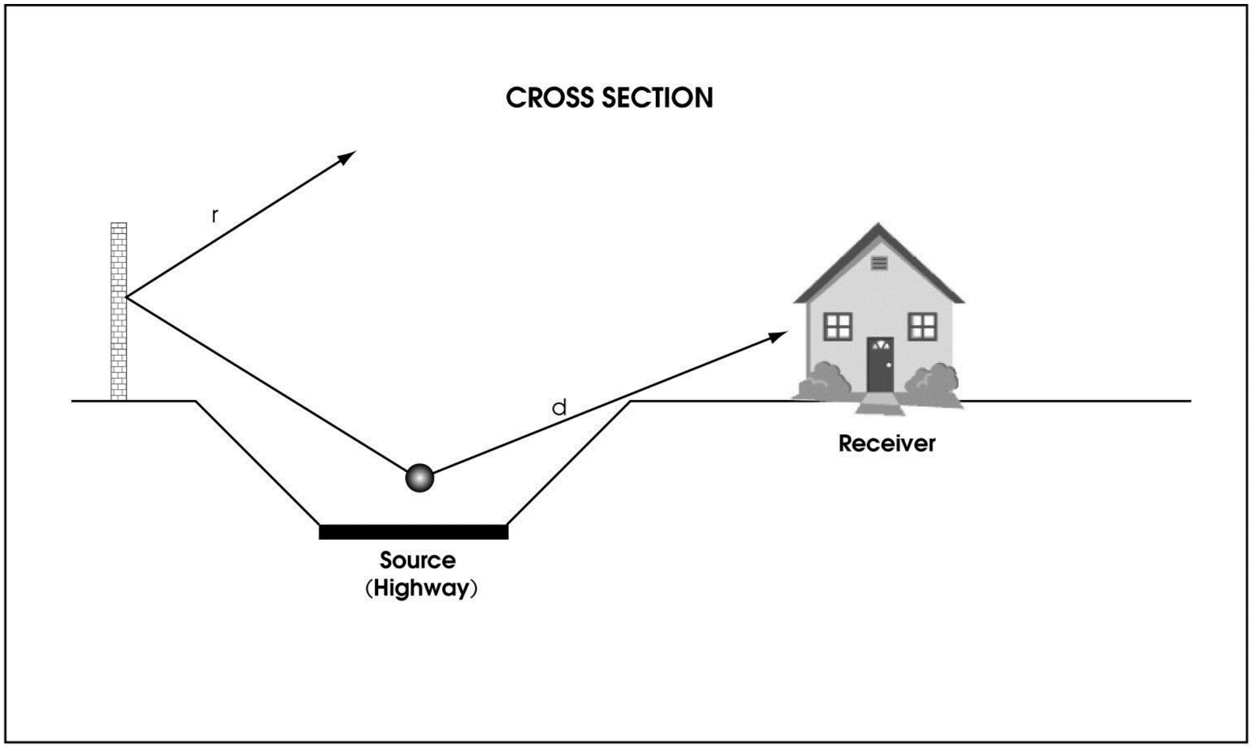


Figure 5-28. Single-Barrier Reflection (Noise Barrier on Top of Opposite Cut)

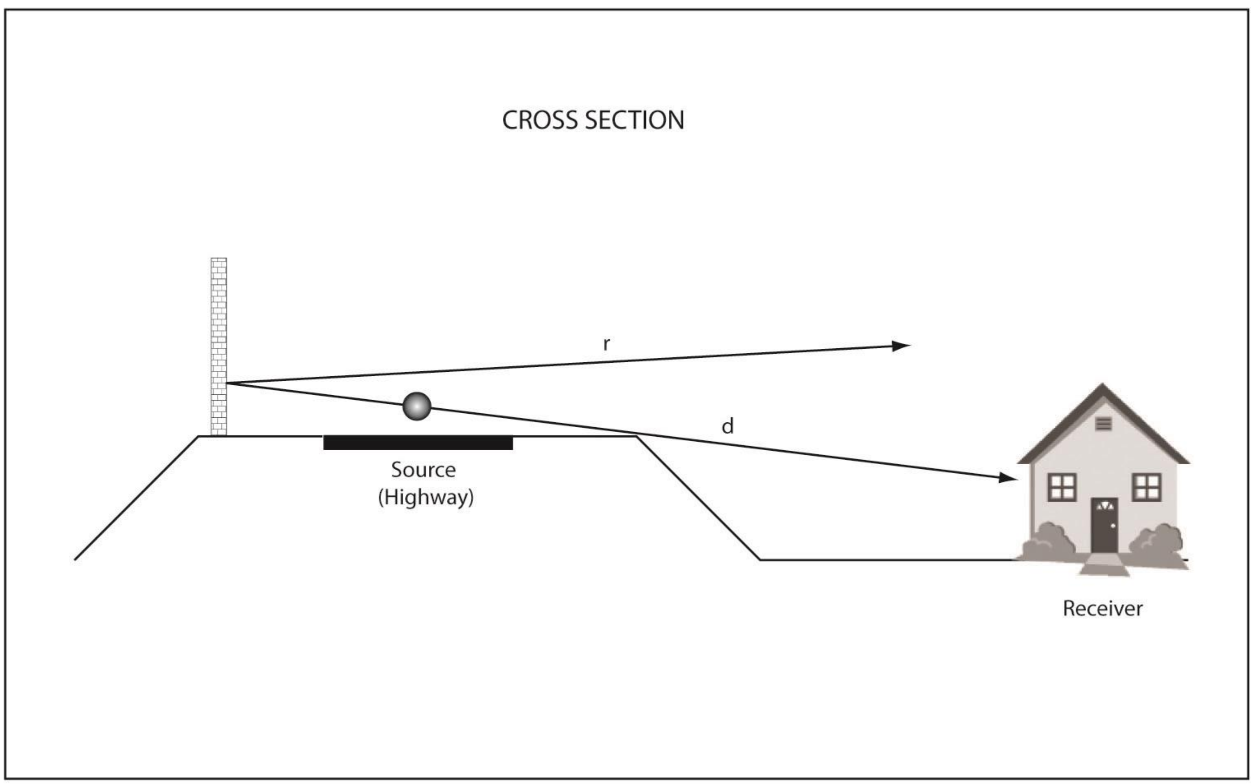


Figure 5-29. Highway and Noise Barrier on Fill

5.1.7.3 Modeling Single Barrier Reflections

TNM currently has no provisions for calculating single barrier reflections. In the future, however, it is planned to have that capability.

For simple situations, the effects of reflections can be evaluated in TNM using image sources. Figures 5-30 and 5-31 illustrate these concepts in cross section and plan views.

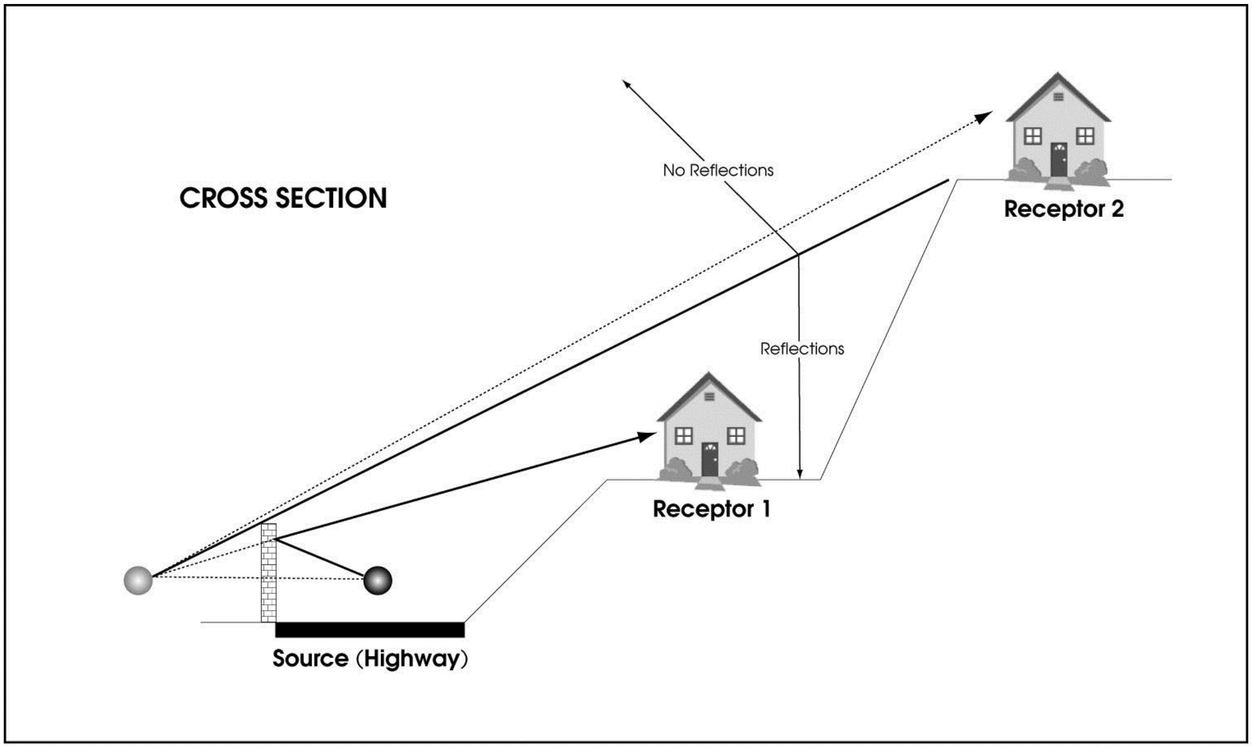


Figure 5-30. Placement of Image Sources (Cross Sectional View)

Figure 5-30 illustrates the placement of an image source in cross section by drawing a line perpendicular to the reflective wall (or its vertical extension) that passes through the real source. The image source is positioned on that line at the same distance from the wall as the real source but on the opposite side. The image source is analogous to a mirror image of the real source, with the wall acting as the mirror.

It is important to point out that just as mirror images cannot be seen from all angles, not all image sources necessarily contribute to reflections. A straight line drawn from the image source to the receiver must pass through the wall before the image source can contribute to the noise at the receiver. Please note that Receptor 1 lies in the “zone of reflections,” while Receptor 2 does not experience reflective noise. In some cases, there are reflections from cars but not heavy trucks, or vice versa, depending on the site geometry. In other cases, only traffic noise from certain lanes will be reflected, while noise from others will not. Accurate site cross sections will reveal which image sources are relevant.

Figure 5-31 illustrates how an image source can be created in a plan view. A general case is shown with a finite wall that is not parallel to the roadway. Examination of Figure 5-31 reveals that for the purposes of creating an image source a finite wall creates a unique finite image line source for a particular receiver on the opposite side of a highway.

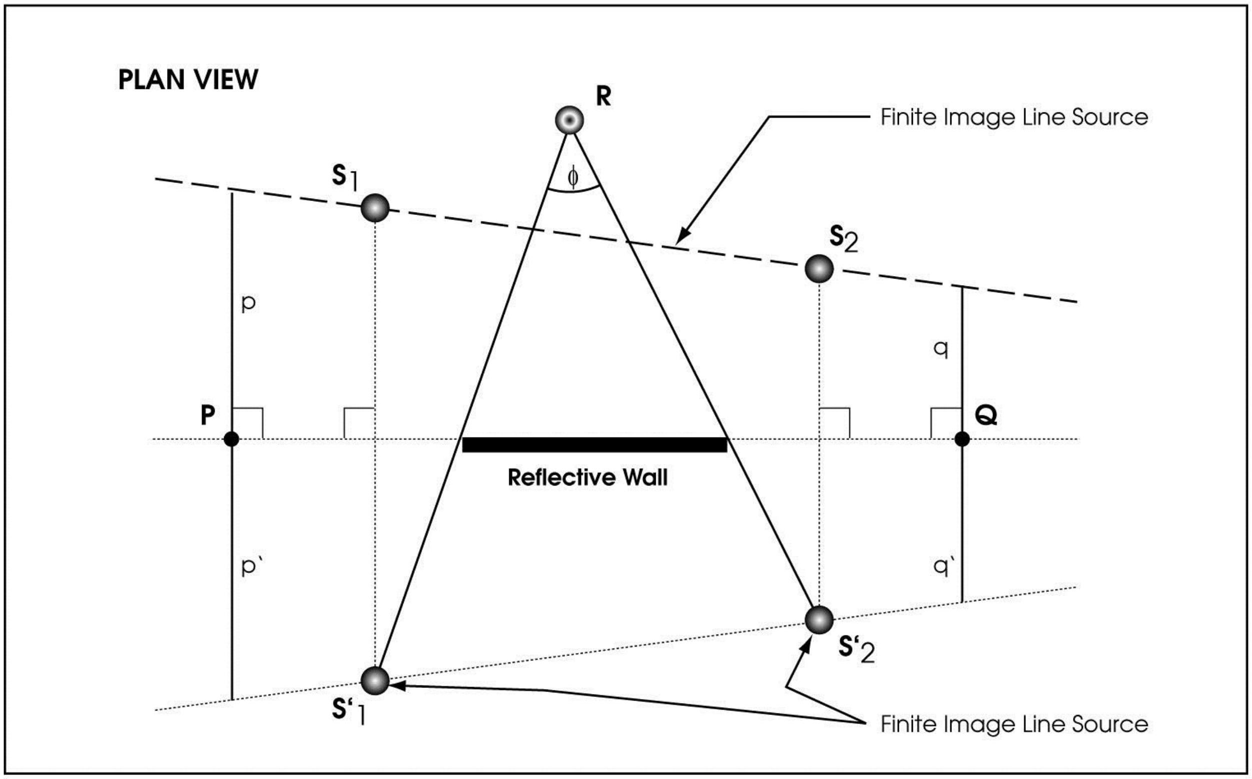


Figure 5-31. Placement of Image Sources (Plan View)

To construct the finite image line source, lines perpendicular to the wall or its extensions at two random locations (e.g., *P* and *Q*) can be drawn. Along these lines, distances *p* and *q* from the wall to the roadway line L, at *P* and *Q*, respectively, can be measured and reconstructed on the image side of the wall ($p = p'$, $q = q'$). A line L' connecting the two points defined by distances p' and q' establishes the direction of the image line source. Next, the termini of the infinite image line source can be determined by the intersections of line L' with two lines from the receiver *R* through both end points of the wall. S'_1 and S'_2 are now the end points of the finite image line source and represent image sources of real sources S_1 and S_2. To correctly account for the reflections at *R*, the finite image source S'_1 –

S'_2 must be input along with the infinite real line source L. Because the reflective wall does not shield R, it must not be included in the analysis.

Please note that for a given source and noise barrier length, the locations S'_1 and S'_2 will be receiver-dependent. For each receiver location, the finite image source $S'_1 - S'_2$ will have a different length unless both the real line source and reflective wall are deemed infinite. When analyzing the effects of the reflections from the wall, each receiver must be analyzed and modeled separately unless both the line source and reflective wall are infinitely long. However, where receiver locations do not change the length of $S'_1 - S'_2$ significantly, the length may be averaged and applied to these receivers.

Only primary reflections should be considered when employing the above methods. Further, because each receiver is affected by a different set of reflections, the number of receivers modeled should be minimized. Even in that case, however, modeling of reflective noise can be very cumbersome. TNM does not currently have provisions for reflection calculations except for the parallel barrier analysis module discussed in the next section.

5.1.7.4 Parallel Barriers

Multiple reflections between reflective parallel noise barriers can potentially reduce the acoustical performance of each individual barrier. Figure 5-32 shows a simple illustration of only five of the many possible reflective paths in addition to the direct path to the top of the barrier. Theoretically, there are an infinite number of possible reflective noise paths. Each reflection essentially becomes a new source, which may add to the noise diffracted by the barrier nearest to the receiver. This in turn may reduce the barrier's effectiveness.

However, Figure 5-32 clearly shows that as the number of reflections for each possible path increases, the path length becomes significantly longer. However, in all instances the barrier-to-receiver distance is the same. Only the path lengths from source to receiver that are located between the barriers change. For the direct path, this distance is defined as $W - S$, where W is the separation distance between the two barriers and S is the distance from the far barrier to the source.

For the first reflective path, the distance is approximately $W + S$. For the second reflective path, it is approximately $3W - S$. Further examination of Figure 5-32 shows that the path length difference between the first reflective path and the direct path is $2S$. The difference between the second and first reflective paths is $2(W - S)$. The pattern repeats itself for subsequent reflections. These increases in path length distances for each subsequent reflection soon make their contribution to the total diffracted noise insignificant (only the first few reflections are important).

For example, for the special case where $W = 2S$ (source halfway between the barriers), each subsequent reflective path increases by W. Assuming that the distance between the source and receiver $D = W$ (a fairly typical situation) and the Noise Reduction Coefficient (NRC) is 0.05 (95% of energy reflected at each reflection point), the contribution of each subsequent reflection decreases rapidly because of increasing path length, as shown in Table 5-2. The table assumes only the effects of increasing distances and a slight absorption by the walls (5% at each reflection point), and does not include the effects of the location of the final point of reflection with respect to the source location. This affects the amount of diffraction by the wall on the receiver side, which will be different for each reflective path. Pavement reflections, constructive and destructive interference of sound waves, frequency shifts, effects of the traffic mix, traffic stream, and lane distribution are ignored also.

Noise contributions from parallel barrier reflections obviously depend on the source-to-receiver distance. For a fixed W, the relative distance attenuation for each reflective path decreases as D increases. The contribution of each reflection also increases as W decreases in relation to D (Figure 5-32).

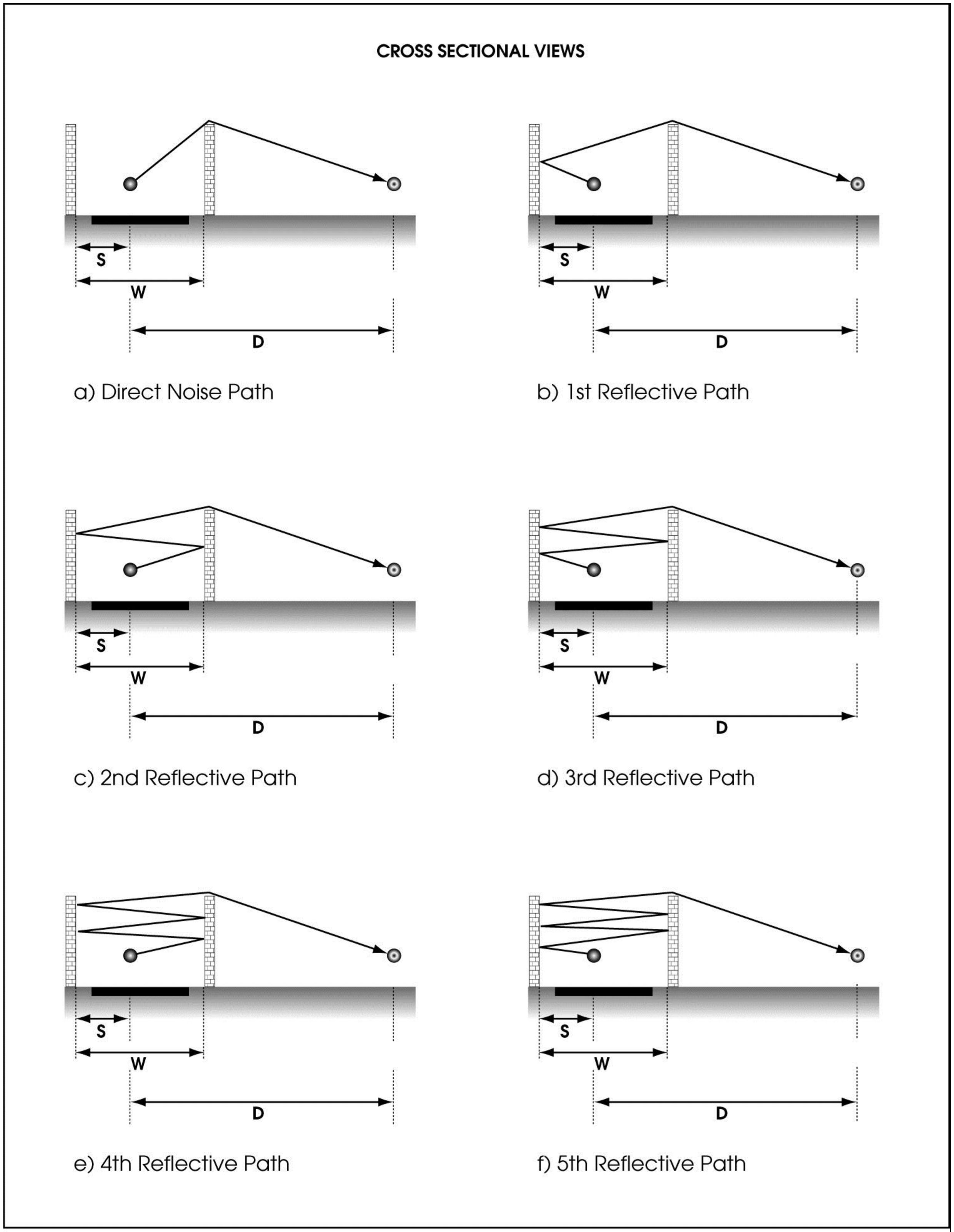


Figure 5-32. Various Reflective Noise Paths for Parallel Noise Barriers

Table 5-2. Contribution of Reflections for Special Case Where W = 2S, D = W, and NRC = 0.05

Noise Path	Distance, (Source to Receiver of Reflected Paths)	(1) Distance Adjustment (Direct to Reflective Path) 10log(W / NW) (where N = 2 through 11) (dBA)	(2) Absorbed (NRC = 0.05) (dBA)	(1 + 2) Contribution (RE: Direct) (dBA)	Cumulative Total Noise Level (RE: Direct) (dBA) (Direct + 1st Reflective + 2nd Reflective, etc.)
Direct	W	0 (Ref.)	0	0 (Ref.)	0 (Ref.)
1st reflective	2W	-3.0	-0.2	-3.2	+1.7
2nd reflective	3W	-4.8	-0.45	-5.25	+2.5
3rd reflective	4W	-6.0	-0.7	-6.7	+3.0
4th reflective	5W	-7.0	-0.9	-7.9	+3.3
5th reflective	6W	-7.8	-1.1	-8.9	+3.6
6th reflective	7W	-8.5	-1.3	-9.8	+3.8
7th reflective	8W	-9.0	-1.6	-10.6	+3.9
8th reflective	9W	-9.5	-1.8	-11.3	+4.1
9th reflective	10W	-10.0	-2.0	-12.0	+4.2
10th reflective	11W	-10.4	-2.2	-12.6	+4.3

Noise contributions of reflections between parallel barriers degrade the performance (insertion loss) of each noise barrier. The amount of degradation that takes place depends on the site geometry and barrier configurations. In addition to the factors shown in Figure 5-32 and Table 5-2, there is another important relationship between the ratio of the separation between two parallel barriers (W) and their average height (H_{AVG}), and the amount of insertion loss degradation. As a rule, if the W / H_{AVG} ratio is 10:1 or more, the insertion loss degradation is less than 3 dBA. This has been supported by research done by Caltrans and others (California Department of Transportation 1991 and Federal Highway Administration 1990). Because of suggested noise barrier height limits in the *Highway Design Manual*, parallel noise barriers in California typically have a W / H_{AVG} ratio of 10:1 or more. Although there have been claims to this effect, there are no known instances in which reflective parallel noise barriers in any configuration have ever measurably increased noise levels over those without noise barriers. The W / H_{AVG} guideline applies not only to noise barriers, but also to retaining walls or combinations of both. Figure 5-33 illustrates these concepts.

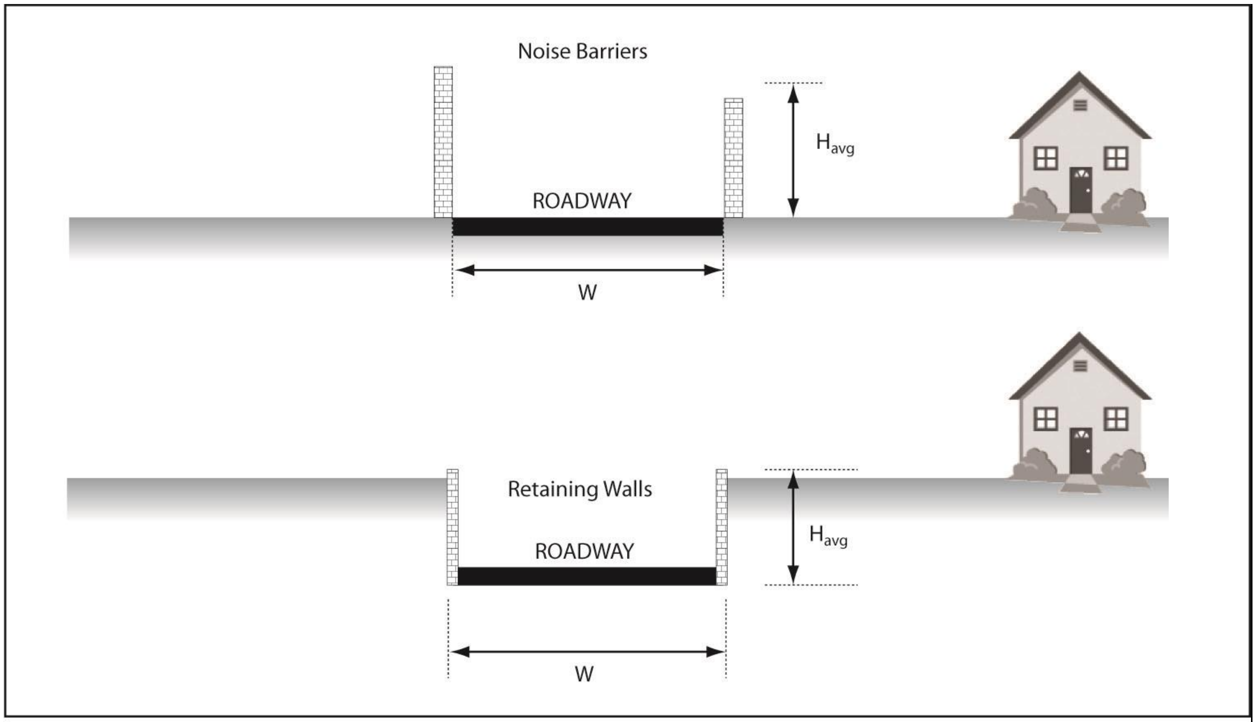


Figure 5-33. *W* / *H*$_{AVG}$ Ratio Should be 10:1 or Greater

5.1.7.5 Reflections off Structures and Canyon Effects

Generally, the same rules that apply to reflections off noise barriers also apply to those off retaining walls. Because the height limitations to noise barriers do not pertain to retaining walls, there is more potential for noise reflections, especially when the retaining walls are along stretches of depressed freeways. However, no noise barriers in this configuration have ever been shown objectively and conclusively to result in higher noise levels than those of a similar at-grade freeway because of reflective noise.

Complex multi-level highway interchanges can present some challenges in noise abatement design. The widespread spatial distributions of traffic noise sources and receivers make it difficult to design noise barriers that interrupt all direct noise paths between the many source-to-receiver combinations. Additionally, reflective surfaces of concrete structural components create many opportunities for noise reflections to circumvent noise barriers. Figure 5-34 shows one example of a potential complication created by the interaction of structures and noise barriers.

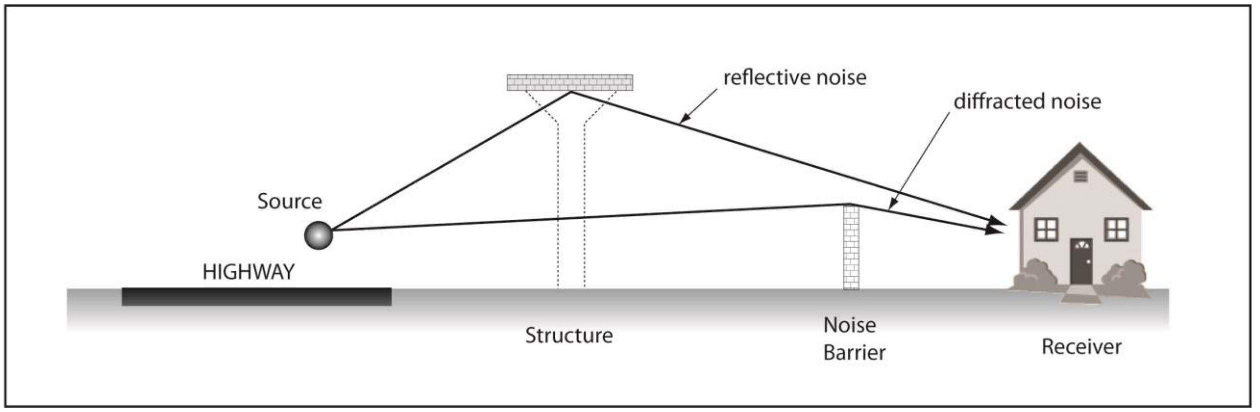


Figure 5-34. Noise Reflection off Structure

The structure in the illustration provides a point (or line) of reflection off the structure's soffit. This essentially creates a new line source with respect to the receiver shown. Unlike the highway noise sources that are shielded from the receiver by the noise barrier, the reflected noise (new source) is not shielded.

High median barriers (e.g., 5-foot-high concrete glare screens) are typically not considered an issue. Because of the barriers' limited height, reflections most likely are scattered and interrupted by the traffic stream.

The effects of reflections near tunnel portals can substantially increase noise at receptors near the portal. A study conducted in Germany (Woehner 1992) provides guidance on how to reduce noise at tunnel portals by applying acoustical absorption to the tunnel walls near the opening. The report indicates that the depth of treatment into the tunnel should be 2 to 3 times the diameter of the tunnel opening.

To date, Caltrans measurements have yet to conclusively reveal issues associated with the interaction between structures and noise barriers. The effects of reflections off structures would be limited because of the small reflecting surface and therefore affect only a relatively small group of receivers because of the small reflecting surface.

Studies of highways through canyons typically have shown noise increases of less than 3 dBA from canyon effects. Noise increases generated from highways in narrow canyons with steep side slopes theoretically could be more than 3 dBA, depending on groundcover and the steepness and smoothness of side slopes. The canyon walls, to some extent, act as parallel soundwalls with respect to multiple reflections. However, unless the slopes are perfectly vertical, buildup of reflections will be more limited because of the slope angles.

Highways on hillsides with nearly vertical rock cuts are somewhat similar to the single barrier situation discussed previously. No perceptible noise increases are expected. Because of the angle of the cut slope, reflections are directed skyward, while receivers would likely be below the highway.

5.1.7.6 Double-Deck Bridge Reflections

A special case of multiple noise reflections is a double-deck bridge. Frequently, noise measurements taken at receivers near such a structure differ substantially from those modeled for the same conditions because of the model's inability to account for the noise contributions generated by lower-deck traffic, and reflecting between the lower road deck and the bottom (soffit) of the upper deck. An example of how to calculate the contributions of these reflections manually will be shown in this section.

In Figure 5-35, the noise levels at the receiver are determined by the direct diffracted path from the lower deck traffic (sources S_1 and S_2), traffic from the upper deck, and contributions from reflections between the lower deck and the soffit of the upper deck. The direct noise levels from the lower and upper decks can be modeled in the TNM. The contributions of the multiple reflections between the decks, however, cannot be modeled in TNM and require manual calculations that can be added to the results of TNM. To accomplish this, ignore the contributions of the upper-deck traffic and begin by modeling the geometry of the lower deck, the receiver, and the associated traffic at S_1 and S_2. In Figure 5-35, the direct paths from S_1 and S_2 are diffracted by the barrier at the edge of the lower deck.

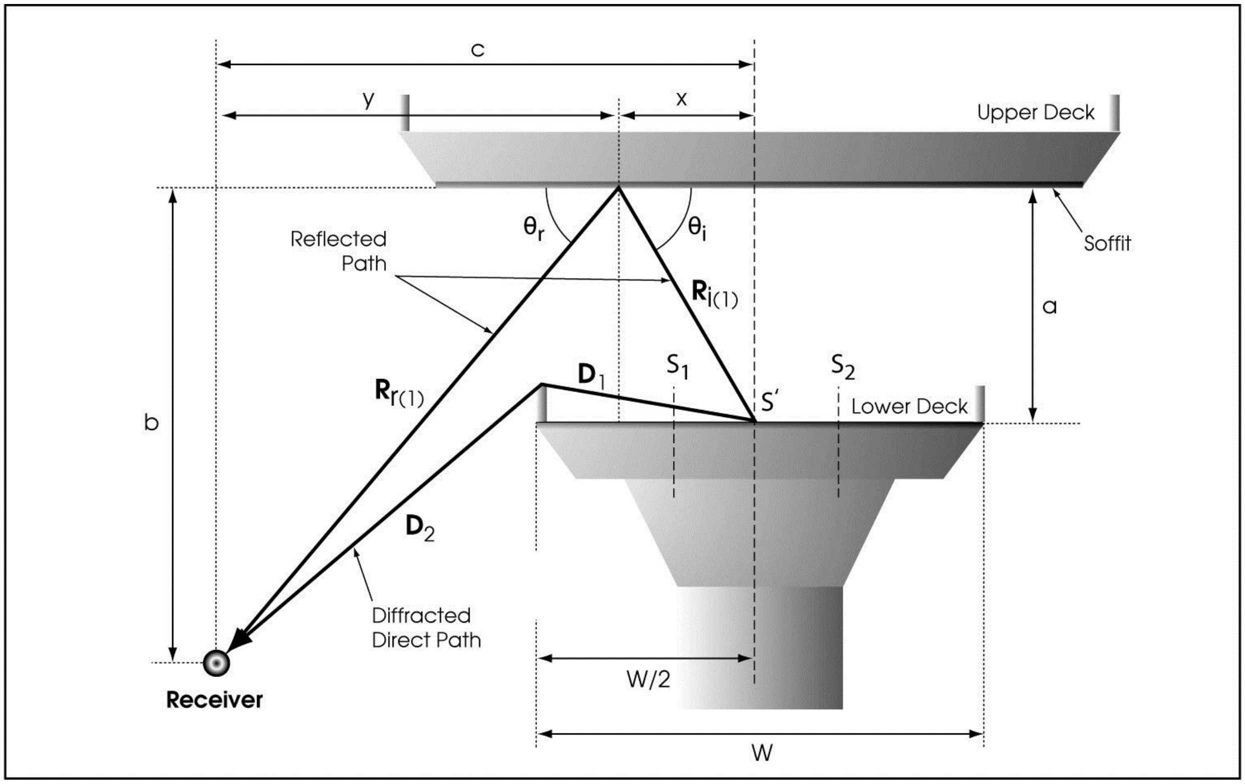


Figure 5-35. Double-Deck Structure Reflections, First Reflective Path

Contribution of Primary Reflection

Begin by analyzing only the primary (first) reflective path, $R_{(1),}$ as shown in Figure 5-35. Subsequent reflections will be analyzed similarly and will be discussed later in this section. $R_{(1)}$, consisting of the incident path $R_{i(1)}$ and path after first reflection $R_{r(1)}$, is not diffracted by the edge of the bridge. For simplicity, one path originating from S' is shown to represent an average of the primary reflective paths from both S_1 and S_2. The direct diffracted paths from S_1 and S_2 are similarly shown as one average path originating at S'. This approximation will yield results that are sufficiently accurate. Please note that all the sources depicted in Figure 5-35 are actually lines shown on end (disappearing into the paper). Therefore, all the direct and reflected paths are actually planes and propagate as line sources.

If the path lengths of both the direct diffracted and reflected paths are known, the line-source noise contribution of the reflective path relative to the direct path can be calculated as follows:

$$10\log(D/R_{(1)}) \quad \textbf{(5-2)}$$

Where:
D = direct path length ($D_1 + D_2$)
$R_{(1)}$ = primary reflected path length ($R_{i(1)} + R_{r(1)}$)

However, this would be true only if D would be undiffracted. Any calculated reflected noise contributions would be relative to the undiffracted noise level originating from S_1 and S_2. These contributions could then be added to the diffracted noise level at the receiver. The difference between the undiffracted and diffracted noise levels can be calculated from modeled results.

The diffracted noise level at the receiver can be modeled with the geometry shown in Figure 5-35, eliminating the upper deck. The required dimensions are all given: the line source locations S_1 and S_2; the location of the edge of the bridge deck, including a jersey or other barrier; and the dimensions a to c.

The undiffracted noise level requires relocation of the receiver while keeping the distance of the diffracted path length, and raising the receiver high enough to not be influenced by the barrier at the edge of the bridge deck. This requires the straight-line path of the receiver to be at least 5 feet higher than the top of the (jersey) barrier. The difference between the diffracted and undiffracted noise level at the receiver can now be expressed relative to the undiffracted noise level. For instance, if the diffracted noise level is 60 dBA and the undiffracted noise level is 70 dBA, the latter is the reference, and the former becomes -10 dBA.

The contribution of the primary reflections (simplified by a single path representing both paths from S_1 and S_2) can now be calculated using Equation 5-2. Using Figure 5-35, calculate the lengths of D and $R_{(1)}$. D can be calculated as described below:

$$D = D_1 + D_2 \quad \textbf{(5-3)}$$

Where:
$D_1 \approx W/2$
$D_2 = \sqrt{[(b-a)^2 + (c - W/2)^2]}$

The calculation of $R_{(1)}$ requires additional manipulation. First, it is known the primary reflective path consists of $R_{i(1)}$ and $R_{r(1)}$, and the angle of incidence (θ_i) equals the angle of reflection (θ_r). It is also known that the primary reflective path must originate at S’ and end at the receiver. Within these constraints, the location of the point of reflection, which lies on the soffit of the upper deck, a distance *x* from S’ and a horizontal distance *y* from the receiver, which in turn lies a horizontal distance of *c* from S', can be calculated as described below. (It should be emphasized that the point of reflection and the source at S' are actually lines.)

Because $\theta_i = \theta_r$, x/y = a/b (sides of proportional triangles)

Therefore, x = y(a/b) and y = x(b/a)

In c = x + y (given), substitute y(a/b) for x

Therefore, c = y(a/b) + y = y[(a/b) + 1] and y = [c/(a/b) + 1] = bc/(a + b)

Similarly, x(b/a) can be substituted for y

By the above process, x = ac/(a + b)

Because a, b, and c are given, x and y can be readily calculated.

$R_{i(1)} = \sqrt{(x^2 + a^2)}$ and $R_{r(1)} = \sqrt{(y^2 + b^2)}$.

$R_{(1)} = R_{i(1)} + R_{r(1)}$

The noise contribution of R_1 relative to the undiffracted noise level at the receiver now can be calculated.

Example 1

Given

a = 30 feet

b = 50 feet

c = 60 feet = x + y

W = 66 feet

Undiffracted noise level from lower deck at image receiver = 70 dBA, L_{eq}(h)

Diffracted noise from lower deck is 60 dBA, L_{eq}(h)

Calculate

1. Contribution of primary reflection
2. Total noise level from lower deck at receiver (including primary reflection)

Step 1: Compute D

$D = D_1 + D_2$

$D_1 = W / 2 = 66 / 2 = 33$ feet

$D_2 = \sqrt{[(b - a)^2 + (c - W / 2)^2]} = \sqrt{[(50 - 30)^2 + (60 - 33)^2]} = 33.6$ feet

D = 33 + 33.6 = **66.6 feet**

Step 2: Compute $R_{(1)}$

$R_{(1)} = R_{i(1)} + R_{r(1)}$

$R_{i(1)} = \sqrt{[x^2 + a^2)}$

$R_{r(1)} = \sqrt{[y^2 + b^2)}$

a and b are given

$x = ac / (a + b)$

$y = bc / (a + b)$

$x = (30 * 60) / (30 + 50) = 22.5$ feet

$y = (50 * 60) / (30 + 50) = 37.5$ feet

$R_{i(1)} = \sqrt{[22.5^2 + 30^2)} = 37.5$ feet

$R_{r(1)} = \sqrt{[y^2 + b^2)} = \sqrt{[37.5^2 + 50^2)} = 62.5$ feet

$R_{(1)} = 37.5$ feet + 62.5 feet = 100 feet

From Equation 5-2, the contribution of the primary reflective path is 10log(D / $R_{(1)}$), or 10log(66.6 / 100) = -1.8 dBA (RE: undiffracted noise level). The total noise level (RE: undiffracted noise level) is -10 dBA (diffracted noise level from lower deck) plus -1.8 dBA (from primary reflection), or $10\log(10^{-10/10} + 10^{-1.8/10}) = -1.2$ dBA. This means that because of the undiffracted primary reflection, the noise level from the lower deck at the receiver rose from (70 – 10) = 60 dBA to (70 – 1.2) = 68.8 dBA.

At this point, a discussion of the geometry and characteristics of the upper deck soffit surface is appropriate. In Figure 5-35, the point of reflection of the primary reflective path falls on the soffit. This may not always be the case, however, depending on the width of the upper deck and locations of the traffic sources and receivers. Each reflection must begin at the source and end at the receiver and the angles of incidence and reflection must be equal. If any of the constraints are not met, the reflection will not contribute. To determine whether the reflection contributes, *x* must be calculated first. The upper bridge deck must be sufficiently wide for the point of reflection to fall on the soffit surface, as determined by the distance *x* in Figure 5-35. If it does not, the reflection will not be a noise contributor. Similarly, the orientation of the upper deck relative to the lower deck must be accurately known. In Figure 5-35, the two decks are assumed to be parallel. If they are not, additional angle complications will be encountered in determining the reflective paths.

Other factors have been ignored so far. The soffit surface seldom is a perfect reflector (i.e., less than 100% of the incident sound energy is reflected back) at each point of reflection. If the sound absorptive characteristics of the soffit are known, Equation 5-2 can be expanded to include the fraction of incident noise energy that is reflected at each reflection point.

The equation can then be written as follows:

$$10\log[(D / R_{(1)})(1 - \alpha), \text{ or } (1 - NRC)] \quad \textbf{(5-4)}$$

Where:

α or NRC = fraction of noise energy absorbed by soffit material

(1 – α) or (1 – NRC) = fraction being reflected

If α or NRC = 1, all noise energy is absorbed; none is reflected.

If α or NRC = 0, no noise energy is absorbed; all is reflected

Difference between α and NRC is discussed in Section 5.1.7.7 below.

For example, the NRC for a concrete surface is frequently given as 0.05. In Example 1, the contribution of the primary reflective noise path would be 10log[(66.6 / 100)(1 – 0.05)] = -2.0 dBA, instead of -1.8 dBA for a 100% reflection of noise energy. The difference between perfect reflection (NRC = 0) and NRC = 0.05 is 0.2 dBA. This difference is independent of distance and cumulative for each reflection point.

Contributions of Subsequent Reflective Paths

Figure 5-36 shows additional reflective noise paths from S’ to the receiver. The second reflective path is almost identical to the primary noise path and consists of two reflection points, the first at S’ on the pavement and the second almost coinciding with the primary reflection point.

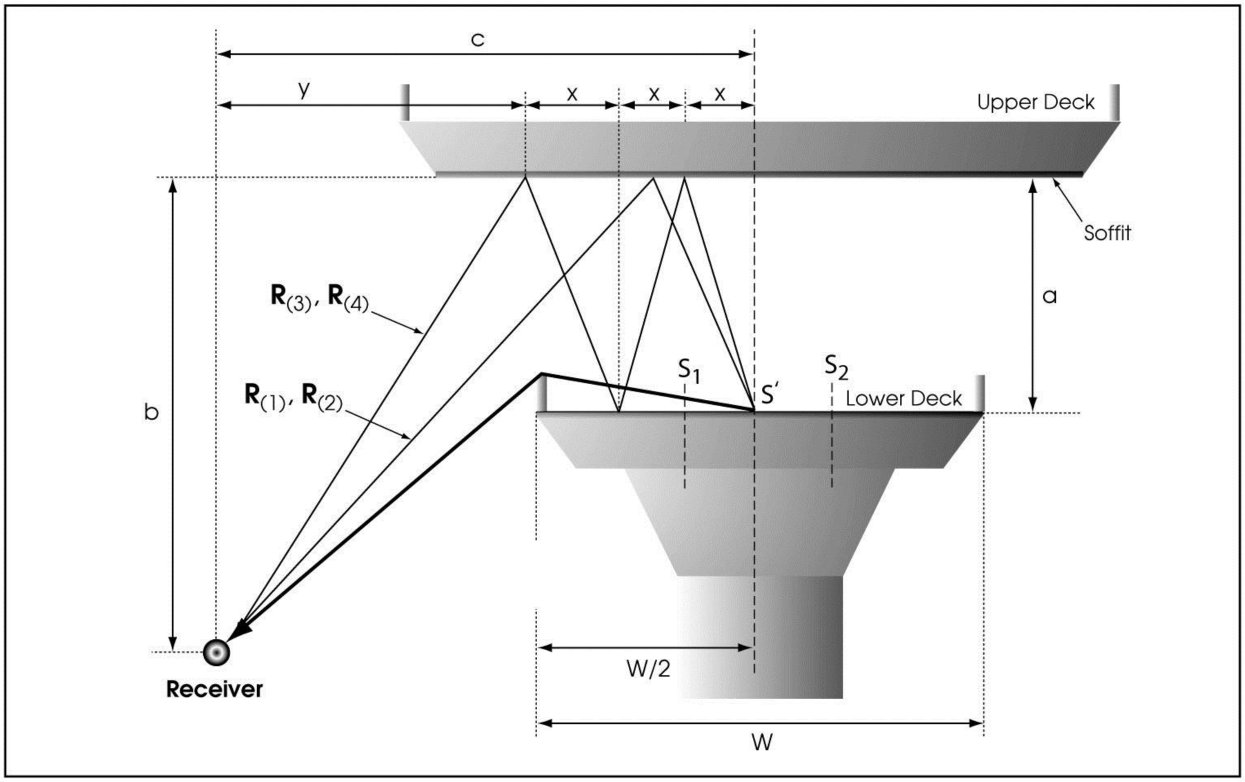


Figure 5-36. Multiple Reflective Paths

The difference between the primary and secondary noise paths is very small; therefore, they can be assumed to be the same. However, its contribution must be accounted for separately. The same is true for any even-numbered reflective path (e.g., the fourth reflective path almost coincides with the third reflective path). As discussed before, the number of possible reflective paths is limited to the following restrictions.

- Each reflective path must start at S' and end at the receiver.
- For each reflective path, the angles of incidence and reflection must be equal.
- For the nth reflective path, the last upper reflection point at distance $(n)x$ must fall on the soffit surface.
- The last lower reflection point at distance $(n - 1)x$ must fall on the lower deck surface.

For each reflective path, the distance x can be calculated as shown for the primary path. For the nth reflective path, $c = y + (n)x$. Therefore, $x = ac / [(n)a + b)$ and $y = bc / [(n)a + b)$. Also, $y = c - nx$. Actually, n refers to the odd-numbered reflective paths only. Each even-numbered reflective path is approximately equal to the previous odd-numbered one. Therefore, the noise contributions for the even-numbered reflective paths are also approximately the same as the previous odd-numbered reflective path (i.e., the noise contribution of $R_{(2)}$ equals $R_{(1)}$, and the contribution of $R_{(4)}$ equals $R_{(3)}$). The reflective path lengths can be calculated as shown in Example 1.

Using the same data as Example 1, the contributions of the remainder reflections can be determined. As stated, $R_{(2)} \approx R_{(1)}$, and the contributions are equal. $R_{(3)}$, which consists of three short incident/reflection paths (Figure 5-36) and a final long reflective path to the receiver, and its contribution can be calculated as follows.

Example 2

$x = ac / (3a + b) = (30)(60)/(90 + 50) = 12.9$ feet

$y = c – 3x = 60 – 3(12.9) = 21.3$ feet

Also, $y = bc / (3a + b)$, which can serve as a check:

$y = (50)(60) / (90 + 50) = 21.4$ feet

(Slight difference in results of y is because of rounding.)

Three short paths (all equal) = $\sqrt{(x^2 + a^2)} = \sqrt{(12.9^2 + 30^2)} = 32.7$ feet

Final reflective path = $\sqrt{(y^2 + b^2)} = \sqrt{(21.3^2 + 50^2)} = 54.3$ feet

$R_{(3)} = 3(32.7) + 54.3 = 152.4$ feet

$R_{(3)}$ contribution = $10\log(D / R_{(3)}) = 10\log(66.6 / 152.4) = -3.6$ dBA

$R_{(4)}$ contribution = $R_{(3)}$ contribution = -3.6 dBA

Close examination of Figure 5-36 indicates that the number of possible reflective paths is limited by *x* and the smaller of the half-widths of the soffit or lower deck. By comparing the half-widths of both the soffit and lower deck with calculated *n*(*x*), where *n* is each whole interval of *x*, the number of reflection points will become apparent. However, it should be noted that the final reflective path is the *n*th + 1 reflective path (in this case, *n* + 1 = 4).

Finally, the results from Examples 1 and 2 can be tabulated in summary form. An example of this format is shown in Table 5-3. All the reflective noise contributions shown are referenced to the undiffracted noise level at the receiver, but at the distance of the diffracted path. Because the reflective contributions are all without diffractions but the noise at the receiver (without reflections) is diffracted, all contributions to the undiffracted noise at the receiver must be normalized. As indicated in the discussion of primary reflection, undiffracted noise can be modeled by placing the receiver in such a position that no diffraction takes place. The previous discussion used undiffracted noise of 70 dBA and diffracted noise (without including reflections) of 60 dBA. The results table reuses these values. In that case, the reference is 70 dBA and all other values are relative to this reference. Also included is the correction for non-perfect reflections (assumed NRC = 0.05 [Equation 5-4] at each reflection point). Please note that reflective paths 2 and 4 actually have two and four reflection points very close to the source and therefore will be corrected for NRC 0.05.

Table 5-3. Summary of Reflective Noise Contributions and Cumulative Noise Levels

(1) Reflective Path Number $R_{(n)}$	(2) Contribution Relative to Ref.[a] $[10\log(D / R_{(n)})]$	(3) Correction for NRC = 0.05(n) $10\log(1 – 0.05)$	(4) [(2) + (3)] Adjusted Contribution (AC_n) Re: Ref.[a]	(5) Cumulative Noise Level (L_n)[b] Re: Ref.[a]	(6) [(5) + Ref.[a]] Absolute Noise Level
None	-10 dBA	None	0	L= -10 dBA (Given)	60 dBA (Given)
1	-1.8 dBA	-0.2 dBA	AC_1 = -2.0 dBA	L_1 = -1.4 dBA	68.6 dBA
2	-1.8 dBA	-0.4 dBA	AC_2 = -2.2 dBA	L_2 =+1.2 dBA	71.2 dBA
3	-3.6 dBA	-0.7 dBA	AC_3 = -4.3 dBA	L_3 = +2.3 dBA	72.3 dBA
4	-3.6 dBA	-0.9 dBA	AC_4= -4.5 dBA	L_4 = +3.2 dBA	73.2 dBA

[a] Ref. = reference of 70 dBA.

[b] Cumulative noise levels in column 5 are calculated as follows:

$L_1 = 10\log(10^{L/10} + 10^{AC1/10})$ $L_2 = 10\log(10^{L1/10} + 10^{AC2/10})$

$L_3 = 10\log(10^{L2/10} + 10^{AC3/10})$ $L_4 = 10\log(10^{L3/10} + 10^{AC4/10})$

5.1.7.7 Minimizing Reflections

When designing reflective parallel noise barriers, it is recommended that a minimum 10:1 W / H_{AVG} ratio is maintained between the two barriers to avoid perceivable barrier performance degradations. Earth berm noise barriers are not reflective and therefore not affected by W/H_{AVG} ratios of less than 10:1.

Sound absorption has been promoted as a solution for noise reflection issues. As part of an ongoing program, Caltrans considers a variety of proprietary noise barrier products and systems, some of which have sound-absorptive characteristics. . For more information on barrier materials and new products, the designer should check with the Caltrans Headquarters Office of Design and Local Programs for availability of approved materials, and the Division of Structures Design to determine which materials have been approved for use on noise barriers. Sound-absorptive materials can be an inherent property of the barrier or added on to an existing barrier (retrofit). The Caltrans new products webpage lists approved noise barrier products. These barrier products include reflective, absorptive, transparent, and bridge-rail-mounted options. The new products webpage is available here:

http://www.dot.ca.gov/hq/esc/approved_products_list/

The amount of noise absorption of the materials is rated by a noise absorption coefficient α. The coefficient is defined as the ratio of the acoustical energy absorbed by the material to the total energy incident on that material. For any particular material, α is frequency-dependent, and its value for each specific frequency ranges from 0 (perfect reflector) to 1 (perfect absorber). To rate the overall absorptive characteristics of the material, a measure of the average α over the frequency range of interest is useful. For traffic noise frequencies, an appropriate measure is the NRC, which is the arithmetic average of α in four octave bands with center frequencies of 250, 500, 1,000, and 2,000 Hz, calculated as follows:

$$NRC = (\alpha_{250} + \alpha_{500} + \alpha_{1,000} + \alpha_{2,000})/4 \qquad \textbf{(5-5)}$$

If approved absorptive materials are considered, a minimum NRC of 0.85 should be used as a criterion. This value means that 85% of the incident noise energy is absorbed and 15% reflected. For a single reflection, this can only add a maximum of 0.6 dBA to the direct noise level, instead of the theoretical 3 dBA for a perfect reflector (NRC = 0).

5.1.8 Miscellaneous Acoustical Design Considerations

There are various other factors that can affect the acoustical performance of noise barriers. Some (maintenance access, emergency access, and drainage openings) are discussed in *Highway Design Manual* Chapter 1100. The criteria in Chapter 1100 are based on actual noise measurements performed by the TransLab in the 1980s. Although the information is mostly useful to the designer of the noise barrier, it is repeated here for the noise analysts because they often need to field questions about the acoustical integrity of the noise barrier's design features. Refer to the Caltrans website for the latest version of the *Highway Design Manual*.

5.1.8.1 Maintenance Access behind Noise Barriers

Noise barriers placed within the area between the shoulder and right-of-way line complicate the ongoing maintenance operations behind the noise barrier. From a maintenance perspective, it would be best to place the noise barrier on the right-of-way line, which would avoid access issues and the need of a chain link fence. However, this location may not be preferable for acoustical reasons, as discussed in Section 5.1.2. If the right-of-way line borders a frontage road or other public easement, access to the strip of land between the barrier and the right-of-way can be provided through gates in the chain link right-of-way fence. If not, access may be provided by offsets in the barrier (Figure 5-37). The acoustical integrity of the noise barrier can be maintained by either providing a solid gate of appropriate material and transmission loss (see Section 5.1.1) to close the opening between the two barriers, or by providing a barrier overlap of two-and-a-half to three times the offset distance without closing the opening (Figure 5-38).

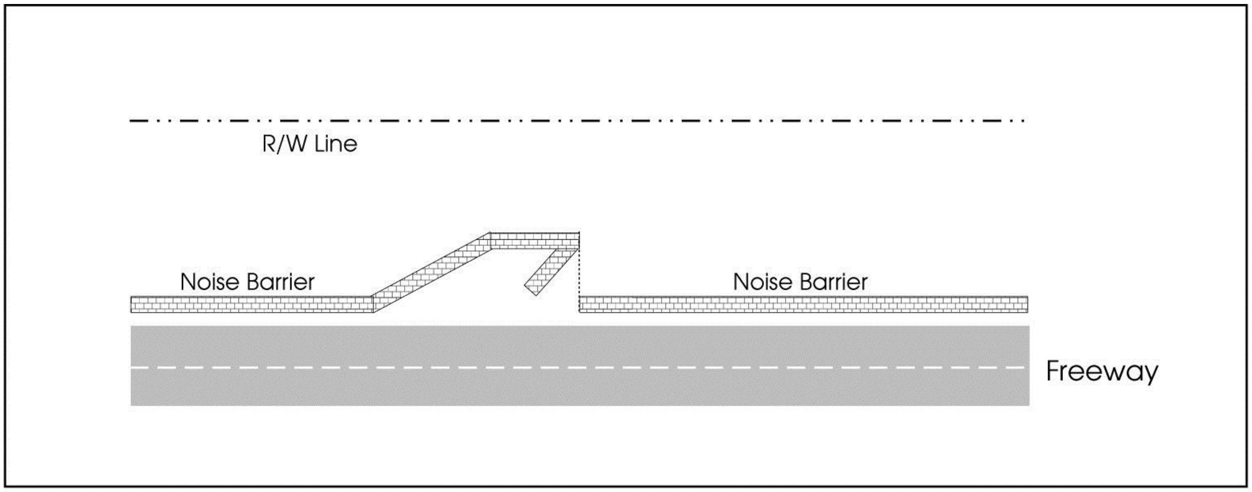


Figure 5-37. Barrier Offset with Solid Gate

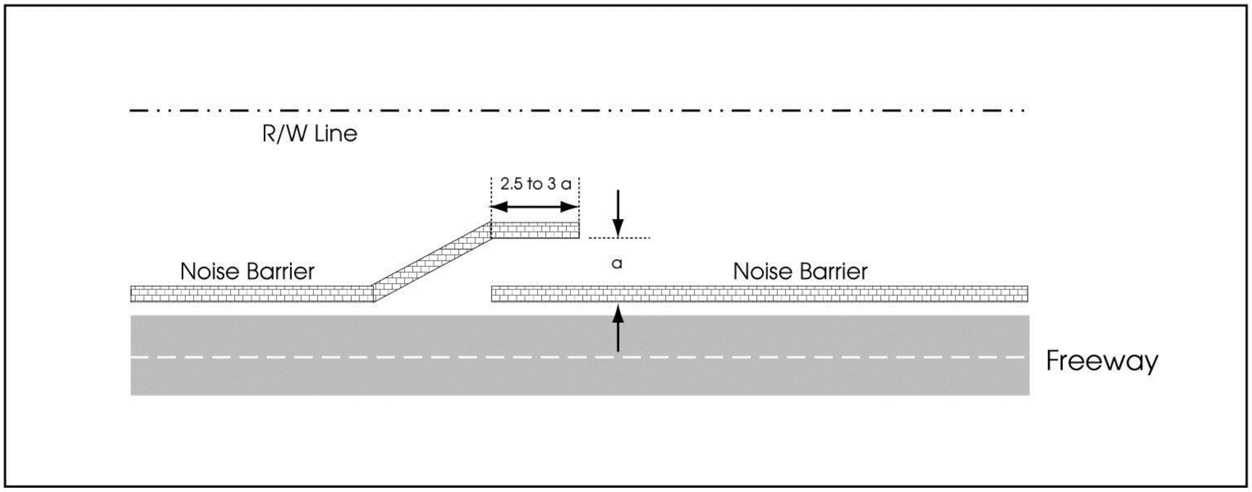


Figure 5-38. Barrier Overlap Offset 2.5 to 3 Times the Width of the Access Opening

5.1.8.2 Emergency Access Gates in Noise Barriers

In addition to access gates and openings in noise barriers for routine maintenance, emergency access gates may be constructed to provide access to a freeway when emergency vehicles cannot reach the scene of an accident. The gates are not intended to provide alternate emergency access to adjacent neighborhoods. Small openings in the noise barrier may also be provided to allow fire hoses to be passed through. The number of gates should be minimized, and the gates should be at least 1,000 feet apart. Where possible, the maintenance openings and emergency access gates should be combined in one location. The Division of Structures Design has incorporated the design of the gates in the soundwall details. The fire hose openings should be located as close as possible to the fire hydrants on the local streets. The size and spacing of the openings normally do not compromise the acoustical performance of a noise barrier. Design details of these openings are available from the Division of Structures Design.

5.1.8.3 Drainage Openings in Noise Barriers

Drainage through noise barriers is sometimes required for various site conditions. Depending on size and spacing, small unshielded openings at ground level can be provided in the barriers to allow drainage without compromising the acoustical performance of the barrier. This can be accomplished if the following size and spacing criteria are observed.

- Openings of 8 by 8 inches or smaller if the openings are spaced at least 10 feet on center.
- Openings of 8 by 16 inches or smaller if the openings are spaced at least 20 feet on center and the noise receiver is at least 10 feet from the nearest opening.

The location and size of drainage openings need to be designed based on the hydraulics of the area. The designer should also consider possible erosion that may occur at the drainage openings.

Where drainage requirements dictate openings that do not conform to these criteria, shielding of the opening may be necessary to uphold the acoustical performance of the noise barrier in the vicinity of a receiver. Shield design should be done with consultation of the district hydraulics unit and noise analyst.

5.1.8.4 Vegetation as Noise Barriers

In spite of a general perception of its effectiveness in lowering noise levels, shielding by shrubbery and trees typically used in landscaping along highways provides an imperceptible amount of noise reduction (less than 1 dB) (California Department of Transportation 1995). Such plantings are not effective for reducing highway noise. A possible explanation for the contradiction of objectively measured noise with general perception is that shrubs shielding traffic from the receiver reduce the visual awareness of the traffic. In such cases, the reduction in visual awareness of the traffic is commonly accompanied by a reduction in auditory awareness of the traffic. The role of landscaping and planting in enhancing the aesthetics of a noise barrier and combating graffiti are addressed in the next section.

5.2 Non-Acoustical Considerations

Final selections of materials, locations, heights, lengths, and shapes of noise barriers include non-acoustical considerations such as safety and aesthetics. Although the noise analyst is normally not involved with these decisions, the analyst should be aware that recommended acoustical designs of noise barriers are sometimes altered because of non-acoustical considerations.

5.2.1 Safety

Safety considerations include lateral clearances, sight distance requirements, and guardrail or safety-shaped barrier requirements. These safety considerations are addressed in *Highway Design Manual* Chapter 1100.

The Division of Structure Design has developed standard plans for noise barriers (soundwalls). Standard plans for soundwalls can be downloaded from the Caltrans website:

http://www.dot.ca.gov/hq/esc/oe/construction_standards.html

Other designs, retrofit treatments, and alterations to noise barriers should be approved by the Office of Structure Design. Approved commercial noise barrier products including absorptive barriers are listed on the Caltrans website:

http://www.dot.ca.gov/hq/esc/approved_products_list/pdf/noise_barrier_systems.pdf

The standard plans also include designs for gates that provide emergency access to community fire hydrants, emergency access for stranded motorists, and rapid access to accidents, as discussed in Section 5.1.8.

A minimum height criterion of 6 feet for soundwalls in *Highway Design Manual* Chapter 1100 was partially designed to control pedestrian access to the freeway. The online version of the *Highway Design Manual* at the Caltrans website should be checked for the latest changes and referrals.

5.2.2 Aesthetics

The visual impact of noise barriers on adjoining communities and motorists is a major consideration in the design of noise barriers. A high noise barrier placed close to single-story residences could result in a visual effect. A high barrier also can create shadows, impede natural airflows, or block panoramic views. *Highway Design Manual* Chapter 1100 outlines maximum recommended heights for noise barriers located at distances of 15 feet or less and more than 15 feet from the traveled way.

In general, visual dominance of high walls near residences is reduced when the soundwall is located at least two to four times its height from the nearest receiver. The visual impact is further softened with berms and landscaping (Figure 5-39). Landscaped earth berms are aesthetically superior to soundwalls and acoustically perform equally or slightly better. However, in many locations, they are not suitable because of space limitations.

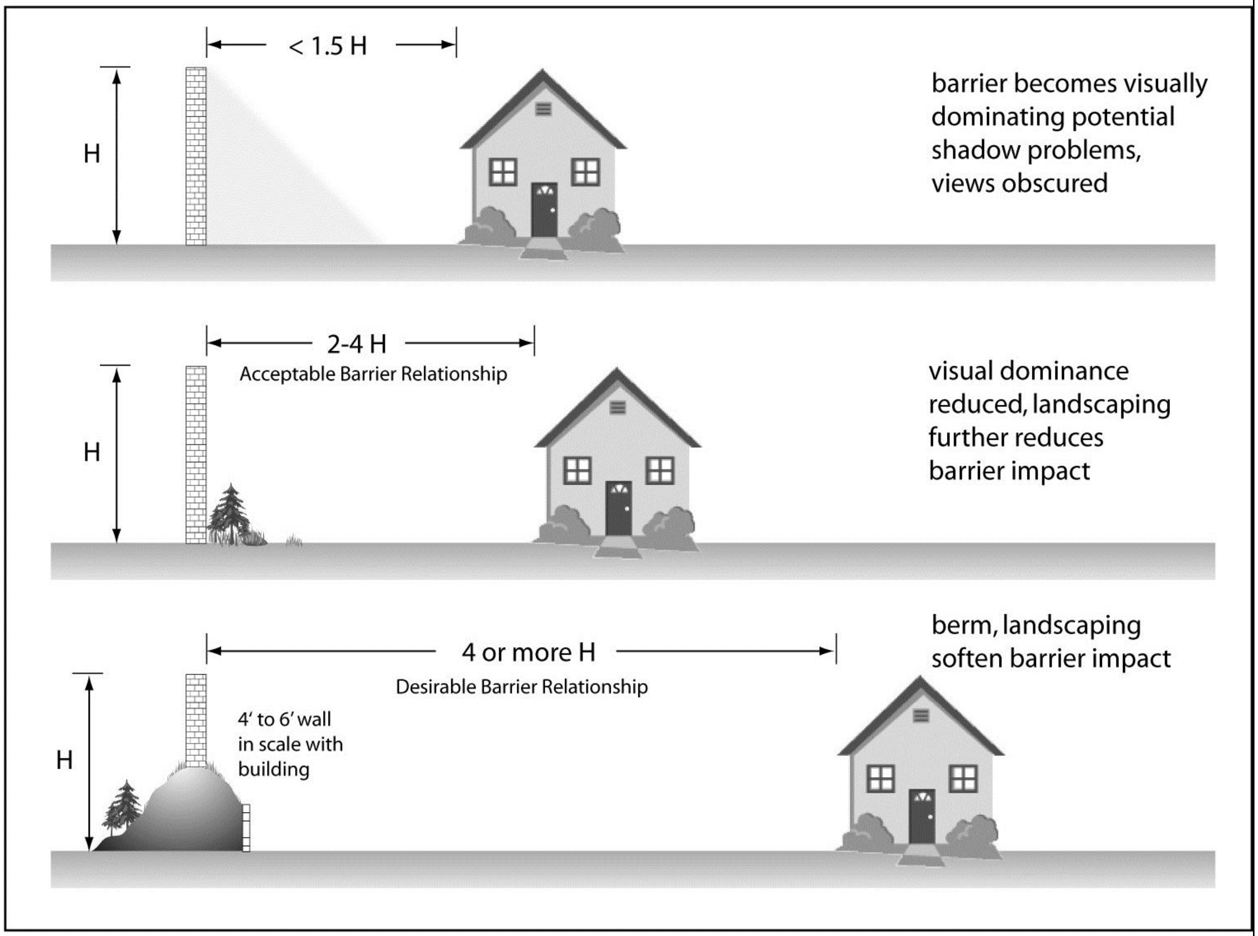


Figure 5-39. Spatial Relationship of Barrier to Adjoining Land Use

Soundwalls should not have abrupt beginnings or endings; they should be tapered or stepped. Aesthetic treatments are normally developed by the Division of Landscaping. If landscaping is to be placed adjacent to the soundwall where it eventually will screen a substantial portion of the wall, only minimal aesthetic treatment is justified.

Walls should reflect the character of the surroundings as much as possible. In cases where the general architecture of a community has a certain character, soundwall material, texture, and color should fit this character at the community side of the wall. Ideally, the community should have some input in the aesthetic design of noise barriers.

On the motorist side of the wall, the emphasis should be on the overall form, color, and texture of the wall. Visual effects on the driver from brick patterns and other forms and shapes should be considered when designing soundwalls. Small details will not be noticed at normal highway speeds. Instead, the emphasis should be on avoiding a tunnel effect through various forms, and visual treatments. Landscaping can be used effectively to accomplish this goal. As discussed, shrubs and trees used for landscaping along a highway do not provide effective shielding by themselves, but they can enhance the aesthetics of a noise barrier and combat graffiti by denying access to a large smooth surface and reducing its visibility from the highway or community side.

Further guidance on aesthetics can be found in *Highway Design Manual* Chapter 1100. Another useful reference on all aspects of noise barrier design and extensive coverage of aesthetics is the *FHWA Noise Barrier Design Handbook* (Fleming et al. 2011).

Section 6

Noise Study Reports

The primary function of a noise study report is to present the methods and results of a traffic noise analysis, as well as the data supporting the conclusions, to a target audience that includes both laypersons and technical noise analysts. To satisfy both audiences, the author can provide a summary for laypersons and decision-makers, and a technical report for experienced readers who desire more detail than what is provided in the summary.

The summary should briefly describe the existing land use and noise environment, project alternatives, future noise environment, traffic noise impacts, and noise abatement and mitigation considered. The technical report needs to fully support the conclusions that are incorporated into the environmental document and should satisfy technical reviewers who wish to assess the validity of the noise study, including methods and assumptions. Sufficient information should be presented to allow any trained noise analyst to reach the same conclusions.

As with all technical environmental studies, the level of effort to be spent on the noise study report needs to correspond to the size and complexity of the project, and degree of controversy surrounding it.

After completion of the noise study report, the noise abatement decision report (NADR) is prepared. The NADR is a design responsibility and is prepared to compile information from several sources. These sources include the noise study report, other relevant environmental studies, and design information. The NADR brings this information together into a single, comprehensive document that is completed before public review of the project. The NADR is prepared before publication of the draft environmental document.

The draft environmental document is the primary means of conveying information on noise impacts and abatement to the public, and reflects conclusions and information contained in the noise study report and NADR.

6.1 Outline

Table 6-1 shows an outline for a typical noise study report. Not all reports will need this level of detail. Others may require more because of special circumstances. An annotated noise study report outline has been prepared by Caltrans and is available: <http://www.dot.ca.gov/ser/forms.htm>. This outline provide guidance on the contents of noise study reports and provides a template with standard language that can be used a starting point for those who are preparing noise study reports.

Table 6-1. Noise Study Report Outline

Summary (or Executive Summary)

Purpose of Noise Report
Brief Description of the Project
Brief Description of the Land Use and Terrain
Existing Noise Levels (Ambient and Background)
Future Predicted Noise Levels
Traffic Noise Impacts (if Any)
Noise Abatement/Mitigation Considered (Range of Heights, Lengths, Insertion Losses, and Number of Benefited Receivers)
Reasonable Monetary Allowances per Benefited Receiver for Abatement Considered
Areas Where Abatement/Mitigation Is Not Feasible
Construction Noise

Chapter 1. Introduction

1. Purpose of Report
2. Background

Chapter 2. Project Description

1. Detailed Description of All Project Alternatives
2. Maps Showing Alignment and Profiles

Chapter 3. Fundamentals of Traffic Noise

1. Decibels and Frequency
2. Noise Source Characteristics (Vehicles and Roadways)
3. Noise Propagation
4. Perception at the Receiver, A-Weighting, and Noise Descriptors
5. Decibel Scale

Chapter 4. Federal and State Policies and Procedures

1. Traffic Noise Analysis Protocol
2. Technical Noise Supplement

Chapter 5. Study Methods and Procedures

1. Selection of Receivers and Measurement Sites
2. Field Measurement Procedures (Note: Field Data in Appendices):
    a. Instrumentation and Setups
    b. Noise Measurements
    c. Traffic Counts and Speeds
    d. Meteorology
    e. Data Reduction
3. Noise Prediction Method Used: TNM as mandated in 23 CFR 772

Chapter 6. Existing Noise Environment

1. Detailed Description of Noise-Sensitive Land Use
2. Maps Showing Receivers and Noise Measurement Sites
3. Table Showing Existing Noise Levels at Receivers:
    a. Field-Measured Results (Ambient and Background)
    b. Modeled Results
4. Discussion on Model Calibration (if Appropriate) for Adjusting Modeled Noise Levels (Existing or Future)

Chapter 7. Future Noise Environment, Impacts, and Considered Abatement/ Mitigation

1. Discuss Future Traffic Data Assumptions and Site Geometry
2. Table Showing Predicted Noise Levels and Identification of Traffic Noise Impacts, if Any
3. Discussion of Noise Abatement Options
4. Table Showing Future Noise Levels and Insertion Losses (Noise Reduction) for Various Noise Barrier Heights, Lengths, and Locations
5. Table showing top-of-wall elevations as a function of station number
6. Table Summarizing Data Necessary for “Reasonableness” Determination
7. Discussion of Areas Where Abatement/Mitigation Is Not Feasible

Chapter 8. Construction Noise

Chapter 9. References

Appendix A. Traffic Data

Appendix B. Predicted Future Noise Levels and Noise Barrier Analysis

Appendix C. Noise Barrier Reasonableness Analysis Worksheets

Appendix D. Noise Barrier Analysis

Appendix E. Supplemental Data

1. Instrumentation, Manufacturer, Model, Type, Serial Number, and Calibration
2. Measurement Site Details and Instrument Setups
3. Measurement Procedures, Duration, and Number of Repetitions
4. Measured Noise Data, Dates, and Times
5. Meteorological Conditions
6. Traffic Counts
7. Data Reduction and Measurement Results
8. Details of Computer Modeling Assumptions, Inputs, and Outputs

6.2 Summary

The noise study findings and conclusions should be presented near the front of the noise study report in the form of a summary (sometimes called *Executive Summary*). The summary is extracted from the technical portion of the noise study report. This requires the technical portion to be written first.

The summary should target laypersons and managers who are interested in the findings and conclusions of the noise study but not concerned about all of the technical details. Because the author of the noise study report is usually not the author of the project's environmental document, the summary should be written in such a manner that it can be copied into the environmental document. This will help to reduce misinterpretations, inconsistencies, loss of vital information, and numerical transpositions. The summary should be short, usually no longer than a few pages. The elements mentioned in Table 6-1 should be described briefly. A table listing receivers, existing noise levels, future noise levels without noise barriers, future noise levels with noise barriers (various heights), and insertion loss should be sufficient to summarize the results of the noise study.

6.3 Noise Impact Technical Study

The noise impact technical study is the main body of the noise study report. It contains detailed descriptions of why and how the noise study was performed and how the conclusions were reached. Sufficient detail is needed for someone to be able to duplicate the study from the information included in report.

6.3.1 Introduction

The introduction should include the purpose of the noise study report, study objectives, background information such as the need for the project and study, and any other general information useful to the understanding of the noise study report.

6.3.2 Project Description

The project description should include a detailed description of all project alternatives. There should be enough information for the reader to understand the project and how it fits into the transportation system of the area. An appropriate location map that shows the alternative alignments studied and their spatial relationship with noise-sensitive receivers such as residences, schools, hospitals, churches, and parks should be included.

6.3.3 Fundamentals of Traffic Noise

A short review of the physical principles of traffic noise at the source and its propagation, as well as subjective human perception, will provide a link for laypersons to understand the technical information. The contents of this section may be in a standard format or tailored to specific studies.

The noise characteristics of vehicles should be described briefly. Vehicle noise emissions increase with speed, and increased traffic volumes increase traffic noise, but it takes a doubling of traffic to increase noise levels by only 3 dB.

Noise propagation (line vs. point source) over acoustically hard and soft ground, effects by meteorological factors such as wind and temperature gradients, and shielding by terrain or noise barriers should be discussed.

Human perception of noise is frequency-dependent, which leads to a discussion on A-weighting, its purpose, and its use. If the character of the noise is unchanged sound level increases or decreases generally are perceived as follows: 3 dBA as barely perceptible, 5 dBA as readily perceptible, and 10 dBA as a doubling or halving of noise. This should be followed with a discussion on commonly used noise descriptors, such as L_{eq}(h).

Inclusion of a decibel scale that shows a link between everyday activities and associated noise levels will provide the reader with a scale by which to evaluate the severity of traffic noise.

This discussion does not need to be restricted to the above items. Other topics may be included as appropriate, some of which may be specifically tailored to the nature of the noise study. The information presented in this TeNS may be beneficial in explaining various phenomena. For instance, where controversies surrounding parallel or single noise barrier noise reflections are an issue, it may prove beneficial to include relevant selected text from Section 5.1.7 or 7.1. Text from Section 7.1 may be similarly useful in addressing concerns about the effects of noise barriers on distant receivers.

6.3.4 Federal and State Standards and Policies

This section addresses the applicable federal and state standards and policies. Caltrans noise analysis policies are in the Protocol and *Highway Design Manual*. Federal requirements are identified in 23 CFR 772. State requirements are contained in Streets and Highways Code Section 216. Terms used in the policies and standards should be mentioned in this section including the NAC, definitions of appropriate noise descriptors, and traffic noise impact criteria.

6.3.5 Study Methods and Procedures

Study methods and procedures followed should be identified in the noise study report. This section should describe selecting receivers, noise measurement sites, field measurement procedures, and noise prediction methods (see Sections 3 and 4).

The discussion of selecting the receivers and noise measurement sites should focus on the reasons they were selected. Selections are based on expectations of worst noise impacts, geometry of the project, representativeness, acoustical equivalence, and human use (see Sections 3.2 and 4.3.1). The importance of selecting receivers outside the area of project influence must not be overlooked. These receivers are extremely useful for documenting background noise levels and, after the project is built, guarding against unsubstantiated public claims that noise barriers constructed as part of the project increased noise levels at distant receivers (see Section 7.1.1).

The discussion on field measurement procedures (see Section 3) should include descriptions of instrumentation, setups, noise measurement procedures, traffic counts and speeds, meteorological observations, and data reduction methods. Model calibration procedures (see Section 4.4) should also be discussed.

The appendices to the noise report should indicate the measurement equipment used, calibration information, dates and times of measurements, measured noise data, traffic counts and speeds, meteorological conditions, site topography, and detailed measurement locations. (As a general rule, the microphone locations should be retraceable within 3 feet horizontally, and 1 foot vertically.) If measurements were taken at a time different from the worst noise hour, the adjustment and procedure used (see Section 3.3.1.2), any receivers modeled and calibrated, and any inputs should be shown.

Noise level predictions must be based on the methodology in the FHWA Traffic Noise Model. These and other documents pertinent to the noise study should be referenced as appropriate.

6.3.6 Existing Noise Environment

Before traffic noise impacts can be evaluated, detailed knowledge of the existing noise environment is required. A description of the project's surrounding land use (e.g., residential, commercial, undeveloped land, farmland) should be included in this section. The number and types of receptors involved should be reported so that the reader understands the size and characteristics of the area under study. Particularly sensitive land uses should also be pointed out. For undeveloped land, future uses should be included if they are known. For reporting purposes the Protocol requires that at least one receiver be included in an area that is undeveloped. The presence of any other stationary or mobile noise sources (e.g. arterials, airports, railyards) should also be noted.

The general topography surrounding the project and any issues in noise measurements or modeling should be pointed out in this section, especially for complicated or unusual situations. A discussion on background noise levels (i.e., noise levels unaffected by the existing highway) is also appropriate as well as a general description of traffic flow conditions (i.e., traffic level of service). The importance of selecting measurement sites to document background noise levels is discussed in Section 3.1.1.

For each receiver selected for the noise impact analysis, the following should be shown.

- Location or address.
- Type of development.
- Number of units represented by the receiver.
- Land use activity category and NAC.
- Existing noise level results (data logs should be included in the appendices).
- State whether existing noise level was measured or modeled (predicted).
  - If measured, whether measurement was adjusted to worst hour noise (see Section 3.3.1.2).

- If predicted, whether prediction included model calibration (see Section 4.4) (details of the calibration, such as the calibration constant and explanations of why they were excessively large, should be in the appendices).

Table 6-2 suggests how the information might be displayed in tabular form. The format shown is only an example. The information may be presented in other ways as long as the result is clear, concise, and effective.

This section should only show a summary of the results. It is important to mention whether the existing noise levels reflect the worst noise hour or other time periods. The text should include brief discussions of meteorological conditions during measurements and meteorological criteria. Noise measurement data, traffic counts, speeds, meteorological conditions, site locations, and topography should be included in the appendices.

6.3.7 Future Noise Environment, Impacts, and Considered Abatement

This section of the noise study report addresses the future noise environment. A discussion of the assumptions and data used to model predicted noise levels is appropriate. The source of predicted future traffic volumes (e.g., traffic models, assumed level of service [LOS] C or D, design-hour traffic), vehicle mix, and speeds should be included. The actual input and output data should be presented in the appendices.

The predicted results for future noise levels, traffic noise impacts, and considered abatement, if any, should be presented clearly and concisely. It is usually best to display summary information in tables. Examples of presenting predicted noise levels and impacts are shown in Tables 6-3 and 6-4. The table shows receivers, receiver type, location or address, existing noise levels, predicted noise levels, noise increase or decrease, activity category, NAC, and impact type. A project map showing receivers and approximate locations of noise barrier locations considered should be included.

The table showing predicted noise and impact results provides information for discrete receivers. The information must be expanded to include the entire study area. Table 6-2 shows how many units were represented by each selected receiver. This information can be used to identify areas of traffic noise impacts and the acoustical design of noise barriers (e.g., insertion loss, length, and height). For projects where traffic noise impacts have been identified, heights and lengths of all feasible noise barriers or other abatement measures should be shown, as well as enough information to determine the reasonable noise abatement allowance per benefited residence for each noise barrier and height considered. This allowance is necessary to determine whether abatement measure costs are reasonable. Although noise barriers are normally considered for abatement, other measures may also be considered (see the Protocol) and in some instances might be a better option.

If noise barriers are be considered for the project, the future noise levels and noise insertion losses for various barrier heights or alternate locations should be provided in tabular form. As stated in Section 1102.3 of the Caltrans *Highway Design Manual* a noise barrier should intercept the line of sight from the exhaust stack of a truck to the receptor. The truck stack height is assumed to be 11.5 feet above the pavement. The receptor is assumed to be 5 feet above the ground and located 5 feet from the living unit nearest the roadway. Table 6-4 provides an example of how this information can be reported.

The procedures for determining the preliminary reasonableness of noise abatement (see the Protocol) require various inputs, most of which have been discussed. Table 6-5 is an example of how this information may be displayed. The fact that barrier heights and locations are preliminary and subject to change should be mentioned.

If appropriate, it should be mentioned that noise barriers under consideration can create their own impacts. Barriers may interfere with the passage of air, interrupt scenic views, or create shadows. They can also create maintenance access challenges, make it difficult to maintain landscaping, create drainage or snow removal issues, and provide pockets for trash to accumulate. In certain circumstances, they may raise concerns about safety by blocking areas from the view of patrolling police. Noise barriers can also raise concerns about traffic safety by reducing stopping or merging sight distance or by reducing errant vehicle recovery room.

It is not uncommon for roadway geometries to change between the time the noise study report is completed and final design. Because calculated barrier attenuation values are directly tied to the geometric relationship between the roadway, barrier, and receivers, it is important to document the top and bottom elevations of noise barriers relative to the elevation of the roadway. Then if geometries change in the final design, an assessment can be made as to the significance of the geometric change relative to calculated barrier attenuation. If the geometric change is large enough it may be necessary to re-run the noise model with the new geometries to ensure that predicted attenuation values are maintained or to re-assess cost reasonableness if attenuation values change significantly.

To document the elevations used in the noise analysis a top-of-wall profile should be provided for each noise barrier evaluated. The elevation profile should be provided for the minimum height wall that breaks the truck stack line-of-sight and the wall height that meets the reasonableness design goal (7 dB noise reduction at one or more benefited receiver). It may also be useful to include the elevation of the base of the barrier and outside travel lane. Table 6-6 is an example of how roadway and barrier elevations can be reported.

6.3.8 Construction Noise

Construction noise impacts and likely abatement measures (if necessary) should be discussed briefly. Unless the project involves construction activities that are likely to generate unusually high noise levels such as pile driving or pavement breaking, the discussion should be concise. Detailed discussions of typical construction equipment noise levels are probably not necessary unless the project involves unusually sensitive receptors or nighttime work or if the project is controversial. Caltrans Standard Specification Section 14-8 should be discussed. It states the following.

- Do not exceed 86 dBA L_{max} at 50 feet from the job site activities from 9 p.m. to 6 a.m.

- Equip an internal combustion engine with the manufacturer-recommended muffler. Do not operate an internal combustion engine on the job site without the appropriate muffler.

Procedures for analysis, monitoring, and abatement of construction noise can be found in Section 7.5.

6.3.9 References

Typical references may include 23 CFR 772, *FHWA Highway Traffic Noise: Analysis and Abatement Guidance* (December 2011), the Protocol, *Highway Design Manual* Chapter 1100, FHWA-PD-96-009 and -010, DOT-VNTSC-FHWA-98-1 and -2, and other appropriate documents.

Table 6-2. Existing Noise Levels (Example)

Receiver	Location or Address	Type of Development	Units Represented	Noise Abatement Category and Criterion	Existing Worst Hour Noise Level, (dBA-L_{eq}[h])	Noise Level Measured[a] or Modeled[b]?
1	1234 Elm Street, backyard, center of patio (first-row residence)	Residential	15	B (67)	74	Measured
2	4321 Main Street, 5 feet from façade (first-row residence)	Residential	9	B (67)	75	Measured
3	2336 Elm Street, center of backyard (first-row residence)	Residential	24	B (67)	73	Modeled
4	3538 Elm Street, center of backyard (first-row residence)	Residential	18	B (67)	74	Modeled
5	1212 Church Street, 10 feet north of bottom front step	Church	1	C (67)	68	Measured
6	1723 Oak Street, center of front lawn (0.25 mile from the freeway, background noise level)	Residential	24	B (67)	56	Measured
7	1052 Sycamore Drive, middle of cul-de-sac, (0.25 mile from the freeway, background noise level)	Residential	30	B (67)	55	Measured

[a] Unless otherwise indicated, all measurements shown reflect worst hour noise levels (i.e., they were either measured during the noisiest hour [see Section 3.3.1.1] or were adjusted to worst hour traffic characteristics [see Section 3.3.1.2]).

[b] Unless otherwise indicated, modeled receivers include a calibration constant (see Sections 3.1.2, 4.3.3, and 4.4).

Table 6-3. Predicted Traffic Noise Impacts (Example)

Receiver	Type, Location, or Address	Existing Noise Level (dBA-L_{eq}[h])	Predicted Noise Level (dBA-L_{eq}[h])	Noise Increase (+) or Decrease (–)	Activity Category and NAC, (L_{eq}[h])	Impact Type[a]
1	1234 Elm Street, backyard, center of patio (first-row residence)	74	75	+1	B (67)	A/E
2	4321 Main Street, 5 feet from façade (first-row residence)	75	76	+1	B (67)	A/E
3	2336 Elm Street, center of backyard (first-row residence)	73	74	+1	B (67)	A/E
4	3538 Elm Street, center of backyard (first-row residence)	74	75	+1	B (67)	A/E
5	1212 Church Street, 10 feet north of bottom front step	68	69	+1	C (67)	A/E
6	1723 Oak Street, center of front lawn (0.25 mile from freeway, background noise level)	56	56	0	B (67)	None
7	1052 Sycamore Drive, middle of cul-de-sac (0.25 mile from freeway, background noise level)	55	55	0	B (67)	None

Table 6-4. Noise Abatement Predicted Noise Levels and Insertion Loss (dBA) for Soundwall 1 at Right-of-Way (Example)

		With Wall											
		Height = 6 feet		Height = 8 feet		Height = 10 feet[a]		Height = 12 feet		Height = 14 feet		Height = 16 feet	
Receiver	Without Wall	$L_{eq}(h)$	Ins. Loss	$L_{eq}(h)$	Ins. Loss	$L_{eq}(h)$	Ins. Loss	$L_{eq}(h)$	Ins. Loss	$L_{eq}(h)$	Ins. Loss	$L_{eq}(h)$	Ins. Loss
1	75	70	5	69	6	68[a]	7	66	9	65	10	64	11
2	76	70	6	69	7	68[a]	8	67	9	65	11	64	12
3	74	70	4	69	5	68[a]	6	66	8	65	9	63	11
4	75	70	5	69	6	68[a]	7	66	9	65	10	64	11
5	69	65	4	64	5	63[a]	6	61	8	60	9	59	10
6	56	56	NA[b]	56	NA[b]	56	NA[b]	56	NA[b]	56	NA[b]	56	NA[b]
7	55	55	NA[b]	55	NA[b]	55	NA[b]	55	NA[b]	55	NA[b]	55	NA[b]

[a] Breaks line of sight between 11.5-foot truck stack and 5-foot-high receiver per Section 1102.3 of the *Highway Design Manual*..

[b] NA = not applicable (no barrier considered).

Table 6-5. Data for Reasonableness Determination (Example)

	Predicted without Soundwall[a]	
Soundwall	Absolute Noise Level (L_{eq}[h], dBA)	Build vs. No Build (dBA)
SW-1	75	+1
SW-2	74	+1

[a] At critical receivers.

	Predicted with Soundwall[a]					
Soundwall	Height = 6 feet	Height = 8 feet	Height = 10 feet	Height = 12 feet	Height = 14 feet	Height = 16 feet
SW-1						
Insertion Loss (dBA)	5	6	7	9	10	11
Benefited Residences	24	24	24	48	72	96
Reasonable Allowance Per Benefited Residence	$55,000	$55,000	$55,000	$55,000	$55,000	$55,000
SW-2						
Insertion Loss (dBA)	4	5	6	8	9	11
Benefited Residences	0	24	24	48	48	96
Reasonable Allowance Per Benefited Residence	Not Feasible	$55,000	$55,000	$55,000	$55,000	$55,000

[a] At critical receivers.

Table 6-6. Roadway and Barrier Geometries (Example)

Barrier ID	Station	Elevation of Outside Lane (feet)	Elevation of Wall Base (feet)_	Elevation of Top of 6 ft Wall	Elevation of Top of 8 ft Wall	Elevation of Top of 10 ft Wall[a]	Elevation of Top of 12 ft Wall	Elevation of Top of 14 ft Wall	Elevation of Top of 16 ft Wall
SW-1	100+00	1255	1258	1264	1266	1268	1270	1272	1274
	100+25	1256	1259	1265	1267	1269	1271	1273	1275
	100+50	1258	1261	1267	1269	1271	1273	1275	1277
	100+75	1257	1260	1266	1268	1270	1272	1274	1276
	200+00	1255	1258	1264	1266	1268	1270	1272	1274
	200+25	1254	1257	1263	1265	1267	1269	1271	1273
	200+50	1252	1255	1261	1263	1265	1267	1269	1271
	200+75	1251	1254	1260	1262	1264	1266	1268	1270
SW-2	300+00	1251	1252	1258	1260	1262	1264	1266	1268
	300+25	1253	1254	1260	1262	1264	1266	1268	1270
	300+50	1254	1255	1261	1263	1265	1267	1269	1271
	300+75	1255	1256	1262	1264	1266	1268	1270	1272
	300+00	1256	1257	1263	1265	1267	1269	1271	1273
	300+25	1255	1256	1262	1264	1266	1268	1270	1272
	300+50	1254	1255	1261	1263	1265	1267	1269	1271
	300+75	1253	1254	1260	1262	1264	1266	1268	1270

[a] Breaks line of sight between 11.5-foot truck stack and 5-foot-high receiver per Section 1102.3 of the *Highway Design Manual*.

6.4 Appendices

Any details that would support the conclusions of the noise study report should be included in the appendices, such as instrumentation used, calibration data, field measurement data (e.g., noise, traffic, weather, dates, times, personnel), site details (e.g., plan views, cross sections), computer modeling inputs, and model results. If the analysis includes model calibrations (see Section 4.4), they should be shown in simple table form (see Table 6-7 for an example). The appendices should fill in all details that are not in the main report so the analysis could be repeated by an independent analyst.

Table 6-7. Model Calibration (Example)

Receiver	Measured Noise Level (dBA-L_{eq}[h])	Calculated Noise Level* (dBA-L_{eq}[h])	Calibration Constant (dBA)
1	68	70	-2
2	66	69	-3
3	70	71	-1
4	69	72	-3

*Calculated noise level = noise model result (see Section 4.4.1.1)

If measurements were taken at a time different than the worst noise hour, the adjustment and procedure used (see Section 3.3.1.2), any receivers modeled and calibrated, and any inputs should be shown.

The appendices are a good place to describe issues encountered during the noise study, such as difficulties of site accessibility (include a map of the access route) or contaminating noise sources, such as barking dogs, air conditioners, pool equipment, children's playgrounds, nearby construction, and aircraft. Such information may be useful if additional study or analysis is required.

Section 7
Non-Routine Considerations and Issues

Sections 2 to 6 address the routine phases of Caltrans highway noise fieldwork and analyses. The subjects in this section are considered non-routine. Because Caltrans is occasionally involved in these special situations, they are included to round out the knowledge base of the Caltrans noise analysts or other interested party. The subjects addressed in this section are listed below.

- 7.1: Noise Barrier Issues
- 7.2: Sound Intensity and Power
- 7.3: Pavement Noise
- 7.4: Insulating Facilities from Highway Noise
- 7.5: Construction Noise Analysis, Monitoring, and Abatement
- 7.6: Earthborne Vibrations
- 7.7: OSHA Noise Standards
- 7.8: Effects of Transportation and Construction Noise on Marine Life and Wildlife (Bioacoustics)

7.1 Noise Barrier Issues

This section discusses some challenging issues and non-routine considerations related to noise barriers. Noise barriers are generally considered beneficial for residents near a freeway. However, there have been claims about perceived noise increases at distances farther than those for which the noise barriers were designed. This issue involves complex relationships between highway and barrier configurations, intervening terrain, receiver location, and atmospheric influences. This section discusses what Caltrans and others have found about this issue and suggests ways to study the effects of noise barriers on distant receivers. Some elements of this discussion involve routine considerations addressed in Section 5.

The effectiveness of vegetation typically used in highway landscaping in reducing noise is also discussed. This issue occasionally surfaces when trimming or removal of shrubs and trees by Caltrans maintenance personnel triggers complaints of perceived noise increases.

7.1.1 Effects of Noise Barriers on Distant Receivers

The public and media in California have on occasion raised concerns that noise barriers increase noise levels at distances of up to 3 miles. The alleged increases were attributed to certain site geometries, noise barrier configurations, intervening terrain, and interacting meteorology. Continuing research by Caltrans and others has provided some answers to these concerns. However, there is a continued need for field research to verify prediction algorithms in prediction models for distances more than 500 feet, alter them if needed, and investigate conditions that lead to any newly identified concerns. This section discusses what Caltrans and others have found.

7.1.1.1 Background

Normally, noise barriers are designed for residences and noise-sensitive receptors located adjacent to a highway, and their effects are generally limited to receivers within about 500 feet of the highway. With few exceptions, there is little disagreement that properly designed noise barriers reduce highway noise within this distance, except for the limited conditions described in Section 5.1.7. Noise prediction models have not been adequately validated for distances beyond 500 feet. Caltrans' *Distance Limits for Traffic Noise Prediction Models* (2002) discusses the reasons for the distance limits. However, if there is a reasonable expectation that noise impacts would extend beyond 500 feet those impacts must be evaluated. This may require engineering judgment and supplemental noise measurements to determine impacts.

With the proliferation of noise barriers in California, public concern has emerged that under certain conditions of topography and meteorology noise barriers can increase noise levels at receivers located from 0.25 to 2 miles from freeways. To date, the concerns have been based on subjective perception only. No objective evidence based on noise measurements has been advanced that noise barriers increase noise levels at any distance or under any conditions other than under the limited conditions described in Section 5.1.7. As indicated, present noise prediction models are not reliable to accommodate distances more than

500 feet. In addition, noise prediction models are unable to predict meteorological effects, which play an increasingly important role in observed noise levels with distance, independent of the nature and strength of their source.

The concerns raised by the public, primarily in the San Francisco Bay Area and Los Angeles area, include all three possible categories of source, barrier, and receiver configurations.

- Reflective noise barriers on the sides of highways opposite from those of the receivers (i.e., highways between barriers and receivers).
- Parallel reflective noise barriers on each side of highways.
- Noise barriers between highways and receivers.

The first two issues involve reflective noise of single and parallel barriers, discussed in Section 5.1.7. The third, however, deals with diffracted noise. All three issues of concern involve long noise propagation distances, which are difficult to study because of the numerous variables in topography and meteorology. Caltrans' experience has been that atmospheric conditions can cause measured noise levels at those distances to fluctuate by more than 10 dBA, with or without noise barriers.

Atmospheric refraction is the principal atmospheric process responsible for these fluctuations. A vertical gradient of either temperature or wind velocity produces a corresponding vertical gradient of sound velocity. This causes sound waves to refract (bend) upward or downward. Upward refraction occurs during sound propagation in an upwind direction or temperature lapse conditions (air temperatures decreasing with height). This tends to send noise skyward, leaving a noise shadow near the ground and thereby reducing noise levels. Downward refraction occurs during sound propagation in a downwind direction or in temperature inversions (temperature increasing with height above the ground). Downward refraction tends to send skyward noise down, concentrating noise near the ground, thereby increasing noise levels. Both upward and downward refraction occurs with and without noise barriers. Atmospheric refraction of sound waves is discussed in Section 2.1.4.3.

7.1.1.2 Results of Completed Studies

Caltrans and its consultants and others have performed elaborate research-level studies concerning noise from highways at adjacent and distant receivers, with and without noise barriers for the three barrier configurations mentioned in Section 7.1.1.1 above. It is not the intent of this section to discuss these studies in detail, only to mention their combined results. The studies were performed along the following routes: Interstate (I-) 405 in Los Angeles, various locations on I-680 and I-80 in the Bay Area, and one along State Route (SR) 99 in Sacramento. These studies followed the general guidelines and criteria outlined in Caltrans' *General Guidelines for Studying the Effects of Noise Barriers on Distant Receivers* (1998). The John A. Volpe National Transportation Systems Center (VNTSC) in Cambridge, Massachusetts, performed two similar studies at Dulles International Airport near Washington, DC, and along I-495 near Baltimore for parallel noise barriers. In addition to the research studies, Caltrans has gathered numerous anecdotal data during routine project studies.

In each research study, before– and after–noise barrier measurements were carefully matched by wind speed, wind direction, temperature, relative humidity, and temperature gradients with height above the ground. All measurements were also normalized for traffic variations. Brief summaries of results of the studies are provided below.

Study Results for Single Barrier on the Opposite Side

The results of studies involving noise level increases for single barriers on the opposite side of a highway in simple terrain, as discussed in Section 5.1.7.2, agreed remarkably with the theoretical calculations shown in the same section, particularly in Figure 5-26. For distances of 50 to 100 feet, the increases were generally 0 to 1 dBA. At 400 feet, the measured results were a 2.4-dBA increase as calculated. For longer distances, the increases were difficult to discern with accuracy but never more than 3 dBA, even in complex terrain as discussed in Section 5.1.7.2.

Study Results for Parallel Barriers

The results of studies involving parallel noise barriers (i.e., one on each side of the highway), as discussed in Section 5.1.7.4, showed degradations in performance of each barrier because of multiple reflections between two reflective barriers. The degradations appeared to increase with distance from and height above the highway/barrier configuration. Degradations also appeared to be a function of the W/H ratio, discussed in Section 5.1.7.4 and depicted in Figure 5-33. The VNTSC study at Dulles International Airport concluded that the maximum degradation at a 6:1 W/H ratio was 6 dBA at distances for which noise barriers are typically designed. At another location near Baltimore, a maximum degradation of 2.8 dBA was measured by VNTSC for a 9:1 W/H ratio. Caltrans measured a maximum degradation of 1.4 dBA for a W/H ratio of 15:1 along SR 99.

Almost all parallel barrier configurations in California have a W/H ratio of at least 10:1, and most are about 15:1. Based on the studies by VNTSC and Caltrans, Caltrans Highway Design Manual Chapter 1100 advises a minimum W/H ratio of 10:1 or more to avoid degradations of 3 dBA or more. Please note that degradation in barrier performance does not indicate an increase in noise level above that without a noise barrier. Instead, it reduces the effectiveness of each barrier on each side of the highway.

Studies along I-680 and I-80 in the Bay Area also showed no measurable noise increase at receivers 0.25 to 2 miles from the highway and barriers.

Study Results for Receiver behind Single Barrier

For receivers behind a single barrier, field studies indicate that barriers are effective within about 330 feet of a highway. Caltrans has collected an abundance of data in research and routine studies over the years to substantiate this claim.

Caltrans has also experienced, in the course of many measurements, that beyond 330 feet or so from a highway, traffic noise levels often approach background levels (the noise levels associated with normal day-to-day activities in the community). Although soundwalls cannot attenuate noise below these levels, Caltrans has never experienced noise increases (above no-barrier noise levels) at any distance behind noise barriers. However, some people continue to believe that noise barriers will increase noise levels at distant receivers behind a barrier.

Explanations have sometimes centered on noise waves “going over the wall and coming back to the ground.” This is called diffraction and is actually responsible for noise attenuation, rather than an increase in noise, when compared to the direct noise received without a noise barrier, as explained in Sections 2, 4, and 5.

Another popular “explanation” for perceived noise increase from soundwalls is that the soundwall “lifts” the noise over tiers of homes that normally would shield the receiver. A soundwall will elevate the noise source over tiers of homes no more than the intervening homes do. Soundwalls in California are generally limited in height to 16 feet, approximately equal to the average height of residential development.

There generally is a loss of “ground effect” behind a noise barrier. Without a noise barrier, the direct path of the traffic noise to the receiver travels closer to the ground than after a noise barrier is built. Noise waves close to the ground are subject to excess attenuation because of absorption by the ground. Therefore, when a noise barrier is built, there is a trade-off between barrier attenuation (a decrease in noise) and a loss of excess attenuation.

The net reduction of noise from barrier attenuation and loss of excess attenuation is called barrier insertion loss (see Section 5.1.5). Close to a barrier, the barrier attenuation benefit far outweighs the loss of excess attenuation. At farther distances, however, barrier attenuation diminishes while the cumulative effects of the loss of excess attenuation increase. Caltrans acoustical design procedures for noise barriers take these factors into consideration by applying different noise dropoff rates to with– and without–noise barrier cases. If these drop-off rates were kept constant and applied to long distances, there would be a distance at which the loss in ground effect would eventually exceed the barrier attenuation.

Extensive amounts of field data gathered during a Caltrans noise propagation research project show that differences between excess attenuation rates of elevated sources (e.g., truck stacks, noise diffracted over a noise barrier) and those close to the ground (e.g., tire noise) diminish after few hundred feet or so. The findings can be applied to noise barriers, which in essence “elevate” the source. The cumulative effect of decreasing differences in elevated and near-ground excess attenuation rates with distance appear to be at a maximum at about 200 to 300 feet behind the barrier, where the effect of the differences is the greatest. At greater distances, the differences in elevated and near-ground noise levels appear to become smaller until they disappear at some distance beyond about 400 feet.

Questions have also been raised at times about whether noise “redirected” by noise barriers “bounces off” temperature inversion layers. Redirections on the scale being discussed involve a maximum of 16-foot-high noise barriers and a distance of 0.25 mile or more, are less than 1 degree, and therefore are negligible. Studies under these conditions have confirmed that the difference between barrier and no barrier was not measurable although the noise levels were considerably higher.

After years of research and field measurements under controlled conditions, Caltrans has found no objective evidence that noise levels increase perceptibly because of noise barriers. It is widely accepted by acousticians that normal human ears can barely perceive 3-dBA changes in traffic noise levels when the frequency content of the noise has not changed. Such an increase in noise levels from noise barriers has never been measured.

7.1.1.3 Studying the Effects of Noise Barriers on Distant Receivers

Allegations of noise barriers increasing noise levels at distant receivers based on perception only are unreliable at best. With possible noise fluctuations of more than 10 dBA from meteorological factors alone, people making such claims must not only remember the noise levels before the barrier, but also have knowledge of the meteorological conditions associated with those noise levels. To confirm whether noise barriers do increase noise levels in some instances, a complex before- and after-barrier field study must be undertaken.

Before– and after–noise barrier noise measurements do not adequately address the previous issues unless the measurements are carefully matched by before- and after-barrier conditions of meteorology, traffic, and topography. These types of studies are not routine. Technical Advisory, Noise, TAN-98-01-R9701 *General Guidelines for the Effects of Noise Barriers on Distant Receivers*, November 30, 1998, provides guidelines and criteria for conducting such studies. The advisory is available on the website of Caltrans Division of Environmental Analysis, Noise and Vibration Studies (http://www.dot.ca.gov/hq/env/noise/index.htm).

Procedures for measuring the performance of noise barriers including parallel barriers are provided in the 2009 version of TeNS.

7.1.2 Shielding Provided by Vegetation

No discussion on noise barriers is complete without mentioning the shielding effectiveness of trees, shrubs, and other vegetation typically used for landscaping along highways. Caltrans research on the shielding effectiveness of such vegetation at three different sites in late 1980s and early 1990s concluded that the mean noise reduction was less than 1 dBA, and ranged from 0 dBA to less than 3 dBA (California Department of Transportation 1995). The research further concluded that such vegetative barriers were not an effective measure to reduce highway traffic noise on a routine basis.

However, Caltrans receives complaints of noise increases when Caltrans maintenance personnel trim shrubs and bushes along highways. The most likely explanation for the increase in noise complaints is more related to visual aspects than noise. When shrubs shield traffic from the view of residences, the awareness of the traffic is reduced (i.e., “out of sight, out of mind”). When the vegetation is trimmed or eliminated, the adjacent residents will be able to see the traffic and will be reminded of the noise.

In some cases, residents complaining about ineffective noise barriers have been satisfied when noise barriers have been combined with trees, shrubs, or ivy. Although noise did not noticeably decrease in those cases, the aesthetics of the barriers were improved. Early community acceptance studies have indicated a correlation between barrier acceptance and perceived effectiveness in reducing noise. Therefore, the use of vegetation with noise barriers can be beneficial by improving community acceptance and perceived effectiveness.

As discussed above wind can cause sound waves to refract (bend) upward or downward. When wind is blowing from a source to a receiver downward refraction can increase the sound energy received at the receiver. When a barrier is located between the source and the receiver downward wind refraction can reduce the affective noise reduction provided by the barrier. Research conducted by University Ghent in Belgium (Renterghem and Botteldooren 2008) studied how a tree canopy between the barrier and the receiver affects the degredation of barrier performance from downwind refraction. The study concluded that the presences of a row of trees between a barrier and receiver can provide an important improvement in downwind noise barrier performance up to a distance of 30 times the noise barrier height. Coniferous trees were found to the most effective in this regard. Other references indicate that 100 horizontal feet of tall grass and thick shrubbery can provide up to 5 dB of additional attenuation and 100 feet of dense woods can provide up to 2 dB of additional attenuation (Hoover & Keith 2000).

7.2 Sound Intensity and Power

This document has consistently described the amplitude of sound at a specific location in terms of sound pressure level or noise level. This is also the case for all noise standards, criteria, and descriptors mentioned in this document. In fact, SPL is used in virtually all environmental noise studies for two primary reasons: 1) it is easiest to measure, and 2) it best describes the impact at the receiver.

However, it is important for the noise analyst to know that there are other ways to express sound amplitude. Although considerably more difficult to measure, sound intensity and sound power often provide more useful information about noise sources than sound pressure level. Caltrans has begun using sound intensity in pavement noise studies, and future plans call for other uses to locate and map specific locations of vehicle noise subsources. This section briefly discusses sound power and intensity to broaden the knowledge of noise analysts who may in the future be involved with sound intensity or sound power studies.

7.2.1 Sound Power

Sound pressure level describes a local condition. When the noise from a certain source is measured, such as a truck, in terms of sound pressure level, the information is incomplete without knowing the distance, nature, and radiation pattern of the source, intervening terrain, obstacles, reflections, and atmospheric conditions. A change in one or more of these factors will probably change the sound pressure level.

Sound power is a property of the noise source and is independent of the factors influencing sound pressure. Knowing the sound power of a noise source, the sound pressure level can be calculated under a variety of conditions and at different locations. The sound power of a source is a constant. Power is a rate of energy, or the amount of energy produced each second. Energy is force times distance, most commonly expressed as newton meters (Nm), with newton (N) being the unit of force. A force of 1 N is the force required to accelerate 1 kilogram 1 meter per second per second. If sound power is the rate of energy flow, the units are Nm/s, or watts (W).

Sound power may be visualized as the wattage of a light bulb and sound pressure level as the amount of light received by a reader in a room. The latter would depend on many factors, such as the power of the light bulb, distance from the light bulb, shadows from obstacles between the light bulb and reader, and reflections from walls.

From Section 2.1.3.2, sound pressure level is expressed in decibels, and 1 dB is defined as follows:

$$10\log_{10}(P_1 / P_0)^2 \quad \textbf{(7-1)}$$

Where:

P_1 = the sound pressure

P_0 = a reference pressure of 20 μPa

Pascal is the unit of pressure (force per unit area); 1 Pa = 1 N/m^2. Sound power may similarly be expressed in decibels. The definition of a sound power level (L_W) is:

$$L_W = 10\log_{10}(W_1 / W_0) \qquad \textbf{(7-2)}$$

Where:

$W_0 = 10^{-12}$ W

W_1 = total acoustic power

L_W = sound power level in decibels

Sound pressure level should actually be referred to as $L_{P,}$ although in environmental noise just L (e.g., L_{eq}) has normally been used. Using decibels in both sound power and sound pressure levels can be confusing. To avoid confusion, the international standard ISO 9296 requires documentation of sound power ratings in units of bels (B) rather than decibels. However, in the United States, decibels are often also used for sound power levels. In any case, the descriptors should be clearly noted whether they are sound power level or sound pressure level units. If a quantity is expressed in bels, 1 B = 10 dB.

Sound power cannot be measured directly. However, it can be calculated from sound intensity, which can be measured. One practical use of sound power level is rating product noise from hair dryers to refrigerators.

7.2.2 Sound Intensity

Sound intensity is a measure of a directional rate of energy flowing through a unit of area. The units of sound intensity are watts per square meter (W/m^2) and can be expressed in decibels RE: 1 picowatt (pW) per m^2 (1 pW = 10^{-12} W). This implies that if the entire measurement area around a source is known, its sound power can be calculated if the mean sound intensity for the measurement area is known. The measurement area (usually hemispherical) around a source increases with distance, and because sound intensity decreases with increasing area, sound power remains constant at any distance. To reduce the influence of background noise, sound intensity measurements are taken close to the source. Caltrans commonly uses on-board sound intensity (OBSI) measurements to characterize sound generated by various types of pavement. OBSI measurements are discussed in more detail in Section 7.3 below.

The sound intensity level (L_I) is calculated as follows:

$$L_I = 10\log_{10}(I_1 / I_0) \quad \textbf{(7-3)}$$

Where:

L_I = sound intensity level in decibels

I_1 = sound intensity of interest in W/m^2

I_0 = reference intensity of 10^{-12} W/m^2

The sound intensity of interest (I_1) in W/m^2 can be calculated as follows:

$$I_1 = I_0 * 10^{(L_I/10)} \quad \textbf{(7-4)}$$

Sound intensity (I) is the product of sound pressure (P) and particle velocity (v):

$$I = P * v \quad \textbf{(7-5)}$$

Sound pressure is measured in pascals (N/m^2). Particle velocity is measured in meters per second (m/s). Therefore, the product of sound pressure and particle velocity yields W/m^2 (N/m^2 * m/s). In Section 2.1.3.1, it is explained briefly that particle velocity is the (back and forth) movement of air molecules. In Figure 2-2, it was shown that the motion is 90° out of phase with the fluctuating sound pressure. When the sound pressure is 0, the particle velocity is at its maximum either in a positive (away from the source) or negative (toward the source) direction.

A sound field includes both sound pressure and particle velocity and is therefore described by sound intensity, which includes amplitude and direction. Where sound pressure fluctuations are easy to measure with a sound level meter, the measurement of particle velocity requires more sophisticated instrumentation.

Sound intensity is most commonly measured with a pair of phase-matched microphones facing each other at a fixed distance apart (Figure 7-1). This two-microphone sound intensity probe measures only the total sound intensity traveling parallel to the microphones' axis and is therefore highly directional. If the probe is pointed at the source (Microphone 1 toward the source and Microphone 2 away from the source) the sound intensity is positive. If the probe is pointed away from the source, the sound intensity will be negative. Because of this directional characteristic, sound intensity is useful in measuring and mapping sound fields around sound sources. The reference point of a sound intensity probe is halfway between the diaphragms of the two microphones facing each other, and the reference direction is along the axis of the microphones.

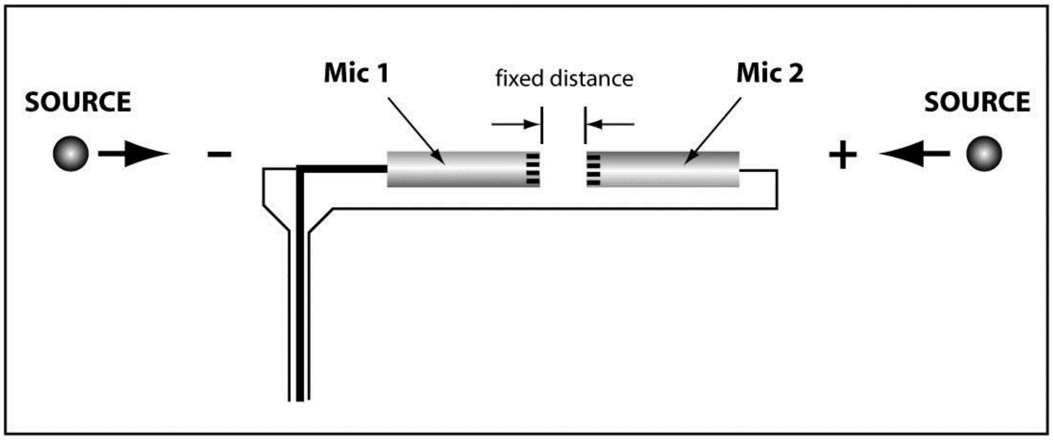


Figure 7-1. Schematic of a Sound Intensity Probe

Other sound intensity probes include a two-microphone, side-by-side system. This type of probe is aimed at 90° to the source and relies on "grazing" type microphones, which are sensitive to sound pressures directed parallel to the membranes, instead of perpendicular (Figure 7-2).

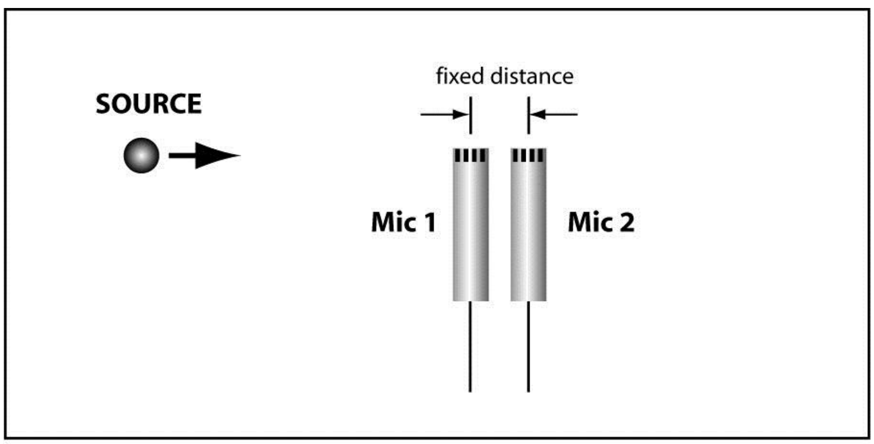


Figure 7-2. Side-by-Side Microphone Probe

To determine the total sound power of a source in watts, the sound intensity (I_k) must be first measured perpendicular to the unit area (A_k) (Figure 7-3). The power for that unit area (W_k) is then the product of I_k and A_k. Therefore, the total power (W_{total}) is calculated as follows:

$$W_{total} = \sum_1^K (A_k \times I_k) \qquad \textbf{(7-6)}$$

The result in units of decibel can be calculated from Equation 7-2, or shown in B by dividing the decibel result by 10.

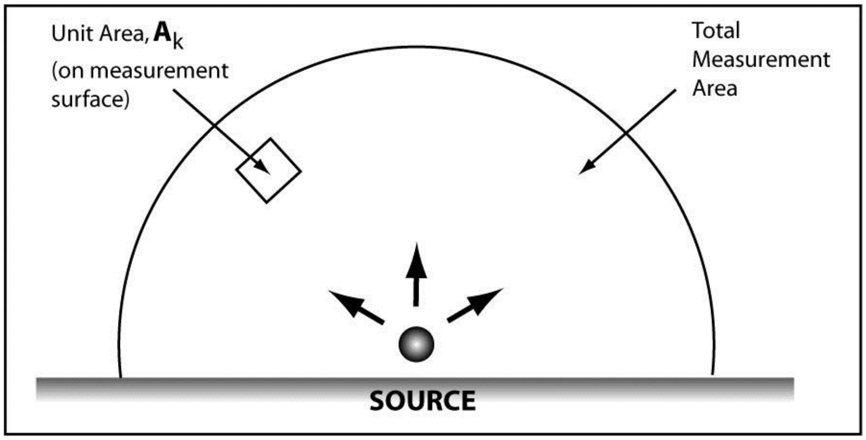


Figure 7-3. Sound Power Measurement Area

7.3 Tire/Pavement Noise

In Section 2, noise is discussed in terms of source, path, and receiver. All three components must be present before noise impacts can occur. Strategies involving quieting the source, disrupting the path, or insulating the receiver may conceptually be used to achieve noise abatement. Using a common analogy of a loud stereo set in a room, there are three options open to lowering the sound to a listener in an adjacent room. The first is lowering the volume at the stereo, quieting the source. The second option is to close the door between the two rooms, disrupting the path. As a third option, the listener can wear earplugs, insulating the receiver.

Although quieting the source would conceptually be the simplest and most effective method of noise abatement, Caltrans has so far dealt with noise abatement by disrupting the path by constructing noise barriers between the highway source and resident receivers. This approach is used because Caltrans has limited options at quieting the highway noise source. For instance, Caltrans has no control over quieting vehicles. This has been the responsibility of the U.S. Environmental Protection Agency, which over the years, through regulatory and legislative action, has mandated stricter new vehicle noise standards, especially for trucks. The only control Caltrans has at the source is highway design. Highway alignments could be selected away from sensitive receivers, and new highways could be depressed. Unfortunately, many factors other than noise dictate highway design. In addition, new development often occurs along existing highways, further limiting noise abatement options.

One detail of highway design that affects noise at the source is the type and texture of pavement used. There are two major types of pavement:

flexible asphalt concrete (AC) which is black in color and rigid PCC which is white in color. Historically, new AC generally tends to be quieter than new PCC, but aggregate size, surface texture, and age/condition can cause wide variations in tire pavement noise levels. The differences in noise reducing characteristics between AC and PCC are narrowing as new construction techniques are being developed. It has been well known for at least a decade that OGAC produces less noise from tire/pavement interaction than DGAC. It is also known that longitudinal (parallel to direction of travel) texturing, tining, or grooving in PCC is much less noisy than transverse (perpendicular to direction of travel) texturing, tining, or grooving. What is least understood is the longevity of the lower noise benefits associated with "quieter" pavement. There are many regional variables that affect pavement performance, such as road base condition, environment, traffic loads, mix design, and quality of construction material and methods. In general as pavements age and wear, the acoustic characteristics change and tire/pavement noise becomes louder.

Caltrans has gathered increasing evidence that OGAC retains its noise reduction benefits throughout the years in typical applications at lower elevations on snow-free highways. The longest-running quiet pavement noise study to date, being conducted on I-80 near Davis, California, demonstrates that after over 13years of operation, OGAC continues to yield 4- to 5-dBA lower noise levels than the previous DGAC pavement. Other studies have shown the same trend. The pavement noise results are based on actual traffic streams, wayside noise measurements carefully controlled for the effects of meteorology, and supplemental OBSI measurements.

Studies using innovative approaches such as sound-intensity measurements of tire/pavement interactions have been employed to study the relative noise benefits of various pavement mixes and textures. In all cases, the sound-intensity measurements are augmented and correlated with wayside noise measurements. This is important because vehicle noise consists of four primary subsources: mechanical noise, exhaust noise (stack exhaust on heavy trucks), tire/pavement noise, and aerodynamic noise (at high speeds). The stricter EPA standards initiated in the 1970s have lowered mechanical and exhaust noise subsources. At highway speeds, tire/pavement noise affects total vehicle noise to a greater extent than all the other vehicle noise subsources combined. Tire/pavement noise on a passenger car operating at a steady freeway speed may account for as much as 75% to 90% of the vehicle noise energy, but these percentages may not be the same on louder, more acoustically complex heavy trucks. It is possible to perceptively lower overall traffic noise levels by careful pavement selection and design. Future Caltrans-sponsored research will include the relative contribution of subsources of vehicles to help confirm the validity of the importance of tire/pavement noise through the use of complex microphone arrays and multi-channel signal processors.

FHWA policy does not allow quieter pavement to be considered as a noise abatement measure. Caltrans practice of calibrating noise prediction models allows for optional calibration adjustments for various pavement types (California Department of Transportation 2003). This practice does not mean that quieter pavement is to be used as a noise abatement measure. Rather, the process is used to account for an otherwise unexplained portion of differences between measured and predicted noise results. Without the adjustment for pavement, this difference would have been added anyway, without explaining the cause.

The following studies and reports provide useful and relevant information related to tire/pavement noise.

Determining End Limits of Quieter Pavement Projects (Rymer and Donavan 2011).

Standard Method of Test for Measurement of Tire/Pavement Noise Using the On-Board Sound Intensity (OBSI) Method (American Association of State Highway and Transportation Officials 2012)

I-80 Davis OGAC Pavement Noise Study (Illingworth & Rodkin 2011a)

Eight Year Evaluation of the Noise Performance of the Caltrans Asphalt Research Pavements on LA 138 (Illingworth & Rodkin 2011b)

Initial and Long-Term Evaluation of the Tire-Pavement Noise Produced by Various Portland Cement Concrete Surface Textures Measurements on the State Route KN 58 Mojave Bypass 2003 to 2010 (Illingworth & Rodkin 2011c)

Comparative Measurements of Tire/Pavement Noise in Europe and the United States Noise Intensity Testing in Europe (NITE) Study (Illingworth & Rodkin 2006)

Caltrans Thin Lift Study: Effects of Asphalt Pavements on Wayside Noise (Rochat et al. 2010)

Caltrans Memorandum—Quieter Pavement Bulletin (Shatnawi 2009)

NCHRP Report 635 Acoustic Beamforming: Mapping Sources of Truck Noise (National Cooperative Highway Research Program 2009)

NCHRP Project 1-44: Measuring Tire-Pavement Noise at the Source (National Cooperative Highway Research Program 2011a)

NCHRP Project 1-44 (1) Measuring Tire-Pavement Noise at the Source: Precision and Bias Statement (National Cooperative Highway Research Program 2011b)

The Little Book of Quieter Pavement (Federal Highway Administration 2007)

Rumble strips and expansion joints can be the source of impulse noise when vehicle tires strike the strips or joints. Locations of rumble strips or expansion joints relative to noise sensitive receptors should be considered to minimize community noise impacts. Alternative rumble strip and expansion joint designs that reduce noise are currently being explored by Caltrans.

7.4 Insulating Facilities from Highway Noise

Revisions to 23 CFR 772 that occurred in 2011 eliminated the interior noise abatement criterion for residential uses and eliminated noise insulation of private residences as a fundable form of noise abatement. 23 CFR 772 does however include an interior noise abatement criterion for Activity Category D land use facilities (auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.) Noise insulation of Activity Category D land use facilities is listed in 23 CFR 772 as a fundable form of noise abatement.

If a situation arises where interior noise at Activity Category D land use facilities must be evaluated as part of a noise study report, the normal procedure is to determine exterior noise levels using standard modeling methods and then to apply building noise reduction factors recommended by FHWA based on the building construction type and window condition. Table 7-1 summarizes building noise reduction factors recommended by FHWA (Federal Highway Administration 2011).

Table 7-1. FHWA Building Noise Reduction Factors

Building Type	Window Condition	Noise Reduction Due to Exterior of Building
All	Open	10 dB
Light Frame	Ordinary Sash (closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	30 dB
The windows shall be considered open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.		

Source: Federal Highway Administration 2011.

If interior noise impacts are identified the first course of action is to consider the use of an exterior barrier to reduce noise. If an exterior barrier is not feasible or does not provide sufficient noise reduction, insulation of the facility can be considered. This would require a detailed evaluation of existing building noise reduction and potential methods for improving the noise reduction. The 2009 version of TeNS provides detailed methods for measuring existing building noise reduction which are consistent with ASTM E966-02, "Standard Guide for Field Measurements of Airborne Sound Insulation of Building Facades and Façade Elements."

7.5 Construction Noise Analysis, Monitoring, and Abatement

Construction noise is usually a concern only in exceptional cases, such as when pile driving and crack-and-seat pavement rehabilitation operations are planned. Ground vibration generated by pile driving and crack-and-seat operation also increase concern by the public. Caltrans Standard Specifications Sections 14-8 and the Caltrans Standard Special Provisions Section 5-1 discuss construction noise levels. Caltrans Standard Specifications are applied to all construction projects. The Standard

Special Provisions provide a menu of special provisions that can be selectively applied to a project based on the specific needs of the project.

Section 14-8 of the Caltrans standard specifications addresses noise and states:

> Do not exceed 86 dBA L_{max} at 50 feet from the job site activities from 9 p.m. to 6 a.m.
>
> Equip an internal combustion engine with the manufacturer-recommended muffler. Do not operate an internal combustion engine on the job site without the appropriate muffler.

Section 5-1, *Noise Control*, of the Standard Special Provisions states the following.

General

This section applies to equipment on the project or associated with the project, including trucks, transit mixers, stationary equipment, and transient equipment. Do not exceed 86 dBA L_{max} at 50 feet from the job site activities from _____ p.m. to _____ a.m. except you may perform the following activities during the hours and for the days shown in the following table:

Noise Restriction Exceptions

Activity	Hours		Days	
	From	To	From	Through

Do not operate construction equipment or run the equipment engines from 7:00 p.m. to 7:00 a.m. or on Sundays except you may operate equipment within the project limits during these hours to:

1. Service traffic control facilities.
2. Service construction equipment.

Noise Monitoring

Provide one Type 1 sound level meter and one acoustic calibrator to be used by the Department until contract acceptance. Provide training by a person trained in noise monitoring to one Department employee designated by the Engineer. The sound level meter must be calibrated and certified by the manufacturer or other independent acoustical laboratory before delivery to the Department. Provide annual recalibration by the manufacturer or other independent acoustical laboratory. The sound level meter must be capable of taking measurements using the A-weighting network and the slow response settings. The measurement microphone must be fitted with a windscreen. The Department returns the equipment to you at contract acceptance. Use if a sound meter is required. The contract lump sum price paid for noise monitoring includes full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all work involved in noise monitoring.

As a state agency, Caltrans is not required to comply with local noise ordinances. However, as a matter of practice, it is Caltrans' intent to comply with 23 CFR 771.105 which states that it is FHWA policy that:

> [t]o the fullest extent possible all environmental investigations, reviews, and consultation be coordinated as a single process, and compliance with all applicable environmental requirements shall be reflected in the environmental documentation.

If construction noise on any highway project is anticipated to be a substantial concern, further analysis is recommended. The following items are to be examined.

- Land uses or activities that may be affected by construction noise.
- Level, timing (scheduling), and duration of construction.
- Measures to reduce adverse construction noise impacts on the community that could be included in the project's plans and specifications.

Caltrans does not routinely analyze construction noise during the project development phase. However, as is discussed in Section 6.3.2, construction noise impacts and likely abatement measures (if necessary) should be discussed briefly in the noise study report for all projects. Generally, Caltrans will only consider construction noise and its abatement in greater detail during the project impact analysis if the project is large, is controversial, or has a prolonged construction phase with extensive pile driving or other loud operations. Construction noise impacts on wildlife may also need to be considered in some special situations. An example would be where pile driving will occur near nesting birds that are on the endangered species list. The effects of noise on wildlife are discussed in more detail in Section 7.8.

Caltrans construction or environmental personnel are sometimes asked to monitor construction noise levels during the construction phase to ensure the contractor's compliance with the Caltrans Standard Specifications, project-specific Special Provisions, or other construction noise limits that may be imposed on the project. The monitoring is usually performed in response to complaints from adjacent residents, but there may also be situations where the contractor must demonstrate compliance with a specific limit on noise.

In January 2006, the FHWA published the FHWA Roadway Construction Noise Model Users guide, which provides guidance on how to use the

FHWA Windows-based construction noise model. It provides useful information on construction noise analysis, equipment noise source levels, and impact criteria.

In addition to noise, construction activities can potentially generate earthborne vibrations that may disturb, damage, or interfere with activities at vibration-sensitive receivers. Section 7.6 briefly discusses earthborne vibrations.

7.5.1 Consideration of Construction Noise during Project Development Phase

If the project is large, is controversial, or has a prolonged construction phase with extensive pile driving or other loud operations, construction noise should be analyzed during the project development phase, along with routine noise analyses, and the analysis should be included in the environmental documentation. Details of construction operations are frequently lacking or minimal in this phase. Therefore, the analysis will usually be qualitative rather than quantitative, and addressed in the environmental document only in general terms, with references to the Standard Specification, Standard Special Provisions, and other appropriate directives. A qualitative discussion may include information on the following topics.

- Residences or land use activities to be impacted most by construction noise.
- Principal types of equipment to be used.
- Noise characteristics (impact noise, continuous noise, etc.) and range of noise levels of equipment used at reference distances.
- Duration of construction and the loudest operations.
- Appropriate specifications, special provisions, and regulations by which the contractor must abide.
- Noise monitoring for compliance during construction.
- Abatement strategies that can potentially be provided, such as one or more of the following.
    - Temporary walls, earth berms, or noise curtains.
    - Alternative, less noisy construction methods.
    - Restricted hours of operation.
    - Planning and routing haul roads away from residences.

- Building soundwalls required for traffic noise abatement for the project first.

If some details about the types and numbers of construction equipment, types of operations, duration, and scheduling are available during the project development phase, a quantitative analysis may be performed. A quantitative analysis may include all of the factors for the qualitative analysis and the following.

- Calculating expected noise levels at the affected receivers or at a standard distance (usually 50 feet) as dictated by criteria.
- Comparisons of calculated noise levels to specifications, special provisions, and other pertinent criteria.

Caltrans construction noise criteria are typically expressed using the L_{max} descriptor at a reference distance. As stated above, an L_{max} of 86 dBA at 50 feet is commonly used by Caltrans as a maximum construction noise limit. Equipment and operations are usually at or less than that level, except for blasting, pile drivers (impact or vibratory), hoe rams, pavement breakers for crack-and-seat operations, and other impact equipment. Table 7-2 summarizes typical construction noise levels identified in the FHWA Roadway Construction Noise Model User's Guide (Federal Highway Administration 2006). These noise levels come directly from data developed during the construction of the Central Artery Tunnel Project in Boston completed December 2007.

Table 7-2. Typical Construction Equipment Noise

Equipment Description	L_{max} Noise Limit at 50 feet, dB, Slow	Usage Factor	Impact Device?
All other equipment more than 5 horsepower	85	50	No
Auger drill rig	85	20	No
Backhoe	80	40	No
Bar bender	80	20	No
Blasting	94	N/A	Yes
Boring jack power unit	80	50	No
Chain saw	85	20	No
Clam shovel	93	20	Yes
Compactor (ground)	80	20	No
Compressor (air)	80	40	No
Concrete batch plant	83	15	No
Concrete mixer truck	85	40	No
Concrete pump truck	82	20	No
Concrete saw	90	20	No

Equipment Description	L_{max} Noise Limit at 50 feet, dB, Slow	Usage Factor	Impact Device?
Crane (mobile or stationary)	85	16	No
Dozer	85	40	No
Dump truck	84	40	No
Excavator	85	40	No
Flat bed truck	84	40	No
Front end loader	80	40	No
Generator (25 kilovolt-amperes [kVA] or less)	70	50	No
Generator (more than 25 kVA)	82	50	No
Gradall	85	40	No
Grader	85	40	No
Horizontal boring hydraulic jack	80	25	No
Hydra break ram	90	10	Yes
Impact pile driver (diesel or drop)	95	20	Yes
Jackhammer	85	20	Yes
Mounted impact hammer (hoe ram)	90	20	Yes
Paver	85	50	No
Pickup truck	55	40	No
Pneumatic tools	85	50	No
Pumps	77	50	No
Rock drill	85	20	No
Scraper	85	40	No
Slurry plant	78	100	No
Slurry trenching machine	82	50	No
Soil mix drill rig	80	50	No
Tractor	84	40	No
Vacuum street sweeper	80	10	No
Vibratory concrete mixer	80	20	No
Vibratory pile driver	95	20	No
Welder/Torch	73	40	No

Source: Federal Highway Administration 2006.

Table 7-2 also provides a typical usage factor for each equipment type. The usage factor is an estimate of the fraction of time each piece of equipment operates at full power. The usage factor can be used to estimate L_{eq} from the L_{max} values listed in Table 7-2 in those cases where the impact criteria is expressed in terms of L_{eq}. Equation 7-10 can used to estimate L_{eq} from L_{max}. It also includes a term for estimating noise at distances other than 50 feet.

$$L_{eq}(h), dBA = L_{max} \text{ at 50 feet} - 20\log(D / 50) + 10\log(UF) \qquad \textbf{(7-7)}$$

Where:

L_{max} at 50 feet can be looked up in Table 7-2 or similar table

D = distance of interest

UF = usage factor or fraction of time period of interest equipment is in use

If more than one piece of equipment is in operation in the same location, Equation 7-7 can be used for each piece of equipment and the results can be summed to give a combined noise level at the location of interest. Typically, only noise levels from the two or three loudest pieces of equipment are summed. The FHWA Roadway Construction Noise Model automates most of this process.

7.5.2 Noise Monitoring during Construction

Construction noise monitoring may be part of a program called for in the environmental document, in regulatory permits, or in response to noise complaints. Noise monitoring requirements may be in response to effects on both humans and wildlife. Refer to Section 7.8 for more discussion on the effects of construction noise on wildlife. In most cases, the noise measurements are used to ensure compliance with the appropriate criteria specified in construction contract specifications or other applicable regulations. In the case of complaints, measurements may be conducted to identify the source of the complaints and to develop solutions for reducing the noise. As discussed above, Caltrans is not required to comply with local noise ordinances. However, as a matter of practice, it is Caltrans intent to comply with all applicable environmental requirements per 23 CFR 771.105.

If construction noise monitoring is necessary, the districts' environmental units or trained construction personnel will usually perform the measurements. In some cases, the contractor or subcontractor may perform noise monitoring as part of the construction contract.

The manner in which construction noise measurements are taken depends on the applicable criteria. If the criterion calls for a certain L_{max} at a reference distance, the sound level meter must be placed at the requested distance from stationary equipment and the noise measured in the L_{max} mode during full operation of the equipment. Ideally, the noise level should be measured from four different directions, approximately 90° from each other (Figure 7-4). This may not be possible, however, and perhaps only two or three directions can be measured. A sufficient time period in each of the microphone positions should be allowed to permit the

L_{max} to occur. Sound level meters usually have an L_{max}-hold button. In this mode, the recorded L_{max} only changes when a higher noise level than the previous maximum is recorded. If the noise is relatively constant and the L_{max}-hold does not change for 30 seconds, the measurement is completed. If the noise is not constant, such as with pile driving, a longer time period of at least 2 minutes is recommended.

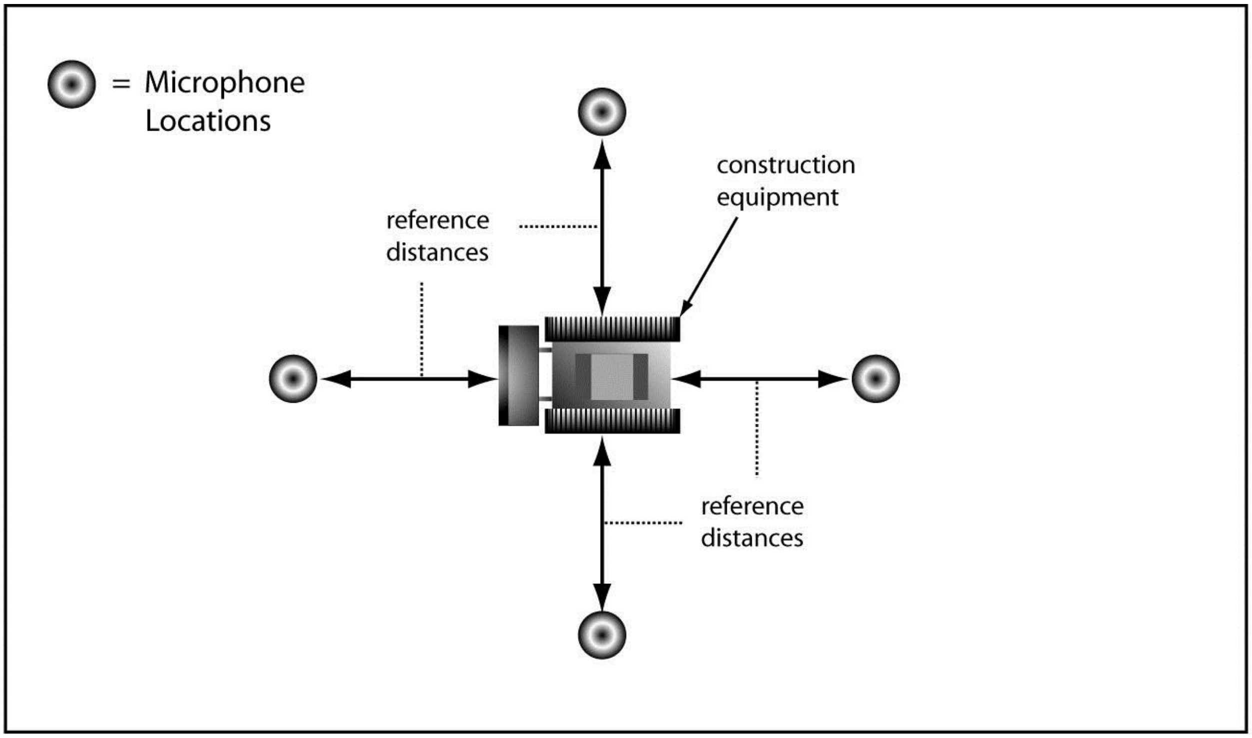


Figure 7-4. Measuring One Piece of Equipment

If more than one piece of stationary construction equipment is involved in the same operation, the reference distance should be measured from the nearest piece of equipment, preferably from various directions (Figure 7-5).

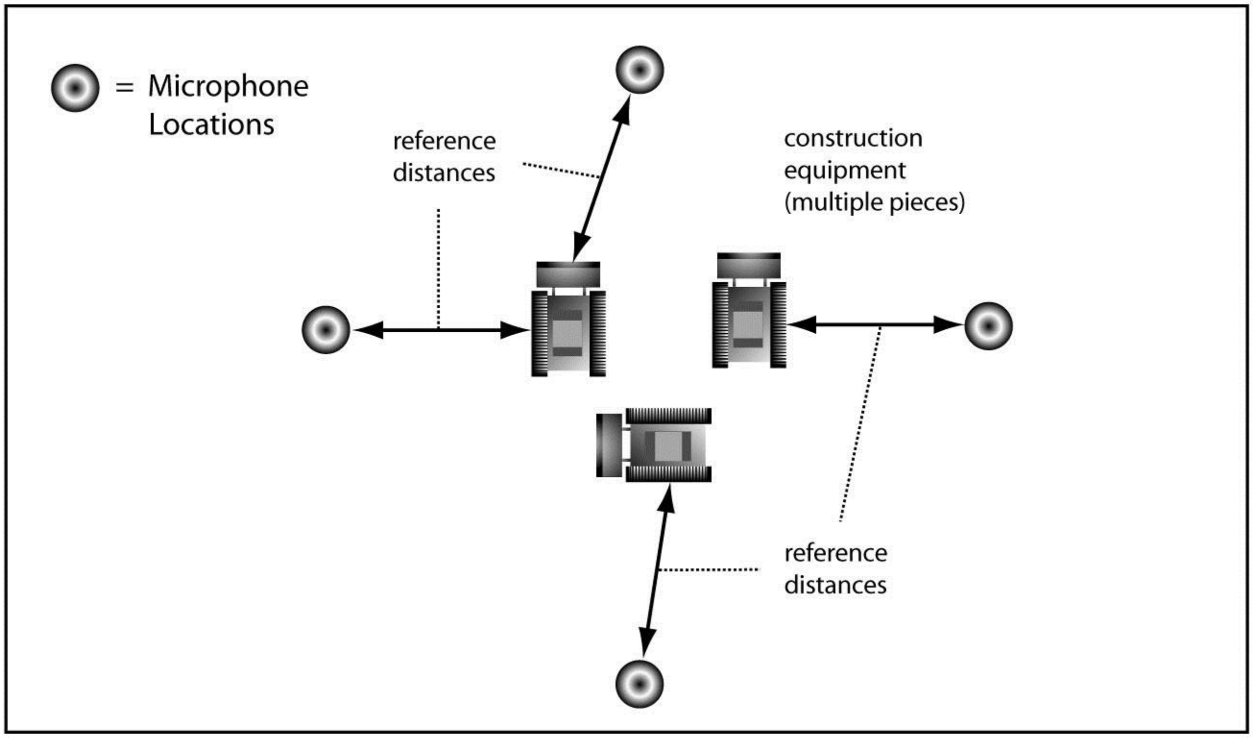


Figure 7-5. Measuring Multiple Pieces of Equipment Operating in Same Area

For mobile equipment, the reference distance is the closest distance at the point of passby. The equipment should be measured from two directions—equipment moving from left to right and from right to left.

If the response time setting of the meter is not specified in the criteria, the slow setting should be used for equipment producing continuous noise. For impact noise, such as pile driving, the response setting should be switched to impulse. In all cases, a minimum of three measurements should be taken at each microphone position. The highest L_{max} should be used for comparison with applicable standards or criteria.

In the less frequent cases where a construction noise criterion may call for a certain noise level at the project right-of-way line or a residence, the microphone locations must coincide with the locations called for in the criterion. In the event a criterion calls for a descriptor different from L_{max}, such as L_{eq}, the proper descriptor must be measured by the sound level meter. All previously mentioned provisions are applicable. Section 3 should be consulted for general noise measurement provisions.

Additional information on construction noise measurements can be found in "Measurement of Highway-Related Noise," Report FHWA-PD-96-046, May 1996, available through the National Technical Information Service in Springfield, Virginia, and in the FHWA Construction Noise Handbook which is available:

http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook

7.5.3 Construction Noise Abatement

In the event that construction noise exceeds or is expected to exceed applicable standards and criteria, the following options are open to abate the noise at the source, in the path, and at the receiver.

7.5.3.1 Abatement at Source

Noise control at the source is the most sensible approach because it does not limit abatement for a single source-receiver pair, but instead lowers construction noise at all receivers. Caltrans Standard Specifications require all construction equipment to have adequate mufflers and be well maintained. If these specifications are not enough to reduce noise levels to less than the standards and criteria, other options can be used, including one or more of the following.

- Reroute haul routes away from residences.
- Require modern equipment.
- Plan noisiest operations for times of day when people are less sensitive to noise.
- Plan operations to minimize the use of backup warning devices.
- Set backup warning devices to lowest level without jeopardizing safety.
- Operate equipment at minimum power.
- Use quieter alternate methods or equipment.

7.5.3.2 Abatement in Path

There are several options open to abate construction noise in the source-to-receiver noise path. These usually include temporary enclosures around stationary equipment, temporary barriers, and noise curtains. If permanent noise barriers are part of the project, their construction should be scheduled first. Other strategies include effective use of temporary earth mounds as barriers, creating buffer zones between equipment and residences, or making use of existing structures as barriers.

7.5.3.3 Abatement at Receiver

Abatement at the residence is usually done as a last resort. Strategies include window treatment or other insulation techniques. This is usually only cost-effective if relatively few residences are involved. Another strategy is temporary relocation of residents.

7.5.3.4 Community Awareness

Community awareness may be the most effective approach to reduce complaints of construction noise. Residents' tolerance toward construction noise is greatly increased if they are informed that the noise is temporary, that they have a telephone number to call for more information and to report specific noise concern, and that every effort will be made to address those concerns. Door-to-door personal contacts are the most effective, but this may be time-consuming. Other ways to relate the information are hotlines, project websites, automated phone calls, frequent community meetings, letters to the impacted residences, and local news coverage.

If construction noise is anticipated to be a major issue, the community should have an opportunity to provide considerable input early in the project development stage. It is essential that communication channels between the Caltrans resident engineer and the community stay open during the construction phase as well. A real time monitoring and reporting system with posting of measured noise levels on a website can be an effective way to keep the public informed on the project noise conditions associated with large, long-term projects. Responsibilities for addressing noise complaints should be included in the construction contract documents.

7.6 Earthborne Vibration

Caltrans has been involved with vibration studies since 1958. Until 1992, the Caltrans Transportation Laboratory in Sacramento conducted all vibration studies. Since then, most vibration studies have been contracted out. However, the Caltrans Division of Environmental Analysis does perform some vibration monitoring to investigate complaints.

Earthborne vibrations generated by construction activities or by traffic once a transportation facility is in operation can under certain circumstances be a serious concern. This section emphasizes the awareness and early recognition of potential vibration issues. When vibration-sensitive receptors or activities are located near a proposed new alignment or near an existing facility scheduled for heavy reconstruction, potential vibration impacts should be addressed during the project development phase with assistance of the Caltrans Division of Environmental Analysis. Caltrans' *Transportation- and Construction-Induced Vibration Guidance Manual* (2004) provides a wealth of information on vibration, including summaries of Caltrans experiences, and should be consulted.

During construction, pile driving, pavement breaking for crack-and-seat operations, demolition of old structures, and blasting are among the worst vibration offenders. Concerns may include annoyance, interference with activities, and structural damage. Therefore, construction activities involving generation of high-level vibrations must be carefully planned.

Although construction activities potentially generate the highest vibration levels and most damage, they are temporary in nature. Long-term effects of vibration may be caused by the transportation facility after it is completed. Normally, highway traffic does not generate high enough levels to cause damage to residences or other structures, even at very close distances. However, vibrations caused by heavy trucks can interfere with vibration-sensitive activities or equipment. Laboratories using sensitive electronic equipment, laser surgery, or close-tolerance machining are a few examples of operations that can be affected by nearby highway traffic.

In addition trains can produce some of the highest vibrations on a transportation facility. Caltrans has needed to consider cases involving train vibrations where a new highway or light-rail facility necessitated realignment of railroad tracks closer to residences or sensitive operations.

Potential vibration issues should be recognized as early as possible, and strategies to address the concerns should be coordinated with the Caltrans Division of Environmental Analysis. Potentially impacted vibration-sensitive receptors should be considered early in the design development process so that effective mitigation design strategies can be identified.

7.7 Occupational Hearing Loss and OSHA Noise Standards

This section does not pertain to environmental noise standards or NAC. Occupational hearing loss is a concern in certain occupations where workers are exposed to high noise levels. These occupations could be relevant to Caltrans operations, such as construction, maintenance, and materials laboratories. OSHA has set standards for permissible noise exposures. When the limits of these permissible exposures are approached, OSHA requires the employer "to administer a continuing, effective hearing conservation program" to prevent hearing loss. When the maximum allowable noise exposure is exceeded, the employer must take certain steps to control the noise. OSHA occupational noise exposure standards are addressed by 29 CFR 1910.95 and should be consulted if excessive noise exposure is suspected. For general reference, the most relevant information in 29 CFR 1910.95 is summarized below.

7.7.1 Noise-Induced Hearing Loss

Occupational noise-induced hearing loss develops slowly over a period of time when exposed to high continuous or intermittent noise levels. This should not be confused with traumatic hearing loss, which is caused by a single transient high-level noise event, such as a gunshot or explosion. The most important aspects of occupational noise-induced hearing loss are listed below.

- It is always sensory-neural (affects the hair cells in the inner ear).
- It typically affects both ears equally.
- The first sign of hearing loss is a *notching*, or reduced hearing sensitivity at 3,000, 4,000, or 6,000 Hz, with normal sensitivity in higher or lower frequencies. This is in contrast to age-related hearing loss, which also begins at 3,000 to 6,000 Hz but continues into higher frequencies.
- Noise-induced hearing loss due to chronic noise exposure is greatest during the first 10 years or so of exposure and slows down afterward. Age-related hearing loss, however, accelerates over time.
- Noise-exposed ears are not more sensitive to future noise exposure and do not progress beyond the added normal age-related hearing loss once the noise exposure is discontinued.

7.7.2 OSHA Noise Standards

Occasionally, the exposure of Caltrans personnel or contractors to noise is a concern. 29 CFR 1910.95(a) requires the employer to protect the employee against the effects of noise exposure when the permissible noise exposures in Table 7-3 are exceeded. The noise levels must be measured on the A-scale with the sound level meter at slow response.

29 CFR 1910.95(b)(1) requires that when the permissible noise exposure levels are exceeded, "feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of

Table [7-3], personal protective equipment shall be provided and used to reduce sound levels within the levels of the table."

29 CFR 1910.95(b)(2) considers variations in noise level involving maxima at intervals of 1 second or less to be continuous.

Table 7-3. Table G-16 Permissible Noise Exposure

Duration per Day (Hours)	Sound Level (dBA, Slow Response)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Notes: When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions [C(1) / T(1)] + [C(2) / T(2)] + ……[C(n) / T(n)] exceeds 1, the mixed exposure should be considered to exceed the limit value. C(1), C(2), etc. indicate the times of exposure at a specific noise level. T(1), T(2), etc. indicate the times permissible for that specific exposure. Exposure to impulsive or impact noise should not exceed 140 dB peak (as opposed to rms) sound pressure level.

Two simple examples of the calculation shown in the footnote of the above table are provided below.

- C(1) = 3 hours at 95 dBA and C(2) = 5 hours at 90 dBA. The corresponding T(1) and T(2) values from the permissible noise exposure table are T(1) = 4 hours and T(2) = 8 hours. Using the calculation in the footnote, the exposure is:

  $$3/4 + 5/8 = 0.75 + 0.625 = \mathbf{1.375\ (>1)}.$$

  The maximum allowable exposure has been exceeded.

- C(1) = 1 hour at 100 dBA and C(2) = 3 hours at 90 dBA. The corresponding T(1) and T(2) values from the permissible noise exposure table are T(1) = 2 hours and T(2) = 8 hours. Using the calculation in the footnote, the exposure is:

  $$1/2 + 3/8 = 0.50 + 0.375 = \mathbf{0.875\ (<1).}$$

  The maximum allowable exposure has not been exceeded.

The fractions may also be expressed as percentages, with 100% the maximum allowable exposure level. The first example would result in 137.5% and the second in 87.5%.

29 CFR 1910.95(c)(1–2) requires the employer to "administer a continuing, effective hearing conservation program…whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level…of 85 decibels, measured on the A-scale (slow response). Or equivalently, a dose of fifty percent." The 85-dBA noise level or dose of 50% is also referred to as the action level. The hearing conservation program is fully described in 29 CFR 1910.95(c–o).

7.8 Effects of Transportation and Construction Noise on Marine Life and Wildlife (Bioacoustics)

The effects of highway and construction noise on marine life and wildlife is generally referred to as bioacoustics. Concerns regarding these effects generally arise in response to requirements of the federal Endangered Species Act, National Marine Fisheries Service, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, and other resource agencies that have jurisdiction in the project area.

Caltrans biologists routinely address environmental issues related to all of the effects of transportation and construction on animals. Noise is only one of the issues, but it can be an important factor in the overall impact assessment. Underwater noise from pile driving can affect some fish within close range. In the San Diego area, Caltrans has built earth berms and soundwalls to protect nesting areas for Least Bell's Vireo, an endangered bird species. The task of addressing noise impacts on marine and terrestrial wildlife rests primarily with the biologists. However, noise analysts provide a supporting role to the biologists in providing technical noise expertise. Accordingly, it is critical that biologists coordinate directly with the project noise analyst when evaluating noise impacts on wildlife.

Addressing the effects of noise on marine and terrestrial animal species provides an exceptionally difficult challenge and requires specialized expertise. With marine life, the acoustical environment is vastly different than on land. In both marine and terrestrial environments, there is a great variety of animal species, each with different tolerances to noise. The nature of the adverse effects on the different species can also differ. On land, some birds may be flushed from their nesting areas, which may interfere with reproduction. Songbirds, which depend on their songs to find a mate, may be unable to communicate with each other in a noisy environment, therefore missing the opportunity to reproduce. Other animals may be temporarily or permanently driven from their habitat. The hearing frequency response to noise is also different in each species. For example the hearing range for humans is 20 to 20kHz whereas the hearing range for bats is 10 Hz to 200 kHz and the range for birds is 1KHz to 5 KHz. Accordingly, the use of the human response A-scale when evaluating noise impacts on other species may not be appropriate in some cases.

The Caltrans' document *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* (Guidance Manual) provides detailed guidance on the process for evaluating underwater noise impacts on fish from pile driving (2009). This document is available: <http://www.dot.ca.gov/hq/env/bio/fisheries_bioacoustics.htm>.

National Cooperative Highway Research Program Research Results Digest 363- Hydroacoustic Impacts on Fish from Pile Installation (National Cooperative Highway Research Program 2011c) provides additional on pile driving noise impacts on fish. This document is available: <http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_363.pdf>.

Specific guidance on how to address airborne noise effects on terrestrial wildlife has not yet been developed by Caltrans. Caltrans has however commissioned a report entitled *The Effects of Highway Noise on Birds* (Dooling and Popper 2007) which provides background on the effects of noise on birds and provides recommended criteria for impact assessment. This document is available: <http://www.dot.ca.gov/hq/env/bio/avian_bioacoustics.htm>

Another useful resource is the FHWA document *Synthesis of Noise Effects on Wildlife Populations* (Federal Highway Administration 2004).

Section 8
Glossary

The terms and definitions in this glossary are either used in this TeNS or are commonly found in environmental noise literature. To make this glossary more useful to the highway traffic noise analyst, these definitions are generally oriented toward highway traffic noise and abatement, not general acoustics.

Absorption: The attenuation of sound caused by conversion of sound energy into other forms of energy, usually heat, within a medium. Absorption is a property of the medium. In noise barrier material, absorption can be considered the complement of reflection. A perfectly absorptive material does not reflect any sound energy, and a non-absorptive (i.e., reflective) material reflects almost all sound energy. In either case, a small portion of sound energy is transmitted through the barrier and continues in roughly the same direction as the incident noise propagation. In typical highway traffic noise barriers, the sound energy passing through is less than 1% of the incident noise energy. See also "Transmission Loss."

Absorption Coefficient: A term that approximately equals the ratio of sound energy absorbed by a material to the energy incident on the material. Absorption coefficients range from 0 (no absorption) to 1 (perfect absorption). In highway noise barriers, material with an absorption coefficient of 0 will reflect back almost all incident noise energy, and material with a coefficient of 1 will not reflect back any sound energy. The absorption coefficient depends on material, sound frequency, and angle of incidence.

Absorptive Grounds: Types of ground, such as normal earth and most grounds with vegetation, that are absorptive to sound energy and that reverse the phase of reflected energy at grazing angles of incidence. See also "Soft Sites" and "Ground Effects."

Acoustics: The broad field of science that deals with the production, propagation, reception, effects, and control of sound, both audible and inaudible to the human ear, and occurring in all media.

Airborne Sound: Sound that reaches the point of interest primarily by propagation through the air.

Ambient Noise: All-encompassing noise at a given place and time. This is usually a composite of sounds from all sources near and far, including any specific sources of interest.

Amplitude: The strength or magnitude of the pressure of a sound wave.

Anechoic Chamber: A room that has boundaries designed to absorb nearly all of the sound incident on them, producing a test room that is essentially free from reflected sound, and simulates free field conditions for the limited space defined by the room's boundaries.

Angle of Diffraction: The angle through which sound energy is diffracted as it passes over the top of a noise barrier and proceeds toward the receiver. Receivers deeper into the shadow zone have larger angles of diffraction and therefore higher barrier attenuation. See also "Diffraction" and "Shadow Zone."

Angle of Incidence: The angle formed by the radial line of sound waves striking a surface at a specific location and the plane of that surface. See also "Angle of Reflection."

Angle of Reflection: The angle formed by the radial line of sound waves reflecting off a surface at a specific location and the plane of that surface. See also "Angle of Incidence."

Atmospheric Effects: Sound absorption by air molecules and water vapor, sound refraction caused by temperature and near-ground wind gradients, and air turbulence are collectively called atmospheric effects. Although atmospheric effects are mostly responsible for substantial noise fluctuations at distant receivers, they also can have a significant effect at distances within 330 feet.

Audible Spectrum: The frequency range normally associated with human hearing, usually considered between 16 and 20,000 Hz. For noise control purposes, the audible spectrum of interest usually lies between 20 and 10,000 Hz.

Audiogram: A graph showing hearing loss as a function of frequency.

Audiometer: An instrument for measuring hearing sensitivity or loss.

Automobile: A vehicle classification for the purpose of noise prediction modeling, defined as all vehicles with two axles and four wheels designed primarily for transportation of nine or fewer passengers (automobiles) or transportation of cargo (light trucks). Generally, the gross weight is less than 10,000 pounds.

Average Level: Typically the energy-averaged noise level in decibels, wherein the contributing levels are first converted to relative energies or energy ratios, and added and divided by the number of contributing levels. The result is then converted back to decibels.

A-Weighted Sound Level: Expressed in dBA or dB(A). Frequency-weighted sound pressure level approximating the frequency response of the human ear. It is defined as the sound level in decibels measured with a sound level meter having the metering characteristics and a frequency weighting specified in the American National Standards Institute Specification for Sound Level Meters, ANSI S 1.4–1983. The A-weighting de-emphasizes lower frequency sound sounds below 1,000 Hz (1 kHz) and higher frequency sounds above 4 kHz. It emphasizes sounds between 1 and 4 kHz. A-weighting is the most commonly used measure for traffic and environmental noise throughout the world.

Background Noise: The total noise in a system or situation independent of the presence of (i.e., without) the noise source of interest.

Baffle: A shielding structure or series of partitions used to increase the effective external transmission path length between two points in an acoustic system.

Band: See "Frequency Band."

Band Center Frequency: The designated geometric mean frequency of a band of noise.

Band Pressure Level: The SPL contained within a specified band.

Barrier Attenuation: The noise reduction from barrier diffraction only.

Broadband Noise: Noise with components over a wide range of frequencies.

Calibrator: A device used to calibrate or properly adjust for valid measurement results a sound level meter and microphone system. Calibration must be performed before and after the sound level measurement sequence.

Community Noise Equivalent Level: A noise level that accounts for all the A-weighted noise energy from a source during 24 hours, and weights the evening (7 p.m. to 10 p.m.) and night (10 p.m. to 7 a.m.) noise by adding 5 and 10 dBA, respectively, during these periods.

Compression: The portion of a sound wave in which the air molecules are slightly compressed with respect to the barometric air pressure. The opposite of rarefaction.

Cylindrical Divergence: Sound waves generated by a line source, such as approximated by a highway, tend to form cylindrical wavefronts that propagate by radiating outward from their original line source in cylindrical pressure waves of ever-increasing areas. This process is referred to as cylindrical divergence or spreading. The same sound energy distributed over an ever-increasing cylindrical area is responsible for reducing the sound's energy per unit area (i.e., intensity) by half for each doubling of distance. This corresponds with a noise level decrease of 3 dB per doubling of distance.

Cycles per Second: See "Hertz."

Day-Night Level: See "L_{dn}."

Decibel: A decibel is one-tenth of a bel. It is a measure on a logarithmic scale that indicates the squared ratio of sound pressure to a reference sound pressure (unit for sound pressure level) or the ratio of sound power to a reference sound power (unit for sound power level). See also "Sound Pressure Level" and "Sound Power Level."

Descriptor: A generic term for a noise indicator such as L_{eq}, L_{max}, or L_{dn}.

Diffuse Sound Field: A sound field in which the time average of the mean square sound pressure is the same everywhere and the flow of acoustic energy in all directions is equally probable. For example, a sound source in a reverberation room, where many reflected sound waves are present and the sound level is equal at any location in the room.

Diffraction: The bending of sound pressure waves around an obstacle. The ease with which the pressure waves diffract around an obstacle depends on the ratio of wavelength to the size of the obstacle. Pressure waves with a given wavelength diffract more readily around a small object than a large one. Pressure waves with longer wavelengths diffract more easily around an object of a given size than pressure waves with a shorter wavelength. Because of the above principles, highway traffic noise barriers provide a more defined noise "shadow" behind the barrier and more noise attenuation for higher-frequency noise than lower-frequency noise. See also "Angle of Diffraction" and "Shadow Zone."

Doppler Effect: The change in observed frequency of a sound wave caused by a time rate of change in the effective path length between the sound source and receiver. If the path length rate of change causes the source and receiver to approach each other, the observed frequency shifts upward. If the source and receiver recede relative to each other, the frequency shifts downward. The frequency shift is called the Doppler shift, and the unit is hertz.

Dosimeter: An instrument measuring noise exposure for compliance with OSHA standards.

Dynamic Range: The range in sound levels, in decibels, through which a source or receiver can emit or receive sound. For example, the dynamic range of a sound level meter typically ranges from 20 to 140 dB.

Emission Level: A measure of the noise output of a single vehicle. It is the maximum noise level, in dBA, observed during a passby of the vehicle at 50 feet. See also "Reference Energy Mean Emission Level."

Energy Average: The result of energy averaging or a method of averaging various SPLs based on their squared pressures. This method involves the conversion of decibels to equivalent relative energy or energy ratios, averaging the values, and changing the values back to decibels.

Energy Ratio: See "Relative Energy."

Equivalent Distance: The distance to a specific receiver from an imaginary single lane that acoustically represents a multilane highway or a group of lanes, such as directional lanes.

Equivalent Level: See "L_{eq}."

Excess Attenuation: Sound attenuation in addition to that caused by geometric spreading. It is usually meant to be the attenuation from ground effects and sometimes atmospheric effects. See also "Geometric Spreading," "Ground Effects," and "Atmospheric Effects."

Existing Noise Levels: The noise resulting from the natural and mechanical sources and human activity considered to be usually present in a particular area.

Far Field: The region beyond the near field, where the effects of source dimensions are less important and noise propagates with a simple relationship between sound level and distance.

Filter: A device for separating components of a signal based on their frequency. It allows components in one or more frequency bands to pass relatively unattenuated and attenuates components in other frequency bands.

Flanking Noise: Refers to noise energy that arrives at an observer by an unexpected or unexamined pathway. For example, in the design of noise barriers, the calculations predict the energy that diffracts over the top of the barrier. If significant amounts of noise energy reach the observer by passing around its ends far up and down the roadway, this energy has flanked the barrier along unexpected "flanking paths."

Flow Resistivity: A measure of the acoustical absorption of the ground located between a sound source and receiver. As applied in the FHWA TNM the units of flow resistivity are cgs rayls. Water and hard pavement are highly acoustically reflective and are assigned a flow resistivity value of 20,000 cgs rayls. At the other extreme is power snow which is assigned a value of 10 cgs rayls.

Free Field: A sound field that is free from enclosures or boundaries, and in which there are no reflections and accompanying interference and reverberation effects such as found in auditoriums.

Frequency: The number of oscillations per second of a periodic wave sound and of a vibrating solid, expressed in units of hertz, formerly cycles per second (cps). 1 Hz = 1 cps = 1 oscillation per second. The value is the reciprocal (1/x) of the period of oscillations in seconds. The symbol for frequency is f.

Frequency Band: An interval of the frequency spectrum defined between an upper and lower cutoff frequency. The band may be described in terms of these two frequencies or (preferably) by the width of the band and the geometric mean frequency of the upper and lower cutoff frequencies (e.g., an octave band "centered" at 500 Hz).

Frequency Response: The response to an oscillating phenomenon (e.g., sound pressure) by an object (e.g., microphone or ear) measured in decibels as a function of frequency. For example, the A-weighting curve corresponds closely to the frequency response of human hearing at a certain constant level of sound energy. See also "A-Weighted Sound Level."

Frequency Spectrum: The description of a sound wave's resolution into components of different frequency and usually different amplitude and phase.

Fresnel Number: A dimensionless value used in predicting the attenuation of a noise barrier located between a noise source and receiver. In its simplest mathematical form, $N = 2\delta / \lambda$, where δ is the path length difference between the sound path from the source to receiver via the top of the barrier and the straight line between the source and receiver, and λ is the wavelength of the sound (the units of δ and λ must be the same). Generally, the larger the value of N, the greater the attenuation.

Fundamental Frequency: The frequency with which a periodic function (e.g., sound wave) reproduces itself, sometimes called the first harmonic. See also "Harmonic."

Geometric Divergence: Refers to the shape of sound pressure wavefronts and the manner in which they propagate. Geometric divergence or spreading is a generic term used for specific types of divergence, such as cylindrical or spherical divergence. See also "Cylindrical Divergence" and "Spherical Divergence."

Gradient: Variation of speed of sound, temperature, and wind velocity with height above the ground surface. A gradient in speed of sound can be caused by differences in temperature with height above the ground or differences in wind velocities with height above the ground. The speed of sound gradient in turn causes atmospheric refraction of sound which can create noise "shadows" (i.e., decreases) in certain areas and noise concentrations (i.e., increases) in others. See also "(Atmospheric) Refraction."

Ground Effects: The effects of sound grazing absorptive ground. See also "Absorptive Grounds."

Hard Site: Term used for reflective characteristics of the ground surface between a noise source and receiver. The term is most often used in traffic noise prediction models, where it is associated with a 3 dB per doubling of distance line source attenuation (because of geometric spreading only, without excess attenuation).

Harmonic: A sinusoidal (i.e., pure-tone) component whose frequency is a whole-number multiple of the fundamental frequency of the wave. If a component has a frequency twice that of the fundamental frequency, it is called the second harmonic.

Heavy Truck: A vehicle type for the purpose of noise prediction modeling defined as all vehicles with three or more axles designed for transportation of cargo. Generally, the gross weight is more than 26,500 pounds.

Hertz: Unit of frequency, formerly called cycles per second. 1 Hz = 1 cps. See also "Frequency."

Hourly Equivalent Sound Level: See "L_{eq}(h)."

Incident Sound: Direct sound striking a surface. See also "Angle of Incidence."

Infrasound: A sound with a frequency less than the audible sound spectrum (i.e., generally lower than 16 to 20 Hz).

Insertion Loss: The actual noise level reduction at a specific receiver from construction of a noise barrier between the noise source (e.g., traffic) and the receiver. Generally, it is the net effect of the barrier attenuation and loss of ground effects.

Inverse First Power: The increasing of sound amplitude from the process of cylindrical divergence from a line source. See also "Cylindrical Divergence." For a line source, the sound pressure level SPL_1 at distance D_1 is related to the sound pressure level SPL_2 at a distance of D_2 as follows:

$$SPL_1 - SPL_2 = 10\log(D_1 / D_2)$$

Inverse Square: The increasing of sound amplitude from the process of spherical divergence from a point source. See also "Spherical Divergence." For a point source, the sound pressure level SPL_1 at distance D_1 is related to the sound pressure level SPL_2 at a distance of D_2 as follows:

$$SPL_1 - SPL_2 = 10\log(D_1 / D_2)^2$$

kHz: Abbreviation for kilohertz, or 1,000 Hz. See also "Hertz."

L_{dn}: Abbreviation for the day-night level noise descriptor. It is the energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring from 10 p.m. to 7 a.m.

L_{eq}: The equivalent steady-state sound level that in a stated period of time would contain the same acoustical energy as the time-varying sound level during the same period.

L_{eq}(h): The energy-average of the A-weighted sound levels occurring during a 1-hour period in decibels (i.e., a 1-hour L_{eq}). See also "L_{eq}."

Level: In acoustics, the value of a logarithm of the ratio or ratio squared of that quantity *t* a reference quantity of the same kind in decibels. The base of the logarithm is commonly 10. The reference quantity and kind of level must be specified (e.g., sound pressure level of 60 dB RE: 20 μPa, sound power level RE: 10^{-12} W).

Line of Sight: A straight line between the observer's location and a specific noise source.

Line Source: A source of noise spread out into a line, such as approximated by the combined traffic on a roadway.

L_{max}: The highest SPL in a specific time period.

Logarithm: A mathematical operation that, for values more than 1, condenses these values into smaller values through the reverse of y^x, where x is the number being operated on. Normally, the base, or value of y, is taken as 10 (common log). If the base is not specified, its value is usually considered 10. Therefore, if $10^x = a$, then $x = \log_{10}a$, or log a. If a > 1, x is positive. If a = 1, x = 0. If 0 < a < 1, x is negative. Please note that *a* must never be 0. For example:

$10^2 = 100$; log100 = 2; x = 2, a = 100
$10^0 = 1$; log1 = 0; x = 0, a = 1
$10^{-2} = 0.01$; log0.01 = -2; x = -2, a = 0.01

Loudness: The judgment of intensity of a sound in terms of which sounds may be ranked on a scale from soft to loud. On this scale, a doubling of a reference sound energy is barely perceptible to the human ear, a tripling of the sound energy is readily perceptible, and 10 times the sound energy is about twice as loud. Decreasing the sound by the same factors has a reciprocal effect—reducing the reference sound energy to one-tenth of the original energy the sound is perceived as half as loud. Although loudness depends primarily on the intensity of the sound, it also depends on the sound's frequency and wave form.

Loudness Level: Defined as the median SPL in a specified number of trials of a 1,000-Hz tone that is judged equally loud to the listener as the sound in question. Described in units of phons. Please note that the calculated loudness level, *L*, in phons is related to loudness in sones as follows:

$$L = 10\log_2 n_s$$

Where:

L = the loudness level in phons

n_s = loudness in sones

A twofold change in loudness corresponds to an interval of 10 phons. See also "Phon" and "Sone."

L_x: The sound pressure level exceeded *x* percent of a specific time period. For example, L_{10} is the level exceeded 10% of the time, and L_{50} is the level exceeded 50% of the time.

Masking: The action of bringing one sound, audible when heard by itself, to inaudibility or unintelligibility by the introduction of another sound.

Medium: A substance carrying a sound wave, such as air, water, or steel.

Medium Truck: A vehicle classification for the purpose of noise prediction modeling, defined as all vehicles with two axles and six wheels designed for transportation of cargo. Generally, the gross weight is more than 10,000 pounds and less than 26,500 pounds.

Meter Response: Measure of the quickness with which the needle of an analog sound level meter or the display of a digital sound level meter follows changes in the actual sound level.

Microphone: An electroacoustic transducer that transforms sound waves into equivalent electric waves.

Natural Frequency: Frequency of free oscillation of a system (i.e., the frequency at which a system vibrates when given an initial excitation and allowed to vibrate freely without constraints).

Near Field: The part of a sound field, usually within about two wavelengths of the lowest sound frequency from a sound source, in which the dimensions of the sound source have an important effect and where there is no simple relationship between sound level and distance. For traffic noise, the near field usually exists within 25 feet of the nearest traffic. Noise measurements or predictions should be avoided in the near field.

Noise: Sound that is loud, unpleasant, unexpected, or otherwise undesirable.

Noise Barrier: A generic term for any feature that blocks or diminishes sound in its path from the source to receiver. Although the term can technically refer to any feature, manmade or natural, the two most common features included in noise barriers are soundwalls and earth berms. Almost all noise barriers in California are soundwalls; therefore, the terms “noise barrier” and “soundwall” are frequently interchanged, although soundwalls are a subset of noise barriers. See also “Soundwalls” and “Earth Berms.”

Noise Contour: An imaginary line shown on a plan along which all sound levels are equal.

Noise Floor: The level of noise, in decibels, that represents the threshold of sensitivity for a sound level meter and below which the inherent (i.e., device’s own) noise limits its detectability of low-level signals.

Noise Reduction Coefficient: A value representing the arithmetic average of the absorption coefficients in four octave bands with respective center frequencies of 250, 500, 1,000, and 2,000 Hz.

Octave: The interval between two sounds having a frequency ratio of 1:2; (e.g., 500 to 1,000 Hz; 440 to 880 Hz).

Octave Band: A frequency band in which the interval between the upper and lower cutoff frequency is one octave. As with all frequency bands, the octave band is usually described by its center frequency. Octave bands are centered by preferred frequencies described by ISO R 266. An example is the 500-Hz octave band. See also “Frequency Band.”

One-Third Octave: The interval between two sounds having a frequency ratio of the cube root of 2 (approximately 1.26). Three contiguous one-third octaves cover the same frequency range as an octave.

One-Third Octave Band: A frequency band in which the interval between the upper and lower cutoff frequency is one-third of an octave. As with all frequency bands, the one-third octave band is usually described by its center frequency. Three contiguous octave bands make up one octave band. As with octave bands, one-third octave bands are centered by preferred frequencies described by ISO R 266. For example, three one-third octave bands centered at 400, 500, and 630 Hz make up the 500-Hz octave band. See also “Frequency Band.”

Overall Level: The SPL that includes all the energy in all frequency bands of interest.

Pascal: A unit of pressure (in acoustics, normally rms sound pressure) equal to 1 Newton per square meter (N/m^2). The pascal is abbreviated Pa. A reference pressure for a sound pressure level of 0 dB is 20 μPa.

Peak Sound Level: See "Peak Sound Pressure Level."

Peak Sound Pressure: The maximum instantaneous (i.e., non-rms) sound pressure for a transient or impulsive sound of short duration or in a specified time interval for a sound of long duration. The unit is pascals.

Peak Sound Pressure Level: Level of peak sound pressure. The unit is decibels with stated frequency weighting, if any. See also "Peak Sound Pressure" and "Sound Pressure Level."

Permanent Threshold Shift: Permanent hearing loss from frequent exposures to noise of high intensities. See also "Temporary Threshold Shift."

Phon: Unit of loudness judged or calculated in definition of loudness level. See also "Loudness Level."

Pink Noise: Broadband noise that yields the same energy for each octave band over its entire range of frequencies. Because, going from low to high frequencies, each subsequent octave band contains twice the frequency range as the previous band, the energy decreases with increasing frequency to maintain equal energy per octave band. Compare with white noise.

Point Source: A noise source essentially concentrated at a single point from which noise propagates outward in all directions. A single vehicle observed from some distance can be approximated as a point source. See also "Spherical Divergence" and "Spreading."

Propagation: The passage of sound energy from a noise source to receiver through a medium (e.g., air).

Pure Tone: A sound wave whose waveform is a sine wave (single frequency).

Random Incidence: Refers to sound waves that strike the receiver randomly from all angles of incidence. Such waves are common in a diffuse sound field.

Random Noise: Noise that has random characteristics in both time and amplitude (i.e., any occurrence of any amplitude is as likely to occur at any one moment as any other).

Rarefaction: The portion of a sound wave in which the air molecules are rarefied or in a slight vacuum with respect to the barometric air pressure. The opposite of compression.

Rate of Decay: The time rate at which SPL decreases at a given receiver after the sound source is turned off. The commonly used unit is decibels per second (dB/s). It is used in measuring reverberation time of a room. See also “Reverberation” and “Reverberation Time.”

Receiver: Most basically defined as any natural or artificial sensor that can perceive, register, or be affected by sound (e.g., human ear, microphone). When modeling noise, a receiver is a point in the model that represents a single receptor or multiple receptors (defined below). For example if three single-family residences are in an area where acoustic conditions are the same, each residence is a receptor. For more modeling purposes the three residences can be represented by a single receiver in the model.

Receptor: Most basically defined as any natural or artificial sensor that can perceive, register, or be affected by sound (e.g., human ear, microphone). In the context of a noise analysis under the requirements of 23 CFR 772 a receptor is a single specific dwelling unit or the equivalent of a single dwelling unit. For example in a park with three baseball fields, each field is considered to be equivalent to a single dwelling unit for the purposes of noise analysis.

Reference Energy Mean Emission Level: The speed-dependent, energy-averaged maximum passby noise level generated by a defined vehicle type, as measured by a sound level meter at 50 feet from the centerline of travel at a height of 5 feet.

Reference Pressure: Any sound pressure to which a test pressure is being compared on a decibel scale, such as in the following expression:

$$\text{dB} = 10\log_{10}\left(\frac{p_1}{p_0}\right)^2$$

Where:

P_0 = reference pressure (usually defined as 20 μPa).

Also, the sound pressure at 1,000 Hz that normal young adults can just detect, taken as 20 μPa.

Reflection: Bouncing back of sound waves away from an object that is larger in exposed section than the wavelengths and of sufficient surface weight, density, and stiffness to present a very large increase in impedance compared to the surrounding air.

Reflective Ground: Grounds that do not absorb sound energy and reflect back most of the energy. Examples are paved surfaces (e.g., asphalt, concrete) and hard-packed soils. The opposite of absorptive ground.

Refraction: The bending of sound waves in arcing curves either downward or upward because of different velocities of sound with respect to height above the ground. The sound velocity differences are caused either by differences in near-ground wind velocity from wind shear, or vertical changes in temperature (sound velocity increases with air temperature). Downward refraction occurs for downwind sound propagation and during near-ground temperature inversions (temperature increases with height), and is responsible for noise increases. Upward refraction occurs for upwind sound propagation and during near-ground temperature lapses (temperature decreases with height), and is responsible for noise decreases.

Relative Energy: The energy ratio between a sound level and reference level. For example, the sound energy of 60 dB is 10^6, or 1,000,000 times larger than that of 0 dB. The sound energy of 67 dB is $10^{6.7}$, or 5,011,872 times larger than that of 0 dB.

To add or subtract sound levels, the relative energies (not the decibel levels) may be added directly. Therefore, for the case above, total relative energy is as follows:

60 dB + 67 dB = 1,000,000 + 5,011,872 = **6,011,872 (RE: 0 dB)**
10log(6,011,872) = **67.8 dB.**

The same result would be obtained if a reference of 50 dB were selected, as shown below.

$50 \text{ dB} + 10\log[10^{(6-5)} + 10^{(6.7-5)}] =$
$50 \text{ dB} + 10\log(10^1 + 10^{1.7}) =$
50 dB + 10log(60.12) =
50 dB + 17.8 = **67.8 dB.**

Resonance: The relatively large amplitude of sound or vibration produced when the frequency of the source of the sound or vibration “matches” (i.e., synchronizes) with the natural frequency of vibration of an object. See also “Natural Frequency.”

Resonator: A device that resounds or vibrates in sympathy with a source of sound and vibration (i.e., the source frequency matches the natural frequency of the resonator).

Reverberant Field: The region in a room where the reflected sound dominates, as opposed to the noise source where the direct sound dominates.

Reverberation: The persistence of sound in an enclosed space, because of multiple reflections, after the sound source has stopped.

Reverberation Room: A room having a long reverberation time, especially designed to make a sound field inside it as diffuse as possible. Also called a live room. The opposite of an anechoic chamber. See also "Anechoic Chamber."

Reverberation Time: The time taken for the sound energy to decrease to one millionth (10^{-6}), corresponding to a drop of 60 dB in SPL, of its steady-state value when the sound source is suddenly stopped. It is a measure of the persistence of an impulsive sound in a room and of acoustical absorption present inside the room.

Root Mean Square Pressure: The square root of the mean of the squares of a set of instantaneous positive, negative, or zero pressure amplitudes. The rms value is calculated by squaring the pressure values at each instant, adding them, dividing the total by the number of values, and taking the square root of the result. The squaring of both the positive and negative values ensures a positive result. An rms sound pressure is directly correlated with sound energy. For a single-frequency sound or sine wave, there is a simple relationship between the peak sound pressure and rms value:

$$\text{Peak} = \sqrt{2} * \text{rms} \approx 1.414 * \text{rms}$$

$$\text{rms} = (1 / \sqrt{2}) * \text{Peak} \approx 0.707 * \text{Peak}$$

Shadow Zone: The area behind a noise barrier that is blocked from direct view of the source of noise on the roadway.

Shielding: A noise reduction at the receiver because of the placement or existence of natural or artificial barriers (e.g., walls, berms, rows of buildings, or trees, if thick and dense enough).

Sine Wave: A sound wave, audible as a pure tone, in which the sound pressure is a sinusoidal function of time.

Soft Site: See "Absorptive Ground."

Sound: A vibratory disturbance created by a moving or vibrating source in the pressure and density of a gaseous, liquid medium or in the elastic strain of a solid that is capable of being detected by hearing organs. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to the ears. The medium of main concern is air. Unless otherwise specified, sound will be considered airborne, not structureborne, earthborne, etc.

Sound Energy: See "Relative Energy."

Sound Insulation: The use of structures and materials designed to reduce the transmission of sound from one room or area to another, or from the exterior to interior of a building. Also, the degree by which sound transmission is reduced by means of sound-insulating structures and materials.

Sound Intensity: The average rate of sound energy transmitted in a specified direction through a unit area normal to this direction at a point considered.

Sound Level: Frequency-weighted SPL measured using metering characteristics and frequency weighting, such as A, B, or C, specified in the ANSI Specification for Sound Level Meters.

Sound Level Meter: An instrument used for measuring sound levels in a specified manner. It generally consists of a microphone, amplifier, output display, and frequency weighting networks.

Sound Power: The total amount of energy radiated into the atmosphere per unit time by a source of sound.

Sound Power Level: The level of sound power, averaged over a period of time, the reference being 10^{-12} watts.

Sound Pressure Level: Ten times the logarithm to the base 10 of the ratio of the time mean-square pressure of a sound, in a stated frequency band to the square of the reference sound pressure in gasses, of 20 μPa. SPL represents only unweighted rms levels. The unit is decibels. See also "Root Mean Square."

$$\text{SPL} = 10\log_{10}\left(\frac{p_1}{p_0}\right)^2$$

Where:

P_0 = reference pressure of 20 μPa.

P_1 = sound pressure.

Source: A general term designating the sound energy generator. In transportation, noise sources are classified as point and line sources, which have different propagation characteristics. See also “Point Source” and “Line Source.”

Source Heights: The effective acoustic height of vehicle noise sources. These heights have been determined from vehicle noise emission data, and are programmed in the appropriate computerized noise prediction models. The heights represent the energy average of all subsources (e.g., exhaust, tires, and engine noise) and are most important in evaluating noise barrier attenuation.

Sound Transmission Class: A single figure rating system designed to estimate sound insulation properties of a partition or a rank ordering of a series of partitions. It is intended for use primarily when speech and office noise constitutes the principal problem.

Spectrum: See “Frequency Spectrum.”

Speed of Sound: The speed of sound for standard temperature of dry air at 32ºF and standard air pressure of 29.29 inches Hg standard is 1,087.3 feet per second. From these base values, the variation of speed of sound with temperature is described by the following equations:

$$\text{English Units: } c = 1051.3\sqrt{1 + \frac{T_f}{459}}$$

Where:

c = speed of sound

T_f = temperature in ºF

Spherical Divergence: Sound waves generated by a point source, such as approximated by a single vehicle, tend to form spherical wavefronts that propagate by radiating outward from their original point source in spherical pressure waves of ever-increasing areas. This process is referred to as “spherical divergence” or “spreading.” The same sound energy distributed over an ever-increasing spherical area is responsible for reducing the sound's energy per unit area (intensity) by one-quarter for each doubling of distance. This corresponds with a noise level decrease of 6 dB per doubling of distance. See also "Cylindrical Divergence."

Spherical Wave: A sound wave in which the surfaces of constant phase are concentric spheres. A small (point) source radiating into an open space produces a free sound field of spherical waves.

Steady-State Sound: Sounds for which average characteristics remain constant in time (e.g., sound of an air conditioner, fan, or pump).

Structureborne Sound: Sound that reaches the receiver over at least part of its path by vibration of a solid structure.

Temporary Threshold Shift: A temporary hearing loss, evidenced by an increase in the threshold of audibility (see "Threshold of Audibility") occurring after exposure to noise of high intensity. After a given time, usually up to several hours, the ear recovers to almost normal, but not quite so. After an excessive number of exposures of high intensity a hearing loss, or permanent threshold shift develops gradually.

Threshold of Audibility: The minimum SPL at which a person can hear a specific sound for a specified fraction of trials.

Transducer: A device capable of being actuated by waves from one or more transmission systems or media, and supplying related waves to one or more other transmission systems or media (e.g., microphones, loud speakers, accelerometers, seismometers).

Transient Sound: Transient sounds are those whose average properties do not remain constant over time (e.g., aircraft flyover, passing train, sonic boom, gunshot).

Transmission Loss: The loss in sound energy at a specific frequency, expressed in decibels, as sound passes through a barrier or a wall. It may be expressed mathematically as:

$$10 \times Log\left[\frac{E_1}{E_2}\right]$$

Where:

E_1 = sound energy leaving the back of the wall

E_2 = sound energy as it strikes the front of the wall

Transmission loss is not a reduction in total energy, only a transformation from sound energy into heat. Almost all highway noise barriers provide a loss of at least 25 dBA, which means that less than 1/3 of a percent of the sound energy travels through the wall.

Wave: In acoustics, a propagation wave is a cyclic pressure variation in air. The waves move at a characteristic speed (e.g., the speed of sound) through the medium (e.g., air) as an elastic response to a pressure perturbation at a source.

Wave Front: A portion of any wave, whether in compression or rarefaction state, that can be followed as it propagates throughout the medium, analogous to the crest of a tidal wave as it crosses the ocean. At all points on the wave front, the wave has equal amplitude and phase.

Wavelength: For a non-periodic wave, such as sound in air, the normal distance between analogous points of any two successive waves. The wavelength of sound in air or water is inversely proportional to the frequency of the sound. Therefore, the lower the frequency, the longer the wavelength.

White Noise: Broadband noise, the energy of which is constant over a wide range of frequencies (i.e., energy/Hz = constant). Because each octave band range increases by a factor of two, from low to high frequencies, each subsequent octave band contains twice the acoustical energy as the previous one. This corresponds to an increase of 3 dB in energy for each subsequent octave band. Compare with “Pink Noise.”

Ultrasonic: Pertaining to sound frequencies above the audible sound spectrum (in general, more than 20,000 Hz).

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Appendix A

References Cited

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Appendix A
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Rte	Desig Status (OD= Officially Designated;	County	Caltrans Dist	"OD" or "E" State Scenic Highway Location (from/to)	Begin County	*Post Mile	End County	*Post Mile	Length Designated (miles)	Official Des #	Official Desig Date
1	E	Ora/LA	12/7	I-5 SO San Juan Cap./Route 19 near Long Beach	Ora	0	LA	3.6			
1	E	LA/Ven	7	Route 187 near Santa Monica/Route 101 near El Rio	LA	32.2	Ven	21.1			
1	E	Santa Barbara	5	Route 101 at Las Cruces to Route 246 near Lompoc	SB	R 0.0	SB	19.3			
1	E	SLO	5	Route 227 SO Oceano/Route 101 near Pismo Beach	SLO	10.3	SLO	16.7			
1	E	SLO/Mon/SCr/SM/SF	5/4	Route 101 near San Luis Obispo/Route 35 near Daly City	SLO	16.7	SF	1.9			
1	E	SF	4	Route 35 in SF/Route 101 near Golden Gate Br in SF	SF	1.9	SF	7.1			
1	E	Mar/Son/Men	4/1	Route 101 near Marin City/Route 101 near Leggett	Marin	0.0	Men	105.6			
1	**OD**	**SANTA BARBARA**	**5**	**FR Route 101 NR LAS CRUCES TO NR LOMPOC**	**SANTA BARBARA**	**0**	**SANTA BARBARA**	**18.6**	**18.6**	**30**	December 14, 1971
1	**OD**	**SAN LUIS OBISPO**	**5**	**FR SAN LUIS OBISPO CIL TO MONTEREY CL**	**SAN LUIS OBISPO**	**17.73**	**SAN LUIS OBISPO**	**74.3**	**56.6**	**54**	August 13, 1999
1	**OD**	**MONTEREY**	**5**	**FR SAN LUIS OBISPO CL TO CARMEL RIVER**	**MONTEREY**	**0.0**	**MONTEREY**	**72.3**	**72.3**	**1**	June 7, 1965
1	**OD**	**MONTEREY**	**5**	**FR CARMEL RIVER TO Route 68**	**MONTEREY**	**72.3**	**MONTEREY**	**78.1**	**5.8**	**14**	May 21, 1970
1	**OD**	**SAN MATEO**	**4**	**FR SANTA CRUZ CL TO S CIL HALF MOON BAY**	**SAN MATEO**	**0.0**	**SAN MATEO**	**26.2**	**26.2**	**39**	June 25, 1976
2	E	LA/SBD	7/8	Route 210 in La Can. Flintridge/Route 138 Via Wrtwd	LA	22.9	SBD	6.36			
2	**OD**	**LOS ANGELES**	**7**	**FR 2.7 MI NO Route 210 @ LA CANADA TO SAN BERND CL**	**LOS ANGELES**	**27.2**	**LOS ANGELES**	**82.3**	**55.1**	**22**	March 12, 1971
3	E	Trinity	2	Route 36 near Peanut/Route 299 near Douglas City	Trinity	L0.0	Trinity	L30.9			
3	E	Tri/Sis	2	Route 299 near Weaverville/Montague	Trinity	30.9	Sis	54.2			
4	E	Contra Costa	4	Route 160 near Antioch/Route 84 near Brentwood	Contra Costa	31.1	Contra Costa	40.5			
4	E	Cal/Alp	10	Route 49 near Angel's Camp/Route 89	Cal	21.4	Alp	31.7			
4	**OD**	**CALAVERAS**	**10**	**FR EO ARNOLD TO ALPINE CL**	**CALAVERAS**	**41.6R**	**CALAVERAS**	**65.9**	**24.3**	**26**	**November 9, 1971**
4	**OD**	**ALPINE**	**10**	**FR CALAVERAS CL TO Route 89**	**ALPINE**	**0.0**	**ALPINE**	**31.7**	**31.7**	**18**	**September 14, 1970**
5	E	San Diego	11	Intl Bdry at Tijuana/Route 75 SO SD Bay	San Diego	0.0	San Diego	4.6			
5	E	SD/Ora	11/12	Opposite Coronado/Route 74 near San Juan Cap.	SD	R14.0	Ora	9.6			
5	E	LA	7	I-210 near Tunnel Station/Route 126 near Castaic	LA	R44.0	LA	R55.5			
5	E	Mer/San Joaq	10	Route 152 WO Los Banos/I-580 near Vernalis	Mer	17.6	San Joaq	0.7			
5	E	Shasta	2	Route 44 near Redding/Shasta Reservoir	Shasta	R15.5	Shasta	R28.2			
5	E	Siskiyou	2	Route 89 near Mt Shasta/Route 97 near Weed	Siskiyou	R8.5	Siskiyou	R19.1			
5	E	Siskiyou	2	Route 3 near Yreka/Oregon State Line near Hilt	Siskiyou	R48.2	Siskiyou	R69.3			
5	**OD**	**MERCED**	**10**	**FR Route 152 TO STANISLAUS CL**	**MERCED**	**17.6**	**MERCED**	**32.5**	**14.9**	**8**	October 25, 1968
5	**OD**	**STANISLAUS**	**10**	**FR MERCED CL TO SAN JOAQUIN CL**	**STANISLAUS**	**0**	**STANISLAUS**	**28.1**	**28.1**	**8**	October 25, 1968
5	**OD**	**SAN JOAQUIN**	**10**	**FR STANISLAUS CL TO I-580**	**SAN JOAQUIN**	**0.0**	**SAN JOAQUIN**	**0.7L**	**0.7**	**37**	June 7, 1974
8	E	SD/Imp	11	Sunset Cliffs Blvd/Route 98 near Coyote Wells	SD	T0.0	Imp	R10.0			
9	E	SCr	5	Route 1 near Santa Cruz/Route 236 near Boulder Creek	SCr	0.0	SCr	13			
9	E	SCr	5	Route 236 near Boulder Creek/Route 236 near Waterman	SCr	13.0	SCr	20.8			
9	E	SCr	5	Route 236 near Waterman Gap/Route 35	SCr	20.8	SCr	27.1			
9	E	SCl	4	Route 35/Route 17 near Los Gatos	SCl	0.0	SCl	11.5			
9	**OD**	**SANTA CLARA**	**4**	**FR SANTA CRUZ CL @ SARATOGA GAP TO BLANEY PLAZA**	**SANTA CLARA**	**0.0**	**SANTA CLARA**	**7.5**	**7.5**	**42**	October 18, 1979
9	**OD**	**SANTA CLARA**	**4**	**FR BLANEY PLAZA TO LOS GATOS CIL**	**SANTA CLARA**	**7.5**	**SANTA CLARA**	**10.8**	**3.4**	**4**	May 2, 1968
12	E	Sonoma	4	Route 101 near Santa Rosa/Route 121 near Sonoma	Sonoma	R16.0	Sonoma	41.4			
12	**OD**	**SONOMA**	**4**	**FR DANIELLI AVE EO SANTA ROSA TO LONDON WAY NR AQUA CALIENTE**	**SONOMA**	**22.5**	**SONOMA**	**34**	**11.5**	**38**	December 17, 1974
13	E	Alameda	4	From Route 24 to Route 580	Alameda	9.62	Alameda	4.26			
14	E	Kern	6	Route 58 near Mojave/Route 395 near Little Lake	Kern	16	Kern	64.5			

**Post Miles for eligible segments are approximate; legal limits of State Scenic Highways are described in the Streets Highways Code*
(For limits of federal byways, visit FHWA "America's Bways" or USFS Scenic Byway programs).

EEC ORIGINAL PKG

Rte	Desig Status (OD= Officially Designated;	County	Caltrans Dist	"OD" or "E" State Scenic Highway Location (from/to)	Begin County	*Post Mile	End County	*Post Mile	Length Designated (miles)	Official Des #	Official Desig Date
15	E	SD/Riv	11/8	Route 76 near San Luis Rey River/Route 91 near Corona	SD	R46.5	Riv	41.5			
15	E	SBd	8	Route 58 near Barstow/Route 127 near Baker	SBd	76.9	SBd	R136.6			
16	E	Col/Yol	3	Route 20/Capay	Col	0.0	Yol	25.3			
17	E	SCr/SCl	5/4	Route 1 near Santa Cruz/Route 9 near Los Gatos	SCr	0.0	SCl	7.1			
18	E	SBd	8	Route 138 near Mt Anderson/Route 247 near Lucerne Vly	SBd	R17.7	SBd	73.8			
20	E	Men	1	Route 1 near Fort Bragg/Route 101 near Willits	Men	R0.0	Men	R33.2			
20	E	Men/Lak/Col	1/3	Route 101 near Calpella/Route 16	Men	33.2	Col	3.5			
20	E	Nevada	3	Route 49 near Grass Valley/I-80 near Emigrant Gap	Nevada	R12.2	Nevada	45.7			
20	OD	NEVADA	3	FR SKILLMAN FLAT CAMPGROUND TO 1/2 MI EO LOWELL HILL RD	NEVADA	33	NEVADA	39.5	6.5	23	March 12, 1971
24	E	Contra Costa	4	Alameda/Contra Costa CL to Rte 680 in Walnut Crk	Contra Costa	0.0	Contra Costa	9.1			
24	OD	CONTRA COSTA	4	FR E PORTAL OF CALDECOTT TUNNEL TO I-680 NR WALNUT CREEK	CONTRA COSTA	R0.3	CONTRA COSTA	9.1	8.8	45	October 22, 1982
25	E	Mon/SBt	5	Route 198/Route 156 near Hollister	Mon	0.0	SBt	51.4			
27	E	LA	7	Route 1/Mulholland Dr.	LA	0.0	LA	11.1			
27	OD	LOS ANGELES	7	"TOPANGA CANYON STATE SCENIC HIGHWAY"	LOS ANGELES	1.0	LOS ANGELES	3.5	2.5	61	March 22, 2017
28	E	Placer	3	Route 89 in Tahoe City/Nevada SL (All)	Placer	0.0	Placer	11.0			
29	E	Sol/Nap	4	Route 37 near Vallejo/Route 221 near Napa	Sol	4.7	Nap	R8.7			
29	E	Nap/Lk	4/1	Trancas St in Napa/Route 20 near Upper Lake	Nap	13.0	Lk	52.5			
30	E	SBd	8	Route 330 near Highland/Route 10 near Redlands (deleted)	SBd	T29.5	SBd	33.3			
33	E	Ventura	7	Route 101 near Ventura/Route I50	Ventura	0.0	Ventura	11.2			
33	E	Ven/SB/SLO	7/5	Route 150/Route 166 in Cuyama Valley	Ventura	11.2	SLO	11.5			
33	E	Fresno	6	Route 198 near Coalinga/Route 198 near Oilfields	Fresno	15.7	Fresno	24.3			
33	OD	VENTURA	7	FR 6.4 MI NO Route 150 TO 23.3 MI NO Route 150	VENTURA	17.6	VENTURA	34.5	16.9	32	February 18, 1972
33	OD	VENTURA	7	FR 23.3 MI NO Route 150 TO 30.5 MI NO Route 150	VENTURA	34.5	VENTURA	41.7	7.2	50	July 11, 1988
33	OD	VENTURA	7	FR 30.5 MI NO Route 150 TO 36.8 MI NO Route 150	VENTURA	41.7	VENTURA	48.0	6.3	32	February 18, 1972
33	OD	VENTURA	7	FR 36.8 MI NO Route 150 TO SANTA BARBARA CL	VENTURA	48.0	VENTURA	57.5	9.5	50	July 11, 1988
35	E	SCl/SCr/SM/SF	4/5	Route 17 To Route 92/I-280/Route 1 in SF (All)	SCl	0.0	SF	3.2			
35	OD	SAN MATEO	4	FR SCRUZ CL TO SCLARA CL	SAN MATEO	0.0	SAN MATEO	2.1	2.1	7	September 13, 1968
35	OD	SAN MATEO	4	FR SCLARA CL TO HALF MOON BAY RD (Route 92)	SAN MATEO	2.1	SAN MATEO	23.0	20.9	2	January 22, 1968
36	E	Hum/Tri	1/2	Route 101 near Alton/Route 3 near Peanut	Hum	0.0	Tri	R28.7			
36	E	Teh/Plu	2	Route 89 near Morgan Summit/Route 89 near Deer Crk	The	87.7	Plu	6.3			
37	E	Marin	4	Route 251 near Nicasio/Route 101 near Novato (unconstructed)	Marin	0.0	Marin	11.2			
37	E	Mrn/Son/Sol	4	Route 101 near Ignacio/Route 29 near Vallejo	Mrn	11.2	Sol	9.5			
38	E	SBd	8	Route 10 near Redlands/Route 18 near Fawnskin (All)	SBd	0.0	SBd	49.5			
38	OD	SAN BERNARDINO	8	FR 0.1 MI EO SOUTH FORK CAMPGROUND TO 2.9 MI SO Route 18 @ STATE LANE	SAN BERNARDINO	31.0	SAN BERNARDINO	46.7	15.7	3	March 19, 1968
39	E	LA	7	Route 210 near Azusa/Route 2	LA	14.1	LA	44.4			
40	E	SBd	8	Barstow/Needles	SBd	0.0	SBd	154.6			
41	E	SLO	5	Route 1 near Morro Bay/Route 101 near Atascadero	SLO	0.0	SLO	15.9			
41	E	SLO/Ker/Kin	5/6	Route 46 near Cholame/ Route 33	SLO	43.8	Kin	8.1			
41	E	Mad/Mpa	6	Route 49 near Oakhurst/Yosemite National Park	Mad	35.5	Mpa	4.9			
44	E	Shasta	2	I-5 near Redding/Route 89 near Old Station	Shasta	0.0	Shasta	62.7			
46	E	SLO	5	Route 1 near Cambria/Route 101 near Paso Robles	SLO	0.0	SLO	29.8			
46	E	SLO	5	Route 101 near Paso Robles/Route 41 near Cholame	SLO	29.8	SLO	55.1			

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EEC ORIGINAL PKG

Rte	Desig Status (OD= Officially Designated;	County	Caltrans Dist	"OD" or "E" State Scenic Highway Location (from/to)	Begin County	*Post Mile	End County	*Post Mile	Length Designated (miles)	Official Des #	Official Desig Date
49	E	Mad/Mpa/Tuo	10/3	Route 41 near Oakhurst/Route 120 near Moccasin	Mad	0.0	Tuo	R8.8			
49	E	Tuo/Cal/Ama/ED/Pla/Nev	3	Route 120/Route 20 near Grass Valley	Tuo	R8.8	Nev	R14.5			
49	E	Nev/Yub/Sie	3	Route 20 near Nevada City/Route 89 near Sattley	Nevada	15.1	Sie	47.5			
49	**OD**	**SIERRA**	**3**	**FR YUBA CL TO YUBA SUMMIT**	**SIERRA**	**0.0**	**SIERRA**	**41.2**	**41.2**	**24**	July 14, 1971
50	E	El Dorado	3	Route 49 near Placerville/Nevada SL near Lake Tahoe	El Dorado	17.7	El Dorado	80.4			
50	**OD**	**EL DORADO**	**3**	**FR EASTERN LIMIT OF GOV CENTER IC IN PLACERVILLE TO ECHO SUMMIT**	**EL DORADO**	**16.8**	**EL DORADO**	**66.5**	**49.7**	**46**	April 2, 1985
50	**OD**	**EL DORADO**	**3**	**FR ECHO SUMMIT TO SOUTH LAKE TAHOE CIL**	**EL DORADO**	**66.5**	**EL DORADO**	**74.4**	**7.9**	**47**	April 1, 1986
52	E	San Diego	11	I-5 EO La Jolla/Route 67 near Santee (All)	San Diego	0.0	San Diego	17.1			
52	**OD**	**SAN DIEGO**	**11**	**FROM NEAR SANTO ROAD TO NEAR MAST BOULEVARD**	**SAN DIEGO**	**9.5**	**SAN DIEGO**	**13.0**	**3.5**	**59**	February 2, 2016
53	E	Lake	1	Route 29 near Lwr Lk/Route 20 EO Clr Lake Oaks (All)	Lake	0.0	Lake	7.5			
57	E	Ora/LA	12/7	Route 90/Route 60 near City of Industry	Ora	19.9	LA	R4.5			
58	E	Ker/SBd	6/8	Route 14 near Mojave/I-15 near Barstow	Ker	112.0	SBd	R4.5			
62	E	Riv/SBd	8	I-10 near Whitewater/Arizona SL (All)	Riv	0.0	SBd	142.7			
62	**OD**	**RIVERSIDE**	**8**	**FR I-10 TO SAN BERNARDINO CL**	**RIVERSIDE**	**0.0**	**RIVERSIDE**	**9.2**	**9.2**	**34**	September 14, 1972
68	E	Monterey	5	City of Monterey/Route 101 near Salinas	Monterey	0.0	Monterey	22.0			
68	**OD**	**MONTEREY**	**5**	**FR Route 1 IN MONTEREY TO SALINAS RIVER**	**MONTEREY**	**L4.3**	**MONTEREY**	**R17.8**	**13.5**	**6**	June 19, 1968
70	E	But/Plu	3/2	Route 149 near Wicks Corner/Route 89 near Blairsden	But	20.5	Plu	33.0			
71	E	Riverside	8	Route 91 near Corona/Route 83 NO Corona	Riverside	0.0	Riverside	G3.0			
74	E	Ora/Riv	12/8	I-5 near San Juan Capistrano/I-111 (All)	Ora	0.0	Riv	R96.0			
74	**OD**	**RIVERSIDE**	**8**	**FR W BDRY OF SAN BERND NAT'L FOREST TO Route 111 IN PALM DESERT**	**RIVERSIDE**	**48.3**	**RIVERSIDE**	**R96.0**	**47.7**	**25**	October 18, 1971
75	E	SD	11	I-5 in Palm City/I-5 in San Diego (All)	SD	9.0	SD	22.3			
75	**OD**	**SAN DIEGO**	**11**	**FR IMPERIAL BEACH CIL TO AVENIDA DEL SOL IN CORONADO**	**SAN DIEGO**	**11.2**	**SAN DIEGO**	**18.4**	**7.2**	**36**	March 4, 1974
75	**OD**	**SAN DIEGO**	**11**	**SAN DIEGO-CORONADO BRIDGE**	**SAN DIEGO**	**20.5**	**SAN DIEGO**	**21.9**	**1.4**	**11**	December 17, 1969
76	E	SD	11	I-5 near Oceanside/Route 79 near Lake Henshaw (All)	SD	0.0	SD	52.3			
78	E	SD/Imp	11	Route 79 near Santa Ysabel/Route 86 passing near Julian	SD	51.1	Imp	13			
78	**OD**	**SAN DIEGO**	**11**	**FR W BDRY OF ANZA BORREGO DESERT STATE PARK TO E BDRY**	**SAN DIEGO**	**71.9**	**SAN DIEGO**	**90.1**	**18.2**	**31**	December 14, 1971
79	E	SD	11	Route 8 near Descanso/Route 78 near Julian	SD	0.0	SD	20.2			
79	E	SD/Riv	11/8	Route 78 near Santa Ysabel/Route 371 near Aguanga	SD	20.2	Riv	2.3			
80	E	SF/Ala	4	I-280 near First Street in SF/Route 61 in Oakland	SF	3.2	Ala	2.8			
80	E	Pla/Nev/Sie	3	Route 20 near Emigrant Gap/Nevada State Line	Pla	R59.5	Sie	1.6			
84	E	Ala	4	Route 238/I-680 near Sunol	Ala	10.8	Ala	18.0			
84	**OD**	**ALAMEDA**	**4**	**FR Route 238 (MISSION BLVD) EAST TO I 680**	**ALAMEDA**	**10.8**	**ALAMEDA**	**17.9**	**7.1**	**57**	July 7, 2007
88	E	Ama/Alp	10	Route 49 in Jackson/Nevada State Line	Ama	14.3	Alp	25.3			
88	**OD**	**ALPINE**	**10**	**FR AMADOR CL TO NEVADA SL**	**ALPINE**	**0.0**	**ALPINE**	**25.3**	**25.3**	**19**	September 14, 1970
88	**OD**	**AMADOR**	**10**	**FR DEW DROP RANGER STATION TO ALPINE CL**	**AMADOR**	**38.2**	**AMADOR**	**71.6**	**33.5**	**49**	July 30, 1986
89	E	Mono/Alp/ED/Pla/Nev/Sie/Plu/Teh/Sha/Sis	9/10/3	Route 395 near Coleville/I-5 near Mt Shasta (All)	Mono	0.0	Sis	R34.6			
89	**OD**	**EL DORADO**	**3**	**FR ALPINE CL TO PLACER CL**	**EL DORADO**	**0.0**	**EL DORADO**	**27.4**	**27.4**	**48**	April 1, 1986
89	**OD**	**MONO**	**9**	**FR 3.2 MILES WO Route 395 TO ALPINE CL**	**MONO**	**3.2**	**MONO**	**7.6**	**4.4**	**27**	November 9, 1971
89	**OD**	**ALPINE**	**10**	**FR MONO CL TO E JCT Route 88 & FR W JCT Route 88 TO EL DORADO CL**	**ALPINE**	**0.0**	**ALPINE**	**24.0**	**24**	**20**	September 14, 1970
91	E	Ora/Riv	12/8	Route 55 near Santa Ana Canyon/I-15 near Corona	Ora	R9.2	Riv	7.5			
91	**OD**	**ORANGE**	**12**	**FR Route 55 TO EAST CIL OF ANAHEIM**	**ORANGE**	**R9.2**	**ORANGE**	**R13.4**	**4.2**	**29**	November 15, 1971

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EEC ORIGINAL PKG

Rte	Desig Status (OD= Officially Designated;	County	Caltrans Dist	"OD" or "E" State Scenic Highway Location (from/to)	Begin County	*Post Mile	End County	*Post Mile	Length Designated (miles)	Official Des #	Official Desig Date
92	E	San Mateo	4	Route 1 near Half Moon Bay/I-280 near Crystal Springs Lk	San Mateo	0.0	San Mateo	R7.3			
94	E	SD	11	Route 125 near Spring Valley/I-8 WO Jacumba	SD	10.1	SD	64.2			
96	E	Hum/Sis	1/2	Route 299 near Willow Creek/I-5 NO Yreka (All)	Hum	0.0	Sis	105.8			
97	E	Siskiyou	2	I-5 in Weed/Oregon SL NO Dorris (All)	Siskiyou	0.0	Siskiyou	54.1			
101	E	LA/Ven/SB/SLO	7/5	Route 27 (Topanga Cyn Blvd)/Route 46 near Paso Robles	LA	25.3	SLO	57.9			
101	E	Mon/SBt	5	Route 156 near Prunedale Northeasterly To Route 156	Mon	95.4	SBt	3.1			
101	E	Marin	4	Opposite San Francisco/Route 1 in Marin City	Marin	0.0	Marin	4.1			
101	E	Marin	4	Route 37 near Ignacio/Route 37 (unconstructed) near Novato	Marin	19.1	Marin	20.9			
101	E	Mendocino	1	Route 20 near Calpella/Route 20 near Willits	Men	30.8	Men	46.4			
101	E	Men/Hum/DN	1	Route 1 near Leggett/Route 199 near Crescent City	Men	T91.3	DN	R30.8			
101	E	Del Norte	1	Route 197 near Fort Dick/Oregon SL	Del Norte	36.3	Del Norte	46.5			
101	**OD**	**SANTA BARBARA**	**5**	**"GAVIOTA COAST STATE SCENIC HIGHWAY" FROM NEAR CITY OF GOLETA'S WESTERN BOUNDARY TO ROUTE 1 AT LAS CRUCES**	**SANTA BARBARA**	**27.5**	**SANTA BARBARA**	**48.9**	**21.4**	**60**	December 13, 2016
101	**OD**	**DEL NORTE**	**1**	**FR S BDRY DEL NORTE REDWOODS ST. PARK TO N BDRY NR CRESCENT CITY**	**DEL NORTE**	**11.0**	**DEL NORTE**	**23.1**	**12.1**	**12**	February 18, 1970
108	E	Tuo/Mno	10/9	Route 49 near Sonora/Route 395	Tuo	0.0	Mno	15.2			
111	E	Imp/Riv	8	Bombay Beach-Salton Sea SP/Route 195. near Mecca	Imp	57.6	Riv	18.4			
111	E	Riv	8	Route 74 near Palm Desert/I-10 near Whitewater	Riv	39.6	Riv	R63.4			
116	E	Sonoma	4	Route 1 near Jenner/Route 101 near Cotati	Sonoma	0.0	Sonoma	35.5			
116	**OD**	**SONOMA**	**4**	**FR Route 1 TO SOUTH CIL SEBASTOPOL**	**SONOMA**	**0.0**	**SONOMA**	**27.8**	**27.8**	**51**	September 20, 1988
118	E	Ven/LA	7	Route 23/Desoto Ave. near Browns Canyon	Ven	17.4	LA	R2.7			
120	E	Tuolumne	10	Route 49 near Chinese Camp/Route 49 near Moccasin	Tuolumne	15.5	Tuolumne	23.9			
120	E	Mono	9	E Bdry Yosemite/Route 395 near Mono Lake	Mono	0.0	Mono	13.4			
121	E	Sonoma	4	Route 37 near Sears Point/Route 12 near Sonoma	Sonoma	0.0	Sonoma	7.5			
121	E	Napa	4	Route 221 near Napa St. Hosp./near Trancas St in Napa	Napa	6.0	Napa	9.4			
125	**OD**	**SAN DIEGO**	**11**	**FR Route 94 NR SPRING VALLEY TO I-8 NR LA MESA**	**SAN DIEGO**	**13.5**	**SAN DIEGO**	**R15.3**	**1.8**	**21**	March 1, 1971
126	E	Ven/LA	7	Route 150 near Santa Paula/I-5 near Castaic	Ven	R12.0	LA	0R5.8			
127	E	SBd/Iny	8/9	I-15 near Baker/Nevada SL (All)	SBd	L0.0	Iny	49.4			
128	E	Men/Son/Napa/Sol/Yolo	1/4/3	Junction Route 1 /Junction Route 505 (entire route)	Men	0.00	Yolo	9.8			
138	E	SBd	8	Route 2 near Wrightwood/Route 18 near Mt Anderson	SBd	6.6	SBd	R37.9			
139	E	Mod/Sis	2	Route 299 near Canby/Oregon SL near Hatfield	Mod	0.0	Sis	5.0			
140	E	Mariposa	10	Route 49 at Mariposa/Yosemite Nat'l Park	Mariposa	21.2	Mariposa	51.8			
140	**OD**	**MARIPOSA**	**10**	**FR NO MARIPOSA TOWN PLNG AREA TO WO EL PORTAL TOWN PLNG AREA**	**MARIPOSA**	**22.8**	**MARIPOSA**	**49.9**	**27.1**	**52**	September 30, 1991
142	E	SBd	8	Orange CL/Peyton Dr.	SBd	0.0	SBd	4.4			
146	E	San Benito	5	Pinnacles Nat. Mon./Route 25 in Bear Valley	San Benito	G10.2	San Benito	15.2			
150	E	SB/Ven	5/7	Route 101 near Ven/SB CL/Route 126 near Santa Paula (All)	SB	0	Ven	34.4			
151	E	Shasta	2	Shasta Dam/I-5 near Project City (All)	Shasta	0.0	Shasta	R6.7			
151	**OD**	**SHASTA**	**2**	**FR SHASTA DAM TO NR LAKE BLVD**	**SHASTA**	**0.0**	**SHASTA**	**3.3**	**3.3**	**44**	September 9, 1981
152	E	SCr	5	Route 1/Santa Clara CL at Hecker Pass	SCr	0.0	SCr	8.3			
152	E	SCl/Mer	4/10	Route 156 near San Felipe/I-5	SCl	22.1	Mer	13.9			
152	**OD**	**MERCED**	**10**	**FR SANTA CLARA CL TO JUNCTION OF I-5**	**MERCED**	**0.0**	**MERCED**	13.8	**13.8**	**15**	June 19, 1970

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EEC ORIGINAL PKG

Rte	Desig Status (OD= Officially Designated;	County	Caltrans Dist	"OD" or "E" State Scenic Highway Location (from/to)	Begin County	*Post Mile	End County	*Post Mile	Length Designated (miles)	Official Des #	Official Desig Date
154	E	SB	5	Route 101 near Los Olivos Via San Marcos Pass/Route 101 in Santa Barbara (All)	SB	0.0	SB	32.3			
154	**OD**	**SANTA BARBARA**	**5**	**FR Route 101 NR LOS OLIVOS VIA SAN MARCOS PASS TO Route 101 IN SANTA BARBARA**	**SANTA BARBARA**	**0.0**	**SANTA BARBARA**	**32.3**	**32.3**	**9**	November 22, 1968
156	E	Mon/SBt/SCl	5/4	Route 1 near Castroville/Route 152 NE of Hollister (All)	Mon	0.0	SCl	0.7			
156	**OD**	**MONTEREY**	**5**	**FR 1 MI EO CASTROVILLE TO Route 101 NR PRUNEDALE**	**MONTEREY**	**R1.0**	**MONTEREY**	**T5.3**	**4.3**	**35**	September 14, 1972
158	E	Mono	9	Route 395 near June Lk/Route 395 SO Lee Vining (All)	Mono	0.0	Mono	15.8			
160	E	CC/Sac	4/3	Route 4 near Antioch/Sacramento	CC	0.0	Sac	36.0			
160	**OD**	**SACRAMENTO**	**3**	**FR CONTRA COSTA CL TO S CIL SACRAMENTO**	**SACRAMENTO**	**L0.0**	**SACRAMENTO**	**35.0**	**45.8**	**10**	October 3, 1969
161	E	Sis	2	Route 97 near Dorris/Route 139 near Hatfield (All)	Sis	0.0	Sis	19.4			
163	E	San Diego	11	Ash Street in San Diego/I-8	San Diego	0.6	San Diego	3.8			
163	**OD**	**SAN DIEGO**	**11**	**FR S BDRY BALBOA PARK TO N BDRY**	**SAN DIEGO**	**0.9**	**SAN DIEGO**	**2.2**	**1.2**	**53**	April 24, 1992
166	E	SLO/SB/SLO	5	Route 101 near Santa Maria/Route 33 in Cuyama Valley	SLO	8.9	SLO	74.7			
168	E	Fresno	6	Route 65 near Clovis/Huntington Lake	Fresno	4.0	Fresno	49.7			
168	E	Inyo	9	Camp Sabrina/Route 395	Inyo	0.0	Inyo	18.3			
168	E	Iny/Mno	9	395 at Big Pine/ Route 266 at Oasis	Iny	18.3	Mno	1.4			
168	**OD**	**INYO**	**9**	**FR CMP SABRINA TO BROCKMN LN @ PAIUTE-SHOS IND RESV NR BISHOP**	**INYO**	**0.0**	**INYO**	**16.3**	**16.3**	**16**	June 19, 1970
173	E	SBd	8	Route 138 near Slvrwd Lk/Route 18 SO Lk Arwhd (All)	SBd	0.0	SBd	23.0			
174	E	Nevada	3	Bear River at Placer CL/Grass Valley CiL	Nevada	0.0	Nevada	10.2			
178	E	Inyo	9	E Bdry Dth Vly Nat'l Mon/Route 127 near Shoshone	Inyo	25.0	Inyo	43.0			
180	E	Fresno	6	Route 65 (unconstructed) near Minkler/Kings Canyon Nat'l Park Bdry near Cedar Grove	Fresno	77.3	Fresno	137.9			
180	**OD**	**FRESNO/TUL**	**6**	**FR (a) ALTA MAIN CANAL NEAR MINKLER TO NEAR THE GENERAL GRANT GROVE SECTION OF KINGS CANYON NAT'L PARK (KCNP) (b) GENERAL GRANT GROVE SECTION OF KCNP TO KCNP BDRY NEAR CEDAR GROVE**	**FRESNO**	**77.3**	**FRESNO**	137.9	**58**	**58**	October 15, 2015
190	E	Tul/Iny	6/9	Route 65 near Porterville/Route 127 near Death Valley Jct	Tul	R15.2	Iny	140.7			
190	**OD**	**INYO**	**9**	**FR W BDRY DEATH VALLEY NATIONAL MON TO E BDRY**	**INYO**	**68.9**	**INYO**	**124.4**	**55.5**	**5**	May 10, 1968
190	**OD**	**INYO**	**9**	**FR W BDRY DEATH VALLEY NATIONAL PARK TO E BDRY (EXTENSION)**	**INYO**	**42.4**	**INYO**	**68.9**	**26.5**	**56**	January 7, 2002
197	E	Del Norte	1	N Side of Smith River Fr Route 199/Route 101 (All)	Del Norte	0.0	Del Norte	7.1			
198	E	Mon/Fre	5/6	Route 101 near San Lucas/Route 33 near Coalinga	Mon	0.0	Fre	22.7			
198	E	Fresno	6	Route 33 near Oilfields/I-5	Fresno	22.6	Fresno	26.8			
198	E	Tulare	6	Route 99 near Goshen/Sequoia Nat'l Park	Tulare	R3.8	Tulare	44.2			
199	E	Del Norte	1	Route 101 near Crescent City/Oregon SL (All)	Del Norte	0.0	Del Norte	36.4			
203	E	Mono	9	Madera CL near Minaret Summit/Route 395 (All)	Mono	0.0	Mono	R8.6			
209	E	San Diego	11	Pt Loma/I-5 in San Diego (All)	San Diego	0.0	San Diego	R7.8			
210	E	LA	7	I-5 near Tunnel Station/Route 134	LA	R0.0	LA	R25.0			
215	E	Riverside	8	Route 74 near Romoland/Route 74 near Perris	Riverside	23.5	Riverside	26.3			
221	E	Napa	4	Route 29 at Suscol Rd/Route 121 in Napa (All)	Napa	0.0	Napa	2.7			
236	E	SCr	4	Route 9 near Bldr Ck/Route 9 NE of Big Basin SP (All)	SCr	0.0	SCr	17.7			
239	E	Ala/CC	4	I-580 WO Tracy/Route 4 near Brentwood (All) (unconstructed)	Ala	0.0	CC	7.0			
243	E	Riverside	8	Route 74 near Mountain Cntr/I-10 near Banning (All)	Riverside	0.0	Riverside	29.7			
243	**OD**	**RIVERSIDE**	**8**	**FR Route 74 TO BANNING CIL**	**RIVERSIDE**	**0.0**	**RIVERSIDE**	**28.2**	**28.2**	**33**	March 21, 1972
247	E	SBd	8	Route 62 near Yucca Valley/I-15 near Barstow (All)	SBd	0.0	SBd	78.1			

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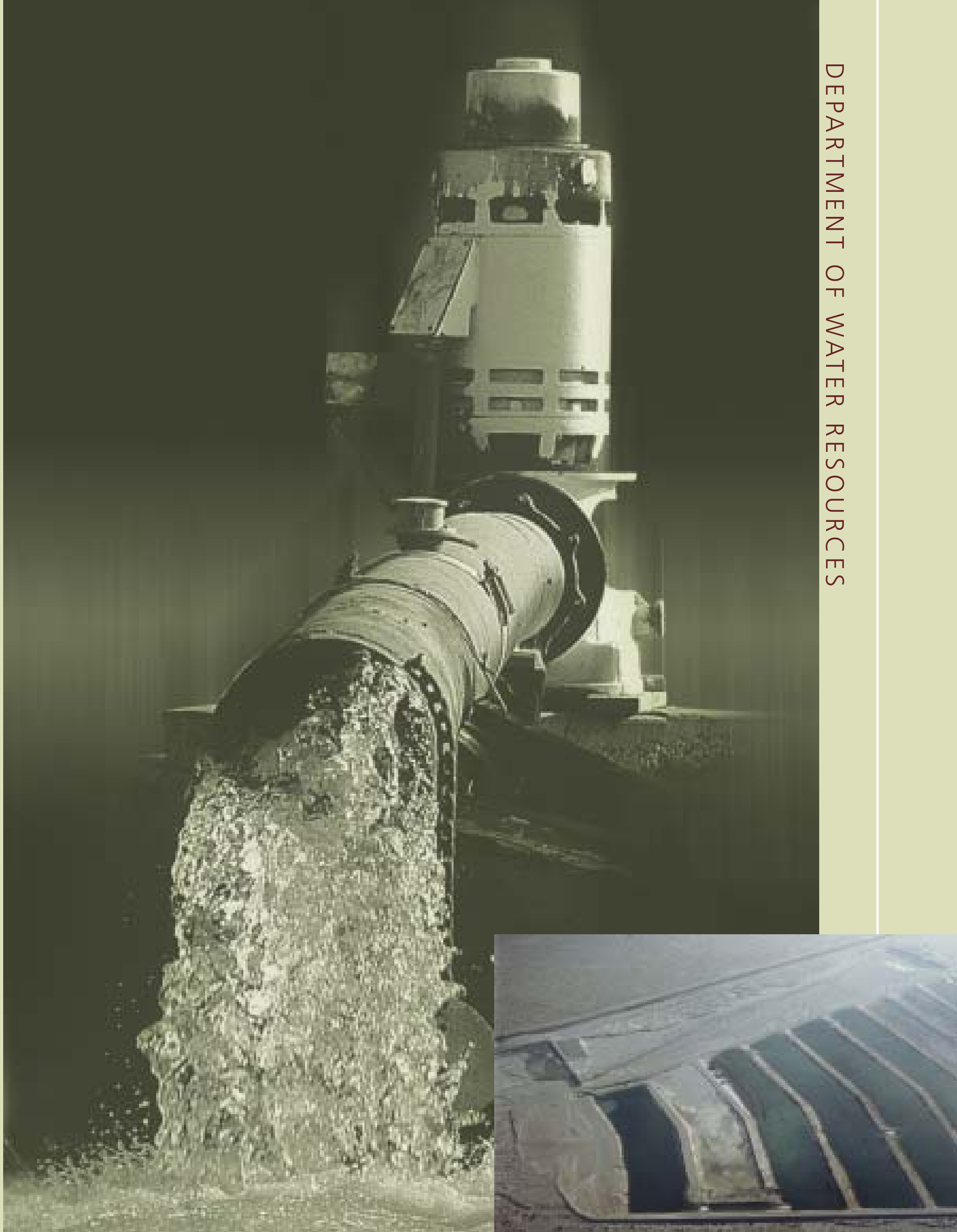
Rte	Desig Status (OD= Officially Designated;	County	Caltrans Dist	"OD" or "E" State Scenic Highway Location (from/to)	Begin County	*Post Mile	End County	*Post Mile	Length Designated (miles)	Official Des #	Official Desig Date
251	E	Marin	4	Route 37 near Nicasio/Route 1 near Point Reyes (unconstructed)	Marin	0.0	Marin	5.1			
254	E	Humboldt	1	Route 101 near Sylvandale/0.1 Mi NO Jordan Creek (All)	Humboldt	0.0	Humboldt	47.0			
266	E	Mono	9	Nevada SL EO Oasis/Route 168 at Oasis	Mono	0.0	Mono	4.3			
280	E	SCl/SM/SF	4	Route 17/I-80 near First Street in San Francisco	SCl	L5.4	SF	T7.0			
280	OD	SAN MATEO	4	FR SANTA CLARA CL TO NORTH CIL SAN BRUNO	SAN MATEO	R0.0	SAN MATEO	R21.8	21.8	43	April 28, 1980
299	E	Humboldt	1	Route 101 near Arcata/Route 96 near Willow Creek	Humboldt	0.0	Humboldt	38.8			
299	E	Tri/Sha	2	Route 3 near Weaverville/I-5 near Redding	Tri	51.6	Sha	R25.9			
299	E	Sha/Las/Mod	2	Route 89 near Burney/Route 139 near Canby	Sha	80.1	Mod	21.8			
330	E	SBd	8	Route 30 near Highland/Route 18 near Running Springs (All)	SBd	29.5	SBd	44.1			
395	E	Ker/Iny/Mno	6/9	Route 14 near Little Lake/Route 89 near Coleville	Ker	29.7	Mno	117.0			
395	OD	INYO	9	FR FORT INDEPENDENCE TO FISH SPRINGS RD	INYO	76.5	INYO	96.6	20.1	17	July 30, 1970
395	OD	MONO	9	FR INYO CL TO NEAR LONG VALLEY RESORT	MONO	R0.0	MONO	R18.0	18.0	55	June 5, 2000
395	OD	MONO	9	FR NR LONG VALLEY RESORT TO 1.1 MI NO Route 203	MONO	R18.0	MONO	R26.90	8.9	28	November 9, 1971
395	OD	MONO	9	FR 1.1 MI NO Route 203 TO Route 120	MONO	R26.9	MONO	50.7	23.8	55	June 5, 2000
395	OD	MONO	9	FR LEE VINING TO EVANS TRACT	MONO	52	MONO	74.5	22.5	55	June 5, 2000
395	OD	MONO	9	FR BRIDGEPORT TO SO WALKER	MONO	76.8	MONO	104.8	28.0	55	June 5, 2000
580	E	SJ/Ala	4/10	I-5 SW of Vernalis/I-80	SJ	0.0	Ala	47.4			
580	OD	ALAMEDA	4	FR SAN JOAQUIN CL TO Route 205	ALAMEDA	0.0	ALAMEDA	0.4	0.4	13	February 18, 1970
580	OD	ALAMEDA	4	FR SAN LEANDRO CIL TO Route 24 IN OAKLAND	ALAMEDA	R34.5	ALAMEDA	45.2	10.7	40	June 25, 1976
580	OD	SAN JOAQUIN	10	FR I-5 TO ALAMEDA CL	SAN JOAQUIN	0.0	SAN JOAQUIN	15.4R	15.4	37	June 7, 1974
680	E	Ala/CC	4	Santa Clara CL/Route 24 in Walnut Creek	Ala	0.0	CC	14.4			
680	OD	ALAMEDA	4	FR MISSION BLVD IN FREMONT TO BERNAL AVE NR PLEASANTON	ALAMEDA	R6.4	ALAMEDA	R16.8	10.4	41	June 15, 1978
680	OD	ALAMEDA	4	FR BERNAL AVE NR PLEASANTON TO CONTRA COSTA CL	ALAMEDA	R16.8	ALAMEDA	R21.9	5.1	45	October 22, 1982
680	OD	CONTRA COSTA	4	FR ALAMEDA CL TO Route 24	CONTRA COSTA	R0.0	CONTRA COSTA	14.4	14.4	45	October 22, 1982

*Post Miles for eligible segments are approximate; legal limits of State Scenic Highways are described in the Streets Highways Code (For limits of federal byways, visit FHWA "America's Bways" or USFS Scenic Byway programs).

DEPARTMENT OF WATER RESOURCES



BULLETIN 118 · UPDATE 2003

CALIFORNIA'S GROUNDWATER

EEC ORIGINAL PKG

Cover photograph:
A typical agricultural well with the water discharge pipe and the electric motor that drives the pump.

Inset photograph:
Groundwater recharge ponds in the Upper Coachella Valley near the Whitewater River that use local and imported water. Recharge ponds are also called spreading basins or recharge basins.

State of California
The Resources Agency
Department of Water Resources

CALIFORNIA'S
GROUNDWATER

BULLETIN 118 *Update 2003*

October 2003

If you need this publication in an alternate form, contact the Department's Office of Water Education at 1-800-272-8869.

Foreword

Groundwater is one of California's greatest natural resources. In an average year, groundwater meets about 30 percent of California's urban and agricultural water demands. In drought years, this percentage increases to more than 40 percent. In 1995, an estimated 13 million Californians, nearly 43 percent of the State's population, were served by groundwater. The demand on groundwater will increase significantly as California's population grows to a projected 46 million by the year 2020. In many basins, our ability to optimally use groundwater is affected by overdraft and water quality impacts, or limited by a lack of data, management, and coordination between agencies.

Over the last few years, California voters and the Legislature have provided significant funding to local agencies for conjunctive use projects, groundwater recharge facilities, groundwater monitoring, and groundwater basin management activities under Proposition 13 and the Local Groundwater Management Assistance Act of 2000. Most recently, the 2002 passage of Proposition 50 will result in additional resources to continue recent progress toward sustaining our groundwater resources through local agency efforts. We are beginning to see significant benefits from these investments.

The State Legislature recognizes the need for groundwater data in making sound local management decisions. In 1999, the Legislature approved funding and directed the Department of Water Resources (DWR) to update the inventory of groundwater basins contained in Bulletin 118 (1975), *California's Ground Water* and Bulletin 118-80 (1980), *Ground Water Basins in California.* In 2001, the Legislature passed AB 599, requiring the State Water Resources Control Board to establish a comprehensive monitoring program to assess groundwater quality in each groundwater basin in the State and to increase coordination among agencies that collect groundwater contamination information. In 2002, the Legislature passed SB 1938, which contains new requirements for local agency groundwater management plans to be eligible for public funds for groundwater projects.

Effective management of groundwater basins is essential because groundwater will play a key role in meeting California's water needs. DWR is committed to assisting local agencies statewide in developing and implementing effective, locally planned and controlled groundwater management programs. DWR is also committed to federal and State interagency efforts and to partnerships with local agencies to coordinate and expand data monitoring activities that will provide necessary information for more effective groundwater management. Coordinated data collection at all levels of government and local planning and management will help to ensure that groundwater continues to serve the needs of Californians.

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California Department of Pesticide Regulation
California Department of Toxic Substances Control
California Department of Health Services
California State Water Resources Control Board
California Regional Water Quality Control Boards
United States Geological Survey
United States Bureau of Reclamation

We also wish to thank numerous reviewers who provided valuable comments on the April 2003 public review draft of this bulletin.

Acronyms and abbreviations

AB Assembly Bill
BMO Basin management objective
CAS California Aquifer Susceptibility
CVP Central Valley Project
DBCP Dibromochloropropane
DCE Dichloroethylene
DHS California Department of Health Services
DPR California Department of Pesticide Regulation
DTSC California Department of Toxic Substances Control
DWR California Department of Water Resources
DWSAP Drinking Water Source Assessment Program
EDB Ethylene dibromide
EC Electrical conductivity
EMWD Eastern Municipal Water District
EWMP Efficient water management
EPA U.S. Environmental Protection Agency
ESA Federal Endangered Species Act
ET Evapotranspiration
ETAW Evapotranspiration of applied water
EWA Environmental Water Account
GAMA Groundwater Ambient Monitoring and Assessment
GIS Geographic information system
GMA Groundwater Management Agency
gpm Gallons per minute
GRID Groundwater Resources Information Database
GRIST Groundwater Resources Information Sharing Team
H & S Health and Safety Code
HR Hydrologic region
ISI Integrated Storage Investigations
ITF Interagency Task Force
JPA Joint powers agreement
maf Million acre-feet
MCL Maximum contaminant level
mg/L Milligrams per liter
MOU Memorandum of understanding
MTBE Methyl tertiary-butyl ether
OCWD Orange County Water District
PAC Public Advisory Committee
PCE Tetrachloroethylene
PCA Possible contaminating activity
PPIC Public Policy Institute of California
ROD Record of Decision
RWQCB Regional Water Quality Control Board
SB Senate Bill
SGA Sacramento Groundwater Authority
SVOC Semi-volatile organic compound
SVWD Scotts Valley Water District
SWRCB State Water Resources Control Board

taf Thousand acre-feet
TCE Trichloroethylene
TDS Total dissolved solids
UWMP Urban water management plan
USACE U.S. Army Corps of Engineers
USBR U.S. Bureau of Reclamation
USC United States Code
USGS U.S. Geological Survey
VOC Volatile organic compound
WQCP Water Quality Control Plan

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Major Findings

1. **Groundwater provides about 30% of the State's water supply in an average year, yet in many basins the amount of groundwater extracted annually is not accurately known.**
   - In some regions, groundwater provides 60% or more of the supply during dry years.
   - Many small- to moderate-sized towns and cities are entirely dependent on groundwater for drinking water supplies.
   - 40% to 50% of Californians rely on groundwater for part of their water supply.
   - In many basins, groundwater use is indirectly estimated by assuming crop evapotranspiration demands and surveying the acreage of each crop type.

2. **Opportunities for local agencies to manage their groundwater resources have increased significantly since the passage of Assembly Bill 3030 in 1992. (Water Code § 10750 et seq.). In the past several years more agencies have developed management programs to facilitate conjunctive use, determine the extent of the resource, and protect water quality.**
   - The act provides the authority for many local agencies to manage groundwater.
   - The act has resulted in more than 200 local agencies adopting groundwater management plans to date.
   - The act encourages regional cooperation in basins and allows private water purveyors to participate in groundwater management through memoranda of understanding with public agencies.
   - Many local agencies are recognizing their responsibility and authority to better manage groundwater resources.

3. **Agencies in some areas have not yet developed groundwater management plans.**
   - Concerns about cooperative management, governance, and potential liabilities have kept some agencies from developing management plans.
   - Development of management programs to maintain a sustainable groundwater supply for local use has not been accomplished throughout the State.

4. **A comprehensive assessment of overdraft in the State's groundwater basins has not been conducted since Bulletin 118-80, but it is estimated that overdraft is between 1 million and 2 million acre-feet annually.**
   - Historical overdraft in many basins is evident in hydrographs that show a steady decline in groundwater levels for a number of years.
   - Other basins may be subject to overdraft in the future if current water management practices are continued.
   - Overdraft can result in increased water production costs, land subsidence, water quality impairment, and environmental degradation.
   - Few basins have detailed water budgets by which to estimate overdraft.
   - While the most extensively developed basins tend to have information, many basins have insufficient data for effective management or the data have not been evaluated.
   - The extent and impacts of overdraft must be fully evaluated to determine whether groundwater will provide a sustainable water supply.
   - Modern computer hardware and software enable rapid manipulation of data to determine basin conditions such as groundwater storage changes or groundwater extraction, but a lack of essential data limits the ability to make such calculations.
   - Adequate statewide land use data for making groundwater extraction estimates are not available in electronic format.

5. **Surface water and groundwater are connected and can be effectively managed as integrated resources.**
   - Groundwater originates as surface water.
   - Groundwater extraction can affect flow in streams.
   - Changes in surface water flow can affect groundwater levels.
   - Legal systems for surface water and groundwater rights can make coordinated management complex.

6. **Groundwater quality and groundwater quantity are interdependent and are increasingly being considered in an integrated manner.**
   - Groundwater quantity and groundwater quality are inseparable.
   - Groundwater in some aquifers may not be usable because of contamination with chemicals, either from natural or human sources.
   - Unmanaged groundwater extraction may cause migration of poor quality water.
   - Monitoring and evaluating groundwater quality provides managers with the necessary data to make sound decisions regarding storage of water in the groundwater basin.
   - State agencies conduct several legislatively mandated programs to monitor different aspects of groundwater quality.
   - California Department of Water Resources (DWR) monitors general groundwater quality in many basins throughout the State for regional evaluation.

7. **Land use decisions affecting recharge areas can reduce the amount of groundwater in storage and degrade the quality of that groundwater.**
   - In many basins, little is known about the location of recharge areas and their effectiveness.
   - Protection and preservation of recharge areas are seldom considered in land use decisions.
   - If recharge areas are altered by paving, channel lining, or other land use changes, available groundwater will be reduced.
   - Potentially contaminating activities can degrade the quality of groundwater and require wellhead treatment or aquifer remediation before use.
   - There is no coordinated effort to inform the public that recharge areas should be protected against contamination and preserved so that they function effectively.

Additional Important Findings

8. **Funding to assist local groundwater management has recently been available in unprecedented amounts.**
   - Proposition 13 (Water Code, § 79000 et seq.) authorized $230 million in loans and grants for local groundwater programs and projects, almost all of which has been allocated.
   - The Local Groundwater Management Assistance Act of 2000 (Water Code, § 10795) has resulted in more than $15 million in grants to local agencies in fiscal years 2001, 2002, and 2003.
   - Proposition 50 (Water Code, § 79500 et seq) will provide funding for many aspects of water management, including groundwater management and groundwater recharge projects.
   - Funding for the California Bay-Delta program has provided technical and facilitation assistance to numerous local groundwater planning efforts.

9. **Local governments are increasingly involved in groundwater management.**
   - Twenty-four of the 27 existing county groundwater management ordinances have been adopted since 1990.
   - Most ordinances require the proponents of groundwater export to demonstrate that a proposed project will not cause subsidence, degrade groundwater quality, or deplete the water supply before the county will issue an export permit.
   - While the ordinances generally require a permit for export of groundwater, most do not require a comprehensive groundwater management plan designed to ensure a sustainable water resource for local use.
   - Some local governments are coordinating closely with local water agencies that have adopted groundwater management plans.
   - Many local governments are monitoring and conducting studies in an effort to better understand groundwater resources.

10. **Despite the increased groundwater management opportunities and activities, the extent of local efforts is not well known.**
    - There is no general requirement that groundwater management plans be submitted to DWR, so the number of adopted plans and status of groundwater management throughout the State are not currently known.
    - There are no requirements for evaluating the effectiveness of adopted plans, other than during grant proposal review.
    - No agency is responsible for tracking implementation of adopted plans.
    - Unlike urban water management plans, groundwater management plans are not required to be submitted to DWR, making the information unavailable for preparing the California Water Plan.

11. **Despite the fact that several agencies often overlie each groundwater basin, there are few mechanisms in place to support and encourage agencies to manage the basin cooperatively.**
    - Some local agencies have recognized the benefits of initiating basinwide and regional planning for groundwater management and have recorded many successes.
    - Regional cooperation and coordination depends on the ability of local agencies to fund such efforts.
    - There is no specific State or federal program to fund and support coordination efforts that would benefit all water users in a region and statewide.

12. **The State Legislature has recognized the need to consider water supplies as part of the local land use planning process.**
    - Three bills—Senate Bill 221[1], SB 610[2], and AB 901[3]—were enacted in 2001 to improve the assessment of water supplies. The new laws require the verification of sufficient water supply as a condition for approving certain developments and compel urban water suppliers to provide more information on the reliability of groundwater as an element of supply.
    - The Government Code does not specifically require local governments to include a water resources element in their general plans.

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[1] Business and Professions Code Section 11010, Government Code Sections 65867.5, 66455.3, and 66473.7.
[2] Public Resources Code Section 21151.9, Water Code Sections 10631, 10656, 10657, 10910-10912, 10915.
[3] Water Code Sections 10610.2, 10631, 10634.

13. **The need to monitor groundwater quality and contamination of groundwater continues to grow.**
    - As opportunities for developing additional surface water supplies become more limited, subsequent growth will increasingly rely on groundwater.
    - Human activities are likely the cause of more than half the exceedances of maximum contaminant levels in public water supply wells.
    - New contaminants are being regulated and standards are becoming more stringent for others, requiring increased monitoring and better management of water quality.

14. **Monitoring networks for groundwater levels and groundwater quality have not been evaluated in all basins to ensure that the data accurately represent conditions in the aquifer(s).**
    - Groundwater levels are monitored in about 10,000 active wells including those basins where most of the groundwater is used.
    - Groundwater levels are not monitored in approximately 200 basins, where population is sparse and groundwater use is generally low.
    - Groundwater quality monitoring networks are most dense near population centers and may not be representative of the basin as a whole.
    - Many of the wells being monitored are not ideally constructed to provide water level or water quality information that is representative of a specific aquifer.
    - Many wells are too deep to monitor changes in the unconfined (water table) portion of basins.

15. **The coordination of groundwater data collection and evaluation by local, State, and federal agencies is improving.**
    - The State Water Resources Control Board (SWRCB) recently formed the Groundwater Resources Information Sharing Team (GRIST) consisting of several State and federal agencies with groundwater-related programs.
    - DWR established a website in 1996 that has provided water-level data and hydrographs for more than 35,000 active and inactive wells monitored by DWR and cooperating agencies.
    - DWR collects and maintains water level data in part through partnerships with local agency cooperators.
    - DWR staff collaborated with many local, State, and federal agencies in developing this update of Bulletin 118.
    - SWRCB recently formed an interagency task force to develop a comprehensive groundwater quality monitoring program for assessing every groundwater basin in the State as required by the Groundwater Quality Monitoring Act of 2001 (AB 599; Water Code, § 10780 et seq.).
    - Water purveyors have concerns about balancing public access to data with water supply security.

16. **Boundaries of groundwater basins have been determined using the best available geologic and hydrologic information. These boundaries are important in determining the availability of local water supplies.**
    - Basin boundaries were derived primarily by identifying alluvial sediments on geologic maps using the best available information, but are subject to change when new information becomes available.
    - The Water Code requires the use of basin boundaries defined in Bulletin 118 in groundwater management plans and urban water management plans.
    - The location of basin boundaries will become more critical as the demand for water continues to increase.
    - Subbasin boundaries may be delineated for management convenience rather than based on hydrogeologic conditions.

17. **Little is known about the stream-aquifer interaction in many groundwater basins.**
    - Groundwater and surface water are closely linked in the hydrologic cycle.
    - The relationship between streamflow and extraction of groundwater is not fully understood in most basins and is generally not monitored.
    - Groundwater extraction in many basins may affect streamflow.
    - Interaction of groundwater flow and surface water may affect environmental resources in the hyporheic zone.
    - An understanding of stream-aquifer interaction will be essential to evaluating water transfers in many areas of the State.

18. **Although many new wells are built in fractured rock areas, insufficient hydrogeologic information is available to ensure the reliability of groundwater supplies.**
    - Population is increasing rapidly in foothill and mountain areas in which groundwater occurs in fractured rock.
    - The cumulative effect of groundwater development may reduce the yield of individual wells, lower the flow of mountain streams, and impact local habitat.
    - Characterization of groundwater resources in fractured rock areas can be very expensive and complex.
    - Many groundwater users in these areas have no other water supply alternatives.
    - Recent dry years have seen many wells go dry in fractured rock areas throughout the State.
    - Groundwater management in these areas is beginning, but there is insufficient data to support quantitative conclusions about the long-term sustainable yield.

19. **When new wells are built, drillers are required to file a Well Completion Report with DWR. That report contains a lithologic log, the usability of which varies considerably from driller to driller.**
    - The Well Completion Reports are confidential and not available to the public, as stipulated by the Water Code, unless the owner's permission is obtained.
    - The usefulness of the information in Well Completion Reports varies but is not fully realized.
    - Public access to Well Completion Reports would increase understanding of groundwater conditions and issues.
    - There is no provision in the Water Code that requires submission of geophysical logs, which would provide an accurate log of the geologic materials within the aquifer.
    - Geophysical logs would provide a greatly improved database for characterization of aquifers.

Recommendations

Major Recommendations

1. **Local or regional agencies should develop groundwater management plans if groundwater constitutes part of their water supply. Management objectives should be developed to maintain a sustainable long-term supply for multiple beneficial uses. Management should integrate water quantity and quality, groundwater and surface water, and recharge area protection.**
   - Groundwater management in California is a local agency responsibility.
   - In basins where there is more than one management agency, those agencies should coordinate their management objectives and program activities.
   - A water budget should be completed that includes recharge, extraction and change in storage in the aquifer(s).
   - Changes in groundwater quality should be monitored and evaluated.
   - Stakeholders should be identified and included in development of groundwater management plans.

2. **The State of California should continue programs to provide technical and financial assistance to local agencies to develop monitoring programs, management plans, and groundwater storage projects to more efficiently use groundwater resources and provide a sustainable supply for multiple beneficial uses. DWR should:**
   - Post information about projects that have successfully obtained funding through various grant and loan programs.
   - Provide additional technical assistance to local agencies in the preparation of grant and loan applications.
   - Continue outreach efforts to inform the public and water managers of grant and loan opportunities.
   - Participate, when requested, in local efforts to develop and implement groundwater management plans.
   - Continue to assess, develop, and modify its groundwater programs to provide the greatest benefit to local agencies.
   - Develop grant criteria to ensure funding supports local benefits as well as Statewide priorities, such as development of the California Water Plan and meeting Bay-Delta objectives.

3. **DWR should continue to work with local agencies to more accurately define historical overdraft and to more accurately predict future water shortages that could result in overdraft.**
   - A water budget should be developed for each basin.
   - The annual change in storage should be determined for each basin.
   - The amount of annual recharge and discharge, including pumping, should be determined.
   - Changes in groundwater quality that make groundwater unusable or could allow additional groundwater to be used should be included in any evaluation of overdraft.

4. **Groundwater management agencies should work with land use agencies to inform them of the potential impacts various land use decisions may have on groundwater, and to identify, prioritize, and protect recharge areas.**
   - Local planners should consider recharge areas when making land use decisions that could reduce recharge or pose a risk to groundwater quality.
   - Recharge areas should be identified and protected from land uses that limit recharge rates, such as paving or lining of channels.

- Both local water agencies and local governments should pursue education and outreach to inform the public of the location and importance of recharge areas.
- DWR should inform local agencies of the availability of grant funding and technical assistance that could support these efforts.

5. **DWR should publish a report by December 31, 2004 that identifies those groundwater basins or subbasins that are being managed by local or regional agencies and those that are not, and should identify how local agencies are using groundwater resources and protecting groundwater quality.**
   - Such information will be necessary to confirm whether agencies are meeting the requirements of SB 1938 (Water Code Section 10753.7).
   - Collection and summary of existing groundwater management plans will provide a better understanding of the distribution and coordination of groundwater management programs throughout the State.
   - Successful strategies employed by specific local agencies should be highlighted to assist others in groundwater management efforts.
   - Similarly, the impact of groundwater management ordinances throughout the State should be evaluated to provide a better understanding of the effect of ordinances on groundwater management.

6. **Water managers should include an evaluation of water quality in a groundwater management plan, recognizing that water quantity and water quality are inseparable.**
   - Local water managers should obtain groundwater quality data from federal, state, and local agencies that have collected such data in their basin.
   - Local agencies should evaluate long-term trends in groundwater quality.
   - Local agencies should work closely with the SWRCB and DWR in evaluating their groundwater basins.
   - Local agencies should establish management objectives and monitoring programs that will maintain a sustainable supply of good quality groundwater.

7. **Water transfers that involve groundwater (or surface water that will be replaced with groundwater) should be consistent with groundwater management in the source area that will assure the long term sustainability of the groundwater resource.**

8. **Continue to support coordinated management of groundwater and surface water supplies and integrated management of groundwater quality and groundwater quantity.**
   - Future bond funding should be provided for conjunctive use facilities to improve water supply reliability.
   - Funding for feasibility and pilot studies, in addition to construction of projects will help maximize the potential for conjunctive use.
   - DWR should continue and expand its efforts to form partnerships with local agencies to investigate and develop locally controlled conjunctive use programs.

9. **Local, State, and federal agencies should improve data collection and analysis to better estimate groundwater basin conditions used in Statewide and local water supply reliability planning. DWR should:**
   - Assist local agencies in the implementation of SB 221, SB 610, and AB 901 to help determine water supply reliability during the local land use planning process.
   - Provide and continue to update information on groundwater basins, including basin boundaries, groundwater levels, monitoring data, aquifer yield, and other aquifer characteristics.

- Identify areas of rapid development that are heavily reliant on groundwater and prioritize monitoring activities in these areas to identify potential impacts on these basins.
- Evaluate the existing network of wells monitored for groundwater elevations, eliminate wells of questionable value from the network, and add wells where data are needed.
- Work cooperatively with local groundwater managers to evaluate the groundwater basins of the State with respect to overdraft and its potential impacts, beginning with the most heavily used basins.
- Expand DWR and local agency monitoring programs to provide a better understanding of the interaction between groundwater and surface water.
- Work with SWRCB to investigate temporal trends in water quality to identify areas of water quality degradation that should receive additional attention.
- Estimate groundwater extraction using a land use based method for over 200 basins with little or no groundwater budget information.
- Integrate groundwater budgets into the California Water Plan Update process.

10. **Increase coordination and sharing of groundwater data among local, State, and federal agencies and improve data dissemination to the public. DWR should:**
    - Use the established website to continually update new groundwater basin data collected after the publication of California's Groundwater (Bulletin 118-Update 2003).
    - Publish a summary update of Bulletin 118 every five years coincident with the California Water Plan (Bulletin 160).
    - Publish, in cooperation with SWRCB, a biennial groundwater report that addresses current groundwater quantity and quality conditions.
    - Coordinate the collection and storage of its groundwater quality monitoring data with programs of SWRCB and other agencies to ensure maximum coverage statewide and reduce duplication of effort.
    - Make groundwater basin information more compatible with other Geographic Information System-based resource data to improve local integrated resources planning efforts.
    - Compile data collected by projects funded under grant and loan programs and make data available to the public on the DWR website.
    - Encourage local agency cooperators to submit data to the DWR database.
    - Maximize the accuracy and usefulness of data and develop guidelines for quality assurance and quality control, consistency, and format compatibility.
    - Expand accessibility of groundwater data by the public after considering appropriate security measures.
    - State, federal and local agencies should expand accessibility of groundwater data by the public after considering appropriate security measures.
    - Local agencies should submit copies of adopted groundwater management plans to DWR.

Additional Important Recommendations

11. **Local water agencies and local governments should be encouraged to develop cooperative working relationships at basinwide or regional levels to effectively manage groundwater. DWR should:**
    - Provide technical and financial assistance to local agencies in the development of basinwide groundwater management plans.
    - Provide a preference in grant funding for groundwater projects for agencies that are part of a regional or basinwide planning effort.
    - Provide Proposition 50 funding preferences for projects that are part of an integrated regional water management plan.

12. **Groundwater basin boundaries identified in Bulletin 118 should be updated as new information becomes available and the basin becomes better defined. DWR should:**
    - Identify basin boundaries that are based on limited data.
    - List the kind of information that is necessary to better define basin boundaries.
    - Develop a systematic procedure to obtain and evaluate stakeholder input on groundwater basin boundaries.

13. **Improve the understanding of groundwater resources in fractured rock areas of the State.**
    - DWR, in cooperation with local and federal agencies, should conduct studies to determine the amount of groundwater that is available in fractured rock areas, including water quality assessment, identification of recharge areas and amounts, and a water budget when feasible.
    - Local agencies and local governments should conduct studies in their areas to quantify the local demands on groundwater and project future demands.
    - The Legislature should consider expanding the groundwater management authority in the Water Code to include areas outside of alluvial groundwater basins
    - DWR should include information on the most significant fractured rock groundwater sources in future updates of Bulletin 118.

14. **Develop a program to obtain geophysical logs in areas where additional data are needed.**
    - DWR should encourage submission of geophysical logs, when they are conducted, as a part of the Well Completion Report.
    - The geophysical logs would be available for use by public agencies to better understand the aquifer, but would be confidential as stipulated by the Water Code.
    - DWR should seek funding to work with agencies and property owners to obtain geophysical logs of new wells in areas where additional data are needed.
    - Geophysical logs would be used to better characterize the aquifers within each groundwater basin.

15. **Educate the public on the significance of groundwater resources and on methods of groundwater management.**
    - DWR should continue to educate the public on statewide groundwater issues and assist local agencies in their public education efforts.
    - Local agencies should expand their outreach efforts during development of groundwater management plans under AB 3030 and other authority.
    - DWR should develop educational materials to explain how they quantify groundwater throughout the State, as well as the utility and limitations of the information.
    - DWR should continue its efforts to educate individual well owners and small water systems that are entirely dependent on groundwater.

Introduction

Introduction

Groundwater is one of California's greatest natural resources. In an average water supply year, groundwater meets about 30 percent of California's urban and agricultural demand. In drought years, this percentage increases to 40 percent or even higher (DWR 1998). Some cities, such as Fresno, Davis, and Lodi, rely solely on groundwater for their drinking water supply. In 1995, an estimated 13 million Californians (nearly 43 percent of the State's population) used groundwater for at least a portion of their public supply needs (Solley and others 1998). With a projected population of nearly 46 million by the year 2020, California's demand on groundwater will increase significantly. In many basins, our ability to optimally use groundwater is affected by overdraft and water quality, or limited by a lack of data, lack of management, and coordination between agencies.

In the last few years, California has provided substantial funds to local agencies for groundwater management. For example, the nearly $2 billion Water Bond 2000 (Proposition 13) approved by California voters in March 2000 specifically authorizes funds for two groundwater programs: $200 million for grants for feasibility studies, project design, and the construction of conjunctive use facilities; and $30 million for loans for local agency acquisition and construction of groundwater recharge facilities and grants for feasibility studies for recharge projects. Additionally, the Local Groundwater Management Assistance Act of 2000 (AB 303) resulted in $15 million in fiscal years 2001, 2002, and 2003 for groundwater studies and data collection intended to improve basin and subbasin groundwater management. These projects focus on improving groundwater monitoring, coordinating groundwater basin management, and conducting groundwater studies.

The State Legislature has increasingly recognized the importance of groundwater and the need for monitoring in making sound groundwater management decisions. Significant legislation was passed in 2000, 2001 and 2002. AB 303 authorizes grants to help local agencies develop better groundwater management strategies. AB 599 (2001) requires, for the first time, that the State Water Resources Control Board (SWRCB), in cooperation with other agencies, develop a comprehensive monitoring program capable of assessing groundwater quality in every basin in the State with the intent of maintaining a safe groundwater supply. SB 610 (2001) and SB 901 (2001) together require urban water suppliers, in their urban water management plans, to determine the adequacy of current and future supplies to meet demands. Detailed groundwater information is required for those suppliers that use groundwater. SB 221 (2001) prohibits approval of certain developments without verification of an available water supply. These bills are significant with respect to groundwater because much of California's new development will rely on groundwater for its supply.

Finally, SB 1938 (2002) was enacted to provide incentives to local agencies for improved groundwater management. The legislation modified the Water Code to require that specific elements be included in a groundwater management plan for an agency to be eligible for certain State funding administered by the Department of Water Resources for groundwater projects. AB 303 is exempt from that requirement.

History of Bulletin 118

DWR has long recognized the need for collection, summary, and evaluation of groundwater data as tools in planning optimal use of the groundwater resource. An example of this is DWR's Bulletin 118 series. Bulletin 118 presents the results of groundwater basin evaluations in California. The Bulletin 118 series was preceded by Water Quality Investigations Report No. 3, *Ground Water Basins in California* (referred to in this bulletin as Report No. 3), published in 1952 by the Department of Public Works, Division of Water Resources (the predecessor of DWR). The purpose of Report No. 3 was to create a base index map of the "more important ground water basins" for carrying out DWR's mandate in Section 229 of the Water Code. Section 229 directed Public Works to:

> …investigate conditions of the quality of all waters within the State, including saline waters, coastal and inland, as related to all sources of pollution of whatever nature and shall report thereon to the Legislature and to the appropriate regional water pollution control board annually, and may recommend any steps which might be taken to improve or protect the quality of such waters.

Report No. 3 identified 223 alluvium-filled valleys that were believed to be basins with usable groundwater in storage. A statewide numbering system was created in cooperation with the State Water Pollution Control Board (now the State Water Resources Control Board) based on the boundaries of the nine Regional Water Quality Control Boards. In 1992, Water Code Section 229 was amended, resulting in the elimination of the annual reporting requirements.

In 1975, DWR published Bulletin 118, *California's Ground Water*, (referred to in this report as Bulletin 118-75). Bulletin 118-75 summarized available information from DWR, U.S. Geological Survey, and other agencies for individual groundwater basins to "help those who must make decisions affecting the protection, additional use, and management of the State's ground water resources."

Bulletin 118-75 contains a summary of technical information for 248 of the 461 identified groundwater basins, subbasins, and what were referred to as "areas of potential ground water storage" in California as well as maps showing their location and extent. The Bulletin 118-75 basin boundaries were based on geologic and hydrogeologic conditions except where basins were defined by a court decision.

In 1978, Section 12924 was added to the California Water Code:

> The Department shall, in conjunction with other public agencies, conduct an investigation of the State's groundwater basins. The Department shall identify the State's groundwater basins on the basis of geologic and hydrogeologic conditions and consideration of political boundary lines whenever practical. The Department shall also investigate existing general patterns of groundwater pumping and groundwater recharge within such basins to the extent necessary to identify basins which are subject to critical conditions of overdraft.

DWR published the report in 1980 as *Ground Water Basins in California: A Report to the Legislature in Response to Water Code Section 12924* (referred to in this report as Bulletin 118-80). The bulletin included 36 groundwater basins with boundaries different from Bulletin 118-75. The changed boundaries resulted by combining several basins based on geologic or political considerations and by dividing the San Joaquin Valley groundwater basin into many smaller subbasins based primarily on political boundaries. These changes resulted in the identification of 447 groundwater basins, subbasins, and areas of potential groundwater storage. Bulletin 118-80 also identified 11 basins as subject to critical conditions of overdraft.

Box A Which Bulletin 118 Do You Mean?

Mention of an update to Bulletin 118 causes some confusion about which Bulletin 118 the California Department of Water Resources (DWR) has updated. In addition to the statewide Bulletin 118 series (Bulletin 118-75, Bulletin 118-80, and Bulletin 118-03), DWR released several other publications in the 118 series that evaluate groundwater basins in specific areas of the State. Region-specific Bulletin 118 reports are listed below.

- Bulletin 118-1. Evaluation of Ground Water Resources: South San Francisco Bay
  Appendix A. Geology, 1967
  Volume 1. Fremont Study Area, 1968
  Volume 2. Additional Fremont Study Area, 1973
  Volume 3. Northern Santa Clara County, 1975
  Volume 4. South Santa Clara County, 1981
- Bulletin 118-2. Evaluation of Ground Water Resources: Livermore and Sunol Valleys, 1974
  Appendix A. Geology, 1966
- Bulletin 118-3. Evaluation of Ground Water Resources: Sacramento County, 1974
- Bulletin 118-4. Evaluation of Ground Water Resources: Sonoma County
  Volume 1. Geologic and Hydrologic Data, 1975
  Volume 2. Santa Rosa Plain, 1982
  Volume 3. Petaluma Valley, 1982
  Volume 4. Sonoma Valley, 1982
  Volume 5. Alexander Valley and Healdsburg Area, 1983
- Bulletin 118-5. Bulletin planned but never completed.
- Bulletin 118-6. Evaluation of Ground Water Resources: Sacramento Valley, 1978

The Need for Bulletin 118 Update 2003

Despite California's heavy reliance on groundwater, basic information for many of the groundwater basins is lacking. Particular essential data necessary to provide for both the protection and optimal use of this resource is not available. To this end, the California Legislature mandated in the Budget Act of 1999 that DWR prepare:

> ...the statewide update of the inventory of groundwater basins contained in Bulletin 118-80, which includes, but is not limited to, the following: the review and summary of boundaries and hydrographic features, hydrogeologic units, yield data, water budgets, well production characteristics, and water quality and active monitoring data; development of a water budget for each groundwater basin; development of a format and procedures for publication of water budgets on the Internet; development of the model groundwater management ordinance; and development of guidelines for evaluating local groundwater management plans.

The information on groundwater basins presented in Bulletin 118 Update 2003 is mostly limited to the acquisition and compilation of existing data previously developed by federal, State, and local water agencies. While this bulletin is a good starting reference for basic data on a groundwater basin, more recent data and more information about the basin may be available in recent studies conducted by local water management agencies. Those agencies should be contacted to obtain the most recent data.

Report Organization

Bulletin 118 Update 2003 includes this report and supplemental material consisting of individual descriptions and a Geographic Information System-compatible map of each of the delineated groundwater basins in California. The basin descriptions will be updated as new information becomes available, and can be viewed or downloaded at http://www.waterplan.water.ca.gov/groundwater/118index.htm (Appendix A). Basin descriptions will not be published in hard copy.

This report is organized into the following topics:

- Groundwater is one of California's most important natural resources, and our reliance on it has continued to grow (Chapter 1).
- Groundwater has a complex legal and institutional framework in California that has shaped the groundwater management system in place today (Chapter 2).
- Groundwater management occurs primarily at the local water agency level, but may also be instituted at the local government level. At the request of the Legislature, DWR has developed some recommendations for a model groundwater management ordinance and components for inclusion in a groundwater management plan (Chapter 3).
- Groundwater has had a flurry of activity in the Legislature and at the ballot box in recent years that will affect the way groundwater is managed in California (Chapter 4).
- Groundwater programs with a variety of objectives exist in many State and federal agencies (Chapter 5).
- Groundwater concepts and definitions should be made available to a wide audience (Chapter 6).
- Groundwater basins with a wide range of characteristics and concerns exist in each of California's 10 hydrologic regions (Chapter 7).

Chapter 1
Groundwater – California's Hidden Resource

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Groundwater – California's Hidden Resource

In 1975, *California's Ground Water – Bulletin 118* described groundwater as "California's hidden resource." Today, those words ring as true as ever. Because groundwater cannot be directly observed, except under a relatively few conditions such as at a spring or a wellhead, most Californians do not give much thought to the value that California's vast groundwater supply has added to the State. It is unlikely that California could have achieved its present status as the largest food and agricultural economy in the nation and fifth largest overall economy in the world without groundwater resources. Consider that about 43 percent of all Californians obtain drinking water from groundwater. California is not only the single largest user of groundwater in the nation, but the estimated 14.5 million acre-feet (maf) of groundwater extracted in California in 1995 represents nearly 20 percent of all groundwater extracted in the entire United States (Solley and others 1998).

California's Hydrology

California's climate is dominated by the Pacific storm track. Numerous mountain ranges cause orographic lifting of clouds, producing precipitation mostly on the western slopes and leaving a rain shadow on most eastern slopes (Figure 1 and Figure 2). These storms also leave tremendous accumulations of snow in the Sierra Nevada during the winter months. While the average annual precipitation in California is about 23 inches (DWR 1998), the range of annual rainfall varies greatly from more than 140 inches in the northwestern part of the State to less than 4 inches in the southeastern part of the State.

Snowmelt and rain falling in the mountains flow into creeks, streams, and rivers. The average annual runoff in California is approximately 71 maf (DWR 1998). As these flows make their way into the valleys, much of the water percolates into the ground. The vast majority of California's groundwater that is accessible in significant amounts is stored in alluvial groundwater basins. These alluvial basins, which are the subject of this report, cover nearly 40 percent of the geographic area of the State (Figure 3).

This bulletin focuses on groundwater resources, but in reality groundwater and surface water are inextricably linked in the hydrologic cycle. As an example, groundwater may be recharged by spring runoff in streams, but later in the year the base flow of a stream may be provided by groundwater. So, although the land surface is a convenient division for categorizing water resources, it is a somewhat arbitrary one. It is essential that water managers recognize and account for the relationship between groundwater and surface water in their planning and operations.

Figure 1 Shaded relief map of California

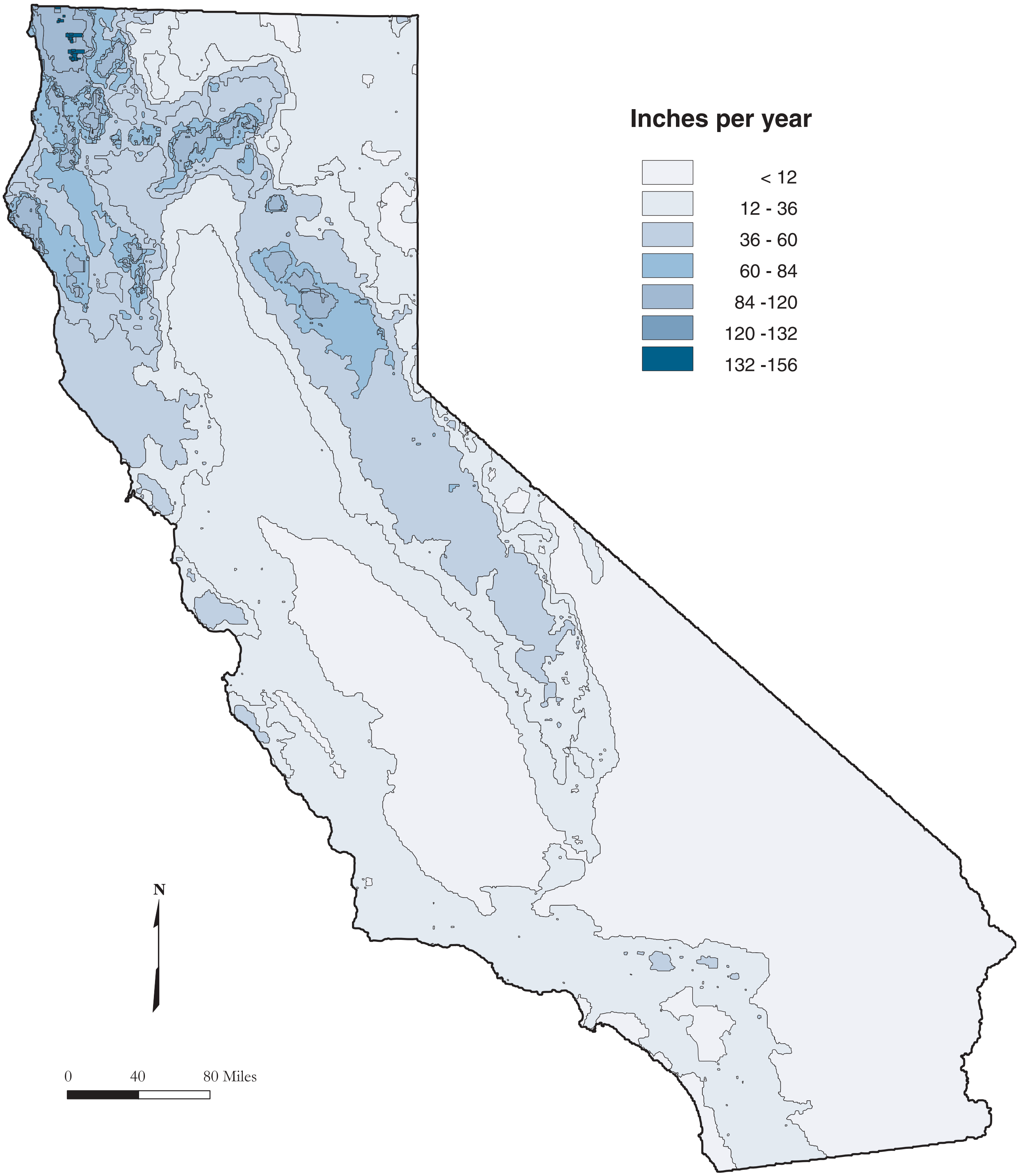

Figure 2 Mean annual precipitation in California, 1961 to 1990

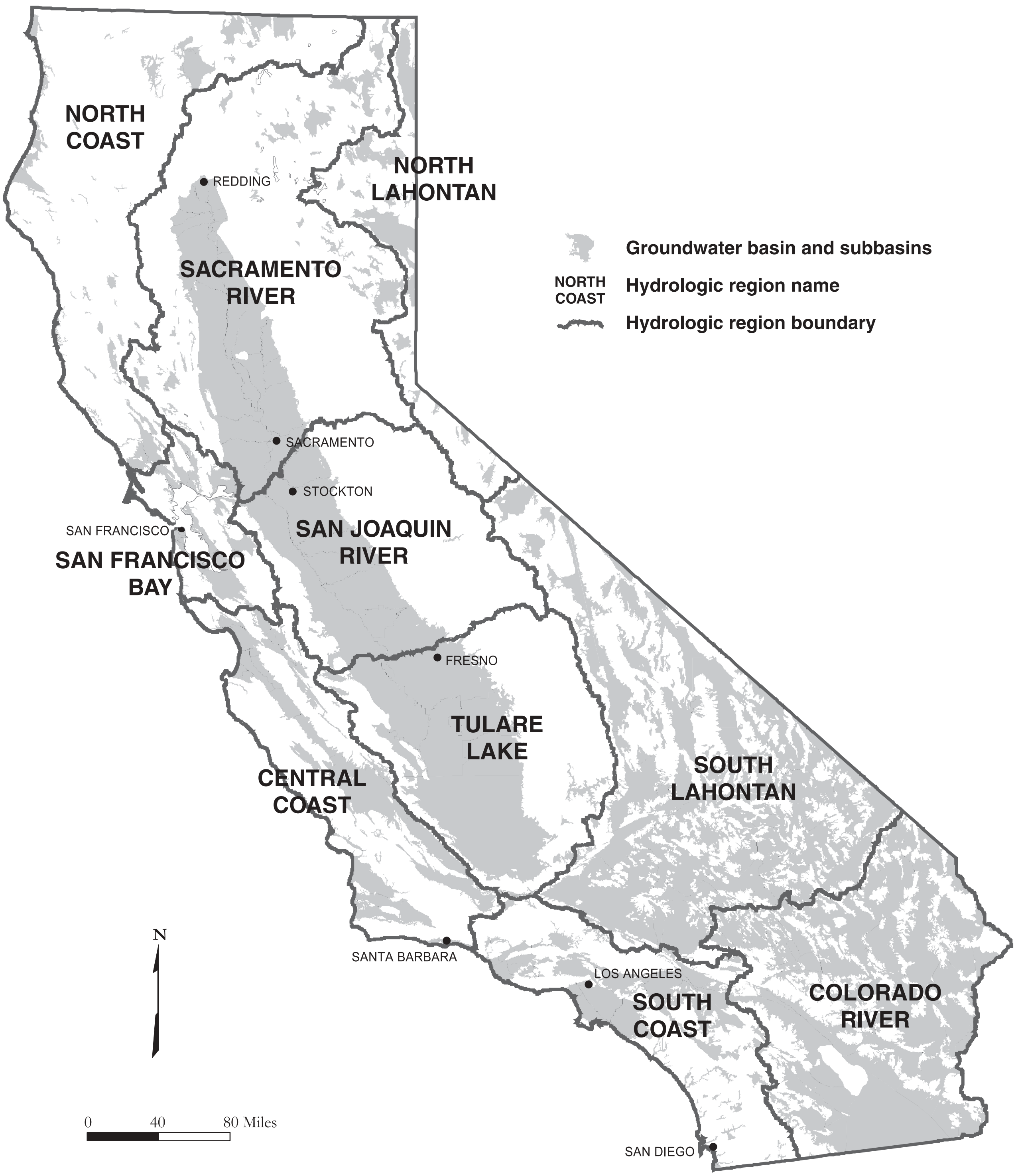

Figure 3 Groundwater basins, subbasins and hydrologic regions

California's Water Supply System

The economic success achieved in California could not have been foreseen a century ago. California's natural hydrologic system appeared too limited to support significant growth in population, industry, and agriculture. The limitations revolved around not only the relative aridity of the State, but the geographic, seasonal, and climatic variability that influence California's water supply. Approximately 70 percent of the State's average annual runoff occurs north of Sacramento, while about 75 percent of the State's urban and agricultural water needs are to the south. Most of the State's precipitation falls between October and April with half of it occurring December through February in average years. Yet, the peak demand for this water occurs in the summer months. Climatic variability includes dramatic deviations from average supply conditions by way of either droughts or flooding. In the 20th century alone, California experienced multiyear droughts in 1912–1913, 1918–1920, 1922–1924, 1929–1934, 1947–1950, 1959–1961, 1976–1977, and 1987–1992 (DWR 1998).

California has dealt with the limitations resulting from its natural hydrology and achieved its improbable growth by developing an intricate system of reservoirs, canals, and pipelines under federal, State and local projects (Figure 4). However, a significant portion of California's water supply needs is also met by groundwater. Typically, groundwater supplies about 30 percent of California's urban and agricultural uses. In dry years, groundwater use increases to about 40 percent statewide and 60% or more in some regions.

The importance of groundwater to the State's development may have been underestimated at the beginning of the 20th century. At that time, groundwater was seen largely as just a convenient resource that allowed for settlement in nearly any part of the State, given groundwater's widespread occurrence. Significant artesian flow from confined aquifers in the Central Valley allowed the early development of agriculture. When the Water Commission Act defined the allocation of surface water rights in 1914, it did not address allocation of the groundwater resource. In the 1920s, the development of the deep-well turbine pump and the increased availability of electricity led to a tremendous expansion of agriculture, which used these high-volume pumps and increased forever the significance of groundwater as a component of water supply in California.

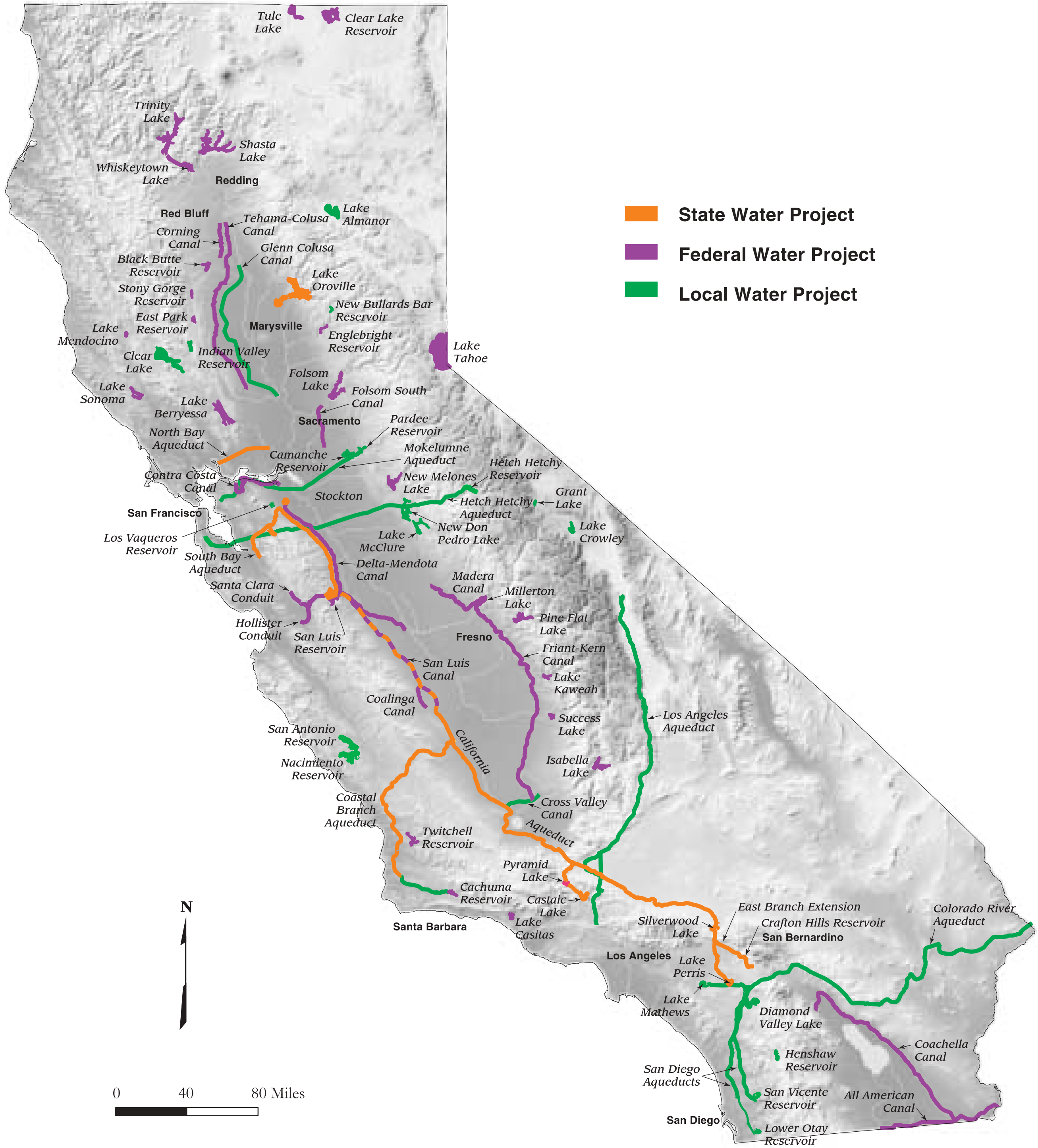

Figure 4 Water projects in California

Box B Will Climate Change Affect California's Groundwater?

California's water storage and delivery system can be thought of as including three reservoir systems—the snowpack of the Sierra Nevada, an extensive system of dams, lakes, and conveyance systems for surface water, and finally the aquifers that store groundwater. Precipitation in the form of snow is stored in the Sierra in winter and early spring and under ideal conditions melts in a manner that allows dams to capture the water for use during California's dry season. When snow melts faster, the dams act as flood control structures to prevent high runoff from flooding lowland areas. Water storage and delivery infrastructure—dams and canals—has been designed largely around the historical snowpack, while aquifers have played a less formal and less recognized role.

What will be the effect of climate change on California's water storage system? How will groundwater basins and aquifers be affected?

The latest report of the Intergovernmental Panel on Climate Change (2001) reaffirms that climate is changing in ways that cannot be accounted for by natural variability and that "global warming" is occurring. Studies by the National Water Assessment Team for the U.S. Global Change Research Program's National Assessment of the Potential Consequences of Climate Variability and Change identify potential changes that could affect water resources systems. For California, these include higher snow levels leading to more precipitation in the form of rain, earlier runoff, a rise in sea level, and possibly larger floods. In addition to affecting the balance between storage and flood control of our reservoirs, such changes in hydrology would affect wildlands, resulting in faunal and floral displacement and resulting in changes in vegetative water consumption. These changes would also affect patterns of both irrigated and dryland farming.

A warmer, wetter winter would increase the amount of runoff available for groundwater recharge; however, this additional runoff in the winter would be occurring at a time when some basins, particularly in Northern California, are either being recharged at their maximum capacity or are already full. Conversely, reductions in spring runoff and higher evapotranspiration because of warmer temperatures could reduce the amount of water available for recharge and surface storage.

The extent to which climate will change and the impact of that change are both unknown. A reduced snowpack, coupled with increased seasonal rainfall and earlier snowmelt may require a change in the operating procedures for existing dams and conveyance facilities. Furthermore, these changes may require more active development of successful conjunctive management programs in which the aquifers are more effectively used as storage facilities. Water managers might want to evaluate their systems to better understand the existing snowpack-surface water-groundwater relationship, and identify opportunities that may exist to optimize groundwater and other storage capability under a new hydrologic regime that may result from climate change. If more water was stored in aquifers or in new or reoperated surface storage, the additional water could be used to meet water demands when the surface water supply was not adequate because of reduced snowmelt.

Recent Groundwater Development Trends

While development of California's surface water storage system has slowed significantly, groundwater development continues at a strong pace. A review of well completion reports submitted to the California Department of Water Resources (DWR) provides data on the number and type of water wells drilled in California since 1987. For the 14-year period, DWR received 127,616 well completion reports for water supply wells that were newly constructed, reconditioned, or deepened—an average of 9,115 annually[1]. Of these, 82 percent were drilled for individual domestic uses; 14 percent for irrigation; and about 4 percent for a combined group of municipal and industrial uses (Figure 5). Although domestic wells predominate, individual domestic use makes up a small proportion of total groundwater use in the State.

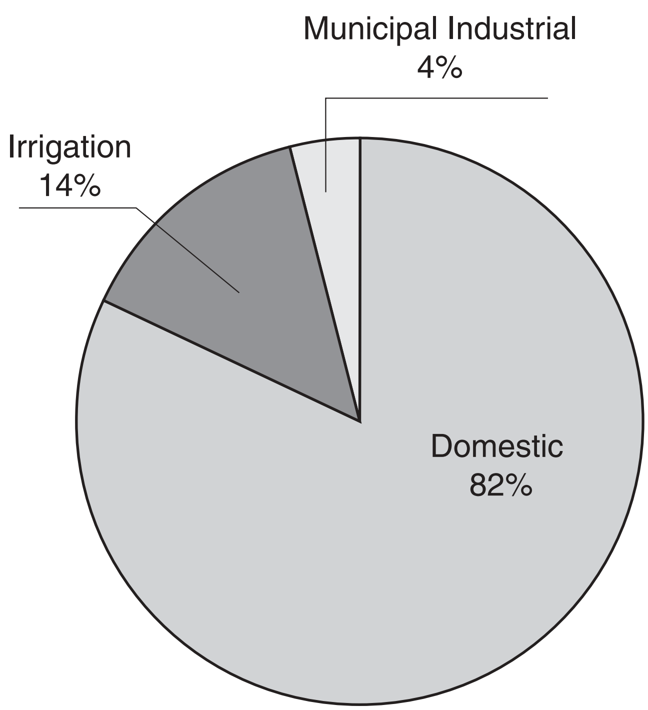

Figure 5 Well completion reports filed with DWR from 1987 through 2000

The most evident influence on the number of wells constructed is hydrologic conditions. The number of wells constructed and modified increases dramatically with drought conditions (Figure 6). The number of wells constructed and modified annually from 1987 through 1992 is more than double the annual totals for 1995 through 2000. Each year from 1987 through 1992 was classified as either dry or critically dry; water years 1995 through 2000 were either above normal or wet, based on measured unimpaired runoff in the Sacramento and San Joaquin valleys. In addition to providing an indication of the growth of groundwater development, well completion reports are a valuable source of information on groundwater basin conditions.

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[1] DWR also received an average of 4,225 well completion reports for monitoring, which were not included above because they do not extract groundwater for supply purposes.

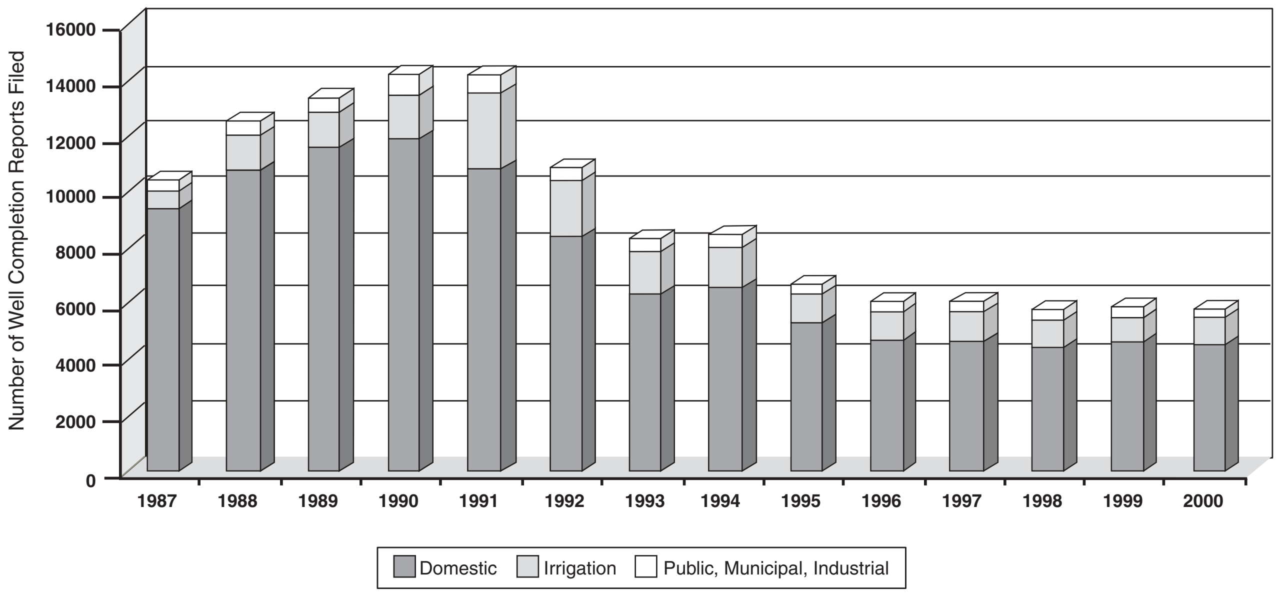

Figure 6 Well completion reports filed annually from 1987 through 2000

The Need for Groundwater Monitoring and Evaluation

Some 34 million people called California their home in the year 2000, and a population of nearly 46 million is expected by 2020. The increased population and associated commercial, industrial, and institutional growth will bring a substantially greater need for water. This need will be met in part by improved water use efficiency, opportunities to reoperate or expand California's surface water system, and increased desalination and recycling of water sources not currently considered usable. This need will also be met by storing and extracting additional groundwater. However, the sustainability of the groundwater resource, both in terms of what is currently used and future increased demand, cannot be achieved without effective groundwater management. In turn, effective groundwater management cannot be achieved without a program of groundwater data collection and evaluation.

Perhaps surprising to many, California does not have a comprehensive monitoring network for evaluating the health of its groundwater resource, including quantity and quality of groundwater. The reasons for this are many with the greatest one being that information on groundwater levels and groundwater quality is primarily obtained by drilling underground, which is relatively expensive. Given that delineated groundwater basins cover about 40 percent of the State's vast area, the cost of a dedicated monitoring network would be prohibitive. The other important reason for the lack of a comprehensive network is that, as will be discussed later in this report, groundwater is a locally controlled resource. State and federal agencies become involved only when a groundwater issue is directly related to the mission of a particular agency or if a local agency requests assistance. For these and other reasons, California lacks a cohesive, dedicated monitoring network.

Box C What about Overdraft?

Overdraft is the condition of a groundwater basin in which the amount of water withdrawn by pumping over the long term exceeds the amount of water that recharges the basin. Overdraft is characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. Overdraft can lead to increased extraction costs, land subsidence, water quality degradation, and environmental impacts.

The California Water Plan Update, Bulletin 160-98 (DWR 1998) estimated that groundwater overdraft in California in 1995 was nearly 1.5 million acre-feet annually, with most of the overdraft occurring in the Tulare Lake, San Joaquin River, and Central Coast hydrologic regions. The regional and statewide estimates of overdraft are currently being revised for the 2003 update of Bulletin 160. While these estimates are useful from a regional and statewide planning perspective, the basin water budgets calculated for this update of Bulletin 118 clearly indicate that information is insufficient in many basins to quantify overdraft that has occurred, project future impacts on groundwater in storage, and effectively manage groundwater. Further technical discussion of overdraft is provided in Chapter 6 of this bulletin.

When DWR and other agencies involved in groundwater began to collect data in the first half of the 20th century, it quickly became evident that there were insufficient funds to install an adequate number of monitoring wells to accurately determine changes in the condition of groundwater basins. Consequently, to create a serviceable monitoring network, the agencies asked owners of irrigation or domestic wells for permission to measure water levels and to a lesser extent to monitor water quality. These have been called “wells of opportunity.” In many areas, this approach has led to a network of wells that provide adequate information to gain a general understanding of conditions in the subsurface and to track changes through time. In some areas, groundwater studies were conducted and often included the construction of a monitoring well network. These studies have gradually contributed to a more detailed understanding of some of California’s groundwater basins, particularly the most heavily developed basins.

Given the combination of monitoring wells of opportunity and dedicated monitoring wells, it might be assumed that an adequate monitoring network in California will eventually accumulate. However, several factors contribute to reducing the effectiveness of the monitoring network for data collection and evaluation: (1) The funding for data programs in many agencies, which was generally insufficient in the first place, has been reduced significantly. (2) When private properties change ownership, some new owners rescind permission for agency personnel to enter the property and measure the well. (3) The appropriateness of using these private wells is questionable because they are often screened over long intervals encompassing multiple aquifers in the subsurface, and in some cases construction details for the well are unknown. (4) Some wells with long-term records actually reach the end of their usefulness because the casing collapses or something falls into the well, making it unusable. In some cases, groundwater levels may drop below the well depth. (5) As water quality or water quantity conditions change, the monitoring networks may no longer be adequate to provide necessary data to manage groundwater.

The importance of long-term monitoring networks cannot be overstated. Sound groundwater management decisions require observation of trends in groundwater levels and groundwater quality. Only through these long-term evaluations can the question of sustainability of groundwater be answered. For example, this report contains a summary of groundwater contamination in public water supply wells throughout the State collected from 1994 through 2000. While this provides a "snapshot" of the suitability of the groundwater currently developed for public supply needs, it does not address sustainability of groundwater for public uses. Sustainability can only be determined by observing groundwater quality over time. If conditions worsen, local managers will need to take steps to prevent further harm to groundwater quality. Long-term groundwater records require adequate funding and staff to develop groundwater monitoring networks and to collect, summarize, and evaluate the data.

Chapter 2
Groundwater Management in California

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Groundwater Management in California

Groundwater management, as defined in this report, is the planned and coordinated monitoring, operation, and administration of a groundwater basin or portion of a groundwater basin with the goal of long-term sustainability of the resource. Throughout the history of water management in California, local agencies have practiced an informal type of groundwater management. For example, since the early 20th century, when excess surface water was available, some agencies intentionally recharged groundwater to augment their total water supply. In 1947, the amount of groundwater used was estimated at 9 million to 10 million acre-feet. By the beginning of the 21st century, the amount of groundwater used had increased to an estimated 15 million acre-feet. Better monitoring would provide more accurate information. This increased demand on California's groundwater resources, when coupled with estimates of population growth, has resulted in a need for more intensive groundwater management.

In 1914, California created a system of appropriating surface water rights through a permitting process (Stats 1913, ch. 586), but groundwater use has never been regulated by the State. Though the regulation of groundwater has been considered on several occasions, the California Legislature has repeatedly held that groundwater management should remain a local responsibility (Sax 2002). Although they are treated differently legally, groundwater and surface water are closely interconnected in the hydrologic cycle. Use of one resource will often affect the other, so that effective groundwater management must consider surface water supplies and uses.

Figure 7 depicts the general process by which groundwater management needs are addressed under existing law. Groundwater management needs are identified at the local water agency level and may be directly resolved at the local level. If groundwater management needs cannot be directly resolved at the local agency level, additional actions such as enactment of ordinances by local governments, passage of laws by the Legislature, or decisions by the courts may be necessary to resolve the issues. Upon implementation, local agencies evaluate program success and identify additional management needs. The State's role is to provide technical and financial assistance to local agencies for their groundwater management efforts, such as through the Local Groundwater Assistance grant program (see Chapter 4, AB 303).

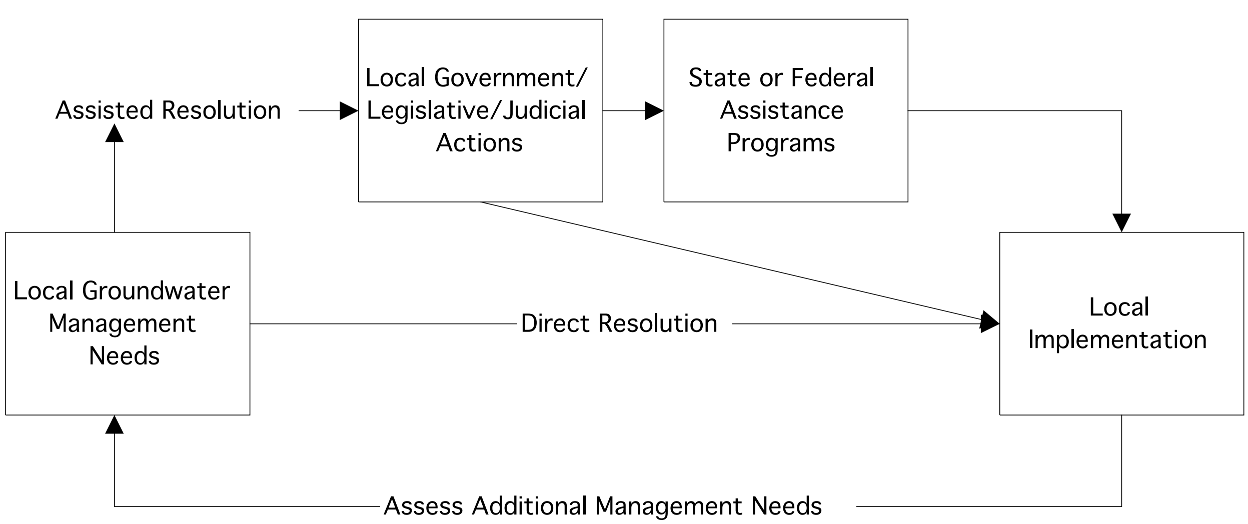

Figure 7 Process of addressing groundwater management needs in California

How Groundwater is Managed in California

There are three basic methods available for managing groundwater resources in California: (1) management by local agencies under authority granted in the California Water Code or other applicable State statutes, (2) local government groundwater ordinances or joint powers agreements, and (3) court adjudications. Table 1 shows how often each of these methods has been used, and each method is discussed briefly below. No law requires that any of these forms of management be applied in a basin. Management is often instituted after local agencies or landowners recognize a specific groundwater problem. The level of groundwater management in any basin or subbasin is often dependent on water availability and demand.

Table 1 Groundwater management methods

Method	Frequency of use[a]
Local water agencies	Undetermined number of agencies with authority to manage some aspect of groundwater under general powers associated with a particular type of district.
	Thirteen agencies with specially legislated authority to limit or regulate extraction.
	Seven agencies with adopted plans under authority from Water Code Section 10750 et seq.[b] (AB 255 of 1991).
	More than 200 agencies with adopted plans under authority from Water Code Section 10750 et seq. (AB 3030 of 1992).
Local groundwater management ordinances	Currently adopted in 27 counties.
Court adjudication	Currently decided in 19 groundwater basins, mostly in Southern California. Three more basins are in court.

a. The numbers for some methods are unknown because reporting to the California Department of Water Resources is not required.
b. Section 10750 *et seq*. was amended in 1992.

Groundwater Management through Authority Granted to Local Water Agencies

More than 20 types of local agencies are authorized by statute to provide water for various beneficial uses. Many of these agencies also have statutory authority to institute some form of groundwater management. For example, a Water Replenishment District (Water Code, § 60000 et seq.) is authorized to establish groundwater replenishment programs and collect fees for that service. A Water Conservation District (Water Code, § 75500 et seq.) can levy groundwater extraction fees. Table 2 lists these and other types of local agencies that deliver water and may have authority to institute some form of groundwater management. Most of these agencies are identified in the Water Code, but their specific authority related to groundwater management varies. The Water Code does not require that the agencies report their activities to the California Department of Water Resources (DWR).

Table 2 Local agencies with authority to deliver water for beneficial uses, which may have authority to institute groundwater management

Local agency	Authority	Number of agencies[a]
Community Services District	Gov. Code § 61000 et seq.	313
County Sanitation District	Health and Safety Code § 4700 et seq.	91
County Service Area	Gov. Code § 25210.1 et seq.	897
County Water Authority	Water Code App. 45.	30
County Water District	Water Code § 30000 et seq.	174
County Waterworks District	Water Code § 55000 et seq.	34
Flood Control and Water Conservation District	Water Code App. 38.	39
Irrigation District	Water Code § 20500 et seq.	97
Metropolitan Water District	Water Code App 109.	1
Municipal Utility District	Pub. Util. Code § 11501 et seq.	5
Municipal Water District	Water Code § 71000 et seq.	40
Public Utility District	Pub. Util. Code § 15501 et seq.	54
Reclamation District	Water Code § 50000 et seq.	152
Recreation and Park District	Pub. Resources Code § 5780 et seq.	110
Resort Improvement District	Pub. Resources Code § 13000 et seq.	-
Resource Conservation District	Pub. Resources Code § 9001 et seq.	99
Water Conservation District	Water Code App. 34; Wat. Code § 74000 et seq.	13
Water District	Water Code § 34000 et seq.	141
Water Replenishment District	Water Code § 60000 et seq.	1
Water Storage District	Water Code § 39000 et seq.	8

a. From State Controller's Office Special Districts Annual Report, 49th Edition.

Greater authority to manage groundwater has been granted to a small number of local agencies or districts created through special acts of the Legislature. For example, the Sierra Valley Groundwater Basin Act of 1980 (Water Code, App. 119) created the first two groundwater management districts in California. Currently, 13 local agencies have specific groundwater management authority as a result of being special act districts. The specific authority of each agency varies, but they can generally be grouped into two categories. Most of the agencies formed since 1980 have the authority to limit export and even control some in-basin extraction upon evidence of overdraft or the threat of overdraft. These agencies can also generally levy fees for groundwater management activities and for water supply replenishment. Agencies formed prior to 1980 do not have authority to limit extraction from a basin. However, the groundwater users in these areas are generally required to report extractions to the agency, and the agency can levy fees for groundwater management or water supply replenishment. Some of these agencies have effectively used a tiered fee structure to discourage excessive groundwater extraction in the basin. Table 3 lists the names of special act districts with legislative authority to manage groundwater.

Table 3 Special act districts with groundwater management authority in California

District or agency	Water Code citation[a]	Year agency established in Code[b]
Desert Water Agency	App. 100	1961
Fox Canyon Groundwater Management Agency	App. 121.	1982
Honey Lake Groundwater Management District	App. 129.	1989
Long Valley Groundwater Management District	App. 119.	1980
Mendocino City Community Services District	Section 10700 et seq.	1987
Mono County Tri-Valley Groundwater Management District	App. 128.	1989
Monterey Peninsula Water Management District	App. 118.	1977
Ojai Groundwater Management Agency	App. 131.	1991
Orange County Water District	App. 40.	1933
Pajaro Valley Water Management Agency	App. 124.	1984
Santa Clara Valley Water District	App. 60.	1951
Sierra Valley Groundwater Management District	App. 119.	1980
Willow Creek Groundwater Management Agency	App. 135.	1993

a. From West's Annotated California Codes (1999 update)
b. This represents the year the agency was established in the Water Code. Specific authorities, such as those for groundwater management activities, may have been granted through later amendments.

In 1991, AB 255 (Stats. 1991, Ch. 903) was enacted authorizing local agencies overlying basins subject to critical conditions of overdraft, as defined in DWR's Bulletin 118-80, to establish programs for groundwater management within their service areas. Water Code section 10750 et seq. provided these agencies with the powers of a water replenishment district to raise revenue for facilities to manage the basin for the purposes of extraction, recharge, conveyance, and water quality. Seven local agencies adopted plans under this authority.

The provisions of AB 255 were repealed in 1992 with the passage of AB 3030 (Stats. 1992, Ch. 947). This legislation was significant in that it greatly increased the number of local agencies authorized to develop a groundwater management plan and set forth a common framework for management by local agencies throughout California. AB 3030, which is codified in Water Code section 10750 et seq., provides a systematic procedure to develop a groundwater management plan by local agencies overlying the groundwater basins defined by Bulletin 118-75 (DWR 1975) and updates. Upon adoption of a plan, these agencies could possess the same authority as a water replenishment district to "fix and collect fees and assessments for groundwater management" (Water Code, § 10754). However, the authority to fix and collect these fees and assessments is contingent on receiving a majority of votes in favor of the proposal in a local election (Water Code, § 10754.3). More than 200 agencies have adopted an AB 3030 groundwater management plan. None of these agencies is known to have exercised the authority of a Water Replenishment District.

Water Code section 10755.2 expands groundwater management opportunities by encouraging coordinated plans and by authorizing public agencies to enter into a joint powers agreement or memorandum of understanding with public or private entities that provide water service. At least 20 coordinated plans have been prepared to date involving nearly 120 agencies, including cities and private water companies.

Local Groundwater Ordinances

A second general method of managing groundwater in California is through ordinances adopted by local governments such as cities or counties. Twenty-seven counties have adopted groundwater ordinances, and others are being considered (Figure 8). The authority of counties to regulate groundwater has been challenged, but in 1995 the California Supreme Court declined to review an appeal of a lower court decision *Baldwin v. County of Tehama* (1994) that holds that State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage groundwater under their police powers. However, the precise nature and extent of the police power of cities and counties to regulate groundwater is uncertain.

The Public Policy Institute of California recently performed a study of California's water transfer market, which included a detailed investigation of the nature of groundwater ordinances by counties in California. The report found that 22 counties had adopted ordinances requiring a permit to export groundwater. In all but three cases, restricting out-of-county uses appears to be the only purpose (Hanak 2003). One ordinance, adopted recently in Glenn County (Box D, "Basin Management Objectives for Groundwater Management"), takes a comprehensive approach by establishing management objectives for the county's groundwater basins. Several other counties in Northern California are considering adopting similar management objective based ordinances.

Ordinances are mostly a recent trend in groundwater management, with 24 of the 27 ordinances enacted since 1990. Local ordinances passed during the 1990s have significantly increased the potential role of local governments in groundwater management. The intent of most ordinances has been to hold project proponents accountable for impacts that may occur as a result of proposed export projects. Because adoption of most of these ordinances is recent, their effect on local and regional groundwater management planning efforts is not yet fully known. However, it is likely that future groundwater development will take place within the constraints of local groundwater management ordinances. Table 4 lists counties with groundwater management ordinances and their key elements.

Figure 8 Counties with groundwater ordinances

Box D Basin Management Objectives for Groundwater Management

Most county groundwater management ordinances require that an export proponent prove the project will not deplete groundwater, cause groundwater quality degradation, or result in land subsidence. Although these factors could be part of any groundwater management plan, these ordinances do not require that a groundwater management plan be developed and implemented.

The only ordinance requiring development and adoption of objectives to be accomplished by management of the basin was adopted by the Glenn County Board of Supervisors in 2000. The action came after a citizens committee spent five years working with stakeholders. The process of developing a groundwater management ordinance for Glenn County began in 1995 when local landowners and county residents became concerned about plans to export groundwater or substitute groundwater for exported surface water. Control of exports was the focus of early ordinance discussions.

After long discussions and technical advice from groundwater specialists, the committee realized that goals and objectives must be identified for effective management of groundwater in the county. What did the county want to accomplish by managing groundwater within the county? What did groundwater management really mean?

The concept of establishing basin management objectives emerged (BMOs). BMOs would establish threshold values for groundwater levels, groundwater quality, and land surface subsidence. When a threshold level is reached, the rules and regulations require that groundwater extraction be adjusted or stopped to prevent exceeding the threshold.

The Glenn County Board of Supervisors has adopted BMOs, which were developed by an advisory committee, for groundwater levels throughout the county. While currently there are 17 BMOs representing the 17 management areas in the county, the goal is to begin managing the entire county in a manner that benefits each of the local agencies and their landowners, as well as landowners outside of an agency boundary. The committee is now developing BMOs for groundwater quality and land surface subsidence.

There is no single set of management objectives that will be successful in all areas. Groundwater management must be adapted to an area's political, institutional, legal, and technical constraints and opportunities. Groundwater management must be tailored to each basin or subbasin's conditions and needs. Even within a single basin, the management objectives may change as more is learned about managing the resource within that basin. Flexibility is the key, but that flexibility must operate within a framework that ensures public participation, monitoring, evaluation, feedback on management alternatives, rules and regulations, and enforcement.

Table 4 Counties with ordinances addressing groundwater management

County	Year enacted	Key elements (refer to ordinances for exemptions and other details)
Butte	1996	Export permit required (extraction & substitute pumping), Water Commission and Technical Advisory Committee, groundwater planning reports (county-wide monitoring program)
Calaveras	2002	Export permit required (extraction & substitute pumping)
Colusa	1998	Export permit required (extraction & substitute pumping)
Fresno	2000	Export permit required (extraction & substitute pumping)
Glenn	1990 rev. 2000	Water Advisory Committee and Technical Advisory Committee, basin management objectives and monitoring network, export permit required (1990)
Imperial	1996	Commission established to manage groundwater, including controlling exports (permit required), overdraft, artificial recharge, and development projects
Inyo	1998	Regulates (1) water transfers pursuant to Water Code Section 1810, (2) sales of water to the City of Los Angeles from within Inyo Co., (3) transfer or transport of water from basins within Inyo County to another basin with the County, and (4) transfers of water from basins within Inyo Co. to any area outside the County.
Kern	1998	Conditional use permit for export to areas both outside county and within watershed area of underlying aquifer in county. Only applies to southeastern drainage of Sierra Nevada and Tehachapi mountains.
Lake	1999	Export permit required (extraction & substitute pumping)
Lassen	1999	Export permit required (extraction & substitute pumping)
Madera	1999	Permit required for export, groundwater banking, and import for groundwater banking purposes to areas outside local water agencies
Mendocino	1995	Mining of groundwater regulated for new developments in Town of Mendocino
Modoc	2000	Export permit required for transfers out of basin
Mono	1988	Permit required for transfers out of basin
Monterey	1993	Water Resources Agency strictly regulates extraction facilities in zones with groundwater problems
Napa	1996	Permits for local groundwater extractions; exemptions for single parcels and agricultural use
Sacramento	1952 rev. 1985	Water Agency established to manage and protect groundwater management zones; replenishment charges
San Benito	1995	Mining groundwater (overdraft) for export prohibited; permit required for off-parcel use, injecting imported water; influence of well pumping restrictions
San Bernardino	2002	Permit required for any new groundwater well within the desert region of the county
San Diego	1991	Provides for mapping of groundwater impacted basins (defined); projects within impacted basins require groundwater investigations
San Joaquin	1996	Export permit required (extraction & substitute pumping)
Shasta	1997	Export permit required (extraction & substitute pumping)
Sierra	1998	Export permit required or for off-parcel use
Siskiyou	1998	Permit required for transfers out of basin
Tehama	1992	Mining groundwater (overdraft) for export prohibited; permit required for off-parcel use; influence of well pumping restrictions
Tuolumne	2001	Export permit required (extraction & substitute pumping)
Yolo	1996	Export permit required (extraction & substitute pumping)

Adjudicated Groundwater Basins

A third general form of groundwater management in California is court adjudication. In some California groundwater basins, as the demand for groundwater exceeded supply, landowners and other parties turned to the courts to determine how much groundwater can rightfully be extracted by each user. The courts study available data to arrive at a distribution of the groundwater that is available each year, usually based on the California law of overlying use and appropriation. This court-directed process can be lengthy and costly. As noted in Table 5, the longest adjudication took 24 years. Many of these cases have been resolved with a court-approved negotiated settlement, called a stipulated judgment. Unlike overlying and non-overlying rights to groundwater, such decisions guarantee to each party a proportionate share of the groundwater that is available each year. The intense technical focus on the groundwater supply and restrictions on groundwater extraction for all parties make adjudications one of the strongest forms of groundwater management in California.

There are 19 court adjudications for groundwater basins in California, mostly in Southern California (see Table 5). Eighteen of the adjudications were undertaken in State Superior Court and one in federal court. For each adjudicated groundwater basin, the court usually appoints a watermaster to oversee the court judgment. In 15 of these adjudications, the court judgment limits the amount of groundwater that can be extracted by all parties based on a court-determined safe yield of the basin. The basin boundaries are also defined by the court. The Santa Margarita Basin was adjudicated in federal court. That decision requires water users to report the amount of surface water and groundwater they use, but groundwater extraction is not restricted.

Most basin adjudications have resulted in either a reduction or no increase in the amount of groundwater extracted. As a result, agencies often import surface water to meet increased demand. The original court decisions provided watermasters with the authority to regulate extraction of the quantity of groundwater; however, they omitted authority to regulate extraction to protect water quality or to prevent the spread of contaminants in the groundwater. Because water quantity and water quality are inseparable, watermasters are recognizing that they must also manage groundwater quality.

Box E Adjudication of Groundwater Rights in the Raymond Basin

The first basin-wide adjudication of groundwater rights in California was in the Raymond Basin in Los Angeles County in 1949 (*Pasadena v. Alhambra*). The first water well in Raymond Basin was drilled in 1881; 20 years later, the number of operating wells grew to about 140. Because of this pumping, the City of Pasadena began spreading water in 1914 to replenish the groundwater, and during the next 10 years the city spread more than 20,000 acre-feet.

Pumping during 1930 through 1937 caused water levels to fall 30 to 50 feet in wells in Pasadena. After attempting to negotiate a reduction of pumping on a cooperative basis, the City of Pasadena, on September 23, 1937, filed a complaint in Superior Court against the City of Alhambra and 29 other pumpers to quiet title to the water rights within Raymond Basin. The court ruled that the city must amend its complaint, making defendants of all entities pumping more than 100 acre-feet per year, and that it was not a simple quiet title suit but, a general adjudication of the water rights in the basin.

In February 1939, a court used the reference procedure under the State Water Code to direct the State Division of Water Resources, Department of Public Works (predecessor to the Department of Water Resources) as referee to review all physical facts pertaining to the basin, determine the safe yield, and ascertain whether there was a surplus or an overdraft. The study took 2-1/2 years to complete and cost more than $53,000, which was paid by the parties. The resulting Report of Referee submitted to the court in July 1943 found that the annual safe yield of the basin was 21,900 acre-feet but that the actual pumping and claimed rights were 29,400 acre-feet per year.

Most parties agreed to appoint a committee of seven attorneys and engineers to work out a stipulated agreement. In 1944, the court designated the Division of Water Resources to serve as watermaster for the stipulated agreement, which all but one of the parties supported. On December 23, 1944, the judge signed the judgment that adopted the stipulation.

The stipulation provided that (1) the water was taken by each party openly, notoriously, and under a claim of right, which was asserted to be, and was adverse to each and all other parties; (2) the safe yield would be divided proportionally among the parties; and (3) each party's right to a specified proportion of the safe yield would be declared and protected. It also established an arrangement for the exchange of pumping rights among parties.

Based on the stipulation, the court adopted a program of proportionate reductions. In so doing, the court developed the doctrine of mutual prescription, whereby the rights were essentially based on the highest continual amount of pumping during the five years following the beginning of the overdraft, and under conditions of overdraft, all of the overlying and appropriative water users had acquired prescriptive rights against each other, that is, mutual prescription.*

In 1945, one party appealed the judgment, and in 1947, the District Court of Appeals reversed and remanded *Pasadena v. Alhambra.* However, on June 3, 1949, the State Supreme Court overturned the appellate court's decision and affirmed the original judgment. In 1950, the court granted a motion by the City of Pasadena that there be a review of the determination of safe yield, and in 1955, the safe yield and the total decreed rights were increased to 30,622 acre-feet per year. In 1984, watermaster responsibilities were assigned to the Raymond Basin Management Board.

*In City of Los Angeles v. City of San Fernando (1975) the California Supreme Court rejected the doctrine of mutual prescription and held that a groundwater basin should be adjudicated based on the correlative rights of overlying users and prior appropriation among non-overlying users. For further discussion, see Appendix B.

Table 5 List of adjudicated basins

Court name	Relationship to DWR Bulletin 118 basin name; county	Basin No.	Filed in court	Final decision	Watermaster and/or website
1—Scott River Stream System	Scott River Valley; Siskiyou	1-5	1970	1980	Two local irrigation districts
2—Santa Paula Basin	Subbasin of Santa Clara River; Ventura	4-4	1991	1996	Three-person technical advisory committee from United Water CD, City of Ventura, and Santa Paula Basin Pumpers Association; www.unitedwater.org
3—Central Basin	Northeast part of Coastal Plain of Los Angeles County Basin; Los Angeles	4-11	1962	1965	DWR—Southern District; wwwdpla.water.ca.gov/sd/watermaster/watermaster.html
4—West Coast Basin	Southwest part of Coastal Plain of Los Angeles County Basin; Los Angeles	4-11	1946	1961	DWR—Southern District; wwwdpla.water.ca.gov/sd/watermaster/watermaster.html
5—Upper Los Angeles River Area	San Fernando Valley Basin (entire watershed); Los Angeles	4-12	1955	1979	Superior Court appointee
6—Raymond Basin	Northwest part of San Gabriel Valley Basin; Los Angeles	4-13	1937	1944	Raymond Basin Management Board
7—Main San Gabriel Basin	San Gabriel Valley Basin, excluding Raymond Basin; Los Angeles	4-13	1968	1973	Water purveyors and water districts elect a nine-member board; www.watermaster.org/
Puente Narrows, *Addendum to Main San Gabriel Basin decision*			1972	1972	Two consulting engineers
8—Puente	San Gabriel Valley Basin, excluding Raymond Basin; Los Angeles	4-13	1985	1985	Three consultants
9—Cummings Basin	Cummings Valley Basin; Kern	5-2	1966	1972	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm
10—Tehachapi Basin	Tehachapi Valley West Basin and Tehachapi Valley East Basin; Kern	5-28 6-45	1966	1973	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm
11—Brite Basin	Brite Valley; Kern	5-80	1966	1970	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm

Table 5 List of adjudicated basins (continued)

Court name	Relationship to DWR Bulletin 118 basin name; county	Basin No.	Filed in court	Final decision	Watermaster and/or website
12—Mojave Basin Area Adjudication	Lower, Middle & Upper Mojave River Valley Basins; El Mirage & Lucerne valleys; San Bernardino	6-40, 6-41, 6-42	1990	1996	Mojave Water Agency; www.mojavewater.org/mwa700.htm
13—Warren Valley Basin	Part of Warren Valley Basin; San Bernardino	7-12	1976	1977	Hi-Desert Water District; www.mojavewater.org
14—Chino Basin	Northwest part of Upper Santa Ana Valley Basin; San Bernardino and Riverside	8-2	1978	1978	Nine people, recommended by producers and appointed by the court; www.cbwm.org/
15—Cucamonga Basin	North central part of Upper Santa Ana Valley Basin; San Bernardino	8-2	1975	1978	Not yet appointed, operated as part of Chino Basin
16—San Bernardino Basin Area	Northeast part of Upper Santa Ana Basin; San Bernardino and Riverside	8-2	1963	1969	One representative each from Western Municipal Water District of Riverside County & San Bernardino Valley Municipal Water District
17—Six Basins	Six subbasins in northwest upper Santa Ana Valley; Upper & Lower Claremont Heights, Canyon, Pomona, Live Oak & Ganesha; Los Angeles. Small portions of Upper Claremont Heights and Canyon are in San Bernardino County	4-14, 8-2	1998	1998	Nine-member board representing all parties to the judgment
18—Santa Margarita River watershed	The Santa Margarita River watershed, including 3 groundwater basins: Santa Margarita Valley, Temecula Valley and Cahuilla Valley Basins; San Diego and Riverside.	9-4, 9-5, 9-6	1951	1966	U.S. District Court appointee
19—Goleta	Goleta Central Basin; judgment includes North Basin; Santa Barbara	3-16	1973	1989	No watermaster appointed; the court retains jurisdiction

How Successful Have Groundwater Management Efforts Been?

This chapter describes the opportunities for local agencies to manage their groundwater resources. Many have questioned whether these opportunities have led to an overall successful system of groundwater management throughout California. How successful groundwater management has been throughout the State is a difficult question and cannot be answered at present. While there are many examples of local agency successes (see Box F, "Managing through a Joint Powers Agreement," Box G, "Managing a Basin through Integrated Water Management," and Box H, "Managing Groundwater Using both Physical and Institutional Solutions"), there are neither mandates to prepare groundwater management plans nor reporting requirements when plans are implemented, so a comprehensive assessment of local planning efforts is not possible. Additionally, many plans have been adopted only recently, during a period of several consecutive wet years, so many of the plan components are either untested or not implemented.

At a minimum, successful groundwater management should be defined as maintaining and maximizing long-term reliability of the groundwater resource, focused on preventing significant depletion of groundwater in storage over the long term and preventing significant degradation of groundwater quality. A review of some of the groundwater management plans prepared under AB 3030 reveals that some plans are simply brief recitations about continuing the agency's existing programs. Not all agencies that enacted groundwater management plans under AB 3030 are actively implementing the plan.

Despite this apparent lack of implementation of groundwater management plans prepared under AB 3030, the bill has certainly increased interest in more effective groundwater management. With more than 200 agencies participating in plans and more than 120 of those involved in coordinated plans with other agencies, AB 3030 has resulted in a heightened awareness of groundwater management. Additionally, annual reports published by a few water agencies indicate that they are indeed moving toward better coordination throughout the basin and more effective management of all water supplies. Given the history of groundwater management in California, these seemingly small steps toward better management may actually represent giant strides forward.

More recently, financial incentives have played a large role in driving groundwater management activities. For example, under grant and loan programs resulting from Proposition 13 of 2000 (see description in Chapter 4), local agencies submitted applications proposing a total increase in annual water yield of more than 300,000 acre-feet through groundwater storage projects. Additional projects and programs would be developed with sufficient funding for feasibility and pilot studies. Unfortunately, not enough funding exists for all of the proposed projects, and many other legal and institutional barriers remain (see Box I, "Impediments to Conjunctive Management Programs in California"). It is clear, however, that further incentives would help agencies move ahead more aggressively in their groundwater management planning efforts.

Additional progress in groundwater management is reflected by passage of amendments to the Water Code (§§ 10753.4 and 10795.4 as amended, §§ 10753.7, 10753.8, and 10753.9 as amended and renumbered, and §§ 10753.1 and 10753.7 as added) through SB 1938 of 2002. The amendments require that groundwater management plans include specific components for agencies to be eligible for some public funds for groundwater projects. The provisions of SB 1938 (2001) are fully described in Chapters 3 and 4.

This evaluation of groundwater management success has not really considered ordinances and adjudications. Adjudications have been successful at maintaining the groundwater basin conditions, often restricting pumping for all basin users. In some cases, adjudication provides the necessary framework for more proactive management as well. Ordinances have successfully restricted exports from basins, but have not

Box F Managing through a Joint Powers Agreement

In 1993, representatives from business, environmental, public, and water purveyor interests formed the Sacramento Area Water Forum to develop a plan to protect the region's water resources from the effects of prolonged drought as the demand for water continues to grow. The Water Forum was founded on two co-equal objectives: (1) to provide a reliable and safe water supply for the region's economic health and planned development to the year 2030 and (2) to preserve the fishery, wildlife, recreational and aesthetic values of the lower American River.

After a six-year consensus-based process of education, analysis and negotiation, the participants signed a Water Forum agreement to meet these objectives. The agreement provides a framework for avoiding future water shortages, environmental degradation, groundwater contamination, threats to groundwater reliability, and limits to economic prosperity.

The Sacramento Groundwater Authority (SGA) was formed to fulfill a key Water Forum goal of protecting and managing the north-area groundwater basin. The SGA is a joint powers authority formed for the purpose of collectively managing the region's groundwater resources. This authority permits SGA to make contractual arrangements required to implement a conjunctive use program, and also provides potential partners with the legal and political certainty for entering into long-term agreements.

SGA's regional banking and exchange program is designed to provide long-term supply benefits for local needs, but also will have the potential to provide broader statewide benefits consistent with American River environmental needs. Water stored in Folsom Lake would be conjunctively used with groundwater in order to reduce surface water diversions in dry years and to achieve in-lieu recharge of the basin in wet years. The conjunctive use program participants include 16 water providers in northern Sacramento and southern Placer counties that serve water to more than half a million people.

Two of three implementation phases of the program are complete. In the first phase, program participants identified long-term water supply needs and conducted an inventory of existing infrastructure that could be used to implement the program. In the second phase, SGA completed two pilot banking and exchange projects, demonstrating the technical, legal, and institutional viability of a regional conjunctive use program. In the first pilot study, water agencies worked with the U.S. Bureau of Reclamation and the Sacramento Area Flood Control Agency to bank 2,100 acre-feet of groundwater, providing additional flood storage capacity in Folsom Lake. In the second pilot study, Citrus Heights and Fair Oaks water districts and the city of Sacramento extracted and used 7,143 acre-feet of groundwater, forgoing a portion of their rights to surface water, making this water available to the Environmental Water Account. The third phase of the SGA program is to further solidify the institutional framework and construct facilities to implement a full-scale regional conjunctive use program. These facilities, that will result in an average annual yield of 21,400 acre-feet, are currently under construction, funded in part by a $21.6 million grant under Proposition 13 of 2000.

Box G Managing a Basin through Integrated Water Management

Orange County Water District (OCWD) was established in 1933 by an uncodified Act (Water Code App. 40) to manage Orange County's groundwater basin and protect the Santa Ana River rights of water users of north-central Orange County. The district manages the groundwater basin, which provides as much as 75 percent of the water supply for its service area. The district strives for a groundwater-based water supply with enough reserves to provide a water supply through drought conditions. An integrated set of water management practices helps achieve this, including the use of recharge, alternative sources, and conservation.

Recharge

The Santa Ana River provides the main natural recharge source for the county's groundwater basin. Increased groundwater use and lower-than-average rainfall during the late 1980s and early 1990s forced the district to rely on an aggressive program to enhance recharge of the groundwater basin. Programs used today to optimize water use and availability include:

- Construction of levees in the river channel to increase infiltration.
- Construction of artificial recharge basins within the forebay.
- Development of an underwater basin cleaning vehicle that removes a clogging layer at the bottom of the recharge basin and extends the time between draining the basin for cleaning by a bulldozer.
- Use of storm water captured behind Prado Dam that would otherwise flow to the ocean.
- Use of imported water from the State Water Project and Colorado River.
- Injection of treated recycled water to form a seawater intrusion barrier.

Alternative Water Use and Conservation

OCWD has successfully used nontraditional sources of water to help satisfy the growing need for water in Orange County. Projects that have added to the effective supply of groundwater are:

- Use of treated recycled water for irrigation and industrial use.
- In-lieu use to reduce groundwater pumping.
- Change to low-flow toilets and showerheads.
- Participation of 70 percent of Orange County hotels and motels in water conservation programs.
- Change to more efficient computerized irrigation.

Since 1975, Water Factory 21 has provided recycled water that meets all primary and secondary drinking water standards set by the California Department of Health Services. OCWD has proposed a larger, more efficient membrane purification project called the Groundwater Replenishment System (GWRS), which is scheduled to begin operating at 70,000 acre-feet per year in 2007. By 2020 the system will annually supply 121,000 acre-feet of high quality water for recharge, for injection into the seawater intrusion barrier, and for direct industrial uses.

This facility will use a lower cost microfiltration and reverse osmosis treatment process that produces water of near distilled quality, which will help reverse the trend of rising total dissolved solids (TDS) in groundwater caused by the recharge of higher TDS-content Santa Ana River and Colorado River waters. The facility will use about half the energy required to import an equivalent amount of water to Orange County from Northern California. The GWRS will be funded, in part, by a $30 million grant under Proposition 13 of 2000.

Source: Orange County Water District

Box H Managing Groundwater using both Physical and Institutional Solutions

Four agencies share responsibility for groundwater management in Ventura County. Coordination and cooperation between these agencies focus on regular meetings, attendance at each other's board meetings, joint projects, watershed committees, and ongoing personal contacts to discuss water-related issues. The agencies and their areas of responsibility are:

- United Water Conservation District – physical solutions, monitoring, modeling, reporting, administering management plans and adjudication;
- Fox Canyon Groundwater Management Agency – pumping allocations, credits and penalties, abandoned well destruction, data for irrigation efficiency;
- County of Ventura – well permits, well construction regulations, tracking abandoned wells; and
- Calleguas Municipal Water District – groundwater storage of imported water.

In Ventura County 75% to 80% of the extracted groundwater is for agriculture; the remainder is for municipal and industrial use. Seawater intrusion into the aquifers was recognized in the 1940s and was the driving force behind a number of groundwater management projects and policies in the county's groundwater basins. As groundwater issues became more complicated at the end of the 20th century, these groundwater management projects and policies were useful in solving a number of problems.

Physical Solutions

Physical solutions substitute supplemental surface water for groundwater pumping near coastal areas, increase basin recharge, and increase the reliability of imported water. Projects include:

- Winter flood-flow storage for dry season release
- Wells and pipelines to move pumping for drinking water away from the coast
- Diversion structures to supply surface water to spreading grounds and irrigation
- Pipelines to convey surface water to coastal areas
- Las Posas Basin Aquifer Storage and Recovery project

Institutional Solutions

Institutional solutions focus on developing and implementing effective groundwater management programs, reducing pumping demands, tracking groundwater levels and water quality, managing groundwater pumping patterns, and destroying abandoned wells to prevent cross-contamination of aquifers. Solutions include:

- Creation of Fox Canyon Groundwater Management Agency (GMA), which represents each major pumping constituency
- Use of irrigation efficiency (agriculture), water conservation, and alternative sources of water (urban) to reduce pumping by 25%
- Manage outside the GMA area through an AB 3030 plan and a court adjudication
- Limit new permits for wells in specific aquifers to avoid seawater intrusion
- Creation of a program to destroy abandoned wells
- Creation of a database of historical groundwater levels and quality information collected since the 1920s
- Development of a regional groundwater flow model and a regional master plan for groundwater projects
- Creation of an irrigation weather station to assist in irrigation efficiency

Implementation of these physical and institutional management tools has resulted in the reversal of seawater intrusion in key coastal monitoring wells. These same tools are being used to mitigate saline intrusion (not seawater) in two inland basins and to reduce seasonal nitrate problems in the recharge area. Work is being expanded to help reduce loading of agricultural pesticides and nutrients. Without close coordination and cooperation of the county's water-related agencies, municipalities, and landowners, it would have been very difficult to implement most of these solutions. Although such coordination takes time, the investment has paid off in solutions that help provide a sustainable water supply for all water users in Ventura County.

Source: United Water Conservation District necessarily improved groundwater management. The primary intent of most ordinances is to ensure that proponents of projects are held accountable for potential impacts of the proposed export projects. As studies lead to a better understanding of local water resources, development of pilot export and transfer projects, with appropriate monitoring, may lead to greater certainty in managing groundwater resources. Areas managed under adjudications and ordinances will continue to develop more active management approaches. Population growth and its accompanying increased demand on the resources is a certainty. Most geographic areas in California are not immune to this growth, so strategies for more than just maintaining existing groundwater supply through extraction or export restrictions need to be implemented.

Box I Impediments to Conjunctive Management Programs in California

In 1998 the National Water Research Institute, in cooperation with the Association of Ground Water Agencies and the Metropolitan Water District of Southern California, conducted a workshop to determine the biggest impediments to implementing a cost-effective conjunctive water management program in California.

Since that time, some steps have been taken to overcome those impediments, but several important barriers remain. Workshop participants identified the 10 most significant obstacles:

1) Inability of local and regional water management governance entities to build trust, resolve differences (internally and externally), and share control.
2) Inability to match benefits and funding burdens in ways that are acceptable to all parties, including third parties.
3) Lack of sufficient federal, State, and regional financial incentives to encourage groundwater conjunctive use to meet statewide water needs.
4) Legal constraints that impede conjunctive use, regarding storage rights, basin judgments, area of origin, water rights, and indemnification.
5) Lack of statewide leadership in the planning and development of conjunctive use programs as part of comprehensive water resources plans, which recognize local, regional, and other stakeholders' interests.
6) Inability to address quality difference in "put" versus "take"; standards for injection, export, and reclaimed water; and unforeseeable future groundwater degradation.
7) Risk that water stored cannot be extracted when needed because of infrastructure, water quality or water level, politics, and institutional or contractual provisions.
8) Lack of assurances to prevent third-party impacts and assurances to increase willingness of local citizens to participate.
9) Lack of creativity in developing lasting "win-win" conjunctive use projects, agreements, and programs.
10) Supplemental suppliers and basin managers have different roles and expectations in relation to conjunctive use.

[**Editor's note**: The California Department of Water Resources' Conjunctive Water Management program has taken significant steps to overcome several of these impediments, using a combination of California Bay-Delta Authority, DWR, Proposition 13, and AB 303 funds to promote locally planned and controlled conjunctive use programs.]

Future Groundwater Management in California

Trying to predict what will happen with groundwater management in California is difficult given that actions by all of the involved groups—landowners, local governments, local, State, and federal agencies, and the courts—will continue to shape groundwater management in the future. However, the increasing population and its demands on California's water supply will accelerate the rate at which groundwater management issues become critical and require resolution. Some general conclusions are:

- Groundwater management will continue to be a local responsibility with increasing emphasis on how actions in one part of a basin impact groundwater resources throughout the basin. Regional cooperation and coordination of groundwater management activities will increase.
- As the State's population continues to grow, the increased reliance on groundwater will keep the topic of groundwater management at the forefront of legislative interest.
- Coordinated management of groundwater and surface water resources, through further development of conjunctive water management programs and projects, will become increasingly important.
- The increased reliance on groundwater in the future will necessitate a more direct link between land use planning, watershed management, floodplain management, and groundwater management plans.
- Current trends indicate that financial incentives in the form of loans and grants are increasing groundwater management planning and implementation at the local level. These successes will only continue at the current pace with increased funding to local agencies.
- Management of groundwater will increasingly include consideration of groundwater quality and groundwater quantity.
- Groundwater will be an important element in the trend toward an integrated water management approach that considers the full range of demand management and supply alternatives.
- Understanding of the relationship of groundwater and surface water and the role of groundwater in the environment will continue to grow.

Box J Managing Groundwater Quantity and Quality

When people hear the words “groundwater monitoring”’ they may think either of measuring groundwater levels or of analyzing for groundwater quality. In reality, monitoring and management of groundwater quantity and groundwater quality are inseparable components of a management plan.

Although the primary focus of the California Department of Water Resources (DWR) is on groundwater quantity and the measures taken by local agencies to manage supply, management must also consider groundwater quality. Natural or anthropogenic contamination and pumping patterns that are not managed to protect groundwater quality may limit the quantity of groundwater that is available for use in a basin.

Several State programs provide useful data as well as regulatory direction on groundwater quality that managers can use in managing their groundwater supply. One program is the Drinking Water Source Assessment and Protection Program prepared by the California Department of Health Services in response to 1996 amendments to the federal Safe Drinking Water Act. The DWSAP requires water purveyors to assess sources of drinking water, develop zones indicating time of travel of groundwater, and identify potentially contaminating activities around supply wells. The goal is to ensure that the quality of drinking water sources is maintained and protected. Other useful water quality data for groundwater managers is collected by the agencies within the California Environmental Protection Agency, including the State Water Resources Control Board, Department of Pesticide Regulation and the Department of Toxic Substances Control, which are discussed in more detail in Chapter 5. Each of these agencies has a specific statutory responsibility to collect groundwater quality information and protect water quality.

Protection of Recharge Areas

Groundwater recharge areas, and the human activities that can render them unusable, are an example of the need to coordinate land use activities to protect both groundwater quality and quantity. Protection of recharge areas, whether natural or man-made, is necessary if the quantity and quality of groundwater in the aquifer are to be maintained. Existing and potential recharge areas must be protected so that they remain functional, that is they continue to provide recharge to the aquifer and they are not contaminated with chemical or microbial constituents. Land-use practices should be implemented so that neither the quantity nor quality of groundwater is reduced. A lack of protection of recharge areas could decrease the availability of usable groundwater and require the substitution of a more expensive water supply.

Many potentially contaminating activities have routinely been practiced in recharge areas, leading to the presence of contaminants in groundwater. In many areas, groundwater obtained from aquifers now requires remediation. Recent studies in some areas show that recharge areas are contaminated, but down-gradient wells are not, indicating that it is only a matter of time before contaminants in wells reach concentrations that require treatment of the groundwater.

In addition to quality impacts, urban development, consisting of pavement and buildings on former agricultural land, lining of flood control channels, and other land use changes have reduced the capacity of recharge areas to replenish groundwater, effectively reducing the safe yield of some basins.

Box J Managing Groundwater Quantity and Quality (continued)

To ensure that recharge areas continue to replenish high quality groundwater, water managers and land use planners should work together to:

- Identify recharge areas so the public and local zoning agencies are aware of the areas that need protection from paving and from contamination;
- Include recharge areas in zoning categories that eliminate the possibility of contaminants entering the subsurface;
- Standardize guidelines for pre-treatment of the recharge water, including recycled water;
- Build monitoring wells to collect data on changes in groundwater quality that may be caused by recharge; and
- Consider the functions of recharge areas in land use and development decisions.

Chapter 3
Groundwater Management Planning and Implementation

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Groundwater Management Planning and Implementation

The 1990s were a very important decade in the history of groundwater management in California. In 1992, the State Legislature provided an opportunity for more formal groundwater management with the passage of AB 3030 (Water Code § 10750 et seq.). More than 200 agencies have adopted an AB 3030 groundwater management plan. Additionally, 24 of the 27 counties with ordinances related to groundwater management adopted those laws during the 1990s. Plans prepared under AB 3030 certainly brought unprecedented numbers of water agencies into the groundwater management arena, and counties are now heavily involved in groundwater management, primarily through ordinances. However, many plans prepared under AB 3030 have had little or no implementation, and many counties focus primarily on limiting exports rather than on a comprehensive management program. As a result, the California Budget Act of 1999 (Stats. 1999, ch. 50), which authorized this update to Bulletin 118, directed the California Department of Water Resources (DWR) to complete several tasks, including developing criteria for evaluating groundwater management plans and developing a model groundwater management ordinance. This chapter presents the results of these directives. The intent is to provide a framework that will assist local agencies in proactively planning and implementing effective groundwater management programs.

Criteria for Evaluating Groundwater Management Plans—Required and Recommended Components

In 2002, the Legislature passed SB 1938 (Stats 2002, ch 603), which amended Water Code section 10750 et seq to require that groundwater management plans adopted by local agencies include certain components to be eligible for public funds administered by DWR for construction of groundwater projects; the statute applies to funds authorized or appropriated after September 1, 2002. In addition to the required components, DWR worked with representatives from local water agencies to develop a list of additional recommended components that are common to effective groundwater management.

Both the "required" and the "recommended" components are tools that local agencies can use either to institute a groundwater management plan for the first time or to update existing groundwater management plans. These components are discussed below and listed in Appendix C, which can be used as a checklist by local agencies to assess whether their groundwater management plans are addressing these issues.

Required Components of Local Groundwater Management Plans

As of January 1, 2003, amendments to Water Code Section 10750 et seq., resulting from the passage of SB 1938, require new groundwater management plans prepared under section 10750, commonly referred to as AB 3030 plans, to include the first component listed below.

Groundwater management plans prepared under any statutory authority must include components 2 through 7 to be eligible for the award of public funds administered by DWR for the construction of groundwater projects or groundwater quality projects. These requirements apply to funds authorized or appropriated after September 1, 2002. Funds appropriated under Water Code section 10795 et seq. (AB 303 – Local Groundwater Assistance Fund) are specifically excluded.

1) Documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan" (Water Code, § 10753.4 (b)).

2) Basin management objectives (BMOs) for the groundwater basin that is subject to the plan (Water Code, § 10753.7 (a)(1)).
3) Components relating to the monitoring and management of groundwater levels, groundwater quality, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping (Water Code, § 10753.7 (a)(1)).
4) A plan by the managing entity to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin" (Water Code, § 10753.7 (a)(2)). A local agency includes "any local public agency that provides water service to all or a portion of its service area" (Water Code, § 10752 (g)).
5) Adoption of monitoring protocols (Water Code, § 10753.7 (a)(4)) for the components in Water Code section 10753.7 (a)(1). Monitoring protocols are not defined in the Water Code, but the section is interpreted to mean developing a monitoring program capable of tracking changes in conditions for the purpose of meeting BMOs.
6) A map showing the area of the groundwater basin as defined by DWR Bulletin 118 with the area of the local agency subject to the plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan (Water Code, § 10753.7 (a)(3)).
7) For local agencies not overlying groundwater basins, plans shall be prepared including the above listed components and using geologic and hydrologic principles appropriate to those areas (Water Code, § 10753.7 (a)(5)).

Recommended Components of Groundwater Management Plans

Although the seven components listed above are required only under certain conditions, they should always be considered for inclusion in any groundwater management planning process. In addition to the required components of a groundwater management plan resulting from the passage of SB 1938, it is recommended that the components listed below be included in any groundwater management plan adopted and implemented by a local managing entity. These additional components were developed in accord with the Budget Act of 1999 and with the assistance of stakeholder groups. The components should be considered and developed for specific application within the basin, subbasin, or agency service area covered by the plan. Additional components will likely be needed in specific areas. The level of detail for each component will vary from agency to agency. None of the suggested data reporting in the components should be construed to require disclosure of information that is confidential under State law. Local agencies should consider both the benefits of public dissemination of information and water supply security in developing reporting requirements.

Manage with the Guidance of an Advisory Committee

The managing entity should establish an advisory committee of interested parties that will help guide the development and implementation of the plan. The committee can benefit management in several ways. First, the committee can bring a variety of perspectives to the management team. As the intent of local groundwater management is to maintain and expand local benefits from the availability of the resource, it makes sense that the intended beneficiaries are a part of the management process. Second, the committee is free to focus on the specifics of groundwater management without being distracted by the many operational activities that the managing entity (such as a water district) must complete. Third, some parties could be negatively impacted by certain groundwater management decisions, and these actions and potential adverse impacts should be a part of the decision-making process to help reduce future conflicts. Finally, the advisory committee helps the managing entity gain the confidence of the local constituency by providing the opportunity for interested parties to participate in the management process.

Many managing entities have already elected to use advisory committees for implementation of their groundwater management plans. The composition of these committees varies widely. Some groups consist entirely of stakeholders, others add local or State government representatives or academic members as impartial third parties, and some have included consultants as technical advisers. Some plans use multiple advisory committees to manage unique subareas. Some plans appoint advisory committees with different objectives, such as one that deals with technical issues and another that deals with policy issues. There is no formula for the composition of an advisory committee because it should ultimately be based on local management needs and should include representation of diverse local interests.

The Tulare Lake Bed Coordinated Management Plan provides an example of the benefit of an advisory committee. The plan includes nine groups of participants, making coordination and communication a complicated issue. To allow for greater communication, an executive committee was established consisting of one voting member from each public agency participating in the plan and one voting member representing a combined group of private landowner plan participants. The committee administers groundwater management activities and programs for the plan (TLBWSD 2002).

Describe the Area to Be Managed under the Plan

The plan should include a description of the physical setting and characteristics of the aquifer system underlying the plan area in the context of the overall basin. The summary should also include a description of historical data, including data related to groundwater levels, groundwater quality, subsidence, and groundwater-surface water interaction; known issues of concern with respect to the above data; and a general discussion of historical and projected water demands and supplies. All of these data are critical to effective groundwater management because they demonstrate the current understanding of the system to be managed and serve as a point of departure for monitoring activities as part of plan implementation.

Create a Link Between Management Objectives and Goals and Actions of the Plan

The major goal of any groundwater management plan is to maintain a reliable supply of groundwater for long-term beneficial uses of groundwater in the area covered by the plan. The plan should clearly describe how each of the adopted management objectives helps attain that goal. Further, the plan should clearly describe how current and planned actions by the managing entity help meet the adopted management objectives. The plan will have a greater chance of success by developing an understanding of the relationship between each action, management objectives, and the goal of the groundwater management plan.

For example, prevention of contamination of groundwater from the land surface is a management objective that clearly supports the goal of groundwater sustainability. Management actions that could help support this objective include (1) educating the public through outreach programs that explain how activities at the surface ultimately impact groundwater, (2) developing wellhead protection programs or re-evaluating existing programs, (3) working with the local responsible agency to ensure that permitted wells are constructed, abandoned, and destroyed according to State well standards, (4) investigating whether local conditions necessitate higher standards than those adopted by the local permitting agency for the construction, abandonment, or destruction of wells, and (5) working with businesses engaged in practices that might impact groundwater to reduce the risks of contamination.

The concept of having a management objective is certainly not new. While many existing plans do not clearly include management objectives nor specifically identify actions to achieve objectives, some plans indirectly include these components. As an example, Eastern Municipal Water District's (EMWD) Groundwater Management Plan states that its goal includes maximizing "the use of groundwater for all beneficial uses in such a way as to lower the cost of water supply and to improve the reliability of the total water supply for all users." To achieve this goal, EMWD has listed several issues to be addressed. One is the prevention of long-term depletion of groundwater. This can be defined as a management objective even though it is not labeled as such. Where this management objective is currently unmet in the North San Jacinto watershed portion of the plan area, EMWD has identified specific actions to achieve that objective including the reduction of groundwater extraction coupled with pursuing the construction of a pipeline to act as an alternative source of surface water for the impacted area (EMWD 2002).

Describe the Plan Monitoring Program

The groundwater management plan should include a map indicating the locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence, stream gaging, and other applicable monitoring. The groundwater management plan should summarize the type of monitoring (for example, groundwater level, groundwater quality, subsidence, streamflow, precipitation, evaporation, tidal influence), type of measurements, and the frequency of monitoring for each location. Site specific monitoring information should be included in each groundwater management plan. The plan should include the well depth, screened interval(s) and aquifer zone(s) monitored and the type of well (public, irrigation, domestic, industrial, monitoring). These components will serve as a tool for the local managing entity to assess the adequacy of the existing monitoring network in tracking the progress of plan activities.

The groundwater management plan developed for the Scotts Valley Water District (SVWD) provides a detailed description of the monitoring program in Santa Cruz County (Todd Engineers 1994) Table 6 is SVWD's monitoring table, which serves as an example of the level of detail that is useful in a plan (Todd Engineers 2003a). Figure 9 shows the locations and types of monitoring points for each monitoring site. The monitoring table specifies in detail the data available and the planned monitoring. These serve as useful tools for SVWD to visualize the types and distribution of data available for their groundwater management activities. In addition to the minimum types of monitoring, SVWD summarizes other types of data that are relevant to their groundwater management effort.

Describe Integrated Water Management Planning Efforts

Water law in California treats groundwater and surface water as two separate resources with the result that they have largely been managed separately. Such management does not represent hydrologic reality. Recently, managers of a number of resources are becoming increasingly aware of how their planning activities could impact or be impacted by the groundwater system. Because of this, the local managing entity should describe any current or planned actions to coordinate with other land use, zoning, or water management planning entities.

Integrated management is addressed in existing groundwater management plans in several ways, including conjunctively managing groundwater with surface water supplies, recharging water from municipal sewage treatment plants, and working with local planning agencies to provide comments when a project is proposed that could impact the groundwater system.

Examples of planning efforts that should be integrated with groundwater management may include watershed management, protection of recharge areas, agricultural water management, urban water management, flood management, drinking water source assessment and protection, public water system emergency and disaster response, general plans, urban development, agricultural land preservation, and environmental habitat protection or restoration. Another example that may appear insignificant is transportation infrastructure. However, local impacts on smaller aquifers could be significant when landscaping of medians and interchanges requires groundwater pumping for irrigation or when paved areas are constructed over highly permeable sediments that act as recharge zones for the underlying aquifer.

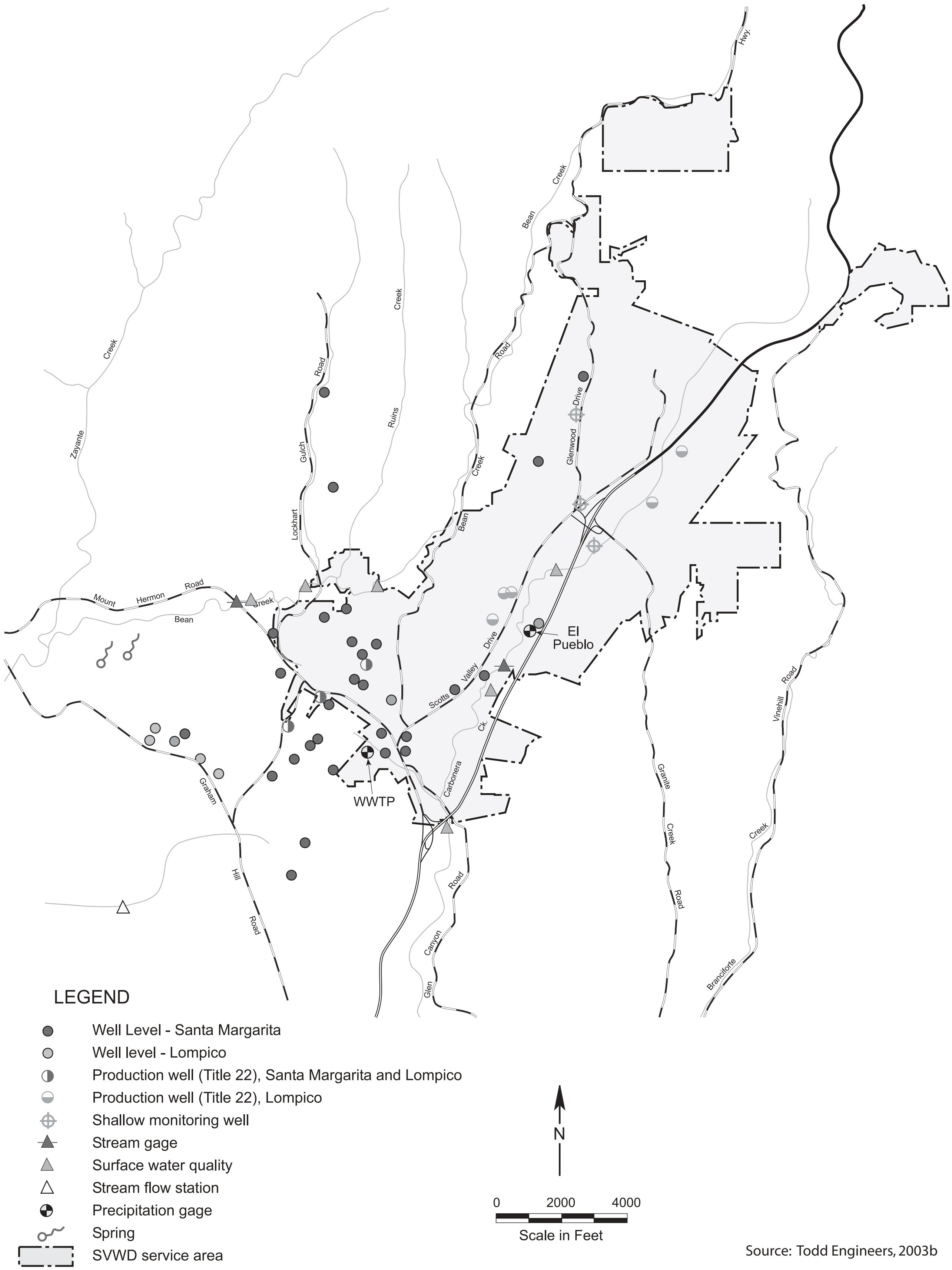
Table 6 Scotts Valley Water District's Groundwater Monitoring Plan

Monitoring type	Location	Measurement type	Date started	Frequency/ maintainer	Notes
Precipitation	El Pueblo Yard	15-minute recording	Feb-85	Daily/District, Monthly/City	Other historic gages:(1) Blair site on Granite Ck. Rd. (Jan. 1975 - Dec. 1980) (2) Hacienda Dr. (Jul. 1974 - Mar. 1979) (3) El Pueblo Yard bucket gage (Jan. 1981 - Jan. 1985)
	WWTP	5-minute recording	1990	Daily/City	
Evaporation	El Pueblo Yard	Pan	Jan-86	Daily/District	Evaporation pan raw data not compiled after July 1990
Evapotranspiration	De Laveaga Park, Santa Cruz	Automated active weather station	Sep-90	California Irrigation Management Information System/Monthly	Data available on-line through CIMIS
Streamflow	Carbonera Ck at Scotts Valley @ Cabonera Way Bridge (#111613000)	15-minute recording	Jan-85	USGS/ Daily	Other historic gages: (1) Carbonera Ck @ Santa Cruz (#11161400) 150 feet upstream from mouth (1974-1976 partial data)
	Bean Ck near Scotts Valley @ Hermon Crossing (#11160430)	15-minute recording	Dec-88	USGS/ Daily	(2) Bean Ck near Felton (#11160320) (1973-1978 partial data), low flows at same location (1983-1988)
	Eagle Creek In Henry Cowell Redwoods State Park	Bucket-Fall, Flow Meter-Spring	Mar-01	Semi-annually/ Todd Engineers	(3) Carbonera Creek @ Glen Canyon (1990-1994?)
Well Inventory	T10S/R01E Sections 6-9, 16-20, 30 and T10S/R02E Sections 1,11-14, 23-26, 36	Over 400 wells: location, log, type, capacity, etc. stored in GIS, and Access database	1950s	Logs from DWR maintained by Todd Engineers	
Groundwater Levels	~34 Santa Magarita aquifer and ~14 Lompico formation wells	Depth to water	1968	Quarterly/ District and cooperators	Data from over 75 wells, as early as 1968, bi-monthly 1983-1989
Pumpage	T10S/R01E Sections 6-9, 16-20, 30 and T10S/R02E Sections 1,11-14, 23-26, 36 District wells in production and on standby	Metered	1975	Monthly/ Scotts Valley Water District, Mt. Hermon Association, Hanson Aggregates West, San Lorenzo Valley Water District	Other historic pumpage data: Manana Woods (1988-1996 partial data)

Table 6 Scotts Valley Water District's Groundwater Monitoring Plan (continued)

Monitoring type	Location	Measurement type	Date started	Frequency/ maintainer	Notes
Groundwater Quality	T10S/R01E Sections 6-9, 16-20, 30 and T10S/R02E Sections 1,11-14,23-26, 36 District wells in production	Title 22 constituents	1963	At least semi-annual/ District and others	Data from over 80 wells, as early as 1963, monitoring frequency similar to groundwater level program
	North Scotts Valley 3 shallow monitoring wells	Metals, nitrogen species, general minerals	Mar-01	Semi-annually/ Todd Engineers	
Surface Water Quality	4 sites on Carbonera and 3 sites on Bean Creek	Grab samples - metals, nitrogen species, general minerals	Mar-01	Semi-annually/ Todd Engineers	
Wastewater Outflows	City of Scotts Valley WWTP @ Lundy Lane	Wastewater outflow volume and effluent quality	1965	Daily/City of Scotts Valley	Plant operational in 1965 (septic systems pre-1965)
Recycled Water Production	Scotts Valley WWTP	Recycled water quantity and quality	2002	At least quarterly/ WWTP	

Source: Todd Engineering 2003a



Source: Todd Engineers, 2003b

Figure 9 Scotts Valley Water District's Groundwater Management Plan monitoring locations

Box K What are Management Objectives?

Management objectives are the local managing entity's way of identifying the most important issues in meeting local resource needs; they can be seen as establishing a "value system" for the plan area. There is no fixed set of management objectives for any given plan area. Some of the more commonly recognized management objectives include the monitoring and managing of groundwater levels, groundwater quality, inelastic land subsidence, and changes in streamflow and surface water quality where they impact or are impacted by groundwater pumping. Management objectives may range from being entirely qualitative to strictly quantified.

Each management objective would have a locally determined threshold value associated with it, which can vary greatly. For example, in establishing a management objective for groundwater quality, one area may simply choose to establish an average value of total dissolved solids as the indicator of whether a management objective is met, while another agency may choose to have no constituents exceeding the maximum contaminant level for public drinking water standards. While there is great latitude in establishing management objectives, local managers should remember that the objectives should serve to support the goal of a sustainable supply for the beneficial use of the water in their particular area.

An example of an alternative management objective is Orange County Water District's (OCWD) objective of maintaining available storage space in its management area at 200,000 acre-feet. The objective does not require that groundwater elevations be fixed at any particular location, although managing to this objective would likely have the net benefit of stabilizing water levels. Groundwater storage is a dynamic value, so attempting to meet this management objective is an ongoing challenge. OCWD has implemented many management actions directly aimed at managing the basin to meet this objective.

The Deer Creek and Tule River Authority provides an excellent example of how groundwater management activities can be coordinated with other resources. The authority, in conjunction with the U.S. Bureau of Reclamation, has constructed more than 200 acres of recharge basins as part of its Deer Creek Recharge-Wildlife Enhancement Project. When available, the project takes surplus water during winter months and delivers it to the basins, which serve as winter habitat for migrating waterfowl, creating a significant environmental benefit. Most of the water also recharges into the underlying aquifer, thereby benefiting the local groundwater system.

Report on Implementation of the Plan

The managing entity should produce periodic reports—annually or at other frequencies determined by the local managing entity—summarizing groundwater basin conditions and groundwater management activities. For the period since the previous update, the reports should include:

- A summary of monitoring results, including historical trends,
- A summary of actual management actions,
- A summary, supported by monitoring results, of whether management actions are achieving progress in meeting management objectives,
- A summary of proposed management actions, and
- A summary of any plan component changes, including addition or modification of management objectives.

Unfortunately, many plans were prepared in the mid-1990s with little or no follow-up documentation of whether the plan is actually being implemented. This makes it difficult to determine what progress has been achieved in managing the groundwater resource. Periodic reports will serve as a tool for the managing entity to organize its many activities to implement the plan, act as a driving force for plan implementation, and help interested parties understand the progress made by local entities in managing their groundwater resource.

Progress reports on SVWD (Todd Engineers 2002) and EMWD (2002) groundwater management plans serve as excellent examples of the value of such an exercise. Both reports effectively portray the results of management actions: progress toward achieving objectives and specific recommendations for future management actions. An example of reporting on the modification of a management objective for water quality can be found in EMWD's 2000 Annual Report (EMWD 2001). A task force of more than 20 water suppliers and wastewater agencies, including EMWD, worked to update the Regional Water Quality Control Board's Region 5 Basin Plan objectives for nitrogen and total dissolved solids in water, effectively changing EMWD's management objectives for those constituents.

Evaluate the Plan Periodically

The managing entity and advisory committee should re-evaluate the entire plan. Periodic evaluation of the entire management plan is essential to define successes and failures under the plan and identify changes that may be needed. Additionally, re-evaluation of the plan should include assessment of changing conditions in the basin that may warrant modification of the plan or management objectives. Adjustment of components in the plan should occur on an ongoing basis if necessary. The re-evaluation of the plan should focus on determining whether the actions under the plan are meeting the management objectives and whether the management objectives are meeting the goal of sustaining the resource.

While there are several examples of existing groundwater management plans that demonstrate ongoing changes to plan activities, there are no known examples of such an approach to entirely re-evaluate an existing plan. This is likely due in part to the occurrence of several consecutive wet years in the mid- and late-1990s. The abundant surface water supplies reduced the need to actively manage groundwater supplies in many cases. More recent dry conditions and the recent passage of SB 1938 will create an excellent opportunity for managing entities to begin a re-evaluation of existing plans.

Model Groundwater Management Ordinance

As discussed in the previous chapter, ordinances are groundwater management mechanisms enacted by local governments through exercise of their police powers to protect the health and safety of their citizens. In Baldwin v. Tehama County (1994), the appellate court declared that State law does not preempt the field of groundwater management.

In the mid- to late-1990s, many counties adopted ordinances that effectively prevented export of groundwater from the county, even though none specifically prohibited export. The intent of each of these ordinances is to sustain groundwater as a viable local resource. To ensure that goal, an export project proponent is required by most of the ordinances to show that the proposed project will not cause depletion of the groundwater, degradation of groundwater quality, or subsidence before a permit to export groundwater can be issued. Although these ordinances do not specifically require threshold limits for each of these potential negative impacts, a project proponent can really only show that these negative effects will not occur if the proponent develops a groundwater management plan.

Many of these ordinances were developed in response to the plans of some agencies or landowners to export groundwater or develop a groundwater substitution project where surface water is exported and groundwater is substituted for local use. In some cases, short-term export actually took place, leading to a number of claims of negative third party impacts. Residents of some counties became concerned because no one knew how much groundwater was available for local use and how much groundwater was available for export. In short, details of the hydrology of the basin, including surface water and groundwater availability, water quality, and the interaction of surface water and groundwater were not known. This lack of detailed knowledge about the operating potential of their groundwater resources led counties to take what they viewed as protective action, which consisted of requiring a permit before anyone could export groundwater from the county.

From the perspective of DWR, groundwater should be managed in a manner that ensures long-term sustainability of the resource for beneficial uses. Those beneficial uses are to be decided by the local stakeholders within the basin. In some areas, there may be an ample supply of water, so groundwater exports or substitution projects are feasible while local beneficial uses of the water supply are maintained. In other areas, limiting exports may be necessary to maintain local beneficial uses. Such determinations can be made only after the data are collected and evaluated and the results are used to develop management objectives for the basin.

While developing both the criteria for evaluating groundwater management plans and the model groundwater management ordinance, DWR staff has borne two principles in mind. First, the goal of groundwater management, whether accomplished by a plan or by an ordinance, is to sustain and often expand a groundwater resource. Second, groundwater management, whether accomplished by a plan or by an ordinance, requires that local agencies address and resolve the same or similar issues within the boundaries of the agencies. To say it in different words, whether it is a plan or an ordinance, good groundwater management should address the same issues and problems and arrive at the same conclusions and solutions to satisfy the needs of the local area. While some areas may allow or promote exports, others may not.

As stated above, the Legislature required a model ordinance as one of the elements of this update of Bulletin 118. The model ordinance is included as Appendix D and can be used by local governments that have identified a need to adopt a groundwater management ordinance. The model is an example of what a local ordinance might include. Local conditions will require some additions, modifications, or deletions. The variety of political, institutional, legal, technical, and economic opportunities and constraints throughout California guarantees that there will be differences to which the model will have to be adapted. Local governments interested in adopting a groundwater management ordinance are encouraged to consider all components included in the model.

Water Code section 10753.7(b)(1)(A) allows an agency to participate in or consent to be subject to a groundwater management plan, a basin-wide management plan, or other integrated regional water management plan in order to meet the funding eligibility requirements that resulted from passage of SB 1938 (2001). A local government that adopts an ordinance should consider whether or not it will have local agencies that do not have their own groundwater management plan, but consent to be managed under the ordinance. If this situation is anticipated, the ordinance should include the required components described in the Water Code so State funding can be pursued.

Chapter 4

Recent Actions Related to Groundwater Management

Chapter 4
Recent Actions Related to Groundwater Management

The past few years have seen significant actions that impact groundwater management in California. Below are several examples of recent actions including legislation, ballot measures, and executive orders that show the State Legislature and the citizens of California clearly recognize the importance of groundwater and its appropriate management in meeting the present and future water supply needs of the State.

Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act of 2000 (Proposition 13)

On March 7, 2000, California voters approved a $1.97-billion general obligation bond known as the Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act (Proposition 13). Of the nearly $2 billion, $230 million was earmarked for groundwater programs. The act authorizes $200 million for grants for feasibility studies, project design, and construction of conjunctive use facilities (Water Code, § 79170 et seq.) and $30 million in loans for local agency acquisition and construction of groundwater recharge facilities and feasibility study grants for projects potentially eligible for the loan program (Water Code, § 79161 et seq.). More than $120 million have been awarded in grants and loans to local agencies in the first two years of implementation of these programs.

California Bay-Delta Record of Decision

The goal of the California Bay-Delta (formerly CALFED) program is to restore ecosystem health and improve water management in the Bay-Delta system. The program has four primary objectives:

- Provide good water quality for all beneficial uses,
- Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species,
- Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system, and
- Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.

The Record of Decision (ROD), released in August 2000, sets forth a 30-year plan to address ecosystem health and water supply reliability problems in the Bay-Delta system. The ROD lays out specific actions and investments over the first seven years to meet program goals. Most important, with respect to groundwater is the California Bay-Delta program's commitment to local groundwater management. The ROD states, "CALFED will work with local governments and affected stakeholders to develop legislation to strengthen AB 3030 and provide technical and financial incentives to encourage more effective basin-wide groundwater management plans…" (CALFED 2000). The ROD encourages basin management that is developed at the subbasin level so that it addresses local needs, but is coordinated at the basin-wide level so that it considers impacts to other users in the basin. The ROD also commits Bay-Delta agencies to "facilitate and fund locally supported, managed, and controlled groundwater and conjunctive use projects with a total of 500,000 acre-feet to 1 million acre-feet (maf) of additional storage capacity by 2007" (CALFED 2000).

Local Groundwater Management Assistance Act of 2000 (AB 303, Water Code Section 10795 et seq.)

The goal of the Local Groundwater Management Assistance Act is to help local agencies better understand how to manage groundwater resources effectively to ensure the safe production, quality, and proper storage of groundwater in the State. The act created the Local Groundwater Assistance Fund, which must be appropriated annually. In three years, more than $15 million in grants were awarded for 71 projects. Grants went to local agencies for groundwater studies and projects that contribute to basin and subbasin management objectives, including but not limited to groundwater monitoring and groundwater basin management. Grants are available to all geographic areas of the State. This act serves to emphasize that groundwater is recognized as an important local resource and, to the extent that groundwater is properly managed at the local level, serves to benefit all Californians.

Groundwater Quality Monitoring Act of 2001 (AB 599, Water Code Section 10780 et seq.)

Assembly Bill 599, known as the Groundwater Quality Monitoring Act of 2001, set a goal to establish comprehensive groundwater monitoring and increase the availability of information about groundwater quality to the public. The objective of the program is to highlight those basins in which contamination has occurred or is likely to occur and provide information that will allow local managers to develop programs to curtail, treat, or avoid additional contamination. The act required the State Water Resources Control Board (SWRCB), in coordination with an Interagency Task Force (ITF) and a Public Advisory Committee (PAC), to integrate existing monitoring programs and design new program elements, as necessary, to establish a comprehensive statewide groundwater quality monitoring program.

Through the ITF and PAC, the Comprehensive Groundwater Quality Monitoring Program was developed. The program will seek to:

- Accelerate the monitoring and assessment program already established by the SWRCB,
- Implement monitoring and assessment in accordance with a prioritization of basins/subbasins,
- Increase coordination and data sharing among groundwater agencies, and
- Maintain groundwater data in a single repository to provide useful access by the public while maintaining appropriate security measures.

The Comprehensive Groundwater Quality Monitoring Program is expected to provide the following key benefits:

- A common base communications medium for agencies to utilize and supply groundwater quality data at multiple levels,
- A mechanism to unite local, regional and statewide groundwater programs in a common effort,
- Better understanding of local, regional and statewide water quality issues and concerns that in turn can provide agencies at all levels with better information to deal with the concerns of consumers and consumer advocate groups,
- Trend and long-term forecasting information for groundwater agencies, which is essential for groundwater management plan preparation and implementation, and
- The motivation for small- and medium-sized agencies to begin or improve their own groundwater monitoring and management programs.

Water Supply Planning

Three bills enacted by the Legislature to improve water supply planning processes at the local level became effective January 1, 2002. In general, the new laws are intended to improve the assessment of water supplies during the local planning process before land use projects that depend on water are approved. The new laws require the verification of sufficient water supplies as a condition for approving developments, and they compel urban water suppliers to provide more information on the reliability of groundwater if used as a supply.

SB 221 (Bus. and Prof. Code, § 11010 as amended; Gov. Code, § 65867.5 as amended; Gov. Code, §§ 66455.3 and 66473.7) prohibits approval of subdivisions consisting of more than 500 dwelling units unless there is verification of sufficient water supplies for the project from the applicable water supplier(s). This requirement also applies to increases of 10 percent or more of service connections for public water systems with less than 500 service connections. The law defines criteria for determining "sufficient water supply," such as using normal, single-dry, and multiple-dry year hydrology and identifying the amount of water that the supplier can reasonably rely on to meet existing and future planned uses. Rights to extract additional groundwater must be substantiated if used for the project.

SB 610 (Water Code, §§ 10631, 10656, 10910, 10911, 10912, and 10915 as amended; Pub. Resources Code, § 21151.9 as amended) and AB 901 (Water Code, §§ 10610.2 and 10631 as amended; Water Code § 10634) make changes to the Urban Water Management Planning Act to require additional information in Urban Water Management Plans (UWMP) if groundwater is identified as a source available to the supplier. Required information includes a copy of any groundwater management plan adopted by the supplier, proof that the developer or agency has rights to the groundwater, a copy of the adjudication order or decree for adjudicated basins, and if not adjudicated, whether the basin has been identified as being overdrafted or projected to be overdrafted in the most current DWR publication on the basin. If the basin is in overdraft, the UWMP must include current efforts to eliminate any long-term overdraft. A key provision in SB 610 requires that any project subject to the California Environmental Quality Act supplied with water from a public water system must provide a water supply assessment, except as specified in the law. AB 901 requires the plan to include information relating to the quality of existing sources of water available to an urban water supplier over given periods and include the manner in which water quality affects water management strategies and supply reliability.

Emergency Assistance to the Klamath Basin

On May 4, 2001, the Governor proclaimed a State of Emergency in the Klamath Basin in Siskiyou and Modoc counties. The proclamation included disaster assistance of up to $5 million under authority of the State Natural Disaster Assistance Act. This assistance went directly into constructing wells to extract groundwater for use on cover crops to avoid loss of critical topsoil. The Governor's proclamation also included $1 million for a study of the Klamath River Basin to determine the long-term water supply in the California portion of the basin.

Governor's Drought Panel

The Governor's Advisory Drought Planning Panel was formed in 2000 to develop a contingency plan to address the impacts of critical water shortages in California. The panel formed with the recognition that critical water shortages may severely impact the health, welfare, and economy of California. Panel recommendations included securing funding for the Local Groundwater Management Assistance Act (described above), continued support of critical groundwater monitoring in basins with inadequate data, and the formation of a technical assistance and education program for "rural homeowners and small domestic water systems relying on self-supplied groundwater" (GADPP 2000).

Sacramento Valley Water Management Agreement

On May 22, 1995, SWRCB adopted the "Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta Estuary" (the 1995 WQCP). Following this action, SWRCB initiated a water rights hearing process with the intent of allocating responsibility for meeting the standards of the 1995 WQCP among water right holders in areas tributary to the Delta. The water rights hearing was conducted in phases with all phases being resolved with the exception of Phase 8, which involved water rights holders in the Sacramento Valley.

Proceeding with Phase 8 may have involved litigation and judicial review for years. That extended process could have resulted in adverse impacts to the environment and undermined progress on other statewide water management initiatives. To avoid the consequences of delay, the Sacramento Valley Water Users, DWR, the U.S. Bureau of Reclamation (USBR), and export water users developed the Sacramento Valley Water Management Agreement. The agreement became effective April 20, 2001. At that time, SWRCB issued an order staying the Phase 8 hearing for 18 months. The parties negotiated a short-term settlement agreement that obligated DWR and USBR to continue to fully meet the Bay-Delta water quality standards while providing for the development of conjunctive use and system improvement projects by participating upstream water rights holders that would make water available to help meet water quality standards while improving the reliability of local water supplies. SWRCB has subsequently dismissed the Phase 8 proceedings, and work is being undertaken on both short-term and long-term activities included in the Sacramento Valley Water Management Agreement.

Groundwater Management Water Code Amendments

In September 2002, SB 1938 (Water Code, § 10753.4 and § 10795.4 as amended; Water Code, § 10753.7, § 10753.8 and § 10753.9 as amended and renumbered; Water Code, § 10753.1 and § 10753.7 as added) was signed into law. The act amends existing law related to groundwater management by local agencies. The law requires any public agency seeking State funds administered through DWR for the construction of groundwater projects or groundwater quality projects to prepare and implement a groundwater management plan with certain specified components. Prior to this, there were no required plan components. New requirements include establishing basin management objectives, preparing a plan to involve other local agencies in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management. The requirements apply to agencies that have already adopted groundwater management plans as well as agencies that do not overlie groundwater basins identified in Bulletin 118 and its updates when these agencies apply for state funds. The requirements do not apply to funds administered through the AB 303-Local Groundwater Management Assistance Act (Water Code, § 10795 et seq.) or to funds authorized or appropriated prior to September 1, 2002. Further discussion of the requirements is included in Chapter 3 and Appendix C.

Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50)

California voters approved the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50; Water Code, § 79500 et seq.) in the November 2002 elections. The initiative provides for more than $3.4 billion of funding, subject to appropriation by the Legislature, for a number of land protection and water management activities.

Several chapters of Proposition 50 allocate funds for specified water supply and water quality projects, including:

- Chapter 3 Water Security. Provides $50 million to protect State, local, and regional drinking water systems from terrorist attack or deliberate acts of destruction or degradation.

- Chapter 4 Safe Drinking Water. Provides $435 million for grants and loans for infrastructure improvements to meet safe drinking water standards.
- Chapter 5 Clean Water and Water Quality. Provides $390 million for a number of water quality and environmental improvements.
- Chapter 6 Contaminant and Salt Removal Technologies. Provides $100 million for desalination of ocean or brackish waters as well as treatment and removal of contaminants.
- Chapter 7 California Bay-Delta program. Provides $825 million for continuing implementation of all elements of the program.
- Chapter 8 Integrated Regional Water Management. Provides $500 million for many categories of water management projects that will protect communities from drought, protect and improve water quality, and reduce dependence on imported water supplies.
- Chapter 9 Colorado River. Provides $70 million for canal-lining projects necessary to reduce water use and to meet commitments related to California's allocation of water from the Colorado River.

Chapter 5

The Roles of State and Federal Agencies in California Groundwater Management

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Even though groundwater management is a local responsibility and mostly voluntary, several State and federal agencies have key roles in California groundwater management. Some of these roles may not be immediately recognized, but because they work toward the goal of maintaining a reliable groundwater supply, they are closely related to groundwater management. Some of the programs available through the California Department of Water Resources (DWR) and other agencies that assist local agencies in managing groundwater resources are described below.

Local Groundwater Management Assistance from DWR

DWR's role in groundwater management begins with the fundamental understanding that groundwater management is locally driven and management programs should respond to local needs and concerns. DWR recognizes that when groundwater is effectively managed at the local level, benefits are realized at a statewide level.

DWR has historically maintained many programs that directly benefit local groundwater management efforts including:

- Providing assistance to local agencies to assess basin hydrogeologic characteristics,
- Assisting local agencies to identify opportunities to develop additional groundwater supply,
- Monitoring groundwater levels and quality,
- Providing watermaster services for court-adjudicated basins,
- Providing standards for well construction and destruction,
- Managing the State's extensive collection of well completion reports, and
- Reviewing proposals and distributing grant funds and low-interest loans for conjunctive use projects, as well as local groundwater management and monitoring programs.

Conjunctive Water Management Program

DWR's Conjunctive Water Management Program consists of a number of integrated efforts to assist local agencies in improving groundwater management and increasing water supply reliability.

One goal of the Integrated Storage Investigations (ISI) Program, an element of the Bay-Delta program, is to increase water supply reliability statewide through the planned, coordinated management and use of groundwater and surface water resources. The effort emphasizes forming working partnerships with local agencies and stakeholders to share technical data and costs for planning and developing locally controlled and managed conjunctive water management projects.

Toward that end, the Conjunctive Water Management Program has:

- Developed a vision in which DWR would assist local agencies throughout the State so that these agencies can effectively manage groundwater resources,
- Adopted a set of working principles to ensure local planning; local control, operation, and management of conjunctive use projects; voluntary implementation of projects; and local benefits from the proposed projects,
- Executed to date memoranda of understanding with 37 local agency partners and provided technical and financial assistance to study groundwater basins and assess opportunities for conjunctive water management,

- Provided technical assistance in the form of groundwater monitoring, groundwater modeling, and local water management planning, as well as a review of numerous regional and statewide planning efforts on a variety of water issues, and
- Provided facilitation assistance to promote broad stakeholder involvement in regional water management planning processes.

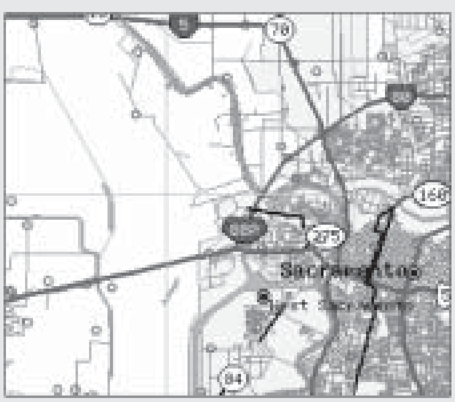
DWR staff review proposals and distribute grants pursuant to the Local Groundwater Management Assistance Act of 2000 (AB 303). To date, DWR has awarded more than $15 million to local agencies to fund 71 projects dealing with groundwater investigation, monitoring, or management.

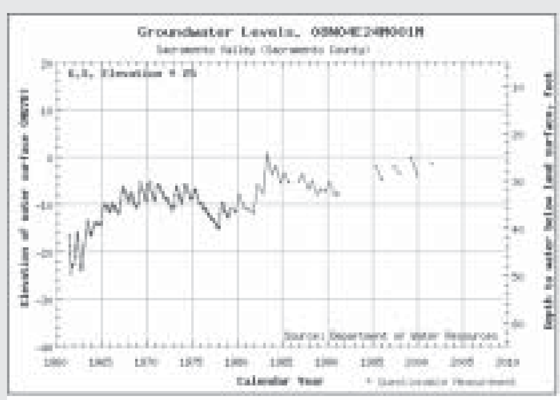
With funds provided under Proposition 13, DWR has awarded more than $170 million in loans and grants for groundwater recharge and storage studies and projects to local agencies throughout the State. Applicant estimates of the water supply reliability increases that will be realized from these projects exceeds 150 thousand acre-feet annually. Recipients of loans and grants must provide progress reports to allow an evaluation of the successes of the various programs. Figure 10 shows the distribution of loan and grant awardees throughout the State.

Both grant programs have active outreach efforts to inform and to assist agencies in preparation of applications. Selection of projects for funding relies in part on input from advisory committees composed of stakeholders from throughout the State.

Box L Providing Data:
The Internet Makes Groundwater Elevation Data Readily Accessible to the Public

In 1996, the California Department of Water Resources (DWR) began providing Internet access to groundwater level data and hydrographs for wells in groundwater basins throughout California. The website provides historical data for more than 35,000 wells monitored by DWR and its many cooperators and has proven very popular, with more than 60,000 visits to date. Options include a form or map interface to locate wells with water level data and the ability to download long-term water levels for specific wells or seasonal measurements for specific areas to create groundwater contour maps. The accessibility of this data makes it a significant resource for local agencies in making sound groundwater management decisions. The address of the site is http://wdl.water.ca.gov/.





Wells can be located with a map interface. By clicking on a well, a hydrograph with the latest data available is automatically generated.

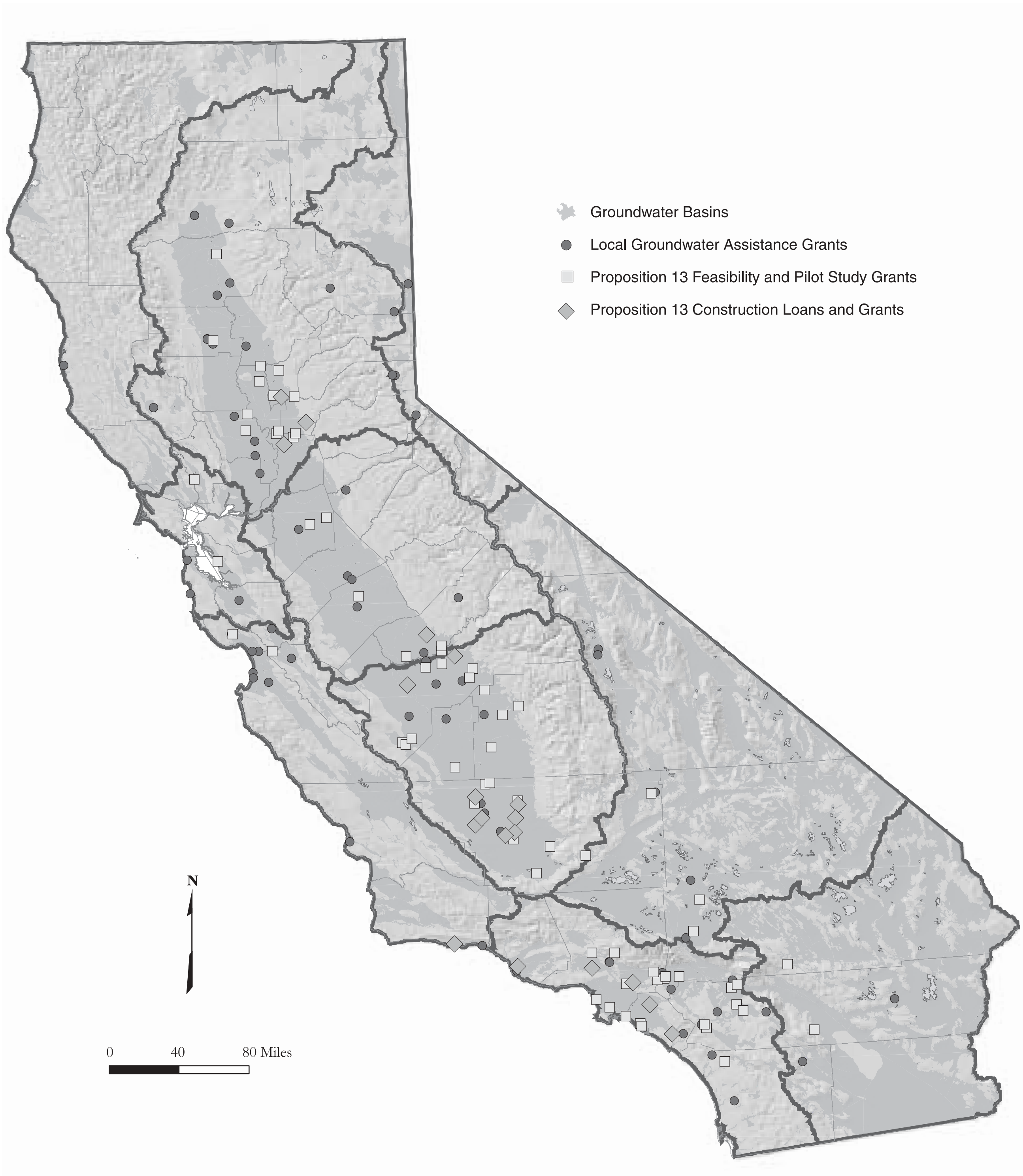


Figure 10 Broad distribution of grant and loan awardees for 2001 through 2003

Assistance from Other State and Federal Agencies

Many other State and federal agencies provide groundwater management assistance to local agencies. Some of those roles are described below. For more information on the roles of various agencies in protecting the groundwater resource, see the California Department of Health Services' Drinking Water Source Assessment and Protection Program Document (DHS 2000), California Groundwater Management (Bachman and others 1997), or the individual agency websites.

State Water Resources Control Board and Regional Water Quality Control Boards

http://www.swrcb.ca.gov The mission of the State Water Resources Control Board (SWRCB) is to ensure the highest reasonable quality of waters of the State, while allocating those waters to achieve the optimum balance of beneficial uses. In turn, the nine Regional Water Quality Control Boards (RWQCB) develop and enforce water quality objectives and implement plans to protect the beneficial uses of the State's waters, recognizing differences in climate, topography, geology, and hydrology.

SWRCB has many responsibilities regarding the protection of the groundwater resource. One of the more notable is the Groundwater Ambient Monitoring and Assessment (GAMA) Program. GAMA is a recently enacted program that will provide a comprehensive assessment of water quality in water wells throughout the state. GAMA has two main components: the California Aquifer Susceptibility (CAS) Assessment and the Voluntary Domestic Well Assessment Project.

The CAS combines age dating of water and sampling for low-level volatile organic compounds (VOCs), such as methyl tertiary-butyl ether (MTBE), to assess the relative susceptibility of all of approximately 16,000 public supply wells throughout the State. Age dating provides a general assessment of how quickly groundwater is moving through the system, while the sampling of low-level VOCs allows greater reaction time for potential remediation strategies before contaminants reach action levels. Sampling is being conducted by staff from the U.S. Geological Survey (USGS) and Lawrence Livermore National Laboratory. The CAS Assessment was developed cooperatively with DHS and DWR.

The Voluntary Domestic Well Assessment Project will provide a previously unavailable sampling of water quality in domestic wells, which will assist in assessing the relative susceptibility of California's groundwater. Because water quality in individual domestic wells is unregulated, the program is voluntary and will focus, as resources permit, on specific areas of the state. Constituents to be analyzed include nitrate, total and fecal coliform bacteria, MTBE, and minerals. Additional constituents will be added in areas with known water quality problems.

Other SWRCB/RWQCB activities related to groundwater protection include developing basin plans that identify existing and potential beneficial uses of marine water, groundwater, and surface waters; regulating the discharge of waste that may affect water quality in California; monitoring of landfills and hazardous waste facilities; establishing standards for the construction and monitoring of underground storage tanks; establishing management plans for control of nonpoint source pollutants; and issuing cleanup and abatement orders that require corrective actions by the responsible party for a surface water or groundwater pollution problem or nuisance.

The Groundwater Quality Monitoring Act of 2001 (AB599, Water Code, § 10780 et seq.) required the SWRCB to develop a comprehensive monitoring program in a report to the Legislature. See Chapter 4 for details.

California Department of Health Services

http://www.dhs.ca.gov/ps/ddwem The DHS Drinking Water Program, part of the Division of Drinking Water and Environmental Management, is responsible for DHS implementation of the federal Safe Drinking Water Act, as well as California statutes and regulations related to drinking water. As part of this responsibility, DHS inspects and provides regulatory oversight of approximately 8,500 public water systems (and approximately 16,000 drinking water wells) to assure delivery of safe drinking water to all California consumers.

Public water system operators are required to regularly monitor their drinking water sources for microbiological, chemical and radiological contaminants to show that drinking water supplies meet regulatory requirements (called primary maximum contaminant levels–MCLs). Among these contaminants are approximately 80 specific inorganic and organic chemical contaminants and six radiological contaminants that reflect the natural environment as well as human activities.

Public water system operators also monitor their water for a number of other contaminants and characteristics that deal with the aesthetic properties of drinking water (known as secondary MCLs). They are also required by regulation to analyze for certain unregulated contaminants (to allow DHS to collect information on emerging contaminants, for example), and to report findings of other contaminants that may be detected during routine monitoring. The DHS water quality monitoring database contains the results of analyses since 1984. These data, collected for purposes of regulatory compliance with drinking water laws, also provide an extensive body of information on the quality of groundwater throughout the State.

California Department of Pesticide Regulation

http://www.cdpr.ca.gov/dprprograms.htm The California Department of Pesticide Regulation (DPR) protects human health and the environment by regulating pesticide sales and use and by promoting reduced-risk pest management. DPR plays a significant role in monitoring for the presence of pesticides and in preventing further contamination of the groundwater resource.

DPR conducts six types of groundwater monitoring:

1) Monitoring for pesticides on a DPR-determined Ground Water Protection List, which lists pesticides with the potential to pollute groundwater;
2) Four-section survey monitoring to verify a reported detection and to help determine if a detected pesticide resulted from legal agricultural use;
3) Areal extent monitoring to identify the extent of contaminated wells;
4) Adjacent section monitoring to identify additional areas sensitive to pesticide movement to groundwater;
5) Monitoring to repeatedly sample a network of wells to determine whether pesticide residues are declining; and
6) Special project monitoring.

When pesticides are found in groundwater, they are normally regulated in one-square mile areas identified in regulation as sensitive to groundwater pollution. These pesticides are subject to permitting by the county agricultural commissioner and to use restrictions specified in regulation. DPR maintains an extensive database of pesticide sampling in groundwater and reports a summary of annual sampling and detections to the State Legislature.

California Department of Toxic Substances Control

http://www.dtsc.ca.gov The California Department of Toxic Substances Control (DTSC) has two programs related to groundwater resources protection: the Hazardous Waste Management Program and the Site Mitigation Program. These programs are authorized under Division 20 of the California Health and Safety Code, and implementing regulations are codified in Title 22 of the California Code of Regulations.

A critical element of both programs is maintaining environmental quality and economic vitality through the protection of groundwater resources. This is accomplished through hazardous waste facility permitting and design; oversight of hazardous waste handling, removal, and disposal; oversight of remediation of hazardous substances releases; funding of emergency removal actions involving hazardous substances, including the cleanup of illegal drug labs; cleanup of abandoned hazardous waste sites; oversight of the closure of military bases; and pollution prevention.

If groundwater is threatened or impacted by a hazardous substance release, DTSC provides technical oversight for the characterization and remediation of soil and groundwater contamination. DTSC and the nine RWQCBs coordinate regulatory oversight of groundwater remediation. To ensure site-specific groundwater quality objectives are met, DTSC consults with RWQCB staff and appropriate groundwater basin plans.

Box M Improving Coordination of Groundwater Information

California's groundwater resources are addressed by an array of different State and federal agencies. Each agency approaches groundwater from a unique perspective, based on its individual statutory mandate. As a result, each agency collects different types of groundwater data and information. To facilitate the effective and efficient exchange of groundwater resource information, the State Water Resources Control Board (SWRCB) is coordinating the Groundwater Resources Information Sharing Team (GRIST), which is composed of representatives from various groundwater agencies. Agencies currently participating in GRIST are:

- State Water Resources Control Board
- Department of Health Services
- Department of Water Resources
- Department of Pesticide Regulation
- Lawrence Livermore National Laboratory
- U.S. Geological Survey

One of the tasks of the GRIST is to identify data relevant to California groundwater resources. A listing of the data, along with the appropriate agency contacts and Internet links, will be maintained by SWRCB on the Groundwater Resources Information Database. In addition, to facilitate effective information sharing and communication among stakeholders, groundwater data will be made available on the SWRCB GeoTracker system. GeoTracker is a geographic information system that provides Internet access to environmental data. The centralization of environmental data through GeoTracker will enable more in-depth geospatial and statistical analyses of groundwater data in the future. For more information about GeoTracker, visit the GeoTracker Internet site at http://geotracker.arsenautlegg.com.

California Bay-Delta Authority

http://calwater.ca.gov The California Bay-Delta program was initiated in 1994 to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Sacramento-San Joaquin Bay-Delta System. The partnership currently consists of more than 20 State and federal agencies. An important element of the program is to increase storage by developing an additional 500,000 acre-feet to 1.0 million acre-feet of groundwater storage capacity by the year 2007 (CALFED 2000).

Effective January 1, 2003, a newly formed State agency assumed responsibility for overseeing implementation of the Bay-Delta program. The California Bay-Delta Authority provides a permanent governance structure for the collaborative state-federal effort. The authority was established by enactment of Senate Bill 1653 in 2002. The legislation calls for the authority to sunset on January 1, 2006, unless federal legislation has been enacted authorizing the participation of appropriate federal agencies in the authority.

U.S. Environmental Protection Agency

http://www.epa.gov/safewater The U.S. Environmental Protection Agency (EPA) Office of Ground Water and Drinking Water, together with states, tribes, and many partners, protects public health by ensuring safe drinking water and protecting groundwater. The EPA's role in California groundwater is primarily related to protection of the resource and comes in the form of administering several federal programs in close coordination with State agencies such as SWRCB, DHS, and DTSC.

U.S. Geological Survey

http://ca.water.usgs.gov USGS has published results of many studies of California groundwater basins. USGS maintains an extensive groundwater level and groundwater quality monitoring network and has compiled this data in a database. The California District is working on cooperative programs with local, State, and other federal agencies. The most notable programs include three regional studies of the San Joaquin-Tulare Basin, the Sacramento River Basin, and the Santa Ana River basin under the National Water Quality Assessment Program. Results were published for the San Joaquin-Tulare Basin in 1995 and the Sacramento River Basin in 2000. The Santa Ana River basin study is in progress.

U.S. Bureau of Reclamation

http://www.usbr.gov The U.S. Bureau of Reclamation (USBR) operates the Central Valley Project (CVP), an extensive network of dams, canals, and related facilities that delivers about 7 maf during normal years for agricultural, urban, and wildlife use. USBR's role with respect to groundwater is generally limited to monitoring for impacts to the groundwater systems adjacent to its CVP facilities. Through the cooperative efforts of USBR, DWR, irrigation districts, farmers, and other local entities, groundwater level data have been collected continuously since project conception in the 1930s and 1940s.

In addition to CVP monitoring, USBR monitors groundwater levels to identify potential impacts as a result of two other projects in California. That monitoring includes the Santa Ynez basin as part of the Cachuma Project on the central coast, and the Putah Creek Cone as part of the Solano Project in the southwest Sacramento Valley. Both monitoring efforts are required as part of permitting for the projects.

USBR is planning to implement a groundwater information system to collect and distribute to the public the large volume of historical groundwater level data associated with its projects.

Chapter 6

Basic Groundwater Concepts

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This chapter presents general concepts relating to the origin, occurrence, movement, quantity, and quality of groundwater. The concepts will be useful in providing the nontechnical reader with a basic understanding of groundwater. For more experienced readers, many topics are discussed specifically as they apply to California or as the terms are used in this report. A glossary of terms is included at the end of this report. For additional reading on basic groundwater concepts see *Basic Ground-Water Hydrology* (Heath 1983).

Origin of Groundwater

Groundwater is a component of the hydrologic cycle (Figure 11), which describes locations where water may occur and the processes by which it moves or is transformed to a different phase. In simple terms, water or one of its forms—water vapor and ice—can be found at the earth's surface, in the atmosphere, or beneath the earth's surface. The hydrologic cycle is a continuum, with no beginning or end; however, it is often thought of as beginning in the oceans. Water evaporates from a surface water source such as an ocean, lake, or through transpiration from plants. The water vapor may move over the land and condense to form clouds, allowing the water to return to the earth's surface as precipitation (rain or snow). Some of the snow will end up in polar ice caps or in glaciers. Most of the rain and snowmelt will either become overland flow in channels or will infiltrate into the subsurface. Some of the infiltrated water will be transpired by plants and returned to the atmosphere, while some will cling to particles surrounding the pore spaces in the subsurface, remaining in the vadose (unsaturated) zone. The rest of the infiltrated water will move gradually under the influence of gravity into the saturated zone of the subsurface, becoming groundwater. From here, groundwater will flow toward points of discharge such as rivers, lakes, or the ocean to begin the cycle anew. This flow from recharge areas to discharge areas describes the groundwater portion of the hydrologic cycle.

The importance of groundwater in the hydrologic cycle is illustrated by considering the distribution of the world's water supply. More than 97 percent of all earth's water occurs as saline water in the oceans (Fetter 1988). Of the world's fresh water, almost 75 percent is in polar ice caps and glaciers, which leaves a very small amount of fresh water readily available for use. Groundwater accounts for nearly all of the remaining fresh water (Alley and others 1999). All of the fresh water stored in the world's rivers and lakes accounts for less than 1 percent of the world's fresh water.

Occurrence of Groundwater

Groundwater is the water occurring beneath the earth's surface that completely fills (saturates) the void space of rocks or sediment. Given that all rock has some open space (voids), groundwater can be found underlying nearly any location in the State. Several key properties help determine whether the subsurface environment will provide a significant, usable groundwater resource. Most of California's groundwater occurs in material deposited by streams, called alluvium. Alluvium consists of coarse deposits, such as sand and gravel, and finer-grained deposits such as clay and silt. The coarse and fine materials are usually coalesced in thin lenses and beds in an alluvial environment. In this environment, coarse materials such as sand and gravel deposits usually provide the best source of water and are termed aquifers; whereas, the finer-grained clay and silt deposits are relatively poor sources of water and are referred to as aquitards. California's groundwater basins usually include one or a series of alluvial aquifers with intermingled aquitards. Less frequently, groundwater basins include aquifers composed of unconsolidated marine sediments that have been flushed by fresh water. The marine-deposited aquifers are included in the discussion of alluvial aquifers in this bulletin.

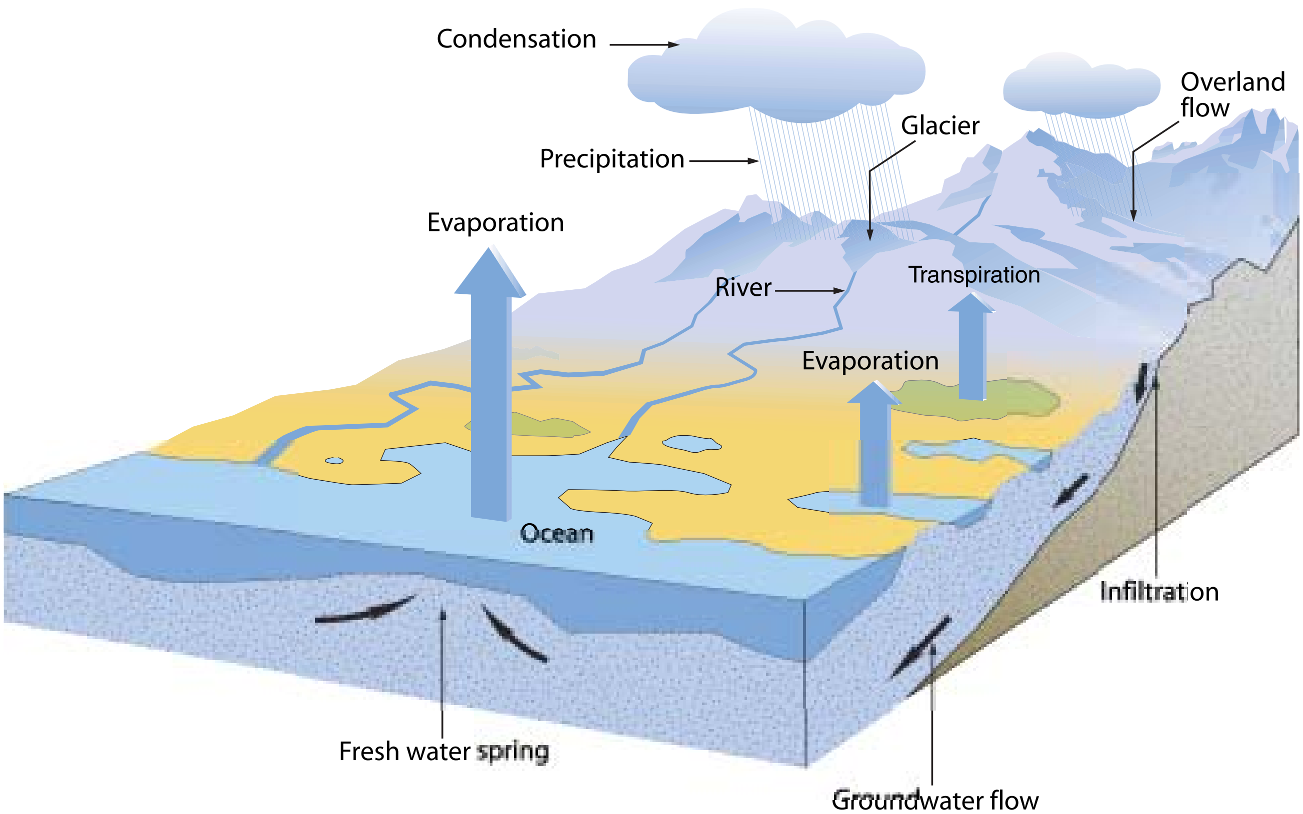

Figure 11 The Hydrologic Cycle

Although alluvial aquifers are most common in California, other groundwater development occurs in fractured crystalline rocks, fractured volcanics, and limestones. For this report, these nonalluvial areas that provide groundwater are referred to as "groundwater source areas," while the alluvial aquifers are called groundwater basins. Each of these concepts is discussed more fully below.

Groundwater and Surface Water Interconnection

Groundwater and surface water bodies are connected physically in the hydrologic cycle. For example, at some locations or at certain times of the year, water will infiltrate the bed of a stream to recharge groundwater. At other times or places, groundwater may discharge, contributing to the base flow of a stream. Changes in either the surface water or groundwater system will affect the other, so effective management requires consideration of both resources. Although this physical interconnection is well understood in general terms, details of the physical and chemical relationships are the topic of considerable research.

These details are the subject of significant recent investigations into the hyporheic zone, the zone of sand and gravel that forms the channel of a stream. As surface water flows downstream it may enter the gravels in the

Box N One Resource, Two Systems of Law

In California, two distinct legal regimes govern the appropriation of surface water and subterranean streams, and percolating groundwater. The California Water Code requires that water users taking water for beneficial use from surface watercourses and "subterranean streams flowing through known and definite channels" obtain water right permits or licenses from the State Water Resources Control Board (SWRCB) (Water Code § 1200 et seq.). Groundwater classified as percolating groundwater is not subject to the Water Code provisions concerning the appropriation of water, and a water user can take percolating groundwater without having a State-issued water right permit or license. Current Water Code section 1200 is derived from a provision in the Water Commission Act of 1913, which became effective on December 19, 1914.

The SWRCB developed a test to identify groundwater that is in a subterranean stream flowing through a known and definite channel and is therefore subject to the SWRCB's permitting authority. The physical conditions that must be present in a subterranean stream flowing in a known and definite channel are: (1) a subsurface channel must be present; (2) the channel must have relatively impermeable bed and banks; (3) the course of the channel must be known or capable of being determined by reasonable inference; and (4) groundwater must be flowing in the channel. Whether groundwater is subject to the SWRCB's permitting authority under this test is a factual determination. Water that does not fit this test is "percolating groundwater" and is not subject to the SWRCB's permitting authority.

The SWRCB has issued decisions that find that groundwater under the following streams constitutes a "subterranean stream flowing through known and definite channels" and is therefore subject to the SWRCB's permitting authority (Murphey 2003 pers com):

Los Angeles River in Los Angeles County
Sheep Creek in San Bernardino County
Mission Basin of the San Luis Rey River in San Diego County
Bonsall Basin of the San Luis Rey River in San Diego County
Pala Basin of the San Luis Rey River in San Diego County
Carmel River in Monterey County
Garrapata Creek in Monterey County
Big Sur River in Monterey County
Russian River
Chorro Creek in San Luis Obispo County
Morro Creek in San Luis Obispo County
North Fork Gualala River in Mendocino County

Contact the SWRCB, Division of Water Rights for specific stream reaches and other details of these decisions.

hyporheic zone, mix with groundwater, and re-enter the surface water in the stream channel. The effects of this interchange between surface water and groundwater can change the dissolved oxygen content, temperature, and mineral concentrations of the water. These changes may have a significant effect on aquatic and riparian biota.

Significantly, the physical and chemical interconnection of groundwater and surface water is not well represented in California's water rights system (see Box N "One Resource, Two Systems of Law").

Physical Properties That Affect Groundwater

The degree to which a body of rock or sediments will function as a groundwater resource depends on many properties, some of which are discussed here. Two of the more important physical properties to consider are porosity and hydraulic conductivity. Transmissivity is another important concept to understand when considering an aquifer's overall ability to yield significant groundwater. Throughout the discussion of these properties, keep in mind that sediment size in alluvial environments can change significantly over short distances, with a corresponding change in physical properties. Thus, while these properties are often presented as average values for a large area, one might encounter different conditions on a more localized level. Determination of these properties for a given aquifer may be based on lithologic or geophysical observations, laboratory testing, or aquifer tests with varying degrees of accuracy.

Porosity

The ratio of voids in a rock or sediment to the total volume of material is referred to as porosity and is a measure of the amount of groundwater that may be stored in the material. Figure 12 gives several examples of the types of porosity encountered in sediments and rocks. Porosity is usually expressed as a percentage and can be classified as either primary or secondary. Primary porosity refers to the voids present when the sediment or rock was initially formed. Secondary porosity refers to voids formed through fracturing or weathering of a rock or sediment after it was formed. In sediments, porosity is a function of the uniformity of grain size (sorting) and shape. Finer-grained sediments tend to have a higher porosity than coarser sediments because the finer-grained sediments generally have greater uniformity of size and because of the tabular shape and surface chemistry properties of clay particles. In crystalline rocks, porosity becomes greater with a higher degree of fracturing or weathering. As alluvial sediments become consolidated, primary porosity generally decreases due to compaction and cementation, and secondary porosity may increase as the consolidated rock is subjected to stresses that cause fracturing.

Porosity does not tell the entire story about the availability of groundwater in the subsurface. The pore spaces must also interconnect and be large enough so that water can move through the ground to be extracted from a well or discharged to a water body. The term "effective porosity" refers to the degree of interconnectedness of pore spaces. For coarse sediments, such as the sand and gravel encountered in California's alluvial groundwater basins, the effective porosity is often nearly equal to the overall porosity. In finer sediments, effective porosity may be low due to water that is tightly held in small pores. Effective porosity is generally very low in crystalline rocks that are not highly fractured or weathered.

While porosity measures the total amount of water that may be contained in void spaces, there are two related properties that are important to consider: specific yield and specific retention. Specific yield is the fractional amount of water that would drain freely from rocks or sediments due to gravity and describes the portion of the groundwater that could actually be available for extraction. The portion of groundwater that is retained either as a film on grains or in small pore spaces is called specific retention. Specific yield and specific retention of the aquifer material together equal porosity. Specific retention increases with decreasing grain size. Table 7 shows that clays, while having among the highest porosities, make poor sources of groundwater because they yield very little water. Sand and gravel, having much lower porosity than clay, make excellent sources of groundwater because of the high specific yield, which allows the groundwater to flow to wells. Rocks such as limestone and basalt yield significant quantities of groundwater if they are well-weathered and highly fractured.

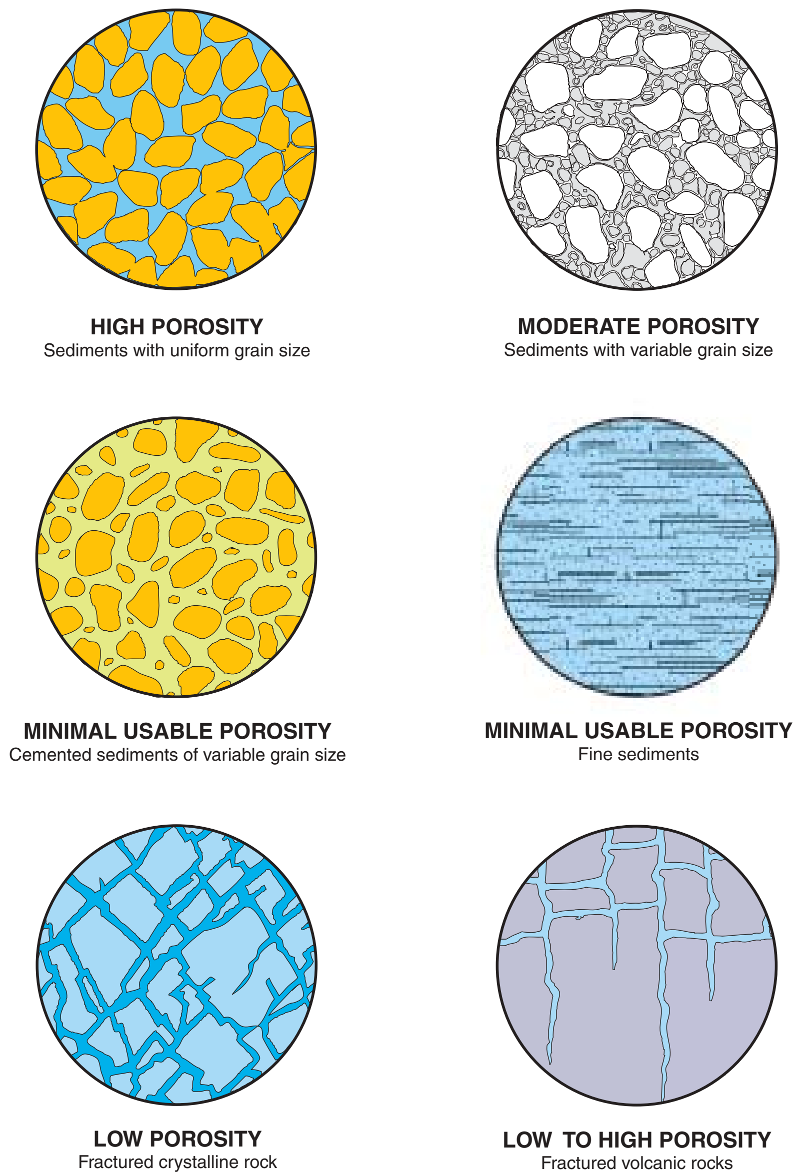

Figure 12 Examples of porosity in sediments and rocks

Table 7 Porosity (in percent) of soil and rock types

Material	Porosity	Specific yield	Specific retention
Clay	50	2	48
Sand	25	22	2
Gravel	20	19	1
Limestone	20	18	2
Sandstone (semiconsolidated)	11	6	5
Granite	0.1	0.09	0.01
Basalt (young)	11	8	3

Modified from Heath (1983)

Hydraulic Conductivity

Another major property related to understanding water movement in the subsurface is hydraulic conductivity. Hydraulic conductivity is a measure of a rock or sediment's ability to transmit water and is often used interchangeably with the term permeability. The size, shape, and interconnectedness of pore spaces affect hydraulic conductivity (Driscoll 1986).

Hydraulic conductivity is usually expressed in units of length/time: feet/day, meters/day, or gallons/day/square-foot. Hydraulic conductivity values in rocks range over many orders of magnitude from a low permeability unfractured crystalline rock at about 10^{-8} feet/day to a highly permeable well-sorted gravel at greater than 10^{4} feet/day (Heath 1983). Clays have low permeability, ranging from about 10^{-3} to 10^{-7} feet/day (Heath 1983). Figure 13 shows hydraulic conductivity ranges of selected rocks and sediments.

Transmissivity

Transmissivity is a measure of the aquifer's ability to transmit groundwater through its entire saturated thickness and relates closely to the potential yield of wells. Transmissivity is defined as the product of the hydraulic conductivity and the saturated thickness of the aquifer. It is an important property to understand because a given area could have a high value of hydraulic conductivity but a small saturated thickness, resulting in limited overall yield of groundwater.

Aquifer

An aquifer is a body of rock or sediment that yields significant amounts of groundwater to wells or springs. In many definitions, the word "significant" is replaced by "economic." Of course, either term is a matter of perspective, which has led to disagreement about what constitutes an aquifer. As discussed previously, coarse-grained sediments such as sands and gravels deposited in alluvial or marine environments tend to function as the primary aquifers in California. These alluvial aquifers are the focus of this report. Other aquifers, such as those found in volcanics, igneous intrusive rocks, and carbonate rocks are described briefly in the section Groundwater Source Areas.

Aquitard

An aquitard is a body of rock or sediment that is typically capable of storing groundwater but does not yield it in significant or economic quantities. Fine-grained sediments with low hydraulic conductivity, such as clays and silts, often function as aquitards. Aquitards are often referred to as confining layers because they retard the vertical movement of groundwater and under the right hydrogeologic conditions confine groundwater that is under pressure. Aquitards are capable of transmitting enough water to allow some flow between adjacent aquifers, and depending on the magnitude of this transfer of water, may be referred to as leaky aquitards.

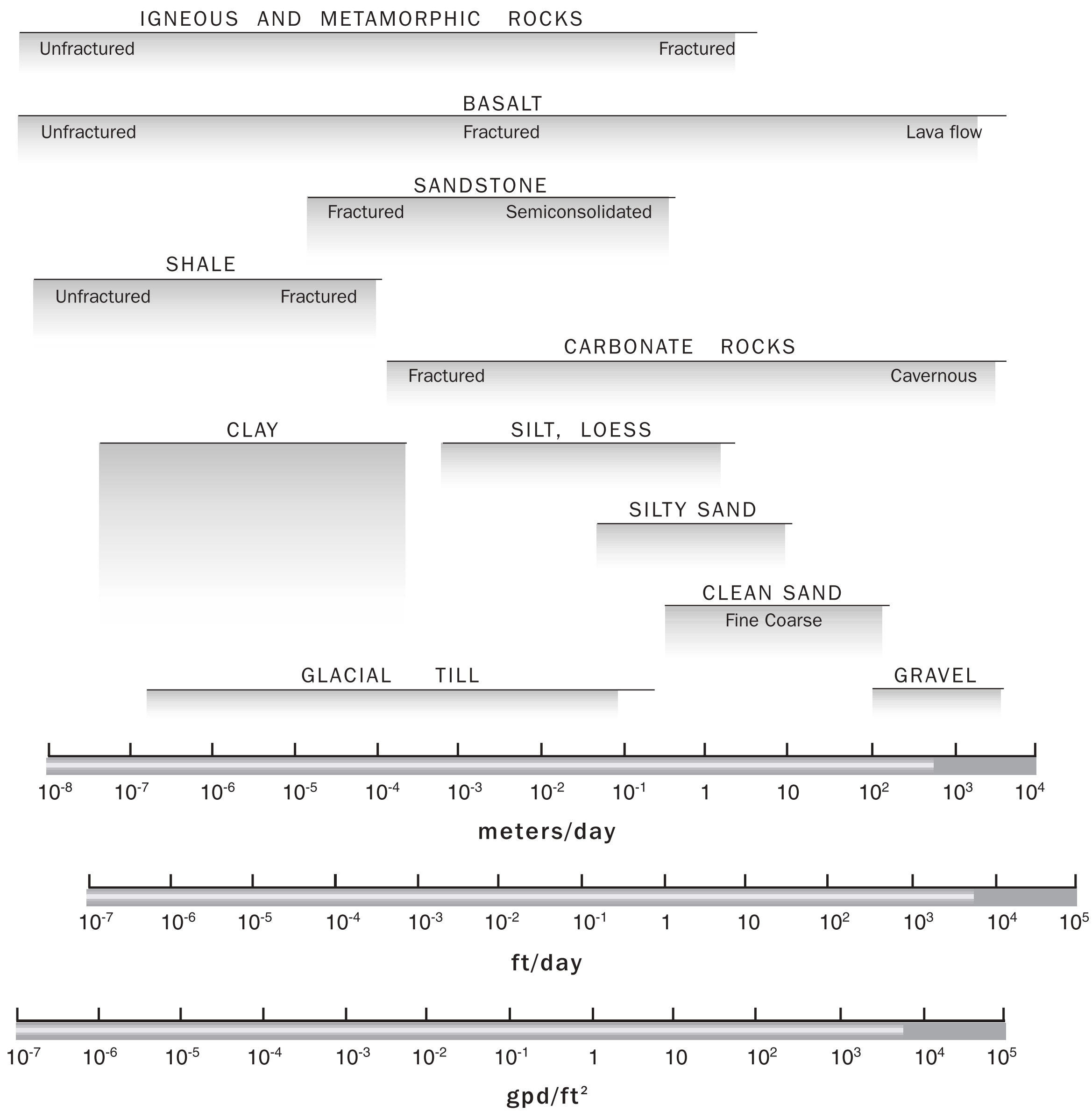

Figure 13 Hydraulic conductivity ranges of selected rocks and sediments

Unconfined and Confined Aquifers

In most depositional environments, coarser-grained deposits are interbedded with finer-grained deposits creating a series of aquifers and aquitards. When a saturated aquifer is bounded on top by an aquitard (also known as a confining layer), the aquifer is called a confined aquifer (Figure 14). Under these conditions, the water is under pressure so that it will rise above the top of the aquifer if the aquitard is penetrated by a well. The elevation to which the water rises is known as the potentiometric surface. Where an aquifer is not bounded on top by an aquitard, the aquifer is said to be unconfined. In an unconfined aquifer, the pressure on the top surface of the groundwater is equal to that of the atmosphere. This surface is known as the water table, so unconfined aquifers are often referred to as water table aquifers. The arrangement of aquifers and aquitards in the subsurface is referred to as hydrostratigraphy.

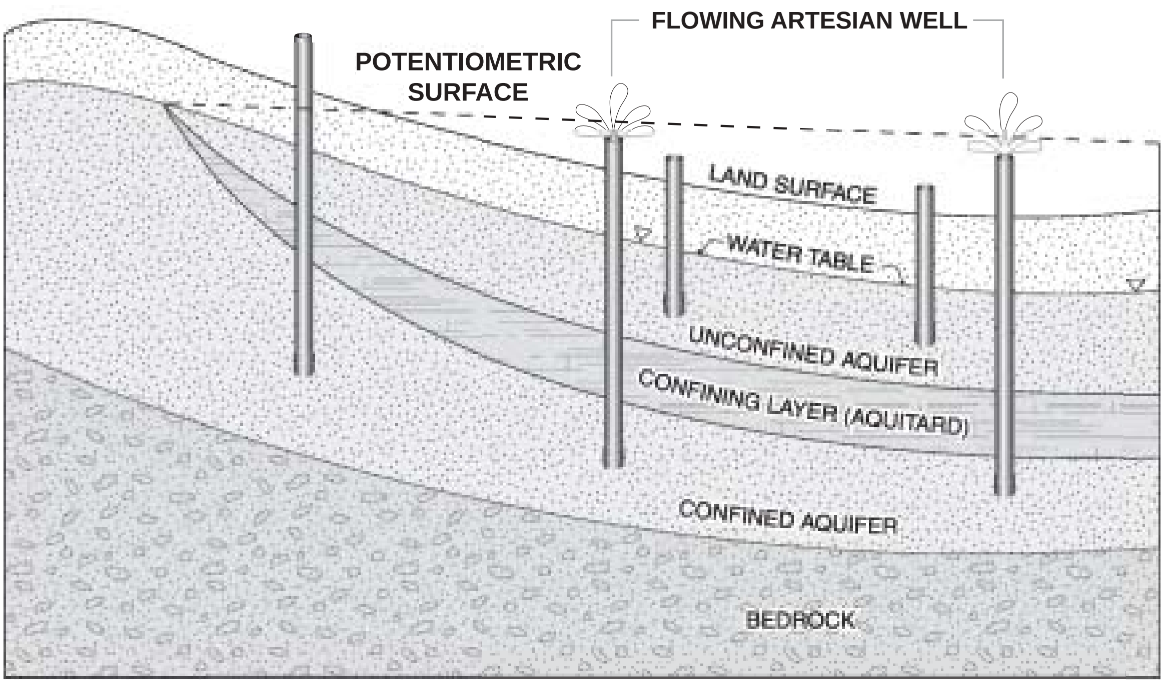

Figure 14 Interbedded aquifers with confined and unconfined conditions

With the notable exception of the Corcoran Clay of the Tulare Formation in the San Joaquin Valley and the aquitard in West Coast Basin in Los Angeles County, there are no clearly recognizable regional aquitards in California alluvial basins. Instead, due to the complexity of alluvial environments, it is the cumulative effect of multiple thin lenses of fine-grained sediments that causes increasing confinement of groundwater with increasing depth, creating what is often referred to as a semiconfined aquifer.

In some confined aquifers groundwater appears to defy gravity, but that is not the case. When a well penetrates a confined aquifer with a potentiometric surface that is higher than land surface, water will flow naturally to the surface. This is known as artesian flow, and results from pressure within the aquifer. The pressure results when the recharge area for the aquifer is at a higher elevation than the point at which discharge is occurring (Figure 14). The confining layer prevents the groundwater from returning to the surface until the confining layer is penetrated by a well. Artesian flow will discontinue as pressure in the aquifer is reduced and the potentiometric surface drops below the land surface elevation.

Groundwater Basin

A groundwater basin is defined as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and a definable bottom. Lateral boundaries are features that significantly impede groundwater flow, such as rock or sediments with very low permeability or a geologic structure such as a fault. Bottom boundaries would include rock or sediments of very low permeability if no aquifers occur below those sediments within the basin. In some cases, such as in the San Joaquin and Sacramento Valleys, the base of fresh water is considered the bottom of the groundwater basin. Table 8 is a generalized list of basin types and the features that define the basin boundaries.

Table 8 Types and boundary characteristics of groundwater basins

Characteristics of groundwater basins	
Groundwater basin	An aquifer or an aquifer system that is bounded laterally and at depth by one or more of the following features that affect groundwater flow: • Rocks or sediments of lower permeability • A geologic structure, such as a fault • Hydrologic features, such as a stream, lake, ocean, or groundwater divide
Types of basins and their boundaries	
Single simple basin	Basin surrounded on all sides by less permeable rock. Higher permeability near the periphery. Clays near the center. Unconfined around the periphery. Confined near the center. May have artesian flow near the center.
Basin open at one or more places to other basins	Many desert basins. Merged alluvial fans. Topographic ridges on fans. Includes some fault-bounded basins.
Basin open to Pacific Ocean	260 basins along the coast. Water-bearing materials extend offshore. May be in contact with sea water. Vulnerable to seawater intrusion.
Single complex basin	Basin underlain or surrounded by older water-bearing materials and water-bearing volcanics. Quantification is difficult because of unknown contacts between different rock types within the basin.
Groundwater in areas of volcanic rocks	Basin concept is less applicable in volcanic rocks. Volcanic rocks are highly variable in permeability.
Groundwater in weathered crystalline rocks (fractured hard rock)—not considered a basin	Small quantities of groundwater. Low yielding wells. Most wells are completed in the crystalline rock and rely on fractures to obtain groundwater.
Political boundaries or management area boundaries	Usually not related to hydrogeologic boundaries. Formed for convenience, usually to manage surface water storage and delivery.

Although only the upper surface of a groundwater basin can be shown on a map, the basin is three-dimensional and includes all subsurface fresh water-bearing material. These boundaries often do not extend straight down, but are dependent on the spatial distribution of geologic materials in the subsurface. In fact, in a few cases near California's coastal areas, aquifers in the subsurface are known to extend beyond the mapped surface of the basin and may actually be exposed under the ocean. Under natural conditions, fresh water flows from these aquifers into the ocean. If groundwater levels are lowered, sea water may flow into the aquifer. This has occurred in Los Angeles, Orange, Ventura, Santa Cruz and Monterey Counties, and some areas around San Francisco Bay. Depiction of a groundwater basin in three dimensions requires extensive subsurface investigation and data evaluation to delineate the basin geometry. Figure 15 is a cross-section showing how a coastal basin might appear in the subsurface.

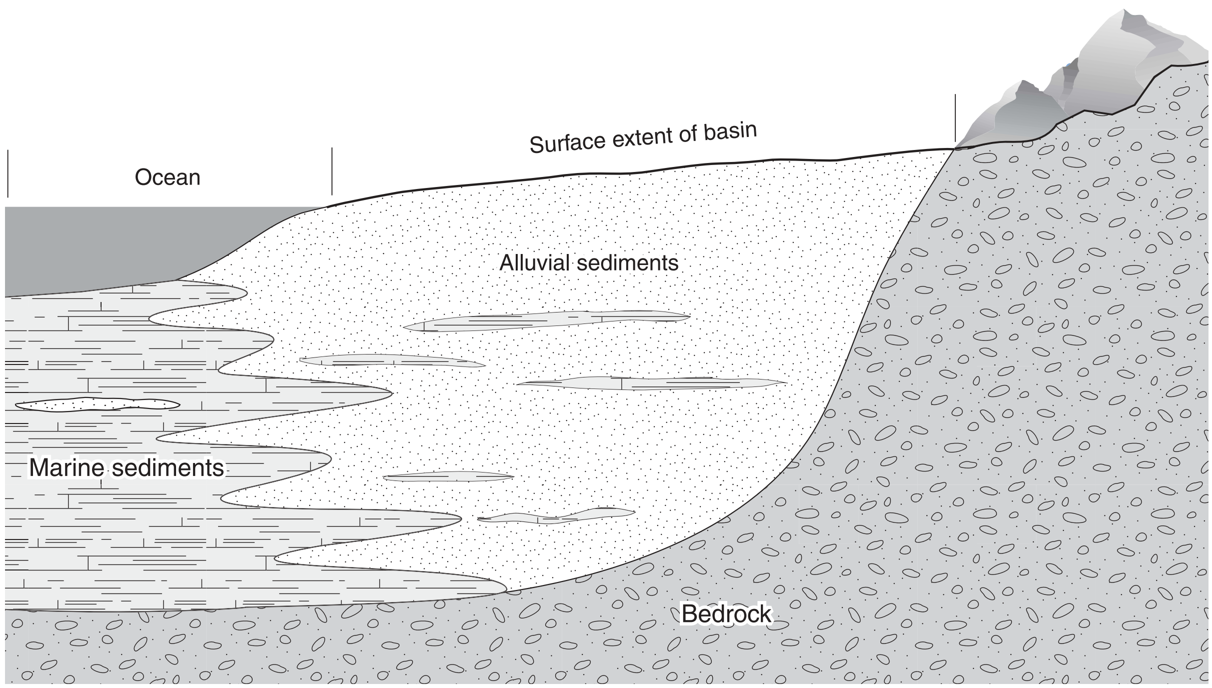

Figure 15 Groundwater basin near the coast with the aquifer extending beyond the surface basin boundary

Groundwater basin and subbasin boundaries shown on the map included with this bulletin are based on evaluation of the best available information. In basins where many studies have been completed and the basin has been operated for a number of years, the basin response is fairly well understood and the boundaries are fairly well defined. Even in these basins, however, there are many unknowns and changes in boundaries may result as more information about the basin is collected and evaluated. In many other basins where much less is known and understood about the basin, boundaries will probably change as a better understanding of the basin is developed. A procedure for collecting information from all the stakeholders should be developed for use statewide so that agreement on basin boundaries can be achieved.

Groundwater Subbasin

A subbasin is created by dividing a groundwater basin into smaller units using geologic and hydrologic barriers or, more commonly, institutional boundaries (see Table 8). These subbasins are created for the purpose of collecting and analyzing data, managing water resources, and managing adjudicated basins. As the definition implies, the designation of a subbasin boundary is flexible and could change in the future. The limiting rule for a subbasin is that it should not cross over a groundwater basin boundary.

An example of a hydrologic subbasin boundary would be a river or stream that creates a groundwater divide. While hydrologic boundaries may limit groundwater flow in the shallow subsurface, data indicate significant groundwater flow may occur across the boundary at greater depths. In addition, the location of the boundary may change over time if pumping or recharge patterns change. Institutional subbasin boundaries could be based on a political boundary, such as a county line or a water agency service area, or a legally mandated boundary, such as a court adjudicated basin.

Groundwater Source Areas

Groundwater in California is also found outside of alluvial groundwater basins. Igneous extrusive (volcanic), igneous intrusive, metamorphic, and sedimentary rocks are all potential sources of groundwater. These rocks often supply enough water for domestic use, but in some cases can also yield substantial quantities. In this report, the term groundwater source area is used for rocks that are significant in terms of being a local groundwater source, but do not fit the category of basin or subbasin. The term is not intended to imply that groundwater actually originates in these rocks, but that it is withdrawn from rocks underlying a generally definable area. Because of the increased difficulty in defining and understanding the hydrogeologic properties of these rocks, the limited data available for the areas in which these rocks occur, and the relatively small, though rapidly growing, segment of the population served by these water supplies, they are discussed separately from groundwater basins.

Volcanics

Groundwater in volcanics can occur in fractures that result from cooling or changes in stress in the crust of the Earth, lava tubes, tree molds, weathering surfaces, and porous tuff beds. Additionally, the volcanics could overlie other deposits from an alluvial environment. Flow in the fractures may approach the same velocities as that of surface water, but there is often very limited storage potential for groundwater. The tuff beds can act similarly to alluvial aquifers.

Some of the most productive volcanic rocks in the State include the Modoc Plateau volcanics in the northeast and the Napa-Sonoma volcanics northeast of San Francisco Bay (Figure 16). Wells in Modoc Plateau volcanics are commonly reported to yield between 100 and 1,000 gallons per minute, with some yields of 4,000 gpm (Planert and Williams 1995). Bulletin 118-75 assigned identification numbers to these volcanic rocks throughout the State (for example, Modoc Plateau Recent Volcanic Areas, 1-23). The numbers led some to interpret them as being groundwater basins. In this update, the numbers corresponding to the volcanics are retired to eliminate this confusion.

Figure 16 Significant volcanic groundwater source areas

Igneous Intrusive, Metamorphic, and Sedimentary Rocks

Groundwater in igneous intrusive, metamorphic, and consolidated sedimentary rocks occurs in fractures resulting from tectonism and expansion of the rock as overburden pressures are relieved. Groundwater is extracted from fractured rock in many of the mountainous areas of the State, such as the Sierra Nevada, the Peninsular Range, and the Coast Ranges. Rocks in these areas often yield only enough supply for individual domestic wells, stock water wells, or small community water systems. Availability of groundwater in such formations can vary widely, even over a distance of a few yards. Areas of groundwater production from consolidated rocks were not defined in previous versions of Bulletin 118 and are not included in this update.

As population grows in areas underlain by these rocks, such as the foothills of the Sierra Nevada and southern California mountains, many new wells are being built in fractured rock. However, groundwater data are often insufficient to accurately estimate the long term reliability of groundwater supplies in these areas. Additional investigation, data evaluation, and management will be needed to ensure future sustainable supplies. The Legislature recognized both the complexity of these areas and the need for management in SB 1938 (2002), which amended the Water Code to require groundwater management plans with specific components be adopted for agencies to be eligible for certain funding administered by DWR for construction of groundwater projects. Water Code section 10753.7(a)(5) states:

> Local agencies that are located in areas outside the groundwater basins delineated on the latest edition of the department's groundwater basin and subbasin map shall prepare groundwater management plans incorporating the components in this subdivision, and shall use geologic and hydrologic principles appropriate to those areas.

In carbonate sedimentary rocks such as limestone, groundwater occurs in fractures and cavities formed as a result of dissolution of the rock. Flow in the largest fractures may approach the velocities of surface water, but where these rocks occur in California there is limited storage potential for groundwater. Carbonate rocks occur mostly in Inyo County near the Nevada border (USGS 1995), in the Sierra Nevada foothills, and in some parts of the Sacramento River drainage north of Redding. The carbonates near the Nevada state border in Inyo County are part of a regional aquifer that extends northeastward into Nevada. Springs in Nevada and in the Death Valley region in California are dependent on groundwater flow in this regional aquifer. In other parts of the country, such as Florida, carbonate rocks constitute significant sources of groundwater.

Movement of Groundwater

The movement of groundwater in the subsurface is quite complex, but in simple terms it can be described as being driven by potential energy. At any point in the saturated subsurface, groundwater has a hydraulic head value that describes its potential energy, which is the combination of its elevation and pressure. In an unconfined aquifer, the water table elevation represents the hydraulic head, while in a confined aquifer the potentiometric surface represents the hydraulic head (Figure 14). Water moves in response to the difference in hydraulic head from the point of highest energy toward the lowest. On a regional scale, this results in flow of groundwater from recharge areas to discharge areas. In California, pumping depressions around extraction wells often create the discharge points to which groundwater flows. Groundwater may naturally exit the subsurface by flowing into a stream, lake, or ocean, by flowing to the surface as a spring or seep, or by being transpired by plants.

The rate at which groundwater flows is dependent on the hydraulic conductivity and the rate of change of hydraulic head over some distance. In the mid-19th century, Henry Darcy found through his experiments on sand filters that the amount of flow through a porous medium is directly proportional to the difference between hydraulic head values and inversely proportional to the horizontal distance between them (Fetter 1988). His conclusions extend to flow through aquifer materials. The difference between hydraulic heads divided by the distance between them is referred to as the hydraulic gradient. When combined with the hydraulic conductivity of the porous medium and the cross-sectional area through which the groundwater flows, Darcy's law states:

$$Q = KA(dh/dl) \text{ (volume/time)}$$

Where:

Q = flow discharging through a porous medium
K = hydraulic conductivity (length/time)
A = cross-sectional area ($length^2$)
dh = change in hydraulic head between two points (length)
dl = distance between two points (length)

This version of Darcy's law provides a volumetric flow rate. To calculate the average linear velocity at which the water flows, the result is divided by the effective porosity. The rate of movement of groundwater is very slow, usually less than 1,000 feet per year because of the great amount of friction resulting from movement through the spaces between grains of sand and gravel.

Quantity of Groundwater

Because groundwater is a precious resource, the questions of how much there is and how more can be made available are important. There are many terms and concepts associated with the quantity of groundwater available in a basin, and some controversy surrounding their definition. Some of these include groundwater storage capacity, usable storage capacity, groundwater budget, change in storage, overdraft, and safe yield. This section discusses some of the more common terms used to represent groundwater quantity in California.

Groundwater Storage Capacity

The groundwater storage capacity of an individual basin or within the entire State is one of the questions most frequently asked by private citizens, water resource planners, and politicians alike. Total storage capacity seems easy to understand. It can be seen as how much physical space is available for storing groundwater. The computation of groundwater storage capacity is quite simple if data are available: capacity is determined by multiplying the total volume of a basin by the average specific yield. The total storage capacity is constant and is dependent on the geometry and hydrogeologic characteristics of the aquifer(s) (Figure 17).

Estimates of total groundwater storage capacity in California are staggering. Previous estimates of total storage range from 850 million acre-feet (maf) to 1.3 billion acre-feet (DWR 1975, DWR 1994). However, due to incomplete information about many of the groundwater basins, there has never been an accurately quantified calculation of total storage capacity statewide. Even if such a calculation were possible, the utility of such a number is questionable because total storage capacity might lead to overly optimistic estimates of how much additional groundwater development can contribute to meeting future demands.

Total groundwater storage capacity is misleading because it only takes into account one aspect of the physical character of the basin. Many other factors limit the ultimate development potential of a groundwater basin. These limiting factors may be physical, chemical, economic, environmental, legal, and institutional (Table 9). Some of these factors, such as the economic and institutional ones, can change with time. However, there may remain significant physical and chemical constraints that will limit groundwater development.

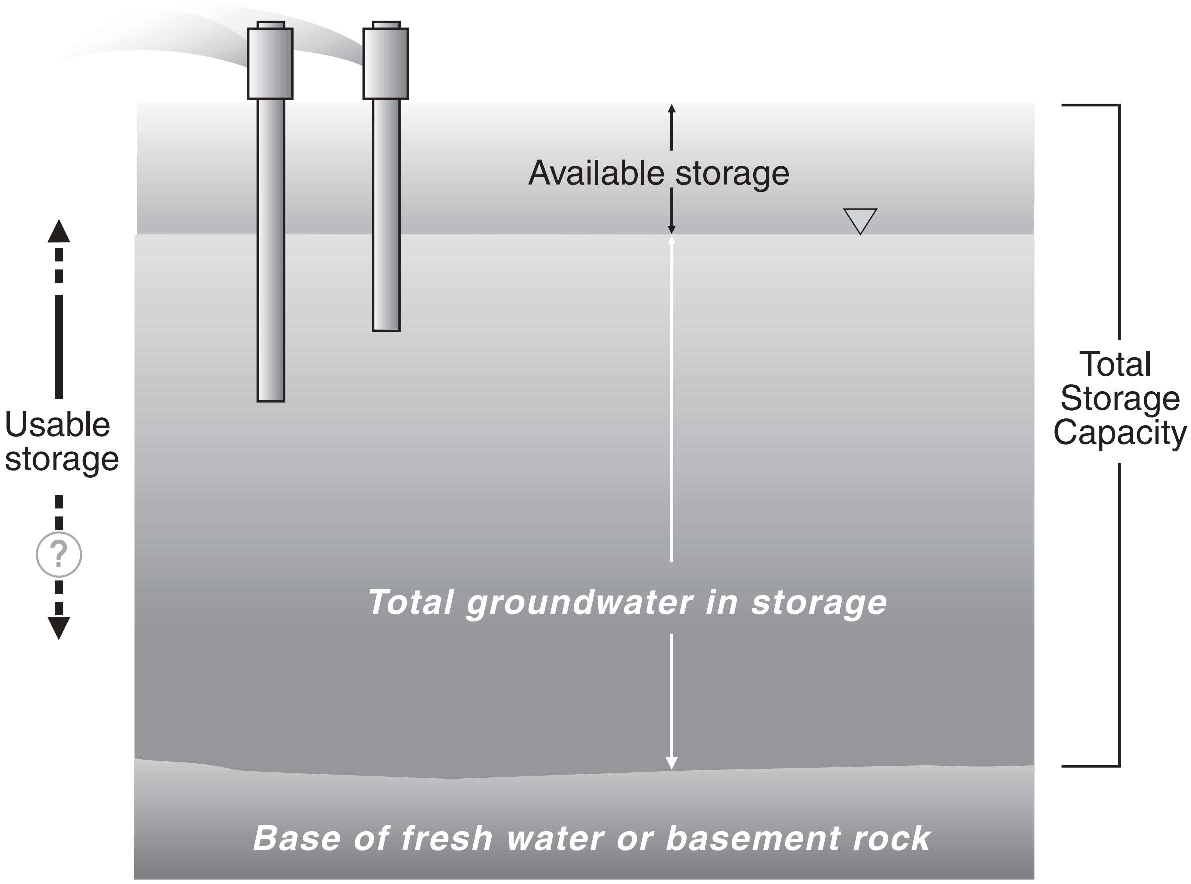

Figure 17 Schematic of total, usable, and available groundwater storage capacity

Table 9 Examples of factors that limit development of a groundwater basin

Limiting factor	Examples
Physical	Basin recharge area not adequate to sustain development; pumping too concentrated in a portion of basin; well yields too low for intended use.
Quality	Water quality not suitable for intended use; increased potential for seawater intrusion in coastal areas; upwelling of poorer quality water in deeper parts of basin.
Economic	Excessive costs associated with increased pump lifts and deepening of wells; cost of treating water if it does meet requirements for intended use.
Environmental	Need to maintain groundwater levels for wetlands, stream base flow, or other habitat.
Institutional	Local groundwater management plans or ordinances restricting use; basin adjudication; impacts on surface water rights of others.

Usable Groundwater Storage Capacity

Usable storage capacity is defined as the amount of groundwater of suitable quality that can be economically withdrawn from storage. It is typically computed as the product of the volume of the basin to some basin-specific depth that is considered economically available and the average specific yield of the basin (see Figure 17).

As more groundwater is extracted, groundwater levels may fall below some existing wells, which may then require replacement or deepening. This may be a consideration in management of the basin and will depend on the cost of replacement, the cost of pumping the water from deeper zones, and whether managers are willing to pay that cost. Other impacts that may increase the cost include subsidence and groundwater quality degradation. The usable storage may change because of changes in economic conditions.

Estimates of usable storage represent only the total volume of groundwater assumed to be usable in storage, not what would be available for sustained use on an annual basis. Previous estimates of usable groundwater storage capacity range from 143 to 450 maf (DWR 1975, DWR 1994). Unfortunately, the term "usable storage" is often used to indicate the amount of water that can be used from a basin as a source of long-term annual supply. However, the many limitations associated with total groundwater storage capacity discussed above may also apply to usable storage.

Available Groundwater Storage Capacity

Available storage capacity is defined as the volume of a basin that is unsaturated and capable of storing additional groundwater. It is typically computed as the product of the empty volume of the basin and the average specific yield of the unsaturated part of the basin (see Figure 17). The available storage capacity does not include the uppermost portion of the unsaturated zone in which saturation could cause problems such as crop root damage or increased liquefaction potential. The available storage will vary depending on the amount of groundwater taken out of storage and the recharge. The total groundwater in storage will change inversely as the available storage changes.

Available storage has often been used as a number to represent the potential for additional yield from a particular basin. Unfortunately, many of the limitations that exist in developing existing supply discussed above also limit taking advantage of available storage. Although limitations exist, looking only at available groundwater storage capacity may underestimate the potential for groundwater development. Opportunities to use groundwater already in storage and create additional storage space would be overlooked by this approach.

Groundwater Budget

A groundwater budget is an analysis of a groundwater basin's inflows and outflows to determine the change in groundwater storage. Alternatively, if the change in storage is known, the value of one of the inflows or outflows could be determined. The basic equation can be expressed as:

INFLOWS – OUTFLOWS = CHANGE IN STORAGE

Typical inflows include:

- natural recharge from precipitation;
- seepage from surface water channels;
- intentional recharge via ponds, ditches, and injection wells;
- net recharge of applied water for agricultural and other irrigation uses;
- unintentional recharge from leaky conveyance pipelines; and
- subsurface inflows from outside basin boundaries.

Outflows include:
- groundwater extraction by wells;
- groundwater discharge to surface water bodies and springs;
- evapotranspiration; and
- subsurface outflow across basin or subbasin boundaries.

Groundwater budgets can be useful tools to understand a basin, but detailed budgets are not available for most groundwater basins in California. A detailed knowledge of each budget component is necessary to obtain a good approximation of the change in storage. Absence or inaccuracy of one or more parameters can lead to an analysis that varies widely from a positive to a negative change in storage or vice versa. Since much of the data needed requires subsurface exploration and monitoring over a series of years, the collection of detailed field data is time-consuming and expensive. A management plan should develop a monitoring program as soon as possible.

Change in Groundwater Storage

As stated above, a groundwater budget is one potential way of estimating the change in storage in a basin, although it is limited by the accuracy and availability of data. There is a simpler way—by determining the average change in groundwater elevation over the basin, multiplied by the area overlying the basin and the average specific yield (or storativity in the case of a confined aquifer). The time interval over which the groundwater elevation change is determined is study specific, but annual spring-to-spring changes are commonly used. A change in storage calculation does not attempt to determine the volume of water in storage at any time interval, but rather the change from a previous period or baseline condition.

A change in storage calculation is a relatively quick way to represent trends in a basin over time. If change in storage is negligible over a representative period, the basin is in equilibrium under current use. Changes in storage calculations are more often available for a groundwater basin than groundwater budgets because water level measurements are available in many basins. Specific yield and storativity are readily estimated based on knowledge of the hydrogeologic setting and geologic materials or through aquifer pumping tests. Although simple, change in storage calculations have potential sources of error, so it is important to treat change in storage as just one of many tools in determining conditions in a groundwater basin. Well data sets must be carefully evaluated before use in these calculations. Mixing of wells constructed in confined and unconfined portions of the basin and measurement of different well sets over time can result in significant errors.

Although the change in storage calculation is a relatively quick and inexpensive method of observing changes in the groundwater system, the full groundwater budget is preferable. A detailed budget describes an understanding of the physical processes affecting storage in the basin, which the simple change in storage calculation does not. For example, the budget takes into account the relationship between the surface water and the groundwater system. If additional groundwater extraction induced additional infiltration of surface water, the calculated change in storage could be minimal. However, if the surface water is used as a source of supply downstream, the impact of reduced flows could be significant.

Overdraft

Groundwater overdraft is defined as the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions (DWR 1998). Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. If overdraft continues for a number of years, significant adverse impacts may occur, including increased extraction costs, costs of well deepening or replacement, land subsidence, water quality degradation, and environmental impacts.

Despite its common usage, the term overdraft has been the subject of debate for many years. Groundwater management is a local responsibility, therefore, the decision whether a basin is in a condition of overdraft is the responsibility of the local groundwater or water management agency. In some cases, local agencies may choose to deliberately extract groundwater in excess of recharge in a basin (known as "groundwater mining") as part of an overall management strategy. An independent analysis of water levels in such a basin might conclude that the basin is in overdraft. In other cases, where basin management is less active or nonexistent, declining groundwater levels are not considered a problem until levels drop below the depth of many wells in the basin. As a result, overdraft may not be reported for many years after the condition began.

Water quality changes and subsidence may also indicate that a basin has been overdrafted. For example, when groundwater levels decline in coastal aquifers, seawater fills the pore spaces in the aquifer that are vacated by the groundwater, indicating that the basin is being overdrafted. Overdraft has historically led to as much as 30 feet of land subsidence in one area of the State and lesser amounts in other areas.

The word "overdraft" has been used to designate two unrelated types of water shortages. The first is "historical overdraft" similar to the type illustrated in Figure 18, which shows that ground water levels began to decline in the mid 1950s and then leveled off in the mid 1980s, indicating less groundwater extraction or more recharge. The second type of shortage is "projected overdraft" as used in the *California Water Plan Update* (DWR 1998). In reality, this is an estimate of future water shortages based on an assumed management program within the basin, including projected supply and projected demand. If water management practices change in those basins in which a water shortage is projected, the amount of projected shortage will change.

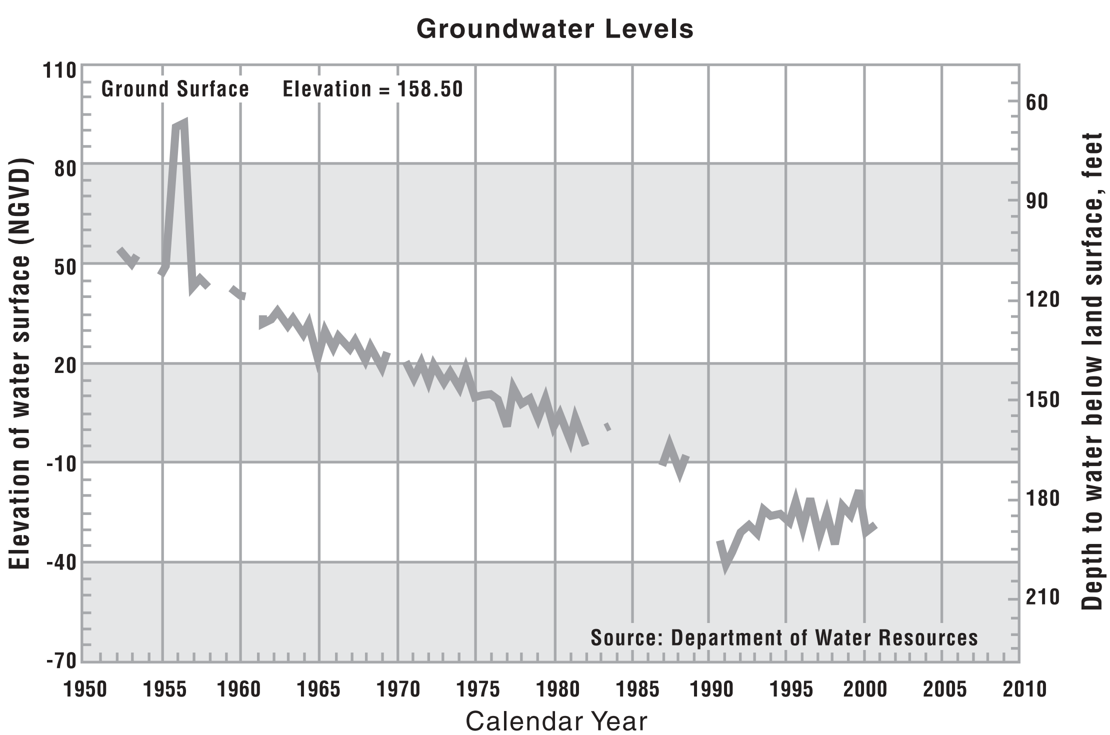

Figure 18 Hydrograph indicating overdraft

In some basins or subbasins, groundwater levels declined steadily over a number of years as agricultural or urban use of groundwater increased. In response, managing agencies developed surface water import projects to provide expanded water supplies to alleviate the declining groundwater levels. Increasing groundwater levels, or refilling of the aquifer, demonstrate the effectiveness of this approach in long-term water supply planning. In some areas of the State, the past overdraft is now being used to advantage. When the groundwater storage capacity that is created through historical overdraft is used in coordination with surface water supplies in a conjunctive management program, local and regional water supplies can be augmented.

In 1978, DWR was directed by the legislature to develop a definition of critical overdraft and to identify basins that were in a condition of critical overdraft (Water Code § 12924). The process that was followed and the basins that were deemed to be in a condition of critical overdraft are discussed in Box O, "Critical Conditions of Overdraft." This update to Bulletin 118 did not include similar direction from the legislature, nor funding to undertake evaluation of the State's groundwater basins to determine whether they are in a state of overdraft.

Box O Critical Conditions of Overdraft

In 1978, DWR was directed by the legislature to develop a definition of critical overdraft and to identify those basins in a critical condition of overdraft (Water Code §12924). DWR held public workshops around the state to obtain public and water managers' input on what the definition should include, and which basins were critically overdrafted. Bulletin 118-80, *Ground Water Basins in California* was published in 1980 with the results of that local input. The definition of critical overdraft is:

> *A basin is subject to critical conditions of overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts.*

No time is specified in the definition. Definition of the time frame is the responsibility of the local water managers, as is the definition of significant adverse impacts, which would be related to the local agency's management objectives.

Eleven basins were identified as being in a critical condition of overdraft. They are:

- Pajaro Basin
- Ventura Central Basin
- Chowchilla Basin
- Kings Basin
- Tulare Lake Basin
- Kern County Basin
- Cuyama Valley Basin
- Eastern San Joaquin County Basin
- Madera Basin
- Kaweah Basin
- Tule Basin

The task was not identified by the Legislature, nor was the funding for this update (2003) sufficient to consult with local water managers and fully re-evaluate the conditions of the 11 critically overdrafted basins. Funding and duration were not sufficient to evaluate additional basins with respect to conditions of critical overdraft.

If a basin lacks existing information, the cost of a thorough evaluation of overdraft conditions in a single basin could exceed $1 million. In this update of Bulletin 118, DWR has included groundwater budget information for each basin description, where available. In most cases, however, sufficient quantitative information is not available, so conditions of overdraft or critical overdraft were not reported.

While this bulletin does not specifically identify overdrafted basins (other than the 11 basins from Bulletin 118-80), the negative effects of overdraft are occurring or may occur in the future in many basins throughout the State. Declining water levels, diminishing water quality, and subsidence threaten the availability of groundwater to meet current and future demands. A thorough understanding of overdraft can help local groundwater managers minimize the impacts and take advantage of the opportunity created by available groundwater storage capacity. Local groundwater managers and DWR should seek funding and work cooperatively to evaluate the groundwater basins of the State with respect to overdraft and its potential impacts. Beginning with the most heavily used basins and relying to the extent possible on available data collected by DWR and through local groundwater management programs, current or projected conditions of critical overdraft should be identified. If local agencies take the lead in collecting and analyzing data to fully understand groundwater basin conditions, DWR can use the information to update the designations of critically overdrafted basins. This can be a cost effective approach since much of the data needed to update the overdraft designations are the same data that agencies need to effectively manage groundwater.

Safe Yield

Safe yield is defined as the amount of groundwater that can be continuously withdrawn from a basin without adverse impact. Safe yield is commonly expressed in terms of acre-feet per year. Depending on how it is applied, safe yield may be an annual average value or may be calculated based on changed conditions each year. Although safe yield may be indicated by stable groundwater levels measured over a period of years, a detailed groundwater budget is needed to accurately estimate safe yield. Safe yield has commonly been determined in groundwater basin adjudications.

Proper application of the safe yield concept requires that the value be modified through time to reflect changing practices within the basin. One of the common misconceptions is that safe yield is a static number. That is, once it has been calculated, the amount of water can be extracted annually from the basin without any adverse impacts. An example of a situation in which this assumption could be problematic is when land use changes. In some areas, where urban development has replaced agriculture, surface pavement, storm drains, and sewers have increased runoff and dramatically reduced recharge into the basin. If extraction continued at the predetermined safe yield of the basin, water level decline and other negative impacts could occur.

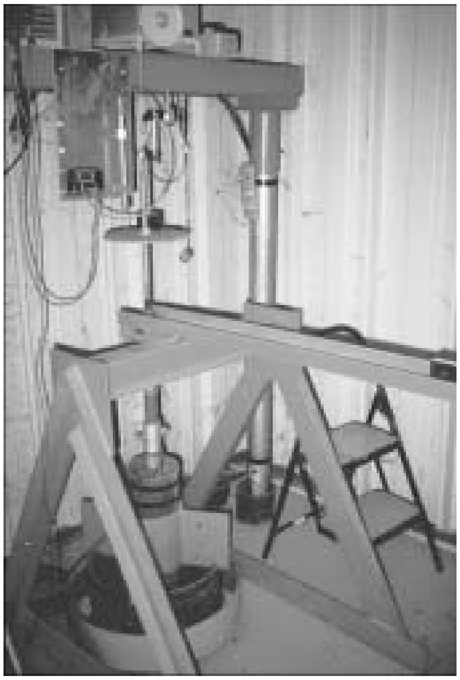

Figure 19 Photograph of extensometer

An extensometer is a well with a concrete bench mark at the bottom. A pipe extends from the concrete to the land surface. If compaction of the finer sediments occurs, leading to land surface subsidence, the pipe in the well will appear to rise out of the well casing. When this movement is recorded, the data show how much the land surface has subsided.

Subsidence

When groundwater is extracted from some aquifers in sufficient quantity, compaction of the fine-grained sediments can cause subsidence of the land surface. As the groundwater level is lowered, water pressure decreases and more of the weight of the overlying sediments is supported by the sediment grains within the aquifer. If these sediments have not previously been surcharged with an equivalent load, the overlying load will compact them. Compaction decreases the porosity of the sediments and decreases the overall volume of the finer grain sediments, leading to subsidence at the land surface. While the finer sediments within the aquifer system are compacted, the usable storage capacity of the aquifer is not greatly decreased.

Data from extensometers (Figure 19) show that as groundwater levels decline in an aquifer, the land surface falls slightly. As groundwater levels rise, the land surface also rises to its original position. This component of subsidence is called elastic subsidence because it recovers. Inelastic subsidence, the second component of subsidence, is what occurs when groundwater levels decline to the point that the finer sediments are compacted. This compaction is not recoverable.

Conjunctive Management

Conjunctive management in its broadest definition is the coordinated and combined use of surface water and groundwater to increase the overall water supply of a region and improve the reliability of that supply. Conjunctive management may be implemented to meet other objectives as well, including reducing groundwater overdraft and land subsidence, protecting water quality, and improving environmental conditions. Although surface water and groundwater are sometimes considered to be separate resources, they are connected in the hydrologic cycle. By using or storing additional surface water when it is plentiful, and relying more heavily on groundwater during dry periods, conjunctive management can change the timing and location of water so it can be used more efficiently.

Although a specific project or program may be extremely complex, there are several components common to conjunctive management projects. The first is to recharge surplus surface water when it is available to increase groundwater in storage. Recharge may occur through surface spreading, by injection wells, or by reducing groundwater use by substituting surface water. The surplus surface water used for recharge may be local runoff, imported water, stored surface water, or recycled water. The second component is to reduce surface water use in dry years or dry seasons by switching to groundwater. This use of the stored groundwater may take place through direct extraction and use, pumping back to a conveyance facility, or through exchange of another water supply. A final component that should be included is an ongoing monitoring program to evaluate operations and allow water managers to respond to changes in groundwater, surface water, or environmental conditions that could violate management objectives or impact other water users.

Quality of Groundwater

All water contains dissolved constituents. Even rainwater, often described as being naturally pure, contains measurable dissolved minerals and gases. As it moves through the hydrologic cycle, water dissolves and incorporates many constituents. These include naturally occurring and man-made constituents.

Most natural minerals are harmless up to certain levels. In some cases, higher mineral content is preferable to consumers for taste. For example, minerals are added to many bottled drinking waters after going through a filtration process. At some level, however, most naturally occurring constituents, along with those introduced by human activities, are considered contaminants. The point at which a given constituent is considered a contaminant varies depending on the intended use of the groundwater and the toxicity level of the constituents.

Beneficial Uses

For this report, water quality is a measure of the suitability of water for its intended use, with respect to dissolved solids and gases and suspended material. An assessment of water quality should include the investigation of the presence and concentration of any individual constituent that may limit the water's suitability for an intended use.

The SWRCB has identified 23 categories of water uses, referred to as beneficial uses. The beneficial use categories and a brief description of each are presented in Appendix E. The actual criteria that are used to evaluate water quality for each of the beneficial uses are determined by the nine Regional Water Quality Control Boards, resulting in a range of criteria for some of the uses. These criteria are published in each of the Regional Boards' Water Quality Control Plans (Basin Plans)[1].

A summary of water quality for all of the beneficial uses of groundwater is beyond the scope of this report. Instead, water quality criteria for two of the most common uses—municipal supply (referred to as public drinking water supply in this report) and agricultural supply—are described below.

Public Drinking Water Supply

Standards for maximum contaminant levels (MCLs) of constituents in drinking water are required under the federal Safe Drinking Water Act of 1974 and its updates. There are primary and secondary standards. Primary standards are developed to protect public health and are legally enforceable. Secondary standards are generally for the protection of aesthetic qualities such as taste, odor, and appearance, and cosmetic qualities, such as skin or tooth discoloration, and are generally non-enforceable guidelines. However, in California secondary standards are legally enforceable for all new drinking water systems and new sources developed by existing public water suppliers (DWR 1997). Under these primary and secondary standards, the U.S. Environmental Protection Agency regulates more than 90 contaminants, and the California Department of Health Services regulates about 100. Federal and State primary MCLs are listed in Appendix F.

Agricultural Supply

An assessment of the suitability of groundwater as a source of agricultural supply is much less straightforward than that for public water supply. An evaluation of water supply suitability for use in agriculture is difficult because the impact of an individual constituent can vary depending on many factors, including soil chemical and physical properties, crop type, drainage, and irrigation method. Elevated levels of constituents usually do not result in an area being taken entirely out of production, but may lower crop yields. Management decisions will determine appropriate land use and irrigation methods.

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[1] Digital versions of these plans are available online at http://www.swrcb.ca.gov/plnspols/index.html

There are no regulatory standards for water applied on agriculture. Criteria for crop water have been provided as guidelines. Many constituents have the potential to negatively impact agriculture, including more than a dozen trace elements (Ayers and Westcot 1985). Two constituents that are commonly considered with respect to agricultural water quality are salinity—expressed as total dissolved solids (TDS)—and boron concentrations.

Increasing salinity in irrigation water inhibits plant growth by reducing a plant's ability to absorb water through its roots (Pratt and Suarez 1996). While the impact will depend on crop type and soil conditions, it is useful to look at the TDS of the applied water as a general assessment tool. A range of values for TDS with their estimated suitability for agricultural uses is presented in Table 10. These ranges are modified from criteria developed for use in the San Joaquin Valley by the San Joaquin Valley Drainage Program. However, they are similar to values presented in Ayers and Westcot (1985).

Table 10 Range of TDS values with estimated suitability for agricultural uses

Range of TDS (mg/L)	Suitability
<500	Generally no restrictions on use
500 – 1,250	Generally slight restrictions on use
1,250 – 2,500	Generally moderate restrictions on use
>2,500	Generally severe restrictions on use

Modified from SJVDP (1990)
TDS = total dissolved solids

High levels of boron can present toxicity problems in plants by damaging leaves. The boron is absorbed through the root system and transported to the leaves. Boron then accumulates during plant transpiration, resulting in leaf burn (Ayers and Westcot 1985). Boron toxicity is highly dependent on a crop's sensitivity to the constituent. A range of values of dissolved boron in irrigation water, with their estimated suitability on various crops is presented in Table 11. These ranges are modified from Ayers and Westcot (1985).

Table 11 Range of boron concentrations with estimated suitability on various crops

Range of dissolved boron (mg/L)	Suitability
<0.5	Suitable on all but most highly boron sensitive crops
0.5 – 1.0	Suitable on most boron sensitive crops
1.0 – 2.0	Suitable on most moderately boron sensitive crops
>2.0	Suitable for only moderately to highly boron tolerant crops

Source: Modified from Ayers and Westcot 1985

Contaminant Groups

Because there are so many potential individual constituents to evaluate, researchers have often summarized contaminants into groups depending on the purpose of the study. Recognizing that there are exceptions to any classification scheme, this update considered groups according to their common sources of contamination—those naturally occurring and those caused by human activities (anthropogenic). Each of these sources includes more than one contaminant group. A listing of the contaminant groups and the individual constituents belonging to those groups, summarized in this report, is included in Appendix F.

Naturally Occurring Sources

In this report, naturally occurring sources include three primary groups: (1) inorganic constituents with primary MCLs, (2) inorganic constituents with secondary MCLs, and (3) radiological constituents. Inorganics primarily include naturally occurring minerals such as arsenic or mercury, although human activities may certainly contribute to observed concentrations. Radiological constituents include primarily naturally occurring constituents such as radon, gross alpha, and uranium. Although radioactivity is not considered a significant contaminant statewide, it can be locally important, particularly in communities in the Sierra Nevada.

Anthropogenic Sources

Anthropogenic contaminants include pesticides, volatile organic compounds (VOCs), and nitrates. Pesticides and VOCs are often grouped together into an organic contaminant group. However, separating the two gives a general idea of which contaminants are primarily from agricultural activities (pesticides) and which are primarily from industrial activities (VOCs). One notable exception to the groupings is dibromochloropropane (DBCP). Even though this compound is a VOC, DBCP is a soil fumigant and is included with pesticides. Nitrates are a surprising anthropogenic class to some observers. Nitrogen is certainly a naturally occurring inorganic constituent. However, because most nitrates are associated with agriculture (see Box P, "Focused on Nitrates: Detailed Study of a Contaminant") and nitrates are among California's leading contaminants, it is appropriate to consider them separately from inorganics.

Box P Focused on Nitrates: Detailed Study of a Contaminant

Because water has so many potential uses, the study of water quality means different things to different people. Thomas Harter, a professor at the University of California at Davis, has chosen to focus on nitrates as one of his research interests. Harter's monitoring network consists of 79 wells on 5 dairies in the San Joaquin Valley.

A common result of dairy activities is the release of nitrogen into the surroundings, which changes to nitrate in groundwater. Nitrates are notorious for their role in interfering with oxygen transport in babies, a condition commonly referred to as "blue baby syndrome." Nitrates are also of interest because more public supply wells have been closed due to nitrate contamination than from any other contaminant (Bachman and others 1997).

Harter's study has focused on two primary activities. The first is a meticulous examination of nitrogen at the surface and nitrates in the uppermost 25 feet of the subsurface. This monitoring has been ongoing since 1993, and has shown that a significant amount of nitrate can reach shallow groundwater. The second focus of the study has been to change management practices to reduce the amount of nitrogen available to reach groundwater, along with continued monitoring. This has occurred since 1998. Results of the study are better management practices that significantly reduce the amount of nitrogen available to groundwater. This will help minimize the potential adverse impacts to groundwater quality from nitrates.

Chapter 7

Inventory of California's Groundwater Information

Chapter 7
Inventory of California's Groundwater Information

The groundwater information in this chapter summarizes the available information on statewide and regional groundwater issues. For more detailed information on specific groundwater basins see the supplement to this report that is available on the California Department of Water Resources (DWR) website, http://www.waterplan.water.ca.gov/groundwater/118index.htm. See Appendix A for information on accessing individual basin descriptions and the map delineating California's groundwater basins.

Statewide Groundwater Information

There is a large amount of data available for many of the State's most heavily developed groundwater basins. Conversely, there is relatively little data available on groundwater in the undeveloped areas. The information in this report is generally limited to a compilation of the information readily available to DWR staff and may not include the most up-to-date data generated by studies that have been completed recently by water management agencies. For this reason, the collection of additional, more recent data on groundwater basins should be continued and integrated into the basin descriptions. Statewide summaries are included below.

Groundwater Basins

There are currently 431 groundwater basins delineated, underlying about 40 percent of the surface area of the State. Of those, 24 basins are subdivided into a total of 108 subbasins, giving a total of 515 distinct groundwater systems described in this report (Figure 20). Basin delineation methods are described in Appendix G. Additionally, many of the subbasin boundaries were developed or modified with public input, but little physical data. These boundaries should not be considered as precisely defining a groundwater basin boundary; the determination of whether any particular area lies within a groundwater basin boundary should be determined only after detailed local study.

Groundwater basin and subbasin boundaries shown on the map included with this bulletin are based on evaluation of the best available information. In basins where many studies have been completed and the basin has been operated for a number of years, the basin response is fairly well understood and the boundaries are fairly well defined. Even in these basins, however, there are many unknowns and changes in boundaries may result as more information about the basin is collected and evaluated.

Groundwater Budgets

Rather than simply providing all groundwater budget data collected during this update, the budget information was classified into one of three categories indicating the relative level of detail of information available. These categories, types A, B, and C, are discussed in Box R, "Explanation of Groundwater Data Tables." A type A budget indicates that much of the information needed to characterize the groundwater budget for the basin or subbasin was available. DWR staff did not verify these type A budgets, so DWR cannot address the accuracy of the data provided by them. Type B indicates that enough data are available to estimate the groundwater extraction to meet local water use needs. This is useful in understanding the reliance of a particular area on groundwater. Type C indicates a low level of knowledge of any of the budget components for the area.

Figure 21 depicts where these type A, B, and C budgets occur. In general, there is a greater level of understanding (type A or B) in the more heavily developed areas in terms of groundwater use. These include the Central Valley and South Coast. The lowest level of knowledge of groundwater budget data is in the southeast desert area. A discussion of groundwater use in each region is included below.

Box Q How Does the Information in This Report Relate to the Recently Enacted Laws Senate Bill 221 and Senate Bill 610 (2002)?

Recently enacted legislation requires developers of certain new housing projects to demonstrate an available water supply for that development. If a part of that proposed water supply is groundwater, urban water suppliers must provide additional information on the availability of an adequate supply of groundwater to meet the projected demand and show that they have the legal right to extract that amount of groundwater. SB 610 (2002) amended the Water Code to require, among other things, the following information (Section 10631(b)(2)):

> *For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.*

The hydrogeologic information contained in the basin descriptions that supplement this update of Bulletin 118 includes only the information that was available in California Department of Water Resources (DWR) files through reference searches and through limited contact with local agencies. Local agencies may have conducted more recent studies that have generated additional information about water budgets and aquifer characteristics. Unless the agency notified DWR, or provided a copy of the recent reports to DWR staff, that recent information has not been included in the basin descriptions. Therefore, although SB 610 refers to groundwater basins identified as overdrafted in Bulletin 118, it would be prudent for local water suppliers to evaluate the potential for overdraft of any basin included as a part of a water supply assessment.

Persons interested in collecting groundwater information in accordance with the Water Code as amended by SB 221 and SB 610 may start with the information in Bulletin 118, but should follow up by consulting the references listed for each basin and contacting local water agencies to obtain any new information that is available. Otherwise, evaluation of available groundwater resources as mandated by SB 221 and SB 610 may not be using the most complete and recent information about water budgets and aquifer characteristics.

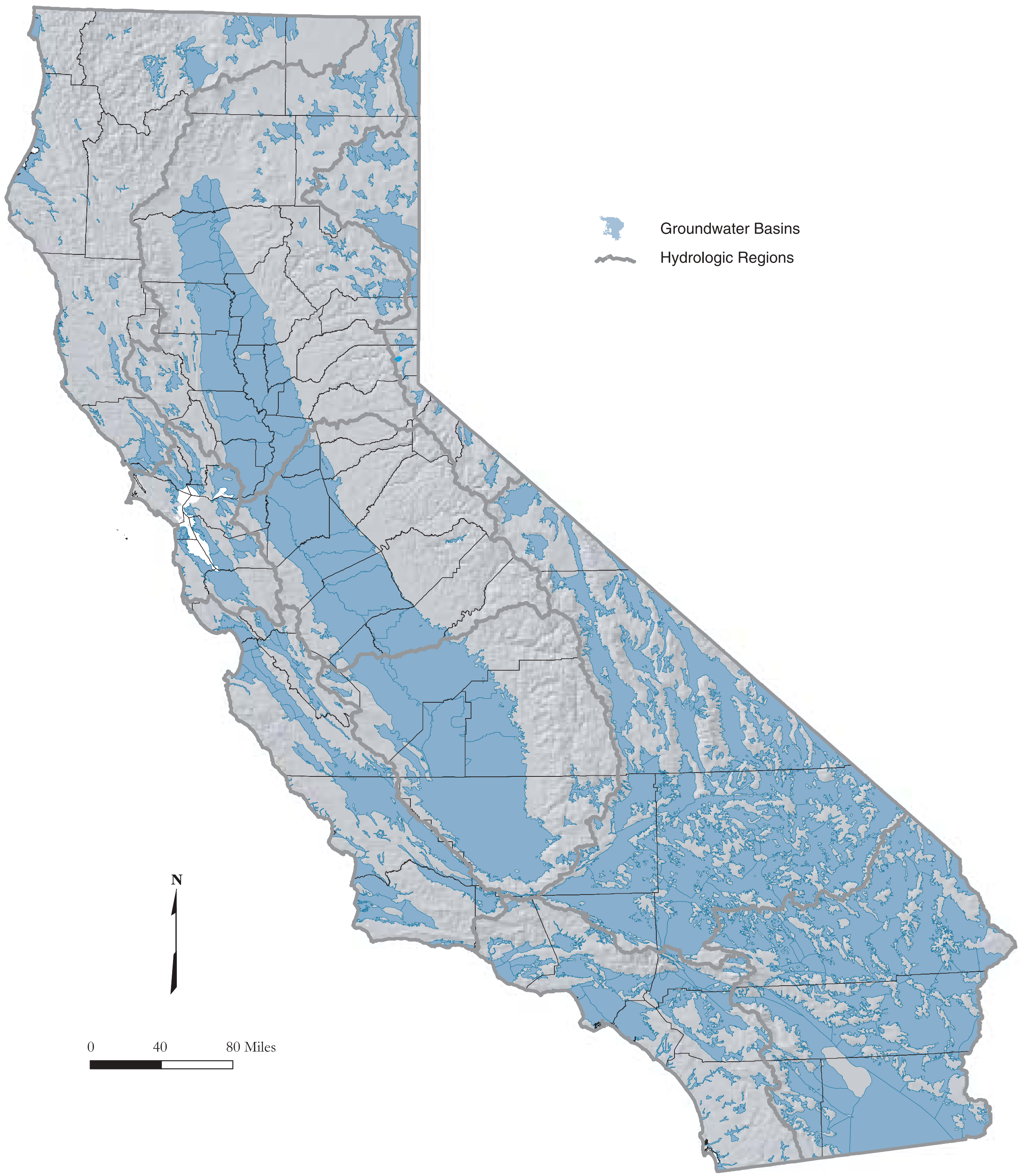

Figure 20 Groundwater basins and subbasins

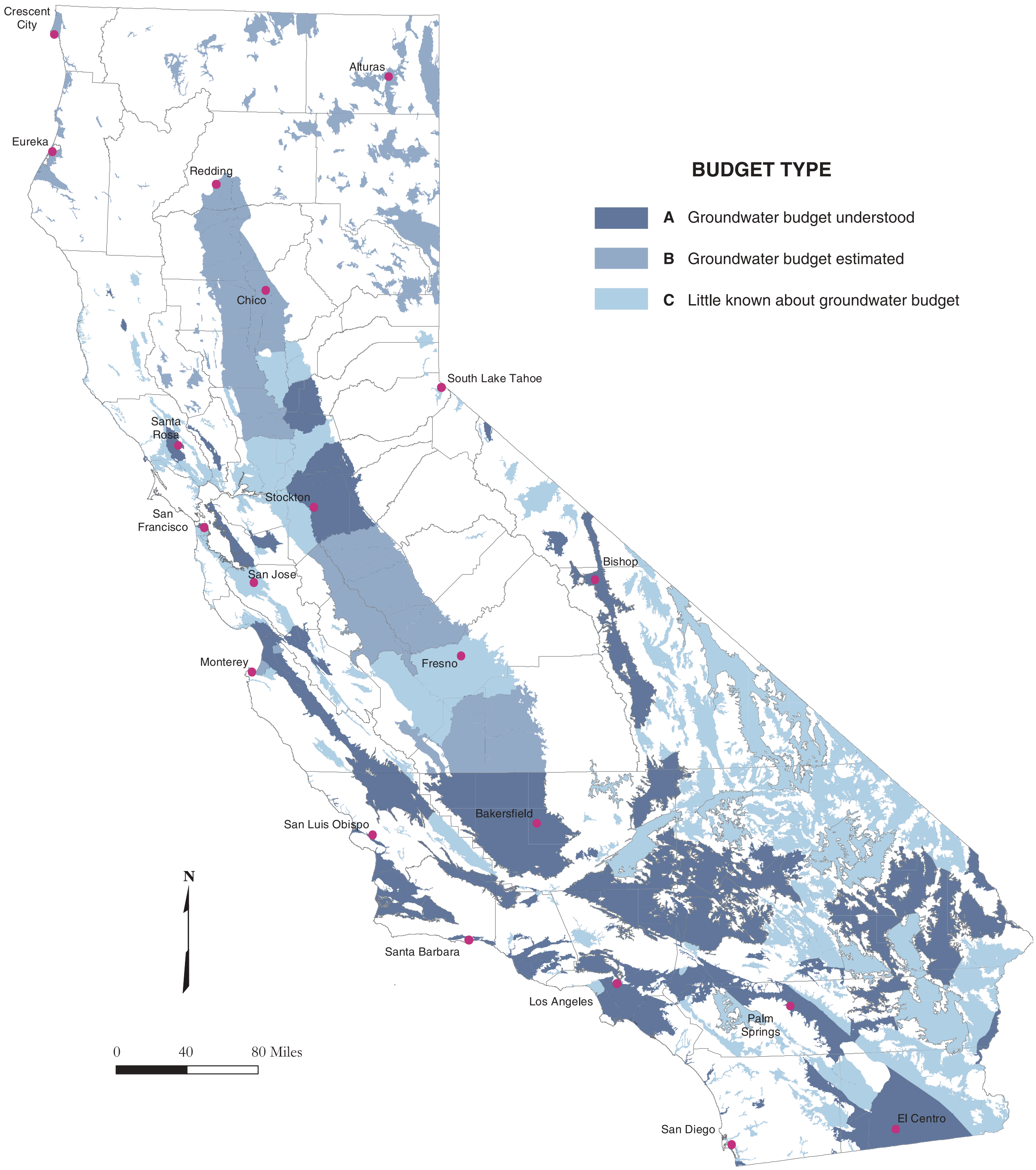

Figure 21 Basin and subbasin groundwater budget types

Box R Explanation of Groundwater Data Tables

A groundwater data table for each hydrologic region is included at the end of each hydrologic region section in Chapter 7. The tables include the following information:

Basin/Subbasin Number. The basin numbering format is x-xxx.xx. The first number in the sequence assigns the basin to one of the nine Regional Water Quality Control Board boundaries. The second number is the groundwater basin number. Any number following the decimal identifies that the groundwater basin has been further divided into subbasins. Reevaluation of available hydrogeologic information resulted in the deletion of some basins and subbasins identified in Bulletins 118-75 and 118-80. Because of this, there are some gaps in the sequence of basin numbers in this report. The methods used for developing the current groundwater basin maps are discussed in Appendix H. The names and numbers of the basins deleted, along with any comments related to their elimination are included in the appropriate region in Chapter 7. Previously unidentified groundwater basins or subbasins that were delineated during this update are assigned new identification numbers that sequentially follow the last number used in Bulletin 118-80 for groundwater basins or subbasins.

Basin or Subbasin Name. Basin names are based on published and unpublished reports, topographic maps, and local terminology. Names of more recently delineated basins or subbasins are based on the principal geographic feature, which in most cases corresponds to the name of a valley. In the case of a subbasin, its formal name should include the name of the basin (for example, Sacramento Valley Groundwater Basin, North American Subbasin). However, both locally and informally, the term subbasin is used interchangeably with basin (for example, North American Basin).

Area. The area for each basin or subbasin is presented in acres rounded to three significant figures (for example, 147,148 acres was rounded to 147,000 acres). The area describes only the upper surface or map view of a basin. The basin underlies the area and may extend beyond the surface expression (discussed in Chapter 6).

Groundwater Budget Type. The type of groundwater budget information available was classified as Type A, B, or C based on the following criteria:

Type A – indicates one of the following: (1) a groundwater budget exists for the basin or enough components from separate studies could be combined to give a general indication of the basin's groundwater budget, (2) a groundwater model exists for the basin that can be used to calculate a groundwater budget, or (3) actual groundwater extraction data exist for the basin.

Type B – indicates that a use-based estimate of groundwater extraction is calculated for the basin. The use-based estimate is determined by calculating the overall use from California Department of Water Resources land use and urban water use surveys. Known surface water supplies are then subtracted from the total demand leaving the rest of the use to be met by groundwater extraction.

Type C – indicates that there are not enough data to provide either an estimate of the basin's groundwater budget or groundwater extraction from the basin.

Well Yields. Maximum and average well yields in gallons per minute (gpm) are reported for municipal supply and agricultural wells where available. Most of the values reported are from initial tests reported during construction of the well, which may not be an accurate indication of the long-term production capacity of the wells.

Box R continued on next page

Box R Explanation of Groundwater Data Tables (continued)

Types of Monitoring. This includes monitoring of both groundwater levels and quality. "Levels" indicate the number of wells actively monitored without consideration of frequency. Most wells are monitored semi-annually, but many are monitored monthly. "Quality" indicates the number of wells monitored for various constituents; these could range from a grab sample taken for a field specific conductance measurement to a full analysis of organic and inorganic constituents. "Title 22" indicates the number of public water system wells that are actively sampled and monitored under the direction of California Department of Health Services (DHS) Title 22 Program.

Total Dissolved Solids. This category includes range and average values of total dissolved solids (TDS). This data primarily represents data from published reports. In some cases, a range of average TDS values is presented.

Active Monitoring

The summary of active monitoring includes wells that are monitored for groundwater elevation or groundwater quality within the delineated groundwater basins as of 1999. Groundwater elevation data collected by DWR and cooperators are available online at http://wdl.water.ca.gov. Most of the water quality data are for public supply wells and were provided by the California Department of Health Services (DHS). Other groundwater level and water quality monitoring activities were reported by local agencies during this update. The summary indicates that there are nearly 14,000 wells monitored for groundwater levels, 10,700[1] wells monitored under DHS water quality monitoring program, and 4,700 wells monitored for miscellaneous water quality by other agencies.

[1] These numbers include the wells in basins and subbasins only; throughout the entire state, DHS has responsibility for more than 16,000 public supply wells.

Box S What Happens When an MCL Exceedance Occurs?

All suppliers of domestic water to the public are subject to regulations adopted by the U.S. Environmental Protection Agency under the Safe Drinking Water Act (42 U.S.C. 300f et seq.) as well as by the California Department of Health Services under the California Safe Drinking Water Plan Act (Health and Safety Code §§ 116270-116750).

These regulations include primary drinking water standards that establish maximum contaminant levels (MCLs) for inorganic and organic chemicals and radioactivity. MCLs are based on health protection, technical feasibility, and economic factors.

California requires public water systems to sample their drinking water sources, analyze for regulated contaminants, and determine compliance with the MCLs on a regular basis. Sampling frequency depends on the contaminant, type of water source, and previous sampling results; frequency can range from monthly to once every nine years, or none at all if sampling is waived because the source is not vulnerable to the contaminant.

Primary MCLs are enforceable standards. In California, compliance is usually determined at the wellhead or the surface water intake. To meet water quality standards and comply with regulations, a water system with a contaminant exceeding an MCL must notify the public and remove the source from service or initiate a process and schedule to install treatment for removing the contaminant.

Notification requirements reflect the severity of the associated health risks; immediate health concerns prompt immediate notice to consumers. Violations that do not pose a significant health concern may use a less immediate notification process. In addition to consumer notification, a water system is required by statute to notify the local governing body (for example, city council or county board of supervisors) whenever a drinking water well exceeds an MCL, even if the well is taken out of service.

Detections of regulated contaminants (and certain unregulated contaminants) must also be reported to consumers in the water system's annual Consumer Confidence Report.

Groundwater Quality

The summary of water quality relied heavily on data from the DHS Title 22 water quality monitoring program. The assessment consisted of querying the DHS database for active wells that have constituents exceeding the maximum contaminant level (MCL) for drinking water. Summaries of this assessment for each of the State's hydrologic regions (HRs) are discussed in this chapter.

DHS data are the most comprehensive statewide water quality data set available, but this data set should not be used as a sole indicator of the groundwater quality in California. Data from these wells are not necessarily representative of any given basin; it only represents the quality of groundwater where a public water supply is extracted.

The Natural Resources Defense Council (NRDC 2001) issued a report that concludes California's groundwater resources face a serious long-term threat from contamination. Despite heavy reliance on groundwater, no comprehensive statewide assessments of groundwater quality were available. In response to the NRDC report, the State Water Resources Control Board (SWRCB) is planning a comprehensive assessment of the State's groundwater quality. This program is discussed in Chapter 4, in the section titled "Groundwater Quality Monitoring Act of 2001 (AB 599)."

Regional Groundwater Use

The importance of groundwater as a resource varies regionally throughout the State. For planning purposes, DWR divides California into 10 hydrologic regions (HRs), which correspond to the State's major drainage areas. HR boundaries are shown in Figure 22. A review of average water year supplies from the California Water Plan (DWR 1998) shows the importance of groundwater as a local supply for agricultural and municipal use throughout the State and in each of California's 10 HRs (Table 12 and Figure 23).

Table 12 Annual agricultural and municipal water demands met by groundwater

Hydrologic region	Total Demand Volume (TAF)	Demand met by Groundwater (TAF)	Demand met by Groundwater (%)
North Coast	1063	263	25
San Francisco Bay	1353	68	5
Central Coast	1263	1045	83
South Coast	5124	1177	23
Sacramento River	8720	2672	31
San Joaquin River	7361	2195	30
Tulare Lake	10556	4340	41
North Lahontan	568	157	28
South Lahontan	480	239	50
Colorado River	4467	337	8

Source: DWR 1998

With more than 80 percent of demand met by groundwater, the Central Coast HR is heavily reliant on groundwater to meet its local needs. The Tulare Lake and South Lahontan HRs meet more than 40 percent of their local demand from groundwater. The South Coast, North Coast, North Lahontan, San Joaquin River, and Sacramento River HRs take between 20 and 40 percent of their supply from groundwater. Groundwater is a relatively minor source of supply in the San Francisco Bay and Colorado River HRs.

Of all the groundwater extracted annually in the state, an estimated 35 percent is produced from the Tulare Lake HR. More than 70 percent of groundwater extraction occurs in the Central Valley (Tulare Lake, San Joaquin River, and Sacramento River HRs combined). Nearly 20 percent is extracted in the highly urbanized South Coast and Central Coast HRs, while less than 10 percent is extracted in the remaining five HRs combined.

Figure 22 California's 10 hydrologic regions

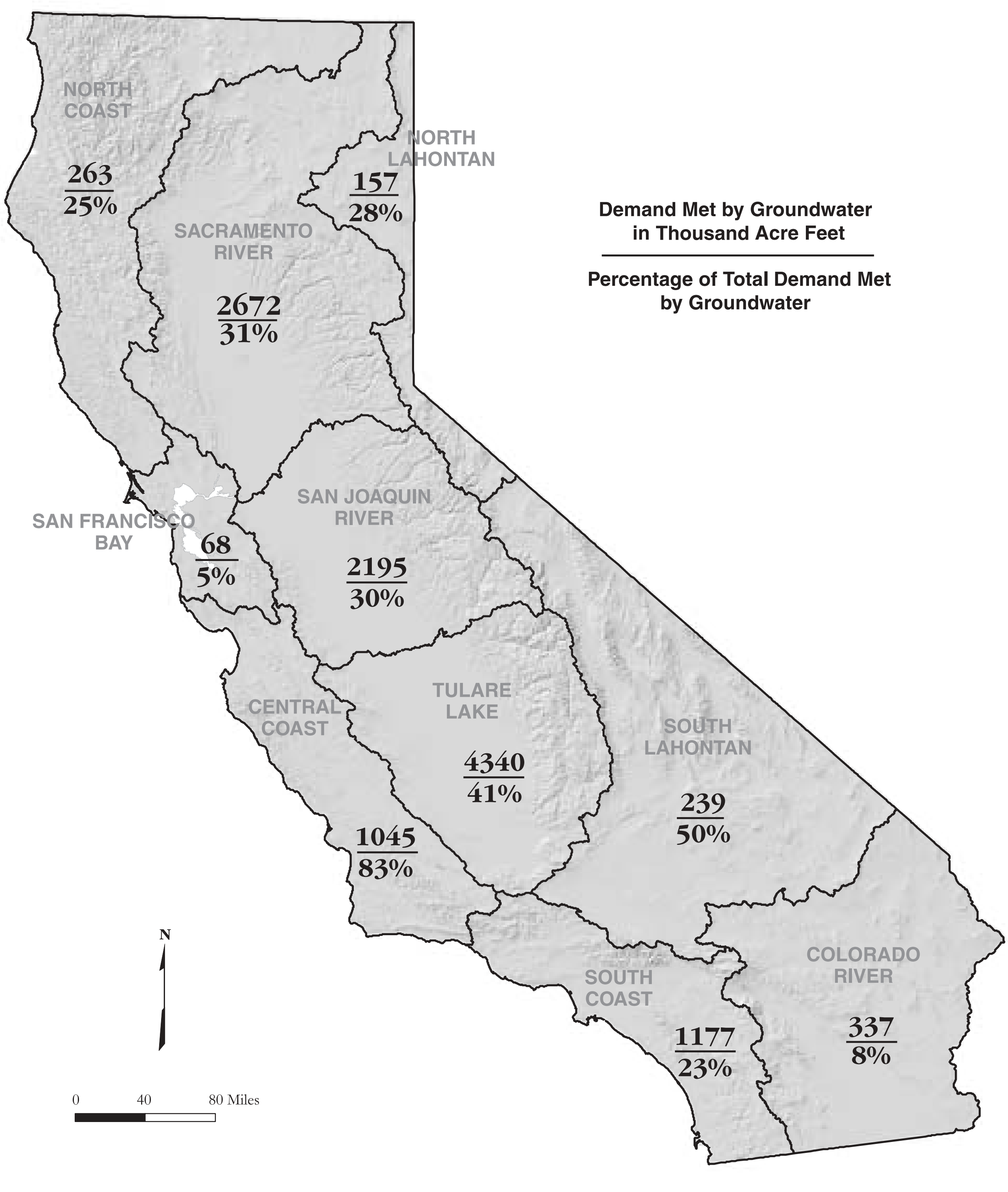

Figure 23 Agricultural and urban demand supplied by groundwater in each hydrologic region

The remainder of this chapter provides a summary of each of the 10 HRs. A basin location map for each HR is followed by a brief discussion of groundwater occurrence and groundwater conditions. A summary tabulation of groundwater information for each groundwater basin within the HR is provided. Greater detail for the data presented in these tables, including a bibliography, is provided in the individual basin/subbasin descriptions in the supplemental report (see Appendix A). Because the groundwater basin numbers are based on the boundaries of the State's nine Regional Water Quality Control Boards (RWQCB), Figure 24 shows the relationship between the Regional Board boundaries and DWR's HR boundaries.

The groundwater basin tabulations give an overview of available data. Where a basin is divided into subbasins, only the information for the subbasins is provided. The data for each subbasin generally come from different sources, so it is inappropriate to sum the data into a larger basin summary. An explanation of each of the data items presented in the summary table is provided in Box R.

Figure 24 Regional Water Quality Control Board regions and Department of Water Resources hydrologic regions

North Coast Hydrologic Region

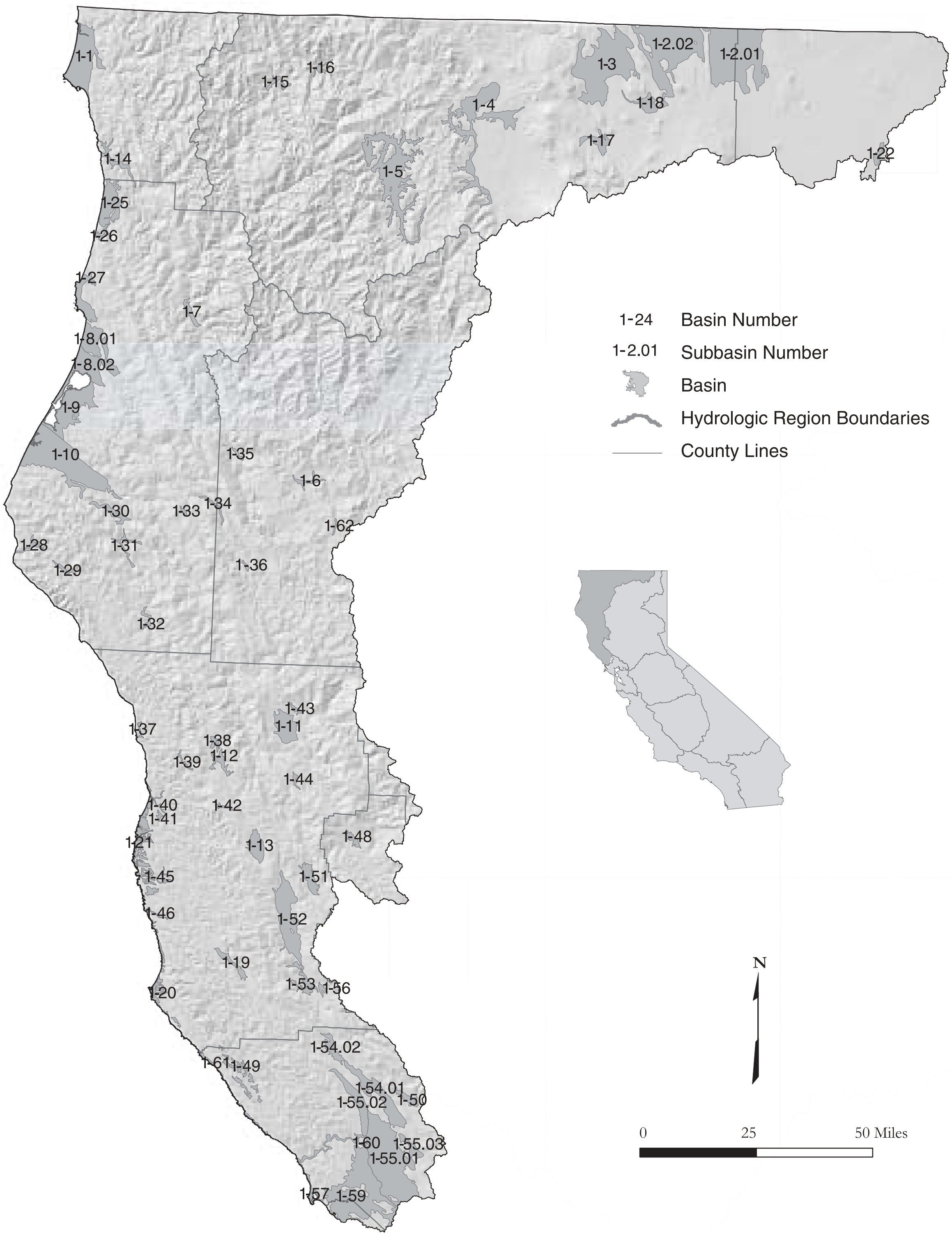

Figure 25 North Coast Hydrologic Region

Basins and Subbasins of the North Coast Hydrologic Region

Basin/subbasin	Basin name
1-1	Smith River Plain
1-2	Klamath River Valley
1-2.01	Tule Lake
1-2.02	Lower Klamath
1-3	Butte Valley
1-4	Shasta Valley
1-5	Scott River Valley
1-6	Hayfork Valley
1-7	Hoopa Valley
1-8	Mad River Valley
1-8.01	Mad River Lowland
1-8.02	Dows Prairie School Area
1-9	Eureka Plain
1-10	Eel River Valley
1-11	Covelo Round Valley
1-12	Laytonville Valley
1-13	Little Lake Valley
1-14	Lower Klamath River Valley
1-15	Happy Camp Town Area
1-16	Seiad Valley
1-17	Bray Town Area
1-18	Red Rock Valley
1-19	Anderson Valley
1-20	Garcia River Valley
1-21	Fort Bragg Terrace Area
1-22	Fairchild Swamp Valley
1-25	Prairie Creek Area
1-26	Redwood Creek Area
1-27	Big Lagoon Area
1-28	Mattole River Valley
1-29	Honeydew Town Area
1-30	Pepperwood Town Area
1-31	Weott Town Area
1-32	Garberville Town Area
1-33	Larabee Valley
1-34	Dinsmores Town Area
1-35	Hyampom Valley
1-36	Hettenshaw Valley
1-37	Cottoneva Creek Valley
1-38	Lower Laytonville Valley
1-39	Branscomb Town Area
1-40	Ten Mile River Valley
1-41	Little Valley

Basin/subbasin	Basin name
1-42	Sherwood Valley
1-43	Williams Valley
1-44	Eden Valley
1-45	Big River Valley
1-46	Navarro River Valley
1-48	Gravelley Valley
1-49	Annapolis Ohlson Ranch Formation Highlands
1-50	Knights Valley
1-51	Potter Valley
1-52	Ukiah Valley
1-53	Sanel Valley
1-54	Alexander Valley
1-54.01	Alexander Area
1-54.02	Cloverdale Area
1-55	Santa Rosa Valley
1-55.01	Santa Rosa Plain
1-55.02	Healdsburg Area
1-55.03	Rincon Valley
1-56	McDowell Valley
1-57	Bodega Bay Area
1-59	Wilson Grove Formation Highlands
1-60	Lower Russian River Valley
1-61	Fort Ross Terrace Deposits
1-62	Wilson Point Area

Description of the Region

The North Coast HR covers approximately 12.46 million acres (19,470 square miles) and includes all or portions of Modoc, Siskiyou, Del Norte, Trinity, Humboldt, Mendocino, Lake, and Sonoma counties (Figure 25). Small areas of Shasta, Tehama, Glenn, Colusa, and Marin counties are also within the region. Extending from the Oregon border south to Tomales Bay, the region includes portions of four geomorphic provinces. The northern Coast Range forms the portion of the region extending from the southern boundary north to the Mad River drainage and the fault contact with the metamorphic rocks of the Klamath Mountains, which continue north into Oregon. East of the Klamath terrane along the State border are the volcanic terranes of the Cascades and the Modoc Plateau. In the coastal mountains, most of the basins are along the narrow coastal strip between the Pacific Ocean and the rugged Coast Range and Klamath Mountains and along inland river valleys; alluviated basin areas are very sparse in the steep Klamath Mountains. In the volcanic terrane to the east, most of the basins are in block faulted valleys that once held Pleistocene-age lakes. The North Coast HR corresponds to the boundary of RWQCB 1. Significant geographic features include basin areas such as the Klamath River Basin, the Eureka/Arcata area, Hoopa Valley, Anderson Valley, and the Santa Rosa Plain. Other significant features include Mount Shasta, forming the southern border of Shasta Valley, and the rugged north coastal shoreline. The 1995 population of the entire region was about 606,000, with most being centered along the Pacific Coast and in the inland valleys north of the San Francisco Bay Area.

The northern mountainous portion of the region is rural and sparsely populated, primarily because of the rugged terrain. Most of the area is heavily forested. Some irrigated agriculture occurs in the narrow river valleys, but most occurs in the broader valleys on the Modoc Plateau where pasture, grain and alfalfa predominate. In the southern portion of the region, closer to urban centers, crops like wine grapes, nursery stock, orchards, and truck crops are common.

A majority of the surface water in the North Coast HR goes to environmental uses because of the "wild and scenic" designation of most of the region's rivers. Average annual precipitation ranges from 100 inches in the Smith River drainage to 29 inches in the Santa Rosa area and about 10 inches in the Klamath drainage; as a result, drought is likely to affect the Klamath Basin more than other portions of the region. Communities that are not served by the area's surface water projects also tend to experience shortages. Surface water development in the region includes the U.S. Bureau of Reclamation (USBR) Klamath Project, Humboldt Bay Municipal Water District's Ruth Lake, and U.S. Army Corps of Engineer's Russian River Project. An important factor concerning water demand in the Klamath Project area is water allocation for endangered fish species in the upper and lower basin. Surface water deliveries for agriculture in 2001, a severe drought year, were only about 20 percent of normal.

Groundwater Development

Groundwater development in the North Coast HR occurs along the coast, near the mouths of some of the region's major rivers, on the adjacent narrow marine terraces, or in the inland river valleys and basins. Reliability of these supplies varies significantly from area to area. There are 63 groundwater basins/subbasins delineated in the region, two of which are shared with Oregon. These basins underlie approximately 1.022 million acres (1,600 square miles).

Along the coast, most groundwater is developed from shallow wells installed in the sand and gravel beds of several of the region's rivers. Under California law, the water produced in these areas is considered surface water underflow. Water from Ranney collectors installed in the Klamath River, Rowdy Creek, the Smith

River, and the Mad River supply the towns of Klamath, Smith River and Crescent City in Del Norte County and most of the Humboldt Bay area in Humboldt County. Except on the Mad River, which has continuous supply via releases from Ruth Reservoir, these supplies are dependent on adequate precipitation and flows throughout the season. In drought years when streamflows are low, seawater intrusion can occur causing brackish or saline water to enter these systems. This has been a problem in the town of Klamath, which in 1995 had to obtain community water from a private well source. Toward the southern portion of the region, along the Mendocino coast, the Town of Mendocino typifies the problems related to groundwater development in the shallow marine terrace aquifers. Groundwater supply is limited by the aquifer storage capacity, and surveys done in the Town of Mendocino in the mid-1980s indicate that about 10 percent of wells go dry every year and up to 40 percent go dry during drought years.

Groundwater development in the inland coastal valleys north of the divide between the Russian and Eel Rivers is generally of limited extent. Most problems stemming from reliance on groundwater in these areas is a lack of alluvial aquifer storage capacity. Many groundwater wells rely on hydrologic connection to the rivers and streams of the valleys. The City of Rio Dell has experienced water supply problems in community wells and, as a result, recently developed plans to install a Ranney collector near the Eel River. South of the divide, in the Russian River drainage, a significant amount of groundwater development has occurred on the Santa Rosa Plain and surrounding areas. The groundwater supplies augment surface supplies from the Russian River Project.

In the north-central part of the North Coast HR, the major groundwater basins include the Klamath River Valley, Shasta Valley, Scott River Valley, and Butte Valley. The Klamath River Valley is shared with Oregon. Of these groundwater basins, Butte Valley has the most stable water supply conditions. The historical annual agricultural surface water supply has been about 20,000 acre-feet. As farming in the valley expanded from the early 1950s to the early 1990s, bringing nearly all the arable land in the valley into production, groundwater was developed to farm the additional acres. It has been estimated that current, fully developed demands are only about 80 percent of the available groundwater supply. By contrast, water supply issues in the other three basins are contingent upon pending management decisions regarding restoration of fish populations in the Klamath River and the Upper Klamath Basin system. The Endangered Species Act (ESA) fishery issues include lake level requirements for two sucker fish species and in-stream flow requirements for coho salmon and steelhead trout. Since about 1905, the Klamath Project has provided surface water to the agricultural community, which in turn has provided water to the wildlife refuges. Since the early 1990s, it has been recognized that surface water in the Klamath Project is over-allocated, but very little groundwater development had occurred. In 2001, which was a severe drought year, USBR delivered a total of about 75,000 acre-feet of water to agriculture in California, about 20 percent of normal. In the Klamath River Groundwater Basin this translated to a drought disaster, both for agriculture and the wildlife refuges. In addition, there were significant impacts for both coho salmon and sucker fisheries in the Klamath River watershed. As a result of the reduced surface water deliveries, significant groundwater development occurred, and groundwater extraction increased from an estimated 6,000 acre-feet in 1997 to roughly 60,000 acre-feet in 2001. Because of the complexity of the basin’s water issues, a long-term Klamath Project Operation plan has not yet been finalized. Since 1995, USBR has issued an annual operation plan based on estimates of available supply. The Scott River Valley and Shasta Valley rely to a significant extent on surface water diversions. In most years, surface water supplies the majority of demand, and groundwater extraction supplements supply as needed depending on wet or dry conditions. Discussions are under way to develop strategies to conjunctively use surface water and groundwater to meet environmental, agricultural, and other demands.

Groundwater Quality

Groundwater quality characteristics and specific local impairments vary with regional setting within the North Coast HR. In general, seawater intrusion and nitrates in shallow aquifers are problems in the coastal groundwater basins; high total dissolved solids (TDS) content and general alkalinity are problems in the lake sediments of the Modoc Plateau basins; and iron, boron, and manganese can be problems in the inland basins of Mendocino and Sonoma counties.

Water Quality in Public Supply Wells

From 1994 through 2000, 584 public supply water wells were sampled in 32 of the 63 basins and subbasins in the North Coast HR. Analyzed samples indicate that 553 wells, or 95%, met the state primary Maximum Contaminant Levels (MCL) for drinking water. Thirty-one wells, or 5%, sampled have constituents that exceed one or more MCL. Figure 26 shows the percentage of each contaminant group that exceeded MCLs in the 31 wells.

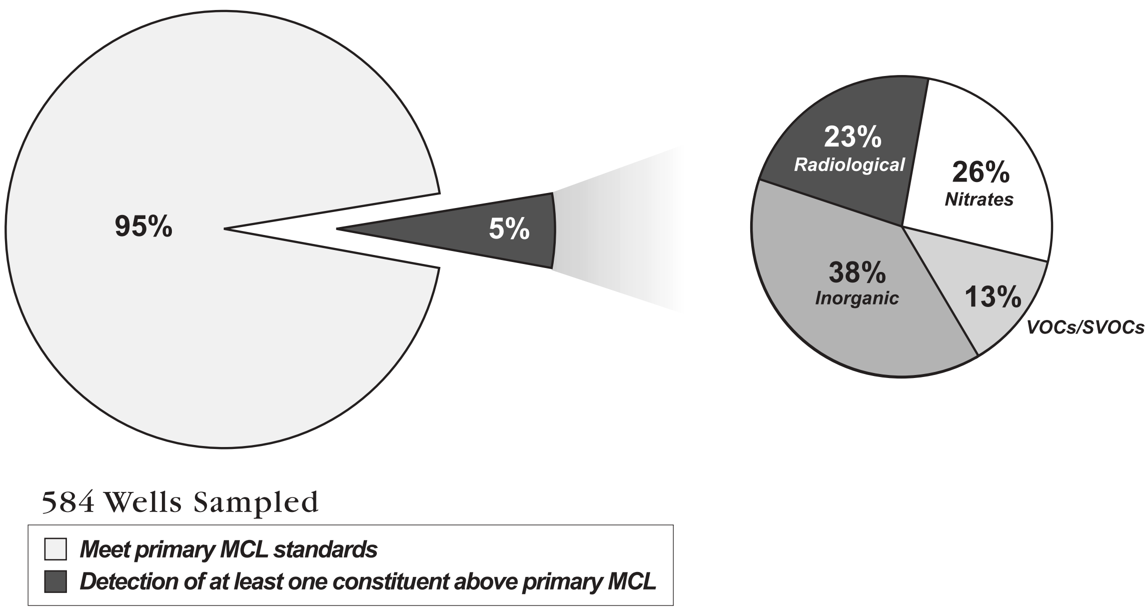

Figure 26 MCL exceedances in public supply wells in the North Coast Hydrologic Region

Table 13 lists the three most frequently occurring individual contaminants in each of the five contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 13 Most frequently occurring contaminants by contaminant group in the North Coast Hydrologic Region

Contaminant group wellsInorganics – Primary exceedance	Contaminant - # of wells Aluminum – 4	Contaminant - # of wells Arsenic – 4	Contaminant - # of 4 tied at 1
Inorganics – Secondary	Manganese – 150	Iron – 108	Copper – 2
Radiological	Radium 228 – 3	Combined RA226 + RA228 – 3	Radium 226 – 1
Nitrates	Nitrate(as NO_3) – 7	Nitrite(as N) – 1	
VOCs/SVOCs	TCE – 2	3 tied at 1 exceedance	

TCE = Trichloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

Since Bulletin 118-80 was published, RWQCB 2 boundary has been modified. This resulted in several basins being reassigned to RWQCB 1. These are listed in Table 14, along with other modifications to North Coast HR.

Table 14 Modifications since Bulletin 118-80 of groundwater basins in North Coast Hydrologic Region

Basin name	New number	Old number
McDowell Valley	1-56	2-12
Knights Valley	1-50	2-13
Potter Valley	1-51	2-14
Ukiah Valley	1-52	2-15
Sanel Valley	1-53	2-16
Alexander Valley	1-54	2-17
Santa Rosa Valley	1-55	2-18
Lower Russian River Valley	1-60	2-20
Bodega Bay Area	1-57	2-21
Modoc Plateau Recent Volcanic Area	deleted	1-23
Modoc Plateau Pleistocene Volcanic Area	deleted	1-24
Gualala River Valley	deleted	1-47
Wilson Grove Formation Highlands	1-59	2-25
Fort Ross Terrace Deposits	1-61	
Wilson Point Area	1-62	

Fort Ross Terrace Deposits (1-61) and Wilson Point Area (1-62) have been defined since B118-80 and are included in this update. Mad River Valley Groundwater Basin (1-8) has been subdivided into two subbasins. Sebastopol Merced Formation (2-25) merged into Basin 1-59 and was renamed Wilson Grove Formation Highlands.

There are a couple of deletions of groundwater basins from Bulletin 118-80. The Modoc Plateau Recent Volcanic Area (1-23) and the Modoc Plateau Pleistocene Volcanic Area (1-24) are volcanic aquifers and were not assigned basin numbers in this bulletin. These are considered to be groundwater source areas as discussed in Chapter 6. Gualala River Valley (1-47) was deleted because the State Water Resources Control Board determined the water being extracted in this area as surface water within a subterranean stream.

Table 15 North Coast Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm) Maximum	Well Yields (gpm) Average	Types of Monitoring Levels	Types of Monitoring Quality	Types of Monitoring Title 22	TDS (mg/L) Average	TDS (mg/L) Range
1-1	SMITH RIVER PLAIN	40,450	B	500	50	7	10	33	164	32 - 496
1-2	KLAMATH RIVER VALLEY									
1-2.01	UPPER KLAMATH LAKE BASIN - Tule Lake	85,930	B	3,380	1,208	40	8	5	721	140 - 2,200
1-2.02	UPPER KLAMATH LAKE BASIN - Lower Klamath	73,330	B	2,600	1,550	4	-	-	-	-
1-3	BUTTE VALLEY	79,700	B	5,000	2,358	28	13	9	310	55 - 1,110
1-4	SHASTA VALLEY	52,640	B	1,200	273	9	15	24	-	-
1-5	SCOTT RIVER VALLEY	63,900	B	3,000	794	6	10	5	258	47 - 1,510
1-6	HAYFORK VALLEY	3,300	B	200	-	-	5	-	-	-
1-7	HOOPA VALLEY	3,900	B	300	-	-	4	-	125	95 - 159
1-8	MAD RIVER VALLEY									
1-8.01	MAD RIVER VALLEY LOWLAND	25,600	B	120	72	4	9	2	184	55 - 280
1-8.02	DOWS PRAIRIE SCHOOL AREA	14,000	B	-	-	-	3	-	-	-
1-9	EUREKA PLAIN	37,400	B	1,200	-	4	4	6	177	97 - 460
1-10	EEL RIVER VALLEY	73,700	B	1,200	-	8	11	29	237	110 - 340
1-11	COVELO ROUND VALLEY	16,400	C	850	193	9	5	29	239	116 - 381
1-12	LAYTONVILLE VALLEY	5,020	A	700	7	4	3	-	149	53 - 251
1-13	LITTLE LAKE VALLEY	10,000	A	1,000	45	7	7	-	340	97 - 1,710
1-14	LOWER KLAMATH RIVER VALLEY	7,030	B	-	-	-	-	-	-	43 - 150
1-15	HAPPY CAMP TOWN AREA	2,770	B	-	-	-	-	17	-	-
1-16	SEIAD VALLEY	2,250	B	-	-	-	2	2	-	-
1-17	BRAY TOWN AREA	8,030	B	-	-	-	-	-	-	-
1-18	RED ROCK VALLEY	9,000	B	-	-	-	-	-	-	-
1-19	ANDERSON VALLEY	4,970	C	300	30	7	5	7	-	80 - 400
1-20	GARCIA RIVER VALLEY	2,240	C	-	-	-	-	-	-	-
1-21	FORT BRAGG TERRACE AREA	24,100	C	75	14	-	-	51	185	26 - 650
1-22	FAIRCHILD SWAMP VALLEY	3,300	B	-	-	-	-	-	-	-
1-25	PRAIRIE CREEK AREA	20,000	B	-	-	-	-	1	106	-
1-26	REDWOOD CREEK AREA	2,000	B	-	-	1	0	4	-	102 - 332
1-27	BIG LAGOON AREA	13,400	B	-	-	1	0	31	174	-
1-28	MATTOLE RIVER VALLEY	3,150	B	-	-	-	-	2	-	-
1-29	HONEYDEW TOWN AREA	2,370	B	-	-	-	-	1	-	-
1-30	PEPPERWOOD TOWN AREA	6,290	B	-	-	-	-	1	-	-
1-31	WEOTT TOWN AREA	3,650	B	-	-	-	-	2	-	-
1-32	GARBERVILLE TOWN AREA	2,100	B	-	-	-	-	5	-	-
1-33	LARABEE VALLEY	970	B	-	-	-	-	-	-	-
1-34	DINSMORES TOWN AREA	2,300	B	-	-	-	-	3	-	-
1-35	HYAMPOM VALLEY	1,350	B	-	-	-	-	1	-	-
1-36	HETTENSHAW VALLEY	850	B	-	-	-	-	-	-	-
1-37	COTTONEVA CREEK VALLEY	760	C	-	-	-	-	-	118	118
1-38	LOWER LAYTONVILLE VALLEY	2,150	C	-	-	-	-	-	-	-
1-39	BRANSCOMB TOWN AREA	1,320	C	-	-	-	-	-	130	80 - 179
1-40	TEN MILE RIVER VALLEY	1,490	C	-	-	-	-	-	-	-
1-41	LITTLE VALLEY	810	C	-	-	-	-	-	-	-

Table 15 North Coast Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
1-42	SHERWOOD VALLEY	1,150	C	-	-	-	-	-	-	-
1-43	WILLIAMS VALLEY	1,640	C	-	-	-	-	-	-	-
1-44	EDEN VALLEY	1,380	C	-	-	-	-	-	140	140
1-45	BIG RIVER VALLEY	1,690	C	-	-	-	-	2	-	-
1-46	NAVARRO RIVER VALLEY	770	C	-	-	-	-	-	-	-
1-48	GRAVELLEY VALLEY	3,000	C	-	-	-	-	3	-	-
1-49	ANAPOLIS OHLSON RANCH FOR. HIGHLANDS	8,650	C	36	-	-	0	1	260	260
1-50	KNIGHTS VALLEY	4,090	C	-	-	-	-	-	-	-
1-51	POTTER VALLEY	8,240	C	100	-	2	0	1	-	140 - 395
1-52	UKIAH VALLEY									
1-53	SANEL VALLEY	5,570	C	1,250	-	5	8	6	-	174 - 306
1-54	ALEXANDER VALLEY									
1-54.01	ALEXANDER AREA									
1-54.02	CLOVERDALE AREA	6,500	C	-	500	3	-	13	-	130 - 304
1-55	SANTA ROSA VALLEY									
1-55.01	SANTA ROSA PLAIN	80,000	A	1,500	-	43	-	155	-	-
1-55.02	HEALDSBURG AREA	15,400	C	500	-	8	-	28	-	90 - 500
1-55.03	RINCON VALLEY	5,600	C	-	-	2	-	12	-	-
1-56	McDOWELL VALLEY	1,500	C	1,200	-	-	-	-	145	143 - 146
1-57	BODEGA BAY AREA	2,680	A	150	-	-	-	6	-	-
1-59	WILSON GROVE FORMATION HIGHLANDS	81,500	C	-	-	14	-	68	-	-
1-60	LOWER RUSSIAN RIVER VALLEY	6,600	C	500 +	-	1	-	32	-	120 - 210
1-61	FORT ROSS TERRACE DEPOSITS	8,490	C	75	27	-	-	13	320	230 - 380
1-62	WILSON POINT AREA	700	B	-	-	-	-	-	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS = total dissolved solids

San Francisco Bay Hydrologic Region

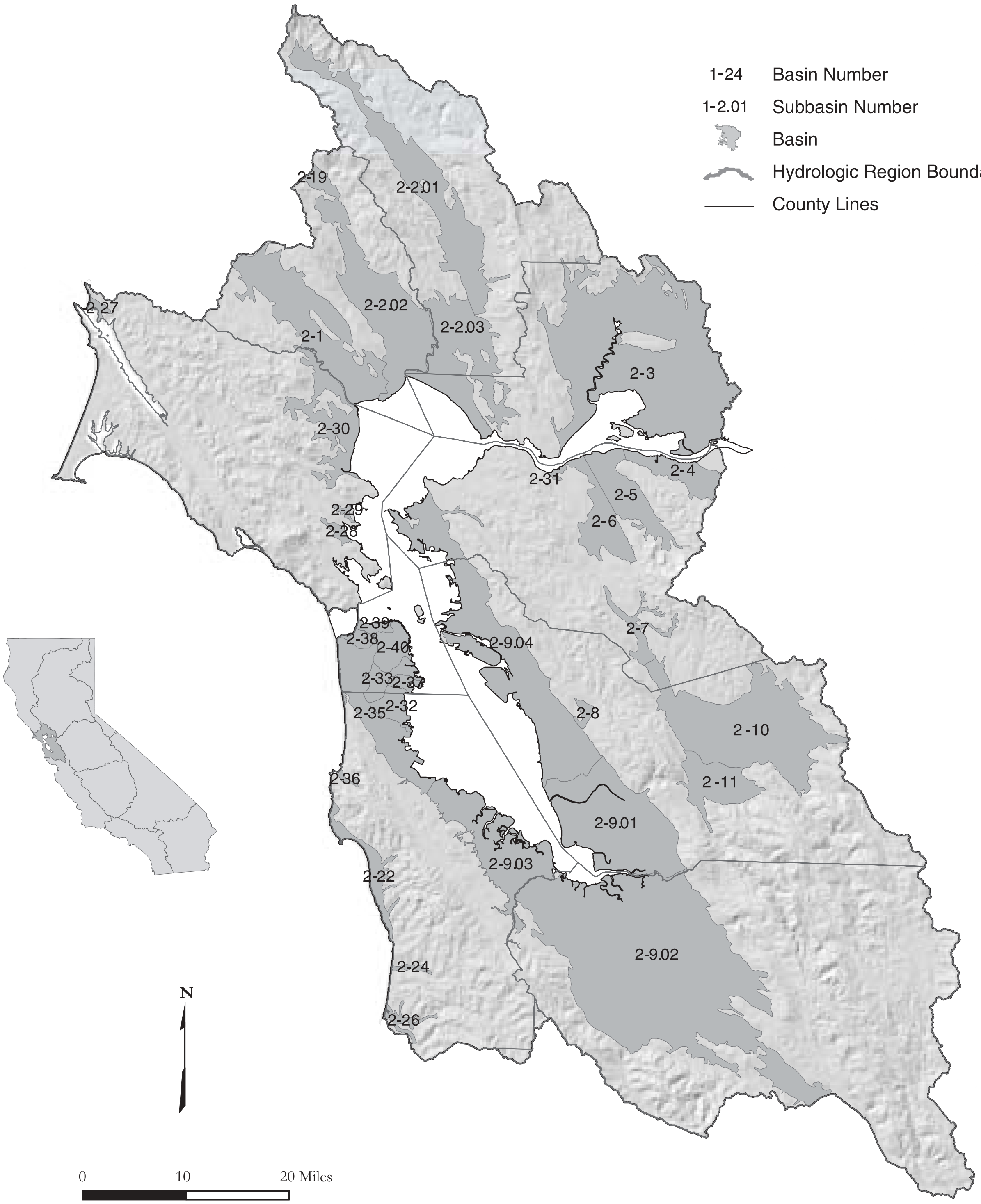

Figure 27 San Francisco Bay Hydrologic Region

Basins and Subbasins of the San Francisco Bay Hydrologic Region

Basin/subbasin	Basin name
2-1	Petaluma Valley
2-2	Napa-Sonoma Valley
2-2.01	Napa Valley
2-2.02	Sonoma Valley
2-2.03	Napa-Sonoma Lowlands
2-3	Suisun-Fairfield Valley
2-4	Pittsburg Plain
2-5	Clayton Valley
2-6	Ygnacio Valley
2-7	San Ramon Valley
2-8	Castro Valley
2-9	Santa Clara Valley
2-9.01	Niles Cone
2-9.02	Santa Clara
2-9.03	San Mateo Plain
2-9.04	East Bay Plain
2-10	Livermore Valley
2-11	Sunol Valley
2-19	Kenwood Valley
2-22	Half Moon Bay Terrace
2-24	San Gregorio Valley
2-26	Pescadero Valley
2-27	Sand Point Area
2-28	Ross Valley
2-29	San Rafael Valley
2-30	Novato Valley
2-31	Arroyo Del Hambre Valley
2-32	Visitacion Valley
2-33	Islais Valley
2-35	Merced Valley
2-36	San Pedro Valley
2-37	South San Francisco
2-38	Lobos
2-39	Marina
2-40	Downtown San Francisco

Description of the Region

The San Francisco Bay HR covers approximately 2.88 million acres (4,500 square miles) and includes all of San Francisco and portions of Marin, Sonoma, Napa, Solano, San Mateo, Santa Clara, Contra Costa, and Alameda counties (Figure 27). The region corresponds to the boundary of RWQCB 2. Significant geographic features include the Santa Clara, Napa, Sonoma, Petaluma, Suisun-Fairfield, and Livermore valleys; the Marin and San Francisco peninsulas; San Francisco, Suisun, and San Pablo bays; and the Santa Cruz Mountains, Diablo Range, Bolinas Ridge, and Vaca Mountains of the Coast Range. While being the smallest in size of the 10 HRs, the region has the second largest population in the State at about 5.8 million in 1995 (DWR 1998). Major population centers include the cities of San Francisco, San Jose and Oakland.

Groundwater Development

The region has 28 identified groundwater basins. Two of those, the Napa-Sonoma Valley and Santa Clara Valley groundwater basins, are further divided into three and four subbasins, respectively. The groundwater basins underlie approximately 896,000 acres (1,400 square miles) or about 30 percent of the entire HR.

Despite the tremendous urban development in the region, groundwater use accounts for only about 5 percent (68,000 acre-feet) of the region's estimated average water supply for agricultural and urban uses, and accounts for less than one percent of statewide groundwater uses.

In general, the freshwater-bearing aquifers are relatively thin in the smaller basins and moderately thick in the more heavily utilized basins. The more heavily utilized basins in this region include the Santa Clara Valley, Napa-Sonoma Valley, and Petaluma Valley groundwater basins. In these basins, the municipal and irrigation wells have average depths ranging from about 200 to 500 feet. Well yields in these basins range from less than 50 gallons per minute (gpm) to approximately 3,000 gpm. In the smaller basins, most municipal and irrigation wells have average well depths in the 100- to 200-foot range. Well yields in the smaller and less utilized basins are typically less than 500 gpm.

Land subsidence has been a significant problem in the Santa Clara Valley Groundwater Basin in the past. An extensive annual monitoring program has been set up within the basin to evaluate changes in an effort to maintain land subsidence at less than 0.01 feet per year (SCVWD 2001). Additionally, groundwater recharge projects have been implemented in the Santa Clara Valley to ensure that groundwater will continue to be a viable water supply in the future.

Groundwater Quality

In general, groundwater quality throughout most of the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are high TDS, nitrate, boron, and organic compounds.

The areas of high TDS (and chloride) concentrations are typically found in the region's groundwater basins that are situated close to the San Francisco Bay, such as the northern Santa Clara, southern Sonoma, Petaluma, and Napa valleys. Elevated levels of nitrate have been detected in a large percentage of private wells tested within the Coyote Subbasin and Llagas Subbasin of the Gilroy-Hollister Valley Groundwater Basin (in the Central Coast HR) located to the south of the Santa Clara Valley (SCVWD 2001). The shallow aquifer zone within the Petaluma Valley also shows persistent nitrate contamination. Groundwater with high TDS, iron, and boron levels is present in the Calistoga area of Napa Valley, and elevated boron levels in other parts of Napa Valley make the water unfit for agricultural uses. Releases of fuel hydrocarbons from leaking underground storage tanks and spills/leaks of organic solvents at industrial sites have caused minor to significant groundwater impacts in many basins throughout the region. Methyl tertiary-butyl ether (MTBE) and chlorinated solvent releases to soil and groundwater continue to be problematic. Environmental oversight for many of these sites is performed either by local city and county enforcement agencies, the RWQCB, the Department of Toxic Substances Control, and/or the U.S. Environmental Protection Agency.

Water Quality in Public Supply Wells

From 1994 through 2000, 485 public supply water wells were sampled in 18 of the 33 basins and subbasins in the San Francisco Bay HR. Analyzed samples indicate that 410 wells, or 85 percent, met the state primary MCLs for drinking water standards. Seventy-five wells, or 15 percent, have constituents that exceed one or more MCL. Figure 28 shows the percentages of each contaminant group that exceeded MCLs in the 75 wells.

Table 16 lists the three most frequently occurring contaminants in each contaminant group and the number of wells in the HR that exceeded the MCL for those contaminants.

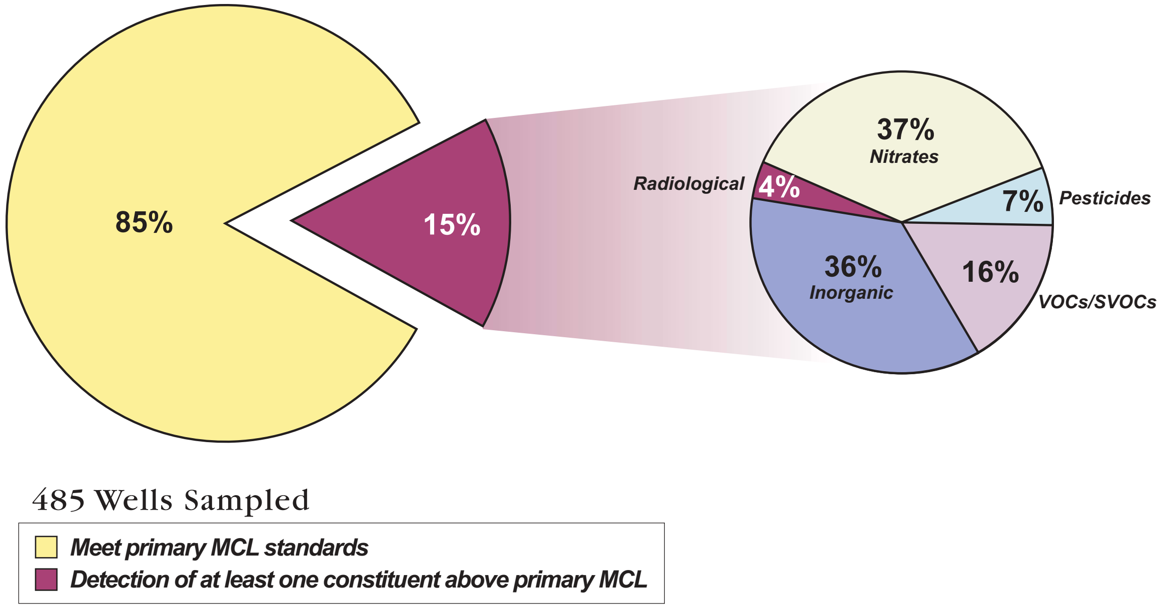

Figure 28 MCL exceedances in public supply wells in the San Francisco Bay Hydrologic Region

Table 16 Most frequently occurring contaminants by contaminant group in the San Francisco Bay Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics	Iron – 57	Manganese – 57	Fluoride – 7
Radiological	Gross Alpha – 2	Radium 226 – 1	
Nitrates	Nitrate (as NO_3) – 27	Nitrate + Nitrite – 3	Nitrite (as N) – 1
Pesticides	Di(2-Ethylhexyl)phthalate – 4	Heptachlor – 1	
VOCs/SVOCs	PCE – 4	Dichloromethane – 3	TCE– 2 Vinyl Chloride – 2

TCE = Trichloroethylene
PCE = Tetrachloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Coumpound

Changes from Bulletin 118-80

Since Bulletin 118-80 was published, RWQCB 2 boundary has been modified. This resulted in several basins being reassigned to RWQCB 1. These are listed in Table 17.

Table 17 Modifications since Bulletin 118-80 of groundwater basins in San Francisco Bay Hydrologic Region

Basin name	New number	Old number
McDowell Valley	1-56	2-12
Knights Valley	1-50	2-13
Potter Valley	1-51	2-14
Ukiah Valley	1-52	2-15
Sanel Valley	1-53	2-16
Alexander Valley	1-54	2-17
Santa Rosa Valley	1-55	2-18
Lower Russian River Valley	1-60	2-20
Bodega Bay Area	1-57	2-21

No additional basins were assigned to the San Francisco Bay HR in this revision. However, the Santa Clara Valley Groundwater Basin (2-9) has been subdivided into four subbasins instead of two, and the Napa-Sonoma Valley Groundwater Basin is now three subbasins instead of two.

There are several deletions of groundwater basins from Bulletin 118-80. The San Francisco Sand Dune Area (2-34) was deleted when the San Francisco groundwater basins were redefined in a USGS report in the early 1990s. The Napa-Sonoma Volcanic Highlands (2-23) is a volcanic aquifer and was not assigned a basin number in this bulletin. This is considered to be a groundwater source area as discussed in Chapter 6. Bulletin 118-80 identified seven groundwater basins that were stated to differ from 118-75: Sonoma County Basin, Napa County Basin, Santa Clara County Basin, San Mateo Basin, Alameda Bay Plain Basin, Niles Cone Basin, and Livermore Basin. They were created primarily by combining several smaller basins and subbasins within individual counties. This report does not consider these seven as basins. There is no change in numbering because the basins were never assigned a basin number.

Table 18 San Francisco Bay Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Active Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
2-1	PETALUMA VALLEY	46,100	C	100	-	16	7	24	347	58-650
2-2	NAPA-SONOMA VALLEY									
2-2.01	NAPA VALLEY	45,900	A	3,000	223	19	10	23	272	150-370
2-2.02	SONOMA VALLEY	44,700	C	1,140	516	18	9	35	321	100-550
2-2.03	NAPA-SONOMA LOWLANDS	40,500	C	300	98	0	6	9	185	50-300
2-3	SUISUN-FAIRFIELD VALLEY	133,600	C	500	200	21	17	35	410	160-740
2-4	PITTSBURG PLAIN	11,600	C	-	-	-	-	9	-	-
2-5	CLAYTON VALLEY	17,800	C	-	-	-	-	48	-	-
2-6	YGNACIO VALLEY	15,500	C	-	-	-	-	-	-	-
2-7	SAN RAMON VALLEY	7,060	C	-	-	-	-	-	-	-
2-8	CASTRO VALLEY	1,820	C	-	-	-	-	-	-	-
2-9	SANTA CLARA VALLEY									
2-9.01	NILES CONE	57,900	A	3,000	2,000	350	120	20	-	-
2-9.02	SANTA CLARA	190,000	C	-	-	-	10	234	408	200-931
2-9.03	SAN MATEO PLAIN	48,100	C	-	-	-	2	14	407	300-480
2-9.04	EAST BAY PLAIN	77,400	A	1,000	UNK	29	16	7	638	364-1,420
2-10	LIVERMORE VALLEY	69,500	A	-	-	-	-	36	-	-
2-11	SUNOL VALLEY	16,600	C	-	-	-	-	2	-	-
2-19	KENWOOD VALLEY	3,170	C	-	-	-	-	13	-	-
2-22	HALF MOON BAY TERRACE	9,150	C	-	-	5	-	9	-	-
2-24	SAN GREGORIO VALLEY	1,070	C	-	-	-	-	-	-	-
2-26	PESCADERO VALLEY	2,900	C	-	-	3	-	4	-	-
2-27	SAND POINT AREA	1,400	C	-	-	-	-	6	-	-
2-28	ROSS VALLEY	1,770	C	-	-	-	-	-	-	-
2-29	SAN RAFAEL VALLEY	880	C	-	-	-	-	-	-	-
2-30	NOVATO VALLEY	20,500	C	-	-	-	-	1	-	-
2-31	ARROYO DEL HAMBRE VALLEY	790	C	-	-	-	-	-	-	-
2-32	VISITACION VALLEY	880	C	-	-	-	-	-	-	-
2-33	ISLAIS VALLEY	1,550	C	-	-	-	-	-	-	-
2-35	MERCED VALLEY	10,400	C	-	-	-	-	10	-	-
2-36	SAN PEDRO VALLEY	880	C	-	-	-	-	-	-	-
2-37	SOUTH SAN FRANCISCO	2,170	C	-	-	-	-	-	-	-
2-38	LOBOS	2,400	A	-	-	-	-	-	-	-
2-39	MARINA	220	A	-	-	-	-	-	-	-
2-40	DOWNTOWN SAN FRANCISCO	7,600	C	-	-	-	-	-	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS - total dissolved solids

Central Coast Hydrologic Region

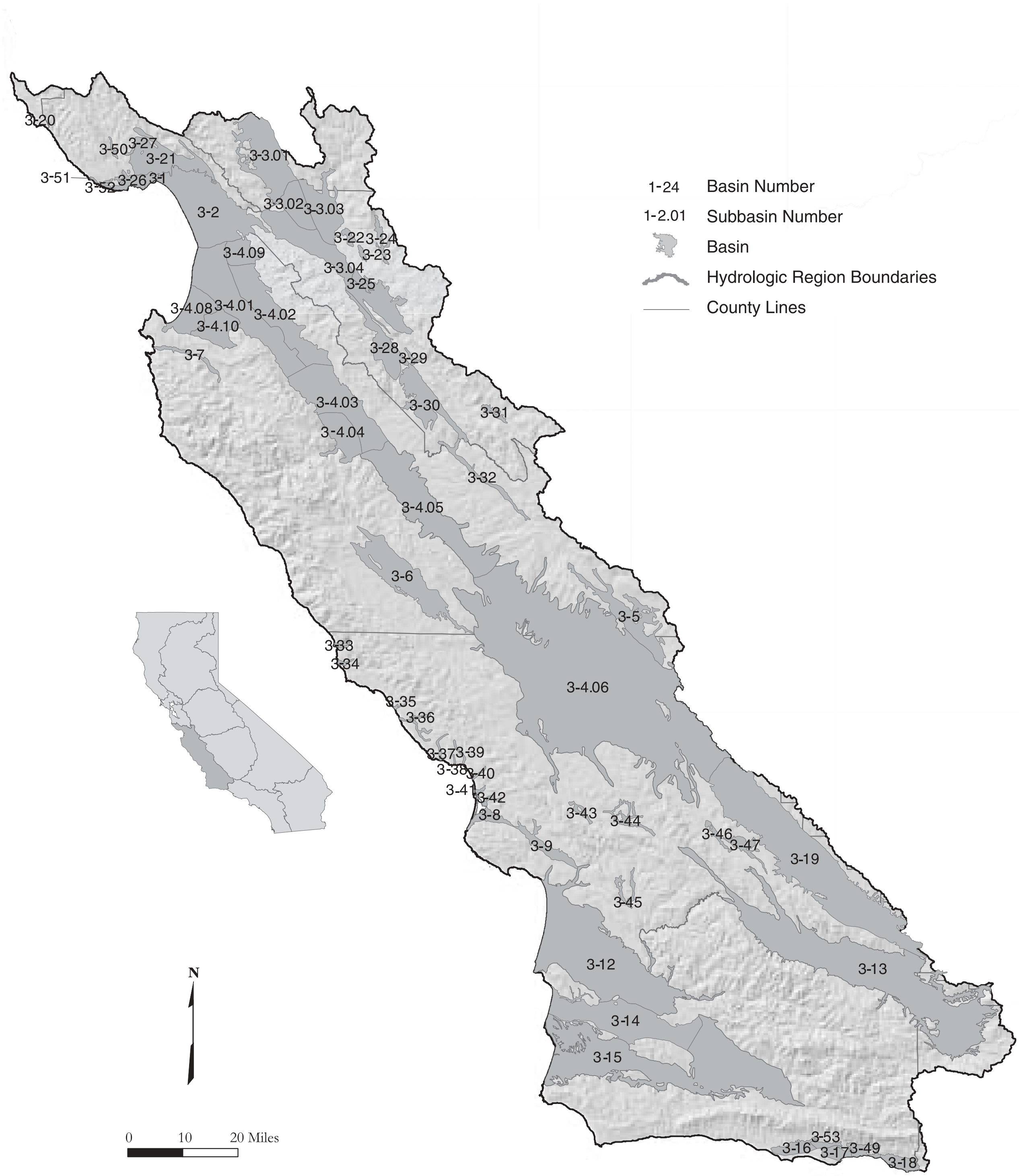

Figure 29 Central Coast Hydrologic Region

Basins and Subbasins of Central Coast Hydrologic Region

RegionBasin/ subbasin	Basin name
3-1	Soquel Valley
3-2	Pajaro Valley
3-3	Gilroy-Hollister Valley
3-3.01	Llagas Area
3-3.02	Bolsa Area
3-3.03	Hollister Area
3-3.04	San Juan Bautista Area
3-4	Salinas Valley
3-4.01	180/400 Foot Aquifer
3-4.02	East Side Aquifer
3-4.04	Forebay Aquifer
3-4.05	Upper Valley Aquifer
3-4.06	Paso Robles Area
3-4.08	Seaside Area
3-4.09	Langley Area
3-4.10	Corral de Tierra Area
3-5	Cholame Valley
3-6	Lockwood Valley
3-7	Carmel Valley
3-8	Los Osos Valley
3-9	San Luis Obispo Valley
3-12	Santa Maria River Valley
3-13	Cuyama Valley
3-14	San Antonio Creek Valley
3-15	Santa Ynez River Valley
3-16	Goleta
3-17	Santa Barbara
3-18	Carpinteria
3-19	Carrizo Plain
3-20	Ano Nuevo Area
3-21	Santa Cruz Purisima Formation
3-22	Santa Ana Valley
3-23	Upper Santa Ana Valley
3-24	Quien Sabe Valley
3-25	Tres Pinos Valley
3-26	West Santa Cruz Terrace
3-27	Scotts Valley
3-28	San Benito River Valley
3-29	Dry Lake Valley
3-30	Bitter Water Valley
3-31	Hernandez Valley
3-32	Peach Tree Valley
3-33	San Carpoforo Valley
3-34	Arroyo de la Cruz Valley

RegionBasin/ subbasin	Basin name
3-35	San Simeon Valley
3-36	Santa Rosa Valley
3-37	Villa Valley
3-38	Cayucos Valley
3-39	Old Valley
3-40	Toro Valley
3-41	Morro Valley
3-42	Chorro Valley
3-43	Rinconada Valley
3-44	Pozo Valley
3-45	Huasna Valley
3-46	Rafael Valley
3-47	Big Spring Area
3-49	Montecito
3-50	Felton Area
3-51	Majors Creek
3-52	Needle Rock Point
3-53	Foothill

Description of the Region

The Central Coast HR covers approximately 7.22 million acres (11,300 square miles) in central California (Figure 29). This HR includes all of Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara counties, most of San Benito County, and parts of San Mateo, Santa Clara, and Ventura counties. Significant geographic features include the Pajaro, Salinas, Carmel, Santa Maria, Santa Ynez, and Cuyama valleys; the coastal plain of Santa Barbara; and the Coast Range. Major drainages in the region include the Salinas, Cuyama, Santa Ynez, Santa Maria, San Antonio, San Lorenzo, San Benito, Pajaro, Nacimiento, Carmel, and Big Sur Rivers.

Population data from the 2000 Census suggest that about 1.4 million people or about 4 percent of the population of the State live in this HR. Major population centers include Santa Barbara, Santa Maria, San Luis Obispo, Gilroy, Hollister, Morgan Hill, Salinas, and Monterey.

The Central Coast HR has 50 delineated groundwater basins. Within this region, the Gilroy-Hollister Valley and Salinas Valley groundwater basins are divided into four and eight subbasins, respectively. Groundwater basins in this HR underlie about 2.390 million acres (3,740 square miles) or about one-third of the HR.

Groundwater Development

Locally, groundwater is an extremely important source of water supply. Within the region, groundwater accounted for 83 percent of the annual supply used for agricultural and urban purposes in 1995. For an average year, groundwater in the region accounts for about 8.4 percent of the statewide groundwater supply and about 1.3 percent of the total state water supply for agricultural and urban needs. In drought years, groundwater in this region is expected to account for about 7.2 percent of the statewide groundwater supply and about 1.9 percent of the total State water supply for agricultural and urban needs (DWR 1998).

Aquifers are varied and range from large extensive alluvial valleys with thick multilayered aquifers and aquitards to small inland valleys and coastal terraces. Several of the larger basins provide a dependable and drought-resistant water supply to coastal cities and farms.

Conjunctive use of surface water and groundwater is a long-standing practice in the region. Several reservoirs including Hernandez, Twitchell, Lake San Antonio, and Lake Nacimiento are operated primarily for the purpose of groundwater recharge. The concept is to maintain streamflow over a longer period than would occur without surface water storage and thus provide for increased recharge of groundwater. Seawater intrusion is a major problem throughout much of the region. In the Salinas Valley Groundwater Basin, seawater intrusion was first documented in the 1930s and has been observed more than 5 miles inland.

Groundwater Quality

Much of the groundwater in the region is characterized by calcium sulfate to calcium sodium bicarbonate sulfate water types because of marine sedimentary rock in the watersheds. Aquifers intruded by seawater are typically characterized by sodium chloride to calcium chloride, and have chloride concentrations greater than 500 mg/L. In several areas, groundwater exceeds the MCL for nitrate.

Water Quality in Public Supply Wells

From 1994 through 2000, 711 public supply water wells were sampled in 38 of the 60 basins and subbasins in the Central Coast HR. Analyzed samples indicate that 587 wells, or 83 percent, met the state primary MCLs for drinking water. One-hundred-twenty-four wells, or 17 percent, have constituents that exceed one or more MCL. Figure 30 shows the percentages of each contaminant group that exceeded MCLs in the 124 wells.

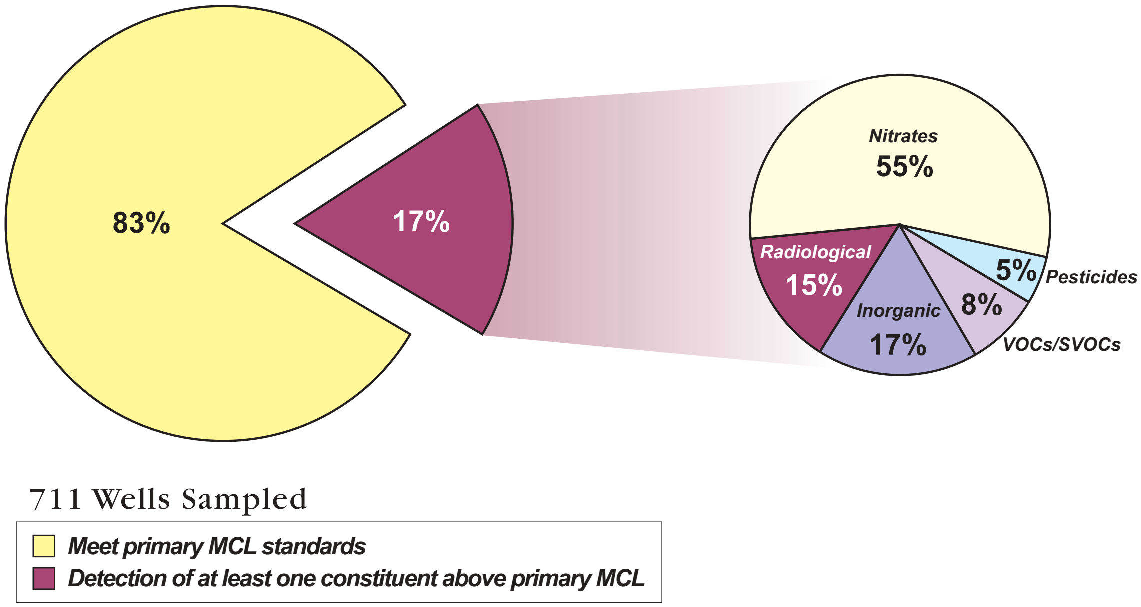

Figure 30 MCL exceedances in public supply wells in the Central Coast Hydrologic Region

Table 19 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 19 Most frequently occurring contaminants by contaminant group in the Central Coast Hydrologic Region

Contaminant group wells	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of
Inorganics – Primary	Antimony – 6	Aluminum – 4	Chromium (Total) – 4
Inorganics – Secondary	Iron – 145	Manganese – 135	TDS – 11
Radiological	Gross Alpha – 15	Radium 226 – 3	Uranium – 3
Nitrates	Nitrate (as NO_3) – 69	Nitrate + Nitrite – 24	
Pesticides	Heptachlor – 4	Di (2-Ethylhexyl) phthalate – 2	
VOCs/SVOCs	TCE – 3	3 are tied at 2 exceedances	

TCE = Trichloroethylene
VOC = Volatile Organic Compound
SVOC= Semivolatile Organic Compound

Changes from Bulletin 118-80

Four new basins have been defined since Bulletin 118-80. They are Felton Area, Majors Creek, Needle Rock Point, and Foothill groundwater basins. Additionally, new subbasins have been broken out in both the Gilroy-Hollister Valley Groundwater Basin (3-3) and the Salinas Valley Groundwater Basin (3-4) (Table 20).

Table 20 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Central Coast Hydrologic Region

Subbasin name	New number	Old number
Llagas Area	3-3.01	3-3
Bolsa Area	3-3.02	3-3
Hollister Area	3-3.03	3-3
San Juan Bautista Area	3-3.04	3-3
180/400 Foot Aquifer	3-4.01	3-4
East Side Aquifer	3-4.02	3-4
Upper Forebay Aquifer	3-4.04	3-4
Upper Valley Aquifer	3-4.05	3-4
Pismo Creek Valley Basin	3-12	3-10
Arroyo Grande Creek Basin	3-12	3-11
Careaga Sand Highlands Basin	3-12 and 3-14	3-48
Felton Area	3-50	
Majors Creek	3-51	
Needle Rock Point	3-52	
Foothill	3-53	

Pismo Creek Valley Basin (3-10) and Arroyo Grande Creek Basin (3-11) have been merged into the Santa Maria River Valley Basin (3-12).
Careaga Sand Highlands Basin (3-48) has been merged into the Santa Maria River Valley Basin (3-12) and San Antonio Creek Valley Basin (3-14).

Table 21 Central Coast Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
3-1	SOQUEL VALLEY	2,500	C	1,421	665	6	6	16	482	270-990
3-2	PAJARO VALLEY	76,800	A	2,000	500	185	185	149	580-910	300-30,000
3-3	GILROY-HOLLISTER VALLEY									
3-3.01	LLAGAS AREA	55,600	C	-	-	-	-	95	-	-
3-3.02	BOLSA AREA	21,000	A	-	400	11	<11	3	-	400-1800
3-3.03	HOLLISTER AREA	32,700	A	-	400	42	<42	35	-	400-1600
3-3.04	SAN JUAN BAUTISTA AREA	74,300	A	-	400	37	<37	40	-	460-1700
3-4	SALINAS VALLEY									
3-4.01	180/400 FOOT AQUIFER	84,400	A	-	-	166	218	82	478	223-1,013
3-4.02	EAST SIDE AQUIFER	57,500	A	-	-	74	67	53	450	168-977
3-4.04	FOREBAY AQUIFER	94,100	A	-	-	89	91	35	624	300-1,100
3-4.05	UPPER VALLEY AQUIFER	98,200	A	4,000	-	36	37	17	443	140-3,700
3-4.06	PASO ROBLES AREA	597,000	A	3,300	-	183	-	58	614	165-3,868
3-4.08	SEASIDE AREA	25,900	B	3,500	1,000		7	24	400	200-900
3-4.09	LANGLEY AREA	15,400	B	1,570	450	-	-	52	-	52-348
3-4.10	CORRAL DE TIERRA AREA	22,300	C	948	450	-	3	26	-	355-679
3-5	CHOLAME VALLEY	39,800	C	3,000	1,000	1	-	1	-	-
3-6	LOCKWOOD VALLEY	59,900	C	1,500	100	-	-	9	-	-
3-7	CARMEL VALLEY	5,160	C	1,000	600	50	23	12	260-670	220-1,200
3-8	LOS OSOS VALLEY	6,990	A	700	230	-	-	10	354	78-33,700
3-9	SAN LUIS OBISPO VALLEY	12,700	A	600	300	-	-	11	583	278-1,949
3-12	SANTA MARIA RIVER VALLEY	184,000	A	2,500	1,000	286	10	108	598	139-1,200
3-13	CUYAMA VALLEY	147,000	A	4,400	1,100	17	2	8	-	206-3,905
3-14	SAN ANTONIO CREEK VALLEY	81,800	A	-	400	30	-	9	415	129-8,040
3-15	SANTA YNEZ RIVER VALLEY	204,000	A	1,300	750	163	21	76	507	400-700
3-16	GOLETA	9,210	A	800	500	49	11	17	755	617-929
3-17	SANTA BARBARA	6,160	A	625	560	75	36	5	-	217-385
3-18	CARPINTERIA	8,120	A	500	300	41	41	4	557	317-1,780
3-19	CARRIZO PLAIN	173,000	C	1,000	500	-	-	1	-	-
3-20	ANO NUEVO AREA	2,032	C	-	-	-	-	2	-	-
3-21	SANTA CRUZ PURISIMA FORMATION	40,200	C	200	20	-	-	39	440	380-560
3-22	SANTA ANA VALLEY	2,720	C	130	-	-	-	-	-	-
3-23	UPPER SANTA ANA VALLEY	1,430	C	-	-	-	-	-	-	-
3-24	QUIEN SABE VALLEY	4,710	C	122	122	-	-	-	-	-
3-25	TRES PINOS VALLEY	3,390	C	1,225	-	-	-	3	-	-
3-26	WEST SANTA CRUZ TERRACE	7,870	C	550	200	-	-	7	480	378-684
3-27	SCOTTS VALLEY	774	C	410	100-900	26	7	7	360	100-980
3-28	SAN BENITO RIVER VALLEY	24,200	C	2,000	-	-	-	3	-	-
3-29	DRY LAKE VALLEY	1,420	C	-	-	-	-	-	-	-
3-30	BITTER WATER VALLEY	32,200	C	-	-	-	-	-	-	-
3-31	HERNANDEZ VALLEY	2,860	C	160	58	-	-	-	-	-

Table 21 Central Coast Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
3-32	PEACH TREE VALLEY	9,790	C	117	84	-	-	-	-	-
3-33	SAN CARPOFORO VALLEY	200	C	-	-	-	-	-	-	217-385
3-34	ARROYO DE LA CRUZ VALLEY	750	C	-	-	-	-	-	-	211-381
3-35	SAN SIMEON VALLEY	620	A	170	100	-	-	4	413	46-2,210
3-36	SANTA ROSA VALLEY	4,480	A	708	400	-	-	2	-	298-2,637
3-37	VILLA VALLEY	980	C	-	-	-	-	-	-	260-1,635
3-38	CAYUCOS VALLEY	530	C	166	100	-	-	-	-	815-916
3-39	OLD VALLEY	750	C	335	200	-	-	-	-	346-2,462
3-40	TORO VALLEY	721	C	500	0	-	-	-	-	458-732
3-41	MORRO VALLEY	1,200	C	442	300	-	-	6	1150	469-5,100
3-42	CHORRO VALLEY	3,200	C	700	200	-	-	6	656	60-3,606
3-43	RINCONADA VALLEY	2,580	C	0	0	-	-	-	-	-
3-44	POZO VALLEY	6,840	C	230	100	-	-	5	-	287-676
3-45	HUASNA VALLEY	4,700	C	0	0	-	-	-	-	-
3-46	RAFAEL VALLEY	2,990	C	0	0	-	-	-	-	-
3-47	BIG SPRING AREA	7,320	C	0	0	-	-	-	-	-
3-49	MONTECITO	6,270	A	1,000	750	88	2	4	700	600-1,100
3-50	FELTON AREA	1,160	C	825	244	6	-	2	-	69-400
3-51	MAJORS CREEK	364	C	50	38	-	-	-	-	-
3-52	NEEDLE ROCK POINT	480	C	450	320	-	-	-	-	-
3-53	FOOTHILL	3,120	A	-	-	-	8	7	828	554-1,118

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

South Coast Hydrologic Region

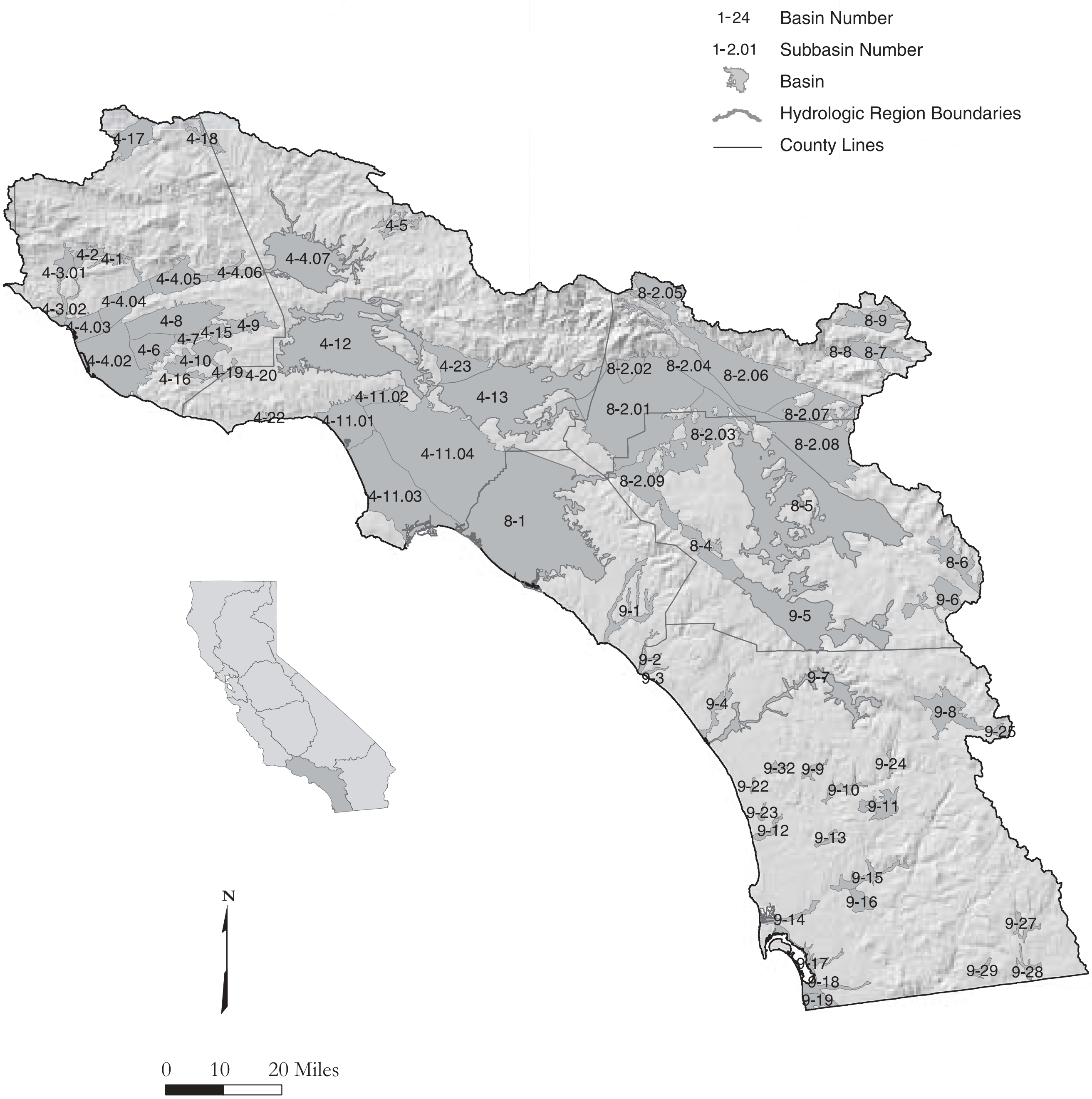

Figure 31 South Coast Hydrologic Region

Basins and Subbasins of the South Coast Hydrologic Region

Basin/subbasin	Basin name
4-1	Upper Ojai Valley
4-2	Ojai Valley
4-3	Ventura River Valley
4-3.01	Upper Ventura River
4-3.02	Lower Ventura River
4-4	Santa Clara River Valley
4-4.02	Oxnard
4-4.03	Mound
4-4.04	Santa Paula
4-4.05	Fillmore
4-4.06	Piru
4-4.07	Santa Clara River Valley East
4-5	Acton Valley
4-6	Pleasant Valley
4-7	Arroyo Santa Rosa Valley
4-8	Las Posas Valley
4-9	Simi Valley
4-10	Conejo Valley
4-11	Coastal Plain of Los Angeles
4-11.01	Santa Monica
4-11.02	Hollywood
4-11.03	West Coast
4-11.04	Central
4-12	San Fernando Valley
4-13	San Gabriel Valley
4-15	Tierre Rejada
4-16	Hidden Valley
4-17	Lockwood Valley
4-18	Hungry Valley
4-19	Thousand Oaks Area
4-20	Russell Valley
4-22	Malibu Valley
4-23	Raymond
8-1	Coastal Plain of Orange County
8-2	Upper Santa Ana Valley
8-2.01	Chino
8-2.02	Cucamonga
8-2.03	Riverside-Arlington
8-2.04	Rialto-Colton
8-2.05	Cajon
8-2.06	Bunker Hill
8-2.07	Yucaipa
8-2.08	San Timoteo
8-2.09	Temescal

Basin/subbasin	Basin name
8-4	Elsinore
8-5	San Jacinto
8-6	Hemet Lake Valley
8-7	Big Meadows Valley
8-8	Seven Oaks Valley
8-9	Bear Valley
9-1	San Juan Valley
9-2	San Mateo Valley
9-3	San Onofre Valley
9-4	Santa Margarita Valley
9-5	Temecula Valley
9-6	Coahuila Valley
9-7	San Luis Rey Valley
9-8	Warner Valley
9-9	Escondido Valley
9-10	San Pasqual Valley
9-11	Santa Maria Valley
9-12	San Dieguito Creek
9-13	Poway Valley
9-14	Mission Valley
9-15	San Diego River Valley
9-16	El Cajon Valley
9-17	Sweetwater Valley
9-18	Otay Valley
9-19	Tijuana Basin
9-22	Batiquitos Lagoon Valley
9-23	San Elijo Valley
9-24	Pamo Valley
9-25	Ranchita Town Area
9-27	Cottonwood Valley
9-28	Campo Valley
9-29	Potrero Valley
9-32	San Marcos Area

Description of the Region

The South Coast HR covers approximately 6.78 million acres (10,600 square miles) of the southern California watershed that drains to the Pacific Ocean (Figure 31). The HR is bounded on the west by the Pacific Ocean and the watershed divide near the Ventura-Santa Barbara County line. The northern boundary corresponds to the crest of the Transverse Ranges through the San Gabriel and San Bernardino mountains. The eastern boundary lies along the crest of the San Jacinto Mountains and low-lying hills of the Peninsular Range that form a drainage boundary with the Colorado River HR. The southern boundary is the international boundary with the Republic of Mexico. Significant geographic features include the coastal plain, the central Transverse Ranges, the Peninsular Ranges, and the San Fernando, San Gabriel, Santa Ana River, and Santa Clara River valleys.

The South Coast HR includes all of Orange County, most of San Diego and Los Angeles Counties, parts of Riverside, San Bernardino, and Ventura counties, and a small amount of Kern and Santa Barbara Counties. This HR is divided into Los Angeles, Santa Ana and San Diego subregions, RWQCBs 4, 8, and 9 respectively. Groundwater basins are numbered according to these subregions. Basin numbers in the Los Angeles subregion are preceded by a 4, in Santa Ana by an 8, and in San Diego by a 9. The Los Angeles subregion contains the Ventura, Santa Clara, Los Angeles, and San Gabriel River drainages, Santa Ana encompasses the Santa Ana River drainage, and San Diego includes the Santa Maria River, San Luis Rey River and the San Diego River and other drainage systems.

According to 2000 census data, about 17 million people live within the boundaries of the South Coast HR, approximately 50 percent of the population of California. Because this HR amounts to only about 7 percent of the surface area of the State, this has the highest population density of any HR in California (DWR 1998). Major population centers include the metropolitan areas surrounding Ventura, Los Angeles, San Diego, San Bernardino, and Riverside.

The South Coast HR has 56 delineated groundwater basins. Twenty-one basins are in subregion 4 (Los Angeles), eight basins in subregion 8 (Santa Ana), and 27 basins in subregion 9 (San Diego).

The Los Angeles subregion overlies 21 groundwater basins and encompasses most of Ventura and Los Angeles counties. Within this subregion, the Ventura River Valley, Santa Clara River Valley, and Coastal Plain of Los Angeles basins are divided into subbasins. The basins in the Los Angeles subregion underlie 1.01 million acres (1,580 square miles) or about 40 percent of the total surface area of the subregion.

The Santa Ana subregion overlies eight groundwater basins and encompasses most of Orange County and parts of Los Angeles, San Bernardino, and Riverside counties. The Upper Santa Ana Valley Groundwater Basin is divided into nine subbasins. Groundwater basins underlie 979,000 acres (1,520 square miles) or about 54 percent of the Santa Ana subregion.

The San Diego subregion overlies 27 groundwater basins, encompasses most of San Diego County, and includes parts of Orange and Riverside counties. Groundwater basins underlie about 277,000 acres (433 square miles) or about 11 percent of the surface of the San Diego subregion.

Overall, groundwater basins underlie about 2.27 million acres (3,530 square miles) or about 33 percent of the South Coast HR.

Groundwater Development

Groundwater has been used in the South Coast HR for well over 100 years. High demand and use of groundwater in Southern California has given rise to many disputes over management and pumping rights, with the resolution of these cases playing a large role in the establishment and clarification of water rights law in California. Raymond Groundwater Basin, located in this HR, was the first adjudicated basin in the State. Of the 16 adjudicated basins in California, 11 are in the South Coast HR. Groundwater provides about 23 percent of water demand in normal years and about 29 percent in drought years (DWR 1998).

Groundwater is found in unconfined alluvial aquifers in most of the basins of the San Diego subregion and the inland basins of the Santa Ana and Los Angeles subregions. In some larger basins, typified by those underlying the coastal plain, groundwater occurs in multiple aquifers separated by aquitards that create confined groundwater conditions. Basins range in depth from tens or hundreds of feet in smaller basins, to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this HR depending on aquifer characteristics and well location, size, and use. Some aquifers are capable of yielding thousands of gallons per minute to municipal wells.

Conjunctive Use

Conjunctive use of surface water and groundwater is a long-standing practice in the region. At present, much of the potable water used in Southern California is imported from the Colorado River and from sources in the eastern Sierra and Northern California. Several reservoirs are operated primarily for the purpose of storing surface water for domestic and irrigation use, but groundwater basins are also recharged from the outflow of some reservoirs. The concept is to maintain streamflow over a longer period of time than would occur without regulated flow and thus provide for increased recharge of groundwater basins. Most of the larger basins in this HR are highly managed, with many conjunctive use projects being developed to optimize water supply.

Coastal basins in this HR are prone to intrusion of seawater. Seawater intrusion barriers are maintained along the Los Angeles and Orange County sections of the coastal plain. In Orange County, recycled water is injected into the ground to form a mound of groundwater between the coast and the main groundwater basin. In Los Angeles County, imported and recycled water is injected to maintain a seawater intrusion barrier.

Groundwater Quality

Groundwater in basins of the Los Angeles subregion is mainly calcium sulfate and calcium bicarbonate in character. Nitrate content is elevated in some parts of the subregion. Volatile organic compounds (VOCs) have created groundwater impairments in some of the industrialized portions of the region. The San Gabriel Valley and San Fernando Valley groundwater basins both have multiple sites of contamination from VOCs. The main constituents in the contamination plumes are trichloroethylene (TCE) and tetrachloroethylene (PCE). Some of the locations have been declared federal Superfund sites. Contamination plumes containing high concentrations of TCE and PCE also occur in the Bunker Hill Subbasin of the Upper Santa Ana Valley Groundwater Basin. Some of these plumes are also designated as Superfund sites. Perchlorate is emerging as an important contaminant in several areas in the South Coast HR.

Groundwater in basins of the Santa Ana subregion is primarily calcium and sodium bicarbonate in character. Local impairments from excess nitrate or VOCs have been recognized. Groundwater and surface water in the Chino Subbasin of the Santa Ana River Valley Groundwater Basin have elevated nitrate concentrations, partly derived from a large dairy industry in that area. In Orange County, water from the Santa Ana River provides a large part of the groundwater replenishment. Wetlands maintained along the Santa Ana River near the boundary of the Upper Santa Ana River and Orange County Groundwater Basins provide effective removal of nitrate from surface water, while maintaining critical habitat for endangered species.

Groundwater in basins of the San Diego subregion has mainly calcium and sodium cations and bicarbonate and sulfate anions. Local impairments by nitrate, sulfate, and TDS are found. Camp Pendleton Marine Base, in the northwestern part of this subregion, is on the EPA National Priorities List for soil and groundwater contamination by many constituents.

Water Quality in Public Supply Wells

From 1994 through 2000, 2,342 public supply water wells were sampled in 47 of the 73 basins and subbasins in the South Coast HR. Analyzed samples indicate that 1,360 wells, or 58 percent, met the state primary MCLs for drinking water. Nine-hundred-eighty-two wells, or 42 percent, have constituents that exceed one or more MCL. Figure 32 shows the percentages of each contaminant group that exceeded MCLs in the 982 wells.

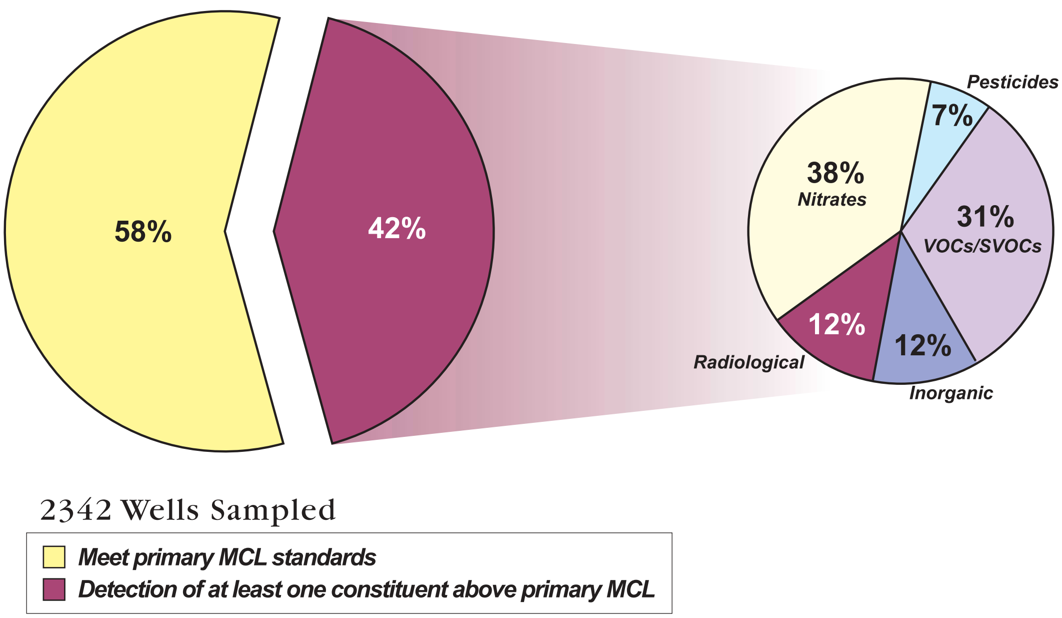

Figure 32 MCL exceedances in public supply wells in the South Coast Hydrologic Region

Table 22 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Changes from Bulletin 118-80

Several modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report (Table 23). The Cajalco Valley (8-3), Jamul Valley (9-20), Las Pulgas Valley (9-21), Pine Valley (9-26), and Tecate Valley (9-30) Groundwater Basins have been deleted in this report because they have thin deposits of alluvium and well completion reports indicate that groundwater production is from underlying fractured bedrock. The Conejo Tierra Rejada Volcanic (4-21) is a volcanic aquifer and was not assigned a basin number in this bulletin. This is considered to be groundwater source area as discussed in Chapter 6.

Table 22 Most frequently occurring contaminants by contaminant group in the South Coast Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 56	Thallium – 13	Aluminum – 12
Inorganics – Secondary	Iron – 337	Manganese – 335	TDS – 36
Radiological	Gross Alpha – 104	Uranium – 40	Radium 226 – 9 Radium 228 – 9
Nitrates	Nitrate (as NO_3) – 364	Nitrate + Nitrite – 179	Nitrate Nitrogen (NO_3-N) – 14
Pesticides	DBCP – 61	Di(2-Ethylhexyl)phthalate –5	Heptachlor – 2 EDB – 2
VOCs/SVOCs	TCE – 196	PCE – 152	1,2 Dichloroethane – 89

DBCP = Dibromochloropropane
EDB = Ethylene Dibromide
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds

The Ventura River Valley (4-3), Santa Clara River Valley (4-4), Coastal Plain of Los Angeles (4-11), and Upper Santa Ana Valley (8-2) Groundwater Basins have been divided into subbasins in this report. The extent of the San Jacinto Groundwater Basin (8-5) has been decreased because completion of Diamond Valley Reservoir has inundated the valley. Paloma Valley has been removed because well logs indicate groundwater production is solely from fractured bedrock. The Raymond Groundwater Basin (4-23) is presented as an individual basin instead of being incorporated into the San Gabriel Valley Groundwater Basin (4-13) because it is bounded by physical barriers and has been managed as a separate and individual groundwater basin for many decades. In Bulletin 118-75, groundwater basins in two different subregions were designated the Upper Santa Ana Valley Groundwater Basin (4-14 and 8-2). To alleviate this confusion, basin 4-14 has been divided, with parts of the basin incorporated into the neighboring San Gabriel Valley Groundwater Basin (4-13) and the Chino subbasin of the Upper Santa Ana Valley Groundwater Basin (8-2.01). The San Marcos Area Groundwater Basin (9-32) in central San Diego County is presented as a new basin in this report.

Table 23 Modifications since Bulletin 118-80 of groundwater basins and subbasins in South Coast Hydrologic Region

Basin/subbasin name	Number	Old number
Upper Ventura River	4-3.01	4-3
Lower Ventura River	4-3.02	4-3
Oxnard	4-4.02	4-4
Mound	4-4.03	4-4
Santa Paula	4-4.04	4-4
Fillmore	4-4.05	4-4
Piru	4-4.06	4-4
Santa Clara River Valley East	4-4.07	4-4
Santa Monica	4-11.01	4-11
Hollywood	4-11.02	4-11
West Coast	4-11.03	4-11
Central	4-11.04	4-11
Upper Santa Ana Valley	Incorporated into 8-2.01 and 4-13	4-14
Conejo-Tierra Rejada Volcanic	deleted	4-21
Raymond	4-23	4-13
Chino	8-2.01	8-2
Cucamonga	8-2.02	8-2
Riverside-Arlington	8-2.03	8-2
Rialto-Colton	8-2.04	8-2
Cajon	8-2.05	8-2
Bunker Hill	8-2.06	8-2
Yucaipa	8-2.07	8-2
San Timoteo	8-2.08	8-2
Temescal	8-2.09	8-2
Cajalco Valley	deleted	8-3
Tijuana Basin	9-19	
Jamul Valley	deleted	9-20
Las Pulgas Valley	deleted	9-21
Batiquitos Lagoon Valley	9-22	
San Elijo Valley	9-23	
Pamo Valley	9-24	
Ranchita Town Area	9-25	
Pine Valley	deleted	9-26
Cottonwood Valley	9-27	
Campo Valley	9-28	
Potrero Valley	9-29	
Tecate Valley	deleted	9-30
San Marcos Area	9-32	Not previously identified

Table 24 South Coast Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Active Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
4-1	UPPER OJAI VALLEY	3,800	A	200	50	4	-	1	707	438-1,249
4-2	OJAI VALLEY	6,830	A	600	383	24	-	22	640	450-1,140
4-3	VENTURA RIVER VALLEY									
4-3.01	UPPER VENTURA RIVER	7,410	C	-	600	17	-	18	706	500-1,240
4-3.02	LOWER VENTURA RIVER	5,300	A	-	20	-	-	2	-	760-3,000
4-4	SANTA CLARA RIVER VALLEY									
4-4.02	OXNARD	58,000	A	1,600	-	127	127	69	1,102	160-1,800
4-4.03	MOUND	14,800	A	-	700	11	11	4	1,644	1,498-1,908
4-4.04	SANTA PAULA	22,800	A	-	700	60	50	10	1,198	470-3,010
4-4.05	FILLMORE	20,800	A	2,100	700	23	-	10	1,100	800-2,400
4-4.06	PIRU	8,900	A	-	800	19	-	3	1,300	608-2,400
4-4.07	SANTA CLARA RIVER VALLEY EAST	66,200	C	-	-	-	-	62	-	-
4-5	ACTON VALLEY	8,270	A	1,000	140	-	-	7	-	-
4-6	PLEASANT VALLEY	21,600	A	-	1,000	9	-	12	1,110	597-3,490
4-7	ARROYO SANTA ROSA VALLEY	3,740	A	1,200	950	6	-	7	1,006	670-1,200
4-8	LAS POSAS VALLEY	42,200	A	750	-	-	-	24	742	338-1,700
4-9	SIMI VALLEY	12,100	A	-	394	13	-	1	-	1,580
4-10	CONEJO VALLEY	28,900	A	1,000	100	-	-	3	631	335-2,064
4-11	COASTAL PLAIN OF LOS ANGELES									
4-11.01	SANTA MONICA	32,100	C	4,700	-	-	-	12	916	729-1,156
4-11.02	HOLLYWOOD	10,500	A	-	-	5	5	1	-	526
4-11.03	WEST COAST	91,300	A	1,300	-	67	58	33	456	-
4-11.04	CENTRAL	177,000	A	11,000	1,730	302	64	294	453	200-2,500
4-12	SAN FERNANDO VALLEY	145,000	A	3,240	1,220	1398	2385	126	499	176-1,16
4-13	SAN GABRIEL VALLEY	154,000	A	4,850	1,000	67	296	259	367	90-4,288
4-15	TIERRA REJADA	4,390	A	1,200	172	4	1	-	-	619-930
4-16	HIDDEN VALLEY	2,210	C	-	-	-	-	1	453	289-743
4-17	LOCKWOOD VALLEY	21,800	A	350	25	-	-	1	-	-
4-18	HUNGRY VALLEY	5,310	C	-	28	-	-	-	<350	-
4-19	THOUSAND OAKS AREA	3,110	C	-	39	2	-	-	1,410	1,200-2,300
4-20	RUSSELL VALLEY	3,100	A	-	25	-	-	-	-	-
4-22	MALIBU VALLEY	613	C	1,060	1,030	-	-	-	-	-
4-23	RAYMOND	26,200	A	3,620	1,880	88	-	70	346	138-780
8-1	COASTAL PLAIN OF ORANGE COUNTY	224,000	A	4,500	2,500	521	411	240	475	232-661
8-2	UPPER SANTA ANA VALLEY									
8-2.01	CHINO	154,000	A	1,500	1,000	12	8	187	484	200-600
8-2.02	CUCAMONGA	9,530	C	4,400	2,115	1	1	21	-	-
8-2.03	RIVERSIDE-ARLINGTON	58,600	A	-	-	11	3	43	-	370-756
8-2.04	RIALTO-COLTON	30,100	A	5,000	545	50	5	41	337	
8-2.05	CAJON	23,200	C	200	60	-	-	5	-	-
8-2.06	BUNKER HILL	89,600	A	5,000	1,245	398	169	204	-	150-550
8-2.07	YUCAIPA	25,300	A	2,800	206	19	3	45	334	-

Table 24 South Coast Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Active Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
8-2.08	SAN TIMOTEO	73,100	A	-	-	67	12	36	-	-
8-2.09	TEMESCAL	23,500	C	-	-	2	2	20	753	373-950
8-4	ELSINORE	25,700	C	5,400	-	1	1	18	-	
8-5	SAN JACINTO	188,000	C	-	-	150	115	56	463	160-12,000
8-6	HEMET LAKE VALLEY	16,700	C	820	196	-	-	9	-	-
8-7	BIG MEADOWS VALLEY	14,200	C	120	34	-	-	8	-	-
8-8	SEVEN OAKS VALLEY	4,080	C	-	-	-	-	1	-	-
8-9	BEAR VALLEY	19,600	A	1,000	500	57	57	52	-	-
9-1	SAN JUAN VALLEY	16,700	C	1,000	-	-	-	8	760	430-12,880
9-2	SAN MATEO VALLEY	2,990	A	-	-	-	-	5	586	490-770
9-3	SAN ONOFRE VALLEY	1,250	A	-	-	-	-	2	-	600-1,500
9-4	SANTA MARGARITA VALLEY	626	A	1,980	-	4	-	-	-	337-9,030
9-5	TEMECULA VALLEY	87,800	C	1,750	-	140	4	67	476	220-1,500
9-6	COAHUILA VALLEY	18,200	C	500	-	2	-	1	-	304-969
9-7	SAN LUIS REY VALLEY	37,000	C	2,000	500	-	-	28	1,258	530-7,060
9-8	WARNER VALLEY	24,000	C	1,800	800	-	-	4	-	263
9-9	ESCONDIDO VALLEY	2,890	C	190	50	-	-	1	-	250-5,000
9-10	SAN PASQUAL VALLEY	4,540	C	1,700	1,000	-	-	2	-	500-1,550
9-11	SANTA MARIA VALLEY	12,300	A	500	36	3	-	2	1,000	324-1,680
9-12	SAN DIEGUITO CREEK	3,560	A	1,800	700	-	-	-	-	2,000
9-13	POWAY VALLEY	2,470	C	200	100	-	-	1	-	610-1,500
9-14	MISSION VALLEY	7,350	C	-	1,000	-	-	-	-	-
9-15	SAN DIEGO RIVER VALLEY	9,890	C	2,000	-	-	-	5	-	260-2,870
9-16	EL CAJON VALLEY	7,160	C	300	50	1	-	2,340		
9-17	SWEETWATER VALLEY	5,920	C	1,500	300	7	7	9	2,114	300-50,000
9-18	OTAY VALLEY	6,830	C	1,000	185	-	-	-	-	500->2,000
9-19	TIJUANA BASIN	7,410	A	2,000	350	-	-	-	-	380-3,620
9-22	BATIQUITOS LAGOON VALLEY	741	C	-	-	-	-	-	1,280	788-2,362
9-23	SAN ELIJO VALLEY	883	C	1,800	-	-	-	-	-	1,170-5,090
9-24	PAMO VALLEY	1,500	C	-	-	-	-	-	369	279-455
9-25	RANCHITA TOWN AREA	3,130	C	125	22	-	-	-	-	283-305
9-27	COTTONWOOD VALLEY	3,850	C	-	-	-	-	1	-	-
9-28	CAMPO VALLEY	3,550	C	-	<40	-	-	4	-	800
9-29	POTRERO VALLEY	2,020	C	-	-	-	-	4	-	-
9-32	SAN MARCOS VALLEY	2,130	C	60	-	-	-	-	-	500-700

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

Sacramento River Hydrologic Region

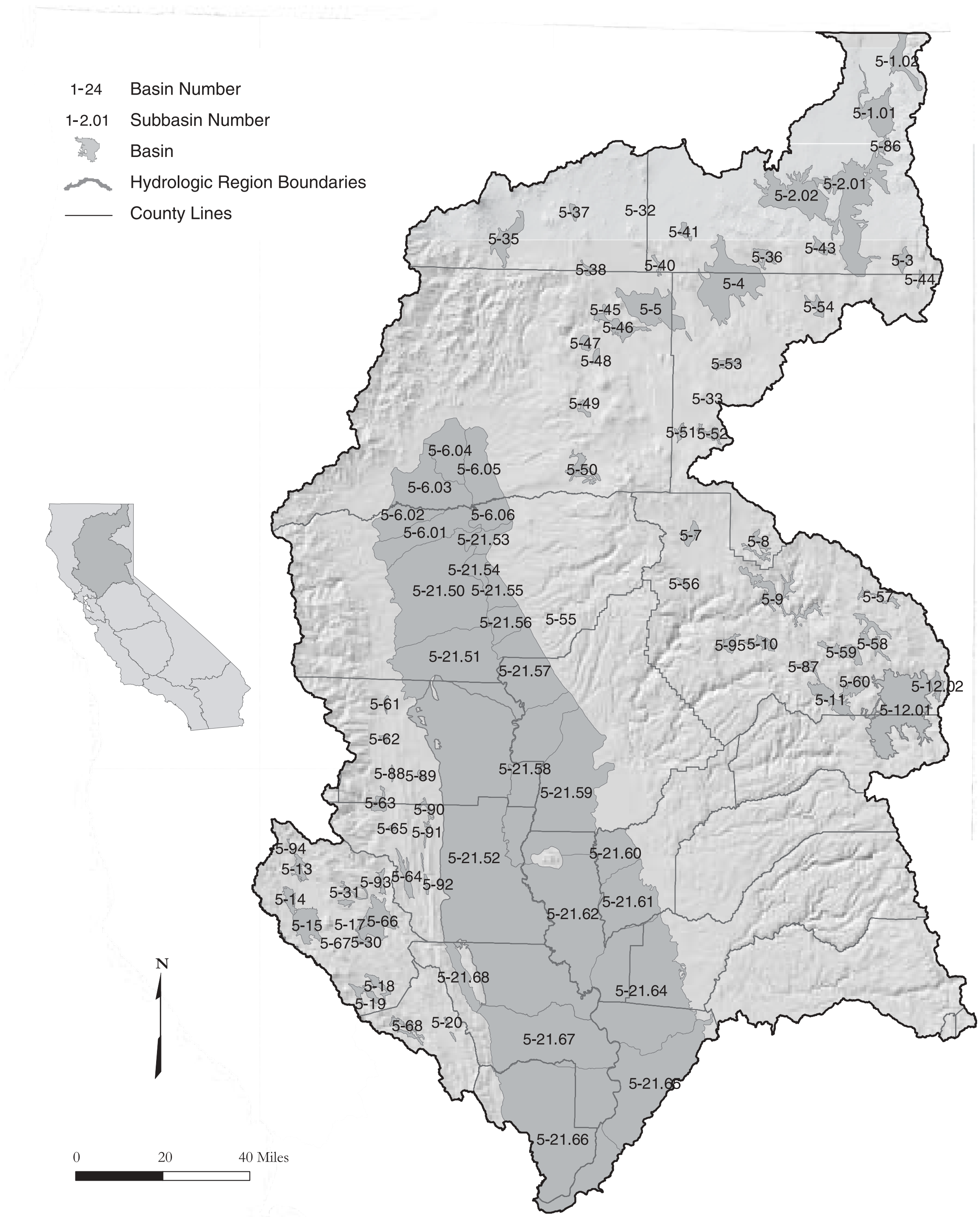

Figure 33 Sacramento River Hydrologic Region

Basins and Subbasins of the Sacramento River Hydrologic Region

Basin/subbasins	Basin name
5-1	Goose Lake Valley
5-1.01	Lower Goose Lake Valley
5-1.02	Fandango Valley
5-2	Alturas Area
5-2.01	South Fork Pitt River
5-2.02	Warm Springs Valley
5-3	Jess Valley
5-4	Big Valley
5-5	Fall River Valley
5-6	Redding Area
5-6.01	Bowman
5-6.02	Rosewood
5-6.03	Anderson
5-6.04	Enterprise
5-6.05	Millville
5-6.06	South Battle Creek
5-7	Lake Almanor Valley
5-8	Mountain Meadows Valley
5-9	Indian Valley
5-10	American Valley
5-11	Mohawk Valley
5-12	Sierra Valley
5-12.01	Sierra Valley
5-12.02	Chilcoot
5-13	Upper Lake Valley
5-14	Scotts Valley
5-15	Big Valley
5-16	High Valley
5-17	Burns Valley
5-18	Coyote Valley
5-19	Collayomi Valley
5-20	Berryessa Valley
5-21	Sacramento Valley
5-21.50	Red Bluff
5-21.51	Corning
5-21.52	Colusa
5-21.53	Bend
5-21.54	Antelope
5-21.55	Dye Creek
5-21.56	Los Molinos
5-21.57	Vina
5-21.58	West Butte
5-21.59	East Butte
5-21.60	North Yuba
5-21.61	South Yuba
5-21.62	Sutter
5-21.64	North American
5-21.65	South American
5-21.66	Solano
5-21.67	Yolo
5-21.68	Capay Valley

Basin/subbasins	Basin name
5-30	Lower Lake Valley
5-31	Long Valley
5-35	Mccloud Area
5-36	Round Valley
5-37	Toad Well Area
5-38	Pondosa Town Area
5-40	Hot Springs Valley
5-41	Egg Lake Valley
5-43	Rock Prairie Valley
5-44	Long Valley
5-45	Cayton Valley
5-46	Lake Britton Area
5-47	Goose Valley
5-48	Burney Creek Valley
5-49	Dry Burney Creek Valley
5-50	North Fork Battle Creek
5-51	Butte Creek Valley
5-52	Gray Valley
5-53	Dixie Valley
5-54	Ash Valley
5-56	Yellow Creek Valley
5-57	Last Chance Creek Valley
5-58	Clover Valley
5-59	Grizzly Valley
5-60	Humbug Valley
5-61	Chrome Town Area
5-62	Elk Creek Area
5-63	Stonyford Town Area
5-64	Bear Valley
5-65	Little Indian Valley
5-66	Clear Lake Cache Formation
5-68	Pope Valley
5-86	Joseph Creek
5-87	Middle Fork Feather River
5-88	Stony Gorge Reservoir
5-89	Squaw Flat
5-90	Funks Creek
5-91	Antelope Creek
5-92	Blanchard Valley
5-93	North Fork Cache Creek
5-94	Middle Creek
5-95	Meadow Valley

Description of the Region

The Sacramento River HR covers approximately 17.4 million acres (27,200 square miles). The region includes all or large portions of Modoc, Siskiyou, Lassen, Shasta, Tehama, Glenn, Plumas, Butte, Colusa, Sutter, Yuba, Sierra, Nevada, Placer, Sacramento, El Dorado, Yolo, Solano, Lake, and Napa counties (Figure 33). Small areas of Alpine and Amador counties are also within the region. Geographically, the region extends south from the Modoc Plateau and Cascade Range at the Oregon border, to the Sacramento-San Joaquin Delta. The Sacramento Valley, which forms the core of the region, is bounded to the east by the crest of the Sierra Nevada and southern Cascades and to the west by the crest of the Coast Range and Klamath Mountains. Other significant features include Mount Shasta and Lassen Peak in the southern Cascades, Sutter Buttes in the south central portion of the valley, and the Sacramento River, which is the longest river system in the State of California with major tributaries the Pit, Feather, Yuba, Bear and American rivers. The region corresponds approximately to the northern half of RWQCB 5. The Sacramento metropolitan area and surrounding communities form the major population center of the region. With the exception of Redding, cities and towns to the north, while steadily increasing in size, are more rural than urban in nature, being based in major agricultural areas. The 1995 population of the entire region was 2.372 million.

The climate in the northern, high desert plateau area of the region is characterized by cold snowy winters with only moderate precipitation and hot dry summers. This area depends on adequate snowpack to provide runoff for summer supply. Annual precipitation ranges from 10 to 20 inches. Other mountainous areas in the northern and eastern portions of the region have cold wet winters with large amounts of snow, which typically provide abundant runoff for summer supplies. Annual precipitation ranges from 40 to more than 80 inches. Summers are generally mild in these areas. The Coast Range and southern Klamath Mountains receive copious amounts of precipitation, but most of the runoff flows to the coast in the North Coastal drainage. Sacramento Valley comprises the remainder of the region. At a much lower elevation than the rest of the region, the valley has mild winters with moderate precipitation. Annual precipitation varies from about 35 inches in Redding to about 18 inches in Sacramento. Summers in the valley are hot and dry.

Most of the mountainous portions of the region are heavily forested and sparsely populated. Three major national forests (Mendocino, Trinity, and Shasta) make up the majority of lands in the Coast Range, southern Klamath Mountains, and the southern Cascades; these forests and the region's rivers and lakes provide abundant recreational opportunities. In the few mountain valleys with arable land, alfalfa, grain and pasture are the predominant crops. In the foothill areas of the region, particularly adjacent to urban centers, suburban to rural housing development is occurring along major highway corridors. This development is leading to urban sprawl and is replacing the former agricultural production on those lands. In the Sacramento Valley, agriculture is the largest industry. Truck, field, orchard, and rice crops are grown on approximately 2.1 million acres. Rice represents about 23 percent of the total irrigated acreage.

The Sacramento River HR is the main water supply for much of California's urban and agricultural areas. Annual runoff in the HR averages about 22.4 maf, which is nearly one-third of the State's total natural runoff. Major water supplies in the region are provided through surface storage reservoirs. The two largest surface water projects in the region are USBR's Shasta Lake (Central Valley Project) on the upper Sacramento River and Lake Oroville (DWR's State Water Project) on the Feather River. In all, there are more than 40 major surface water reservoirs in the region. Municipal, industrial, and agricultural supplies to the region are about 8 maf, with groundwater providing about 2.5 maf of that total. Much of the remainder of the runoff goes to dedicated natural flows, which support various environmental requirements, including in-stream fishery flows and flushing flows in the Delta.

Groundwater Development

Groundwater provides about 31 percent of the water supply for urban and agricultural uses in the region, and has been developed in both the alluvial basins and the hard rock uplands and mountains. There are 88 basins/subbasins delineated in the region. These basins underlie 5.053 million acres (7,900 square miles), about 29 percent of the entire region. The reliability of the groundwater supply varies greatly. The Sacramento Valley is recognized as one of the foremost groundwater basins in the State, and wells developed in the sediments of the valley provide excellent supply to irrigation, municipal, and domestic uses. Many of the mountain valleys of the region also provide significant groundwater supplies to multiple uses.

Geologically, the Sacramento Valley is a large trough filled with sediments having variable permeabilities; as a result, wells developed in areas with coarser aquifer materials will produce larger amounts of water than wells developed in fine aquifer materials. In general, well yields are good and range from one-hundred to several thousand gallons per minute. Because surface water supplies have been so abundant in the valley, groundwater development for agriculture primarily supplement the surface supply. With the changing environmental laws and requirements, this balance is shifting to a greater reliance on groundwater, and conjunctive use of both supplies is occurring to a greater extent throughout the valley, particularly in drought years. Groundwater provides all or a portion of municipal supply in many valley towns and cities. Redding, Anderson, Chico, Marysville, Sacramento, Olivehurst, Wheatland, Willows, and Williams rely to differing degrees on groundwater. Red Bluff, Corning, Woodland, Davis, and Dixon are completely dependent on groundwater. Domestic use of groundwater varies, but in general, rural unincorporated areas rely completely on groundwater.

In the mountain valleys and basins with arable land, groundwater has been developed to supplement surface water supplies. Most of the rivers and streams of the area have adjudicated water rights that go back to the early 1900s, and diversion of surface water has historically supported agriculture. Droughts and increased competition for supply have led to significant development of groundwater for irrigation. In some basins, the fractured volcanic rock underlying the alluvial fill is the major aquifer for the area. In the rural mountain areas of the region, domestic supplies come almost entirely from groundwater. Although a few mountain communities are supplied in part by surface water, most rely on groundwater. These groundwater supplies are generally quite reliable in areas that have sufficient aquifer storage or where surface water replenishes supply throughout the year. In areas that depend on sustained runoff, water levels can be significantly depleted in drought years and many old, shallow wells can be dewatered. During 2001, an extreme drought year on the Modoc Plateau, many well owners experienced problems with water supply.

Groundwater development in the fractured rocks of the foothills of the southern Cascades and Sierra Nevada is fraught with uncertainty. Groundwater supplies from fractured rock sources are highly variable in terms of water quantity and water quality and are an uncertain source for large-scale residential development. Originally, foothill development relied on water supply from springs and river diversions with flumes and ditches for conveyance that date back to gold mining era operations. Current development is primarily based on individual private wells, and as pressures for larger scale development increase, questions about the reliability of supply need to be addressed. Many existing foothill communities have considerable experience with dry or drought year shortages. In Butte County residents in Cohasset, Forest Ranch, and Magalia have had to rely on water brought up the ridges in tanker trucks. The suggested answer has been the development of regional water supply projects. Unfortunately, the area's development pattern of small, geographically dispersed population centers does not lend itself to the kind of financial base necessary to support such projects.

Groundwater Quality

Groundwater quality in the Sacramento River HR is generally excellent. However, there are areas with local groundwater problems. Natural water quality impairments occur at the north end of the Sacramento Valley in the Redding subbasin, and along the margins of the valley and around the Sutter Buttes, where Cretaceous-age marine sedimentary rocks containing brackish to saline water are near the surface. Water from the older underlying sediments mixes with the fresh water in the younger alluvial aquifer and degrades the quality. Wells constructed in these areas typically have high TDS. Other local natural impairments are moderate levels of hydrogen sulfide in groundwater in the volcanic and geothermal areas in the western portion of the region. In the Sierra foothills, there is potential for encountering uranium and radon-bearing rock or sulfide mineral deposits containing heavy metals. Human-induced impairments are generally associated with individual septic system development in shallow unconfined portions of aquifers or in fractured hard rock areas where insufficient soil depths are available to properly leach effluent before it reaches the local groundwater supply.

Water Quality in Public Supply Wells

From 1994 through 2000, 1,356 public supply water wells were sampled in 51 of the 88 basins and subbasins in the Sacramento River HR. Samples analyzed indicate that 1,282 wells, or 95 percent, met the state primary MCLs for drinking water. Seventy-four wells, or 5 percent, have constituents that exceed one or more MCL. Figure 34 shows the percentages of each contaminant group that exceeded MCLs in the 74 wells.

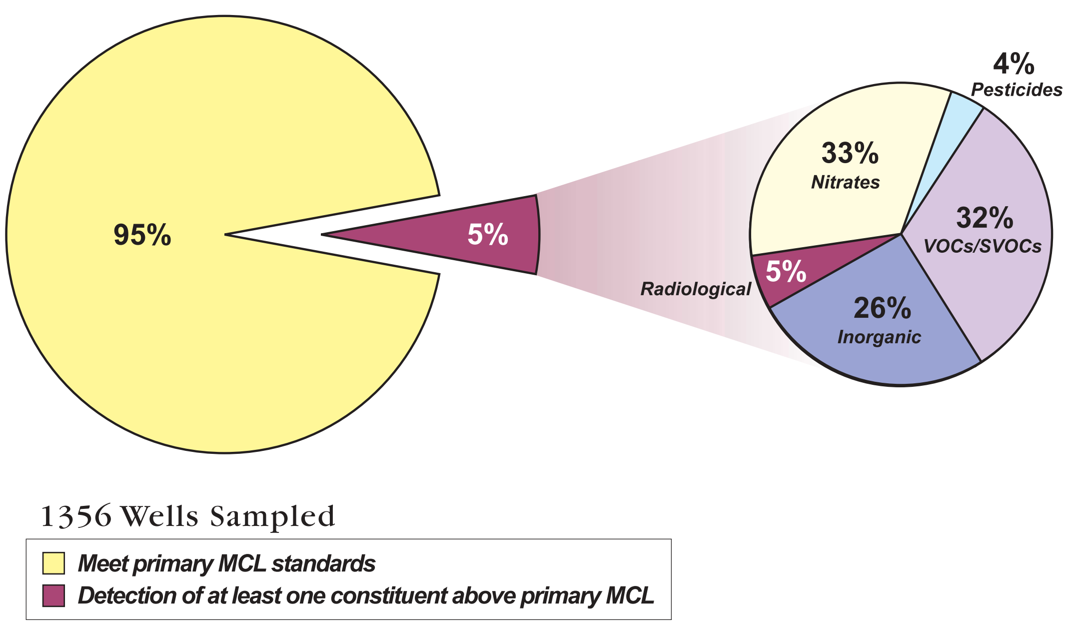

Figure 34 MCL exceedances in public supply wells in the Sacramento River Hydrologic Region

Table 25 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 25 Most frequently occurring contaminants by contaminant group in the Sacramento River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Cadmium – 4	Chromium (Total) – 3	3 tied at 2
Inorganics – Secondary	Manganese – 221	Iron – 166	Specific Conductance – 3
Radiological	Gross Alpha – 4		
Nitrates	Nitrate (as NO_3) – 22	Nitrate + Nitrite – 5	Nitrate Nitrogen (NO_3-N) – 2
Pesticides	Di(2-Ethylhexyl)phthalate – 4		
VOCs/SVOCs	PCE – 11	TCE – 7	Benzene – 4

PCE = Tetrachloroethylene
TCE = Trichloroethylene
VOC = Volatile Organic Compounds
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

Some modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report. These are listed in Table 26.

Table 26 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Sacramento River Hydrologic Region

Basin name	New number	Old number
Fandango Valley	5-1.02	5-39
Bucher Swamp Valley	deleted	5-42
Modoc Plateau Recent Volcanic Areas	deleted	5-32
Modoc Plateau Pleistocene Volcanic Areas	deleted	5-33
Mount Shasta Area	deleted	5-34
Sacramento Valley Eastside Tuscan Formation Highlands	deleted	5-55
Clear Lake Pleistocene Volcanics	deleted	5-67

No additional basins were assigned to the Sacramento River HR in this revision. However, four basins have been divided into subbasins. Goose Lake Valley Groundwater Basin (5-1) has been subdivided into two subbasins, Fandango Valley (5-39) was modified to be a subbasin of Goose Lake Valley. Redding Area Groundwater Basin has been subdivided into six subbasins, Sierra Valley Groundwater Basin has been subdivided into two subbasins, and the Sacramento Valley Groundwater Basin has been subdivided into 18 subbasins.

There are several deletions of groundwater basins from Bulletin 118-80. Bucher Swamp Valley Basin (5-42) was deleted due to a thin veneer of alluvium over rock. Modoc Plateau Recent Volcanic Areas (5-32), Modoc Plateau Pleistocene Volcanic Areas (5-33), Mount Shasta Area (5-34), Sacramento Valley Eastside Tuscan Formation Highlands (5-55), and Clear Lake Pleistocene Volcanics (5-67) are volcanic aquifers and were not assigned basin numbers in this bulletin. These are considered to be groundwater source areas as discussed in Chapter 6.

Table 27 Sacramento River Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-1	GOOSE LAKE VALLEY									
5-1.01	LOWER GOOSE LAKE	36,000	B	-	400	9	9	-	183	68 - 528
5-1.02	FANDANGO VALLEY	18,500	B	2,000	-	3	-	-	-	-
5-2	ALTURAS AREA								357	180 - 800
5-2.01	SOUTH FORK PITT RIVER	114,000	B	5,000	1,075	9	-	8	-	-
5-2.02	WARM SPRINGS VALLEY	68,000	B	400	314	3	-	11	-	-
5-3	JESS VALLEY	6,700	B		3,000	-	-	-	-	-
5-4	BIG VALLEY	92,000	B	4,000	880	19	9	10	260	141 - 633
5-5	FALL RIVER VALLEY	54,800	B	1,500	266	16	7	3	174	115 - 232
5-6	REDDING AREA									
5-6.01	BOWMAN	85,330	B	2,000	589	8	2	13	-	70 - 247
5-6.02	ROSEWOOD	45,320	B	-	-	4	-	-	-	118 - 218
5-6.03	ANDERSON	98,500	B	1,800	46	11	10	69	194	109-320
5-6.04	ENTERPRISE	60,900	B	700	266	11	3	43	-	160 - 210
5-6.05	MILLVILLE	67,900	B	500	254	6	5	4	140	-
5-6.06	SOUTH BATTLE CREEK	32,300	B	-	-	0	0	0	360	-
5-7	LAKE ALMANOR VALLEY	7,150	B	-	-	10	4	4	105	53 - 260
5-8	MOUNTAIN MEADOWS VALLEY	8,150	B	-	-	-	-	-	-	-
5-9	INDIAN VALLEY	29,400	B	-	-	-	4	9	-	-
5-10	AMERICAN VALLEY	6,800	B	40	40		4	11	-	-
5-11	MOHAWK VALLEY	19,000	B	-	500	1	2	15	248	210 - 285
5-12	SIERRA VALLEY									
5-12.01	SIERRA VALLEY	117,700	B	1,500	640	34	15	9	312	110 - 1,620
5-12.02	CHILCOOT	7,550	B	-	-	15	-	8	-	-
5-13	UPPER LAKE VALLEY	7,260	B	900	302	12	3	6	-	-
5-14	SCOTTS VALLEY	7,320	B	1,200	171	9	1	9	158	140 - 175
5-15	BIG VALLEY	24,210	B	1,470	475	49	11	7	535	270 - 790
5-16	HIGH VALLEY	2,360	B	100	37	5	2	-	598	480 - 745
5-17	BURNS VALLEY	2,900	B	-	30	1	5	-	335	280 - 455
5-18	COYOTE VALLEY	6,530	B	800	446	6	3	3	288	175 - 390
5-19	COLLAYOMI VALLEY	6,500	B	1,000	121	10	4	3	202	150 - 255
5-20	BERRYESSA VALLEY	1,400	C	-	-	0	-	0	-	-
5-21	SACRAMENTO VALLEY									
5-21.50	RED BLUFF	266,750	B	1,200	363	30	10	56	207	120 - 500
5-21.51	CORNING	205,640	B	3,500	977	29	7	30	286	130 - 490
5-21.52	COLUSA	918,380	B	5,600	984	98	30	134	391	120 - 1,220
5-21.53	BEND	20,770	B	-	275	0	3	9		334-360
5-21.54	ANTELOPE	18,710	B	800	575	4	5	22	296	-
5-21.55	DYE CREEK	27,730	B	3,300	890	8	1	3	240	159 - 396
5-21.56	LOS MOLINOS	33,170	B	1,000	500	3	3	9	217	
5-21.57	VINA	125,640	B	3,850	1,212	23	5	69	285	48 - 543
5-21.58	WEST BUTTE	181,600	B	4,000	1,833	32	8	36	293	130 - 676

Table 27 Sacramento River Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-21.59	EAST BUTTE	265,390	B	4,500	1,019	43	4	44	235	122 - 570
5-21.60	NORTH YUBA	100,400	C	4,000	-	21	-	32	-	-
5-21.61	SOUTH YUBA	107,000	C	4,000	1,650	56	-	6	-	-
5-21.62	SUTTER	234,000	C	-	-	34	-	115	-	-
5-21.64	NORTH AMERICAN	351,000	A	-	800	121	-	339	300	150 - 1,000
5-21.65	SOUTH AMERICAN	248,000	C	-	-	105	-	247	221	24-581
5-21.66	SOLANO	425,000	C	-	-	123	23	136	427	150 - 880
5-21.67	YOLO	226,000	B	4,000+	1,000	127	20	185	880	480 - 2,060
5-21.68	CAPAY VALLEY	25,000	C	-	-	11	-	3	-	-
5-30	LOWER LAKE VALLEY	2,400	B	100	37		3	5	568	290 - 1,230
5-31	LONG VALLEY	2,600	B	100	63	-	-	-	-	-
5-35	MCCLOUD AREA	21,320	B	-	380	-	-	1	-	-
5-36	ROUND VALLEY	7,270	B	2,000	800	2				148 - 633
5-37	TOAD WELL AREA	3,360	B	-	-	-	-	-	-	-
5-38	PONDOSA TOWN AREA	2,080	B	-	-	-	-	-	-	-
5-40	HOT SPRINGS VALLEY	2,400	B	-	-	-	-	-	-	-
5-41	EGG LAKE VALLEY	4,100	B	-	20	-	-	-	-	-
5-43	ROCK PRAIRIE VALLEY	5,740	B	-	-	-	-	-	-	-
5-44	LONG VALLEY	1,090	B	-	-	-	-	-	-	-
5-45	CAYTON VALLEY	1,300	B	-	400	-	-	-	-	-
5-46	LAKE BRITTON AREA	14,060	B	-	-	-	-	2	-	-
5-47	GOOSE VALLEY	4,210	B	-	-	-	-	-	-	-
5-48	BURNEY CREEK VALLEY	2,350	B	-	-	-	-	2	-	-
5-49	DRY BURNEY CREEK VALLEY	3,070	B	-	-	-	-	-	-	-
5-50	NORTH FORK BATTLE CREEK VALLEY	12,760	B	-	-	-	-	3	-	-
5-51	BUTTE CREEK VALLEY	3,230	B	-	-	-	-	-	-	-
5-52	GRAYS VALLEY	5,440	B	-	-	-	-	-	-	-
5-53	DIXIE VALLEY	4,870	B	-	-	-	-	-	-	-
5-54	ASH VALLEY	6,010	B	3,000	2,200	-	-	-	-	-
5-56	YELLOW CREEK VALLEY	2,310	B	-	-	-	-	-	-	-
5-57	LAST CHANCE CREEK VALLEY	4,660	B	-	-	-	-	-	-	-
5-58	CLOVER VALLEY	16,780	B	-	-	-	-	-	-	-
5-59	GRIZZLY VALLEY	13,400	B	-	-	-	-	1	-	-
5-60	HUMBUG VALLEY	9,980	B	-	-	-	-	8	-	-
5-61	CHROME TOWN AREA	1,410	B	-	-	-	-	-	-	-
5-62	ELK CREEK AREA	1,440	B	-	-	-	-	-	-	-
5-63	STONYFORD TOWN AREA	6,440	B	-	-	-	-	-	-	-
5-64	BEAR VALLEY	9,100	B	-	-	-	-	-	-	-
5-65	LITTLE INDIAN VALLEY	1,270	B	-	-	-	-	-	-	-
5-66	CLEAR LAKE CACHE FORMATION	30,000	B	245	52		-	4	-	-
5-68	POPE VALLEY	7,180	C	-	-	-	-	1	-	-
5-86	JOSEPH CREEK	4,450	B	-	-	-	-		-	-

Table 27 Sacramento River Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-87	MIDDLE FORK FEATHER RIVER	4,340	B	-	-	-	-	2	-	-
5-88	STONY GORGE RESERVOIR	1,070	B	-	-	-	-	-	-	-
5-89	SQUAW FLAT	1,300	C	-	-	-	-	-	-	-
5-90	FUNKS CREEK	3,000	C	-	-	-	-	-	-	-
5-91	ANTELOPE CREEK	2,040	B	-	-	-	-	-	-	-
5-92	BLANCHARD VALLEY	2,200	B	-	-	-	-	-	-	-
5-93	NORTH FORK CACHE CREEK	3,470	C	-	-	-	-	-	-	-
5-94	MIDDLE CREEK	700	B	-	75	-	-	1	-	-
5-95	MEADOW VALLEY	5,730	B	-	-	-	-	1	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

San Joaquin River Hydrologic Region

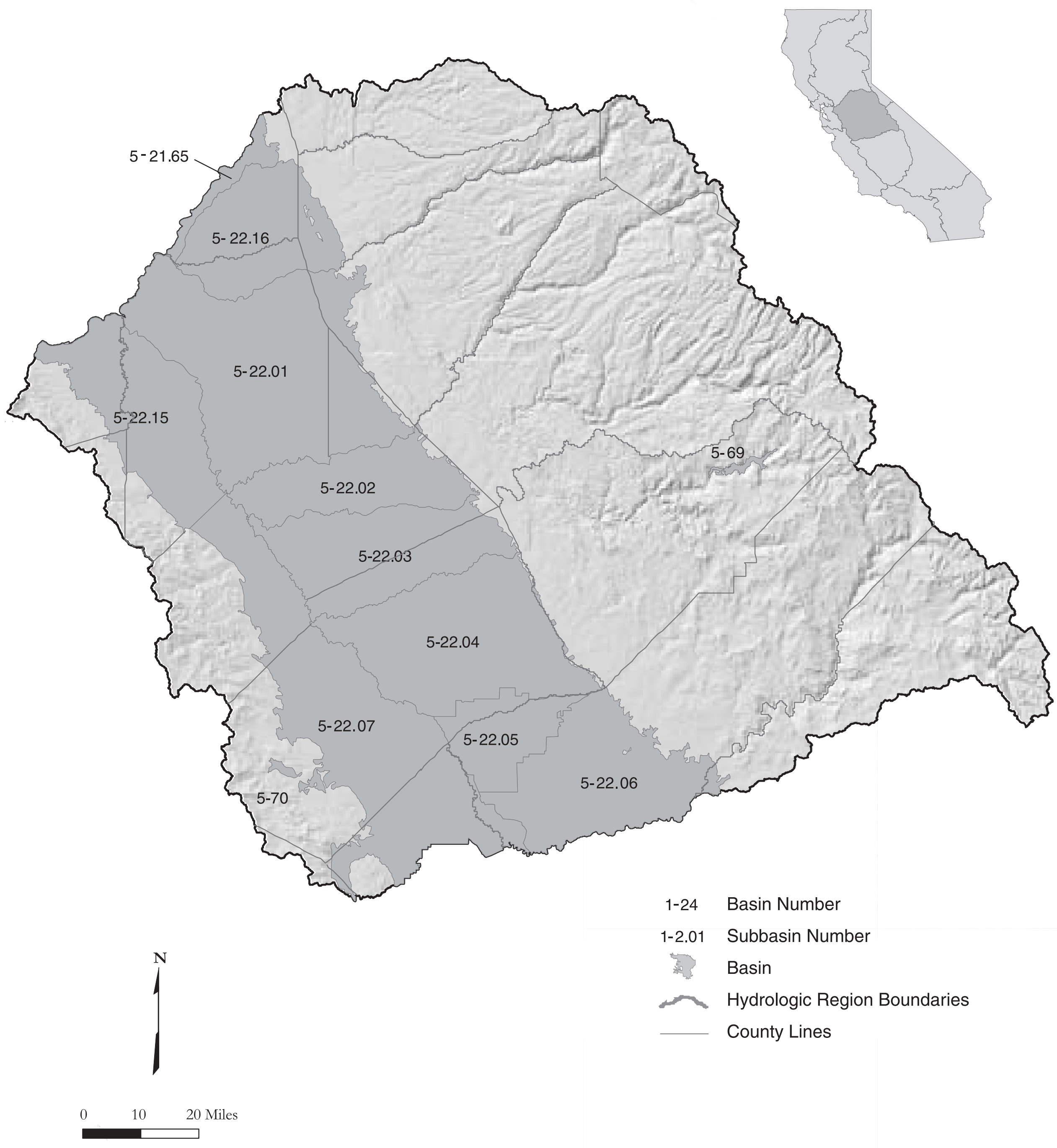

Figure 35 San Joaquin River Hydrologic Region

Basins and Subbasins of the San Joaquin River Hydrologic Region

Basin/subbasin	Basin name
5-22	San Joaquin Valley
5-22.01	Eastern San Joaquin
5-22.02	Modesto
5-22.03	Turlock
5-22.04	Merced
5-22.05	Chowchilla
5-22.06	Madera
5-22.07	Delta-Mendota
5-22.15	Tracy
5-22.16	Cosumnes
5-69	Yosemite Valley
5-70	Los Banos Creek Valley

Description of the Region

The San Joaquin River HR covers approximately 9.7 million acres (15,200 square miles) and includes all of Calaveras, Tuolumne, Mariposa, Madera, San Joaquin, and Stanislaus counties, most of Merced and Amador counties, and parts of Alpine, Fresno, Alameda, Contra Costa, Sacramento, El Dorado, and San Benito counties (Figure 35). The region corresponds to a portion near the middle of RWQCB 5. Significant geographic features include the northern half of the San Joaquin Valley, the southern part of the Sacramento-San Joaquin Delta, the Sierra Nevada and Diablo Range. The region is home to about 1.6 million people (DWR 1998). Major population centers include Merced, Modesto, and Stockton. The Merced area is entirely dependent on groundwater for its supply, as will be the new University of California at Merced campus.

Groundwater Development

The region contains two entire groundwater basins and part of the San Joaquin Valley Groundwater Basin, which continues south into the Tulare Lake HR. The San Joaquin Valley Groundwater Basin is divided into nine subbasins in this region. The basins underlie 3.73 million acres (5,830 square miles) or about 38 percent of the entire HR area.

The region is heavily groundwater reliant. Within the region groundwater accounts for about 30 percent of the annual supply used for agricultural and urban purposes. Groundwater use in the region accounts for about 18 percent of statewide groundwater use for agricultural and urban needs. Groundwater use in the region accounts for 5 percent of the State's overall supply from all sources for agricultural and urban uses (DWR 1998).

The aquifers are generally quite thick in the San Joaquin Valley subbasins, with groundwater wells commonly extending to depths of up to 800 feet. Aquifers include unconsolidated alluvium and consolidated rocks with unconfined and confined groundwater conditions. Typical well yields in the San Joaquin Valley range from 300 to 2,000 gpm with yields of 5,000 gpm possible. The region's only significant basin located outside of San Joaquin Valley is Yosemite Valley. Yosemite Valley Basin supplies water to Yosemite National Park and has substantial well yields.

Conjunctive Use

Since near the beginning of the region's agricultural development, groundwater has been used conjunctively with surface water to meet water needs. Groundwater was and is used when and where surface water is unable to fully meet demands either in time or area. For several decades, this situation was more of an incidental conjunctive use than a formal one. Historical groundwater use has resulted in some land subsidence in the southwest portion of the region.

Groundwater Quality

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are TDS, nitrate, boron, chloride, and organic compounds. The Yosemite Valley Groundwater Basin has exceptionally high quality groundwater.

Areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. The high TDS content of west-side groundwater is due to recharge of streamflow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentration of salts due to evaporation and poor drainage. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Boron and chloride are likely a result of concentration from evaporation near the valley trough. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected in groundwater throughout the region, but primarily along the east side of the San Joaquin Valley where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is dibromochloropropane (DBCP), a now-banned soil fumigant and known carcinogen once used extensively on grapes and cotton. Industrial organic contaminants include TCE, dichloroethylene (DCE), and other solvents. They are found in groundwater near airports, industrial areas, and landfills.

Water Quality in Public Supply Wells

From 1994 through 2000, 689 public supply water wells were sampled in 10 of the 11 basins and subbasins in the San Joaquin River HR. Samples analyzed indicate that 523 wells, or 76 percent, met the state primary MCLs for drinking water. One-hundred-sixty-six wells, or 24 percent, have constituents that exceed one or more MCL. Figure 36 shows the percentages of each contaminant group that exceeded MCLs in the 166 wells.

Table 28 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Changes from Bulletin 118-80

The subbasins of the San Joaquin Valley, which were delineated as part of the 118-80 update, are given their first numeric designation in this report. Additionally, the Cosumnes Subbasin has been added to the subbasins within the San Joaquin River HR. It is worth noting that the southern portion of the South American Subbasin of the Sacramento Valley Groundwater Basin is also included as part of this HR. The subbasin names and numbers within the region are listed in Table 29.

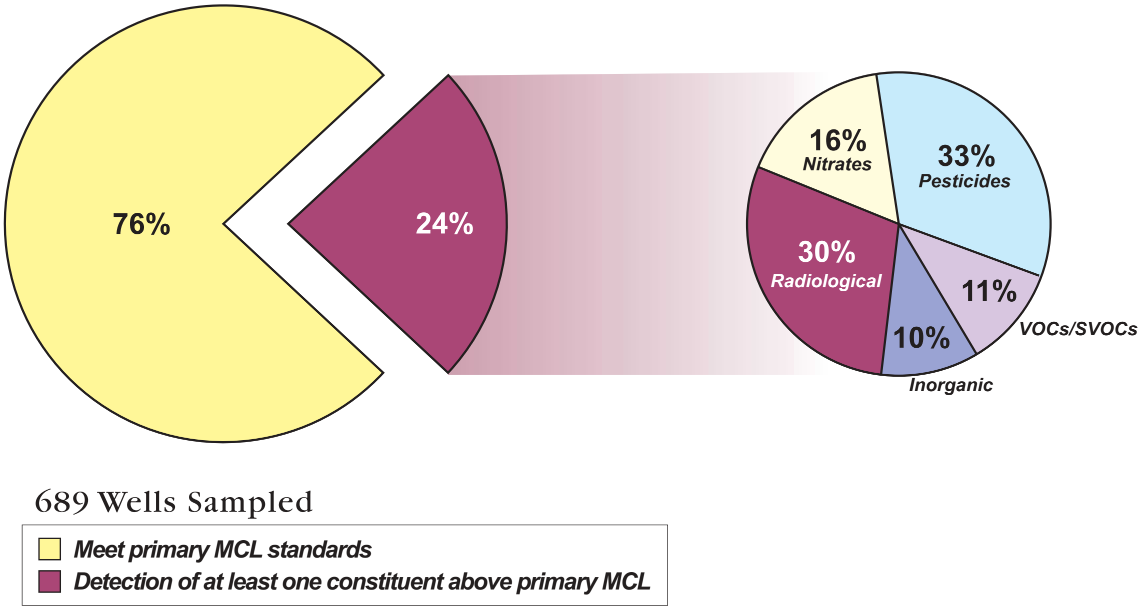

Figure 36 MCL exceedances in public supply wells in the San Joaquin River Hydrologic Region

Table 28 Most frequently occurring contaminants by contaminant group in the San Joaquin River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Aluminum – 4	Arsenic – 4	4 tied at 2 exceedances
Inorganics – Secondary	Manganese – 123	Iron – 102	TDS – 9
Radiological	Uranium – 33	Gross Alpha – 26	Radium 228 – 6
Nitrates	Nitrate (as NO_3) – 23	Nitrate + Nitrite – 6	Nitrate Nitrogen (NO_3-N) – 3
Pesticides	DBCP – 44	Di(2-Ethylhexyl)phthalate – 11	EDB – 6
VOCs	PCE – 8	Dichloromethane – 3	TCE – 3

DBCP = Dibromochloropropane
EDB = Ethylenedibromide
PCE = Tetrachloroethylene
TCE = Trichloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Table 29 Modifications since Bulletin 118-80 of groundwater basins and subbasins in San Joaquin Hydrologic Region

Subbasin name	New number	Old number
Eastern San Joaquin	5-22.01	5-22
Modesto	5-22.02	5-22
Turlock	5-22.03	5-22
Merced	5-22.04	5-22
Chowchilla	5-22.05	5-22
Madera	5-22.06	5-22
Delta-Mendota	5-22.07	5-22
Tracy	5-22.15	5-22
Cosumnes	5-22.16	5-22

Table 30 San Joaquin River Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-22	SAN JOAQUIN VALLEY									
5-22.01	EASTERN SAN JOAQUIN	707,000	A	1,500	-	345	69	540	310	30 - 1,632
5-22.02	MODESTO	247,000	B	4,500	1000-2000	230	15	209	60-500	200-8300
5-22.03	TURLOCK	347,000	B	4,500	1000-2000	307	0	163	200-500	100-8300
5-22.04	MERCED	491,000	B	4,450	1500-1900	378	0	142	200-400	100-3600
5-22.05	CHOWCHILLA	159,000	B	4,750	750-2000	203	0	28	200-500	120-6400
5-22.06	MADERA	394,000	B	4,750	750-2000	378	0	127	200-400	100-6400
5-22.07	DELTA-MENDOTA	747,000	B	5,000	800-2000	816	0	120	770	210-86,000
5-22.15	TRACY	345,000	C	3,000	500-3,000	18	14	183	1,190	210-7,800
5-22.16	COSUMNES	281,000	A	1,500	-	75	13	72	218	140-438
5-69	YOSEMITE VALLEY	7,500	C	1,200	900	0	0	3	54	43-73
5-70	LOS BANOS CREEK VALLEY	4,840	C	-	-	0	0	0	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

Tulare Lake Hydrologic Region

Figure 37 Tulare Lake Hydrologic Region

Basins and Subbasins of Tulare Lake Hydrologic Region

Basin/subbasin	Basin name
5-22	San Joaquin Valley
5-22.08	Kings
5-22.09	Westside
5-22.10	Pleasant Valley
5-22.11	Kaweah
5-22.12	Tulare Lake
5-22.13	Tule
5-22.14	Kern County
5-23	Panoche Valley
5-25	Kern River Valley
5-26	Walker Basin Creek Valley
5-27	Cummings Valley
5-28	Tehachapi Valley West
5-29	Castaic Lake Valley
5-71	Vallecitos Creek Valley
5-80	Brite Valley
5-82	Cuddy Canyon Valley
5-83	Cuddy Ranch Area
5-84	Cuddy Valley
5-85	Mil Potrero Area

Description of the Region

The Tulare Lake HR covers approximately 10.9 million acres (17,000 square miles) and includes all of Kings and Tulare counties and most of Fresno and Kern counties (Figure 37). The region corresponds to approximately the southern one-third of RWQCB 5. Significant geographic features include the southern half of the San Joaquin Valley, the Temblor Range to the west, the Tehachapi Mountains to the south, and the southern Sierra Nevada to the east. The region is home to more than 1.7 million people as of 1995 (DWR, 1998). Major population centers include Fresno, Bakersfield, and Visalia. The cities of Fresno and Visalia are entirely dependent on groundwater for their supply, with Fresno being the second largest city in the United States reliant solely on groundwater.

Groundwater Development

The region has 12 distinct groundwater basins and 7 subbasins of the San Joaquin Valley Groundwater Basin, which crosses north into the San Joaquin River HR. These basins underlie approximately 5.33 million acres (8,330 square miles) or 49 percent of the entire HR area.

Groundwater has historically been important to both urban and agricultural uses, accounting for 41 percent of the region's total annual supply and 35 percent of all groundwater use in the State. Groundwater use in the region represents about 10 percent of the State's overall supply for agricultural and urban uses (DWR 1998).

The aquifers are generally quite thick in the San Joaquin Valley subbasins with groundwater wells commonly exceeding 1,000 feet in depth. The maximum thickness of freshwater-bearing deposits (4,400 feet) occurs at the southern end of the San Joaquin Valley. Typical well yields in the San Joaquin Valley range from 300 gpm to 2,000 gpm with yields of 4,000 gpm possible. The smaller basins in the mountains surrounding the San Joaquin Valley have thinner aquifers and generally lower well yields averaging less than 500 gpm.

The cities of Fresno, Bakersfield, and Visalia have groundwater recharge programs to ensure that groundwater will continue to be a viable water supply in the future. Extensive groundwater recharge programs are also in place in the south valley where water districts have recharged several million acre-feet for future use and transfer through water banking programs.

The extensive use of groundwater in the San Joaquin Valley has historically caused subsidence of the land surface primarily along the west side and south end of the valley.

Groundwater Quality

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are high TDS, nitrate, arsenic, and organic compounds.

The areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. High TDS content of west-side water is due to recharge of stream flow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentration of salts because of evaporation and poor drainage. In the central and west-side portions of the valley, where the Corcoran Clay confining layer exists, water quality is generally better beneath the clay than above it. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Areas of high nitrate concentrations are known to exist near the town of Shafter and other isolated areas in the San Joaquin Valley. High levels of arsenic occur locally and appear to be associated with lakebed areas. Elevated arsenic levels have been reported in the Tulare Lake, Kern Lake and Buena Vista Lake bed areas. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected throughout the valley, but primarily along the east side where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is DBCP, a now-banned soil fumigant and known carcinogen once used extensively on grapes. Industrial organic contaminants include TCE, DCE, and other solvents. They are found in groundwater near airports, industrial areas, and landfills.

Water Quality in Public Supply Wells

From 1994 through 2000, 1,476 public supply water wells were sampled in 14 of the 19 groundwater basins and subbasins in the Tulare Lake HR. Evaluation of analyzed samples shows that 1,049 of the wells, or 71 percent, met the state primary MCLs for drinking water. Four-hundred-twenty-seven wells, or 29 percent, exceeded one or more MCL. Figure 38 shows the percentages of each contaminant group that exceeded MCLs in the 427 wells.

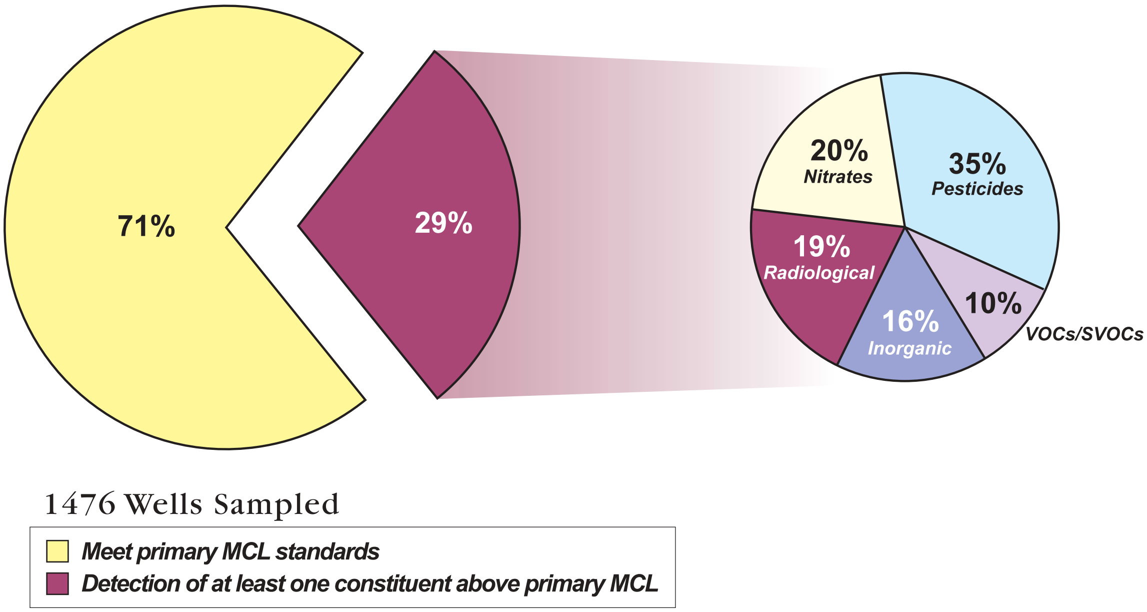

Figure 38 MCL exceedances by contaminant group in public supply wells in the Tulare Lake Hydrologic Region

Table 31 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 31 Most frequently occurring contaminants by contaminant group in the Tulare Lake Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics - Primary	Fluoride – 32	Arsenic – 16	Aluminum – 13
Inorganics - Secondary	Iron – 155	Manganese – 82	TDS – 9
Radiological	Gross Alpha – 74	Uranium – 24	Radium 228 – 8
Nitrates	Nitrate(as NO_3) – 83	Nitrate + Nitrite – 14	Nitrite(as N) – 3
Pesticides	DBCP – 130	EDB – 24	Di(2-Ethylhexyl)phthalate – 7
VOCs/SVOCs	TCE – 17	PCE – 16	Benzene – 6 MTBE – 6

DBCP = Dibromochloropropane
EDB = Ethylenedibromide
TCE = Trichloroethylene
PCE = Tetrachloroehylene
VOC = Volatile organic compound
SVOC = Semivolatile organic compound

Changes from Bulletin 118-80

There are no newly defined basins since Bulletin 118-80. However, the subbasins of the San Joaquin Valley, which were delineated as part of the 118-80 update, are given their first numeric designation in this report (Table 32).

Table 32 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Tulare Lake Hydrologic Region

Subbasin name	New number	Old number
Kings	5-22.08	5-22
Westside	5-22.09	5-22
Pleasant Valley	5-22.10	5-22
Kaweah	5-22.11	5-22
Tulare Lake	5-22.12	5-22
Tule	5-22.13	5-22
Kern County	5-22.14	5-22
Squaw Valley	deleted	5-24
Cedar Grove Area	deleted	5-72
Three Rivers Area	deleted	5-73
Springville Area	deleted	5-74
Templeton Mountain Area	deleted	5-75
Manache Meadow Area	deleted	5-76
Sacator Canyon Valley	deleted	5-77
Rockhouse Meadows Valley	deleted	5-78
Inns Valley	deleted	5-79
Bear Valley	deleted	5-81

Several basins have been deleted from the Bulletin 118-80 report. In Squaw Valley (5-24) all 118 wells are completed in hard rock. Cedar Grove Area (5-72) is a narrow river valley in Kings Canyon National Park with no wells. Three Rivers Area (5-73) has a thin alluvial terrace deposit but 128 of 130 wells are completed in hard rock. Springville Area (5-74) is this strip of alluvium adjacent to Tule River and all wells are completed in hard rock. Templeton Mountain Area (5-75), Manache Meadow Area (5-76), and Sacator Canyon Valley (5-77) are all at the crest of mountains with no wells. Rockhouse Meadows Valley (5-78) is in wilderness with no wells. Inns Valley (5-79) and Bear Valley (5-81) both have all wells completed in hard rock.

Table 33 Tulare Lake Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-22	SAN JOAQUIN VALLEY									
5-22.08	KINGS	976,000	C	3,000	500-1,500	909	-	722	200-700	40-2000
5-22.09	WESTSIDE	640,000	C	2,000	1,100	960	-	50	520	220-35,000
5-22.10	PLEASANT VALLEY	146,000	B	3,300	-	151	-	2	1,500	1000-3000
5-22.11	KAWEAH	446,000	B	2,500	1,000-2,000	568	-	270	189	35-580
5-22.12	TULARE LAKE	524,000	B	3,000	300-1,000	241	-	86	200-600	200-40,000
5-22.13	TULE	467,000	B	3,000	-	459	-	150	256	200-30,000
5-22.14	KERN COUNTY	1,950,000	A	4,000	1,200-1,500	2,258	249	476	400-450	150-5000
5-23	PANOCHE VALLEY	33,100	C	-	-	48	-	-	1,300	394-3530
5-25	KERN RIVER VALLEY	74,000	C	3,650	350	-	-	92	378	253-480
5-26	WALKER BASIN CREEK VALLEY	7,670	C	650	-	-	-	1	-	-
5-27	CUMMINGS VALLEY	10,000	A	150	56	51	-	15	344	-
5-28	TEHACHAPI VALLEY WEST	14,800	A	1,500	454	64	-	19	315	280-365
5-29	CASTAC LAKE VALLEY	3,600	C	400	375	-	-	3	583	570-605
5-71	VALLECITOS CREEK VALLEY	15,100	C	-	-	-	-	0	-	-
5-80	BRITE VALLEY	3,170	A	500	50	-	-	-	-	-
5-82	CUDDY CANYON VALLEY	3,300	C	500	400	-	-	3	693	695
5-83	CUDDY RANCH AREA	4,200	C	300	180	-	-	4	550	480-645
5-84	CUDDY VALLEY	3,500	A	160	135	3	-	3	407	325-645
5-85	MIL POTRERO AREA	2,300	C	3,200	240	7	-	7	460	372-657

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

North Lahontan Hydrologic Region

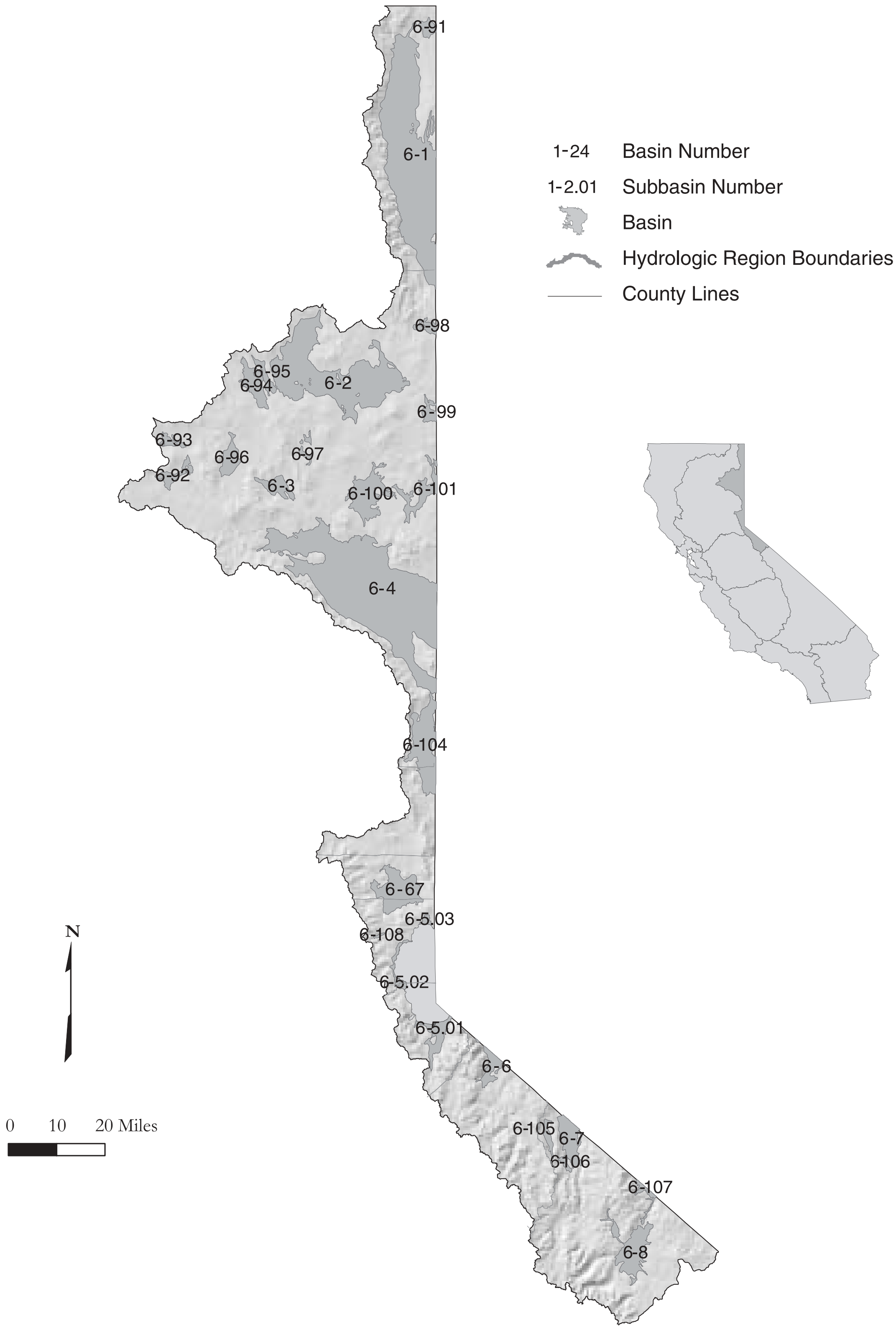

Figure 39 North Lahontan Hydrologic Region

Basins and Subbasins of the North Lahontan Hydrologic Region

Basin/subbasin	Basin name
6-1	Surprise Valley
6-2	Madeline Plains
6-3	Willow Creek Valley
6-4	Honey Lake Valley
6-5	Tahoe Valley
6-5.01	Tahoe Valley South
6-5.02	Tahoe Valley West
6-5.03	Tahoe Valley North
6-6	Carson Valley
6-7	Antelope Valley
6-8	Bridgeport Valley
6-67	Martis (Truckee) Valley
6-91	Cow Head Lake Valley
6-92	Pine Creek Valley
6-93	Harvey Valley
6-94	Grasshopper Valley
6-95	Dry Valley
6-96	Eagle Lake Area
6-97	Horse Lake Valley
6-98	Tuledad Canyon
6-99	Painters Flat
6-100	Secret Valley
6-101	Bull Flat
6-104	Long Valley
6-105	Slinkard Valley
6-106	Little Antelope Valley
6-107	Sweetwater Flat
6-108	Olympic Valley

Description of the Region

The North Lahonton HR covers approximately 3.91 million acres (6,110 square miles) and includes portions of Modoc, Lassen, Sierra, Nevada, Placer, El Dorado, Alpine, Mono, and Tuolumne counties (Figure 39). Reaching south from the Oregon border almost to Mono Lake on the east side of the Sierra, this region encompasses portions of two geomorphic provinces. From Long Valley north, most of the groundwater basins of the region were formed by basin and range block faulting near the western extent of the province. South from Long Valley, most of the basins are in the alpine valleys of the Sierra Nevada or are at the foot of the Sierra along the California-Nevada border where streams and rivers draining the eastern Sierran slopes terminate in desert sinks or lakes. The region corresponds to approximately the northern half of RWQCB 6. Significant geographic features include the Sierra Nevada, the volcanic terrane of the Modoc Plateau, Honey Lake Valley, and Lake Tahoe. The latter two areas are the major population centers in the region. The 1995 population of the entire region was about 84,000 people (DWR, 1998).

The northern portion of the region is rural and sparsely populated. Cattle ranching and associated hay cropping are the predominant land uses in addition to some pasture irrigation. Less than 4 percent of the entire region is irrigated. About 75 percent of the irrigated lands are in Modoc and Lassen counties, and most of the remainder is in Alpine and Mono counties. Much of the southern portion of the region is federally owned and managed as national forest lands where tourism and recreation constitute much of the economic base.

Much of the North Lahontan HR is chronically short of water due to the arid, high desert climate, which predominates in the region. Throughout the northern portion of the region where annual precipitation can be as low as 4 inches, runoff is typically scant and streamflows decrease rapidly during the irrigation season as the snowpack in the higher elevations melts. In the southern portion of the region, annual precipitation ranges from more than 70 inches (mostly snow in the higher elevations of the mountains) to as little as 8 inches in the low elevation valleys. In wet years, surface water can meet much of the agricultural demand, but in dry years, most of the region relies heavily on groundwater to meet water supply needs.

Groundwater Development

There are 24 groundwater basins in the region, one of which is divided into three subbasins. Thirteen of these basins are shared with Nevada and one with Oregon. These basins underlie approximately 1.03 million acres (1,610 square miles) or about 26 percent of the entire region. Although the groundwater basins were delineated based on mapped alluvial fill, much of the groundwater produced in many of them actually comes from underlying fractured rock aquifers. This is particularly true in the volcanic areas of Modoc and Lassen counties where, in many basins, volcanic flows are interstratified with lake sediments and alluvium. Wells constructed in the volcanics commonly produce large amounts of groundwater, whereas wells constructed in fine-grained lake deposits produce less. Because the thickness and lateral extent the of the hard rocks outside of the defined basin are generally not known, actual groundwater in storage in these areas is unknown.

Locally, groundwater is an important resource accounting for about 28 percent of the annual supply for agricultural and urban uses. Groundwater use in the region represents less than 1 percent of the State's overall supply for agricultural and urban uses (DWR 1998).

In the northern portion of the region, a sizable quantity of groundwater (nearly 130,000 acre-feet) is extracted annually for agricultural and municipal purposes. Groundwater extracted from the Honey Lake Valley Basin accounts for 41,900 acre-feet of the agricultural supply and 12,000 acre-feet of the municipal supply (based on normalized data from 1990). An additional 3,100 acre-feet is extracted to meet the demands of the Honey Lake Wildlife Area, which provides habitat for several threatened species (Bald Eagle, Sandhill Crane, Bank Swallow, and Peregrine Falcon).

Well yields in the Honey Lake Valley Basin are greatest in alluvial and volcanic deposits. Wells drawing from these deposits may have yields that vary from 10 gpm to more than 2,000 gpm, but drawdown in these cases is generally high. Eight wells in the Honey Lake Wildlife Area have an average yield of between 1,260 and 2,100 gpm. Depths of completed wells in the region range from 20 to 720 feet.

The Honey Lake Valley Basin is very close to exceeding prudent perennial yield, and future development could come at the expense of water for agriculture. A 1987 agreement between DWR, the state of Nevada, and the U.S. Geological Survey resulted in a study of the groundwater flow system in eastern Honey Lake Valley. Upon conclusion of the study in September 1990, a Nevada state engineer ruled that only about 13,000 acre-feet could be safely transferred from the basin.

No major changes in water use are anticipated in the near future in the northern portion of the region. Irrigated agriculture is already constrained by economically available water supplies. A small amount of agricultural expansion is expected but only in areas that can support minor additional groundwater development. Likewise, the modest need for additional municipal and irrigation supplies can be met by minor expansion of present surface systems or by increased use of groundwater.

The principal drainages in the southern portion of the region are the Truckee, Walker and Carson rivers. Water rights in these drainages historically have been heavily contested, and allocations are limited by interstate agreements with Nevada, in-stream environmental requirements, and miscellaneous private rights holders. In the Lake Tahoe Basin, further development is strictly limited because of concerns regarding water quality in the lake. Surface water storage developed in the region's drainages provides urban and agricultural supply to the Reno/Sparks area and to the many smaller communities in the eastern Sierra and at the foot of the mountain slopes. Most communities rely on a combination of surface water and groundwater supply.

In the upper Truckee drainage, the primary groundwater basins underlie the areas around Lake Tahoe and Martis Valley, where the Town of Truckee is located. Both areas use surface water and groundwater for urban and surrounding rural domestic supplies.

Little is known about the small groundwater basins developed along the foot of the eastern Sierra. Most communities overlying these basins are along the streams and rivers flowing down the mountains, and groundwater is extracted from the underlying alluvium. Groundwater augments surface supplies for agricultural purposes and supports municipal and rural domestic supplies.

Groundwater Quality

In basins in the northern portion of the region, groundwater quality ranges widely from excellent to poor. Wells that obtain their water supply from lake deposits can have high concentrations of boron, arsenic, fluoride, nitrate, and TDS. TDS content generally increases toward the central portions of these basins where concentrations have accumulated over time. The groundwater quality along the margins of most of these basins tends to be of much better quality. There is a potential for future groundwater pollution occurring in urban/suburban areas where single-family septic systems have been installed, especially in hard rock areas. Groundwater quality in the alpine basins is good to excellent; but, as in any area where single-family septic systems have been installed, there is potential for degradation of groundwater quality.

Water Quality in Public Supply Wells

From 1994 through 2000, 169 public supply water wells were sampled in 8 of the 26 basins and subbasins in the North Lahontan HR. Evaluation of the analyzed samples indicates that 147 wells, or 87 percent, met the state primary MCLs for drinking water. Twenty-two wells, or 13 percent, have constituents that exceed one or more MCL. Figure 40 shows the percentages of each contaminant group that exceeded MCLs in the 22 wells.

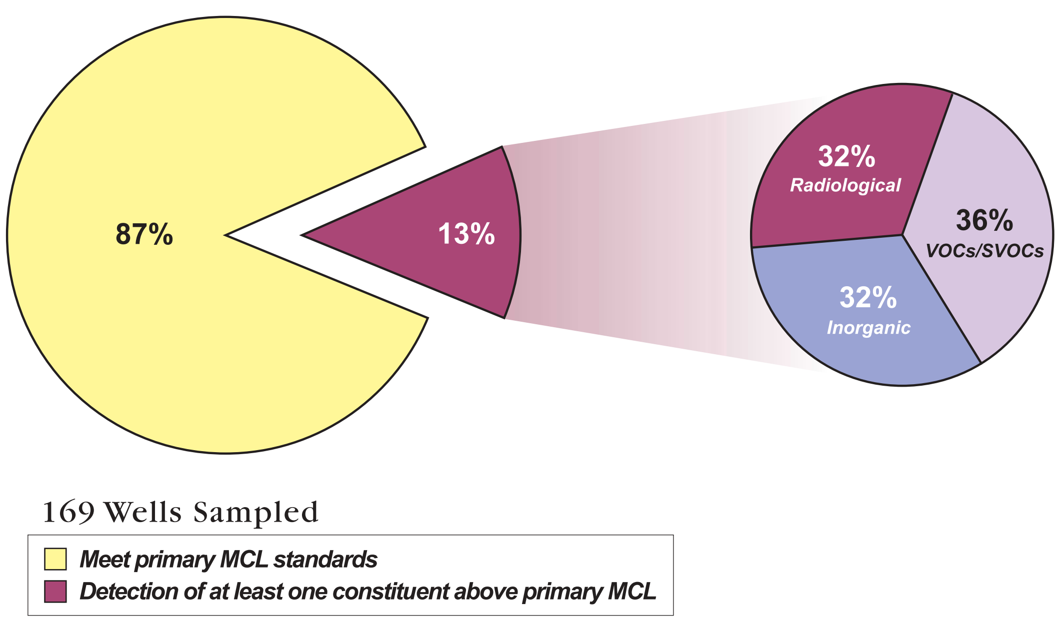

Figure 40 MCL exceedances in public supply wells in the North Lahontan Hydrologic Region

Table 34 lists the three most frequently occurring contaminants in each contaminant group and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 34 Most frequently occurring contaminants by contaminant group in the North Lahontan Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 3	Thallium – 3	3 tied at 1 exceedance
Inorganics – Secondary	Iron – 14	Manganese – 13	TDS – 1
Radiological	Gross Alpha – 7	Uranium – 5	Radium 226 – 1
VOCs/SVOCs	1,2 Dichloroethane – 8	TCE – 2	MTBE – 1

TCE = Trichloroethylene
MTBE = Methyltertiarybutylether
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

There are no newly defined basins since Bulletin 118-80. The only delineated areas removed from the list of region basins are the Recent and Pleistocene volcanic areas of the Modoc Plateau, previously numbered 6-102 and 6-103, respectively.

Table 35 North Lahontan Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
6-1	SURPRISE VALLEY	228,000	B	2,500	1,383	16	11	4	224	87 - 1,800
6-2	MADELINE PLAINS	156,150	B	-	450	2	6	-	402	81 - 1,790
6-3	WILLOW CREEK VALLEY	11,700	B	-	-	7	4	-	401	90 - 1,200
6-4	HONEY LAKE VALLEY	311,150	B	2,500	784	39	24	49	518	89 - 2,500
6-5	TAHOE VALLEY									
6-5.01	TAHOE SOUTH	14,800	C	4,000	-	6	-	54	-	59 - 206
6-5.02	TAHOE WEST	6,000	C	-	-	-	9	3	103	68 - 128
6-5.03	TAHOE VALLEY NORTH	2,000	C	900	-	-	-	-	141	-
6-6	CARSON VALLEY	10,700	C	-	-	-	-	-	-	-
6-7	ANTELOPE VALLEY	20,100	A	-	-	-	-	12	-	-
6-8	BRIDGEPORT VALLEY	32,500	C	-	-	-	-	6	-	-
6-67	MARTIS VALLEY	35,600	C	-	-	-	-	-	-	-
6-91	COW HEAD LAKE VALLEY	5,600	B	-	-	-	-	-	-	-
6-92	PINE CREEK VALLEY	9,530	B	-	-	-	-	1	-	-
6-93	HARVEY VALLEY	4,500	B	-	-	-	-	-	-	-
6-94	GRASSHOPPER VALLEY	17,670	B	-	-	-	-	-	-	-
6-95	DRY VALLEY	6,500	B	-	-	-	-	-	-	-
6-96	EAGLE LAKE AREA	-	B	-	-	-	4	4	-	-
6-97	HORSE LAKE VALLEY	3,800	B	-	-	-	-	-	-	-
6-98	TULEDAD CANYON	5,200	B	-	-	-	-	-	-	-
6-99	PAINTERS FLAT	6,400	B	-	-	-	-	-	-	-
6-100	SECRET VALLEY	33,680	B	-	-	2	2	-	-	125 - 3,200
6-101	BULL FLAT	18,100	B	-	-	-	-	-	-	-
6-104	LONG VALLEY	46,840	B	-	-	31	4		302	127 - 570
6-105	SLINKARD VALLEY	4,500	C	-	-	-	-	-	-	-
6-106	LITTLE ANTELOPE VALLEY	2,500	C	-	-	-	-	-	-	-
6-107	SWEETWATER FLAT	4,700	C	-	-	-	-	-	-	-
6-108	OLYMPIC VALLEY	700	C	600	330	-	-	2	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

South Lahontan Hydrologic Region

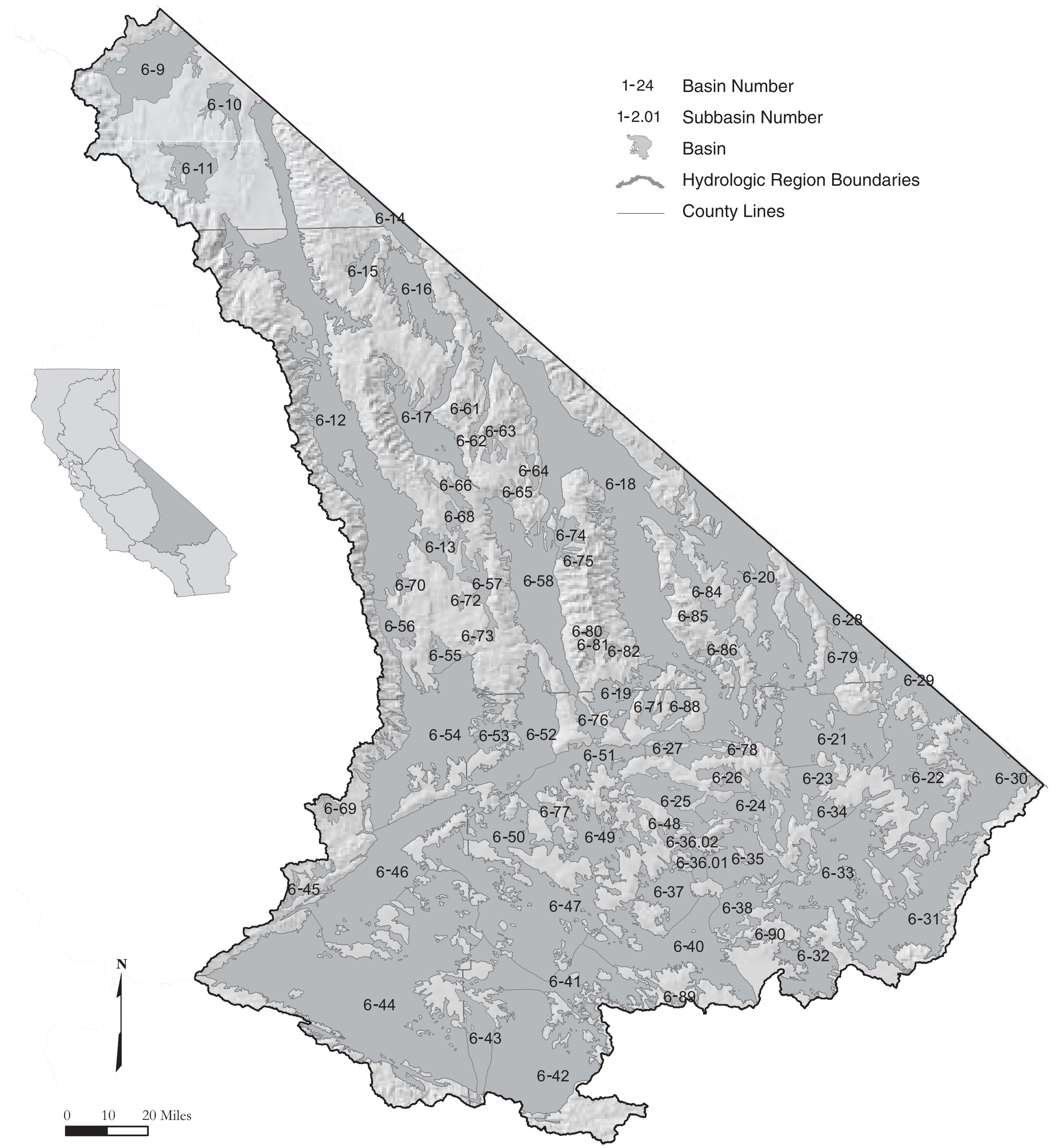

Figure 41 South Lahontan Hydrologic Region

Basins and Subbasins of the South Lahontan Hydrologic Region

Basin/subbasin	Basin name
6-9	Mono Valley
6-10	Adobe Lake Valley
6-11	Long Valley
6-12	Owens Valley
6-13	Black Springs Valley
6-14	Fish Lake Valley
6-15	Deep Springs Valley
6-16	Eureka Valley
6-17	Saline Valley
6-18	Death Valley
6-19	Wingate Valley
6-20	Middle Amargosa Valley
6-21	Lower Kingston Valley
6-22	Upper Kingston Valley
6-23	Riggs Valley
6-24	Red Pass Valley
6-25	Bicycle Valley
6-26	Avawatz Valley
6-27	Leach Valley
6-28	Pahrump Valley
6-29	Mesquite Valley
6-30	Ivanpah Valley
6-31	Kelso Valley
6-32	Broadwell Valley
6-33	Soda Lake Valley
6-34	Silver Lake Valley
6-35	Cronise Valley
6-36	Langford Valley
6-36.01	Langford Well Lake
6-36.02	Irwin
6-37	Coyote Lake Valley
6-38	Caves Canyon Valley
6-40	Lower Mojave River Valley
6-41	Middle Mojave River Valley
6-42	Upper Mojave River Valley
6-43	El Mirage Valley
6-44	Antelope Valley
6-45	Tehachapi Valley East
6-46	Fremont Valley
6-47	Harper Valley
6-48	Goldstone Valley
6-49	Superior Valley
6-50	Cuddeback Valley
6-51	Pilot Knob Valley
6-52	Searles Valley
6-53	Salt Wells Valley
6-54	Indian Wells Valley
6-55	Coso Valley
6-56	Rose Valley
6-57	Darwin Valley
6-58	Panamint Valley
6-61	Cameo Area
6-62	Race Track Valley
6-63	Hidden Valley
6-64	Marble Canyon Area
6-65	Cottonwood Spring Area
6-66	Lee Flat
6-68	Santa Rosa Flat
6-69	Kelso Lander Valley
6-70	Cactus Flat
6-71	Lost Lake Valley
6-72	Coles Flat
6-73	Wild Horse Mesa Area
6-74	Harrisburg Flats
6-75	Wildrose Canyon
6-76	Brown Mountain Valley
6-77	Grass Valley
6-78	Denning Spring Valley
6-79	California Valley
6-80	Middle Park Canyon
6-81	Butte Valley
6-82	Spring Canyon Valley
6-84	Greenwater Valley
6-85	Gold Valley
6-86	Rhodes Hill Area
6-88	Owl Lake Valley
6-89	Kane Wash Area
6-90	Cady Fault Area

Description of the Region

The South Lahontan HR covers approximately 21.2 million acres (33,100 square miles) in eastern California. This region includes about 21 percent of the surface area of California and both the highest (Mount Whitney) and lowest (Death Valley) surface elevations of the contiguous United States. The HR is bounded on the west by the crest of the Sierra Nevada and on the north by the watershed divide between Mono Lake and East Walker River drainages; on the east by Nevada and the south by the crest of the San Gabriel and San Bernardino mountains and the divide between watersheds draining south toward the Colorado River and those draining northward. This HR includes the Owens, Mojave, and Amargosa River systems, the Mono Lake drainage system, and many other internally drained basins. Average annual precipitation is about 7.9 inches, and runoff is about 1.3 maf per year (DWR 1994).

The South Lahontan HR includes Inyo County, much of Mono and San Bernardino counties, and parts of Kern and Los Angeles counties (Figure 41). National forests, national and state parks, military bases and other public lands comprise most of the land in this region. The Los Angeles Department of Water and Power is also a major landowner in the northern part of the HR and controls rights to much of the water draining the eastern Sierra Nevada.

According to 2000 census data, the South Lahontan HR is home to about 530,000 people, or 1.6 percent of the state's population. The major population centers are in the southern part of the HR and include Palmdale, Lancaster, Victorville, Apple Valley, and Hesperia.

Groundwater Development

In this report, 76 groundwater basins are delineated in the South Lahontan HR, and the Langford Valley Groundwater Basin (6-36) is divided into two subbasins. The groundwater basins underlie about 11.60 million acres (18,100 square miles) or about 55 percent of the HR.

Most of the groundwater production is concentrated, along with the population, in basins in the southern part of this region. Groundwater provides 41 percent of water supply for agriculture and urban uses (DWR 1998). Much of this HR is public land with very low population density, within these areas there has been little groundwater development and little is known about the basins.

In most smaller basins, groundwater is found in unconfined alluvial aquifers; however, in some of the larger basins, or near dry lakes, aquifers may be separated by aquitards that cause confined groundwater conditions. Depths of the basins range from tens or hundreds of feet in smaller basins to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this region depending on aquifer characteristics and well location, size, and use.

Conjunctive use of surface water and groundwater is practiced in the more heavily pumped basins. Some water used in the southern part of the HR is imported from Northern California by the State Water Project. Some of this imported water is used to recharge groundwater in the Mojave River Valley basins (6-40, 6-41, and 6-42). Surface water and groundwater are exported from the South Lahontan HR to the South Coast HR by the Los Angeles Department of Water and Power.

Groundwater Quality

The chemical character of the groundwater varies throughout the region, but most often is calcium or sodium bicarbonate. Near and beneath dry lakes, sodium chloride and sodium sulfate-chloride water is common. In general, groundwater near the edges of valleys contains lower TDS content than water beneath the central part of the valleys or near dry lakes.

Drinking water standards are most often exceeded for TDS, fluoride, and boron content. The EPA lists 13 sites of contamination in this HR. Of these, three military installations in the Antelope Valley and Mojave River Valley groundwater basins are federal Superfund sites because of VOCs and other hazardous contaminants.

Water Quality in Public Supply Wells

From 1994 through 2000, 605 public supply water wells were sampled in 19 of the 77 basins and subbasins in the South Lahontan HR. Analyzed samples indicate that 506 wells, or 84 percent, met the state primary MCLs for drinking water. Ninety-nine wells, or 16 percent, have constituents that exceed one or more MCL. Figure 42 shows the percentages of each contaminant group that exceeded MCLs in the 99 wells.

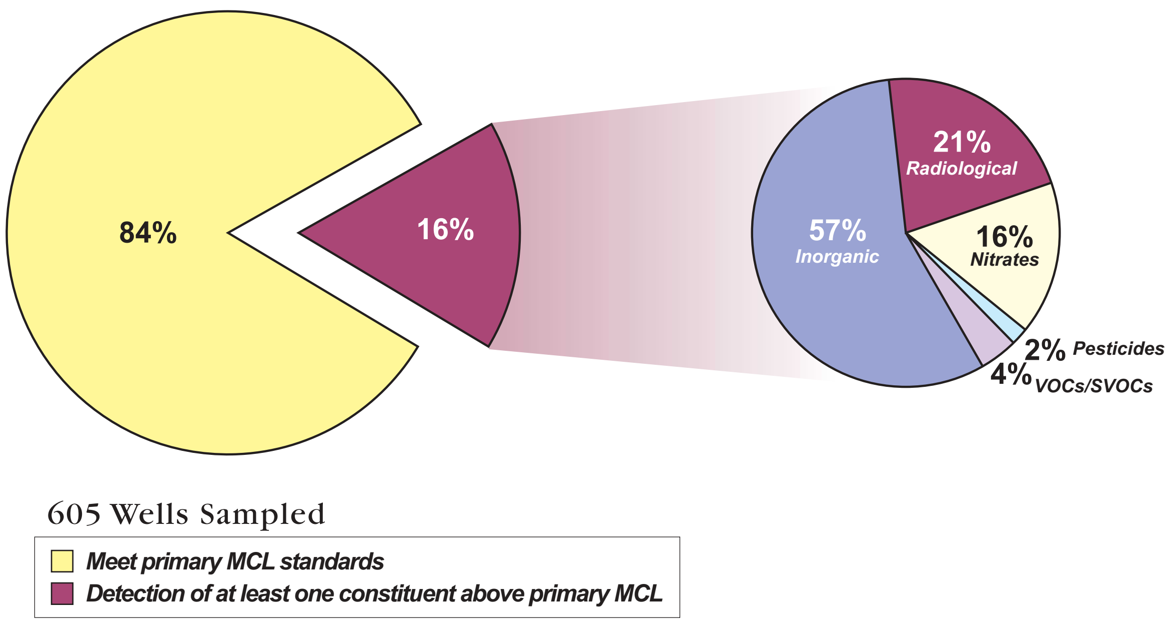

Figure 42 MCL exceedances in public supply wells in the South Lahontan Hydrologic Region

Table 36 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 36 Most frequently occurring contaminants by contaminant group in the South Lahontan Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 30	Arsenic – 19	Antimony – 5
Inorganics – Secondary	Iron – 82	Manganese – 36	Specific Conductance – 5 TDS – 5
Radiological	Gross Alpha – 18	Uranium – 7	Radium 228 – 2
Dissolved Nitrogen	Nitrate (as NO_3) – 12	Nitrate + Nitrite–6	Nitrite (as N) – 4
Pesticides	Di(2-Ethylhexyl)phthalate) – 2		
VOCs/SVOCs	MTBE – 2	TCE – 2	Carbon Tetrachloride – 2

TCE = Trichloroethylene
MTBE = Methyltertiarybutylether
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

Several modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report (Table 37). Langford Valley Groundwater Basin (6-36) has been divided into two subbasins. Granite Mountain Area (6-59) and Fish Slough Valley (6-60) groundwater basins have been deleted because no information was found concerning wells or groundwater in these basins or because well completion reports indicate that groundwater production is derived from fractured rocks beneath the basin. Furnace Creek Area Groundwater Basin (6-83) has been incorporated into Death Valley Groundwater Basin (6-18), and Butterbread Canyon Valley Groundwater Basin (6-87) has been incorporated into Lost Lake Valley Groundwater Basin (6-71).

Table 37 Modifications since Bulletin 118-80 of groundwater basins and subbasins in South Lahontan Hydrologic Region

Basin/subbasin name	New number	Old number
Langford Well Lake	6-36.01	6-36
Irwin	6-36.02	6-36
Troy Valley	Incorporated into 6-40 and 7-14.	6-39
Granite Mountain Area	Deleted	6-59
Fish Slough Valley	Deleted	6-60
Furnace Creek Area	Deleted – incorporated into 6-18	6-83
Butterbread Canyon Valley	Deleted – incorporated into 6-71	6-87

Troy Valley Groundwater Basin (6-39) has been split at the Pisgah fault, which is a groundwater barrier, and has been incorporated into Lower Mojave River Valley (6-40) and Lavic Valley (7-14) groundwater basins. This change incorporates part of the South Lahontan HR into a basin in the Colorado River HR[1]. The Middle Mojave River Valley Groundwater Basin (6-41) has changed boundaries along the north (Harper Valley; 6-47) and east sides (Lower Mojave River Valley; 6-40). The new boundaries are along the Camp Rock-Harper Lake fault zone, Waterman fault, and Helendale fault. Groundwater level elevations indicate that these faults are likely strong barriers to groundwater movement.

The boundary between the Upper Mojave River Valley Groundwater Basin (6-42) and the Lucerne Valley Groundwater Basin (7-19) was changed from the regional surface divide to the southern part of the Helendale fault, which is a groundwater barrier. This change incorporates part of the Colorado Desert HR into a basin in the South Lahontan HR[2].

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[1] The boundaries of the hydrologic regions are defined by surface drainage patterns. In this case, faults impede groundwater flow causing it to flow beneath the surface drainage divide into the adjacent hydrologic region.

[2] See previous note.

Table 38 South Lahontan Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
6-09	MONO VALLEY	173,000	A	800	480	-	-	-	-	2060
6-10	ADOBE LAKE VALLEY	39,800	C	-	-	-	-	-	-	-
6-11	LONG VALLEY	71,800	A	250	90	20	-	5	-	-
6-12	OWENS VALLEY	661,000	A	8,100	1,870	700	7	89	-	300-450,000
6-13	BLACK SPRINGS VALLEY	30,800	C	-	-	-	-	-	-	-
6-14	FISH LAKE VALLEY	48,100	C	-	-	-	-	-	-	-
6-15	DEEP SPRINGS VALLEY	29,900	C	700	390	-	-	-	-	-
6-16	EUREKA VALLEY	129,000	C	-	-	-	-	1	-	-
6-17	SALINE VALLEY	146,000	C	-	-	-	-	-	-	-
6-18	DEATH VALLEY	921,000	C	-	-	28	-	6	-	-
6-19	WINGATE VALLEY	71,400	C	-	-		-		-	-
6-20	MIDDLE AMARGOSA VALLEY	390,000	C	3,000	2,500	2	-	4	-	-
6-21	LOWER KINGSTON VALLEY	240,000	C	-	-	-	-	-	-	-
6-22	UPPER KINGSTON VALLEY	177,000	C	24	-	-	-	5	-	-
6-23	RIGGS VALLEY	87,700	C	-	-	-	-	-	-	-
6-24	RED PASS VALLEY	96,500	C	-	-	-	-	-	-	-
6-25	BICYCLE VALLEY	89,600	C	710	-	-	12	6	618	508-810
6-26	AVAWATZ VALLEY	27,700	C	-	-	-	-	-	-	-
6-27	LEACH VALLEY	61,300	C	-	-	-	-	-	-	-
6-28	PAHRUMP VALLEY	93,100	C	300	150	-	-	-	-	-
6-29	MESQUITE VALLEY	88,400	C	1,500	1,020	-	-	-	-	-
6-30	IVANPAH VALLEY	199,000	C	600	400	-	-	9	-	-
6-31	KELSO VALLEY	255,000	C	370	290	-	-		-	-
6-32	BROADWELL VALLEY	92,100	C	-	-	-	-	1	-	-
6-33	SODA LAKE VALLEY	381,000	C	2,100	1,100	-	-	3	-	-
6-34	SILVER LAKE VALLEY	35,300	C	-	-	-	-		-	-
6-35	CRONISE VALLEY	127,000	C	600	340	-	-	-	-	-
6-36	LANGFORD VALLEY									
6-36.01	LANGFORD WELL LAKE	19,300	C	1,700	410	11	7	3	498	440-568
6-36.02	IRWIN	10,500	C	550	-	40	-	3	528	496-598
6-37	COYOTE LAKE VALLEY	88,200	A	1,740	660	5	-	-	-	300-1000
6-38	CAVES CANYON VALLEY	73,100	A	300	-	4	1	4	-	300-1000
6-40	LOWER MOJAVE RIVER VALLEY	286,000	A	2,700	770	70	21	52	300	-
6-41	MIDDLE MOJAVE RIVER VALLEY	211,000	A	4,000	1,000	74	3	14	500	-
6-42	UPPER MOJAVE RIVER VALLEY	413,000	A	5,500	1,030	120	22	153	500	1105
6-43	EL MIRAGE VALLEY	75,900	A	1,000	230	50	3	21	-	-
6-44	ANTELOPE VALLEY	1,110,000	A	7,500	286	262	10	248	300	200-800
6-45	TEHACHAPI VALLEY EAST	24,000	C	150	31	31	-	9	361	298-405
6-46	FREMONT VALLEY	2,370,000	C	4,000	500	23	-	13	596	350-100,000
6-47	HARPER VALLEY	410,000	A	3,000	725	11	3	19	-	179-2391
6-48	GOLDSTONE VALLEY	28,100	C	-	-	-	-	-	-	-
6-49	SUPERIOR VALLEY	120,000	C	450	100	-	-	-	-	-

Table 38 South Lahontan Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
6-50	CUDDEBACK VALLEY	94,900	C	500	300	-	-	-	-	-
6-51	PILOT KNOB VALLEY	139,000	C	-	-	-	-	1	-	-
6-52	SEARLES VALLEY	197,000	C	1,000	300	-	-	-	-	-
6-53	SALT WELLS VALLEY	29,500	C	-	-	-	-	-	-	-
6-54	INDIAN WELLS VALLEY	382,000	A	3,800	815	116	20	63	312	110-1620
6-55	COSO VALLEY	25,600	C	-	-	-	-	-	-	-
6-56	ROSE VALLEY	42,500	C	-	-	-	-	1	-	-
6-57	DARWIN VALLEY	44,200	C	130	43	-	-	-	-	-
6-58	PANAMINT VALLEY	259,000	C	35	30	-	-	-	-	-
6-61	CAMEO AREA	9,310	C	-	-	-	-	-	-	-
6-62	RACE TRACK VALLEY	14,100	C	-	-	-	-	-	-	-
6-63	HIDDEN VALLEY	18,000	C	-	-	-	-	-	-	-
6-64	MARBLE CANYON AREA	10,400	C	-	-	-	-	-	-	-
6-65	COTTONWOOD SPRING AREA	3,900	C	-	-	-	-	-	-	-
6-66	LEE FLAT	20,300	C	-	-	-	-	-	-	-
6-68	SANTA ROSA FLAT	312	C	-	-	-	-	-	-	-
6-69	KELSO LANDER VALLEY	11,200	C	-	-	-	-	-	-	-
6-70	CACTUS FLAT	7,030	C	-	-	-	-	-	-	-
6-71	LOST LAKE VALLEY	23,300	C	-	-	-	-	-	-	-
6-72	COLES FLAT	2,950	C	-	-	-	-	-	-	-
6-73	WILD HORSE MESA AREA	3,320	C	-	-	-	-	-	-	-
6-74	HARRISBURG FLATS	24,900	C	-	-	-	-	1	-	-
6-75	WILDROSE CANYON	5,160	C	-	-	-	-	-	-	-
6-76	BROWN MOUNTAIN VALLEY	21,700	C	-	-	-	-	-	-	-
6-77	GRASS VALLEY	9,980	C	-	-	-	-	-	-	-
6-78	DENNING SPRING VALLEY	7,240	C	-	-	-	-	-	-	-
6-79	CALIFORNIA VALLEY	58,300	C	-	-	-	-	-	-	-
6-80	MIDDLE PARK CANYON	1,740	C	-	-	-	-	-	-	-
6-81	BUTTE VALLEY	8,810	C	-	-	-	-	-	-	-
6-82	ANVIL SPRING CANYON VALLEY	4,810	C	-	-	-	-	-	-	-
6-84	GREENWATER VALLEY	59,900	C	-	-	-	-	-	-	-
6-85	GOLD VALLEY	3,220	C	-	-	-	-	-	-	-
6-86	RHODES HILL AREA	15,600	C	-	-	-	-	-	-	-
6-88	OWL LAKE VALLEY	22,300	C	-	-	-	-	-	-	-
6-89	KANE WASH AREA	5,960	C	60	-	-	-	-	-	-
6-90	CADY FAULT AREA	7,960	C	-	-	-	-	-	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

Colorado River Hydrologic Region

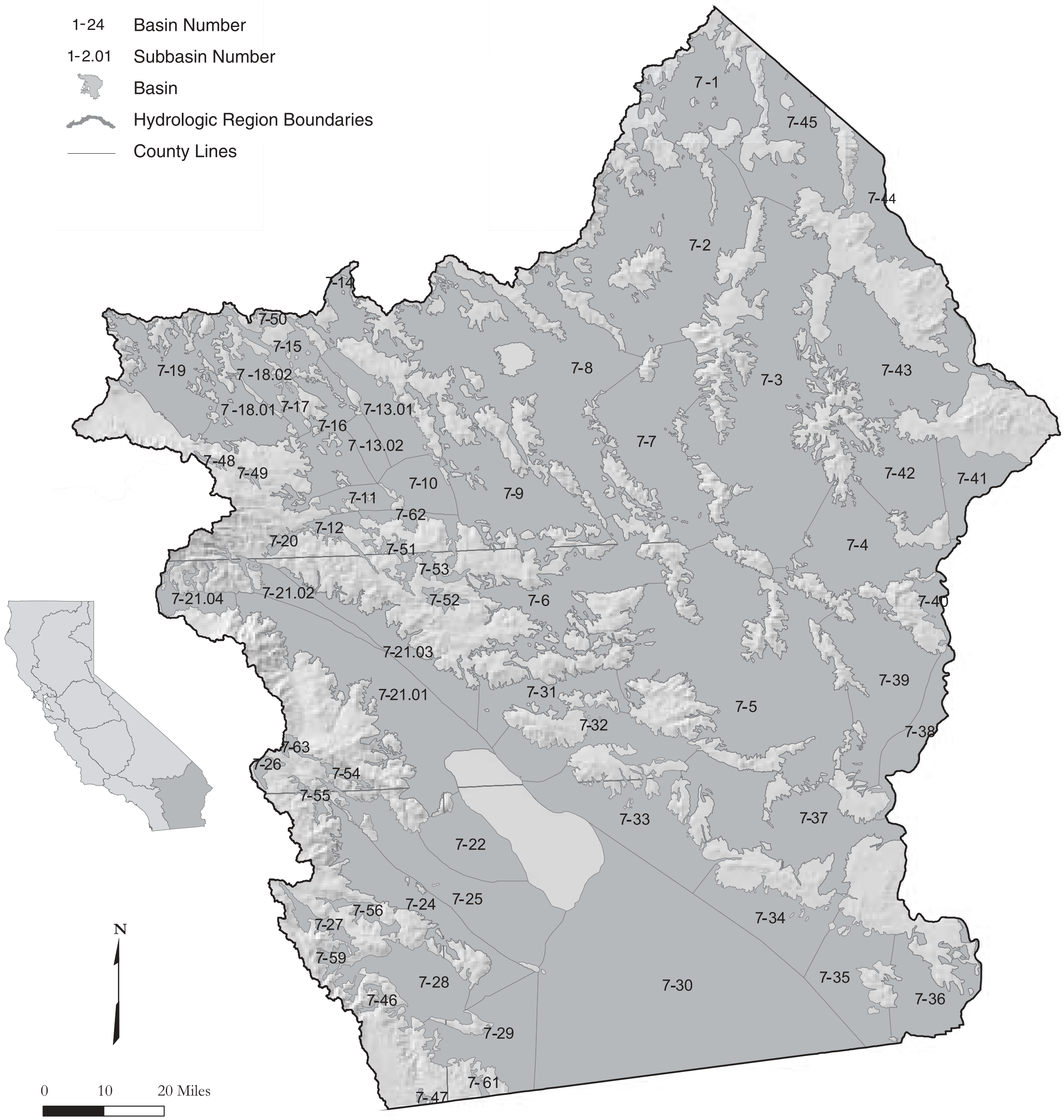

Figure 43 Colorado River Hydrologic Region

Basins and Subbasins of Colorado River Hydrologic Region

Basin/subbasin		Basin name
7-1		Lanfair Valley
7-2		Fenner Valley
7-3		Ward Valley
7-4		Rice Valley
7-5		Chuckwalla Valley
7-6		Pinto Valley
7-7		Cadiz Valley
7-8		Bristol Valley
7-9		Dale Valley
7-10		Twentynine Palms Valley
7-11		Copper Mountain Valley
7-12		Warren Valley
7-13		Deadman Valley
	7-13.01	Deadman Lake
	7-13.02	Surprise Spring
7-14		Lavic Valley
7-15		Bessemer Valley
7-16		Ames Valley
7-17		Means Valley
7-18		Johnson Valley Area
	7-18.01	Soggy Lake
	7-18.02	Upper Johnson Valley
7-19		Lucerne Valley
7-20		Morongo Valley
7-21		Coachella Valley
	7-21.01	Indio
	7-21.02	Mission Creek
	7-21.03	Desert Hot Springs
	7-21.04	San Gorgonio Pass
7-22		West Salton Sea
7-24		Borrego Valley
7-25		Ocotillo-Clark Valley
7-26		Terwilliger Valley
7-27		San Felipe Valley
7-28		Vallecito-Carrizo Valley
7-29		Coyote Wells Valley
7-30		Imperial Valley
7-31		Orocopia Valley
7-32		Chocolate Valley
7-33		East Salton Sea
7-34		Amos Valley
7-35		Ogilby Valley
7-36		Yuma Valley
7-37		Arroyo Seco Valley
7-38		Palo Verde Valley
7-39		Palo Verde Mesa
7-40		Quien Sabe Point Valley
7-41		Calzona Valley
7-42		Vidal Valley
7-43		Chemehuevi Valley
7-44		Needles Valley
7-45		Piute Valley
7-46		Canebrake Valley
7-47		Jacumba Valley
7-48		Helendale Fault Valley
7-49		Pipes Canyon Fault Valley
7-50		Iron Ridge Area
7-51		Lost Horse Valley
7-52		Pleasant Valley
7-53		Hexie Mountain Area
7-54		Buck Ridge Fault Valley
7-55		Collins Valley
7-56		Yaqui Well Area
7-59		Mason Valley
7-61		Davies Valley
7-62		Joshua Tree
7-63		Vandeventer Flat

Description of the Region

The Colorado River HR covers approximately 13 million acres (20,000 square miles) in southeastern California. It is bounded on the east by Nevada and Arizona, the south by the Republic of Mexico, the west by the Laguna, San Jacinto, and San Bernardino mountains, and the north by the New York, Providence, Granite, Old Dad, Bristol, Rodman, and Ord Mountain ranges. An average annual precipitation of 5.5 inches and average annual runoff of only 200,000 acre-feet makes this the most arid HR of California (DWR 1994). Surface runoff drains to many closed basins or to the Colorado River.

This HR includes all of Imperial, most of Riverside, much of San Bernardino, and part of San Diego counties (Figure 43). Many of the alluvial valleys in the region are underlain by groundwater aquifers that are the sole source of water for local communities.

About 533,000 people live within the Colorado River HR (DWR, 1998). The largest population centers are Palm Springs, Palm Desert, Indio, Coachella, and El Centro.

Groundwater Development

The earliest groundwater development in California may have been prehistoric water wells dug by the Cahuilla Indians in Coachella Valley of the Colorado River HR. In this report, 64 groundwater basins/subbasins are delineated in this HR. The Deadman Valley, Johnson Valley Area, and Coachella Valley groundwater basins have been divided into subbasins. Groundwater basins underlie about 8.68 million acres or about 26 percent of this HR.

In the Colorado River HR, groundwater provides about 8 percent of the water supply in normal years for agricultural and urban uses (DWR 1998). In most smaller basins, groundwater is found in unconfined alluvial aquifers. In some of the larger basins, particularly near dry lakes, aquifers may be separated by aquitards that create confined groundwater conditions. Depths of basins range from tens or hundreds of feet in smaller basins and along arms of ephemeral rivers to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this region depending on aquifer characteristics and well location, size, and use. Some aquifers are capable of yielding thousands of gallons per minute to municipal wells.

Conjunctive use of surface water and groundwater is a long-standing practice in the region. Water is imported from the Colorado River for irrigation in Imperial, Coachella, and Palo Verde Valleys and from groundwater recharge in Coachella Valley. Water imported from Northern California is used to replenish Warren and Joshua Tree groundwater basins. Many agencies have erected systems of barriers to allow more efficient percolation of ephemeral runoff from surrounding mountains. The concept of utilizing groundwater basins in this sparsely populated HR for storing water that would be pumped during drought years is getting much attention.

Groundwater Quality

The chemical character of groundwater in the Colorado River HR is variable. Cation concentration is dominated by sodium with calcium common and magnesium appearing less often. Bicarbonate is usually the dominant anion, although sulfate and chloride waters are also common. In basins with closed drainages, water character often changes from calcium-sodium bicarbonate near the margins to sodium chloride or chloride-sulfate beneath a dry lake. It is not uncommon for concentrations of dissolved constituents to rise dramatically toward a dry lake where saturation of mineral salts is reached. An example of this is found at Bristol Valley Groundwater Basin, where the mineral halite (sodium chloride) is formed and then mined by evaporation of groundwater in trenches in Bristol (dry) Lake. The TDS content of groundwater is high in many of the basins in this region. High fluoride content is common; sulfate content occasionally exceeds drinking water standards; and high nitrate content is common, especially in agricultural areas.

Two of the primary challenges in the Colorado River HR are overdraft in the Coachella Valley and leaking underground storage tanks. The EPA has not yet placed any contamination sites in this HR on the Superfund National Priorities List; however, one site is under consideration because of high pesticide levels.

Water Quality in Public Supply Wells

From 1994 through 2000, 314 public supply water wells were sampled in 23 of the 64 basins and subbasins in the Colorado River HR. Analyzed samples indicate that 270 wells, or 86 percent, met the state primary MCLs for drinking water standards. Forty-four wells, or 14 percent, have constituents that exceed one or more MCL. Figure 44 shows the percentages of each contaminant group that exceeded MCLs in the 44 wells.

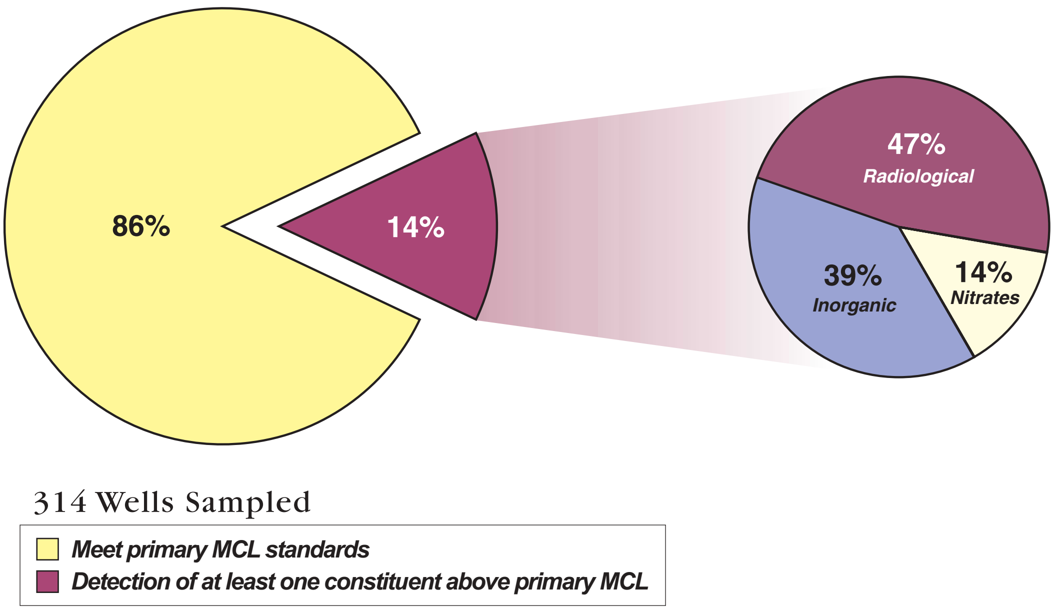

Figure 44 MCL exceedances in public supply wells in the Colorado River Hydrologic Region

Table 39 lists the three most frequently occurring contaminants in each contaminant group and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 39 Most frequently occurring contaminants by contaminant group in the Colorado River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 17		
Inorganics – Secondary	Iron – 38	Manganese – 26	TDS – 5
Radiological	Radium 228 – 3	Combined RA226 + RA228 – 3	Radium 226 – 1
Nitrates	Nitrate (as NO_3) – 6	Nitrate + Nitrite – 1	

Changes from Bulletin 118-80

Several modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report (Table 40). Jacumba Valley East Groundwater Basin (7-60) has been deleted because of lack of information about groundwater in this basin. The Pinyon Wash Area (7-57) and Whale Peak Area (7-58) groundwater basin names have been deleted because they are now incorporated into other larger basins. Similarly, Clark Valley (7-23) and Ocotillo Valley (7-25) groundwater basins are now the combined Ocotillo-Clark Valley Groundwater Basin (7-25). The Deadman Valley (7-13), Johnson Valley Area (7-18), and Coachella Valley (7-21) groundwater basins have been subdivided into subbasins in this report. The western boundary of Lucerne Valley Groundwater Basin (7-19) has been moved eastward from the HR boundary to the Helendale fault. Groundwater level elevations indicate that this fault is a groundwater barrier and that groundwater flows westward back under the surface divide into the Upper Mojave River Groundwater Basin (6-42). The boundary between Lucerne Valley (7-19) and Johnson Valley Area (7-18) groundwater basins is delineated in this report.

The boundaries of Twentynine Palms Valley (7-10), Copper Mountain Valley (7-11), Warren Valley (7-12), Deadman Lake (7-13), and Ames Valley (7-16) groundwater basins have been redrawn in light of newer groundwater level data. These data indicate that the Pinto Mountain fault is a groundwater barrier. Joshua Tree Groundwater Basin (7-62) is a new basin that has been delineated from parts of Copper Mountain Valley and Twentynine Palms Valley Groundwater Basins because the Pinto Mountain fault is such a strong barrier. Buck Ridge Fault Valley Groundwater Basin (7-54) was presented in Bulletin 118-80 as two unconnected deposits of water-bearing alluvium separated by outcrop of nonwater-bearing rocks. These water-bearing deposits have been designated as separate groundwater basins in this report, with the Buck Ridge Fault Valley Groundwater Basin (7-54) as the northern basin and Vandeventer Flat Groundwater Basin (7-63) presented as the southern basin.

Table 40 Modifications since Bulletin 118-80 of groundwater basins in Colorado River Hydrologic Region

Basin name	New number	Old number
Clark Valley	Delete – combined with 7-25	7-23
Ocotillo-Clark Valley	7-25 (now combined)	7-25
Pinyon Wash Area	Incorporated into 7-56	7-57
Whale Peak Area	Incorporated into 7-28	7-58
Jacumba Valley East	Deleted	7-60
Joshua Tree	7-62 (new)	
Vandeventer Flat	7-63 (new)	

Table 41 Colorado River Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
7-1	LANFAIR VALLEY	157,000	C	70	16	-	-	9	515	173-2,260
7-2	FENNER VALLEY	454,000	A	200	100	-	-	4	515	173-2,260
7-3	WARD VALLEY	961,000	A	260	180	-	-	1	-	327-589
7-4	RICE VALLEY	189,000	C	65	-	-	-	-	-	-
7-5	CHUCKWALLA VALLEY	604,000	C	3,900	1,800	12	-	10	-	424
7-6	PINTO VALLEY	183,000	A	1,480	900	-	-	1	-	-
7-7	CADIZ VALLEY	270,000	C	167	66	-	-	-	400	300-3000
7-8	BRISTOL VALLEY	498,000	A	3,000	-	-	-	-		300-298,000
7-9	DALE VALLEY	213,000	C	380	275	-	-	2	-	-
7-10	TWENTYNINE PALMS VALLEY	62,400	C	3,000	540	27	-	2	640	-
7-11	COPPER MOUNTAIN VALLEY	30,300	A	2,450	250	2	-	2	-	180-214
7-12	WARREN VALLEY	17,200	A	4,000	350	27	18	17	196	129-269
7-13	DEADMAN VALLEY									
7-13.01	DEADMAN LAKE	89,200	C	2,000	-	28	3	1	-	311-985
7-13.02	SURPRISE SPRING	29,300	C	1,370	680	26	6	9	177	141-1,050
7-14	LAVIC VALLEY	102,000	C	140	80	-	-	-	-	-
7-15	BESSEMER VALLEY	39,100	C	0	-	-	-	-	-	-
7-16	AMES VALLEY	110,000	C	2,000	-	19	3	11	459	-
7-17	MEANS VALLEY	15,000	C	0	-	1	-	-	-	-
7-18	JOHNSON VALLEY AREA									
7-18.01	SOGGY LAKE	76,800	C	-	-	6	-	1	-	300-2,000
7-18.02	UPPER JOHNSON VALLEY	34,800	C	-	-	-	-	-	-	3,000
7-19	LUCERNE VALLEY	148,000	A	1,000	-	22	9	21	301	200-5,000
7-20	MORONGO VALLEY	7,240	C	600	90	-	-	5	-	-
7-21	COACHELLA VALLEY									
7-21.01	INDIO	336,000	A	1,880	650	30	-	204	300	-
7-21.02	MISSION CREEK	49,000	A	3,500	715	5	-	15	<500	-
7-21.03	DESERT HOT SPRINGS	101,000	C	2,500	985	10	-	2	-	800-1,000
7-21.04	SAN GORGONIO PASS	38,700	A	1,000	0	17	8	5	-	106-205
7-22	WEST SALTON SEA	106,000	C	540	400	v	-	-	-	-
7-24	BORREGO VALLEY	153,000	A	2,000	0	10	10	25	-	300-2,440
7-25	OCOTILLO-CLARK VALLEY	223,000	C	3,500	1,760	1	-	2	-	-
7-26	TERWILLIGER VALLEY	8,030	C	100	-	-	-	1	-	500
7-27	SAN FELIPE VALLEY	2,340	C	500	30	-	-	1	-	-
7-28	VALLECITO-CARRIZO VALLEY	122,000	C	2,500	260	-	-	1	-	-
7-29	COYOTE WELLS VALLEY	146,000	A	-	-	25	6	9	-	-
7-30	IMPERIAL VALLEY	961,000	A	1,000	-	19	-	45	1088	498-7,280
7-31	OROCOPIA VALLEY	96,500	A	210	165	0	-	1	-	-
7-32	CHOCOLATE VALLEY	130,000	C	0	0	0	-	-	-	-
7-33	EAST SALTON SEA	196,000	C	0	0	1	-	4	-	-
7-34	AMOS VALLEY	130,000	C	100	50	3	-	1	-	-
7-35	OGILBY VALLEY	134,000	C	4,000	50	27	1	3	-	-

EEC ORIGINAL PKG

Table 41 Colorado River Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
7-36	YUMA VALLEY	3,780	C	100	40	59	0	15	-	-
7-37	ARROYO SECO VALLEY	258,000	C	-	-	2	0	0	-	-
7-38	PALO VERDE VALLEY	73,400	A	-	-	11	-	19	840	658-1,030
7-39	PALO VERDE MESA	226,000	C	2,750	1,650	20	-	13	-	-
7-40	QUIEN SABE POINT VALLEY	25,300	C	25	-	-	-	3	-	-
7-41	CALZONA VALLEY	81,000	C	2,340	500	0	0	0	-	
7-42	VIDAL VALLEY	138,000	C	1,800	675	-	-	1	-	-
7-43	CHEMEHUEVI VALLEY	273,000	A	0	0	1	0	1	-	-
7-44	NEEDLES VALLEY	88,400	A	1,500	980	34	-	11	-	-
7-45	PIUTE VALLEY	176,000	C	1,500	200	-	-	-	-	-
7-46	CANEBRAKE VALLEY	5,420	C	125	-	-	-	-	-	-
7-47	JACUMBA VALLEY	2,450	A	1,000	-	-	-	3		296-6,100
7-48	HELENDALE FAULT VALLEY	2,620	C	-	-	-	-	-	-	-
7-49	PIPES CANYON FAULT VALLEY	3,390	C	-	-	-	-	-	-	-
7-50	IRON RIDGE AREA	5,250	C	-	-	-	-	-	-	-
7-51	LOST HORSE VALLEY	17,300	C	-	-	-	-	-	-	-
7-52	PLEASANT VALLEY	9,670	C	-	-	-	-	-	-	-
7-53	HEXIE MOUNTAIN AREA	11,200	C	-	-	-	-	-	-	-
7-54	BUCK RIDGE FAULT VALLEY	6,930	C	-	-	-	-	-	-	-
7-55	COLLINS VALLEY	7,080	C	1,500	-	-	-	-	-	-
7-56	YAQUI WELL AREA	15,000	C	0	-	-	-	1	-	-
7-59	MASON VALLEY	5,530	C	0	0	0	0	1	-	-
7-61	DAVIES VALLEY	3,570	C	0	0	0	0	-	-	-
7-62	JOSHUA TREE	33,800	A	2,200	1,110	25	5	14	180	117-185
7-63	VANDEVENTER FLAT	6,750	C	50	17	-	-	-	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

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Glossary

Glossary

A

acre-foot (af) The volume of water necessary to cover one acre to a depth of one foot; equal to 43,560 cubic feet or 325,851 gallons.

adjudication A case that has been heard and decided by a judge. In the context of an adjudicated groundwater basin, landowners or other parties have turned to the courts to settle disputes over how much groundwater can be extracted by each party to the decision.

alluvial Of or pertaining to or composed of alluvium.

alluvium A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material, deposited during comparatively recent geologic time by a stream or other body of running water, as a sorted or semi sorted sediment in the bed of the stream or on it's floodplain or delta, as a cone or fan at the base of a mountain slope**.**

anthropogenic Of human origin or resulting from human activity.

appropriative right The right to use water that is diverted or extracted by a nonriparian or nonoverlying party for nonriparian or nonoverlying uses. In California, surface water appropriative rights are subject to a statutory permitting process while groundwater appropriation is not.

aquitard A confining bed and/or formation composed of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer. It does not readily yield water to wells or springs, but stores ground water.

aquifer A body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs.

aridity A term describing a climate or region in which precipitation is so deficient in quantity or occurs so infrequently that intensive agricultural production is not possible without irrigation.

artesian aquifer A body of rock or sediment containing groundwater that is under greater than hydrostatic pressure; that is, a confined aquifer. When an artesian aquifer is penetrated by a well, the water level will rise above the top of the aquifer.

artesian pressure Hydrostatic pressure of artesian water, often expressed in terms of pounds per square inch; or the height, in feet above the land surface, of a column of water that would be supported by the pressure.

artificial recharge The addition of water to a groundwater reservoir by human activity, such as putting surface water into dug or constructed spreading basins or injecting water through wells.

available groundwater storage capacity The volume of a groundwater basin that is unsaturated and capable of storing groundwater.

average annual runoff The average value of total annual runoff volume calculated for a selected period of record, at a specified location, such as a dam or stream gage.

average year water demand Demand for water under average hydrologic conditions for a defined level of development.

B

basin management objectives (BMOs) See management objectives

beneficial use **O**ne of many ways that water can be used either directly by people or for their overall benefit. The State Water Resources Control Board recognizes 23 types of beneficial use with water quality criteria for those uses established by the Regional Water Quality Control Boards.

borehole geophysics The general field of geophysics developed around the lowering of a variety of probes into a boring or well. Borehole logging provides additional information concerning physical, electrical, acoustic, nuclear and chemical aspects of the soils and rock encountered during drilling.

C

community water system A public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 year-long residents (DHS 2000).

confined aquifer An aquifer that is bounded above and below by formations of distinctly lower permeability than that of the aquifer itself. An aquifer containing confined ground water. See artesian aquifer.

conjunctive use The coordinated and planned management of both surface and groundwater resources in order to maximize the efficient use of the resource; that is, the planned and managed operation of a groundwater basin and a surface water storage system combined through a coordinated conveyance infrastructure. Water is stored in the groundwater basin for later and planned use by intentionally recharging the basin during years of above-average surface water supply.

contaminant Any substance or property preventing the use or reducing the usability of the water for ordinary purposes such as drinking, preparing food, bathing washing, recreation, and cooling. Any solute or cause of change in physical properties that renders water unfit for a given use. (Generally considered synonymous with pollutant).

critical conditions of overdraft A groundwater basin in which continuation of present practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts. The definition was created after an extensive public input process during the development of the Bulletin 118-80 report.

D

deep percolation Percolation of water through the ground and beyond the lower limit of the root zone of plants into groundwater.

desalination A process that converts seawater or brackish water to fresh water or an otherwise more usable condition through removal of dissolved solids.

domestic well A water well used to supply water for the domestic needs of an individual residence or systems of four or fewer service connections.

drinking water system See public water system

drought condition Hydrologic conditions during a defined period when rainfall and runoff are much less than average.

drought year supply The average annual supply of a water development system during a defined drought period.

E

electrical conductivity (EC) The measure of the ability of water to conduct an electrical current, the magnitude of which depends on the dissolved mineral content of the water.

effective porosity The volume of voids or open spaces in alluvium and rocks that is interconnected and can transmit fluids.

environmental water Water serving environmental purposes, including instream fishery flow needs, wild and scenic river flows, water needs of fresh-water wetlands, and Bay-Delta requirements.

evapotranspiration (ET) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces.

G

groundwater basin An alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom.

groundwater budget A numerical accounting, the *groundwater equation*, of the recharge, discharge and changes in storage of an aquifer, part of an aquifer, or a system of aquifers.

groundwater in storage The quantity of water in the zone of saturation.

groundwater management The planned and coordinated management of a groundwater basin or portion of a groundwater basin with a goal of long-term sustainability of the resource.

groundwater management plan A comprehensive written document developed for the purpose of groundwater management and adopted by an agency having appropriate legal or statutory authority.

groundwater mining The process, deliberate or inadvertent, of extracting groundwater from a source at a rate in excess of the replenishment rate such that the groundwater level declines persistently, threatening exhaustion of the supply or at least a decline of pumping levels to uneconomic depths.

groundwater monitoring network A series of monitoring wells at appropriate locations and depths to effectively cover the area of interest. Scale and density of monitoring wells is dependent on the size and complexity of the area of interest, and the objective of monitoring.

groundwater overdraft The condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions.

groundwater quality See water quality

groundwater recharge facility A structure that serves to conduct surface water into the ground for the purpose of replenishing groundwater. The facility may consist of dug or constructed spreading basins, pits, ditches, furrows, streambed modifications, or injection wells.

groundwater recharge The natural or intentional infiltration of surface water into the zone of saturation.

groundwater source area An area where groundwater may be found in economically retrievable quantities outside of normally defined groundwater basins, generally referring to areas of fractured bedrock in foothill and mountainous terrain where groundwater development is based on successful well penetration through interconnecting fracture systems. Well yields are generally lower in fractured bedrock than wells within groundwater basins.

groundwater storage capacity volume of void space that can be occupied by water in a given volume of a formation, aquifer, or groundwater basin.

groundwater subbasin A subdivision of a groundwater basin created by dividing the basin using geologic and hydrologic conditions or institutional boundaries.

groundwater table The upper surface of the zone of saturation in an unconfined aquifer.

groundwater Water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation in which it is situated. It excludes soil moisture, which refers to water held by capillary action in the upper unsaturated zones of soil or rock.

H

hazardous waste Waste that poses a present or potential danger to human beings or other organisms because it is toxic, flammable, radioactive, explosive or has some other property that produces substantial risk to life.

hydraulic barrier A barrier created by injecting fresh water to control seawater intrusion in an aquifer, or created by water injection to control migration of contaminants in an aquifer.

hydraulic conductivity A measure of the capacity for a rock or soil to transmit water; generally has the units of feet/day or cm/sec.

hydrograph A graph that shows some property of groundwater or surface water as a function of time.

hydrologic cycle The circulation of water from the ocean through the atmosphere to the land and ultimately back to the ocean.

hydrologic region A study area consisting of multiple planning subareas. California is divided into 10 hydrologic regions.

hydrostratigraphy A geologic framework consisting of a body of rock having considerable lateral extent and composing a reasonably distinct hydrologic system.

hyporheic zone The region of saturated sediments beneath and beside the active channel and that contain some proportion of surface water that was part of the flow in the surface channel and went back underground and can mix with groundwater.

I

infiltration The flow of water downward from the land surface into and through the upper soil layers.

infiltration capacity The maximum rate at which infiltration can occur under specific conditions of soil moisture.

in-lieu recharge The practice of providing surplus surface water to historic groundwater users, thereby leaving groundwater in storage for later use.

ISI Integrated Storage Investigations Program, an element of the CALFED Bay Delta initiative.

J

joint powers agreement (JPA) An agreement entered into by two or more public agencies that allows them to jointly exercise any power common to the contracting parties. The JPA is defined in Chapter 5 (commencing with Section 6500) of Division 7 of Title 1 of the California Government Code.

L

land subsidence The lowering of the natural land surface due to groundwater (or oil and gas) extraction.

leaky confining layer A low-permeability layer that can transmit water at sufficient rates to furnish some recharge from an adjacent aquifer to a well.

lithologic log A record of the lithology of the soils, sediments and/or rock encountered in a borehole from the surface to the bottom.

lithology The description of rocks, especially in hand specimen and in outcrop, on the basis of such characteristics as color, mineralogic composition, and grain size.

losing stream A stream or reach of a stream that is losing water by seepage into the ground.

M

management objectives Objectives that set forth the priorities and measurable criteria of local groundwater basin management. For example, one management objective could be to minimize degradation of groundwater quality with a criteria set that groundwater will not be degraded by more than 100 mg/l in terms of TDS.

maximum contaminant level (MCL) The highest drinking water contaminant concentration allowed under federal and State Safe Drinking Water Act regulations.

N

natural recharge Natural replenishment of an aquifer generally from snowmelt and runoff; through seepage from the surface.

nonpoint source Pollution discharged over a wide land area, not from one specific location. These are forms of diffuse pollution caused by sediment, nutrients, etc., carried to lakes and streams by surface runoff.

O

operational yield An optimal amount of groundwater that should be withdrawn from an aquifer system or a groundwater basin each year. It is a dynamic quantity that must be determined from a set of alternative groundwater management decisions subject to goals, objectives, and constraints of the management plan.

ordinance A law set forth by a governmental authority.

overdraft See groundwater overdraft

overlying right Property owners above a common aquifer possess a mutual right to the reasonable and beneficial use of a groundwater resource on land overlying the aquifer from which the water is taken. Overlying rights are correlative (related to each other) and overlying users of a common water source must share the resource on a pro rata basis in times of shortage. A proper overlying use takes precedence over all non-overlying uses.

P

perched groundwater Groundwater supported by a zone of material of low permeability located above an underlying main body of groundwater.

perennial yield The maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time (during which water supply conditions approximate average conditions) without developing an overdraft condition.

perforated interval The depth interval where slotted casing or screen is placed in a well to allow entry of water from the aquifer formation.

permeability The capability of soil or other geologic formations to transmit water. See hydraulic conductivity.

pesticide Any of a class of chemicals used for killing insects, weeds or other undesirable entities. Most commonly associated with agricultural activities, but has significant domestic use in California.

point source A specific site from which wastewater or polluted water is discharged into a water body.

pollution (of water) The alteration of the physical, chemical, or biological properties of water by the introduction of any substance into water that adversely affects any beneficial use of water.

porosity The ratio of the voids or open spaces in alluvium and rocks to the total volume of the alluvium or rock mass.

possible contaminating activity (PCA) Human activities that are actual or potential origins of contamination for a drinking water source. PCAs include sources of both microbiological and chemical contaminants that could have an adverse effect upon human health (DHS 2000).

potentiometric surface The surface to which the water in a confined aquifer will rise in a tightly cased well.

prescriptive right rights obtained through the open and notorious adverse use of another's water rights. By definition, adverse use is not use of a surplus, but the use of non-surplus water to the direct detriment of the original rights holder.

primary porosity Voids or open spaces that were present when alluvium and rocks were originally deposited or formed.

public supply well A well used as a part of a public water system.

public water system A system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. (DHS 2000).

pueblo right A water right possessed by a municipality which, as a successor of a Spanish or Mexican pueblo, entitled to the beneficial use of all needed, naturally-occurring surface and groundwater of the original pueblo watershed Pueblo rights are paramount to all other claims.

R

recharge Water added to an aquifer or the process of adding water to an aquifer. Ground water recharge occurs either naturally as the net gain from precipitation, or artificially as the result of human influence. See artificial recharge.

recharge basin A surface facility constructed to infiltrate surface water into a groundwater basin.

riparian right A right to use surface water, such right derived from the fact that the land in question abuts upon the banks of streams.

runoff The volume of surface flow from an area.

S

safe yield The maximum quantity of water that can be continuously withdrawn from a groundwater basin without adverse effect.

salinity Generally, the concentration of mineral salts dissolved in water. Salinity may be expressed in terms of a concentration or as electrical conductivity. When describing salinity influenced by seawater, salinity often refers to the concentration of chlorides in the water. See also total dissolved solids.

saline intrusion The movement of salt water into a body of fresh water. It can occur in either surface water or groundwater bodies.

saturated zone The zone in which all interconnected openings are filled with water, usually underlying the unsaturated zone.

seawater intrusion barrier A system designed to retard, cease or repel the advancement of seawater intrusion into potable groundwater supplies along coastal portions of California. The system may be a series of specifically placed injection wells where water is injected to form a hydraulic barrier.

secondary porosity Voids in a rock formed after the rock has been deposited; not formed with the genesis of the rock, but later due to other processes. Fractures in granite and caverns in limestone are examples of secondary openings.

seepage The gradual movement of water into, through or from a porous medium. Also the loss of water by infiltration into the soil from a canal, ditches, laterals, watercourse, reservoir, storage facilities, or other body of water, or from a field.

semi-confined aquifer A semi-confined aquifer or leaky confined aquifer is an aquifer that has aquitards either above or below that allow water to leak into or out of the aquifer depending on the direction of the hydraulic gradient.

service area The geographic area served by a water agency.

specific conductance See electrical conductivity

specific retention The ratio of the volume of water a rock or sediment will retain against the pull of gravity to the total volume of the rock or sediment.

specific yield the ratio of the volume of water a rock or soil will yield by gravity drainage to the total volume of the rock or soil.

spring a location where groundwater flows naturally to the land surface or a surface water body.

stakeholders Any individual or organization that has an interest in water management activities. In the broadest sense, everyone is a stakeholder, because water sustains life. Water resources stakeholders are typically those involved in protecting, supplying, or using water for any purpose, including environmental uses, who have a vested interest in a water-related decision.

stratigraphy The science of rocks. It is concerned with the original succession and age relations of rock strata and their form, distribution, lithologic composition, fossil content, geophysical and geochemical properties—all characters and attributes of rocks as strata—and their interpretation in terms of environment and mode of origin and geologic history.

subsidence See land subsidence

subterranean stream Subterranean streams "flowing through known and definite channels" are regulated by California's surface water rights system.

surface supply Water supply obtained from streams, lakes, and reservoirs.

sustainability Of, relating to, or being a method of using a resource so that the resource is not depleted or permanently damaged.

T

total dissolved solids (TDS) a quantitative measure of the residual minerals dissolved in water that remain after evaporation of a solution. Usually expressed in milligrams per liter. See also salinity

toxic Poisonous, relating to or caused by a poison. Toxicity is determined for individual contaminants or for mixtures of contaminants as found in waste discharges.

transmissivity The product of hydraulic conductivity and aquifer thickness; a measure of a volume of water to move through an aquifer. Transmissivity generally has the units of ft^2/day or gallons per day/foot. Transmissivity is a measure of the subsurface's ability to transmit groundwater horizontally through its entire saturated thickness and affects the potential yield of wells.

transpiration An essential physiological process in which plant tissues give off water vapor to the atmosphere.

U

unconfined aquifer An aquifer which is not bounded on top by an aquitard. The upper surface of an unconfined aquifer is the water table.

underground stream Body of water flowing as a definite current in a distinct channel below the surface of the ground, usually in an area characterized by joints or fissures. Application of the term to ordinary aquifers is incorrect.

unsaturated zone The zone below the land surface in which pore space contains both water and air.

urban water management plan (UWMP) An UWMP is required for all urban water suppliers having more than 3,000 connections or supplying more than 3,000 acre-feet of water. The plans include discussions on water supply, supply reliability, water use, water conservation, and water shortage contingency and serve to assist urban water suppliers with their long-term water resources planning to ensure adequate water supplies for existing and future demands.

usable storage capacity The quantity of groundwater of acceptable quality that can be economically withdrawn from storage.

V

vadose zone See unsaturated zone

volatile organic compound (VOC) A manmade organic compound that readily vaporizes in the atmosphere. These compounds are often highly mobile in the groundwater system and are generally associated with industrial activities.

W

water quality Description of the chemical, physical, and biological characteristics of water, usually in regard to its suitability for a particular purpose or use.

water table See groundwater table

water year A continuous 12-month period for which hydrologic records are compiled and summarized. Different agencies may use different calendar periods for their water years.

watershed The land area from which water drains into a stream, river, or reservoir.

well completion report A required, confidential report detailing the construction, alteration, abandonment, or destruction of any water well, cathodic protection well, groundwater monitoring well, or geothermal heat exchange well. The reports were called *Water Well Drillers' Report* prior to 1991 and are often referred to as "driller's logs." The report requirements are described in the California Water Code commencing with Section 13750.

WQCP Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta Estuary.

Metric Conversions

Quantity	To Convert from Metric Unit	To Customary Unit	Multiply Metric Unit By	To Convert to Metric Unit Multiply Customary Unit By
Length	millimeters (mm)	inches (in)	0.03937	25.4
	centimeters (cm) for snow depth	inches (in)	0.3937	2.54
	meters (m)	feet (ft)	3.2808	0.3048
	kilometers (km)	miles (mi)	0.62139	1.6093
Area	square millimeters (mm^2)	square inches (in^2)	0.00155	645.16
	square meters (m^2)	square feet (ft^2)	10.764	0.092903
	hectares (ha)	acres (ac)	2.4710	0.40469
	square kilometers (km^2)	square miles (mi^2)	0.3861	2.590
Volume	liters (L)	gallons (gal)	0.26417	3.7854
	megaliters	million gallons (10*)	0.26417	3.7854
	cubic meters (m^3)	cubic feet (ft^3)	36.315	0.028317
	cubic meters (m^3)	cubic yards (yd^3)	1.308	0.76455
	cubic dekameters (dam^3)	acre-feet (ac-ft)	0.8107	1.2335
Flow	cubic meters per second (m^3/s)	cubic feet per second (ft^3/s)	35.315	0.028317
	liters per minute (L/mn)	gallons per minute (gal/mn)	0.26417	3.7854
	liters per day (L/day)	gallons per day (gal/day)	0.26417	3.7854
	megaliters per day (ML/day)	million gallons per day (mgd)	0.26417	3.7854
	cubic dekameters per day (dam^3/day)	acre-feet per day (ac-ft/day)	0.8107	1.2335
Mass	kilograms (kg)	pounds (lbs)	2.2046	0.45359
	megagrams (Mg)	tons (short, 2,000 lb.)	1.1023	0.90718
Velocity	meters per second (m/s)	feet per second (ft/s)	3.2808	0.3048
Power	kilowatts (k/W)	horsepower (hp)	1.3405	0.746
Pressure	kilopascals (kPa)	pounds per square inch (psi)	0.14505	6.8948
	kilopascals (kPa)	feet head of water	0.32456	2.989
Specific Capacity	liters per minute per meter drawdown	gallons per minute per foot drawdown	0.08052	12.419
Concentration	milligrams per liter (mg/L)	parts per million (ppm)	1.0	1.0
Electrical Conductivity	microsiemens per centimeter (µS/cm)	micromhos per centimeter	1.0	1.0
Temperature	degrees Celsius (°C)	degrees Fahrenheit (°F)	(1.8X°C)+32	0.56(°F-32)

Appendices

Appendix A
Obtaining Copies of Supplemental Material

Bulletin 118 Update 2003 includes this report and supplemental material consisting of individual basin descriptions and a GIS-compatible map of each of the delineated groundwater basins in California. The supplemental material will be updated as new information becomes available and can be viewed or downloaded at http://www.waterplan.water.ca.gov/groundwater/118index.htm

Appendix B
The Right to Use Groundwater in California

California does not have a statewide management program or statutory permitting system for groundwater. Some local agencies have adopted groundwater ordinances under their police powers, or have adopted groundwater management programs under a variety of statutory authorities.

Prior to a discussion of groundwater management, it is helpful to understand some of the laws governing the right to use groundwater in California. When the Water Commission Act of 1913 (Stats. 1913, Ch. 586) became effective in 1914, appropriative surface water rights became subject to a statutory permitting process. This appropriation procedure can be found in Water Code Section 1200 *et seq*. Groundwater classified as underflow of a surface stream, a "subterranean stream flowing through a known and definite channel," was made subject to the State permit system. However, most groundwater in California is presumed to be "percolating water," that is, water in underground basins and groundwater which has escaped from streams. This percolating water is not subject to a permitting process. As a result, most of the body of law governing groundwater use in California today has evolved through a series of court decisions beginning in the early 20th century. Key cases are listed in Table B-1, and some of the most significant are discussed below.

Table B-1 Significant court cases related to the right to use groundwater in California

Case	Issues addressed
Katz v. Walkinshaw, 141 Cal. 116 (1903)	Established Correlative Rights Doctrine. Correlative rights of overlying users, and surplus supply available for appropriation among non-overlying users.
Peabody v. City of Vallejo, 2 Cal. 2d 351 (1935)	Limited riparian rights under the reasonable and beneficial use requirement of the 1928 constitutional amendment; requirement of reasonable and beneficial use.
Pasadena v. Alhambra, 33 Cal. 2d 908 (1949)	First basin adjudication in California; established Doctrine of Mutual Prescription.
Niles Sand and Gravel Co. v. Alameda County Water District, 37 Cal. App. 3d 924 (1974)	Established right to store water underground as a servitude.
Techachapi-Cummings County Water District v. Armstrong, 49 Cal. App. 3d 992 (1975)	Modified the Mutual Prescription Doctrine articulated in Pasadena v. Alhambra. Overlying owners' water rights must be quantified on the basis of current, reasonable and beneficial need, not past use. By analogy to riparian rights, factors to be considered include: the amount of water available, the extent of ownership in the basin, and the nature of projected use.
Los Angeles v. San Fernando, 14 Cal. 3d 199 (1975)	Significantly modified Mutual Prescription Doctrine by disallowing it against public entities (Civil Code section 1007); established pueblo right above overlying owner right; established right to store imported water underground and recapture when needed above the right of overlying landowner.
Wright v. Goleta Water District, 174 Cal. App. 3d 74 (1985)	The unexercised water rights of overlying owners are protected from appropriators; notice and opportunity must be given to overlying owners to resist any interference with their rights.
Hi-Desert County Water District v. Blue Skies Country Club,	Retention of overlying right; no acquisition of prescriptive right by 23 Cal. App. 4th 1723 (1994) overlying owner.
Baldwin v. Tehama County, 31 Cal. App. 4th 166 (1994)	City and County regulation of groundwater through police power. County limitations on export upheld.
City of Barstow v. Mojave Water Agency,	Held that in considering a stipulated physical solution 23 Cal. 4th 1224 (2000) involving equitable apportionment, court must consider correlativerights of parties that did not join the stipulation.

This table modified from Bachman and others 1997

Katz v. Walkinshaw (141 Cal. 116)

In the 1903 decision, *Katz v. Walkinshaw*, the California Supreme Court rejected the English Common Law doctrine of groundwater rights and established the Doctrine of Correlative Rights. Prior to the *Katz* decision, California had followed the doctrine articulated in the 1843 English decision of *Acton v. Blundell* (12 M. & W. 324, 152 Eng. Rep. 1223), which established that landowners enjoyed absolute ownership of groundwater underneath their property. The 1903 decision rejected the English Common Law approach as unsuitable for the "natural conditions" in California, and instead established the Correlative Rights Doctrine analogous to a riparian right. Each overlying landowner was entitled to make reasonable beneficial use of groundwater with a priority equal to all other overlying users. Water in excess of the needs of the overlying owners could be pumped and used on nonoverlying lands on a first-in-time, first-in-right basis under what is known as an appropriative right. An appropriative groundwater right, unlike its surface water counterpart, is not subject to a permitting process. Where overlying owners made full use of available supplies, appropriative rights were extinguished. Where there was insufficient water to meet even the needs of the overlying owners, the court applied the Correlative Rights Doctrine to apportion the available groundwater among the overlying landowners. Figure B-1 depicts the rights to use groundwater established in *Katz v. Walkinshaw*.

City of Pasadena v. City of Alhambra (33 Cal. 2d 908)

The 1949 decision, *Pasadena v. Alhambra*, added significant complexity to the right to use groundwater in California. This decision, involving the adjudication of the Raymond Basin, established the doctrine of mutual prescription. Groundwater levels in the basin had been declining for many years by the time court action was initiated. Most substantial pumpers, both overlying and appropriators, were joined in the action. Previously, appropriators only had a right to water surplus to the needs of overlying users. However, based upon a stipulation by most of the parties, the court in *Pasadena* adopted a program of proportionate reductions. These appropriators had each effectively gained a prescriptive right, similar to that of surface water rights, in which they had taken the water in an open, notorious, and hostile manner for at least five years. Mutual prescription provided groundwater rights to both overlying users and appropriators in depleted groundwater basins by prorating their rights based on the highest continuous amount of pumping during the five years following commencement of the overdraft. All of the users in the Raymond Basin were thus entitled to extract their portion of the court-approved safe yield of the basin.

City of Los Angeles v. City of San Fernando (14 Cal. 3d 199)

In 1975, in *Los Angeles v. San Fernando*, the California Supreme Court significantly limited the Mutual Prescription Doctrine introduced in Pasadena v. Alhambra. This opinion had far-reaching impacts on both the right to use groundwater and the practice of conjunctive use of groundwater and surface water to manage a basin. The case began in 1955, when the City of Los Angeles sued the cities of San Fernando, Glendale, Burbank and other pumpers, asserting a prior right to the San Fernando Valley groundwater basins in the northern part of the City of Los Angeles. The court, relying on Civil Code Section 1007, held that public agencies and public utilities cannot lose their groundwater rights by prescription. This holding effectively ruled out any future "mutual prescription" settlements or judgments involving rights held by public entities.

With respect to the native water supply of the San Fernando Basin, the court found that the City of Los Angeles had prior rights to all of this supply pursuant to its "pueblo right." Pueblo rights are traceable to rights recognized by the Spanish crown and the Mexican government. Under the Spanish/Mexican system, water rights were held in trust by pueblos for the benefit of all of its inhabitants. Under the Treaty of Guadalupe Hidalgo executed by Mexico and the United States in 1848, the municipal successors to Spanish/Mexican pueblos retained their pueblo rights upon the cession of California. In the San Fernando decision, the court confirmed Los Angeles' pueblo right, finding it superior to the rights of all overlying landowners. While a pueblo right is rare, it is an example of the complexity of the rights to use groundwater in California.

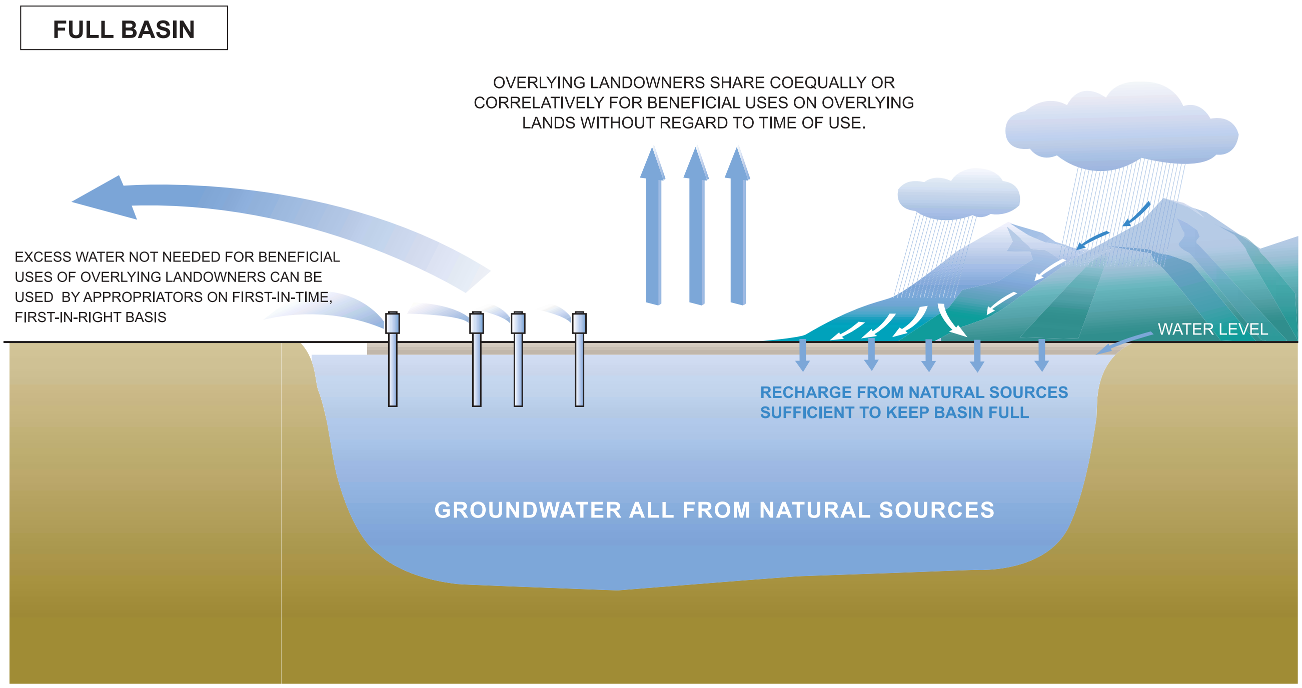

Figure B-1 Rights to groundwater use in full basin established in Katz v. Walkinshaw

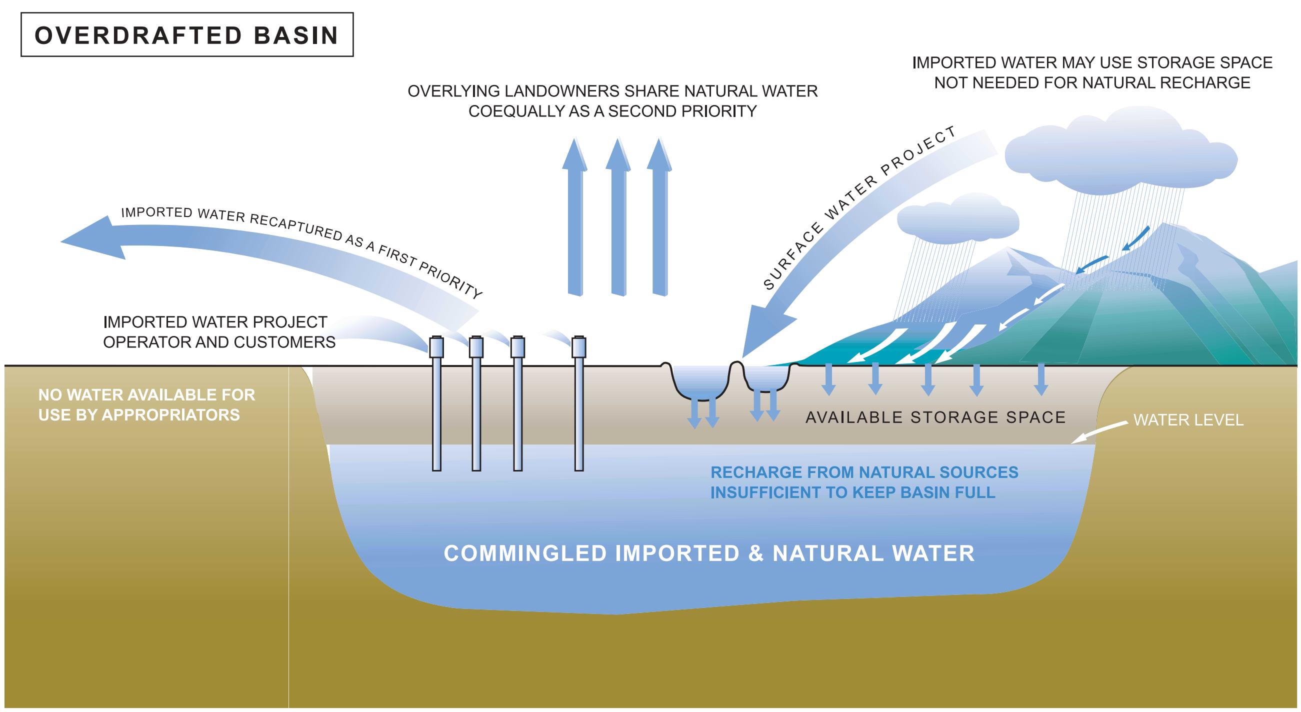

Figure B-2 Rights to groundwater use in overdrafted basin established in Los Angeles v. San Fernando

For the future of conjunctive use of groundwater basins, the court's holding with respect to the rights to available storage space in the Basin is significant. The court upheld the right of public agencies – namely the cities of San Fernando, Los Angeles, Burbank, and Glendale–to recapture the imported water they added to the Basin. The court held that the rights of the respective public agencies to recover such imported water are of equal priority to the City of Los Angeles' pueblo right, and that all such public agency rights are "prior to the rights dependent on ownership of overlying land or based solely upon appropriation of groundwater from the basin." The court remanded the case, directing the trial court to apportion the safe yield of the Basin accordingly.

The court noted that there did not appear to be any shortage of underground storage space in relation to the demand and, hence, the court did not find it necessary to determine priorities as to the future use of such space. The Judgment issued by the trial court on remand, however, provided: "To the extent of any future spreading or in lieu storage of import water or reclaimed water by Los Angeles, Glendale, Burbank or San Fernando, the party causing said water to be so stored shall have a right to extract an equivalent amount of ground water from the San Fernando Basin." Pursuant to the Judgment, a court-appointed Watermaster now manages the groundwater extraction and storage rights within the ULARA. Figure B-2 depicts the rights to use groundwater established in Los Angeles v. San Fernando in an overdrafted basin where water has been stored.

City of Barstow v. Mojave Water Agency (23 Cal. 4th 1224)

In 2000, the California Supreme Court partially overturned the 1995 adjudication of the Mojave River Basin. The trial court had approved a negotiated settlement (or stipulated agreement) that failed to include a well-by-well determination of water rights. The trial court held the negotiated settlement to be binding on all users in the basin, including some pumpers who had not agreed to the settlement. The lower court decision was based on the doctrine of "equitable apportionment," in which the available water is shared based on concepts of equity and fairness. The Court of Appeal had partially reversed the lower court, and held that the trial court did not have the authority to ignore California's traditional water rights doctrine giving overlying users a priority right to beneficial and reasonable use of the groundwater. The Court of Appeal affirmed the trial court's negotiated settlement except as it applied to two of the parties. First, the Court of Appeal reversed the holding against a non-negotiating party since the trial court had ignored that party's existing overlying water rights. Secondly, the Court of Appeal reversed the trial court's judgment as it applied to a company, where the negotiated agreement did not give the company a water-allowance equal to its actual water use. The Supreme Court affirmed the Court of Appeal decision, but reversed the judgment applying to the company's water-allowance. The Supreme Court also affirmed that the trial court could not apply the doctrine of equitable apportionment when overlying water users had already established a prior water right. The Court stated that, while the trial court could impose a physical solution (such as the negotiated settlement), the court could not simply ignore affected owners' legal water rights. Equitable apportionment, thus, remains a tool for adjudicating basin groundwater rights, but only if all parties stipulate to its use.

Appendix C
Required and Recommended Components of Local Groundwater Management Plans

Section 10750 et seq. of the Water Code, commonly referred to as Assembly Bill 3030, stipulates certain procedures that must be followed in adopting a groundwater management plan under this section.

Amendments to Section 10750 et seq. added the requirement that new groundwater management plans prepared under Section 10750 et seq. must include component 1 below (SB1938 (Stats 2002, Ch 603)).

In addition, the amendments mandate that if the agency preparing the groundwater management plan intends to apply for funding administered by the California Department of Water Resources (DWR) for groundwater or groundwater quality projects, the agency must prepare and implement a groundwater management plan that includes components 2, 3, 6, 7 and 9 below. DWR recommends that all the components below be included in any groundwater management plan to be adopted and implemented by a local managing entity.

Consideration and development of these components for the specific conditions of the basin to be managed under the plan will help to ensure effective groundwater management. In developing these criteria, DWR recognizes that the goal of a groundwater management plan and the goal of an ordinance to manage groundwater should be the same—assurance of a long-term, sustainable, reliable, good quality groundwater supply. Such efforts can benefit greatly from cooperative management within the basin or region.

None of the suggested data reporting in the components below should be construed as recommending disclosure of information that is confidential under State law.

1. Include documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan," which may include appointing a technical advisory committee (Water Code § 10753.4 (b)).
2. Include a plan by the managing entity to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin." (Water Code § 10753.7 (a)(2)). A local agency includes "any local public agency that provides water service to all or a portion of its service area"
(Water Code § 10752 (g)).
3. Provide a map showing the area of the groundwater basin, as defined by DWR Bulletin 118, with the area of the local agency subject to the plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan (Water Code § 10753.7 (a)(3)).
4. Establish an advisory committee of stakeholders (interested parties) within the plan area that will help guide the development and implementation of the plan and provide a forum for resolution of controversial issues.
5. Describe the area to be managed under the plan, including:
    a. The physical structure and characteristics of the aquifer system underlying the plan area in the context of the overall basin.

b. A summary of the availability of historical data including, but not limited to, the components in Section 7 below.

c. Issues of concern including, but not limited to, issues related to the components in Section 7 below.

d. A general discussion of historical and projected water demands and supplies.

6. Establish management objectives (MOs) for the groundwater basin that is subject to the plan. (Water Code § 10753.7 (a)(1)).

7. Include components relating to the monitoring and management of groundwater levels, groundwater quality, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping. (Water Code § 10753.7 (a)(1)). Consider additional components listed in Water Code § 10753.8 (a) through (l).

8. For each MO, describe how meeting the MO will contribute to a more reliable supply for long-term beneficial uses of groundwater in the plan area, and describe existing or planned management actions to achieve MOs.

9. Adopt monitoring protocols for the components in Section 7 (Water Code § 10753.7 (a)(4)). Monitoring protocols are not defined in the Water Code, but the section is interpreted to mean developing a monitoring program capable of tracking changes in conditions for the purpose of meeting MOs.

10. Describe the monitoring program, including:

a. A map indicating the general locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence stations, or stream gages.

b. A summary of monitoring sites indicating the type (groundwater level, groundwater quality, subsidence, stream gage) and frequency of monitoring. For groundwater level and groundwater quality wells, indicate the depth interval(s) or aquifer zone monitored and the type of well (public, irrigation, domestic, industrial, monitoring).

11. Describe any current or planned actions by the local managing entity to coordinate with other land use, zoning, or water management planning agencies or activities (Water Code § 10753.8 (k), (l)).

12. Provide for periodic report(s) summarizing groundwater basin conditions and groundwater management activities. The report(s), prepared annually or at other frequencies as determined by the local management agency, should include:

a. Summary of monitoring results, including a discussion of historical trends.

b. Summary of management actions during the period covered by the report.

c. A discussion, supported by monitoring results, of whether management actions are achieving progress in meeting MOs.

d. Summary of proposed management actions for the future.

e. Summary of any plan component changes, including addition or modification of MOs, during the period covered by the report.

f. Summary of actions taken to coordinate with other water management and land use agencies, and other government agencies.

13. Provide for the periodic re-evaluation of the entire plan by the managing entity.

14. For local agencies not overlying groundwater basins, plans should be prepared including the above listed components and using geologic and hydrologic principles appropriate to those areas (Water Code § 10753.7 (a)(5)).

Appendix D
Groundwater Management Model Ordinance

In developing this model ordinance, the California Department of Water Resources recognizes that the goal of a groundwater management plan and the goal of an ordinance to manage groundwater should be the same—assurance of a long-term, sustainable, reliable, good quality groundwater supply. Such efforts require cooperative management within the region or sub-region.

Chapter X

Groundwater Management Ordinance

Sections:
X.01 Declaration of Findings
X.02 Purpose
X.03 Declaration of Intent
X.04 Definitions
X.05 Groundwater Management Program
X.06 Management Objectives
X.07 Monitoring Program Network
X.08 Monitoring Frequency
X.09 Changes in Monitoring
X.10 Review of Technical Data
X.11 Data Dissemination
X.12 Actions when MO Noncompliance is Reported
X.13 Regional Coordination
X.14 Integrated Resource Management
X.15 Data Relating to Export and Substitution of Groundwater

X.01 Declaration of Findings - The Board finds that:

A. The protection of the groundwater resource for its use within the County is of major concern to the residents of the County for the protection of their health, welfare, and safety.
B. The reliability and sustainability of the groundwater supply for all beneficial uses are of critical importance to the economic, social, and environmental well-being of the County.
C. A lack of effective groundwater management may have significant negative impacts, including, but not limited to:
   1. Lower groundwater levels leading to additional expenses from:
      a) Increased energy consumption.
      b) The need to deepen existing wells.
      c) The need to build new wells.
      d) The need to destroy non-functioning wells.
   2. Costly damage to public roads, bridges, canals, and other structures caused by land subsidence.
   3. Reduction of surface and subsurface flows leading to the potential loss of critical riparian and wetland habitat.
   4. Degradation of groundwater quality.

D. It is essential for management purposes to adopt a monitoring program addressing groundwater levels, groundwater quality, land subsidence, and surface water flow and quality where it directly impacts or is impacted by groundwater.

X.02 Purpose - In support of the findings above, the County has determined that this groundwater management ordinance is necessary to ensure that:

A. Groundwater continues to be a reliable and sustainable resource.
B. The extraction of groundwater does not result in significant adverse economic, environmental, or social impacts.
C. Groundwater quality is protected.
D. Excessive land surface subsidence from groundwater extraction is prevented.

X.03 Declaration of Intent

A. The County intends to foster prudent groundwater management practices by establishing a policy that encourages appropriate management of the resource based on recommendations by a committee of stakeholders.
B. The County intends that its groundwater management activities occur as an open and public process that considers input from all stakeholders in the County.
C. The County intends to work cooperatively with interested local agencies to further develop and implement joint groundwater management activities.
D. The County does not intend to regulate, in any manner, the use of groundwater, except as a last resort to protect the groundwater resource.
E. The County intends to act as an enforcing agency should the local resource become threatened.
F. The County does not intend to infringe upon the rights of surface water users in the managed area.
G. The County does not intend to limit other authorized means of managing groundwater within the County.

X.04 Definitions

A. "Aquifer" means a geologic formation that stores groundwater and transmits and yields significant quantities of water to wells and springs. Significant quantity is an amount that that satisfies local needs and may range from thousands of gallons per minute to less than 5 gpm, depending on rock type and intended use.
B. "Board" means the Board of Supervisors of the County.
C. "District" means a district or municipality, located wholly or partially within the boundaries of the County, that is a purveyor of water for agricultural, domestic, or municipal use.
D. "Enforcement Agency" means the Board as the enforcement agency under this chapter.
E. "Groundwater" means all water beneath the surface of the earth below the zone of saturation, but does not include subterranean streams flowing in known and definite channels.
F. "Groundwater Basin" means an aquifer or series of aquifers with a reasonably defined lateral and vertical extent, as defined in Bulletin 118 by Department of Water Resources. "Non-basin areas" are outside defined groundwater basins and contain smaller amounts of groundwater in consolidated sediments or fractured hard rock.
G. "Groundwater Export" means the conveyance of groundwater outside of the boundaries of the County and outside of the boundaries of any district that is partially within the County.
H. "Groundwater Substitution" means the voluntary use of an available groundwater supply instead of surface water for the purposes of using the surface water outside the County and outside the boundaries of any district that is partially within the County.

I. “Land Subsidence” means the lowering of the ground surface caused by the inelastic consolidation of clay beds in the aquifer system.
J. “Management Objective”(MO) means a condition identified for each subunit to ensure that the groundwater supply is reliable and sustainable. The MOs set acceptable conditions with respect to groundwater levels, groundwater quality, inelastic land surface subsidence, and surface water flows and quality. Compliance with the MO is tracked by a monitoring program and threshold values that are adopted for each Management Objective.
K. “Recharge” means flow to groundwater storage from precipitation, and infiltration from streams, irrigation, spreading basins, injection wells, and other sources of water.
L. “Reliability” means having an available, predictable, and usable groundwater supply at any given point in time.
M. “Stakeholder” means an individual or an entity, such as a water supplier or a county resident, with a permanent interest in the availability of the groundwater resource.
N. ”Subunit” means any subdivision of a groundwater basin or non-basin area in the County created for the purposes of representation of stakeholders and the establishment of local area management objectives.
O. “Sustainable” means the groundwater resource is maintained for use by residents in the basin over a prolonged period of time.
P. “Technical Advisory Committee” means a committee of persons knowledgeable in groundwater management, hydrology, and hydrogeology established for the purpose of providing technical guidance to the Water Advisory Committee.
Q. “Threshold values” mean the limits established by the WAC for groundwater levels, groundwater quality, land surface subsidence, and surface water flow and quality that are not to be exceeded if the MOs are to be met.
R. “Water Advisory Committee” (WAC) means a multimember advisory body established for the purpose of aiding the Board in providing effective management of the groundwater resources in the County, and representing all of the subunits that are identified.
S. “Water Management Entities” means any local agency, or group of agencies, authorized to manage groundwater.

X.05 Groundwater Management Program

A. The County recognizes that effective groundwater management is key to maintaining a reliable and sustainable resource. For the purposes of establishing an effective groundwater management program, the Board shall appoint a WAC to establish MOs and make recommendations to the Board to ensure that MOs are met.
B. For purposes of establishing a WAC, the groundwater basins and non-basin areas of the County will be divided into subunits based on hydrogeologic principles and institutional boundaries. These subunits shall be established by the Board based on public input to address the groundwater management needs of the County. The WAC shall consist of members that represent each subunit. Upon establishment of the subunits, the Board shall appoint a member to represent each subunit on the WAC.
C. The WAC shall have the following responsibilities to the Board:
   1. Recommend MOs for each groundwater management subunit.
   2. Recommend a groundwater monitoring network for purposes of tracking MOs.
   3. Recommend the frequency of monitoring.
   4. Propose changes in monitoring.
   5. Ensure monitoring data receive technical review.
   6. Ensure that monitoring data are made available to the public.

7. Recommend actions to resolve noncompliance with MOs.

D. For the purposes of providing technical advice to the WAC in carrying out its responsibilities, a technical advisory committee (TAC) shall be established. The TAC shall consist of local experts or a combination of local expertise and technical consultants from private and public organizations that are nominated by the WAC and approved by the Board. Individuals appointed to the TAC should be highly knowledgeable in groundwater management, hydrology, and hydrogeology. The TAC shall review technical data collected by monitoring programs within the County and advise the WAC.

X.06 Management Objectives

A. To ensure that the County maintains a reliable and sustainable groundwater supply, MOs for groundwater levels, groundwater quality, land subsidence, and surface water flow and quality shall be adopted for each subunit. Threshold values that are not to be exceeded shall be defined for each MO.

B. Compliance with the MOs will be determined by evaluation of data collected from groundwater level, groundwater quality, land subsidence, and surface water flow and quality monitoring networks. Evaluation of these data with respect to threshold values shall be the basis for determining compliance with the MOs.

C. Each WAC member shall recommend MOs for their subunit. The WAC shall develop a comprehensive set of recommendations for all subunits, and the Board shall adopt these MOs for the County. MOs may differ from subunit to subunit, but the established MOs shall be consistent with the overall goal of supply reliability for the County.

D. Groundwater management practices based on the established MOs for one subunit of the County shall not adversely impact adjacent subunits.

X.07 Monitoring Program Network

The WAC shall develop County-wide monitoring programs to collect representative data on groundwater levels, groundwater and surface water quality, land surface subsidence, and stream flow and quality. Each subunit shall propose its own monitoring program, and the WAC shall adopt a comprehensive monitoring program for the County. The data collected, showing current conditions and changes over time as a result of groundwater extraction, shall be evaluated by the WAC in consultation with the TAC. The WAC will recommend policies and actions to ensure that MOs for each subunit are met. The collection and evaluation of the data shall be based on scientifically sound principles, and shall incorporate appropriate quality assurance and quality control protocols.

A. Groundwater levels: The groundwater level monitoring network shall be proposed by the WAC and approved by the Board. The intent of the groundwater level monitoring network is to measure water levels in selected wells that can adequately determine representative conditions in the aquifer system for determination of compliance with the MOs. The network will include selected municipal, domestic, and irrigation wells owned by water districts, private parties, and municipal and industrial water suppliers. Where needed, dedicated monitoring wells may be installed. Participation by well owners will be voluntary.

B. Water Quality: The groundwater quality monitoring network shall be proposed by the WAC and approved by the Board. The intent of the groundwater quality monitoring network is to monitor selected wells that can adequately determine representative groundwater quality conditions in the aquifer system for identification of compliance with the MOs. The network will include selected municipal, domestic, and irrigation wells owned by water districts, private parties, and municipal and industrial water suppliers. Where needed, dedicated monitoring wells may be installed. Participation by well owners will be voluntary.

C. Land Subsidence: The land subsidence program and network shall be proposed by the WAC and approved by the Board. The intent of the land subsidence monitoring is to detect land subsidence for determination of compliance with the MOs. The network may include benchmarks that are surveyed for changes in elevation throughout the County, based on the judgment of the WAC of the need for such a program.

D. Surface Water Flow and Quality: The surface water flow and quality network shall be proposed by the WAC and approved by the Board. The intent of this network is to detect changes in surface water flow or surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping for evaluation of compliance with MOs.

X.08 Monitoring Frequency

The recommended frequency of collection of data for each of the parameters listed above shall be determined by the WAC. Initially, each parameter should be measured at the frequencies outlined below, unless the WAC notes upon evaluation of existing data that more frequent monitoring or additional analyses are called for.

A. Groundwater levels should be measured at least three times during the year: one measurement prior to the period of highest groundwater use, one measurement during peak groundwater use, and one measurement following the period of highest groundwater use (approximately the months of ______, ______, and ______).

B. Groundwater quality measurements of electrical conductivity, temperature, and pH should be obtained at least twice annually during the periods of highest and lowest groundwater use (approximately the months of _____ and ______). Upon evaluation of the data, the WAC may propose analyses for other constituents.

C. Selected benchmarks in the County land subsidence monitoring network should be surveyed every five years at a minimum. These surveys should be conducted following aquifer recovery and prior to the period of highest groundwater extraction (approximately the month of_____).

D. Measurement of surface water flow and quality in areas determined to directly affect groundwater levels or quality or that are affected by groundwater pumping shall be obtained at least ___ times per month as long as there are flows in the channel.

X.09 Changes in Monitoring

If evaluation of the groundwater level, groundwater quality, land subsidence, surface water flow, or surface water quality data indicates a need for more or less frequent measurements or analyses, the WAC may propose a change in the monitoring frequency. Similarly, if evaluation of the data indicates that additional monitoring sites are necessary, the WAC may propose an additional or a reduced number of sites for data collection. The Board shall adopt these changes when supported by credible evidence.

X.10 Review of Technical Data

A. The TAC shall propose and the WAC shall adopt standard methods using scientifically sound principles for review and analysis of the collected data. The TAC will meet, as needed and requested by the WAC, to evaluate the technical data and shall report their findings at appropriate meetings of the WAC. The WAC shall meet at least __ times per month during the period of maximum groundwater use (months of _____ through ______) and quarterly during the off season (months of ______ through ______), or as necessary.

B. During the period of highest groundwater use, the WAC meetings will focus on data review and analysis with respect to compliance with the current MOs. During the period of low groundwater use, the WAC meetings will focus on a review of compliance with MOs for the previous period of high groundwater use and consideration of the need for changes to the MOs.

X.11 Data Dissemination

The WAC, in addition to establishing methods for data collection and evaluation, shall establish methods for data storage and dissemination. The WAC shall disseminate the monitoring data and evaluation reports through public presentations and through a County-maintained groundwater Internet site. At a minimum, the WAC shall publicly present findings from the monitoring program to the Board twice annually.

X.12 Actions when MO Noncompliance is Reported

A. Action by Technical Advisory Committee. In the event that the TAC identifies an area that is not in compliance with the MOs, or if noncompliance is reported by any other means, the TAC shall report to the WAC on the regional extent and magnitude of the noncompliance. This information shall also be released to the public no later than ___ days from the time that noncompliance with MOs was identified. The TAC shall then collect all available pertinent hydrologic data, investigate possible causes for noncompliance with MOs, and recommend actions to the WAC to bring the area into compliance. These recommendations shall be made no later than ___ days after the report of noncompliance is released to the public. The TAC shall first make recommendations that focus on correcting the noncompliance through negotiations with all parties in the affected area.

B. Action by Water Advisory Committee. The WAC shall act as lead negotiator in re-establishing compliance with the MO. If negotiations with parties in the affected area do not result in timely and positive action to re-establish compliance with MOs for the basin, the WAC may recommend a plan to the Board to modify, reduce or terminate groundwater extraction in the affected area or take other necessary actions. Such a plan will be recommended to the Board only after the WAC has thoroughly reviewed the recommendations of the TAC at a public meeting. The modification, reduction, or termination of groundwater extraction in the affected area shall first be applied to wells involved in any export or substitution programs, and then to other wells if necessary. Domestic wells shall not be considered for any modification, reductions, or termination of groundwater extraction.

C. Action by Board of Supervisors. The Board of Supervisors, using its police powers, shall act as the enforcement agency for this ordinance. Any recommendation of the WAC may be appealed to the Board within __ working days.

X.13 Regional Coordination

Management decisions recommended by the WAC and adopted by the Board shall not deleteriously affect groundwater resources in any portions of groundwater basins or non-basin areas that share a common groundwater resource in adjacent counties. To accomplish this goal, the WAC shall meet and coordinate with water management entities outside the County that overlie a common groundwater basin at least twice per year once prior to the period of highest groundwater use and once following the period of highest groundwater use.

X.14 Integrated Resource Management

A. To ensure integration of planning activities within the County, the WAC shall inform County departments involved with groundwater related activities, including but not limited to Land Use or Zoning, Planning, Public Works, Utilities, and Environmental Health, of all WAC meetings and actions regarding MOs. In turn, these County departments shall take into consideration the adopted MOs when approving development or zoning changes or construction projects that may rely on or affect groundwater quantity or quality.

B. To the greatest extent practicable, the WAC should also integrate resource management planning with other agencies within the basin. Resource activities that could benefit from integrated planning with groundwater management include, but are not limited to:
   - Groundwater management planning by other agencies—agricultural, municipal, industrial, local government
   - Watershed management plans
   - Urban water management plans
   - Management and disposal of municipal solid waste and municipal sewage
   - Drinking water source assessment and protection programs
   - Public water system emergency and disaster response plans
   - Surface water and groundwater conjunctive management programs
   - Expansion of surface and groundwater facilities
   - Water efficiency programs
   - Water recycling programs
   - Environmental habitat construction or restoration programs
   - Water quality protection programs
   - Recharge programs
   - Transportation infrastructure planning

X.15 Data Relating to Export and Substitution of Groundwater

A. Districts, persons, or contractors intending to operate a groundwater export or groundwater substitution program shall submit the following data to the WAC __ working days prior to commencing the program:
   1. A description of the project with the total amount of groundwater to be exchanged or substituted
   2. The dates over which the project will take place.
   3. A statement of the anticipated impacts of the project relative to adopted MOs.
   4. A discussion of possible contingencies in the event of MO noncompliance.
   5. A map showing the location of the wells to be used by the program.
   6. A summary of any monitoring program proposed.
   7. All required environmental documentation.

B. While the program is in operation, the following information shall be provided to the WAC at least ___ times per month:
   1. All static and pumping groundwater level measurements made in the pumping well during the period of extraction for the export or substitution program.
   2. The amount of groundwater extracted from each well per week.
   3. Static groundwater level measurements in at least __ of the most proximal wells to the project pumping wells that can be practicably monitored.
   C. All costs for providing such information to the WAC shall be borne by the project participants.

Note: Although the terms "County" and "Board" are used throughout the model ordinance for clarity, the model could be used by any local government or agency with appropriate authority or powers.

Appendix E
SWRCB Beneficial Use Designations[1]

Agricultural Supply (AGR) – Uses of water for farming, horticulture, or ranching including, but not limited to irrigation, stock watering, or support of vegetation for ranch grazing.

Aquaculture (AQUA) – Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Cold Freshwater Habitat (COLD) – Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST) – Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Freshwater Replenishment (FRSH) – Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Groundwater Recharge (GWR) – Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Hydropower Generation (POW) – Uses of water for hydropower generation.

Industrial Process Supply (PRO) – Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND) – Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

Inland Saline Water Habitat (SAL) – Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Marine Habitat (MAR) – Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Migration of Aquatic Organisms (MIGR) – Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

Municipal and Domestic Supply (MUN) – Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Navigation (NAV) – Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Noncontact Water Recreation (REC-2) – Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Ocean Commercial and Sport Fishing (COMM) – Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

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[1] From SWRCB 2000

Preservation of Biological Habitats of Special Significance (BIOL) – Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

Rare, Threatened, or Endangered Species (RARE) – Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance or plant or animal species established under State or federal law as rare, threatened or endangered.

Shellfish Harvesting (SHELL) – Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

Spawning, Reproduction, and/or Early Development (SPWM) – Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Warm Freshwater Habitat (WARM) – Uses of water that support warmwater ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Water Contact Recreation (REC-1) – Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Wildlife Habitat (WILD) – Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Appendix F
Federal and State MCLs and Regulation Dates for Drinking Water Contaminants

	U.S. Environmental Protection Agency		California Department of Health Services	
Contaminant	MCL (mg/L)	Date[a]	MCL (mg/L)	Effective date
Inorganics				
Aluminum	0.05 to 2[b]	1/91	1 0.2[b]	2/25/89 9/8/94
Antimony	0.006	7/92	0.006	9/8/94
Arsenic	0.05 0.01	eff: 6/24/77 2001	0.05	77
Asbestos	7 MFL[c]	1/91	7 MFL[c]	9/8/94
Barium	1 2	eff: 6/24/77 1/91	1	77
Beryllium	0.004	7/92	0.004	9/8/94
Cadmium	0.010 0.005	eff: 6/24/77 1/91	0.010 0.005	77 9/8/94
Chromium	0.05 0.1	eff: 6/24/77 1/91	0.05	77
Copper	1.3[d]	6/91	1[b] 1.3[d]	77 12/11/95
Cyanide	0.2	7/92	0.2 0.15	9/8/94 6/12/03
Fluoride	4 2[b]	4/86 4/86	2	4/98
Lead	0.05[e] 0.015[d]	eff: 6/24/77 6/91	0.05[e] 0.015[d]	771 2/11/95
Mercury	0.002	eff: 6/24/77	0.002	77
Nickel	Remanded	0.1	9/8/94	
Nitrate	(as N)10	eff: 6/24/77	(as N03) 45	77
Nitrite (as N)	1	1/91	1	9/8/94
Total Nitrate/Nitrite (as N)	10	1/91	10	9/8/94
Selenium	0.01 0.05	eff: 6/24/77 1/91	0.01 0.05	77 9/8/94
Thallium	0.002	7/92	0.002	9/8/94
Radionuclides				
Uranium	30 g/L	12/7/00	20 pCi/L	1/1/89
Combined radium-226 & 228	5 pCi/L	eff: 6/24/77	5 pCi/L	77
Gross Alpha particle activity	15 pCi/L	eff: 6/24/77	15 pCi/L	77
Gross Beta particle activity	dose of 4 millirem/yr	eff: 6/24/77	50 pCi/L[f]	77

Contaminant	U.S. Environmental Protection Agency MCL (mg/L)	U.S. Environmental Protection Agency Date[a]	California Department of Health Services MCL (mg/L)	California Department of Health Services Effective date
Strontium-90	8 pCi/L	eff: 6/24/77 now covered by Gross Beta	8 pCi/L[f]	77
Tritium	20,000 pCi/L	eff: 6/24/77 now covered by Gross Beta	20,000 pCi/L[f]	77
VOCs				
Benzene	0.005	6/87	0.001	2/25/89
Carbon Tetrachloride	0.005	6/87	0.0005	4/4/89
1,2-Dichlorobenzene	0.6	1/91	0.6	9/8/94
1,4-Dichlorobenzene	0.075	6/87	0.005	4/4/89
1,1-Dichloroethane	- -	- -	0.005	6/24/90
1,2-Dichloroethane	0.005	6/87	0.0005	4/4/89
1,1-Dichloroethylene	0.007	6/87	0.006	2/25/89
cis-1,2-Dichloroethylene	0.07	1/91	0.006	9/8/94
trans-1,2-Dichloroethylene	0.1	1/91	0.01	9/8/94
Dichloromethane	0.005	7/92	0.005	9/8/94
1,3-Dichloropropene	- -	- -	0.0005	2/25/89
1,2-Dichloropropane	0.005	1/91	0.005	6/24/90
Ethylbenzene	0.7	1/91	0.68 0.7 0.3	2/25/89 9/8/94 6/12/03
Methyl-tert-butyl ether (MTBE)	- -	- -	0.005[b] 0.013	1/7/99 5/17/00
Monochlorobenzene	0.1	1/91	0.03 0.07	2/25/89 9/8/94
Styrene	0.1	1/91	0.1	9/8/94
1,1,2,2-Tetrachloroethane	- -	- -	0.001	2/25/89
Tetrachloroethylene	0.005	1/91	0.005	5/89
Toluene	1	1/91	0.15	9/8/94
1,2,4 Trichorobenzene	0.07	7/92	0.07	9/8/94
1,1,1-Trichloroethane	0.200	6/87	0.200	2/25/89
1,1,2-Trichloroethane	0.005	7/92	0.032 0.005	4/4/89 9/8/94
Trichloroethylene	0.005	6/87	0.005	2/25/89
Trichlorofluoromethane	- -	- -	0.15	6/24/90
1,1,2-Trichloro-1,2,2- Trifluoroethane	- -	- -	1.2	6/24/90
Vinyl chloride	0.002	6/87	0.0005	4/4/89
Xylenes	10	1/91	1.750	2/25/89

Contaminant	U.S. Environmental Protection Agency MCL (mg/L)	Date[a]	California Department of Health Services MCL (mg/L)	Effective date
SVOC's				
Alachlor	0.002	1/91	0.002	9/8/94
Atrazine	0.003	1/91	0.003 0.001	4/5/89 6/12/03
Bentazon	- -	- -	0.018	4/4/89
Benzo(a) Pyrene	0.0002	7/92	0.0002	9/8/94
Carbofuran	0.04	1/91	0.018	6/24/90
Chlordane	0.002	1/91	0.0001	6/24/90
Dalapon	0.2	7/92	0.2	9/8/94
Dibromochloropropane	0.0002	1/91	0.0001 0.0002	7/26/89 5/3/91
Di(2-ethylhexyl)adipate	0.4	7/92	0.4	9/8/94
Di(2-ethylhexyl)phthalate	0.006	7/92	0.004	6/24/90
2,4-D	0.10.07	eff: 6/24/77 1/91	0.1 0.07	77 9/8/94
Dinoseb	0.007	7/92	0.007	9/8/94
Diquat	0.02	7/92	0.02	9/8/94
Endothall	0.1	7/92	0.1	9/8/94
Endrin	0.0002 0.002	eff: 6/24/77 7/92	0.0002 0.002	77 9/8/94
Ethylene Dibromide	0.00005	1/91	0.00002 0.00005	2/25/89 9/8/94
Glyphosate	0.7	7/92	0.7	6/24/90
Heptachlor	0.0004	1/91	0.00001	6/24/90
Heptachlor Epoxide	0.0002	1/91	0.00001	6/24/90
Hexachlorobenzene	0.001	7/92	0.001	9/8/94
Hexachlorocyclopentadiene	0.05	7/92	0.05	9/8/94
Lindane	0.004 0.0002	eff: 6/24/77 1/91	0.004 0.0002	77 9/8/94
Methoxychlor	0.1 0.04	eff: 6/24/77 1/91	0.1 0.04 0.03	77 9/8/94 6/12/03
Molinate	- -	- -	0.02	4/4/89
Oxamyl	0.2	7/92	0.2 0.05	9/8/94 6/12/03
Pentachlorophenol	0.001	1/91	0.001	9/8/94
Picloram	0.5	7/92	0.5	9/8/94
Polychlorinated Biphenyls	0.0005	1/91	0.0005	9/8/94
Simazine	0.004	7/92	0.010 0.004	4/4/89 9/8/94

Contaminant	U.S. Environmental Protection Agency MCL (mg/L)	Date[a]	California Department of Health Services MCL (mg/L)	Effective date
Thiobencarb	- -	- -	0.07 0.001[b]	4/4/89 4/4/89
Toxaphene	0.005 0.003	eff: 6/24/77 1/91	0.005 0.003	77 9/8/94
2,3,7,8-TCDD (Dioxin)	$3x10^{-8}$	7/92	$3x10^{-8}$	9/8/94
2,4,5-TP (Silvex)	0.01 0.05	eff: 6/24/77 1/91	0.01 0.05	77 9/8/94
Disinfection Byproducts				
Total trihalomethanes	0.10 0.080	11/29/79 eff: 11/29/83 eff: 1/1/02[g]	0.10	3/14/83
Total haloacetic acids	0.060	eff: 1/1/02[g]		
Bromate	0.010	eff: 1/1/02[g]		
Chlorite	1.0	eff: 1/1/02[g]		
Treatment Technique				
Acrylamide	TT[h]	1/91	TT[h]	9/8/94
Epichlorohydrin	TT[h]	1/91	TT[h]	9/8/94

Source: http://www.dhs.ca.gov/ps/ddwem/chemicals/MCL/EPAandDHS.pdf

a. "eff." indicates the date the MCL took effect; any other date provided indicates when EPA established (that is, published) the MCL.

b. Secondary MCL.

c. MFL = million fibers per liter, with fiber length > 10 microns.

d. Regulatory Action Level; if system exceeds, it must take certain actions such as additional monitoring, corrosion control studies and treatment, and for lead, a public education program; replaces MCL.

e. The MCL for lead was rescinded with the adoption of the regulatory action level described in footnote d.

f. MCLs are intended to ensure that exposure above 4 millirem/yr does not occur.

g. Effective for surface water systems serving more than 10,000 people; effective for all others 1/1/04.

h. TT = treatment technique, because an MCL is not feasible.

Federal and State MCLs – updated 05/23/03

Appendix G
Development of Current Groundwater Basin/Subbasin Map

This Bulletin 118 update represents the first time that groundwater basin boundaries have been released as a digital coverage. The basin boundaries for the revised groundwater basin map were primarily defined using geologic contacts and hydrogeologic barriers. Specifically the identification of the groundwater basins was initially based on the presence and areal extent of unconsolidated alluvial sediments identified on 1:250,000 scale, geologic maps published by the California Department of Conservation, Division of Mines and Geology. The identified groundwater basin areas were then further evaluated through review of relevant geologic and hydrogeologic reports and well completion reports, and using the basin definition criteria listed in Table 8. Basin boundaries that are specified in each of the court decisions has been used for the boundaries of adjudicated basins.

Well completion reports for wells present in basin areas that were identified from the geologic map were reviewed to identify the depth to the top of the water table and the top of impermeable bedrock. If there was less than 25 feet of permeable material present or if there was no groundwater present within the permeable material, the area was eliminated from the map. The well completion reports were also reviewed to determine if water supply wells located within the delineated basin area were extracting groundwater from the permeable materials underlying the area or from the bedrock beneath the permeable material. If the wells only extracted groundwater from the bedrock, the area was eliminated from the map. This resulted in the elimination of some areas identified as basins in previous Bulletin 118 publications. If there were no wells present in basin areas identified from the geologic map and no other information on the geology underlying these areas, the areas were retained in the current version of the map. Additional hydrogeologic information might or might not verify that these areas should be retained as groundwater basins.

Groundwater basins were delineated and separated from each other by the following restrictions on groundwater flow. For more detail on the types of basins and the flow boundaries of those basins, see Table 8.

Impermeable Bedrock. Impermeable bedrock with lower water yielding capacity. These include consolidated rocks of continental and marine origin and crystalline/or metamorphic rock.

Constrictions in Permeable Materials. A lower permeability material, even with openings that are filled with more permeable stream channel materials, generally forms a basin boundary for practical purposes. While groundwater may flow through the sediment-filled gaps, the flow is restricted to those gaps.

Fault. A fault that crosses permeable materials may form a barrier to groundwater movement if movement along the fault plane has created fine material that impedes groundwater movement or juxtaposed low permeability material adjacent to an aquifer. This is usually indicated by noticeable difference in water levels in wells and/or flow patterns on either side of the fault. Not all faults act as barriers to groundwater flow.

Low Permeability Zone. Areas of clay or other fine-grained material that have significant areal or vertical extent generally form a barrier to groundwater movement within the basin but do not form basin boundaries.

Groundwater Divide. A groundwater divide is generally considered a barrier to groundwater movement from one basin to another for practical purposes. Groundwater divides have noticeably divergent groundwater flow directions on either side of the divide with the water table sloping away from the divide. The location of the divide may change as water levels in either one of the basins change, making such a "divide" less useful. Such a boundary is often used for subbasins.

Adjudicated Basin Boundaries. The basin boundaries established by court order were used for all adjudicated basins. These court-decided boundaries affect the location of natural boundaries of adjoining basins. Some adjudicated basins are represented as subbasins in this bulletin.

Available reports on the geologic and hydrogeologic conditions in the delineated basin areas were also reviewed to determine if there was information that would further define the boundaries of the basin areas. This review resulted in changes to some of the basin boundaries identified in previous versions of Bulletin 118.

Several of the larger groundwater basins were further subdivided into groundwater subbasins in Bulletin 118-80 and additional large groundwater basins were subdivided during this 2003 revision. The subbasin boundaries were also primarily defined using geologic contacts and hydrogeologic divides where possible. If this was not possible, political or institutional boundaries were used.

The hydrogeologic information contained in the basin descriptions that supplement this update of Bulletin 118 includes only the information that was available in California Department of Water Resources (DWR) files through reference searches and through limited contact with local agencies. Local agencies may have conducted more recent studies that have generated additional information about water budgets and aquifer characteristics. Unless the agency notified DWR or provided a copy of the recent reports to DWR staff that recent information has not been included in the basin descriptions. Therefore, although Senate Bill 610 refers to groundwater basins identified as overdrafted in Bulletin 118, it would be prudent for local water suppliers to evaluate the potential for overdraft of any basin included as a part of a water supply assessment.

Persons interested in collecting groundwater information in accordance with the Water Code as amended by SB 221 and SB 610 may start with the information in Bulletin 118, but should follow up by consulting the references listed for each basin and contacting local water agencies to obtain any new information that is available. Otherwise, evaluation of available groundwater resources as mandated by SB 221 and SB 610 may not be using the most complete and recent information about water budgets and aquifer characteristics.

Groundwater basin and subbasin boundaries shown on the map included with this bulletin are based on evaluation of the best available information. In basins where many studies have been completed and the basin has been operated for a number of years, the basin response is fairly well understood and the boundaries are fairly well defined. Even in these basins, however, there are many unknowns and changes in boundaries may result as more information about the basin is collected and evaluated.

In many other basins where much less is known and understood about the basin, boundaries will probably change as a better understanding of the basin is developed. A procedure for collecting information from all the stakeholders should be developed for use statewide so that agreement on basin boundaries can be achieved.

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

STATE OF CALIFORNIA

General Plan Guidelines

2017

GOVERNOR'S OFFICE OF PLANNING AND RESEARCH

Director's Message

After a multi-year effort involving literally dozens of workshops, hundreds of meetings, and thousands of participants, I am very pleased to present the 2017 version of the General Plan Guidelines. This is the first comprehensive update since 2003, and, not surprisingly, there are many changes. In an effort to reduce time, cost, and burden, we have included hundreds of links to resources, now available by a single click. We have included an on-line mapping tool, free of charge, which allows access to state and federal and other GIS data resources. The mapping tool also allows users to download and add their own GIS layers. OPR will add additional functions to the tool in the future. We have identified changes in the law and added new sections on a number of topics including health and equity.

A great deal has changed in California since 2003, and the General Plan Guidelines reflect that. Most importantly, climate change and its implications permeate almost every aspect of the Guidelines, as it must. One thing that has not changed is the importance of the general plan itself and the unique perspective each jurisdiction brings to the process and the plan vision.

Going forward, OPR will be adding resources and links periodically, making the Guidelines more of a living document. We encourage you to help OPR identify the best resources and links as part of this effort. Most importantly, we hope that these Guidelines help improve the planning process and promote periodic general plan updates.

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Table of Contents

CHAPTER 4

CHAPTER 10

1

Introduction

Planning Healthy, Equitable, Resilient, and Economically Vibrant Places

"By far the greatest and most admirable form of wisdom is that needed to plan and beautify cities and human communities."

—Socrates

The general plan is more than the legal underpinning for land use decisions; it is a vision about how a community will grow, reflecting community priorities and values while shaping the future. To assist local governments in preparing general plans and the public in participating in that process, the Governor's Office of Planning and Research (OPR) periodically revises guidelines for the preparation and content of local general plans (Gov. Code § 65040.2).

This 2017 edition of the General Plan Guidelines (GPG) contains significant changes to the 2003 General Plan Guidelines. For mandatory and common optional elements of the general plan, the GPG sets out each statutory requirement in detail, provides OPR recommended policy language, and includes online links to city and county general plans that have adopted similar policies. Each chapter contains a sample selection of policies. Users can also click the links provided for more detailed policies and plans. All of the referenced policies as well as additional policies are compiled in Appendix A. For ease of use, the new GPG is text-searchable, and provides sample policy language for local governments to use or adapt. The update contains new resources and templates for cities and counties to use in considering themes, structures, and policies for their general plans, including new compendiums on infill development, renewable energy, and mitigation for conversion of agricultural land. As more resources and data sources become available, they will be added and linked to these General Plan Guidelines. The new online platform will allow OPR to add updated text, links, and information directly to the GPG, and announce any additions through the GPG listserv and on the OPR website. The GPG is a resource to help planners accomplish their respective community's priorities and vision while meeting larger state goals, increasing community collaboration, and potentially improving competitiveness for funding opportunities.

As of 2015, more than half of local jurisdictions have general plans that are over 15 years old. Often, this is because the process of adopting a general plan has become too time-consuming and costly. In order to streamline the process and reduce costs, this comprehensive update of OPR's GPG provides free online tools and resources, promotes increased use of online data, and includes templates, sample policies, and links to more information. The General Plan Mapping Tool draws data sets from multiple sources, allowing users to incorporate local, regional, and statewide data into local general plans. Local jurisdictions may pull from and modify provided policies and templates, analyze consistent data through the tool, and craft general plans at a lower cost and with less uncertainty. These new resources will increase efficiencies in the development of general plan updates for communities of all sizes throughout the state.

NEW in the 2017 *General Plan Guidelines* suite of tools:

- Updated and expanded sections on visioning and community engagement
- New sections on healthy communities, equitable and resilient communities, economic development, and climate change
- GPG Mapping Tool, enabling free, easy access to helpful data for cities and counties
- Links to additional online tools and resources
- Recommended policies in cut and paste format, with examples of adopted policy language
- Reformatted sections on the mandatory elements, including a new section on environmental justice
- Expanded equity and environmental justice section
- Infill compendium
- Renewable energy compendium
- Model template for mitigation of agricultural land conversion

The term "element" refers to the topics that California law requires to be covered in a general plan (Gov. Code § 65302). There is no mandatory structure or maximum number of elements that a general plan must include. Once added into the general plan, each element, regardless of statutory requirement, assumes the same legal standing, and must be consistent with other elements (Gov. Code § 65300.5). The general plan is the perfect space for innovation, reflecting the unique character of each community. The format and content of general plans can vary between jurisdictions. Planners must address mandatory elements, but they have discretion to organize general plans by values (core concepts that the community

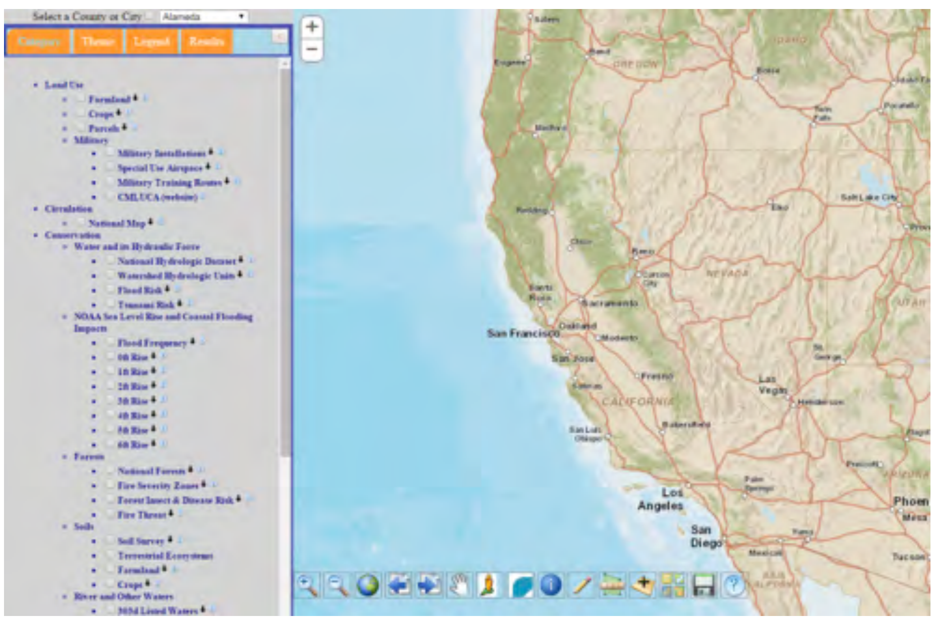
Figure 1: Examples of General Plan Layout

wants to enhance or uphold), themes (overarching issues identified by the community as important), challenges or goals identified through community engagement, or even by the elements themselves. Cities and counties may create new models of organizing their general plans, based on the needs and priorities identified during public engagement. Riverside County, for example, included a healthy communities element in its general plan update. The City of Fullerton structured its general plan around four focus areas, identified through community engagement, and addressed all of the elements through those focus areas. The City of Sacramento framed its general plan around sustainability and livable communities, and focused each of the required elements – as well as additional elements – around those goals. The County of Marin created a separate, easy to read summary of its 2007 countywide plan, featuring model strategies and metrics related to climate change, social equity, and other themes. OPR designed the GPG to assist every city and county in accordance with its local jurisdiction's unique vision, using whatever structure best achieves the goals of the community.

The 2017 GPG update includes a free General Plan Mapping Tool. The tool incorporates the requirements for the mandatory elements as well as themes and provides Geographic Information Systems (GIS) resources for city and county planners to use when drafting a general plan.

The tool provides access to data (varying as available from county, city, and parcel-level information) to help inform decision-making processes and enhance public participation. The mapping tool uses a platform specifically designed for general plans.

Figure 2: The General Plan Mapping Tool



1

Recommendations and Sample Language

OPR has included recommendations and sample policy language to provide cities and counties with information, data, examples, and ideas to consider in their general plan. These recommendations may not fit the needs of every city and county or every circumstance. Rather, these recommendations represent a toolbox of options, allowing jurisdictions to use them as they are, modify them as appropriate within statutory requirements, or consider them as examples to inform their own policies.

According to state law,

> "Decisions involving the future growth of the state, most of which are made and will continue to be made at the local level, should be guided by an effective planning process, including the local general plan, and should proceed within the framework of officially approved statewide goals and policies directed to land use, population growth and distribution, development, open space, resource preservation and utilization, air and water quality, and other related physical, social and economic development factors." (Gov Code § 65030.1)

The following text box describes the statutory state planning priorities of the Governor's Office of Planning and Research Environmental Goals and Policy Report, as they appear in Government Code section 65041.1. The GPG aims to help achieve goals consistent with both documents by recommending practices and policies for cities and counties to incorporate locally.

STATE PLANNING PRIORITIES

California Government Code section 65041.1

The state planning priorities, which are intended to promote equity, strengthen the economy, protect the environment, and promote public health and safety in the state, including in urban, suburban, and rural communities, shall be as follows:

(a) To promote infill development and equity by rehabilitating, maintaining, and improving existing infrastructure that supports infill development and appropriate reuse and redevelopment of previously developed, underutilized land that is presently served by transit, streets, water, sewer, and other essential services, particularly in underserved areas, and to preserving cultural and historic resources.

(b) To protect environmental and agricultural resources by protecting, preserving, and enhancing the state's most valuable natural resources, including working landscapes such as farm, range, and forest lands, natural lands such as wetlands, watersheds, wildlife habitats, and other wildlands, recreation lands such as parks, trails, greenbelts, and other open space, and landscapes with locally unique features and areas identified by the state as deserving special protection.

(c) To encourage efficient development patterns by ensuring that any infrastructure associated with development, other than infill development, supports new development that does all of the following:

(1) Uses land efficiently.

(1) Is built adjacent to existing developed areas to the extent consistent with the priorities specified pursuant to subdivision (b).

(1) Is located in an area appropriately planned for growth.

(1) Is served by adequate transportation and other essential utilities and services.

(1) Minimizes ongoing costs to taxpayers.

This GPG document is advisory. Nevertheless, courts periodically refer to the GPG to interpret planning law. For this reason, the GPG closely adheres to statute and current case law. It also relies upon commonly accepted principles of contemporary planning practice. The following words are used to indicate whether a particular subject in the GPG is mandatory, advisory, or permissive:

(a) "Must" or "shall" identifies a mandatory statutory requirement that all public agencies are required to follow.

(b) "Should" or "suggest(ed)" identifies guidance provided by OPR based on policy considerations contained in California's planning laws.

(c) "May" or "can (could)" identifies a permissive recommendation that is left fully to the discretion of the local governments involved.

OPR updated the GPG in coordination with a number of other tool, policy, and program update efforts to ensure references to external tools support the intent of the GPG. Some examples of these concurrent updates include the following:

- AB 32 Scoping Plan Update
- Cal–Adapt
- California Climate Adaptation Planning Guide
- California Coastal Commission Local Coastal Plan guidance
- California State Energy Efficiency Collaborative GHG and climate tools
- General Plan Mapping Tool
- Safeguarding California Plan
- State Hazard Mitigation Plan
- SB 244(2011), SB 743(2013), SB 379(2015), SB 1000(2016)
- California Statewide Housing Assessment
- California State Wellness Plan

- California Strategic Growth Council
- California Water Plan
- CEQA Guidelines Update
- Cool California and the Funding Wizard
- Environmental Goals and Policy Report

The GPG also includes new sections on environmental justice, healthy communities, equity and resilience, economic development, and climate change; as well as compendiums on infill development, renewable energy, and agricultural land conservation.

How to Use These Guidelines

The General Plan Guidelines are intended to be user friendly and practical for planners, decision makers, and the general public. The GPG and the General Plan Mapping Tool can be used to frame conversations around planning, evaluate data and identify priorities, research formats and policies from similar communities, and enhance capacity for fiscally constrained departments and organizations working to update general plans. Each chapter of the GPG lays out the requirements contained in statute, connections to other requirements, additional considerations, and related data and policies to consider. Each mandatory element also includes a completeness checklist to assist communities in meeting statutory requirements. Recognizing the vast diversity of California's communities in size, demographics, geography, economics, and resources, the GPG present examples in various jurisdictions whenever possible.

Statutory Requirements

This document provides textboxes containing the statutory language that creates a legal obligation to address each of the required elements in a general plan. These textboxes can be found in the chapters corresponding to each of the elements. The information following the statutory language contains OPR's recommendations for meeting the requirement. Each statutory reference is hyperlinked to the full text of the Government Code for easy access.

Requirement Description

This section includes considerations, resources, data, and other information for developing general plan policies. Many elements are interrelated, so tables in each requirement description section note linkages between elements. This section also includes additional information through hyperlinks, which lead to examples and resources.

Recommended Data

Each section also includes recommendations for data that jurisdictions may wish to use to examine and determine specific needs and policies. Tables identify the data according to the potential intent of analysis. Where the recommended data is available, tables provide direct links to the General Plan Mapping Tool. As the GPG is reviewed and updated, additional data links will be added. Because the same data may be useful for multiple analytical purposes, some data link to multiple sections of the guidelines. The recommended data are not exhaustive but can serve as a starting point for considering the specific needs of a community and for identifying further information needed to help inform decisions related to those needs.

Parts of a General Plan

(for more detailed descriptions and examples, see Appendix E)

Development Policy – a general plan statement that guides action, including goals and objectives, principles, policies, standards, and plan proposals.

Diagram – a graphic expression of a general plan's development policies, particularly its plan proposals, which must be consistent with the general plan text (Gov Code § 65300.5).

Goal – a general expression of community values and direction, expressed as ends (not actions).

Objective – a specified end, condition, or state that is a measurable intermediate step toward attaining a goal.

Principle – an assumption, fundamental rule, or doctrine guiding general plan policies, proposals, standards, and implementation measures.

Policy – a specific statement that guides decision–making and helps implement a general plan's vision.

Standards – a rule or measure establishing a level of quality or quantity that must be complied with or satisfied.

Plan Proposal – describes the development intended to take place in an area. Plan proposals are often expressed on the general plan diagram.

Implementation Measure – an action, procedure, program, or technique that carries out general plan policy. Each policy should have at least one corresponding implementation measure.

Recommended Policies

The government code directs OPR to provide land use policy advice. In order to do so, the GPG includes both general plan policy recommendations and links to external resources that provide policy guidance. Where possible, links are provided to the sample policies, case studies, and external reports.

Adopted state programs described in the draft Environmental Goals and Policy Report – an overview of the state's environmental goals and the key steps needed to achieve them – provide the basis for many of the policy recommendations. OPR also examined current academic publications and conducted extensive outreach to local governments, community, and advocacy groups in building policy recommendations. Cross–cutting recommendations include consideration of equity, health, and climate issues within jurisdictions,communities, and regions. With thoughtful planning based on such considerations, California will foster a future that has a strong economy, thriving built and natural environments, and a healthy, prosperous citizenry.

GPG policy recommendations focus on four key themes.

1. Climate Change: In California, climate change has been the subject of multiple Executive Orders and legislation. It is a high priority subject for any general plan update. EO B-30-15 established interim emissions reduction targets for 2030; EO S-03-05

established long-term targets for 2020 and 2050; and EO S-13-08 established climate change adaptation and resilience as a priority. Further state goals include reduction of petroleum use by up to 50 percent by 2030, and an increase of renewable energy to 50 percent by 2030 through the Clean Energy and Pollution Reduction Act of 2016. California has set greenhouse gas (GHG) emissions reduction requirements in numerous sectors including land use and transportation planning (Assembly Bill 32, the Global Warming Solutions Act of 2006 (Nunez), hereafter referred to as AB 32; Senate Bill 375, the Sustainable Communities and Climate Protection Act of 2008 (Steinberg), hereafter referred to as SB 375; Senate Bill 743, the Transit Oriented Development Act of 2013 (Steinberg), hereafter referred to as SB 743). The AB 32 Scoping Plan includes sections on local government and the importance of local action to help achieve statewide climate goals. Additionally, the Safeguarding California Plan, Cal-Adapt, Climate Change Handbook for Regional Water Planning, and the California Climate Adaptation Planning Guide provide guidance for resilience and adaptation efforts. OPR's GPG recommendations focus on how the general plan can achieve GHG emissions reductions, increase resiliency to climate change impacts, and lead to healthier and more prosperous communities.

2. **Economics**: Policies related to all elements of the general plan greatly affect economic opportunity, development, and stability. Decisions regarding land use and circulation have direct and indirect fiscal implications for local economies, and, in turn, economies of urban and rural centers affect the health, climate, and equity of communities. As with all general plan topics, even if addressed in a separate section, economic development must link and integrate with other elements in order to be successful.

3. **Healthy Communities**: In 2012 the Governor issued Executive Order B-19-12 and created the Governor's Let's Get Healthy California Task Force. Chronic disease, such as obesity, diabetes, cancer, heart disease, and asthma affect quality of life and productivity. In addition, social, economic, and environmental factors where people live, work, and play affect their health and well-being. The Task Force identified

A general plan allows a community to envision its future growth and development

Image by Urban Advantage, Ferrell Madden Lewis the creation and expansion of healthy communities to be one of three major focus areas for the promotion of overall health improvement. Because planning offers one important way to improve the community's health, OPR offers recommendations for jurisdictions interested in incorporating health-supporting policies into their general plan.

4. **Equitable Opportunities**: Planning decisions affect the entire community, and the entire community must be allowed equal access to the public process (Gov Code § 11135). From determining proximity to localized noise or air pollution, to providing healthy grocery options, to creating access to employment and education opportunity, planning and policy affect everyone. Incorporating equity into all aspects of planning will ensure that residents of a city or county benefit from reduced GHG emissions, climate change adaptation policies, active transportation options, and healthy communities with access to economic opportunity for all. OPR's recommendations for equity incorporate statutory requirements for environmental justice guidance (Gov Code § 65040.12(c)) into an expanded focus on equity throughout the general plan.

Additionally, based on statewide goals, the update includes model guides and best practices related to infill development, renewable energy, and mitigation of agricultural land conversion.

Readers should note that the recommended policies are simply recommendations, intended to provide a starting point from which local governments can craft unique policies reflecting the priorities and circumstances of their communities. The GPG aims to create a suite of tools for communities to utilize in updating their general plans. By providing information, resources, and data on statutory requirements as well as non-statutory considerations relevant to planning, the GPG can help diverse community members work together towards a shared vision for their future growth.

2

A Vision for Long-Range Planning

Designing Healthy, Equitable, Resilient, and Economically Vibrant Places

"A city is not gauged by its length and width, but by the broadness of its vision and the height of its dreams."

—Herb Caen

Why the General Plan Matters

California state law requires each city and county to adopt a general plan "for the physical development of the county or city, and any land outside its boundaries which in the planning agency's judgment bears relation to its planning" (Gov. Code § 65300). The general plan expresses the community's development goals and embodies public policy relative to the distribution of future land uses, both public and private. The California Supreme Court has described general plans as the "charter to which [zoning] ordinance[s] must conform", but the general plan extends far beyond zoning and land use (Lesher Communications, Inc. v. City of Walnut Creek (1990) 52 Cal.3d 531, 540).

According to Litman's Land Use Impact Costs of Transportation, studies show that land use decisions affect transportation, electricity, and water demand. Each planning decision affects multiple objectives beyond the immediate outcomes. General plans benefit local communities by promoting better projects, streamlined processes, integrated planning, and improved access and use of available resources.

A general plan allows a community to create a vision for its future.

Image by Urban Advantage, Ferrell Madden Lewis

Furthermore, local policies affect building decisions, energy efficiency, and the development of infrastructure.

A local general plan should start with a shared community vision that will help set priorities throughout the planning process, and inform decision makers about community values. Creating a community vision may include the following:

- Expanded outreach to all members of the community, including public agencies and local residents
- Looking back to identify past challenges and accomplishments
- Examining current data and emerging data trends
- Considering future issues, challenges, and goals

With continued input and engagement from community members and decision makers, the processes of preparing, adopting, implementing, and maintaining the general plan serves to:

- Provide a basis for local government decision-making, including decisions on development approvals and exactions
- Provide residents with opportunities to participate in the planning and decision-making processes of their communities
- Inform residents, developers, decision makers, and other cities and counties of the ground rules that guide development within a particular community

Engaging the community in multiple ways ensures a strong general plan. For example, the City of Chula Vista held numerous community workshops to craft their vision statement, and used it to inform future goals and policies. The City of Chino engaged with the community at existing events in developing its vision statement, traveling to farmers markets, events, and local groups before meeting with city officials to craft the final statement. Chino also used the vision statement to inform the land use diagram included in their general plan, ensuring the community's values were reflected in the future growth of the city. Chapter 3 discusses community engagement in more detail.

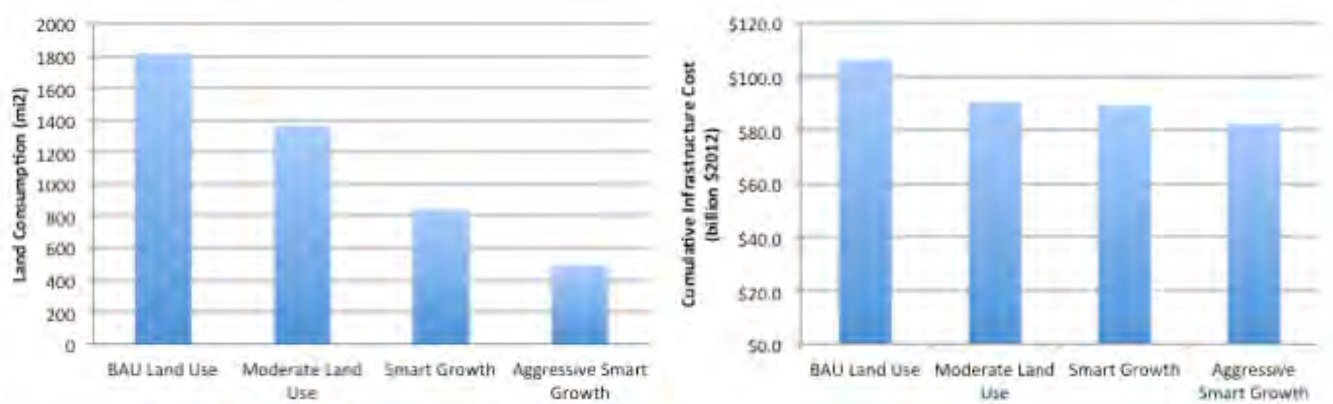
Local General Plans and Statewide Goals

Cities and counties are critical partners in helping to achieve statewide goals. The U.S. Census Bureau projects California's population to reach 50 million residents by 2050. While the largest population will continue to be in Los Angeles County and the San Francisco Bay Area, the largest growth rates are expected to be in the Inland Empire, Sacramento Region, and San Joaquin Valley. Additionally, California's demographic diversity continues to increase, making California a minority-majority state, with residents from over sixty nations, speaking dozens of languages. Almost half of California's residents will identify as Hispanic by 2050, despite decreased immigration from Latin America. Increased immigration from Asia and the Middle East will continue to diversify communities and increase the foreign born percentage of Californians to nearly thirty percentl. The overall state economy will continue to grow, but numerous factors will affect how individuals and families benefit. Shifts in demand for labor, regional disparities, and increasing retirement rates among older residents will create differing needs throughout the state. As all Californians live longer, an increase in elderly and middle age residents will increase and shift demands on infrastructure such as housing and education, and resources including transportation and social services. Accommodating this growth equitably while protecting the state's environment, supporting equitable development and a strong economy, and preserving the state's natural and working landscapes – all in the context of climate change – will be critical in the coming decades. Cities and counties are key partners in achieving these goals at both the state and local level.

Decisions made at the local level have a real impact on, for example, statewide greenhouse gas emissions. Local actions help determine how vulnerable the community and the state will be in the face of a changing climate and, alternatively, how resilient they can be by addressing such vulnerabilities. In many cases, the impacts of these decisions can be measured. For instance, tools like Urban Footprint can estimate health, infrastructure, services and other costs associated with various land use patterns. Measuring impacts and outcomes enables communities to weigh costs and benefits of new development and to grow in a manner consistent with community values.

Quantifying outcomes can provide meaningful contrasts for general plan development. For example, the graphs below show the aggregate impacts of development decisions on land consumption and infrastructure costs, statewide.

Figure 3: Land Consumption and Infrastructure Costs Increase with Less Dense Development Patterns



These results come from analysis prepared by Calthorpe Associates for the state as a whole. City– and county–level analyses have yielded similar results. Current density patterns (BAU) and increasingly dense development expectations form the basis for the land use assumptions.

California's Planning Priorities

The 1978 Urban Strategy first articulated statewide planning priorities for California which were adopted in law in 2002. Briefly, the priorities are to

1. Promote infill development and rehabilitation and utilization of existing infrastructure, including water, sewer, and transportation.
2. Protect the state's natural and working lands, including agricultural land, lands of cultural and historic significance, wetlands, and wildlands.
3. Develop in an efficient manner that limits sprawl and minimizes costs to taxpayers.

These priorities are intended to inform planning and investment at all levels of government.

2

California's Planning Priorities

The state planning priorities, which are intended to promote equity, strengthen the economy, protect the environment, and promote public health and safety in the state, including in urban, suburban, and rural communities, shall be as follows:

(a) To promote infill development and equity by rehabilitating, maintaining, and improving existing infrastructure that supports infill development and appropriate reuse and redevelopment of previously developed, underutilized land that is presently served by transit, streets, water, sewer, and other essential services, particularly in underserved areas, and to preserving cultural and historic resources.

(b) To protect environmental and agricultural resources by protecting, preserving, and enhancing the state's most valuable natural resources, including working landscapes such as farm, range, and forest lands, natural lands such as wetlands, watersheds, wildlife habitats, and other wildlands, recreation lands such as parks, trails, greenbelts, and other open space, and landscapes with locally unique features and areas identified by the state as deserving special protection.

(c) To encourage efficient development patterns by ensuring that any infrastructure associated with development, other than infill development, supports new development that does all of the following:

(1) Uses land efficiently.

(1) Is built adjacent to existing developed areas to the extent consistent with the priorities specified pursuant to subdivision (b).

(1) Is located in an area appropriately planned for growth.

(1) Is served by adequate transportation and other essential utilities and services.

(1) Minimizes ongoing costs to taxpayers

As of this update, the state is in the midst of a severe drought, continues to lose agricultural lands due to conversion, and continues to face severe air quality challenges in several regions. At the same time, since the 1970s, California has introduced a robust suite of environmental goals and policies that will help combat these issues. These policy tools have and will continue to help improve the quality of the state's environment. Most notably, the suite of policies that California has adopted to address climate change will touch on nearly every facet of the state's development.

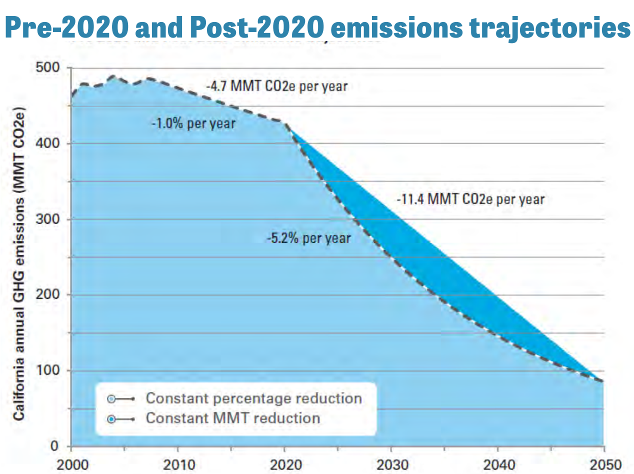
California's Climate Change Policy and Local Communities

The effects of climate change and pollution pose great risks for Californians, including more frequent and more intense forest fires, more air pollution, deadly heat waves, a significant reduction in snowpack and state water supplies, sea level rise and erosion along California's long coastline, and billions of dollars in damage to our agricultural, tourism, recreation, and other industries. These impacts have the potential to be hugely disruptive to how local governments operate.

Executive Order S-03-05 established greenhouse gas (GHG) emissions reduction targets for the state. Subsequently, AB 32 (2006) established a comprehensive program to achieve quantifiable, cost-effective reductions of greenhouse gases on a scheduled basis. Additional legislation supported AB 32, including SB 375 (2008), which aligned land use and transportation with environmental goals locally through Sustainable Community Strategies (SCS), and Executive Order B-30-15, which establishes 40 % below 1990 levels by 2030 as an intermediate target towards the 2050 goals. The 2014 revised AB 32 scoping plan highlights the importance of local government in reducing emissions to achieve long-term statewide goals. In order to achieve California's 2050 emissions goal of 80% below 1990 levels, emissions must decline several times faster than the rate needed to reach the 2020 emissions limit. The 2017 revised scoping plan, per SB 32 and SB 197, is being developed to include 2030 targets and additional local guidance.

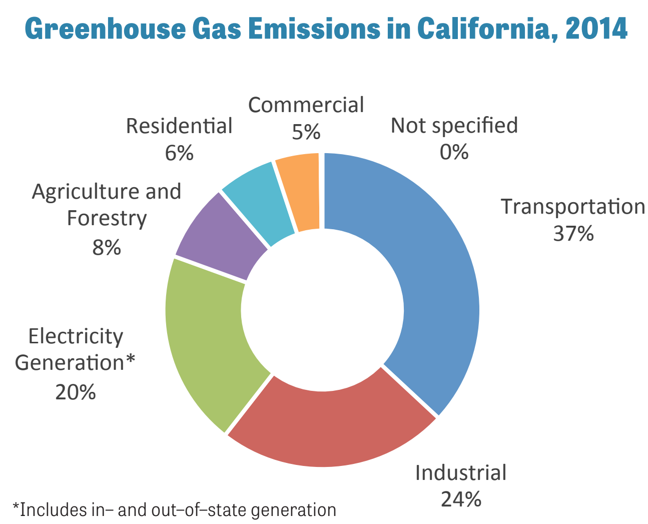
Transportation and electricity generation are the largest sources of the state's GHG emissions. State policies focus on reducing transportation emissions through cleaner fuels and promoting alternative access to destinations (e.g., walking, biking, transit, and carpooling). The state's goals for renewable energy and energy efficiency will also reduce emissions from electricity generation.

Figure 4: GHG Emissions Reductions Will Need to Occur at a Faster Rate to Achieve the State's 2050 GHG Emissions Reduction Target of 80 percent below 1990 levels, as established by EO S-3-05



Source: Data from California Air Resources Board

Figure 5: GHG Emissions in California Are Dominated by Emissions from Transportation and Electricity Generation (Data from: California Air Resources Board)



General Plan Basics

The purpose of a general plan is to guide land use planning decisions. Under state law, subdivisions, capital improvements, development agreements, and many other land use actions must be consistent with the adopted general plan. In counties and general law cities, zoning and specific plans are also required to conform to the general plan. In addition, preparing, adopting, implementing, and maintaining the general plan serves to identify the community's land use, circulation, environmental, economic, and social goals and policies as they relate to future growth and development.

2

The City of Fresno engaged in a robust four-year process to update its general plan, which focuses on encouraging new development within the existing footprint of the city. Citing past mistakes that left some neighborhoods behind and hoping to reverse sprawl patterns, the City used Rapid Fire – the predecessor to Urban Footprint – to engage the entire community in creating their new plan for future growth.

Source: www.fresno.gov

General Plan Elements

In statute, the general plan is presented as a collection of "elements," or topic categories (Gov. Code §65302). These elements are briefly summarized below. Examples from cities and counties in the state are embedded in the GPG with links throughout the document.

- **Land Use**: designates the type, intensity, and general distribution of uses of land for housing, business, industry, open space, education, public buildings and grounds, waste disposal facilities, and other categories of public and private uses.
- **Circulation**: correlates with the land use element and identifies the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals, and other local public utilities and facilities.
- **Housing**: assesses current and projected housing needs for all economic segments of the community. In addition, the housing element embodies policies for providing adequate housing and includes action programs for that purpose. By statute, the housing element must be updated every, five or eight years, according to a schedule set by the Department of Housing and Community Development (HCD).
- **Conservation**: addresses the conservation, development, and use of natural resources, including water, forests, soils, rivers, and mineral deposits.
- **Open Space**: details plans and measures for the long-range preservation and conservation of open-space lands, including open space for the preservation of natural resources, the managed production of resources, agriculture, outdoor recreation, and public health and safety.
- **Noise**: identifies and appraises noise problems within the community and forms the basis for land use distribution determinations.
- **Safety**: establishes policies and programs to protect the community from risks associated with seismic, geologic, flood, and wildfire hazards, as well as from other concerns such as drought.
- **Environmental Justice** (if completed as a stand-alone element): identifies objectives and policies to reduce pollution exposure, improve air quality, promote public facilities, improve food access, advance access to housing, and increase physical activity in identified disadvantaged communities.

- **Air Quality**: establishes policies and programs to reduce impacts to air quality in the San Joaquin Valley Air Pollution Control District. Air quality considerations are also required for cities and counties who are required to include an environmental justice element in their general plans, and are optional elements in other areas of the state.
- **Other optional elements, identified by community**: health, equity, community development, water, climate change, and resiliency are some examples of additional elements that can be added to general plans or used to frame general plans.

The level of discussion given to each issue in the general plan depends upon local conditions and the relative local importance of that issue. When a city or county determines that an issue specified in the law is not locally relevant, the general plan may briefly discuss the reason for that decision but does not otherwise have to address that issue (Gov. Code § 65301). A jurisdiction may choose to combine elements as appropriate for local context.

A general plan may also include other topics of local interest. In addition to the mandatory elements, a city or county may adopt any other elements that relate to its physical development (Gov. Code § 65303).

Once adopted, these optional elements become an integral part of the general plan with the same force and effect as the mandatory elements. Accordingly, zoning, subdivisions, public works, specific plans, and other areas that must be consistent with the general plan must also be consistent with any optional elements. Likewise, the practice of developing stand-alone climate action, adaptation, or emissions reduction plans , if properly linked to the general plan, must also be internally consistent if used to support or augment policy, programs and implementation associated with the general plan.

Common topics that might be addressed in an additional, separate element include air quality (outside the San Joaquin Valley), climate change, capital improvements, community design, healthy communities, economic development, energy, water, and watershed planning. Depending upon the format a jurisdiction decides to use for its general plan, these topics may also be crosscutting themes, addressing required and optional elements throughout each chosen section.

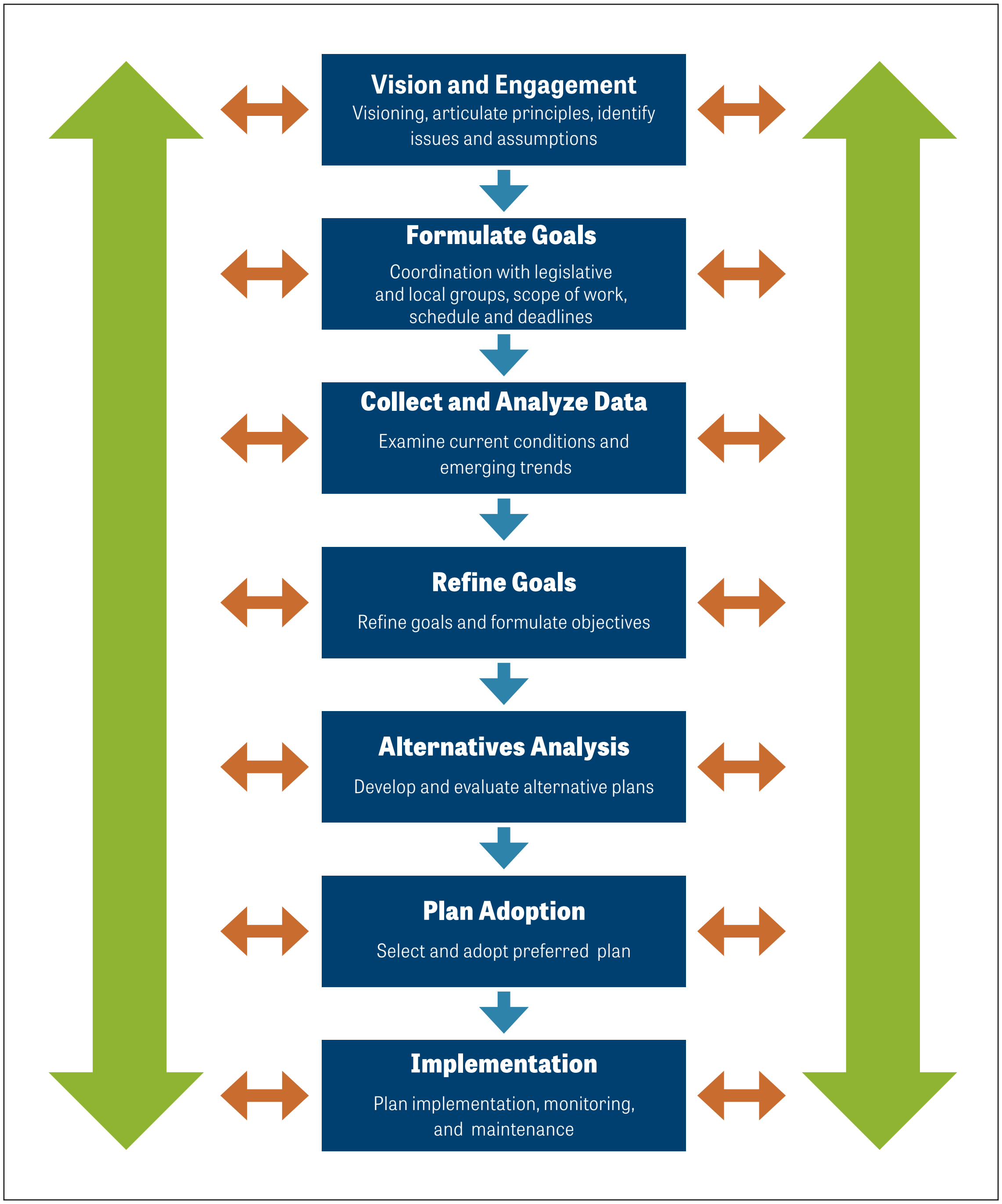
An optional element may indicate how a local government will apply its existing police power or other authority to address the issues included in the optional element. For example, a historic preservation element may lay the foundation for historic district regulations or participation in the California Main Street Program, or a strategic fire prevention planning element could identify wildfire hazard areas, control new development within those areas, and provide the basis for zoning, subdivision, and brush clearance ordinances intended to minimize fire hazards.

In the statutory descriptions of the elements, a number of issues appear in more than one element. In order to minimize redundancies or internal conflicts in the general plan, combining elements or organizing the plan by issue often makes practical sense. This idea is explored further in Chapter 1.

A number of state and federal laws, such as the Infrastructure Planning: Priorities and Funding Act of 2002 the Surface Mining and Reclamation Act of 1975, the California Endangered Species Act of 1970, and others can affect the content of the general plan. These laws are discussed in detail throughout these guidelines.

2

General Plan Flow Chart



Placemaking and Urban Design

While the general plan land use map is two dimensional, placemaking takes land use policies into a three-dimensional realm by focusing on what a place will actually look like when it is built. Great districts, corridors, and sites contribute to the vitality and quality of life of a community by considering carefully the placement of buildings, the relationship of buildings to one another and to public spaces, and the design and quality of sidewalks, open spaces, and other elements of the public realm. Many communities address placemaking and urban design through an optional element such as an urban design element. However, these policies can also be incorporated into a land use element as urban form is closely related to the location of land uses and land use densities and intensities. Urban design considers the relationship between land use and the image or character of the built environment with the ultimate goal of attaining a strong sense of place. Placemaking re-envisions a community's assets, spaces, and surroundings and their relationships to each other. Using extensive public participation, placemaking attempts to create public spaces that are useful, attractive, and utilized extensively by the community, who consequently feel ownership and pride in the space.

Form based codes may be one useful tool for achieving the placemaking and urban design visions of the community. Functioning as both zoning designations and design standards, form based codes focus on creating places by examining building types, standards, sidewalks, landscaping, and other relevant issues. The form based code approach is applicable to many types of communities and can be especially meaningful in suburban contexts seeking to instill a stronger sense of place in sprawl environments and in areas focusing on infill development. Placemaking is also important to carefully plan for the public realm.

Several cities have taken varied approaches to incorporate urban design and placemaking into their general plans and land use elements.

- The City of Fullerton developed The Fullerton Vision to identify 12 distinct focus areas within which to concentrate potential change through community-led planning processes.
- The City of Sacramento's Land Use and Urban Design chapter focused on creating complete neighborhoods, distinct and memorable places, and excellence in the design of the city's form and structure through development standards and clear design direction.
- The City of Tracy used a community character element in its general plan to develop urban design principles including human-scale design, community focal points, and visual landmarks and entryways.
- The City of Brea community development element contains an urban design plan with policies for creating a sense of place and policies for creating connections. The plan also includes a Public Realm Urban Design Palette which establishes direction for city-sponsored improvements of public property, including city gateways, landscape corridors, neighborhood linkages, and public plazas.

Criteria for the General Plan

General Plan criteria must include comprehensiveness, internal consistency, and long-term perspective, which are discussed below.

Comprehensiveness

Every city and county must adopt "a comprehensive, long-term general plan" (Gov. Code § 65300). The general plan must cover a local jurisdiction's entire planning area and address the broad range of issues associated with a city's or county's development. The overall general plan may also include linkages to regional plans, incorporating, where appropriate, regional policy and context.

Geographic Comprehensiveness

The plan must cover the territory within the boundaries of the adopting city or county as well as "any land outside its boundaries which in the planning agency's judgment bears relation to its planning" (Gov. Code § 65300). For cities, this means all territory within the city limits, both public and private. Counties must address all unincorporated areas.

When establishing its planning area, each city should consider using its sphere of influence as a starting point, and building off of that area based on factors such as its location in a watershed. The Local Agency Formation Commission (LAFCO) in every county adopts a sphere of influence for each city to represent "the probable physical boundaries and service area" of that city (Gov. Code § 56076). Although there is no direct requirement that the sphere of influence and the planning area match, the former provides a convenient measure of the city's region of interest.

When making its general plan, a county should consider the general plans of every city within the county itself as well as adjacent jurisdictions even if they are in a different county.

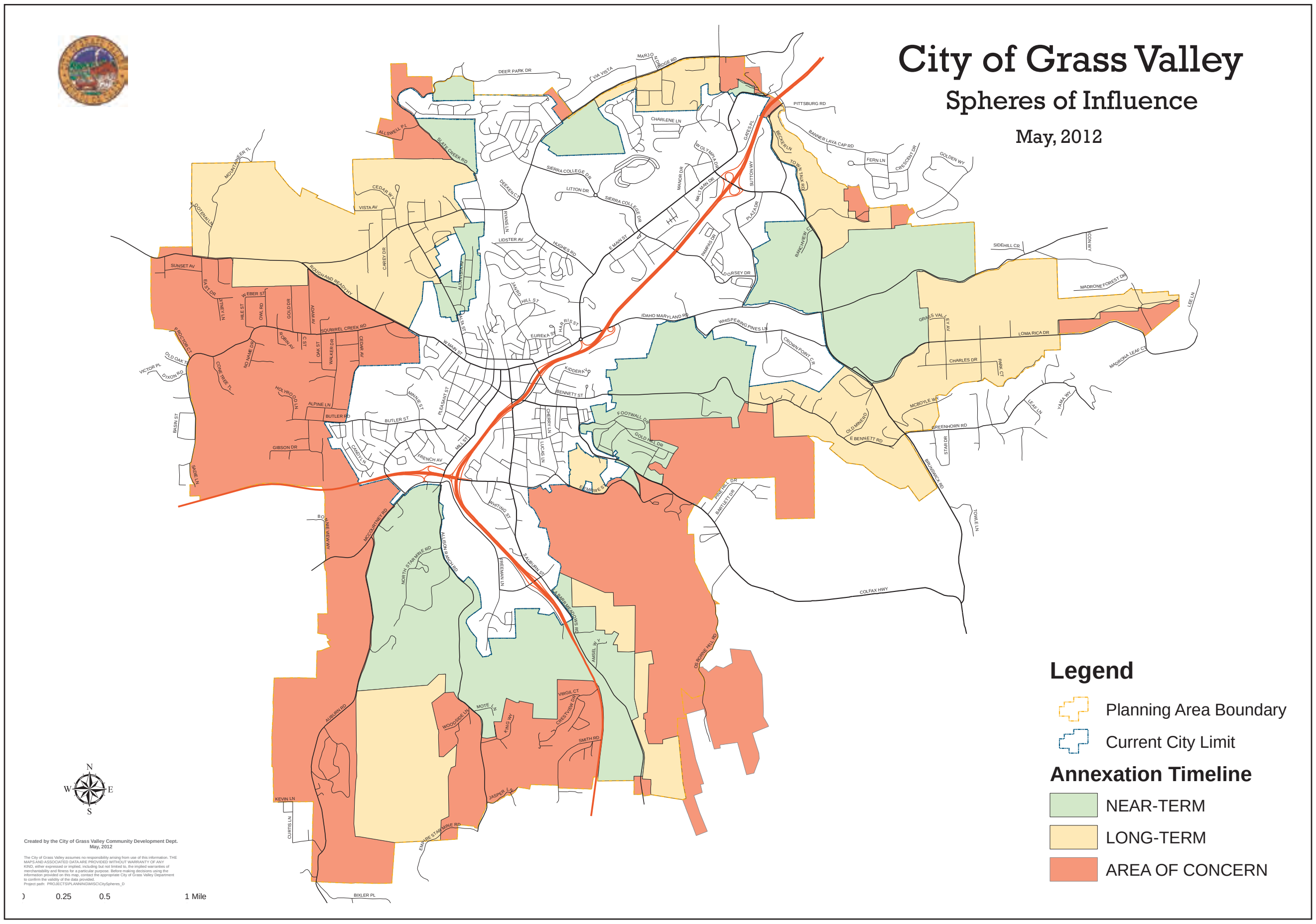
In addition, since issues are not confined to political boundaries, the law provides for planning outside of the jurisdiction's territory. Cooperative extraterritorial planning can be used to manage groundwater resources; guide appropriate development within specific geographic context (such as areas that may be affected by sea level rise as a result of climate change) and the orderly and efficient extension of services and utilities; ensure the preservation of open space, agriculture, and resource conservation lands; and establish consistent standards for development in the plans of adjoining jurisdictions.

Cities and counties should work together to delineate planning areas and may establish formal agreements for processing development proposals. As urbanization occurs and adjoining cities expand, the potential for conflict between cities competing for the same lands increases. Intercity cooperation in establishing planning areas can proactively help to avoid such disputes and avoid additional costs.

Regional Context

Viewing the local general plan in its regional context is important. Traditionally, the concept of "community" encompassed only a local entity—the city or county. With the growing interdependence of local governments, joint planning and procurement, and the increased prevalence of important issues that transcend local boundaries such as transportation, provision of energy, climate change, air quality, water supply and management, and floodplain and flood risk management, it is becoming more important to consider the regional perspective. Cities and counties should coordinate plans regionally when possible and appropriate, in

Figure 6: Map Showing Spheres of Influence for Grass Valley, CA



www.cityofgrassvalley.com/content/maps/sphere-influence-map

alignment with their sustainable community strategies, to work towards regional goals. For example, identifying risks from natural hazards and climate change may present opportunities for integrated resource management that extend across jurisdictional boundaries. Using available data –such as watershed-based floodplain management, mapped earthquake faults, or high fire-hazard areas, integrated water management plans (and new requirements for groundwater sustainability plans), sustainable community strategies, hazard mitigation plans, local coastal programs and other planning documents – will improve planning and expand opportunities. Each local planning agency should coordinate its general plan with regional planning efforts as much as possible. The general plan process allows local jurisdictions to integrate requirements with opportunities provided by multiple regional documents and initiatives.

The legislature has mandated consideration of certain regional impacts, such as regional housing needs, in the general plan. Local general plans should recognize the city or county's regional role so as to better satisfy regional needs, meet federal and state standards, and coordinate the location of public facilities. Accordingly, city planners should, like the City of Fullerton, include a discussion of the extent to which the general plan's policies, standards, and proposals correspond to regional plans and the plans of adjoining communities. A city or county may need to reexamine its own general plan when its neighbors make important changes to their plans.

Issue Comprehensiveness

While a general plan must address a broad range of issues, the plan should focus on those issues that are relevant to the planning area (Gov. Code§ 65301(c)). The plan must address the jurisdiction's physical development, such as general locations, appropriate mix, timing, and extent of land uses and supporting infrastructure. The broad scope of physical development issues may range from appropriate areas for building factories to open space for preserving endangered species. This may include regional issues in addition to the more localized issues described in the planning statutes.

Land use decisions not only have physical and environmental impacts, but also social and economic consequences, especially for vulnerable and disadvantaged communities. Recognizing these concerns in the general plan can help cities and counties plan for or mitigate them. Social and economic issues may be discussed within the context of the mandatory elements, such as environmental justice, housing, and land use, or in additional optional elements such as economic development or community health. Both methods are discussed in the GPG.

Internal Consistency

Internal consistency requires that no policy conflicts, either textual or diagrammatic, can exist between the components of an otherwise complete and adequate general plan such as internally referenced external documents like a climate action plan or a local energy assurance plan (Gov. Code § 65300.5). Different policies must be balanced and reconciled within the plan. The internal consistency requirement has five dimensions, described below.

Equal Status Among Elements

All elements of the general plan have equal legal status. In Sierra Club v. Board of Supervisors of Kern County (1981) 126 Cal.App.3d 698, two of Kern County's general plan elements, land use and open space, designated conflicting land uses for the same property. A provision in their general plan text reconciled this and other map inconsistencies by stating that "if in any instance there is a conflict between the land use element and the open-space element, the land use element controls." The court of appeals struck down this clause because it violated the internal consistency requirement under Government Code section 65300.5. This holding affirmed the principle that no element is legally subordinate to another; the general plan must resolve potential conflicts among its elements through clear language and policy consistency.

Consistency Between Elements

All elements of a general plan, whether mandatory or optional, must be consistent with one another. *In Concerned Citizens of Calaveras County v. Board of Supervisors* (1985) 166 Cal.App.3d 90, the county land use element contained proposals expected to result in increased population. The circulation element, however, failed to provide feasible remedies for the predicted traffic congestion that would follow. The county simply

> **"In construing the provisions of this article the Legislature intends that the general plan and elements and parts thereof comprise an integrated, internally consistent and compatible statement of policies for the adopting agency."**
>
> (Gov Code § 65300.5)

stated that it would lobby for funds to solve the future traffic problems. The court held that this vague response was insufficient to reconcile the conflicts.

Housing element law requires local agencies to adopt housing element programs that achieve the goals and implement the policies of the housing element. The element must identify the means by which consistency will be achieved and maintained with other general plan elements, including land use (Gov. Code § 65583(c)).

A city or county may incorporate by reference all or a portion of another jurisdiction's plan, a regional plan, or its own subsidiary plan, such as a climate action plan, into its general plan. When doing so, the city or county should make sure that any materials incorporated by reference are consistent with the rest of its general plan.

Consistency Within Elements

Each element's data, analyses, goals, policies, and implementation programs must be consistent with and complement one another. Established goals, data, and analysis form the foundation for any ensuing policies. For example, if one portion of a circulation element indicates that county roads are sufficient to accommodate the projected level of traffic while another section of the same element describes a worsening traffic situation aggravated by continued subdivision activity, the element is not internally consistent (*Concerned Citizens of Calaveras County v. Board of Supervisors* (1985) 166 Cal.App.3d 90)

Area Plan Consistency

All principles, goals, objectives, policies, and plan proposals set forth in an area or community plan must be consistent with the overall general plan.

The general plan should explicitly discuss the role of area plans if they are to be used. Similarly, each area plan should discuss its specific relationship to the general plan.

Airport land use compatibility plans must also be consistent with the general plan. Where appropriate, climate action plans should also be consistent with the general plan. Climate action plans can be created concurrently with or closely following a general plan update. However, if a local agency's resources do not allow for concurrent preparation of a general plan update and the climate action plan, general plans may be amended later to integrate all or part of the climate action plan.

Text and Diagram Consistency

The general plan's text and its accompanying diagrams and maps are integral parts of the plan. They must be in agreement. For example, a conflict exists if a general plan's land use element diagram designates residential development in an area where the text describes the presence of prime agricultural land and written policies to preserve agricultural land or open space. The plan's text and diagrams must be reconciled, because "internal consistency requires that general plan diagrams of land use, circulation systems, open-space and natural resources areas reflect written policies and programs in the text for each element."

Long – Term Perspective

Since the general plan affects the welfare of current and future generations, state law requires that the plan take a long-term perspective (Gov. Code § 65300). The general plan projects conditions and needs into the future as a basis for determining objectives. It also establishes long-term policy for day-to-day decision-making based upon those objectives.

The time frames for effective planning vary among issues. The housing element, for example, specifically involves time increments of five or eight years, according to the HCD schedule. Sewer, water, and road systems are generally designed with a 30- to 50-year lifespan. Capital improvement planning is typically based upon a five- or seven-year term. Economic trends may change rapidly in response to outside forces. Climate change is affecting local governments now, but longer term planning should anticipate the significant changes in the environmental setting associated with a changing climate as indicated by the best available science.

Differences in time frame also affect the formulation of general plan goals, objectives, policies, and implementation measures. Goals and objectives are longer term, specific policies are shorter in their outcomes, and implementation programs have the shortest span because they must quickly respond to the demands of new funding sources, the results of their own activities, and the jurisdiction's immediate needs and problems.

Most jurisdictions have selected 20 years as the horizon for the general plan. The horizon does not mark an end point but rather provides a general context in which to make shorter-term decisions. The local jurisdiction may choose a time horizon that serves its particular needs including a later horizon year time frame to address long term issues like climate change and land use. Planning is a continuous process; as such, the general plan should be reviewed regularly, regardless of its horizon, and revised as new information becomes available and as community needs and values change. With easier access to data, cities and counties have the opportunity to evaluate their general plans more often, link directly to responsible agencies, or monitor their process through data analysis or public dashboards. The City of Sacramento, for example, conducts annual reviews of their general plan as well as five-year updates to the document based on the annual assessments. These regular reviews and updates reduce the potential cost of a comprehensive rewriting of their general plan, while keeping it timely and relevant to community needs.

Considerations for General Plans

Area Plans, Community Plans, and Specific Plans

Area and community plans are part of the general plan. A specific plan is a tool for implementing the general plan but is not part of the general plan. The following paragraphs look briefly at each of these types of plans. In addition to consistency between plans, general plans must also be consistent with airport land use compatibility plans in specified regions, unless overridden by a two-thirds vote of the local government, pursuant to Public Utilities Code section 21676.

"Area plan" and "community plan" are terms for plans that focus on a particular region or community within the overall general plan area. A resolution is required to adopt an area or community plan as an amendment to the general plan, in the manner set out in Government Code section 65350. Such plans refine the policies of the general plan as they apply to a smaller geographic area and are implemented by ordinances and other discretionary actions, such as zoning. The area or community plan process also provides a forum for resolving local conflicts. Large cities and counties where there are a variety of distinct communities or regions commonly use these plans.

As discussed earlier, an area or community plan must be internally consistent with the general plan. To facilitate such consistency, the general plan should provide a policy framework for the detailed treatment of specific issues in the various area or community plans. Ideally, to simplify implementation, the area or community plans and the general plan should share a uniform format for land use categories, terminology, and diagrams.

Each area or community plan need not address all of the issues identified by Government Code section 65302 when the overall general plan satisfies these requirements. For example, an area or community plan need not discuss fire safety if the jurisdiction-wide plan adequately addresses the subject and the area or community plan is consistent with those policies and standards. While an area or community plan may provide greater detail regarding policies affecting development in a defined area, adopting one or a series of such plans does not substitute for regular updates to the general plan. Many of the mandatory general plan issues are most effectively addressed on a jurisdiction-wide basis that ties together the policies of the individual area or community plans.

A specific plan is a hybrid that can combine policy statements with development regulations (Gov. Code § 65450). It can be used to address the development requirements for a single project such as urban infill or a planned community. As a result, its emphasis is on concrete standards and development criteria. Its text and diagrams will address the planning of necessary infrastructure and facilities, as well as land uses and open space. In addition, it will specify those programs and regulations necessary to finance infrastructure and public works projects. A specific plan may be adopted either by resolution, like a general plan, or by ordinances such as zoning.

Specific plans must be consistent with all facets of the general plan, including the policy statements. In turn, zoning, subdivisions, and public works projects must be consistent with the specific plan (Gov. Code § 65455). Once a specific plan has been adopted, later projects may not require additional review (Cal. Code Regs., tit. 14, § 15182). The publication *A Planner's Guide to Specific Plans*, by the Governor's Office of Planning and Research (OPR), provides further information on relationships between plans.

Adoption of Another Jurisdiction's General Plan and Joint Adoption

A city or county may adopt part or all of a general plan of another public agency, or adopt a functional plan –such as a regional transportation plan, climate action plan or sustainable community strategy –prepared by a special district, regional planning agency, or some other public agency (Gov. Code § 65301(a)).

One of the benefits of this approach is that it eliminates duplication of effort in collecting data for more technical elements. A city and county may jointly prepare and separately adopt an entire general plan or individual elements within a general plan. Although joint adoption of another jurisdiction's plan or elements may be advantageous, a city or county remains solely responsible for the legal adequacy of its general plan. The other jurisdiction's plan and elements whether jointly prepared or not must be sufficiently detailed to address the concerns of the adopting agency and to provide adequate coverage of the issues required in the Government Code. A plan or element that is jointly prepared or adopted from another jurisdiction's general plan has the same legal standing as the rest of the adopting agency's general plan and internal consistency requirements continue to apply. Similarly, discretionary zoning, subdivision, and capital improvement project decisions must be consistent with the joint plan or element. One example is Government Code section 65302(g), which specifically provides that a city may adopt the county's safety element if the county's element "is sufficiently detailed and contains appropriate policies and programs for adoption by a city."

Funding a General Plan

Updating a general plan can be a costly exercise. The cost of preparing or revising the general plan will vary tremendously with the scope of the program and the jurisdiction's circumstances. A new plan or a comprehensive revision will be much more costly than a general plan amendment. For most jurisdictions, preparing and maintaining the general plan is a general fund expense. The availability of general purpose planning grants is limited. There are, however, federal and state funds for particular planning issues, such as housing, transportation, and habitat. These planning processes can be incorporated into the general plan process in order to leverage resources.

The cost of a general plan amendment associated with a particular development is typically passed on to the developer. Some jurisdictions attempt to recoup the costs of comprehensive updates in a similar manner. In 2002, the Legislature changed state law to allow development fees to include "costs reasonably necessary to prepare and revise the plans and policies that a local agency is required to adopt before it can make any necessary findings and determinations" (Gov. Code § 66014). This change makes it clear that an update of the general plan and related planning documents may be a recoverable expense.

Potential rotating sources of funding for portions of the general plan include:

- Choice Neighborhoods Planning Grants (US HUD)
  - » Grants for planning transformation of housing and surrounding built environment
- Brownfields Area-Wide Planning Grants (US EPA)
  - » Grants to research, plan and develop implementation strategies for an area affected by one or more brownfields
- TIGER Discretionary Grants (US DOT)
  - » Grants for local communities to plan and implement transportation in relation to other goals. Some annual cycles allocate funding for planning only.

The California Air Resources Board manages the Funding Wizard, which lists current funding opportunities for a broad variety of topics related to sustainabilty and climate change.

The US EPA Smart Growth National Funding Opportunities page houses a list of additional funding opportunities.

Despite the option to adopt another jurisdiction's general plan or to jointly adopt provisions of a general plan among multiple agencies, each adopting agency must retain its sole and independent authority to make amendments to its general plan unless the government approves a joint powers agreement. In *Alameda County Land Use Association c. City of Hayward* (1995) 38 Cal.App.4th 1716, the appellate court overturned a memorandum of understanding (MOU) adopted by Alameda County and the cities of Hayward and Pleasanton to specify general plan goals and policies regarding the "Ridgelands Area." The MOU provided that any amendment to the applicable sections by one jurisdiction would not be effective unless "parallel amendments" were approved by the other two. The court held this arrangement to be an impermissible divestment of the police power, restricting the individual agencies' legislative authority to amend their general plan.

3

Community Engagement and Outreach

Designing Healthy, Equitable, Resilient, and Economically Vibrant Places

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"Cities (and counties) have the capability of providing something for everybody, only because, and only when, they are created by everybody."

—Jane Jacobs

Introduction

Robust and inclusive community engagement is a vital component of drafting and updating a general plan. State law requires the local planning agency to provide opportunities for the involvement of the community. Such involvement should include public agencies, public utility companies, community groups, and others through hearings or other appropriate methods (Gov. Code § 65351). The law also requires that a jurisdiction make a diligent effort to include all economic groups when drafting, adopting and implementing its housing element (Gov. Code § 65583(c)(8)). For the purposes of this chapter, the term "update" will refer to adoption of new general plans as well as amendments to existing plans.

By law, cities and counties must hold at least two public hearings before adopting a general plan: one by the planning commission and another by the legislative body (either the city council or the board of supervisors) (Gov. Code §65353(a), §65355). Government Code section 65351 requires that during the preparation or amendment of a general plan, the planning agency must provide opportunities for community input through public hearings and any other means the planning agency deems appropriate. Specifically, Government Code section 65351 requires that the planning agency shall "provide opportunities for the involvement of citizens, California Native American tribes, public agencies, public utility companies, and civic, education, and other community groups." Government Code section 65357 requires that copies of the documents adopting or amending a general plan, including the diagrams and text, shall be made available to the public. The courts have found a general plan amendment invalid when it was not made available to the public (*City of Poway v. City of San Diego* (1991) 229 Cal. App. 3d 847, 861). Most planning departments, however, conduct more than the minimal number of hearings. Many jurisdictions undertake extensive outreach that exceeds the minimum statutory requirements. The spectrum of community engagement ranges from informing and consulting the public to involving, collaborating, and ultimately empowering local communities.

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A general plan update affects every aspect and member of the community. Broad participation – particularly direct or representative participation of local residents – will help achieve desired outcomes.

Many entities have recognized the ability of strong community engagement to improve local conditions, inform policy, enhance equity, and create better program outcomes. Community engagement as a process can also help strengthen community bonds. Creating the opportunity for community dialogue throughout the general plan update – while sometimes challenging – can result in a more informed plan with more public support.

As stated in Chapter 2, a general plan should start with a community's vision, but community engagement should continue throughout the process, from visioning to adoption and implementation, depending on the scope and extent of the project. A thorough update for an average-sized city typically requires at least one full year or more. The nature of the outreach process and its intended outcomes will differ in each stage of the update:

1. **Exploration**: The initial stages of outreach allow stakeholders to identify community strengths, assets, priorities for future development, and areas for improvement and, thus, to start the process of formulating a vision for the future. In addition, the exploration phase presents an opportunity to educate residents about land use planning principles prior to more extensive outreach.
2. **Collaborative Action**: After establishing a general baseline for community goals, planners should engage collaboratively with partners, considering different options for reaching the set goals and aligning policy priorities to attain the vision.
3. **Decision Making**: Exploration and collaboration should identify various policy priorities necessary for achieving the general plan vision. These priorities should then inform a framework to help identify policy options, choose among them, and assemble a draft plan.
4. **Monitoring and Evaluation**: Community engagement should continue after the plan is drafted. Updates on successful policy implementation and implementation challenges can be an opportunity to elicit feedback and help evaluate progress toward community goals.

Web-based engagement

Propel Vallejo developed a concise electronically available web document to highlight various planning options based on community input. By synthesizing all of the available information, the city created scenarios to elicit more input and inform the decision-making stage.

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This chapter discusses various issues planning departments may consider when designing a public engagement process. It also provides tools and lists resources to inform the outreach process and ensure community involvement, input, and support for the general plan. As illustrated by Figure 7 below, statutory requirements only require limited meetings and fall into the "inform" area on the engagement spectrum. However, many jurisdictions recognize the benefits of a more involved process, and offer more extensive engagement and collaborative opportunities. Some communities have even conducted such an extensive engagement process that it moves towards "empower" in the engagement spectrum. The scenario land use planning and data informed process in the Fresno and the Vallejo plans are examples.

Figure 7: Public Engagement Spectrum

INCREASING IMPACT ON THE DECISION →

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.

http://c.ymcdn.com/sites/www.iap2.org/resource/resmgr/foundations_course/IAP2_P2_Spectrum_FINAL.pdf

Process Design

Designing the outreach process before starting a general plan update helps ensure adequate input from various stakeholders. Unexpected events can occur during an update, including changes in elected leadership, funding, and staff. Having an outreach plan in place will help keep the process on track. In addition to any organized participation activities, the Brown Act requires that meetings of appointed advisory committees, planning commissions, and local legislative bodies be public. This section provides guidance for developing an outreach plan.

Establish an Outreach Strategy

Establishing a road map to plan public engagement efforts may help guide outreach throughout the process. Local jurisdictions vary tremendously throughout California, and engagement strategies will also vary based on local circumstances. Local communities should help define the outreach strategy most relevant to their needs. There are some issues to consider across planning for all areas, however. These include:

- Funding available for engagement activities, including translation services as needed
- Timeline for activities
- Expectation setting for stakeholders

- Staff time, knowledge, and other expertise necessary to conduct outreach and education
- Communication tools available
- Process to ensure efforts are transparent, accessible, and fun
- Methods available to capture and record dialogue at outreach events
- Variety of meeting spaces
- Methods to continue engagement after the initial process has been completed

Some helpful tools in outreach include:

Oversight Responsibility

Assigning a staff member to oversee and be responsible for the engagement and outreach process will ensure dedicated attention to this important procedural step.

Advisory Committee or Board

Establishing a diverse advisory board or committee comprised of experts and community members can be helpful throughout the general plan update process. An advisory body can provide insight as to how to reach multiple populations, address potentially controversial issues, understand sensitive community needs, and represent a greater portion of the community. Establishment of the advisory body early in the process allows the board to inform the general outreach strategy from the beginning. An advisory board can also establish what community engagement will include for its own jurisdiction, and how community and stakeholder input is handled and communicated back to the public. Additionally, an advisory body can help build community capacity on issues such as data use and evaluation, as well as the historical context of land use planning. A manageably sized advisory body – around 10 people with an effective facilitator – should include multiple voices from the community and represent its diversity. General plan advisory board members should be drawn from the broad range of communities that exist within a jurisdiction to represent the varied interests that the public engagement process hopes to capture and to inclusively inform and enhance the general outreach strategy.

The following categories of advisory body members should be considered:

- Business leaders and/or representatives from chambers of commerce
- Representatives from the technology sector
- Local agency leaders, including water agencies, fire departments, law enforcement, parks and recreation, health officers, public works leads, and others
- Community development leaders
- Health leaders
- Representatives and advocates from various income groups, special needs populations, and neighborhoods in the jurisdiction

- Multi-lingual representatives
- State and/or federal agency leaders, if the jurisdiction has a high proportion of public lands
- School representatives
- Faith-based community representatives
- Agriculture and food system representatives
- Environmental justice representatives
- Academics
- Local philanthropic organizations
- Individual community leaders

Survey of Overlapping Efforts

Multiple public engagement processes may be in progress simultaneously. For instance, outreach to solicit input on an application for grant funding may occur at the same time as outreach for an update of the general plan. Concurrent outreach processes can confuse participants; and this confusion poses a potential challenge for recruitment and involvement. Additionally, other public or private agencies – for example, departments of parks and recreation, hospitals, departments of public health, or non-governmental organizations – may be conducting outreach simultaneously. Increased awareness of ongoing efforts to gain input can help avoid overlapping or conflicting outreach efforts and might even allow outreach sessions to be combined.

Scale

Outreach for a county's general plan is a much larger undertaking than for a city's due to the broader catchment area. Stakeholders may also have less of a perceived stake in the process because county general planning is further removed from their local jurisdiction. Sharing how information will be incorporated into the planning process can relate the importance of participation and increase community input.

Partnership

All affected stakeholders should be represented in any public participation process. In a general plan process, this is the entire community. Partnership with various stakeholders also provides the opportunity to establish paid or unpaid volunteers to work within the community during the outreach process. Stakeholder groups in the general plan process may include:

- Community and neighborhood groups
- School districts, charter schools, and county offices of education
- County transportation commissions
- Utilities and public service providers of:
  - » Energy

- » Water, including water supply and wastewater. These entities involve flood/stormwater districts, regional water management groups, (groundwater sustainability agencies (GSAs), reclamation districts, etc.
- » Telecommunications
- » Waste

Engaging more members of the community helps ensure a general plan that serves the needs of all residents

Source: http://www.futour.it/english/?p=48

- Regional groups that can identify synergies with other regional efforts
- Affordable housing and special needs population representatives and advocates
- Non-profit and for-profit builders
- State and federal partners, as appropriate
- Educational institutions
- Industry and business
- Civic and community service organizations
- Non-governmental organizations
- Religious communities
- Existing boards and commissions, such as planning boards, departments of parks and recreation, etc.
- Other public agencies
- Topical experts:
  - » Groups working on climate change
  - » County health departments
  - » Environmental justice groups

Tribal leaders

Innovation or technology officers

Local food groups

Agricultural community members

Tribal Consultation

When adopting or amending a General Plan, or designating open space, local governments must consult with California Native American tribes traditionally affiliated with the general plan area for the purpose of preserving or mitigating impacts to places, features, and objects described in Sections 5097.9 and 5097.993 of the Public Resources Code that are located within the city's or county's jurisdiction (Gov. Code § 65352.3, 65562.5). For more information about this consultation requirement, see the Governor's Office of Planning and Research's Supplement to the General Plan Guidelines, the Tribal Consultation Guidelines.

Cultural Considerations

Cultural differences may be present between and among professional groups as well as between and among community members. Reaching out to different professional groups and organizations not traditionally involved in planning may present additional challenges and opportunities. Understanding different interaction norms, priorities, levels of comfort with professional terminology, and expectations for project completion is essential to a productive process.

It is important to consider cultural diversity throughout the design of the community engagement process, including both overt differences, such as literacy level, socioeconomic status, and language, and more nuanced differences such as local history and cultural norms. Designing a process that is sensitive to all these considerations may help encourage broader, more equitable, and more informed participation.

To ensure equitable outreach, the following factors should be considered:

Literacy Level: It may be more difficult to reach out to Limited English Proficient (LEP) individuals, immigrant communities, or people with lower educational attainment. Planning agencies should design outreach materials and events to accommodate different literacy levels and provide background information when referring to complex concepts. Avoid the use of acronyms where possible.

Socioeconomic Status: Groups with lower socioeconomic status are often disproportionately affected by environmental hazards while facing greater barriers to participation in efforts to remediate them. These barriers may be addressed by considering factors such as location and timing of outreach, accessibility by public transportation, availability of childcare, and availability of food. Reviewing demographic information, such as the data available in the American Community Survey (ACS), can help identify the potential needs of each community.

Language: All communication should be done in the major languages spoken in the community. This includes any advertising and written background materials as well as live interpretation at key public events. Some documents, such as the draft general plan or the draft environmental impact report, may be infeasible to translate in their entirety. In such cases, the planning agency should consider translating an executive summary into the major languages spoken in the community. Interpreters should be available at meetings when it is clear that non-English speaking members of the community will be present. Many local non-profit organizations can provide minimal or low cost services for public benefit.

Age: Aging populations have specific needs that should be addressed to capture their input in the process. Considering time of day and location of events, as well as Americans with Disabilities Act (ADA) access to events and services available at the locations, will help include more elderly residents. The needs of young residents must also be considered, including outreach methods that benefit multiple groups such as social media and online platforms, location access and amenities, and innovative tools for discussion at events.

Local History: Certain communities may have participated in previous outreach efforts that did not result in change. Over time, either not being included or participating and/or not feeling utilized may affect future participation. Understanding the local context is helpful prior to beginning outreach. Fostering dialogue around racial inequities that have existed in the land use context can be challenging. Jurisdictions have started to engage with skilled facilitators to have conversations that advance participation and engagement opportunities. In particular, specific outreach to tribal governments should be considered.

Cultural Norms: California is rich in diversity. Each city and county across the state is comprised of different ethnic groups from around the world. From 1980-2010, the percentage of people of color, for example, increased from 33.4 percent to 59.8 percent, and is expected to increase to 73.3 percent by 2040. Some community members may not be as familiar with the democratic form of government and the ability to openly share opinions; others may be accustomed to different gender roles, or may be fearful to have conversations and dialogue recorded. It is hard to learn all of the cultural nuances for each group in the community, but working in partnership with local non-profits or other groups skilled at working across cultures can help ensure all groups are able to participate in a meaningful outreach process.

Outreach Structure

Community members and other stakeholders have many competing interests and limited time. Allowing different levels and types of involvement in the process can help foster participation. For example, going to places where people already gather—a community health center, a street fair, a cultural event, a public event at a local religious or community center, or a community event at a local school—may allow attendees to give input without a large time commitment. This is an especially helpful mode of outreach when looking for feedback on specific topics, such as health, equity, and environmental justice. Meeting stakeholders in locations they are familiar and comfortable with can also help to bridge cultural and trust gaps. Other more time-intensive activities, such as focus groups, charrettes, and workshops, can be made available for stakeholders who are interested in providing more in-depth input. The structure of outreach is also important for transparency and continuing communication throughout the process of a plan update. Ongoing information sharing can help maintain community relationships and build trust in the process, especially if culturally appropriate communication methods are used. Web-based communications, for example, may exclude stakeholder groups without regular access to the Internet, and should be supplemented by other methods for greater reach across groups.

Data

Data and data visualizations can be powerful tools to catalyze community engagement. Some local jurisdictions have used maps with geospatial data and charts to examine transit routes, map community assets and risks, or share health outcome information to allow community members to understand planning in a tangible way. Data presentations should be tailored to their specific audience. For instance, some members might want specific details, including how the data are generated and collected. Other stakeholder groups may only be interested in general associations and how the data fit into the process. Missing data should be considered alongside existing data. Including funds in the budget to collect data as the general plan process proceeds will help address identified gaps in data availability.

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There are also methods to allow community members to collect local data themselves. Tools such as walk audits, surveys of building types, and community photos help communities envision improvement while increasing potential participation. Considering how these data are valued – versus other data sets and sources such as traditional data, including how much weight they will carry in the process and how public contributors will be incorporated – is important to help ensure improved community data and input.

On the Horizon

As technology has advanced in the private sector, people have become accustomed to using the Internet and their personal cell phones to locate services, buy products, fund projects through crowdsourcing, and share their lives on social media. This constant and immediate interaction is changing the cultural norms for level of involvement with business, other community members, and, ultimately, with government agencies. Groups such as Code for America build open source technology to improve access to government services. Some places are starting to allow citizens to use personal cell phones to do surveys of local conditions, tweet responses to proposed policy options, or even provide their commentary online for local city council meetings rather than participate in person. As more local jurisdictions create positions for innovation officers and facilitate new ways of interacting with local government, planning departments will likely have new opportunities for engagement. However, jurisdictions should not ignore age and cultural differences in the rate of adoption of new technology as potential methods of engagement increase. As with any strategy, balancing alternative methods and using various tools to engage diverse perspectives will help increase input and prevent unintentional exclusion of community members.

Technology continues to create new methods of engaging the community in analysis and decision making

Source: https://www.pexels.com/search/analytics/

Partnering for increased engagement in Salinas

In fall 2013, the City of Salinas initiated an Economic Development Element (EDE) planning process. The City's initial goal was to position Salinas for outside investment to become the agricultural technology capital. However, when the City asked local community based organizations (CBOs) about their economic development priorities, multiple new topics emerged including training for transitioning agricultural workers; reducing poverty; support for local entrepreneurs and small businesses; more childcare facilities; education and youth development; and tracking the city's economic indicators by neighborhood, race/ethnicity, and income group.

The CBOs also wanted improved community engagement for the EDE process. Early activities required a technical understanding which intimidated numerous residents (and CBOs) into not participating. While 75% of Salinas residents identify as Latino and 66% of residents speak Spanish at home, the workshop presentations and materials were all in English with limited Spanish interpretation assistance. The collaborative Building Healthy Communities

– East Salinas (BHC), identified this need and entered an MOU with the City to provide additional engagement opportunities tailored to the Latino residents in East Salinas (93% Latino).

This supplemental effort consisted of a pop-up workshop, a community workshop, and house meetings to learn about East Salinas residents' challenges with employment, education, shopping, and businesses. Additionally, BHC convened bi-weekly meetings with coalition members so they could collaboratively provide support and feedback to the City on engagement and policy proposals.

The BHC-led pop-up workshop's materials and hosts were bilingual and activities included a vision photo booth, goal prioritization dot exercise, and posters that asked people for ideas about "Small Businesses, Entrepreneurship and Innovation" and "Youth Development." The activities did not require any prior knowledge of the planning process or of economic development policy. A few months later, BHC and the Monterey County Health Department co-hosted a community workshop in East Salinas, held in Spanish with English translation. Activities framed EDE topics at an individual or household level making the discussion accessible to all attendees. Community leaders also organized, facilitated, and summarized small house meetings in Spanish to hear from many undocumented and mono-lingual Spanish-speaking families. From these activities, the resident's and business owners and workers articulated their dreams for their families and Salinas youth.

BHC's involvement in the process shifted the EDE's framework, promoted inclusion of policies with a health and equity framework, and created an entire quality of life section in the element. Evaluation metrics were modified to show breakdowns by race and ethnicity and include health and quality of life indicators. This process demonstrated that East Salinas residents have valuable contributions when culturally-appropriate community engagement opportunities are available. The City now sees BHC and other local CBOs as partners and allies. City of Salinas Planning RFPs now include requirements for processes to include fully bi-lingual and collaborative planning processes.

Source: Beth Altshuler, Raimi + Associates; Building Healthy Communities — East Salinas; and City of Salinas

Engagement Tools

There are a wide variety of engagement tools that can be used to inform and engage the community in a public participation process. Tools should be chosen based on the needs, strengths, and resources of the community. Using multiple techniques can help to reach a wider range of community residents. Community members who help develop the general plan may become champions throughout the process, helping carry the plan through adoption and implementation. Below are examples of different tools that may be employed.

Meetings, Workshops, and Events

Well-timed meetings help solicit input and keep participants informed. Ensuring that meetings and outreach activities are held at a variety of times and locations—after work hours, on weekends, or at facilities that are easily accessible via public transit—helps increase potential participation. Meeting types can vary depending on a variety of factors, including the meeting's purpose or its participants. In addition to regular meeting structures, project leads can use innovative methods such as story telling, games, or white board activities to capture input. Meeting types include, but are not limited to:

- Public hearings
- Town hall meetings
- Open houses
- Events in non-traditional places, such as farmers' markets, churches, health fairs, school events, and community fairs
- Panel discussions
- Neighborhood meetings
- Meetings of civic organizations, such as chambers of commerce
- Focus groups
- Small in-home meetings

Activities

Activities are a helpful tool to expand thinking and demonstrate new opportunities and possibilities. For example, conducting a "walk audit," where local residents physically walk around as a group and collect standardized information about the condition of the built environment, could highlight infrastructure and safety needs. Activities can also provide group-learning opportunities and build relationships between community members and planning and consulting staff.

Tours

Tours to other cities and counties can show decision-makers and participants examples from other communities and help them visualize ideas for their own community. Tours within an agency's own jurisdiction are also a good way to experience parts of the city or district with which participants may be less familiar. Organized tours of recent or proposed projects within the community may also provide a good basis of discussion for decision makers and participants.

Open Houses

Open houses can allow community members to view plan proposals, data, and maps in a casual environment that allows people to come and go as their schedules allow. Open houses can be held at a church, school, community center, local business, or other location easily accessible to the public. Planners and visitors should be able to talk informally about the planning process, with translators present as necessary. Open houses can be combined with other tools, such as written or visual surveys.

Community Image Surveys and Photo Voice

Photos can be a powerful engagement tool to change the built environment. Various methods have been used with photos. Community Image Surveys are a visual preference method that are scored and used to assess preferences. Photovoice is a participatory method where users can capture elements about the environment and use them as a starting point for a discussion about their community.

Design Charrettes

Design charrettes are interactive, visual, and time-intensive events where the public can participate with interdisciplinary teams of planners, architects, engineers, and artists, as well as each other. While charrettes are often used for specific plans and individual projects, they can also help community members visualize what they want their community to look like. These preferences can then be translated into general plan goals and specifications.

Web Based Meeting and Engagement Tools

Webinars, online conferences, and Internet collaboration tools allow for easy, convenient engagement with the public. People with busy schedules, families, or limited mobility may find participation simpler via web-based tools where they can enter questions or comments based on their own availability. Web-based tools range from simple online webinars or meetings to open forums, documents with commenting capability, and collaborative images for visioning. While some community members may not have access or interest in using online tools, including them in an engagement strategy may increase participation.

Mailings – email and regular mail

Mailings can be used to advertise process, request input, or share information. Per Government Code sections 65091 and 65092, some notices must be mailed in prescribed ways, but in all other situations the types of mailing used should be based on the desired input goals. Mass surveys or opinion mailings work well to broaden the range of participants in the process and can also share information about process scope, timelines, website links, data availability and other issues. Newsletters work to keep the public updated on the process as well. Some communities utilize existing mailing services, such as utility bills, to reduce costs.

Surveys

Surveys are most often used in the beginning of a general plan process to help identify community issues and concerns and to identify residents' opinions about the strengths and weaknesses of their community. A survey can help identify issues to be addressed by the general plan and areas where residents would like more information. A good survey includes the public early in the process, broadens the range of participants by including residents who do not come to meetings, and publicizes the general plan process. A statistically valid survey of local opinion, while more difficult to conduct, can be persuasive to decision makers and the public. Including demographic questions in a survey will help identify any inequities in response rates and detect important differences in opinions among groups.

There are a number of methods available to improve access and equity in surveys. Pilot testing the survey instrument with an advisory group or with a diverse group of pilot subjects may improve the form. The survey should be piloted in every language in which it will be offered to ensure that translations are conveying the intended information. While this will add time to the process, it may ultimately yield more accurate results and improve public perception of the data. Door-to-door surveys may also be an effective outreach method and can yield a higher response rate than traditional mail surveys.

Additionally, soliciting feedback on data interpretation may be useful before finalizing analyses. Because different interests may interpret the same data in multiple ways, providing an opportunity for discussion, feedback, and suggestions on how to analyze results may provide a stronger sense of transparency and trust in the process.

3

Beyond outreach

Conducting outreach with communities before and during the general plan update is key to having a more informed plan. Capturing input along the way is important for presentations back to city councils and county boards of supervisors to show how the plan is informed by community input. Beyond initial outreach, it is also important to have a mechanism in place to communicate with stakeholders who were involved during the update process, so they are aware of how their input was incorporated into the plan. Mechanisms to keep track of progress after the plan has been adopted have been well received in communities.

Jurisdictions have used different mechanisms to do this work. Some jurisdictions have assigned the various components of the general plan to different departments, allowing stakeholders to follow progress based on goals that align with the adpoted goals of existing agencies.

4

Required Elements

Designing Healthy, Equitable, Resilient, and Economically Vibrant Places

"A city (or county) is not an accident but the result of coherent visions and aims."

—Leon Krier, ***The Architecture of Community***

Quick Links to Individual Elements

Land Use	**Conservation**	**Noise**	**Environmental Justice**
Circulation	**Open Space**	**Safety**	**Air Quality**
Housing			

Introduction

All statutory references are to the California Government Code unless otherwise noted.

While a general plan will contain the community vision for future growth, California law also requires each plan to address the mandated elements listed in Government Code section 65302. The mandatory elements for all jurisdictions are land use, circulation, housing, conservation, open space, noise, and safety. Cities and counties in the San Joaquin Air Pollution Control District must also address air quality in their general plans. Cities and counties that have identified disadvantaged communities must also address environmental justice in their general plans, including air quality. The purpose of the following sections is to outline the content of each element as required by statute.

Relationships Among Elements and Issues

This chapter presents each of the mandatory elements separately. There is no requirement that a general plan be organized into separate elements, however, and planners should consider local context in general plan preparation. A jurisdiction may organize its general plan in any format, including consolidated elements, so long as all of the relevant statutory issues are addressed (Gov. Code § 65301; Kings County Farm Bureau v. City of Hanford (1990) 221 Cal.App.3d 692). The elements and issues should form an integrated, internally consistent plan, and inconsistencies cannot be remedied by a statement giving one element precedence over the others (Gov. Code § 65300.5; Sierra Club v. Board of Supervisors of Kern County (1981) 126 Cal.App.3d 698). A concise general plan can avoid repetitive discussions of topics by consolidating the statutory requirements into a few functional elements. When revising a single element, local agencies should examine and, if necessary, revise the other elements, including optional elements, to avoid internal inconsistencies. The statutory elements call for interrelated content. For example, consideration given in the conservation element to the vegetation that supports an endangered wildlife species also involves analyzing topography, weather, fire hazards, availability of water, and density of development—issues which arise in other elements as well. The table on the following page illustrates the potential relationships among the mandatory elements and the issues addressed in a general plan. Not every general plan will address these issues to the same extent or in the same manner. Cities and counties should design their general plan format to suit the topographic, geologic, climatologic, political, socioeconomic, cultural, and historical diversity of their community. Each section in this GPG document will also highlight the relationships between the elements.

Topics, Elements	Land Use	Circulation	Housing	Conservation	Open Space	Noise	Safety	Environmental Justice
Agriculture	IN STATUTE	-	IN STATUTE	RELATED	IN STATUTE	-	RELATED	RELATED
Air Quality	RELATED	RELATED	RELATED	-	RELATED	-	RELATED	IN STATUTE
Airports	RELATED	IN STATUTE	RELATED	-	RELATED	IN STATUTE	RELATED	RELATED
Bicycle and Pedestrian Routes	RELATED	IN STATUTE	RELATED	-	-	-	RELATED	RELATED
Climate Change (Adaptation)	RELATED	RELATED	RELATED	RELATED	RELATED	-	RELATED	RELATED
Climate Change (GHG Emissions)	RELATED	RELATED	RELATED	RELATED	RELATED	-	RELATED	RELATED
Density	IN STATUTE	RELATED	IN STATUTE	-	-	-	RELATED	RELATED
Education	IN STATUTE	RELATED	RELATED	-	-	-	RELATED	RELATED
Social Equity	RELATED	RELATED	RELATED	RELATED	RELATED	RELATED	RELATED	RELATED
Environmental Justice	RELATED	RELATED	IN STATUTE	-	-	-	RELATED	IN STATUTE
Fire	RELATED	-	IN STATUTE	-	IN STATUTE	-	IN STATUTE	RELATED
Fisheries	RELATED	-	-	IN STATUTE	IN STATUTE	RELATED	RELATED	RELATED
Flooding	IN STATUTE	RELATED	IN STATUTE	IN STATUTE	-	-	IN STATUTE	RELATED
Food Access	RELATED	RELATED	RELATED	-	-	-	RELATED	IN STATUTE
Forests/Timber	IN STATUTE	RELATED	-	IN STATUTE	IN STATUTE	-	RELATED	RELATED
Health	RELATED	RELATED	RELATED	RELATED	RELATED	RELATED	RELATED	IN STATUTE
Housing	IN STATUTE	RELATED	IN STATUTE	RELATED	RELATED	RELATED	RELATED	IN STATUTE
Industrial Uses	IN STATUTE	RELATED	RELATED	-	-	IN STATUTE	RELATED	IN STATUTE
Land Reclamation	-	-	-	IN STATUTE	-	-	RELATED	RELATED
Land Use	IN STATUTE	IN STATUTE	IN STATUTE	IN STATUTE	RELATED	IN STATUTE	IN STATUTE	RELATED

■ Identified in statute ■ Closely related to statutory requirements

Topics, Elements	Land Use	Circulation	Housing	Conservation	Open Space	Noise	Safety	Environmen-tal Justice
Military Compatibility	IN STATUTE	RELATED	RELATED	RELATED	RELATED	RELATED	RELATED	RELATED
Minerals	RELATED	RELATED	-	IN STATUTE	IN STATUTE	-	RELATED	RELATED
Noise Contours	RELATED	IN STATUTE	RELATED	-	-	IN STATUTE	-	RELATED
Public Buildings	IN STATUTE	RELATED	RELATED	RELATED	RELATED	RELATED	IN STATUTE	RELATED
Railways and Yards	RELATED	IN STATUTE	RELATED	-	-	IN STATUTE	RELATED	RELATED
Recreation	IN STATUTE	RELATED	-	RELATED	IN STATUTE	-	RELATED	IN STATUTE
Scenic Resources	IN STATUTE	RELATED	RELATED	RELATED	IN STATUTE	RELATED	-	RELATED
School Siting	IN STATUTE	RELATED	RELATED	-	RELATED	RELATED	IN STATUTE	RELATED
Seismic Hazards	RELATED	RELATED	RELATED	RELATED	IN STATUTE	-	IN STATUTE	RELATED
Soil Conservation	RELATED	RELATED	RELATED	IN STATUTE	IN STATUTE	-	-	RELATED
Soil Instability	RELATED	RELATED	RELATED	-	-	-	IN STATUTE	RELATED
Transportation Routes	RELATED	IN STATUTE	IN STATUTE	RELATED	IN STATUTE	IN STATUTE	IN STATUTE	RELATED
Transportation Terminals	RELATED	IN STATUTE		IN STATUTE	-	RELATED	RELATED	RELATED
Utilities/ Easements	RELATED	IN STATUTE	RELATED	RELATED	IN STATUTE	RELATED	RELATED	RELATED
Waste Facilities	IN STATUTE	RELATED	IN STATUTE	-	-	RELATED	RELATED	RELATED
Water Quality	RELATED	-	-	IN STATUTE	IN STATUTE	-	RELATED	RELATED
Water Supply	RELATED	-	IN STATUTE	IN STATUTE	IN STATUTE	-	IN STATUTE	RELATED
Watersheds	RELATED	-	RELATED	IN STATUTE	IN STATUTE	-	RELATED	-
Waterways/Water Bodies	RELATED	-	RELATED	IN STATUTE	IN STATUTE	RELATED	RELATED	-
Wildlife	RELATED	RELATED	RELATED	IN STATUTE	IN STATUTE	-	-	-

■ Identified in statute ■ Closely related to statutory requirements

Regardless of which format a general plan takes, the content must form an integrated, internally consistent plan (*Sierra Club v. Board of Supervisors of Kern County* (1981) 126 Cal.App.3d 698).

Mandatory Element Format

The Government Code requires OPR to "develop and adopt guidelines for the preparation of and the content of the mandatory elements required in city and county general plans" (Gov. Code § 65040.2). According to the Government Code, the guidelines shall be "advisory to each city and county in order to provide assistance in preparing and maintaining their respective general plans" (Gov. Code § 65040.2(c)).

These Guidelines present the statutory elements in the order that they appear in Government Code section 65302. This order should not be construed as a ranking of importance or the order in which a jurisdiction should prepare elements. Elements can be prepared in any order or combined, as discussed in.

For a glossary of terms and a description of the parts of a general plan, see Appendix E.

4

Land Use Element

Introduction

The most fundamental decisions in planning begin with land use: what to put where. Land use planning envisions the future of a city or county and interacts with all other elements of planning. At its best, the land use element will reflect the community's vision; promote thoughtful, equitable, and accessible distribution of different land uses, including residential, commercial, industrial, agricultural, and open space; and align well with other general plan elements. Planners can also use the land use element as a tool to improve public health, reduce infrastructure costs, enhance local economies, and address long-term environmental issues such as climate change and water resources.

The land use element can also help resolve conflicts and identify trade-offs in land use decisions. For example, increasing density may result in a higher population, but it can also help enhance water supply reliability, reduce long-term costs of infrastructure maintenance, improve water use efficiency, land conservation, housing and transit options, and equity. Designating "least-conflict" areas for solar development may increase energy independence and generate local economic benefits while also preserving valuable agricultural lands. Pursuing urban infill projects may require higher intensity development directed at a limited number of parcels varying in suitability, but infill may also allow for more accessible transit and walkability thus reducing vehicle miles traveled and subsequent greenhouse gas emissions. Identifying and resolving such issues in the land use element can result in development patterns that are predictable, coherent, and reflect community values.

> Gov. Code § 65302 (a) A land use element that designates the proposed general distribution and general location and extent of the uses of the land for housing, business, industry, open space, including agriculture, natural resources, recreation, and enjoyment of scenic beauty, education, public buildings and grounds, solid and liquid waste disposal facilities, greenways as defined in Section 816.52 of the Civil Code and other categories of public and private uses of land. The location and designation of the extent of the uses of the land for public and private uses shall consider the identification of land and natural resources pursuant to paragraph (3) of subdivision (d). The land use element shall include a statement of the standards of population density and building intensity recommended for the various districts and other territory covered by the plan. The land use element shall identify and annually review those areas covered by the plan that are subject to flooding identified by flood plain mapping prepared by the Federal Emergency Management Agency (FEMA) or the Department of Water Resources. The land use element shall also do both of the following:
>
> (1) Designate in a land use category that provides for timber production those parcels of real property zoned for timberland production pursuant to the California Timberland Productivity Act of 1982 (Chapter 6.7 (commencing with Section 51100) of Part 1 of Division 1 of Title 5).

(2) Consider the impact of new growth on military readiness activities carried out on military bases, installations, and operating and training areas, when proposing zoning ordinances or designating land uses covered by the general plan for land, or other territory adjacent to military facilities, or underlying designated military aviation routes and airspace.

(A) In determining the impact of new growth on military readiness activities, information provided by military facilities shall be considered. Cities and counties shall address military impacts based on information from the military and other sources.

(B) The following definitions govern this paragraph:

(i) "Military readiness activities" mean all of the following:

(I) Training, support, and operations that prepare the men and women of the military for combat.

(II) Operation, maintenance, and security of any military installation.

(III) Testing of military equipment, vehicles, weapons, and sensors for proper operation or suitability for combat use.

(ii) "Military installation" means a base, camp, post, station, yard, center, homeport facility for any ship, or other activity under the jurisdiction of the United States Department of Defense as defined in paragraph (1) of subsection (g) of Section 2687 of Title 10 of the United States Code.

In this way, the land use element functions as a guide to planners, the general public, and decision makers. Its objectives, policies, and programs relate directly to the other elements. In practice, the land use element is often the most visible and frequently used element in a general plan.

CORRELATIONS AMONG ELEMENTS

	Circulation	Housing	Conservation	Open Space	Noise	Safety	EJ
Land Use	IN STATUTE	IN STATUTE	IN STATUTE	RELATED	IN STATUTE	IN STATUTE	RELATED

■ Identified in statute ■ Closely related to statutory requirements

Completeness Checklist

Local agency staff can use the following checklist to help ensure that the land use element addresses all required issues. Please note that use of this checklist is purely advisory, and only contains issues that are legally required in Government Code section 65302(a). Conservation elements may address additional issues at the discretion of the local government. Because general plan formats may vary, this checklist suggests identifying where the particular government code provision is satisfied.

California Government Code Section	Brief Description of Requirement
§ 65302(a)	General distribution, location, and extent of:
§ 65302(a)	Housing Density and intensity Potential for flooding impacts.
§ 65302(a)	Business Density and intensity Potential for flood?
§ 65302(a)	Industry Density and intensity Potential for flood?
§ 65302(a)	Open space, including agriculture, natural resources, recreation, and scenic resources Potential for flood?
§ 65302(a)	Education Density and intensity Potential for flood?
§ 65302(a)	Public facilities Density and intensity Potential for flood?
§ 65302(a)	Solid and liquid waste disposal Density and intensity Potential for flood?
§ 65302(a)(1)	Timberland Production Intensity Potential for flood?
§ 65302(a)	Other Density and intensity Potential for flood?
§ 65302(a)	Greenways, as defined in Civil Code Section 816.52
§ 65302(a)	Identify areas subject to flood plain mapping Annual review
§ 65302(a)(2)	Impact on military land use compatibility and readiness
§ 65302(b)(1)	Correlation with the circulation element