SECTION 4
DESCRIPTION OF THE PROJECT ALTERNATIVES

4.1 INTRODUCTION

This section describes the Cadiz Project and the alternatives evaluated in this Final EIR/EIS, including the No Project Alternative.

The federal actions necessary for implementation of the Cadiz Project include the following:

- The Cadiz Project will need an amendment of the California Desert Conservation Plan (CDCA Plan) for an exception to the utility corridor requirement. This proposed amendment of the CDCA Plan is a planning action by the BLM and involves a separate decision by the BLM from that required for the proposed issuance of right-of-way grant for the Cadiz Project. An exception to the CDCA Plan is needed to allow for water conveyance and power distribution facilities outside of a designated corridor.
- Grants of right-of-way for construction and operation of the water conveyance facility and power distribution facility. A temporary 200-foot wide right-of-way will be necessary for construction activities, and a permanent 80-foot wide right-of-way (or 120-foot along a canal section) will be necessary for operations and maintenance activities. The permanent right-of-way will be within the limits of the construction temporary right-of-way.
- Site specific approvals for groundwater basin monitoring and data gathering facilities.

Metropolitan will also obtain the right-of-way around each well in the project wellfield, a 40-foot wide corridor centered over the alignment of the wellfield piping, and a permanent easement for the project spreading basins. These permanent easements will be granted to Metropolitan by Cadiz Inc.

The Cadiz Project consists of facilities in five general areas, as follows:

- Project spreading basins in the Fenner Gap;
- Water conveyance and power distribution facilities between the Colorado River Aqueduct and the project spreading basins;
- Pumping plants to pump water from the Colorado River Aqueduct through the water conveyance facility to the project spreading basins;
- Project wellfield in the Fenner Gap to extract water from the groundwater aquifer system and pump it back to the Colorado River Aqueduct; and
- Groundwater basin monitoring and data gathering facilities located throughout the Cadiz and Fenner valleys.

Detailed descriptions of the alternatives are provided in this section, in the following order:

- Eastern Alternative.
- Western Alternative.
- Combination Alternative.
- Eastern/Canal Alternative.
- No Project Alternative.

The four Cadiz Project alternatives are shown on Figure 4-1. The alternatives, their appurtenances, and proposed operation and maintenance are discussed in detail in the following paragraphs.

In addition, discussions of the hydraulic characteristics, right-of-way requirements, feasibility, capital costs and anticipated construction activities, manpower requirements and construction schedules are included in this section.

4.2 EASTERN ALTERNATIVE

4.2.1 GENERAL DESCRIPTION

As shown in Figure 4-2, the Eastern Alternative begins at the project spreading basins in the Fenner Gap area, approximately three miles north of unimproved Cadiz-Rice Road. The water conveyance facilities route proceeds due south for three miles, then parallels Cadiz-Rice Road and the Arizona California Railroad Company (ARZC) rail lines in a southeasterly direction toward abandoned Chubbuck Station. Southeast of abandoned Chubbuck Station, the water conveyance facilities turn south, generally following the 820-foot contour for approximately three miles around the west side of Danby Dry Lake. The water conveyance facilities then turn southeast, still generally following the 820-foot contour, between the south side of Danby Dry Lake and along the Iron Mountains for approximately ten miles until crossing Metropolitan's existing power transmission right-of-way. The water conveyance facilities continue around the east side of the Iron Mountains where they connect to an unimproved road. The water conveyance facilities parallel the unimproved road, enter the Iron Mountain Pumping Plant site, and discharge into the existing Iron Mountain Pumping Plant forebay. The total length of the Eastern Alternative is approximately 34.6 miles.

4.2.2 HYDRAULIC CHARACTERISTICS

A hydraulic profile of the Eastern Alternative is shown on Figure 4-3. The Cadiz Project analysis is based on a nominal design flow of 200 to 250 cubic feet per second (cfs). Figure 4-3 indicates the elevation to which water must be pumped in order to overcome friction losses in the water conveyance facilities. Factors that affect system hydraulics include flow rate, size and cross section of the water conveyance facilities, length, and the type of material used.

As indicated, during spreading cycles, the maximum hydraulic grade line elevation of 1,388 feet is experienced at the Cadiz Pumping Plant. The maximum pipeline pressure during spreading cycles occurs near mile 27 of the pipeline, where the pressure is 250 pounds per square inch (psi). During withdrawal cycles, the maximum hydraulic grade line elevation is at the wellfield site, at an elevation of 1,348 feet. The maximum conveyance facility pressure during withdrawal cycles occurs near mile 5, where the pressure is 235 psi.

4.2.3 CONSTRUCTION ACTIVITIES

The major construction equipment expected to be used for the Eastern Alternative is listed by type and number in this section. Table 4-1 summarizes equipment needed for trench excavation, pipe placement, backfill, appurtenant facility construction and erection of structures for the Eastern Alternative.

TABLE 4-1
CONSTRUCTION EQUIPMENT REQUIRED FOR THE EASTERN ALTERNATIVE

Description	Number
1.5 cy Loader-Backhoe	4
¾ ton Pickup Truck	24
1 cy Backhoe	4
Flatbed Truck w/ Crane	4
Crane	4
3 cy Hydraulic Backhoe	4
End Dump Truck, 12 cy	4
35 ton Crane (RT)	4
Tractor/Lowboy Hauling Rig	4
Tamping Spade	8
Hand Held Vibrator Plate	8
3 cy Rubber Tire Loader	4
Highway Water Truck	8
Vibrator Compactor	4
Forklift, 7.5 ton	4
Truck Mounted Vertical Auger Drill	4
Generator	12
Concrete Truck	Varies
Bedding Hopper/Conveyor Systems	4
Trench Shield	4
Z-bar Shoring	4
Truck Crane	4
Pile Hammer, Diesel	4
Pile Leads	4
The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.	

Water Conveyance Facilities Construction

Construction of the water conveyance facilities would be conducted in segments and would include trench excavation, utility preservation and/or relocation, pipe placement, backfill, appurtenant construction and restoration along the entire pipeline route. The pipeline would be buried, with a minimum earth cover of three feet. Where the facilities cross drainages, the depth of cover might be up to ten feet, and scour protection for the pipeline would be provided.

While the lengths of the individual construction segments would be comparable, productivity would be controlled by the trench type and construction corridor width, restrictions in construction operations and difficulties in construction of railroad or arroyo crossings. The rail line crossings would either be bore and jack or conventional tunnel with ribs and lagging or linear plate. All tunnel construction would require a bore pit and a receiving pit. For the Cadiz Project, an area of 150 feet by 100 feet is estimated to be sufficient for the bore pit and a surrounding construction activities. The receiving pit would likely be a shored excavation area of 20 feet by 12 feet.

The type of trench excavation for the pipeline would depend on several factors, including available construction space, soil/rock materials in the trench, groundwater level and allowable cut slope. Prior to a more detailed inspection, aerial photographs of the alternatives were used to establish the preliminary right-of-way availability for each alternative. General assumptions were made about the soil/rock material type, extent of groundwater infiltration and special facilities, such as utility crossings. Special crossing items at arroyos, rail lines and road crossings would require additional special trench types. In the event that rock material is encountered, blasting might be used during trench excavation.

Trenching operations would depend on the trench type and the construction method selected by the contractor. Where necessary, trench shields or soldier piles and timber lagging could be used. Soldier piles could be driven in advance of the pipe heading and the lagging could be installed as the trench excavation progresses. In unrestricted working areas and with a crane used to install pipe, an average of eight to ten sections per day could be installed. Pipe sections would likely be 40 or 48 feet in length. In restricted work areas such as shored trench, where a crane must place the pipe in the trench, the average installation rate would be approximately half the rate in unrestricted work areas. Overall, the average length of time that any one area along the pipeline would be disturbed is anticipated to be three months.

It is anticipated that the excavated material would be used for pipe bedding. Water may have to be added to the excavated material to obtain proper compaction around the pipe. Using excavated materials for pipe bedding would eliminate the need to transport bedding materials from local rock quarries.

Throughout construction, the top four to six inches of topsoil would be stockpiled and cleared and grubbed vegetation would be mulched and set aside with the topsoil. At the completion of construction of each segment of the pipeline, the stockpiled topsoil and mulch would be re-spread over the re-contoured permanent right-of-way.

The surface would be re-contoured to preserve the original runoff pattern. Topsoil and mulch would be stockpiled for a maximum of three months prior to respreading.

The length of pipe sections transported would be determined by the existing weight limits on roads and highways but would not exceed 48 feet. Transportation of the pipe sections is a primary consideration since most public roads and highways have load restrictions of approximately 45 tons. Caltrans has indicated that, under a repetitive hauling permit, the absolute maximum load width permitted is 14 feet. In any event, all the required permits to haul pipe on public roads would be obtained. An alternative method for pipe delivery would be to transport pipe sections by rail lines in the project area.

In addition, the general area of Chubbuck Station (CA-SBR-3283H) outside the construction limits would be identified on the project specifications and maps as an Environmentally Restricted Area (ERA) in consultation with the project archeologist. The area and the work limits would be flagged and construction activity would not be allowed within this ERA. The construction corridor would be narrowed to a maximum of 40 feet for approximately 1.25 miles adjacent to this site, in consultation with the project archaeologist.

The general area of the Patton Camp (AE-CAD-13H) outside the construction limits would be identified on the project specifications and maps as an ERA in consultation with the project archaeologist. The area and the work limits would be flagged and construction activity would not be allowed within this ERA. The construction corridor in the immediate vicinity of this site would be limited to that area west of the ARZC rail lines and east of the All American Pipeline and focused, to the extent possible, on areas previously distributed by construction.

Cadiz Pumping Plant Construction

The Cadiz Pumping Plant would be built adjacent to the existing Iron Mountain Pumping Plant on land owned by Metropolitan. Construction equipment anticipated to be used is shown in Table 4-2. A staging area would likely be located on Metropolitan’s property between the existing electrical substation and this proposed pumping plant.

Construction of the Cadiz Pumping Plant would involve site preparation. This first phase would involve clearing the building site of objectionable surface materials and obstacles to construction (stripping vegetation and initial grading). Minimum site work would be anticipated. Additional construction activities for the pumping plant would include trench and structure excavation; above-grade building; pipe; pump and valve installation; appurtenant construction and feature restoration around the entire pumping plant.

TABLE 4-2
CADIZ PUMPING PLANT
CONSTRUCTION EQUIPMENT

Description	Number
Grader	1
Dozer	1
Hydraulic Backhoe, 1.0 cy	1
¾ Pickup Truck	8
End Dump Truck, 12 cy	2
Crane	1
Gas Welding Machine	2
Tractor/Lowboy Hauling Rig	1
Concrete Mixer	2
Hand Held Vibrator Plate	4
3 cy Rubber Tire Loader	2
Highway Water Truck	1
Compressor	2
Trench Shield	1
Z-bar Shoring	1
Vibrator Compactor	2
Truck Mounted Vertical Auger Drill	1
Pile Hammer, Diesel	1
Pile Leads	1
Front End Loader	1
Roller	1
Generator	2
Concrete Truck	Varies

The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.

A second phase of excavation would be required for the foundation of the facility, underground structures and buried utilities. Part of the excavated material would be stockpiled on site for backfill and site grading; the remainder would be disposed of or stockpiled on the pumping plant site.

Buildings would be erected to house the motors, pumps, communications and control rooms. The structure would likely have a split-faced block exterior. All below-grade and at least part of some above-ground structures would be constructed from cast-in-place reinforced concrete.

The Cadiz Pumping Plant would be constructed in a previously disturbed area and at a maximum distance from the historic structures in this complex. In addition, the Cadiz Pumping Plant would be designed and constructed in a style compatible with the existing architecture of the Iron Mountain Pumping Plant complex, and consistent with the Secretary of the Interior's *Standards and Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings* (1995), in consultation with the project archaeologist. The design would be compatible with, but distinctive from, the existing historic buildings. The new design would be contemporary and would reference design motifs from the historic buildings. It would also be compatible in terms of mass (dimensions and scale), material (building composition), relationship of solids to voids (roof lines and window placement) and overall color. The predominant building composition at the Iron Mountain Pumping Plant structures includes poured and formed concrete walls (some with stucco exteriors) and low, gabble-hipped roofs, finished in red-colored tile.

After completion of the construction of the Cadiz Pumping Plant, excavated areas would be backfilled and stockpiled material would be graded to a finish grade.

4.2.4 CONSTRUCTION SCHEDULE

Elements included in the Cadiz Project construction schedule are the pumping plant, water conveyance facility, power distribution facilities, project spreading basins and project wellfield. Each of these items requires a unique time frame for construction. The facilities required to store water would be completed by the winter of 2002/2003.

4.2.5 RIGHT-OF-WAY REQUIREMENTS

Temporary and permanent rights-of-way would be required to construct and operate the Eastern

Alternative water conveyance and power distribution facilities. The other project facilities under the Eastern Alternative would be located on properties owned by Metropolitan or Cadiz Inc. and would not require temporary or permanent rights-of-way.

Temporary construction easements would be required to construct the water conveyance and power distribution facilities. An estimated 200-foot wide right-of-way would be necessary during construction. The Eastern Alternative facilities would be contained in a permanent right-of-way 80 feet in width, that would allow access for operation and maintenance. A typical cross section for water conveyance facility construction is shown on Figure 4-4.

The Eastern Alternative is estimated to require 503 acres of temporary construction easement and 336 acres of permanent right-of-way.

4.2.6 FEASIBILITY CAPITAL COST

The cost estimates for the Eastern Alternative shown in Table 4-3 include, but are not limited to, costs for engineering design, construction, administration, conveyance facility land acquisition and environmental mitigation. These costs include a contingency.

TABLE 4-3
EASTERN ALTERNATIVE
ESTIMATED CONSTRUCTION COST
(1999 $)

Item	Estimated Cost
Cadiz Pumping Plant	$11,173,000
Conveyance/Power Facilities	$86,358,000
Spreading Basins	$3,513,000
Wellfield Facilities	$30,672,000
Land/Mitigation/Erosion Control	$2,204,000
Eng, Legal, Admin	$15,824,000
Total Project Cost	**$149,744,000**

4.3 WESTERN ALTERNATIVE

4.3.1 GENERAL DESCRIPTION

As shown on Figure 4-5, the Western Alternative begins at the project spreading basins in the Fenner Gap area, approximately three miles north of unimproved Cadiz-Rice Road. The water conveyance facilities route proceeds due south for three miles, then parallels Cadiz-Rice Road and the ARZC rail line in a southeasterly direction to a point located due north of the Kilbeck Hills. At this point, the water conveyance facilities turn south-southwest, skirting the western slopes of the of the Kilbeck Hills and the Iron Mountains for approximately 20 miles, at which point it joins the Colorado River Aqueduct at the west portal of the Iron Mountain Tunnel. The total length of the Western Alternative would be approximately 33.3 miles.

4.3.2 HYDRAULIC CHARACTERISTICS

A hydraulic profile of the Western Alternative is shown on Figure 4-6. The Cadiz Project analysis is based on a nominal design flow of 200 to 250 cfs. Figure 4-6 indicates the elevation to which water must be pumped in order to overcome friction losses in the conveyance system. Factors that affect system hydraulics include flow rate, size and cross section of water conveyance facilities, length, and the type of material used for the water conveyance facilities. As indicated, during spreading cycles, the maximum hydraulic grade line elevation of 1,372 feet is experienced at the Cadiz Pumping Plant. The maximum pipeline pressure during spreading cycles occurs at mile 21 of the pipeline, where the pressure is 235 psi. During withdrawal, the maximum hydraulic gradeline elevation is at the project wellfield, at an elevation of 1,442 feet. The maximum conveyance facility pressure during withdrawal cycles occurs at mile 5, where the pressure is 275 psi.

4.3.3 CONSTRUCTION ACTIVITIES

The major construction equipment that would be expected to be used for the Western Alternative is listed by type and number in Table 4-4. This table summarizes equipment needed for trench excavation, pipe placement, backfill, appurtenant facility construction and erection of structures.

TABLE 4-4
WESTERN ALTERNATIVE
CONSTRUCTION EQUIPMENT

Description	Number
1.5 cy Loader-Backhoe	4
¾ ton Pickup Truck	24
1 cy Backhoe	4
Flatbed Truck w/ Crane	4
Crane	4
3 cy Hydraulic Backhoe	4
End Dump Truck, 12 cy	4
35 ton Crane (RT)	4
Tractor/Lowboy Hauling Rig	4
Tamping Spade	8
Hand Held Vibrator Plate	8
3 cy Rubber Tire Loader	4
Highway Water Truck	8
Vibrator Compactor	4
Forklift, 7.5 ton	4
Truck Mounted Vertical Auger Drill	4
Generator	12
Concrete Truck	Varies
Bedding Hopper/Conveyor Systems	4
Trench Shield	4
Z-bar Shoring	4
Truck Crane	4
Pile Hammer, Diesel	4
Pile Leads	4
The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.	

Water Conveyance Facilities Construction

Construction of the water conveyance facilities would be conducted in segments and would include trench excavation, utility preservation and/or relocation, pipe placement, backfill, appurtenant construction and restoration along the entire pipeline route. The pipeline would be buried with a minimum earth cover of three feet. Where the facilities cross drainages, the depth of cover might be up to ten feet, and scour protection for the pipeline would be provided.

While the lengths of the individual construction segments would be comparable, productivity would be controlled by the trench type and construction corridor width, restrictions in construction operations and difficulties in construction of railroad or arroyo crossings. The rail line crossings would either be bore and jack or conventional tunnel with ribs and lagging or linear plate. All tunnel construction would require a bore pit and a receiving pit. For the Cadiz Project, an area of 150 feet by 100 feet is estimated to be sufficient for the bore pit and surrounding construction activities. The receiving pit would likely be a shored excavation area 20 feet by 12 feet.

The type of trench excavation for the pipeline would depend on several factors, including available construction space, soil/rock material in the trench, groundwater level and allowable cut slope. Prior to a more detailed inspection, aerial photographs of the alternatives were used to establish the preliminary right-of-way availability for each alternative. General assumptions were made about the soil/rock material type and extent of groundwater infiltration and special facilities, such as utility crossings. Special crossing items at arroyos, railroads and road crossings would require additional special trench types. In the event that rock material is encountered, blasting might be used during trench excavation.

Trenching operations would depend on the trench type and the construction method selected by the contractor. Where necessary, trench shields or soldier piles and timber lagging could be used. Soldier piles could be driven in advance of the pipe heading and the lagging could be installed as the trench excavation progresses. In unrestricted working areas and with a crane used to install pipe, an average of eight to ten sections per day could be installed. Pipe sections would likely be 40 or 48 feet in length. In restricted work areas such as shored trench, where a crane must place the pipe in the trench, the average installation rate would be approximately half the rate in unrestricted work areas. Overall, the average length of time that any one area along the pipeline would be disturbed is anticipated to be three months.

It is anticipated that the excavated material would be used for pipe embedment. Water may have to be added to the excavated material to obtain proper compaction around the pipe. Using excavated materials for pipe embedment would eliminate the need to transport bedding materials from local rock quarries.

Throughout construction, the top four to six inches of topsoil would be stockpiled and cleared, and grubbed vegetation would be mulched and set aside with the topsoil. At the completion of construction of each segment of the pipeline, the stockpiled topsoil and mulch would be re-spread over the recontoured permanent right-of-way. The surface would be re-contoured to preserve the original runoff pattern. Topsoil and mulch would be stockpiled for a maximum of three months prior to respreading.

The length of pipe sections transported would be determined by the existing weight limits on roads and highways but would not exceed 48 feet. Transportation of the pipe sections is a primary consideration since most public roads and highways have load restrictions of approximately 45 tons. Caltrans has indicated that under a repetitive hauling permit the absolute maximum width permitted is 14 feet. In any event, all the required permits to haul pipe on public roads would be obtained. An alternative method for pipe delivery would be to transport pipe sections by rail lines in the project area.

Cadiz Pumping Plant (West Portal)

The Cadiz Pumping Plant (West Portal) would be built at the west portal of the Iron Mountain Tunnel. Construction equipment anticipated to be used in installing this pumping plant is shown in Table 4-5.

The staging area for construction of the Cadiz Pumping Plant (West Portal) and the Western Alternative would be parallel to the 200-foot wide construction right-of-way. Figure 4-7 shows the Cadiz Pumping Plant (West Portal) site plan and the location of the staging area. An alternative staging area may be available at the tunnel tailings area south of the Iron Mountain Tunnel, which would provide approximately 7.5 acres of storage area. The construction staging area would provide space for storage of materials, pipe, equipment and vehicles needed for construction. It is assumed that the construction trailers would be located at this site. Access to this site would be provided via an existing unimproved road that connects the staging area to Highway 62.

Construction of the Cadiz Pumping Plant (West Portal) would involve site preparation. This phase involves clearing the building site of surface materials and obstacles to construction (stripping vegetation and initial grading). Minimum site work is anticipated because the Cadiz Pumping Plant (West Portal) would be built on vacant land.

A second phase of excavation would be required for the foundation of the facility, underground structures and buried utilities. Part of the excavated material would be stockpiled on site for backfill and site grading; the remainder would be disposed of or stockpiled on the pumping plant site. Additional construction activities for the pumping plant include site clearing, trench and structure excavation, pipe, pump and valve installation, appurtenant construction and feature restoration around the entire pump station.

Buildings would be erected to house the motors, pumps, communications and control rooms. The superstructure would likely have a split-faced block exterior. All below-grade and at least part of some

TABLE 4-5
CONSTRUCTION EQUIPMENT
CADIZ PUMPING PLANT (WEST PORTAL)

Description	Number
Grader	1
Dozer	1
Hydraulic Backhoe, 1.0 cy	1
¾ Pickup Truck	8
End Dump Truck, 12 cy	2
Crane	1
Gas Welding Machine	2
Tractor/Lowboy Hauling Rig	1
Concrete Mixer	2
Hand Held Vibrator Plate	4
3 cy Rubber Tire Loader	2
Highway Water Truck	1
Compressor	2
Trench Shield	1
Z-bar Shoring	1
Vibrator Compactor	2
Truck Mounted Vertical Auger Drill	1
Pile Hammer, Diesel	1
Pile Leads	1
Front End Loader	1
Roller	1
Generator	2
Concrete Truck	Varies
The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.	

above-ground structures would be constructed from cast-in-place reinforced concrete.

After completion of these structures, excavated areas would be backfilled, and stockpiled material would be graded to a finish grade.

4.3.4 CONSTRUCTION SCHEDULE

Elements included in the Cadiz Project construction schedule are the pumping plant, water conveyance facilities, power distribution facilities, spreading basins and wellfield. Each of these items would require a unique time frame for construction. The facilities required to store water would be completed by the winter of 2002/2003.

4.3.5 RIGHT-OF-WAY REQUIREMENTS

Temporary and permanent rights-of-way would be required to construct and operate the Western Alternative water conveyance and power distribution facilities. The other project facilities under the Western Alternative would be located on properties owned by Metropolitan or Cadiz Inc. and would not require temporary or permanent rights-of-way.

Temporary construction easements would be required to construct the water conveyance and power distribution facilities. An estimated 200-foot wide right-of-way would be necessary during construction. The permanent facilities would be contained in a permanent right-of-way, 80 feet in width, which would allow access for operation and maintenance. A typical cross section for conveyance facility construction was shown earlier on Figure 4-4.

TABLE 4-6
WESTERN ALTERNATIVE
ESTIMATED CONSTRUCTION COST
(1999 $)

Item	Estimated Cost
Cadiz Pumping Plant	$11,515,000
Conveyance Power Facility	$84,684,000
Spreading Basins	$3,513,000
Wellfield Facilities	$30,672,000
Land/Mitigation/Erosion Control	$3,797,000
Eng, Legal, Admin	$15,663,000
Total Project Cost	**$149,844,000**

The Western Alternative is estimated to require 484 acres of temporary construction easement and 323 acres permanent right-of-way.

4.3.6 FEASIBILITY CAPITAL COST

The cost estimates for the Western Alternative shown in Table 4-6 include, but are not limited to, costs for engineering design, construction, administration, land conveyance facility acquisition and environ-mental mitigation. These costs include contingency.

4.4 COMBINATION ALTERNATIVE

4.4.1 GENERAL DESCRIPTION

As shown on Figure 4-8, the Combination Alternative route begins at the project spreading basins in the Fenner Gap area approximately three miles north of unimproved Cadiz-Rice Road. The water conveyance facilities route proceeds due south for three miles, then parallels Cadiz-Rice Road and the ARZC rail line in a southeasterly direction towards the abandoned Chubbuck Station. Southeast of the abandoned Chubbuck Station, the water conveyance facilities turn south, skirting the eastern slopes of the Kilbeck Hills for approximately six miles. At the saddle between the Kilbeck Hills and the Iron Mountains, the Combination Alternative turns southwest for a distance of approximately two miles. There, the alignment takes a southeasterly heading, skirting the western slopes of the Iron Mountains for about 11 miles until it discharges into the Colorado River Aqueduct at the west portal of the Iron Mountain Tunnel. The total length of the Combination Alternative would be approximately 34.0 miles.

4.4.2 HYDRAULIC CHARACTERISTICS

A hydraulic profile of the Combination Alternative is shown on Figure 4-9. The Cadiz Project analysis is based on a nominal design flow of 200 to 250 cfs. Figure 4-9 indicates the elevation to which water must be pumped in order to overcome friction losses in the water conveyance facilities. Factors that affect system hydraulics include flow rate, size and cross section conveyance facilities, length, and the type of material used for the conveyance facilities. As indicated, during spreading cycles, the maximum hydraulic grade line elevation of 1,382 feet is experienced at the Cadiz Pumping Plant. The maximum pipeline pressure during spreading cycles occurs at mile 24 of the pipeline, where the pressure is 235 psi. During withdrawal cycles, the maximum hydraulic grade-line elevation is at the wellfield site, at an elevation of 1,450 feet. The maximum water conveyance facilities pressure during withdrawal cycles occurs at mile 5 of the pipeline, where the pressure is 285 psi.

4.4.3 CONSTRUCTION ACTIVITIES

The major construction equipment expected to be used for the Combination Alternative is listed by type and number in Table 4-7. This table summarizes equipment needed for trench excavation, pipe placement, backfill, appurtenant facility construction and erection of structures.

Water Conveyance Facilities Construction

Construction of the water conveyance facilities would be conducted in segments and would include trench excavation, utility preservation and/or relocation, pipe placement, backfill, appurtenant construction, and restoration along the entire pipeline route. The pipeline would be buried, with a minimum earth cover of three feet. Where the facilities cross drainages, the depth of cover might be up to ten feet, and scour protection for the pipeline would be provided.

While the lengths of the individual construction segments would be comparable, productivity would be controlled by the trench type and construction corridor width, restrictions in construction operations and difficulties in construction of rail line or arroyo crossings. The rail line crossings would either be bore and jack or conventional tunnel with ribs and lagging or linear plate. All tunnel construction would require a bore pit and a receiving pit. For the Cadiz Project, an area of 150 feet by 100 feet is estimated to be sufficient for the bore pit and surrounding construction activities. The receiving pit would likely be a shored excavation area 20 feet by 12 feet.

TABLE 4-7
COMBINATION ALTERNATIVE
CONSTRUCTION EQUIPMENT

Description	Number
1.5 cy Loader-Backhoe	4
¾ ton Pickup Truck	24
1 cy Backhoe	4
Flatbed Truck w/ Crane	4
Crane	4
3 cy Hydraulic Backhoe	4
End Dump Truck, 12 cy	4
35 ton Crane (RT)	4
Tractor/Lowboy Hauling Rig	4
Tamping Spade	8
Hand Held Vibrator Plate	8
3 cy Rubber Tire Loader	4
Highway Water Truck	8
Vibrator Compactor	4
Forklift, 7.5 ton	4
Truck Mounted Vertical Auger Drill	4
Generator	12
Concrete Truck	Varies
Bedding Hopper/Conveyor Systems	4
Trench Shield	4
Z-bar Shoring	4
Truck Crane	4
Pile Hammer, Diesel	4
Pile Leads	4

The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.

The type of trench excavation for the pipeline would depend on several factors, including available construction space, soil/rock material in the trench groundwater level and allowable cut slope. Prior to a more detailed inspection, aerial photographs of the alternatives were used to establish the preliminary right-of-way availability for each alternative. General assumptions were made about the soil/rock material type, extent of groundwater infiltration and special facilities, such as utility crossings. Special crossing items at arroyos, rail lines and road crossings would require additional special trench types. In the event that rock material is encountered, blasting might be used during trench excavation.

Trenching operations would depend on the trench type and the construction method selected by the contractor. Where necessary, trench shields or soldier piles and timber lagging could be used. Soldier piles could be driven in advance of the pipe heading and the lagging could be installed as the trench excavation progresses. In unrestricted working areas where a crane is used to install pipe, an average of eight to ten sections per day could be installed. Pipe sections would likely be 40 feet or 48 feet in length. In restricted work areas such as shored trench, where a crane must place the pipe in the trench, the average installation rate would be approximately half the rate in unrestricted work areas. Overall, the average length of time that any one area along the water conveyance facilities would be disturbed is anticipated to be three months.

It would be anticipated that the excavated material would be used for pipe embedment. Water may have to be added to the excavated material to obtain proper compaction around the pipe. Using excavated materials for pipe embedment would eliminate the need to transport bedding materials from local rock quarries. Throughout construction, the top four to six inches of topsoil would be stockpiled and cleared and grubbed vegetation would be mulched and set aside with the topsoil. At the completion of construction of each segment of the pipeline, the stockpiled topsoil would be re-spread over the recontoured permanent right-of-way. The surface would be re-contoured to preserve the original runoff pattern. Topsoil and mulch would be stockpiled for a maximum of three months prior to respreading.

The length of pipe sections transported would be determined by the existing weight limits on roads and highways but would not exceed 48 feet. Transportation of the pipe sections is a significant factor since most public roads and highways have load restrictions of approximately 45 tons. Caltrans has indicated that, under a repetitive hauling permit, the absolute maximum load width permitted is 14 feet. In any event, all the required permits to haul pipe on public roads would be obtained. An alternative method for pipe delivery would be to transport pipe sections by rail lines in the project area.

In addition, the general area of Chubbuck Station (CA-SBR-3283H) outside the construction limits would be identified on the project specifications and maps as an ERA in consultation with the project archaeologist. The area and the work limits would be flagged and construction activity would not be allowed within this ERA. The construction corridor would be narrowed to a maximum of 40 feet for approximately 1.25 miles adjacent to this site, in consultation with the project archaeologist.

The general area of the Patton Camp (AE-CAD-13H) outside the construction limits would also be identified on the project specifications and maps as an ERA in consultation with the project archaeologist. The area and the work limits would be flagged and construction activity would not be allowed within this ERA. The construction corridor in the immediate vicinity of this site would be limited to that area west of the railroad and east of the All American Pipeline and focused, to the extent possible, on areas previously disturbed by construction.

Cadiz Pumping Plant (West Portal) Construction

The Cadiz Pumping Plant (West Portal) would be built at the west portal of the Iron Mountain Tunnel on land owned by Metropolitan. Construction equipment used for installing the pumping plant would be the same as used for the Western Alternative, as shown in Table 4-8.

TABLE 4-8
CADIZ PUMPING PLANT (WEST PORTAL)
CONSTRUCTION EQUIPMENT

Description	Number
Grader	1
Dozer	1
Hydraulic Backhoe, 1.0 cy	1
¾ Pickup Truck	8
End Dump Truck, 12 cy	2
Crane	1
Gas Welding Machine	2
Tractor/Lowboy Hauling Rig	1
Concrete Mixer	2
Hand Held Vibrator Plate	4
3 cy Rubber Tire Loader	2
Highway Water Truck	1
Compressor	2
Trench Shield	1
Z-bar Shoring	1
Vibrator Compactor	2
Truck Mounted Vertical Auger Drill	1
Pile Hammer, Diesel	1
Pile Leads	1
Front End Loader	1
Roller	1
Generator	2
Concrete Truck	Varies

The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.

Construction of the pump station would involve site preparation. This first phase would involve clearing the building site of surface materials and obstacles to construction (stripping vegetation and initial grading). Minimum site work is anticipated.

A second phase of excavation would be required for foundation of the facility, underground structures and buried utilities. Part of the excavated material would be stockpiled on site for backfill and site grading; the remainder would be disposed of or stockpiled on the pumping plant site.

Additional construction activities for the pump station include trench and structure excavation, above-grade building, pipe, pump and valve installation appurtenant construction and feature restoration around the entire pump station.

Buildings would be erected to house the motors, pumps, communications and control rooms. The superstructure would likely have a split-faced block exterior. All below-grade and at least part of some above-ground structures would be constructed from cast-in-place reinforced concrete.

After completion of these structures, excavated areas would be backfilled and stockpiled material would be graded to a finish grade.

4.4.4 CONSTRUCTION SCHEDULE

Elements included in the Cadiz Project construction schedule are the pumping plant, water conveyance facilities, power distribution systems facilities, project spreading basins and project wellfield. Each of these items requires a unique time frame for construction. The facilities required to store water would be completed by the spring of 2003.

4.4.5 RIGHT OF WAY REQUIREMENTS

Temporary and permanent rights-of-way would be required to construct and operate the Combination Alternative water conveyance and power distribution facilities. The other project facilities would be located on properties owned by Metropolitan or Cadiz Inc. and would not require temporary or permanent rights-of-way.

Temporary construction easements would be required to construct the conveyance and power transmission facilities. An estimated 200-foot wide right-of-way would be necessary during the construction period. The Cadiz Project facilities would be contained in a permanent right-of-way 80 feet in width, which would allow access for operation and maintenance. A typical cross section for the water conveyance facilities construction was shown earlier on Figure 4-4.

The Combination Alternative is estimated to require 495 acres of temporary construction easement and 330 acres of permanent right-of-way.

TABLE 4-9
COMBINATION ALTERNATIVE
ESTIMATED CONSTRUCTION COST
(1999 $)

Item	Estimated Cost
Cadiz Pumping Plant	$11,515,000
Conveyance Power Facility	$86,368,000
Spreading Basins	$3,513,000
Wellfield Facilities	$30,672,000
Land/Mitigation/Erosion Control	$4,587,000
Eng, Legal, Admin	$15,866,000
Total Project Cost	**$152,521,000**

4.4.6 FEASIBILITY CAPITAL COST

The cost estimates for the Combination Alternative shown in Table 4-9 include, but are not limited to, costs for engineering design, construction, administration, conveyance facility land acquisition and environmental mitigation. These costs include contingency.

4.5 EASTERN/CANAL ALTERNATIVE

4.5.1 GENERAL DESCRIPTION

As shown of Figure 4-10, the Eastern/Canal Alternative begins at the project spreading basins in the Fenner Gap area approximately three miles north of unimproved Cadiz-Rice Road. The water conveyance facilities route proceeds due south for three miles, then parallels Cadiz-Rice Road and the ARZC rail line in a southeasterly direction towards the abandoned Chubbuck Station. Southeast of the abandoned Chubbuck Station, the water conveyance facilities turn south, generally following the 820-foot contour of Danby Dry Lake for approximately four miles. The water conveyance facilities then transition from an underground pipeline to a canal section and turn southeast, following the 755-foot contour, for approximately eight miles along the Iron Mountains. The canal section transitions back into an underground pipeline section while maintaining a southeasterly heading, and crosses Metropolitan's existing power transmission right-of-way. The water conveyance facilities continue around the east side of the Iron Mountains where they connect to an unimproved road. From this point, the water conveyance facilities parallel the unimproved road and enter the Iron Mountain Pumping Plant site, where they discharge into the existing Iron Mountain Pumping Plant forebay. The total length of the Eastern/Canal Alternative would be approximately 34.6 miles.

4.5.2 HYDRAULIC CHARACTERISTICS

A hydraulic profile of the Eastern/Canal Alternative is shown on Figure 4-11. The Cadiz Project analysis for the pipeline sections is based on a nominal design flow of 200 to 250 cfs. The analysis for the canal section was based on an 8-foot base width concrete-lined trapezoidal channel with 1.5:1 side slopes. Figure 4-11 indicates the elevation to which water must be pumped in order to overcome friction losses in the conveyance system. Factors that affect system hydraulics include flow rate, size and cross section of the water conveyance facilities, length, and the type of material used for the conveyance facilities. As indicated, during spreading cycles, the maximum hydraulic grade line elevation of 1,216 feet is experienced at the Intermediate Pumping Plant No. 1. The maximum pipeline pressure during spreading cycles occurs at mile 21 of the pipeline, where the pressure is 200 psi. During withdrawal cycles, the maximum hydraulic gradeline elevation occurs at the wellfield site, at an elevation of 1,200 feet. The maximum conveyance facility pressure during withdrawal occurs at approximately mile 5 of the pipeline, where the pressure is 170 psi.

4.5.3 CONSTRUCTION ACTIVITIES

The major construction equipment expected to be used for the Eastern/Canal Alternative is listed by type and number in Table 4-10. This table summarizes equipment needed for trench excavation, pipe placement, canal lining, backfill, appurtenant facility construction and erection of structures.

TABLE 4-10
EASTERN/CANAL ALTERNATIVE
CONSTRUCTION EQUIPMENT

Description	Number
1.5 cy Loader-Backhoe	8
¾ ton Pickup Truck	32
1 cy Backhoe	4
Flatbed Truck w/ Crane	8
Crane	12
3 cy Hydraulic Backhoe	8
End Dump Truck, 12 cy	4
Tractor/Lowboy Hauling Rig	8
Tamping Spade	12
Hand Held Vibrator Plate	12
3 cy Rubber Tire Loader	16
Highway Water Truck	16
Vibrator Compactor	4
Forklift, 7.5 ton	4
Truck Mounted Vertical Auger Drill	4
Generator	12
Concrete Truck	12
Bedding Hopper/Conveyor System	8
Trench Shield	4
Z-Bar Shoring	4
Truck Cane	4
Pile Hammer, Diesel	4
Pile Leads	4
Dozer	4
Scraper	4
Sheep-foot Compactor	4

The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.

Water Conveyance Facilities Construction

Construction of the water conveyance facilities would be conducted in segments and would include trench and canal excavation, utility preservation and/or relocation, pipe and siphon placement, canal lining, backfill, appurtenant construction and restoration along the entire conveyance facility route. Pipeline segments would be buried, with a minimum earth cover of three feet. Where the pipeline crosses drainages, the depth of cover might be up to ten feet, and scour protection for the pipeline would be provided. Canal segments would follow the ground profile, with earthen berms on either side of the canal. Drainage crossings would pass over the canal.

While the lengths of the individual construction segments would be comparable, productivity would be controlled by the trench type, canal excavation and construction corridor width, restrictions in construction operations; and difficulties in construction of railroad or arroyo crossings.

The rail line crossings would either be bore and jack or conventional tunnel with ribs and lagging or linear plate. All tunnel construction would require a bore pit and a receiving pit. For the Cadiz Project, an area of 150 feet by 100 feet is estimated to be sufficient for the bore pit and surrounding construction activities. The receiving pit would likely be a shored excavation area 20 feet by 12 feet.

The type of trench and canal excavation for the pipeline would depend on several factors, including available construction space, soil/rock material in the trench, groundwater level and allowable cut slope. Prior to a more detailed inspection, aerial photographs of the alternatives were used to establish the preliminary right-of-way availability for each alternative. General assumptions were made about the soil/rock material type, extent of groundwater infiltration and special facilities, such as utility crossings. Special crossing items at arroyos, rail lines and road crossings would require additional special trench types. In the event that rock material is encountered, blasting might be used during trench excavation.

Trenching operations would depend on the trench type and the construction method selected by the contractor. Where necessary, trench shields or soldier piles and timber lagging could be used. Soldier piles could be driven in advance of the pipe heading and the lagging could be installed as the trench excavation progresses. In unrestricted working areas and with a crane used to install pipe, an average of eight to ten sections per day could be installed. Pipe sections would likely be 40 or 48 feet in length. In restricted work areas such as shored trench, where a crane must place the pipe in the trench after delivery by the pipemobile, the average installation rate would be approximately half the rate in unrestricted work areas. Overall, the average length of time that any one area along the pipeline would be disturbed is anticipated to be three months.

It is anticipated that the excavated material would be used for pipe embedment. Water may have to be added to the excavated material to obtain proper compaction around the pipe. Using excavated materials for pipe embedment would eliminate the need to transport bedding materials from local rock quarries.

Throughout construction, the top four to six inches of topsoil would be stockpiled, and cleared and grubbed vegetation would be mulched and set aside with the topsoil. At the completion of construction of each segment of the pipeline, the stockpiled topsoil would be re-spread over the re-contoured permanent right-of-way. The surface would be re-contoured to preserve the original runoff pattern. Topsoil and mulch would be stockpiled for a maximum of three months prior to respreading.

The length of pipe sections transported would be determined by the existing weight limits on roads and highways but would not exceed 48 feet. Transportation of the pipe sections is a significant factor since most public roads and highways have load restrictions of approximately 45 tons. Caltrans has indicated that under a repetitive hauling permit, the absolute maximum load width permitted is 14 feet. In any event, all the required permits to haul pipe on public roads would be obtained. An alternative method for pipe delivery would be to transport pipe sections by rail lines in the project area.

In addition, the general area of Chubbuck Station (CA-SBR-3283H) outside the construction limits would be identified on the project specifications and maps as an ERA in consultation with the project archaeologist. The area and the work limits would be flagged and construction activity would not be allowed within this ERA. The construction corridor would be narrowed to a maximum of 40 feet for approximately 1.25 miles adjacent to this site, in consultation with the project archaeologist.

The general area of the Patton Camp (AE-CAD-13H) outside the construction limits would also be identified on the project specifications and maps as an ERA in consultation with the project archaeologist. The area and the work limits would be flagged and construction activity would not be allowed within this ERA. The construction corridor in the immediate vicinity of this site would be limited to that area west of the railroad and east of the All American Pipeline and focused, to the extent possible, on areas previously disturbed by construction.

Intermediate Pumping Plant No. 1 Construction

Intermediate Pumping Plant No. 1 would be built at mile 21 on the Eastern/Canal Alternative. Construction equipment that would be used in installing this pumping plant is shown in Table 4-11.

TABLE 4- 11
INTERMEDIATE PUMPING PLANT NO. 1
CONSTRUCTION EQUIPMENT

Description	Number
Grader	1
Dozer	1
Hydraulic Backhoe, 1.0 cy	1
¾ Pickup Truck	8
End Dump Truck, 12 cy	2
Crane	1
Gas Welding Machine	2
Tractor/Lowboy Hauling Rig	1
Concrete Mixer	2
Hand Held Vibrator Plate	4
3 cy Rubber Tire Loader	2
Highway Water Truck	1
Compressor	2
Trench Shield	1
Z-bar Shoring	1
Vibrator Compactor	2
Truck Mounted Vertical Auger Drill	1
Pile Hammer, Diesel	1
Pile Leads	1
Front End Loader	1
Roller	1
Generator	2
Concrete Truck	Varies

The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.

Construction of this pumping plant would involve site preparation. This phase involves clearing the building site of objectionable surface materials and obstacles to construction (stripping vegetation and initial grading). Additional construction activities for the pumping plant include trench and structure excavation, above-grade building, pipe, pump and valve installation, appurtenant construction and feature restoration around the entire pump station.

A second phase of excavation would be required for foundation of the facility, underground structures and buried utilities. Part of the excavated material would be stockpiled on site for backfill and site grading; the remainder would be disposed of or stockpiled on the pumping plant site.

Buildings would be erected to house the motors, pumps, communications and control rooms. The superstructure would likely have a split-faced block exterior. All below-grade and at least part of some above-ground structures would be constructed from cast-in-place reinforced concrete.

After completion of these structures, excavated areas would be backfilled, and stockpiled material would be graded to a finish grade.

Intermediate Pumping Plant No. 2

Intermediate Pumping Plant No. 2 would be built at mile 29 on the Eastern/Canal Alternative. Construction equipment anticipated to be used in installing the structure is shown in Table 4-12.

Construction of this pumping plant would involve the same building methods as the previously described for the Intermediate Pumping Plant No. 1.

TABLE 4-12
INTERMEDIATE PUMPING PLANT NO. 2
CONSTRUCTION EQUIPMENT

Description	Number
Grader	1
Dozer	1
Hydraulic Backhoe, 1.0 cy	1
¾ Pickup Truck	8
End Dump Truck, 12 cy	2
Crane	1
Gas Welding Machine	2
Tractor/Lowboy Hauling Rig	1
Concrete Mixer	2
Hand Held Vibrator Plate	4
3 cy Rubber Tire Loader	2
Highway Water Truck	1
Compressor	2
Trench Shield	1
Z-bar Shoring	1
Vibrator Compactor	2
Truck Mounted Vertical Auger Drill	1
Pile Hammer, Diesel	1
Pile Leads	1
Front End Loader	1
Roller	1
Generator	2
Concrete Truck	Varies
The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.	

4.5.4 CONSTRUCTION SCHEDULE

Elements included in the Cadiz Project construction schedule are the pumping plant, water conveyance facilities, power distribution facilities, project spreading basins and project wellfield. Each of these items requires a unique time frame for construction. The facilities required to store water would be completed by the spring of 2003.

4.5.5 RIGHT-OF-WAY REQUIREMENTS

Temporary and permanent rights-of-way would be required to construct and operate the Eastern/Canal Alternative water conveyance and power distribution facilities, Intermediate Pumping Plant No. 1 and Intermediate Pumping Plant No. 2. The other facilities under the Eastern/Canal Alternative are located on properties owned by Metropolitan and Cadiz Inc. and would not require temporary or permanent rights-of-way.

Temporary construction easements would be required to construct the water conveyance and power distribution facilities. An estimated 200-foot wide corridor would be necessary during the construction period. The pipeline facilities would be contained in a permanent right-of-way, 80 feet in width, which would allow access for operation and maintenance. The canal segment would be contained within a 120-foot wide permanent right-of-way. A typical cross section for pipeline construction was shown earlier on Figure 4-4. A typical cross section for canal construction is shown on Figure 4-12.

Intermediate Pumping Plant No. 1 would be sited at mile 21 of the alignment, and would require approximately 1.5 acres of permanent right-of-way. Intermediate Pumping Plant No. 2 at mile 29 would require 1.5 acres of permanent right-of-way. Figure 4-13 illustrates the site plan and associated right-of-way requirements for Intermediate Pumping Plant No. 1, and Figure 4-14 shows the detailed site plan for Intermediate Pumping Plant No. 1. The site plan and detail for Intermediate Pumping Plant No. 2 would be comparable.

The Eastern/Canal Alternative is estimated to require 525 acres of temporary construction easement, and 350 acres of permanent right-of-way.

4.5.6 FEASIBILITY CAPITAL COST

The cost estimates for the Eastern/Canal Alternative shown in Table 4-13 include, but are not limited to, costs for engineering design, construction, administration, water conveyance, power distribution facilities and environmental mitigation. These costs include a contingency.

TABLE 4-13
EASTERN/CANAL ALTERNATIVE
ESTIMATED CONSTRUCTION COST
(1999 $)

Item	Estimated Cost
Intermediate Pumping Plant No. 1	$11,447,000
Intermediate Pumping Plant No. 2	$11,011,000
Conveyance/Power Facilities	$84,962,000
Spreading Basins	$3,513,000
Wellfield Facilities	$30,672,000
Land/Mitigation/Erosion Control	$6,500,000
Eng, Legal, Admin	$17,010,000
Total Project Cost	**$165,115,000**

4.6 CHARACTERISTICS COMMON TO ALL ALTERNATIVES

Certain Cadiz Project components are common to all the alternatives. These are the project spreading basins, wellfield, wellfield power facilities, certain staging areas, power distribution facilities, pipeline appurtenant features, and instrumentation and control systems. These common Cadiz Project components are discussed below.

4.6.1 PROJECT SPREADING BASINS

The project spreading basins will encompass a total area of 390 acres, with about 330 acres of usable recharge area. The project spreading basins will use a parallel train approach in which water could be diverted to each train through slide gate-operated control structures. Water will flow by gravity through all the basins in each train. Figure 4-15 shows a site plan of the project wellfield and spreading basins. Each basin will range in size from about 10 to 15 acres. Approximately 40 cells will be constructed. Individual basins will be about 400 feet wide and range from 1,700 to 2,100 feet long.

The invert of each basin will be level and each successive basin in the train will drop in elevation consistent with the slope of the existing ground surface. Individual basins will be approximately 3.2 feet lower in elevation than the upstream basin. The basins will be constructed with earthen berms using from 3:1 to 6:1 (horizontal:vertical) side slopes. The outside levees might be protected with riprap to control potential erosion.

Interior berms might be protected with riprap or geotextile fabric to prevent erosion from wave action. The berm top will be 16 feet wide to allow equipment access for periodic maintenance of the basins. Typical cross sections of the spreading basins are shown on Figures 4-16 and 4-17. The maximum water depth in each basin cell will be 3.5 feet. Freeboard for the earthen berms will be between 1.5 to 2.5 feet.

Structures associated with the project spreading basins include control structures, inlet structures, flow control structures and overflow structures. Control structures will control and divert water from the transmission pipeline to the inlet structure of each train. The control structure will consist of a reinforced concrete box approximately nine feet square and 16 feet deep. The structure will house two 72-inch slide gates that will be used to control flow into the basins. A typical control structure is shown on Figure 4-18.

Basin inlet structures will carry water from the control structures and discharge to the basin cells. Basin inlet structures will consist of a reinforced concrete foundation, horizontal and vertical discharge piping, and a steel framed trash grating. The top of the discharge pipe will be approximately 0.5 feet above the maximum basin water level and will spill on to a concrete slab surrounded by riprap. A typical inlet structure is shown on Figure 4-19.

Flow control structures will be used to cascade flow from upstream basin cells to downstream basin cells. The flow control structures will consist of a reinforced concrete structure with wingwalls, weir guides and supports, weir boards, piping, handrails and riprap at the inlet and outlet. The weir boards will be removable to allow operation of the basins at various water depths. A typical flow control structure will be used as an overflow device in the last basin cell of each train. This overflow structure will provide for berm integrity by preventing the berms from being overtopped by excess flow to the basins (Figure 4-20).

The overflow structure will discharge to the area surrounding the project spreading basins, and any discharged water will percolate into the ground until the incoming flow stops.

Virtually all construction-related activities will take place on the site of the spreading basin facilities. The only substantial off-site activities will be those associated with the delivery of ready-mixed concrete, other construction materials and process material equipment to the site.

It is the intent of the project spreading basin design to have balanced cut and fill over the entire basin area. Construction activities for the project spreading basins will include site preparation, clearing and grubbing, excavation, embankment or berm construction, utility preservation and/or relocation, pipe placement, backfill, gate and valve installation, and appurtenant construction.

Construction equipment used to complete the project spreading basins is shown in Table 4-14.

TABLE 4-14
CONSTRUCTION EQUIPMENT REQUIRED FOR THE PROJECT SPREADING BASINS

Description	Number
Grader	1
Dozer	1
Scraper	1
Compactor (Sheep-foot)	1
Concrete Mixer	1
Crane	1
End Dump Truck, 12 cy	2
Concrete Truck	Varies
Tractor/Lowboy Hauling Rig	1
3 cy Rubber Tire Loader	1
Highway Water Truck	2
Trench Shield	1
Z-bar Shoring	1
Front End Loader	1
Roller	1
¾ ton Pickup Truck	4
1 cy Backhoe	1

The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.

The project spreading basins will be constructed by excavating native material and placing and compacting the soil to form berms. Riprap might be placed on the interior and exterior berm faces with a loader. The interior berm face might alternately be protected by a geotextile fabric that will be placed using a loader and manual labor. A backhoe will excavate trenches for underground piping, valves and related substructures. Underground piping, valves and related substructures will be placed, and the excavation will be backfilled with native material and compacted to final grade. Mechanical equipment, such as gate valves, miscellaneous metalwork and piping, will be set with a crane.

The project spreading basins will be located on Cadiz Inc. landholdings, and will not require any temporary or permanent rights-of-way.

4.6.2 PROJECT WELLFIELD

A project wellfield, comprised of approximately 30 wells, will be constructed to recover stored Colorado River water and indigenous groundwater. The project wellfield will be located in the vicinity of the Fenner Gap on Cadiz Inc. landholding. The project wellfield and manifold system is shown on Figure 4-21.

The project wellfield will include three existing agricultural irrigation wells which will be upgraded to meet the Cadiz Project requirements. Each new well will have a 16-20 inch diameter casing and provide a design capacity of about 6.7-8.3 cfs per well, for a nominal wellfield design capacity of 200-250 cfs. Motors used to operate the wells will range from 1,000 to 1,250 horsepower, and will be electrically powered using power supplied through Metropolitan's existing Colorado River Aqueduct power transmission system.

Construction of the project wellfield will involve site preparation; clearing and grubbing; well drilling; utility preservation and/or relocation; pipe placement; backfill; pump, motor and valve installation; and appurtenant construction. Most of the construction-related activities and installation will take place on the site of the project wellfield. The only substantial off-site activities will be those associated with transporting construction materials and appurtenances, and process equipment to the site.

Well drilling will be accomplished with drill rigs using the reverse rotary drill method. A pilot borehole, approximately 36-inches in diameter, will be drilled to a depth of approximately 30 feet and conductor casing will be cemented in place. The borehole will then be extended to depth, up to 1,000 feet deep, using a bore diameter of 28 to 32 inches, but would not be completed in the carbonate bedrock aquifer. The drilling operation will be continuous, 24 hours per day. A crane will then lower the well casing into the borehole. The annular space between the well casing and borehole will be filled with a specified mixture of soil and rock, called a filter pack, to ensure that fine-grained material from the formation surrounding the well is not pumped through the well during operation. A concrete seal will be placed at the top 50 feet of the annular space to provide a sanitary seal for the well. Figure 4-22 illustrates a typical well cross section.

The well pump bowls and driveshaft will be lowered into the well casing using a crane, and will then be aligned to ensure proper operation of the well. The electrical drive motor will be mounted on the wellhead, and appurtenant equipment, including flow meter, discharge piping, isolation valves and controls, will be installed. Plan and profile views of a typical well are shown on Figure 4-23.

A backhoe will excavate pipe trenches for the project wellfield distribution piping that will carry water to the transmission pipeline leading to the Colorado River Aqueduct. A crane will be used to lower pipe segments into the trench. The pipe trench will be backfilled by a loader, and the backfill compacted to ensure pipe integrity. A separate trench will be excavated to install the project wellfield monitoring and control systems. The monitoring and control systems will allow remote operation to be controlled from the Iron Mountain Pumping Plant. A schematic diagram of the monitoring and control system is shown on Figure 4-24.

Construction equipment used to complete the wellfield is shown in Table 4-15.

TABLE 4-15
CONSTRUCTION EQUIPMENT REQUIRED FOR THE PROJECT WELLFIELD

Description	Number
Grader	1
Dozer	1
¾ Ton Pickup Truck	6
End Dump Truck, 12 cy	2
Crane	2
Air Compressor	2
Tractor/Lowboy Hauling Rig	2
3 cy Rubber Tire Loader	1
Highway Water Truck	1
Truck Crane	1
Concrete Truck	Varies
Well Driller	4
The types and quantities of equipment are approximate and intended only for estimating construction related impacts. Actual equipment types and quantity may vary.	

Construction of the project wellfield power supply and distribution facilities will occur concurrently with the construction of the project wellfield. Pads will be graded for the two switchyards. Concrete foundations will be placed on grade by concrete trucks. Large equipment will then be set on the foundations by a crane. A site plan for a typically wellfield substation is shown on Figure 4-25.

Power to individual wells could be supplied overhead or underground. If overhead, power poles will be installed in the wellfield area. A vertical auger will drill holes where poles will be placed. A small crane will lower poles into the ground. Conductors will be strung on the poles by lineman in a bucket-lift pulling wire from a reel truck. If the power is routed underground, a backhoe will excavate a trench from the switchyard to each well. Conduit to house conductors will be placed in the trench, and cement slurry will be placed around the conduit. The trench will be backfilled and conductors will be pulled through the conduit from a reel truck.

4.6.3 POWER DISTRIBUTION FACILITIES

Power distribution facilities for the project wellfield will parallel the water conveyance facilities between the Colorado River Aqueduct and the Fenner Gap area. To power the project wellfield, a 69 kV power distribution system will be required. The power poles will be placed within the permanent right-of-way obtained for the water conveyance facilities. Poles will be 50 - 60 feet in length, with 43 - 52 feet above ground. Each pole will carry three conductors and provide a minimum conductor ground clearance of 23 feet at maximum conductor sag. A typical power pole installation is shown on Figure 4-26.

If the Eastern/Canal Alternative is implemented, an additional power supply line would be strung on the existing power poles from Iron Mountain Pumping Plant to the Intermediate Pumping Plants. This line would be 6.9 kV and would be installed on the same pole as the 69 kV line. The pole would be slightly taller to allow for the three additional conductors required for this Alternative.

If the Western Alternative or the Combination Alternative is selected, an additional segment of 69kV power supply line would be required between Iron Mountain Pumping Plant and the western portal of the Iron Mountain Tunnel. This segment of the power supply line would proceed southwest from the Iron Mountain Pumping Plant along an unimproved road for approximately six miles, turn west at the Riverside County line and proceed west for about three miles to an unimproved road, then turn northwest and proceed for about three miles to the west portal of the Iron Mountain Tunnel.

Construction of the power line would occur concurrently with the water conveyance facility installation.

4.6.4 POWER SUPPLY FACILITIES

The existing 230kV switchrack at Iron Mountain Pumping Plant will be extended to provide two additional bays as shown on Figure 4-27. One bay will be for the new 69kV substation serving the overhead line to the wellfield and the other bay will be for the new pumping plant substation. Each bay will consist of a transformer, circuit breaker and disconnect switches. Overhead conductors will connect the switchrack extension to the new substations, with each one located in proximity to the switchrack. The pumping plant substation will be located southeast of the existing switchrack and will consist of a line termination structure and a 230kV/69kV transformer. Cables will connect directly to the low side of the transformer and will run underground to the pumping plant.

4.6.5 STAGING AREAS

A staging area or areas will be prepared for the temporary storage of equipment and materials needed during construction of the Cadiz Project. Preparation of these staging areas will consist of crushing vegetation in place or blading the site in a manner that will allow native vegetation to recover from rootstock. The location of the storage areas will depend on which alternative was selected. The discussion below describes where these temporary staging areas will be located.

Wellfield Staging Area

A construction staging area for the construction of the project wellfield and the northern segment of the water conveyance facilities will be contained within the 390 acre area used for the project spreading basins. The construction staging area will provide space for material storage, pipe, equipment and vehicles needed for construction. Temporary construction trailers will also be housed on the site. Access to the staging area will be from Cadiz-Rice Road.

Intermediate Staging Area

An intermediate staging area for equipment and material storage and construction trailers will be located between Cadiz-Rice Road and the AZRC rail line. The location of this staging area is shown on Figure 4-28. Pipe sections, bedding material, reinforced steel, valves, a 5,000 to 10,000 gallon water storage tank and miscellaneous supplies will be stored at this staging area. This triangular shaped tract of land is approximately 1,500 feet long by 300 feet wide, providing nearly five acres for a construction staging area. Existing drainages define the west and east limits of this staging area site. The area is north and east of the Killbeck Hills. Equipment and materials will probably be delivered to this staging area from Cadiz rather than from the Iron Mountain Pumping Plant.

Access to this staging area will be from Cadiz-Rice Road. Although this staging area is adjacent to rail lines and material could be shipped by rail to the site, preliminary discussions with pipe suppliers indicate that pipe will be transported to the job site on trucks.

West Portal Staging Area

The staging area for construction of the Cadiz Pumping Plant (West Portal) and the West and Combination alternatives would parallel the 200-foot wide construction right-of way. Figure 4-29 shows the location of this staging area. An alternative staging area may be available at the tunnel tailings area south of the Iron Mountain Tunnel which could provide approximately 7.5 acres of storage.

This construction staging area would provide space for storage of materials, pipe, equipment and vehicles needed for construction. Construction trailers would presumably be located at this site. Access to this site would be provided via an existing unimproved road approximately five miles long that connects the staging area to Highway 62 as shown on Figure 4-30.

Cadiz Pumping Plant Staging Area

It is anticipated that a staging area for the Cadiz Pumping Plant and Eastern Alternative would be located south of the Eastern Alternative. A staging area of five to seven acres is anticipated at this site, as shown on Figure 4-31. Access to the staging area would be along the existing unimproved road east of the Colorado River Aqueduct.

Alternative staging areas may be available at several disturbed areas east and south of the existing Colorado River Aqueduct forebay. The staging area for the Cadiz Pumping Plant would likely be located between the existing electric substation and the Cadiz Pumping Plant.

Intermediate Pumping Plant

The staging area for construction of the Intermediate Pumping Plant would be parallel to the 200-foot wide construction right-of-way. Figure 4-28 shows the location of this staging area. This staging area would provide space for storage of construction materials, pipe, equipment and vehicles. Construction trailers would presumably be located at this site. Access to this site would be provided by the existing unimproved road east of the Colorado River Aqueduct and within the construction easement for the Eastern Alternative.

4.6.6 APPURTENANCES

The use of appurtenant features in the delivery system will facilitate its operation by allowing routine inspection, maintenance and repair, or by shutting off water flow. The appurtenances described below and shown on Figure 4-32 are applicable to each Cadiz Project alternative.

Blowoff Valves

Blowoff valves will be used to drain water from the water conveyance facilities to facilitate inspection and repair from the inside of the pipeline, and will be located at selected low points on the pipeline alignment. The final blowoff valve locations, sizes and types will be determined during detailed final design. A typical blowoff installation will consist of a pipe connected perpendicular to the transmission pipeline, a valve and valve operator to control flow from the transmission pipeline, and a pipe riser to deliver flow from the transmission pipeline.

Air Release/Vacuum Relief Valve Assemblies

When operating, the pipeline is intended to flow full and under pressure. However, air or mixtures of water and air could also flow through the pipeline. Air and vacuum valve assemblies are intended to ventilate air from the pipeline. On initial filling of the pipeline with water, air will be released through the air and vacuum valves.

Combination air and vacuum valves will be provided to exhaust small volumes of air from the pipeline under pressure and allow air into the pipeline when it is drained. Air and vacuum valve assemblies will be provided at high points in the pipeline and on the downward sloping side of line valves. These valves may be located in structures either below or above grade. Final locations will be determined during detailed design.

Access Manholes

Access manholes will be provided along the pipeline to allow for internal inspection and maintenance of the pipeline.

The manholes will typically be 24-inch flanged tees buried or contained within a concrete structure. They will be placed at approximately 1,500-foot intervals and will be denoted by permanent marker posts along the right-of-way. The metal or concrete marker posts will be approximately three feet high. Access manholes will be located close to valves and low points as well as at intermediate locations along the pipeline.

4.6.7 INSTRUMENTATION AND CONTROL SYSTEM

A control and monitoring system for the project will monitor the well levels, flow data and pump status information. Monitoring sensors will be located at project pumping plant facilities and wellfield substations. Each wellfield substation will gather data from 15 remote input/output drops located at each of the 30 well sites. The system will communicate via microwave. Fiber optic cable will be used for communications from each of the wellfield substations to the individual well sites.

The system will provide on/off initiates to the wells to maintain constant flow. Facilities at the Iron Mountain Pumping flow. Each well site will be provided with a flow meter and pressure sensor on the discharge of the well pump, and a level meter to indicate the level of water in the well. Well monitoring systems will provide information on the well level, flow rate, high and low levels, status of the pump and status of the motor.

The system will be integrated with the existing Supervisory Control and Data Acquisition (SCADA) system currently used for Colorado River Aqueduct operations.

4.6.8 GROUNDWATER MONITORING AND MANAGEMENT PLAN MONITORING FACILITIES

A monitoring network containing a total of 24 different monitoring features has been identified for assessing potential impacts to the four critical resources identified in Section 5 of this EIR/EIS. These monitoring features include small diameter observation wells, observation well clusters, survey benchmarks, evapotranspiration stations, weather stations, stream gages, air quality monitoring instrumentation, meteorological towers and other miscellaneous items. A detailed description of all monitoring features, their locations and monitoring frequencies is contained in the Management Plan, published as Volume IV of this Final EIR/EIS.

4.7 OPERATIONS AND MAINTENANCE

4.7.1 SPREADING BASINS

The water conveyance facilities will terminate at the project spreading basins and will discharge Colorado River water for percolation into the ground for storage and future use by Metropolitan. The project spreading basins will consist of multiple cells into which Colorado River water could be selectively discharged.

The project spreading basins will be monitored remotely to confirm performance in percolating water into the underground aquifer. As percolation rates decline, operations personnel will redirect Colorado River water discharge to new spreading basin cells. The spreading basins will be located on Cadiz Inc. landholdings. A maintenance road will be constructed around the perimeter of the spreading basins which will facilitate access for inspection and maintenance. Routine inspection will be performed weekly and will consist of two maintenance personnel inspecting the facilities. Routine maintenance will include periodic cleaning of debris from off-line cells of the spreading basin interior. Fine-grained sediment will be removed from the bottom of the spreading basins using heavy equipment. All inspection and maintenance activities will be performed within the permanent Cadiz Project right-of-way.

4.7.2 PROJECT WELLFIELD FACILITIES

The project wellfield facilities will draw water from underground storage into the transmission conduit for discharge to the Colorado River Aqueduct for use by Metropolitan. The project wellfield facilities will include the wells, the well pumps and electric motors, the electrical power switchyards, the individual well discharge piping and control valves, collector piping and all appurtenant facilities.

The project wellfield facilities will be controlled and monitored remotely to maintain the water delivery rate at the Colorado River Aqueduct consistent with desired parameters. The wellfield facilities will all be located on Cadiz Inc. landholdings. A maintenance road will be constructed to provide access to each project wellfield site and the collector pipelines. Routine inspection performed weekly will consist of two maintenance personnel inspecting each well site. Other components of the project wellfield will be inspected on about a monthly basis. All inspection and maintenance activities will be performed within the permanent Cadiz Project right-of-way.

In addition, the boundary of the rock alignment feature (AE-CAD-8H) will be identified on all project specifications and maps as an ERA, in consultation with the project archeologist. The ERA will be flagged prior to any construction activity within 1,000 feet of this site. No construction activity will be allowed within this ERA.

4.7.3 WATER CONVEYANCE FACILITIES

Cadiz Pumping Plant

The Cadiz Pumping Plant will take water from the Colorado River Aqueduct and provide sufficient hydraulic head to deliver the water via the transmission conduit to the project spreading basins for storage in the aquifer system. The Cadiz Pumping Plant will consist of an above ground structure housing vertical turbine, electric motor driven pumping units.

The Cadiz Pumping Plant will be located on land owned by Metropolitan and will be provided with an access road for inspection and maintenance. A supervisor and one operator will be on duty during the normal daily operation of this facility. Routine inspection will be performed daily during periods of pumping plant operation. The individual pumping units will be inspected on an approximately annual basis.

Intermediate Pumping Plants

Intermediate Pumping Plants would be required for the Eastern/Canal Alternative only. The intermediate pumping plants would take water from a canal segment and lift it to the adjacent pipeline segment. Each intermediate pumping plant would consist of an above ground structure housing vertical turbine, electric motor driven pumping units.

The Intermediate Pumping Plants would be within dedicated right-of-way and would be provided with access roads for inspection and maintenance. A supervisor and one operator would be on duty during the normal daily operation of the facility. Routine inspection would also be performed daily during periods of pumping plant operation. The individual pumping units would be inspected on about an annual basis.

Water Conveyance Facilities

The water conveyance facilities will serve two functions: first, deliver Colorado River water from the Colorado River Aqueduct to the project spreading basins for storage in the aquifer system; and second, deliver water from the project wellfield back to the Colorado River Aqueduct for use by Metropolitan. The water conveyance facilities will consist of a concrete lined, open gravity flow canal with a bottom width of about eight feet, or a single barrel, pressurized pipeline with a nominal design flow of 200 to 250 cfs.

The water conveyance facilities will be within the dedicated permanent right-of-way and generally adjacent to the Cadiz Project maintenance road which will facilitate access for inspection and maintenance. Routine maintenance will be performed weekly and will consist of two maintenance personnel driving the right-of-way to inspect the above ground facilities. Approximately every five years, the pipeline segments will be drained and maintenance personnel will enter the pipeline and perform an inspection of the underground facilities. All appropriate safety procedures for access into a confined space will be followed. Canal segments will be drained on about an annual basis for inspection and cleaning.

Power Distribution Facilities

The electrical power supply for the Cadiz Project facilities including the Cadiz Pumping Plant, the Intermediate Pumping Plants (as required), the project wellfield facilities and the project spreading basins will be supplied from a new power distribution line.

The power distribution line will be within the dedicated permanent right-of-way and generally adjacent to the Cadiz Project maintenance road which will facilitate access for inspection and maintenance. Routine inspection performed once each month will consist of two maintenance personnel driving the right-of-way to inspect the facilities. All inspection and maintenance activities will be performed from within the permanent project right-of-way.

4.7.4 GROUNDWATER MONITORING AND MANAGEMENT PLAN MONITORING FACILITIES

The Management Plan will require the installation, inspection and maintenance of monitoring facilities to provide for collection of data. These facilities are detailed in Table 1 and Figures 4 and 5 of the Management Plan, Volume IV of this Final EIR/EIS which include more specific information such as frequency of monitoring and general location.

These monitoring facilities are generally sited in three areas: 1) the project area aquifer, 2) on the lakebeds or the margins of Bristol and Cadiz dry lakes, and 3) the Mojave National Preserve and surrounding areas. Facilities in the project area aquifer will include approximately 20 survey benchmarks; three cluster wells, each consisting of three observation wells; use and potential modification of 14 existing observation wells; construction of one new observation well; and construction of three 10-meter-tall meteorological towers. Facilities on the lakebeds or near the margins of Bristol and Cadiz dry lakes will include six new cluster wells, each consisting of three observation wells; two evapotranspiration monitoring stations; two staff gages; and four air quality monitoring stations. Facilities between the project area and the Mojave National Preserve will include four cluster wells, each consisting of two or three wells; and two soil moisture sensors. One new weather station will be located in the Mojave National Preserve.

Additionally, an inventory of springs in the Preserve and surrounding area will be prepared. Approximately eight of these springs will be selected for regular monitoring. If necessary, two stream gages could be constructed in the Mojave National Preserve and surrounding area. Certain additional monitoring facilities could be constructed in the project area aquifer and include an extensometer well and microgravity stations.

The Management Plan has specified general locations for the monitoring facilities. During the implementation of the Management Plan, additional technical information will be developed to select specific locations for all monitoring facilities. Impacts associated with the monitoring program will be related to the drilling of new monitoring wells at specific locations, modification of existing wells for monitoring purposes, placement of other types of monitoring equipment within the potentially affected region, and inspecting these facilities to collect data and provide maintenance. There is also the potential for the development of new access or power distribution facilities to support the monitoring facilities. However, it is the intent of the Management Plan to site monitoring facilities such that existing access and power facilities will be used to the extent practicable.

The monitoring facilities for the project will be located near existing roads, to the extent possible, to facilitate access for data collection and maintenance. A detailed schedule for data collection is presented in the Management Plan. Where practical, data collection will be automated to minimize site visits by operations staff.

Water quality samples will be periodically collected from observation wells throughout the project area, as defined in the Management Plan. Testing protocols for observation well sampling require a small amount of water to be flushed from the observation well (three well casing volumes). This water will be pumped from the well with a small pump lowered down the well. The pumped groundwater will be allowed to flow on to the ground adjacent to the well, and a sample of groundwater will then be taken and sent to a laboratory for analysis. Water level measurements may also be performed at the same time.

Periodic visits will be made to other monitoring facilities (e.g. ET stations, weather stations, etc.) to gather data, as defined in the Management Plan. These visits will generally consist of downloading data from computer equipment contained within the monitoring facility. An annual survey of benchmarks will be conducted and will consist of a two-man or three-man survey crew performing a survey of land elevations.

Maintenance activity for the monitoring network will be minimal. The observation wells will be periodically inspected to ensure integrity of the well. Other monitoring facilities will be periodically inspected for damage from vandalism or equipment failure, and will be repaired or replace as necessary.

4.8 THE NO PROJECT ALTERNATIVE

The No Project Alternative evaluates the effects of not implementing the Cadiz Project. Discussion of Metropolitan's planning assumptions, system operations, and effects of the No Project Alternative is provided in the following sections.

4.8.1 PLANNING ASSUMPTIONS FOR THE NO PROJECT ALTERNATIVE

The No Project Alternative was evaluated to determine the supply deficit, through 2020, if the Cadiz Project was not implemented. This evaluation considered deficits that could occur, then addressed the probable local response to deficits and the potential impacts associated with that range of responses. In planning for the Cadiz Project, a number of assumptions were made regarding the conditions affecting supply and demand, as well as the water supply and distribution system. The assumptions for water demands and supplies were described earlier in Section 2.

The No Project Alternative assumes the existing delivery priorities for water would be maintained. Under this assumption, water would be delivered according to the following priorities:

- Municipal and industrial demands.
- Agricultural demands.
- Maintenance of seawater barrier.
- Enhanced groundwater replenishment.
- Seasonal in-lieu storage programs.
- Surface reservoir storage.

Under the No Project Alternative, the existing distribution system would include a range of operating options available to Metropolitan for minimizing system failures and unscheduled outages. As explained in detail in the following sections, the range of options would be defined by:

- Current operating procedures that provide for optimum system reliability.
- Operation to maximize deliveries, which would involve a substantial decrease in system reliability.

4.8.2 OPERATING OPTIONS EVALUATED

There are several options that could be implemented under the No Project Alternative, including continued overdrafting of groundwater basins, construction of desalination/purification facilities and not meeting demands in the service area. The potential environmental impacts of the No Project Alternative are fully discussed in Section 5.

Continued Overdrafting of Groundwater Basins

Under the No Project Alternative, all existing facilities and all facilities for which environmental documentation has been certified would be operated to their fullest extents, allowing for preventive maintenance, rehabilitation and repairs. At all other times, the existing facilities would be operated at 90 percent of their maximum capacity on an as-needed basis. This would be consistent with current operations to assure system safety and reliability.

Groundwater Storage

With continued overdrafting, long-term storage deficits would be significant and the groundwater basins would have to be drawn down substantially. Such a level of overdrafting would not be sustainable; eventually it would adversely affect normal year production, further contributing to long-term adverse impacts. Overdrafting to meet needs under the No Project Alternative is, therefore, not considered feasible.

Conveyance and Storage Deficits

Without the Cadiz Project, Metropolitan's supply deficit would increase by additional approximately 150,000 acre-feet per year during dry years. These increased deficits would be the result of an inability to convey available supplies from the State Water Project and Colorado River Aqueduct to Metropolitan, DWR reservoirs and/or directly to Metropolitan member agencies.

Construction of Desalination/Purification Facilities

Construction and operation of a desalination facility capable of meeting storage deficits is one option to meet supply needs in lieu of constructing and operating the Cadiz Project. Based on this increased supply deficit of approximately 150,000 acre-feet, a peak flow deficit condition of 400 acre-feet per day would be realized. At this deficit level, the required desalination plant capacity would have to be approximately 125 million gallons per day (mgd). The current technology for constructing a plant of this capacity would be to construct multiple modules of smaller capacity.

The optimal size of a reverse osmosis module using existing technology would be about 25-mgd, large enough to reduce redundancy of cost, yet small enough to maintain reliability, high yield and stay within the range of current technology. Meeting the estimated water needs using these criteria would require five modules at 25-mgd each. The capital cost of a 25-mgd reverse osmosis module is estimated at approximately $100 million. The total capital costs for a 125-mgd plant, including large diameter pipelines and high capacity pump stations, was estimated to be $500 million. This cost does not include the land requirements of approximately 125 acres, which, if located near the sea, would cost an estimated $1 million or more per acre. The annual operating costs of a seawater desalination plant, exclusive of capital repayment, would be about $1,500-1,800 per acre-foot, or $217 - 261 million in dry years. Pumping costs to convey the desalted water to points of use would be about $195 per acre-foot, or about $28.3 million per year in dry years. In addition, the 125-mgd facility would require an electric power source of about 125 megawatts and an environmentally acceptable method of brine disposal.

Desalination is considered a viable long-term approach to increasing supplies, but is not considered an appropriate solution to seasonal or long-term storage deficit problems at this time. Desalination to meet water requirements under the No Project Alternative is, therefore, not feasible.

4.8.3 MOST PROBABLE NO PROJECT SCENARIO

The most probable operations scenario under the No Project Alternative would involve efforts to maximize deliveries by operating at maximum capacity during periods of high demand and to replenish groundwater storage when possible. Under this scenario, scheduled outage time to rehabilitate aging equipment, make physical repairs and perform preventive maintenance would be deferred indefinitely. Over time, facility malfunctions and major outages would occur at a higher frequency. These major outages could result in potential overdraft of groundwater basins and sudden, high levels of rationing.