Mojave Water Agency
Water Supply Reliability and Groundwater Replenishment Program

CHAPTER 5: ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION

5.1 Environmental Setting: General

5.1.1 Setting

The 4,900 square mile MWA service area lies inland of the coastal Los Angeles/Riverside/San Bernardino Basin and is separated from this basin by the San Gabriel and San Bernardino mountains, which reach elevations of over 10,000 feet (MWA 2004b). The primary transportation linkage to the more urbanized areas of the coastal basin is Interstate 15/State Highway 395 via the Cajon Pass. Other road links to the more urbanized coastal basin include Highway 18/14 via Palmdale, Highway 18 via Big Bear Lake and Lake Arrowhead, and Highway 62 from the Morongo Basin to Riverside County via Interstate 10. Most development in the MWA service area is (a) along the Interstate 15/State Highway 395 corridor and (b) concentrated in the Hesperia, Victorville, Apple Valley, and Adelanto areas. The other major population center is Barstow at the intersection of Interstate 15, Interstate 40, and State Highway 58. In 2000, about 74% of the population of the MWA service area was located in the Alto Basin, within 20 to 40 miles of the Los Angeles Basin (via Interstate 15/State Highway 395). Another 10% of the total population in MWA's service area was located in the Centro Basin, concentrated at Barstow. The Yucca Valley in the Morongo Basin has the only other major population zone, with a year 2000 population of about 17,000. From 1990 to 2000, growth was greatest in the Alto and Oeste basins, which lie closest to the I-15/State Highway 395 corridor. As available land has been developed in the coastal basin areas and housing costs have risen to record highs, the pace of development has increased in all inland areas of southern California. In Victorville, for example, 390 new houses were constructed in 2000, 637 in 2001, 986 in 2002, and 2,103 in 2003. Outside of the urban centers, the MWA service area is sparsely populated and development is generally distributed along major roads which offer utility connections.

In response to a comment from Department of Water Resources (Appendix A), MWA notes that the MWA service area incorporates much of the south-central Mojave Desert, an area of low precipitation and long periods of high temperature and low humidity. The basin consists of a series of valleys formed as a result of uplift, volcanic activity, and seismic activity along the San Andreas Fault and related earthquakes. These valleys tend to be hydrologically and hydrogeologically isolated. Most of the water available to people and wildlife is derived from runoff from the mountains to the west and south, and the various basins are crossed by desert washes that lead to dry lake beds. Runoff percolates rapidly into groundwater when it reaches the valley floor and runoff reaching dry lakes accumulates and then dries out rapidly. Surface water quality tends to deteriorate with distance from the mountains. Along the Mojave River, water flows under the channel and is forced to the surface at several sites where seismic activity has created blocks to sub-surface flow.

Wildlife in the Mojave Basin show various typical adaptations to an environment characterized by seasonally extreme hot and dry conditions and periodically more severe and extended drought. For plants, these adaptations include deep roots, waxy/oily leaves, creation of plant/soil "crusts" that reduce erosion of the very thin topsoils, and loss of leaves during drought conditions. Animal adaptations include burrowing, estivation or hibernation during dry periods, special physiological adaptations to drought, and/or the ability to recolonize marginal habitat where localized extinctions may occur during extreme droughts. These adaptations make desert ecosystems relatively sensitive to human disturbance, particularly disturbance that affects soil integrity and fragments habitat.

Climate in the high desert is typical of California's inland deserts. Winters are cool (average daily temperatures of 45 F to 66 F) but seldom freezing, and there is minimal precipitation; about 75% of average annual precipitation at Victorville falls in December-March. The extended warm season (May through October) is hot and dry (average daily high temperatures from 80 F to 98 F). Extreme daily high temperatures may exceed 110. Precipitation generally declines with distance from the mountain ranges.

The majority of the MWA service area is high desert, consisting of valleys and closed basins, with a general trend towards declining elevations from west to east, and south to north. Elevation at Victorville, for example, is 2715 feet. Elevation at Afton Canyon is about 1550 feet. With the exception of some drainage from the Morongo Basin to the Colorado River, rivers drain north and east to dry lake beds. Except in extraordinary years, rivers and streams are dry most of the year and surface water is available only at springs and where localized geology causes upwelling or groundwater moving downstream in the Alluvial Aquifer.

From a socio-economic perspective, the MWA service area has historically been relatively isolated from the more densely populated coastal basins to the south and west. This is reflected in key socio-economic indicators. In Victorville, for example, median household income, median house value, median education level, and median age are all below California state averages (City-data.com 2005). The economies of the region are influenced by large military installations, such as George Air Force Base (north of Victorville), Edwards Air Force Base (partially within MWA service area on the west), the US Marine Corps Logistics Base ant Nebo and Yermo, and the Fort Irwin National Training Center (north of Barstow). Interstate 15/State Highway 395 provide for area residents to commute to jobs in Riverside, San Bernardino, and Los Angeles counties. Key demographic, economic, and social development trends in the MWA service area include (MWA 2004a):

- A net 1990-2000 population decline of 7,000 in the Morongo Basin;
- A net 1990-2000 population decline of 3,700 in the Baja Basin;
- Declining agricultural water consumptive use;
- Increasing urban water consumptive use; and
- Increasing concentration of population in and around the existing urban centers.

Combined with the increased housing construction in the Alto and Oeste basins, these trends suggest a shift towards an urban/industrial/commercial economy becoming more closely linked to the economies of the coastal basin. Changes in demographics and in regional development are reflected in the regional effort to address water supply and water quality issues. Since 2003, water conservation and water supply are being addressed in a coordinated manner via the Alliance for Water Awareness and Conservation, which includes water districts, cities, and other local government agencies along with the US Bureau of Reclamation and University of California Cooperative Extension.

The Proposed Project takes place in the context of a number of water management programs in the MWA service area. In addition to MWA's completion of projects initiated following the 1994 Regional Water Management Plan, there are three pending projects within the City of Hesperia and the City of Victorville that are features of the Proposed Project. The first project is VVWD's recharge project south of the Green Tree golf course. When surveys were being conducted for this EIR, this project was observed to be in early stages of clearing the land for construction. It has therefore been assumed to be an existing project. MWA and VVWD are in on-going discussions regarding the cooperative use of this facility and 3,600 acre-feet of capacity per year has been assumed for analysis purposes.

Second, the City of Hesperia has identified sites for and is investigating and obtaining funding for two flood detention basins -- at Cedar Avenue and at the Ranchero Road crossing of Antelope Wash (City of Hesperia 2003). It has been assumed that these projects will go forward. At Cedar Avenue, however, construction activity for recharge facilities may alter the configuration of the basin and involve substantially greater surface disturbance and earth moving than the detention basin alone. At the Antelope Wash-Ranchero Road detention basin, the City proposes to raise the road (currently on grade) on a berm. It has been assumed that construction and on-going maintenance to clean out debris following flooding would result in this site being cleared routinely. In addition, recharge at this site may require only minimal construction of berms and other facilities (which will be inundated periodically and subject to erosion from flood flows). For this reason, construction-related effects of recharge at this site have been assumed to accrue to the City's Project.

5.1.2 Scope of Impact Assessment

The 2004 PEIR evaluated the potential for the Proposed Project to affect Agriculture and Mineral Resources and found that there was no mechanism by which the broad suite of projects evaluated could affect these resources. No aspect of the Proposed Project has features which would change this general conclusion of the 2004 PEIR. There is no active agriculture or mining at any of the proposed facility sites. Consistent with this prior finding, this Project EIR does not specifically address Agriculture or Mineral Resources.

5.2 Aesthetics

5.2.1 Environmental Setting

As discussed in the 2004 PEIR, the MWA service area has significant scenic resources. With generally cloudless conditions, the various isolated valleys and plains provide long-range views of the surrounding desert mountains, with generally dry washes, streams, and rivers visible at various times. The Mojave River itself is a scenic resource, particularly in the areas with riparian vegetation lining the channel. The open desert generally consists of creosote bush scrub and western Mojave Desert saltbush scrub, mixed with occasional Joshua trees that may occur as dense woodland. The overall character of the MWA service area is that of an expansive open desert horizon, sparsely populated.

Within the urban centers of MWA's service area, towns are a mix of old historic areas surrounded by new urban commercial and residential development. There are no designated scenic highways or vista points, but there are roads that could be eligible for such designation. San Bernardino County uses the following criteria for determination of scenic value for a landscape feature or scenic vista:

- Provides a vista of undisturbed natural areas;
- Includes a unique or unusual feature which comprises an important or dominant portion of the viewshed; and/or
- Offers a distant vista which provides relief from less attractive views of nearby features (such as views of mountain backdrops from urban areas).

The Town of Apple Valley and County of San Bernardino have developed aesthetic guidelines for the protection of native plants (Town of Apple Valley 2000; County of San Bernardino 1989) County of San Bernardino guidelines have been adopted and cross-referenced in the City of Hesperia Municipal Code. These guidelines are focused on maintaining the natural plant heritage of the desert and contain provisions protecting native trees and riparian vegetation. Protection is specifically provided for Joshua Trees and several types of native cactus.

5.2.2 Facilities Impacts

5.2.2.1 Mechanisms for Effect

Only above-ground construction could adversely affect aesthetics. The facilities of all alternatives involve different levels of above ground construction at recharge basins, wells, and (potentially) connections to existing power lines. These facilities may affect a viewshed in several ways:

- By blocking view of a distant landscape feature due to walls or raised berms at recharge basins and well sites;

- By changing the character of an existing setting (wells and recharge basins) by altering vegetative cover in rivers or washes which are a part of the viewshed of residents living along the crest of the wash;
- By having a demonstrable negative effect on local views (well containment structures within a residential area or impacts to Joshua Tree/juniper habitat);
- By raising levee berms to 3-5 feet above ground level adjacent to existing development and thereby altering the local view.

5.2.2.2 Facility Impacts: Minimum Facilities Alternative

The Minimum Facilities Alternative would involve above-ground construction along the Mojave River north and south of Highway 18 (wells), construction of several small bridges and drop structures in Unnamed Wash, and could involve raising low levees on either side of the Unnamed Wash as it flows from Arrowhead Lake Road to the Mainstem channel. All other features of this alternative involve use of existing facilities, buried facilities such as pipelines, connections to existing wells, and the use of the Mainstem Mojave River for recharge, involving intermittent short term construction of sand berms in the riverbed. New-construction elements of the Minimum Facilities Alternative that would be visible to the public are:

- Mojave River Well Field;
- Intermittent use of construction equipment in the Mojave River for berm construction and maintenance; and
- Bridges, drop structures, and levees at Unnamed Wash.

<u>Mojave River Well Field:</u> The well field proposed for the Minimum Facilities Alternative would involve drilling of up to 25 new wells on vacant lands and road easements adjacent to commercial and residential development along the Mojave River. The existing context of this area is characterized by:

- A gentle slope leading down to the Mojave River on both sides of the floodplain, and
- Mixed residential and commercial development.

Wells would be sited to minimize visibility from residential property. A typical enclosed well occupies about 100 square feet of space, and would be enclosed in a 10 X 10 X 8 structure that would be designed and/or landscaped to blend with existing commercial and residential development. Such enclosed wells are found in numerous areas of the urban landscape of the Alto subarea. These small enclosures would be visible from roads and some residences. They would be sited to be consistent with existing local policies, guidelines, and regulations.

<u>Instream Mojave River Recharge</u>: Prior to recharge releases from Silverwood Lake (Cedar Springs Dam) or Rock Springs (via the Morongo Basin Pipeline), MWA would use earth moving equipment to push up low temporary berms to enhance spreading of water across the riverbed and slow down surface flow to enhance percolation. Existing conditions in this reach of the river are:

- The riverbed is dry in most months, and
- There is intermittent construction activity for flood control purposes in the riverbed, including movement of construction materials.

Short-term construction activities will not affect views for an extended period of time and use of the Mainstem Mojave River for recharge will provide a more frequent water view to adjacent landowners.

Unnamed Wash

Unnamed Wash has been designated as open space in the Rancho Las Flores Environmental Impact report, with development along the margins of the wash, particularly in the upstream watershed of the wash in the Summit Valley area. Construction of Proposed Project facilities would not alter use for open space, and would be consistent with open space recreational aesthetics. A bridge across the wash would function as a trails link and erosion-control drop structures would be designed to blend in with the surroundings. The use of the wash for recharge would involve periods of sustained inundation, and could result in an incised channel. The roadway at Arrowhead Lake Road would be raised several feet to accommodate flow under the road, and would therefore provide marginally better views of the Mojave River and adjacent hills and mountains. Low levees to contain wash flows across the floodplain would be vegetated and would blend in with the disturbed grasslands and scrub vegetation of the floodplain.

5.2.2.3 Facility Impacts: Small Projects Alternative

The Small Projects Alternative would add four above-ground recharge facilities to those of the Minimum Facilities Alternative:

- Off-Channel Mojave River Recharge: 100 acres on the west side of the Mojave River about 3 to 4 miles south of the Morongo Basin pipeline;
- Oro Grande Wash Recharge: Approximately 80 acres of new recharge at Oro Grande Wash at two sites north and south of the California Aqueduct;
- Cedar Avenue Detention Basin Recharge: Approximately 60 acres of recharge at a flood water detention basin; and
- Antelope Wash Detention Basin (Ranchero Road) Recharge: Approximately 65 gross acres of recharge at a flood detention basin.

Off-Channel Mojave River Recharge: At either of the two sites being considered (East and West) the 100-acre recharge basin would be located in undeveloped areas that have previously been disturbed: for disposal of treated water (West) and for farming (East). Both sites are at the base of a slope along the river floodplain.

The West Site is disturbed, has remnants of old levees, and is in the immediate viewshed of 3 houses. The effects of a new recharge basin at this site would be to raise a low levee along the downslope side of Highway 173 for about 0.5 miles. Given the slope of the ground, this levee would be from 2-3 feet and would probably not affect views of the Mojave River itself or of surrounding hills. The recharge basins would be distantly visible from parts of Highway 173 from Mojave Forks Dam and from the crest of the hill immediately south of the recharge basin. The East Site would be located near a poultry ranch facility in an area served only by local roads. It would be in an area where flood control involves the construction of low berms along the river and where there is only sparse adjacent housing. Low berms needed along the upslope end of the recharge facility would not affect the viewshed of adjacent houses. Neither the east or west site has locally-protected riparian or Joshua Tree habitats.

Oro Grande Wash Recharge Basin(s): These recharge facilities would be constructed within the wash, below grade. Existing aesthetic conditions at the potential south project site are characterized by:

- There is residential and commercial development along portions of the wash in the proposed reach, with about 30 housing units along the rim of the wash in a development just south of the California Aqueduct and east of Oro Grande Wash and about 15 residential units about 0.25 miles north of the California Aqueduct, again along the east rim of the wash;
- The wash has been disturbed by off-road vehicle and other use such as trash dumping;
- There is a road crossing (Highway 395) from which it is possible to view the wash;
- The wash is not visible from Interstate 15.

Work at this site could be viewed from Highway 395 and from some commercial development to the east of the wash. All work would be below grade and would not affect views of surrounding landscape, mountains, or the valley below.

Existing aesthetic conditions at the potential north project site are characterized by:

- To the east, the site has been graded for housing;
- The site itself has been graded for storm water detention;
- To the west, there is some mixed creosote scrub.
- To the north, there is an existing golf course across a major road.

Site aesthetics have essentially already been lost due to grading for storm water detention, and recharge would be undertaken within this area. There is a small area of Joshua Tree habitat along the south of the potential recharge site, already disturbed and near development. No new aesthetic effects are anticipated.

Cedar Avenue Detention Basin Recharge: This element of the Small Projects Alternative would not be visible from the north and east, as the existing California Aqueduct would block this view. There is sparse existing development (about 5 houses) along the south and west boundaries of the potential detention basin/recharge facility, where the views would again be of the levees of the California Aqueduct. No locally-protected vegetation types are found on site.

At this site, the recharge facility will function as a dual purpose facility -- providing flood control and recharge. The facility will have low berms (3-5 feet high) to contain flood flows from local drainage that tend to collect against the California Aqueduct and threaten homes to the west and south of the aqueduct.

Regardless of who constructs these berms, they would not alter existing views from adjacent development, which are of a similar facility -- the California Aqueduct. This facility would have no affect on view of significant scenic resources, views of which are already affected by the nearby levee of the California Aqueduct. Planting along outer berm where levees are adjacent to existing development would reduce localized impacts to a level of less than significant.

<u>Antelope Wash Detention Basins (Ranchero Road) Recharge</u>: At this site, existing conditions include:

- Scattered existing housing and commercial development along the rim of the wash, with a total of about 30 residential units along the rim of the wash;
- Guard rails along the existing road to the north of the proposed recharge and detention basins, which block view of the wash from cars traveling on the south side of the road; and
- A moderate level of existing landscape disturbance due to human use of the wash.

At the site, Ranchero Road is currently an on-grade crossing of the wash. A flood detention basin is proposed by the City of Hesperia at this site, involving an embankment to raise the road and detain flood flows to reduce downstream peak floods. The flood detention basins would involve complete removal of vegetation and there would be periodic inundation of the site. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas.

The detention basin (and any recharge berms constructed within it) would be visible from some portions of the road to the north and from a few adjacent residential buildings. In this site, recharge will be consistent with the flood management function of the site, and vegetation will be periodically cleared by MWA and/or flood control authorities. Operation of the basin for recharge will not alter the visual character of the site, which will be maintained for flood control purposes as well, including routine removal of shrub vegetation to ensure basin outlet works are not clogged by vegetation during flooding.

5.2.2.4 Facility Impacts: Large Projects Alternative

The Large Projects Alternative would add three large detention basins to the Small Projects Alternative, with up to 580 acres of recharge at three sites. All of these features would be visible from some vantage points. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas.

Oeste Recharge Basin: Existing conditions at the two potential sites for these basins are characterized by:

- No existing development along the boundary of the recharge basins on the west side of the Oeste site;
- Four existing homes along the boundary of the recharge basins on the east side of the Oeste Site; and
- Sparse development in the general area.

Recharge basins at this site would involve construction of levees about 3 to 5 feet in height and these levees would be closer to nearby residences than the levees of the existing California Aqueduct. They would therefore somewhat alter the current view. They would not affect views of the surrounding mountains or interrupt vistas in any direction.

Alto Recharge Basin: Existing conditions at this site on the north side of the California Aqueduct include:

- Views of the sites are substantially blocked from the south by the existing California Aqueduct;
- The view from the north is of the bare ground and the north levee of the California Aqueduct;
- There is residential development (8 houses) along portions of the proposed perimeter levees at both sites;
- There is mixed disturbed desert scrub and Joshua Tree habitat; and
- There is a road crossing the California Aqueduct immediately west of the proposed site.

Recharge basins at this site would create a view of 3 to 5 foot earthen levees. This view would be consistent with the existing view, but the levees would be closer to adjacent residences. The new levees would not be high enough to affect views of the surrounding mountains or interrupt vistas in any direction.

Antelope Wash Recharge Basins: The additional recharge basins would be located in sparsely developed canyons north and south of the California Aqueduct. The potential sites are characterized by:

- There is existing housing (total 40-50 houses) along the northern rim of Antelope Wash in this reach and in a small new development on the southern rim, and this housing has an unobstructed view of the mountains to the south and east;
- Immediately below this housing, there is a road at the base of the bluffs on the north side of the wash;
- The wash is currently a semi-disturbed desert wash with extensive stands of native vegetation, including sensitive Joshua Tree/California Juniper/Desert Scrub communities.

Recharge basins in this portion of Antelope Wash would be visible from the housing lining the bluffs and from the road. The viewer would look down on the new basins, but the facilities would not otherwise alter views of surrounding vistas.

The Ranchero Road area is characterized by scattered housing and commercial development, including Hesperia Airport. If this upstream Antelope Wash recharge site were to be replaced by an expanded Ranchero Road recharge area as described in Chapter 4, page 4-31, impacts to the high aesthetic values of the upstream recharge site would be avoided. Expansion of the recharge basins to include areas from the airport to downstream of the Ranchero Road detention basin would therefore have lower aesthetic impacts than those associated with the upper recharge basin. Given the moderate to high level of existing development, including the airport complex, no significant aesthetic impacts would be anticipated by construction and operation of recharge basins in this reach.

5.2.3 Operational Impacts

5.2.3.1 Mechanisms for Effect

Operations will not alter the view of recharge facilities except (a) to the extent that the internal structures of the recharge basins might be visible. Given that off-stream recharge basins have been sited on relatively flat land, the internal portions of the recharge basins will not be readily visible except at:

- Oro Grande Wash (view from Highway 395 and local road crossing and from some adjacent development along the rim of the wash);
- Antelope Wash (view from road crossings and residential development on the rim of the wash);
- Mojave River Off-Channel Recharge (view from Highway 173 coming out of the mountains); and
- Instream Mojave River Recharge.

At all of these sites there would be intermittent water views during recharge. The view within the basins when not filled would be of open, sandy soils separated by earthen berms. For the Mainstem Mojave River, on-going operations will frequently alter the view of the Mainstem Mojave River, which will be wetted with greater frequency. During recharge, the dry-sandy appearance of the river between Mojave Forks Dam/Unnamed Wash and Rock Springs will be changed to the appearance of a flowing river.

5.2.3.2 Operational Effects

Operational effects on aesthetics, both beneficial and adverse, will increase with the magnitude of the Proposed Project and the volumes of delivery associated with banking, exchange, and MWA operations. As the magnitude of deliveries increases, the wetted area of recharge areas will increase and the frequency of flow in washes and the Mainstem Mojave River will increase.

These effects will be most pronounced in the Unnamed Wash and the Mainstem Mojave River. Although it is not feasible to precisely determine the schedule for delivery of water related to banking, time-shift exchanges, and MWA deliveries, the Proposed Project clearly contemplates delivery to recharge in wet years and return of banked water via exchange in dry years. In normal-to-wet years, the Unnamed Wash and the Mainstem Mojave River will be wetted for longer periods of time than they would be otherwise. In dry years, MWA may take delivery of only a small portion of its SWP supply, and its own deliveries to recharge will be minimal. This will not likely affect dry-year flows in unnamed wash and the Mainstem Mojave River because, even without making returns to Metropolitan, the available SWP supply can be accommodated using only existing facilities. Thus, the net effect of the Proposed Project in the aesthetics of the Unnamed Wash and the Mainstem Mojave River will be to increase the frequency of a water view for residents, primarily in normal-to-wet years. At sites where the interior of recharge basins is visible, the same pattern of wetted and non-wetted conditions would occur.

5.2.4 Significance of Impacts, Mitigation and Significance of Impacts after Mitigation

Per the 2004 PEIR, the facilities associated with the various alternatives would have significant aesthetic effects if they (phrases in parentheses refer to column titles headings on Table 5-1):

1. Blocked scenic views (block view);
2. Altered the appearance of designated scenic resources (alter resources);
3. Created significant contrasts with the scale, form, line, color, and/or overall visual character of the existing landscape setting (contrast with existing view);
4. Were inconsistent with applicable local guidelines or regulations (inconsistent w/local);
5. Conflicted with adopted visual resource policies (local policy conflict);
6. Had a substantial, demonstrable negative effect (negative effect);
7. Substantially reduced the vividness, intactness, or unity of high quality views (affect high-quality view);
8. (Substantially changed the quality of scenic corridors or views from scenic highways (change view from scenic highways).

The potential significance of alternative facilities is summarized in regard to these issues on Table 5-1. The rationale for the analysis summarized on Table 5-1 is then discussed below, along with proposed mitigation and significance after implementation of mitigation measures.

5.2.4.1 Instream Mojave River Recharge

On the Mojave River, recharge operations will intermittently enhance views of the river for all residents with a view by providing a desirable water view. The anticipated 2-weeks of construction activity necessary to raise low berms for recharge in the river bed is consistent with on-going flood control channel maintenance activities and will not create a significant adverse aesthetic effect. Given the width of the floodplain and the low sand berms, the berms will be only barely visible to most residents and from most roads. No significant effect is anticipated. No mitigation is required.

5.2.4.2 Mojave River Well Field

Although wells would be enclosed in small structures and sited to minimize impacts to residential areas, well structures along the Mojave River have the potential to alter local views in the immediate vicinity of the wells. To mitigate for this potential impact, MWA would enclose wells in structures designed to be consistent with structures in the immediate vicinity and/or would plant screening vegetation. With this mitigation, impacts would be reduced to a level of less-than-significant.

Table 5-1. Significance of aesthetic impacts associated with potential project alternatives, compared to the 8 criteria for significance. NSI = no significant impact; PSI = Potential significant impact prior to mitigation. Potential effects are shown in bold type.

FACILITY	POTENTIAL SIGNIFICANT IMPACTS, BY SIGNIFICANCE CRITERIA							
	Block view	**Alter resources**	**Contrast with existing views**	**Inconsistent with local regulations**	**Local policy conflict**	**Negative effect**	**Affect High quality view**	**Change view--scenic road**
Instream Mojave River Recharge	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
SWP Delivery via Unnamed Wash	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Mojave River Well Field	NSI	NSI	**PSI**	NSI	NSI	**PSI**	NSI	NSI
Off-Channel Mojave River Recharge: West	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Off-Channel Mojave River recharge: East	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Oro Grande Wash Recharge	NSI	NSI	**PSI**	NSI	NSI	**PSI**	NSI	NSI
Cedar Avenue Detention Basin Recharge	NSI	NSI	NSI	NSI	NSI	**PSI**	NSI	NSI
Antelope Wash Detention Basin Recharge	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Oeste Recharge and Wells	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NSI
Alto Recharge and Wells	NSI	NSI	NSI	NSI	NSI	**PSI**	NSI	NSI
Antelope Wash Recharge	NSI	**PSI**	**PSI**	NSI	NSI	**PSI**	NSI	**PSI**
Antelope Wash Downstream Relocation	NSI	NSI	NSI	NSI	NSI	NSI	NSI	NIS

5.2.4.3 SWP Delivery via Unnamed Wash

Views of scenic resources will not be significantly affected by the small bridges and drop structures (artificial waterfalls) in the upper reaches of the wash (west of Arrowhead Lake Road). In this area, the wash will be enhanced aesthetically by flowing water and by incidental growth of sparse riparian vegetation. Downstream of Arrowhead Lake Road, the levees will be low and rapidly colonized by the non-native grasses in this area, blending into the surrounding landscape. This general area has remnant areas with raised levees and the bridge and levees would not be inconsistent with the existing visual character of the site. No significant impacts are anticipated and no mitigation is required.

5.2.4.4 Oro Grande Wash Recharge

Oro Grande Wash near the California Aqueduct has been disturbed by ongoing off-road vehicle use, existing road berms and the aqueduct, and other activities. Construction of recharge basins will nonetheless somewhat alter the viewshed from adjacent housing. When dry, the recharge basins will present a view of a sandy, unvegetated basin, in contrast to the currently sparse scrub. When wet, the basins would provide a pleasing water view. The removal of one or two Joshua Trees would not conflict with local protection for these aesthetically valuable plants because County and local code allows for such removal by public utilities. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Given the disturbed nature of the wash, recharge basins are not an aesthetically inconsistent use of this area and impacts will be less-than-significant.

5.2.4.5 Cedar Avenue Detention Basin Recharge

At the Cedar Avenue site, the existing view from adjacent housing is across disturbed scrub vegetation to the levees of the California Aqueduct; new facilities at these sites would not change the character of the viewshed but would bring levees closer to adjacent housing. These effects would be in addition to those of the flood control facility to be constructed by the City of Hesperia. To mitigate these potential effects, where levee for recharge basins or canals would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Given the existing view of levees and disturbed scrub vegetation, this mitigation would enhance the appearance of the recharge basins and reduce impacts to a level of less-than-significance.

5.2.4.6 Antelope Wash Detention Basin (Ranchero Road) Recharge

Prior to use as a recharge facility, Antelope Wash at Ranchero Road will be altered by the proposed City of Hesperia detention basin and on-going vegetation maintenance associated with this flood management function. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Given prior construction and operation of the detention basin, the addition of gating to the detention basin outlet and creation of a series of low berms to spread flows will, in the context of the proposed flood control project, have a less-than-significant impact on aesthetics at this site.

5.2.4.7 Off-Channel Mojave River Recharge

For recharge south of the Morongo Basin Pipeline, recharge facilities at either site have little potential for significant impact. The sites slope gently downstream from the road, and therefore the upslope berm may be relatively low. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Both sites are isolated from significant areas of residential development and they would have no substantial effect on the views of those using Highway 173 or the local roads on the east side of the river. No significant impacts are anticipated and no mitigation is required.

5.2.4.8 Oeste Recharge and Wells

Recharge facilities at the Oeste sites would be immediately adjacent to the California Aqueduct in an area with little residential development. Only one existing residence would be within 200 feet of a facility outer berm, and the existing view from this residence is of the California Aqueduct. The facilities would be visible from local roads, but low berms along the road would not affect views of surrounding mountains or other scenic resources. Wells would be enclosed in small structures and sited to minimize impacts to residential areas, and designed to be consistent with structures in the immediate vicinity. MWA would also plant drought tolerant native screening vegetation along the outside of the perimeter levee maintenance road and where wells are sited. With this mitigation, impacts are anticipated to be less than significant.

5.2.4.9 Alto Recharge and Wells

The Alto recharge basins would be located adjacent to the California Aqueduct, which is a prominent feature of the existing viewshed. The recharge facilities would be visible to a few residents. To mitigate these potential effects, where levee for recharge basins would be constructed adjacent to existing development, MWA would plant native shrubs between the perimeter levee maintenance road and private property. Shrubs such as rabbit bush grow naturally at the site, would grow to a height of 3-5 feet without irrigation, and will provide a more natural view for property owners. Wells would be enclosed in small structures, sited to minimize impacts to residential areas, and designed to be consistent with structures in the immediate vicinity. These mitigations would enhance the appearance of the recharge basins and wells and reduce impacts to a level of less-that-significance.

5.2.4.10 Antelope Wash Recharge

Antelope wash is a significant natural feature in the viewshed of about 60 residents and is visible from the road that runs along the base of the cliffs and north of the wash. Construction of recharge basins at this site would adversely affect this view, removing a significant stand of mature native vegetation. Although Antelope Wash is not designated as a scenic resource, it has substantial visual integrity as a natural landscape (despite some disturbance) and consists of a mix of desert scrub and Joshua Tree/Juniper desert scrub. Wells that may be constructed in the vicinity of the recharge basins would be enclosed in structures that would be aesthetically consistent with structures in surrounding areas. Construction and operation of recharge facilities at this site would have a significant effect on aesthetics, at least at a local level. MWA would contour the outer berms of recharge facilities and plant native shrubs along the outer margins of the perimeter levee maintenance roads to minimize effects; at this site, perimeter screening may include transplanting or planting of Joshua Trees and junipers. This would reduce aesthetic impacts for drivers on the road along the north bank of the wash.

The conversion of a large area of mature natural vegetation to unvegetated recharge would have adverse aesthetic impacts when dry, but could be considered of scenic value as a water view during recharge operations. With these mitigations, and considering the high aesthetic value of any water view in the desert, it is probable that the aesthetic effects of recharge at this site would be considered less-than-significant under CEQA. MWA may also consider moving the proposed Antelope Wash Recharge Basin downstream to a site with less scenic integrity. There are several sites downstream where there are higher levels of disturbance and less mature vegetation communities. These sites were not formally surveyed for the Proposed Project because of access constraints, but MWA may conduct future studies of these sites as alternatives to the Antelope Wash site identified in this Project EIR. If they are determined to have lower levels of impact for the full range of CEQA impact categories, they will be considered as potential alternatives to recharge at the site documented in this EIR.

The alternative of relocating this recharge to the area downstream from the Hesperia Airport as described in Chapter 4, page 4-31 would avoid these adverse impacts and reduce aesthetic effects of this increment of recharge capacity to less-than-significant.

5.2.5 Unavoidable Significant Impacts after Mitigation

With the proposed mitigation actions, and considering the current disturbed nature of the local viewsheds in many locations proposed for facility development, the potentially significant adverse impacts of facility development under all alternatives would be reduced to a level of less than significance.

5.2.6 Effects of the No Project Alternative

As described in Section 3.4.2, the No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan, and would involve development of recharge and conveyance capacity without banking capacity. Ultimately, MWA would develop additional facilities that would allow it to meet its obligations to import, recharge, store, and equitably distribute up to 75,800 acre-feet of SWP supply in a year. The No Project Alternative would therefore have the effect of (a) reducing the rate at which aesthetic impacts would occur and (b) re-siting of some facilities so that aesthetic effects were transferred from one site to another.

Aesthetic effects associated with Minimum Facilities Alternative and Small Project Alternative facilities will probably occur as described above because these facilities will probably be developed, albeit over a longer period of time. Potential re-siting of recharge for Off-Channel Mojave River Recharge, Oeste Recharge, and Alto Recharge would transfer any aesthetic effects associated with these elements to other sites. Reductions in the lengths of buried pipelines associated with the No Project Alternative would not affect aesthetic impacts. Given that such re-siting would occur as a result of prior development of these sites, re-siting would occur in the context of development in these areas and aesthetic effects would probably be similar.

5.3 Air Quality

5.3.1 Environmental Setting

The environmental setting is described in detail in the 2004 PEIR. The Mojave Desert Air Basin is affected by locally-generated and regionally-generated pollution, but conditions for the formation of inversion layers and ozone formation are different than conditions in the South Coast Air Basin to the south and west. Frequent and often extreme winds also provide for better mixing and dispersal of pollutants. Nevertheless, from 1999-2003, the Mojave Desert Air Basin was in a state of nonattainment relative to ozone about 80-90 days per year and respirable particulate matter (PM10) about 18-32 days per year. Ozone is primarily a problem in the summer, when (a) pollution is transported into the basin from the west and (b) prevailing winds may decline in velocity at night, promoting concentration of pollutants. Existing Mojave Desert Air Quality Management District (MDAQMD) plans and policies for the management of air quality in the Mojave Desert Air Basin have been formulated to meet both Federal and California Air Resources Board requirements. Current plans are:

- Draft MDAQMD 2004 Ozone Attainment Plan
- Federal Particulate Matter (PM10) Attainment Plan

These plans provide specific guidance and permitting requirements for stationary sources and facilities such as those proposed under all three alternatives would generally not be regulated by MDAQMD. Construction activities would be subject to MDAQMD rules:

- Rule 401: Visible emissions
- Rule 402: Nuisance
- Rule 403: Fugitive Dust
- Rule 1103 Paving
- Rule 1111 Architectural coatings

Any project that disturbs greater than 100 acres is required to prepare a Dust Control Plan. In addition, MDAQMD has established significance standards for emissions from project construction activities, including emissions from construction vehicles (Table 5-2).

Table 5-2. MDAQMD Significance Thresholds for construction and operation emissions (MWA 2004b).

POLLUTANT	SIGNIFICANCE THRESHOLDS	
	Annual (tons/yr)	Daily (lbs/day)
Carbon monoxide (CO)	100	548
Oxides of Nitrogen (NOx)	25	137
Volatile Organic Compounds (VOCs) Reactive Organic Gases (ROG's)	25	137
Oxides of Sulfur (SOx)	25	137
Particulate Matter (PM10)	15	82

5.3.2 Facilities Impacts

5.3.2.1 Mechanisms for Effect

Construction and operation/maintenance have the potential to emit all of the pollutants shown on Table 5-2, via the following mechanisms:

- Vehicle emissions during construction
- Vehicle emissions during long-term maintenance and operation
- Removal of vegetation, resulting in increased wind-erosion and PM10 mobilization

5.3.2.2 2004 PEIR analysis

At recharge sites, there is also potential for operations to cause a reduction in PM10 emissions when basins are being recharged. The wetted area of the basins would not be exposed to winds and wind-generated erosion, resulting in some reductions in ambient PM10 levels. The 2004 PEIR estimated the potential daily effects of a typical recharge basin construction project, pipeline construction project, and injection well construction project (Table 5-3), based on typical construction scenarios and evaluation of emissions associated with typical construction equipment.

Table 5-3. 2004 PEIR estimated daily unit construction emissions for a typical recharge basin, well, and pipeline project, MWA service area. (PM10 emissions are restricted to brake wear, tire wear, and entrained road dust from on-road vehicle travel. Estimates do not include fugitive dust during construction.**)**

PROJECT TYPE	PROJECT SIZE	MDAQMD STANDARD/ESTIMATED EMISSIONS[1]			
		CO	NOx	VOCs/ROGs	PM10
Recharge Basin	20 acres	548/133	137/110	137/15	82/19
Well	1 well	548/93	137/68	137/13	82/12
Pipeline/canal	1 construction crew	548/106	137/78	137/12	82/18

The 2004 PEIR noted that the estimates on Table 5-3 were to be used as a general guideline and that "prior to approval, emissions estimates would determine significance of individual projects." The 2004 PEIR notes that the air quality impacts of facility operations would not likely exceed either daily or yearly MDAQMD thresholds for significance. The 2004 PEIR estimates were based on calculations of emissions from a standard set of construction equipment, assuming continuous operation over an 8-hour day. They were also based on outdated equipment specifications, not on new 1999 EPA regulations that went into effect in 2004 (EPA 2004). In addition, they do not reflect the May 11, 2004 Final Rule for diesel engines, which includes a set of new engine standards to be implemented in a series of phases or tiers, the first of which will take effect in 2007.

5.3.2.3 Methods for Calculating Project-Specific Emissions

Estimates of Emissions from Construction Equipment

There are a number of methods for estimating emissions from construction equipment. The 2004 PEIR methodology was based on continuous operation of equipment and was inconsistent with EPA's models for estimating emissions. Use of the EPA models and probable load factors yields a better estimate, but there are studies indicating that the EPA modeling may over or underestimate actual emissions by about $\pm$ 5% (Environment Canada 2004). In addition, emissions of SOx are sensitive to the sulfur content of diesel fuel, and use of highway diesel compared to the diesel typically used for construction results in an estimated 85% reduction in SOx emissions (Genesis Engineering 2003). As a result of these uncertainties, a number of entities have tried to characterize and model *actual emissions* from typical construction equipment in use.

For example, the Sacramento Air Quality Management District (SMAQMD 2004) has developed a set of final CEQA guidelines which specify construction equipment emissions rates to be used in CEQA analyses, and these have been adopted by several other AQMDs in California (Eldorado County APCD 2001). The SMAQMD emission rates are based on field data for typical road construction. Road grading and excavation are similar to the type of grading, excavation, and general earth moving which would be undertaken for the Proposed Project. Although road building requires a wider range of construction equipment than the Proposed Project, the same basic grading, excavating, filling, hauling, and drilling equipment is used. The SMAQMD estimates of emissions from each type of standard construction equipment are thus a reasonable basis for estimating emissions from construction of recharge basins, canals, pipelines, and even wells. Other entities have conducted extensive tests of actual construction fleets (such as Genesis Engineering 2003) to develop typical exhaust/crankcase emissions factors for typical construction equipment.

These different approaches yield different results. For example, the SMAQMD CEQA guidelines specify an hourly ROG of 0.65 pounds/day for a typical backhoe/loader. For a 102 horsepower diesel backhoe loader, the Genesis Engineering study of City of Seattle construction equipment developed an estimate of 0.777 grams/horsepower-hour ROG for exhaust emissions and a total 0.793 grams/horsepower hour (including crankcase emissions), or 1.43 pounds/day. This estimate was based on continuous operation of equipment for a full 8-hour day. Given that typical equipment in operation for an 8 hour day is under full load approximately 50% of the time, the Genesis Engineering (2003) estimate would be adjusted to about 0.71 pounds per day. This would be about 8% more than the SMAQMD estimate, reflecting the variation in estimates identified by Environment Canada (2004).

From this comparison, it is clear that estimates of diesel emissions are therefore not a precise science; a key variable in calculations is the daily use patterns for the various pieces of machinery used. But the SMAQMD and Genesis Engineering data are within 10% of each other, suggesting that the SMAQMD estimates are probably an appropriate basis for estimating construction equipment emissions for individual pieces of typical construction equipment, if a contingency is applied to address potential error and to deal with emissions from the many small engines used on a construction sites such as gas generators, small hand tools such as compactors, and so forth. Given the variation in emissions estimates for different types of equipment, the analysis approach adopted in this EIR has been to utilize the SMAQMD CEQA guidelines and adjust them upwards by 25% to provide for a conservative estimate.

For well and pipeline construction, the daily emissions rates in the SMAQMD CEQA guidelines for drilling rigs were adjusted upward by a factor of 2 to reflect the higher horsepower of production well-drilling rigs and reduced for most other equipment to reflect the reduced hours of operation for scrapers, dozers, dump trucks, loaders, and other earth moving equipment that may be used, but used infrequently, during well drilling and pipeline construction.

The SMAQMD guidelines do not include SOx, which is not considered a major problem associated with construction equipment and is highly dependent on fuel composition. For these calculations, the field estimates of SOx emissions developed by Genesis Engineering (2003) for the City of Seattle were used, and, consistent with analysis by Genesis Engineering (2003) were adjusted downward by a conservative 80% to reflect use of lower sulfur highway diesel to minimize sulfur emissions. Highway diesel is fully compatible with construction equipment and adds approximately $0.025 per gallon to the cost of construction (Genesis Engineering 2003).

Finally, PM10 emissions from construction equipment are probably the least significant component of construction-related particulate generation. Fugitive dust generation would be a significant issue for recharge basins, but not for pipelines, wells, and levees, where the average area exposed to active construction would be small, less than a maximum of 10,000 square feet (levees at Unnamed Wash). For all elements of the proposed project, fugitive dust emissions will be controlled in a manner consistent with MDAQMD rules.

Analysis Methodology. For analysis of Alternatives air quality impacts, a "unit" approach was taken. That is a minimum unit of construction was established and daily emissions were calculated for this unit. Units were:

- For recharge basins: a 40-acre recharge basin constructed over a period of 30-40 days;

- For wells: a single production well constructed over a period of 20-30 days;
- For pipelines: 100 feet of pipeline per day, involving one construction crew in a continuous operation;
- For levees: 100 feet of levee per day, involving a single construction crew in a continuous operation;
- For work in the Mojave Mainstem: a single diesel (D-7) operating for 10 working days.

These unit values could then be used to evaluate the potential emissions from the various alternatives by determining the number of units of each type of construction which would be on-going at any time and summing the unit emissions from each unit.

5.3.2.4 Daily Unit Emissions Estimates

The unit emissions estimates from these calculations are shown on Tables 5-4 through 5-8. The construction emissions calculations on Tables 5-4 through 5-8 do not include hauling of construction equipment to the site, which are shown separately and are based on use of a 300 horsepower flat bed hauler. Hauling equipment to the construction and from the worksite would involve round trips of about 50 miles by up to 8 hauling rigs. Each round trip would take approximately 1 hour (on average). Assuming a hauling rig of 300 hp, this would generate emissions approximately equal to those generated by a 300 hp water truck operated 8 hours:

Table 5-4. Daily Emissions Calculation: Typical 40-acre recharge basin to be constructed in 30 working days. Based on SMAQMD CEQA Guidelines and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	CO	NOx	SOx	PM10
Scraper	2	100%	7.28	59.24	45.84	0.21	1.42
Loader	1	100%	0.65	3.65	6.66	0.07	0.34
Water truck	2	180%	6.48	55.12	37.60	0.50	1.04
Excavator	1	100%	1.84	15.64	10.67	0.06	0.29
Medium dozer	1	100%	0.65	4.64	4.98	0.06	0.19
Subtotal			16.9	138.29	105.75	0.9	3.28
With 25% Contingency			21.13	172.86	132.19	1.13	4.1
Fugitive Dust, based on 10 acres of exposed surface at 26.4 lbs/day							**264**
TOTAL			**21.13**	**172.86**	**132.19**	**1.13**	**268.1**
Hauling	4	25%	3.60	30.62	20.89	0.27	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-5. Daily Emissions Calculation: Typical levee construction in floodplain of Unnamed Wash at 400 feet per day. Based on SMAQMD CEQA Guidelines and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	**CO**	**NOx**	**SOx**	**PM10**
Scraper	2	100%	7.28	59.24	45.84	0.21	1.42
Loader	1	20%	0.13	0.73	1.33	0.02	0.07
Water truck	1	50%	1.80	15.31	10.45	0.14	0.29
Medium dozer	1	50%	0.33	2.32	2.49	0.03	0.1
Roller/Compactor	1	50%	0.92	6.56	6.05	0.14	0.26
Subtotal			10.46	84.16	66.16	0.54	2.14
With 25% contingency			13.08	105.2	82.7	0.68	2.68
Fugitive Dust, based on 10 acres of exposed surface at 26.4 lbs/day							**264**
TOTAL			**13.08**	**105.2**	**82.7**	**0.68**	**266.68**
Hauling	4	25%	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-6. Daily Peak Emissions Calculation: Well construction. Based on SMAQMD CEQA Guidelines, construction equipment emission rates for 2006 and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	**CO**	**NOx**	**SOx**	**PM10**
Scraper	1	20%	0.73	5.9	4.58	0.04	0.14
Loader	1	25%	0.17	1.16	1.25	0.02	0.04
Water truck	1	10%	0.36	3.06	2.09	0.03	0.06
Dump truck, 10cy	1	10%	0.36	3.06	2.09	0.03	0.06
Small Compactor	1	10%	0.18	1.31	1.41	0.03	0.06
Small Dozer	1	10%	0.18	1.31	1.41	0.03	0.06
Large drilling rig	1	100%	4.42	37.50	30.44	1.00	0.70
Subtotal			6.4	53.30	43.27	1.18	1.12
With 25% contingency			8.0	66.6	54.09	1.48	1.4
Fugitive Dust, based on 0.1 acres of exposed surface at .264 lbs/day							0.264
TOTAL			**8.0**	**66.6**	**54.09**	**1.48**	**1.66**
Hauling	4	25%	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-7. Daily Emissions Calculation: Pipeline construction. Based on SMAQMD CEQA Guidelines and Genesis Engineering (2003) estimates for SOx emissions adjusted to reflect use of highway diesel fuel. Paving ROG generation of about 0.06 pounds per day is included in the contingency for ROG.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	CO	NOx	SOx	PM10
Backhoe/loader	1	100	0.65	3.65	6.66	0.07	0.34
Hydraulic excavator	1	100	1.84	15.64	10.67	0.06	0.29
Dump truck, 10cy	1	50	1.80	15.31	10.45	0.12	0.29
On/off-site water truck	1	50	1.80	15.31	10.45	0.12	0.29
Pipe layer/crane	1	100	1.44	12.27	8.37	0.30	0.23
Small Compactor	1	25	0.46	3.28	3.53	0.08	0.13
Small Dozer	1	50	0.33	1.85	3.33	0.04	0.17
Subtotal			8.32	67.31	53.46	0.79	1.74
With 25% contingency			10.40	84.31	66.82	0.99	2.18
Fugitive Dust, based on 0.2 acres of exposed surface at .528 lbs/day							0.528
TOTAL			**10.40**	**84.31**	**66.82**	**0.99**	**2.72**
Hauling	4	0.25	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Table 5-8. Daily Emissions Calculation. Berm construction in the Mojave River Mainstem. Not including tractor hauling of equipment to/from site.

EQUIPMENT	#	DAILY USE	ESTIMATED EMISSIONS (pounds/day)				
			ROG	CO	NOx	SOx	PM10
Large Dozer (D-7 or 8)	1	100%	1.45	10.35	11.12	0.2	0.43
With 25% contingency			1.81	12.9	13.9	0.25	0.54
Fugitive Dust, based on 10 acres of disturbed surface at 26.4 lbs/day							**264**
TOTAL			**1.81**	**12.9**	**13.9**	**0.25**	**264.54**
Hauling	4	25%	7.20	45.34	67.10	0.54	3.56
Crew trips	20	NA	0.52	4.20	0.38	NA	0.024

Based on these calculations, the unit emissions for recharge basins, canals, wells, pipelines, and work in the Mojave River are shown on Table 5-9.

Table 5-9. Estimated daily unit emissions associated with construction activities, including a 25% contingency.

FACILITY	**DAILY EMISSIONS ESTIMATE (POUNDS PER DAY)**				
	ROG	**CO**	**NOx**	**SOx**	**PM10**
Construction Equipment Emissions					
40-acre Recharge Basin	21.13	172.86	132.19	1.13	268.1
Levee (Unnamed Wash)	13.08	105.20	82.7	0.68	266.68
One Production Well	8.0	66.6	54.09	1.48	1.66
Pipeline Construction	10.40	84.31	66.82	0.99	2.72
Instream Mojave River Recharge Berms	1.81	12.9	13.9	0.25	264.54
Total (1 unit of each type/day)	**54.42**	**441.87**	**349.7**	**4.53**	**803.7**
MDAQMD CEQA Significance Threshold	137	548	137	137	82
Simultaneous Construction will exceed CEQA Significance Thresholds?	NO	NO	YES	NO	YES

Using these daily unit estimates of equipment emissions and fugitive dust emissions, it is possible to estimate the approximate magnitude of construction-related emissions for each alternative. These unit estimates for each type of construction are a baseline for impact analysis. Increasing the number of increments constructed in a day, such as increasing the rate of pipeline construction from 100 feet per day to 300 feet per day, would incrementally increase equipment load factors and would thus increase daily emissions for all constituents except fugitive dust.

5.3.3 Alternative Emissions Estimates

The potential air quality impacts associated with construction of proposed facilities for all alternatives are shown on Table 5-10.

Table 5-10. Estimated incremental construction-related daily emissions for all Proposed Project facilities, by alternative. Assumes that recharge basins would be constructed in increments of 40 acres and the acreage of soil exposed to active construction at recharge basins will remain 10 af/day. Basin cells will be completed and watered.

FACILITY AND TYPE	UNITS	ESTIMATED DAILY EMISSIONS (pounds per day)				
		ROG	**CO**	**NOx**	**SOx**	**PM10**
Minimum Facilities Alternative						
Instream Mojave River Recharge	NA	1.81	12.9	13.9	0.25	264.54
Mojave River Well Field	1	8.0	66.6	54.09	1.48	1.4
Mojave River Well Field Delivery Pipelines	1	10.40	84.31	66.82	0.99	2.18
Levee (Unnamed Wash)	1	13.08	105.20	82.7	0.68	266.68
TOTAL, ALL Facilities		**28.21**	**230.41**	**188.9**	**4.2**	**534.8**
Small Projects Alternative						
Off-Channel Mojave River Recharge	2.5	21.13	172.86	132.19	1.13	268.1
Off-Channel Mojave River Recharge Pipeline	1	10.40	84.31	66.82	0.99	266.18
Oro Grande Wash Recharge	2.0	21.13	172.86	132.19	1.13	268.1
Oro Grande Wash Pipelines	1	10.40	84.31	66.82	0.99	2.18
Cedar Avenue Detention Basin Recharge	1.5	21.13	172.86	132.19	1.13	268.1
Cedar Avenue Detention Basin Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
Antelope Wash Detention Basin Recharge (Ranchero Road)	1.55	21.13	172.86	132.19	1.13	268..1
Antelope Wash Detention Basin Recharge (Ranchero Road) Pipeline	1	10.40	84.31	66.82	0.99	2.18
Subtotal, Small Projects Alt. Facilities		**126.12**	**1028.68**	**796.04**	**8.48**	**1345.1**
Large Project Alternative						
Oeste Recharge	8.25	21.13	172.86	132.19	1.13	268.1
Oeste Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
Alto Recharge	3.75	21.13	172.86	132.19	1.13	268.1
Alto Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
Antelope Wash Recharge Basins	2.5	21.13	172.86	132.19	1.13	268.1
Antelope Wash Recharge Pipelines	1	10.40	84.31	66.82	0.99	2.18
SWP Delivery via Unnamed Wash (Canal)	1	21.13	172.86	132.19	1.13	268.1
Oeste and Alto Wells	1	8.0	66.6	54.09	1.48	1.4
Total, Large Projects Facilities		**123.72**	**1010.97**	**783.31**	**8.97**	**1080.34**
MDAQMD CEQA Thresholds		137	**548**	**137**	137	**82**

5.3.4 Summary Analysis

In addition to the impacts shown on Table 5-10, MWA may also construct wells near Off-Channel Mojave River Recharge, Oro Grande Wash, Cedar Avenue Detention Basin, Antelope Wash at Ranchero Road, and Antelope Wash south of the Hesperia Airport. Construction schedule has not been determined.

From Table 5-10, simultaneous construction of a number of facilities will clearly cause daily and annual MDAQMD thresholds of significance to be exceeded for all but SO_x emissions. From the construction schedule in Chapter 4, it is likely that multiple wells and multiple recharge basins would be constructed at any given time. The magnitude of daily alternative impacts on air quality would thus depend on the construction schedule. Exact construction scheduling cannot be accomplished until final design specifications have been developed, but the effects of construction schedule on emission rates can be evaluated based on overall construction time and overlap of construction activities (Table 4-18).

For the Minimum Facilities Alternative, pipeline, well construction, and construction at Unnamed Wash involve extended construction periods; all three components are important to initiation of routine delivery of banked and MWA replacement water supplies to the Mojave River Aquifer and the adjacent Regional Aquifer. In addition, construction of the well field connecting and delivery pipelines may require simultaneous construction of several portions of the pipelines at once (east and west side of the river). Otherwise, benefits of the well field would be available to only a portion of MWA's Alto subarea producers. This would also limit the delivery of banked water, since deliveries to the Mojave River are to be balanced with extractions from the Mojave River and Regional aquifers adjacent to the river. Thus, it is not feasible to avoid significant air quality impacts associated with construction of the Minimum Facilities Alternative, except via the implementation of emissions controls mitigation. The added recharge capacity (and associated production wells) for the Small Projects Alternative and the Large Projects Alternative may be phased. The daily pre-mitigation emissions for construction of recharge basins and associated wells and pipeline are shown on Table 5-11.

Table 5-11. Incremental effects of phasing construction to provide for 1 unit of recharge, well, and pipeline construction per day.

FACILITY	DAILY EMISSIONS ESTIMATE (POUNDS PER DAY)				
	ROG	**CO**	**NOx**	**SOx**	**PM10**
40-acre Recharge Basin	21.13	172.86	132.19	1.13	268.1
One Production Well	8.0	66.6	54.09	1.48	1.66
Pipeline Construction	10.40	84.31	66.82	0.99	2.72
Total (1 unit of each type/day)	**39.53**	**323.77**	**253.1**	**3.6**	**272.48**
MDAQMD CEQA Significance Threshold	137	548	137	137	82
Simultaneous Construction will exceed CEQA Significance Thresholds?	NO	NO	**YES**	NO	**YES**

Recharge basin construction in increments of 40 acres, at 45 days per unit would result in an extended period of construction (See also Table 4-18):

- Off-channel Mojave River recharge: 120 days
- Oro Grande Wash Recharge: 100 days
- Cedar Avenue Detention Basin Recharge: 80 days
- Antelope Wash Recharge (Ranchero Road): NA (City Construction)
- Oeste Recharge: 400 days
- Alto Recharge: 170 days
- Antelope Wash recharge: 120 days

An incremental construction schedule for all Small Projects Alternative and Large Project Alternatives would significantly reduce emissions from construction, but pre-mitigation impacts would still remain significant for NO_x and PM10.

Because project air quality impacts are proportional to the construction area, relocation of recharge from the upstream recharge site to an expanded Ranchero Road site as described in Chapter 4, page 4-31 could result in marginal reductions in construction and operational impacts associated with recharge basin repair and maintenance, because there may be substantial overlap of these operations with flood control maintenance.

5.3.5 Operational Impacts

Non-periodic maintenance of facilities is exempt from the provisions of the Fugitive Dust Rule (Rule 403.2 (D)(1)(g) Exemptions). Regardless of the exemption, the potential for facility operations is addressed below.

The operation and maintenance of recharge basins and associated facilities with potential for substantial air quality emissions will primarily involve (a) intermittent 15-day periods of berm grading in the Mainstem Mojave River and (b) maintenance of recharge basins, including inspection and intermittent removal of fines which may accumulate on the top of recharge basins. Fine-grained sediments from water delivered to recharge basins accumulate in a layer of sands and clays mixed with organic matter, forming a thin crust on the recharge basin that must be periodically removed prior to use of the basin. Removal of fines may be necessary annually or on a longer schedule, depending on build up of fines in the basins.

Maintenance generally involves the use of scraper, loader, and small dump truck. Material removed generally has high organic content and may be used by landscape contractors for fill and/or as a component of commercial mulch. Scraped material may be stockpiled outside of the recharge basin, in which case the stockpile will be compacted and watered to minimize wind erosion. Alternately, material removed from recharge basins during routine maintenance may be sold as fill or for use in producing commercial potting soil/mulch. Given this type of activity, estimated impacts of operations on air quality are:

- Grading of low sand berms in the Mainstem Mojave River will not generate emissions in excess of MDAQMD significance thresholds (Table 5-11).
- Removal of fines that accumulated in recharge cells may be accomplished following watering to reduce potential for PM10 emissions, and will be done on a cell-by-cell basis. Given cell size of 10 to 20 acres, daily emissions will be well below the levels of activities associated with recharge basin construction and will thus be below MDAQMD thresholds of significance. Maintenance will vary in timing. In Kern County's recharge basins, removal of fine sediments is undertaken in some basins while others are in operation. Given a similar management approach, it is likely that maintenance will be phased and no more than about 20 acres will be affected at any given time, resulting in emissions below significance thresholds.

All wells and pumps associated with the proposed facilities would be electric powered and would not generate emissions. In addition, water banking raises groundwater levels and reduces pumping energy requirements. Given that a vast majority of the water that MWA will return to Metropolitan will be via exchange of SWP supplies, the Proposed Project would result in groundwater levels higher than under the baseline condition and thus reduce the energy required to extract groundwater at all sites where water is banked. Given that most water used in the MWA service area is groundwater, the Proposed Project would result in net energy savings to the MWA service area. There would thus be no indirect energy effects on local power generation facilities and no indirect increase in emissions associated with the operation of the banking project.

Energy developed to deliver exchange supplies to Metropolitan operations will also not be affected. Metropolitan's Integrated Resources Plan (Metropolitan 2005) provides for the purchase of supplies from north of the Delta as a feature of long-term water supply reliability programs. The energy to transport such supplies to Metropolitan's service area is the same as the energy needed to convey exchange supplies provided by MWA, and may be less because of MWA's ability as a SWP Contractor to schedule deliveries more flexibly than would be feasible via a purchase. Thus, energy required for the exchange component of operations will not be greater than that for the baseline condition and no indirect increase in power consumption and related emissions from power plants will occur.

There would also be no long-term significant impacts to air quality associated with wells and pipelines, which will not have exposed soil surfaces. Daily management activities, including routine inspection and operation of facilities will involve use of vehicles, but these highway vehicles will not generate emissions in excess of the MDAQMD CEQA thresholds.

Operation of recharge basins has some potential to reduce wind-borne dust from the recharge sites. When wetted, these sites will not produce dust that would otherwise be mobilized by wind blowing over dry soil. In addition, experience in Kern County, which experiences periods of high winds and dust storms, suggests that wind-borne dust may be trapped by internal levees much as snow is trapped along fence lines and other points of lower wind velocity. The potential benefit of the Proposed Project on long-term generation of wind-borne dust is not quantifiable, but benefits may be expected. The routine use of the Mainstem Mojave River for recharge may also reduce local dust generation in this reach of the river. The beneficial effects of recharge on wind-borne dust increase with the magnitude of the proposed program, particularly for off-channel recharge basins, which will be used more frequently as program deliveries increase. Operations will therefore not have significant air quality impacts and no mitigation is required.

5.3.6 Mitigation and Significance of Impacts after Mitigation

5.3.6.1 Significance Thresholds

The Proposed Project would be considered to have a significant air quality impact if it:

- Conflicted with or obstructed implementation of the applicable air quality plan;
- Violated any air quality standard or contributed to an existing or projected air quality violation;
- Resulted in a cumulatively considerable net increase of any nonattainment pollutant;
- Exposed sensitive receptors to substantial pollutant concentrations; or
- Created objectionable odors affecting a substantial number of people.

The Mojave Desert Air Quality Management District (MDAQMD) and Antelope Valley Air Quality Management District (AVAQMD) have jointly published recommendations that establish specific daily and annual thresholds levels, above which impacts are considered significant.

Based on the above analysis and as summarized below, construction of the Proposed Project Facilities would generate emissions that would exceed the MDAQMD and AVAQMD thresholds of significance.

5.3.6.2 PM10 and Fugitive Dust

For all alternatives, MWA will implement all of the fugitive dust control measures required by Rule 403 (Fugitive Dust):

- Use periodic watering for short-term stabilization of Disturbed Surface Area (maintaining moist disturbed surfaces);
- Take action sufficient to prevent project-related trackout onto paved surfaces;
- Cover loaded haul vehicles while operating on Publicly Maintained paved surfaces;
- Stabilize graded site surfaces upon completion of grading;
- Cleanup project-related Trackout or spills on Publicly Maintained paved surfaces within 24-hours; and
- Reduce non-essential Earth-Moving Activity under High Wind conditions

The South Coast AQMD provides some guidance related to the effectiveness of these mitigation actions, noting that keeping exposed soil continuously moist reduces fugitive dust from exposed surfaces by 75%, watering haul roads reduces fugitive dust by 3%, and covering haul/dump trucks results in an additional 2% reduction. Implementation of these measures would reduce PM10/fugitive dust emissions from construction of the Minimum Facilities Alternative from 534.8 pounds per day to 106.96 pounds per day.

Implementation of these measures for construction of the additional recharge basins provided for in the Small Projects Alternative and Large Projects Alternative would reduce 40-acre-unit PM10/fugitive dust emissions from 272.4 pounds per day to 54.48 pounds per day. If recharge basin construction is phased in 40-acre increments, then, implementation of these measures would reduce daily PM10/fugitive dust emissions to a level of less than significant. Simultaneous construction of any two 40-acre units would, however, result in significant daily PM10/fugitive dust emissions.

5.3.6.3 NOx

NOx emissions from diesel-powered equipment are a persistent concern, even in Europe where diesel fuel of very high quality is available. MWA's requirement that highway diesel fuel be used in construction will have only a fractional influence on NOx production. No practical phasing of construction elements, including incremental construction of recharge basins, effectively reduces construction-related NOx emissions to levels of less than significant. Even assuming sequential construction of the facilities provide for in these alternatives, the simultaneous construction of recharge basins and the wells/pipelines associated with each recharge-basin facility would result in daily NOx emissions in excess of MDAQMD thresholds of significance.

5.3.6.4 ROG, CO, and SOx

Construction of the Minimum Facilities Alternative involving simultaneous construction of up to 5 wells and 2 segments of pipeline would not result in impacts in excess of MDAQMD thresholds of significance for ROG, CO, or SOx, but construction involving higher levels of activity would cause significant impacts related to these constituents. Similarly, simultaneous construction of 2 units of recharge would not cause impacts in excess of MDAQMD thresholds of significance for ROG, CO, or SOx, but construction involving higher levels of activity would cause significant impacts related to these constituents.

5.3.6.5 Comparative Significance of Construction-Related Air Quality Impacts

Although all construction scenarios would involve air quality impacts in excess of MDAQMD thresholds of significance, the relative magnitude of the potential emissions in the context of overall diesel emissions within MWA's service area can be understood by comparing construction emissions from construction of all Large Projects Alternative facilities simultaneously to emissions from diesel truck traffic within MWA's service area. The most meaningful comparison for diesel is NOx and PM10.

For 2004, Caltrans annual average daily truck traffic for the major roads in the MDAQMD service area (Caltrans 2005) are:

- Interstate 15 at Victorville: 13,013
- Highway 395 at Palmdale road: 2,699

- Highway 18 at Highway 395: 649
- Highway 58: 6512

Assuming that some of this traffic on these interconnecting roads involves the same vehicles, a conservative estimate of daily truck traffic on these major roads in the MDAQMD area is about 15,000 truck trips per day. On these roads, with sparse development, these trips would generally be long haul trips. Assuming an average trip length of 100 miles and an average speed of 65 mph, average trip length would be 1.5 hours. If California standards for diesel emissions are assumed to be met by all trucks, then a 1.5 hour trip by a truck with a 300-horsepower diesel would generate:

NOx:	300 x 5.0 g/hp-hr/454 x 1.5	=	4.95 pounds of NOx
PM10:	300 x 0.1 g/hp-hr/454 x 1.5	=	0.1 pounds of PM 10

Using these approximate values, 15,000 truck trips per day would generate:

NOx:	4.95 pounds/day x 15,000	=	67,500 pounds per day
PM10:	0.1 pounds/day x 15,000	=	1,500 pounds per day

These estimated values for diesel emissions are conservative in two ways. First, they assume all trucks operating on the major roads comply with California diesel emissions standards. Second, they do not account for PM10 emissions from traffic as a result of tire wear, and road dust. These conservative values are compared to the values for project-related NOx and PM10 emissions, with project-related PM10 emissions adjusted to reflect the effects of mitigation, on Table 5-12.

Table 5-12. NOx and PM10 emissions from simultaneous construction of all potential project facilities compared to estimated emissions from commercial truck traffic on major roads in the MWA service area. (PM10 emissions from construction adjusted to reflect mitigation).

POLLUTANT	EMISSIONS IN POUNDS/DAY		PROJECT EMISSIONS AS A % OF TRUCK EMISSIONS
	Large Project Alternative	Truck Traffic	
NOx	1,979	67,500	3%
PM10 (vehicle)	54	1,500	4%
PM10 (Fugitive dust)	580	Not estimated	Not estimated

The comparison on Table 5-12 suggests that maximum probable emissions from simultaneous construction of all of the proposed project's Large Projects Alternative would be from 3-4% of total emissions from long-haul truck traffic in the MWA service area and a substantially smaller fraction of total emissions from all sources.

Even within this broader context, simultaneous construction of multiple recharge and other facilities under the Minimum Facilities Alternative, the Small Projects Alternative and/or the

Large Projects Alternative would result in emissions in excess of both daily and annual MDAQMD CEQA thresholds of significance for NOx, CO, ROG, and PM10. Feasible mitigation such as use of highway diesel fuels and use of additional pollution equipment to trap exhaust particulates or NOx would be implemented as part of the project, but would not likely reduce emissions to a level of less-than-significant. MWA would evaluate potential for phasing of construction to reduce emissions, but phasing:

- May not be feasible given the need to utilize recharge facilities early in the proposed banking/exchange project, and
- May extend the duration of other categories of impact such as noise and traffic.

In summary, even with all feasible mitigation, it is likely that construction of facilities for the Proposed Project will result in emissions which exceed daily and annual MDAQMD thresholds of significance. Long-term operations activities will not result in emissions that exceed daily or annual MDAQMD thresholds of significance.

The long-term operation and maintenance of facilities would not involve activities that would result in current air quality impacts in excess of MDAQMD and AVAQMD significance thresholds. Some reductions in wind-borne dust may be anticipated as a result of operations of recharge basins.

5.3.7 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan, and would involve development of recharge and conveyance capacity without banking capacity. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year plus available supplies under Article 21 of the SWP contract. The effect of the No Project Alternative on air quality impacts would be to defer implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

By delaying construction of some facilities, the No Project Alternative would reduce net annual emissions and allow for a greater scheduling flexibility. Individual facilities may be constructed over a longer period of time, thus reducing daily vehicle emissions and fugitive dust from construction. In addition, lack of a pipeline connection from the Mojave River Well Field to the California Aqueduct would reduce net construction activity and fugitive dust emissions. Nonetheless, given the unit impacts of construction on NOx and PM10 emissions, it is likely that there would be periodic violations of daily MDAQMD thresholds of significance for these constituents. The No Project Alternative would reduce annual emissions related to construction, but would continue to periodically have significant daily emissions related to construction. Given long-term implementation of EPA diesel emissions programs, the delay associated with the No Project Alternative would also mean that vehicles with lower average emissions would be utilized in construction, therefore further reducing daily emissions.

5.4 Biological Resources

5.4.1 Environmental Setting

5.4.1.1 General

The MWA service area is entirely to the north of the ridgeline of the San Bernardino Mountains, which separate the Mojave Basin from the coastal basin that includes Los Angeles, Orange, western Riverside, and western San Bernardino counties. The mountains form an ecological divide, dramatically reducing coastal influence in the MWA service area. Precipitation in the MWA service area is about 30 to 40 percent of that in the coastal basin, and the flora and fauna of the MWA service area reflect this low-moisture, high-temperature environment. Although there are times when general winter storms affect the entire MWA service area, significant precipitation is often intermittent and precipitation may be distributed in a patchy manner.

Native plants have a number of drought-tolerant characteristics, such as waxy leaves; early season; and rapid growth, flowering, and germination. Animals are also physiologically and behaviorally adapted to a hot, low-moisture environment and use burrowing, hibernation, and nocturnal behavior to minimize exposure to desert conditions. In such an environment, activities which affect water availability may be considered inherently important. Thus, rivers, washes, adjacent riparian areas, lakes, and springs are relatively rare and important ecological features.

A vast majority of the vegetation in the MWA service area falls into three categories: desert scrub, alkali desert scrub, and Joshua Tree "forest." Desert scrub is associated with stabilized sand-dune accumulations. The desert scrub community consists of low growing perennial plants with a few taller shrubs such as creosote bush and a suite of forbs and grasses (Table 5-13). Desert scrub occurs in virtually all upland areas from sea level to 4000 feet. Alkali desert scrub distribution is more limited, and it is usually associated with dry lake beds and floodplains. Its plant communities are adapted to saline soils (Table 5-13). Joshua Tree forest is a mixed woodland community occurring between areas of desert scrub and higher elevation pinyon-juniper woodlands. As a transitional community between lowlands and mountains, the Joshua Tree forest may occur in and along desert washes and along the lower slopes of the foothills of the northern San Bernardino Mountains.

Within the matrix of desert scrub, alkali desert scrub, and Joshua Tree forest, there are a number of plant and animal communities of limited distribution. Along the Mainstem Mojave River, there are reaches of desert riparian vegetation (Table 5-13) where there is high groundwater and/or surface flow. Two of these areas, from the Narrows to near Helendale and downstream from Yermo, are designated by CDFG as riparian protection zones; they represent the majority of desert riparian vegetation communities in the MWA service area.

Desert wash communities (Table 5-13) occur in the ephemeral, generally dry washes that drain to the Mojave River from local uplands. These washes may contain a variety of vegetative communities, which are generally more robust and diverse than the desert scrub communities that generally surround them. Periodic flow enhanced large shrub growth and results in a variability in the plant community from the low-flow channel to the edges of the canyons.

The foothills of the San Bernardino Mountains are dominated by three other plant communities: mixed chaparral, chamise-redshank chaparral, and pinyon-juniper woodland (Table 5-13). These shrub communities are distributed in patches along the northern slopes of the San Bernardino Mountains from the valley floor to elevations of up to 8,000 feet. Their distribution is affected by slope, aspects, and soils. All three communities are affected by recurring fire. Their dominant plants are characterized by high oil content and waxy leaves. Many have seeds which must be exposed to heat and/or smoke before they germinate. These communities are therefore characterized by infrequent cycles of often intense fire, followed by sprouting of seeds and sprouting of new growth from the root crown of the burned plant. A period of rapid growth follows until dead and decaying branches reach a critical mass and a new fire cycle occurs. Fire cycles may range from 15 to over 50 years.

5.4.1.2 Issues and Conservation Planning

The West Mojave Basin has experienced significant growth over the past 30 years, with associated habitat loss and disturbance. This has occurred primarily in the urbanizing Victor Valley, Yucca Valley, Barstow areas, and at Fort Irwin north of Barstow. Development in these areas, off-road vehicle use, and development along road corridors has affected the status of a number of desert species, most notably the desert tortoise, the Mohave ground squirrel, and a suite of riparian-dependent birds. In addition, there are numerous desert plants with a distribution limited to certain soil and hydrologic conditions. A number of these species have been listed as threatened or endangered under the federal and/or California endangered species acts.

Table 5-13. Major plant communities of the MWA service area that may be affected by Proposed Project alternatives.

COMMON PLANTS	COMMON ANIMALS	POTENTIAL T&E AND PROTECTED SPECIES IN PROJECT AREA HABITATS
Desert Scrub (creosote bush scrub)		
Creosote bush Catclaw Desert agave Coastal bladderpod White brittlebush Burrobush White bursage Barrell cactus Hedgehog cactus Branched pencil Teddybear cholla Palmer's coldenia Wiggin's croton Desert globemallow Jojoba Littleleaf ocotillo Beavertail pricklypear Rabbitbush Desert sand verbena Desert senna Squaw waterweed Anderson's wolfberry Mojave yucca Evening primrose Galleta Galletagrass Spanish needles	Couch's spadefoot toad Desert tortoise Desert iguana Common kingsnake Black-throated sparrow Pocket mice (various) Kangaroo rats (various) Antelope squirrel Kit fox Coyote Bobcat Desert cottontail rabbit Black-tailed jackrabbit California horned lark Raven Le Conte's thrasher Prairie falcon Coast horned lizard	**Listed or protected** Desert tortoise (FT/CT) Mohave ground squirrel (ST/FSC) **Other Special Status Species** Western burrowing owl (FSC/CSC) Prairie falcon (CSC) Le Conte's thrasher (CSC) Ferruginous hawk (CSC) Coast horned lizard (CSC) Barstow wooly sunflower (CNPS 1B) Booth's evening primrose (CNPS 2) Desert cymopterus (CNPS 1B) Mohave monkeyflower (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B) Small-flowered androstephium (CNPS 2) Clokey's cryptantha (CNPS 1B) Creamy blazing star (CNPS 1B) Crucifiction thorn (CNPS 2)
Joshua Tree Forest		
Joshua trees California juniper Singleleaf pinyon California buckwheat Longspine horsebrush Desert thorn Cactus Mojave yucca	Pocket mice (various) Kangaroo rats (various) Kit fox Coyote Bobcat Desert cottontail rabbit Antelope squirrel Black-tailed jackrabbit California horned lark Le Conte's thrasher Raven Prairie falcon Coast horned lizard Desert night lizard Ladder-backed woodpecker Cactus wren Scott's oriole	**Listed or protected** Desert tortoise (FT/ST) Mohave ground squirrel ST/FSC) **Other Special Status Species** Western burrowing owl (FSC/CSC) Desert cymopterus (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B)
Desert Riparian		
Cottonwood Willow Tamarisk Velvet ash Mesquite	Pocket mice (various) Kangaroo rats (various) Coyote Bobcat Desert cottontail rabbit	**Listed or protected** Desert tortoise (FT/ST) Yellow-billed cuckoo (FE/CE) SW willow flycatcher (FE/CE) Mohave ground squirrel (ST/FSC)

	Black-tailed jackrabbit California horned lark Le Conte's thrasher Prairie falcon Coast horned lizard Cooper's hawk Yellow-breasted chat Brown-crested flycatcher Summer tanager Raven Gambel's quail Mourning dove Chuckwalla	Mojave River vole (FSC/CSC) Arroyo toad (FE/CSC) California red-legged frog (FT/CSC) Mojave tarplant (CE) **Other Special Status Species** Cooper's hawk (CSC) Yellow Warbler (CSC) Long-eared owl (CSC) Western burrowing owl (FSC/CSC) Prairie falcon (CSC) Yellow-breasted chat (CSC) Brown-crested flycatcher (CSC) Summer tanager (CSC) Southwestern pond turtle (FSC/CSC) San Diego horned lizard (CSC) Mohave monkeyflower (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B)
Desert Wash		
Active wash area Catclaw Allscale Saltbush Desert willow Mesquite Desert almond Cheesebush Skunkbush Blackstem Pigmy cedar **Adjacent uplands** Creosote bush Catclaw Desert agave White brittlebush Burrobush White bursage Barrell cactus Hedgehog cactus Branched pencil Teddybear cholla Litteleaf ocotillo Beavertail pricklypear Rabbitbush Mojave yucca Evening primrose	Pocket mice (various) Kangaroo rats (various) Coyote Bobcat Desert cottontail rabbit Antelope squirrel Black-tailed jackrabbit California horned lark Le Conte's thrasher Raven Coast horned lizard Desert night lizard Ladder-backed woodpecker Cactus wren	**Listed or protected** Desert tortoise (FT/CT) Mohave ground squirrel (ST/FSC) **Other Special Status Species** Western burrowing owl (FSC/CSC) Prairie falcon (CSC) Le Conte's thrasher (CSC) California horned lark (CSC) San Diego horned lizard (CSC) Barstow wooly sunflower (CNPS 1B) Booth's evening primrose (CNPS 2) Desert cymopterus (CNPS 1B) Mohave monkeyflower (CNPS 1B) Plummer's mariposa lily (CNPS 1B) Robinson's monardella (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B) Small-flowered androstephium (CNPS 2) Southern skullcap (CNPS 1B)
Mixed Chaparral		
Chamise Birchleaf mountain mahogany Silk-tassel Toyon Yerba-santa California buckeye Poison oak Sumac California buckthorn Hollyleaf cherry Montana chaparral pea California fremontia	Pocket mice (various) Kangaroo rats (various) Coyote Bobcat Desert cottontail rabbit Black-tailed jackrabbit California horned lark Le Conte's thrasher Prairie falcon Coast horned lizard Red tail hawk Mountain kingsnake	**Listed or protected** Desert tortoise (FT/CT) Western burrowing owl (FSC/CSC) **Other Special Status Species** San Diego horned lizard (CSC) Short-joint beaver-tail cactus (CNPS 1B) Grey vireo (CSC)

	Ringtail cat Badger Mule deer Mountain lion	
Chamise-redshank Chaparral		
Chamise Redshank Toyon Ceanothus Sugar sumac	Pocket mice (various) Kangaroo rats (various) Coyote Bobcat Desert cottontail rabbit Black-tailed jackrabbit California horned lark Le Conte's thrasher Prairie falcon Coast horned lizard Red tail hawk Mountain kingsnake Ringtail cat Mule deer Mountain lion Badger	**Listed or protected** Desert tortoise (FT/ST) Western burrowing owl (FSC/CSC) **Other Special Status Species** Short-joint beaver-tail cactus (CNPS 1B) Grey vireo (CSC)
Pinyon-juniper Woodland		
Pinyon Juniper White fir Blackbrush Common snakeweed Narrowleaf golden bush Parry's nolina Curlleaf mountain mahogany Antelope bitterbush Parry's rabbitbrush Mojave yucca Ponderosa pine	Pinyon mouse Bushy-tailed woodrat Pinyon jay Plain titmouse Bushtit	**Listed or protected** Desert tortoise (FT/ST) Western burrowing owl (FSC/CSC) **Other Special Status Species** Baja navarretia (CNPS 1B) Short-joint beaver-tail cactus (CNPS 1B) Prairie falcon (CSC)

Legend:

FE	=	Listed as endangered under the federal Endangered Species Act
FT	=	Listed as threatened under the federal Endangered Species Act
FSC	=	Listed as a species of concern by USFWS
CE	=	Listed as endangered under the California Endangered Species Act
FT	=	Listed as threatened under the California Endangered Species Act
CFP	=	Listed as fully protected under California Fish and Game Code
CSC	=	Listed as a species of concern by CDFG
CNPS	=	California Native Plant Society. CNPS produces lists of species, each list reflecting a CNPS Judgment related to the potential of species rarity and potential for extinction. Though unofficial and having no legal standing, designations as CNPS 1B or CNPS 2 indicate that a species is rare and potentially threatened.

In response, regional land management agencies and regulatory agencies have developed a comprehensive multi-species habitat conservation plan (West Mojave Plan) that is intended to guide development and conservation planning in all of the western Mojave Basin, including MWA's service area. The final Environmental Impact Statement/Environmental Impact Report for the West Mojave Plan was issued in the spring of 2005 (BLM 2005). The West Mojave Plan identifies areas of conservation priority and areas where development may occur with lower potential impacts; mitigation ratios for impacts to natural habitats are varied depending on the relative sensitivity of the habitats within zones. Although the West Mojave Plan is not yet in implementation and changes may be made, it summarizes nearly a decade of study, analysis, and planning and represents the general consensus of a large number of local and regional experts regarding the relative sensitivity and importance of various habitats and geographic areas for a wide range of species.

Except for Unnamed Wash, Oeste Recharge, Alto Recharge, and Antelope Wash Recharge south of the California Aqueduct, all of the potential facilities for the Proposed Project are located in or near development or agricultural lands, are currently disturbed habitats, and are outside of the boundaries of existing and/or proposed conservation areas. In addition, all of the new facilities are in West Mojave Plan proposed "No Survey Zones" for desert tortoise, reflecting several decades of surveys in these areas which have found no sign, or minimal sign, of desert tortoise. In the proposed No Survey Zones, the West Mojave Plan provides for impact analysis and multi-species mitigation based on habitat type, condition, and suitability. New facilities for the Proposed Project would be constructed in two zones:

- An urban zone south of State Highway 18 and east of State Highway 395, where conditions are highly disturbed and thus proposed mitigation ratios are 0.5 acres of mitigation for each 1 acre of habitat impact; and
- A semi-rural zone south of State Highway 18 and west of State Highway 395, where proposed mitigation ratios are 1.0 acres of mitigation for each acre of habitat impact.

If implemented and adopted by local governments, the West Mojave Plan explicitly provides for much higher mitigation ratios in other areas to provide (a) an incentive for development in the Proposed Project area and (b) a disincentive for development in more sensitive areas. In addition, review of available data on sightings of threatened and endangered species in the Proposed Project area (West Mojave Plan and CNDDB 2004) indicates that there have been few recent sightings of desert tortoise or Mohave ground squirrel in the Proposed Project area. This suggests that listed species are unlikely to be found in the Proposed Project area.

5.4.2 Facilities Impacts: Mechanisms for Effect

5.4.2.1 General

Construction of project facilities in areas of wildlife habitat will involve removal of habitats within the construction right-of-way. For both recharge areas and pipelines these impacts would have permanent effects on wildlife habitat, which would not be expected to recover within the construction right of way due to (a) routine inspection and monitoring along the rights-of-way, aesthetic treatment, and/or (c) potential long-term management. Construction would permanently alter soil structure as well, with a loss of soil integrity and alteration of soil hydrogeology. Any special-status plant species in the construction right-of-way would be permanently removed.

Loss of habitat may be accompanied by potential direct injury to threatened and endangered animal species, due to crushing of burrows. The primarily daytime burrowing/nocturnal foraging behavior of virtually all terrestrial desert species would limit potential for animals to be active during the daylight hours, and thus it is likely that any injury or death would occur to animals in their burrows. All burrowing species at a construction site would be affected.

During construction in or adjacent to wildlife habitat , there would also be general noise and visual disturbance during daylight hours, but the daytime burrowing/nighttime foraging pattern of desert animals would tend to ameliorate this type of effect. In the area immediately adjacent to the construction right-of-way, ground vibration and noise may drive some burrowing animals from their burrows resulting in exposure to predation and stress associated with activity during the heat of the day.

At the Unnamed Wash, routine and sustained releases of water in many year types and over periods when flow would otherwise not occur would alter the habitats of the wash. At release rates of 100 to 500 cfs, there is potential for the wash to erode, creating an incised channel, with loss of scrub habitats. Channel maintenance would control potential invasion of this area by exotic phreatophytes such as tamarisk. During recharge operations, the canal at the downstream end of the wash would potentially inhibit wildlife movement along the western side of the river. There would also be maintenance access roads along the wash to provide for crews to inspect and maintain drop structures. These access roads would likely also be used as trails.

Finally, recharge of groundwater in the vicinity of the Mojave River has potential to raise groundwater levels along the river banks to within 20 to 40 feet of the surface, which may encourage the growth of deep-rooted phreatophyte vegetation, including invasive species such as tamarisk.

5.4.2.2 Range of Threatened, Endangered, and other Special-Status Species

Direct effects associated with habitat loss are applicable to special-status species if (a) the habitat at the site is suitable for the species and (b) the habitat occurs within the known range of the species. The potential for listed threatened and/or endangered species to occur at various sites under consideration for Proposed Project facilities is described below, based on field surveys and habitat characterizations and on data about the known distribution of the species, based on species accounts prepared by regional species experts for the West Mojave Plan (BLM 2005).

<u>Desert tortoise (FT/CT)</u>. The West Mojave Plan evaluates the current distribution of the desert tortoise and concludes that the neither individuals nor substantial signs of the species have been

found in recent years south of State Highway 18 (West Mojave Plan Map 3-6). This does not mean that the species has been declared extirpated south of State Highway 18; it may be interpreted to mean that the likelihood of finding desert tortoise would decrease with distance south of this major east-west arterial road. This reflects (a) the habitat-fragmentation effects of roads and (b) the on-going urban and suburban development that is occurring along and south of State Highway 18. Pending a final decision related to the proposed West Mojave Plan "no survey zone" for desert tortoise, pre-construction surveys would be conducted for this species.

<u>Mohave ground squirrel (FSC/ST)</u>. Mohave ground squirrels aestivate in burrows during periods of low moisture and high temperatures (as long as March through November). Part of their life history strategy is to defer reproduction in years of low food supply, and as a result local populations may be extirpated during periods of extended drought. The Mohave ground squirrel is known to travel long distances and to recolonize areas where local populations have been extirpated. The species is also sensitive to development, and roads/developed areas may block recolonization. The Mohave ground squirrel's range extends south of State Highway 18 and could include virtually all habitats with (a) appropriate desert scrub characteristics, (b) soil appropriate for burrowing and not likely to be inundated during the summer, and (c) connectivity to other populations. Features that would affect connectivity in the Proposed Project area where new facilities may be constructed include the California Aqueduct, State Highways 18 and 395, and the urban development of Hesperia, Adelanto, Victorville, and Apple Valley. The species is thus less likely to occur in an urban matrix, south and west of the junction of Interstate 15 and State Highway 395. This is reflected in mapping of historic and recent sightings in the California Natural Diversity Database (CNDDB 2005). Pre-construction surveys would be conducted for this species except in the Mainstem Mojave River and adjacent loose sandy soils where burrowing is not feasible.

<u>Mojave tarplant (CE)</u>. The Mojave tarplant occupies habitats typical of *Hemizonia* species -- clay, silty, or gravelly soils that are seasonally saturated (CDFG 2000). Both CDFG (2000) and LePre (2004) note that the species has not been found in San Bernardino County since 1933. LePre (2004) indicates that the species has been extirpated from the county. Extirpated plants have, however, been known to re-appear in areas where they have been declared extirpated, and pre-construction surveys would be conducted where soil conditions for the plant might be appropriate. Nevertheless, this species is not likely to occur in the area in general and less likely to occur in (a) urban areas, (b) in dry upland areas, and (c) in disturbed habitats.

<u>Arroyo toad (FE/CSC)</u>. The arroyo toad requires shallow slow-moving stream and riparian habitats that are disturbed naturally by flooding (USFWS 2005). The arroyo toad is found in the east and west forks of the Mojave River and at Mojave Forks Dam where the two forks converge. Mainstem Mojave River habitat is not suitable from about 0.75 miles downstream of Mojave Forks Dam to the Narrows, because this area is not routinely flooded and high percolation rates cause the river to go dry during periods when the arroyo toad would require ponds for egg and tadpole rearing. None of the other potential sites for new facilities has suitable ponded habitat for the toad.

California red legged frog (FT/CSC). The California red-legged frog requires permanent pond-type conditions, none of which occur within Proposed Project new facility areas. As noted in the 2004 PEIR, it has been observed in ponds near Silverwood Lake.

Yellow-billed cuckoo (FE/CE). This riparian species may occur in the vicinity of Mojave Forks Dam and in patches of riparian habitat upstream (USFWS 2005). It may occur in riparian habitats downstream of the Narrows. There is no suitable desert riparian habitat at other Proposed Project facility sites.

Southwestern willow flycatcher (FE/CE). This riparian species may occur in dense willow thickets or tamarisk in the vicinity of Mojave Forks Dam and in patches of riparian habitat upstream. It may occur in riparian habitats downstream of the Narrows. There is no suitable desert riparian habitat at Proposed Project facility sites.

5.4.2.3 Range of other Special Status Species

Western burrowing owl (FSC/CSC). Western burrowing owl was once a common inhabitant of grasslands and pasture lands, living in burrows adjacent to roads and levees, and along the banks of washes (CDFG 2005). Burrowing owls are less likely to occur (a) in urban areas, (b) in areas with dense soils and/or sandy soils where burrows may not be maintained, and (c) in areas with limited rodent populations.

Mojave river vole (FSC/CSC). This species occurs in weedy herbaceous growth in wet areas along the Mojave River and adjacent irrigated pasture, burrowing in soft, but not sandy soils. It may occur immediately downstream from Mojave Forks Dam, but is not likely to be found in the Proposed Project reach of the Mainstem Mojave River and/or at other sites considered for facilities due to lack of routinely wet conditions and weedy herbaceous vegetation in the Mainstem Channel upstream of the Narrows and along the dry portions of the floodplain which may be used for facility construction. The species may be found adjacent to off-channel recreational lakes, but these are outside of the Proposed Project area.

Prairie falcon (CSC). This species forages across most of the MWA service area, nesting in cliff habitats. No nesting habitat occurs at any of the Proposed Project facility sites.

Le Conte's thrasher (FSC/CSC). Le Conte's thrasher utilizes a wide range of desert scrub and desert wash habitats, nesting in dense spiny cactus 2-8 feet above ground. The species is thus likely to occur where there is adequately developed cactus habitat. It may forage over any of the proposed sites.

Ferruginous hawk (CSC). The ferruginous hawk is a winter resident, nesting in tall trees and artificial nest sites such as power poles. This species is expected to forage across a wide range of desert habitats. There is no nesting habitat at the various facility sites, but the species may forage over them.

Cooper's hawk (CSC). The Cooper's hawk nests in riparian forest habitats along the Mojave River. Only the riparian habitat immediately downstream of Mojave Forks Dam would be suitable for Cooper's hawk nesting; all other facility sites are devoid of significant riparian habitats. The species may forage over a wide range of desert habitats and may thus forage at all facility sites.

California horned lark (CSC). California horned lark is a ground-breeding bird broadly distributed in open desert habitats. It may occur in all but heavily disturbed (graded, barren soil) areas where facilities are proposed. This species was documented on most of the Proposed Project facility sites during spring 2005 surveys.

Long-eared owl (CSC). The long-eared owl nests in wooded areas and forages in adjacent open areas. It is distributed throughout such habitats in the MWA service area, and would be expected to nest in riparian forest habitats upstream and downstream of Mojave Forks Dam. Nesting habitat is not available at other facility sites, but the species may forage over all facility sites.

Yellow Warbler (CSC). In the MWA service area, the yellow warbler is a riparian species known only at one location, 5 miles southwest of Hesperia near Mojave Forks Dam. It is unlikely to occur at other potential facility sites.

Yellow-breasted chat (CSC). The yellow-breasted chat is a riparian thicket species that may occur in the riparian habitats immediately downstream of Mojave Forks Dam, but there is no habitat for the species at other potential facility sites.

Brown-crested flycatcher (CSC). The brown-crested flycatcher is a riparian thicket species that may occur in the riparian habitats immediately downstream of Mojave Forks Dam, but there is no nesting habitat for the species at other potential facility sites. It may forage above other potential facility sites that are near river habitats.

Summer tanager (CSC). Summer tanagers are riparian thicket birds that may occur in the riparian habitats immediately downstream of Mojave Forks Dam, but there is no nesting habitat for the species at other potential facility sites. It may forage above other potential facility sites that are near river habitats.

Grey vireo (CSC). This chaparral species may occur in the hills to the south of Hesperia, including unnamed wash. The species is unlikely to occur outside of dry chaparral and sage scrub habitats and not probable at other potential facility sites.

Southwestern pond turtle (FSC/CSC). This species is known to inhabit ponds, rivers, canals, lakes, and marshes. It prefers low-velocity habitat and inhabits the riparian areas from Mojave Forks Dam to Silverwood Lake. It is amphibious, and this may explain its adaptation to a wide range of aquatic environments; it has the ability to move to land during periods of floods. In the reach below Silverwood Lake, its survival reflects its behavioral adaptation to highly variable hydrology. It is not likely to be found at other potential facility sites.

San Diego horned lizard/coast horned lizard (CSC). These related species are found in a variety of desert habitats and may be anticipated to inhabit all potential facility sites where soils have not been compacted and burrowing is therefore feasible.

Mojave fringe-toed lizard. Written comments on the draft EIR from the California Department of Fish and Game suggested that MWA include the Mojave fringe-toed lizard in its analysis. MWA initially reviewed distribution data for the Mojave fringe-toed lizard, which shows known distribution well to the north and east of proposed project areas. In addition, according to the California R015 California Wildlife Habitat Relationships System (California Department of Fish and Game California Interagency Wildlife Task Group): "The Mojave fringe-toed lizard occurs in desert regions of Inyo, San Bernardino, Los Angeles, and Riverside [Counties]. It is restricted to fine, loose, wind-blown deposits in sand dunes, dry lakebeds, riverbanks, desert washes, sparse alkali scrub and desert shrub habitats."

CDFG also included the Lucerne Valley in its list of potential project locations. Although a potential project site in this area was evaluated during initial screening of alternatives, the proposed project does not include any new facilities or activities in this area. There are areas near the Lucerne valley where Mojave fringe-toed lizards have been found. There would also be potential habitat for the species in this area, where there is suitable fine, loose, windblown sand. However, the elimination of the Lucerne Valley as a potential project facility/activity site early in the analysis means that the sites actually being considered for project construction and operation are a considerable distance outside of the known range for this species.

In addition, MWA has explicitly avoided siting recharge basins in areas with the fine, wind-blown sands required for the species to escape high daytime temperatures. Sandy habitats in the Mojave River channel that will be affected by in-channel recharge are coarse and subject to surface flow, as well as being upstream of the historic distribution of the Mojave fringe-toed lizard, which was primarily between Helendale and Camp Cady (West Mojave Plan Working Group, 1999). No dune-type habitats will be affected by the project. The creosote scrub habitats that may be affected by the project have been chosen to avoid fine sandy areas such as the wash at Sheep Creek, because these areas may also be associated with subsurface layers of fines and clays, which are not suitable for groundwater recharge.

In short, there is no reasonable potential for the proposed project to affect Mojave fringe-toed lizards because (a) none of the proposed sites are within the known range of the species and (b) groundwater recharge is optimized where there are coarse sands and sandy loams, and the selection of such sites probably eliminates potential for the Mojave fringe-toed lizard. Nevertheless, as provided in the EIR, we will survey for special-status species prior to construction. If Mojave fringe-toed lizards are found during such surveys, MWA will notify CDFG and initiate consultation regarding appropriate avoidance and mitigation.

In addition, there are a number of habitat- special status plant associations (See Table 5-13). The special status plants associated with each habitat on Table 5-13 are assumed to be present at sites with each habitat type, even if they were not observed during surveys. Desert plants often have long seed dormancies and germination patterns that reflect variable desert hydrology. The seed bank may therefore exist even if the species does not germinate in a given year.

5.4.3 Impact Analysis Methods

The purpose of impacts analysis is to provide decision makers with a sound basis for ranking and selection of alternatives. For biological resources, this may be accomplished on a habitat and habitat quality basis, by evaluating the probability of various special-status species to utilize each site, based on factors such as habitat type, habitat condition, isolation from adjacent occupied habitats due to roads or development, and whether known populations occur at or near the site. Based on these factors, and on habitat surveys and mapping conducted in spring 2005 (Cadre Environmental 2005), the relative site sensitivity can be evaluated, generally, and for threatened and endangered species.

Habitat surveys and mapping were not conducted in urban areas, such as along the probable alignments of wells and pipelines for the Mojave River Well Field (Minimum Facilities Alternative). These facilities would generally be constructed in or adjacent to public roads and other rights of way through the City of Hesperia and the Town of Apple Valley and no habitat impacts would be anticipated in these developed areas. There is some potential for well and pipeline construction on the slopes leading down to the Mojave River. Although this area is disturbed by adjacent development and by incidental local use, disturbed habitats typical of desert scrub would potentially be affected. Well sites are not known with precision at this time, and therefore impacts are assumed to approximately 1-2 acres of desert scrub (10 well pads and short segments of connecting pipeline). Work in the Mainstem Mojave River to push up berms to enhance recharge (Minimum Facilities Alternative) would not affect wildlife habitat because construction management protocols prohibit work within 100 feet of native vegetation. Finally, in the Unnamed Wash area, recent data from surveys conducted for the Rancho Las Flores Environmental Impact Report were used (in preparation).

5.4.4 Facility Impacts: Specific Mechanisms for Effect

Construction of recharge basins, wells, and pipelines, bridges, levees, and drop structures would result in permanent loss of all native habitats within the footprint of these facilities. During grading for these facilities, burrowing animals could be injured or killed. These areas would remain devoid of habitat.

Construction of recharge basins in washes (Antelope Wash and Oro Grande Wash) and along the floodplain of the Mainstem Mojave River could affect wildlife movement to and from the San Bernardino Mountains and the Mainstem Mojave River. This effect on wildlife movement would not necessarily occur in Unnamed Wash, because (a) the wash would remain in open space, (b) incidental growth of riparian vegetation along the centerline of the wash could enhance habitat diversity and quality in the wash and enhance wildlife movement, and (c) structures constructed in the wash would have minimal effects on wildlife movement. Construction of other recharge basins would not affect wildlife movement because all of these recharge basins would be located adjacent to the California Aqueduct, which currently inhibits north-south wildlife movement and wildlife movement may be feasible via the raised levee system of the recharge basins; wildlife are commonly observed to utilize levee systems in water banks as part of their movement corridors.

Buried pipelines and other small facilities such as well housings will be operated with little effect on wildlife. Recharge basins and canals would introduce water to areas that currently have limited and highly seasonal water supply. Recharge basins could be expected to attract wildlife and alter the adjacent wildlife communities. Species attracted to recharge facilities (when in use) would include ravens, plovers, stilts, and avocets. Ravens are a predator of desert tortoise and they may forage in a wide band of habitat around sources of water and food (William Wagner, Wagner Environmental, personnel communication). The introduction of surface water sources into areas where such sources are scarce may increase raven use of the area and indirectly affect desert tortoise. Ravens do not require large bodies of water to utilize an area, and raven use of an area may not increase proportionally to the surface area of water. It should be noted that all proposed facilities are adjacent to the California Aqueduct, in urban areas where food and surface water are plentiful, and/or adjacent to the Mainstem Mojave River. Some ravens may be attracted to Proposed Project facilities, but a substantial increase in raven populations is not likely because there is already plentiful water available at or near all sites. In addition, there are food sources at or near all of the proposed facility sites. In short, there are not at present significant constraints to raven occupation and use of habitats at Proposed Project sites.

Although recharge will occur on a 24-hour basis, routine operation such as maintenance of facilities will cause noise and visual disturbance, but will generally be limited to daylight hours, when most desert animals are in burrows. Noise and visual disturbance are not likely to cause effects on the adjacent burrowing animal population.

5.4.5 Facility Impacts

Table 5-14 summarizes the potential for construction and operation effects on biological resources, both direct and indirect, which are summarized by alternative below.

5.4.5.1 Minimum Facilities Alternative

The Minimum Facilities Alternative includes operations of existing recharge basins, and the recharge basin being constructed at Green Tree Road; at these sites, there will be an increase in the frequency and duration of recharge basin use, resulting in extended periods of surface water availability. Impacts of Proposed Project are summarized below.

<u>Operation of Existing Facilities</u>. Use of existing facilities would have no direct effects on habitats or special-status species. Also, banking would not substantially increase the frequency at which existing recharge facilities in the Baja, Centro, and Morongo Basins would be used, because banking supplies delivered to these areas, combined with other supplies delivered to meet MWA replacement water obligations, would not exceed MWA's total replacement water obligations for these areas or other deliveries. This limitation on use of banked water in these subareas would be necessitated by the inability to make direct returns to Metropolitan from these

areas (unlike the Alto subarea where direct returns may be feasible). There would thus be no significant change in deliveries of supplies to these groundwater basins, and no substantial increase in the availability of water, which may attract ravens and other potential desert tortoise predators. No change in predation rates on desert tortoise would therefore be expected.

Mojave River Recharge. Recharge to the Mainstem Mojave River would involve releases from Silverwood Lake and/or the California Aqueduct via Unnamed Wash and Rock Springs. In the 2003-2005 pilot project, releases from Silverwood Lake were restricted to September 15 through February 15, and were found to be fully contained within the active channel below the reservoir. In response to a comment from Department of Water Resources (see Appendix A), MWA notes that based on data to date, 2003 deliveries to MWA were 24,874 acre-feet and in 2005 were approximately 20,000 acre-feet. No erosion or scour of adjacent habitats was observed. Recharge via Unnamed Wash would cause some changes in habitats in this drainage, as outlined below.

Use of the Mainstem Mojave River channel for recharge will have no direct effects on habitat because construction in the riverbed will be restricted to areas 100 feet away from native habitats. Construction equipment will enter the river at locations currently used for access. All in-river work will be conducted during daylight hours and in periods of no natural flow in the river. Soil conditions in the river are unsuitable for burrowing animals and infrequent flows also make the riverbed itself unsuitable for burrowing. When there is natural flow, this flow tends to be highly erosive in the Hesperia/Victorville reach, as was demonstrated during the 2003-2004 pilot project, when moderate precipitation resulted in flows that washed out the berms constructed as part of the pilot project.

This aspect of the Minimum Facilities Alternative would have no affect on habitats and low potential for direct effects on listed Federal Species. There are no recent records of desert tortoise in the area, the Mohave ground squirrel would not be found in the mainstem river, and there are no suitable habitats for the Mojave tarplant. It is probable that wildlife utilize the river bed for north-south movement, but this would not be affected significantly because the berms to be constructed will not block movement. East-west movement may be affected in the reach where there is surface flow (approximately to Rock Springs), but (a) wildlife may utilize the raised berms, (b) water depths will be low in the downstream reaches and will not be a barrier to larger animals, (c) surface flow is not anticipated north of this area unless Rock Springs Outlet is in use, and (d) inflow rates will be monitored and managed to reduce the potential for surface flow in the vicinity of the well field. East-west wildlife movement will thus not be blocked for any extended period of time.

Given that this recharge area may be in use for many months during the year, and over a period of years, there is a possibility that ravens will utilize the area for water. This should not have a significant effect on raven populations and indirectly on desert tortoise because there is already plentiful surface water supply at various recreational lakes and ponds, including artificial fish-rearing facilities, outside of the Proposed Project area along the Mainstem Mojave River, and there is surface flow in the Narrows as well. The availability of surface water in this southern reach, where signs of desert tortoise are rare, should not therefore cause an increase in raven predation.

Given that extractions at the well field are limited to 90% of deliveries to recharge (as described), a portion of the water recharged will (a) migrate laterally to the regional aquifer and marginally raise groundwater elevations and (b) migrate downstream to the Narrows, where increases in surface flow may incidentally help sustain riparian vegetation.

Finally, recharge may under some conditions raise groundwater levels to from 20 to 40 feet below the surface. Phreatophyte vegetation may colonize these areas. Both MWA and flood control officials have programs for removal of exotic phreatophyte species such as tamarisk, and would take action to do so if they are found. These on-going, existing programs would reduce the potential for phreatophytes to colonize the river reach between Mojave Forks Dam to the Narrows.

<u>Mojave River Well Field and Pipelines.</u> The well field and pipelines will be constructed in an urban and disturbed area. No significant wildlife habitats will be permanently affected; several wells may be constructed on the vegetated slope above the river channel, but this area is highly disturbed and wells may be sited to avoid any pockets of viable habitat. There is a low potential for Mohave ground squirrels in the undeveloped areas along this reach of the Mainstem Mojave River. Well footprints will be small. Pipelines will be underground in public rights-of-way. Wells will be adjacent to these rights of way. Buried facilities will not affect wildlife movement. The wells and pipelines will be self-contained and will not provide water for ravens. Special status species that could be affected by construction include:

- Barstow wooly sunflower (CNPS List 1B): low potential
- Booth's evening-primrose (CNPS List 2): potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkeyflower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential
- Mojave river vole (FSC/CSC) limited potential

<u>SWP Delivery via Unnamed Wash</u>. Unnamed Wash is good quality desert scrub habitat with some elements of desert wash. The watershed is quite small, flows are infrequent and of short duration, and thus significant desert wash habitats do not now exist. In response to a comment from County of San Bernardino (Appendix A), MWA also notes that, based on the field surveys of existing habitat conditions, there is no evidence of existing overbank flooding at a level that creates conditions for an wide area of desert wash habitat. Wash habitat is intermittent and confined to a small area about 15-30 feet wide. The adjacent habitat is desert scrub, a

community that does not depend on periodic overbank flows for plant propagation. In addition, as noted above, more sustained flows from recharge operations would likely raise groundwater levels adjacent to the channel. This would be more likely to marginally promote some expansion of wash, rather than restricting it. The site is south of the known range of the Mohave ground squirrel and the desert tortoise. Habitat surveys suggest that the habitat would support special-status species, including:

- Barstow wooly sunflower (CNPS List 1B): low potential
- Booth's evening-primrose (CNPS List 2): potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkeyflower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): observed on site
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The wash drains to the Mojave River, a jurisdictional Water of the United States, and will therefore be subject to jurisdiction of the U.S. Army Corps of Engineers, CDFG, and the Lahontan RWQCB. No jurisdictional wetland habitats currently occur in the wash, which is only intermittently wet.

Approximately 6 to 8 acres of desert wash and desert scrub habitats will be permanently affected by construction of the proposed turnout, canal/or pipeline, drop structures to control erosion, unpaved access and maintenance roads, and small bridges. There will also be a short term loss of non-native grasslands associated with construction of the bridge under Arrowhead Lake Road and the low levees downstream of this road. It is anticipated that long-term operation of the turnout will increase the frequency of flow down the wash and increase the area affected by flow, and that an incised channel may form as a result of more frequent inundation. Deliveries of SWP supplies would occur for extended periods of time, providing surface water and raised groundwater levels adjacent to the centerline of the wash. The result will probably be creation of a permanent sandy-rock bottomed channel with adjacent desert wash shrub habitats. Routine maintenance will be minimal, but the channel will be maintained to exclude vegetation, such as tamarisk, that may result in restrictions in channel flow. The channel and the open space to be conserved by Rancho Las Flores will provide a movement linkage between the Mainstem Mojave River and remaining habitat in the wash and upstream of the wash. The loss of 6 to 8 acres of desert wash habitat resulting from drop structures and maintenance roads would be considered a significant impact.

<u>Impact Summary</u>

As noted on Table 5-14, the Minimum Facilities Alternative would affect about 6-8 acres of desert wash habitat in Unnamed Wash, but would otherwise not affect wildlife habitats.

Potential for impact to special-status species is low. There is a low potential for wells and pipelines to affect Mohave ground squirrel. Burrowing owls and other special-status species may use the slopes leading to the Mojave River, and impacts to 1-2 acres of wildlife habitat may occur in this portion of the Well Field and Pipeline area.

5.4.5.2 Small Projects Alternative

The focus of the Small Projects Alternative is to increase recharge capacity in the Alto subarea. Four recharge basins may be constructed under this alternative, all located in or adjacent to water courses.

<u>Off-channel Mojave River Recharge and Pipeline.</u> A number of sites were evaluated for this potential 100 acre-facility. Sites in the first mile downstream of Mojave Forks Dam were determined to have significant riparian habitats and suitable habitat for the arroyo toad (FE/CSC), Yellow-billed cuckoo (FE/CE), and Southwestern willow flycatcher (FE/CE), as well as a suite of other special-status (unlisted) plant and animal species. There is an established arroyo toad population upstream of the dam and thus there is a likelihood of arroyo toad use of suitable downstream habitats. For this reason and because of known cultural resource sites, upstream (southern) locations for an off-channel recharge basin were eliminated from consideration. Impacts associated with this site are therefore not shown on Table 5-14.

The potential East Site for this facility consists of disturbed grasslands and desert scrub located south of an existing poultry operation. It is off channel and not subject to routine flooding. Thus, even if Mohave tarplant was not extirpated from this portion of its historic range, there is little potential for it to be found in this habitat. Also, it is south of the known distribution of Mohave ground squirrel, although there is some potential for the species to colonize this area from populations to the north. The pipeline needed to bring water to this site would be constructed in the alignment of an existing unpaved road, with no native habitat. Some potential for impacts to burrowing owls along the road exists. Given the level of habitat disturbance, the site may support:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The site is within the floodplain of the Mojave River, but is outside of the Mainstem channel. It has no features that would indicate Corps of Engineers jurisdiction.

If the East Site were chosen for this facility, it would place berms in the path of wildlife moving along the river and the base of the hills. Simultaneous operation of the recharge basin and recharge to the Mainstem Mojave River would thus reduce the width of area available for wildlife movement. However, the site would not be lighted, it is immediately south of an old poultry operation and some scattered housing, and wildlife are known to utilize recharge basins for movement and foraging. In addition, wildlife movement on the opposite bank of the Mainstem Mojave River would not be affected if this site were chosen. Finally, wildlife movement north is limited by the constraints of the Narrows and by commercial and residential development. The most important movement corridor for wildlife is along the river upstream of the proposed recharge site and then along the hills to the east. The proposed recharge facility, east site, would not significantly affect this movement and would preserve about 100 acres of open space in a portion of this movement corridor that may alternatively be developed to a higher density than at present. No significant effect on nocturnal movement is anticipated. Intermittent use of this site for recharge would result in greater availability of surface water, but the site is a considerable distance from known desert tortoise habitat and ravens attracted to the site have alternative water supplies in closer proximity to desert tortoise habitats. The potential for significant increases in raven predation on desert tortoise as a result of operations is therefore low.

Construction of the pipeline from Rock Springs to this site would occur in sandy soils along an unpaved road alignment near the edge of the mainstem channel. This would potentially affect burrowing animals along the road alignment for the pipeline. But the soils are quite sandy, and there is only a low potential that burrowing owls or Mohave ground squirrels would be found in the vicinity of the road.

The West Site consists of a disturbed non-native grassland adjacent to a recreational lake and treated wastewater discharge ponds. The pipeline from Rock Springs to this site would be constructed within the right-of-way of Arrowhead Lake Road, which is the disturbed eastern shoulder of the road. The heavy growth of non-native grasses, lack of desert scrub plants, and historic levels of disturbance make it unlikely to support special-status plant species, although it may still provide habitat for western burrowing owl and Mohave ground squirrel. It is likely foraging habitat for Le Conte's thrasher, prairie falcon, and Cooper's hawk.

If the West Site were chosen for this facility, it would place berms in the path of wildlife moving along the river and the base of the hills. As for the East Site, simultaneous operation of the recharge basin and recharge to the Mainstem Mojave River would thus reduce the width of area available for wildlife movement. However, the site would not be lighted, it is immediately south of a recreation lake and near scattered housing, and wildlife are known to utilize recharge basins for movement and foraging. In addition, wildlife movement on the opposite bank of the Mainstem Mojave River would not be affected if this site were chosen. Finally, wildlife movement north is limited by the constraints of the Narrows and by commercial and residential development. The most important movement corridor for wildlife is along the river upstream of the proposed recharge site and then along the hills to the west. The proposed recharge facility, west site, would not significantly affect this movement and would preserve about 100 acres of open space in a portion of this movement corridor that may alternatively be developed to a higher density than at present. No significant effect on nocturnal movement is anticipated. Intermittent use of this site for recharge would result in greater availability of surface water, but the site is a considerable distance from known desert tortoise habitat and ravens attracted to the site have alternative water supplies in closer proximity to desert tortoise habitats. The potential for significant increases in raven predation on desert tortoise as a result of operations is therefore low.

Impacts associated with pipeline construction to the West Site would be temporary. Given that there is only one CNDDB record of Mohave grounds squirrel in the Proposed Project area, and that the range of the Mohave ground squirrel extends only slightly south of Highway 18, the potential for Mohave ground squirrel to be found in this area is minimal.

<u>Oro Grande Wash Recharge Basins</u>. The potential recharge basins and internal pipelines at Oro Grande Wash would be constructed at a site bounded by the California Aqueduct, State Highway 395, Phelan Road, and Interstate 15. A majority of construction would occur in desert scrub habitats in the lower portions of the wash; more sensitive Joshua Tree/California Juniper scrub occurs upslope of the probable basin locations, but could be affected by construction. Pipelines to deliver water to these basins would be constructed within the wash or in/adjacent to public roads.

If recharge basins were constructed in Oro Grande Wash, there is a small potential for direct effects on Mohave ground squirrel (ST/FSC) and effects on nine special status plant species and four special status animal species:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Plummer's mariposa lily (CNPS List 1B): low potential
- Robinson's monardella (CNPS List 1B): low potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Southern skullcap (CNPS List 1B): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The site's distance from known desert tortoise habitat and isolation by three major highways makes desert tortoise presence highly unlikely and project potential for effects on desert tortoise should be considered only marginally higher than none. The site is not near known desert tortoise habitat and the availability of surface water during recharge operations, while it may attract ravens, is not likely to result in increased predation on known desert tortoise habitat which is 10 miles away.

Although the natural portion of Oro Grande Wash terminates at the Green Tree Golf Course and downstream wildlife communities are limited, the was probably at one time a wildlife movement corridors under Interstate 15. Wildlife movement is now constrained to the culverts under the California Aqueduct and any wildlife movement along this wash would be adapted to human habitation, such as coyotes, and raccoons. These species may utilize culverts, but it is not likely that the wash is used by large numbers of animals for movement.

Construction of facilities in Oro Grande Wash would therefore have a limited potential to affect local populations of Mohave ground squirrel (if local extirpations have not already occurred) and other special-status species, but the functional isolation of the site by roads, aqueducts, and encroaching development in the Interstate 15 corridor would suggest that these effects would not be important to the long-term preservation of the affected species. This is reflected in the low mitigation ratio assigned to this area in the West Mojave Plan.

<u>Cedar Avenue Detention Basin</u>. The site for the Cedar Avenue Detention basin is highly disturbed, including areas that show evidence of previous grading and recreational vehicle use. The site is isolated on the north by the California Aqueduct, although there is a flowage structure that allows flood flows to pass over the Aqueduct. Isolation of the site suggests that there is little potential for Mohave ground squirrel or desert tortoise. Although disturbed, the site has a low potential to support some special-status species:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- California horned lark (CSC): observed on site
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The site is isolated from known desert tortoise habitat by State Highway 18, State Highway 395, Interstate 15, and the California Aqueduct. Direct effects on desert tortoise are highly unlikely. The site is not a wildlife movement corridor; there is development around it and the California Aqueduct is a barrier to wildlife movement, with the possible exception of human-adapted species such as coyotes, which may cross the Aqueduct via the flowage structure. This isolation, particularly the California Aqueduct, would probably exclude Mohave ground squirrel from the site.

Antelope Wash Recharge (Ranchero Road). This site is unsuitable for recharge until the dip crossing at Ranchero Road has been replaced with a detention basin. This work, performed in advance of the development of recharge basins in the detention basin, would result in complete removal of any wildlife habitat at the site and thus the potential construction of recharge basins would have no direct effects on wildlife or their habitat. Construction of recharge basins within this proposed City of Hesperia Detention basin would therefore have no significant impacts on wildlife.

In the long-term, wildlife movement would be restricted by use of the site as a flood detention basin, the flood gates under Ranchero Road, and on-going development around the wash. Operations may increase the availability of water and attract ravens, but the site is far from known desert tortoise populations and there is available water in many locations near the site.

Summary of Impacts. If all facilities of the Small Projects Alternative were constructed, and the East site chosen for Off-Channel Mojave River Recharge, habitat effects would include loss of:

- 53 acres of disturbed habitats
- 157 acres of desert scrub in various condition from disturbed to moderate quality
- 30 acres of Joshua Tree habitat

Effects related to these habitats would include low potential to potential impacts on up to 14 special-status (unlisted) species, and very low potential impacts to desert tortoise and Mohave ground squirrel.

If all facilities of the Small Projects Alternative were constructed, and the West site was chose for Off-Channel Mojave River Recharge, habitat effects would include the loss of:

- 113 acres of disturbed habitats
- 97 acres of desert scrub in various condition from disturbed to moderate quality
- 30 acres of Joshua Tree habitat

Effects related to these habitats would include low potential to potential impacts on up to 14 special-status (unlisted) species, and very low potential impacts to desert tortoise and Mohave ground squirrel.

5.4.5.3 Large Projects Alternative

The Large Projects Alternative includes 3 potential recharge basins to expand on or substitute for the capacity of the other alternatives. The potential recharge sites are further away from existing development that those for the other alternatives, reflecting MWA's alternative formulation strategy of siting recharge to minimize impacts and costs before addressing larger and more remote sites.

Oeste Recharge, Pipelines, and Wells. The potential recharge site in the Oeste subarea would be constructed about 15 miles east of State Highway 395 and immediately south of State Highway 18. This is the most remote site under consideration. Surveys indicate that the various parcels being considered (and adjacent areas) are a monotypic Creosote Bush Scrub form of desert scrub that may support a typical desert scrub wildlife community. The site is within several miles of known desert tortoise habitat and thus there is a moderate to high potential for an isolated individual tortoise to be found, even though signs of desert tortoise south of State Highway 18 are rare. The habitat is in the range of the Mohave ground squirrel and it is moderately to highly likely that the species would be found on site. The potential for desert tortoise and Mohave ground squirrel to be found in this portion of the Mojave Basin is reflected in the 1:1 mitigation ratio assigned to this portion of the Victor Valley in the West Mojave Plan. In addition to these two listed species, the site may support:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The construction of recharge basins would remove about 300 to 350 acres of habitat for these species, which would be considered a significant impact.

The sites at Oeste are isolated from development, but are also between the California Aqueduct and State Highway 18, thus being partially isolated from adjacent wildlife communities. There are several local washes that pass under Highway 18 and over the California Aqueduct, and several local roads pass over the Aqueduct as well. There is therefore some likelihood that wildlife movement occurs at the two sites. If this is the case, the presence of recharge basins may affect wildlife movement, but this effect would probably not be significant. Wildlife are known to use recharge basin levees for movement and the presence of water may enhance conditions for movement as well.

Given that Oeste recharge basins would be within 5 miles of known desert tortoise habitat north of State Highway 18, their operation may attract ravens which would forage within known desert tortoise habitat. This could result in increased predation on desert tortoise in the southern portion of their existing range. This would be considered a significant and adverse effect on desert tortoise, affecting populations within the area designated for conservation of the species.

Alto Recharge, Pipelines, and Wells. The potential recharge sites in the Alto area (at the junction of the California Aqueduct and the Mojave River Pipeline) are bounded on the south by

the California Aqueduct in an area parcelized for rural-residential development and would be expected to develop during the period when the Proposed Project would be developed and operated. There is existing development to the east and an east-west road crossing of the California Aqueduct to provide for access to the urban areas to the east.
The easternmost recharge site in this area is a monotypic Mojavean creosote bush scrub, while the western site is Mojavean creosote bush scrub with fingers of Joshua tree/Mojavean creosote bush scrub. Being 4 miles south of State Highway 18, the sites probably do not support desert tortoise, but there is moderate to high potential for Mohave ground squirrel and a suite of special-status species:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

The construction of recharge basins would remove about 150 acres of habitat for these species, which would be considered a significant impact.

The sites at Alto are isolated from development except on the east, but there are expanses of similar habitat between these sites and State Highway 18. There are several local washes that pass under Highway 18 and over the California Aqueduct, and several local roads pass over the Aqueduct as well. It is therefore likely that the sites are part of a large wildlife community and that there is unconstrained movement of wildlife within the area. If this is the case, the presence of recharge basins may affect wildlife movement, but this effect would probably not be significant. Wildlife are known to use recharge basin levees for movement and the presence of water may enhance conditions for movement as well.

Given that Alto recharge basins would be within 7 miles of known desert tortoise habitat north of State Highway 18, their operation may attract ravens which would forage within known desert tortoise habitat. This could result in increased predation on desert tortoise in the southern portion of their existing range. This would be considered a significant and adverse effect on desert tortoise, affecting populations within the area designated for conservation of the species.

<u>Antelope Wash Recharge and Pipelines</u>. Recharge basins at this site would be located in designated open space south and east of the Hesperia Airport, adjacent to a range of hills that separate the wash from the Mainstem Mojave River. The potential recharge site is dominated by Joshua Tree/California Juniper/Desert Scrub, with an expanse of Joshua Trees across the upper portions of the wash. Although the wash is well outside of the known range of the desert

tortoise, and on the edge of Mohave ground squirrel range (and subject to flooding and thus not good burrowing habitat), it may supports a suite of other special-status species, including:

- Booth's evening-primrose (CNPS List 2): potential
- Barstow wooly sunflower (CNPS List 1B): low potential
- Desert cymopterus (CNPS List 1B): potential
- Mohave monkey flower (CNPS List 1B): potential
- Robinson's monardella (CNPS List 1B): low potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Southern skullcap (CNPS List 1B): low potential
- Short-joint beaver-tailed cactus (CNPS List 1B): potential
- Small-flowered androstephium (CNPS List 2): potential
- Western burrowing owl (FSC/CSC): potential
- Le Conte's thrasher (CSC): potential
- Prairie falcon (CSC): potential foraging
- Coast horned lizard (CSC): potential

In the urbanizing portion of the Victor Valley, large stands of Joshua Tree habitat have become increasingly rare, and loss of up to 80 acres of this habitat type, with its sensitive species, would be considered a significant impact. In addition, the California Aqueduct goes into pipeline in the vicinity of the wash and there is thus connectivity between the wash and the adjacent hills. Recharge basin construction and operation could affect wildlife movement between the mountains and lower portions of the wash. The significance of this wildlife movement is probably not great because the downstream portions of the wash flow through heavily developed areas, but it could be considered significant, depending on the extent to which the recharge basins filled the lower portions of the wash. Wildlife are known to use recharge basin levees for movement, and thus the current level of wildlife movement in the wash could be reduced, but connectivity would probably not be severed. Operations may increase the availability of water and attract ravens, but the site is far from known desert tortoise populations and there is available water in many locations near the site. No indirect impacts to desert tortoise are anticipated.

As discussed in the draft EIR Section 5.4, habitat quality and potential wildlife use of the upstream recharge site is substantially better than that downstream of the dirt road that would be the southern boundary of the alternative expanded Ranchero Road recharge basins (Chapter 4, page 4-31). The potential for special status species to utilize the downstream site would also be lower, in part because construction of the Ranchero Road detention basin will result in disturbance of a substantial portion of the habitats at this site. In addition, shifting this recharge capacity downstream would eliminate impacts to 68 acres of moderate to high quality Joshua Tree/juniper habitat, replacing it with impacts to disturbed desert scrub habitat (in the portion of the site upstream of the area which will be flooded when the detention basin is in use). The remaining area would be routinely disturbed by maintenance of the detention basin, including post-flood sediment and debris removal.

Summary of Impacts. If all facilities proposed for the Large Projects Alternative were constructed and operated, this would result in the following habitat loss:

- 23 acres of disturbed habitat,
- 498 acres of desert scrub habitat, and
- 68 acres of Joshua Tree habitat (no impacts to this habitat type if recharge is relocated to downstream site)

Of this habitat, all but 100 acres in Antelope Wash would have a low-to-moderate potential for Mohave ground squirrel, and a low potential for desert tortoise impacts. Although the Alto and Oeste areas would have a higher potential for use by desert tortoise and Mohave ground squirrel, this potential remains low-to-moderate because surveys conducted over the past 20 years have seldom found these species south of Highway 18. The higher potential sensitivity of these sites compared to those further to the south and east reflects the West Mojave Plan's mitigation ratios, which are 0.5 to 1 for all other Proposed Project sites but 1 to 1 for the Alto and Oeste recharge sites.

Relocation of the upstream Antelope Wash recharge to the downstream location would substantially reduce potential impacts to special-status species.

5.4.6 Operational Impacts

5.4.6.1 Mechanism for Effects

Operations of the Proposed Project facilities (Table 5-14) may affect biological resources in several ways:

- Flow in the Mainstem Mojave River and Unnamed Wash may inhibit wildlife movement across these areas
- Although extractions from the Mojave River Well Field will be matched to net recharge rates, additional flow in the Mainstem River may result in increases in surface flow in the narrows and the Transition Zone because extractions of 90% of recharge will mean that at least 5% of recharge from banking will not be extracted for use and may flow downstream.
- Recharge operations will result in increased availability of water in some areas, attracting wildlife.

5.4.6.2 Operational Effects: Minimum Facilities Alternative

A majority of the potential operational effects of the Proposed Project occur as a result of the Minimum Facilities Alternative, which provides for extended periods of flow on the Unnamed Wash and the Mainstem Mojave River. Movement of small animals of all species would probably be inhibited when there was flow. The availability of water would also attract other species, and the wildlife community could be expected to change as a result. These effects would not likely increase proportionally to the magnitude of the project because (a) the necessary recharge/extraction balancing for the Mainstem Mojave River effectively defines the maximum recharge and (b) additional recharge facilities would be used to address needs to increase banking project and long-term MWA increases in deliveries to recharge.

Table 5-14. Summary of Project Effects on Special Status Species and Habitats. Potential for effects on threatened and endangered species reflect relative effects among the alternatives. In general, this potential is low. (Disturbed refers to area of bare ground due to roads, off-road vehicle tracks, and previous grading or construction). Listed species effect: 0 = none, 1 = low, 2 = moderate, 3 = high. Recharge includes associated wells and pipelines.

FACILITY	CONSTRUCTION EFFECTS												OPERATIONS EFFECTS		
	Habitats affected (acres)				FSC/CSC		Potential T&E species affected								
	Disturbed	Desert scrub	Joshua tree/juniper	Desert wash	Animals	Plants	Desert Tortoise	Mohave Ground Squirrel	Mojave tarplant	Yellow-billed cuckoo	SW willow flycatcher	Arroyo toad	Wildlife Movement Affected (Relative Level of Effect	Wildlife Attraction to Water and Indirect Effects	Enhanced Predation by Ravens (Relative Level of Effect)
Minimum Facilities Alternative															
Mojave River Recharge Berms	0	0	0	0	0	0	0	0	0	0	0	0	Low	Low	Low
Mojave River Well Field & Pipelines	0	1-2	0	0	5	6	0-1	1	0	0	0	0	Low	None	Low
SWP Delivery via Unnamed Wash	1	6-8	0	<2	4	8	0-1	1	0	0	0	0	Low	Low	Low
Use of Existing Recharge	0	0	0	0	0	0	0	0	0	0	0	0	Low	Low	Low
Small Projects Alternative															
Off-Channel Mojave River Recharge: East	40	60	0	0	4	6	0-1	0-1	0	0	0	0	Mod	Low	Low
Off-Channel Mojave River Recharge: West	100	0	0	0	4	6	0-1	0-1	0	0	0	0	Low	Low	Low
Oro Grande Wash Recharge	13	37	30	0	5	9	0-1	0-1	0	0	0	0	Low	Low	Mod
Cedar Avenue Detention Basin	0	60	0	0	4	6	0-1	0-1	0	0	0	0	Low	Low	Low
Antelope Wash Detention Basin Recharge	Not applicable. Initial construction of the detention basin by City of Hesperia would remove all habitats.														
Large Project Alternative															
Oeste Recharge, pipelines, and wells	9	330	0	0	4	6	1	1-2	0	0	0	0	Low	Mod	Low
Alto Recharge, pipelines, and wells	10	140	0	0	5	6	1	1-2	0	0	0	0	Low	Mod	Low
Antelope Wash Recharge and wells	4	28	68	0	4	9	0-1	0-1	0	0	0	0	Mod	Mod	Low
Downstream Antelope Wash site	60	40	0	0	4	9	0-1	0-1	0	0	0	0	Low	Low	Low

Wildlife movement in Unnamed Wash will eventually be constrained by the planned development of this area, which includes housing on either side of the wash and drainage and water treatment facilities. Even considering this, the Proposed Project would introduce a new constraint on wildlife. Wildlife movement across the Mainstem would continue to be feasible north of Rock Springs and during many periods when Mainstem Mojave River recharge is suspended. The recharge rates for the river are quite high, and thus input of the maximum recharge of about 48,000 acre-feet per year may be accomplished rapidly (with extensive surface flow) or at lower rates (with less extensive downstream migration of surface flow). At a maximum recharge rate of 500 cfs (1,000 acre-feet per day), the maximum period of surface flow in the river would be about 50 days per year. At this rate, surface flow might extend to near the Narrows. At a lower rate of 100 cfs (200 acre-feet per day), surface flow would probably not extend more than several miles downstream of Mojave Forks Dam because recharge is sustainable for several months at about 100-300 cfs (200 to 600 acre-feet per day, even during flood periods; see Water Resources: Hydrology in Section 5-14). At this rate, much of the river would be dry, and the wetted area would be wet for about 120 days. In short, wildlife movement across the river and across Unnamed Wash will be at worst affected totally for only about 50 days per year and at best affected in a limited reach about 120 days per year. In addition, when Unnamed Wash is in operation, it is unlikely that there would be need to make deliveries via Silverwood Lake and thus east-west movement along the northern slope of the San Bernardino Mountains would be unaffected.

Wildlife may be attracted to the new water source (when it is available) but there is already significant open water in the vicinity of the Mainstem Mojave River due to development of off-channel recreation lakes and other facilities. Any wildlife attraction effects have probably already occurred and the addition of flow in the mainstem may have little effect on wildlife communities in this urbanizing reach of the river, given the intermittent nature of this new flow regime.

5.4.6.3 Small Projects Alternative

With the exception of Off-Channel Mojave River Recharge, new facilities would have minimal potential to affect wildlife movement. Facilities at Oro Grande Wash, Antelope Wash at Ranchero Road, and Cedar Avenue Detention Basin are currently isolated by major roads and/or development. Significant wildlife movement at these sites is not anticipated. Off-Channel Mojave River Recharge at either east or west site would affect movement to some extent, but wildlife are known to utilize recharge areas for movement.

As recharge magnitude increases at these facilities, the frequency and duration of wetting will be increased and wildlife will be temporarily attracted to the water source. Given the isolation of the sites at Oro Grande Wash, Cedar Avenue, and Antelope Wash at Ranchero Road from adjacent wildlife habitat, this attraction effect will be minimal.

5.4.6.4 Large Projects Alternative

Operation of recharge basins at Oeste, Alto, and Antelope Wash would not substantially affect wildlife movement because these facilities would (a) be readily used by wildlife and (b) be utilized intermittently. Wildlife movement at Oeste and Alto is already affected by Highway 18 to the north and the California Aqueduct to the south. Thus, while wildlife movement is feasible in these areas, there are more significant constraints already in place. At Antelope Wash, wildlife movement could be significantly constrained due to the alteration of habitat conditions in the wash. Relocation of the upstream Antelope Wash recharge to a downstream location would reduce wildlife movement impacts.

The introduction of water to these facilities, which would be expected to increase as banking and exchange project magnitude increases, would likely attract wildlife and, given the relatively undeveloped nature of habitat in these areas, could alter wildlife communities. There is some development in these areas and thus some water availability. The California Aqueduct runs nearby. But open, unfenced areas of water could attract wildlife. The potential for wildlife attraction increases with the magnitude of the banking and exchange program because a larger program increases the frequency and duration of recharge.

5.4.7 Significance, Mitigation, and Significance of Impacts after Mitigation

5.4.7.1 Significance Thresholds

Under CEQA, thresholds for significance of biological resources are based on Section 15065 and Appendix G of the CEQA *Guidelines*, as well as professional judgment. Impacts to biological resources would be considered significant if the Proposed Project activities:

- Have a substantial adverse impact, either directly or through habitat modifications, on an species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by California Department of Fish and Game or US Fish and Wildlife Service;
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service;
- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance;
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat

conservation plan;
- Substantially reduce the habitat of a fish and wildlife species;
- Cause a fish or wildlife population to drop below self-sustaining levels;
- Threaten to eliminate a plant or animal community; or
- Reduce the number or restrict the range of an endangered, rare, or threatened species.

5.4.7.2 Significance

Based on the above analysis of the potential for the Proposed Project to affect fish, wildlife, and their habitats, potentially significant effects of Proposed Project facility construction and operation could involve:

- Direct and indirect impacts on several threatened and/or endangered species,
- Direct impact on wildlife habitats
- Direct effects on wildlife movement
- Indirect effect on wildlife community structure by attracting wildlife to water

Based on preliminary field surveys (and the data and analysis that has formed the scientific basis for the West Mojave Plan), the probability of direct take of individual desert tortoise or Mohave ground squirrel is very low. The proposed project facilities are outside of the known current range of the desert tortoise, although it is possible that isolated individuals may still survive south of Highway 18. The projects with appropriate Mohave ground squirrel habitat are within the historic range of the species, but sightings south of Highway 18 have been rare and most of the proposed facilities are in urbanizing areas of highly fragmented habitat with limited access for either desert tortoise or Mohave ground squirrel. Federal and State listed threatened or endangered plants are unlikely to be found at the project sites, but sites will be again surveyed for these plants prior to construction.

Several of the proposed project sites have also been heavily disturbed by prior use. The recharge basin sites at Cedar Avenue, Antelope Wash (Ranchero Road), and both east and west sites for Off-Channel Mojave River Recharge lack substantial integrity as wildlife habitat. Soils have been disturbed and conditions for native plants are compromised. Specifically:

- At the Cedar Avenue site, a majority of the habitat has been identified as disturbed Mojavean Desert Scrub and there is evidence of off-road vehicle use. The site is isolated on the north and east by the California Aqueduct, and by ranchettes along its other boundaries. No CDFG sensitive habitats occur on site. In addition, the site is subject to flooding when runoff in excess of the capacity of existing drainage systems collects at the base of the California Aqueduct; this alters basic hydrologic and soil conditions in the area. Finally, the site has been designated for a flood detention basin by the City of Hesperia.
- At the Antelope Wash, Ranchero Road site, there is development (including an airport) to the west and residential development to the east. The City of Hesperia plans a flood

detention basin at this site, and MWA would integrate its recharge facilities into the City's recharge basin.

- At the west site for Off-Channel Mojave River Recharge, past land use as a site for disposal of waste has resulted in a site characterized in initial biological surveys as non-native grassland. The site has been divided into leveed basins separated by low berms, and has been maintained and flooded routinely. Soil structure and chemistry have been altered and the site is monotypic grassland, with virtually no shrub habitats.
- At the east site for Off-Channel Mojave River recharge, past use for agriculture has resulted in a virtually shrub-less habitat, with areas of disturbed Mojavean Desert Scrub mixed with areas of almost bare earth.

These four sites were selected in part because of their (a) isolation, (b) low habitat value, and (c) past history of disturbance. Although there is a low potential for finding patches of some special-status plant species at these sites, their wildlife communities are probably dominated by animals well-adapted to human environments. Finally, the proposed recharge basins will function at least as well for human-adapted wildlife as the habitats presently available. There will be shrub habitat along portions of the perimeter maintenance roads, grasses and forbs along levees, and available water. When not in use, recharge basins will be disturbed non-native grasslands. Wildlife will be able to utilize these sites for movement. At these four sites, construction and operation of recharge facilities would therefore not result in a loss of significant wildlife habitat. Recharge basins at these sites will not inhibit wildlife movement and no significant indirect impacts are anticipated.

The Oro Grande Wash has different site characteristics from the above four sites, but was also selected in part because of low potential for significant impacts to wildlife. South of California Aqueduct, the site is completely isolated from adjacent wildlife habitats by the aqueduct, State Highway 395, Phelan Road, and Interstate 15. Wildlife must cross these barriers or pass through culverts under raised road beds or the aqueduct. In addition, there is development on the east and west sides of the site which introduces human disturbance, and the site has evidence of extensive off-road vehicle use. The southern portion of the site is thus more likely to be a sink for wildlife and probably does not contribute to adjacent wildlife communities. The northern portion of Oro Grande Wash is also heavily disturbed. It is located in a quarter section of undeveloped land that is isolated to the south by the California Aqueduct, to the east by development and Interstate 15, and to the north by Bear Valley Road (State Highway 18) and new medium to high density development. There is extensive ranchette (low-density) development extending several miles to the west of the site. The Oro Grande Wash sites for recharge are therefore functionally islands of disturbed habitat within an urban/suburban matrix. At the Oro Grande Wash sites, the proposed recharge basins will probably function at least as well for human-adapted wildlife as the habitats presently available. There will be shrub habitat along portions of the perimeter maintenance roads, grasses and forbs along levees, and available water. When not in use, recharge basins will be disturbed non-native grasslands. Wildlife will be able to utilize these sites for movement. At Oro Grande Wash, construction and operation of recharge facilities would therefore not result in a net loss of significant wildlife habitat.

Recharge basins at these sites will not inhibit wildlife movement and no significant indirect impacts are anticipated.

Indirect impacts associated with Mojave River Recharge include some constraints on wildlife movement across the river during active recharge operations. East-west movement across the Mainstem Mojave River channel has not been studied, but probably occurs. It will be affected by recharge, but at worst the channel would be completely wetted for only a short period of time. Given Metropolitan's historic pattern of deliveries to groundwater banks, recharge is most likely to occur in the spring and summer (See Section 5.13, below). After February 15, recharge in this period would not be made from Silverwood Lake and east-west wildlife movement along the north slope of the mountains would be unaffected throughout the spring, summer and early fall. In addition, recharge operations will not generally involve wetting of the Mojave River channel past Rock Springs for an extended period of time and wildlife movement would be possible in the reach between the Narrows and Rock Springs Road much of the time. This area is within the urban reach of the River, and no significant wildlife movement is anticipated as a result. The effects of recharge operations on the Mainstem Mojave River are thus less than significant.

MWA also considered the potential for water at all recharge basins to attract wildlife, with subsequent changes in wildlife communities and potential minor increases in ravens and raven-related predation on desert tortoise. There is, however, substantial water and food available at present throughout the Proposed Project Area. Proposed new facilities would be constructed within the urban matrix or within a matrix of hundreds of small ranchettes to the east of Hesperia. Thus, food and water probably do not at present constrain raven populations in this portion of MWA's service area. Even in the vicinity of the Oeste and Alto recharge basins, there is substantial available water in the California Aqueduct, there is nearby intermittent development along Highway 18, and there are approximately 1,500 housing units within 5 miles of the Oeste and Alto recharge basin sites. Thus, the introduction of water to these areas would probably not significantly increase populations of ravens in this area. No significant indirect effects on desert tortoise are thus anticipated.

In addition, avian species foraging would not be adversely affected by recharge basin construction. Recharge basins are a complex habitat and would support small mammals and lizards, which are common prey for a variety of birds. In addition, the intermittent recharge at these sites would marginally increase populations of some insects which will provide forage for bats and insectivorous birds.

Potential for impacts to special status species is thus likely to be limited to habitat loss associated with project features at Unnamed Wash, Antelope Wash (airport site), and at the Alto and Oeste Recharge basins.

The potential Alto Recharge basin site was selected in part because of its proximity to the California Aqueduct and its functional isolation from significant areas of wildlife habitat. The smaller eastern site consists of 10-acre or smaller parcels adjacent to a low-density development of about 40 houses. To the south, the site is isolated by the California Aqueduct. To the west, there is a graded site for maintenance of the California Aqueduct. This already parcelized 38-acre recharge site may be developed for low-density housing (its current zoning status). The larger (112 acres) site to the west includes 12 acres of land with water project facilities and the remaining 100 acres consists of Mojavean Creosote Bush Scrub with fingers of Joshua Tree/Mojavean Creosote Bush Scrub that have developed where drains across the California Aqueduct have altered drainage patterns. There is evidence of disturbance, but the general habitat quality is good.

The potential Oeste Recharge basin sites (east and west) were selected in part because they generally avoid the Sheep Creek Wash, although there is some drainage across the western parcels where drains across the California Aqueduct have been constructed. The eastern site consists of disturbed Mojavean Creosote Bush Scrub bounded on the south by the California Aqueduct and on the north by Highway 18 and ranchette development across Highway 18. There is patchy development mixed with wildlife habitat to the east of the site. The western site is located between the California Aqueduct and Highway 18 and part of the southern boundary is formed by a raised-bed railroad line.

The Oeste and Alto Recharge sites have moderate quality habitat and some potential for special-status plant species. Potential for Mohave ground squirrel and desert tortoise is low, as reflected in the West Mojave Plan's preliminary designation of these areas no survey zones. Habitat value is low, however, due to the isolation of the sites in a triangle formed by the California Aqueduct, Highway 18, and the railroad. These features limit wildlife movement and Highway 18 carries significant car and truck traffic. Major roads are often sinks for animals and connectivity between the proposed recharge sites at Alto and Oeste and viable communities to the north of Highway 18 is probably minimal. The sites may support special-status plants. Although their isolation from viable wildlife habitats to the north makes these sites of low value in the long term (as reflected in the West Mojave Plan which encourages development south of Highway 18 by providing for low mitigation ratios south of the highway and high mitigation ratios north of the highway), the development of these sites for recharge would be considered significant under CEQA because (a) Joshua Tree habitat at the Alto site is protected by local ordinance and (b) the sites may support special-status plants.

Recharge basins at Antelope Wash south of the California Aqueduct would impact a generally high quality mixed juniper and Joshua Tree habitat. Although upstream portions of the wash are not high quality habitat, there is no current development between the California Aqueduct and the San Bernardino Mountains. The site is connected to habitats in the San Bernardino Mountains and therefore remains a viable part of a larger area of wildlife habitat. Removal of this habitat would be considered significant under CEQA. This impact would be avoided by relocation of the site downstream as described in Chapter 4, page 4-31.

Unnamed Wash is a relatively undisturbed habitat, portions of which are designated to remain as open space in the Rancho Las Flores development. Impacts to the Desert Wash habitat as a result of construction and maintenance of an outlet channel from the California Aqueduct, rock drop structures, a bridge crossing, and maintenance roads/trails along the wash would be considered significant under CEQA.

No wetland habitats will be affected. Movement effects will be minimal. The Proposed Project is not in conflict with existing community or regional planning.

In summary, habitats at Cedar Avenue, Oro Grande Wash, Antelope Wash (Ranchero Road), Off-channel Mojave River Recharge (east and west), and Oeste Recharge are isolated and/or highly disturbed and impacts at these sites would be less-than-significant unless special-status plant species were identified at these sites. Similarly, only impacts to the Joshua Tree habitats at Alto recharge would be considered potentially significant (because this habitat is protected by local ordinance). The site is otherwise isolated from viable wildlife habitat. Impacts to habitats at Unnamed Wash and Antelope Wash south of the California Aqueduct would be considered significant under CEQA.

5.4.7.2 Proposed Mitigation

Given the elimination of the biologically-most-sensitive potential Off-Channel Mojave River Recharge site (near Mojave Forks Dam), and the focus on full use of existing recharge and recharge associated with dual-purpose projects (flood control) in the Minimum Facilities and Small Projects Alternatives, the Proposed Project facilities represent a continuum of the least damaging practicable alternatives for a given level of recharge and extraction.

As specified in the 2004 PEIR and in Section 5.4.2.2 above, prior to site disturbance, MWA would conduct protocol surveys for potential special-status species at facility sites and would report results to the CDFG and USFWS. In the highly unlikely event that individuals of threatened or endangered species are found at sites before construction, MWA would implement standard impact avoidance and minimization measures prior to initiating construction. For Mohave ground squirrel and desert tortoise, these may include trapping and removal of the species per CDFG and USFWS procedures. If special status plants were found on site, MWA would either avoid impact to these plants or mitigate for their impacts at a ratio of 1 acres of mitigation for each acre of special-status plant habitat identified. Mitigation may be accomplished by purchase of lands with appropriate plant species or by transfer of funds to CDFG for use in their acquisition programs. In either case, MWA would provide for management via a one-time management endowment. The Proposed Project involves sites under the jurisdiction of the Corps of Engineers, and impact minimization and mitigation could be addressed administratively through the resulting Section 7 consultation if federally-listed species are documented on the sites.

Unless special-status plants are identified at the sites, no mitigation is proposed for facility development at:

- Oro Grande Wash
- Cedar Avenue Detention Basin

- Off-Channel Mojave River Recharge
- Antelope Wash (Ranchero Road)
- Oeste Recharge

At the Alto Recharge sites, MWA would mitigate for loss of about 15 acres of Joshua Tree habitat and any special-status plant habitat identified during focused pre-construction surveys at a ratio of 1:1.

Impacts to Desert Wash habitat in Unnamed Wash would be mitigated consistent with the terms of the pending Rancho Las Flores Habitat Conservation Plan or at a 1:1 ratio if this plan has not been approved by the time construction is initiated.

Impacts to locally-protected Joshua Tree habitat at the Antelope Wash south of the California Aqueduct may be mitigated at a 1:1 ratio. As noted in discussion of project aesthetic impacts, prior to approval of the 100-acre-Antelope Wash recharge basin south of Hesperia Airport, MWA may also consider realignment of this basin to a site further downstream where existing conditions may be more heavily disturbed. This alternative recharge site, described in Chapter 4, would substantially reduce impacts and would not require 1:1 mitigation for impacts to Joshua Tree habitats.

In addition to habitat mitigation, MWA would adopt reasonable measures to avoid and minimize effects to special-status species, including those incorporated into the Proposed Project description and outlined in Chapter 4.

In their comments on the DEIR, California Department of Fish and Game noted that there was no explicit mitigation proposed for potential project impacts to burrowing owls and recommended a mitigation protocol for unavoidable impacts to this species (see Appendix A for the specific protocol recommended).

MWA is aware of the protection for burrowing owls as provided in Fish and Game Code section 3503.5. ("It is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto.")

MWA will conduct pre-construction surveys for burrowing owls to determine if there are occupied habitats for the species. If burrowing owls are found in the potential area of effect, MWA would consult with Ms. Rebecca Jones, CDFG Environmental Scientist (as directed by CDFG in their comments). In consultation with Ms. Jones, MWA may then choose to take action to avoid impacts to burrowing owls (such as constructing outside of the nesting season and/or establishing a buffer zone between construction activity and any active nest). Recharge basins have not proved incompatible with burrowing owls (there is occupied burrowing owl habitat adjacent to recharge areas at Kern Water Bank, for example). If, in consultation with Ms. Jones, MWA finds that the impacts of its facilities would be inconsistent with the protections provided under Fish and Game Code Section 3503.5, MWA would consider feasible avoidance, minimization, and mitigation, including the recommended protocol described in Appendix A, and would implement the appropriate actions.

5.4.7.3 Significance after Mitigation

Given the low probability of any impact to threatened or endangered species associated with the Proposed Project sites and the habitat mitigation proposed, the proposed mitigation would reduce the direct biological resources impacts of all facilities to a level of less-than-significant.

5.4.8 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site some of them because of development that would constrain siting options for MWA.

Under the No Project Alternative, the facilities of the Minimum Facilities Alternative and the Small Project Alternative would likely be constructed and operated as described in the Project EIR. The potential delay in implementation would, however, result in a smaller potential for take of threatened and endangered species because these species populations would have been reduced within this portion of their range due to on-going urban development south of Highway 18. For the three facilities which might have to be re-sited due to delay in implementation (Off-channel recharge, Alto recharge, and Oeste Recharge) re-siting would potentially involve movement of the Alto and Oeste facilities further north of the California Aqueduct. This would marginally increase the potential for impacts to Mohave ground squirrel and desert tortoise. Potential re-siting of Off-Channel Mojave River Recharge would most likely reflect development pressure from the north, and thus involve re-siting of the facility to the south, where potential project impacts on riparian habitat, arroyo toad, and on wildlife movement would be greater.

5.5 Cultural Resources

5.5.1 Environmental Setting

During the late Pleistocene, the deserts contained woodlands; basins were joined by rivers; and herds of horses, camels, and mammoths roamed the fertile basins. As the glaciers retreated between 12,100 B.P. and 10,100 B.P., both vegetation and animals began to move to higher elevations. Due to fluctuations in the lake levels in the southern portions of the Mojave Desert, the floral and faunal composition of the Project area did not become established until after 4300 B.P., during the late Holocene. Based on research from pollen records and pack rat middens, it is believed that the low-elevation woodlands of the Mojave Desert were replaced by desert vegetation between 12,000 and 8,000 years ago (AEW 2005, citing Earle et al. 1997; Mehringer 1967; Van Devender and Spaulding 1979).

Vegetation in the Project area is currently composed of Mojave Desert scrub from the saltbush scrub (halophytic and arid phases), creosote bush scrub, Joshua tree and juniper woodland, and wash wetland or mesquite communities (AEW 2005, citing Earle et al. 1997; Sawyer 1994; Vasek and Barbour 1977). Numerous plant species in these communities were utilized as foods and medicines, or provided materials for making bows, arrows, baskets, cordage, digging sticks, houses, or fuel for Native American groups. The Project area also provides habitat for a variety of animals, including birds, insects, reptiles, rodents, pronghorn and bighorn sheep, coyote, and fox, which may have been hunted by Native American groups as well (AEW 2005, citing Earle et al. 1997).

5.5.1.1 Prehistoric Setting

The prehistoric cultural chronology for the general Project area has been divided into seven cultural periods: Fluted Point Period, Lake Mojave Period, Pinto Period, Gypsum Period, Saratoga Springs Period, Late Period, and Contact/Ethnographic Period. For purposes of evaluating the cultural resources identified during the archaeological survey of the Project area, only the Gypsum Period, Saratoga Springs Period, Late Period, and Contact/Ethnographic Period are reviewed below.

<u>Gypsum Period (4000–1500 B.P.):</u> Several Gypsum Period sites have been identified in the general Project area. This period is characterized by a trend toward increasingly effective moisture, which began in the late middle Holocene and culminated in a pronounced pluvial episode between ca. 3700 and 3500 B.P. At that time, a number of basins in the Mojave and Owens river drainages supported perennial lakes (AEW 2005, citing Enzel et al. 1992). In general, the projectile points of this cultural period are fairly large (dart point size), but also include more refined notched (Elko), concave base (Humboldt), and small stemmed (Gypsum) forms. In addition to diagnostic projectile points, Gypsum Period sites include leaf-shaped points, rectangular-based knives, flake scrapers, T-shaped drills, and occasionally, large scraper planes, choppers, and hammerstones (AEW 2005, citing Warren 1984:416). Manos and milling stones are common; the mortar and pestle also were introduced during this period. Other artifacts include shaft smoothers, incised slate and sandstone tablets and pendants, bone awls, *Olivella* shell beads, and *Haliotis* beads and ornaments. A wide range of perishable items dating to this period was recovered from Newberry Cave, located along the Mojave River near the southern end of the Troy Lake Basin, including atlatl hooks, dart shafts and foreshafts, sandals and S-twist cordage, tortoise-shell bowls, and split-twig animal figurines. The presence of both *Haliotis* and *Olivella* shell beads and ornaments and split-twig animal figurines indicates that the California desert occupants were in contact with populations from the southern California coast, as well as the southern Great Basin (e.g., Arizona, Utah, and Nevada).

Technologically, the artifact assemblage of this period is similar to that of the preceding Pinto Period; new tools also were added either as innovations or as “borrowed” cultural items. Included are the mortar and pestle, used for processing hard seeds (e.g., mesquite pods [*Prosopis glandulosa]*) and acorns, pine nuts, yuccas, and agaves, as well as the bow and arrow, as evidenced by the presence of Rose Spring projectile points late in this period. Ritual activities became important, as evidenced by split-twig figurines (likely originating from northern Arizona) and petroglyphs depicting hunting scenes. Finally, increased contact with neighboring groups likely provided the desert occupants important storable foodstuffs during less productive seasons or years, in exchange for valuable lithic materials such as obsidian, chalcedonies, and cherts. The increased carrying capacity and intensification of resources suggests higher populations in the desert with a greater ability to adapt to arid conditions (AEW 2005, citing Warren 1984:420). Large villages or village complexes also appear in the archaeological record during the Gypsum Period, reflecting a transition from seasonal migration (i.e., seasonal round) to year-round sedentary occupation of the Western Mojave Desert (AEW 2005, citing Sutton 1988).

<u>Saratoga Springs Period (1500–800 B.P.):</u> The Saratoga Springs Period saw essentially a continuation of the Gypsum Period subsistence adaptation throughout much of the California deserts. Unlike the preceding period, however, the Saratoga Springs Period is marked by strong regional cultural developments, especially in the southern California desert regions, which were heavily influenced by the Hakataya (Patayan) culture of the lower Colorado River area (Warren 1984:421–422). Specifically, turquoise mining and long distance trade networks appear to have attracted both the Anasazi and Hakataya peoples into the California deserts from the east and southeast, respectively, as evidenced by the introduction of Buff and Brown Ware pottery and Cottonwood and Desert Side-notched projectile points. The initial date for the first Hakataya influence on the southern Mojave Desert remains unknown; however, it does appear that by about 1000 to 1100 B.P. the Mojave Sink was heavily influenced, if not occupied by, lower Colorado River peoples. Trade with the California coastal populations also appears to have been important in the Western Mojave Desert region and helped to stimulate the development of large complex villages containing deep middens and cemeteries that have been dated from 2200 to 300 B.P., as well as large quantities of shell beads and steatite items from the coast.

Brown and Buff Ware pottery, first appearing on the lower Colorado River at about 1200 B.P. started to diffuse across the California deserts by about 1100 B.P. (AEW 2005, citing Moratto 1984:425). Associated with the diffusion of this pottery were Desert Side-notched and Cottonwood Triangular projectile points dating to about 800 to 850 B.P., suggesting a continued spread of Hakataya influences. Trade along the Mojave River also expanded resulting in middlemen between coastal and Colorado River populations. The Hakataya influence in coastal and inland southern California regions appears to have diminished during the late Protohistoric Period when the extensive trade networks along the Mojave River and in Antelope Valley appear to have broken down and the large village sites were abandoned (AEW 2005, citing Warren 1984:427). Evidence presented by Jones and others (1999) points to the apparent concordance between the reduction in use of the interior desert and the Medieval Climatic Anomaly. This period, lasting from approximately 1100 to 650 B.P., was typified by increased aridity here as elsewhere in the southwest (AEW 2005, citing Stine 1994; Warren 1984:427). This dry period may have led to the withdrawal of southwestern Native populations, such as the Anasazi, from marginal desert areas. Warren (cited in AEW 2005) also suggests that the apparent disruption in trade networks may have been caused by the movement of Chemehuevi populations southward across the trade routes during late Protohistoric times.

Late Period (800–300 B.P.): The Late Period reflects an adaptive modification of the cultural developments that were established during the Saratoga Springs Period. With the waning of the Medieval Climatic Anomaly, desert settlement is believed to have expanded. Bettinger and Baumhoff (cityed in AEW 2005) propose an expansion of Numic-speakers around 800 B.P., possibly precipitated by this climatic crisis, while Moratto (cited in AEW 2005) has suggested an earlier beginning date for this expansion (1000–900 B.P.), perhaps associated with prolonged drought. However, it is not currently known what effect Numic expansion had on the immediate Project area as Numic-speakers appear to have moved into the area during an earlier period.

Socioeconomic and sociopolitical organization continued to increase in complexity during this period, and by this time the "desert village" model of settlement appears to have become generalized in at least some areas of the western Mojave Desert. This model is based on population-driven sedentism and geographical limitation of gathering and hunting territories as accompanied by ever more intensive exploitation of a larger array of less attractive and less cost-efficient food resources (AEW 2005, citing Earle et al. 1997).

With the return of wetter conditions around 500 B.P., there is some evidence of population increase in southern California and archaeological evidence indicates that the Late Period populations utilized a greater variety of subsistence resources. This included the exploitation of both small and large mammals, and in some areas, fish. The continuation of milling technologies reflect a persistence of seed collecting, and the frequency of special purpose sites increases proportionally with a growing awareness of resource availability and potential (AEW 2005, citing McIntyre 1990).

Contact/Ethnographic Period (300 B.P.–present): At the time of the first historic contact the western Mojave Desert was occupied primarily by the Serrano, a Shoshonean ethnographic group whose language is classified in the Takic subfamily of the Uto-Aztecan linguistic family (AEW 2005, citing Moratto 1984:534). This group developed socioeconomic and sociopolitical systems that set them apart from other Uto-Aztecan groups in the Mojave Desert and linked them to coastal Takic-speaking groups, the Gabrielino and Luiseño (AEW 2005, citing Warren 1984:344). In the southern Mojave, sites are characterized by Desert Side-notched and Cottonwood triangular points and lower Colorado Buff and Tizon Brown ceramic wares.

The Serrano were hunters and gatherers who utilized both large and small game, as well as numerous plant resources. Large game such as deer, mountain sheep, and pronghorn were hunted with bow and arrows, and smaller animals such as rabbits and various rodents were taken with throwing sticks, nets, and arrows. Acorns, pinyon nuts, and mesquite beans were among the staple foods supplemented by seeds from plants such as chia and ricegrass, and roots and tubers, and greens (AEW 2005, citing Bean and Smith 1978).

The Serrano and neighboring language groups were socially organized on the basis of independent but interacting village communities. Each of these villages consisted of one or more patrilineal clans that belonged to one of two exogamous moieties and maintained complex ceremonial relationships with neighboring communities (AEW 2005, citing Gifford 1918; Strong 1929). The Serrano clan that occupied the Mojave Forks region was known as the *Kaiwiem*, and was affiliated with the coyote moiety. Within the larger Kaiwiem territory there were several subregions, one of which encompassed the Mojave Forks area and were known as *Wa'peat*, which took its name from the Serrano word for juniper, which is the dominant species in the region from Summit Valley to Hesperia. The main village of *Wa'peat* was called *Guapiabit* by the early Spanish explorers; this village was located at the west end of Summit Valley at the Las Flores Ranch. *Guapiabit* was visited in 1776 by Spanish missionary Francisco Garces, in 1806 by Father Jose Maria Zalvidea, and in 1819 by the Lieutenant Gabriel Moraga expedition at which time it appeared that the village had been abandoned (AEW 2005, citing Altschul et al. 1989:16–18).

The actual Mojave River Forks area, and quite possibly CA-RIV-176, or the Deep Creek Site identified in the Mojave River Dam Area parcels, was called *Maka'taveat* by the Serrano, which was a landmark on the Mojave Trail at its junction with a trail from the Mojave River up to Bear Valley. The next major village to the north was *Atongaibit*, or the Hendrick Ranch Site (CA-SBR-48), located about 3 kilometers north of the Deep Creek Site. It has also been postulated that the village of *Atongaibit* may have included all the archaeological sites along the Mojave River between the Deep Creek Site on the south and the Hendrick Ranch Site on the north. Many Serrano villages were dispersed linearly along rivers and were composed of small isolated pockets of habitation, and as these were occupied seasonally during the winter months, the exact location of residential structures could change yearly with archaeological deposits accumulating over a large area with only a small portion ever occupied at one time (AEW 2005, citing Altschul et al. 1989:18).

5.5.1.2 Historical Setting

For the most part, the western Mojave Desert has a somewhat abbreviated history as it was a frontier to be crossed rather than settled. As discussed above, the earliest non-Native people to enter the general Project region were the Spanish explorers. In 1776, Francisco Garces, a priest associated with a Spanish mission in Tucson, traveled with several Indian guides along the Old Mojave Indian Trail and approached the Mojave River area in the vicinity of present-day Hesperia in March of that year. During subsequent years, several other Spanish explorers traversed the Project area.

In 1821, Mexico declared its independence, and as the colonial administration disintegrated, American explorers and entrepreneurs began exploring the California desert, the first of which was Jedediah Strong Smith, who first crossed the Colorado River into California in 1826. Like Garces, Smith and his group of approximately 30 trappers were led by several Indian guides along the Old Mojave Indian Trail, over the Cajon Pass, to the Mission San Gabriel. As early as 1828, Indian horse thieves, including some from the Mojaves, the Chemehueves, and the Utes, as well as white men and runaway mission Indians, began raiding the large coastal missions and Mexican ranchos stealing hundreds of fine horses. Summit Valley, just east of the Cajon Pass, likely became a rendezvous point for the horse thieves prior to crossing the Mojave Desert

(AEW 2005, citing de Barros 1990:2-51)). The largest and best organized of these raiding parties was led by the legendary *Walkara*, a Ute Indian known as the "Hawk of the Mountains," and Thomas "Peg-leg" Smith; over a 20-year period it is reported that they had gathered more than 5,000 prized horses from the greater San Bernardino Valley and ran them across the Cajon Pass, following the Mojave River and the Old Mojave Indian Trail to the Colorado River and points to the east and south (http://www.wemweb.com/traveler/towns/16victor/16vhist/history.html).

Few changes occurred in Alta California until the Missions were fully secularized in 1836. By the 1830s, trappers and traders with commercial interests were traveling regularly from Santa Fe, New Mexico, to Los Angeles, following the Old Mojave Indian Trail. For several years, the "fork on the road" at the Mojave River lower narrows led eastward to Santa Fe; this was known as the "Spanish Trail." After the Mormons colonized Utah, Salt Lake City gradually supplanted Santa Fe as a destination of commerce, and this route became known as the Salt Lake-Santa Fe Trail (AEW 2005, citing Sturm 1993:16).

After gold was discovered on the western slope of the Sierra Nevada Mountains in 1849, many immigrants followed the Spanish Trail in search of riches in California. California became a state of the United States in 1850. The San Bernardino Baseline and Meridian was established in 1853 and mapping of the desert lands began in earnest, followed by settlers seeking land to homestead (AEW 2005, citing Sturm 1993:17). Also in the early 1850s, a graded road had been built up the southern face of the San Bernardino Mountains, making it possible to freight wagon loads of supplies and lumber to and from the sawmills in the mountains that provided lumber for residences and commercial businesses in the San Bernardino Valley.

By the 1860s, there were numerous mining claims along the San Bernardino Mountain periphery, including a gold claim at Big Bear Lake, staked by William Holcomb of San Bernardino. The boom that followed saw the creation of the town of Belleview in the mountains and the building of additional roads from the Victor Valley side of the Cajon Pass to points southward (http://www.wemweb.com/traveler/towns/16victor/16vhist/history.html). The 1870s and 1880s witnessed expanded mining in the desert region as well. The Oro Grande Mining District, which included Hesperia, Victor, and Oro Grande, was a rich region for minerals, including gold, silver, gem stones, marble, and limestone (AEW 2005, citing Sturm 1993:17). Miners needed supplies, which increased demand for roads and services. In 1854, a wagon road was built from San Bernardino to Salt Lake; however, the road was poorly constructed, particularly over the Cajon Pass. In 1861, an early settler named John Brown, a San Bernardino pioneer, and two associates built a toll road, known as Browns Toll Road, across the west Cajon Pass, which shortened the trip and eliminated some of the steeper segments of the climb (AEW 2005 citing de Barros 1990:2-52). Later in 1883 the California Southern Railroad, later known as the Atchison Topeka & Santa Fe Railroad (AT&SF), was built over the Cajon Pass; the railroad reached the Atlantic & Pacific Railroad (later known as the Union Pacific Railroad) junction in Barstow/Dagget in 1885. In 1923, the former Browns Toll Road became paved for the first time, and in 1933 the Brown Toll Road became part of the state highway system.

Although ranching began as early as 1863 at Rancho Las Flores in Summit Valley of the Cajon Pass, historical settlement of the western Mojave was initially based on mining. However, in the later part of the nineteenth century, Victor Valley was slowly being settled by ranchers and farmers, and the railroad companies began to engage in the real estate business, with the Southern Pacific Railroad promoting the township of Hesperia. Following in the tracks of the railroads, land developers such as Appleton Land & Water Company and Ursela M. Poates promoted real estate in the 1890s and 1900s due to the area's agricultural potential for orchards of apples, pears, and grapes (www.wemweb.com/traveler/towns/16victor/16vhist/history.html). In 1915, the state legislature and the federal government authorized the Victor Valley Water Project, largest of its era in the nation, and the AT&SF Railroad began to lay double trackage to serve the anticipated needs of the growing Victor Valley. In 1916, the Arrowhead Reservoir & Power Company was formed; however, by 1917, many of Victor Valley's homesteaders, ranchers, dam builders, and cow-hands left the Valley for World War I. It was not until after World War II that the Victor Valley witnessed another expansion of settlement.

5.5.2 Facilities Impacts

Prior to archaeological surveys of the seven accessible Proposed Project locations, a literature and records search was conducted by personnel from the San Bernardino County Archaeological Information Center, housed at the San Bernardino County Museum in Redlands, in May 2005. Results of this search are described below by the proposed Project locations.

Intensive archaeological surveys of the seven proposed Project locations were performed by four Applied Earth Works archaeologists from May 10 to May 23, 2005. Survey transect spacing ranged from 10 to 15 meters. All landforms likely to contain or exhibit prehistoric or historically sensitive cultural resources were inspected carefully to insure that all visible, potentially significant or important cultural resources were discovered and documented. Additionally, surveyors also investigated any unusual landforms, contours, soil changes, distinctive vegetation patterns, features (e.g., road cuts, ditches, stream cuts), and other potential cultural site markers. Surveyors were particularly attentive when transecting through Project areas where previously recorded cultural resources had been identified as being located on, or directly adjacent to, the proposed parcels of interest. All potentially significant cultural resources identified were documented on State of California Department of Parks Recreation Primary Record Forms (DPR 523). Site locations were plotted on the appropriate 1:24,000 scale USGS topographic map using GPS, as well as the Project's aerial maps.

Surveys were not conducted along potential pipeline alignments, because pipelines would be constructed within existing public rights-of-way and these rights of way were either disturbed or paved. Surveys of well sites in urban areas were not conducted for the same reason. No evaluation was made of the Mainstem Mojave River because (a) the river is subject to infrequent but significant scouring flows, sediment transport, and subsequent sediment deposition and (b) grading activity to push up low sand berms in the channel would not extend below the level of recent scour/deposition and thus no significant cultural resources would be encountered.

Results of cultural resource surveys have been transmitted to the Native American Heritage Commission which has also been contacted regarding siting of sacred sites. The Commission responded on September 9, 2005 noting that there are no known sacred sites in the immediate project area and enclosing a list of appropriate Native American individuals/organizations who may have knowledge of cultural resources in the project area.

5.5.2.1 Mechanisms for Effect

To the extent that construction activities involve sub-surface excavations, project construction activities would have potential to disturb buried prehistoric and historic cultural resources.

5.5.2.2 Survey Results

The results of cultural resources literature search and field surveys are shown on Table 5-15. In addition to survey of the sites shown on Table 5-15, surveys were conducted at a site immediately downstream and to the east of Mojave Forks Dam. The literature search for this area revealed a listed prehistoric site covering a large portion of the potential recharge basin area. For this and other reasons, recharge in the immediate vicinity of Mojave Forks Dam will not be pursued.

In addition to the literature survey and field surveys performed for this project, extensive investigations of cultural resources have been undertaken as part of the proposed Rancho Las Flores development, which would eventually extend into the Unnamed Wash which is a feature of the Minimum Facilities Alternative. These investigations (Rancho Las Flores 2004) identified a number of historic and pre-historic sites along the West Fork of the Mojave River and several sites in the Mesas surrounding this river valley. A majority of known resources have been found along the West Fork of the Mojave River and at its confluence with Deep Creek. These are all south of the proposed sites along the Mojave River. No sites were identified in the vicinity of Unnamed Wash.

Table 5-15. Results of literature search and cultural resources survey. NA = Not applicable because site was paved or highly disturbed.

SITE	SURVEY RESULTS AND EVALUATION		
	Literature Search	**Field Survey**	**Potential for Buried Cultural Resources**
Minimum Facilities Alternative			
Instream Mojave River Recharge	NA: Active riverbed	NA: Active riverbed	None
Mojave River Well Field and Pipeline	NA: Urban, paved or highly disturbed	NA: Urban, paved or highly disturbed	Moderate to High
SWP Delivery via Unnamed Wash (Canal)	No prior surveys	Surveyed for Rancho Las Flores project.	Moderate
Small Projects Alternative			
Off-Channel Mojave River Recharge: East Site	No records of significant sites	Remnants of historic farmhouse located 2300 feet east of Mojave River channel.	Moderate
Off-Channel Mojave River Recharge: West Site	No records of significant sites	No surface resources found. Land disturbed by agriculture and other activities	Moderate
Off-Channel Mojave River Recharge Pipeline	No records of significant resources	NA: To be constructed in paved or unpaved public rights of way, which are highly disturbed.	Moderate
Oro Grande Wash and Pipeline (both sites)	No records of significant resources	No cultural resources identified.	Low, disturbed
Cedar Ave. Detention Basin and Pipelines	Two historic refuse scatters	No cultural resources identified	Low
Antelope Wash Detention Basin Recharge (Ranchero Road) and Pipelines	No prior surveys	No cultural resources identified	Low
Large Projects Alternative			
Oeste Recharge, Wells, and Pipelines	No prior survey	No cultural resources identified	Low
Alto Recharge, Wells, and Pipelines	Historic unpaved road	No present evidence of historic roads, no other resources identified	Low
Antelope Wash Recharge	No prior surveys	No present evidence of cultural resources	Low

5.5.2.3 Site Sensitivity Analysis

Given the scarcity of water resources in the desert, the highest probability for buried cultural resources probably occurs adjacent to springs and drainages, particularly the Mainstem Mojave River, which would serve as the logical locus for larger prehistoric and historic settlements. The Mojave River and various tributary washes themselves are unlikely to contain such resources because of periodic erosion and deposition associated with infrequent but heavy precipitation. No new facilities are proposed outside of the Oeste and Alto areas, and these areas are north of the steep San Bernardino Mountains. High energy flows from the mountains have eroded washes to a depth of 30 to 50 feet in many places. Upper portions of these washes may have slopes of 25 to 50 feet per mile. Similarly the Mainstem Mojave River consists of a broad, sandy riverbed, generally dry and devoid of vegetation. The sands that make up the riverbed are rapidly eroded and transported downstream during even moderate flows, as was evidenced by the rapid destruction of sand berms constructed for the 2003-2004 Banking Demonstration Project. Flows in excess of 500 cfs resulted in washout of the sand berms. Flood flows such as those experienced in 2005 would be expected to erode, transport, and re-distribute river bed sediments throughout the potential project reach of the river.

Although there was probably pre-historic and historic use of all of the areas where new facilities may be sited, permanent or semi-permanent prehistoric and historic sites were generally located along the rivers and washes and the highest probability of encountering buried resources at potential new facility sites is along the banks of the Mojave River, outside of the area which would be subject to highly erosive flows. Soil composition is probably a good indicator of the potential for buried resources, because unconsolidated sands in the floodplain have probably been subject to erosion and deposition, and intact buried resources are not likely to be found. Such soils are most suitable for groundwater recharge, and excavation depths of 3-5 feet will probably not extend below the zone of recent flood-related disturbance. Thus the most sensitive potential sites for buried resources are probably associated with well fields and pipelines along the Mojave River and in the upslope urbanized areas.

Cultural resource literature review identified no known cultural resource sites in the Antelope Wash area, either at the upstream or downstream site at Ranchero Road, and none would be expected in an area subject to substantial flooding and scour. The potential for buried cultural resources to be found during construction would be no higher at the downstream site than at the upstream site. There would therefore be no change in projected impacts to cultural resources associated with relocation of the upstream Antelope Wash recharge site to a downstream site. With the mitigation provided for in the draft EIR, the expansion of recharge at Ranchero Road in lieu of development of recharge at the upstream site would reduce impacts to a level of less-than-significant.

5.5.3 Operational Impacts

Following construction of new facilities, there is no mechanism by which routine operations and maintenance would affect cultural resources.

5.5.4 Mitigation and Significance of Impacts after Mitigation

Under CEQA, impacts to cultural resources would be considered significant if the Proposed Project activities:

- Cause a substantial adverse change in the significance of a historical resource as defined in § 15064.5;
- Cause a substantial adverse change in the significance of an archaeological resource pursuant to § 15064.5;

- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature;
- Disturb any human remains, including those interred outside of formal cemeteries?

The 2004 Regional Water Management Plan specifies mitigation for cultural resources impacts that is consistent with the CEQA *Guidelines* for reducing such impacts to a level of less than significance:

- Implementing agencies shall avoid impacts if feasible on identified cultural resources including prehistoric and historic archeological sites, locations of importance to Native Americans, human remains, and historic buildings and structures. Methods of avoidance may include, but not be limited to, project re-route or re-design, project cancellation, or identification of protection measures such as capping or fencing.
- Implementing agencies shall retain archeological monitors during construction for ground-disturbing activities that have the potential to impact significant archeological remains as determined by a qualified archeologist.

Based on this policy and the results of literature search and field surveys, MWA would implement the monitoring provision above for all facilities located adjacent to the Mainstem Mojave River, including:

- The Mojave River Well Field
- The Well Field Delivery Pipelines
- Off-Channel Mojave River Recharge (east or west site) and the supply pipeline to this site

If the eastern site is selected for Off-Channel Mojave River Recharge, MWA would also design the recharge to avoid the recently identified historic farmhouse site and/or provide for a suitable archeological testing and recovery program consistent with State of California and Federal policy.

Because previously unrecorded and/or unanticipated archaeological deposits, features, and Native American burials may be encountered during implementation of the Project, the Project Archaeologist would prepare a *Construction Phase Monitoring and Cultural Resources Treatment Plan* prior to Project construction. The purpose of this *Plan* would be to clearly outline and expedite the process by which the Mojave Water Agency will resolve any significant impacts upon newly discovered, historically significant cultural resources, including consultation with the State Historic Preservation Officer (SHPO), thereby eliminating untimely and costly delays in construction. Specifically, the *Plan* would outline the process by which cultural resource discovery notifications are made and treatment plans are implemented, describe the cultural resource classes anticipated during Project construction, describe the treatment options for each cultural resource class, and detail procedures for implementing treatment. In addition, the *Plan* would summarize the Native American involvement in the Project (including a sample Native American Burial Agreement), outline the procedures for curation of materials recovered during site treatment (including a proposed Archaeological Curation Agreement with a facility that meets California curation standards), and address report requirements. This *Plan* would be submitted to the SHPO for review and comment prior to Project construction.

Implementation of these measures will reduce the potential for cultural resources impacts to a level of less-than-significant.

5.5.5 Summary Comparison of Alternative Impacts

As mitigated, none of the alternative facilities would affect a known prehistoric or historic cultural site. The highest probability of finding buried cultural resources is associated with (a) the Minimum Facilities Alternative well field and associated distribution pipelines and (b) the Small Projects Alternative off-stream recharge basin and associated distribution pipeline on either the east or west banks of the Mainstem Mojave River. Implementation of Cultural Resources Management elements of the Proposed Project will result in no significant impacts to such resources.

5.5.6 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The highest probabilities for finding significant buried cultural resources are associated with excavations for the Minimum Facilities Alternative and the Small Projects Alternative. The No Project Alternative would likely involve construction of these facilities over the long-term, resulting in similar levels of effects and similar levels of mitigation. The shorter pipeline from the Mojave River Well Field to local producer facilities would marginally reduce the potential for finding buried cultural sites. The No Project Alternative would probably not, therefore, result in a significant reduction in cultural resources impacts when compared to the various facilities alternatives.

5.6 Geology and Soils

5.6.1 Environmental Setting

The 2004 PEIR described 21 soil associations within MWA's service area, and provides a map of these associations. Based on this mapping, the various facilities to be utilized in the proposed water banking/exchange program are:

- **Recharge basins at Yucca Valley, Newberry Springs**: Rockland (rocky sandy alluvium)

- **Recharge basins at Daggett, Hodge, and Lenwood:** Arizo-Daggett (gravelly sand)
- **Recharge basins, wells, and pipelines in Oeste and Alto**: Greenfield-Ramona (gravelly sand and sand)
- **Mainstem Mojave River and adjacent floodplain**: Riverwash (sandy alluvium)
- **Well fields and pipelines in Hesperia, Victorville, Apple Valley, and Adelanto**: Adelanto Mojave, Mojave-Adelanto variants; Greenfield Ramona, Hanford-Greenfield, Ramona (sandy loams):

In general, these are loosely consolidated, porous soils and sites for recharge basins and well fields have been selected based on these characteristics. No surface fines or clays are found in the proposed recharge areas. There may be some lenses of clays in the areas designated for distribution pipelines. The sandy loam soil associations (Adelanto Mojave, Mojave-Adelanto variants; Greenfield Ramona, Hanford-Greenfield, Ramona soils) have potential for high erosion due to windy conditions. None of these soils are designated as expansive, although pipelines in sandy loam areas may cross intrusions of expansive soils.

As the 2004 PEIR notes, a majority of the facilities being contemplated for the Proposed Project lie in areas crossed by a series of earthquake faults which trend northwesterly direction: the Helendale Fault (northeast of Apple Valley), the Lenwood Fault (southwest of Barstow) and the Calico Fault (near Newberry Springs). South of Yucca Valley, the Morongo Valley Fault runs at a 90-degree angle to these northwesterly trending faults. The Mojave Segment of the San Andreas Fault is to the southwest of the MWA service area. MWA's service area is seismically active, with local faults capable of generating earthquakes of 4.8 to 7.6 maximum magnitude (Richter magnitude) or up to VIII on the Modified Mercalli Intensity Scale. The highest potential for seismic-related damage to structures is in the southern portion of MWA's service area, and is associated with the San Andreas Fault. All new facilities for the Proposed Project would be located in this zone.

Seismic-induced groundshaking and associated liquefaction of soils may occur in some locations where facilities may be sited, including in the City of Hesperia (areas with high groundwater), along the Mainstem Mojave River between Mojave Forks Dam and the Narrows, and at Barstow. Potential for liquefaction increases as groundwater elevations rise. Partially as a result of significant overdrafting of groundwater basins, groundwater in the Regional Aquifer is generally quite deep. Based on groundwater elevation data from California Department of Water Resources (MWA 2004b; USGS 2002), in the Oeste and Alto areas, groundwater is generally 300 ro-400 feet or more below ground surface. USGS has estimated that groundwater levels in the Alto Regional Aquifer have declined between 50 and 75 feet since mid-1940, by 100 feet in the Centro area, and almost 100 feet in the Baja area.

In the Mojave River Aquifer, groundwater levels fluctuate in response to river flow. For example, upstream of the Narrows, DWR shows groundwater levels fluctuating from about 10 to 50 feet below ground surface. Near the Narrows, groundwater is forced to the surface and well levels are at or near ground-surface elevation. To the south, near potential off-stream recharge basins on the Mainstem Mojave River, groundwater elevations range from 40 to 90 feet below ground surface. There are similar river-influenced fluctuations in groundwater levels near Lenwood, Daggett, and Newberry Springs. Well levels are generally 30 to 80 feet below ground surface near the river, while wells located away from the river in the Regional Aquifer are lower and there has been a decline over the years. The 2004 PEIR summarizes the data from regional wells and notes that areas with groundwater less than 50 feet below ground surface occur from Mojave Forks Dam downstream to about Rock Springs, in the Lenwood - Hodge reach of the river, and near Newberry Springs. Relatively high groundwater levels also occur near the existing recharge basins southwest of Yucca Valley.

5.6.2 Facilities Impacts

5.6.2.1 Mechanisms for Effect

The Proposed Project has no potential for creating landslide or affecting expansive soils. Siting of facilities precludes these effects because none of the proposed facilities is sited in a landslide area or on expansive soils, with the exception of pipelines which will be buried and will not contribute to phenomena associated with expansion and contraction of soils due to cycles of wet and dry conditions. The Proposed Project Alternative also has no significant potential to create subsidence, because (a) there will be a net increase in recharge as a result of the Proposed Project, (b) recharge will always occur prior to extraction, (c) soil conditions in the Mainstem Mojave River and Mojave River Floodplain Aquifer are not likely to result in subsidence, and (d) groundwater levels in the Regional Aquifer where soil conditions create a potential for subsidence will occur in areas where groundwater levels are at least 200-300 feet below the surface and surface subsidence associated with historic overdraft has already occurred. Recharge and conveyance of groundwater may thus affect geology in several ways:

- Recharge may raise groundwater levels to near the surface, resulting in an increased risk of liquefaction during seismic-induced ground shaking;
- Recharge and groundwater extraction may result in short term declines in water levels;
- Water stored in recharge facilities and pipelines may be released if facilities are damaged by seismic ground shaking;
- Exposed soils may erode during high winds;
- Soils may erode in Unnamed Wash until the channel reaches equilibrium; and
- Soils may erode during construction.

Liquefaction Effects: Liquefaction effects are difficult to estimate precisely because they depend on the interaction of soil type, soil age, soil saturation level, depth to groundwater, earthquake source, earthquake path, and specific site processes (Silva et al 2003). Nevertheless, basic approaches to evaluating liquefaction susceptibility are well established, and reasonable judgments about relative impacts can be made based on soils characteristics and depth of groundwater. For example, Knudsen et al (2000) evaluated liquefaction potential on a qualitative scale (Very High to Very Low) for soil types versus depth to groundwater in the San Francisco Bay area. In general, they note that potential liquefaction effects are low to very low when depth to groundwater is greater than 30 feet, and consistently very low for depths to groundwater of greater than 50 feet. Key findings related to soil/depth relationships were:

- For recent stream channel deposits, liquefaction potential isVery High at < 10 feet, High for depths of 10 to 30 feet, and Moderate for depths of 30 to 50 feet;
- For alluvial fan deposits, liquefaction potential is Moderate at < 10 feet, Moderate for depths of 10 to 30 feet, and Low for depths of 30 to 50 feet; and
- For alluvial terrace deposits, liquefaction potential is High for depths from 0 to 30 feet and Moderate to Low for depths of 30 to 50 feet.

This is consistent with findings from numerous other studies where depth to groundwater/soil relationships have been studied (for example Davral et al 2001). Based on these studies, it is reasonable to conclude that liquefaction potential is a concern when depth to groundwater is about 30 feet. At 50 feet, potential liquefaction effects are very low, even for unconsolidated sandy soils. The potential for liquefaction to adversely affect human safety is related to liquefaction potential and the proximity of development to areas of high groundwater.

Liquefaction is a localized phenomenon, a function of saturated soils in the immediate vicinity. Groundwater recharged mounds below the recharge zone, with maximum elevation of groundwater immediately below the recharge basin. Groundwater sinks as it spreads, and in porous soils such as those used for recharge has a relatively high rate of horizontal and vertical movement. Potential for liquefaction effects from recharge therefore decrease with distance from the recharge site and may also be affected by localized pumping, which creates a cone of depression at the well site.

<u>Short-term declines in groundwater levels during extraction:</u> The 1996 adjudication prohibits pumping of natural production out of the basin and thus the net effect of banking on the Regional and Mojave River aquifers is that there will always be more groundwater in storage than is pumped for local use or for making return deliveries to Metropolitan. The Proposed Project could result in recharge of one portion of the aquifers and pumping from another portion. In the short term, this has potential to lower local well levels.

<u>Impacts related to damage to facilities:</u> Recharge in the Mainstem Mojave River will have no potential for impact associated with failure as a result of seismic shaking because the riverbed is the low point of the basin and any water contained in the temporary sand berms of the riverbed will simply run downstream.

At other existing and new recharge basins, basin size is small and/or facilities are relatively isolated from adjacent development. Recharge basins also consist of a series of small cells (to minimize wave action due to wind) and damage. In addition, recharge basins are constructed by removing about 1.5 feet of soil to use in levee construction. A recharge basin 5 feet deep thus generally has levees extending only 3.5 feet above ground level. Finally, in the event of a levee failure, it is not likely that there would be a catastrophic failure of the entire levee. Rather a break in the levee would occur, adjacent soil would fall into the break, and the break would expand; as the basin drained, the rate of drainage would decline. Failure of internal cells would have similar effects.

Release from a damaged 20-acre recharge basin, filled to a depth of 3.5 feet (1.5 feet below pre-construction grade, would be about 40 acre-feet. For recharge basins in local washes, a release would be accommodated by the wash itself, and no damage to adjacent properties would occur. Given that recharge basins other than those in washes are sited on relatively flat ground, the effect of such a release would be to create sheet flow no deeper than about 2 feet immediately next to the levee, with depths declining rapidly as the water spread out along streets. Velocities would be low.

Water release associated with damage from pipelines is limited by automatic shut off valve installed to limit releases during seismic events. These valves shut down flow from the source and result in isolation of various segments of pipelines. Leakage is thus minimal, even if a segment of pipeline fails; a 1-mile segment of 54" pipeline contains approximately 2 acre feet of water, and even a catastrophic failure would result in release of only a portion of this supply. There would be localized erosion and flooding associated with such releases. The effect of the banking project on existing pipelines is to extend the period of their use and increase the potential for the pipeline to be in use during a seismic event.

Soil erosion from high winds: Soil erosion is a potential problem, but experience in Kern County during periods of high wind and dust storms suggests that recharge basins and irrigation canals collect, rather than distribute sediments. At Arvin-Edison Water Storage District, high winds often trap wind-borne sediment, filling recharge basins and requiring periodic cleanout. The effect of recharge basins on wind-driven erosion may therefore be to ameliorate problems associated with wind-driven dust. In addition, none of the existing or proposed facilities is located on a soil series likely to be subject to high erosion from winds.

Erosion during construction: Wind and precipitation may cause soil erosion during construction. Erosion from winds is an Air Quality concern and is addressed in the discussion of Air Quality impacts. Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.2.2 Potential Effects: Minimum Facilities Alternative

Liquefaction: The Minimum facilities Alternative could involve annual recharge of about 48,000 acre-feet with on-going extraction at the Mojave River Well Field of about 44,000 acre feet in the Mojave River Aquifer between Mojave Forks Dam and the Narrows. Project feasibility-level technical analyses (Bookman-Edmonston 2004a) indicate that about 61,000 acre-feet of storage could be accommodated without raising groundwater levels at mid-channel to 20 feet below surface elevation, an elevation limitation incorporated into the project to avoid increasing liquefaction risk. Once the initial fill is provided, groundwater levels in this reach of the Mainstem Mojave River would then be managed by matching annual input of groundwater in the southern portion of the reach to groundwater extraction and use in the northern portions of the reach. This is an essential feature of the banking and exchange program and will contribute to stabilization of groundwater adjacent to the Mainstem Mojave River at levels below those likely to cause liquefaction. The analysis leading to this conclusion is described below.

In 2001 the US Geological Survey (USGS 2001) modeled changes in groundwater levels throughout the Mojave River Basin based on recharge of 1,300,000 acre-feet of SWP supply over a 20-year period. Their modeling suggests that without recharge, groundwater levels would continue to decline in virtually all areas. With this magnitude of recharge, groundwater levels would rise in the vicinity of (hypothetical) recharge sites in the Oeste, Alto, Centro, and Baja subareas, rising as much as 50-200 feet in the active recharge area and to a lesser but still substantial extent as much as 10 miles away from recharge sites. The magnitude of net recharge used in their model (1.3 million acre-feet) greatly exceeds the magnitude of the Proposed Project, but the general trend towards mounding of water below recharge sites and a slow horizontal migration of this water would be expected regardless of the magnitude of the project. The USGS analysis confirms that groundwater levels will rise in the vicinity of recharge basins.

Existing depth to groundwater is greater than about 300 feet throughout the Regional Aquifer areas that would be affected by the Minimum Facilities Alternative. Because groundwater recharge will be distributed throughout the MWA service area, the magnitude of recharge at any site will be minimized and it is not likely that groundwater levels will rise above 50 feet below ground surface at any Regional Aquifer site. Groundwater levels at recharge basins in Hodge, Lenwood, and Daggett are adjacent to the Mojave River and depth to groundwater varies from about 30 to 80 feet. There is a potential for increased groundwater recharge associated with banking to raise water levels and increase the potential for liquefaction, but predicted seismic shaking in this area is low (0.2-0.3g) and the area adjacent to the recharge basins is sparsely populated and agricultural. At Newberry Springs, groundwater levels have been declining and recharge would not likely raise groundwater levels to within 50 feet of the ground surface. At Yucca Valley, increased recharge may raise groundwater levels to less than 50 feet, and the area is predicted to experience 0.5 to 0.6g shaking, but the area is sparsely developed and the risk of adverse effect is low. At all of these sites, Bookman-Edmonston (2004a) projected a substantial capacity for recharge, well in excess of that contemplated in the Proposed Project, with maximum groundwater depth of 20 feet or more at the recharge site. Groundwater levels adjacent to the site would be lower. The proposed project is therefore not likely to substantially increase liquefaction potential at these sites.

Bookman-Edmonston (2004a) modeled potential groundwater levels in the Mainstem Mojave River at approximately Rock Springs in response to a 5-year hypothetical input of about 156,000 acre-feet per year with subsequent pumping at a rate of 134,740 acre-feet per year. This analysis suggests that groundwater levels would rise by about 40 feet at this site over a 5-year recharge/pumping program.

Based on these and other considerations, Bookman-Edmonston (2004b) concluded that the Mojave River Mainstem could store a maximum of 61,000 acre-feet, assuming a dry zone of 20 feet within the upper portion of the aquifer in mid-channel, to reduce the risk of liquefaction and water use by phreatophytes. Groundwater would mound under the active recharge area, with groundwater levels declining as water spread towards the river's banks. At river edge, then, groundwater levels would be lower than at mid-channel. On the west, development in the area begins on land about 20 feet above the mid-river channel itself. In the middle of the proposed well field, for example, the river channel elevation is about 2880 and all adjacent development is above elevation 2900. Thus, on the west of the channel, virtually all development would occur in areas where groundwater levels would be at least 40 feet or more below the surface. Groundwater levels along the slope leading down to the river would be deeper. On the east banks of the river, the floodplain is flatter, but is raised by about 10 to 15 feet above the river channel. In this area, maintaining water levels about 20 feet below the mid-channel surface would mean that groundwater below developed areas would be at or below 30 to 40.

Under the Proposed project, recharge would probably not result in storage of 61,000 acre-feet, but would involve on-going recharge and extraction at a marginally lower level. The potential effects of recharge-extraction on groundwater levels can be illustrated with a typical operation scenario, based on Metropolitan and MWA efforts to optimize recharge during periods when water quality is highest. If deliveries are assumed to be up to 48,800 acre-feet within a 4 month period (March through June; a delivery rate of about 153 cfs or about 30% of the proposed maximum delivery rate) and extraction rates are assumed to be constant at a rate of 3700 acre feet per month, then monthly increase in storage during deliveries would be:

Delivery:	12,200 acre-feet
Extraction	-3,700
Net:	8,500

Over a typical 4-month delivery period, storage in the Floodplain Aquifer would rise by 34,000 acre-feet, or 27,000 acre-feet less than the storage level at which groundwater levels would be 20 feet below the mid-channel surface. The Mojave River Well Field would create cones of depression at the junction of the Floodplain Aquifer and the Regional Aquifer from Rock Springs Road to Bear Valley Road and it is assumed that the well field would extract 85 to 90% of recharge, with the remaining water welling up as it approached the Narrows and becoming surface flow. Given an estimate that storage of 61,000 acre-feet would raise groundwater levels to within 20 feet of the riverbed, the lower net increase in storage occurring within the 4 months of the recharge-extraction cycle would result in lower groundwater levels than predicted for a 61,000 acre-foot level of storage. Under the probable project operations scenario, storage except losses to the Narrows would be extracted by the well field within the 4-mile reach south of Bear Valley Road. If wells are sited on either side of the river and about 1250 feet from the river channel at this reach, then the area affected by mounding of recharged water is about 3500 feet wide or about a total of 1700 acres, representing capacity of about 27,000 acre-feet. Assuming even distribution of the unused capacity, the probable groundwater depths would be about 45 feet below ground surface at the channel edge and to 55 to 65 feet below the nearest adjacent development. Following the initial 4-month pulse of recharge, water levels would continue to decline as a result of on-going extraction, not rising again until there was natural flow or a new recharge pulse. In short, because the Proposed Project would maintain mid-channel groundwater levels at or below 20 feet, and proposed coordinated operation of recharge and extraction from the river is likely, liquefaction effects associated with recharge of the Mainstem Mojave River are unlikely.

Based on these considerations, the potential for the Minimum Facilities Alternative to increase the risk of adverse effects related to liquefaction is:

- Yucca Valley: Very Low (minimal increase in groundwater level, low risk of damage);
- Newberry Springs: Very Low (low starting groundwater levels, little potential to raise levels to above 50 feet;
- Lenwood, Hodge, and Daggett: Very Low (moderate potential to raise groundwater levels to above 50 feet, but there is minimal development adjacent to recharge and groundwater levels will decline outside of the recharge basin);
- Mojave River Mainstem: Very Low (potential to raise groundwater levels to within 40 to 50 feet from ground surface in the floodplain aquifer immediately adjacent to the river).

<u>Short-term declines in groundwater levels during extraction:</u> For the Minimum Facilities Alternative, groundwater extraction will be balanced . No adverse impact is anticipated.

<u>Impacts related to damage to facilities:</u> For the Minimum Facilities Alternative, new facilities at Newberry Springs will be in an agricultural matrix and a low seismic hazard area, with only a few residences within 0.25 miles of the facility. Levee failure is unlikely and water leaking from a failed levee would be carried away from the site on local roads and spread rapidly across the flat plain, and percolate into the ground. Potential for adverse impact is low.

<u>Soil erosion from high winds:</u> As noted above, recharge basins have been found to trap blowing sediments. No impact from soil erosion is anticipated.

<u>Soil erosion in Unnamed Wash</u>. Although the Proposed Project in Unnamed Wash would include construction of several drop structures to reduce potential erosion in areas where such erosion may be high, it is probable that routine flow of up to 500 cfs will result in an incised channel in this wash. There would be short term sediment mobilization as this channel formed and this sediment would recruit to the Mainstem Mojave River. Erosion control with drop structures would limit sediment recruitment by limiting flow velocities in steep sections of the wash. It is not possible to precisely estimate the channel configuration, but the existing wash is subject to periodic high flows and flows following the natural contour of the wash. Exposed soils would be a mix of sands, gravels, and cobbles typical of soils in desert wash environments. Mobilization of fines would be minimal.

<u>Erosion during construction:</u> Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.2.3 Small Projects Alternative

Liquefaction: The Small Projects Alternative adds off-stream recharge capacity along the Mojave River and at three sites in the Regional Aquifer. Off-Channel Mojave River Recharge may contribute to groundwater flow in the Mojave River Floodplain Aquifer, but total recharge of this aquifer will be managed to control groundwater levels. Use of this recharge basin would not, therefore, affect the proposed management of groundwater levels in the Mainstem Mojave River. Recharge sites in the Regional Aquifer will contribute to raising groundwater levels, but groundwater will remain substantially below 100-400 feet. No liquefaction effects are anticipated.

Short-term declines in groundwater levels during extraction:

The recharge of the Regional Aquifer in the Hesperia Area may allow for some direct return of water from existing City of Hesperia wells, in lieu of supply from wells along the California Aqueduct. To the extent that this is feasible, the Small Projects Alternative would reduce potential for localized declines in well levels.

Impacts related to damage to facilities:

Damage to all of the recharge facilities proposed for the Small Projects Alternative except the facility at Cedar Avenue would result in discharge to an existing wash or directly into the Mojave River. Drainage from potential recharge would therefore be contained in existing watercourses. At Cedar Avenue, the recharge basin would be designed primarily for flood control purposes and only incidentally for recharge. This facility would be designed to withstand anticipated seismic forces during a flood condition. Failure during recharge, when only a fraction of its capacity may be in use, is therefore highly unlikely. No adverse impact is anticipated.

Soil erosion from high winds: As noted above, recharge basins have been found to trap blowing sediments. No impact from soil erosion is anticipated.

Erosion during construction: Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.2.4 Large Projects Alternative

Liquefaction: The Large Projects Alternative would add up to 580 acres of Regional Aquifer recharge capacity to the Proposed Project, in areas with existing groundwater levels 400 to 600 feet below ground surface. Recharge is not expected to increase groundwater levels to a point at which liquefaction becomes an issue. No impacts are anticipated. The use of the unnamed wash to deliver water to the Mojave River would not affect the basic water in/water out balance described for the Minimum Facilities Alternative and thus the Large Projects Alternative would not change potential for liquefaction on the Mainstem Mojave River.

Short-term declines in groundwater levels during extraction: The Large Projects Alternative would substantially increase storage and extraction capacity in the vicinity of the California Aqueduct. Direct pump back from these facilities would occur after recharge, with wells sited downslope from the recharge sites to intercept the mound of water moving towards them. Some short-term reductions in groundwater levels may occur where the wells intercept groundwater, but these levels would recover as the mounded groundwater migrated into the resulting cones of depression. No impacts are anticipated.

Impacts related to damage to facilities: Large Project Facilities north of the California Aqueduct would be sited in areas with sparse development. Given their potential size and capacity, failure of the levees during a seismic event, while not anticipated, would result in some erosive flow in the immediate vicinity of the levee break and sheet flow across the broad, flat valley. Water escaping from damaged recharge basins in the Antelope Wash would be fully contained in this broad wash and much of any release would percolate into the ground before reaching the proposed City of Hesperia flood detention basin at Ranchero Road. No impacts are anticipated.

Soil erosion from high winds: As noted above, recharge basins have been found to trap blowing sediments. No impact from soil erosion is anticipated.

Erosion during construction: Erosion as a result of precipitation and runoff from the construction site would be infrequent, but there is a potential for such erosion associated with all facilities to be constructed.

5.6.3 General Operational Effects

Groundwater levels at all recharge sites will initially rise as a result of the Proposed Project because MWA would return at least a portion of banked supplies via exchange and all banking deliveries will result in at least a 5% increase in net supply. Rises in groundwater levels will generally be greater as the magnitude of the project increases. In addition, if expanded facilities allow MWA to import more water from, for example, SWP Article 21 supplies, then pre-delivery of this water will raise water levels. The exception to this generality is the Instream Mojave River Recharge element of the Minimum Facilities Alternative which will have a maximum recharge and this recharge will be balanced by extractions.

It is not possible to predict the rise in groundwater because banking and exchange supplies will be variable and will be distributed to up to 13 recharge areas. MWA will generally try to match banking deliveries and pre-deliveries of its own supplies to the imported water needs of various subareas, pre-delivering water that may be utilized in lieu of SWP deliveries in dry years. Groundwater will mound beneath groundwater basins and be extracted on a routine basis by subarea producers. The effects of recharge are thus likely to be small and limited to the vicinity of the recharge site.

Although well fields will be located near recharge areas, there may be short term imbalances in recharge and extraction at specific sites. Underground movement of water, while generally understood due to the general flow from the mountains north and towards the Mojave River, may vary in rate, and thus there may be irregularities in groundwater depth across a general gradient. Groundwater levels in individual wells may vary and some local lowering of groundwater levels is possible.

No erosion is anticipated due to releases from Silverwood Lake, as the pilot project showed that flows of 500 cfs are contained within the existing channel and do not result in velocities adequate to remove in-channel vegetation. Erosion will occur in Unnamed Wash as more frequent and longer duration flows are released from the California Aqueduct. This erosion will be concentrated in the early period of operation as the streambed reaches equilibrium. Thereafter, flows of 500 cfs will be contained in the channel and there will be sediment recruitment and transport typical of a reasonable stable stream.

Potential for liquefaction is limited to the Mainstem Mojave River, where routine recharge/extraction of about 48,000/44,000 acre-feet (respectively) will mean that groundwater levels will below the 20-foot level determined by Bookman-Edmonston (2003a) to result from recharge of about 61,000 acre-feet. Increasing the magnitude of the program through exchanges or increases in other facilities will not affect this potential.

5.6.4 Mitigation and Significance of Impacts after Mitigation

5.6.4.1 Under CEQA, the Proposed Project would be considered to have significant effects related to geology and soils if activities were to:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: a) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42; b) Strong seismic ground shaking; c) Seismic-related ground failure, including liquefaction; or d) Landslides;
- Substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property; or
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

As noted in the above analysis, the Proposed Project has limited mechanisms for potential to cause significant effects. Any potential Proposed Project effects are limited to (a) liquefaction, (b) short-term declines in groundwater, (c) impacts related to damage of facilities, (d) soil erosion from high winds, (e) erosion in Unnamed Wash, and erosion during construction. Mitigation for these effects and significance of effects with mitigation implemented is discussed, by mechanism for effect, below.

5.6.4.2 Liquefaction

There is a low potential for operation of the Mainstem Mojave River recharge to increase risks associated with liquefaction in the floodplain immediately adjacent to the river. To reduce this risk, MWA will monitor existing well levels and establish an additional system of shallow monitoring wells to track changes in groundwater levels as the mound of recharged water moves downstream to the extraction well field. These wells will allow real-time management of recharge rates to minimize the potential for groundwater levels under developed areas to rise to within 30 feet of the surface. Similar monitoring will occur at Lenwood and Hodge to ensure that recharge at these sites does not result in high groundwater levels. With this mitigation measure, the potential for the project to increase risks associated with liquefaction is less-than-significant.

5.6.3.3 Short-term declines in groundwater levels during extraction

Proposed Project facilities will be operated and monitored to ensure that groundwater levels are not adversely affected by the project. For the banking element of the Proposed Project, banked water will always be in excess of returns to Metropolitan. The exchange element of the Proposed Project involves exchanges of SWP supplies that are not recharged and will have no effect on groundwater levels. There may be localized effects on groundwater levels during extraction of supplies for direct return of groundwater to Metropolitan and/or as a result of local subarea producers pumping differentially from one well or another. Water mounded at recharge sites may also not move towards the intercepting well field at a uniform rate, and extractions may create localized declines in groundwater levels as a result. This may cause water levels for adjacent wells to decline. If MWA determines that its operations have adversely affected groundwater levels in an adjacent well, it will either (a) compensate the owner of the well for increased energy costs associated with pumping or (b) reduce extractions so that groundwater levels recover to baseline conditions.

5.6.4.4 Impacts related to damage to facilities

Although the potential for impacts related to damage from facility failure during a seismic event is low, there is some potential for erosive flows affecting properties immediately adjacent to MWA recharge basins. It is not feasible to predict where seismic-related damage might occur. MWA will maintain a stockpile of rock at each recharge facility where levee damage might result in minor flooding of adjacent property to ensure that any levee damage can be rapidly patched to reduce potential for erosive flows.

5.6.4.5 Soil erosion from high winds

No effects related to wind-driven soil erosion are anticipated and no mitigation is proposed.

5.6.4.6 Erosion in Unnamed Wash

Drop structures will be constructed as part of the Proposed Project to reduce excess erosion and sediment transport. Levees will be placed along the edge of the 100-year floodplain to contain releases.

5.6.4.7 Erosion during construction

To mitigate for the potential for soil erosion from construction sites, MWA has incorporated best management practices for water quality (see Section 4.5.8) into the Proposed Project. Implementation of this mitigation protocol would reduce potential for erosion associated with construction to a level of less-than-significant.

No significant impacts associated with geological conditions and geologic hazards are anticipated in Antelope Wash at either the upstream recharge site or the Ranchero Road recharge site. Normal flows would be routed through the recharge basins and would not be captured for natural recharge. Expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to geology and soils.

5.6.5 Summary Comparison of Alternative Impacts

There is potential for soil erosion from both wind and runoff of precipitation associated with all elements of construction; this potential increases with the total area affected by construction. Potential for liquefaction effects associated with rising groundwater levels is low and limited to the use of the Mainstem Mojave River; few structures are located on the alluvial soils immediately adjacent to the river channel due to flooding concerns and thus the number of structures potentially subject to liquefaction is small. There will be soil erosion and sediment recruitment to the Mainstem Mojave River associated with use of Unnamed Wash to convey SWP supplies to the river. This erosion will be a function of channel building during the initial use of the wash and should reach a dynamic equilibrium following several years of channel use. Erosion will be minimized with rock drop structures where the channel is steep. With proposed mitigations, the construction and operation of the potential facilities for the Proposed Project would not have significant effects related to geology and soils.

5.6.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of

the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.
The No Project Alternative would initially result in lower levels of recharge into all recharge areas because banking deliveries would not be added to the deliveries required of MWA to meet replacement water obligations. Groundwater levels would therefore remain more stable, neither rising as a result of banking nor declining as a result of direct return of banked water via pumping and delivery to the California Aqueduct. It is likely that in the short-term the No Project Alternative would result in generally lower groundwater levels in the Mojave River Aquifer and adjacent Regional Aquifer in the Alto subarea than under the various facilities alternatives. The small potential for liquefaction effects associated with mounding of water under recharge areas as a result of banking would not occur.

5.7 Hazards and Hazardous Materials

5.7.1 Environmental Setting

The 2004 PEIR identifies 9 known Superfund Contamination Sites in the MWA service area, all of them located in urban areas, mostly associated with military activity, mining, and cement manufacturing. In addition, the 2004 PEIR identifies sites of leaking fuel tanks, hazardous waste generators, and landfills that may affect groundwater. Again, these sites are associated with urban areas. None is in the vicinity of (or upslope of) proposed recharge and extraction facilities of the various Proposed Project Alternatives. Wastewater treatment plants (percolation ponds for local treatment plants) are located along the Mojave River. A July 2003 Regional Water Quality Control Board (LRWQMB 2001) list of impaired water bodies does not include surface water resources in the MWA service area.

5.7.2 Facilities and Operations Impacts

5.7.2.1 Mechanisms for Effect

The 2004 PEIR identifies several mechanisms by which the Proposed Project alternative facilities or operations could affect hazards and hazardous materials:

- Project construction could encounter soils during excavation that have been subject to contamination, including petroleum hydrocarbons, poly-chlorinated biphenols, pesticides, nitrates, and metals;
- Some project elements, such as pumping facilities, could involve storage and handling of hazardous materials, which could enter the environment during accidents. In addition, fuels storage and handling during construction could result in spills of fuels, and other hydrocarbon products. Construction-related hazardous materials handling and potential for adverse impacts increases with the acreage and duration of construction.; and
- Construction of many facilities, particularly pipelines and urban well fields, will occur within public road rights-of-way. As noted in the discussion of traffic, construction could

affect the movement of vehicles, including vehicles providing police, fire, and emergency service.

These effects increase as the magnitude of the banking and exchange program increases.

5.7.2.2 Minimum Facilities Alternative

The Minimum Facilities involves construction and operation of up to 25 wells along the Mojave River and would involve releases of SWP supplies from Silverwood Lake, the California Aqueduct down Unnamed Wash, and from the Morongo Basin Pipeline at the Rock Springs Outlet. The U.S. Environmental Protection Agency (USEPA 2004) has finalized a Groundwater Protection Rule which will require monitoring and management of groundwater extraction facilities. If facilities are found to have deficiencies (that is, high viral or bacterial counts), then corrective action is required. Local agencies have requested that MWA supply raw water to their facilities, where they will monitor water quality and treat water at their existing facilities. Thus, the Proposed Project does not specifically involve construction or operation of treatment facilities.

During construction of the Minimum Facilities Alternative pipelines, there is a possibility of excavation in areas with contaminated soils, particularly during construction along public rights-of-way in urban areas.

During construction of all facilities, there is potential for fuel and lubricant leaks and spills from construction equipment.

During construction in the public right-of-way, could result in minor traffic delays that could affect implementation of an emergency response plan or emergency evacuation plan,

5.7.2.3 Small Projects Alternative

The Small Projects Alternative adds recharge capacity to the Minimum Facilities Alternative, including additional pipelines to connect recharge areas to the California Aqueduct and existing MWA pipelines. Two of the recharge areas would be City of Hesperia flood detention basins; no hazardous materials occur at these sites. Two other detention basins are located in active washes. In these washes, which are subject to infrequent high flood flows, there is no residential or commercial development and no probable source of contamination. There is a potential for contaminated soils along the Mojave River where a pipeline would be constructed between the Morongo Basin Pipeline and a recharge basin to the south. Contaminated soil associated with an historic poultry operation may be encountered on the east side of the river. Contaminated soils associated with water treatment plant discharges to percolation ponds may be found on the west side of the river.

During construction of facilities, there is thus some potential for excavation of soils contaminated by past commercial and industrial activity. During construction of all facilities, there is potential for fuel and lubricant leaks and spills from construction equipment.

5.7.2.4 Large Projects Alternative

The Large Projects Alternative would add significant recharge capacity to the Proposed Project at three sites and provide for groundwater extraction by up to 25 wells. Development adjacent to these facility sites is sparse and there is minimal potential for these previously undeveloped lands to be contaminated. At Antelope Wash, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to hazards and hazardous materials.

5.7.3 Mitigation and Significance of Impacts after Mitigation

5.7.3.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant effects if activities:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials;
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;
- Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school;
- The project was located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment;
- For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area;
- For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area;
- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan;
- Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

The project does not involve routine transport of hazardous materials, will not involve storage of hazardous materials that may accidentally be released, does not involve emissions of toxic materials, will not affect airport operations, and will not cause conditions that could increase risks associated with wildland fires. The Proposed Project, by bringing water sources into new areas may enhance wildland fire fighting. Based on the above analysis, the Proposed Project's potential for significant impacts associated with hazards and hazardous materials is limited to: (a) construction-related excavations, (b) potential fuel and lubricant spills during construction, and (c) temporary interference with emergency response during construction.

5.7.3.2 Construction-Related Excavations

Review of the 2004 PEIR maps related to potential for hazardous materials sites indicated that there are no known hazardous materials sites in the Proposed Project area. Minor areas of soil contamination may be found during construction. Consistent with the 2004 PEIR, prior to construction all sites will be evaluated to identify past uses that may have resulted in soil contamination. If the site assessment identifies a potential for contaminated soils, MWA would conduct further analysis to confirm this finding and would either (a) redesign the area to avoid impacts or (b) remediate the contamination to meet Regional Water Quality Control Board standards. During construction of pipelines in areas that cannot be assessed prior to construction, MWA would provide for monitoring of excavated soils and construction contracts will specify monitoring procedures and proper procedures for reporting and responding to potentially contaminated soils. Excavated materials containing hazardous waste will be handled, transported, and disposed of in accordance with applicable regulations. With these mitigations, the potential for adverse impacts associated with excavation of facilities in areas with contaminated soils will be less-than-significant.

5.7.3.3 Potential Fuel and Lubricant Spills during Construction

The Proposed Project includes protocols for management of fuels and lubricants during construction. With these mitigations, the potential for adverse impacts associated with fuels and lubricant handling during construction will be less-than-significant.

5.7.3.4 Effects to Emergency Response Plans or Evacuation Plans

Project traffic management, including selection of a Well Field Pipeline alignment that minimizes potential for traffic delays, will reduce the potential for the project to affect emergency response plans or evacuation plans to a level of less than significant.

5.7.4 Summary Comparison of Alternative Impacts

All aspects of the Proposed Project that involve excavation have some potential for encountering contaminated soils and for construction-related fuel and lubricant spills. Construction in the public right-of-way may affect emergency response/evacuation in some areas. This potential increases marginally as the scope of construction increases. With proposed mitigation, all of the alternative facilities, individually or in combination, would have less-than-significant impacts.

5.7.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.
The No Project Alternative would delay construction of some facilities and the Mojave River Well Field and other pipelines would be reduced in total length. The result would be a small reduction in risk associated with excavation in areas where soils could be contaminated and where fuel and lubricant spills associated with construction could occur.

5.8. Land Use

5.8.1 Environmental Setting

The MWA service area is located in the western portion of San Bernardino County in the Desert Region. The southwestern portions of this region (Victor Valley subregion) have experienced annual population growth of 6% to 9% and concentrated along the I-15 corridor (California Department of Finance 2004). Lower growth rates have occurred in and around the City of Barstow (0.2% in 2003); this has been attributed to a shortage of potable water. Growth in the Morongo Basin has been greater in the town of Yucca Valley and adjacent Twenty-Nine Palms than in the Morongo Basin portions of the MWA service area. Since 1975, the pattern of growth has been a concentration of development and population within existing cities and towns, with some urban sprawl outside of city/town limits. As evidenced by recent reductions in water use for agriculture, agriculture is declining as development occurs. Since 1995, water use for agriculture in MWA's service area has declined from 54,400 acre-feet to 28,600 acre-feet in 2001 (MWA 2004a), indicating reductions in agricultural acreage. The Proposed Project will take place within the context of the County of San Bernardino General Plan, Victor Valley Subregional Planning Area and Barstow Subregional Planning Area; the general plans for the Cities of Victorville, Barstow, Adelanto, and Hesperia and Town of Apple Valley; the U.S. Bureau of Land Management California Desert Conservation Area Plan and the pending West Mojave Plan; and the California Department of Conservation's programs for the conservation of farmland.

5.8.2 Facilities Impacts

5.8.2.1 Mechanisms for Effect

The Proposed Project Facilities could have a potentially significant effect on land use if they:

- Conflicted with applicable city and county land use designations,
- Were located on important farmland or Williamson Act lands, and/or

- Were located on lands designated by Bureau of Land Management for other uses, particularly for sensitive species conservation under the BLM West Mojave Plan.

5.8.2.2 Minimum Facilities Alternative

Potential for Minimum Facilities Alternative land use impact is shown on Table 5-16 and discussed below.

Table 5-16. Potential land use impacts of Facilities for the Minimum Facilities Alternative

FACILITY	POTENTIAL EFFECTS ON LAND USE		
	Conflict with Land Use Designation?	**Agricultural Land Converted?**	**Conflict with BLM West Mojave Plan?**
Mojave River Berms	NO	NO	NO
Mojave River Well Field and Pipeline	NO	NO	NO
SWP Delivery via Unnamed Wash	NO	NO	NO

The construction of temporary sand berms in the mainstem Mojave River would have no impact on land use. The dry river bed is within the floodplain of the Mojave River. This reach of the Mainstem Mojave River, dry in almost all years, is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development).

The Mojave River well field and associated pipeline would be urban infrastructure, generally constructed in public rights of way. Wells would be constructed within commercial and residential areas, with a post construction footprint of approximately 15 x 15 feet each, resulting in conversion of about 5,000 square feet of land (0.11 acres) from commercial/residential to infrastructure. The General Plan for the City of Hesperia provides for integration of utilities and residential/commercial land uses, so the well-field will not have substantial impacts on existing or proposed land uses. No agricultural lands are located in the vicinity of the well field/pipelines. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development).

Use of the Unnamed Wash to deliver water from the California Aqueduct to the Mojave River would not directly affect land use, and on-going coordination between MWA, the City of Hesperia, and Rancho Las Flores, will ensure that conflicts with this planned development are minimized. Based on preliminary drawings prepared by Rancho Las Flores for their pending Environmental Impact Report, the drainage to be used would flow between a Town Center unit and adjacent housing and the lower drainage would be predominantly open space and an off-channel water treatment plant. At the downstream end of the wash, flow would be collected in an earthen intake structure and conveyed beneath Highway 173 (Arrowhead Lake Road) to flow between low levees across lands designated for development. Proposed levees would approximately follow the contour of the 100-year flood plain. Development within the 100-year floodplain is constrained by Federal Emergency Management Administration regulations and thus the use of the floodplain for water conveyance would not conflict with any local development plans. The development of an incised channel across the floodplain would probably reduce potential for sheet flow across the floodplain and would also provide an aesthetic resource for adjacent development. There would be no significant conflict with potential development use. The affected area is not agricultural nor identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the arroyo toad (which requires ponded water for eggs and larvae development).

5.8.2.3 Small Projects Alternative

Potential for Small Projects Alternative land use impact is shown on Table 5-17 and discussed below.

Table 5-17. Potential land use impacts of facilities for the Minimum Facilities Alternative and Small Projects Alternative

FACILITY	POTENTIAL EFFECTS ON LAND USE		
	Conflict w/Land Use Designation?	**Ag. Land Conversion?**	**Conflict w/ West Mojave Plan?**
Minimum Facilities Alternative			
Instream Mojave River Recharge	NO	NO	NO
Mojave River Well Field and Pipeline	NO	NO	NO
SWP Delivery via Unnamed Wash	NO	NO	NO
Small Projects Alternative			
Off-Channel Mojave River Recharge (East Site)	YES	NO	NO
Off-Channel Mojave River Recharge (West Site)	YES	NO	NO
Off-Channel Mojave River Recharge Pipelines	NO	NO	NO
Oro Grande Wash Recharge and Pipelines	NO	NO	NO
Cedar Avenue Detention Basin Recharge and Pipelines	NO	NO	NO
Antelope Wash Detention Basin Recharge (Ranchero Road) and Pipelines	NO	NO	NO

Off-stream recharge along the Mojave River at the potential east recharge site would be located on lands designated for a combination of agricultural and low-density residential uses. Approximately 100 total acres would be converted from these potential uses. Based on review of maps from the California Digital Conservation Atlas, it appears that about 60% of the site has been mapped as agricultural, the remainder is low-density residential. The Department of Conservation considers conversion of 100 acres of farmland to other uses to be an effect requiring an EIR to be prepared, but the CEQA significance of conversion is based on analysis of effects within the regional context. The east recharge site has been characterized during biological surveys as disturbed ruderal and disturbed Mojavean desert scrub. The actual use of the land is therefore no longer agricultural and its conversion to other uses would not, in fact, result in a loss of active agriculture in the MWA service area. There is no residential development on the site. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development).

The west site for this recharge would be located on land designated for open space. The site has been used for wastewater treatment in the past and use for recharge would thus not significantly alter land use. No recreational or new public uses are currently planned for the site. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development). The Proposed Project use would not conflict with past use or the primary open space value of the site, which is primarily preservation of scenic views from Arrowhead Lake Road. None of the other elements of the Small Projects Alternative would have land use effects for the following reasons:

- The pipeline between the Morongo Basin Pipeline and the recharge basin to the south would be constructed in existing public rights of way;
- The two recharge basins in existing wash areas are in flood-prone areas where no agriculture or development is designated;
- The recharge area at the proposed Cedar Avenue detention basin would make incidental use of a designated flood detention basin;
- None of the facilities is located in a conservation area under the West Mojave Plan.

5.8.2.4 Large Projects Alternative

The Large Projects Alternative adds recharge and extraction-well capacity to the Small Projects Alternative. Effects on land use are summarized on Table 5-18 and discussed below.

Recharge, wells, and pipelines at both the Oeste and Alto recharge areas would be constructed in areas designated for low density residential of the Victor Valley Subregional Planning Area, with conversion of 480 acres to public uses. There is currently sparse development in this area, which covers approximately 200 square miles west of Interstate 15. The Oeste and Alto recharge basins, in combination, would therefore affect about 0.005 percent of the developable land designated for low to medium density residential (and commercial) within the western portion of the Victor Valley Subregional Planning area. No designated farmland exists in this area, although some grazing occurs on undeveloped lands. The affected area is not identified as a conservation area for the West Mojave Plan and is not designated as critical habitat for the Arroyo Toad (which requires ponded water for eggs and larvae development). For Antelope Wash, the upstream recharge site and the Ranchero Road recharge site are located in public rights of way, and development is limited due to the potential for flooding in the wash. With implementation of best management practices for noise and other factors that could affect adjacent development, no land use impacts would occur. Expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to land use.

Table 5-18. Potential land use impacts of facilities for all Project Alternatives

FACILITY	POTENTIAL EFFECTS ON LAND USE		
	Conflict w/Land Use Designation?	**Ag. Land Conversion?**	**Conflict w/West Mojave Plan?**
Minimum Facilities Alternative			
Instream Mojave River Recharge	NO	NO	NO
Mojave River Well Field and Pipeline	NO	NO	NO
SWP Delivery via Unnamed Wash	NO	NO	NO
Small Projects Alternative			
Off-Channel Mojave River Recharge (East)	YES	NO	NO
Off-Channel Mojave River Recharge (West)	YES	NO	NO
Off-Channel Mojave River Recharge Pipelines	NO	NO	NO
Oro Grande Wash Recharge and Pipelines	NO	NO	NO
Cedar Avenue Detention Basin Recharge and Pipelines	NO	NO	NO
Antelope Wash Detention Basin Recharge (Ranchero Road) and Pipelines	NO	NO	NO
Large Projects Alternative			
Oeste Recharge and wells	YES (330 acres)	NO	NO
Alto Recharge and wells	YES (150 acres)	NO	NO
Antelope Wash Recharge	NO	NO	NO

5.8.3 Operational Impacts

5.8.3.1 Mechanisms for Effect

The operation and maintenance of recharge and associated facilities may have potential indirect effects on adjacent land use if they are perceived as incompatible with existing or proposed uses. Factors such as noise, visible fencing, and other aesthetic issues may affect the perceived incompatibility of such facilities. It is difficult to quantify these effects because there are both positive and negative aspects to each. Noise associated with intermittent operation and maintenance may be offset by reduced noise that would be associated with the development that would otherwise occur on the facility site. Visible fencing and levees may affect views at ground level, but this may be offset by the absence of housing or commercial development (which would have even greater effects on view). The net indirect effect of recharge basins and associated facilities on land use is thus not clear.

In areas where there are extensive recharge and conveyance facilities associated with water banking, such as Kern County, these facilities do not appear to be incompatible with development, and there is residential and commercial development along canals and along the exterior levees of recharge basins.

5.8.3.2 Operations Effects: All Alternatives

Except for underground pipelines, all of the proposed facilities may indirectly affect perceived compatibility with adjacent development. Experience with similar facilities in Kern County suggests that neither residential nor commercial development is significantly constrained, and that there are benefits as well as adverse effects associated with living adjacent to recharge facilities. No significant operational effects are therefore anticipated.

5.8.3.3 Operational effects related to project magnitude

Project magnitude affects the number and size of recharge facilities, but once such facilities have been constructed, the magnitude, frequency, and duration of recharge would not change land use impacts.

5.8.4 Mitigation and Significance of Impacts after Mitigation

5.8.4.1 Significance Thresholds

Under CEQA, the Proposed Project could be considered to have significant land use impacts if it:

- Physically divided an established community;
- Conflicted with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect; or
- Conflicted with any applicable habitat conservation plan or natural community conservation plan.

5.8.1.2 Mitigation and Significance after Mitigation

MWA has avoided conflicts between regional land use planning efforts (a) through siting of recharge basins and other facilities in areas that do not conflict with significant existing development and do not conflict with regional conservation planning, (b) by providing for multiple uses of planned flood detention facilities, and (c) by maximizing use of the recharge capacity of existing facilities and the Mainstem Mojave River as the basis for the Minimum Facilities Alternative, which is a baseline for the other Proposed Project alternatives. In addition, to further reduce potential land use impacts, MWA would:

- Continue to coordinate with Rancho Las Flores to ensure compatibility of the Unnamed Wash feature of the Minimum Facilities Alternative with the proposed development;
- Coordinate with city and town officials to develop methods to ensure long-term compatibility of recharge and associated facilities with development; and

- Design of facilities to minimize adverse indirect effects on noise, and other factors that may affect perceived incompatibility of such facilities with residential and commercial development.

None of the facilities requiring construction, nor their operation, is in conflict with regional conservation efforts, particularly the West Mojave Plan; none is sited in an area designated for conservation under that plan or has been designated as critical habitat for other species. None of the facilities affects active agricultural lands. The siting of recharge, along with mitigation to reduce conflicts of the proposed facilities with future development, would reduce land use impacts from all aspects of the Proposed Project to a level of less-than-significant.

5.8.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

To the extent that changes in land use occur in the vicinity of Proposed Project facilities (off-channel Mojave River recharge and recharge basins at Alto and Oeste), there is a greater potential for land use conflicts under the No Project Alternative, and re-siting in the context of future development would likely be complicated by changes in land use. The No Project Alternative therefore would not reduce impacts when compared to the Proposed Project.

5.9. Noise

5.9.1 Environmental Setting

Environmental noise for mobile sources such as construction equipment is regulated by state and federal agencies, which establish noise standards and technology for such equipment. Noise from stationary sources is generally regulated by local agencies. Noise from both sources is a potential CEQA issue for the Proposed Project. There are various methods for describing noise:

- A-weighted decibels (dBA): A direct measure of sound energy intensity, adjusted for the variation in frequency response of the human ear;
- Maximum noise level (L_{max}): The highest noise level measured in a given period;
- Energy-equivalent noise level (L_{min}): The average noise level over a given period;
- Day-Night noise level (DNL): A weighted noise level for a 24-hour period; and
- Community noise equivalent level (CNEL): Equal to DNL except that a 5 dBA adjustment is added to the night noise level.

Noise energy levels (dBA) decrease with distance from the source. For "line" sources such as traffic, noise levels decrease by 3 to 4.5 dBA for every doubling of the reference distance from the source. For stationary sources, noise reduction is 6.0 to 7.5 dBA for every doubling of the reference distance from the source. Thus, for example, if traffic noise is measured at 65 dBA at 50 feet, it will be reduced to 62 to 60.5 dBA at 100 feet. Noise levels are also affected by topography, structures, wind direction, and humidity. Noise regulations in the MWA service area vary by community (Table 5-19).

There have been a number of studies of construction noise levels. The 2004 PEIR cites EPA data from 1971, noting that typical construction activities generate noise of from 78 to 89 (L_{min}) at 50 feet. The National Park Service notes that typical noise levels from construction equipment range from 74 dBA to 89 dBA at 50 feet (NPS 2000).

A majority of these studies have been based on tests in the 1970's and 1980's, and there have been improvements in construction equipment noise management since then. A conservative estimate of potential for construction to exceed noise standards can be made using the 1971 EPA estimates, and projecting these estimated noise levels at 50, 100, 200, 400, and 800 feet:

- 50 feet: 78 dBA to 89 dBA
- 100 feet: 72 dBA to 83 dBA
- 200 feet: 66 dBA to 77 dBA
- 400 feet: 60 dBA to 71 dBA
- 800 feet 54 dBA to 65 dBA

Comparing estimated construction noise to the community noise standards on Table 5-19, construction noise will exceed all standards for nighttime even at 800 feet from the construction site, and will exceed most of the daytime standards for daytime at 800 feet as well.

Ambient noise levels along highway and major arterial corridors generally exceed community standards. The 2004 PEIR cites the Caltrans March 1980 Noise Manual in noting that noise levels in excess of 80 dBA are common in a noisy urban environment and that heavy traffic generates about 64 dBA at 300 feet (or about 75-80 dBA at 50 feet). Daytime construction noise in an urban commercial area will thus not be significantly greater than the ambient noise level.

Table 5-19. Noise regulations in portions of the MWA service area which may be affected by construction and operation of the Proposed Project (from local jurisdiction ordinances)

NOISE STANDARD	JURISDICTION				
	Adelanto	Apple Valley (may not exceed for more than 30 minutes in any hour)	Hesperia (may not exceed for more than 30 minutes in any hour)	Victorville (may not exceed for more than 30 minutes in any hour)	San Bernardino County
CNEL Residential Daytime	65	45	60	65	Construction equipment exempt from noise standards during daylight hours.
CNEL Residential Nighttime		40	55	55	
CNEL Multi-family Daytime		50			
CNEL Multi-family Nighttime		45			
CNEL Commercial Daytime	75	60-65	65 anytime	70 anytime	
CNEL Commercial Nighttime		55-60	65 anytime	70 anytime	
CNEL Light/heavy industrial		70/75 anytime	70 anytime	75 anytime	
CNEL Schools (exterior)					
CNEL Schools (interior)	60				
CNEL Libraries (max)	65				
CNEL Libraries (average)	40				
CNEL Hospital, nursing home (max)	55				
CNEL Hospital, nursing home (average)	45				
CNEL recreational areas (not quiet)	70				

5.9.2 Facilities Impacts

5.9.2.1 Mechanisms for Effect

Construction equipment will generate almost continuous noise levels of from 78 dBA to 89 dBA at 50 feet from the construction site, with lower noise levels at greater distances. The potential for each alternative to cause adverse noise impacts is summarized on Table 5-20 and discussed below.

Table 5-20. Summary of Potential Noise Impacts, All Alternatives.

FACILITY	DISTANCE TO NEAREST RECEPTOR (FEET)	ESTIMATED NOISE LEVEL AT RECEPTOR (dBL)	APPROXIMATE RESIDENCES AND BUSINESSES AFFECTED
Minimum Facilities Alternative			
Instream Mojave River Recharge	200	64-70	50 residences
Mojave River Well Field	50	78-89	100 residences
Well Field Delivery Pipelines	50	78-89	650+ residences and 100+ businesses
SWP Delivery Via Unnamed Wash	400	60-71	<10
Small Projects Alternative			
Off-channel Mojave River Recharge	400-600	54-71	<15 residences
Oro Grande Wash Recharge (both sites)	200	66-77	60+
Cedar Avenue Detention Basin Recharge	200	66-89	<40
Antelope Wash Detention Basin (Ranchero Road) Recharge	200	66-77	<30
Large Projects Alternative			
Alto Recharge and Pipelines	200	66-77	<10
Oeste Recharge and Pipeline	400	60-71	<5
Antelope Wash Recharge	2000	45-55	<60
	400	60-71	Airport

5.9.2.2 Minimum Facilities Alternative

The Minimum Facilities Alternative would involve construction of temporary sand berms in the Mainstem Mojave River for a period of several weeks in each year. This construction will be upstream of Rock Springs, and in areas where the Mojave River channel is from about 600 to 1000 feet to 2000 feet wide. Adjacent land use is sparse, with only about 50 residences within 100 feet of the river channel. Berm construction will be focused on the mid-channel area, and thus construction equipment will be moving back and forth across the river, in general more than 200 feet from adjacent development. Caterpillar D-7 or D-8 dozers will be used, which have peak noise levels of 82 dBA at 50 feet (US Department of Transportation, Federal Highway Administration). This construction will generate noise levels of 70 dBA when it is closest to adjacent development and on average about 64 dBA, equivalent to heavy traffic.

Construction of the Mojave River Well Field and Well Field Delivery Pipelines on the west side of the River will be in residential and commercial areas along Orchid Street and Eucalyptus Street from the Mojave River to Santa Fe with secondary pipelines extending from Orchid Street to wells along the river. The pipeline would then run along Santa Fe to Mesa Street, and follow the Mesa Street alignment to the California Aqueduct. On the east side of the river, the well field and pipelines will be located about 200-800 feet from the river channel, and then connect to several existing pipelines via short stubs off the pipeline connecting the various wells to one another. In most of these areas, construction will be within 50 feet of residential and or commercial development. This construction will generate noise levels typical for construction, approximately 78 to 89 dBA. Well Field Delivery Pipelines will affect all residences and businesses along a short portion of Eucalyptus Street (from Orchid to Santa Fe for about 2 miles) and then Mesa Street for the remaining 7-8 miles. There would be connecting pipelines along several side streets to existing local reservoir facilities. Based on site survey and review of recent (2004) aerial photographs, these roads have varying levels of development:

- From Orchid Street west to Santa Fe, Eucalyptus Street is residentially and commercially developed on both sides through about 2 miles of Hesperia. About 75 percent of the development in this zone is residential. Residential development is mixed with vacant lots and small commercial. With mixed development, some vacant lots, and frontage of about 100 feet per lot, construction of the Well Field Delivery Pipelines through this portion of Hesperia would affect about 100 residences, and about 20 businesses would be affected.
- For the final 7-8 miles of the pipeline down Santa Fe and then west along Mesa Street, there is residential development only to the north of Mesa Street, and only along about 50% of the road length is developed. Santa Fe Street has a railroad track along the west side of the street. Connecting pipelines to existing reservoir facilities would pass along north-south residential streets. Making the same assumptions as above, pipeline construction in this portion of the route would affect up to 100-200 residences and 20-30 businesses.
- Assuming construction of pipelines to connect various wells along Orchid Street, development is generally on the west of the street, where there are about 20 residences. On the east side of the street, there are about 10 residences.
- For the pipeline to serve Apple Valley, there is relatively sparse existing development in the first three miles, and road construction would affect approximately 50-60 residences and 10 businesses.

The inlet and small levees associated with SWP delivery via Unnamed Wash, would be constructed along the middle of the wash, within about 400 feet of 6 existing homes. Noise levels at these homes would be 60 dBA to 71dBA.

5.9.2.3 Small Projects Alternative

The Off-Channel Mojave River Recharge basins for the Small Projects Alternative would be constructed in areas with few residents. Regardless of whether an eastern site or a western site is selected, the nearest residence would be 400 to 600 feet from the construction site. Noise levels at these receptors would be 60 dBA to 71 dBA. Along the east pipeline (Deep Creek Road) construction would be approximately 800 feet from the nearest residence, resulting in noise levels at this receptor of 54 to 65 dBA. Along the west pipeline (Arrowhead Lake Road and Calpella Avenue) there is residential development along the bluffs overlooking the river about 30 feet above the river channel and about 1000 feet from the pipeline alignment and several residences along the river and about 200 feet from the pipeline alignments. Noise levels from construction would be above City of Hesperia thresholds only for the residences along the river channel.

At Oro Grande Wash, construction would occur below grade and within 200 feet of residential development where there is housing along the east bluffs of the wash south of the California Aqueduct. In this area, construction would generally be about 200 feet away from the development, generating noise levels of 66 dBA to 77 dBA. Additional construction would involve pushing up berms in the detention basin with a grader. Noise levels would be 66 dBA to 77 dBA at adjacent residences.

At the Cedar Avenue Detention Basin Recharge, the levees of the California Aqueduct would block noise to the north and east. On the south and west, there are several residences within 200 feet of the probable outer levee of the facility, and noise levels at these residences would be from 66dBA to 77 dBA. There is construction underway to the southwest, but this development adjoins the potential detention basin site at a corner. Noise levels at the corner would be in the 78 dBA to 89 dBA range, but would attenuate rapidly both west and south of this point of contact between the two projects.

At the Antelope Wash Detention Basin (Ranchero Road), construction of recharge facilities would not be undertaken until after the City of Hesperia had constructed the embankment for raising the road 30 feet above current grade. All construction following that would be within approximately 200 feet of existing housing on the bluffs above the wash. These receptors would be exposed to noise in the 66 dBA to 77 dBA range.

5.9.2.4 Large Projects Alternative

The two large recharge basins for the Large Projects Alternative are located in sparsely developed areas. At the Alto Recharge Basin site, there is scattered development adjacent to the smaller element of this recharge basin, with several houses within 200 feet of the outer levee. Noise levels would be approximately 66 dBA to 77 dBA for these receptors. At Oeste Recharge Basins, there are two residences about 400 feet from the east boundary of the potential recharge basin, where noise levels would be 60 dBA to 71 dBA.

The recharge basin in the Antelope Wash would be located to the east and south of the Hesperia Airport, and would be about 2000 feet from existing residences along the bluffs overlooking the wash. At this distance, noise from construction would be 45 dBA to 55 dBA. Airport users would be affected by construction noise, with noise at about 400 feet from some facilities estimated at 60 dBA to 71 dBA.

For all facilities of all alternatives, construction noise would be a temporary effect. For pipelines, the construction site will move at a rate of about 100 feet per working day and noise will thus affect a given residence or business along the pipeline route as construction moves past the site. At 100 feet per day, residents and businesses within 50 feet of the pipeline alignment would experience noise levels of 78-89 dBA for only one day, when construction was immediately in front of the residence or business. Noise levels in the range of 66 to 83 dBA would be experienced for about 4 days as construction moved to within 250 feet and moved away from the site by 250 feet. Similarly, noise levels from about 58 dBA to 70 dBA would be experienced for 4 additional days when construction was between 450 and 250 feet away from the residence or business. The remainder of the time, noise levels would be typical of ambient noise along a moderately busy street, from 54 to 65 dBA. For Antelope Wash, construction noise for recharge basin construction could be marginally higher at the expanded Ranchero Road site than at the upstream site. Relocation of the upstream recharge to the area downstream as described in Chapter 4, page 4-31 could marginally increase short-term noise impacts of the proposed project. MWA proposes best management practices that reduce these temporary noise impacts to a level of less-than significant. Given implementation of these best management practices, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to noise effects.

Noise associated with recharge basin construction would be more constant. Noise associated with well drilling would be experienced for about 15-20 working days.

5.9.3 Operational Impacts

5.9.3.1 Mechanisms for Effect

During operations, stationary facilities such as wells, pumps, and potential chloramination facilities would generate relatively constant noise. As noted in the Project Description, these facilities would be fully enclosed in locked buildings. These buildings would be designed to ensure that noise levels outside the buildings did not exceed 40 dBA at the site, or about 36 dBA at 50 feet. This is equivalent to the interior of a library. These facilities would therefore have no mechanism by which they could routinely generate adverse noise impacts.

Operation and maintenance of recharge facilities will involve periodic use of heavy equipment to remove fine sediments from the recharge basin cells and maintain and repair levees. A majority of this work would be undertaken within the outer levees, which would block and deflect noise. Routine levee inspection and maintenance traffic would have potential to cause short-term daytime noise effects for adjacent residents and businesses. Maintenance involving vegetation control (mowing and weed-whacking) would create short-term temporary disturbance.

5.9.3.2 Minimum Facilities Alternative

There are no facilities associated with the Minimum Facilities Alternative that would involve routine operation and maintenance involving construction. No operational noise impacts are anticipated.

5.9.3.3 Small Projects Alternative

There would be routine operational noise from maintenance and repair of all of the recharge basins for the Small Projects Alternative. Operations would affect receptors identified in the above analysis.

5.9.3.4 Large Projects Alternative

There would be routine operational noise from maintenance and repair of all of the recharge basins for the Large Projects Alternative. Operations would affect receptors identified in the above analysis.

5.9.3.5 Project magnitude and noise effects

The magnitude of deliveries will have no significant effect on project noise effects. Recharge activities do not generate significant noise. There is potential for some noise associated with releases to Unnamed Wash, but adjacent to development these releases will either flow down a constructed channel or be carried in a pipeline to the head of the wash, which will be in open space and several hundred yards from adjacent housing and commercial development. Noise effects from running water in Unnamed Wash will be insignificant.

5.9.4 Mitigation and Significance of Impacts after Mitigation

5.9.4.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant noise impacts if it resulted in:

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels;
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;
- For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels;
- For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

Based on the above analysis, potentially significant noise impacts associated with the Proposed Project are limited to construction-related activities. Mitigation measures and significance of these effects is discussed below.

5.9.4.2 Mitigation and Significance after Mitigation

To minimize noise impacts, MWA will restrict construction to daylight time periods consistent with local ordinances, which may also require time restrictions along major arterial roads to minimize traffic impacts during rush hours. Construction along roads in developed areas may therefore be practically limited to the period from 8:30 am to 4:30 pm.

For work within 400 feet of housing, MWA will require construction contractors to utilize available noise management technology (muffling) and to maintain noise suppression equipment on construction machinery to ensure that noise emissions are minimized at the source. Equipment not in use for more than 5 minutes will be turned off.

If pile driving equipment is necessary, pile holes will be pre-drilled if feasible and vibratory pile driving equipment will be used whenever possible.

MWA will require construction contractors to locate fixed construction equipment such as generators as far as possible from noise-sensitive receptors.

During construction of wells, pipelines, and associated facilities such as pump stations and chloramination facilities in areas where construction is within 400 feet of a residence or business, construction noise will be periodically monitored on site and at the residence or business. If noise levels are found to exceed those mandated by local ordinance, MWA will, to the extent feasible and in consultation with the resident or business, install temporary noise barriers along the boundary of the construction site to further reduce noise impacts. Barriers may be installed along the boundary of the construction zone or on private property, depending on conditions and the permission of the landowner/resident.

In addition, in areas where there are residences within 400 feet of construction, once construction areas for fixed location construction such as well drilling pads have been cleared and construction can commence, MWA will install temporary noise barriers around the construction site, to the extent feasible, to block noise transmission.

At recharge basin sites where there is adjacent development, MWA will initially construct outer levees along the boundary with adjacent development. This will allow construction of inner levees and basins behind a mound of earth, which will reduce noise levels for adjacent residents and businesses.

MWA will notify residents and noise-sensitive receptors in the affected areas several weeks in advance of operations that would generate noise in excess of local standards. Information distributed will describe the operations and duration of the project.
All stationary equipment will be designed, constructed, and operated to comply with all local noise ordinances.

The majority of potential noise impacts are associated with well-field and pipeline features of the Minimum Facilities Alternative, because these facilities will be constructed in an urban area. Other features of the various alternative facilities would have less potential to affect large numbers of people and to create exterior noise levels at residences, businesses, or public facilities that exceed local standards. Implementation of these noise management mitigations will reduce noise impacts of the project to less-than-significant.

5.9.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

In the short-term, the No Project Alternative could reduce the number of people affected by construction noise. However, if there is substantial development around sites where facilities would eventually be sited, then delay in construction could increase the number of people exposed to construction noise. At the same time, better noise management equipment may be anticipated for construction equipment. Since the effects of construction noise on future development are not predictable, and there are both potential benefits and impacts associated with deferring some construction, the No Project Alternative's effects on noise must be considered neutral when compared to the various facilities alternatives.

5.10 Public Services and Utilities

5.10.1 Environmental Setting

Routine public services are provided by a range of entities within MWA's service area (Table 5-21). As the table indicates, there are a number of joint powers authorities providing regional utility services. Water is supplied by local agencies, which rely on groundwater and on MWA supplies for replacement of pumped groundwater. MWA's conveyance facilities are linked to groundwater recharge areas that provide supply that may be tapped by local producers. There are no municipal hazardous waste facilities. MWA's service area is traversed by major interstate power and natural gas lines, which deliver electric power from eastern generation facilities and natural gas from major producers in the southwest. Emergency services are provided through police and fire departments, supplemented by private company ambulance services.

5.10.2 Facilities Impacts

5.10.2.1 Mechanisms for Effect

The Proposed Project construction and operation will not affect the level of public services required within MWA's service area. No changes in police, fire, or public emergency services will be caused by the construction or operation of facilities. Construction may generate some solid waste, particularly associated with drilling of wells and construction of pipelines. Pipeline alignments may cross through areas with buried soils contaminated by hazardous waste, and this hazardous waste would need to be contained and then disposed of at an appropriate facility. Recharge basins and canals do not tend to generate waste material because soil for their construction is excavated at the site and used in levee construction.

Construction of facilities may also involve excavation in areas with existing buried electric utility lines and pipelines (gas, petroleum, drinking water, sewage). There is some potential for excavations to adversely affect these facilities, causing temporary interruptions in service and the release of materials in pipelines.

5.10.2.2 Minimum Facilities Alternative

The Minimum Facilities Alternative will involve work in an urban setting, particularly the construction of wells and pipelines associated with the Mojave River Well Field element of the alternative. During planning, several alignments for the East-West delivery pipelines were explored, including Sycamore Road and Eucalyptus Road. At the suggestion of the City of Hesperia, Mesa Street was selected because of low levels of development, low traffic volumes, and the ability to route limited traffic around construction easily via local roads. This alignment will reduce the potential for interruptions of public services along major arterial roads through urban areas. Low levels of traffic along this route will mean that public service vehicles may pass readily along the route, even with one lane blocked by construction for about 200 linear feet per day. There is a low potential for interruption of major utilities and for excavation of hazardous wastes along these largely residential alignments.

Well construction, use of the Mojave River Mainstem, use of existing facilities, and construction of bridges, undercrossings, drop structures, and levees associated with use of Unnamed Wash will all involve work outside of the public right of way, except for construction under Arrowhead Lake Road. All can be accomplished without interrupting movement of public service vehicles.

Given the Mesa Street alignment for the Well Field Delivery Pipeline, the Minimum Facilities Alternative has a low potential to result in interruptions of essential public services. The Proposed Project also does not generate a need for additional public services.

Table 5-21. Public service providers in MWA's service area (MWA 2004b).

TYPE OF SERVICE	PROVIDER	JURISDICTION/AREA
POLICE	County of San Bernardino	Unincorporated areas, City of Hesperia, City of Victorville, Town of Yucca Valley, Apple Valley, Adelanto
	California Highway Patrol	State and Interstate highways
	City of Barstow	City of Barstow
FIRE	San Bernardino County Fire Department	Unincorporated areas
	California Department of Forestry and Fire Prevention	Wildland fires, City of Hesperia, Town of Yucca Valley,
	Victorville Fire Department	City of Victorville
	Hesperia Fire Protection District	City of Hesperia
	Regional Fire Protection Authority Apple Valley Fire Prevention District	Hesperia, Barstow, Victorville, Apple Valley, Lucerne Valley, Wrightwood, Adelanto, and Hinkley
	Barstow Fire Protection District	Barstow, Lenwood, Grandview, North Barstow, Barstow Heights
WASTEWATER TREATMENT	Victor Valley Wastewater Reclamation Authority	Victorville, County Sanitation Agencies 42 and 64, Apple Valley, Hesperia
	City of Barstow	City of Barstow
	Town of Yucca Valley	(None --all septic)
WATER	Mojave Water Agency	Entire Service Area
	Southern California Water Company	Barstow, Lucerne Valley, Apple Valley
	City of Hesperia Water Department	City of Hesperia
	Victor Valley Water District	City of Victorville
	City of Adelanto	City of Adelanto
	Baldy Mesa Water District	Unincorporated areas west of Hesperia
	Apple Valley Ranchos Water Company	Apple Valley
	High Desert Water District	Warren Valley, Town of Yucca Valley and unincorporated areas
	Joshua Basin Water District	Unincorporated areas
	County of San Bernardino	County Service Areas
	Numerous smaller water service districts such as Marina Ranchos, Thunderbird, and Apple Valley Foothill	Specific service areas
SOLID WASTE	Barstow Sanitary Landfill	Barstow and unincorporated areas
	Lenwood/Hinkley Landfill	Barstow and unincorporated areas
	City of Hesperia	City of Hesperia
	Mojave Desert Solid Waste Joint Powers Authority	City of Victorville
	Hi-Desert Disposal	Town of Yucca Valley and unincorporated areas

5.10.2.3 Small Projects Alternative

The facilities proposed for the Small Projects Alternative would be constructed outside of public roads. There would be no project effects to the delivery of public services. The Proposed Project also does not generate a need for additional public services.

5.10.2.4 Large Projects Alternative

The proposed facilities for the Large Projects Alternative are located in isolated areas and will involve construction outside of roads and highways. There would be no project effects to the delivery of public services at these sites. The Proposed Project also does not generate a need for additional public services. Expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to public services and utilities.

5.10.3 Operational Impacts

5.10.3.1 Mechanisms for Effect

Otherwise, the operation of recharge and conveyance facilities is not likely to affect the need for or delivery of public services, except when there is a need for pipeline or well maintenance or repair. The magnitude of water deliveries, or the type of banking program selected for implementation, will have no effect on public services as all releases will be contained in the facilities described.

The projects operations involve releases of large amounts of water into the Mojave River from Silverwood Lake and from the California Aqueduct. Releases from Silverwood Lake will remain within the river channel, as demonstrated by the 2003-2004 demonstration project, but may enhance flows past several local recreational areas from September 15 through February 15. Flows in the Mojave River will be monitored and managed to match extractions to inflow, but it is also probable that flows into the Narrows will increase marginally. The 10% loss factor applied to returns from banking will probably result in some recharged water passing through the Narrows. This additional flow, perhaps several thousand acre-feet per year will enhance the existing wildlife and recreation potential of this reach of the river. No new park or recreation facilities will be needed, but some enhancement of aquatic activities may be anticipated.

5.10.4 Mitigation and Significance of Impacts after Mitigation

5.10.4.1 Thresholds of Significance

Under CEQA, the Proposed Project would be considered to have significant impacts to public services if it:

- Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

Police protection
Schools
Parks
Other public facilities

Based on the analysis above, there is no mechanism by which the Proposed Project could have long-term effects on public services. Potential impacts are associated with potential traffic delays that could temporarily delay delivery of public services in areas where construction will occur with the public right-of-way. Mitigation for these effects, and significance after mitigation are discussed below.

5.10.4.2 Mitigation and Significance after Mitigation

The potential for significant public service effects for the Proposed Project facilities is limited to the Minimum Facilities Alternative, Well Field Delivery Pipeline, which may occupy one lane of local service roads through the City of Hesperia. All other construction will be in locations where impacts to the delivery of needed public services will not be affected by construction or long-term operation.

For the Well Field Delivery Pipeline system, MWA would implement traffic controls (as noted in the discussions of traffic and noise impacts). In addition, MWA would coordinate with providers of public services prior to initiating construction to ensure that police, fire, and emergency service providers were aware of the location of any construction activities in the public right of way. During construction in roads, this coordination would occur daily to precisely define the areas where traffic delays might occur. A majority of the potential public service impacts of the Proposed Project would be associated with one facility -- the Mojave River Well Field Delivery Pipelines. Other facilities would not have impacts on the delivery of public services. Implementation of traffic controls and coordination with providers of public services will reduce potential public service impacts of all alternative facilities to a level of less-than-significant.

5.10.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The No Project Alternative would reduce the intensity of construction and allow for construction of the Mojave River Well Field and Delivery Pipelines over a longer period of time (with a shorter pipeline), but it is likely that they would be constructed at some time in the future, given the high level of interest in this water management option. Development in the future could accommodate a construction schedule involving only one segment of pipeline at a time, reducing the potential for traffic-related delays of public services. At the same time, development along potential well-field and delivery-pipeline alignments may intensify if there is a substantive delay in facility development. Delay may therefore mean greater traffic congestion along the proposed pipeline alignments. The No Project Alternative therefore has potential to somewhat ameliorate potential traffic-related problems associated with construction of the pipelines, but might also result in greater problems associated with construction after additional development has occurred.

5.11 Recreation

5.11.1 Environmental Setting

A substantial portion of the MWA service area is in public ownership, with multi-use on Bureau of Land Management lands and recreational uses on Joshua Tree National Park. The Bureau of Land Management has 4 designated areas of intensive use (including off road vehicle use), 6 major wilderness areas, and large areas of general recreation access. Along the Mojave River, there are water-based recreation areas: Mojave Forks Regional Park, Mojave Narrows Regional Park, Hesperia Lake Park, and a number of smaller private recreational lakes. A number of golf courses are located in or near urban areas. Regional parks are supplemented by local-community parks and recreation facilities such as swimming pools, tennis courts, and areas for field sports.

5.11.2 Facilities and Operations Impacts

5.11.2.1 Mechanisms for Effect

The Proposed Project facilities do not create a demand for new or expanded recreation. No new recreation facilities would be required.

Only the west site for the Off-Channel Mojave River Recharge would sited near existing recreation facilities (a recreational lake). A corner of the recharge basin would be about 250 to 300 feet from the south end of the recreation lake, and would not affect access to or use of the lake. Recharge basin construction and operation would have no effects on recreation. Pipeline and well construction in the vicinity of urban parks may create short-term disturbance and reduce access to park facilities for a brief period of time. Operation of wells and buried facilities would not affect recreation. Facilities have been sited in a manner that avoids the conversion of recreation lands to other purposes. Wells and delivery pipelines for the Mojave River Well Field element of the Minimum Facilities Alternative will be sited to minimize potential construction and operation effects on recreation on the east side of the river (trout ponds and the Jess Ranch Country Club.

The operation of recharge involving delivery of water from Silverwood Lake via the West Fork of the Mojave River (September 15 through February 15) could affect recreation at private and public recreation facilities along the West Fork of the Mojave River. Additional late-summer and winter flow may adversely affect some activities by increasing flow rates and depth and enhance others via the same mechanism. Casual swimming and fishing may be affected due to higher flows.

At Unnamed Wash, releases from the California Aqueduct will generally enhance the recreation potential of this wash, which has been designated as open space in the Rancho Las Flores planning documents. Recreation use of this open space may be designed around the wash, and bridges and drop structures may create opportunities for people to enjoy a desert wash habitat.

Neither development of recharge facilities at the upstream recharge site or the Ranchero Road recharge site would have effects on recreation. Thus, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would therefore have no effect on proposed project impacts related to recreation.

5.11.3 Mitigation and Significance of Impacts after Mitigation

5.11.3.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant impacts to recreation if it:

- Would increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated; or
- Include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?

No aspect of the Proposed Project would have these potential effects. However, MWA recognizes that its activities may affect recreational activities in the West Fork of the Mojave River during construction and operation. The magnitude of deliveries under various operations scenarios may affect the duration of recreation effects. MWA therefore addresses mitigation of these potential effects on recreation below.

5.11.3.2 Mitigation and Significance after Mitigation

As was done during the 2003-2004 demonstration project, MWA will notify recreation providers along the West Fork of the Mojave River when deliveries from Silverwood Lake will be made and will ramp such deliveries up in 50-cfs increments to avoid sudden increases in downstream. A similar program will be developed for deliveries made via Unnamed Wash. MWA will coordinate siting of the potential Mojave River Well Field and associated facilities with local governments and the owners of private local facilities to minimize the effects of wells and pipelines on recreational activities along the river in this area (Bear Valley Road to Rock Springs). With these mitigations, the effects of the Proposed Project facilities and operations on recreation would be less-than-significant.

5.11.4 Summary Comparison of Alternative Impacts

None of the facilities proposed for the various alternatives would increase demand for recreation or otherwise require changes to existing or planned recreation development. There may be minor impacts to recreation facilities on the east side of the Mojave River in the vicinity of the Jess Ranch County Club and local trout ponds.

5.11.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The No Project Alternative would probably not avoid impacts to recreation in the vicinity of the Mojave River Well Field, which would probably be constructed at some level at a future date. If recreation were expanded in this area prior to construction of these facilities, a not unlikely event considering the rapid projected growth on both sides of the river which will increase demand for recreation, then potential future project effects on recreation could be greater. The level of future effects under the No Project Alternative are thus potentially lower and potentially higher, depending on the scope and timing of recreation and water project development.

5.12 Traffic

5.12.1 Environmental Setting

Except in the cities and towns, traffic is sparse on all roads except the major highway system. Average daily traffic on Interstate 15, which links the Los Angeles Basin to Las Vegas, ranges from 38,000 to 115,000. Subtracting truck traffic and assuming an average of two passengers per car, this volume of traffic represents about 20% to 70% of the population of MWA's service area. Much of the traffic on the major highways is thus commute traffic to major cities and through traffic involving non-residents.

Like many rapidly developing urban-suburban areas, the Victor Valley area, and to a lesser extent Barstow, are experiencing traffic congestion as a result of rapid development. As an example, average Daily Traffic on State Highway 18 through Apple Valley is approximately 33,000 to 43,000 cars per day. Peak traffic hours account for a majority of this traffic (CalTrans 2004). Weekday traffic on major arterials such as Bear Valley Road and Apple Valley Road is characterized by a morning and evening rush hour with substantial delays at controlled intersections and through commercial areas. Accordingly, there are a number of highway projects underway or planned in Hesperia, Victorville, Adelanto, and Apple Valley.

5.12.2 Facilities Impacts

5.12.2.1 Mechanisms for Effect

Traffic to and from construction sites would add 15-30 one-way rush-hour trips per project to the local road system. In addition, delivery of water to remote construction sites would involve several highway water trucks operating on a constant basis daily. There would be traffic associated with hauling construction equipment to construction sites. The level of traffic impact associated with construction traffic would depend on how many project facilities were being constructed at a given time.

The primary construction-related traffic impact would occur for construction of pipelines within local roads. This would generally involve construction in a single lane, with traffic controls in effect on other lanes. On two-lane roads, one lane would be blocked and traffic control would involve (a) alternating delay in one direction while traffic from the other direction is allowed to pass or (b detouring traffic around the construction site. With either approach, delay would generally be brief, as the construction zone will be from 200 to 300 feet at maximum; the maximum detour distance would be several blocks, resulting in a delay of not more than one minute. On four-lane roads, traffic in one lane would be blocked, leaving three active lanes. Traffic control under these circumstances would generally involve alternating the available lanes to accommodate rush-hour traffic, with two lanes open in the predominant rush hour direction.

5.12.2.2 Minimum Facilities Alternative

The Minimum Facilities Alternative would involve construction at three sites: (a) the Mojave River Well Field, (b) Well Field Delivery Pipelines, and the Unnamed Wash.

On the west side of the Mojave River, the Mojave River Well Field and Delivery Pipelines would involve construction along Carob and Orchid Avenue in Hesperia and along Jess Ranch Parkway and across undeveloped lands to the south of the Jess Ranch Country Club. There is also potential well construction along the undeveloped portion of the floodplain downslope from Orchid Street and south along Wilson Road. Wells along Wilson Road would be connected to the main well-field pipeline along Orchid Ave via Talisman Street. From Orchid Street, the Well Field Delivery Pipeline would run west along Eucalyptus Street to Santa Fe and then turn south to Mesa Street. The Mesa Street alignment would then be followed under Interstate 15, and continue west to connect to the California Aqueduct.

There will be four side lines from Eucalyptus Street and Mesa Street to (a) County Service Facility 64 (via Santa Fe), (b) Victor Valley Water District Reservoirs via Pinion Street, (c) Victor Valley Water District reservoirs via Amethyst Street, and (d) Hesperia Plant 14.

Talisman Street, Carob Avenue, Orchid Street, Wilson Road, Pinion Street and Amethyst Street are two-lane local streets with traffic serving local neighborhoods. Alternative access to neighborhoods served by these streets is (respectively) via Peach Avenue, Jacaranda Street, Lemon Street and Peach Avenue, and Sycamore Street. In this area, traffic delay would affect few people, because alternative routes through the neighborhood are readily available, requiring drivers to make short detours through local streets. No arterial roads would be affected. Eucalyptus Street is an east-west local road, with limited access and a few segments of unpaved road. On Eucalyptus, there is alternative internal neighborhood access via Sycamore Street and local traffic may also be diverted around the pipeline construction area, with no lane controls required. When the pipeline transitions to Mesa Street, levels of traffic decline. Mesa Street carries local traffic and was recommended by City of Hesperia officials primarily for this reason. On the east side of the well field, well and pipeline construction would run along the west and south side of Jess Ranch Parkway, a local road that serves a country club. Wells and pipelines would then approximately follow the alignment of Apple Valley Road along the west side of the country club and cross undeveloped land to the terminus of Tussing Ranch Road.

Impact to traffic associated with the Mojave River Well Field and associated Well Field Delivery Pipelines would be:

- Temporary and minor delays to local neighborhood traffic, for which there are alternative travel routes;
- 1 day delays associated with construction in front of individual residences, during which time resident access to driveways may be reduced and on-street parking will be limited to one side of the street. These delays will occur only during daylight construction hours.
- Temporary minor increases in traffic on roads used by local traffic as detours around the construction zone.
- The addition of 15-30 cars per day to the local road system (for construction traffic) and traffic associated with hauling equipment to the various construction sites. The probable main arterials used to access the local road system would Bear Valley Road and Peach Avenue. The addition of traffic to Bear Valley Road in rush hour could contribute to traffic congestion, but this arterial carries thousands of cars per day, and thus the addition of construction traffic is likely to have only a minor effect, probably within the rage of variability in daily traffic.
- The addition of from 5 to 10 dump trucks per day to local road traffic for hauling spoil away from pipeline and well construction areas.
- Increased construction crew and equipment hauling traffic on access roads for the facilities at the Unnamed Wash (via Arrowhead Lake Road).

Because the Mojave River Well Field and the Well Field Delivery Pipelines have been sited to (a) minimize pipeline length and (b) avoid major arterial roads, traffic impacts will be limited in time and scope. Well construction will result in local drivers having to divert around the well site for no more than about 30 days. Access to homes and driveways will not be blocked. Pipeline construction will affect only a 300-400 foot long section of road at any given time, and the duration of traffic impacts for any given site will be 3-4 days.

Operation and inspection of facilities once constructed will involve routine water quality monitoring and inspection of wells. A Pump Station on undeveloped land at the east end of Eucalyptus Street will be visited by staff daily. Traffic generated by this level of routine work will amount to not more than 10 daily trips along the pipeline alignments.

5.12.2.3 Small Projects Alternative

The Small Projects Alternative will generate construction related traffic, including hauling of construction equipment to the site, along the following routes:

- For the Off-Channel Mojave River Recharge and Pipelines: (West Alignment) Arrowhead Lake Road and arterial roads leading to it (Bear Valley Road and Rock Springs Road); (East Alignment) Deep Creek Road and arterial roads leading to it (Rock Springs Road).
- For Oro Grande Wash: Main-Street/Phelan Road and arterial roads leading to it.
- For Cedar Avenue Detention Basin: Escondido Street and Cedar Avenue
- For Antelope Wash at Ranchero Road: Ranchero Road

Major arterial access to these sites will vary by facility, and for construction-related traffic increases, even simultaneous construction of all Small Projects Alternative facilities would result in construction traffic increases of only 20-30 trips per day to each site, with access via a variety of arterials. This would represent a fraction of the traffic carried by the major north-south and east-west arterials.

Except for the roads leading to Off-Channel Mojave River Recharge, construction itself will not affect traffic, except that (a) off-highway construction vehicles such as water trucks and (b) construction crews will enter the road and may cause momentary delay during construction hours.

Construction delays along the alignment of the pipeline for the west site for Off-Channel Mojave River Recharge would be (a) brief delay along Glendale and Calpella roads (because there are alternative local roads into and out of the area and detours around construction will involve delay of about 1 minute) and (b) moderate delays along Arrowhead Lake Road (because construction will generally be feasible in the public right of way along the road, and construction in the road will be minimized). Some delay due to driver curiosity may occur. Detouring around Arrowhead Lake Road is not feasible in the affected reach.

Traffic impacts associated with the east site for the Off-Channel Mojave River Recharge would occur along Deep Creek Road, which is primarily used by local traffic and does not carry significant traffic during weekday hours. There is no convenient detour via paved roads. Use of Deep Creek Road for pipeline construction will therefore involve traffic delay associated with traffic control. Delays of up to several minutes are possible.

Operations of all Small Projects Facilities would involve routine inspection and maintenance as well as management of several recharge facilities. This would involve daily/weekly routine access to these sites. Traffic generated by this level of routine work will amount to approximately 20 daily trips along the pipeline alignments and to the 4 recharge basins.

5.12.2.4 Large Projects Alternative

The Large Projects Alternative involves off-road work at three relatively remote locations. The traffic-related effects of this work would be:

- Increased construction crew and equipment hauling traffic on access roads for the Oeste and Alto Recharge Basins and Pipelines (Highway 18);
- Increased construction crew and equipment hauling traffic on access roads for the Antelope Wash Recharge (via Ranchero Road);

The addition of construction traffic on Highway 18 could cause short delays on this busy arterial.

At Antelope Wash, the construction and operation of recharge basins would not involve work in the public roads, and only about 20-30 trips per day per facility are likely to occur. The probable access to both the upstream recharge site and the Ranchero Road recharge site is Ranchero Road and the dirt road running along MWA's Mojave River Pipeline alignment. Given similar patterns of access, no substantial change in traffic related to commuting construction crews and hauling of construction equipment to and from the site would occur as a result of relocating upstream recharge capacity to a downstream recharge site as described in Chapter 4.

5.12.3 Operations Effects

Operations will have very small effects on traffic. Routine operations traffic associated with personnel commuting to work would add 2-5 trips per day on any given road. There will be infrequent movement of maintenance equipment between sites, but this is likely to result in addition of 1-2 vehicles per move and to occur infrequently. Operational traffic will probably increase marginally as the magnitude of the banking and exchange program increases. None of these increases would result in significant traffic effects.

5.12.4 Mitigation and Significance of Impacts after Mitigation

5.12.4.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant traffic effects if activities were to:

- Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections);
- Exceed, either individually or cumulatively, a level of service standard established by the

county congestion management agency for designated roads or highways;

- Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks;
- Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment);
- Result in inadequate emergency access;
- Result in inadequate parking capacity;
- Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?

The project has no mechanism for causing effects related to parking, hazards related to road design; alternative transportation plans or programs, or air traffic patterns. Its effects are only related to short-term impacts on traffic as a result of construction crews and equipment hauling and to work in the public right-of-way.

5.12.4.2 Mitigation and Significance after Mitigation

To minimize potential traffic effects associated with construction and operation of facilities, MWA will comply with all local encroachment permit requirements. In addition, MWA will:

- Schedule hauling of construction equipment (and water, if feasible) to and from the various construction sites prior to or following rush hours;
- Use off-road rights-of-way (road shoulders and sidewalks) for construction to the extent feasible;
- Encourage construction crews to carpool to construction sites;
- Identify and clearly mark emergency access routes around sites where construction takes place within the public right-of-way;
- On a daily basis, inform local emergency services of the location of all sites involving construction in the public right-of-way; and
- If the Minimum Facilities Alternative pipeline for delivery from the Mojave River Well Field is implemented, it will be installed under Interstate 15 using directional drilling or "jack and bore" techniques.

Because construction crew traffic and long-term operations traffic will represent a minor fraction of total traffic on access roads to the proposed facilities, because traffic may be detoured around a majority of the construction sites which are in or adjacent to public roads, impact associated with most elements of the Proposed Project would be considered less-than-significant before mitigation. With implementation of the above mitigation measures, including compliance with terms and conditions of road encroachment regulations and rules, all of the elements of the proposed project would have traffic impacts considered less-than-significant.

5.12.5 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA.

The effect of the No Project Alternative on construction-related and operations-related traffic is likely to vary, depending on the level of facility development pursued under the No Project Alternative and the timing of this development. An extended period of water recharge and conveyance facility development would reduce traffic impacts because they could be spread out over a longer period of time. At the same time, probable increases in development over this time will result in greater traffic congestion. It is probable that traffic impacts associated with future development of some of the facilities proposed would be approximately the same as those for the Proposed Project, and after mitigation would be less-than-significant.

5.13 Water Resources (Water Quality)

5.13.1 Environmental Setting

Surface water supplies in the MWA service area are unreliable and water users in the MWA service area rely on groundwater for agricultural, residential, and commercial/industrial use. Treatment facilities for surface water supplies are not available and therefore MWA delivers supplemental supplies as surface water to only two power plants, which utilize supply for cooling. Other supplies must be recharged and subsequently extracted.

Under the 1996 Adjudication, MWA functions to provide supplemental water to producers who require additional supplies to offset their production in excess of that allowed under the adjudication. By 2020 to 2025, MWA projects that it will, on average, utilize its entire SWP Table A allocation to meet these requirements.

Under current operations, MWA has limited flexibility in managing its SWP Table A allocations and other available water. It has limited recharge capacity, in part because there is an effective limit of about 60,000 acre-feet of recharge on the Mainstem Mojave River unless some of this recharge is subsequently extracted before passing through the Narrows. In addition, MWA has limited financial capacity to pre-delivery groundwater. Thus, MWA does not currently take all of its SWP Table A supplies.

Current water use practices have the effect of concentrating minerals in soils and groundwater. First, when groundwater is extracted and used for domestic or agricultural irrigation, it is subject to evaporation and transpiration, which results in concentration of the minerals in the water. Second, domestic and industrial water use result in evaporation and concentrations of salts as waste which will then be discharged to sewage treatment facilities, where treatment results in evaporation. These supplies, with higher concentrations of minerals, are then recharged into the groundwater. To the extent that supplies from the Regional Aquifer are extracted and then discharged as treated water to the Regional Aquifer, there is a progressive increase in mineral concentrations in this aquifer.

In their initial screening of alternatives for recharge facility sites, Bookman-Edmonston (2004b) reviewed the available literature on recharge conditions in the MWA service area. They noted that artificial recharge of the Mojave River Floodplain Aquifer and indirectly to the Regional Aquifer has been proposed by several sources (citing Lines 1996 and Stamos, Martin, and Predmore, 2002). Bookman-Edmonston (2004b) describes the general conditions at the sites evaluated for potential recharge.

<u>The Mainstem Mojave River</u>: The Mojave River is the primary source of natural recharge to the MWA service area, with surface water recharging to the Floodplain Aquifer rapidly and moving downstream and laterally to the adjacent Regional Aquifer. Groundwater quality is good, with low TDS and low salts in general, reflecting source water quality. The Mojave River bed consists of unconsolidated sands to a depth of 100+ feet and is connected hydraulically to the Regional Aquifer. There are few clay lenses in the Floodplain Aquifer and, consistent with results from MWA's 2003 pilot project, recharge rates are estimated to range from 5 to 40 feet per day per acre (LRWQCB 2001, citing Durbin and Hardt 1974; USDA 1986; and Pirnie 1988). Horizontal transmissivity to the Regional Aquifer has been estimated using the USGS Mojave River Basin Model (MWA 2004, in Bookman-Edmonston 2004b) and maximum annual recharge and extraction rates for the reach between Mojave Forks Dam and the Narrows, with no controls for water depth and liquefaction, have been estimated at 150,000+ acre-feet and 130,000+ acre feet, respectively. This is clearly a high estimate, but it illustrates the high transmissivity of the soils in the floodplain aquifer. Soil characteristics in this area minimize potential for recharged water to leach minerals into groundwater. Soil characteristics on flood bench on the east side of the river are similar to those of the river itself, sandy with low clay content. The floodplain bench on the west side of the river has higher potential for loam and clay-loam soils and thus has lower permeability and potential for mineral concentrations that could be leached during recharge.

Bookman-Edmonston's (2004b) review of available literature and well logs is consistent with Stamos, Martin, and Predmore (2002) in finding no water quality conditions in the Mojave River Mainstem above the Narrows that would affect use of this reach for artificial recharge.

<u>The Regional Aquifer (Oeste, Alto, Cedar Avenue Detention Basin, Oro Grande Wash, Antelope Wash)</u>. The Regional Aquifer has not been as well characterized as the Floodplain Aquifer. Depth to groundwater in this heavily overdrafted area can be as high as 400 to 600 feet in some areas. There are maps showing concentrations of minerals in wells throughout the MWA service area (Christensen and Fields-Garland 2002, cited in Bookman-Edmonston 2004b) which provide indications of potential for mineral content in the soils overlying the Regional Aquifer. In addition, Bookman-Edmonston (2004b) note that recharge to the Regional Aquifer may be affected by fine-grained materials that (a) may inhibit percolation and (b) contain minerals with

high solute potentials (leaching). Based on characterizations of soils underlying Oro Grande Wash, Izbicki, Radyk, and Michel (2000, cited in Bookman-Edmonston 2004b) conclude that recharge in washes where natural recharge occurs would provide for higher infiltration rates and reduce the potential to encounter concentrations of minerals such as chlorides, heavy metals, and arsenic that may leach out during recharge. Given that runoff is concentrated in washes and has the greatest energy near the mountains, larger fractions of sediment load would settle out in upstream areas of the washes and the potential for clay deposits would be expected to increase with distance from washes and distance downstream. This general trend is confirmed by investigations of groundwater recharge in downstream areas, which found extensive clay layers associated with historic lake-type flooding (Bookman-Edmonston 2004b).

<u>Morongo Basin/Lucerne Valley.</u> The Colorado Regional Water Quality Control Board Basin Plan (CRWQCB 2002, Section VI. A.) describes groundwater hydrology in the Lucerne Valley Planning Area, noting that the area contains numerous small drainage basins. Groundwater is stored principally in unconsolidated alluvium and is generally unconfined. Alluvial deposits are generally hundreds of feet deep and in some areas are known to be 1200 feet deep. Depth to groundwater ranges from flow at the surface to 445 feet. Groundwater generally flows in the general gradient of the land, except where influenced by heavy extraction which creates a localized cone of depression. In this portion of MWA's service area, an overriding objective of CRWQCB is to "minimize the quantities of contaminants reaching any ground water basin and to maintain the existing groundwater quality where feasible. CRWQCB notes that there is groundwater overdraft in the Lucerne Valley and that recycling of groundwater results in "an increase in mineral concentrations such as total dissolved solids (TDS), nitrate etc." Bookman-Edmonston (2004b) did not specifically evaluate hydrogeology of the existing spreading basins in the Morongo Basin/Yucca Valley.

<u>Site Specific Analyses</u>. With the exception of recharge basins in the Morongo Basin, MWA's existing recharge sites that would be used in the banking and exchange program are within the Mojave River Floodplain Aquifer, and have characteristics of this aquifer -- sandy soils, relatively high recharge rates, minimal presence of clay and fine-grained materials that would result in leaching of minerals into groundwater. These conditions also exist in the Mainstem Mojave River reach proposed for recharge and in soils adjacent to this reach, although there are clays beneath portions of the west bank of the Mojave River that could affect recharge rates and leaching potential at this site.

With regard to Regional Aquifer sites, portions of the Oeste and Alto areas adjacent to the California Aqueduct are known to have clay and fine-grained materials between the two proposed recharge sites (Bookman-Edmonston 2004b). But driller's logs do not indicate clays in the areas proposed for recharge.

The hydrogeology of Antelope Wash is not well documented, but Slade and Associates (2004, cited in Bookman-Edmonston 2004b) show 400 feet of sand and gravel beneath Antelope Wash in the City of Hesperia, suggesting that recharge to this wash would recharge the Regional and the Floodplain aquifers. This is not an unexpected finding given the high energy of flows through this wash which would deposit larger fractions of sediments in the wash and finer sediments downstream where the floodplain widens. Recent drilling for the new Westbay well also shows this area to be underlain primarily with sand and gravel.

MWA has recently conducted recharge tests at Oro Grande Wash and found that recharge is not substantially constrained by soil conditions. Soils beneath the wash itself are sandy and recharge rates are adequate to sustain a recharge program. The frequent inundation and natural recharge of the wash results in low potential for soluble minerals and thus leaching problems associated with recharge outside of washes would be avoided.

5.13.2 Analysis of Water Supply and Water Quality Effects

5.13.2.1 Mechanisms for Effect

Biological Effects of Recharge: Recharged surface water may contain bacteria, viruses, and other microorganisms such as *giardia* and *cryptosporidium*. Surface water, and groundwater under the direct influence of surface water, must thus be treated to inactivate these harmful microbes. The federal Surface Water Treatment Rule defines "groundwater under the direct influence of surface water" as:

> "any water beneath the surface of the ground with: (1) significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia*, or (2) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions."

Groundwaters found to be under the influence of surface water must be treated to bring them into compliance with drinking water regulations. Recharge may raise groundwater levels and bring them under the direct influence of surface waters, affecting biological water quality.

Recharged water is bioremediated as it flows vertically and laterally through the unsaturated soil zone during recharge. During movement through the soil, harmful bacteria and viruses are inactivated via a number of aerobic biodegradation processes which are strongly influenced by dissolved oxygen and temperature (Metge 2002). The processes for this are similar to the widespread process of slow sand filtration for treatment of sewage.

Bioremediation rates depend on a variety of factors: rate of water movement through the unsaturated zone, temperature, salinity, dissolved oxygen, pH, microbial size and species, predation, metal/nutrient availability, and microbial growth. The bacteria in surface waters may be effectively inactivated relatively rapidly as groundwater moves through the subsurface soils. For example, at the Montebello recharge basin in Los Angeles, Anders et al (2002) found that bacterial viruses (bacteriophages) were removed (7-log removal standard) from recharged recycled water after traveling only 100 feet downstream. Similarly, the State of Washington Division of Environmental Health (2004) identifies groundwater under the *potential* influence of surface water as groundwater less than 50 feet deep within 200 feet of surface water. This reflects the ability of bioremediation processes to remove harmful bacteria in surface waters within a relatively short distance from the water source. Much of the bioremediation is associated with factors such as bacterial attachment to the surface of sediments in the upper layers of the soil (Rogers 2002).

Potential for the banking and exchange program to cause groundwater to be under the influence of surface water is limited to recharge into the Mainstem Mojave River in the Alto subarea. At other recharge sites, vertical and lateral infiltration rates and groundwater depths effectively eliminate the potential for water extracted from areas near recharge sites to be under the influence of surface water. Prior to construction, MWA will identify and properly decommission any existing wells that could result in introduction of recharge water directly to the groundwater basin. This will effectively eliminate this potential pathway for surface water influence on the aquifer. The potential for recharged water in the Mainstem Mojave River is related to the high potential volume of recharge, rising groundwater levels, and the relatively rapid downstream and lateral movement of recharged groundwater in this reach of the Mojave River Floodplain Aquifer and the adjacent Regional Aquifer.

In the Mojave River Floodplain Aquifer, natural surface water flow is intermittent and thus for a majority of the time, there is no potential for groundwaters to be influenced by surface flows. During periods of high flow, such as occurred in the winter of 2005, the river may have surface flow for several months. There will be surface flow during artificial recharge as well. In the 2003-2004 demonstration project involving ramped releases of up to 500 cfs from Silverwood Lake over a period of about 30 days (November-December) and simultaneous discharges from the Rock Springs Outlet, surface flow was initially recharged rapidly in the upstream portion of the river, but extended from Mojave Forks Dam to near Bear Valley Road at flows of 500 cfs.

Based on MWA's USGS model studies (Bookman-Edmonston 2004b), horizontal conductivity in the Mojave River Aquifer is estimated at 100 feet per day, and the Mojave River Aquifer could contributes 130,000+ acre-feet per year to the adjacent Regional Aquifer, although lateral penetration of this aquifer is at a lower rate. Downstream migration of groundwater percolated into the Mojave River Aquifer in the reach above Rock Springs would therefore take approximately 50 days to reach the upstream edge of the well field and longer to reach wells set off-channel in the zone between the Regional Aquifer and the Floodplain Aquifer. Flow towards the well fields located in the Regional Aquifer would be slower. Recharge would not be undertaken during periods of natural flow.

Physical and water chemistry effects of recharge: In addition to inactivating bacteria and viruses, recharge affects water chemistry in a variety of complex ways. Water for recharge is often of different water quality than that of natural runoff, and variable water quality may affect the chemical and physical characteristics of the subsurface soils.

The most obvious physical effect associated with recharge is the slow formation of an organic layer at the recharge basin site as macro-organic material in recharged water collects in the top

10 cm of the soil (Leenheer 2002). Much of this is a result of adsorption to the surface of the soil grains. Organic carbon removal in this upper layer of the soil may be 25% of the total carbon load in the recharged water (Quanrud et al 1996 cited in Leenheer 2002). This removal of complex organic compounds in the upper layer of recharge basins includes degradation of organic hydrocarbon pollutants. Leenheer (2002) notes that 30-40% of the organic carbon in recharge supplies may be colloids from bacterial cell walls and that virtually all of this carbon is removed in the first one foot of infiltration. Citing Bower et al (1974) and others, Leenheer (2002) notes that DOC removal may be from 48% to 90% as recharged water percolates into the ground and moves horizontally through the soil. These reductions are a function of adsorption and biodegradation. These processes have been found to be enhanced by high dissolved oxygen concentrations in recharged water (Ding et al 1999 cited in Leenheer 2002); SWP supplies typically have high dissolved oxygen concentrations (8.5 to 9.5 mg/l). DOC removal in sand and sandy loams has been measured at 48% and 44% (Rostad 2002, citing Quanrud et al 1996).

Fine sediments may also clog the pore spaces in the recharge basin soils. A vast majority of this potential "clogging" of the recharge basin with organic matter and fine sediments occurs in the upper 1-foot of the soil. Recharge basins in use for decades, such as the recharge basins at Arvin-Edison Water Storage District and North Kern Water District which have been in operation for 40 to over 50 years, require periodic scraping to remove the upper layers of the recharge basin, followed by ripping of the soil to reduce compaction. These routine maintenance activities rapidly restore recharge capacity, suggesting that the physical effects of recharge occur primarily in the upper foot or two of the basin.

Recharge with acidic water may also leach minerals from subsurface soils and result in higher levels of dissolved solids in groundwater (Colorado River Regional Water Quality Control Board 2003 Basin Plan). This is unlikely with SWP supplies, which have pH outside of the acidic range (pH 7.2 to pH 8.0). High levels of dissolved oxygen may also help to mobilize minerals in soil and cause leaching into groundwater. SWP supplies have dissolved oxygen levels of from 8.5 to 9.5 mg/l. These are not higher than natural runoff from the Mojave River watershed in the San Bernardino Mountains and thus no increase in the rate of leaching is likely to occur.

There are a variety of complex chemical processes that occur as recharged water percolates through the subsurface soils. Decomposition of organic compounds occurs (a) in the upper aerobic zone where available oxygen allows aerobic microbes to degrade organic compounds to simpler compounds such a carbon dioxide and (b) in the anaerobic zone where the oxidized forms of inorganic compounds are used by microbes. These oxidation/reduction reactions change the chemistry of the recharged water (reducing concentrations of complex organic compounds) and the chemistry of the soils (such as leaching of minerals from soils into the groundwater). For example, the iron and manganese oxides that are found in most sand and gravel aquifers (Cozzarelli 2002) may be affected by organic matter oxidation, resulting in higher concentrations of dissolved iron and manganese in the receiving groundwater.
Arsenic, a mineral of concern in the MWA service area due to high concentrations in some wells, may be affected by recharge operations in several ways. Leaching of arsenic involves mobilization of the mineral from the solid to aqueous phase, and is facilitated by (a) highly

alkaline conditions (pH > 8); (b) high phosphate concentrations, and (c) anaerobic environments (Bostick and Fendorf 2005). At the same time, Oremland (2002) notes that in the presence of oxygen, iron, and nitrates (but low organics), bacteria may reduce the mobility of arsenic compounds. The rate at which, and conditions under which, leaching and/or mineralization of arsenic may occur are not well quantified and thus the net effect of recharge on arsenic is both site dependent and not predictable at this time.

Indigenous groundwater in the MWA service area affected by the proposed project facilities has a pH range of from 7.7 to 8.3; SWP supplies have approximately the same range, although they seldom exceed pH of 8.0. Import of SWP supplies will therefore probably not increase mobilization of arsenic related to pH values.

Altering Groundwater Levels: Recharge may raise groundwater levels with unintended consequences. For example, recharge at the Yucca Valley recharge basins has raised groundwater levels by 240 feet, and has been associated with high nitrate concentrations and turbidity in water extracted (Densmore and Bohlke 2002). Although nitrate concentrations in the recharged water were low, high nitrate concentrations were an indirect effect of rising groundwater encountering high-nitrate water from nearby septic systems. High turbidity was an indirect result of recharged water becoming saturated with air during recharge, resulting in high levels of dissolved gas in the water pumped from the rising aquifer. Such indirect effects may occur under a wide variety of conditions.

Mass Loading: Finally, recharge of water results in mass loading; that is, minerals in the recharged water will tend to accumulate in groundwater. Subsequent extraction and use of this water can result in evaporation and associated concentration of minerals in the surface soil or use, treatment, and recharge of treated water, resulting in increasing concentrations of minerals in the groundwater. The concentration of minerals in the groundwater basin will ultimately degrade groundwater quality for human use unless the basin drains away from the area of human use.

Various elements of the Project involve import of SWP supplies, recharge into the Mojave River Floodplain Aquifer, and subsequent extraction from this aquifer for use in lieu of extractions from the heavily overdrafted Regional Aquifers and Floodplain Aquifer. To the extent that the Project provides different quality supplies for use, mass loading and concentration of minerals in the MWA service area would vary.

Summary of Mechanisms for Effect: The physical and chemical processes by which recharge affects groundwater quality are complex and site specific. The recharge sites currently in operation and proposed have been selected for a variety of reasons:

- Soil permeability. All of the recharge sites selected are in areas of sandy/loam alluvial soils with minimal potential for clays and virtually no potential for drainage through subsurface rock. Soils in these areas are primarily silicates.

- Mineral leaching (emphasis on arsenic). Proposed recharge areas are in the Alluvial Aquifer, where arsenic levels in indigenous groundwater are lowest, or in low-arsenic areas of the Oeste and Alto Regional Aquifers.
- Mixing of indigenous and recharge supplies: Recharge supplies and indigenous water supplies are of different and variable quality. Recharge areas have been selected to minimize the potential for adverse impacts associated with mixing high quality SWP supplies with very low quality groundwater in some areas of the MWA service area.

Given these considerations, the mechanisms by which recharged water may affect water quality include:

- Bacterial contamination from surface water influence. If recharged water directly affects groundwater as described in the surface water rule, then groundwater quality may be degraded.
- Dissolved organic carbon. Surface water supplies may introduce DOC into groundwaters.
- Changed groundwater levels. Recharge may result in mounding of water, which may bring groundwater into contact with surface contaminants.
- Chemical interactions. Recharged water may leach minerals from the soils as it passes through them or may enhance the mineralization of some minerals, most significantly arsenic compounds, thus removing them from groundwater.
- Net increases in mineral loading in groundwater. Recharge may affect the concentration of minerals in the affected groundwater, either positively or adversely, depending on recharge water quality, site conditions, and operations.

5.13.2.2 Analytical Approach

<u>Priority of Water Quality Constituents for Analysis:</u> Arsenic is probably the most important constituent to address in water quality impact analysis for the MWA service area because arsenic standards have become more stringent and arsenic is a documented problem in some portions of the MWA service area. Variables that may be quantified given available water quality data are:

- Concentrations of arsenic in recharged and receiving waters
- pH of recharged and receiving waters, because pH affects arsenic mobilization
- Sulfates, because sulfur compounds mediate anaerobic reactions with arsenic in groundwater
- Chlorides and total dissolved solids (various mineral salts) because accumulation of salts in groundwater can affect the long-term suitability of groundwater for urban uses. The effects of mixing recharge water with indigenous groundwater can be evaluated in terms of mass loading; that is the total amount of TDS delivered under the base condition versus the Proposed Project alternatives.

Boron is a lower-priority constituent for analysis because SWP supplies generally have lower concentrations on average than occur in the Proposed Project recharge sites and both SWP and

Alto water supplies have concentrations well below those set in California DHS Drinking Water Standards.

Total organic carbon and bromides are of fourth-level concern because (a) their effects are related to formation of trihalomethanes (THM's) as a result of chlorination and chloramination and (b) bromides are not generally found in indigenous groundwater. These constituents would be of greater concern if groundwater must be treated (with chloramines) prior to distribution. At present groundwater is treated at subarea producer's facilities.

Patterns of Water Quality in SWP Supplies: The water quality of SWP supplies varies significantly from month to month and year to year. Water banking and exchange programs involve movement and use of water in specific year types and during specific parts of the year. Long-term average SWP water quality is therefore not a good predictor of actual water quality in the water delivered in banking and exchange projects.

Deliveries of supplies to water banks generally occur in wet years, or in the year immediately following a wet year when there is adequate water supply in SWP storage facilities at Oroville and San Luis reservoirs. In addition, a majority of deliveries to banking projects have generally occurred during the months of March through June, in part because in many wet years, the Department of Water Resources may not have established Table A allocations until after February, when overall precipitation and snow pack conditions are known well enough to predict net available supply. In addition, in a wet year following a dry year, agencies may want to fill surface and groundwater storage within their own service areas prior to making deliveries to third-party groundwater banks. These considerations are reflected in Table 5-22, which describes Metropolitan's historic deliveries to three groundwater banks in Kern County for the period 1993 through 2004.

In addition, banking agencies such as Metropolitan do not generally take deliveries of banked supplies unless they are needed, in part because of the added expense or conveyance to and from banks, and the loss associated with banking. As a result, Metropolitan has historically taken supplies from its Kern County water banks in dry years.

Based on Department of Water Resources monitoring at Check 41 of the California Aqueduct from 1998-2004, there is significant monthly and annual variation in concentrations of various water quality constituents (Tables 5-23 to 5-36). The general trends in SWP water quality are:

- For most constituents, SWP water quality tends to be better in above-normal and wet years. This is a result of high levels of precipitation that dilute minerals and other chemicals in runoff, the positive effects of high flows on sea water intrusion, the extended discharge of water from the Sierra Nevada snow pack (which is of high quality), and the generally higher SWP allocations which mean that more water is released from Lake Oroville and thus sea water intrusion continues to be minimized in the summer. In fall, water quality tends to decline, in part because lower agricultural demand at harvest reduces net release to the Delta and more sea water intrusion occurs (as evidenced by the rapid increase in bromides from September to October; Table 5-24).

- For most constituents, SWP water quality tends to be better in the spring and early summer. This occurs because spring and early summer supplies are dominated by snow pack runoff and high releases from reservoirs as the agricultural irrigation season begins.

Various water quality constituents of concern have different patterns of variation, probably reflecting differences in the sources and mechanisms by which they enter the water (Tables 5-23 through 5-36). They may vary monthly (reflecting factors such as snow melt and runoff to the Delta, reservoir releases, and volume of exports) or annually (reflecting annual precipitation and total runoff and outflow through the Delta). Tables 5-23 through 5-36 illustrate these variations for a 7-year period of record (1998 through 2004) that included a sequence of above normal and wet alternating with below-normal and dry years. Based on this recent period of record, some trends in water quality can be noted

- Arsenic (Table 5-23 & Table 5-39). There is a slight monthly variation apparent in the data, with marginally higher arsenic levels in SWP supplies in late summer. There is no clear dry-year/wet-year pattern. The lack of strong trends may be because arsenic levels are often at or near the level of detection. Arsenic appears to be slightly lower in months when deliveries to water banks have been highest.
- Boron (Table 5-24 & Table 5-39). Boron levels in SWP supplies tend to be highest in winter and spring. There is no clear dry-year/wet-year pattern. Boron appears to be slightly lower in months when deliveries to water banks have been highest.
- Bromides (Table 5-25 & Table 5-39). Bromides are lowest in above-normal and wet years and in the months from February through September, reflecting the effects of higher flow regimes in these months on seawater intrusion into the Delta. Bromides appear to be slightly lower in months when deliveries to water banks have been highest.
- Chlorides (Table 5-26 & Table 5-39). Chlorides are lowest in wet years and in the months from February through September, reflecting the effects of higher flow regimes on seawater intrusion into the Delta. Chlorides are slightly lower in months when deliveries to water banks have been highest.
- Chromium (Table 5-27 & Table 5-39). Chromium shows a slight trend towards higher concentrations in early winter, and in wet years. Chromium appears to be slightly lower in months when deliveries to water banks have been highest.
- Fluorides (Table 5-28 & Table 5-39). There is very little monthly or wet-year/dry-year variation in fluoride concentrations, with all measurements ranging from 0.1 to 0.2 mg/l. What variation there is tends to be in above-normal and wet years, when spring concentrations may be 0.2 mg/l. Fluoride appears to be slightly higher in months when deliveries to water banks have been highest.
- Iron Table 5-29 & Table 5-39). Iron levels are seasonally highest in December-March and are generally at or below detectable levels in the remainder of the year. This may reflect the effects of runoff from lower elevations of the Central Valley and surrounding mountains as a result of winter rainfall. Iron levels are slightly lower in months when deliveries to water banks have been highest.

- Lead (Table 5-30 & Table 5-39). There is no measurable variation in lead concentrations in SWP supplies. Measurements in 1998-2004 were below 0.001 mg/l (1 ppb).
- Nitrates (Table 5-31 & Table 5-39). Nitrates in SWP supplies tend to be lower in spring and summer (reflecting the influence of snowmelt runoff) and to be lower in wet years, reflecting the influence of high overall runoff. Nitrates appear to be slightly lower in months when deliveries to water banks have been highest.
- pH (Table 5-32 & Table 5-39). There is no obvious seasonal pattern for pH in SWP supplies, but pH appears to be lower in wet years than dry years. pH appears to be slightly higher in months when deliveries to water banks have been highest.
- Selenium (Table 5-33 & Table 5-39). There is very little variation in selenium concentrations in SWP supplies, either monthly or annually. Selenium appears to be slightly lower in months when deliveries to water banks have been highest.
- Sulfate (Table 5-34 & Table 5-39). Sulfate. Sulfates tend to be highest in the winter and early spring and were particularly low in the wet year of 1998. Sulfate appears to be slightly lower in months when deliveries to water banks have been highest.
- Total dissolved solids (Table 5-35 & Table 5-39). TDS levels vary with season and by year type, with better water quality in wet years and in spring-summer. TDS appears to be slightly lower in months when deliveries to water banks have been highest.
- Total organic carbon (Table 5-36 & Table 5-39). There is no obvious seasonal or annual pattern for TOC in SWP supplies. TOC appears to be slightly lower in months when deliveries to water banks have been highest.

These monthly and annual difference in SWP water quality are important because Metropolitan deliveries to banking programs vary monthly (Table 5-22) and by year type, with almost all deliveries to banking occurring in above-normal to wet years and a majority of water delivered during the months of March through August (Tables 5-37 and 5-38).

The Pearson's Rank correlations shown on Table 5-38 and the weighted averages calculated for Table 5-39 suggest that water delivered to banking operations would have generally lower concentrations of arsenic, bromides, chlorides, chromium, iron, lead, selenium, sulfate, total dissolved solids, and total organic carbon than water delivered in equal installments over 12 months. That is, the timing of bank deliveries results in better-than-average water quality for these constituents. Banking deliveries would have higher-than-average concentrations of boron, fluoride, and pH. Pearson's rank correlations are a relatively simple but reliable indication of significance. They reflect the strength of the relationship, but not the magnitude of the difference. The importance of the variation in water quality in banked versus average water supply may be evaluated by comparing differences in concentrations of the various constituents to the water quality objectives of the Lahontan Regional Water Quality Control Board (LRWQCB 2004) and the Colorado River Regional Water Quality Control Board (Tables 5-39 and 5-40)

Table 5-22. Monthly Metropolitan deliveries to water banking programs (Arvin-Edison, Semitropic, and Kern Delta), 1993-2004 in acre-feet. Data from Department of Water Resources, SWPAO Branch, 2005. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1993 AN	0	7,458	29,039	13,503	0	0	0	0	0	0	0	0	**50,000**
1995 W	0	0	0	0	18,500	31,500	0	0	0	0	0	0	**50,000**
1996 W	7,004	17,442	19,295	22,700	13,559	0	0	0	2,094	11,000	1,906	0	**95,000**
1997 W	0	7,162	25,522	24,392	20,821	0	5,000	5,000	19,650	12,673	4,780	1,4960	**139,960**
1998 W	12,806	1,103	12,750	10,000	14,000	0	150	1,759	12,519	4,147	0	0	**69,234**
1999 AN	850	7,950	18,161	33,956	51,184	14,155	0	0	2,958	137	4,292	4,369	**177,333**
2000 AN	12,049	4,475	0	10,801	0	21,130	24,803	16,675	17,166	21,119	15,752	5,761	**149,731**
2003 BN	0	0	0	0	32,415	30,827	28,230	59,706	1,400	1,520	675	170	**154,943**
	32,709	**45,590**	**104,767**	**115,352**	**150,479**	**97,612**	**58,183**	**83,140**	**55,787**	**50,596**	**27,405**	**25,260**	

Table 5-23. Arsenic in SWP supplies at the Tehachapi Afterbay (Check 41), January 1998 to December 2004 (from DWR 2005), in micrograms/liter (parts per billion). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	2	2	3	1	3	3	2	3	3	2	2	2	**27**
1999 W	3	3	1	2	2	2	2	2	2	2	2	2	**25**
2000 AN	2	2	2	2	1	2	3	2	2	2	2	2	**24**
2001 D	2	2	2	3	2	2	2.25	3	3	3	4	3	**31.25**
2002 D	2	2	2	3	2	2	2	3	3	1	1	1	**24**
2003 BN	2	2	2	2	2	2	2	2	2	2	1	2	**23**
2004 D	2	2	2	2	2	3	3	3	4	4	4	2	**33**
Total	**15**	**15**	**14**	**15**	**14**	**16**	**16.25**	**18**	**19**	**16**	**16**	**14**	
Mean	**2.14**	**2.14**	**2.0**	**2.14**	**2.0**	**2.3**	**2.3**	**2.6**	**2.7**	**2.3**	**2.3**	**2.0**	**2.24**

Table 5-24. Boron in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.02	0.02	0.02	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	**1.06**
1999 AN	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	**2.1**
2000 AN	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	**1.9**
2001 D	0.2	0.2	0.2	0.2	0.2	0.2	0.19	0.1	0.1	0.2	0.17	0.2	**2.16**
2002 D	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	**2.1**
2003 BN	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	**1.9**
2004 D	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1	**1.9**
Total	**1.22**	**1.22**	**1.22**	**1.3**	**1.3**	**1.2**	**0.79**	**0.8**	**0.7**	**1.1**	**1.07**	**1.2**	
Mean	**0.17**	**0.17**	**0.17**	**0.19**	**0.19**	**0.17**	**0.11**	**0.11**	**0.1**	**0.16**	**0.15**	**0.17**	**0.155**

Table 5-25. Bromides in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million or ppm). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.34	0.24	0.22	0.01	0.01	0.01	0.07	0.19	0.11	0.06	0.06	0.08	**1.4**
1999 AN	0.17	0.13	0.13	0.15	0.18	0.13	0.10	0.11	0.11	0.22	0.27	0.27	**1.97**
2000 AN	0.24	0.16	0.07	0.01	0.18	0.13	0.12	0.12	0.12	0.22	0.27	0.35	**1.99**
2001 D	0.40	0.34	0.31	0.42	0.18	0.13	0.21	0.19	0.19	0.40	0.34	0.31	**3.42**
2002 D	0.24	0.13	0.17	0.23	0.25	0.24	0.15	0.31	0.31	0.47	0.39	0.29	**3.18**
2003 BN	0.32	0.20	0.14	0.13	0.21	0.09	0.10	0.10	0.12	0.28	0.30	0.35	**2.34**
2004 D	0.32	0.11	0.11	0.12	0.20	0.22	0.16	0.17	0.23	0.29	0.14	0.27	**2.34**
Total	**2.03**	**1.31**	**1.15**	**1.07**	**1.21**	**0.95**	**0.91**	**1.19**	**1.19**	**1.94**	**1.77**	**1.92**	
Mean	**0.29**	**0.19**	**0.16**	**0.15**	**0.17**	**0.14**	**0.13**	**0.17**	**0.17**	**0.28**	**0.25**	**0.28**	**0.198**

Table 5-26. Chlorides in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	100	81	77	4	4	2	22	57	37	21	20	25	**450**
1999 AN	48	42	26	49	58	62	44	31	37	71	78	79	**625**
2000 AN	75	61	34	40	64	50	48	46	40	67	85	103	**713**
2001 D	124	106	66	53	64	50	71.5	63	59	134	105	93	**988.5**
2002 D	79	46	59	120	74	80	50	92	92	113	113	98	**1016**
2003 BN	99	62	50	41	79	34	35	35	40	86	94	111	**766**
2004 D	99	46	52	48	73	72	53	57	69	90	76	84	**819**
Total	**624**	**444**	**364**	**355**	**416**	**350**	**323.5**	**381**	**374**	**582**	**571**	**593**	
Mean	**89**	**63**	**52**	**51**	**59**	**50**	**49**	**54**	**53**	**83**	**82**	**85**	**64.0**

Table 5-27. Chromium in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.060**
1999 AN	0.005	0.007	0.005	0.005	0.005	0.007	0.005	0.005	0.005	0.006	0.005	0.006	**0.066**
2000 AN	0.006	0.007	0.006	0.005	0.005	0.006	0.006	0.005	0.005	0.005	0.005	0.006	**0.067**
2001 D	0.005	0.005	0.005	0.005	0.007	0.006	0.0035	0.004	0.006	0.005	0.004	0.002	**0.0575**
2002 D	0.001	0.005	0.006	0.004	0.004	0.004	0.002	0.003	0.003	0.004	0.004	0.004	**0.044**
2003 BN	0.007	0.004	0.002	0.002	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.002	**0.027**
2004 D	0.007	0.002	0.002	0.001	0.002	0.004	0.002	0.002	0.003	0.002	0.004	0.002	**0.033**
Total	**0.036**	**0.035**	**0.031**	**0.027**	**0.030**	**0.033**	**0.0255**	**0.025**	**0.028**	**0.029**	**0.028**	**0.027**	
Mean	**0.0051**	**0.005**	**0.004**	**0.0038**	**0.0043**	**0.0047**	**0.0036**	**0.0036**	**0.004**	**0.0041**	**0.004**	**0.0038**	**0.004**

Table 5-28. Fluoride in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.1	0.1	0.2	0.1*	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	**1.5**
1999 AN	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.3**
2000 AN	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2001 D	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2002 D	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2003 BN	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
2004 D	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.2**
Total	**0.7**	**0.8**	**0.8**	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	
Mean	**0.1**	**0.11**	**0.11**	**0.1**	**0.11**	**0.11**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.10**

* No fluoride record was taken on this date. The average value for this month has been substituted.

Table 5-29. Lead in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
1999 AN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2000 AN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2001 D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2002 D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2003 BN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
2004 D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**
Total	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	
Mean	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	

Table 5-30. Iron in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l. Data summarized from automated sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.021	0.009	0.006	0.005	0.006	0.027	0.022	0.005	0.005	0.005	0.005	0.005	**0.121**
1999 AN	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.017	**0.072**
2000 AN	0.031	0.027	0.026	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.014	**139**
2001 D	0.023	0.018	0.017	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.103**
2002 D	0.020	0.047	0.012	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.125**
2003 BN	0.016	0.005	0.022	0.008	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.091**
2004 D	0.016	0.034	0.010	0.005	0.005	0.005	0.005	0.005	0.005	0.010	0.005	0.023	**128**
Total	**0.106**	**0.131**	**0.098**	**0.039**	**0.036**	**0.057**	**0.052**	**0.036**	**0.035**	**0.040**	**0.035**	**0.074**	
Mean	**0.015**	**0.019**	**0.014**	**0.0056**	**0.0051**	**0.0081**	**0.0074**	**0.0051**	**0.0050**	**0.0057**	**0.0050**	**0.0076**	**0.0086**

Table 5-31. Nitrates in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	1.4	1.7	1.9	0.5	0.63*	0.09	0.12*	0.65	0.50	0.64	0.66	0.79	**3.24**
1999 AN	0.54	0.36	0.76	0.76	0.44	0.48	0.44	0.36	0.35	0.58	0.73	0.86	**6.66**
2000 AN	0.99	1.60	1.10	0.72	0.59	0.65	0.45	0.28	0.04	1.13	0.82	1.0	**9.37**
2001 D	1.1	1.4	1.2	1.1	0.59	0.65	0.6	0.52	0.4	0.4	0.53	0.66	**9.15**
2002 D	1.2	1.1	1.0	1.07	0.76	0.9	0.58	0.26	0.26	0.39	0.61	1.0	**9.13**
2003 BN	1.5	1.6	1.0	0.68	0.72	0.58	0.51	0.28	0.17	0.22	0.28	0.83	**8.37**
2004 D	1.5	0.99	1.64	0.58	0.66	0.69	0.41	0.34	0.41	0.66	1.09	1.01	**9.98**
Total	**8.23**	**8.75**	**8.6**	**5.41**	**4.39**	**4.04**	**2.99**	**2.69**	**2.13**	**4.02**	**4.72**	**6.15**	
Mean	**1.18**	**1.25**	**1.23**	**0.77**	**0.62**	**0.58**	**0.43**	**0.38**	**0.30**	**0.58**	**0.67**	**0.88**	**0.74**

*No data for these months at Check 41. Average for month substituted.

Table 5-32. The pH of SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	7.6	8.0	7.9	7.9*	7.8	7.6	8.0	7.5	7.6	7.4	7.1	7.6	**92**
1999 AN	8.7	8.0	7.4	7.4	7.6	7.6	7.2	7.0	7.5	8.0	7.4	7.2	**91**
2000 AN	7.8	8	7.2	7.2	8	7.5	7.7	7.7	8.3	7.3	8.0	8.1	**92.8**
2001 D	8	8	8.0	8.3	8.2	8.3	8.1	7.5	8.0*	7.9*	8.0	8.0	**96.3**
2002 D	7.7	7.7	8.1	8.3	8.0	7.9	8.3	8.2	8.2	8.2	7.9	7.8	**96.3**
2003 BN	7.9	7.8	7.8	8.0	8.1	7.7	8.0	8.0	8.2	8.1	8.2	8.1	**95.9**
2004 D	7.9	7.9	7.8	8.2	8.3	8.2	8.3	7.8	8.1	8.3	8.2	7.9	**96.9**
Total	**55.6**	**55.4**	**54.2**	**55.3**	**56**	**54.8**	**55.6**	**53.7**	**55.9**	**55.2**	**54.8**	**54.7**	
Mean	**7.94**	**7.91**	**7.74**	**7.9**	**8**	**7.8**	**7.94**	**7..67**	**7.98**	**7.88**	**7.82**	**7.81**	**7.86**

*Data for this month not available. The value used is the monthly average for the other 6 years.

Table 5-33. Selenium in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	0.001	0.001	0.001	0.001*	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	**1.2**
1999 AN	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	**1.2**
2000 AN	0.001	0.001	0.001	0.001*	0.001	0.001	0.001*	0.001	0.001*	0.001*	0.001	0.002	**1.3**
2001 D	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001*	0.001*	0.001*	0.001*	0.001	**1.3**
2002 D	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	**1.2**
2003 BN	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	**1.2**
2004 D	0.001*	0.001*	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	**1.3**
Total	**0.008**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.007**	**0.008**	**0.008**	
Mean	**0.0014**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.0014**	**0.0014**	**0.0011**

*No data for these months at Check 41. Data from upstream Check 29 substituted.

Table 5-34. Dissolved sulfate in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	48	60	59	10	6	4	20	34	27	22	20	22	**332**
1999 AN	44	47	36	55	24	38	29	22	19	27	32	38	**411**
2000 AN	39	49	41	45	40	32	29	28	22	26	29	45	**425**
2001 D	51	58	57	56	41	33	42	30	18.5	38	48	49	**521.5**
2002 D	41	43	54	43	44	45	30	24	24	39	38	50	**475**
2003 BN	49	50	54	35	44	26	22	17	16	26	36	49	**424**
2004 D	49	42	58	35	42	41	25	21	28	34	37	41	**453**
Total	**321**	**349**	**359**	**279**	**241**	**219**	**197**	**176**	**154.5**	**212**	**240**	**294**	
Mean	**45.8**	**49.9**	**51.3**	**39.9**	**34.4**	**31.3**	**28.1**	**25.1**	**22.0**	**30.3**	**34.3**	**42**	**36.2**

Table 5-35. Total dissolved solids (TDS) in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), in mg/l (parts per million). Data summarized from DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	345	317	334	193*	89	73	114	219	198	139	137	152	**2310**
1999 AN	234	223	143	230	249	230	193	157	166	258	257	266	**2606**
2000 AN	309	280	193	210	236	219	207	208	167	241	262	301	**2833**
2001 D	374	337	280	275	239	227	291	228	327	362	329	313	**3582**
2002 D	348	247	276	286	265	291	227	309	309	384	384	368	**3694**
2003 BN	350	291	264	219	299	181	183	170	177	253	302	338	**3027**
2004 D	350	233	263	221	259	277	203	200	245	311	289	292	**3143**
Total	**2310**	**1928**	**1753**	**1441**	**1636**	**1498**	**1418**	**1491**	**1589**	**1310**	**1960**	**2030**	
Mean	**330**	**275**	**250**	**206**	**234**	**214**	**203**	**213**	**227**	**187**	**280**	**290**	**242**

*Data for this month not available. The value used is the average for the other 6 years.

Table 5-36. Total Organic Carbon in SWP supplies at the Tehachapi Afterbay (Check 41), 1998 through 2004 (from DWR 2005), mg/l (parts per million). Data summarized DWR sampling. Year Type: W = Wet; AN = Above Normal, N = Normal, BN = Below Normal, D = Dry

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1998 W	5	4.6	4.5	4.2	3.1	3.3	4.4	3.4	3	2.6	2.5	2.5	**43.1**
1999 AN	9.3	3.2	3.4	3.2	3.2	3.3	3.1	2.8	2.3	2.4	2.2	2.6	**41**
2000 AN	3.5	5.4	5.1	3.2	3.6	3.8	2.9	3.0	2.4	2.2	3.5	4.7	**43.3**
2001 D	5.9	5.3	5.0*	3.7	3.4	3.5	3.0	3.8	2.8	2.5	3.0	2.3	**39.2**
2002 D	5.2	6.4	7.0	4.0	2.8	6.4	4.2	2.8	2.8	3.4	3.3	2.7	**51**
2003 BN	3.4	3.2	3.5	3.0	3.6	2.9	3.0	3.4	2.4	2.5	2.4	3.0	**36.3**
2004 D	3.4	4.5	6.3	3.0	3.4	3.3	2.7	2.8	2.6	2.4	2.4	3.8	**40.6**
Total	**35.7**	**32.6**	**34.8**	**24.3**	**23.1**	**26.5**	**23.3**	**22**	**18.3**	**18**	**19.3**	**21.6**	
Mean	**5.1**	**4.7**	**4.97**	**3.5**	**3.3**	**3.8**	**3.3**	**3.1**	**2.6**	**2.6**	**2.8**	**3.1**	**3.57**

* No data for this month. Average of other 6 months substituted.

Table 5-37. Comparison of Metropolitan deliveries to existing water banks (total deliveries by month for 1993-2003) and mean monthly water quality data for 1998-2004.

PARAMETER	MEAN MONTHLY VALUE											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Metropolitan Water Bank Delivery (af)	**32,709**	**45,590**	**104,767**	**115,352**	**150,479**	**97,612**	**58,183**	**83,140**	**55,787**	**50,596**	**27,405**	**25,260**
Arsenic (ppb)	2.14	2.14	2.0	2.14	2.0	2.3	2.3	2.6	2.7	2.3	2.3	2.0
Boron (mg/l)	0.17	0.17	0.17	0.19	0.19	0.17	0.11	0.11	0.1	0.16	0.15	0.17
Bromides (mg/l)	0.29	0.19	0.16	0.15	0.17	0.14	0.13	0.17	0.17	0.28	0.25	0.28
Chromium (mg/l)	0.0051	0.005	0.004	0.0038	0.0043	0.0047	0.0036	0.0036	0.004	0.0041	0.004	0.038
Chlorides (mg/l)	89	63	52	51	59	50	49	54	53	83	82	85
Fluoride (mg/l)	0.1	0.11	0.11	0.1	0.11	0.11	0.1	0.1	0.1	0.1	0.1	0.1
Iron (mg/l)	0.015	0.019	0.014	0.0056	0.0051	0.0081	0.0074	0.0051	0.0050	0.0057	0.0050	0.0076
Lead (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrates (mg/l)	1.18	1.25	1.23	0.77	0.62	0.58	0.43	0.38	0.30	0.58	0.67	0.88
pH	7.94	7.91	7.74	7.9	8	7.8	7.94	7.67	7.98	7.88	7.82	7.81
Selenium (mg/l)	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008
Sulfate (mg/l)	45.8	49.9	51.3	39.9	34.4	31.3	28.1	25.1	22.0	30.3	34.3	42
TDS (mg/l)	330	275	250	206	234	214	203	213	227	187	280	290
TOC (mg/l	5.1	4.7	4.97	3.5	3.3	3.8	3.3	3.1	2.6	2.6	2.8	3.1

Table 5-38. Relationship between monthly Metropolitan deliveries to water banks (1993-2003) and monthly mean water quality in SWP supplies at Check 41 of the California Aqueduct (Pearson's rank correlation). A negative correlation (r-squared values in bold) indicates SWP water delivered to banks was associated with lower constituent levels.

RELATIONSHIP	R-SQUARED
Monthly Bank Deliveries vs Arsenic	**-0.20**
Monthly Bank Deliveries vs Boron	+0.41
Monthly Bank Deliveries vs Bromides	**-0.67**
Monthly Bank Deliveries vs Chlorides	**-0.67**
Monthly Bank Deliveries vs Chromium	**-0.12**
Monthly Bank Deliveries vs Fluorides	+0.54
Monthly Bank Deliveries vs Iron	**-0.22**
Monthly Bank Deliveries vs Lead	No relationship
Monthly Bank Deliveries vs Nitrates	**-0.13**
Monthly Bank Deliveries vs pH	+0.03
Monthly Bank Deliveries vs Selenium	**-0.64**
Monthly Bank Deliveries vs Sulfate	**-0.05**
Monthly Bank Deliveries vs TDS	**-0.49**
Monthly Bank Deliveries vs TOC	+0.07

Table 5-39. Comparison of SWP water quality to Lahontan Regional Water Quality Control Board Water Quality Objectives for the Mojave River Basin. Weighted mean annual value reflects the seasonal distribution of Metropolitan's banking deliveries per Table 5-22. Bold type indicates improved water quality associated with banking when compared to average annual values for 1998-2004.

WATER QUALITY ELEMENT	LRWQCB WATER QUALITY OBJECTIVES (MOJAVE RIVER AT VICTORVILLE)		SWP WATER QUALITY 1998-2004			
	Average Annual	Maximum (90th percentile)	Annual Mean	Annual Weighted Mean	Range of Monthly Variation	Range of Annual Variation (% of annual WQ Objective)
Arsenic (ppb)	NA	NA	2.24	**2.22**	1-4	1.92-2.60
Boron (mg/l)	0.2	0.3	0.155	**0.153**	0.02-0.2	0.09-0.18 (45%)
Bromides (mg/l)	NA	NA	0.198	**0.178**	0.01-0.47	0.12-0.29
Chlorides (mg/l)	75	100	64	**58.8**	2-134	37.5-84-7 (88%)
Fluoride (mg/l)	0.2	1.5	0.10	0.105	0.1-0.2	0.1-0.0.125 (12%)
Iron (mg/l)	NA	NA	0.0086	**0.0080**	0.005-0.047	0.006-0.011.6
Lead (mg/l)	NA	NA	<0.001	<0.001	No monthly variation	
Nitrates (mg/l)	5	NA	0.74	**0.72**	0.09-1.13	0.27-0.83 (11%)
pH	NA	NA	7.86	7.87	7.1-8.7	7.58-8.08
Selenium (mg/l)	NA	NA	0.0011	**.00104**	0.001-0.002	0.001-0.0011
Sulfate (mg/l)	40	100	36.2	**35.98**	4-60	27.7-43.4 (39%)
TDS (mg/l)	245-312	440	242	**231.4**	73-384	192.5-307.8 (37%)
TOC (mg/l	NA	NA	3.57	**3.29**	2.2-9.3	3.03-3.61

Table 5-40. Comparison of SWP water quality to Colorado River Regional Water Quality Control Board Water Quality Objectives for the Lucerne Basin. Weighted mean annual value reflects the seasonal distribution of Metropolitan's banking deliveries per table 5-22. Bold type indicates improved water quality associated with banking when compared to average annual values for 1998-2004.

WATER QUALITY ELEMENT	CRWQCB WATER QUALITY OBJECTIVES (MUNICIPAL SUPPLIES)		SWP WATER QUALITY 1998-2004			
	Average Annual	**Maximum**	**Annual Mean**	**Annual Weighted Mean**	**Range of Monthly Variation**	**Range of Annual Variation (% of annual WQ Objective)**
Arsenic (ppb)	NA	5	2.24	**2.22**	1-4	1.92-2.60 (14%)
Barium	NA	1.0	0.05	**NA**	NA	NA
Boron (mg/l)	0.2	0.3	0.155	**0.153**	0.02-0.2	0.09-0.18 (45%)
Bromides (mg/l)	NA	NA	0.198	**0.178**	0.01-0.47	0.12-0.29
Chlorides (mg/l)	NA	NA	64	**58.8**	2-134	37.5-84-7 (88%)
Chromium (mg/l)	NA	0.010	0.004	**0.0039**	0.001-0.007	0.0022-0.0056 (34%)
Dissolved oxygen (mg/l)	5-8	5-8	SWP does not routinely report DO in monthly grab sampling. Field sampling data suggest SWP DO is routinely 8.5 to 9.5 mg/l			
Fluoride (mg/l)	0.2	1.5	0.10	0.105	0.1-0.2	0.1-0.0.125 (12%)
Iron (mg/l)	NA	NA	0.0086	**0.0080**	0.005-0.047	0.006-0.012 (75%)
Lead (mg/l)	NA	0.05	<0.001	<0.001	No variation, below detection level of 0.001	
Mercury (mg/l	Not measured in SWP supplies					
Nitrates (mg/l)	NA	10	0.74	**0.72**	0.09-1.13	0.27-0.83 (6%)
pH	6-9	6-9	7.86	7.87	7.1-8.7	7.58-8.08 (8%)
Selenium (mg/l)	NA	0.01	0.0011	**0.00104**	0.001-0.002	0.001-0.0011 (1%)
Sulfate (mg/l)	NA	NA	36.2	**35.98**	4-60	27.7-43.4
TDS (mg/l)	NA	NA	242	**231.4**	73-384	192.5-307.8
TOC (mg/l	NA	NA	3.57	**3.29**	2.2-9.3	3.03-3.61

As illustrated on Tables 5-39 and 5-40, from 1998 through 2004 average annual water quality of SWP supplies never violated either Lahontan Regional Water Quality Control Board or Colorado River Regional Water Quality Control Board water quality objectives. However, the seasonal and annual variation in SWP water quality may be important for chlorides, for boron, sulfates, and for total dissolved solids because (a) there is some potential for Lahontan Regional Water Quality Board water quality objectives to be exceeded for these constituents in some years, and (b) water banking reduces the potential for levels of boron, chlorides, sulfates, and total dissolved solids to exceed water quality objectives. For other constituents, water quality objectives of the two Regional Water Quality Control Boards would not be substantially affected by monthly or inter-annual variation in SWP supplies. For all but boron, chlorides, sulfates, and total dissolved solids, the inter-monthly and inter-annual variations in SWP supplies are not great enough to cause water quality to exceed standards even on a monthly basis.

Tables 5-39 and 5-40 also show the effects of banking on average annual quality of SWP supplies delivered. The figures in bold are the weighted average annual values for SWP water quality constituents. If supplies are delivered per the historic banking pattern (Table 5-22), more supplies are delivered in months with generally better quality than in other months. Note that for fluoride and pH, banking deliveries are marginally detrimental in terms of water quality. For the remainder of the constituents, banking deliveries would improve water quality.

The analysis above describes the probable outcome of banking and exchange, and additional recharge and extraction facilities would also allow MWA to manage to preferentially take SWP supplies during periods when water quality is better. The actual delivery schedule may vary from that analyzed here. That said, a banking and exchange program would probably improve the water quality in SWP deliveries made to MWA's service area as a result of (a) allowing for greater deliveries during March through August and (b) allowing for greater deliveries during above-normal-to-wet years. These improvements would be most significant for chlorides, sulfates, and total dissolved solids. For these constituents, SWP supplies are near limit of the Regional Water Quality Control Boards' water quality objectives, and improvements associated with banking are thus particularly important. Banking and exchange programs would improve SWP water quality for arsenic, bromides, chlorides, sulfate, and TDS, but would result in worse water quality in regard to total organic carbon.

<u>Banking and Groundwater Quality</u>. Both the Lahontan Regional Water Quality Control Board and the Colorado River Regional Water Quality Control Board water quality objectives include provisions that are intended to protect groundwater. In general, their basin plans stress non-degradation of groundwater.

The difference in SWP water quality and indigenous water quality is thus an additional basis for comparing the effects of alternatives, because the mixing of SWP and indigenous water may affect the overall quality of water available for use. For this comparison (Table 5-41), it may again be assumed that SWP supplies delivered as part of a banking program would have water quality reflecting the weighted average water quality shown on Tables 5-39 and 5-40, not average SWP water quality.

Table 5-41. SWP above-normal-to-wet-year water quality (in mg/l) compared to average indigenous water quality, by subarea (Alto Floodplain, Alto Regional, Alto Transition Zone, Oeste Regional, Centro Floodplain, Baja Floodplain, Copper Mountain, Johnson Valley, Means/Ames Valley, and Warren Valley). Local subarea averages from 2004 PEIR.

Constituent	Concentration of Water Quality Constituents (mg/l)										
	State Water Project 1998-2004 (above normal to wet years)	Alto Floodplain	Alto Regional (west)	Alto Transition Zone	Oeste Regional	Centro Floodplain	Baja Floodplain	Copper Mountain	Johnson Valley	Means/Ames Valley	Warren Valley
Arsenic	0.0022	**.0052**	**0.0118**	**0.0062**	**0.004**	**0.0063**	**0.0104**	**0.0049**	0.0019	**0.0038**	**0.0043**
Boron	0.153	0.081	0.037	**0.531**	0.058	**0.772**	**0.931**	**0.133**	**0.525**	**0.157**	0.068
Bromides	0.178	Not routinely measured in local supplies.									
Chlorides	58.8	17.3	2.4	**80.8**	16.3	**132.2**	**132.7**	22.4	**147.3**	19.9	24.4
Fluoride	0.105	**0.580**	**0.697**	**1.297**	**0.627**	**0.651**	**0.707**	**1.612**	**1.355**	**1.380**	**0.518**
Iron	0.008	**0.020**	**0.076**	**0.732**	**0.013**	**0.214**	**0.119**	**0.044**	**0.058**	**0.0098**	**0.015**
Lead	<0.001	Not routinely measured in local supplies.									
Nitrates	0.72	0.35	0.09	0.24	0.45	**3.50**	**6.13**	**2.21**	**0.73**	**6.06**	**8.51**
pH	7.87	**7.9**	**8.5**	7.8	**8.2**	7.6	7.7	**8.1**	7.7	7.6	**7.9**
Selenium	.00104	Not routinely measured in local supplies.									
Sulfate	35.98	17.4	24.7	**123**	**192.5**	**217**	**169.7**	**48.8**	**389.1**	**59.6**	23.2
TDS	231.4	156.0	**245.5**	**518**	**395.6**	**785**	**562.6**	**241.2**	**912.7**	**275.7**	**219.2**

In a program in which banked water is returned entirely by exchange, recharge of SWP supplies per the delivery schedule shown on Table 5-22 would result in enhancement of indigenous groundwater for some constituents and degradation of groundwater in terms of some other constituents. For the nine constituents for which there is consistent data on water quality, recharged water would enhance indigenous groundwater quality in 72% of cases.

- Arsenic: Recharged SWP supplies would be of better quality than indigenous groundwater in 9 of the 10 basins receiving direct recharge. In the Johnson Valley, recharged water would vary from indigenous groundwater by 0.0003 mg/l.
- Boron: Recharged SWP supplies would be of better quality than indigenous groundwater in 5 of the 10 basins receiving direct recharge. In the five basins in which indigenous groundwater would be of better quality, recharged water would have boron concentrations of 15% to 205% higher than the indigenous groundwater.
- Chlorides: Recharged SWP supplies would be of better quality than indigenous groundwater in 4 of the 10 basins receiving direct recharge. Chloride levels in SWP supplies would be substantially higher than those in the remaining 6 groundwater basins.
- Fluoride: Recharged SWP supplies would be of better quality than indigenous groundwater in all 10 of the basins receiving direct recharge.

- Iron: Recharged SWP supplies would be of better quality than indigenous groundwater in all 10 of the basins receiving direct recharge.
- Nitrates: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 5 of the 10 basins receiving direct recharge, and of substantially lower quality in the other 5 basins.
- pH: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 5 of the 10 basins receiving direct recharge, and of substantially lower quality in the other 5 basins.
- Sulfate: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 7 of the 10 basins receiving direct recharge, and of substantially lower quality in the other 3 basins.
- TDS: Recharged SWP supplies would be of substantially better quality than indigenous groundwater in 8 of the 10 basins receiving direct recharge, and marginally lower quality in the other 2 basins.

5.13.3 Effects of the Proposed Project, General

The groundwater effects of banking operations need to be considered from two perspectives:

- First, would the Proposed Project result in violations of DHS drinking water standards?
- Second, in what ways and to what extent would the Proposed Project affect indigenous groundwater?

5.13.3.1 Drinking Water Standards

Department of Health Services drinking water standards establish maximum limits for selected constituents. Table 5-42 compares these standards to average SWP water quality. Table 5-42 does not address DHS and EPA standards for a very long list of pollutants associated with point-source discharges and contaminated groundwater. California Department of Water Resources routinely tests for these contaminants and SWP supplies do not violate them.

Table 5-42 compares DHS drinking water quality standards to the average and maximum concentration detected in SWP supplies at Check 41 on the California Aqueduct (upstream of MWA's diversions). Note that Department of Water Resources does not routinely monitor for some constituents. Data are from DWR (2001, 2005 as indicated). For all primary inorganic chemical standards, the both average and maximum concentrations in SWP water delivered to MWA were below DHS standards. Average SWP concentrations are less than 50% of DHS drinking water standard levels for all measured constituents.

Table 5-42. California Department of Health Services drinking water standards compared to the highest concentrations of mineral constituents in SWP supplies (1998-2004).

Constituent	CONSTITUENT CONCENTRATION AT CHECK 41 OF THE CALIFORNIA AQUEDUCT (in mg/l)			
	DHS Maximum Level (DHS 2003)	SWP Concentration		Average concentration in SWP water as a % of DHS Maximum Concentration
		Average	Maximum	
Aluminum	1.0	0.01(a)	0.01	1%
Antimony	0.006	Not Measured	Not Measured	NA
Arsenic	0.005	0.0022 (b)	0.004	44%
Asbestos	7 MFL	Not Measured	Not Measured	NA
Barium	1.0	0.05(a)	0.05	5%
Beryllium[c]	0.004	<0.001	<0.001	<25%
Cadmium	0.005	0.001(a)	0.001	20%
Chromium	0.05	0.004(a&b)	0.007	8%
Cyanide	0.15	Not Measured	Not Measured	NA
Chloride	250	64(b)	134	26%
Copper (CAL)	1.0	0.002(a)	0.003	<1%
Fluoride	2.0	0.1 (a&b)	0.2	5%
Iron (CAL)	0.3	0.09	0.27	30%
Lead	0.15	<0.001(a&b)	<0.001	<1%
Manganese	0.05	0.005(a)	_0.005	10%
Mercury	0.002	0.0002(a)	0.0002	10%
Nitrate + Nitrite	10	0.85 (a&b)	1.9	9%
Nitrates	10	0.74	NA	7%
pH	8.5	7.8 (b)	NA	Percent comparison not appropriate
Selenium	0.05	<0.002(a&b)	0.002	4%
Silver (CAL)	0.1	0.001(a)	0.001	1%
Sulfate	250	36 (a&b)	60	14%
TDS	500	242 (a&b)	384	48%

Notes:

CAL = Refers to Consumer Acceptance Limits, which are secondary levels of drinking water standards
a. = Data from 1998-1999 in DWR Annual Report (2001)
b. = Data from 1998-2004, as summarized on Tables 5-22 through 5-36
c. Beryllium measured from April 2000 through December 2004

5.13.3.2 Effects of the Proposed Project on indigenous groundwater

Dissolved Organic Carbon Introduction to Groundwater. TOC and DOC levels are not specified in the Basin Plan Objectives for either the LRWQCB or the CRWQCB, but SWP supplies will introduce dissolved organic carbon compounds to receiving groundwaters. As noted in discussion of mechanisms for Proposed Project effects, bacterial interactions with carbon compounds rapidly remove as much as 50% of TOC from recharged water. Banking and exchange will involve import of supplies of better-than-average SWP water quality in regard to

TOC and will therefore reduce introduction of TOC to groundwater when compared to the No Project Alternative.

Changed Groundwater Levels. Rising groundwater levels are an objective of recharge, and groundwater levels in the vicinity of recharge sites will rise. Bookman-Edmonston (2004b) cites estimates of mounding beneath recharge basins resulting in groundwater levels rising up to 90 feet. Long-term groundwater levels in existing recharge basins will probably not be raised significantly beyond levels projected for the No Project Alternative, because banked and exchanged water will be delivered to these basins in amounts needed to meet local water supply needs and returns will be made via exchange of SWP supplies that would otherwise be delivered to these sites. Nonetheless, pre-delivery of banked supplies and the 10% loss factor associated with banking operations will mean that groundwater levels at existing facilities will rise somewhat, with local producers extracting supplies in-lieu of new deliveries during years when banked supplies are returned to Metropolitan. The known nitrate contamination problem in the Morongo Basin, caused by rising groundwater levels encountering concentrations of nitrates from septic tank discharges, will be monitored and deliveries to this basin managed to ensure that water banking does not exacerbate this potential problem.

In the Alto and Oeste areas, groundwater levels in the Floodplain Aquifer can be expected to rise beneath recharge basins and beneath the Mainstem Mojave River. In the Regional Aquifer, where lateral movement of supplies is low, recharge may result in mounding and substantial increases in groundwater levels. Given the heavy overdraft conditions of the Regional Aquifer, this would be seen as a benefit. At best, groundwater levels would be expected to rise 100+ feet. Given current groundwater depths of 200 to 600 feet, this would not cause potential liquefaction effects. In addition, with the exception of Oeste and Alto recharge basins of the Large Projects Alternative, groundwater basins are being sited in locations where natural recharge occurs and there is on-going extraction of stored groundwater. There is no present evidence that rising groundwater levels in these areas would encounter contaminated surface water or soils, but monitoring of extractions from these areas for water quality would rapidly identify potential problems associated with rising groundwater levels encountering influences of surface water and/or existing soil contamination. If this is identified, recharge may be shifted to other sites while the problem is analyzed and addressed.

Chemical Interactions: Arsenic Mobilization Potential. SWP supplies have higher iron concentrations and dissolved oxygen than indigenous groundwater, and in the Alto and Oeste subareas are higher in nitrates. Based on Oremland (2002), this suggests that recharge of these supplies will reduce rather than increase arsenic mobilization. In addition, recharge sites have been selected to avoid areas with clays and fine-grained soils in which soluble mineral concentrations are high and leaching is likely to occur. SWP supplies are also low in arsenic compared to much of the groundwater in MWA's service area, and may dilute arsenic concentrations in receiving groundwater. The effect of the Proposed Project on leaching of minerals from soils, particularly arsenic, is likely to be minor.

Mass Loading of Chemical Constituents. The import of water to a closed groundwater basin (one that does not discharge to the ocean) inherently involves the net import of salts (Colorado River Regional Water Quality Control Board, 2003 Basin Plan). There are potential detrimental long-term impacts associated with a net increase in minerals in the groundwater. As noted Table 5-42, the effect of banking and exchange programs is to pre-deliver water for later use, thereby extending the period during which MWA may meet replacement water requirements with its average annual SWP supply of 58,400 acre-feet. Under the No Project Alternative, MWA would not be able to pre-delivery as much water and would not be able to focus those deliveries in wet years and only during months of better water quality. The accelerated development of recharge and associated facilities proposed for the water banking and exchange project allows MWA to pre-deliver high-quality supplies. But, throughout the 20-30-year period of the proposed project, MWA would use approximately the same volume of water to meet its replacement water obligations. Given MWA's isolation from other sources of supply, when MWA's replacement water obligations begin to exceed available SWP contract allocations sometime after 2020, MWA would probably meet water supply needs by acquiring additional SWP supplies through transfers, from the DWR water bank, or from Article 21 supplies. All of these are SWP sources and, over the long-term, would have the same average annual water quality.

The effect of water banking and exchange on mass loading of chemical constituents in the groundwater basins is therefore to provide slightly better water quality through pre-delivery of water in wet years, with returns via exchange in dry years. The probable monthly variation in deliveries will also enhance water quality. Mass loading of minerals as a result of banking and exchange will therefore be lower than under the No Project Alternative.

A second perspective on mass loading is suggested by the Basin Plan for the Colorado River Regional Water Quality Control Board (2003), which notes that the alternative to importing water to recharge groundwater basins is extraction and use of more groundwater. Continued overdraft means pumping from greater depth. Monitoring in the MWA service area indicates that pumping from greater depth is associated with poorer quality water. Urban uses of this groundwater result in evaporation, addition of some chemical constituents such as nitrates from fertilizers, and then recharge of this lower-quality water back to the groundwater basin following treatment. The result of re-use of groundwater is a progressive increase in the concentrations of chemicals in indigenous groundwater. Imported SWP water if of better quality than existing groundwater in 72% of cases (Table 5-41) and thus has the effect of diluting indigenous groundwater, improving its overall quality. This dilution effect is particularly important in terms of arsenic, sulfate, and TDS, where indigenous groundwater in many areas is already above recommended levels for drinking water.

The banking and exchange project will therefore slightly reduce the net import of chemical water constituents when compared to the import of average-quality SWP supplies, will dilute indigenous groundwater, and will dilute reclaimed water being recharged.

The beneficial effects of banking and exchange in terms of mass loading will be most pronounced in areas where indigenous groundwater is of lower quality. In the Alto subarea

Mojave River Floodplain Aquifer, import of SWP supplies will increase levels of boron, chlorides, nitrates, sulfates, and TDS, but this water will be extracted on a continuous basis at the boundary of the alluvial and regional aquifer. Its use will reduce use of groundwater from the regional aquifer, which is of poorer quality than that of the floodplain aquifer. As a result, regional aquifer supplies may be less utilized and recharge of concentrated regional aquifer supplies in reclaimed water may be reduced. This will affect key water quality constituents such as arsenic, which will be diluted by SWP supplies.

Impacts associated with mass loading are therefore best expressed as trade-offs. Given the advantages of pre-delivery of supplies made possible by the expended recharge capacity of the banking and exchange project, the net impact of the banking and exchange project on indigenous water quality will be beneficial. No significant mass loading impacts are anticipated.

Banking Operations and Water Supply. For impact analysis, water supply and water quality with banking and exchange must be compared to water supply and water quality without banking and exchange. With a banking and exchange program, MWA would import more SWP supplies than it currently does. The general effects of these increased imports on water supply are analyzed below.

With the exception of supplying about 5,000 acre-feet of surface water to two regional power plants, MWA imports of SWP supply (or other supplies available to it) are always recharged to (a) replace water produced in excess local supplies (b) store water for future use. At present, MWA has limited capacity to import water to offset groundwater overdrafting, although pre-delivery of SWP supplies occurs. Without a banking program and facilities to allow import of relatively large amounts of water in a short period of time to take advantage of surplus conditions during wet years, MWA will import supplies at a rate approximately equal to demand; that is, it will use the portion of its SWP supply and other available supply necessary to meet local demand and accomplish storage for future use.

Over a period of 25 to 30 years, this approach would result in a slow increase in MWA's SWP imports and recharge, until, sometime after 2020, average annual demand for supplemental supply is approximately equal to average annual SWP supply. At this point, MWA will either (a) need to acquire and recharge additional supplies to meet demand for replacement water or (b) use pre-delivered groundwater supplies to supplement available SWP supplies.

With a water banking program which enhances MWA's recharge and extraction facilities, particularly a program that involves return of banked supplies via exchange of SWP allocations and not direct return of groundwater, MWA would pre-deliver more SWP and other supply to address groundwater overdraft. To the extent that returns of banked supplies can be made via exchange, water pre-delivered to recharge in excess of replacement demand would offset groundwater overdraft and, following 2020, allow MWA to meet demands for replacement water for an extended period of time without obtaining new supplies. Thus, for example, if banking and exchange operations allow MWA to import 60,000 acre-feet of supply more than required for on-going demand between 2005 and 2020, and this banked water can be returned via exchange, MWA could use this pre-delivered water to help meet post 2020 demand, without seeking new supplies. Assuming an average annual SWP Table A supply of 58,400 acre-feet, and an annual increase in demand for replacement water of 1,500 each year following 2020, the 60,000 acre-feet of pre-delivered water would extend MWA's ability to meet demand as shown on Table 5-43. Banking and exchange programs do not, therefore, result in a net increase in projected groundwater supply, they only change the timing of delivery and recharge.

Table 5-43. Hypothetical extension of MWA supply reliability with a net 60,000 acre-foot pre-delivery from banking/exchange programs.

YEAR	REPLACEMENT DEMAND (af)	SWP SUPPLY (af)	SUPPLY DEFICIT (af)	WITHDRAWAL FROM BANK (60,000 af balance)	REMAINING BANK BALANCE (af)
2021	59,900	58,400	1,500	-1,500	58,500
2022	61,400	58,400	3,000	-3,000	55,500
2023	62,900	58,400	4,500	-4,500	50,000
2024	64,400	58,400	6,000	-6,000	44,000
2025	65,900	58,400	7,500	-7,500	36,500
2026	67,400	58,400	9,000	-9,000	27,500
2027	68,900	58,400	10,500	-10,500	17,000
2028	70,400	58,400	12,000	-12,000	5,000
2029	71,900	58,400	13,500	-5,000	0 (DEFICIT)

5.13.3.3 Water Quality from Wells in the Vicinity of Proposed Project Facilities

The following analysis was added to the FEIR to address a request for clarification in Department of Water Resources comments on the draft EIR.

To the extent that MWA makes returns to Metropolitan using supplies pumped from groundwater, it will need to ensure that these supplies meet any DWR requirements for introduction to the California Aqueduct. The data to address the potential for introduction of groundwater is generally provided in the EIR, but we appreciate DWR's suggestion that we clarify this issue. As the EIR notes in Chapters 3 and 4, the project could involve pump-back to the California Aqueduct from the Mojave River Aquifer upstream of the Mojave Narrows and from wells sited adjacent to potential groundwater recharge facilities. Proposed operations at these sites would generally involve import and recharge of SWP supplies and MWA would seek to optimize the water quality of the supplies delivered through scheduling. Given that wells would be located within about 0.5 miles of the river and within about 0.25 miles from the inland groundwater recharge basins, a vast majority of the supply returned to the California Aqueduct for delivery to Metropolitan via direct pump back would be a mix of SWP supply and indigenous groundwater with some potential for leaching of minerals during recharge.

Deliveries to the California Aqueduct would, however, probably be dominated by exchange, and groundwater pumped back would be monitored and managed to ensure that resulting water quality in the Aqueduct was not degraded. The mix of SWP water and indigenous water in the Mojave River Aquifer (see Table 5-41) would enhance water quality when compared to that in the Aqueduct for some constituents. For other constituents, there would be potential lowering of water quality. A 50-50 mix of SWP and indigenous groundwater from this aquifer would routinely result in a blend that meets DHS drinking water standards for mineral constituents because the water quality of both sources is good.

Pump-back of a mix of SWP water and indigenous groundwater from the Alto and Oeste portions of the Regional Aquifer (Table 5-41) would be of marginally poorer quality, given general levels of some mineral constituents in this aquifer, including arsenic. However, recharge basins have been sited to avoid soil types that contain high levels of arsenic, and indigenous groundwater quality in these areas would be less affected by arsenic as a result. It is thus likely that a mix of SWP water and indigenous groundwater at these recharge sites would result in a blend that would meet DHS drinking water standards for mineral constituents.

The water quality criteria for acceptance of non-project water into the State Water Project are discussed in the *Interim Department of Water Resources Water Quality Criteria for Acceptance of Non-Project Water Into the State Water Project* (dated March 1, 2001) and *Implementation Procedures for the Review of Water Quality from Non-Project Water Introduced into the State Water Project* (dated March 14, 2001). Under these criteria, the quality of the non-SWP water is compared to the ambient water quality of SWP water for the period 1988 through 2004. The criteria reflect that the ambient quality can vary by season and by year-type. If the water is accepted, then monitoring is required to confirm that the water continues to meet the requirements.

DWR has used a two-tier approach for accepting non-project water into the California Aqueduct. Tier 1 programs have a "no adverse impact" criteria and are tied to historical water quality levels in the California Aqueduct. Programs meeting the Tier 1 criteria would likely be approved by DWR. Tier 2 programs would have water quality levels that exceed the historical water quality levels in the California Aqueduct for at least one or more constituents, and so could cause adverse impacts to state water contractors. Tier 2 programs would be referred to a state water contractor facilitation group, which would review the program and make recommendations for DWR's consideration of the project. Under Tier 1, all constituents of non-project water should be within the historical water quality levels measured at the O'Neill Forebay Outlet (formerly measured at Check 13) on the SWP as measured by DWR's water quality monitoring program.

The EIR analysis in Section 5.13.2 and 5.13.3.1. and 5.13.3.2 (above) was based on aggregate groundwater quality data from a number of local wells in the Mojave River Floodplain Aquifer and the adjacent Alto Regional Aquifer. The EIR notes that data from wells located adjacent to groundwater recharge basins is likely to be of better quality, primarily because the proposed recharge sites have been sited to avoid areas with known soils/mineral problems. To clarify this point, MWA has identified a number of wells in the vicinity of the proposed project facilities and has evaluated recent (2004 and 2005) water quality data for these wells. The results of this evaluation are discussed below, with an explicit comparison between current DWR water quality criteria and Department of Health Services drinking water standards. See Tables A through G, in Appendix A, for details.

Indigenous groundwater quality compared to DWR criteria and DHS drinking water standards.

a. Oeste Recharge Basins

Data on indigenous water quality from two wells located about 1 mile downgradient from the proposed Oeste recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). Only one data point (a maximum value for manganese at well number 05N07W28L01) was in excess of DHS drinking water criteria. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-A. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies. These data are the only representative data currently available nearby. Development of any recharge locations would necessarily entail addition geohydrologic site investigations, including site-specific water quality analysis.

Table 5-A. Indigenous water quality from two wells located about 1 mile downgradient from the proposed Oeste recharge basins.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	1	100
Antimony (ug/l)	3	1	5	**6**	**6**
Arsenic (ug/l)	2	1	4	2	2
Barium (ug/l)	50	37	68	**40**	**100**
Beryllium (ug/l)	1	1	1	1	1
Bromide (ug/l)	NA	NA	NA	NA	NA
Cadmium (ug/l)	4	1	5	1	1
Chromium (ug/l)	5	1	11	**10**	**15**
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	**0.17**	0.32
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	**180***
Mercury (ug/l)	0.8	0.2	1	**1**	1
Nickel (ug/l)	1	1	4	**10**	**10**
Nitrate (mg/l)	3.5	0.6	9.6	1	7.9
Selenium (ug/l)	1	1	2	**5**	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	1.9	**184**
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

* Exceeds DHS MCL

b. Alto Recharge Basins

Data on indigenous water quality from one well located to the west and downgradient about a mile from the proposed Alto recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were exceeded in one sample for arsenic. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-B. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-B. Indigenous water quality from one well located to the west and downgradient about a mile from the proposed Alto recharge basins.

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	2	**14***
Barium (ug/l)	50	37	68	0	100
Bromide (ug/l)	NA	NA	NA	NA	NA
Beryllium (ug/l)	1	1	1	0	1
Cadmium (ug/l)	4	1	5	0	1
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	**0.38**	**0.8**
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	0.95	3.9
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	31	87.4
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

* Exceeds DHS MCL

c. Oro Grande Recharge Basins

Data on indigenous water quality from four wells located in the general vicinity of the proposed Oro Grande Recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). Wells were located upstream (H01), downstream (M01 and E08) and in a developed area to the east (13J01). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-C. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies, although bromides were evaluated at several of the Oro Grande wells.

Table 5-C. Indigenous water quality from four wells located in the general vicinity of the proposed Oro Grande Recharge basins

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	60
Antimony (ug/l)	3	1	5	ND	0
Arsenic (ug/l)	2	1	4	1.6	**5.7**
Barium (ug/l)	50	37	68	0	8.4
Beryllium (ug/l)	1	1	1	ND	0
Bromide (ug/l)	0.21	0.05	0.54	0.16	0.5
Cadmium (ug/l)	4	1	5	ND	0
Chromium (ug/l)	5	1	11	0	**42.9**
Copper (ug/l)	5	2	28	ND	0
Fluoride (mg/l)	0.11	0.01	0.55	0.2	**27**
Iron (ug/l)	47	5	416	0	127
Manganese (ug/l)	10	3	60	0	**161**
Mercury (ug/l)	0.8	0.2	1	0	0
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	0.02	0.52
Selenium (ug/l)	1	1	2	ND	0
Silver (ug/l)	4	1	5	0	0
Sulfate (mg/l)	43	17	99	3	34
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	ND	0

d. Cedar Avenue Detention Basin

Data on indigenous water quality from a well located about 1.5 miles downslope and to the west of the proposed Cedar Avenue Recharge basin were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-D. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-D. Indigenous water quality from a well located about 1.5 miles downslope and to the west of the proposed Cedar Avenue Recharge basin

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	0	**10**
Barium (ug/l)	50	37	68	0	**100**
Beryllium (ug/l)	1	1	1	0	**1.8**
Bromide (ug/l)	0.21	0.05	0.54	0	0
Cadmium (ug/l)	4	1	5	0	1.75
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	0.08	0.4
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	0.5	3.2
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	1.8	10.8
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**70**

e. Antelope Wash recharge Basins

Data on indigenous water quality from a well located about a mile downgradient and to the west of the proposed Antelope Wash recharge basins were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-E. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-E. Indigenous water quality from a well located about a mile downgradient and to the west of the proposed Antelope Wash recharge basins

CONSTITUENT	SWP WQ 1988-2004 (GUIDELINES)			INDIGENOUS WATER QUALITY	
	MEAN	MIN	MAX	MIN	MAX
Aluminum (ug/l)	30	4	527	0	0
Antimony (ug/l)	3	1	5	0	0
Arsenic (ug/l)	2	1	4	0	0
Barium (ug/l)	50	37	68	0	0
Beryllium (ug/l)	1	1	1	0	0
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	0
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	0
Fluoride (mg/l)	0.11	0.01	0.55	0.1	0.2
Iron (ug/l)	47	5	416	0	0
Manganese (ug/l)	10	3	60	0	0
Mercury (ug/l)	0.8	0.2	1	0	0
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	4	6
Selenium (ug/l)	1	1	2	0	0
Silver (ug/l)	4	1	5	0	0
Sulfate (mg/l)	43	17	99	3.7	3.9
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	0

f. Green Tree Recharge Basin

Data on indigenous water quality from a well located within the site of the proposed Green Tree recharge basin were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-F. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-F. Indigenous water quality from a well located within the site of the proposed Green Tree recharge basin

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	50
Antimony (ug/l)	3	1	5	0	**6**
Arsenic (ug/l)	2	1	4	0	**8**
Barium (ug/l)	50	37	68	0	**100**
Beryllium (ug/l)	1	1	1	0	1
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	1
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50**
Fluoride (mg/l)	0.11	0.01	0.55	0.1	0.12
Iron (ug/l)	47	5	416	0	100
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	**10**
Nitrate (mg/l)	3.5	0.6	9.6	2.1	2.7
Selenium (ug/l)	1	1	2	0	**5**
Silver (ug/l)	4	1	5	0	**10**
Sulfate (mg/l)	43	17	99	6.7	8.7
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50**

g. Mojave River Well Field

Data on indigenous water quality from 3 wells located near the proposed Mojave River Well Field were compared to DWR pump-back criteria and DHS drinking water criteria (MCLs and Guidelines). DHS drinking water criteria were not exceeded for any constituent monitored. Indigenous water quality is compared to DWR pump-back criteria/guidelines on Table 5-G. Note that bromides and total organic carbon are not routinely monitored in groundwater supplies.

Table 5-G. Indigenous water quality from 3 wells located near the proposed Mojave River Well Field

CONSTITUENT	**SWP WQ 1988-2004 (GUIDELINES)**			**INDIGENOUS WATER QUALITY**	
	MEAN	**MIN**	**MAX**	**MIN**	**MAX**
Aluminum (ug/l)	30	4	527	0	100
Antimony (ug/l)	3	1	5	0	0
Arsenic (ug/l)	2	1	4	0	**10***
Barium (ug/l)	50	37	68	0	**500***
Beryllium (ug/l)	1	1	1	0	0
Bromide (ug/l)	0.21	0.05	0.54	NA	NA
Cadmium (ug/l)	4	1	5	0	5
Chromium (ug/l)	5	1	11	0	10
Copper (ug/l)	5	2	28	0	**50***
Fluoride (mg/l)	0.11	0.01	0.55	**0.23***	0.4
Iron (ug/l)	47	5	416	0	110
Manganese (ug/l)	10	3	60	0	30
Mercury (ug/l)	0.8	0.2	1	0	1
Nickel (ug/l)	1	1	4	0	0
Nitrate (mg/l)	3.5	0.6	9.6	0.7	9.33
Selenium (ug/l)	1	1	2	0	**5***
Silver (ug/l)	4	1	5	0	**10***
Sulfate (mg/l)	43	17	99	3	16.1
Total Organic Carbon (ug/l)	Not routinely monitored				
Zinc (ug/l)	9	5	21	0	**50***

* Values from Well 04N04W24G01, south and a mile inland from the river channel.

The summary data on Tables 5-A through 5-G are detailed on Tables A through G (Appendix B). The data on the detailed tables suggest (a) there is substantive variation in indigenous groundwater quality from well site to well site. For example, all of the values in excess of current DWR pump-back criteria shown on Table 5-G (Mojave River Well Field) are from a well a mile inland from the Mainstem River and at the southern boundary of the probable well field. These data are probably not representative of the water quality likely from the Mojave River Well Field; based on the data from the two wells closer to the river and further downstream, water in the Mojave River Well Field is of consistently better quality (See Table G in Appendix A).

The data also show that indigenous groundwater quality in the vicinity of the major washes (Oro Grande and Antelope Wash) is of better quality, probably reflecting the influence of natural recharge of good quality runoff from the mountains through a sandy substrate.

The data also show that, with only three exceptions, the indigenous water quality in existing wells near the proposed recharge basins is equal to or better than Department of Health Services drinking water criteria. In addition, indigenous water quality is equal to or better than DWR historic water quality at O'Neal Forebay (1988-2004) from many constituents. This is particularly true for the Mojave River Well Field and Antelope Wash. It is also notable (see Tables A through G in Appendix A) that indigenous water quality in the Floodplain and Alto Regional aquifers has consistently low levels of hydrocarbon constituents such as petroleum products and pesticides and herbicides.

In general, these data are consistent with the more generalized findings in the DEIR. They suggest that indigenous groundwater at the proposed sites is of generally better quality than the SWP pump-back guidelines for aluminum, cadmium, iron, manganese, mercury, nitrate, and sulfate and may generally exceed pump-back guidelines for antimony, barium, copper, fluoride, nickel, selenium, silver, and zinc. The well data suggest that maximum concentrations of mineral constituents are the primary issue related to pump-back operations.

These data suggest that pump-back of water from the Antelope Wash and Mojave River Well Field would meet or exceed pump-back guidelines. Water from these sources may be blended with water from other recharge areas to bring overall pump-back into compliance with current pump back guidelines. It should also be noted that wells would be sited to intercept recharged groundwater and that much of the water pumped back to the California Aqueduct would be a mix of indigenous groundwater and banked SWP supplies. It is likely that mixing of SWP and indigenous water supplies would result in a lower potential for maximum levels of various constituents to be in excess of current pump-back guidelines.

As noted in the Project Description, MWA would site wells to optimize water supply and quality and would routinely monitor groundwater quality. Where stored supplies may be used for pump-back of supplies to the California Aqueduct, this monitoring would include monitoring for all relevant constituents identified by DWR as water quality criteria for acceptance of Non-Project Water Into the State Water Project. Based on this monitoring, MWA believes that it could operate to supply water to the California Aqueduct that would meet current and future DWR pump back criteria or guidelines.

5.13.4 Alternative Impacts

5.13.4.1 Minimum Facilities Alternative

For recharge in the Baja, Centro, and Morongo Basin subareas, the Minimum Facilities Alternative would result in deliveries to existing recharge basins of approximately the same amount of water that would be imported and recharged for MWA to meet its replacement obligations.

In the Alto subarea, the Minimum Facilities Alternative, with its emphasis on use of the Mojave River bed for recharge and on continuous extraction of recharged water at the interface of the two aquifers, would mean that water introduced into the Mojave River Floodplain Aquifer would be extracted and used within several years of its recharge, with some potential loss to the Narrows and to the downstream subareas. To some extent, banked water deliveries would thus be utilized in lieu of extractions from other portions of the Regional Aquifer.

Biological Water Quality. Biological water quality is an issue in the Morongo Basin, where rising groundwater levels at recharge sites have in some areas co-mingled with water moving into recharge areas from septic systems. The banking program would have no effect on this problem (compared to normal operations) because banked water would be delivered at the same rate as required replacement water deliveries.

The potential for rising groundwater levels in the Mojave River Floodplain Aquifer to affect water quality in existing and new wells would depend on well siting, well depth, and the characteristics of the soils into which the well has been drilled. To the extent feasible, MWA will site wells near the interface of the Mojave River Floodplain Aquifer and the Regional Aquifer to optimize the potential for removal of bacteria, viruses, and other biological elements of concern, consistent with the need to extract groundwater at a rate approximately equal to the recharge rate. The interface of the recharge and extraction operations can generally be managed to ensure that surface flows do not occur in the vicinity of the well field for an extended period of time. Downstream underground flow rates in the Mojave River are estimated at 100 feet per day, with lateral flow rates (flow away from the river channel towards the Regional Aquifer) being substantially lower. Assuming that lateral flow rates in the Mojave River Floodplain Aquifer are about 50 feet per day and wells will draw water from a depth of several hundred feet, it is likely that wells located off channel will not intercept water until it has migrated through the ground for a period of 10 to 40 days, depending on well placement.

Bacterial water quality is therefore not considered a significant problem for new wells proposed. There may be some surface influences at existing wells, particularly shallow wells which draw directly from the Mojave River Floodplain Aquifer.

Leaching of Minerals during Recharge. Leaching of minerals during Mainstem Mojave River recharge is unlikely to occur because this area is routinely inundated, contains no lenses of fine grained materials that are generally associated with leaching of soluble minerals.

Banking and Exchange versus Normal Operations. The Minimum Facilities Alternative will result in import of about 183,000 to 270,000 acre-feet of SWP supplies, primarily during periods when SWP supplies are of better quality than average year/season supplies. The maximum capacity of the Minimum Facilities Alternative for pumping and return of banked groundwater to the California Aqueduct is 18,000 acre-feet per year. The remainder of returns to Metropolitan would be via exchange, in which dry-year SWP supplies would be delivered to Metropolitan and MWA producers utilized banked groundwater. The net result of banking and exchange would be import of optimal quality SWP supplies per the typical delivery schedule shown on Table 5-22 and the return of (a) MWA SWP dry-year supplies of poorer quality than those delivered for banking and (b) a blend of SWP and Floodplain Aquifer supplies pumped from the Mojave River Well Field. Under normal operations, MWA would import SWP supplies resulting in import of water of generally poorer water quality for most constituents. The water quality difference in with project versus normal operations can be expressed as a set of tradeoffs (Table 5-44).

Table 5-44. Minimum Facility Alternative water quality tradeoffs: Banking versus normal operations.

CONDITION	EFFECT OF BANKING ON MWA SUPPLY	
	Benefit	**Detriment**
Import of SWP supplies per Table 5-22 compared to average annual SWP water quality	Lower arsenic, boron, bromides, chlorides, chromium, iron, nitrates, sulfate, selenium, TDS, and TOC	Higher fluoride and pH
Return of banked water via pumping a mix of SWP and MR Floodplain Aquifer supplies	Net export of arsenic, fluorides, and iron	Net import of boron, bromides, chlorides, sulfate, TDS and TOC

<u>Mixing of SWP supplies with Indigenous Groundwater: SWP Water Quality versus Indigenous Water Quality</u>. To the extent that recharged supplies are not used to make direct returns to Metropolitan, they will slowly move down gradient and mix with indigenous groundwater. Indigenous groundwater that would receive banked supplies from the SWP is of varying quality; no basin has identical water quality and SWP supplies that would be delivered for banking purposes. Again, the effect of mixing SWP and indigenous water supplies is best expressed as a set of tradeoffs, by subarea (Table 5-45). In addition, there is a potential for rising groundwater in the Yucca valley area to mix with nitrate-rich groundwater migrating into the recharge areas from septic systems. This potential mixing concern may limit use of some recharge areas in the Morongo Basin to prevent groundwater levels from rising to the point where they will be affected.

Table 5-45. Minimum Facility Alternative water quality tradeoffs: SWP versus indigenous groundwater.

SUBAREA	EFFECT OF BANKING ON MWA SUPPLY	
	Benefit	**Detriment**
Alto Floodplain	Lower arsenic, fluorides, iron, & pH	Higher boron, chlorides, bromides, nitrates, TOC, sulfates, & TDS
Alto Regional	Lower arsenic, fluorides, iron, pH, & TDS	Higher boron, chlorides, bromides, nitrates, sulfates, & TOC
Centro Floodplain	Lower arsenic, chlorides, iron, sulfate, & TDS	Higher bromides & TOC
Baja Floodplain	Lower arsenic, chlorides, iron, sulfate, & TDS	Higher bromides & TOC
Warren Valley	Lower arsenic, iron, & TDS	Higher bromides, chlorides, TOC, & sulfate

5.13.4.3 Small Projects Alternative

The Small Projects Alternative affects the distribution of recharge among project subareas, allowing for more recharge of the Alto subarea Regional Aquifer. It would affect groundwater quality by blending SWP supplies with indigenous groundwater.

<u>Biological Water Quality</u>. Under the Small Projects Alternative, there is virtually no potential for recharge to affect biological water quality in receiving groundwater (above that of the Minimum Facilities Alternative) because, Regional Aquifer groundwater movement rates are quite slow and groundwater levels are quite deep, even at the potential Off-Channel Mojave River Recharge basin. No surface water influence is anticipated. To the extent that the Off-Channel Mojave River Recharge is used in lieu of recharge to the river itself, it may reduce potential downstream influence of surface water, and reduce the potential for impacts to wells downstream.

<u>Leaching of Minerals</u>. All sites were selected to avoid clay and fine-grained sediments, based on the best available records, including recent well-drilling logs from local agencies. There may be minor differences in soil composition at the west and east sites for Off-channel Mojave River Recharge. Mineral leaching associated with recharge is thus unlikely to be significant.

<u>Banking and Exchange versus Normal Operations</u>. Under the Small Projects Alternative, the only difference in banking and normal operations would be that banked SWP water would be of better quality in terms of arsenic, bromides, chlorides, sulfate, and TDS and of poorer water quality in terms of iron and TOC.

<u>Mixing: SWP Water Quality versus Indigenous Water Quality</u>. The blending of SWP supplies with indigenous groundwater in the Alto Regional Aquifer would result in lower arsenic, iron, and TDS levels in the groundwater and higher levels of chlorides, bromides, TOC, and sulfates.

5.13.4.4 Large Projects Alternative

The Large Projects Alternative affects only the Alto and Oeste Regional Aquifers, allowing for some additional recharge (252,000 to 333,000 acre-feet) and for higher return capacity. It would provide up to 16,500 additional acre-feet of direct return of groundwater to Metropolitan.

<u>Biological Water Quality</u>. Under the Large Projects Alternative, there is virtually no potential for recharge to affect biological water quality in receiving groundwater because Regional Aquifer groundwater movement rates are quite slow and groundwater levels are quite deep.

<u>Leaching of Minerals</u>. Based on Bookman-Edmonston (2004a) characterizations of the Alto, Oeste, and Antelope Wash geology and soils, the selected sites have a low potential for encountering significant lenses of clay and fine-grained soils that contain soluble minerals that could be leached during recharge.

Banking and Exchange versus Normal Operations. The Antelope Wash facility for the Large Projects Alternative would function only as a recharge site. No direct return would be provided. For this facility, the difference between banking and normal operations would be limited to import of wet-year versus all-year SWP supplies, resulting in import of SWP water of better quality in terms of arsenic, bromides, chlorides, sulfate, and TDS and of poorer water quality in terms of iron and TOC.

The Oeste and Alto facilities for the Large Projects Alternative could function as recharge-only facilities or recharge-direct-return facilities. If these facilities were operated such that recharged water was delivered to MWA producers, then the only benefits to MWA would be associated with import of SWP water of better quality in terms of arsenic, bromides, chlorides, sulfate, and TDS and of poorer water quality in terms of iron and TOC.

If these facilities were operated to provide direct return of banked water to Metropolitan, and this water is assumed to be a 50-50 mix of recharged water and indigenous groundwater, then operation would result in net import of bromides, chlorides, and TOC, and net export of arsenic, iron, sulfate, and TDS to Metropolitan in return water.

Mixing: SWP Water Quality versus Indigenous Water Quality. Mixing of projected SWP supplies with indigenous groundwater would affect the Oeste Regional and Alto Regional groundwater basins differently. The blending of SWP supplies with indigenous groundwater in the Alto Regional would result in lower arsenic, iron, and TDS levels in the groundwater and higher levels of chlorides, bromides, TOC, and sulfates. Blending would be particularly beneficial in terms of arsenic levels. Blending of SWP and indigenous Oeste Regional Aquifer groundwater would result in lower arsenic, iron, sulfate, and TDS and higher levels of bromides, chlorides, and TOC. Blending would be particularly beneficial in terms of sulfates and TDS.

5.13.5 Effects on Metropolitan Water Supplies and Water Quality

In banking programs, Metropolitan delivers relatively high-quality SWP supplies to banks and frequently takes lower quality supplies in return, although direct return of banked groundwater may result in improved water quality in terms of some constituents, as it may for the Proposed Project. Metropolitan therefore seeks to obtain a balance of return water that provides for good water quality. Metropolitan optimizes its own use of available SWP supply, taking all that it can in above-normal to wet years for in-basin use and storage. Water delivered to banks represents supply that Metropolitan would not be able to deliver and/or store within its own service area. Thus, banking has no adverse effects on Metropolitan supplies in normal-to-wet years, and in years of low supply, allows Metropolitan to meet a portion of dry-year demand that would otherwise require conservation (rationing) to be greater. The effects of banking on Metropolitan's supply reliability are therefore positive.

In terms of water quality, Metropolitan's dry-year primary use of SWP exchange supplies and secondary use of direct returns from groundwater optimizes supply conveyance, because all facilities are available for returns involving banking-partner SWP supplies. Metropolitan's alternative water supplies are also not likely to be of substantially better quality. Metropolitan has no access to Central Valley Project supplies or to supplies of riparian rights holders in central and northern California. In addition, there are significant supply deficits in the San Joaquin Valley in all year types, and obtaining dry-year supplies from this region is complicated by legal constraints on export of supplies from the region. Metropolitan's alternative sources of dry-year supplies are therefore limited to acquisition of supplies via transfer from other State Water Project contractors, use of DWR's water bank, and/or acquisition of supplies from entities north of the Delta. In many cases, Metropolitan would take initial delivery of these supplemental dry-year supplies via the State Water Project facilities and water quality would be identical to that provided by using banking-partner's SWP supplies in exchange for banked supply. The operation of the proposed water banking and exchange program would therefore not adversely affect the quality of water delivered to Metropolitan's service area, in either wet or dry years.

5.13.6 Effects of Changes in Project Magnitude on Water Quality

Three factors affect Proposed Project magnitude in a manner that could affect water quality: the magnitude of banking, the magnitude of time-shift exchanges, and the magnitude of MWA's own deliveries to groundwater replenishment. The capacity of facilities for recharge and the methods of making return to Metropolitan may be affected by these factors.

MWA and Metropolitan will use State Water Project supplies for virtually all aspects of the Proposed Project. As explained above, these supplies are of significantly better quality in (a) wet years and (b) in the spring and early summer. For SWP purposes, wet years are defined by precipitation in the Central Valley Watershed, and both the higher wet year quality and higher spring-summer water quality are related to snowpack conditions. Larger snowpack conditions lead to longer periods of higher runoff from the high mountains. These flows have lower mineral concentrations than flows from runoff from the valley floor and their higher volume in wet years and in the spring and early summer tends to repel seawater intrusion into the Delta, resulting in lower concentrations of chlorides, bromides, and other constituents associated with saline conditions in the Delta.

As recharge capacity of the Proposed Project increases, the potential for import of Metropolitan supplies for banking, exchange, and MWA's own potential SWP supply, increases. The Minimum Facilities Alternative would accommodate annual recharge of about 90,000 acre-feet, but this would require recharge over a 10-11 month period. The opportunity to take water in the spring and summer, when water quality is best, increases as facility capacity increases, because more recharge can be accommodated in a shorter period of time. The opportunity to optimize wet year deliveries also increases for the same reason. In short, as the magnitude of the Proposed Project increases, in terms of recharge capacity and in terms of overall exchange, the potential to import and store the best quality SWP supplies increases. The effect of adding facilities and adding to the magnitude of the banking project is therefore to allow MWA operators to schedule deliveries, to the extent that supply is available, in fewer months and thus to focus on obtaining supplies during the periods when the SWP is under the greatest impact of snowpack melt and water quality is best.

The magnitude of the proposed project has water quality implications associated with return deliveries as well. MWA's SWP allocations vary by year type, and MWA's ability to make returns via exchange of SWP supplies will be determined based on DWR allocations in return years. For a small project, involving modest amounts of banked water, MWA may be able to make all returns via exchange, even in critical dry years. As project magnitude increases, Metropolitan's average return request will increase, and there will be a greater potential for direct return of groundwater supplies. The exact mix of returns by exchange and returns by pumping of groundwater back to the California Aqueduct is impossible to predict.

In general, wells constructed and operated to make direct returns of groundwater to Metropolitan will be sites around recharge sites. In these areas, groundwater will mound under the recharge area, migrating downgradient. In the Mojave River, the mounding will result in lateral movement of supplies towards wells sited along the boundary of the Floodplain and regional Aquifers. In other areas, wells will generally be sited somewhat downgradient of the recharge basins. When there is to be direct return of supplies to Metropolitan via pumping to the California Aqueduct, then, the pumped supplies will be predominantly SWP supplies previously banked. Some supplies delivered for recharge by MWA may mix with Metropolitan banked supplies. Recharged supplies from both sources may be affected by the recharge process and by some mixing with indigenous groundwater, but given the localized mounding of recharged water and the siting of wells to intercept water as it migrates away from the mounded area, mixing with indigenous groundwater will be limited. In the Mainstem Mojave River, recharged water will mound to within about 30-35 feet of the surface at mid channel in the Mojave River Well Field reach and will be extracted adjacent to this reach in an area where the net flow is from the Floodplain Aquifer to the Regional Aquifer (USGS 2001). Extracted water will therefore be predominantly recharged supply, although some mixing of recharged water and water from surface flow in the Mojave River will occur. In the Alto and Oeste basins, it is likely that mixing of indigenous groundwater and recharged water will be minimal because natural recharge is slow and indigenous groundwater is deep from overdrafting. In both areas, recharge will exceed extraction rates for direct pumping back to the California Aqueduct because much of the return to Metropolitan will be accomplished via exchange.

The net effect of recharge and direct return of pumped water to Metropolitan will be that Metropolitan will receive previously banked supplies only moderately altered by the recharge process and some minor mixing with indigenous supplies. As noted on Table 5-44 and 5-45, recharged supplies may have slightly different characteristics than the supplies returned due to this minor mixing during recharge, and this will mean changes to both indigenous groundwater quality and the quality of recharged supplies.

A second aspect of water quality related to recharge and returns is that SWP supplies delivered to recharge are likely to be better than SWP supplies used to make returns to Metropolitan via exchange. Direct pumping of stored groundwater and return of this water via the California Aqueduct will mean extraction of good quality wet-year supplies, moderately affected by recharge processes. Pumped groundwater will probably have lower total dissolved carbon due to the processing of this constituent during recharge, and may have lower levels of nitrates and nitrites due to breakdown of these constituents. Some minerals may leach from the soil during recharge, and increase mineral concentrations in the wet-year SWP supplies. In general, the direct pumping and return of banked wet year supplies as part of the overall banking and exchange program would be expected to enhance water quality when compared to the quality of SWP dry year supplies, although concentrations of some minerals may be higher. Arsenic leaching as a result of recharge is not anticipated to be a significance issue because (a) the recharge sites have been sited to avoid areas with soils likely to have high concentrations of arsenic, (b) SWP supplies have pH and DO concentrations likely to minimize mobilization of arsenic, and (c) there is likely to be only incidental mixing of recharged supplies and indigenous groundwater as a result of well siting to preferentially intercept recharged supplies.

As the magnitude of the banking element of the proposed project increases, the potential for return water by direct pumping increases, and this generally enhances the quality of water returned to Metropolitan, when compared to the quality of dry-year SWP supplies. The magnitude of the time-shift exchange element does not affect water quality because all exchanges are of SWP supplies. The magnitude of MWA's own use of facilities does not affect water quality associated with returns because no returns are made.

5.13.7 Significance of Impacts

5.13.7.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant effects to water quality if activities were to:

- Violate any water quality standards or waste discharge requirements; or
- Otherwise substantially degrade water quality.

5.13.7.2 Significance of Impacts

As Tables 5-39 and 5-40 indicate, the Proposed Project does not violate surface water quality objectives of the LRWQCB or the CRWQCB. Nevertheless, water quality clearly varies from region to region, river to river. These variations mean that any banking and exchange program will result in pluses and minuses. Each partner will receive slightly different water quality than is received in return. The water quality data for the Proposed Project banking and exchange elements, and for MWA's own use of facilities, shows that operations of the Proposed Project facilities will result in changes in groundwater quality.

Although recharged water would vary in quality when compared to indigenous groundwater and would be of lesser quality for several constituents (depending on groundwater basin characteristics), the net effect of recharge would be to improve indigenous groundwater quality 72% of the time, including very substantial improvements in arsenic, fluoride, and iron in almost all cases. Banked water delivered in above-normal and wet years, and on the general schedule shown on Table 5-22 would be of better quality than the annual average SWP water that would otherwise be imported to meet MWA supplemental water demands in dry years. The net effect of banking on water quality is therefore generally positive. This is particularly true for arsenic, which is substantially lower in SWP supplies than in indigenous groundwater (except in Johnson Valley, where SWP supplies are higher in arsenic by 0.3 parts per billion). Arsenic supplies in SWP water are about 55% better than drinking water standards.

The Proposed Project would not violate surface water quality objectives of the Lahontan Regional Water Quality Control Board or the Colorado River Regional Water Quality Control Board (Tables 5-39 and 5-40). In short, SWP water is considered Class 1 water suitable for all domestic water uses. Its import will generally improve water quality in the basin. The Proposed Project neither violates water quality standards nor substantially degrades water quality. This is consistent with Lahontan Regional Water Quality Control Board findings related to MWA's 2003-2005 pilot project as well. No significant impacts to MWA surface or groundwater would therefore occur.

For Metropolitan, banked water would be water it would otherwise not take delivery of; return water would be of similar quality to the supplies available to Metropolitan from other sources. Metropolitan would therefore experience no significant change in quality of water imported. Direct returns, if any, would be blended with SWP supplies and the resulting mix could improve water quality to Metropolitan except for arsenic, but would also not violate water quality objectives in Metropolitan's service area.

The impacts of banking and exchange on water supply are to pre-deliver substantial supplies for storage and to extend the period over which MWA can meet replacement obligations with current SWP contract supplies and pre-delivered groundwater. No significant impacts to water supply for MWA would occur.

As noted in Section 5-13.1, the alluvium underlying Antelope Wash is deep sand and gravel, and there are no indications of significant variation in alluvium conditions between the upstream Antelope Wash recharge site and the downstream, as described in Chapter 4, page 4-31. Thus, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to water quality.

5.13.8 Mitigation and Significance of Impacts after Mitigation

Because SWP water quality associated with water banking and exchange is superior to that which would otherwise be imported under the No Project Alternative, the implementation of a banking and exchange program would be beneficial compared to the No Project Alternative. There is some potential for groundwater recharge to percolate through clay and fine-grained soils and result in leaching of minerals into indigenous groundwater. This potential is low, given the analysis of proposed site conditions, but water quality in production and monitoring wells will be monitored to detect such potential influences. Wells will also be monitored for potential surface water influence, and recharge will be managed to reduce any effects identified. As noted in Chapter 4, there is potential for some runoff from construction sites; these will be addressed by preparation and implementation of a Storm Water Pollution Prevention Plan based on the guidance in the Caltrans *Storm Water Pollution Prevention Plan and Water Pollution Control Plan Preparation Manual*, March 2003. With these mitigations, impacts will be mitigated to a level of less than significant.

In response to comments from the Lahontan Regional Water Quality Control Board and San Bernardino County Department of Public Works, Environmental Management Division and Water Resources Division. MWA notes that, based on preliminary geotechnical analyses, MWA selected a number of potential recharge basin sites, focusing on areas with characteristics likely to avoid areas with high arsenic concentrations in subsurface soils. These evaluations included analysis of groundwater data from wells in the vicinity of the proposed recharge sites, including evaluations as part of MWA pilot projects at Oro Grande Wash. MWA will confirm these analyses during pre-design and construction geotechnical analyses, when corings at potential well sites will be made and cores examined to ensure that subsurface soil conditions do not result in recharge to areas with high potential arsenic concentrations. If corings identify high arsenic concentrations in soils, then MWA may evaluate and select recharge sites in adjacent areas.

In regard to the potential for recharge in the Mainstem Mojave River to result in surface water influence on groundwater, the proposed project, if fully implemented, would result in a system of over 30 existing and new wells along the river, monitoring of which will provide a coherent view of the effects of the proposed project on groundwater. The Department of Health Services (DHS) "*Drinking Water Source Assessment for Surface Water Sources*" August 18, 2000 describes a number of different protocols for assessing whether a well is under surface water influence. DHS may request various assessment techniques, depending on their judgment of the potential for a well to be under surface water influence. These protocols, or any updated DHS protocols, will be implemented, as appropriate, in consultation with local producers, the County of San Bernardino, and DHS.

5.13.9 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site them because of development that would constrain siting options for MWA. Under the No Project Alternative, MWA would, in the long term, import SWP supplies equivalent to those provided in an accelerated manner as a result of the banking and exchange project. These would be average year water quality supplies, and the No Project Alternative therefore would result in import and recharge of generally poorer quality SWP supplies than those likely to be imported as a result of banking and exchange.

5.14 Water Resources (Hydrology)

5.14.1 Environmental Setting

Surface runoff and river flow in the MWA service area are dominated by infrequent very wet conditions, both as a result of winter storms from the northwest and as a result of summer/fall monsoonal influences associated with subtropical moisture from the south creating short-term periods of locally-heavy rainfall. Locally-heavy summer precipitation has little regional effect. *Per* comments from County of San Bernardino (Appendix A), according to the most recent FEMA Flood Insurance rate Maps, the proposed project may cross areas within Zone A, special flood hazard areas which may be inundated by a 100-year storm event, and zone X.

Infrequent wet years, such as 2004-5, may bring substantial and extended flow to the Mojave River and to local washes that drain to the river. As a result, groundwater levels in the Mojave River Floodplain Aquifer rise and may stay elevated for a period of time while water moves laterally into the Regional Aquifer and downstream into the Narrows.

5.14.2 Mechanisms for Effect

1. Recharge basins sited along the various washes would be subject to infrequent scouring flows which may erode berms and result in sediment transport downstream. This may occur during high flows in Oro Grande Wash and Antelope Wash. Recharge basins in these washes will be constructed using existing soils in the basins and thus the net volume of sediment in these washes will remain constant; high flows that erode recharge basin berms will thus rapidly re-distribute these soils and peak flows in the washes will not be affected by the berms. There is thus no mechanism by which in-basin berms would significantly affect flooding.

2. In Unnamed Wash, the use of the wash to convey up to 500 cfs for an extended period of time will alter the condition of the channel in the wash, resulting in a somewhat incised channel in some locations and reducing potential for overland sheet flow. Development of an incised channel would result in increased recruitment and transport of sands and gravels to the Mainstem Mojave River until an equilibrium condition was achieved.

3. Groundwater recharge and banking have the potential to affect Mojave River Hydrology primarily by raising groundwater levels and therefore reducing the infiltration of flood waters during periods of high natural flow, potentially increasing surface flow.

5.14.3 Potential Project Effects

Potential project effects to hydrology are limited to the Unnamed Wash and the Mainstem Mojave River. In Unnamed Wash, there will be sediment recruitment and transport associated with sustained flows of up to 500 cfs. Where this flow crosses sands and gravels, there will be erosion and an incised channel will be formed. Once this channel has been formed, erosion will be minimal. Deliveries from the California Aqueduct will be suspended during periods of substantial natural runoff, and thus there will be no change in the peak flow down the channel as a result of the project. The incised channel will contain relatively high flows and reduce the potential for sheet flow across the floodplain. Such sheet flow occurs infrequently and changes in sheet flow distribution should not affect vegetation communities, which consist of desert scrub.

Where the wash discharges to the Mainstem Mojave River, there will be an initial discharge of sediment associated with channel formation, resulting in a short term build up of a small alluvial fan at the outlet. This alluvial fan will be rapidly eroded and the sediment transported downstream by moderate flows in the Mainstem Mojave River. Although not significant, this additional sediment may somewhat offset losses in sediment recruitment and transport which have occurred as a result of changes in flow rates associated with lower-than-natural flood flows below Mojave Forks Dam.

Potential project effects on flooding are limited to the Mainstem Mojave River, where MWA may recharge up to 44,400 acre-feet in any given year. The potential for this recharge to affect flood flows depends on two factors:

- The timing of recharge and flooding
- The capacity of recharge into the mainstem during flooding to affect potentially damaging flood flows.

5.14.3.1 The Effects of Recharge Delivery Schedule.

The schedule of recharge for banking and exchange is described in Table 5-22, which illustrates the historic and probable future pattern of Metropolitan deliveries to water banking programs. As Table 5-22 shows, Metropolitan has not routinely delivered substantial amounts of water to banking programs in December, January, or February. Deliveries begin to be ramped up in March. Metropolitan's deliveries to banking peak in May and then generally have declined from May through November.

This historic delivery pattern would have three effects on groundwater levels in the Mainstem Mojave River. First, in wet years, deliveries in March or April would not be made if there was already substantial flow in the river; MWA would divert such deliveries to other recharge basins because banking deliveries and surface flows would flow too rapidly downstream and would not percolate effectively. Thus, even a late winter storm would not be affected by on-going recharge. Second, most deliveries would be made during periods when major flooding on the mainstem river would not occur -- during the late spring and early summer. Finally, a majority of potential Metropolitan deliveries of water to the mainstem river would decline in September, October, November, and December.

The result of the delivery pattern would be that banked water would be recharged and would be moving laterally into the Regional Aquifer for a period of at least 4 months before the rainy season begins in earnest in January. In the alluvial aquifer, lateral movement is relatively rapid, and much of the recharged water would therefore be moving into the Regional Aquifer by the time the rainy season begins.

5.14.3.2 Recharge of flood flows into the Mojave River Floodplain Aquifer

The primary concern related to recharge of banking supplies in the mainstem river is that recharge rates in the Mojave River are high and that, under natural conditions, flood flows are reduced substantially by recharge into the riverbed. The concern is that artificial recharge would "use up" some of this recharge capacity and that flooding would be affected.

Flood flows of significance, such as occurred in 1983, 1996, and 2005, are the result of extreme and extended precipitation. USGS Daily Streamflow data for the Mojave River near Hesperia and Victorville at the lower Narrows (USGS 2005) show a pattern of flood events that suggests that initial storms result in runoff that rapidly fills available recharge capacity of the Mainstem Mojave River in the Proposed Project reach. In 1983 (Table 5-46), there were six separate events when flows in the Mainstem Mojave River exceeded 1,000 cfs, including one two-day period of flow in excess of 11,000 cfs.

The comparison of the USGS stream flow data for Hesperia and Victorville at the Narrows in 1983 (Table 5-46) reveals several patterns related to flow and recharge:

- Early in the year and during the period when flows are rising, flow at Hesperia (upstream) is substantially higher than flow at Victorville in the Lower Narrows. This suggests that during the early part of the rainy season, recharge is reducing flows in the river.
- During peak flow periods, when flows exceed 1,000 cfs, there is a rather large difference in flow rate upstream and downstream, with flows at Hesperia often exceeding those at the Narrows by a factor of 10 or 20. This reflects the rapid spreading of floods across the floodway before they pass through the narrow canyon at the head of the Narrows.
- As the flood begins to recede, there is a brief period when flows downstream are greater than flows upstream. This reflects the draining of the floodway as input from the mountains declines and the flood peak passes downstream.
- After the peak has passed downstream, the difference between flow at Hesperia and flow in the Narrows is relatively stable. Flow at Hesperia is about 80 to 250 cfs higher than flow at the Narrows.

The difference between net flow at Hesperia and net flow at Victorville at the Lower Narrows is a reasonable indicator of total recharge in the river between the two locations, although there is minor evaporation loss (which reduces recharge) and there is some potential for error in stream flow measurements, particularly at high flows. Nevertheless, a large portion of the water in the river at Hesperia that does not reach the lower Narrows may be assumed to be recharged. This groundwater may later become surface flows at the Narrows, but this would occur well after there was any potential for flooding. Most of this recharge occurs during periods of flow in excess of 1,000 cfs (Table 5-47); that is, at higher flows, the flow at Hesperia is proportionally greater than flow in the Narrows. When flows were in excess of 1,000 cfs, the difference in flow at Hesperia and flow at Victorville at Lower Narrows ranged from 509 acre-feet per day to 4,162 acre-feet per day. In periods when flow at Hesperia was less than 1,000 cfs, the average daily difference in flow at the two sites was 306 acre-feet. There also appears to be a strong relationship between flow and recharge. This is probably related to the spreading of very high flows across the wide floodway. The data from 1983 are not precisely representative of data sets from other flood years, but the general patterns of flooding and apparent recharge are also reflected data sets for other wet years. These data suggest:

- After an initial recharge during the first storm of the season, recharge to the river channel is closely related to inflow and to the total area of channel and floodplain that is flooded.
- Following peak flows, and the relatively large volumes of recharge they generate, apparent recharge declines rapidly to from 80 to 300 cfs (159 acre-feet/day to 596 acre-feet per day).
- Given the short duration of flooding outside of the mainstem channel when flows substantially exceed 1,000 cfs, recharge is rapid because this portion of the floodplain has not been saturated by previous flow and percolation rates are therefore high.

These patterns of flow and apparent recharge also suggest that recharge during high flows when flows escape the main channel and cross the floodplain may cause damages to property, occurs in the unsaturated upper layers of the floodplain soils. Given peak flood durations of 3-6 days, and off-channel percolation rates of from 2 to 5 feet per day, flood recharge would occur within the upper 6 to 30 feet of the floodplain alluvium.

5.14.3.3 Potential Effects on Flood Recharge of the Mojave River

Metropolitan deliveries to the proposed banking and exchange program will generally peak in March, April, May, and June. Water recharged in this period will percolate rapidly into the alluvial aquifer and migrate laterally to the regional aquifer over a period of at least 4 months before the start of the potential flood season. During this time, there will be on-going extractions of groundwater from the Mojave River Well Field. The net effect of this type of recharge will be that banked water would (a) move vertically down into the aquifer and laterally away from the river channel. Groundwater levels in the river and in the adjacent floodplain will be maintained at below 20 feet and, as discussed in the analysis of potential liquefaction effects, are likely to be even lower due to on-going extraction. Thus there will be substantial capacity to recharge the upper 20-40 feet of the alluvial aquifer when peak flood flows spread out over the floodway. There will likely also be adequate capacity in the mainstem channel to accommodate flows from the initial storm of the season, after which recharge to the river channel itself will be relatively stable.

There is some potential for active recharge in the late summer and fall to affect the capacity of the river to absorb the first high flow of the rainy season. However, the first storm of the season has historically been a relatively small event, and this potential lack of early season recharge capacity could result in more flow through the Narrows during and following the initial storm, but would not affect subsequent flood flows. In short, recharge operations may have effects on recharge of flows during the initial storm of the season, but would have very little effect on potentially hazardous flooding which occurs following saturation of the watershed following a series of storms.

Table 5-46. Difference between flows at Hesperia (USGS site 10261100) and Victorville (USGS site 10261500) at the lower Narrows (downstream), January 20, 1983 to May 10, 1983. A"+" indicates that flow in the Narrows was greater than flow upstream at Hesperia. (http://nwis.waterdata.usgs.gov/nwis/discharge)

DAY	APPROXIMATE FLOW IN CFS		DIFFERENCE IN FLOW IN CFS
	Hesperia	Lower Narrows	
1-20	56	46	+10
1-21	48	49	-1
1-22	46	49	-3
1-23	262	51	-211
1-24	266	46	-220
1-25	322	48	-274
1-26	250	49	-201
1-27	2090	175	-1915
1-28	1140	836	-304
1-29	1360	1220	-140
1-30	508	629	+121
1-31	358	343	-15
2-1	224	195	-29
2-2	211	104	-107
2-3	217	117	-100
2-4	187	102	-85
2-5	165	67	-98
2-6	162	56	-106
2-7	194	58	-136
2-8	1280	561	-719
2-9	680	631	-49
2-10	692	405	-287
2-11	836	635	-201
2-12	805	659	-146
2-13	801	651	-150
2-14	727	658	-69
2-15	805	617	-188
2-16	799	673	-126
2-17	800	680	-120
2-18	782	687	-95
2-19	770	673	-98
2-20	758	659	-99
2-21	754	651	-103
2-22	753	651	-102
2-23	754	651	-103
2-24	752	651	-101
2-25	748	644	-104
2-26	781	644	-137
2-27	4040	1480	-2560
2-28	4240	2450	-1790

3-1	11600	6400	-5200
3-2	11700	8950	-2750
3-3	6060	4370	-1690
3-4	2920	-2700	-220
3-5	1640	2000	+360
3-6	1380	1700	+320
3-7	840	1560	+720
3-8	789	1100	+311
3-9	828	748	-80
3-10	761	715	-46
3-11	636	675	+39
3-12	685	690	+5
3-13	886	765	-120
3-14	977	786	-191
3-15	1210	796	-414
3-16	1280	828	-462
3-17	1250	817	-433
3-18	1470	817	-653
3-19	1470	917	-553
3-20	1430	1090	-340
3-21	1460	1180	-280
3-22	990	1020	+30
3-23	1120	851	-269
3-24	1290	1010	-280
3-25	1190	1060	-130
3-26	1140	1020	-120
3-27	1140	1010	-130
3-28	1150	1010	-140
3-29	1160	1060	-100
3-30	928	991	+63
3-31	743	556	-187
4-1	755	514	-214
4-2	605	459	-146
4-3	536	459	-77
4-4	395	353	-42
4-5	296	243	-53
4-6	262	213	-49
4-7	243	204	-39
4-8	227	180	-47
4-9	217	164	-53
4-10	221	167	-54
4-11	218	173	-45
4-12	207	167	-40
4-13	215	152	-63
4-14	268	173	-95
4-15	277	177	-100
4-16	281	186	-95
4-17	290	189	-101
4-18	641	309	-332
4-19	502	450	-152
4-20	618	365	-253
4-21	1380	825	-555
4-22	1020	672	-348
4-23	923	636	-287
4-24	856	560	-296

4-25	517	450	-67
4-26	425	262	-163
4-27	454	298	-156
4-28	439	278	-161
4-29	1500	513	-987
4-30	1530	1390	-140
5-1	1060	952	-98
5-2	717	650	-67
5-3	574	456	-118
5-4	543	440	-103
5-5	496	392	-104
5-6	451	367	-84
5-7	437	338	-99
5-8	439	324	-115
5-9	439	347	-102
5-10	425	338	-87
	115445 (229,158 acre-feet)	**79828 (158,458 acre-feet)**	**35,623 (70,717 acre-feet)**

Table 5-47. Volume of inflow in acre-feet to Hesperia and Victorville at the Lower Narrows, January 20, 1983 through May 10 1983.

INFLOW DATES (DAYS)	INFLOW VOLUME IN ACRE FEET		DIFFERENCE IN ACRE FEET	AVERAGE DAILY DIFFERENCE IN CFS/ACRE-FEET
	Hesperia	Victorville at Lower Narrows		
Six flood events (flows greater than cfs)				
Jan 23-31 (8)	13014	6743	6271	395/784
Feb 7-12 (6)	8907	5,854	3053	256/509
Feb 27-Mar9 (11)	91383	66414	24987	2097/4162
Mar 15-29 (15)	37218	28754	8463	284/564
Apr 18-24 (7)	11,791	7577	4214	303/602
Apr 29 - May 1 (3)	8119	5667	2452	412/817
TOTAL	**170,432**	**121,009**	**49440**	**988/1977**
Non-Flood periods (flows of less than 1,000 cfs)				
71 days	**58,726**	**37,449**	**21277**	**154/306**

5.14.4 Significance of Effects and Mitigation

5.14.4.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have significant effects on non-water quality aspects of hydrology if activities were to:

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- Place within a 100-year flood hazard area structures which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or
- Cause inundation by seiche, tsunami, or mudflow.

The Proposed Project: (a) will increase groundwater levels rather than decrease them; (b) will not affect the course of an existing stream or river; (c) will not create runoff exceeding the capacity of drainage systems (existing or planned); (d) will not place housing in a 100-year floodplain; (e) will not place within a 100-year flood hazard area structures which would impede or redirect flood flows; (f) will not expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; and (g) will not cause inundation by seiche, tsunami, or mudflow.

Off-channel Mojave River Recharge will be placed outside of the floodway maintained by San Bernardino County Flood Control and thus will not affect the 100-year flood.

Although recharge late in the summer and fall could affect alluvial aquifer capacity to recharge flows from the first storm of the season, recharge of the Mainstem Mojave River during banking and exchange operations would have little effect on the very large flows that may cause damages in the Hesperia reach of the mainstem river. No significant impacts are anticipated.

5.14.5 Mitigation and Significance of Effects after Mitigation

Although instream recharge will have no clear effect on flooding in the Mainstem Mojave River, MWA will monitor groundwater levels in the Mojave River Well Field for evidence of high groundwater levels in the floodplain outside of the mainstem channel. If there is substantial evidence that recharge is raising these levels to within 20 feet of the surface in this location and at the beginning of the storm season, then MWA would adjust operations by diverting some banked supplies to other recharge facilities. This is unlikely to occur because on-going extractions will help maintain groundwater levels below 20 feet.

Given on-going monitoring of groundwater levels adjacent to the Mainstem Mojave River and the capacity to shift deliveries of SWP supplies to other recharge sites, MWA anticipates no significant effects of recharge on flooding in the Mainstem Mojave River.

In its response to comments from San Bernardino County, Department of Public Works (DPW), MWA recognizes the need to coordinate design and construction of facilities that may affect drainage. MWA does not anticipate that facilities, as described in the EIR, will significantly affect drainage or flooding in washes, but for facilities within the Mainstem Mojave River channel and in washes, MWA will coordinate with the Flood Control District during design to ensure that facilities do not become an obstruction to flows or adversely affect adjacent or downstream properties. A number of the cities in the Proposed Project area have Master Plans of Drainage. MWA will also work with local communities during design, construction, and implementation of the proposed project facilities.*

The Ranchero Road detention basin has been designed to control flow into the constrained channel downstream by retarding flood flows. A secondary effect of this flood control structure, which may impound water to a depth of up to 22 feet, is to negate any significant surface hydrologic effect associated with use of this facility for recharge of imported water. Also, as noted in MWA's response to comments by County of San Bernardino, Department of Public Works (Water Resources Division), "The low berms MWA would construct at these sites [recharge sites in washes] would thus be constructed in areas where flows will already be significantly constrained by downstream structures that effectively create flood detention basins. No significant effect from project facilities on flood passage at these sites is thus anticipated." In response to WRD, MWA reaffirmed that it has always been committed to working with local flood control officials to ensure that the berms constructed for recharge with imported water will not become obstructions to flood flows. Thus, expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site would have no effect on proposed project impacts related to hydrology.

5.14.6 No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site some of them because of development that would constrain siting options for MWA.

Under the No Project Alternative, deliveries to the Mainstem Mojave River would probably be initially lower, until a Mojave River well field was eventually developed in cooperation with local agencies. Both the capacity for recharge of the alluvial and adjacent regional aquifers and capacity to extract recharged supplies would likely be lower than under the Proposed Project. The result would be marginally lower groundwater levels below the Mainstem Mojave River and thus some increase in "first storm of the season" recharge, with less potential for downstream movement of this supply to the Narrows.

5.15 POPULATION, HOUSING and GROWTH

5.15.1 Environmental Setting

The 2004 PEIR analyzed the potential indirect effects of overall water management programs on growth and reached the following general conclusions:

- Since 1975, there has been substantial development and population growth in the overall MWA Service area, but populations in the Copper Mountain Valley and Warren Valley actually declined from 1990 to 2000 at a rate of -0.6% and -4.9%, respectively;
- SCAG projects additional growth by 2020, with growth concentrated in the Adelanto, Hesperia, Victorville, Apple Valley; and Barstow;
- Growth in the Baja and Morongo Basin/Johnson Valley will be slowest;
- Agricultural water use has declined rapidly since 1990 and this decline was more rapid than projected by the 1994 Regional Water Management Plan;
- Overall industrial consumptive use of water increased from 1995 to 2001, rising from 10,700 acre-feet per year to 12,800 acre-feet per year (20%).

The 2004 PEIR note that by about 2020, projected water use is approximately equal to the average annual water supply from all sources, including average annual SWP supply of about 58,600 acre-feet.

The 2004 PEIR suggests that overall water management may have growth accommodating impacts and documents their indirect effects. The 2004 PEIR notes that the effects of projected growth have been assessed in the General Plans and associated Environmental Impact Reports of San Bernardino County, the City of Adelanto, the Town of Apple Valley, the City of Barstow, the City of Hesperia, the City of Victorville, and the Town of Yucca Valley. These agencies, responsible for planning in the MWA service area, have determined that some of the indirect effects of projected and approved population growth and development would be significant and unavoidable, including effects to air quality, biological resources, geology and soils, cultural resources, land use, mineral resources, population and housing, public services and utilities, recreation and open space, transportation and traffic, and utilities and service systems. The determination of whether these general growth-related impacts would be significant under CEQA has thus been evaluated and formal findings made at the county and local level. The 2004 PEIR notes that full implementation of the 2004 Regional Water Management Plan could have significant and unavoidable impacts, but that MWA does not have authority to implement mitigation actions for these effects.

The 2004 PEIR analyzes the potential for a general water banking program involving MWA and Metropolitan Water District of Southern California, concluding that:

> *In Summary, future water banking agreements with MWA are identified in the most recent IRP [Integrated Resources Plan] prepared by Metropolitan. The MWA banking agreement -- and others like it with other SWP contractors -- are mutually beneficial arrangements that assist Metropolitan in meeting its future dry-year demand. Metropolitan supports growth planned by its member agencies. Local member agency General Plans identify local growth trends and policies and evaluate the secondary effects of growth within their jurisdictions."*

The Proposed Project would take place within the context of the growth management plans adopted by regional and local planning agencies in the MWA service area and in the Metropolitan service area. These plans provide for continued managed growth in southern California and specify general approaches to mitigation of the adverse indirect effects of growth. From 2005 through 2020, population in MWA's service area is anticipated to grow at an overall rate of 2.5% per year, from 373,000 in 2005 to 527,700 in 2020 (an increase of 29%). This growth would continue to be concentrated in the southern portion of MWA's service area, and near major highways and military bases.

Water demand is anticipated to grow at a slower rate. In the Mojave Basin, total water consumption is anticipated to grow as well, but at a slower rate. If agricultural consumption stabilizes at 2005 rates, the total increase in consumptive use is projected to grow from 114,700 in 2005 to 142,500 acre-feet per year in 2020, an increase of about 24%. If agricultural consumption continues to decline as it has during recent years, the increase would be lower, from 112,200 acre-feet per year in 2005 to 120,100 acre-feet per year in 2020, an increase of 9%. In the Morongo Basin, consumptive use is projected to increase from 3,100 acre-feet per year in 2005 to 4,000 acre-feet per year in 2020, an increase of 29%. There is no current or projected agricultural use in this basin.

Growth and water demand in MWA's service area occur within the context of overall growth in California. From 1941 through 2004, California growth rates varied from 9.97% to 0.60%, with the highest growth rates occurring during World War II and the subsequent baby boom years of 1945 through 1960, when crude birth rates were in excess of 20% per year (California Department of Finance, Demographic Research Group). From 1960 through 2004, overall population increase varied from 3.46% to 0.60 percent, with crude birth rates generally in decline and below 20%. From 1941 to 2004, both birth rates and death rates declined in a relatively stable pattern, reflecting the inelasticity in population changes resulting from internal growth. Migration to and from California was more variable, with migration rates of from 8.6% to 81.6% from 1941 through 1960. From 1960 through 2004, net migration varied from -4.7% to 19.7%.

In response to comments from Department of Water Resources (Appendix A), MWA notes that in the Regional Water Management Plan adopted by MWA's Board of Directors in early 2005, MWA describes its legally-mandated role in regional planning and its coordination with local and regional governments to address issues related to water supply and growth. As noted in Chapter 1 of the DEIR (Introduction), MWA's mandate is to provide supplemental supplies for use by local producers throughout the Agency. Further the Mojave Basin Area Judgment imposes restrictions on local groundwater production and requirements that local producers purchase supplemental supplies when these restrictions are exceeded. Given the cost of imported supplemental supplies (see Chapter 2), this requirement constitutes a substantial economic incentive to conserve and to manage growth and water supply intelligently.

As the agency designated to provide supplemental supply, MWA is working with local governments, water purveyors, educational institutions, and local community groups to address water conservation. For example, MWA has on-going cooperative programs to promote urban and agricultural water conservation, providing funds to the local RCD. MWA also lends assistance to, and participates in, local programs to enhance water supply through source protection and blending, to eradicate non-native plants that adversely affect supply and native riparian areas, and to monitor groundwater supply and water quality. MWA provides educational materials and economic incentives for water conservation programs. These activities are described in detail in the Regional Water Management Plan and have been incorporated into the supply/demand projections in the Regional Water Management Plan.*

5.15.2 Facilities and Operational Impacts

5.15.2.1 Mechanisms for Effect

There is no mechanism by which the Proposed Project would displace substantial numbers of people or housing, and thus the Proposed Project would have no direct effect on population, housing, or growth. Indirectly, water supply may accommodate growth to the extent that there is available supply in excess of demand and to the extent that other factors necessary for growth to occur (jobs, transportation, utilities, etc.).

5.15.2.2 Proposed Project Effects

Water banking and exchange programs are a response to California's highly variable climate and precipitation, where statistically average years are uncommon. Instead, California's climate is characterized by alternating wet and dry conditions, such as the 1987-1994 drought, which was followed by a period of generally wet years from 1995 through 2000. In an environment of fluctuating water supplies, water banking and exchange programs are intended to ensure a minimum level of supply reliability. Water from wet years is thus captured and stored for use in dry years. The result is thus to reduce the *fluctuations* in supply, that is, to provide supply conditions that approximate average-year conditions on a reliable basis. Water banking and exchange programs thus reduce the potential adverse impacts associated with drought, such as:

- They reduce the frequency and severity of rationing;
- They reduce loss of landscape planting and agricultural production;

- They reduce the potential for groundwater overdraft and subsequent land subsidence; and
- They reduce potential for loss of riparian habitat.

In addition, to the extent that banking and exchange programs allow for the import and storage of supplies which would otherwise not be available due to lack of recharge capacity or funding for their transport, they provide for delivery of average annual levels of supply over a longer period of time (Table 5-42 above). The effects of banking and exchange programs on population growth and development are therefore to allow average annual yearly demand to be met on a more reliable basis over a longer period of time before new supplies must be sought in order to address projected higher demands.

This enhanced water supply reliability provided by water banking and exchange is not well correlated with growth in California. Comparing migration rates to water year-type data from California Department of Water Resources with a standard linear regression shows no relationship between water year type and rate of migration ($r^2 = 0.027$); that is more supply does not induce migration and less supply does not discourage migration. Fluctuations of water supply do not appear to affect population trends in California, which appear more related to economic events, such as the 1993 to 1996 recession in Southern California, which resulted in net migration out of California during a period with 3 wet years and one critical dry year. In contrast, some of the highest recent rates of emigration to California occurred from 1987 through 1992, when there was an extended critical drought.

The Proposed Project also does not create new supply. MWA has had access to SWP supplies in excess of demand since 1978, but has not delivered substantial supplies in excess of demand because of cost and demand considerations. There is no evidence that the mere availability of water has increased net demand or growth within MWA. From 1990 to 2000, although MWA had access to excess SWP supply, there was net growth in the Hesperia, Victorville, Adelanto, and Apple Valley area, but a decline in population in the Baja subarea, suggesting that population was responding to factors other than water supply. The declines and shifts in population during this period thus appear unrelated to MWA's available supply.

Because birth rates, death rates, and migration rates are clearly unrelated to water supply fluctuations, banking and exchange programs that minimize these fluctuations would not induce or accommodate growth. They may ameliorate drought-year conditions, but these conditions do not appear to affect migration into or out of California. Thus there is no mechanism by which banking and exchange programs would affect growth and development. Given this general conclusion, expanding recharge at the Antelope Wash Ranchero Road site in lieu of developing the upstream recharge site would also have no effect on proposed project impacts related to population and housing.

5.15.3 Significance and Mitigation

5.15.3.1 Significance Thresholds

Under CEQA, the Proposed Project would be considered to have a significant impact on population, housing, and growth if it were to:

- Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure);
- Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere;
- Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?

5.15.3.2 Significance of Effects

The Proposed Project does not displace substantial numbers of existing houses or people. In terms of indirect growth inducement effects, the banking elements of the Proposed Project have no potential to induce or accommodate growth because they provide no net increase in water supply availability, except for the increase in groundwater replenishment associated with the 10% loss factor, which may over a period of about 20 years result in 15,000 acre-feet of additional supply (about 750 acre-feet per year). This is about 1% of MWA's Table A allocation and less than 1% of annual water use in the MWA service area. Much of the water associated with the 10% loss factor will likely pass through the Narrows to the transition zone, where its primary benefit will be to riparian vegetation communities. Thus banking has a minimal potential to affect net water supply. No significant effects on growth are anticipated from this aspect of the Proposed Project.

The exchange element of the proposed project will involve MWA and Metropolitan mutual exchanges of SWP supplies to optimize use of their available SWP supplies. This element of the Proposed Project will allow MWA to take delivery of available Table A contract supplies that it would otherwise not pre-deliver to storage due to facility and cost constraints. This water would be stored throughout MWA's service area and would extend the period of time for which MWA's existing SWP Table A supplies would be adequate to meet projected imported water demands. In this sense, the exchange program accommodates growth.

MWA's own use of the Proposed Project facilities will be to further enhance pre-delivery of available SWP supplies, both by taking more of MWA's existing Table A allotments and by taking supplemental SWP supplies available under programs such as the Article 21 program. These supplies would be stored for future use and would extend the period of time for which MWA's existing SWP Table A supplies would be adequate to meet projected demands for imported water. In this sense, MWA's use of the Proposed Project facilities would accommodate growth, but only to the extent that MWA was able to finance delivery of such supplies.

The 2004 PEIR notes that MWA has no authority to manage and/or mitigate for planned growth and that this authority rests with:

- Southern California Association of Governments
- Caltrans
- US EPA
- US Army Corps of Engineers
- County of San Bernardino
- Local cities in MWA's service area
- The Local Agency Formation Commission
- The Lahontan and Colorado River Regional Water Quality Control Boards
- The State Department of Health
- San Bernardino County Flood Control District
- California Air Resources Control Board
- Mojave Desert Air Quality Management District

The 2004 PEIR notes that there are significant and unavoidable impacts associated with growth. The 2004 PEIR further notes that growth is planned and mitigated through the above agencies. One element of their mitigation programs is to charge MWA with mitigation for the effects of planned growth on groundwater resources, water supply, and water quality.

The Proposed Project is part of MWA's mandate to mitigate for past, present, and future growth and its indirect effects on groundwater resources by providing replenishment water and by operating to optimize the quality of water that is imported. The Proposed Project enhances pre-delivery of SWP supplies to groundwater storage and thus helps to remediate long-term overdraft. It also enhances MWA's ability to import SWP supplies in times when they are highest quality. Both of these effects are considered to contribute to mitigation of the adverse direct and indirect of growth planned and approved by other entities.

The 2004 PEIR concludes that the impacts of planned and approved growth in MWA's service area are significant and unavoidable, and that MWA's mitigation obligation is to "implement the 2004 Regional Water Management Plan to address the effects of planned growth on groundwater resources and water supply services within the service area." The Proposed Project is part of MWA's mitigation obligation and MWA has no authority to implement other mitigations for growth planned and approved by others. This Project EIR concurs with the conclusions of the 2004 PEIR. No further mitigation is required.

5.15.4. No Project Alternative

The No Project Alternative assumes continued implementation of the 2004 Regional Water Management Plan. Ultimately, MWA would develop facilities that would allow it to meet its obligations to import and recharge up to 75,800 acre-feet of SWP supply in a year. The effect of the No Project Alternative would be to delay implementation of such facilities and possibly to re-site some of them because of development that would constrain siting options for MWA.

The No Project Alternative would have the same effect on population, housing, and growth as the Proposed Project. MWA would continue to meet all imported water obligations with its SWP supplies, until at some future date the currently available level of SWP supplies proves inadequate to meet obligations. The Proposed Project somewhat delays this event and allows MWA greater opportunities to accommodate demand as technological advances are made in technologies such as desalination and water reuse. Neither of these effects would significantly alter projected growth.

5.16 Use of Energy and Energy Conservation

5.16.1 Environmental Setting

The Proposed Project takes place in the context of high national and regional energy use and rising prices for all forms of hydrocarbon based energy.

5.16.2 Mechanisms for Effect

The Proposed Project may affect energy use directly in three ways:

- The construction of all potential facilities would result in construction energy use of about 920,000 gallons of diesel and gasoline.
- The recharge of water will temporarily raise groundwater levels in some areas, and result in lower water extraction costs in these areas.
- The availability of recharge capacity will allow for MWA to import more of its own SWP supplies in wet years and in the spring of all years. During these times, electrical power production by hydropower is greatest. To the extent that deliveries of SWP supply can be focused on delivery during these periods as a result of greater recharge capacity, deliveries may be deemphasized during some periods of peak electrical power demand and low hydropower availability (potentially August through October).

Exchanges of MWA and Metropolitan supplies will not affect overall energy use associated with delivery of water from the SWP except that pre-delivery of some of MWA's existing SWP Table A supplies to Metropolitan may enhance storage in Metropolitan's service area during periods when MWA has such available supplies, which will generally be in above-normal years. This may reduce Metropolitan's need to import dry year supply, and thus reduce hydrocarbon based energy use for conveyance of supplies in dry years.

5.16.3 Proposed Project Effects

5.16.3.1 Minimum Facilities Alternative

The Minimum Facilities Alternative will utilize about 290,000 gallons of gasoline and diesel fuel for construction of conveyance and recharge facilities. The use of the Mojave River for recharge on an annual basis, with extractions from the Mojave River Well Field matched to recharge volume, will allow for very high rates of recharge and will optimize MWA's capacity to take water in the March through July period, and in wet years, when hydropower is most available. In addition, MWA's new well field will (a) replace some older wells currently in use with more efficient wells and (b) raise groundwater levels at the boundary of the Mojave River Floodplain Aquifer and the Regional Aquifer, further reducing energy use in extraction.

5.16.3.2 Small Projects Alternative

The Small Projects Alternative would increase total Proposed Project construction energy use by about 200,000 gallons of gasoline and diesel fuel. It would further increase MWA's ability to take wet year and wet season deliveries from the SWP, when hydropower is most available. It would raise groundwater levels in the Regional Aquifer in the Victor Valley, and thus reduce energy needs for extraction of stored supplies.

5.16.3.3 Large Projects Alternative

The Large Projects Alternative would increase total Proposed Project construction energy use by about 430,000 gallons of gasoline and diesel fuel. It would further increase MWA's ability to take wet year and wet season deliveries from the SWP, when hydropower is most available. It would raise groundwater levels in the Regional Aquifer in the Victor Valley, and thus reduce energy needs for extraction of stored supplies. The consolidation of recharge at one expanded Antelope Wash facility in the vicinity of Ranchero Road could marginally reduce the total area of construction, and expanding recharge at the Ranchero Road site in lieu of developing the upstream recharge site could potentially reduce project use of energy during construction.

5.16.4 Significance, Mitigation, and Significance after Mitigation

5.16.4.1 Significance of Impacts

Assuming construction over a 2-year period for the Minimum Facilities Alternative, for a 3 year period of the Small Projects Alternative, and a 4 year period for the Large Projects Alternative, annual construction fuel use would be equivalent to:

- Minimum Facilities Alternative: 10,000 100-mile truck trips
- Small Projects Alternative: 11,400 100-mile truck trips
- Large Projects Alternative: 16,000 100-mile truck trips

Annual construction fuel consumption is thus equivalent to not more than one day's average heavy truck traffic in the MWA service area. Construction fuel consumption impacts clearly rise as the magnitude of the alternatives increases. But, in the context of overall energy consumption in the MWA service area and in Southern California in general, they represent a tiny fraction of total energy use, and they are temporary.

In addition, construction fuel use under the Proposed Project may be offset by long-term energy savings associated with (a) use of the Mojave River Well Field and (b) lower energy use during conveyance of SWP supplies to MWA as a result of focusing deliveries in wet years and the wet season.

The magnitude of long-term energy savings related to use of the Mojave River Well Field to replace production from wells drawing supplies from the Regional Aquifer to the west of the river can be illustrated by comparing the probable operations and maintenance costs associated with new wells that may be constructed at Oeste and Alto to the new wells that may be constructed near the Mojave River. In a facilities cost estimate, Bookman Edmonston (2005d) estimated per-acre-foot costs for operation and maintenance (O&M) of wells at these two locations. Per-acre-foot O&M costs for wells at Oeste and wells installed as part of the Mojave River Well Field were estimated at $178 and $125, respectively. Because all wells would be new and have similar life cycle costs, the difference in costs, about $50 per acre-foot extracted, is primarily energy cost to pump from groundwater at different elevations.

If it is assumed that 67% of the $53 lower cost for O&M cost at the Mojave River Well Field would be due to energy cost savings, the energy cost savings is about $35 per acre-foot. Bookman-Edmonston used a power cost of $0.12 per kilowatt hour (kWh). Thus, $35 in energy savings is the result of saving about 291 kWh per acre-foot. Using standard conversions for kWh to gallons of diesel fuel, this is equivalent to about 6.7 gallons of diesel fuel for each acre-foot pumped.

Over the term of the Proposed Project, the annual recharge-extraction of the Mojave River Well Field may be up to 44,000 acre-feet per year. If only half of this capacity is assumed (22,000 acre-feet), and only half of this capacity is used to offset pumping from deeper wells in the Regional Aquifer (11,000 acre-feet), then at 6.7 gallons per acre-foot, annual operation of the Mojave River Recharge and Mojave River Well Field would reduce energy use by the equivalent of about 73,700 gallons per year. Over a 20-year period of operation, this energy savings alone would more than offset construction energy use. At the same time, recharge in the Oeste and Alto areas would also result in rising groundwater levels, with further resulting energy savings.

A second estimate of potential energy savings can be made based on the timing and magnitude of hydropower generation at SWP facilities (DWR 2001). Over a 20-year period, hydropower operations at DWR's Hyatt-Thermalito Generation facility (at Oroville Reservoir) have generated from about 4.8 billion kWh (in 1983) to less than 0.8 billion kWh (in 1991). Hydropower generation at this facility is routinely between 2.5 billion and 4.8 billion kWh in wet years and 0.8 billion to 1.9 billion kWh in dryer years. In addition, peak hydropower availability routinely occurs in May-August. To the extent that MWA can use additional recharge to allow it to take deliveries in wet years and in the wet season of all years, it can optimize use of available hydropower. In other times, DWR must frequently buy power. This is particularly true in the summer of dry years, when operation of the SWP can affect peak demand for electricity in the Central Valley.

The effect of added recharge and well fields is therefore to reduce pumping costs at a local level and to reduce energy demand on the SWP during peak energy demand years and seasons. In this context, the energy use associated with construction is at least offset by the reduced energy consumption associated with long-term operation and is less than significant.

5.16.4.2 Mitigation

Although this analysis suggests that net energy impacts of the Proposed Project will be insignificant and perhaps beneficial, MWA has also committed to an Air Quality mitigation program to reduce emissions during construction (see Section 5.3). This commitment to best management practices includes measures to ensure that equipment is not idled when not in use. This, and other measures to reduce air quality impacts, will further contribute to minimizing energy use.

5.16.4.2 Significance after Mitigation

Net Proposed Project energy use over the 20-25 year term of the project is insignificant and will be reduced further by implementation of construction best management practices for Air Quality. No significant impacts to energy use will occur.