SECTION 3
FORMULATION AND SCREENING OF POTENTIAL PROJECTS AND SITE-SPECIFIC ALTERNATIVES

3.1 INTRODUCTION

This section describes the selection and initial screening evaluation of a wide range of projects, leading to selection and detailed analysis of four Cadiz Project alternatives considered in this Final EIR/EIS. This section explains and documents the planning process leading to alternative selection and the role of technical and environmental considerations and public concerns in this process.

As discussed in Section 2 (Assessment of Project Need and Purpose), a number of potential projects will be utilized to meet the 594,000 acre feet dry-year supply requirement in the Colorado River resource area.

The formulation and screening of potential projects was conducted in a series of increasingly detailed studies, beginning with evaluation of 13 potential projects for supplying water in the Colorado River resource area, and ending with selection of alternative design elements of the Cadiz Project. The fundamental steps in this process were:

1. Identification of potential projects for meeting dry-year supply needs on the Colorado River Aqueduct;
2. Screening to identify feasible projects that could meet this objective; and
3. Formulation of site specific project alternatives.

The formulation effort was focused on proposals received by Metropolitan from numerous public agencies and private entities. These were formulated to a level adequate to allow an initial evaluation for technical feasibility and potential for major environmental impacts. This initial screening-level evaluation was focused on basic issues of site feasibility; primarily addressing hydrogeological, construction and environmental issues. Based on this level of analysis, two feasible sites for meeting groundwater storage and transfer objectives were identified. As noted in Section 2, the Hayfield Project was evaluated in a separate CEQA document and is currently in early stages of implementation.

Having determined that a water storage and transfer project could be feasible at Cadiz, and that none of the other sites evaluated other than Hayfield would be feasible due to hydrogeologic, construction or environmental concerns, as discussed later in this section, the next step was to develop alternative configurations for the Cadiz Project. This analysis included:

1. Development of alternative sites for the project spreading basins and wellfield;
2. Development of alternative sites for connecting water conveyance facilities to the Colorado River Aqueduct; and
3. Development of alternative alignments and designs for facilities to convey water from the Colorado River Aqueduct to the project spreading basins and from the project wellfield to the Colorado River Aqueduct.

This progressively more detailed formulation and screening process was intended to ensure that a wide range of projects was considered and evaluated objectively.

The results of these potential development and screening processes for meeting needs and objectives of the operation of the Colorado River Aqueduct are discussed in detail below.

3.2 PROJECT BACKGROUND

The process which led to the formulation of the Cadiz Project was initiated in November 1997 when Metropolitan established a process to secure supplemental water supplies and regional storage to meet the needs identified by its analysis of dry-year supply and demand through 2020. As outlined in Section 2, Metropolitan has identified a need for approximately 320,000 – 390,000 acre-feet per year of dry-year supply from the Colorado River Aqueduct, in addition to the supplies anticipated from cooperative projects with Coachella Valley Water District and Imperial Irrigation District, and from the San Diego County Water Authority proposed transfer project with the Imperial Irrigation District. As described in Section 2, this need exists even if all projected dry-year supply programs in Metropolitan's service area and other resource areas are implemented.

The initial phase of alternative formulation and screening was focused on a number of proposals. In addition, based on early reconnaissance of groundwater basins near or adjacent to the Colorado River Aqueduct, Metropolitan independently identified two groundwater basins that were added to the list of potential areas for groundwater conjunctive-use projects. Metropolitan's intent was to determine whether its supply and storage needs could be met through these voluntary transactions. If the needed dry-year supply could be met through implementation of one or more of these projects, further project formulation would be unnecessary.

In addition, two proposals were received involving transfers of water from the States of Arizona and Washington that would have required proponents to resolve significant water rights issues. Consideration of these proposals was deferred until the proponents could resolve those water rights issues.

3.3 PROJECT OBJECTIVES

To ensure that all potential alternatives would be evaluated on a consistent basis, quantitative project objectives were developed, consistent with Metropolitan's policy of seeking to meet water supply and water quality needs in a manner consistent with protection of the environment. The objectives were:

1. Storage of up to 1.5 maf of Colorado River water

   Sustained withdrawals of 100,000 acre-feet per year over a period of up to six consecutive years and would require storage of 1.5 maf over the term of the project.

2. Capacity to put or withdraw up to 100,000 acre-feet of water in a given year

   The ability to recharge and withdraw supplies at this rate (or higher) is essential to ensure (1) that supplies available during a wet year could be recharged during the year and (2) that dry-year needs could be met on a timely basis.

3. Potential for dry-year yield of 100,000 acre-feet per year

   The potential of the project to provide an additional and sustainable source of yield in a dry-year would make it feasible to use the project as a source of supply to meet demand in the Metropolitan service area.

4. Potential to produce water quality benefits

   Water from the Colorado River generally has high levels of total dissolved solids. Projects with a potential for enhancing water quality would be beneficial to Metropolitan operations.

5. Acceptable levels of environmental impacts

   Projects with high levels of impact would violate Metropolitan's commitment to act in an environmentally responsible manner.

3.4 STEP ONE: IDENTIFICATION OF POTENTIAL PROJECTS

3.4.1 GENERAL

As a part of the preparation of this EIR/EIS, 13 potential projects were identified for consideration and evaluated. Ten were groundwater storage and conjunctive-use projects, one was a transfer project, and two involved desalting of agricultural drainage water. These potential projects for meeting supplemental water supply and water quality objectives are briefly described below.

3.4.2 POTENTIAL PROJECTS

Arizona Banking (Groundwater Storage) Project

The State of Arizona created the Arizona Water Banking Authority to provide off-stream storage for surplus supplies from its 2.8 maf Colorado River water entitlement. The storage goal for the Arizona Banking Project over the period from 2000 to 2030 is 14.0 maf of Colorado River water, which would otherwise be unused apportioned water and be made available to other water users. Under this project, Metropolitan would contract with Arizona to store surplus Colorado River water in the Central Arizona Project between Lake Havasu and Phoenix. In dry-years, Arizona would then utilize stored water and would exchange surface water from Lake Havasu to Metropolitan. Fees from the sale of exchanged water would fund development of this groundwater banking project. A small-scale demonstration project was implemented, and 89,000 acre-feet of water were stored.

Cadiz Valley Groundwater Storage Project

The Cadiz Valley is a northwest to southeast trending valley about 60 miles long which drains to Cadiz and Bristol dry lakes. Fenner Valley is a northeast to southwest trending valley that intersects Cadiz Valley at a gap (Fenner Gap) located between the Marble and Ship mountains.

Like most of the valleys studied, the alluvial sediments of the valley are underlain by granites and metamorphic rocks, forming a rock-bounded basin overlain with sands and gravels several hundred feet thick. Groundwater lies between approximately 140 and 220 feet below the surface in the proposed project area.

Land use in the area is primarily open space and agriculture. There are existing salt mining operations at Bristol and Cadiz dry lakes. The Burlington Northern & Santa Fe (BNSF) rail line crosses through the Cadiz Project area south of the Ship Mountains. The Arizona and California Railroad Company (ARZC) line branches off the BNSF within the project area and trends southeastward toward Parker, Arizona.

A groundwater storage project in the Cadiz-Fenner area would involve use of the aquifer system at the junction of the Cadiz and Fenner valleys, approximately 35 miles northwest of Metropolitan's existing Iron Mountain Pumping Plant on the Colorado River Aqueduct. The project would include construction of water spreading basins and a wellfield in the Cadiz Valley, a canal and/or pipeline from the Colorado River Aqueduct to the spreading basins, power supply and distribution facilities, and construction of supplemental pumping plant(s), depending on the type of conveyance facilities constructed.

The Cadiz Project area has the capacity to store approximately 1.0 maf of imported water. Studies indicated that indigenous groundwater is moderately low in TDS, ranging from approximately 270 to 420 mg/L in concentration.

The Cadiz Valley lies between the Sheephole Mountains and Old Woman Mountains wilderness areas. The Cadiz Dunes Wilderness Area and the Kilbeck Hills lie in the middle of the project area. It is likely that construction activities and above-ground facilities would be visible from trails in these wilderness areas. Low levels of desert tortoise activity have been documented in the valley, and there is bighorn sheep habitat in the mountains adjacent to the proposed project area.

Hayfield Valley Groundwater Storage Project

Use of the Hayfield Valley for water storage was first evaluated in the 1930s, when an attempt to create a surface storage reservoir on the Colorado River Aqueduct was conducted. Porous soils made it difficult to maintain surface storage, as stored water rapidly drained into the groundwater basin beneath the dry lake bed of Hayfield Lake. The proposed project would involve delivery of approximately 150,000 acre-feet per year to this groundwater basin via the Colorado River Aqueduct, storage of up to 800,000 acre-feet in the basin, and recovery of approximately 150,000 acre-feet per year during dry-years. Metropolitan owns a large part of this valley and competing uses of its resources would therefore be minimal. Indigenous groundwater quality is moderate, with TDS levels in the 270 to 460 mg/L range, or about 30 percent lower than average levels in the Colorado River Aqueduct.

The Hayfield Valley site was determined to be a feasible site, and was studied extensively following initial evaluation. Environmental documentation was completed for this site in early 1999 and the project has been initiated.

Palen Valley Groundwater Storage Project

The Palen Valley, a component of the larger Chuckwalla Valley Drainage Basin, is located about five miles east of the Colorado River Aqueduct, which runs north-south along the eastern edge of the valley. The Valley lies between the Coxcomb Mountains on the west and the Granite and Palen mountains on the east. Elevations in these mountains reach approximately 4,500 feet, and precipitation and runoff are correspondingly low.

Hydrogeological investigations of the Palen Valley were generally conducted in conjunction with investigations of the Upper Chuckwalla Valley, and results are relatively consistent. The Palen Valley is underlain by granitic and metamorphic rocks, with overlying alluvial deposits approximately 1,000 to 1,200 feet deep. Several studies have recorded clay layers which could act as confining layers for groundwater recharge and withdrawal.

Data on groundwater levels for the Palen Valley generally dates to the late 1950s, when tests showed that depth to groundwater ranged from 13 to 325 feet. Preliminary studies indicate that Palen Valley has less than 300,000 acre-feet of storage capacity available. Indigenous water quality varies from moderate (520 mg/L TDS) to highly saline (12,300 mg/L TDS), with a majority of the recorded data indicating TDS levels in excess of 700 mg/L. Other mineral constituents have generally been consistently below Environmental Protection Agency Maximum Containment Levels (EPA MCLs). Palen Valley lies adjacent to Joshua Tree National Park. Construction activities and permanent facilities would be visible from some parts of this park. Desert tortoise are documented in the area. The area is also within a north-south wildlife migration corridor.

A project at this site would involve discharge of water from the Colorado River Aqueduct to adjacent spreading basins and construction of a wellfield, pipeline and pumping station to convey stored supplies back to the Colorado River Aqueduct during dry years.

Pinto Valley Groundwater Storage Project

Located within Joshua Tree National Park, the Pinto Basin is a 20-mile long basin surrounded by mountains and draining at its east end through a gap between the Eagle and Coxcomb mountains. Both surface and subsurface groundwater flows pass through this gap into the Upper Chuckwalla Valley.

Like most other valleys in the region, the Pinto Basin is underlain by granitic and metamorphic rock and overlain by sand, gravel, and clay-rich alluvium approximately 200 to 300 feet thick. Based on previous studies, the large groundwater basin in this area is capable of storing up to 1.5 maf. A Metropolitan test well just north of the gap between the Eagle and Coxcomb mountains produced adequate flows of water with a TDS of about 400 mg/L. Other water quality studies have indicated that indigenous water quality is similar in TDS, ranging from approximately 314 to 580 mg/L TDS.

A project in Pinto Valley would involve conveyance of supplies from the Colorado River Aqueduct 15 miles west into the Pinto Valley, via a pipeline/canal, to 300 to 400 acres of spreading basins, a wellfield and pumping station.

Land use in the Pinto Valley is limited to public uses of the parklands, and construction could adversely affect these uses for several years. Above-ground project facilities would be visible from the Park's trail system and would constitute an inconsistent feature in the landscape.

Joshua Tree National Park is habitat for both bighorn sheep and desert tortoise, and a project in the Pinto Basin would adversely affect protected habitats of both species, as well as established wildlife migration corridors.

Rice Valley Groundwater Storage Project

The Rice Valley is the first large, topographically enclosed alluvial valley west of the Colorado River adjacent to the Colorado River Aqueduct. The valley is bounded on the north by the Turtle Mountains, on the east by the Riverside and West Riverside mountains, and on the south by the Little Maria and Big Maria mountains. Elevations in this watershed are generally less than 3,000 feet and precipitation is accordingly low.

Hydrogeological investigations of the valley have generally been limited to the area near Rice Township. These and other investigations suggest the valley is underlain by granitic and metamorphic rocks. The basement complex is overlain by sand, gravel and clay-rich alluvium. Confining layers of clay have been found in several studies, and suggest that recharge and withdrawal of groundwater could be limited. Storage capacity was estimated at 125,000 acre-feet. United States Geological Survey (USGS) test well data from 1910 to 1972 suggest that depth to groundwater ranges from about 140 feet to over 450 feet. Groundwater flow is generally believed to be to the east and southeast, and may spill into the Colorado River's groundwater regime via Vidal Valley and between the Riverside and Big Maria mountains. Therefore, there is some potential for loss of storage to the Colorado River.

Groundwater quality has been recorded at five wells, with the most recent test conducted in 1956. Indigenous groundwater quality is generally poor, with TDS levels ranging from 662 mg/L to over 2,600 mg/L, but tests of other mineral constituents do not reveal contaminant levels in excess of EPA MCLs. These tests, however, predate modern testing techniques and are, therefore, potentially unreliable.

Land use in Rice Valley is primarily open space and agricultural. The BNSF rail line runs north-south along the eastern edge of the valley between the Big Maria and Little Maria mountains. Rice Valley is documented habitat for the desert tortoise and bighorn sheep.

A project in Rice Valley would involve delivery of supplies to a small (125,000 acre-feet) groundwater basin 10 miles south of the Colorado River Aqueduct, via a pipeline to a spreading basin and wellfield.

Shavers Valley Groundwater Storage Project

The Shavers Valley is located approximately 10 miles north of the Salton Sea and three miles from the Colorado River Aqueduct. The valley is bordered on the north by the Cottonwood Mountains, on the southeast by the Orocopia Mountains and on the southwest by the Mecca Hills. Initial geological investigations show that the valley is underlain by unconsolidated shales, sandstones and gravels. Elevations in Shavers Valley range from 1,000 to 2,000 feet. Less than 10 miles away, the Salton Sea is at an elevation of less than 100 feet above mean seal level above (amsl), creating a very high drainage gradient.

The valley has potential to store up to 350,000 acre-feet of imported water and the indigenous groundwater with TDS ranging from approximately 350 to 550 mg/L. The valley is currently unused and vacant and there would be few competing interests for the valley's resources. The fundamental hydrogeological issue addressed in evaluation of this valley was the ability of the valley to provide long term storage of imported supplies.

Shavers Valley is located due south of Joshua Tree National Park and has been identified as a potential north-south wildlife migration route to the Orocopia Mountains by the Coachella Mountains Conservancy. Desert tortoise occur in this valley. Because of this site's proximity to Joshua Tree National Park, spreading basins, conveyance facilities and power lines would be visible from parts of the mountains on the southern boundary of the Park, as well as from Interstate 10 (I-10). Conveyance facilities to and from the spreading basins would require construction under I-10.

Upper Chuckwalla Valley Groundwater Storage Project

The Upper Chuckwalla Basin is located north of Desert Center. Several side valleys drain to this wide valley (over 10 miles at its southern end), including Hayfield Valley on the west and Pinto and Palen valleys on the north.

The valley, 14 miles long and 10 miles wide, is bounded on the east by the Coxcomb Mountains and on the west by the Eagle Mountains. Elevations in these mountains are generally below 4,000 feet.

Like many of the valleys studied, the Upper Chuckwalla Valley is underlain by granitic and metamorphic rocks, with sand and gravel alluvial deposits approximately 1,000 feet in depth. Initial borings indicated few clay layers, but hydrogeological studies in adjacent valleys raise the possibility that additional clay layers may be present and that these could act as confining layers for groundwater recharge and withdrawal.

Based on studies in 1994, the Upper Chuckwalla Valley was considered to be hydraulically connected to the Colorado River and the valley is included within the Colorado River Aquifer. At approximately 235 feet in elevation, a bedrock ridge may separate the groundwater basin from the Colorado River and, therefore, water stored below this elevation would probably not flow out of the basin to the Colorado River.

There have been a number of groundwater quality studies in the Upper Chuckwalla Valley since 1931. Depth to groundwater has ranged from 13 feet to over 630 feet. Based primarily on studies in 1961 involving 15 wells, indigenous groundwater quality is variable, with TDS levels ranging from 270 mg/L to over 1,310 mg/L. A majority of measurements have been in the 400 mg/L to 900 mg.L range. Several constituents exceed EPA MCLs, including nitrates and fluoride.

This proposal would involve storage of up to 1.0 maf in the Chuckwalla Valley immediately south of the Colorado River Aqueduct. Water would be delivered to spreading basins directly from the Colorado River Aqueduct. A wellfield and conveyance pipeline approximately five miles in length would be constructed to return stored water to the Colorado River Aqueduct.

The Upper Chuckwalla Valley lies immediately adjacent to Joshua Tree National Park. Construction activities and permanent facilities would be visible from trails in this area.

Vidal Valley Groundwater Storage Project

Vidal Valley is located eight miles from the Colorado River Aqueduct adjacent to the Colorado River downstream from Lake Havasu. This triangular-shaped valley is bounded by the Whipple Mountains on the north, the Turtle Mountains on the northwest, and the Riverside Mountains on the south. The Parker Valley of the Colorado River forms the southeastern boundary of Vidal Valley.

This large valley, 25 miles long and 12 miles wide, ranges in elevation from 2,000 feet to 400 feet at the Colorado River. The geology of this valley differs from that of other valleys studied. Three distinct layers of sedimentary deposits overlie the granitic and metamorphic basement rock formations. On the surface, there is a layer of sand and gravel alluvial sediments. Beneath this recent alluvium, there is a layer of fine sand, silt and clay of marine origin. These dense marine sediments overlie a sequence of sands and fanglomerates with occasional interlayed volcanic flows.

Indigenous groundwater in the valley is found both above and below the layer of marine sediments, but the marine layer restricts the connection between these two parts of the groundwater aquifer system. The marine layer would effectively block recharge to the larger, confined, groundwater aquifer below it. Both surface and groundwater drainage are directed to the Colorado River. The valley's groundwater has relatively high TDS levels at 397 to 2,864 mg/L.

Land use in the area is generally open space and agriculture. There are parts of the Colorado River Indian Reservation on the westside of the Colorado River, at the boundary of the valley.

Like other areas studied, the Vidal Valley is a documented habitat for the desert tortoise.

Ward Valley Groundwater Storage Project

The Ward Valley watershed covers an area of approximately 600 square miles and extends northward from Danby Dry Lake more than 40 miles to the vicinity of I-10. The valley is bordered on the west by the Old Woman Mountains and on the east by the Turtle Mountains. The highest peaks in the Old Woman Mountains reach elevations greater than 5,300 feet. Peaks in the Turtle Mountains reach elevations greater than 4,300 feet.

The BLM owns most of the land in Ward Valley, and accordingly, there has been very little development in the area. The high-capacity powerline and access road that serves Metropolitan's Iron Mountain Pumping Plant runs north-south through the length of the valley. A low-level radioactive waste storage facility has been proposed for the northern end of Ward Valley, however its status is uncertain at this time.

There are designated wilderness areas in both the Old Woman and Turtle mountains, and construction activities in Ward Valley could potentially be visible from these areas. Portions of these mountain ranges are also habitat for bighorn sheep. The United States Fish and Wildlife Service has designated Ward Valley as Critical Habitat for desert tortoise.

A storage project in Ward Valley would involve construction of spreading basins and a wellfield in the southern portion of the valley, approximately 5 to 10 miles north of Danby Dry Lake. These facilities would be constructed a sufficient distance from the dry lake to avoid the saline groundwater that occurs at the lake margin. This portion of the valley is characterized by a thick section of alluvial sediments (sand and gravel) which overlie a basement complex of granite and metamorphic rock. These alluvial sediments form the principal aquifer system in the area. TDS is estimated to be in the range of 400 to 600 mg/L.

A conveyance pipeline approximately 15 miles in length would be required to connect the project spreading basins and project wellfield to the forebay of the Iron Mountains Pumping Plant. An alternative alignment, approximately 20 miles in length, would be required to connect these facilities to the Colorado River Aqueduct southeast of the proposed site.

Cadiz Valley Dry-Year Transfer Project

In addition to providing potential groundwater storage for wet-year supplies on the Colorado River Aqueduct, indigenous groundwater in the Cadiz Valley could also be transferred to Metropolitan in dry-years through a transfer project. Transfers of indigenous groundwater have potential to help reduce average TDS levels in Colorado River Aqueduct supplies, especially in dry-years. Indigenous water has TDS levels ranging from approximately 270 to 420 mg/L, which is less than average levels in Colorado River water.

Desalting Projects

Construction and operation of a desalination facility capable of meeting seasonal and long term storage deficits would be one way to meet the dry-year water needs on the Colorado River Aqueduct. One source of water for desalination in the Colorado River Aqueduct basin would be agricultural drainage in the Coachella Valley.

Desalination of agricultural drainage was initially proposed as two separate projects: Desalination of Whitewater River Agricultural Drainage and Desalination of Alamo River Agricultural Drainage. Both these rivers flow across the agricultural lands of the to the Salton Sea, contributing to the increasing salt load in this 35-mile long lake. Together, the two rivers collect up to 700,000 acre-feet of agricultural drainage per year, with minimum annual combined drainage of 450,000 acre-feet. Facilities to desalt this combined minimum annual flow would yield approximately 340,000 acre-feet of water per year.

Facilities would include two desalting plants, 55 miles of canal, 23 miles of pipeline, and four pumping stations to lift desalted water a total of 2,525 feet to the Colorado River Aqueduct. In addition, desalting operations would require facilities to dispose of waste water from the desalting operation. The potential benefits of desalting agricultural drainage include about 340,000 acre-feet yield of very high quality water (very low TDS), available in all years. Desalination would not only meet the dry-year supply need on the Colorado River Aqueduct, but would help to meet normal-year water quality needs on the Colorado River Aqueduct. The proposed (combined) desalination project would have a start up date between 2010 and 2015 and would have an indefinite term.

Desalination would involve disposal of approximately 80,000 acre-feet of highly saline brine per year. Disposal alternatives range from disposal in a brine evaporation area to pumping brine via pipeline south to the Sea of Cortez or west over the Coastal Range to the Pacific Ocean. All these disposal alternatives would involve significant but as yet unquantified environmental impacts.

3.5 STEP TWO: SCREENING OF POTENTIAL PROJECTS

3.5.1 GENERAL

The fundamental purpose of the screening process was to narrow the range of potential projects to those with potentially acceptable levels of costs and environmental impacts and, therefore, limit detailed analysis to storage sites, transfer programs and/or other approaches which are technically feasible and economical while minimizing potential environmental impacts. Specific criteria for screening evaluation were that potential projects carried forward for detailed analysis should:

1. Meet objectives for dry-year water storage and withdrawal;
2. Meet water quality objectives;

3. Be operational prior to 2005-2010 when dry-year needs are projected to exceed available supplies;
4. Have acceptable levels of construction difficulty, and long term maintenance (ground stability, corrosion); and
5. Be feasible from an environmental perspective, with levels of potential environmental impacts that could be mitigated to acceptable levels.

The screening evaluation was an objective and efficient way to reduce the number of storage sites and other programs carried forward for detailed analysis.

To provide an objective basis for screening projects, a Steering Committee, comprised of Metropolitan Board members and member agency general managers, was formed. This committee established the above criteria to evaluate proposals.

Metropolitan also conducted reconnaissance-level studies of potential projects. These studies included extensive review of literature on each of the proposed projects.

Data from these studies, including data on environmental impacts or conflicts with regional environmental goals, were then used to screen less feasible projects from detailed consideration. When this was completed, screening for technical feasibility was conducted by a multi-disciplinary technical review committee consisting of recognized experts in the fields of (a) geology and hydrology, (b) constructability and implementation cost, and (c) financial and economic analysis.

In addition to these technical analyses, Metropolitan conducted its own unit cost analysis. This analysis estimated the real cost of projects with different characteristics based on analysis of when costs are incurred and benefits are received. For example, costs of transfers may be incurred in the same years that the benefits are received. The costs of storage projects are, in contrast, often incurred prior to benefits being received. Under this real cost approach, the deferred revenue from the capital expended early in such projects is taken into account when comparing storage and transfer projects.

Metropolitan evaluated unit costs relative to benefits using probable water supply and demand scenarios that forecast, for example, when supplies would be stored and when they would be recovered from a typical groundwater storage project. The results of different scenarios can then be compared to determine which projects have the lowest cost under expected conditions.

3.5.2 ENVIRONMENTAL CONSIDERATIONS IN THE SCREENING PROCESS

The initial screening focused primarily on technical feasibility issues. At the initial screening level, and in the absence of detailed environmental data that would allow site-specific analysis, the primary environmental issue addressed was conflicts with known environmental resources. Of primary importance in this evaluation was the Desert Tortoise Recovery Plan (USFWS June 1994). One potential project, the Pinto Valley Groundwater Storage Project, was located in a National Park. The other storage and transfer projects considered in the screening analysis were all considered to have potential adverse impacts to desert tortoise. Other key environmental issues addressed at this stage of evaluation were potential for impacts to wildlife migration corridors and impacts to adjacent public uses of park lands and wilderness areas.

Therefore, the initial screening focused on technical and economic feasibility, environmental criteria and the potential for conflicts with the goals and objectives of the National Park Service and wilderness areas.

3.5.3 POTENTIAL PROJECTS CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Based on the screening analysis, ten potential projects were initially eliminated from further consideration and environmental analysis because of multiple technical feasibility issues and/or environmental concerns. One potential project, Pinto Valley, was eliminated entirely on the basis of environmental concerns. The two potential projects for desalination of agricultural drainage were eliminated on the basis of significant technical concerns and unresolved environmental and water rights issues. The sites or programs carried forward for more detailed consideration were those determined to best meet feasibility, cost and environmental criteria.

Arizona Banking Groundwater Storage Project

This project was not carried forward for further analysis at this time because the State of Arizona withdrew its proposal to Metropolitan. Therefore, the status of Southern California's participation in the Arizona Banking Project is considered uncertain at this time. However, Metropolitan intends to continue discussions with the State of Arizona regarding potential groundwater banking and will continue to assess the viability of such a program based on those discussions. If Metropolitan were to proceed with a banking program in Arizona, appropriate environmental review would be conducted at that time.

Palen Valley Groundwater Storage Project

The Palen Valley site is close to the Colorado River Aqueduct and, therefore, would require minimal construction. Project costs would be low to moderate.

However, parts of this valley are immediately adjacent to Joshua Tree National Park and documentation exists that this valley may provide habitat for desert tortoise. Extensive spreading basins in this valley could have an unacceptable level of impact on this species. A wildlife migration corridor would also be affected.

The Palen Valley's extremely poor indigenous water quality, which varies from moderate (520 mg/L TDS) to highly saline (12,300 mg/L TDS), does not meet critical water quality screening criteria. Groundwater in the Palen Valley also contains fluorides and nitrates. In addition, the site's potential yield and storage capacity were below target levels. Use of this site for storage of Colorado River water would not provide the needed yield or maintain current levels of Colorado River water quality.

These adverse environmental and water quality conditions offset the potentially low project cost at a Palen Valley site, and it was not carried forward for more detailed consideration.

Pinto Valley Groundwater Storage Project

Pinto Valley was determined to be a highly favorable site from the perspective of storage capacity and indigenous water quality. Construction costs would be low and would involve a relatively short conveyance facility. The valley has high storage capacity, and a wellhead located in the Eagle

Mountains-Coxcomb Mountains gap would intercept groundwater migrating downstream in an efficient manner.

Although the Pinto Valley would otherwise meet all the initial screening criteria, a project at this site would have significant conflicts with existing National Park uses and environmental values. In addition, recent university surveys have determined that the Pinto Valley has high densities of desert tortoise and a unique herpetological community with a number of rare species. These impacts represent an unacceptable adverse environmental impact and the Pinto Valley site was not carried forward for detailed analysis.

Rice Valley Groundwater Storage Project

The Rice Valley site was eliminated from consideration early in the evaluation process due to the low potential for additional imported water storage capacity and extremely poor water quality.

Shavers Valley Groundwater Storage Project

The Shavers Valley site has several significant potential advantages. First, it is close to the Colorado River Aqueduct, and spreading grounds and wells would need to be only about three miles from the aqueduct, thereby reducing costs associated with pipeline or canal construction. Long term operation and maintenance costs would also be substantially lower than for many of the other potential projects. Construction under I-10, a major east-west artery, would pose some difficulties, but these were not considered unacceptable from the point of project feasibility.

However, the Shavers Valley proposal was eliminated from detailed analysis for a number of reasons. First, Shavers Valley provides low storage potential and high potential for groundwater to migrate from the valley. The unconsolidated shales, sandstones and gravels that underlie this valley will not contain groundwater within the confines of the valley. This, combined with a steep gradient trending towards the Salton Sea to the south, would limit the effectiveness of long term storage in the valley. Although Shavers Valley could provide cost-effective short term storage, its usefulness as a long-term storage site is limited.

Upper Chuckwalla Valley Groundwater Storage Project

Upper Chuckwalla Valley provides numerous advantages due to its proximity to the Colorado River Aqueduct. The site is immediately adjacent to the Colorado River Aqueduct and conveyance facilities would be minimal. The basin is large, with capacity to store an additional 1.0 maf.

However, surrounded by Joshua Tree National Park, the Upper Chuckwalla Valley site would have potentially unacceptable levels of environmental impacts, including land use conflicts related to the Park and adjacent wilderness areas and impacts to desert tortoise habitat. Recent studies have indicated that this area has high densities of desert tortoise.

The proposed groundwater storage project in Upper Chuckwalla Valley also fails to meet critical water quality criteria, with TDS levels in excess of 900 mg/L from some test wells in the area. The former Eagle Mountain Site could also contribute to water quality degradation in the future. The result of these problems could be significant degradation of Colorado River water quality.

The Draft EIR/EIS stated that this potential project was eliminated from further consideration due to potential environmental and water quality concerns. Since that time, Metropolitan has decided to

further examine whether any potential environmental and water quality problems involved with a potential Upper Chuckwalla Valley Project can be overcome. In March 2001, Metropolitan authorized the preparation of detailed feasibility studies for the potential project. If, after the completion of those studies, Metropolitan determines that the environmental and water quality problems could potentially be overcome, environmental documentation for the project would be prepared. However, because the detailed feasibility studies will not be completed until late 2002, this potential project was eliminated from further consideration in this Final EIR/EIS.

Vidal Valley Groundwater Storage Project

The Colorado River Aqueduct bisects the Vidal Valley and thus construction of facilities would pose no significant difficulties or involve high costs. However, the feasibility of long-term storage is limited due to the low capacity of the upper groundwater aquifer and the inability of groundwater to penetrate the basin's marine sediment layer to reach the larger lower aquifer.

In addition, there is significant potential for stored groundwater to be lost from the basin to the Colorado River, reducing the net yield of the project and raising costs on a unit basis. Finally, poor water quality also made this site inappropriate for more detailed consideration.

Ward Valley Groundwater Storage Project

Evaluation of the Ward Valley Groundwater Storage Project focused primarily on environmental and engineering considerations, since available hydrogeological data are not sufficient to fully assess the site at this time. Based on available information, storage capacity in the southern portion of Ward Valley may meet project criteria. Water quality was estimated to range from approximately 400 to 600 mg/L TDS. However, infiltration rates for spreading basins and well yields in the southern portion of the valley are not known.

Potential advantages of the site are offset by engineering difficulties, involving both construction and operation and maintenance. Metropolitan's Iron Mountain Pumping Plant would be the preferred site for linking a conveyance pipeline from the spreading basin and wellfield facilities to the Colorado River Aqueduct. Therefore, any direct alignment would require construction across the corrosive soils and shallow brine of Danby Dry Lake. Approximately five miles of this 15-mile alignment would be within the Danby Dry Lake depression. Such an alignment would also result in high operation and maintenance costs. An alternative alignment, which would link the spreading basin and wellfield facilities to the Colorado River Aqueduct southeast of the site, could potentially avoid corrosive soils in the vicinity of the dry lake. However, such an alignment would require approximately 20 miles of pipeline and necessitate construction of a supplementary pumping plant and related power transmission facilities at the aqueduct.

During withdrawal operations from the Ward Valley Project, approximately 40,000 acre-feet per year would be available for export. The individual pumps on the Colorado River Aqueduct are sized to move approximately 150,000 acre-feet per year each, thus creating a mismatch between the Ward Valley Project and the Colorado River Aqueduct.

Environmental issues were also identified during the screening evaluation. The site is located within designated critical habitat for the desert tortoise. The probable spreading basin sites would be located within Critical Habitat for the desert tortoise and would be adjacent to designated wilderness areas and visible from these areas, and would interrupt north-south wildlife movement.

For both operational and environmental reasons, the Ward Valley project was eliminated from consideration.

Desalination of Agricultural Drainage in the Coachella Valley

Desalination of agricultural drainage in the Coachella Valley was evaluated and determined to have significant potential water supply and water quality benefits. Consideration of desalination would require significant coordination with the on-going program for restoration of the Salton Sea, resolution of brine disposal issues and improvements in technology which would lower costs per acre-foot of yield. Assuming that such issues could be resolved in the near future, full-scale desalination could not be implemented prior to 2010, and implementation by 2010 could be affected by a number of issues, including environmental issues and issues related to resolution of California's Colorado River allocations. In addition, estimated desalination costs were approximately two to four times the cost per acre-foot for other projects. Desalination also utilizes large amounts of energy and requires large land areas, potentially resulting in both local and regional environmental impacts. For these reasons, desalination of agricultural drainage was not carried forward as a method for meeting dry-year storage options.

Metropolitan and others will, however, continue to study desalination of agricultural drainage and ocean seawater as a means of meeting both water supply reliability and water quality needs. The implementation of such projects will, to a large extent, depend on resolution of brine disposal issues and technological advances that lower construction and long-term operation and maintenance costs.

3.5.4 RESULTS OF INITIAL SCREENING OF POTENTIAL PROJECTS

Three projects were carried forward for detailed formulation and evaluation, for the reasons outlined below.

Cadiz Valley Groundwater Storage Project

The Cadiz Valley site has several significant advantages. First, all the lands needed for the spreading basins and wellfield are owned by a single entity, Cadiz Inc. There are relatively few construction difficulties due to the remoteness of the project area and the availability of multiple options for conveyance systems which avoid construction in dunes or highly corrosive dry lake beds. Few, if any, unacceptable social impacts would be anticipated.

This proposed 50-year storage project has the potential to meet approximately one-third to one-half of the Colorado River Aqueduct need for supplemental supplies in 2020, and has adequate storage capacity to meet needs during a long term drought. Available data on indigenous groundwater supplies indicate that TDS levels are low to moderate and would enhance water quality in the Colorado River Aqueduct for this constituent. Indigenous groundwater quality must be monitored for other water quality constituents and demonstrated to be adequate before the project can be implemented. As the local project proponent, Cadiz Inc. has both established water rights and property rights to ensure the implementation of the project, and has the financial and technical support needed to perform its obligations under a cooperative project agreement.

Environmental impacts from a project at the Cadiz site were also not considered unacceptable during screening. The valley is not designated as critical habitat for the desert tortoise. Construction could temporarily impact bighorn sheep movement, but permanent impacts would not occur, assuming construction of an underground pipeline.

For these reasons, the Cadiz Valley groundwater storage project was carried forward for more detailed analysis.

Cadiz Valley Dry-Year Transfer Project

A groundwater transfer project, in combination with a storage project, could help meet the identified Colorado River Aqueduct Phase I screening criteria for dry-year supply in 2020. Therefore, a dry-year transfer element was combined with the groundwater storage project discussed above, and carried forward as one combined dry-year storage and transfer project.

Hayfield Valley Groundwater Storage Project

The Hayfield Project was carried forward for detailed evaluation because it meets all the initial screening criteria. Of particular note is Metropolitan's ownership and protection of a majority of the land in the valley, thereby providing protection against future groundwater contamination. Delivery of Colorado River water to the basin is also minimal in cost, requiring only a spillway to be constructed for release of water from the Colorado River Aqueduct. The Hayfield Project has the potential to meet approximately one-third to one-half of the identified need for supplemental supply in the Colorado River Aqueduct. The environmental effects of the Hayfield Project have been analyzed in a separate document and the Hayfield Project is currently being implemented.

3.6 STEP THREE: FORMULATION OF SITE- SPECIFIC PROJECT ALTERNATIVES

The last step in the alternative formulation for the Cadiz Project considered in the preparation of this EIR/EIS involved the formulation of various Cadiz Project facility configurations.

To minimize the complexity of alternative formulation, an initial effort was made to identify elements of the proposed project that would be common to all site-specific facilities alternatives. This effort was initially focused on evaluation of potential sites for spreading basins and the wellfield and on identifying feasible sites for the connection of conveyance facilities to the Colorado River Aqueduct. The effect of this preliminary analysis was to define the feasible end points of the needed conveyance facilities and, therefore, focus the remaining analysis on conveyance alignments.

Once the common elements for all alternatives (with the exception of the No Project Alternative) were established, detailed comparison of alternatives focused on the conveyance facilities.

3.6.1 SITING OF PROJECT SPREADING BASINS AND WELLFIELD

The locations of the Bristol, Cadiz and Fenner valleys are shown on Figure 3-1. Spreading basins located farther northeast in the Fenner Valley on Cadiz Inc. landholdings, were initially considered but were rejected because they would be constructed on relatively steep slopes, would require more grading and cause more habitat disturbance than spreading basins constructed further south in the Fenner Gap area. Spreading basins south of Fenner Gap were precluded by the highly saline groundwater underlying Bristol and Cadiz dry lakes and the potential for this water to migrate into the project wellfield during extraction operations. Hydrogeologists recommended that to avoid such interaction, the spreading basins and wellfield be located as shown on Figures 3-2 and 3-3.

This configuration would place the spreading basins in an area of high soil permeability and provide for "mounding" of the groundwater stored upslope from Bristol and Cadiz dry lakes. Placement of the wellfield in the general area of the spreading basins, on Cadiz Inc. landholdings, was also recommended.

The intent of these siting considerations would be to reduce lateral movement of water toward the saline groundwater at Bristol and Cadiz dry lakes during recharge and to minimize lateral movement of water from the dry lake towards the wellfield during withdrawal operation. This was selected as the most feasible site for these facilities based on the need to minimize habitat loss due to construction, the need to optimize percolation rates, and the need to maintain water quality in the storage and extraction areas. The siting also places the wellfield and the spreading basins entirely on privately owned land. This minimizes the potential for loss of wildlife habitat as a result of project construction based on the existing agricultural production on this site.

3.6.2 SITING OF PUMPING STATIONS

Siting of primary pumping stations was based on two primary factors: proximity to the Colorado River Aqueduct and distance from the Fenner Gap. As Figure 3-4 shows, the Colorado River Aqueduct is closest to the Fenner Gap at the Iron Mountain Tunnel portals. The ability to minimize the distance for construction of a water conveyance facility, together with use of existing capital improvements, operations and maintenance resources, would reduce the cost of constructing, maintaining and operating a Cadiz Project conveyance facility and could potentially minimize the potential for environmental impacts associated with it. For these reasons, pumping station siting was limited to two sites, one near the west portal of the Iron Mountain Tunnel and one near the existing Iron Mountain Pumping Plant.

3.6.3 SPECIFIC ALIGNMENT ALTERNATIVES CONSIDERED

General

Having established the feasible endpoints of the Cadiz Project, the next phase of detailed alternative project formulation was to identify feasible alignments for water conveyance facilities (pipelines, canals and combinations of pipeline and canal). Alignments and design for water conveyance facilities were constrained by regional topography and soils. The water conveyance facilities must cross several areas of steep topography and must be constructed in alternating sand and rock for the remainder of their lengths.

Initial Screening of Conveyance Facility Types and Alignments

Metropolitan and its technical consultants conducted a preliminary screening of 17 alternative water conveyance facility alignments for the Cadiz Project. The development of the water conveyance facility alignments for the Cadiz Project focused on three main corridors:

a. An eastern corridor beginning at the Iron Mountain Pumping Plant and running northwest near Danby Dry Lake.
b. A western corridor beginning at the west end of the Iron Mountain Tunnel and running northwest through the Cadiz Valley.
c. A central or combination corridor beginning in the south along the western corridor alignment west portal and then crossing east to join the eastern alignment north of the Kilbeck Hills.

Within these three corridors, 17 potential alignments were formulated and evaluated to arrive at a short list of practicable alignments described in Table 3-1 and shown on Figure 3-4. Many of the 17 potential alignments shared common individual segments.

TABLE 3-1
SEVENTEEN CONVEYANCE ALTERNATIVES
GIVEN SCREENING-LEVEL EVALUATION

Alternative (Refer to Figure 3-4)	Segments, North to South (Figure 3-4)	Rational for Elimination Summary
E-1. Eastern Alternative	E-1	Carried forward.
W-4. Western Alternative	E-1, W-4	Carried forward.
C-1. Combination Alternative	E-1, C-1, W-4	Carried forward.
E-6. Eastern/Canal 1 Canal follows 820-foot contour along Iron Mountain	E-1, E-6	Canal construction would involve dewatering and associated environmental impacts; canal would block wildlife migration corridor.
E-5. Eastern/Canal 2 Canal follows 755-foot contour along Iron Mountain	E-1, E-5	Carried forward.
E-7. Eastern/Canal 3 2-way canal conveyance, including canal on 755-foot contour along Iron Mountains	E-7, E-1, E-5	Canal construction would involve dewatering and associated environmental impacts; canal would block two wildlife migration corridors.
E-9. Eastern/Canal 4 2-way canal conveyance, including canal on 820-foot contour along Iron Mountains	E-7, E-1, E-6	Canal would block two wildlife migration corridors.
E-8. All Canal Alternative	E-7, E-8	Canal would completely block east-west wildlife migration; high cost.
E-4. Eastern Pipeline and Tunnel through Iron Mountains	E-1, E-4	Higher cost than Eastern Alternative; similar levels of environmental impacts.
E-2. Eastern Pipeline across Danby Lake and along Cadiz Road	E-2, E-3, E-2, E-4	Requires dewatering across Danby Dry Lake with associated environmental impacts; high cost, greater construction length along ARZC railroad; high corrosion potential across Danby Dry Lake.
E-3. Eastern Pipeline along ARZC Railroad	E-2, E-3, E-2, E-4	Requires dewatering across Danby Dry Lake with associated environmental impacts; high cost, greatest construction length along ARZC railroad; high corrosion potential across Danby Dry Lake.
W-1. Western Pipeline, along west side of Cadiz Valley	W-1	Virtually all of alignment is adjacent to wilderness areas.
W-2. Western Pipeline along western side of Cadiz Valley; cross-valley segment to reach wellfields	W-3, W-1	Most of alignment is adjacent to wilderness areas, construction in dune sands.
W-3. Western Pipeline, through agricultural reserve	W-2, W-1	Impacts agricultural reserve as well as wilderness area.
W-5. Western Pipeline through Cadiz Wilderness	E-1, W-5, W-4	Avoids Sheephole Valley Wilderness Area but crosses Cadiz Dunes Wilderness Area with associated environmental impacts; difficult construction in dunes.
W-6. Western Pipeline/Canal, along west of Kilbeck Hills	E-1, W-4, W-6	Southern canal section blocks wildlife movement; high costs.
W-7. Combination Pipeline/Canal between Kilbeck Hills and Iron Mountains	E-1, C-1, W-6	Southern canal section blocks wildlife movement; high costs.

All potential alignments end at the project spreading basins on Cadiz Inc. property located in the Fenner Gap. The primary differences among these are the alignment itself and whether the water conveyance facility would be pipe, canal or a combination of pipe and canal.

The screening evaluation of potential alternative alignments included consideration of environmental impacts, impacts to property and structures, agriculture and utility conflicts, road and railroad crossings, drainage course crossings, construction and maintenance access, geologic hazards and construction staging areas.

The 17 potential alternative alignments were evaluated in a technical workshop to determine which should be carried forward for further analysis. The pipeline, pipeline/canal and all canal alignments were evaluated based on three criteria: total length, operation and maintenance (O&M), and environmental impact. Cost issues were deferred to the final evaluation of the alignments. A formalized rating system was established to provide a logical basis for comparing the non-economic criteria.

The following technical objectives were targeted:

a. Total Length

The longer the potential alignment, the more likelihood of increased costs, construction issues, O&M concerns, environmental impacts and aesthetic considerations. Therefore, shorter potential alignments were determined to be preferable.

b. Operations and Maintenance

O&M considerations include impacts on O&M staff and general ease of operations and maintenance. O&M issues associated with canals, as opposed to buried pipelines, include cleaning requirements to keep brush, tumbleweeds and sand from entering this exposed water conveyance facility. Also, the canal options include intermediate pumping stations, which create additional O&M requirements.

c. Environmental Impact

Several key environmental concerns were addressed. First, construction in dry lakebeds, such as Danby and Cadiz dry lakes, would involve work where groundwater levels were within several feet of the ground surface. Excavation would therefore involve dewatering of the pipeline or canal, resulting in discharge of high-salinity groundwater. Second, construction along the western edge of the Cadiz Valley would be adjacent to the Sheephole Mountains Wilderness Area. Third, construction through the Cadiz Dunes Wilderness Area would adversely affect sensitive habitat. Finally, open canals pose physical barriers to animals, including the desert tortoise, bighorn sheep and other species. Canals have greater visual impact than buried pipelines as permanent disturbances of the desert surface. Also, canals require crossings for natural drainage and runoff collection berms to direct runoff to the drainage crossings. Thus, all-pipeline alignments were generally determined to be preferable to canal alignments.

Corrosion is also an O&M consideration with buried pipeline. The West and Combination alignments include new facilities at the west portal of the Iron Mountain Tunnel that require full time O&M. This location is a remote site, with access over unimproved roads.

3.6.4 RESULTS OF INITIAL SCREENING OF ALTERNATIVE ALIGNMENTS

The 17 screening-level alternative alignments were evaluated for the three factors previously outlined and then screened for more detailed analyses. Numerous conveyance facility alignments were eliminated on the basis of environmental impacts, primarily impacts associated with construction in or adjacent to designated wilderness areas and impacts associated with dewatering of excavation areas crossing the dry lakes. Several pipeline/canal alignments were eliminated because canal segments would block migration of bighorn sheep, and movement of desert tortoise and other wildlife species. Technical considerations eliminated several pipeline-only alignments. Key technical considerations were the potential for pipeline corrosion and the potential for impacts to the BNSF railroad.

Therefore, this screening indicated that all-pipeline alternatives would generally be preferred to alternatives including canal segments on both technical and environmental grounds. The alternatives carried forward for detailed consideration were:

a. Eastern Alternative
b. Western Alternative
c. Combination Alternative
d. Eastern/Canal Alternative
e. No Project

Based on the initial formulation considerations outlined above, all alternatives except for the No Project Alternative would include spreading basins and a wellfield in the Fenner Gap part of the Cadiz Project area. All alternatives carried forward for detailed consideration would begin at the Iron Mountain Pumping Plant or the west portal of the Iron Mountain Tunnel and end at the spreading basin/wellfield located on Cadiz Inc. landholdings in the Fenner Gap.

3.6.5 CONSIDERATION OF UTILITY CORRIDOR ALTERNATIVE ALIGNMENT

In response to comments, an additional project alternative which more closely follows existing utility corridors was considered, and is shown on Figure 3-5. This Utility Corridor Alternative would proceed north-northeast from Iron Mountain Pumping Plant, crossing Danby Dry Lake, and parallel the existing 230kV power transmission line that supplies the pumping plant. The pipeline would then follow another existing utility corridor, proceeding west and southwest near the Little Piute Mountains until it reaches Route 66. The alignment would then parallel Route 66 to the spreading basins, outside of the designated utility corridors. The 73-mile Utility Corridor Alternative would lie within designated utility corridors for approximately 65 miles, with the last eight miles traversing Class L (limited use) land. The utility corridor crosses land use Class M (moderate use) for approximately 52 miles and Class L land for approximately 13 miles. Approximately 60 miles of the alignment would occur within designated critical habitat for desert tortoise. This alternative was not carried forward because of extensive impacts on desert tortoise, total length of the alignment, increased operation and maintenance activities and environmental impacts associated with crossing Danby Dry Lake.