Desalinated Water Conveyance Facilities Alignment Investigation Report

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1.1 Introduction

The San Diego County Water Authority (Water Authority) is a public agency serving the San Diego region as a wholesale supplier of water. The Water Authority is responsible for supplying and delivering a safe and reliable water supply to its 23 member agencies, comprised of the cities and water districts in San Diego County. Diversifying and expanding their water supply is a critical element in the Water Authority’s long-term planning efforts. With recent advancements in technology, seawater desalination has become a potentially viable way for the Water Authority to diversify their water supply to better serve member agencies. To this end, the Water Authority is considering the development of a project known as the “Seawater Desalination Plant at Encina” (Encina Plant). This project includes a desalinated water treatment plant that will convert seawater to potable (drinking) water and the conveyance facilities to deliver this water to users. The plant will be initially sized at 50 mgd, with provisions built in to expand it to 75 or 100 mgd, as warranted by future demands. Scheduled for completion in 2008, the plant will operate at full capacity year-round, which means that the conveyance facilities must be able to deliver (or drop-off) the full 50 mgd of water to delivery point(s) or users.

1.2 Purpose

The Desalinated Water Conveyance Facilities Project (DWCF) will consist of a series of pump stations, pipelines, and associated facilities to convey desalinated water produced at the Encina Plant to users. The purpose of this “Alignment Investigation Report,” as the first phase of work on DWCF, is to research, document, and develop alternative alignments for the pipeline and pump station(s) (conveyance facilities) to be installed within the study area (see Figure 1-1, Vicinity Map). The alternative alignments developed will be used by the Water Authority’s environmental consultant to prepare the Environmental Impact Report (EIR), required under the California Environmental Quality Act (CEQA).

The primary purpose of this study is to investigate the feasibility of alternative alignments between the Encina Plant and the Second Aqueduct, along with the technical requirements for integration of the desalinated seawater into the regional water supply system. A secondary, but important purpose, is to advance the engineering work so that after alignment selection, the design can proceed efficiently. There is another purpose: in as much as it supports the EIR process, it also is intended to be used as a tool to educate public officials, local residents and other interested area stakeholders about the project, so they will have a firm understanding of project details and can provide productive and insightful input into the alignment selection process through the public outreach program that the Water Authority plans to conduct.

This Report summarizes the many detailed investigations performed. These investigations are available as separately bound appendices to this Report. This first phase of the project needs to provide sufficient
development and evaluation of alternatives to support the EIR and give the Water Authority confidence that they have identified the best alternative.

The purpose of this Executive Summary to provide background information that includes initial design assumptions, an overview of the Boyle/PBS&J team’s approach to this project, the work performed and the steps that lead to the production and distribution of desalinated water.

1.3 Background

The Encina Power Station (formerly owned by San Diego Gas & Electric Company) located north of Cannon Road in Carlsbad, is owned and operated by Cabrillo Power I LLC (Cabrillo). Poseidon Resources Corporation (Poseidon), a private corporation, has an existing contractual relationship with Cabrillo that provides them with exclusive rights to develop a seawater desalination facility on the Encina Power Station site. The Water Authority has been negotiating with Poseidon Resources to purchase 50 mgd of seawater produced at the plant that Poseidon was planning on constructing. Negotiations on the agreement between Poseidon and the Water Authority are ongoing. It is anticipated when the Encina Plant is operational that: (1) the Water Authority conveyance facilities must be ready to operate, and (2) the Encina Plant will supply 50 mgd every day (they are not going to regulate their output to adjust for seasonal demands). Therefore, it is imperative that the amount of water taken by users be constant, 365-days-a-year.

1.4 Project Approach

The Water Authority’s original project objective was:

“The Desalinated Water Conveyance Facilities Project (DWCF) is part of the Seawater Desalination Plant at Encina project that is planned to convey 50-million gallons per day (mgd) of treated product water from the Desalination Plant at Encina to the cities of Carlsbad and Oceanside and to the Second San Diego Aqueduct.”

With that in mind, the Boyle/PBS&J team began investigating the water demands of the cities of Carlsbad (Carlsbad) and Oceanside (Oceanside) to see how much of the 50 mgd of desalinated product water they could positively and without any doubts, agree to take 365 days a year. It was envisioned that any water not taken locally would be routed to the Second Aqueduct for the Water Authority to distribute to other member agencies (for example, if local agencies agreed to take a total of 30 mgd, the remaining 20 would be conveyed via DWCF to the Second Aqueduct for further distribution).
The first step taken in developing alternatives was to combine the individual demands into groups that total 50 mgd. Once it was determined who the recipients could be, the pump station and pipeline facilities to deliver the water were developed for technical and environmental evaluation.

1.5 Report Outline

This report is organized into the following 13 chapters:

Chapter 1 Executive Summary
Chapter 2 Introduction
Chapter 3 Local and Regional Treated Water Demands
Chapter 4 Pipelines
Chapter 5 Pump Stations
Chapter 6 Water Quality
Chapter 7 Second Aqueduct Facilities
Chapter 8 Geotechnical and Phase I Site Assessment
Chapter 9 Environmental Screening and Permits
Chapter 10 Preliminary Cost Estimate
Chapter 11 Project Schedule
Chapter 12 Evaluation Criteria
Chapter 13 Next Steps

Summaries of these chapters are included below.

1.6 Local and Regional Treated Water Demands

The key demand assumptions provided by the Water Authority were:

- The Encina Plant will initially operate at a near-constant flow of 50 mgd year round.
- The demand analysis must account for the delivery of 50 mgd during minimal demand periods (meaning that there will be no flow adjustments at the plant and all 50 mgd will be delivered to the DWCF pipeline daily).
- The Encina Plant was assumed operational in year 2007; and therefore, year 2007 demand forecasts were reviewed.
Direct delivery of desalinated water to local agencies would be advantageous if it reduces the length and/or size of DWCF’s pipeline and/or pump station facilities, or if it reduces the annual volume of water that must be pumped to the hydraulic elevation of the Second Aqueduct. The conclusions are as follows:

- **DWCF needs to deliver most of the water to the Second Aqueduct.** The analyses performed identified that local reliable winter demands are relatively modest in comparison to the 50 mgd initial production rate of the Encina Plant. Consequently, the conveyance facility will need to be sized to carry, at a minimum, most of the water to the Second Aqueduct.

- **Direct deliveries of desalinated water to Carlsbad and Oceanside are physically possible.** Direct deliveries to Carlsbad are possible either at Maerkle Reservoir, other higher elevation points, or both. Construction of a separate pipeline for direct deliveries to Oceanside is possible, but appears uneconomical in comparison to delivering the same increment of water directly to the Second Aqueduct.

- **Direct deliveries of desalinated water to agencies other than Carlsbad and Oceanside are not practicable.** Direct deliveries of desalinated water to Vista Irrigation District, Vallecitos Water District, Olivenhain Municipal Water District, Santa Fe Irrigation District or the San Dieguito Water District are physically possible but are not economical when compared to conveying the same increment of water directly to the Second Aqueduct where it can also be blended with imported water and then delivered indirectly to these and other downstream users. The factors that disfavor direct deliveries to these agencies include: distance to system connection points, pumping required, limited firm wintertime demands, and the presence of base-loaded local water supplies.

### 1.7 Pipelines

The work performed on this task consisted of field investigations, collecting and reviewing existing utility and as-built record drawings, establishing pipeline design criteria, alignment descriptions, street cross-sections, schedules and cost estimates. Technical Memoranda prepared for this task included the “Pipeline Design Criterion Technical Memorandum” (Appendix 4) and the “Pipeline Preliminary Design Technical Memorandum” (Appendix 5). The pipeline design criterion conforms to Water Authority standards.

#### 1.7.1 Pipeline Design Criteria

Key design criteria includes:
Pipeline diameter = 60 inches.
Pipeline material = welded steel.
Pipeline lining = 0.5-inch-thick cement mortar lining.
Pipeline coating = 80 mil dielectric tape with cement mortar armor coat.
Pipeline joints = single welded lap joints, except where double welds are needed for additional thrust restraint.
Cathodic protection = impressed current.

1.7.2 DWCF Pipeline Alignment Screening

A large number of potential alignments (coarse screening) were “fine screened” down to 3 primary alignments and 12 combination alignments that are still under consideration (see Figure 1-2 and Page 7). Fine-screening was based on constructability. All of these remaining alignments are constructible. The alignments all have different costs, traffic, land use, environmental impacts, and differing abilities to deliver water directly to Carlsbad or Oceanside. These differences will be evaluated in the Public Outreach program conducted by the Water Authority for this project and will, through the evaluation process described in Chapter 12, determine the preferred alignment.

1.7.3 Description of Primary DWCF Pipeline Alternatives

There are three primary alignment alternatives (“Blue,” “Green” and “Orange”) in the fine screening phase. These alignments are summarized below by Location, DWCF Purpose and Primary Issues:

Location

Blue Alignment - Beginning on the Encina site, the pipeline crosses under the NCTD railroad tracks and Interstate 5 (I-5) north of Cannon Road. It then crosses the SDG&E-owned property adjacent to the Aqua Hedionda Lagoon, enters Cannon Road and continuing north in Cannon, turns east down El Camino Real and northeast near Sunny Creek Road to Maerkle Reservoir. From Maerkle Reservoir the pipeline heads north, meets with the Water Authority’s Tri-Agencies Pipeline (TAP) corridor and follows the TAP corridor to the Second Aqueduct. The Blue alignment would parallel the TAP. The total pipeline length of the Blue Alignment from the Encina Plant to the Second Aqueduct is approximately 53,400 feet.

Green Alignment - This alignment follows the same Cannon Road corridor from the Encina Plant eastward, and then turns east using the existing Faraday Road and the planned Faraday Road Extension, continuing to the city of Vista and the TAP corridor, and then parallels the TAP eastward to the Second Aqueduct. The total length of the Green Alignment is approximately 49,600 feet from the Encina Plant to the Second Aqueduct.
Chapter 1 – Executive Summary

Orange Alignment – This alignment follows a southerly route via Avenida Encinas crossing south of Cannon Road, then east under the NCTD tracks and I-5, then following College Boulevard and Palomar Airport Road/San Marcos Boulevard directly to the Second Aqueduct. The total pipeline length of the Orange Alignment is approximately 49,100 feet from the Encina Plant to the Second Aqueduct.

**DWCF Purpose**

Blue Alignment - This is the only alternative that passes directly by Maerkle Reservoir. This is important to the City of Carlsbad because it could provide a direct connection of the DWCF to Maerkle Reservoir.

Green Alignment - This alignment is routed through less traffic intensive roadways than the other alignments and if the timing is right, parts of it could be installed with private developer projects, thereby eliminating environmental and community-based impacts.

Orange Alignment - This alignment offers the most direct connection to the Second Aqueduct and would require less pipe materials to construct.

**Primary Issues**

Blue Alignment - This alignment traverses more environmentally sensitive areas than the others. It would impact more residences and requires parallel construction to the TAP. Water quality blending issues would need to be resolved.

Green Alignment - This alignment is dependent upon the developer who is building the Faraday Road Extension. Should that project not be built, another route to the Second Aqueduct would have to be used, limiting the benefits originally identified.

Orange Alignment - The primary issue is the impact of construction on traffic. Palomar Airport Road and San Marcos Boulevard are heavily congested under normal circumstances. Construction will require very carefully coordinated traffic control to reduce impacts.
Chapter 1 – Executive Summary

Primary and Combination Alignment Alternatives: The DWCF alignment alternatives consist of three primary alignments (Blue, Green, and Orange, above), plus nine additional combination alignments. The combination alignments utilize different portions of the primary alignments, along with interconnect segments shown above in pink. The resulting twelve alignment combinations are depicted in the drawings below.
1.7.4 **Tunnels**

Several reaches of the pipeline alignments were identified as candidates for tunneling. Tunneling provides the ability to build the pipeline without disrupting existing surface improvements and utilities. However, tunnel construction is considerably more expensive than traditional open cut pipeline construction methods and the entrance/exit portals can take up considerable room during construction, so they need to be carefully sited.

The “Tunnel Feasibility Technical Memorandum” (see Appendix 7), identified a total of eleven main tunnel segments as follows: five on the Blue alignment; two on the Green alignment; three on the Orange; and one from the Plant Site to the Twin Oaks Diversion Structure in San Marcos. The proposed tunnel segments are shown in Figure 4-4. The tunnel areas have also been identified on the Alignment Summary Maps in Appendix 1 (Reference Exhibits).

1.7.5 **Shoring Methods**

Probable shoring methods were developed based upon the geotechnical assessment with no field exploration performed and may need to be modified once field explorations are completed (see Appendix 10). The majority of open trench construction will require shoring due to restricted construction work zones. The area around Aqua Hedionda Lagoon on the Blue and Green Alignments will require vertical trenching due to the proximity of the pipeline trench in relation to the existing high voltage electric transmission towers.

1.7.6 **Tri-Agencies Pipeline (TAP)**

The TAP was investigated to see if it could be used for a portion of the conveyance system. Investigations have determined that the pipeline does not have adequate hydraulic or pressure capabilities for the project. The analyses performed on the viability of using the TAP are included in Appendix 2.

1.8 **Pump Stations**

A life cycle cost comparison was made of one high-pressure pump station at the Encina Plant site versus two lower pressure stations, one at Encina and one in Carlsbad. The single pump station at Encina has a lower construction cost and lower energy costs because the power is purchased directly from the Encina Power Plant without added transmission and distribution costs.

The pump station(s) are planned to contain room for five 25 mgd pumps, four operating and one standby (see Appendix 6). Initially, just three pumps would be installed for the 50 mgd Encina Plant. The pump
motors would be 7,000 and 3,500 horsepower for the one and two station options. The Encina Power Plant site is very space constrained and therefore, vertical turbine pumps will likely be used since they require less space than typical horizontal pumps. The minimum overall site is approximately 2.5 acres. If the two-station option is selected, then three to four acres would be purchased for the second station and horizontal centrifugal pumps would likely be used, along with a storage reservoir located at an elevation approximately 100 feet higher than the second pump station. This reservoir would avoid the requirement for the deep structure required by the pumps to avoid cavitation. Building sizes for the vertical turbine and horizontal centrifugal pumps range from 14,000 to 29,000 square feet respectively, with heights from 40 to 70 feet depending on the type of pump and overhead crane selected. A 30-foot-deep basin is required for the vertical turbine pump columns. Forebay storage, to facilitate pump start-up and shut down and to buffer minor variations in flow between the treatment plant and the pumps, will be required. The pump station building will be constructed of concrete and/or masonry blocks and will be architecturally treated.

### 1.9 Water Quality

Water quality issues may favor delivering all the desalinated water to the Second Aqueduct where it can be blended with imported water prior to retail delivery. Although the water quality characteristics of desalinated water will be very good, the water will have taste and other aesthetic characteristics that differ from those of the Water Authority’s existing imported water supply. The blend ratio of desalinated water to Aqueduct water will change as local water use changes and this could result in changes in the aesthetic quality of the consumers’ tap water.

Water quality issues have emerged from case studies of projects where new source water was introduced into existing potable water systems. One such issue is the compatibility of the product water on existing plumbing piping. A situation arose in the service area of the Washington Suburban Sanitary Commission (WSSC) in Maryland where the new source water was corroding the copper piping in residences causing leaks and health hazards and leading to legal action.¹ Other water quality issues are related to taste and aesthetics. In the City of Tucson, although not a health threat, when a new source water was provided, the residents received a reddish colored water from their taps, which was very upsetting to that water district’s customers.²

**References:**

2. [http://ag.arizona.edu/swes/tucwater1/cap.htm](http://ag.arizona.edu/swes/tucwater1/cap.htm)

These issues can be significantly reduced by appropriate conditioning at the Encina Plant and/or by blending the Encina Plant’s product water into the existing supply prior to distributing it to member agencies. The Water Authority will develop water quality performance criteria that the Encina Plant will
Chapter 1 – Executive Summary

have to meet to make the desalinated water more compatible with the Metropolitan Water District water they currently receive. At a minimum, these criteria will include all drinking water regulations, aesthetic requirements, corrosion control requirements, and may include other criteria for agricultural and industrial uses. The Encina Plant can then be designed to meet these criteria.

In upcoming phases of DWCF project, expert and lay person panels will be set up to assess the taste and odor characteristics of Metropolitan and desalinated water using standard methods known as Flavor Profile Analysis (FPA). The results of the FPA will be used to determine the treatment approach and also determine acceptable blends for distribution to member agencies. The future phases will also include corrosion pipe loop testing to fine-tune the conditioning for corrosion protection. Frequent monitoring of constituent levels, and comparison to regulations and guidelines, will be implemented for better planning, detection and resolution of water quality issues before they become a health or economic concern. Water quality issues are detailed in Appendix 3 and summarized in Chapter 6 of this report.

1.10 Second Aqueduct Facilities and Hydraulic Transient Analysis

An investigation was made of the facilities that will be needed to connect and integrate the operations of the DWCF with the Second Aqueduct. Options were developed to put desalinated water directly into the Aqueduct pipelines and to pump all the desalinated water to the Twin Oaks Diversion Structure (TODS) in northern San Marcos for blending before distribution. Several meetings were held with Water Authority Engineering and Operations staff to review the issues associated with integration. Some of the facilities required are for the control of hydraulic transients, or surges, that occur when there is a sudden change in flow, such as when a pump station shuts off unexpectedly. This shut off can occur, for example, when there is a power interruption at the pump station.

The Aqueduct pipelines have a number of flow control facilities on them that meter flow out to the member agencies. Depending on the option selected, these facilities may need to be modified or moved. It became apparent as Second Aqueduct issues were studied that detailed investigations into the configuration and operation are required. The investigations completed on the Second Aqueduct and included in Chapter 7 of this report are very preliminary. The facilities required for integration of the DWCF with the Second Aqueduct may be significant and further in-depth analysis is essential.

1.11 Geotechnical Investigation and Phase I Environmental Assessment

A brief geotechnical review was performed (see Appendix 10) that identified the following potential hazards: groundwater, collapsible soils, liquefaction, and hard rock that may require blasting. It is expected that all of these factors can be addressed during final design. A Phase I Environmental Site Assessment (see Appendix 11) was also preformed. While a number of sites were identified and
mitigation may be necessary, it does not appear that any of them would preclude the project. Every effort will be made to avoid hazardous materials in alignment selection and design.

1.12 Environmental Screening and Permits

The project’s environmental document will include both the Encina Plant and the DWCF as one project. While this may be advantageous from a California Environmental Quality Act (CEQA) standpoint, it does raise some permit issues. This will cause the resource agencies to consider both the treatment plant and the conveyance facilities as a “single and complete” project. They will require that one permit be issued that includes both facilities. Since the owner of the treatment plant will have primary permit responsibility and the affected DWCF components will have to be included in their permit applications, this creates a level of difficulty in attaining these permits.

The Blue and Green alignment are in close proximity to Aqua Hedionda Lagoon and cross the Aqua Hedionda Creek north of El Camino Real and on Cannon Road. The following resource agency permits are anticipated to be required on the alignments: U.S. Army Corps of Engineers Section 404, U.S. Fish and Wildlife Section 10, California Coastal Commission, Regional Water Quality Control Board Section 401 Water Quality Certification, and the California Department of Fish and Game 1601 Streambed Alteration Agreement (reference Chapter 9 of this report and Appendix 5). Other permits, reviews, and approvals may include:

- Caltrans Encroachment Permit.
- Cal-OSHA Excavation Permit.
- Cal-OSHA Tunnel Classification.
- State Water Resources Control Board Compliance with General Stormwater Order.
- County of San Diego Well Drilling Permit (for geotechnical borings).
- North County Transit Development Board License Agreement and Right of Entry Permit.
- Regional Water Quality Control Board Groundwater Dewatering Permit.
- Regional Water Quality Control Board Hydrostatic Pipe Testing and Disinfection Discharge Permit.
- City of Carlsbad, Vista and San Marcos Agreements.
- Agreements with Utility Owners.
Chapter 1 – Executive Summary

1.13 Cost Estimates

1.13.1 Introduction

The project team has produced preliminary cost estimates for each of the DWCF alignment alternatives. The estimates include capital costs, annual costs for operation and maintenance, and unit costs of water delivered by each alternative alignment system.

The preliminary cost estimates prepared for the DWCF project have been made at approximately the “Budget Estimate” level of detail, and as such are likely to be accurate on an absolute basis to within a range of +30 to –15 percent. More definitive estimates will require the development of detailed design plans as part of the final design phase of the project.

On a comparative basis, the project team anticipates that the cost estimates accurately differentiate costs of the different alignments to within approximately 3 percent of total cost. Cost differences among the alignments of more than this amount should be considered significant for purposes of planning and alignment selection (reference Appendix 8).

1.13.2 Background – Project Cost Evolution

When first proposed in the 2001 Poseidon report for the City of Carlsbad, the DWCF facilities were defined in concert with a 10 to 25 mgd desalination plant, and consisted of a modest pump station sharing the same site as the proposed desalination plant, a pipeline connection to Carlsbad’s Maerkle Reservoir, and various distribution improvements within the cities of Carlsbad and Oceanside. The 2001 Poseidon report also offered a conceptual sketch of what might be required to upsize the project to 50 mgd. The concept presented called for approximately half the water to be consumed in Carlsbad and Oceanside, and the remainder to be delivered to the Second Aqueduct by means of the Water Authority’s existing Tri-Agencies Pipeline.

During the course of the investigations presented in this report, the DWCF facilities have evolved to be significantly more extensive, and more expensive, than those presented in the 2001 report. The more detailed analyses prepared as part of this work have now shown for example that the DWCF pipeline will need to travel not five miles to Maerkle Reservoir, but almost 10 miles to the Second Aqueduct (to accommodate the 50 mgd). The analysis has also determined that the project pipeline should be upsized to allow for possible future expansion of the desalination plant and avoid future disruptions to the local community. These and other changes now show that the earlier concept cost estimates of the 2001 report were overly optimistic.
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1.13.3 Capital Costs

The study has estimated capital costs for each component of each alignment, and for each alignment as a whole. Capital costs are reported both as construction costs, and as total project costs, where the latter includes mark-ups for project design and administration, environmental mitigation, and related owner costs.

Table 1.13.3-1 presents total construction and total capital costs for the three primary DWCF alignments. These costs are for a 50 mgd, single-pump station configuration. Additional cost tables presenting data for all twelve of the primary and combination alignments are presented in Chapter 10.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>ALIGNMENT:</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>LENGTH:</td>
<td>Blue</td>
<td>Green</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ft</td>
<td>ft</td>
<td>ft</td>
<td></td>
</tr>
<tr>
<td>Pipeline Construction Costs</td>
<td>$57,760,000</td>
<td>$48,350,000</td>
<td>$50,300,000</td>
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<tr>
<td>Tunnel Construction Costs</td>
<td>$14,940,000</td>
<td>$13,850,000</td>
<td>$14,500,000</td>
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<td>Pipeline Right of Way</td>
<td>$9,120,000</td>
<td>$4,590,000</td>
<td>$4,900,000</td>
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<tr>
<td>Pump Station</td>
<td>$27,700,000</td>
<td>$27,700,000</td>
<td>$27,700,000</td>
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<tr>
<td>PS Right of Way @ $1,000,000 per acre</td>
<td>$2,500,000</td>
<td>$2,500,000</td>
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</tr>
<tr>
<td>Aqueduct Connection and PCF</td>
<td>$6,000,000</td>
<td>$6,000,000</td>
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</tr>
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<td>Aqueduct Storage (allowance)</td>
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<td>Aqueduct Modifications (allowance)</td>
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<tr>
<td>Subtotal</td>
<td>$138,000,000</td>
<td>$123,000,000</td>
<td>$125,100,000</td>
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<tr>
<td>Contingency @ 15%</td>
<td>$20,700,000</td>
<td>$18,500,000</td>
<td>$18,800,000</td>
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<td>Subtotal (Total Construction Costs Current Dollars)</td>
<td>$158,700,000</td>
<td>$141,500,000</td>
<td>$143,900,000</td>
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<td>Design &amp; Admin @ 25%</td>
<td>$39,700,000</td>
<td>$35,400,000</td>
<td>$36,000,000</td>
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</tr>
<tr>
<td>Environmental Mitigation @ 2%</td>
<td>$3,200,000</td>
<td>$2,800,000</td>
<td>$2,900,000</td>
<td></td>
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<tr>
<td>Total Capital Current Dollars</td>
<td>$201,600,000</td>
<td>$179,700,000</td>
<td>$182,800,000</td>
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</tr>
<tr>
<td>Escalation to Mid-Point of Construction (August 2007) @ 9.5%</td>
<td>$19,200,000</td>
<td>$17,100,000</td>
<td>$17,400,000</td>
<td></td>
</tr>
<tr>
<td>Total Capital Cost (Escalated to August 2007)</td>
<td>$220,800,000</td>
<td>$196,800,000</td>
<td>$200,200,000</td>
<td></td>
</tr>
<tr>
<td>Cost Increase in comparison to least cost alignment</td>
<td>$24,000,000</td>
<td>$0</td>
<td>$3,400,000</td>
<td></td>
</tr>
<tr>
<td>% Difference</td>
<td>12%</td>
<td>0%</td>
<td>2%</td>
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</tbody>
</table>

Table 1.13.3-1: Total Construction and Total Project Capital Costs – Primary Alignments, 50 mgd
1.13.4 Annual Operations and Maintenance Costs

The project team has analyzed two components of annual costs for project operations and maintenance: 1) energy costs, and 2) other operations and maintenance costs. Energy costs are by far the largest component of annual operations and maintenance costs for the project. The study has calculated energy costs based on an assumed electrical energy rate of $0.06 per kilowatt-hour (kWh) at the Encina pump station, and $0.086/kWh for the second pump station. These assumed rates have been developed by the Water Authority as described in Appendix 2. The analysis assumes that power purchase agreements with Cabrillo Power (the Encina power plant owner) will provide lower rates than would be available through retail purchase outside the Cabrillo property line.

Table 1.13.4-1 below shows a summary of operations and maintenance costs by alignment for a 50 mgd system. (1) Assumes a plant capacity factor of 95%, a pump efficiency of 80%, and a Total Dynamic Pumping Head of 1000 ft (2) Energy Cost is based on $0.06/kWh:

<table>
<thead>
<tr>
<th>Alignment Number and Color Guide</th>
<th>Energy Costs</th>
<th>Other O&amp;M Cost</th>
<th>Total Annual O&amp;M Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual Energy Consumption (1)</td>
<td>Energy Cost (2)</td>
<td>(@ 1% of Total Project Cost)</td>
</tr>
<tr>
<td>1</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,200,000</td>
</tr>
<tr>
<td>1A</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,100,000</td>
</tr>
<tr>
<td>1B</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,100,000</td>
</tr>
<tr>
<td>2</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2A</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,100,000</td>
</tr>
<tr>
<td>2B</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2C</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2D</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$1,900,000</td>
</tr>
<tr>
<td>3</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>3A</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$1,900,000</td>
</tr>
<tr>
<td>3B</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,200,000</td>
</tr>
<tr>
<td>3D</td>
<td>74,900,000 kWh/yr</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
</tbody>
</table>

1.13.5 Total Equivalent Annual Costs / Unit Cost of Water Delivered

Total equivalent annual costs were calculated as the sum of annual operations and maintenance costs, plus amortized capital costs. The study has calculated amortized capital costs based on an assumed interest rate of 5.5 percent per year, as set by the Water Authority.
Unit costs of water delivered were calculated as the total equivalent annual costs, divided by the total annual flow (in acre-feet) of the system. The unit costs are those of the DWCF project only, and do not include costs construction and operation of the desalination plant.

Table 1.13.5-1 below shows a summary of total equivalent annual costs and unit costs of water conveyed, by alignment, for a 50 mgd project. (1) Assumes operations at 50 MGD with a 95% plant capacity factor:

<table>
<thead>
<tr>
<th>Alignment Number and Color Guide</th>
<th>Total Project Capital Cost</th>
<th>Ammortized Capital Cost (30 yrs, i = 5.5%)</th>
<th>Total Annual O&amp;M Cost (@ 1% of Capital)</th>
<th>Total Equivalent Annual Cost (@ 53,000 AF/yr)</th>
<th>Unit Cost of Conveyance ($) /Acre-Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$220,800,000</td>
<td>$15,200,000</td>
<td>$6,700,000</td>
<td>$21,900,000</td>
<td>$413</td>
</tr>
<tr>
<td>1A</td>
<td>$209,700,000</td>
<td>$14,400,000</td>
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<td>$21,000,000</td>
<td>$396</td>
</tr>
<tr>
<td>1B</td>
<td>$209,800,000</td>
<td>$14,400,000</td>
<td>$6,600,000</td>
<td>$21,000,000</td>
<td>$396</td>
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<tr>
<td>2</td>
<td>$196,900,000</td>
<td>$13,500,000</td>
<td>$6,500,000</td>
<td>$20,000,000</td>
<td>$377</td>
</tr>
<tr>
<td>2A</td>
<td>$214,700,000</td>
<td>$14,800,000</td>
<td>$6,600,000</td>
<td>$21,400,000</td>
<td>$404</td>
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<tr>
<td>2B</td>
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<td>$13,500,000</td>
<td>$6,500,000</td>
<td>$20,000,000</td>
<td>$377</td>
</tr>
<tr>
<td>2C</td>
<td>$196,400,000</td>
<td>$13,500,000</td>
<td>$6,500,000</td>
<td>$20,000,000</td>
<td>$377</td>
</tr>
<tr>
<td>2D</td>
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<td>$6,400,000</td>
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<td>$368</td>
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<td>3</td>
<td>$200,200,000</td>
<td>$13,800,000</td>
<td>$6,500,000</td>
<td>$20,300,000</td>
<td>$383</td>
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<tr>
<td>3A</td>
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<tr>
<td>3B</td>
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<td>$6,700,000</td>
<td>$21,500,000</td>
<td>$406</td>
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<td>$13,500,000</td>
<td>$6,500,000</td>
<td>$20,000,000</td>
<td>$377</td>
</tr>
</tbody>
</table>

1.14 Project Schedule

From 2004 through 2005, the Water Authority will be completing the EIR and conducting a public information and outreach program. Preliminary design activities are anticipated to continue during this time. Right of way acquisition is scheduled for most of 2005 and into early 2006. Final design will be completed in late 2005 and bidding and construction is scheduled for 2005 through 2008. Further detail is provided in Chapter 11 and Appendix 8.
1.15 Evaluation Criteria and Community Involvement

The selection of the preferred alignment will be made based on the scoring criteria included in Chapter 12 of this report. The Water Authority is intending, through a Public Outreach Program, to involve stakeholders (homeowners, businesses, politicians, interested parties, etc.) in the alignment selection and scoring process. The intent of the Evaluation Criteria is for the preferred alignment to be selected based upon quantitative, rather than qualitative measures. This type of selection process allows many different types of considerations to be evaluated and rated fairly. Careful consideration of the information contained in this Report and the Appendices is essential before scoring the project alignments, as there are many factors involved.

1.16 Steps Leading to the Production and Distribution of Desalinated Seawater

In addition to the activities described in the project schedule, a value engineering study will be conducted in 2004, as will the water quality testing on corrosion and aesthetics. Teams of independent experts will be assembled to review the pipeline and pump station and overall planning aspects of the project in a weeklong session. The experts will provide input on how to improve the project and reduce costs.

Once the Water Authority and Poseidon Resources have negotiated the terms of their agreement for the purchase of the desalinated water, Poseidon will proceed to bid an engineering, procurement, construction, and possibly operation contract for the plant. Once constructed, the Plant will undergo extensive start-up testing and certifications through the State of California Department of Health Services.

Throughout all of the activities, the Water Authority will maintain close coordination with the City of Carlsbad.
Chapter 2 – Introduction

2.1 Overview

The Water Authority is a public agency serving the San Diego region as a wholesale supplier of water. The Water Authority is responsible for supplying and delivering a safe and reliable water supply to its 23 member agencies, comprised of the cities and water districts in San Diego County. The Water Authority delivers both raw water, for those agencies that have their own treatment plants, and treated water (potable), to those without that capability. Currently, the Water Authority purchases its water from the Metropolitan Water District of Southern California (Metropolitan). This water is delivered to Water Authority member agencies through 5 large diameter pipelines (aqueducts) that stretch from Riverside County to the Mexican border. Pipelines 1 and 2 are in an eastern corridor known as the First Aqueduct and Pipelines 3, 4 and 5, known as the Second Aqueduct, are further west. Generally, Pipelines 3 and 4 deliver treated water, while Pipeline 5 delivers raw water.

Diversifying their water supply has been a critical component in the Water Authority’s long-term planning efforts. In a recent master plan, the Water Authority concluded that a portion of the County’s future water supply would be from desalinated seawater. Since 1991, they have closely studied the development of seawater desalination facilities and due to significant improvements in treatment technology and reductions in cost, the Water Authority is developing a project known as the Seawater Desalination Plant at Encina. This project includes a desalinated water treatment plant that will convert seawater to potable (drinking) water and the conveyance facilities to deliver the water to users. The plant will be initially sized at 50 mgd, with provisions built in to expand it to 75 or 100 mgd, as warranted by future demands. Scheduled for completion in 2008, the plant will operate at full capacity year-round, which means that the distribution point(s) must be capable of receiving the full 50 mgd of desalinated water delivered by the conveyance facilities. As a supply of 50 mgd is much greater than needed by local customers (Carlsbad, Oceanside, etc.), either the excess water, or all of the 50 mgd, must be delivered to the Water Authority’s Second Aqueduct where it can be absorbed into the regional system and distributed to a larger group of customers.

Conveyance to the Second Aqueduct requires pump stations and pipelines to be built and these facilities are the subject of this investigation report. The pump stations must be capable of lifting the water from approximately sea level, to a hydraulic elevation of 1,200 feet, at the Second Aqueduct. The preliminary pipeline diameter is 60 inches and the length is nearly 10 miles.

2.2 Chapter Outline

2.3 DWCF Study Area
2.4 Purpose and Approach
2.5 Authorization and Scope of Work
2.6 Pipeline Alignments and Stakeholders
Chapter 2 – Introduction

2.3 DWCF Study Area

The study area is located in the north coastal area of San Diego County and includes the cities of Carlsbad, Oceanside, Vista and San Marcos, and unincorporated areas of the County bounded by the Pacific Ocean on the west and the Second Aqueduct to the east, as shown in Figure 2-1. The Encina Plant site is located on Encina Power Station property owned and operated by Cabrillo Power I LLC. Poseidon Resources Corporation (Poseidon) has an existing contractual relationship with Cabrillo that gives them exclusive rights to develop a seawater desalination facility at the Encina Power Station site. The Water Authority is negotiating treatment plant construction details with Poseidon.

2.4 Purpose and Approach

The purpose of this study is to investigate the feasibility of alternative alignments between the Encina Plant and the Second Aqueduct, along with developing the technical requirements for integrating the desalinated seawater into the regional supply system. A secondary, but important purpose, is to advance the engineering work so that after alignment selection, the design can proceed efficiently. This report provides the results of the investigations performed, to inform the stakeholders, support the EIR and the Water Authority’s public outreach program, and facilitate the alignment selection process.

The engineering work was completed by three independent, but continuously coordinated, teams to expedite progress. The engineering team coordinated and supported the environmental team, the public information program, and coordinated with local agencies. The approach used in developing alignment alternatives was to meet the following project goals:

- Develop a minimum of three alternative alignments for delivering water from the Plant to the final drop off point at the Second Aqueduct.

- Control construction costs and limit the size and number of structures.

- Identify alignments that are constructible.

- Minimize environmental impacts to the maximum extent practicable.

- Minimize community disruptions to the maximum extent practicable.
Integrate the project with local agency facilities to the maximum extent practicable.

Thoroughly investigate the project options and present findings in a manner that will allow informed decisions to be made by others.

Develop information for the various stakeholders (includes general public and public agencies within the cities of Carlsbad, Vista, San Marcos and Oceanside) to use in selecting a preferred alignment for the Desalinated Water Conveyance Facilities.

2.5 Authorization and Scope of Work

Boyle/PBS&J was contracted with by the Water Authority to provide engineering planning and design services in support of the DWCF project. By Notice to Proceed dated June 25, 2003, the Water Authority authorized Boyle/PBS&J to begin work on Phase 1 of the project. The Phase I contractual scope of work is summarized below with the process shown graphically in Figure 2-2.

Alternatives Formulation/Evaluation. Determine how much water the cities of Carlsbad and Oceanside could commit to take, if the TAP could be used to convey desalinated water to the Second Aqueduct, and formulate various alignments to fulfill stakeholder goals (reference Appendix 2).

Water Quality Investigations. The investigations included reviewing literature and identifying the issues associated with blending two good quality but different water supplies, and specifying the target levels of the various water quality constituents for the treatment plant product water. The results are contained in the “Carlsbad Desalination Pipeline Integration Project” (see Appendix 2).

Pipeline Alignment Investigations. The work performed on this task consisted of field investigations, collecting and reviewing existing utility record drawings, establishing pipeline design criteria, alignment descriptions, schedules and cost estimates. Technical Memoranda prepared for this task included the “Pipeline Design Criterion Technical Memorandum” (see Appendix 4) and the “Pipeline Preliminary Design Technical Memorandum” (see Appendix 5).

Pump Station Investigations. In this task, an economic comparison was made of one high-pressure pump station versus two lower pressure stations. Major pump suppliers were contacted to gather design information on the pumps, which will be custom designed and constructed specifically for this project. Conceptual designs were developed and design criteria assembled. Transient (surge) analysis was performed. These investigations are contained in the “Pump Station Design Criterion Technical Memorandum” (see Appendix 6).
CARLSBAD DESALINATED WATER CONVEYANCE FACILITIES
PHASE I ENGINEERING FLOW CHART

- PROJECT INITIATION

PHASE I ENGINEERING

- SYSTEM FORMULATION & EVALUATION
- WATER QUALITY INVESTIGATIONS
- PIPELINE ALIGNMENT & PUMP STATION
- SITE INVESTIGATIONS
- RIGHT-OF-WAY REQUIREMENTS
- GEOTECHNICAL INVESTIGATION

- BASIS OF DESIGN AND DESIGN CRITERIA

COORDINATION

- ENVIRONMENTAL IMPACT REPORT
- PUBLIC INFORMATION AND OUTREACH
- AGENCY COORDINATION

ALIGNMENT INVESTIGATION REPORT

- VALUE ENGINEERING
- DESIGN
- CONSTRUCTION
Right-of-Way Requirements. For each of the three main alignments, the requirements for temporary construction and permanent easements were determined. Detailed discussions of the right of way issues are included in the “Right of Way Requirements Technical Memorandum” (see Appendix 13).

Environmental Coordination. The engineering team met with and provided engineering support to the Water Authority’s consultant who will be preparing the EIR for the project in compliance with CEQA. Available information on environmental constraints (biology, cultural resources, land use, noise, traffic, permitting) and/or issues was obtained from the consultant and other available sources for use in developing the alignment alternatives to minimize impacts. This information has been incorporated into this report. A noise study, “Acoustical Constraints Screening Assessment Phase I,” (Appendix 14) and traffic study, “Preliminary Transportation Evaluation,” (Appendix 9) were also prepared for this project.

Preliminary Geotechnical Investigation. Existing information on the regional soils, geology and geotechnical issues was collected, reviewed, and evaluated as it relates to pipeline and pump station design. A Phase I Environmental Site Assessment was prepared to identify potential sources of hazardous materials. The complete investigations are contained in the “Preliminary Geotechnical Report” (Appendix 10) and the “Abbreviated Phase I Environmental Site Assessment” (Appendix 11).

Value Engineering. A panel of five independent experts is planned to be assembled for a four-day structured review process of the studies performed to provide suggestions for improvements. The results will be presented in a “Value Engineering Study Report.”

2.6 Pipeline Alignments and Stakeholders

There are an infinite number of ways to route a pipeline from the Encina Plant to the Second Aqueduct. A large number of alternatives were identified initially and these were refined down to three main alternatives through a systematic screening process described later in this report. Through many years of pipeline planning and construction, the Water Authority has found that placing the pipelines in or adjacent to public rights of way is the best approach. It generally offers the most expedient process, avoids environmentally sensitive areas, and is the least costly. Acquisition of new right of way across privately held lands could potentially require more time than is available. Use of public rights of way generally means placing the pipeline within streets, adjacent to the various other utilities normally found in streets such as water, sewer, gas, electric, and communications facilities.

However, construction in streets does cause impacts to the various stakeholders, which requires careful consideration and mitigation where possible. In some cases, the mitigation is already included as a part of the alternative alignment. Examples include tunnels under Interstate 5 and the railroad, and avoidance of Cannon Road and Palomar Airport Road in the vicinity of Interstate 5 to eliminate major traffic impacts of pipeline construction. The alternatives in this report combine mostly public rights of way with some new private easements and special features to avoid the most severe impacts of construction.
There are many stakeholders in this project with a wide variety of special interests. The residents are concerned about high-quality and reliable drinking water and the impact to their lives from construction, such as temporary traffic delays. They will be concerned about safety during construction, and sensitive areas, such as schools. The business community is also concerned about the temporary traffic delays and the impacts on their customers and business. Some of the high-tech businesses have onsite treatment plants to produce ultra-pure water for their research and manufacturing activities. What will be the quality of the new water source and will there be a need to adjust their treatment?

The cities of Carlsbad, Oceanside, Vista, and San Marcos will want their procedures and criteria followed, the proper permits obtained, safe construction, minimized traffic impacts, preservation of existing utilities and structures, and a variety of other things. The alternative alignments use some very heavily traveled streets such as Cannon Road, El Camino Real, Faraday Avenue, and Palomar Airport Road. People living within and outside of Carlsbad use these routes to travel to and from work and they will be concerned about temporary traffic delays. Cabrillo Power, the owner/operator of the Encina Power Plant will be interested in land use issues, integration with power plant facilities, and security. To the Water Authority the project helps fulfill its mission of a safe and reliable water supply. In accomplishing their mission, they want to determine the most cost-effective alternative that meets the needs of these various stakeholders.

2.7 EIR, Public Outreach, and Alignment Selection Process

This project must comply with CEQA and as such, the Water Authority is preparing an EIR. A draft EIR is scheduled for release for public comment in 2005, with a possible Water Authority’s Board of Directors action in late 2005. The comments received will be addressed and published.

Concurrently, the Water Authority will conduct a public outreach process consisting of more than 30 small group meetings, one meeting each with staff of Carlsbad, Oceanside, Vista, and San Marcos, an elected officials workshop, and four public open house workshop type meetings. A speaker’s bureau will be established to make project presentations at already scheduled meetings of various local groups. Informational newsletters will be published bi-monthly and the Water Authority will provide support for feature stories in the local newspapers. The goal of this outreach is to make the pipeline alignment decision-making process transparent while minimizing negative project impacts to the extent possible. All input will be summarized and considered.

The Water Authority’s Board of Directors will consider the EIR and the input provided through the public outreach program, select an alignment or provide other direction, and decide on certification of the EIR in 2005.
2.8 Overall Project Schedule

A summary schedule is shown in Figure 2-3. The project design is scheduled to be completed in late 2005 with construction completed in 2008. An accelerated schedule is also included as Figure 2-4.

2.9 Report Format and Content

The following chapters present the important findings from the detailed studies and reports prepared for the DWCF:

**Local and Regional Treated Water Demands.** Identifies the water use, or demands, of the local agencies and regional Aqueduct system. Highlights that the Encina Plant will produce water 24 hours a day, 365 days per year and therefore, firm usage of the water must be defined. Shows that the pump station and pipeline facilities need to be sized for the entire treatment plant flow.

**Pipelines.** Describes the long list of alternatives, the three short listed alternatives, and the procedure used to arrive at the shortlist. Describes the pipeline features including alignment descriptions, tunnels, right of way requirements, and design criteria.

**Pump Stations.** This chapter describes and compares the alternatives of using one high-pressure pump station or two lower pressure stations. It also describes the key components of the stations including architecture.

**Water Quality.** Discusses the anticipated water quality, taste considerations, approaches to blending with the existing supplies, avoidance of corrosion, and future studies including flavor profile analysis and corrosion pilot testing.

**Second Aqueduct Facilities.** Preliminarily describes potential connection points, operational considerations, and the resulting water qualities. Describes the facilities required to protect the Aqueduct facilities from the surges that result from sudden pump station shut off, for example, in a power failure. Also discusses methods to maintain deliveries to member agencies in the event of a pump station shut off, through the use of storage.

**Geotechnical and Phase I Environmental Assessment.** Discusses the regional soils and geology and their affect on construction. Describes potential hazardous materials sites within the study area.

**Environmental Screening and Permits.** Provides general land uses and jurisdictional boundaries, preliminary environmental assessments, and the permits that will potentially be required to construct the project.
Chapter 2 – Introduction

**Construction Cost Estimates and Schedule.** Preliminary estimates of the construction and associated costs for each alternative. Presents a preliminary schedule of major activities.

**Potential Methods to Evaluate Alternatives.** Provides some of the key considerations in selecting the preferred alternative.

**Next Steps.** Lists the preliminary and final design activities that follow alignment selection, leading up to construction.
<table>
<thead>
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<th>2006</th>
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</tbody>
</table>

**Note:** All tasks consistent with SDCWA schedule dated 11/21/03 except 50% design starts 2 months later, before the start of right of way acquisition and Board Certification of the EIR. 100% design starts 5 months later, after Board Cert. of the EIR.
Chapter 3 – Local and Regional Treated Water Demands

3.1 Purpose and Approach

This chapter describes the location and magnitude of local and regional water demands, and the ability of member agencies to receive projected deliveries of desalinated water. Where these demands are located is important because the DWCF pipeline alignment must be configured to reach areas where the desalinated water plant’s full supply can be delivered on a year-round reliable basis.

As used in this report, the term “local demands” refers to the amount of desalinated water that can be delivered directly into a water agency’s potable (drinking) water distribution system by the DWCF pipeline. The term “Regional demands” refers to treated water demands served from the Water Authority’s aqueduct system to their member agencies.

3.2 Chapter Outline

This chapter is organized as follows:

3.3 Key Assumptions
3.4 Local Agency Demands
3.5 Regional Water Demands
3.6 Conveyance System Configuration to Serve City Demands
3.7 Summary

3.3 Key Assumptions

The following key demand assumptions were provided by the Water Authority based upon information known about the future operation of the Desalination Plant, as follows:

- The Desalination Plant will initially operate at a near-constant flow of 50 mgd year round.

- The demand analysis must account for the delivery of 50 mgd during minimal demand periods (meaning that there will be no flow adjustments at the plant and all 50 mgd will be delivered to the DWCF pipeline daily).

- The Desalination Plant was assumed operational in year 2007; and therefore, year 2007 demand forecasts were reviewed.
3.4 Local Agency Demands

To determine local demands the project team reviewed water agency master plans and worked with local agencies to confirm demand assumptions and projections, and in particular, to quantify firm and reliable low month and/or winter demands. Carlsbad, Oceanside, Vista Irrigation District (VID) and Vallecitos Water District (VWD) were the primary local agencies considered. Previous investigations by the Water Authority had ruled out more distant water agencies due to the cost of extending facilities and other factors.

The demand analysis for each member agency included quantifying the delivery points and location of these points relative to hydraulic elevation, to minimize pumping and energy costs and optimize construction costs for the conveyance system (DWCF). In order to maximize supply opportunities, in some cases, local agency improvements would be necessary for them to sufficiently distribute the desalinated water to their customers. Figure 3-1, Demand Analysis, schematically summarizes the potential ranges of local agency and regional water demands (i.e., the distribution path for 50 mgd of desalinated water).

3.4.1 City of Oceanside Demands

As shown in Figure 3-1, the range of potential demands and specific delivery locations that could be served by the Encina Plant to Oceanside are illustrated. Oceanside maintains a mix of supply that includes the Weese Water Treatment Plant, Mission Basin Desalter, and treated water connections to the Water Authority’s North County Distribution Pipeline and TAP. Projected year 2007 average annual demands are about 30 mgd. Winter demands in Oceanside are about 50 percent of average demands, or about 15 mgd. Part of their demand is supplied by the City’s Mission Basin Desalter plant that produces potable water. Oceanside has plans to expand the facility to a capacity of 6 mgd in the near future. Oceanside believes that that facility could ultimately be expanded to a capacity of 10 or 12 mgd. After factoring in Mission Basin Desalter water deliveries, the firm winter month demands that could be supplied by DWCF desalinated water would be approximately 9 mgd in 2007, and potentially less if the Mission Basin Desalter is further expanded.

The closest Oceanside connection point to the DWCF alignments is at Oceanside’s TAP connection. This serves a small portion of the southerly area of the city and could potentially absorb 1 to 2 mgd of desalinated water supply during winter demand. Delivery of the remaining 7 to 8 mgd of water (from the total 15 mgd winter demands capacity) would require construction of a pipeline to the northwest portion of Oceanside, near the intersection of North Santa Fe Avenue and Melrose Drive. Cost analysis conducted during the Coarse-Screening Phase of the project (see Appendix 2, Coarse Screening Technical Memorandum) demonstrated that the cost of these facilities would be significantly greater than the incremental costs of facilities to move to same increment of water to the Second Aqueduct. Consequently, this option was dropped from further consideration. The only Oceanside demands still...
THE WATER AUTHORITY’S SEAWATER DESALINATION PROJECT - DEMAND ANALYSIS

50 MGD-YEAR 2007
WATER AUTHORITY’S SEAWATER DESALINATION PLANT

CITY OF CARLSBAD
0-10 MGD

- Connection To Tri-Agencies Pipeline Carlsbad No. 3
  - 4-5 MGD Maerkle Reservoir

- Connection To Tri-Agencies Pipeline Carlsbad No. 4
  - 1 MGD Calavera Hills

- Connection To Second Aqueduct Carlsbad No. 1
  - 4-6 MGD Palomar Airport Rd/ La Costa High

CITY OF OCEANSIDE
0-10 MGD

- Connection To Tri-Agencies Pipeline Oceanside No. 4
  - 1-2 MGD San Francisco Peak

- Connection To N. Santa Fe/Melrose 42” Pipeline
  - 8-9 MGD City-North Area

- Connection To SDCWA Second Aqueduct
  - 30-50 MGD SDCWA Pipeline No 4

SDCWA
30-50 MGD

NOTE: ULTIMATE DEMAND ANALYSIS FOR PLANT CAPACITY OF 100 MGD AT YEAR 2015 WILL INCREASE BY 50 MGD OF SUPPLIED WATER TO SDCWA SECOND AQUEDUCT.

Desalinated Water Conveyance Facilities Alignment investigation Report

Figure 3-1 Demand Analysis
considered at this phase of the analysis are the 1 to 2 mgd demands now served by the City's TAP connection.

### 3.4.2 City of Carlsbad Demands

Figure 3-1 also illustrates the range of potential demand ranges and specific delivery locations that could be served by the Encina Plant to Carlsbad. Carlsbad’s current water supply is predominately imported treated water from connections on the Second Aqueduct and TAP. Their projected average annual demands for the year 2007 are approximately 20 mgd. Historically, their minimum or winter demands are less than 50 percent of an average day. Therefore, potential firm demands from the desalinated water plant are no more than 10 mgd. Approximately 4 to 5 mgd of this demand could be served via direct DWCF deliveries to Maerkle Reservoir. The remaining 5 to 6 mgd of their 10 mgd demand would need to be served to higher elevation zones (700 North, 700 South, and the 520 Zone) within the City and this may require additional distribution pipelines to be built, depending on the preferred conveyance pipeline alignment.

### 3.4.3 Vista Irrigation District (VID)

VID has limited potential to receive firm deliveries of desalinated water due to their mix of water supply, which includes both imported and local waters. During the low-demand winter months, VID has the potential to be served solely by local water, making desalinated water a less attractive source.

### 3.4.4 Vallecitos Water District (VWD)

Most of the VWD service area is east of the Second Aqueduct, which makes direct deliveries impractical.

### 3.4.5 Water Quality Considerations

Although the water quality characteristics of desalinated water will be very good, the water will have taste and other aesthetic characteristics that differ from those of the Water Authority’s existing supply of imported water. As long as the blend ratio of desalinated water at the tap changes gradually over a period of weeks or months, the change in the aesthetic characteristics of the water is unlikely to be of significant concern or even noticeable to most consumers. However, rapid and severe changes in the blend ratio of delivered water may be perceived negatively by many customers. These rapid changes could occur due changes in consumer use during periods of peak water use. DWCF can only deliver a constant flow. This flow will be sized for the minimum demand that the local agency can positively commit to receive. When consumer use goes above the amount supplied by DWCF, Aqueduct water will pick up the difference, thereby causing a blend in the two waters. This also affects Second Aqueduct
water users outside of the zones directly fed by DWCF because the blend ratio of desalinated water to Aqueduct water will vary as water use in Carlsbad fluctuates. These concerns could be minimized by avoiding direct deliveries of desalinated water to local agencies, and instead delivering all of the desalinated water to the Second Aqueduct, where it could be blended with imported water prior to delivery to retail customers.

Because of the importance of this issue to the design and operation of the conveyance system facilities, the Water Authority plans to conduct a consumer tasting study of desalinated water in comparison to imported water and to different blends of desalinated and imported water. The study will be conducted concurrently with the public review process planned for 2004. The results of the study will help determine whether direct deliveries of desalinated water to local agencies are feasible.

Another water quality issue that may influence the feasibility of direct deliveries is the need for proper post-treatment conditioning of the water to reduce its corrosivity and to make it compatible with existing distribution systems and customer plumbing systems. The Water Authority plans to conduct pilot testing of desalinated water on different pipe materials to refine its understanding of these issues. The results of the study will help determine whether direct deliveries of desalinated water to local agencies are feasible. Water quality issues are addressed in more detail in Chapter 6.

### 3.5 Regional Water Demands

Regional water demands were summarized for the project team by the Water Authority, based upon information contained in their “Treated Water Enhancement Study” (June 2003). Pertinent results of that study are shown in Figure 3-2, which is reproduced from the Water Authority’s study. A critical finding of the Water Authority’s analysis is that sufficient demands exist south of the TAP connection to use the 50 mgd of desalinated water supplied by the Plant during a wintertime “minimum month” demand condition. Therefore direct deliveries to Carlsbad and Oceanside to meet the initial 50 mgd demand scenario is not absolutely necessary. However, desalination deliveries to the Second Aqueduct in excess of 50 mgd would require that the extra water be delivered either directly to local agencies, or north of the TAP connection which would require reconfiguring one of the Second Aqueduct treated water pipelines. Second Aqueduct facility improvements are described in Chapter 7.

### 3.6 Conveyance System Configuration to Serve City Demands

The DWCF must be configured to be able to reliably deliver 50 mgd of desalinated water year-round. Local demands available in Carlsbad and Oceanside could potentially absorb approximately 11 to 12 mgd. This means that a 50 mgd conveyance system would still need to have capacity to move 38 to 39 mgd of flow east to the Second Aqueduct, and a 100 mgd conveyance system would still need to have eastward capacity of 88 to 89 mgd.
Figure 3-2 Treated Water Demands

Note: Figure reproduced from San Diego County Water Authority Treated Water Enhancement Study Report (June 2003).

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<th>Section</th>
<th>2005</th>
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<td>2015</td>
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<tr>
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<tr>
<td>South of the Crossover</td>
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<td>2015</td>
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<td>79</td>
<td>88</td>
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<td>2010</td>
<td>2015</td>
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<td>60</td>
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Legend:
- **OTAY**
- WATER TREATMENT PLANT
- TREATED WATER PIPELINE

Note: Peak Demand = Peak Day Dry/Hot
Figure 3-2 illustrates potential locations for direct deliveries of desalinated water to maximize the use during low demand periods. Discussed below are specific delivery issues relative to all proposed conveyance pipeline alignments.

### 3.6.1 Conveyance to Oceanside

Of the perhaps 9 mgd of desalinated water that could be delivered to Oceanside, only a small portion of it is serviceable from the Blue Alignment (Oceanside's 1 to 2 mgd TAP demand could be directly served desalinated water). Service of this demand is not feasible from either the Green or the Orange alignments. Direct deliveries to Oceanside would also require construction of additional conveyance facilities and distribution system improvements before it would be able to fully accept desalinated water deliveries. The Blue Alignment could potentially be configured to deliver 1 to 2 mgd to Oceanside’s TAP connection that serves the southerly area of the city. However, even with the Blue Alignment, delivery of the remaining 7 to 8 mgd of water would require construction of a major conveyance system (potentially a pump station and pipeline) to the northwest portion of town, near the intersection of North Santa Fe Avenue and Melrose Drive.

Should the Blue Alignment be selected, and if water quality studies indicate that direct deliveries of desalinated water to customers are acceptable, then the Water Authority and Oceanside will coordinate during the final design phase of the project to determine the best approach to serving Oceanside’s TAP demands. Furthermore, through additional pipeline upgrades in Oceanside's system, the TAP connection supply may be marginally increased.

### 3.6.2 Conveyance to Carlsbad

Depending on which conveyance system alignment is selected for construction, delivery of 10 mgd of water to serve Carlsbad demands would require construction of various connecting pipelines and/or improvements to Carlsbad’s distribution system. For example, the Blue Alignment goes right past Maerkle Reservoir, and so connection facilities could be included with this pipeline to allow water to be delivered directly there. In comparison, the Orange Alignment travels closer to Carlsbad’s 700 Zones, and connection and delivery facilities could be included with this pipeline to allow direct deliveries to those zones.

Should water quality studies indicate that direct deliveries of desalinated water to customers are acceptable, and when an alignment is selected for construction, the Water Authority and Carlsbad could coordinate during the final design phase of the project to determine the best approach for serving Carlsbad’s available demands.
Chapter 3 – Local and Regional Treated Water Demands

3.7 Conclusions

Direct delivery of desalinated water to local agencies would be advantageous if it reduces the length and/or size of DWCF’s pipeline and/or pump station facilities, or if it reduces the annual volume of water that must be pumped to the hydraulic elevation of the Second Aqueduct. The conclusions are as follows:

- **DWCF needs to deliver most of the water to the Second Aqueduct.** The Analysis identified that local reliable winter demands are relatively modest in comparison to the 50 mgd initial production rate of the desalinated water plant. Consequently, the conveyance facility will need to be sized to carry, at a minimum, most of the water to the Second Aqueduct.

- **Direct deliveries of desalinated water to Carlsbad and Oceanside are physically possible.** Direct deliveries to Carlsbad are possible either at Maerkle Reservoir, other higher elevation points, or both. Construction of a separate pipeline for direct deliveries to Oceanside is possible, but is uneconomical in comparison to delivering the same increment of water directly to the Second Aqueduct. A small 1 to 2 mgd increment of Oceanside’s demands could potentially be served by the Blue Alignment.

- **Water quality issues may favor delivering all the desalinated water to the Second Aqueduct where it can be blended with imported water prior to retail delivery. Planned studies will help resolve this issue.** Although the water quality characteristics of desalinated water will be very good, the water will have taste and other aesthetic characteristics that differ from those of the Water Authority’s existing supply of imported water. Without blending, the ratio of desalinated water to Aqueduct water will change as local water use changes and this could result in undesirable changes in the aesthetic quality of the consumers’ tap water.

- **Direct deliveries of desalinated water to agencies other than Carlsbad and Oceanside are not practicable.** Direct deliveries of desalinated water to VID, VWD, Olivenhain Municipal Water District, Santa Fe Irrigation District or the San Dieguito Water District are physically possible but are not economical when compared to conveying the same increment of water directly to the Second Aqueduct. Also, by delivering this water to the Aqueduct, the water can be blended with imported water and then delivered indirectly to these and other downstream users. The factors that disfavor direct deliveries to these agencies include: distance to system connection points, pumping required, limited firm wintertime demands, and the presence of base-loaded local water supplies.
4.1 Purpose and Approach

A “Pipeline Preliminary Design Technical Memorandum” (Pipeline PDTM) based on the research performed on each of the short listed pipeline alignment alternatives and containing information specific to those alignments was prepared for the DWCF project and is included as Appendix 5 to this report. A complementary document, the Pipeline Design Criterion Technical Memorandum (Appendix 4) contains pipeline design guidance and criteria based on Water Authority standards. This chapter provides a summary of the information contained in the Pipeline PDTM.

The Pipeline PDTM addressed the following topics:

- Pipeline Alignment Evaluation, including:
  - Overview of long list and short listed alternatives and methodology used to develop and screen alternatives.
  - General discussion of pipeline horizontal and vertical alignments.
  - Tunnel evaluations supporting alignment alternative development, screening, and preliminary design.
  - Summary of right-of-way requirements for short-listed alternatives.
  - Jurisdictional agencies, permits, and reviews pertinent to the short-listed alignments.

- Summary of Subsurface Conditions. Geologic and geotechnical data to support the preliminary design.

- Hydraulic and Transient Analysis. Review of potential hydraulic conditions and transients due to the DWCF system and its impact on existing Water Authority facilities and operations, and considerations for mitigation.

- Pipeline and Appurtenances. Overview of design criteria to be employed during detailed design.

- Traffic Control Requirements. Assessment of impacts to traffic caused by pipeline construction, and mitigation measures.

- Construction Issues. General discussion of how the pipeline will be constructed and requirements to accommodate the construction effort not covered elsewhere in this report.
Project Schedule. Summary of the project schedule for each short-listed alignment, accounting for the results of the technical studies and constructability issues that will be encountered on the project.

Construction Cost. Summary of estimated construction costs for each short-listed alignment, accounting for the results of the technical studies and constructability issues that will be encountered on the project.

4.2 Chapter Outline

This chapter is organized as follows:

4.3 Alignment Development and Coarse Screening
4.4 Short-Listed Alignments
4.5 Fine Screening Technical Analyses – Pipeline Preliminary Design
4.6 Tunnels
4.7 Rights-of-Way
4.8 Pipeline and Appurtenances
4.9 Construction Issues

4.3 Alignment Development and Coarse Screening

The Alignment Development and Coarse Screening processes were conducted as follows.

4.3.1 Alignment Development Steps

A screening process was used to identify a short-list of alignments for detailed environmental studies and public review. The overall process included the following steps:

- **Long-List Identification.** Identification of multiple possible alignment scenarios based on a very broad overview of project goals and potential alignment constraints.

- **Coarse-Screening.** Through various forms of analyses, both qualitative and quantitative, various long-list alternatives are reduced down to a short-list of candidate alignments warranting more detailed study.

- **Fine-Screening.** The short-listed alignments are considered in detail at a preliminary design level to determine the feasibility of each. Environmental review, public evaluation and comment and technical analyses ultimately contribute to select the preferred alignment.
4.3.2 Long List Alternatives

Details on the Long-List Identification process used on this project are presented in Appendix 2 (Coarse Screening TM). The purpose of the Coarse Screening TM was to identify a wide-range of potential options for pipeline alignments and pump station sites that could meet the project’s needs. In identifying the “long-list” of alternatives, Geographic Information System (GIS) mapping of the alignment study area, meetings with area agencies (cities of Carlsbad and Oceanside, Vista Irrigation District and Vallecitos Water District) and field visits of the project study area to examine alignment corridors and identify opportunities and constraints for alignment siting were used. From this effort, a long list of alternatives was identified. The “Long List” of alternatives is presented in Figure 4-1.

4.3.3 Short List Alternatives – Coarse Screening

The goal of Coarse Screening was to utilize various technical and qualitative analyses to select those alignments that most warranted further consideration during the Fine Screening/Preliminary Design step of the project. The possible conveyance system alignments and configurations were examined in terms of three main categories of analysis:

1. **Demand Analysis**: The location of water demands that could be served by the project;

2. **Plan View Analysis**: The physical siting of conveyance system pipelines and pumping stations in streets and other possible rights-of-way; and

3. **Profile View Analysis**: The engineering and economic aspects of pumping water from near sea level at the planned desalination plant, to higher elevations where the water can be delivered to existing water transmission and distribution systems.

The significant findings and conclusions of the coarse screening process are presented below by category (for more detailed discussion, refer to Appendix 2).

**Demand Analysis**

The engineering team worked with the cities of Carlsbad and Oceanside and other local agencies to determine how much desalinated water could be delivered directly into their systems. The coarse-screening conclusions were:

- The conveyance system (pipeline) needs to sized to carry most of the water to the Second Aqueduct.
- Direct deliveries of desalinated water to Carlsbad and Oceanside are physically possible.
Direct deliveries of desalinated water to agencies other than Carlsbad and Oceanside are not practical.

Water quality and blending issues are a significant concern.

**Plan View Analysis**

A multitude of possible alignment options for the DWCF were examined. The coarse-screening findings of the plan view analysis were:

- Alignments through Carlsbad are preferred over alignments through Oceanside.
- Alignments that stay at lower elevations longer are preferred over alignments that go over the hills of western Carlsbad because of hydraulic transient (surge) considerations.
- Use of existing public rights-of-way will be generally preferred over acquisition of new rights-of-way because of reduced environmental impacts, expense, and expediency. Project pipelines will be mostly located in city streets.
- TAP would need to be replaced in order to serve as part of the conveyance system to the Second Aqueduct.
- Improvements to the Second Aqueduct are needed to accommodate project operations.

**Profile View Analysis**

The conveyance system will include pumping facilities to lift the water from near sea level at the planned desalination plant, to higher elevations where the water can be delivered to existing water transmission and distribution systems. The coarse-screening findings of the profile view analysis were:

- Surge control is an important consideration in the design of the pumping facilities and in the space required for their construction.
- The preferred location of the initial pump station is at the Encina power plant site, where power costs are expected to be lower than for other “outside the fence” sites.
- A single high-lift pump station may be preferable to two lower-lift pump stations.
4.4 Short-Listed Alignments

Based on the conclusions from the Coarse Screening TM analyses, a short list of three alignments were developed and are presented in Figure 4-2. The alignments have been designated as follows:

- Blue (or Northerly) Alignment
- Green (or Central) Alignment
- Orange (or Southerly) Alignment

Additional connector segments, colored in Pink, were added for consideration to allow for flexibility in final alignment selection. These Pink segments interconnect with the three primary alignments, allowing for combination alignments, wherein different segments of the primary alignments are combined to provide additional options. The following paragraphs provide a brief overview of the alignments shown in Figure 4-2.

4.4.1 Blue Alignment Description

The “Blue Alignment” generally follows a Cannon Road corridor from the Seawater Desalination Plant eastward to Maerkle Reservoir in the City of Carlsbad. From Maerkle Reservoir the pipeline heads north and meets the alignment of the TAP. To complete the Blue Alignment, based on the results of the TAP analysis (see Appendix 2) and subsequent DWCF analyses, a new pipeline parallel to the TAP would be required to convey desalinated water to the Second Aqueduct. The total pipeline length of the Blue Alignment from the Plant to the Second Aqueduct is approximately 53,400 feet.

Land use along the Blue Alignment includes a mixture of commercial, residential, industrial, and agricultural uses. West of El Camino Real, land uses include the agricultural Strawberry Fields and residential developments along Cannon Road. East of El Camino Real to the TAP are agricultural and undeveloped land uses, with development plans to convert these areas to residential. Land uses adjacent to the TAP alignment includes industrial, residential, and agricultural.

4.4.2 Green Alignment Description

The “Green Alignment” also follows the same Cannon Road corridor from the Seawater Desalination Plant eastward, but utilizes the existing Faraday Road and planned Faraday Road Extension to extend the pipeline east into the City of Vista to the TAP alignment, and then parallels the TAP eastward to the Second Aqueduct. The total length of the Green Alignment is approximately 49,600 feet from the Plant to the Second Aqueduct.

Since the Blue and Green Alignments are similar at their westernmost and easternmost ends, the land uses adjacent to the Green and Blue Alignments are also the same in those areas. West of Faraday Road
are agricultural uses (Strawberry Fields). Adjacent to the TAP and east of Poinsettia Avenue, land uses are agricultural and residential. Between these ends the Green Alignment follows Faraday Avenue and Poinsettia Avenue. These segments lie primarily in areas of industrial land use.

### 4.4.3 Orange Alignment Description

The “Orange Alignment” takes a southerly route, following College Boulevard and Palomar Airport Road / San Marcos Boulevard directly to the Second Aqueduct. The total pipeline length of the Orange Alignment is approximately 49,100 feet from the Plant to the Second Aqueduct.

Land use adjacent to the Orange Alignment is, beginning at the westerly end of the alignment, commercial, west of Legoland, then to segments within the agricultural Flower Fields. After passing through the Legoland parking lot, the alignment crosses a golf course, and then enters an area of industrial use until reaching El Camino Real. Continuing east, the alignment lies largely within Palomar Airport Road or is adjacent to it. In this area, land uses include industrial and commercial north of Palomar Airport Road and residential to the south.

### 4.4.4 Pink Connector Segments

Four “Pink” connector segments have been included in the detailed analysis. These segments afford the opportunity to utilize various combinations of portions of the Blue, Green, and Orange alignments, as warranted, to minimize costs and other project impacts and/or to maximize project benefits.

### 4.5 Fine Screening Technical Analyses – Pipeline Preliminary Design

Three primary alignments (Blue, Green, and Orange), and four connector segments (Pink) emerged from the Course Screening process for further consideration during the Fine Screening process. These alignments are the subject of this “Alignment Investigation Report” and summaries of the analyses performed follow:

#### 4.5.1 Project Goals

The goals of the DWCF project was to prepare an “Alignment Investigation Report” that would:

- Support the environmental review (EIR) process; and
- Advance engineering progress to expedite final design and construction.

Both of these goals require an extensive amount of engineering effort to fully define the project (to support the EIR), and to identify and begin to solve the key technical challenges as early as possible (to
expedite final design). The results of these efforts are summarized in Appendix 5, “Pipeline Preliminary Design Technical Memorandum” (Pipeline PDTM). The results of the engineering efforts to develop the Pipeline PDTM are summarized graphically in the form of “Summary Maps,” presented in “Appendix 1, Reference Exhibits.” These Summary Maps identify the key pipeline siting issues on each alignment. They account for the presence of existing utilities and identify potential construction staging areas. Tunnel operation information is also incorporated.

### 4.5.2 Special Alignment Considerations

As stated previously, the alignment alternatives are located primarily within existing street rights-of-way. However, as part of alignment identification and refinement, a number of segments warranted special consideration. In particular, these segments appear to offer potentially significant advantages to other alternatives with respect to construction cost, impacts to the community, environmental concerns, or the project schedule. The following sections provide an overview of some of the key segments that underwent special consideration in short-listing the alignments.

#### Tri-Agencies Pipeline (TAP)

During long-list alternative development, the study considered whether it might be advantageous to deliver water from the Seawater Desalination Plant to the Second Aqueduct via the Water Authority’s existing TAP. At that time, it was believed that this concept offered a couple of key advantages, namely:

- It potentially afforded a convenient means to deliver desalinated water directly to local agencies using existing facilities and systems, potentially avoiding costs for new facilities.

- It potentially significantly reduced the total length of new pipeline required, saving capital costs and potential disruptions to the community.

During the Coarse Screening process, the feasibility of using the TAP was analyzed. The feasibility review was based on the hydraulic analysis of the pipeline, preliminary field review of the existing alignment, and limited record drawing review.

Based on the hydraulic analysis and comparison of pipe pressures, it was determined that almost all of TAP would have to be replaced to upgrade its design pressure rating and flow capacity to accommodate the new system. The full TAP analysis is included in Appendix 2-C to Appendix 2.

Subsequent to determining that almost all of TAP would need to be replaced to accommodate desalinated water delivery to the Second Aqueduct, the design team initiated studies of a TAP...
parallel pipeline. In comparing the parallel pipeline to replacing the TAP, the study team reached the same conclusions:

1. Construction costs would be similar for both options.

2. Right-of-way and environmental issues would be similar for both options.

3. Taking the TAP out of service during construction of a replacement pipeline would be operationally difficult.

4. A dedicated parallel pipeline provides better capabilities to address water quality and surge control issues.

Based on this analysis, the project team determined that a TAP parallel pipeline is preferred over TAP replacement. The study therefore assumes that where the Blue and Green Alignments are located parallel to the TAP, these reaches will consist of a new, parallel pipeline.

Field reviews of the TAP alignment were performed to determine feasibility and constraints. This alignment was found to be generally feasible, with some aspects requiring further refinement during detailed design. Documentation for the TAP is included in the “workbooks” assembled for the project. These “workbooks” contain a compilation of utility research, cross sections, plan sketches and other relevant data, organized by alignment segment.

**Carlsbad Land Development Opportunities**

Carlsbad is experiencing tremendous growth throughout its city, and particularly in the DWCF alignment corridors as shown in Figure 4-3. Over the next five to ten years, many of these vacant lands will be fully developed. This presents unique opportunities to locate and construct segments of the DWCF pipeline through several of these planned developments. The potential advantages include:

- Reduced construction costs (DWCF installed in rough graded roadway with other utilities).
- Reduced/faster right-of-way acquisition (DWCF in future street’s public right-of-way).
- Reduced environmental impacts (Developer will already be responsible for mitigation).
- Reduced utility relocations (Utilities not installed yet).
- Reduced community disruption (Community not moved in yet).

Schedule and timing are critical to successfully coordinate the DWCF through these areas. Several of these potential developments are in entitlement processes and may, over the next year, obtain approved tentative maps and environmental clearances. Some projects are in their early land development planning stages and may offer opportunities to reserve pipeline corridors and
right-of-way through their projects. In addition, several critical circulation elements may be constructed in the next two to five years, possibly opening some key pipeline corridor segments for early construction or simply reservation. It will be imperative that the Water Authority closely monitor these corridors and pipeline segments through the public review process, as preferred alignment selection may be influenced or altered based on the timing of the land development projects shown in Figure 4-3. A summary of these opportunities and potential constraints are described below.

**Blue Alignment Opportunities**

1. Pipeline segments just east of I-5 and north of Cannon Road may need to be coordinated with future SDG&E commercial property opportunities. It may be desirable in final alignment selection to parallel the northerly portion of the developable property to minimize impacts.

2. East of El Camino Real offers significant opportunity to coordinate a final pipeline alignment with future land development. Although the preferred alignment generally follows an existing CMWD water easement, this alignment may be adjusted and coordinated with residential development plans within the Mandana and Kato properties. These properties are in the early planning stages of development with tentative map approvals anticipated over the next couple of years. The DWCF pipeline could potentially be located in future roads or pipeline right-of-way secured through close coordination with the City of Carlsbad and the developers.

3. East of El Camino Real, the Water Authority should closely monitor the development progress of several key roads (circulation elements) that are planned to be constructed or widened including:

   - Cannon Road extension.
   - College Boulevard extension.
   - Roadways through Cantarini project.

**Green Alignment Opportunities**

This alignment offers one of the more significant developer coordination opportunities located between El Camino Real and the City of Vista (Melrose Drive). Over one-half mile of DWCF pipeline could potentially be located in the proposed Faraday Road extension. Carlsbad could condition the developer with the requirement to include the DWCF pipeline corridor as part of the Carlsbad Oaks industrial development project. This roadway project is a major circulation element designed to relieve traffic congestion on Palomar Airport Road. Thus, concurrent construction of the pipeline with road improvements could result in significant cost savings to the Water Authority and
avoid costly utility relocations and traffic disruptions in the future, as well as the disruptions to Palomar Airport Road if the proposed roadway is not an option due to the project’s timing.

**Orange Alignment Opportunities**

Although the Orange Alignment generally follows existing roadways, there are a few segments where coordination possibilities exist with future developments:

1. Once DWCF crosses I-5, it is planned to parallel an “open space” area that is being reserved for continued agricultural use. The alignment through the agricultural flower fields offers available space and minimal utility conflicts for routing the pipeline. The final alignment would need to be carefully coordinated to minimize potential impacts to the agricultural area and provide the Water Authority with its necessary access.

2. In the western portion of the alignment parallel to Palomar Airport Road, to minimize traffic impacts a section of DWCF is aligned through a small portion (approximately 800 feet) of Carlsbad’s proposed municipal golf course project. Based on a review of the golf course layout, it appears that the DWCF could be routed through the golf course with minimal impact to the golf course design.

3. A potential exists to shift the proposed DWCF from the Blue Alignment to the Orange Alignment with the Pink segment located between Cannon Road and Hidden Valley Road, along the easterly boundary of Legoland. A developer is currently planning a Resort project in this area. Resort access would be from Cannon Road and may include private access roads and a parking lot. The proposed development may offer the Water Authority an alignment that could be coordinated with future improvements to save project costs and expedite the schedule.

4. Orange Alignment Segments 524 and 523 are located within Palomar Airport Road. To minimize traffic impacts and lower project costs, Orange Alignment Segments 521 and 517 parallel to Palomar Airport Road and aligned with the proposed Poinsettia Road extension through two industrial developments (Forum and Raceway) present opportunities. Both of these projects have approved tentative maps and are under final design.

In summary, several of the proposed pipeline segments offer the Water Authority an opportunity to construct pipelines concurrently with new roadways that would reduce construction costs and minimize environmental impacts, including traffic and sensitive habitat. Schedule and timing is critical in the successful implementation of these options that realistically may not be achievable until final selection of a preferred DWCF alignment alternative.
4.6 Tunnels

As part of the evaluation, several reaches were identified as candidates for tunneling the DWCF pipeline. Tunneling provides the ability to build the transmission main without disrupting existing surface improvements and utilities. However, tunnel construction is considerably more expensive than traditional open cut pipeline construction methods.

A “Tunnel Feasibility Technical Memorandum,” dated October 7, 2003 (Appendix 7) was prepared for this project by Jacobs Associates. This work evaluated the feasibility of tunnels along the alignments and provided preliminary construction cost estimates.

A total of eleven main tunnel alternatives were identified, as follows: five for the Blue alignment; two for the Green alignment; three for the Orange alternative; and finally one for the Plant Site to the TODS. The proposed tunnel segments are shown on Figure 4-4. All tunnel areas have been identified on the alignment summary maps.

The Jacobs Report recommends various site-specific tunneling methods based on the segment length, depth, and anticipated geologic conditions in the area. Table 3 in Appendix 7 provides a matrix for determining applicable tunneling methods based on geologic conditions. Tunnel sections along each alignment were identified to mitigate for the following issues:

- Railroad and Interstate Freeway crossings – Required by agencies.
- Environmental Impacts – Sensitive habitat in canyon crossing areas.
- Utility Conflicts – safety concerns of crossing large gas mains at intersection of El Camino Real and Palomar Airport Road.
- Traffic and Business Impacts – Carlsbad car dealership area.

The following sections discuss the more significant tunnel segments considered:

Blue Alignment

**Macario Canyon Crossing**

Macario Canyon is located along Cannon Road just west of Faraday Avenue. An existing bridge crosses the canyon, but cannot accommodate the DWCF pipeline. Therefore, a number of tunnel alternatives were considered to minimize or avoid impacts to this extremely environmentally sensitive area.
Two options were studied for the tunnel to cross Macario Canyon:

1. A crossing north of Cannon Road would require a 1,900-foot-long tunnel to avoid protected wildlife areas within the canyon. Excavation would be performed using an earth balanced pressure machine and cover above the tunnel would range from 50 to 170 feet.

2. A crossing south of Cannon Road would require a 1,150-foot-long tunnel. This option would require rerouting the Blue/Green alignment to the south side of Cannon Road and would require the use of a microtunnel tunnel-boring machine. Cover above the tunnel would range from 75 to 115 feet.

**Agua Hedionda Creek Tunnel**

Northeast of El Camino Real, the Blue Alignment leaves City streets heading towards Maerkle Reservoir where it crosses Agua Hedionda Creek. To avoid disturbing this environmentally sensitive area, a tunnel option was studied. The proposed 1,150-foot-long tunnel would have a relatively flat profile under Agua Hedionda Creek below the alluvium and slope up to approximately 13 percent to a receiving shaft located near the intersection of Cougar Drive and Palmer Way. The cover above the tunnel would range from 30 to 105 feet. Excavation methods include road header and drill-and-blast technologies.

**Maerkle Reservoir to TAP**

Along the Blue Alignment, as an alternative to paralleling the TAP, a cross-country pipeline extending eastward from Maerkle Reservoir was included. A straight 5,900-foot-long tunnel from Maerkle Reservoir to the TAP via this route was studied. The cover above the tunnel would range from 20 to 250 feet. This tunnel would pass directly beneath Maerkle Reservoir. This option was studied to avoid environmental impacts and give consideration to what appears to be a more direct route to get from Maerkle to the Second Aqueduct.

**Green Alignment**

**Macario Canyon Crossing**

A shorter crossing of Macario Canyon south of Cannon Road was studied for the Green Alignment, requiring the rerouting of the Blue/Green alignment to the south side of Cannon Road. This 610-foot-long tunnel would have a cover ranging from 75 to 100 feet.
Figure 4-4            Tunnel Summary Map
Orange Alignment

**I-5/Auto Park Tunnel**

A tunneled crossing of I-5 is required by Caltrans. As part of the Orange Alignment study, this option was extended to take the tunnel under Car Country Carlsbad and an existing drainage, to the Flower Fields. This alternative would minimize traffic and parking impacts to the businesses in the Auto Park. The 1,500-foot-long tunnel would cross I-5 and the Auto Park, having cover ranging from 20 to 130 feet. The length could be reduced to about 300 feet to just cross I-5 if necessary. Excavation methods include pipe jacking with closed face tunnel boring machine (TBM) or shield with breasting capability, whereby the boring machine can positively support the face of the tunnel as it digs (reference Appendix 7).

**Long Tunnels**

Two long tunnels were considered for comparison with traditional open trench installations. These studies were conducted to evaluate the costs and benefits these options potentially offer to reduce impacts to traffic and environmentally sensitive areas.

**Plant to San Marcos Blvd. and Rancho Santa Fe Rd. Tunnel**

A 40,800-foot-long tunnel, as an alternative to the Orange alignment was studied to connect the Desalination Plant to the Second Aqueduct at the Carlsbad 1 connection point located at San Marcos Boulevard and Ranch Santa Fe Road. The alignment begins 750 feet south of the proposed pump station on the Encina site, crosses the San Diego Northern Railroad, then continues to the Strawberry Fields. The alignment then follows Reaches 209, 216, and 304 and finally crosses under El Camino Real to the east of Palomar Airport Road. The alignment then follows Reaches 524, 523, 525, and 520 to the Second San Diego Aqueduct at the Carlsbad 1 connection Point.

**Plant Site to Twin Oaks Diversion Structure (TODS) Tunnel**

Two options for a long tunnel alternative were studied to deliver the desalinated water directly to the TODS. Option 1 is a 57,500-foot-long tunnel that was eliminated from consideration because the alignment crosses under Agua Hedionda Lagoon, presenting major groundwater control issues. Option 2 is a 59,700-foot-long tunnel that goes east from the proposed desalination plant then northeast to the TODS. Another possible approach for this option would be to tunnel east from the proposed Seawater Desalination Plant, then northeast along an existing power line and continuing to the north side of Calavera Lake. The tunnel would then head northeast to the TODS.
Although both long tunnel segments are theoretically possible, their cost ($3,021 per lineal foot and $2,935/lf) is significantly higher than any of the open trench construction alternatives. Therefore, these options were not carried over into fine screening and final alignment selection.

4.7 Rights-Of-Way

To the extent feasible, each of the alignment alternatives will be constructed primarily in public streets. The Water Authority, through many years of pipeline planning and construction, has found that placing pipelines in or adjacent to public rights of way is the best approach. It generally offers the most expedient process, avoids environmentally sensitive areas and is less costly. Acquisition of new right-of-way across privately held lands could potentially require more time than is available. Use of public rights of way generally means that the pipeline will be placed in streets adjacent to the various other utilities normally found in streets such as water, sewer, gas, electric, and communications facilities. However, there remain portions of the alignments that cross privately held property. In order to construct, operate, and maintain the DWCF, it is necessary to obtain legal permission to cross privately owned property. Right of way (ROW) permissions can take various forms. These include:

- **Encroachment Permits.** These are required when new pipelines will be located in public City street rights-of-way. An encroachment permit provides the Water Authority the right to construct, operate, and maintain facilities within the public street right-of-way.

- **Easements.** These are required where new pipelines will cross non-public property. This would include private property, as well as lands owned by public agencies that are not public rights-of-way. An easement may have two forms:
  - Temporary or Construction Easement. This type of easement provides the Water Authority space and access for construction of facilities. Once construction is completed, the easement is relinquished back to the property owner.
  - Permanent Easement. A permanent easement provides the Water Authority with the right to construct, operate, and maintain facilities on a permanent basis.

  Easements have set boundaries, whereas Encroachments do not.

- **Property Acquisition.** It is assumed for this project that all new DWCF pipeline facilities will be constructed primarily in City street right-of-way, or in new or existing easements across private properties, where needed. No new fee title property acquisitions are anticipated.
For the DWCF project, the following ROW acquisition assumptions have been made:

- Construction in existing public, city street rights-of-way requires acquisition of encroachment permits from the jurisdiction. It is assumed that there will be no cost to the Water Authority (beyond administrative costs) for these permits.

Permanent and temporary construction easements will be purchased from private property owners where needed. Costs for these are assumed to be:

- $1,000,000 / acre for permanent easement in developed or developable lands
- $300,000 / acre for permanent easement in agricultural, open space, and parking lots
- $100,000 / acre for temporary construction easements

Permanent and temporary construction easement widths are assumed to be as follows:

- Depending on terrain and other existing constraints, temporary easement widths will vary between 80 and 120 feet.
- Depending on terrain and other existing constraints, permanent easement widths will vary between 50 and 80 feet.
- Where the proposed alignments parallel TAP, an additional 50-foot-wide permanent easement will need to be acquired.

Within Appendix 1 to this report, maps are presented which graphically depict the location and extent of the temporary and/or permanent construction easements needed to construct, operate, and maintain the DWCF.

Appendix 13 to this report, “Permanent and Temporary Right-of-Way for Construction and Operation and Maintenance of Pipelines” provides more details about right-of-way needs for the project. It includes a table that outlines the easement and encroachment needs of the DWCF.

### 4.8 Pipeline and Appurtenances

To fully define the project for the EIR and advance engineering progress, key pipeline design criteria were established. Appendices 4 and 5 present details about the design criteria and their application to the DWCF. The Summary Maps, segment workbooks, and other studies combine with the design criteria to provide a complete basis for preliminary design of the DWCF pipelines.
4.8.1 Design Criteria

The pipeline design criteria conform to Water Authority standards. Key Criteria include:

- Pipeline diameter = 60 inches.
- Pipeline material = welded steel.
- Pipeline lining = 0.5-inch-thick cement mortar lining.
- Pipeline coating = 80 mil dielectric tape with cement mortar armor coat.
- Pipeline joints = single welded lap joints, except where double welds are needed for additional thrust restraint.
- Cathodic protection = impressed current.

4.8.2 Pipeline Appurtenances

Blowoffs are used to drain the pipeline for inspection, maintenance and repair. Air and vacuum release valves release air trapped in the pipeline and also allow air to enter the pipeline in the event of a break or surge condition to prevent a vacuum. In general, blowoffs are located at low points along the pipeline, and air and vacuum valves are at the high points. Potential blowoff, air and vacuum valve locations were determined along each of the alignments (reference Appendix 5). Water Authority standards for these appurtenant facilities will be applied to the project. Locations where blowoffs could be connected to storm drain systems or where discharge water could be drained from the pipeline into existing channels or drainage courses was identified. 8-inch-diameter blowoffs will be used, per Water Authority standard drawings, and 4-inch-diameter air release valves will be used.

4.8.3 Horizontal Alignment

Using GIS mapping and right-of-way information, preliminary pipeline alignments were prepared for each of the primary alignments and connector segments. Specific alignments were developed based on extensive research of existing utilities along the short listed alignments. The summary maps are graphical in nature, and are not intended to represent design-level detail. However, they do generally reflect the approximate locations proposed for the pipelines in plan view.

Since the alignments predominantly traverse existing streets and encounter numerous utilities, there is no “typical” horizontal location for the project pipelines. Instead, the locations attempt to take into
account the presence of existing utilities, as well as the constructability factors discussed in later sections of this report.

As part of the utility research and alignment development process, detailed cross sections of the right-of-way and utility locations were prepared. The compilation of utility research and the cross sections and plan sketches have been compiled into “workbooks,” organized by alignment segment.

4.8.4 Vertical Alignment

In general, the DWCF pipeline will be installed with 7 feet of minimum cover, in accordance with Water Authority standard practice. Deeper installations may be required where the pipeline encounters existing utilities. Tunnel or trenchless installations will generally require greater installation depths. The Summary Maps (Appendix 1) depict the locations of known utilities to provide a sense of the frequency and need for deep installations and to allow for project budgeting and scheduling. Detailed pipeline profiles will be developed as part of final design.

4.9 Construction Issues

The key construction issues identified and discussed in Appendix 5 describing in general how the pipeline will be constructed and how local construction restriction related ordinances apply to the project are summarized in this section.

4.9.1 Construction Duration and Sequence

As previously indicated, much of the new pipeline will be installed in existing city streets. The following paragraphs provide an overview of a typical construction sequence, assuming the use of a soldier pile shoring system. The Pipeline PDTM (Appendix 5) provides details about the specific shoring methods anticipated along the alignments and a brief shoring discussion is included in Chapter 8.

Typical Construction Sequence (Soldier Pile Shoring System):

1. **Drill and Set Soldier Piles.** Vertical trenching would be the most cost effective excavation method for pipe installations within a paved street with existing utilities. A shoring method of solider piles and steel sheeting would probably have to be used in areas with lesser quality soils. The first step would be to drill and set the soldier piles at approximately 8-foot centers on each side of the trench.

2. **Excavation and Installation of Sheet Shoring.** Excavate the trench. Installation of sheet shoring would be done within the same operation to stabilize the trench.
3. **Install and Grade Bedding Material.** Prepare the subgrade for pipeline installation. This includes compacting the subgrade, installing bedding, grading the bedding, and compaction of the bedding material prior to pipe installation.

4. **Pipe Installation.** Pipe installation includes laying the pipe prior to welding.

5. **Welding and Testing Joints.** With the pipeline placed, welders would weld the joints and perform tests to verify the competency of the weld. It is assumed that the crew would include two welders working on the inside of the pipe.

6. **Taping and Joint Testing.** Once the joints are welded, the exterior of the joints are taped with dielectric tape, similar to that applied over the remainder of the pipeline. Once applied, the entire tape coating system is tested for defects.

7. **Pouring Joint Diapers.** After successful completion of the testing of the dielectric tape, the joints are wire wrapped and “diapers” are installed. Diapers hold the concrete mortar placed at the joints to create a continuous rock-shield armor coat that protects the dielectric tape over the whole pipeline.

8. **Pipe Zone Backfill.** Place and compact bedding backfill to 1 foot over the top of the pipe and install filter fabric and marking tape.

9. **Trench Zone Backfill.** Backfill and compact the trench. This operation includes removing shoring as backfill progresses.

10. **Installing Aggregate Base and Asphalt Concrete Base.** With the trench backfilled, it can be resurfaced and restored for roadway traffic. This operation includes compacting the base material and base paving the trench up to finished grade (to be ground down 1-1/2 inches prior to final cap paving). Final paving will be performed upon completion of all trench backfill.

This entire operation would be expected to take about 15 days if restricted to a localized area. In reality, pipeline construction will progress forward over a long period of time, with multiple specialty crews working concurrently on different aspects of above steps.

The result will be that long portions of trench will remain open and barricaded from traffic. This is particularly true on larger streets, since it will be more economical to allow portions of the pipeline trench to remain open. It is expected that the overall pipeline would be installed on an average of 80 to 100 feet per day. At 100 feet per day, there could be as much as 1500 feet of area barricaded from traffic at any given time.
4.9.2 Construction Work Zones and Traffic Control

For pipelines located in city streets, space will need to be established by traffic control to accommodate the work area. On the larger streets, such as El Camino Real and Palomar Airport Road, since significant sections of trench could remain open for periods of time, it is envisioned that movable k-rail type barricades would be employed to create a designated work area. During non-working hours, the barricades would be placed closer to the open trench, maximizing the area available in the street for traffic. During working hours, the barricades would be moved to increase the work area. With the work area minimized during non-working hours, the area closed to traffic would be 15 to 20 feet wide. The minimum work area during working hours would be approximately 40 feet wide.

On more heavily traveled thoroughfares like Palomar Airport Road, the pipeline will be positioned both to address locations of existing buried utilities and to improve opportunities to employ traffic control and work area designation to minimize impacts to traffic. It is anticipated that along streets like Palomar Airport, re-striping of lanes may be needed to provide the same number of lanes that exist prior to construction. Under this scenario, bike lanes and possibly medians would be temporarily reduced or eliminated to provide more space for traffic.

Along smaller streets, similar strategies would be employed. Re-striping and barricades to accommodate 2-lane traffic adjacent to the open trench would be provided. On the smallest of streets, where there is not space to accommodate a 40-foot construction zone, or even a 20-foot-wide work area during non-working hours, various other approaches would be employed. These include:

- Providing one-way traffic with flagmen during work hours.
- Closing short sections of roadway to through traffic, using detours.
- Requiring the contractor to cover the trench each day to reopen the street to traffic.

These options will impact construction progress.

The “Preliminary Transportation Evaluation” prepared for the project is included as Appendix 9 for reference. It includes details about the specific streets involved in the DWCF and potential traffic mitigation and control measures that may be used in the impacted streets.

4.9.3 Staging Areas

In addition to work zones along the alignments, the contractor will also need staging areas at various locations along the alignment. These areas serve to accommodate field offices and store construction materials and equipment. Several potential staging areas are identified in the Pipeline PDTM (Appendix 5) and are depicted on the Summary Maps in Appendix 1.
Chapter 5 – Pump Stations

5.1 Purpose

The Seawater Desalination Plant is located adjacent to the Pacific Ocean at approximately 40 feet above sea level. Water delivered into the Second Aqueduct must be pumped to an elevation of approximately 1,080 feet above sea level, the elevation of the TODS. The purpose of this chapter is to summarize the design criteria for the pump station alternatives examined in the “Pump Station Design Criterion Technical Memorandum” (Appendix 6). This chapter is organized as follows:

5.2 Pumping Options
5.3 Key Pump Station Design Criteria
5.4 Pump Equipment
5.5 Site Layouts and Constraints
5.6 Forebay Storage
5.7 Pump Station Architecture
5.8 Hydraulic Transients (Surges) and Control

5.2 Pumping Options

Pumping water to the Second Aqueduct from the Seawater Desalination Plant could be accomplished by one high-pressure pump station located at the Encina site, or with two lower pressure stations, one located at Encina and the other between Encina and the Second Aqueduct. Figures 5-1 and 5-2 show hydraulic profiles of the options for the Orange Alignment. With two stations, the Encina Station pumps to a reservoir at about elevation 500 feet and the second pump station pumps to the TODS. A 30-year life-cycle economic comparison of these two options was completed taking into account the initial construction costs and operation and maintenance costs, including energy (reference Appendix D of Appendix 2). It is possible to construct more than two pump stations, but the analysis will show that this is not a practical option.

The key considerations and factors favoring a single pump station include:

- **Construction Cost.** It is less expensive to purchase a site and construct one large station then two smaller ones.

- **Energy Use.** A single station would have less hydraulic or friction loss in the piping than a two-station option. In addition, the single station would have less auxiliary mechanical equipment (such as cooling and ventilation) than two stations. While this is not a major cost item, it does favor the single pump station option.

- **Energy Costs.** Electrical costs are expected to be $0.06 per kilowatt hour (kWh) at the Encina site and $0.086 per kWh at the second station. The cost at Encina is lower since it would be purchased
from the adjacent power plant and does not include transmission and distribution costs. The rate for the second station represents an expected long-term power purchase contract, considerably less than the typical San Diego Gas & Electric (SDG&E) rate. In addition, it is estimated that the cost of the transmission facilities needed to extend power to the second station would be approximately $1,000,000. These costs significantly favor a single high-pressure pump station located at the Encina site.

The one consideration that could favor the two-pump station option is if there was a firm delivery of water to local agencies before it reached the second pump station. This would reduce the capacity of the second pump station and the remaining pipeline to the Second Aqueduct, thereby reducing construction costs. There would also be a reduction in energy costs, because less water would have to be pumped to the Second Aqueduct. The desalination plant is expected to operate 24 hours a day, 365 days a year. Therefore, to realize any of these savings, the local agency would need to commit to taking water year round, and hence this delivery is called “firm.” There are some savings in energy costs from non-firm local deliveries, but there would be no construction costs savings because the pump station and pipeline would have to be constructed for the entire Encina Plant production.

The life-cycle analysis showed that for the 50 mgd project, the single high-pressure station is less expensive unless 16 mgd can be delivered to local agencies on a firm basis or 28 mgd on a non-firm basis. For 100 mgd, the firm and non-firm local deliveries are 30 and 45 mgd respectively. The local agencies may not have high enough demands to accept this much water. It should be noted however that the single station does not preclude the delivery of water directly out of the pipeline to local agencies. This analysis is further documented in the Coarse Screening of Alignment Alternatives Memorandum (Appendix 2).

5.3 Key Pump Station Design Criteria

The key pump station design criteria used in this investigation included those listed below. These criteria will be improved and refined during preliminary and final design.

1. The station will be designed for 50 mgd with provisions built in to allow expansion to 75 and 100 mgd. This means that the site work, building, and piping will be designed for the 100 mgd facility. The initial bid package will require that only three 25 mgd pumps (one is a back-up pump) be installed. By adding one or two pumps at a later date, the capacity could be increased to 75 or 100 mgd.

2. The static lift from the treatment plant to the Second Aqueduct is approximately 1,040 feet and may require up to another 200 feet of head to overcome piping and friction losses.

3. One additional (standby) pump will be provided in each station for reliability.
Chapter 5 – Pump Stations

4. The latest design submittal from the Water Authority’s San Vicente Pump Station project will be used as a guideline example.

5. The Water Authority’s Penasquitos Pressure Control and Hydroelectric Facility will be used as an example for instrumentation and control systems.

5.4 Pump Equipment

The pumps for the high flow and high lift condition are unusual and technical data are not found in readily available manufacturer’s catalogs. Instead, the criteria were provided to twenty manufacturers worldwide to determine their interest in supplying the pumps. The pumps would be built specifically for this application and may take 12 to 14 months to build and deliver. Six firms from both the United States and Japan responded. They provided performance information for both vertical turbine and horizontal centrifugal pumps. Typical vertical turbine and horizontal centrifugal pumps are shown in Figures 5-3 and 5-4. None of the manufacturers stock spare parts for these custom-built pumps. The bid documents will require the construction contractor to deliver spares of certain critical parts. Parts that are manufactured in Japan may take 3 to 6 months to obtain. However, other parts may be manufactured in Southern California with a shortened delivery schedule. None of these factors preclude the use of these pumps, and with a regular maintenance program and proper stocking of spare parts, the pumps will be reliable. Many other water utilities in the United States are using similar pumps.

The electric motors for the 25 mgd pumps would be approximately 7,000 horsepower for the single high-pressure station and 3,500 horsepower for the two-station option. Typical layouts for the vertical turbine and horizontal centrifugal pumps are shown in Figures 5-5 and 5-6. As shown in these figures, horizontal centrifugal pumps require a larger building, approximately 29,000 square feet, than vertical turbine pumps, which require approximately 14,000 square feet. To accommodate the shaft and bowl assemblies on the vertical turbine pumps, approximately 30 feet of depth is required below the motor. In addition, some of the horizontal centrifugal pumps require that the pumps be located nearly 100 feet below the water source. Both the building size and pump depth make the horizontal centrifugal pump option impractical for the Encina site.
Chapter 5 – Pump Stations

Each pump will be equipped with a variable frequency drive (VFD), a device that allows the speed of the pump to be changed between 80 percent and 100 percent of normal motor speed. This in turn allows the capacity to be varied from 7.5 to 25 mgd per pump, to better match the treatment plant production rate. Each pump will also have isolation valves on both the suction and discharge sides, and also a pump control valve on the discharge side to allow a gradual startup. Check valves will be provided on the discharge side of each pump to prevent water flowing backwards through the pumps when they are shut off.

A 21-ton bridge crane will be provided to lift the pump equipment onto trucks for service or replacement. The crane is a large double I-beam bridge that runs on tracks high up on the sides of the station walls. A typical crane is shown in Figure 5-5. Generally, the crane would be capable of lifting the largest and heaviest single piece of pump equipment. As an option, to limit the pump building height, vertical turbine pump columns could be lifted by a mobile truck-mounted crane through removable skylights in the roof.

The pump station will be equipped so that it can be controlled on site, or remotely at the Water Authority’s Operations Center. It will be connected to the Operations Center through a fiber optic cable buried with the pipeline. The controls will be coordinated with the treatment plant control system.

5.5 Site Layouts and Constraints

The Encina pump station site is located at the Encina Power Station in Carlsbad, which is owned and operated by Cabrillo Power I LLC (Cabrillo). Poseidon Resources Corporation (Poseidon) has an existing contractual relationship with Cabrillo that provides them with exclusive rights to develop a seawater desalination facility on this site. The Water Authority’s pump station would be an ancillary facility to the treatment plant. Space for the pump station footprint is very constrained, making it imperative that the pump station be as small as possible. For this reason, vertical turbine pumps are preferred. The overall site layout is shown in Figure 5-9 and requires approximately two and one-half acres.

If the two-pump station option were selected, the Water Authority would purchase an undeveloped parcel on a less space constrained site. The alternative locations for a second pump station site are at: adjacent to Maerkle Reservoir, on the proposed Faraday Avenue extension near the Carlsbad/Vista border, at the northeast corner of the intersection of Faraday Avenue and South Melrose Drive, or south of the existing Carlsbad Raceway track, adjacent to the proposed extension of Poinsettia Avenue. These sites could be configured such that the pump station supply could be a steel tank located approximately 100 feet higher than the pump station. For these reasons, it is assumed that the second station would contain horizontal centrifugal pumps, to limit the depth of excavation needed for the station.
5.6 Forebay Storage

If the Seawater Desalination Plant does not have a clear well to store the water supplying the pump station, forebay storage will be required. Therefore, a concrete storage reservoir is planned between the treatment plant and the pump station at Encina. This reservoir is known as a forebay and provides buffer storage to accommodate differences in flow between the treatment plant and the pump station. These differences in flow could be very small but the storage also allows a gradual shut down and start-up of the pumps in the event that the treatment plant stops production or an aqueduct break occurs. The reservoir also provides for smooth flow patterns to the pumps, thus avoiding vortices and inefficiencies.

It has been determined that the 100 mgd pump station at Encina should have a minimum forebay storage of 2.0 MG. It would be difficult and costly to construct this storage in phases, and so it is assumed that all of the storage should be constructed with the first phase of the pump station, the 50 mgd.

If the two pump station alternative is chosen, the minimum forebay storage for the second station should be 2 MG and could be constructed as a steel tank.

5.7 Pump Station Architecture

The pumps will be housed inside a large building. Building floor plans are provided in Figures 5-5 and 5-6 while section views are shown in Figures 5-7 and 5-8. The building will be constructed of concrete or masonry with architectural treatments. Figure 5-10 illustrates architectural treatment that could be typical on all bare walls along the pump station. Architectural renderings of possible buildings are shown in Figures 5-11, 5-12, and 5-13. A simulation of the pump station building between the two fuel oil storage tanks is shown in Figures 5-14 and 5-15 looking from the north side of Agua Hedionda Lagoon and also looking east from Carlsbad Boulevard (Highway 101). It should be noted that the southerly tank is the proposed location for the desalination plant.
Figure 5-8  Typical Building Section (Horizontal Pumps)
Figure 5-12  
Building Rendering B
Proposed Pumping Station

Figure 5-14 Simulation from North
5.8 Hydraulic Transients (Surges) and Control

When pump stations shut off rapidly, such as when there is an unexpected power failure, a hydraulic transient, surge, or water hammer condition can occur. An analysis was made for the single high-pressure pump station and the results are described in Appendix 12. Depending on which Second Aqueduct configuration concept is chosen, a series of pressurized air chambers (surge tanks) may be included at the pump station site to control the surge. These air chambers are cylindrical steel tanks approximately 10 feet in diameter, partially filled with water and air and are pressurized. In the event of a rapid pump shut off, these chambers force the water into the pipeline and dissipate the surge. A typical set of air chambers (surge tanks) is shown in Figure 5-16.

Another way to control surge is the addition of rotating inertial mass to the pumps by means of a flywheel, a large metal disk centered on the pump shaft. In the event of a power failure, the flywheel keeps the pump spinning longer, slowing down the pumping rate in a more gradual fashion and thus, reducing the surge. Adding flywheels to vertical turbine pumps is thought to be feasible, but requires more research for confirmation.
Chapter 6 – Water Quality

6.1 Purpose and Approach

This chapter summarizes the water quality issues associated with introducing desalinated water into an existing potable water system that was evaluated in Appendix 2 and in the “Carlsbad Desalination Pipeline Integration Project Report” (reference Appendix 3). The unique quality of seawater, and likewise desalinated seawater, raises several water quality concerns that need to be addressed. These issues include: corrosion, scaling, hardness, alkalinity, pH, boron, disinfection methods, disinfection residuals, temperature, biological growth potential, water reuse restrictions, public acceptance (aesthetics) and monitoring. The means by which the desalinated water is integrated into the regional distribution system has a large influence on the water quality issues that arise. This chapter identifies potential issues based on very preliminary data and a literature review. In depth water quality studies and pilot testing are planned in the next phase of work to better define the issues and recommend approaches and solutions.

6.2 Chapter Outline

6.3 Effect of Rapid Changes in Source Water Supply
6.4 Water Quality Comparison Between Metropolitan and Desalinated Water
6.5 Encina Treatment Plant Process
6.6 Options for Delivery of Desalinated Water
6.7 Blending Issues
6.8 Water Quality Monitoring
6.9 Future Investigations

6.3 Effect of Rapid Changes in Source Water Supply

It is important that the desalinated water be introduced into the potable water system in a consistent manner. If it is not, then it is possible that some users will face frequent changes between desalinated and Metropolitan water. The risk, at a minimum, is negative public perception of water quality changes. Consumers typically notice rapid changes in water quality based upon aesthetics (taste, odor, and appearance). An aesthetic quality may not be markedly better or worse, but the “difference” can result in customer complaints to the local water district.

Taste and odor can be affected by changes in water quality parameters such as total dissolved solids (TDS), hardness, chlorine residual, and temperature. A number of water taste tests have been performed to determine the consumer’s sensitivity to changes in water constituents (Appendix 3). The tests used TDS as an indicator and determined that consumers can detect a TDS change on the order of a few
hundred milligrams per liter (mg/l). In addition, consumers indicated a preference for water that tastes familiar.

Assuming desalinated seawater supplies have a TDS of 350 mg/L and imported supplies have a TDS of 500 mg/L, discerning consumers will likely notice a difference. There is also a concern that frequent changes between sources may exacerbate corrosion. Substituting one source water for another based on seasonal demand could be problematic. Blending the desalinated water with the existing water supply prior to distribution would be the most effective solution to this potential problem. Issues related to the aesthetic qualities of desalinated water need to be addressed through pilot scale testing, taste panels, and effective public relations and public information programs to gain and maintain public confidence in the water supply.

6.4 Water Quality Comparison Between Metropolitan and Desalinated Water

Water Authority customers currently receive a blend of Colorado River and Northern California river waters. While these sources have very different compositions, Metropolitan stabilizes the quality of the water by blending these sources in their large reservoirs. The water is then treated at Metropolitan’s Skinner Treatment Plant prior to distribution. Table 6.4-1 below, provides a comparison of pre-conditioned reverse osmosis desalinated water permeate and Metropolitan water.

<table>
<thead>
<tr>
<th>Chemical Constituent</th>
<th>Desalinated Water</th>
<th>Metropolitan Water</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium (mg/l)</td>
<td>109</td>
<td>63</td>
<td>Taste, Ag Use, Recycling</td>
</tr>
<tr>
<td>Chloride (mg/l)</td>
<td>177</td>
<td>83</td>
<td>Taste, Ag Use, Recycling</td>
</tr>
<tr>
<td>Calcium (mg/l)</td>
<td>0.7</td>
<td>10</td>
<td>Water Hardness</td>
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<tr>
<td>Magnesium (mg/l)</td>
<td>2.8</td>
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</tr>
<tr>
<td>Sulfate (mg/l)</td>
<td>5.8</td>
<td>179</td>
<td>Scale Formation</td>
</tr>
<tr>
<td>Boron (mg/l)</td>
<td>1</td>
<td>0.13 - 0.23</td>
<td>Ag Use, Public Health</td>
</tr>
<tr>
<td>TDS (units)</td>
<td>302</td>
<td>500</td>
<td>Ag Use, Taste</td>
</tr>
<tr>
<td>Alkalinity (mg/l CaCO3)</td>
<td>3</td>
<td>89</td>
<td>Corrosion Control</td>
</tr>
</tbody>
</table>
6.5 **Encina Treatment Plant Process**

The Water Authority will develop performance criteria, or maximum constituent levels that the water produced at Encina must meet. At a minimum, these criteria will include all drinking water regulations and may include other criteria depending on how the water will be used and blended with the existing sources. Poseidon will then develop a treatment process to meet these criteria. It is anticipated that the desalinated water treatment plant processes will include:

- **Pretreatment** - The seawater will be pre-treated through a process such as filtration to prepare it for reverse osmosis (RO).

- **Reverse Osmosis Treatment** - In RO, seawater is fed to membranes that pass water in preference to dissolved solids when pressure is applied. This results in a product water with very low mineral content. The minerals that have been removed are returned to the ocean as permitted by the regulatory agencies.

- **Post treatment** - After RO, the “desalinated” water is conditioned with additives to make it more closely resemble the typical potable water supply. The end product will still be different in many ways from Metropolitan water. The TDS in desalinated water is composed almost completely of sodium and chloride and the water has a low alkalinity. Conditioning is also used to obtain a pH and mineral balance to avoid corrosion in the distribution system.

- **Disinfection** - With these treatment processes and the addition of free chlorine, viruses, bacteria, and parasites will be controlled. The desalinated water will need to be treated with the same residual disinfectant used by Metropolitan, chloramines, to accommodate blending of the two waters.

- **Plant Shutdowns** - The Encina Power Generating Station shuts down the power plant periodically for maintenance of the cooling water delivery system. During these shutdowns, the desalination treatment plant will also be shutdown because there will be no available power supply. In addition, while the desalination plant will likely have standby components, a potential remains for occasional mechanical or other system failures to cause the plant to shut down. In cases like these, the Metropolitan supply, or other future supplies, will need to make up the difference.

This is a very general description of the anticipated treatment process and pilot testing will need to be performed on the actual system so that modifications and adjustments can be made to meet the performance requirements.
6.6 Options for Delivery of Desalinated Water

The 50 mgd of desalinated water to be produced by the Encina Plant exceeds the average water demands of Carlsbad, Oceanside and the immediately surrounding area. Some of the alternatives developed to accommodate the 50 mgd that the plant will deliver include:

- Provide Carlsbad and other local agencies with desalinated water (amount would be based on their fixed commitment) and convey the excess remainder to the Second Aqueduct.
- Blend desalinated water with Metropolitan water and convey the blend to the Second Aqueduct.
- Convey all the desalinated water to the Second Aqueduct and,
  - Put it straight into the Aqueduct pipeline, or
  - Convey it all to the TODS, blend it with Metropolitan water, and then put it into the Aqueduct pipeline.

All of these options are technically feasible and all have different water quality implications. For example, with the seasonal variation in local and regional demands, certain member agencies could at times receive 100 percent desalinated water and then 100 percent Metropolitan water the next day. Configuration of the Second Aqueduct to accommodate these options is discussed in Chapter 7.

6.7 Blending Issues

6.7.1 Local Water Uses and Recycling

While a reduction in TDS is beneficial for potable and recycled water used for irrigation, there are specific constituents like chloride, sodium, and boron that are damaging to certain crops and occur at higher levels in desalinated water than in Metropolitan water. These constituents can be managed by modifying the treatment processes, but there is an associated increase in the cost of water. In future phases of the engineering analysis, when the uses of the water and the blending strategies are better defined, this topic will need to be addressed in greater detail.

In San Diego County, there are certain water users such as film processing facilities, chemical manufacturers, beverage makers, and kidney dialysis centers that are particularly sensitive to the chemical properties of their water supply. These users typically meet their requirements with onsite treatment configured to accept Metropolitan water. If a significant change in water quality is likely, it
would be appropriate to conduct a public information program prior to system start-up to give these businesses an opportunity to adjust their processes.

### 6.7.2 Corrosion Control

Unconditioned RO permeate usually has low pH, hardness, and alkalinity. Unless a high degree of blending is done at the RO plant, the RO permeate will require supplemental carbonate alkalinity and possibly pH adjustment for stabilization and control of lead and copper leaching. The hardness and pH adjustment is made by adding chemicals such as soda ash or lime, or chemicals additives such as silicates or polyphosphates. Carbon dioxide is typically used for pH adjustment. Pilot scale testing is strongly recommended to define the corrosion control strategy, and ascertain the effects of wide blend swings on corrosion stability. The specific stabilization strategy to be used at the desalination plant should be pilot tested to assess affects on plumbing materials, biofilm stability and aesthetics. In any event, gradual blending of supplies to minimize rapid changes in water quality should be favored.

### 6.8 Water Quality Monitoring

When introducing a new water supply to an existing system, frequent monitoring of constituent levels and comparing the results with drinking water regulations and guidelines is strongly recommended to resolve any potential water quality issues before they become a health or economic concern. The extent of the monitoring will be dependent on the amount of blending that is done prior to distribution. The more blending that is done with the Metropolitan water supply, the less monitoring will be required. The water quality should be tracked along with the effectiveness of the post-treatment strategy on corrosion in the distribution system. The concentration of lead and copper should be monitored throughout the distribution systems, up to and including the point of delivery at the consumer’s tap. Corrosion and scaling control can only be achieved with both conditioning and monitoring. The disinfectant residual must also be monitored in the system and at blending locations. The amount of boron in the desalinated product water must also be measured and compared to acceptable levels for irrigation.

### 6.9 Future Investigations

#### 6.9.1 Flavor Profile Analysis

Expert and lay person panels will be set up to assess the taste and odor characteristics of Skinner water, desalinated seawater with variations of conditioning, as well as blends of Metropolitan and desalinated water using a standard method known as a “Flavor Profile Analysis” (FPA). Three consumer panels of 12 persons each will be used. It is anticipated that the desalinated water will be obtained from Poseidon’s pilot treatment plant at Encina. Should this not be possible, the Water Authority will contract
with membrane manufacturers to develop water that is as close as possible to the Encina product water. The results of the FPA will be used in determining the conditioning approach and also the acceptable blend ratio in the Second Aqueduct. The blending approach will have a significant effect on the facilities required to integrate DWCF with the Aqueduct and is described in Chapter 7.

6.9.2 Corrosion Pipe Loop Testing

The water that comes out of the reverse osmosis membranes is very aggressive towards concrete and metals and without further treatment, corrosion would rapidly destroy the conveyance and distribution system from the treatment plant to the customer’s indoor plumbing. To avoid this, the water will be conditioned with additives to make it more stable. However, good engineering practice calls for performance of “corrosion pipe loop testing” to fine-tune the types and amounts of additives. To perform these tests, water from the Encina pilot treatment plant would be conditioned and then put into sections of actual pipes removed from the transmission, distribution, and home plumbing systems, to observe its effect. The additives are then adjusted until the water does not damage any of the pipes. New pieces of pipe that are typically used in the systems should also be tested.
# Chapter 7 – Second Aqueduct Facilities and Hydraulic Transients Analysis

## 7.1 Introduction

As discussed earlier in this report, local water demands are not large enough to accept all of the 50 mgd of desalinated water produced by the Encina Plant. Therefore, the remainder must be conveyed to the Water Authority’s Second Aqueduct system where it can be distributed to a larger group of member agencies. The Second Aqueduct consists of three parallel pipelines (3, 4, and 5). Pipelines 3 and 4 carry treated (potable) water and are 72 and 96 inches in diameter, respectively. Pipeline 5 carries untreated raw water and is not a part of this discussion. Connection of the DWCF pipeline to the Second Aqueduct was originally conceived to be through the existing TAP. Engineering analyses showed that using the TAP would require too many improvements and modifications to make it an attractive option, and that a new direct connection to the Second Aqueduct would therefore be required.

At first glance, it is easy to assume that the DWCF pipeline can be connected directly to the Aqueduct and the desalinated water added into the Water Authority system at that point. In practice however, the connection to the Second Aqueduct is not nearly as simple as this. As described in this chapter, the actual connection must incorporate provisions for flow regulatory storage and surge control, and may need to incorporate provisions for water quality blending and for delivery of possible expanded desalination flows in the future.

## 7.2 Purpose and Approach

This Chapter presents the major issues associated with integrating the DWCF and the Second Aqueduct. The scope of work for the DWCF did not anticipate the extent of Second Aqueduct facility planning that would be required for this project. Early on, it became apparent that these facilities and costs would be significant, so the Boyle/PBS&J team adjusted the project approach to provide as much detail as could be accommodated. These investigations will continue concurrently with the public outreach and EIR processes in the next six months to bring the level of detail closer to that for the remainder of the DWCF.

## 7.3 Chapter Outline

This chapter includes the following discussions:

- **7.4** Description of the Second Aqueduct System
- **7.5** Water Demands, Water Constituents and Blending Considerations
- **7.6** Facilities and Improvements Required for Connection to the Second Aqueduct
Chapter 7 – Second Aqueduct Facilities

7.4 Description of the Second Aqueduct System

The DWCF would connect to the Second Aqueduct pipelines at a point south of the TODS and north of the San Marcos Vent. A profile view of Pipelines 3 and 4 is shown in Figure 7-1, and a plan view of the DWCF and Second Aqueduct is shown in Figure 7-2. These pipelines flow by gravity from north to south. The division of flows in the two pipelines is controlled at the TODS by means of a weir at elevation 1,078 feet. The TAP is connected to Pipeline 4 and flows by gravity from east to west, supplying portions of VID, Carlsbad (including Maerkle Reservoir), and the southerly portion of Oceanside.

7.4.1 Future Changes and Improvements

Water Authority planning documents show a future conversion of Pipeline 3 to a raw water pipeline. It became apparent in the course of this study, that beneficial opportunities may be possible if Pipeline 3 were utilized as a desalinated water conveyance pipeline as described later in this chapter. As a result of inquiries made during this study, the Water Authority has re-examined their plans and has determined that Pipeline 3 may be able to stay as a treated water pipeline, subject to further study in the coming months.

To help meet future demands, the Water Authority is considering developing a “Twin Oaks Water Treatment Plant.” With a capacity of up to 100 mgd, it is anticipated that this facility would include a large, possibly 10 MG storage reservoir (clearwell). The low-water level of this reservoir would match the TODS elevation of 1,080 feet, allowing the Aqueduct to be fed by gravity. This clearwell would be a good location to pump the desalinated water to for blending, if that project is implemented. If not, other storage locations at TODS may need to be considered.

7.4.2 Meetings With Water Authority Engineering and Operations Departments

A series of meetings was held with the Water Authority’s Engineering and Operations staff to discuss the connection, flows and demands, normal and emergency operations, and facility improvements related to connecting the DWCF with the Second Aqueduct. Their primary concern was protecting the Aqueduct from surge pressures and that their ability to respond to changes in flow and maintain deliveries to member agencies would not be affected. They noted that during winter minimum water demand conditions, the daily demand south of the TAP may be near or even less than 50 mgd, making it necessary to either reduce the amount of desalinated water delivered, put it into storage, or deliver it to the north. To increase or decrease flow in the Aqueduct, Water Authority staff has to call Metropolitan who then adjusts the flow in Riverside County. It can take one to three hours before the flow change reaches the San Marcos area. Therefore, if the desalinated water delivery suddenly stops, Aqueduct
Chapter 7 – Second Aqueduct Facilities

storage would be needed to continue member agency deliveries while Metropolitan sources are activated.

7.5 Water Demands, Water Constituents, and Blending Considerations

Treated water demands on the Second Aqueduct are shown in the table below ("Treated Water Enhancement Study," San Diego County Water Authority, Preliminary Draft, April 2003).

<table>
<thead>
<tr>
<th>Treated Water Demands South of Tri-Agencies Pipeline (TAP) (Inclusive)</th>
<th>YEAR 2005</th>
<th>YEAR 2010</th>
<th>YEAR 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum (Winter) Month (mgd)</td>
<td>71</td>
<td>55*</td>
<td>62</td>
</tr>
<tr>
<td>Maximum (Summer) Month (mgd)</td>
<td>122</td>
<td>93</td>
<td>104</td>
</tr>
</tbody>
</table>

* Assumes that member agencies’ ongoing or planned treatment plant expansions have been completed, thereby allowing member agency to produce more of its own water and take less from the Second Aqueduct.

Per the table, the 50 mgd produced at the Encina Plant can be used by member agencies located south of the TAP. And although, Year 2010 demands decrease in comparison to Year 2005 demands, all of the water could be used. During maximum months, the demand south of the TAP is approximately 100 mgd.

With a 50 mgd treatment plant and DWCF directly connected to the Second Aqueduct, the water delivered to a member agency south of the TAP could vary from 100 percent desalinated water to a blended, 50 percent desalinated and 50 percent Metropolitan water. Both desalinated and Metropolitan waters are good quality and meet drinking water regulations. However, their constituent levels vary and they may taste different. While the Water Authority does not guarantee its member agencies any particular water constituent ratio other than meeting all drinking water regulations, attempts would be made to try to manage changes in water quality so that it will be generally acceptable to the agencies and their consumers.

7.6 Facilities and Improvements Required for Connection to Second Aqueduct

The facilities needed to connect and integrate the operations of the DWCF with the Second Aqueduct, including those needed for the control of hydraulic transients or surges, are discussed below.
7.6.1 Connections

The connection to Pipeline 3 or Pipeline 4 would be made by removing a section of pipe and inserting a “tee” fitting. The DWCF would then be connected to the outlet of the tee and all joints welded. The use and location of shutoff valves on the connection would be determined during final design. Generally, Pipelines 3, 4, and 5 parallel each other, with 3 on the east, 5 on the west, and 4 in the middle. If a connection is made to Pipeline 3, the DWCF will need to cross under Pipelines 5 and 4 and connect into 3 on the east side. Similarly, for a connection to Pipeline 4, the DWCF would cross under Pipeline 5.

Connection points have been identified near the intersection of San Marcos Boulevard and Rancho Santa Fe Road and also near Pawnee Street and Rancho Santa Fe Road, as shown on the alignment mapping. The site near San Marcos Boulevard may need to be moved north to find a better location for the flow control facility described in the next paragraph.

7.6.2 Downstream Flow Control Facilities

A flow control facility is required in all of the concepts connecting to Pipeline 3 or 4, to meter flow south of the connection point. To construct the flow control facility, a section of the pipeline would be removed and large valves inserted to be used by the Water Authority staff to limit the amount of flow going south to meet member agencies’ demands. The remaining water would flow north. The valves would likely be housed in an above ground masonry building structure.

7.6.3 Pipeline Relining

If an alternative is selected that pressurizes Pipelines 3 or 4 above their design pressure, the Pipeline needs to be relined to withstand the higher pressure. The Water Authority has developed an approach where a steel liner is inserted in an existing pipeline to develop the additional strength needed. There is some reduction in diameter and hydraulic capacity associated with this relining process. Pipeline 3 is a welded steel pipe and it may be possible, through special structural analysis, to strengthen the joints between pipe sections rather than relining. Some portions of Pipeline 4 are also steel while other prestressed sections are “low pressure.” These conditions may allow for joint strengthening rather than relining, similar to Pipeline 3. Relining would then be applied primarily to prestressed steel pipe, subjected to high pressures.

7.6.4 Flow Regulatory Reservoirs

Reservoirs placed in the system potentially serve two functions: 1) isolating the Second Aqueduct from surges, and 2) providing water to the Second Aqueduct to replace the desalinated supply should the DWCF pump station shut down. To avoid Aqueduct modifications, desalinated water would be pumped
directly to a reservoir located at an elevation of approximately 1,100 feet and would then flow by gravity to the Second Aqueduct as illustrated in Figure 7-3. This type of reservoir would serve both functions. The Buena Creek Reservoir concept described in Appendix 12 falls into this category.

Another concept was developed where a portion of Pipeline 3 would be converted to a transmission main to deliver desalinated water to the TODS and to a reservoir at that location. For this concept, member agency turnouts and interconnections of Pipeline 5 with Pipeline 4 would have to be removed. This concept would not isolate Pipeline 3 from surges, but would isolate Pipeline 4. It would also provide the necessary supply in the event of a pump station shut off.

Another concept developed was to locate storage at the San Marcos Vent. While this would not protect Pipelines 3 or 4 against surges, it could provide a water supply to the Second Aqueduct in the event of a sudden decrease in desalinated water flows.

### 7.6.5 Possible San Marcos Vent Tunnel

Depending on how the connection and the Second Aqueduct are configured, it is possible that a pump trip-out could result in the hydraulic gradient of the connected aqueduct pipeline dropping below the elevation of the San Marcos Vent. In this situation, flow south of the vent would be interrupted. A possible remedy to this situation would be to lower the vent elevation by means of a tunnel.

In some of the transient analyses, when the pump station shuts off, and the desalinated water delivery stops suddenly, a phenomena known as “column separation” occurs. When this happens, the water flow that was moving through the pipe actually separates and moves in opposite directions, creating a vacuum that can damage pipes. In some cases, this can be remedied by constructing a tunnel to lower the pipeline, such as at the San Marcos Vent.

### 7.6.6 Member Agency Connections

There are a number of member agency flow control facilities (FCFs) connecting to Pipelines 3 and 4. These FCFs consist of piping and valving that regulate the flow to the agency. The facilities are typically housed in below ground vaults or above ground buildings. Should one of the Pipelines be pressurized, the valves in these facilities may need to be upgraded to accommodate the higher pressures. If Pipeline 3 were converted to a transmission main to deliver desalinated water to the TODS, all member agency connections would need to be transferred over to Pipeline 4 and any interconnections between Pipelines 3 and 4 removed.
Figure 7-3 Second Aqueduct Connection Options

NO SECOND AQUEDUCT IMPROVEMENTS

NEW RESERVOIR
EL. 1100' (APPROXIMATELY)
PROPOSED ENCINA PUMP STATION
EL. 40'
SECOND AQUEDUCT

DWCF
NEW P/L

WITH SECOND AQUEDUCT IMPROVEMENTS

TWIN OAKS DIVERSION STRUCTURE
EL. 1100' (APPROXIMATELY)
PROPOSED ENCINA PUMP STATION
EL. 40'
SECOND AQUEDUCT

DWCF
EX. P/L 3
EX. P/L 4

Desalinated Water Conveyance Facilities Alignment Investigation Report
7.6.7 Hydraulic Transient (Surge) Analysis

A model was developed of the Aqueduct system to simulate pump station shut off surge conditions. The analysis used a 100 mgd sized system because this is the worst-case condition and would account for possible future expansion of the Encina Plant. Note that the pump station moment of inertia shown in the table represents the total for all of the pumps in the Encina Plant. More that 12 analyses of Second Aqueduct connection concepts were examined and by applying various surge control approaches, eight appear to be feasible (reference Appendix 12). The table below shows the concepts across the top, with the surge control facilities on the side. The concepts include two directly connecting to Pipeline 4, one pumping directly to a theoretical Buena Creek Reservoir and then gravity feeding back to the Aqueduct, and three concepts that use Pipeline 3 to convey desalinated water to the TOD. Pumping to either the Buena Creek Reservoir or the TODS appears to offer better water blending capabilities.
Table 7.6.1 – Carlsbad Desalinated Water Conveyance Facilities
Summary of Facility Improvements Associated with Transient Control Alternatives

<table>
<thead>
<tr>
<th></th>
<th>Unlined P4 50 mgd</th>
<th>Unlined P4 100 mgd</th>
<th>Relined P4 100 mgd</th>
<th>BC Reservoir 100 mgd</th>
<th>P3 to TODS 50 mgd</th>
<th>P3 to TODS 100 mgd</th>
<th>P3 to TODS 100 mgd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Control Facility -- Elevation</td>
<td>N</td>
<td>N</td>
<td>P4 SM 920</td>
<td>BC Reservoir</td>
<td>P3 635</td>
<td>P3 635</td>
<td>P3 635</td>
</tr>
<tr>
<td>Modify P3 FCF’s</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>N</td>
<td>Eliminate</td>
<td>Eliminate</td>
<td>Eliminate</td>
</tr>
<tr>
<td>Modify P4 FCF’s</td>
<td>Yes</td>
<td>Yes</td>
<td>Eliminate</td>
<td>N</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Modify Member Agency FCF’s</td>
<td>Yes</td>
<td>Yes</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Pipeline Relining</td>
<td>N</td>
<td>N</td>
<td>P4</td>
<td>N</td>
<td>N**</td>
<td>N**</td>
<td>N**</td>
</tr>
<tr>
<td>Storage (MG)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>-- Location</td>
<td>SM Vent</td>
<td>TODS</td>
<td>TODS</td>
<td>BC</td>
<td>TODS</td>
<td>TODS</td>
<td>TODS</td>
</tr>
<tr>
<td>Tunnel</td>
<td>N</td>
<td>N</td>
<td>SM Vent</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Air Chambers (Gal)</td>
<td>N</td>
<td>170,000*</td>
<td>140,000*</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>100,000 BC</td>
</tr>
<tr>
<td>Increased PS Moment of Inertia (lb-ft^2/sec) ***</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>21,800,000</td>
<td>N</td>
<td>21,800,000</td>
<td>21,800,000</td>
</tr>
<tr>
<td>Added Pipeline</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>****</td>
<td>17,000' of 60&quot;</td>
<td>N</td>
<td>670' of 72&quot; &quot;Surge Pipe&quot;</td>
</tr>
</tbody>
</table>

Notes:
N = Not required
P4 = Pipeline 4
SM = San Marcos
TODS = Twin Oaks Diversion Structure
BC = Buena Creek
* Varies with diameter of pipeline
** Probably not required for steel pipe, may be required for prestressed pipe. Joint welding may also be necessary
*** The feasibility of adding flywheels to vertical turbine pumps requires more investigation with manufacturers.
**** In lieu of new pipe, this alternative could also be considered using P3 as a dedicated desalination conveyance.
7.6.8 Future Investigations

The investigations completed for this report are very preliminary and subject to change. Detailed future studies are required.

7.6.9 Construction Scheduling

Second Aqueduct improvements need to be planned, designed, and constructed before the planned completion of the other DWCF facilities.
8.1 Purpose and Approach

This chapter provides a summary review of the “Preliminary Geotechnical Report,” (Appendix 10) and “Abbreviated Phase 1 Environmental Assessment” (Appendix 11) that examined geotechnical, geological and subsurface conditions existing along the project alignments. Regional and local soils and geology and their effect on construction, as well as a preliminary evaluation of the potential for soil and/or groundwater impacts from subsurface hazardous material sites were investigated.

The geotechnical report was based upon a review of existing geotechnical data, including geotechnical reports from land development projects located adjacent to the proposed alignments, Caltrans logs of test borings for bridges along I-5, published geologic literature, maps of the project area and a brief field review. A search was performed of federal, state, and local government environmental information databases of documented hazardous materials sites, or sites with the presence of known contaminants located near the alignments. The search indicated that there are some sites that could potentially impact an alignment.

8.2 Chapter Outline

8.3 Soils and Geology
8.4 Contaminated Soils
8.5 Groundwater
8.6 Flooding
8.7 Seismicity
8.8 Backfill and Bedding
8.9 Blue Alignment Excavation and Trench Conditions
8.10 Green Alignment Excavation and Trench Conditions
8.11 Orange Alignment Excavation and Trench Conditions
8.12 Shoring Methods
8.13 Future Investigations

8.3 Soils and Geology

Local geology is identified in Figure 8-1. Soils are grouped by their geotechnical properties as it relates to trenching or tunneling. The earth materials shown are conceptually divided into the following seven units. Existing fills are not shown on the map.

- Unit 1- These deposits are typically soft or loose, have a high liquefaction potential, excavate easily but generally require shoring and dewatering.
8.4 Contaminated Soils

The need for groundwater or soil sampling to confirm presence of contaminated soils or groundwater should be determined during final design activities. The sites reported in Appendix 11 as possibly containing soil and/or groundwater contamination are shown in Figure 8-2.

8.5 Groundwater

Shallow groundwater is anticipated in the low-lying coastal areas adjacent to Agua Hedionda Lagoon, in canyon bottoms, and other portions of the project site where alluvial soils may be encountered.

8.6 Flooding

Flooding could occur during and after periods of heavy rain in the stream channels of Agua Hedionda Creek and its tributaries. During these periods of flooding, depending on flow velocities and properties of the sediments, the sediments could be scoured. The potential for scour and flooding will require evaluation during final design.
8.7 Backfill and Bedding

The preliminary investigation conducted to date indicates that Water Authority Standards for backfill and bedding will be sufficient for DWCF project specific requirements.

8.8 Blue Alignment Excavation and Trench Conditions

8.8.1 Excavation/Blasting

Earth materials along this alignment are primary fills, sedimentary deposits, and hard rock formations. Primary fills and sedimentary deposits can generally be excavated with moderate to heavy effort using conventional excavation equipment. Hard rock formations may be extremely difficult and blasting or other special techniques may be required. Hard rock formations may be encountered in the undeveloped areas north and east of Agua Hedionda Creek north of El Camino Real.

8.8.2 Caving

Most earth materials along the Blue Alignment are not generally highly susceptible to caving, with the exception of the Encina Plant area and along Cannon Road and El Camino Real adjacent to estuarine areas or Agua Hedionda Creek. Saturated sand, soft clayey, or silty materials are highly prone to caving. Shallow groundwater is expected near the Encina Plant, in areas along Cannon Road and El Camino Real, and in the Agua Hedionda Creek crossing.

8.9 Green Alignment

8.9.1 Excavation/Blasting Conditions

Earth materials along this alignment are primary fills, sedimentary deposits, and hard rock formations. Primary fills and sedimentary deposits are generally excavatable with moderate to heavy effort using conventional excavation equipment. Hard rock formations may be extremely difficult and blasting or other special techniques may be required. Hard rock may be encountered in the area north of Palomar Airport and further east of El Camino Real along the remainder of the Green Alignment.
8.9.2 Caving

The Encina Plant and alluvial streams or canyon crossings are the only areas generally susceptible to caving. Shallow groundwater is not expected along most of the alignment, except near the Encina Plant where the permanent groundwater is shallow.

8.10 Orange Alignment

8.10.1 Excavation/Blasting Conditions

Earth materials along this alignment are primary fills and sedimentary deposits that are generally excavatable with moderate to heavy effort using conventional excavation equipment. Hard rock could be encountered however, in the stretch between Rutherford Road and Palomar Airport Road along El Camino Real, as well as in the area north of Palomar Airport.

8.10.2 Caving

Most earth materials along the Orange alignment are generally not highly susceptible to caving, with the exception of the area of the Encina Plant where saturated sandy or soft clayey or silty materials highly prone to caving. No shallow groundwater is expected along most of the alignment, except near the Encina Plant where the permanent groundwater table is several feet above sea level.

8.11 Shoring

Figures 8-3 (A-B) summarize the locations where shoring will probably be required during construction along each of the alignments. They also identify the shoring method to be employed. This methodology is based upon the geotechnical assessment with no field exploration performed and may be modified after field explorations are performed. In general, shoring will be required where the width of the construction zone is limited. Shoring would be installed to temporarily retain the earth for worker protection. Typically, shoring systems provide ground reinforcement and stabilization, earth support and retention, cost savings, speedy excavation, and project schedule acceleration. Traditional shoring methods include sheetpiling, soldier piles, and shielding. Shoring is the responsibility of the contractor and was investigated solely to assist in construction cost estimating. Provided below is a brief description of the shoring methodologies included in the Figures.

**Sheetpiling** - Requires a special type of pile used to form in situ walls for earth retention and excavation support. Steel sheetpiling is commonly used. Wood and concrete sheetpiling should only be used in limited conditions.
## PRELIMINARY
### PROBABLE SHORING METHODOLOGY
#### CARLSBAD DESALINATED WATER CONVEYANCE PROJECT

<table>
<thead>
<tr>
<th>ALIGNMENT</th>
<th>FROM</th>
<th>TO</th>
<th>PIPELINE SECTIONS</th>
<th>SOIL TYPE</th>
<th>PROBABLE SHORING METHODOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORANGE</td>
<td>Proposed Pump Station</td>
<td>Center of Legoland</td>
<td>202, 214, 213, 219, 218, 234, 231, 250</td>
<td>Terrace Deposits/Older Alluvium</td>
<td>Trench Shields</td>
</tr>
<tr>
<td>GREEN</td>
<td>Proposed Pump Station</td>
<td>RR Track Crossing</td>
<td>202</td>
<td>Fill Soils</td>
<td>Trench Shields</td>
</tr>
<tr>
<td></td>
<td>RR Track Crossing</td>
<td>Beginning of Tunnel Section</td>
<td>201, 203, 230</td>
<td>Terrace Deposits/Older Alluvium</td>
<td>Trench Shields</td>
</tr>
<tr>
<td></td>
<td>Beginning of Tunnel Section</td>
<td>End of Tunnel Section</td>
<td>238</td>
<td>Sedimentary Formation, Alluvial Soils</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>About 600 feet beyond Whitman Way &amp; Faraday</td>
<td>Faraday Ave and Halley Dr</td>
<td>313</td>
<td>Fill Soils/Alluvium</td>
<td>Sheetpiles (where groundwater likely) or Soldier Pile (where groundwater not anticipated but loose sands possible)</td>
</tr>
<tr>
<td></td>
<td>Faraday Ave and Halley Dr</td>
<td>Park Center Dr</td>
<td>313, 317, 419, 510, 509, 504, 503</td>
<td>Sedimentary Formation, Fill, or Rock</td>
<td>Trench Shields</td>
</tr>
<tr>
<td></td>
<td>Park Center Dr</td>
<td>S Melrose Dr and Sycamore Ave</td>
<td>502, 526,</td>
<td>Sedimentary Formation, Conglomerate, or Rock</td>
<td>Trench Shields</td>
</tr>
<tr>
<td></td>
<td>S Melrose Dr and Sycamore Ave</td>
<td>Rancho Santa Fe Road</td>
<td>529, 530 (parallel TAF)</td>
<td>Sedimentary Formation</td>
<td>Trench Shields</td>
</tr>
<tr>
<td>BLUE</td>
<td>Proposed Pump Station</td>
<td>RR Track Crossing</td>
<td>202</td>
<td>Fill Soils</td>
<td>Trench Shields</td>
</tr>
<tr>
<td></td>
<td>RR Track Crossing</td>
<td>Beginning of Tunnel Section</td>
<td>201, 203, 230</td>
<td>Terrace Deposits/Older Alluvium</td>
<td>Trench Shields</td>
</tr>
<tr>
<td></td>
<td>Beginning of Tunnel Section</td>
<td>End of Tunnel Section</td>
<td>238</td>
<td>Sedimentary Formation, Alluvial Soils</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>About 400 feet north of Cannon &amp; Faraday</td>
<td>Beginning of Tunnel at Cannon Road Bridge</td>
<td>315</td>
<td>Sedimentary Formation</td>
<td>Trench Shields</td>
</tr>
<tr>
<td></td>
<td>About 400 feet north of Cannon &amp; Faraday</td>
<td>Beginning of Tunnel at Cannon Road Bridge</td>
<td>315</td>
<td>Alluvium</td>
<td>Sheetpiles (where groundwater likely) or Soldier Pile (where groundwater not anticipated but loose sands possible)</td>
</tr>
</tbody>
</table>

---

**Desalinated Water Conveyance Facilities Alignment Investigation Report**

Figure 8-3(A) Shoring Methodology
<table>
<thead>
<tr>
<th>ALIGNMENT</th>
<th>FROM</th>
<th>TO</th>
<th>PIPELINE SECTIONS</th>
<th>SOIL TYPE</th>
<th>PROBABLE SHORING METHODOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of Tunnel at Cannon Road Bridge</td>
<td>Beginning of Tunnel at El Camino Real</td>
<td>316</td>
<td>Alluvium</td>
<td>Sheetpile (groundwater likely)</td>
<td></td>
</tr>
<tr>
<td>Beginning of Tunnel at El Camino Real</td>
<td>End of Tunnel at El Camino Real</td>
<td>316</td>
<td>Alluvium</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>End of Tunnel at El Camino Real</td>
<td>Rancho Carlsbad Drive and El Camino Real</td>
<td>316</td>
<td>Alluvium</td>
<td>Sheetpiles (where groundwater likely) or Soldier Pile (where groundwater not anticipated)</td>
<td></td>
</tr>
<tr>
<td>Rancho Carlsbad Drive and El Camino Real</td>
<td>Palmer Way and Cougar Drive</td>
<td>316, 312, 417</td>
<td>Terrace Deposits/Older Alluvium/Claystones</td>
<td>Trench Shields</td>
<td></td>
</tr>
<tr>
<td>Palmer Way and Cougar Drive</td>
<td>Begin Hendionda Creek Bottom</td>
<td>417</td>
<td>Conglomerate</td>
<td>Trench Shields</td>
<td></td>
</tr>
<tr>
<td>Begin Hendionda Creek Bottom</td>
<td>End Hendionda Creek Bottom</td>
<td>417</td>
<td>Alluvium</td>
<td>Sheetpiles (groundwater probable)</td>
<td></td>
</tr>
<tr>
<td>End Hendionda Creek Bottom</td>
<td>Shadowridge Dr/ Tri-Agencies Pipeline</td>
<td>417, 413, 406, 410</td>
<td>Conglomerate, Rock, Sedimentary Formation</td>
<td>Trench Shields</td>
<td></td>
</tr>
<tr>
<td>Shadowridge Dr/ Tri-Agencies Pipeline</td>
<td>Begin Canyon Bottom just east of Shadow Crest</td>
<td>425</td>
<td>Rock</td>
<td>Trench Shields</td>
<td></td>
</tr>
<tr>
<td>Begin Canyon Bottom just east of Shadow Crest</td>
<td>End Canyon Bottom just east of Shadow Crest</td>
<td>425</td>
<td>Alluvium</td>
<td>Sheetpiles (groundwater probable)</td>
<td></td>
</tr>
<tr>
<td>End Canyon Bottom just east of Shadow Crest</td>
<td>Begin West Agua Hendionda Creek Bottom</td>
<td>425</td>
<td>Rock</td>
<td>Trench Shields</td>
<td></td>
</tr>
<tr>
<td>Begin West Agua Hendionda Creek Bottom</td>
<td>End East Agua Hendionda Creek Bottom</td>
<td>527</td>
<td>Alluvium</td>
<td>Sheetpiles (groundwater probable)</td>
<td></td>
</tr>
<tr>
<td>End East Agua Hendionda Creek Bottom</td>
<td>Sycamore and La Mirada</td>
<td>527</td>
<td>Rock and Fill</td>
<td>Trench Shields</td>
<td></td>
</tr>
<tr>
<td>Sycamore and La Mirada</td>
<td>San Diego Aqueduct</td>
<td>529, 530</td>
<td>Sedimentary Formation</td>
<td>Trench Shields</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1) In areas with sufficient access, shoring may not be required where trench may be safely sloped and cost effective.
2) For shoring in caving prone sands or soft, loose, or wet soils below the water table, or where protection of existing facilities is required, cantilever or braced systems such as sheetpiles or soldier pile and lagging systems will be most suitable.
3) Most of the excavations in Units 3 through 7, in areas where protection of existing facilities is not required, can likely be accomplished using trench shields.
4) If groundwater seepage is minor, trench shields may be used with sump pumps.
5) Shoring methodology based upon geotechnical assessment with no field exploration performed. Methodology may be modified after field exploration performed.
Soldier Piles - A method of constructing an earth retaining structure using steel piles spaced along the perimeter of the excavation. Between the piles, horizontal planking is placed to create a retaining wall as the earth is removed.

Shielding - Refers to structures that are able to withstand the forces imposed on them by a cave-in and thereby protects workers within the structure. Shields can be permanent or can be designed to be portable and moved along as the work progresses. Additionally, shields can be either pre-manufactured or built onsite. Shields used in trenches are usually referred to as "Trench Shields."

8.12 Future Investigations

The geotechnical investigations completed for this report are preliminary and additional detailed investigations are required to develop site-specific data with improved variations of the concepts presented herein. The investigations are recommended to include 4 borings per mile drilled to a depth below the bottom of the pipe trench, observation and characterization of the excavated soils, laboratory testing, and preparation of a report with recommendations for design parameters.
Chapter 9 – Environmental Screening and Permits

9.1 Introduction

9.1.1 Purpose and Approach

The investigations conducted on this project are to support the environmental review process that will ultimately select the preferred alignment for the Desalinated Water Conveyance Facilities pipeline and pump station(s). An EIR is being prepared in compliance with the CEQA. That document will include both the proposed Seawater Desalination Plant and the pipelines that will convey the desalinated water to the source point(s) for distribution to consumers (the conveyance facilities). The EIR is being prepared under a separate contract by another Water Authority consultant who has just begun the environmental documentation process. As such, detailed environmental information was not available at the time of this investigation. However, the conveyance facility team did coordinate with the Water Authority’s environmental consultant and their input has been incorporated throughout the investigation process to the maximum extent possible. Meetings conducted with the City of Carlsbad also provided valuable information on areas of environmental significance and open space preserves that could not be disturbed. Where alignments crossed environmentally sensitive areas, tunneling options were investigated to limit surface disturbances.

The purpose of this chapter is to review the environmental issues associated with construction of each of the alignment alternatives. Environmental screening included biological, cultural resources and land use impacts, jurisdictional boundaries, regulatory (permit) requirements, and noise and traffic constraints. The approach utilized has been to review and summarize the detailed reports prepared for traffic, noise, permitting and hazardous materials constraints. Biological, archeological (cultural resources) and land use impacts are based upon information provided by the Environmental Consultant, the City of Carlsbad’s Habitat Management Plan, and our knowledge of the surrounding environment. While this “knowledge” is not a substitute for field surveys, it can provide some insight into visibly recognized issues that focused surveys will quantitatively be determined by the environmental consultant.

9.1.2 Chapter Outline

This chapter is divided into the following sections:

9.2 Environmental Screening (includes Biology/Sensitive Habitat, Cultural Resources, Land Use, City of Carlsbad Habitat Management Plan)
9.3 Jurisdictional Agencies, Permits, Reviews and Approvals
9.4 Noise Constraints
9.5 Traffic Evaluation
9.6 Environmental Constraints Table
9.2 Environmental Screening

The following information was provided by the Water Authority’s environmental consultant in regards to the various desalination conveyance system alignments. This environmental information is separated into four different categories: biology/sensitive habitat, cultural resources, land use/noise, and traffic impacts. This information will ultimately be used in selecting a single preferred alignment. Please note that formal technical studies for this project have yet to be completed, and this information should be considered preliminary and subject to change.

9.2.1 Biology/Sensitive Habitat

Any pipeline that traverses native vegetation or requires a creek crossing (whether via trench, tunnel or above-grade span) warrants special consideration due to sensitive species/habitat concerns and will likely require regulatory agency involvement. Tunnel construction is also a recent regulatory concern, relative to “frac-outs” (“Frac-outs” are the uncontrolled spilling of drilling fluids, usually Bentonite, into the environment. This happens when a hole being drilled fractures or collapses and the fluids that are used to lubricate the drill bit seep out of the hole and the bentonite mud finds a way up through a fracture in the ground, causing what is called a frac out). These impacts can typically be addressed through avoidance, special construction measures (fencing, noise blankets, seasonal avoidance) and/or through developing mitigation programs in consultation with the regulatory agencies (where warranted). Biological and/or sensitive habitat locations along each of the alignment alternatives are presented below.

**Blue Alignment**

- **Agua Hedionda Lagoon/Creek:** Segments 203 and 230 along the westerly portion of the blue alignment are situated very close to the lagoon and Agua Hedionda Creek, both biologically sensitive. Care must be taken during construction to limit disturbances and to keep staging areas away from sensitive resources. Also, a network of electricity transmission lines "criss-crosses" this area, potentially posing challenges during construction and requiring coordination with San Diego Gas and Electric Company (SDG&E).

- **Portion of pipeline within open space area southwest of Maerkle Reservoir:** Segment 413 crosses areas composed primarily of coastal sage scrub habitat, with spots of chaparral mixed in primarily along the hillsides. Chaparral habitat is a sensitive biological resource. Another potential constraint is at Agua Hedionda Creek, where Segment 417 crosses to reach Maerkle Reservoir from El Camino Real.
Portion of pipeline within open space area directly east of Maerkle Reservoir: This portion of the blue alignment is composed of coastal sage scrub. Agua Hedionda Creek exists within the southern portion of this area but does not appear to be impacted. No major biological constraints are anticipated.

**Green Alignment**

**Agua Hedionda Lagoon/Creek:** Segments 203 and 230 along the westerly portion of the green alignment are the same as the blue alignment and are situated very close to the lagoon and Agua Hedionda Creek, both biologically sensitive. Care must be taken during construction to limit disturbances and to keep staging areas away from sensitive resources. Also, a network of electricity transmission lines "criss-crosses" this area, potentially posing challenges during construction and requiring coordination with SDG&E.

**Portion of pipeline East of Faraday within undeveloped area northeast of the airport:** Segments 510, 509, 504 and 503 traverse a large native area. This area contains sensitive biological resources, and crosses Agua Hedionda Creek. It is through the proposed Carlsbad Oaks North development and as such, biological impacts will be mitigated by the developer, not the Water Authority. If this alignment is selected, it is assumed that pipeline construction would only occur after the developer has graded the Faraday Road extension. No biological constraints are anticipated.

**Orange Alignment**

**Portion of pipeline in the vicinity of the Carlsbad Raceway:** The majority of Segment 517 runs through coastal sage scrub/non-native grassland habitat, with some areas of riparian/wetlands that are potentially sensitive. Agua Hedionda Creek traverses a large portion of this area, and is also biologically sensitive.

### 9.2.2 Cultural Resources

Without the benefit of field reconnaissance and an extensive literature.records review, it cannot be determined which pipeline alignments would be constrained by cultural resources. However, any pipeline traversing native areas should be considered as having the potential to impact archaeological, paleontological, and/or historical resources. As such, it would appear that small to moderate portions of each pipeline alignment may impact cultural resources, with the blue alignment traversing the most native area, the green alignment traversing a bit less, and the orange alignment traversing the least native area. These impacts can typically be addressed through avoidance, pre-construction “Phase II” investigations and salvage, and construction monitoring.
9.2.3 Land Use

The proposed pipeline alignments would have short-term land use/noise impacts to some adjacent properties. These impacts would primarily affect nearby residential uses and sensitive biological receptors. It is assumed that no significant long-term operational impacts would occur from the conveyance pipeline and all pump stations would incorporate sufficient noise control elements to mitigate any potential impacts by proper facility siting (as far from sensitive receptors as possible), berms, building enclosures or baffles and sound attenuation devices built into the structure itself to reduce noise to less than significant levels. Noise issues are further discussed in Section 9.4 Acoustical Screening Analysis Summary. Land uses surrounding the alignments are as follows:

- Blue Alignment: The blue pipeline alignment is situated adjacent to numerous residential developments, concentrated primarily within the central and eastern portions of the alignment. This alignment would most likely have the greatest land use constraints.

- Green Alignment: The green alignment is situated adjacent to residential developments at its western- and eastern-most portions (the western-most residential development is still undergoing construction). The central portion of this alignment runs through an industrial area adjacent to the airport.

- Orange Alignment: The orange alignment is situated adjacent to residential receptors within its easternmost portion. All other areas of the pipeline are located near commercial, open space, or industrial uses.

9.2.4 Carlsbad Habitat Management Plan

The City of Carlsbad’s Habitat Management Plan (HMP) is a citywide program for conserving wildlife species and their habitats, particularly species listed as endangered or threatened. The HMP was adopted by the City Council in September 1999 and was updated and amended on January 22, 2003. The City entered into agreements with the U.S. Fish and Wildlife Service and California Department of Fish and Game that gives regulatory approval of the HMP as it relates to the preservation, protection and removal of sensitive habitats and waters. The HMP includes areas known as “Hardline Areas,” further broken down to Proposed Hardline and Existing Hardline areas. Proposed Hardline Areas are defined as properties with conservation and development areas already defined in the HMP. The City would automatically permit any development on these lands that are in substantial conformance with the HMP. Alignment segments crossing Proposed Hardline Areas will need further environmental screening to refine the alignment to either fit with the development’s approved impact areas, or avoid or tunnel under the conserved area. The areas are as follows:

Blue and Green Alignments - Segment 230 and 238, crossing SDG&E’s Hub Park.
Orange Alignment - Segment 223, crossing City Golf Course; and

Existing Hardline areas are areas that have already been conserved or set aside for open space and are mitigation for projects that have been constructed. Impacts to existing hardline areas may not be permitted by the City, which could cause these alignment segments to be tunneled or abandoned. Along the Blue alignment, Segment 406 would need confirmation that it avoids the Hardline Area around Maerkle Reservoir. Segment 238 on the Blue and Green alignment would be tunneled, so there would be no impact to Existing Hardline Areas.

9.3 Jurisdictional Agencies, Permits, Reviews, and Approvals

9.3.1 Purpose and Approach

An overview of the jurisdictional approvals and permit requirements for the Desalinated Water Conveyance Facility (DWCF) Pipeline alignment alternatives is discussed herein. The alignments are shown in Figure 9-1, “Jurisdictional Boundary Map.” Detailed permit matrices specifically identifying the permits associated with each alignment alternative are included in Appendix 5, “Pipeline Preliminary Design Technical Memorandum.” Alternative segments of the primary alignments (dashed lines on Jurisdictional Boundary Map) and the red “connecting” alignments are not separately identified because they pose no additional permit constraints, as they do not cross any environmentally sensitive areas and are primarily located in existing streets in the public right-of-way. The discussion herein summarizes the regulatory implications of the primary alignment alternatives (Blue, Green and Orange) only. Permits or approvals that are common to all three alignments will be presented first, followed by the unique regulatory requirements associated with individual alignment segments. A summary table (Table 9.3 -3) is included that identifies the potential permits for the three alignments and is provided for comparative analysis.

Permits that will be required for all three alignment alternatives are shown in Table 9.3 -1. While the alignment segment locations may vary, the same type of permit will be required from the same agency. Therefore, the level of difficulty in obtaining these particular permits is relatively equal. It should be noted that alignment segments shown in roadways proposed to be built by developers (Faraday, Melrose and Poinsettia (racetrack) extensions), are assumed to be built by those developers (meaning that the DWCF pipeline would be built with the street). The DWCF would not break new ground in these areas, but rather be installed as part of the developer’s roadway construction. It was assumed that should these extensions not be built in time, then the Water Authority would not utilize that particular segment and an alternate connecting segment would be used instead.
Chapter 9 – Environmental Screening and Permits

Table 9.3-1 – DWCF Common Permits

<table>
<thead>
<tr>
<th>Agency, Permit</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Department of Transportation, Encroachment Permit</td>
</tr>
<tr>
<td>Cal-OSHA, Excavation Permit and Underground Classification</td>
</tr>
<tr>
<td>State Water Resources Control Board, Compliance with General Storm Water Order</td>
</tr>
<tr>
<td>Regional Water Quality Control Board, Dewatering Permit and Hydrostatic Pipe Testing</td>
</tr>
<tr>
<td>County HMMD, Well Drilling Permit</td>
</tr>
<tr>
<td>North County Transit Development Board, License Agreement</td>
</tr>
<tr>
<td>Kinder Morgan, Pipeline Inspection Agreement</td>
</tr>
<tr>
<td>Cities of Carlsbad, Vista and San Marcos Right-Way-Use Permits and Noise Variances</td>
</tr>
</tbody>
</table>

9.3.2 Permit Issues

The project’s environmental document will include both the Desalinated Water Treatment Plant and the Conveyance Facilities as one project. This will cause the resource agencies to consider both the treatment plant and the conveyance facilities as a “single and complete” project and would require that one permit be issued that includes both facilities. Table 9.3-2 below identifies those permits. Since the owner of the treatment plant will have primary permit responsibility and the affected DWCF components will have to be included in their permit applications, this creates a level of difficulty in attaining these permits.

Table 9.3-2 – Desalinated Water Treatment Plant/Conveyance Facility Joint Permits

<table>
<thead>
<tr>
<th>Agency, Permit</th>
<th>Desalination Plant</th>
<th>Blue Alignment</th>
<th>Green Alignment</th>
<th>Orange Alignment</th>
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<tr>
<td>U.S. Army Corps of Engineers, Section 404</td>
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<tr>
<td>U.S. Fish &amp; Wildlife Service, Section 10</td>
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<td>California Coastal Commission</td>
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<td>●</td>
</tr>
<tr>
<td>Regional Water Quality Control Board, Section 401 Water Quality Certification</td>
<td>●</td>
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<tr>
<td>California Department of Fish &amp; Game, Section 1601 Streambed Alteration Agreement</td>
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</tbody>
</table>
Specific permits and/or approvals that are unique to a segment are identified below. These are listed by the permitting agency with the affected Segment number (to accommodate the overlap between some alignments), along with a brief explanation of the associated permit issue.

**California Department of Fish & Game, Wildlife Conservation Board**

**Segment 230 and 238 (Blue and Green Alignments)**

The blue and green alignments will require easements/permits from the State of California, Department of Fish and Game, Wildlife Conservation Board where Segment 238 crosses under the corner of parcel 208-020-44. The property is owned in fee title by the State Wildlife Conservation Board as a conservation easement per County of San Diego Document No. 2002-0079527, recorded January 30, 2002. This conservation easement may need to be modified to allow pipeline use, as it was not identified in the recorded document that limits the State’s use of the property to natural resource education, research or enhancement programs only. In addition, although the tunnel portal is located on private property owned by Kelly Land Company, their use of the land is likewise restricted for use as an interpretive center for Agua Hedionda Lagoon and was conditioned by the Coastal Commission under Permit No. 6-84-617-A. This permit may need to be modified.

**San Diego Gas and Electric Company**

**Segment 229, 230 (Blue and Green Alignments)**

Aside from the right-of-way aspect of easement acquisition to allow both the blue and green alignments to cross SDG&E owned property, Segment 230 will require a Joint Use Agreement and Permission to Grade letter and will require full review by SDG&E’s transmission designers due to the alignments’ proximity to existing lattice transmission towers. If allowed, special construction restrictions would apply. It should be noted that SDG&E has a new policy stating that they do not allow longitudinal encroachments and this requirement would need to be waived. Careful coordination for construction in proximity to SDG&E overhead facilities will be required.

**County of San Diego**

**Segment 419 (Green Alignment)**

This portion of the Green Alignment crosses a property owned by the County of San Diego. Before the County will grant an easement, they will require that the property be appraised by a
County-approved appraiser (they have a list of local appraisers to pick from) and the County be paid the full market value based upon this appraisal. It should be noted, that the land is currently used as a waste dump and remediation of any hazardous materials could to be required.

**Federal Aviation Administration**

**Segment 318 and 303 (Orange Alignment)**

FAA regulations regarding equipment height restrictions for construction in proximity to an operating airport will need to be followed. Notification to the FAA and airport administrative staff may be required.

**Private Property Owners**

**Segments 405, 430, and 425 (Blue Alignment)**

Although these segments are not constrained due to permit issues, per se, it should be noted that the property where the blue alignment would be located is generally held by private property homeowner’s associations and acquiring these types of properties can be difficult because the entire homeowner’s association (i.e., every homeowner in the development) could have input into the easement approval process.

**Table 9.3-3 – DWCF Permitting Summary**

<table>
<thead>
<tr>
<th>Agency, Permit</th>
<th>Blue Alignment</th>
<th>Green Alignment</th>
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</tr>
</thead>
<tbody>
<tr>
<td>U.S. Army Corps of Engineers (USACE), Section 404</td>
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<tr>
<td>U.S. Fish &amp; Wildlife Service (USFWS), Section 10</td>
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<tr>
<td>Federal Aviation Administration (FAA), FAR 77</td>
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<tr>
<td>California Coastal Commission</td>
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<tr>
<td>California Department of Fish &amp; Game (CDFG), Section 1601</td>
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<tr>
<td>State of California CDFG, Wildlife Conservation Board, Easement</td>
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<td></td>
</tr>
<tr>
<td>CA Dept. of Transportation, Dist. 11 (Caltrans), Encroachment Permit</td>
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</tbody>
</table>
### Table 9.3-3 – DWCF Permitting Summary

<table>
<thead>
<tr>
<th>Agency, Permit</th>
<th>Blue Alignment</th>
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<th>Orange Alignment</th>
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<td>California Occupational Safety and Health Administration, Mining &amp; Tunneling Unit, Underground Classification</td>
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<td>California State Water Resources Control Board (SWRCB) – Compliance with General Storm Water Order</td>
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<td>County Of San Diego Health Hazardous Materials Management Division (HMMD), Well Drilling Permit</td>
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<tr>
<td>County of San Diego, Easement</td>
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<tr>
<td>North San Diego County Transit Development Board (NCTD), License Agreement and Right of Entry Permit</td>
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<tr>
<td>Regional Water Quality Control Board, San Diego Region (RWQCB), 401 Water Quality Certification</td>
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<tr>
<td>RWQCB, Groundwater Dewatering</td>
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<td>RWQCB, Hydrostatic Pipe Testing</td>
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<td>City of Carlsbad, Right-of-Way Use Permit &amp; Noise Variance</td>
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<td>Carlsbad Municipal Water District, Encroachment Permit or Easement</td>
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<tr>
<td>City of San Marcos, Excavation Permit &amp; Noise Variance</td>
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<tr>
<td>City of Vista Engineering Department</td>
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<td>City of Vista, Right of Way Permit and Noise Variance</td>
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<td>Kinder Morgan (KM), Pipeline Inspection Agreement</td>
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</table>
Table 9.3-3 – DWCF Permitting Summary

<table>
<thead>
<tr>
<th>Agency, Permit</th>
<th>Blue Alignment</th>
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<tbody>
<tr>
<td>San Diego Gas &amp; Electric Company (SDG&amp;E), Joint Use Agreement</td>
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<tr>
<td>Utility Companies - (SDG&amp;E, SBC, Adelphia CATV and Time Warner CATV), Conflict Checks</td>
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</tr>
</tbody>
</table>

It should be noted that a project-specific permit feasibility analysis cannot be determined until necessary field studies are performed to assess the locations of wetlands and the potential presence of special status wildlife species. Obtaining regulatory permits may be more of a time/mitigation cost issue than a feasibility issue. Any alignment crossing a drainage (such as the Agua Hedionda Creek) would require regulatory permitting through USFWS, CDFG, ACOE and RWQCB. Jack and bore techniques or micro tunneling under such drainages would streamline the process substantially or even eliminate the need for a regulatory permit. Any impacts to “listed” species (state and federal) would be addressed as part of the USACOE 404 process and CDFG 1601 process. Due to the requirement for a federal USACOE 404 permit, the 404 process will require “Section 7 Consultation” with USFWS regarding Endangered Species Act issues. If the biological resources assessment and initial consultations with USFWS staff determine that the project may have significant impacts to endangered species, formal Section 7 consultation may require 6-12 months or more to complete. In addition, since the conveyance facilities are a component of the desalination plant, and the desalination plant requires a Coastal Development Permit from the State, special criteria apply regarding wetlands and mitigation requirements (the State Coastal Commission has the authority to review “inland” pipeline impacts if any project impact within the Coastal Zone requires a federal permit/approval, which is the case). Finally, all conveyance lines will require local encroachment permits, which will require coordination with local agencies to ensure that their concerns are addressed. In summary, avoidance or minimization of impacts to native vegetation, wetlands, and sensitive receptors (residential, schools, parks, hospitals, playgrounds, senior facilities) will reduce the time and cost of regulatory and local agency permits/approvals.

9.4 Noise Constraints

9.4.1 Purpose and Approach

This section summarizes the findings presented in the Acoustical Constraints Screening Assessment, Phase I prepared for this project by Investigative Science and Engineering (ISE), dated October 3, 2003 (Appendix 14). ISE performed a course level physical site reconnaissance of the proposed Blue, Green, and Orange Alignments to determine areas that may be sensitive to construction noise, i.e., sensitive
receptor locations. Sensitive receptors are those areas located within 50 to 100 feet of a proposed project alignment (the “worst-case” condition) that could be adversely affected by project-related activities and generally include residences, hospitals, schools, etc. Construction mitigation would be required for any areas where the construction noise threshold of 75 dBA (when measured at the property line) would be exceeded as required by the noise ordinances of the cities of Carlsbad, Vista, and San Marcos and the County of San Diego.

The purpose of the acoustical screening assessment is to identify areas along each of the project alignments that may be sensitive to construction noise and could require mitigation. This information can then be used to determine which alignment has fewer noise constraints and this can be factored into the final alignment selection process.

9.4.2 Sensitive Receptor Locations

The areas identified along each of the proposed project alignments as having sensitive receptors and potentially requiring noise mitigation measures during construction are summarized below. These areas are identified by Segment Number (segment locations are included in Figure 9-1) and a brief description of the area is provided.

**Blue Alignment**

- Segment 315 - northeastern portion of pipe segment 315 within Cannon Road, adjacent to existing homes near El Camino Real.

- Segments 316 and 312 - all portions of alignment within El Camino Real and Palmer Way adjacent to existing homes.

- Segments 406, 405, 430, 425, and 527 - all portions of the alignment between Maerkle Reservoir and Sycamore Avenue adjacent to existing homes.

- Segments 529 and 530 - portions of the alignment within La Mirada Drive, between Poinsettia Avenue and Pawnee Street adjacent to existing homes.

**Green Alignment**

- Segment 313 - short portion of Segment 313 within Faraday Avenue, just west of Halley Drive adjacent to existing businesses.

- Segment 503, 502, and 526 - portions of alignment within South Melrose Drive, slightly extending into Faraday Avenue and Sycamore Avenue adjacent to existing homes.
Segments 529 and 530 - portions of the alignment within La Mirada Drive, between Poinsettia Avenue and Pawnee Street adjacent to existing homes.

**Orange Alignment**

- Segment 520 - all portions of the alignment within Palomar Airport Road, between Business Park Drive and Rancho Santa Fe Road adjacent to existing homes.
- Segment 525 - southerly section of Palomar Airport Road adjacent to residences.

### 9.5 Traffic Evaluation

#### 9.5.1 Purpose and Approach

This section summarizes the findings presented in the Preliminary Transportation Evaluation prepared for this project by Linscott, Law & Greenspan (LLG), dated December 18, 2003 (Appendix 9). LLG performed a preliminary evaluation of transportation impacts and issues associated with implementation of each of the alignment alternatives. Street segment operations and signalized intersection levels of service (LOS) were determined based upon SANDAG and existing city data. Traffic data on a segment-by-segment basis is included in Appendix 9.

The purpose of the transportation evaluation is to identify areas along each of the project alignments that may be impacted by traffic disruptions caused by construction. This information can then be used to determine which alignment has fewer traffic constraints and this can be factored into the final alignment selection process.

#### 9.5.2 Duration of Traffic Impacts

Traffic impacts can be estimated based upon the number of workdays that a roadway segment would be affected during open trench construction.

**Blue Alignment**

Construction of the 21,000 feet of roadway affected by the Blue Alignment would require 159 workdays. It would also affect 19 intersections requiring 200 workdays to construct. There would be a total of 359 workdays where local traffic would be affected. Nighttime construction may be required for the majority of this alignment and potential signal timing/phasing modifications may also be required to minimize traffic impacts.
**Green Alignment**

Construction of the 28,500 feet of roadway affected by the Green Alignment would require 190 workdays. It would also affect 30 intersections requiring 325 workdays to construct. There would be a total of 515 workdays where local traffic would be affected. Nighttime construction may be required for the majority of this alignment and potential signal timing/phasing modifications may also be required to minimize traffic impacts.

**Orange Alignment**

Construction of the 34,700 feet of roadway affected by the Green Alignment would require 231 workdays. It would also affect 22 intersections requiring 211 workdays to construct. There would be a total of 442 workdays where local traffic would be affected. Nighttime construction may be required for the majority of this alignment and potential signal timing/phasing modifications may also be required to minimize traffic impacts.

**9.5.3 Summary**

The primary differences between the three alignments relate primarily to the differing lengths of construction that would occur on public streets.

<table>
<thead>
<tr>
<th>Alignment</th>
<th>Total Length</th>
<th>Total # of Intersections</th>
<th>Total Work Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Alignment</td>
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<td>359</td>
</tr>
<tr>
<td>Green Alignment</td>
<td>28,500 ft</td>
<td>30</td>
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</tr>
<tr>
<td>Orange Alignment</td>
<td>34,700 ft</td>
<td>22</td>
<td>442</td>
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</tbody>
</table>

Most impacts can be mitigated with nighttime construction, flagging, lane closures and other conventional traffic control measures. Although, it should be noted that the roadway segment along the Orange Alignment between El Camino Real to Melrose Avenue has a Year 2005 LOS F rating during normal operations, so construction would impact this segment even more severely.
Chapter 10 – Cost Estimates

10.1 Introduction

10.1.1 Purpose and Approach

This chapter presents the project team’s analysis of costs for each DWCF alignment. The analysis includes both capital costs and annual costs for operation and maintenance. Translation of the capital costs into an equivalent “cost per acre foot” unit cost impact on water rates is not straightforward, due to the varied and complex funding mechanisms available to the Water Authority. These funding sources include capacity charges, property taxes, various short-term debt instruments, and various long-term debt instruments. Depending upon the specific financing mechanism used, which will be a function of the financing of the complete capital improvement program and not just of this individual project, capital costs can have a wide range of impacts on per-acre-foot rates. Even operating costs are anticipated to be melded to a greater or lesser degree with the costs of water from other sources. For these reasons, a full-scale financial water rate analysis is required to determine per-acre-foot member agency costs for desalinated water. This analysis is beyond the scope of this Alignment Investigation Report and will be undertaken separately by the Water Authority.

10.1.2 Chapter Outline

This chapter is organized into the following sections:

10.2 Background – Project Cost Evolution: Reviews how the conveyance system facilities have evolved from a concept to a more thorough definition.

10.3 Capital Costs: Describes the development of total construction and total project cost estimates for each of the project components, and summarizes these for each of the alternative alignments. Detailed cost spreadsheets supporting this section are included in Appendix 8.

10.4 Annual Operations and Maintenance Costs: Presents the project team’s analysis of energy costs and other O&M costs.

10.2 Background – Project Cost Evolution

When proposed in the 2001 Poseidon report for the City of Carlsbad, the DWCF facilities were defined in concert with a 10 to 25 mgd desalination plant, and consisted of a modest pump station sharing the same site as the proposed desalination plant, a pipeline connection to Carlsbad’s Maerkle Reservoir, and various distribution improvements within the City’s of Carlsbad and Oceanside. The 2001 Poseidon report also offered a conceptual sketch of what might be required to upsize the project to 50 mgd. The concept presented called for approximately half the water to be consumed in Carlsbad and Oceanside,
and the remainder to be delivered to the Second Aqueduct by means of the Water Authority’s existing Tri-Agencies Pipeline.

During the course of the investigations presented in this report, the DWCF facilities have evolved to be significantly more extensive, and more expensive, than those presented in the 2001 report. Some of the key features and assumptions that have changed as a result of the more thorough investigations presented here include the following:

- **Conveyance System Length.** The investigations described here have determined that the DWCF will need to construct new pipeline all the way from the desalination plant to the Second Aqueduct, a distance of almost 10 miles. This is approximately twice the length of new pipeline as was identified in the 2001 report.

- **Conveyance System Sizing.** The project team has determined that it will be most economical to size the project pipeline to accommodate future expansions of the desalination plant to as much as 100 mgd.

- **Pipeline Construction Conditions.** The project team has determined that while the identified alignments are all feasible and constructible, the available alignment corridors are highly constrained by existing development, heavy traffic, environmental constraints, and other factors all of which lead to more expensive construction conditions.

- **Pump Station Requirements.** At a capacity of 50 mgd or higher, the project team has determined that the project’s pump station at Encina will require a substantial structure, with substantial space to accommodate it. These requirements were not anticipated in the conveyance system concepts presented in the 2001 report.

### 10.3 Capital Costs

The study has estimated capital costs for each component of each alignment, and for each alignment as a whole. Capital costs are reported both as construction costs and as total project costs, with these terms defined as follows:

- **Construction Costs.** The total construction cost is the estimated contract median bid price for project construction. Construction costs include all of the contractor’s costs for labor, material, applicable taxes on material, equipment, and other direct costs, as well as overhead and profit. Our construction costs also include contingencies at 15 percent to account for project unknowns at this planning/feasibility level of investigation.
Total Project Costs. Total project costs include construction costs as defined above, plus other owner-incurred costs for design, administration, and environmental mitigation. Total Project Costs are the project team’s estimates of the total costs to the Water Authority of advancing the project to completion. These costs are reported in current 2003 dollars, and are also reported escalated to the anticipated mid-point of project construction. These costs do not include interest during construction, or finance costs following project completion.

10.3.1 Opinion of Cost Accuracy

The American Association of Cost Engineers (AACE) categorizes cost estimates into three basic types:

1. **Order-of-Magnitude Estimates**: accurate within +50 to -30 percent.
2. **Budget Estimates**: accurate within +30 and -15 percent.
3. **Definitive or Pre-Bid Estimates**: accurate within +15 to -5 percent.

The opinion of probable construction cost prepared for the DWCF project has been made at approximately the Budget Estimate level of detail, and as such is likely to be accurate on an absolute basis to within the +30 to –15 percent range listed above. More definitive estimates will require the development of detailed design plans as part of the final design process.

On a comparative basis, the project team anticipates that the cost estimates accurately differentiate costs of the different alignments to within approximately 3 percent of total cost. Cost differences among the alignments of more than this amount should be considered significant for purposes of planning and alignment selection.

10.3.2 Component Construction Costs

The project team has estimated construction costs for each component of each alignment. All project components have been assigned to one of the following categories:

- Pipelines and Tunnels
- Pipeline and Tunnel Right-of-Way
- Pump Stations
- Pump Station Right-of-Way
- Aqueduct Improvements

Costs for each component category are reviewed below:
Pipelines and Tunnels

As detailed in Appendix 8, the project team has estimated pipeline construction costs based on assumed construction techniques, conditions, and quantities specific to each segment of each alignment. These conditions are described in Appendix 5 and its technical appendices. In general, the following information and technical reports provided input to the development of the pipeline cost estimates:

- Historical bid data from the Water Authority’s Olivenhain Pipelines and Pipeline 5E-II projects
- Pipeline Design Criterion Technical Memorandum (Appendix 4)
- Water Authority Standard Specifications
- Preliminary Geotechnical Report (Appendix 10)
- Preliminary Transportation Evaluation (Appendix 9)
- Alternative Alignment Maps (Appendix 1)
- Coarse Screening of Alignment Alternatives Memorandum (Appendix 2)
- Draft Pipeline Drainage Study
- Tunnel Feasibility Technical Memorandum (Appendix 7)
- Alignment Right-of-Way Maps (Appendix 13)

Cost estimates for tunnel components are discussed in more detail in Appendix 7. The tunnel numbers developed in Appendix 7 are incorporated as line items in the Appendix 8 cost estimates.

Capital and Unit Cost Summary Tables: Pipeline and tunnel costs are summarized in the tables later in this chapter, and are further detailed in the series of tables attached at the end of this chapter. Those tables present segment-by-segment breakdowns of each of the primary and combination alignment alternatives, including information on unit costs.

Pipeline and Tunnel Right-of-Way

Pipeline right-of-way acquisition requirements and preliminary cost estimates are presented in Appendix 13. In general, these estimates assume the Authority would acquire a 50-foot wide easement for those pipeline segments not in public streets. The estimates also assume that temporary construction easements would be acquired in some areas to aide in pipeline construction. Preliminary cost estimates are based on the Water Authority’s estimate of $1 million per acre for fee acquisition of parcels. This cost is then adjusted downward for acquisition of different forms of easements.

The right-of-way preliminary cost estimates for each pipeline and tunnel segment are incorporated into the summary cost tables presented in this chapter.
Chapter 10 – Cost Estimates

Pump Stations

As detailed in Appendix 8, the project team has estimated pump station construction costs based on assumed construction techniques, conditions, and quantities specific to each segment of each alignment. These conditions are described in Chapter 5 and its technical appendices. In general, the following information and technical reports provided input to the development of the pump station cost estimates:

- Preliminary Pump Station Floor Plan and Site Layout
- Second Pump Station Design and Locations
- Pump Station Diagram of Second Pump Station Alternatives
- Pumping Station Design Criterion Technical Memorandum
- The Encina pump station includes a 30-foot-deep 2-MG forebay.
- The second pump stations includes a 150-foot-diameter x 30-foot-high steel tank located approximately 100 feet higher than the pump station.

Pump Station Right-of-Way

Pump station right-of-way costs are assumed at $1 million per acre, with a 2.5 acre site for the Encina pump station, and a 4 acre site for the possible second pump station locations.

Aqueduct Improvements

The cost summary tables presented in this chapter include allowances for improvements to the Second Aqueduct that will likely be necessary to facilitate operations of the DWCF. These improvements are discussed in Chapter 7. The following improvements are accounted for in the summary cost tables:

- Flow Regulatory Storage: 10 million gallons at $1 per gallon for a total of $10 million.
- Pressure Control Facility: An allowance of $6 million is included, based on costs derived from the Water Authority’s Mercy Road PCF.
- Aqueduct Pipeline Relining and Re-Configuration: An allowance of $10 million is included to allow for possible relining of Pipeline 3 and for conversion of Flow Control Facilities and removal of Pipeline 3 – Pipeline 4 interconnects.
10.3.3 Total Construction Costs

The total construction cost is the sum of the component costs described above for each alignment system, plus a contingency allotment of 15 percent. The contingency accounts for costs not yet discovered or detailed at the current level of pre-design planning.

Total construction costs are summarized by alignment in the cost summary sheets presented in this chapter.

10.3.4 Total Project Costs

Total project costs are the sum of the following:

- **Construction Costs.** From component cost estimates, as above.

- **Design and Administration.** The summary cost tables presented in this chapter apply a 25 percent mark-up to all construction costs to account for engineering design and construction administration costs.

- **Environmental Permitting and Mitigation.** The summary cost tables presented in this chapter apply a 2 percent mark-up to all construction costs to account for possible costs for environmental mitigation.

Cost Spreadsheets: Total construction and total project costs for the three primary alignment systems are summarized below in Table 10.3.4-1 for a 50 mgd, single-pump station configuration DWCF system. Figure 10-1 presents this same information for all twelve combination alignments.
### Table 10.3.4-1: Total Construction and Total Project Capital Costs – Primary Alignments, 50 MGD

<table>
<thead>
<tr>
<th>ALIGNMENT:</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Green</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>LENGTH:</td>
<td>53,743 ft</td>
<td>48,774 ft</td>
<td>49,340 ft</td>
</tr>
<tr>
<td>FLOW:</td>
<td>50 MGD</td>
<td>50 MGD</td>
<td>50 MGD</td>
</tr>
<tr>
<td>TDH (ft.)</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
</tr>
<tr>
<td>Pipeline Construction Costs</td>
<td>$57,760,000</td>
<td>$48,350,000</td>
<td>$50,300,000</td>
</tr>
<tr>
<td>Tunnel Construction Costs</td>
<td>$14,940,000</td>
<td>$13,850,000</td>
<td>$14,500,000</td>
</tr>
<tr>
<td>Pipeline Right of Way</td>
<td>$9,120,000</td>
<td>$4,590,000</td>
<td>$4,090,000</td>
</tr>
<tr>
<td>Pump Station</td>
<td>$27,700,000</td>
<td>$27,700,000</td>
<td>$27,700,000</td>
</tr>
<tr>
<td>PS Right of Way @ $1,000,000 per acre</td>
<td>$2,500,000</td>
<td>$2,500,000</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>Aqueduct Connection and PCF</td>
<td>$6,000,000</td>
<td>$6,000,000</td>
<td>$6,000,000</td>
</tr>
<tr>
<td>Aqueduct Storage (allowance)</td>
<td>$10,000,000</td>
<td>$10,000,000</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>Aqueduct Modifications (allowance)</td>
<td>$10,000,000</td>
<td>$10,000,000</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$138,000,000</td>
<td>$123,000,000</td>
<td>$125,100,000</td>
</tr>
<tr>
<td>Contingency @ 15%</td>
<td>$20,700,000</td>
<td>$18,500,000</td>
<td>$18,800,000</td>
</tr>
<tr>
<td>Subtotal (Total Construction Costs Current Dollars)</td>
<td>$158,700,000</td>
<td>$141,500,000</td>
<td>$143,900,000</td>
</tr>
<tr>
<td>Design &amp; Admin @ 25%</td>
<td>$39,700,000</td>
<td>$35,400,000</td>
<td>$36,000,000</td>
</tr>
<tr>
<td>Environmental Mitigation @ 2%</td>
<td>$3,200,000</td>
<td>$2,800,000</td>
<td>$2,900,000</td>
</tr>
<tr>
<td>Total Capital Current Dollars</td>
<td>$201,600,000</td>
<td>$179,700,000</td>
<td>$182,800,000</td>
</tr>
<tr>
<td>Escalation to Mid-Point of Construction (August 2007) @ 9.5%</td>
<td>$19,200,000</td>
<td>$17,100,000</td>
<td>$17,400,000</td>
</tr>
<tr>
<td>Total Capital Cost (Escalated to August 2007)</td>
<td>$220,800,000</td>
<td>$196,800,000</td>
<td>$200,200,000</td>
</tr>
<tr>
<td>Cost Increase in comparison to least cost alignment</td>
<td>$24,000,000</td>
<td>$0</td>
<td>$3,400,000</td>
</tr>
<tr>
<td>% Difference</td>
<td>12%</td>
<td>0%</td>
<td>2%</td>
</tr>
</tbody>
</table>

### 10.3.5 Capital Costs – Discussion

The cost analysis shows that among the primary alignment alternatives, the Green and the Orange alignments are less costly than the Blue alignment. The higher costs of the Blue alignment arise from its extra length and from its congested construction conditions north of Maerkle and along the Tri-Agencies Pipeline corridor. Additional discussion of these comparative engineering factors is presented in Chapter 4.

### 10.4 Annual Operations and Maintenance Costs

The project team has analyzed two components of annual costs for project operations and maintenance: 1) energy costs, and 2) other operations and maintenance costs.
10.4.1 Energy Costs

Energy costs are by far the largest component of annual operations and maintenance costs for the project. The study has calculated energy costs based on an assumed electrical energy rate of $0.06 per kilowatt-hour (kWh) at the Encina pump station, and $0.086/kWh for the second pump stations. These assumed rates have been developed by the Water Authority as described in Appendix 2. The analysis assumes that power purchase agreements with Cabrillo Power (the Encina power plant owner) will provide lower rates than would be available through retail purchase outside the Cabrillo property line.

10.4.2 Other Operations and Maintenance Costs / Total Operations and Maintenance Costs

The project team has estimated other (non-energy) annual operations and maintenance costs at 1 percent of total project capital costs. The sum of these and the energy costs and revenues described above is the total annual operations and maintenance cost.

Table 10.4.2-1 below shows a summary of operations and maintenance costs by alignment for a 50 mgd operation.
# Capital Cost Summary for Blue, Green, and Orange Primary and Combination Alignment Alternatives

50 mgd, 60-inch Pipe, Single Pump-Lift Configuration

12/19/2003

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>1A</th>
<th>1B</th>
<th>2</th>
<th>2A</th>
<th>2B</th>
<th>2C</th>
<th>3</th>
<th>3A</th>
<th>3B</th>
<th>3C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alignment:</strong></td>
<td>Blue/Blue</td>
<td>Blue/Green</td>
<td>Blue/Orange</td>
<td>Green/Green</td>
<td>Green/Blue</td>
<td>Green/Orange</td>
<td>Orange/Orange</td>
<td>Green/Orange</td>
<td>Orange/Orange</td>
<td>Orange/Blue</td>
<td>Orange/Green</td>
</tr>
<tr>
<td><strong>Length:</strong></td>
<td>53,743 ft</td>
<td>50,725 ft</td>
<td>48,449 ft</td>
<td>48,774 ft</td>
<td>55,297 ft</td>
<td>48,456 ft</td>
<td>48,494 ft</td>
<td>50,832 ft</td>
<td>49,340 ft</td>
<td>48,227 ft</td>
<td>57,768 ft</td>
</tr>
<tr>
<td><strong>Flow:</strong></td>
<td>60 MGD</td>
<td>60 MGD</td>
<td>60 MGD</td>
<td>60 MGD</td>
<td>50 MGD</td>
<td>60 MGD</td>
<td>60 MGD</td>
<td>50 MGD</td>
<td>60 MGD</td>
<td>50 MGD</td>
<td>60 MGD</td>
</tr>
</tbody>
</table>

**Notes:**
- Alignment 1 - Blue/Blue: Blue all the way through
- Alignment 1A - Blue/Green: Blue to green via pink connector segment 308.
- Alignment 1B - Blue/Orange: Blue to orange via pink connector segments 308 and 305.
- Alignment 2 - Green/Green: Green all the way through.
- Alignment 2A - Green/Blue: Green to blue via pink connector segment 308.
- Alignment 2B - Green/Orange: Green to orange via pink connector segment 305.
- Alignment 3C - Green/Orange: Green to orange via pink connector segments 512 and 516.
- Alignment 3D - Green/Orange/Green: Green to orange to green via pink connector segments 201/202/201 and 319.
- Alignment 3 - Orange/Orange: Orange all the way through.
- Alignment 3A - Green/Orange/Orange: Green to orange to green via pink connector segments 201/202/201.
- Alignment 3B - Orange/Blue: Orange to blue via pink connector segment 319 and 309.
- Alignment 3C - Orange/Green: Orange to green via pink connector segment 319.

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**Desalinated Water Conveyance Facilities Alignment Investigation Report**

Figure 10-1 Capital Cost Summary
# Chapter 10 – Cost Estimates

Table 10.4.2-1: Total Annual Operations and Maintenance Costs by Alignment – 50 MGD

<table>
<thead>
<tr>
<th>Alignment Number and Color Guide</th>
<th>Energy Costs</th>
<th>Other O&amp;M Cost (@ 1% of Total Project Cost)</th>
<th>Total Annual O&amp;M Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual Energy Consumption (1)</td>
<td>Energy Cost (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>kWh/yr</td>
<td>$/yr</td>
<td>$/yr</td>
</tr>
<tr>
<td>1</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,200,000</td>
</tr>
<tr>
<td>1A</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,100,000</td>
</tr>
<tr>
<td>1B</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,100,000</td>
</tr>
<tr>
<td>2</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2A</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,100,000</td>
</tr>
<tr>
<td>2B</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2C</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2D</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$1,900,000</td>
</tr>
<tr>
<td>3</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>3A</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$1,900,000</td>
</tr>
<tr>
<td>3B</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,200,000</td>
</tr>
<tr>
<td>3C</td>
<td>74,900,000</td>
<td>$4,500,000</td>
<td>$2,000,000</td>
</tr>
</tbody>
</table>

(1) Assumes a plant capacity factor of 95%, a pump efficiency of 80%, and a Total Dynamic Pumping Head of 1100 ft.

(2) Energy Cost is based on $0.06/kWh
Chapter 11 – Project Schedule

11.1 Purpose

This chapter documents the criteria used in developing the “Preliminary Schedule” (Appendix 8). The schedule is preliminary in nature and is not intended to be final, but rather is presented as a starting point for productive discussion.

11.2 Chapter Outline

Subsequent sections are as follows:

11.2 Background Materials
11.3 Scheduling Criteria
11.4 Schedule Summary
11.5 Updates

The Water Authority provided Historical Data of the Olivenhain Pipelines and Pipeline 5E II. This historical data included a specification for installing 20-foot pipe sections that was used in determining the locations that warranted installation of 20-foot pipe sections. Key information particular to pipelines and pump stations was provided as a basis in formulating the schedule. Reference the attached introductory notes in Appendix 8 for detailed descriptions of the information noted herein. A summary construction schedule is included in Figure 11-1 (includes a schedule for each of the three main alignments).

11.2.1 Pipeline Information

Pipeline information is the same as those noted in Section 10.3.1 of Chapter 10, with the addition of tunnel durations as specified in the “Preliminary Tunnel Analysis” (Appendix 7).

11.2.2 Pump Station Information

Pump station information is the same as those noted in Section 10.3.2 of Chapter 10, with the addition of construction durations based upon rough estimate quantities and square footages for similar type structures.
11.3 Scheduling Criteria

The design activities schedule for the EIR, 50 percent Design, 100 percent Design, Permit & Right-of-Way, and Desalinization Plant Construction tasks are all based on Figure 2-3. Procurement and long lead-time item durations are based on manufacturer estimates.

Pipeline production rates are shown in Appendix 8. Excavation was classified in two ways throughout the schedule: “Open Country” and “Existing Roadway.” Pipe installation/restoration production in existing roadways with light traffic and few below grade obstructions is assumed at 80 linear feet per day, based on conversations with local contractors. In areas with heavy traffic or extensive below grade obstructions, the production was decreased to between 65 and 70 linear feet per day. Pipe installation/restoration production in open country was assumed at approximately 80 linear feet per day. In areas where bench grading or blasting are required, the production was decreased to approximately 70 linear feet per day.

Tunneling durations were obtained from the “Preliminary Tunnel Report” (Appendix 7) and individual tunneling activities are anticipated to be separately contracted and will not impact this schedule’s critical path.

Construction is separated into three staggered construction phases to meet the completion date. The completion date for DWCF includes pipeline and pump station(s), is tied to the Plant’s completion in 2008, to allow immediate production and distribution of desalinated water.

It is noted that phasing for pipeline construction may be accelerated or deferred as required to account for changes in scheduled development, availability of land or rights-of-way acquisition and other considerations that cannot be predicted at this time.

11.4 Schedule Summary

The completion date for the DWCF project is September 2008 with the mid-point of construction in August 2007. The schedule does not take into account Second Aqueduct facility construction. Second Aqueduct improvements will need to be planned, designed, and constructed before the planned completion of other DWCF facilities.

11.5 Updates

The project schedule noted herein is subject to change and will be updated as more definitive information becomes available, or if there is any change in scope.
Chapter 12 – Evaluation Criteria

12.1 Introduction

12.1.1 Purpose and Approach

The purpose of this chapter is to propose criteria for evaluating the alternative alignments and configurations of the Desalinated Water Conveyance Facilities (DWCF) project. The criteria proposed in this chapter are draft criteria for consideration; the actual criteria used to select a preferred alignment will be subject to change and refinement during the course of the project’s public review process.

A quantitative decision process is proposed to evaluate the project alternatives and then to comparatively score them on the basis of specific decision criteria. This type of analysis allows many different types of considerations to be evaluated and represented by a single score.

The process begins with the identification of major project goals, or the summary-level criteria. Each of the summary-level criteria is then divided into subcategories. The subcategories are then given maximum point values for quantification purposes, with all subcategories adding up to a possible maximum 100 points. This matrix evaluation format allows easy comparison of scores among the different alignments.

12.1.2 Chapter Outline

This chapter is divided into the following additional sections:

12-2  Screening Process
12-3  Evaluation Criteria
12-4  Scoring Guidelines

12.2 Screening Process

The alignment evaluation process began with the development of a “long-list” of possible alignments and configurations, as documented in the “Coarse Screening Technical Memorandum” (Appendix 2). As described there, the alternatives were then be evaluated through a three-step screening process as follows:

- **Step 1: Fatal Flaw Analysis:** The initial long-list of alternatives were screened for fatal flaws relative to environmental permitting, constructability, and operational effectiveness. Passing alternatives had to be permittable, constructible, and able to meet the operational requirements of the project. Alternatives passing the initial fatal flaw analysis were then placed on the “refined long-list.”
Chapter 12 – Evaluation Criteria

- **Step 2: Coarse Screening:** The refined long-list of alternatives was evaluated at a coarse level of analysis and screened using the criteria set forth in this Chapter. The result of this process was a “short-list” the three alternatives for refined study and evaluation.

- **Step 3: Fine Screening:** The short-listed alternatives were then evaluated in further detail as to their engineering and costs, environmental effects, operability, and implementability. The results of that work are contained in this Alignment Investigation Report. The Water Authority will now use the information in this report, along with additional information gathered during the project’s continuing public review process, to evaluate the short-listed alternatives and select a preferred project.

  *In addition to the numerical scoring results, alternatives can be eliminated at any stage of the screening on the basis of fatal flaws.*

In utilizing the defined evaluation criteria presented in this chapter, the screening process provides a structured method for weighing the advantages and disadvantages of various project alternatives. Note though that if during the course of continuing project review an alternative is found to have a previously unidentified fatal flaw, the fatal flaw by itself can be cause for elimination without need to rely on the weighted evaluation score. This allows for alignments that are not permittable, constructible, functional, or otherwise feasible to be removed from further consideration.

**12.3 Evaluation Criteria**

Project evaluation criteria are grouped into four summary level criteria, or goals, as follows:

1. Minimize Overall Project Cost
2. Minimize Adverse Social and Environmental Effects
3. Maximize System Implementability / Minimize Project Schedule
4. Maximize Operational Effectiveness and System Reliability

The summary level criteria represent broad policy-level goals of the project. The summary criteria are weighted, with the final weights assigned by the Water Authority Board of Directors.
Each summary level criteria is in turn made up of several subcategory criteria. Subcategory criteria are assigned maximum point scores, with point allocations totaling 100 points per summary level category. The proposed subcategory criteria and their summary level groupings and point allocations are shown below in Table 12.3-1:

Table 12.3-1: Evaluation Criteria with Sample Maximum Point Scores

<table>
<thead>
<tr>
<th>SUMMARY LEVEL CRITERIA (GOALS)</th>
<th>COSTS</th>
<th>ENVIRONMENTAL</th>
<th>IMPLEMENTATION</th>
<th>OPERATIONAL</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
<td>Points</td>
</tr>
<tr>
<td>Minimize Overall Project Costs</td>
<td>75</td>
<td>30</td>
<td>25</td>
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<tr>
<td>Minimize Adverse Social &amp; Environmental Effects</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Maximize System Implementability and Minimize Schedule</td>
<td>30</td>
<td>30</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Maximize Operational Effectiveness and System Reliability</td>
<td>25</td>
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<th>SUBCATEGORY CRITERIA</th>
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<tr>
<td>Life-Cycle Costs</td>
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<td>30</td>
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<td>Initial Capital Costs</td>
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<td>30</td>
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<tr>
<td>Sensitivity to Higher Energy Costs</td>
<td>10</td>
<td>5</td>
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<td>20</td>
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<td>Traffic</td>
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<tr>
<td>Land Use / Noise</td>
<td>25</td>
<td></td>
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</tbody>
</table>

A total of 17 subcategory criteria were selected for evaluation. These criteria were selected because they represent important issues that differentiate the alternatives from each other, and are measurable based on available information about the project concepts.

12.3.1 Summary Criteria 1: Minimize Overall Project Costs

This summary level criteria encompasses factors relative to an alternative’s costs, with the goal of minimizing overall project costs. Subcategory criteria consist of the following:

- **Life-Cycle Costs** are the combined present-worth value of project construction and operation costs over the lifetime of the project. Life-cycle costs present the most complete comparison of costs among the different project alternatives.
Chapter 12 – Evaluation Criteria

- **Initial Capital Costs** are the upfront costs of design, construction, administration, environmental mitigation, and right-of-way, but excluding project operations and maintenance costs. Although not as complete a measure of costs as life-cycle costs, they are included here as a secondary cost measure to reflect a general preference for lower capital costs among two or more projects with approximately equal life-cycle costs.

- **Energy Cost Sensitivity** represents the relative sensitivity of the alignment’s life-cycle costs to possible higher energy costs.

### 12.3.2 Summary Criteria 2: Minimize Adverse Environmental Effects

This summary level criteria encompasses factors concerning the environmental effects of a project on the natural and human environments, with the goal of minimizing adverse effects. Subcategory criteria consist of the following:

- **Biology and Sensitive Habitat** concerns minimizing the impact to special (endangered or threatened) species, habitat, waters/wetlands or other areas that have been designated to be protected by local, state, or federal environmental protection regulations. This parameter also incorporates minimizing conflict with the City of Carlsbad’s adopted Habitat Management Plan.

- **Cultural Resources** concerns the presence of prehistoric, historic, Native American, or other cultural resource sites that have been previously identified and would be impacted by an alignment.

- **Hazardous Materials** concerns whether any hazardous sites are located within an alignment corridor and the level of remediation that would be required.

- **Construction Traffic** concerns minimizing disruptions to local communities from construction traffic (i.e. would access to businesses, residences, or recreational areas, be disrupted by lengthy detours, delays, etc. caused by construction).

- **Land Use / Noise** concerns the number and degree of land use impacts resulting from a particular alignment, and the effect of noise from project construction and operations on adjacent land uses. Land use impacts include changes in planned use and/or zoning.

### 12.3.3 Summary Criteria 3: Maximize System Implementability / Minimize Project Schedule

This summary level criteria encompasses factors concerning an alternatives ability to be permitted and constructed, and on a schedule consistent with the schedule for construction of the ocean desalination plant. Subcategory criteria consist of the following:
Chapter 12 – Evaluation Criteria

- **Permit Feasibility** concerns the level of difficulty involved with obtaining permits required for construction (i.e., can permits be obtained and if so, how difficult is the approval process).

- **Schedule** measures the projected completion date for each alignment alternative, particularly whether the alternative can be completed in time for the projected 2008 on-line date for the desalination plant.

- **Constructability** measures the relative construction difficulty of an alignment alternative and the resulting potential for schedule delays during construction (alignments with more difficult construction may be more likely to experience delays during construction). Constructability factors include steep grades, site access conditions, construction corridor widths, and underground construction.

- **Expandability** addresses the degree to which an alignment or configuration lends itself to serve a possible future expansion of the desalination plant from 50 to 75 or 100 million gallons per day. In particular, alignments which more easily allow for future delivery of water to the Water Authority’s TODS facility (north of San Marcos) will score higher in this category than alignments that do not as readily provide this capability.

12.3.4 **Summary Criteria 4: Maximize Operational Effectiveness and System Reliability**

This summary level criterion examines how well an alternative meets the primary project goals of reliably delivering desalinated water for beneficial use, and how easy the facilities will be to operate and maintain. Subcategory criteria consist of the following:

- **System Reliability** concerns the risk of system outage based upon the relative probability an alternative being out of service and in need of repair from a range of possible causes (earthquake, landslide, etc.) and the expected time it would take to repair the facility.

- **Operational Flexibility** concerns the degree to which an alignment or configuration alternative adds flexibility to the Water Authority’s day-to-day and emergency condition water supply operations. The category includes consideration of an alignments ability to connect with member agency systems in a way that improves the operational flexibility of the region’s water systems as a whole.

- **Operational Complexity** represents the level of difficulty an alternative would be to operate.

- **Maintenance Access** concerns whether the level of difficulty of obtaining maintenance access to a constructed alternative.

- **Water Quality Consistency** measures the degree to which an alignment system alterative provides for delivery to customers of a relatively consistent blend of desalinated water and imported water.
12.4 Scoring Guidelines

Specific performance score definitions for each subcategory criterion are presented below.

**Goal 1: Minimize Overall Project Costs**

**Life-Cycle Costs**

Maximum = Maximum points are assigned to the alignment with the lowest life-cycle cost per unit of water delivered.

Mid-Range = One point is deducted from the maximum point score for each $1 million by which the life-cycle cost of the alternative exceeds that of the least costly alternative.

Minimum = See above description for “mid-range.”

**Initial Capital Costs**

Maximum = Maximum points are assigned to the alignment with the lowest initial capital cost.

Mid-Range = One point is deducted from the maximum point score for each $1 million by which the capital cost of the alternative exceeds that of the least costly alternative.

Minimum = See above description for “mid-range.”

**Sensitivity to Higher Energy Costs**

Maximum = Lowest energy use per unit of water delivered.

Mid-Range = Points are deducted from the maximum point score by the same percentage by which the alternative’s unit energy use exceeds that of the alternative with the lowest unit energy use.

Minimum = See above description for “mid-range.”

**Goal 2: Minimize Adverse Social And Environmental Effects**

**Biology and Sensitive Habitat**

Maximum = No impacts to existing sensitive wildlife species or habitats, and full compatibility with the Carlsbad Habitat Management Plan.
Chapter 12 – Evaluation Criteria

Mid-Range = Potential adverse impacts to sensitive wildlife species, resulting in the temporary loss of occupied habitat for a core population of listed animal species. Also, some incompatibility with the Carlsbad Habitat Management Plan

Minimum = Unavoidable adverse impacts would result in the permanent loss of occupied habitat used by the core population of listed animal species, or would affect a "narrow" endemic species. Also, significant incompatibility with the Carlsbad Habitat Management Plan

Cultural Resources

Maximum = No known historic or pre-historic resources or Native American Traditional Cultural Properties would be impacted.

Mid-Range = One or more untested, but unlikely to be significant (based on survey data only) archeological site(s), or no more than one potentially eligible site are known to exist within or is contiguous to the alternative.

Minimum = One or more previously known (evaluated and/or tested) significant, or more than one potentially eligible archeological site(s) are present within or contiguous to the alternative.

Hazardous Materials

Maximum = No contaminated sites are evident along the entire alignment.

Mid-Range = Contaminated site(s) identified along the alignment would not be expected to affect project construction or operation.

Minimum = Contaminated site(s) identified along the alignment could affect project construction or operation.

Land Use / Noise

Maximum = Project does not interfere with existing and planned land uses, and noise generated by project construction or operation does not impact residential areas or other sensitive receptors.

Mid-Range = Project interferes to a modest degree with existing and planned land uses, and noise generated by project construction or operation impacts some residential areas or other sensitive receptors to a modest degree.
Chapter 12 – Evaluation Criteria

Minimum = Project interferes to a significant degree with existing and planned land uses, and noise generated by project construction or operation impacts many residential areas or other sensitive receptors to a significant degree.

Construction Traffic

Maximum = Project does not interfere with existing traffic patterns, flow, or volume during construction.

Mid-Range = Project has minimal impacts on existing traffic patterns, flow, or volume during construction, and does not reduce the availability of existing parking.

Minimum = Project requires traffic detours or creates substantial delays in traffic flow during construction or reduces carrying capacity or existing parking.

Goal 3: Maximize System Implementability

Permit Feasibility

Maximum = Permit requirements few or covered under existing programs.

Mid-Range = Permitting requirements involve a few agencies or departments not currently involved in the project and local agency permits.

Minimum = Permitting requirements involve many agencies on the federal, state, and local levels and would require significant time and effort to obtain approval and could be potential fatal flaws.

Constructability

Maximum = Construction complexities present minimum risk to successful project completion and minimum risk of schedule delays.

Mid-Range = Construction complexities present moderate risk to successful project completion and/or moderate risk of schedule delays.

Minimum = Construction complexities present major risk to successful project completion and/or major risk of schedule delays.

Expandability
Maximum = Alignment / Configuration provides for future expansion of deliveries to 75 or 100 mgd with minimum realignment and reconstruction.

Mid-Range = Alignment / Configuration provides for future expansion of deliveries to 75 or 100 mgd but with some realignment and reconstruction.

Minimum = Future expansion of deliveries to 75 or 100 mgd requires significant realignment / abandonment and reconstruction.

**Goal 4: Maximize Operational Effectiveness and System Reliability**

**System Reliability**

Maximum = No risk of system outage from natural or manmade events.

Mid-Range = Minimal risk of system outage from natural or manmade events.

Minimum = High risk of system outage from natural or manmade events.

**Operational Flexibility**

Maximum = Alternative provides maximum operational flexibility in allowing the Water Authority to meet member agency demands.

Mid-Range = Alternative provides moderate operational flexibility in allowing the Water Authority to meet member agency demands.

Minimum = Alternative provides minimum operational flexibility in allowing the Water Authority to meet member agency demands.

**Operational Complexity**

Maximum = Operation of the conveyance system poses no unusual complexities outside the normal operations activities of the Water Authority, and requires minimum staffing.

Mid-Range = Operation of the conveyance system poses some unusual complexities outside the normal operations activities of the Water Authority, and requires moderate staffing.

Minimum = Operation of the conveyance system poses significant unusual complexities outside the normal operations activities of the Water Authority, and requires significant staffing.
Chapter 12 – Evaluation Criteria

Maintenance Access

Maximum  =  No difficulty accessing site(s) for maintenance.
Mid-Range =  Some difficulty accessing site.
Minimum  =  Significant difficulty accessing site (special permissions, equipment, etc.).
Chapter 13 – Next Steps
(Leading to the Production and Distribution of Desalinated Seawater)

13.1 Purpose and Approach

This chapter describes the next steps required to move from the Alignment Investigation Report stage (completed with delivery of the final “Alignment Investigation Report”) to design, construction and production of desalinated water at the Encina plant and distribution to Water Authority customer agencies.

13.2 Chapter Outline

The following chapter sections identify the critical tasks that need be completed before final design begins. These are tasks will address important technical and operational questions that need to be answered in the best interest of the public, stakeholders, Water Authority and the project.

13.3 Public Information/Outreach
13.4 Flavor Profile Analysis
13.5 Corrosion Pipe Loop Testing
13.6 Value Engineering and Final Alignment Investigation Report
13.7 Negotiations with Poseidon Resources
13.8 Coordination with the City of Carlsbad
13.9 Continuation of Project Planning by the Phase I Engineering Team
13.10 Environmental Impact Report and Board of Director’s Certification

Stakeholders in this project are encouraged to comment on the contents of this Report and provide input to the Water Authority. There are a number of ways to provide input, including directly to the Public Information Department, through future public meetings in the study area, or through the EIR public comment period.

13.3 Public Information/Outreach

Prior to authorizing final design for the project, the Water Authority plans to begin a public information/outreach program that will include up to 30 small group meetings, 1 meeting each with staff from the cities of Carlsbad, Oceanside, Vista, and San Marcos, an elected officials workshop, and 4 public open house workshop type meetings. A speaker’s bureau will be established to make project presentations at already scheduled meetings of various local groups. Informational newsletters will be published bi-monthly and the Water Authority will provide support for feature stories in local newspapers. The goal of this program is to gain feedback from potentially affected entities, increase their knowledge of the project so that they, as stakeholders, can provide valuable input, to make the pipeline alignment decision-making open and available to the stakeholders, while minimizing negative project impacts to the extent possible. All input will be summarized and considered.
13.4 **Flavor Profile Analysis**

Based upon the information contained in Chapter 6 and Appendix 3, expert and lay person panels will be set up to assess the taste and odor characteristics of Metropolitan water, desalinated seawater with variations of conditioning, and blends of Metropolitan and desalinated water using the standard method, known as “Flavor Profile Analysis” (FPA). Three consumer panels of 12 persons each will be used. It is anticipated that the desalinated water will be obtained from Poseidon’s pilot treatment plant at Encina. Should this not be possible, membrane manufacturers could be contracted with to develop water similar to what will be produced at Encina. The results of the FPA will be used to determine the final conditioning approach and acceptable blend ratios within the Second Aqueduct. This blending approach has a significant affect on the facilities required to integrate DWCF with the Aqueduct.

13.5 **Corrosion Pipe Loop Testing**

Water that comes out of seawater desalination reverse osmosis membranes without any further conditioning is generally very aggressive towards concrete and metals and would rapidly corrode and destroy the conveyance and distribution pipelines from the treatment plant to the consumer’s (homeowner) indoor plumbing. To prevent this, the product water needs to be conditioned with additives to make it more stable.

Good engineering practice calls for the performance of what is known as “Corrosion Pipe Loop Testing” to fine-tune the types and amounts of additives. For these tests, water from the Encina pilot treatment plant would be conditioned and then put into sections of actual pipe removed from the transmission, distribution and home plumbing systems, to observe the effect. The additives are then adjusted until the water does not damage the pipes. New pieces of pipe that are typically used in these systems should be included in the testing process.

13.6 **Value Engineering and Final Alignment Investigation Report**

Prior to authorizing final design for the DWCF project, this draft report and the supporting engineering studies and technical memorandums will be reviewed in a value-engineering (VE) workshop. A panel of five technical experts, with experience in the most important aspects of this project like pipelines and pump stations, will be assembled. They will perform a five-day review including:

- An Information Phase to study the project issues, needs, and requirements.
- A Creative Phase to brainstorm alternative methods for fulfilling the functions.
- An Evaluation Phase to cull the brainstormed alternatives.
- A Development Phase to write up the VE proposals.
- A Presentation Phase to present the proposals to the Water Authority.
Following the five-day session will be a meeting to reconcile the proposals. A value engineering report will be produced documenting the process.

Using the VE report and comments provided by the Water Authority staff, a Final Alignment Investigation Report will be prepared.

13.7 Negotiations with Poseidon Resources

Poseidon Resources has proposed to develop the Seawater Desalination Plant at Encina. As of December 2003, the Water Authority is negotiating with Poseidon on the terms and conditions under which they would purchase the water that is produced. Once the negotiations are successfully concluded, Poseidon would proceed to bid an engineering, procurement, construction (EPC) contract for the Plant. The successful bidder would design the treatment plant in accordance with performance specifications approved by the Water Authority. They will purchase the reverse osmosis membranes and other necessary equipment and construct the treatment plant. The bid package may also include the operation of the Plant for a number of years.

In the event that the Water Authority and Poseidon are unable to reach an agreement, the Water Authority will investigate the possibility of proceeding with the project on its own.

13.8 Coordination with the City of Carlsbad

As so much of this project will be constructed in Carlsbad, the Water Authority is holding specific coordination meetings with Carlsbad staff to address major issues, including water deliveries, alignment considerations, and permit conditions. The role that Carlsbad’s Maerkle Reservoir will play in the project will be determined.

13.9 Continuation of Project Planning by the Phase I Engineering Team

When appropriate, the Phase I engineering team will continue the project planning and defining of the project that will include:

- Support the Public Information/Outreach Program.
- Support the EIR.
- Coordinate With Carlsbad.
- Support for and Coordination with the Water Authority Engineering, Operations, Water Resources, and Right-of-Way Departments.
- Investigate Facilities to Integrate the DWCF with the Second Aqueduct.
13.10 Environmental Impact Report (EIR) and Board of Director’s Certification

The Water Authority is preparing an EIR in accordance with CEQA. The EIR will include both the Desalination Plant and the conveyance facilities. The Report will analyze project impacts to biological, archeological (cultural resources), air quality, noise, traffic, public resources, etc. as required under CEQA. Field and detailed studies will be conducted to support the impact analyses. Mitigation will be developed to reduce impacts to a “less than significant” status. The draft EIR is scheduled to be published during 2005 and will be sent to affected agencies. It will be available in public places, like libraries and the Water Authority offices, for review. There will be a 30-day public review and comment period immediately after the draft EIR is published. The comments will be addressed and a final EIR produced.

The Water Authority’s Board of Director’s will consider the EIR and the input provided through the public information/outreach program and Alignment Investigation Report and select a preferred alignment or provide other direction, and if approved by the Board, certify the EIR.

After the preferred alignment is selected, project final design activities can begin.

13.11 DWCF Implementation

To implement the DWCF, the project requires completion of the EIR, public affairs activities, selection of an alignment, right-of-way acquisition, permitting, institutional arrangements, preliminary design, final design and construction.
Glossary

aqueduct grade line The hydraulic grade line of the Authority aqueduct.
breasting capability Refers to a shield or other device attached to the front of a tunnel drilling machine that spans the face of the tunnel (the area in front of the machine) and supports the dirt to prevent the tunnel from collapsing on itself.
cavitation Vapor bubbles formed on a solid surface (often a pump impeller) in contact with a liquid. A condition in which the water pressure drops below a certain level forming a vacuum condition.
centrifugal pump A pump consisting of an impeller fixed on a rotating shaft that is enclosed in a casing, and having an inlet and discharge connection. As the rotating impeller whirls the water around, centrifugal force builds up enough pressure to force the water through the discharge outlet.
conveyance facilities The pipelines, pump stations and other water supply materials needed to convey water from one location to another.
desalinization The removal of dissolved salts (such as sodium chloride, NACI) from water by natural means (leaching) or by specific water treatment processes.
environmental impact report A document required by the California Environmental Quality Act that evaluates a project, along with project alternatives, for its impact to the environment and social ecosystem.
frac-out The uncontrolled spilling of drilling fluids into the environment when the hole being drilled fractures or collapses and the fluids that are used to lubricate the drill bit seep out of the hole through a fracture in the ground.
hydraulic elevation The amount of pressure or "elevation" needed to allow water to fall by gravity from one pipeline into another or the difference in water level between two points.
imported water supply A water supply which lies outside the region of San Diego County and must be transported into the county.
life cycle The period of time in which a facility or piece of equipment operates or is on-line, from construction completion through to the end of its useful life.
member agency An water agency that is a direct purchaser of water from the Water Authority.
MGD A measurement of water flow equivalent to one million gallons of water per day.
peak season The months of the year when water use is typically the highest, from June to October, inclusive. The remaining months comprise the off-peak season.
potable water Water that is suitable for drinking water.
### Glossary (cont.)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>raw water</strong></td>
<td>Water in its natural state prior to any treatment. Generally, water that requires treatment before it is ready for human consumption.</td>
</tr>
<tr>
<td><strong>product water</strong></td>
<td>Water that has passed through a water treatment plant with all treatment processes completed and the water is ready to deliver to customers.</td>
</tr>
<tr>
<td><strong>reservoir</strong></td>
<td>Any natural or artificial holding area used to store; regulate, or control water.</td>
</tr>
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<td><strong>seasonal demands</strong></td>
<td>The amount of water that is traditionally required by a specified group during the winter ‘wet’ season months versus that amount needed by that same group during the summer months. Water is typically used less in the winter than in the summer, so &quot;winter demands&quot; are considerably less than &quot;summer demands.&quot;</td>
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<tr>
<td><strong>seawater desalination</strong></td>
<td>The overall treatment process by which highly pressurized seawater is taken through a series of membrane filters to remove salts and produce a potable water supply. Reverse osmosis is the mechanical treatment process by which seawater desalination is accomplished.</td>
</tr>
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<td><strong>surge chamber</strong></td>
<td>A chamber or tank connected to a pipe and located at or near a valve that may quickly open or close or a pump that may suddenly start or stop. When the flow of water in a pipe starts or stops quickly, the surge chamber allows water to flow into or out of the pipe and minimize any sudden positive or negative pressure waves or surges in the pipe.</td>
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<tr>
<td><strong>water demand</strong></td>
<td>The amount of water is purchased by a member agency or the amount of water that is used on a daily basis.</td>
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<td><strong>water demand</strong></td>
<td>The amount of water, at present, that is required to meet the needs of a specified group.</td>
</tr>
<tr>
<td><strong>water facilities</strong></td>
<td>As it pertains to the San Diego County Water Authority, any pipelines, pump stations, flow control facilities, reservoirs, or dams that enable the transport of water throughout San Diego County.</td>
</tr>
<tr>
<td><strong>water supplier</strong></td>
<td>A person who owns or operates a public water system.</td>
</tr>
<tr>
<td><strong>water supplies</strong></td>
<td>The amount of water, at present, that is available to meet the needs of a specified group.</td>
</tr>
<tr>
<td><strong>water use</strong></td>
<td>The amount of water, historically, that was made available to meet the needs of a specified group.</td>
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