CDM

Otay Water District

Integrated Water Resources Plan

March 2, 2007

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Mr. James Peasley
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Subject: Final – Integrated Resources Plan

Dear Mr. Peasley:

CDM is pleased to provide you with 15 copies of the Final – Integrated Resources Plan.

The Integrated Resources Plan (IRP) provides the Otay Water District with a guide to face future water resources management decisions. The plan is a result of evaluating several water supply portfolios at a conceptual planning level in the context of specific planning objectives developed with OWD senior staff and Board members.

The CDM team has enjoyed working with Otay Water District and we look forward to future opportunities to serve you. If you have any questions, please do not hesitate to contact me.

Very truly yours,

Michael T. Savage

Michael T. Savage, P.E.
Project Manager
Camp Dresser & Mckee, Inc.

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Acronyms

AFY	Acre-feet per year
AFM	Acre-feet per month
BMP	Best Management Practices
CDM	Camp Dresser & McKee
CDP	Criterium Decision Plus
CEQA	California Environmental Quality Act
CFS	Cubic feet per second
CIP	Capital Improvement Program
CRA	Colorado River Aqueduct
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
DHS	Department of Health Services
DBP	Disinfection By-Product
FCF	Flow control facility
GW	Groundwater
HAA	Haloacetic acid
IRP	Integrated (Water) Resources Plan
LMSE	La Mesa-Sweetwater Extension
mg/l	Milligrams per liter
MGD	Million gallons per day
MOU	Memorandum of Understanding
MWD	Metropolitan Water District of Southern California
NPV	Net present value
O&M	Operation and maintenance
OWD	Otay Water District
RO	Reverse Osmosis
RWCWRF	Ralph W. Chapman Water Reclamation Facility
RWQCB	Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
SBWRP	South Bay Water Reclamation Plant
STELLA	Systems Thinking Experimental Learning Laboratory with Animation
SDCWA	San Diego County Water Authority
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
THM	Tri-halomethane
TOC	Total organic carbon
UV	Ultraviolet

UWMP	Urban Water Management Plan
WBIC	Weather-Based Irrigation Controller
WTP	Water Treatment Plant
WRP	Water Reclamation Plant

Executive Summary

The Otay Water District (OWD) provides water and wastewater services to approximately 179,000 customers throughout its service area in southern San Diego County. OWD delivers potable and reclaimed water supplies to portions of Bonita, Chula Vista, Eastlake, El Cajon, Jamul, La Mesa, Otay Mesa, Rancho San Diego, and Spring Valley (Figure ES-1).

Figure ES-1
Otay Water District Service Area

Currently, OWD relies on imported water to satisfy all of its potable water demands and most of its non-potable demands. With uncertainty surrounding imported water supplies due to potential shortages during drought or seismic emergency conditions, as well as the rising costs of imported water, OWD's dependence on imported water as their main source of supply potentially poses challenges to meet water demands reliably and cost-effectively. OWD has taken a number of short-term actions that will help diversify its water supply portfolio by the year 2010, but significant needs will still exist to reduce imported water dependence after the implementation of these short-term actions.

For these reasons, OWD has undertaken the development of an Integrated Resources Plan (IRP) to examine potential, future supply options and their performance with respect to a set of long-term, comprehensive water resource objectives developed as part of the IRP process. The development of the IRP followed a process that resulted

in a comprehensive and defensible implementation strategy to meet the OWD objectives and allow flexibility to adapt to changes in the water industry and market and regulatory conditions.

OWD Background

Total OWD water demands are anticipated to double in the next 25 years from approximately 40,000 AFY to over 80,000 AFY. This is due to the fact that a large percentage of undeveloped land with residential, commercial, and industrial land use denominations will be developed. The current population of approximately 179,000 is expected to grow to approximately 273,000 people at ultimate built-out conditions. Of the total water demand, the demand for recycled water is expected to increase from about 3,500 AFY to 7,300 AFY in 2030.

Supply for OWD primarily comes from imported water provided by the SDCWA (treated and untreated). Some local agreements with neighboring agencies allow for alternate water supplies in the case that treated water from the SDCWA aqueduct is unavailable. Additionally, OWD owns and operates the Ralph W. Chapman Water Reclamation Plant and delivers recycled water supplies to the Central Area and Otay Mesa Systems. By the spring of 2007 these systems are expected to also receive recycled water from the City of San Diego South Bay Water Reclamation Plant (SBWRP).

Challenges to Meet Future Needs

Otay Water District faces a number of challenges in meeting future growing water demands. Almost all of OWD's supply is imported water supply from SDCWA; this is expected to continue if no action is taken to develop local supplies. Because OWD significantly relies on imported water to meet its water demands, it has greater risk in terms of potential extreme droughts and seismic events that could reduce the amount of imported water available. Additionally, because of the significant investments being made by MWD and SDCWA to improve supply reliability, imported water costs are expected to increase significantly.

Therefore, OWD needs to systematically evaluate a number of supply options to define the best supply portfolio for the future, consistent with its mission to "provide safe, reliable water and wastewater services to our community with innovation, in a cost-efficient, water-wise and environmentally responsible manner."

Integrated Resources Planning Process

An IRP is uniquely and collaboratively developed through the framework of a systematic decision making process which takes into account multiple system objectives and perspectives from multiple stakeholders (including OWD senior staff and board members). An IRP involves the identification of the values and objectives of an organization, and then looks at possible supply-side and demand-side water

management options in a consensus-building process to develop a comprehensive plan to meet the defined objectives.

Through the development of the IRP, planning objectives were defined and weighted by stakeholders to account for the difference in their relative importance. In addition, at least one performance measure was established for each objective.

Parallel to the definition of the objectives and performance measures, water supply options were defined and combined into water supply portfolios. These portfolios were evaluated using a systems model that simulated the behavior of the OWD water system through the year 2030 providing information about raw portfolio performance with respect to OWD's objectives. Portfolio evaluation was an iterative process where the performance results of a set of portfolios were used to refine the next set until preferred portfolios were identified (Figure ES-2).

Raw performance of the simulated portfolios was translated to overall, objective-based performance and the portfolios were ranked using a technique known as the Multi-Attribute Rating Technique. The results of the portfolio analysis and rankings were used to develop preliminary recommendations for a future implementation strategy for OWD. These recommendations were discussed during a workshop with the OWD and new portfolios were developed and analyzed to develop a final implementation strategy.

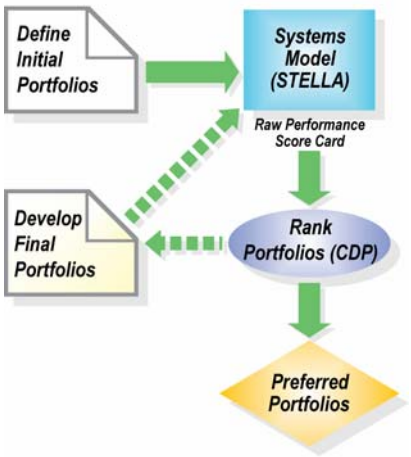


Figure ES-2
IRP Portfolio Evaluation Process

Integrated Resource Plan Results

As part of the IRP process, OWD staff and board members defined the IRP objectives and their relative importance. The six primary water resource objectives identified for this IRP are:

- Meet or Exceed Water Quality Standards and Guidelines
- Achieve Reliability
- Maintain Affordability
- Increase Flexibility
- Increase Diversity
- Address Environmental and Institutional Constraints

The relative importance of the objectives for senior staff members and OWD Board is presented in Figure ES-3. Achieving reliability, meeting and exceeding water quality standards and increasing diversity are important OWD objectives that will need to be achieved by a program resulting from the IRP process.

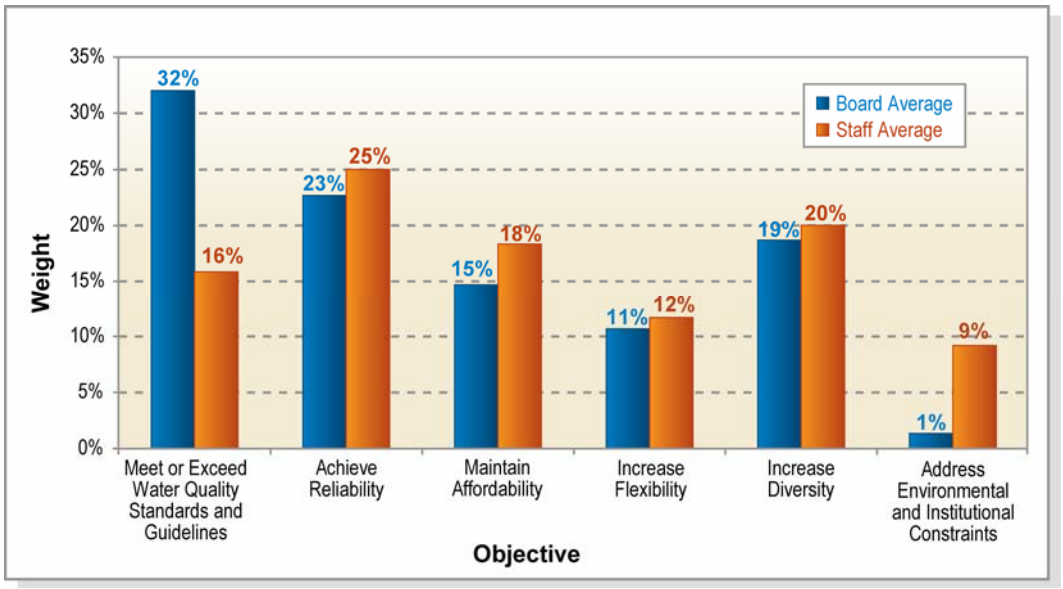


Figure ES-3
Average Weight Assigned by Staff and Bard Members to IRP Objectives

Over 20 water supply portfolios were analyzed and the performance was measured against their ability to meet the IRP objectives.

Throughout the analysis, the options that consistently showed in the top ranked portfolios and that were ultimately considered feasible include the following:

- Additional Conservation
- Central Valley and Land Fallowing Transfers
- Groundwater projects (Demineralization and Conjunctive Use)
- 5-10 MGD Ocean Desalination (Poseidon, or Sweetwater/City of SD's South Bay project)
- Stripping Plant along Spring Valley Trunk Line
- North District Recycled Water Concept

Other options that could be considered for implementation are those that were in at least one of the top three performing portfolios. These options are:

- SD17 Agreement with City of San Diego to treat raw water at Alvarado WTP
- Additional Purchases from South Bay WRP
- North of Delta Transfers

The options listed above are projects, programs and contractual agreements that have shown to best accomplish OWD's goals when combined in a supply mix for the future. Therefore, these projects are recommended for consideration in the IRP implementation strategy.

Implementation Strategy

This IRP identifies an implementation path to keep OWD on track to accomplish its long-term goals while strategically making investments only if and when necessary (Figure ES-4). It is recognized that, due to the high-level planning and policy nature of the IRP, some uncertainties on the technical or implementation aspects of the projects can result in their unfeasibility. For example, some events may make the implementation of a groundwater conjunctive use or desalination project more or less feasible or cost effective. The implementation strategy accounts for these uncertainties and provides an adaptable path that still allows OWD to accomplish it goals. The implementation path is consistent with the IRP's recommendations for a long-term local supply mix. The implementation strategy identifies some short-term, mid-term, and long-term actions and decisions that will take place during implementation.

The implementation path defines potential triggers and the potential actions that could follow. OWD, however, can begin short-term steps immediately, which will bring them closer to achieving longer term goals.

Projects, programs and contractual arrangements included in the short-term actions are:

- Additional conservation measures
- SD17 agreement with the City of San Diego
- Additional purchases from SBWRP
- North District recycled water concept
- Water banking agreements

These actions will serve as the foundation for the rest of the plan strategy.

Implementation Costs

The different end points in the implementation paths presented in the implementation strategy could result in a range of capital investment from approximately $117 million to around $318 million. The top three IRP portfolios ranged from $132 million to $381 million, so the different implementation paths would result in costs comparable to any of the three best scoring portfolios. What is important to recognize is that any of the resulting paths in the implementation strategy would represent a diverse water supply portfolio including projects, programs, and contractual agreements that have shown to best accomplish OWD's goals when combined in a supply mix for the future.

Sensitivity Analyses

Two of the greatest long-term water management concerns for OWD are the reliability and increasing cost associated with imported water purchases (raw or treated) from the SDCWA. In order to test the robustness of the IRP decision, the sensitivity of these two factors was analyzed to determine how the portfolio rankings would change if: (1) imported water were 100 percent reliable even under severe droughts, and (2) the projected cost of imported water were lower than the cost projections used in the main analysis of this IRP. The sensitivity analysis showed that the rankings of the preferred portfolios would remain the same, which indicates that results of the portfolio rankings are robust and that the supply projects and programs included in the top scoring portfolios are likely to achieve the OWD's objectives.

Conclusions

The recommendations in the IRP will help Otay Water District achieve its mission to:

"*provide safe, reliable water and wastewater services to our community with innovation, in a cost-efficient, water-wise and environmentally responsible manner*."

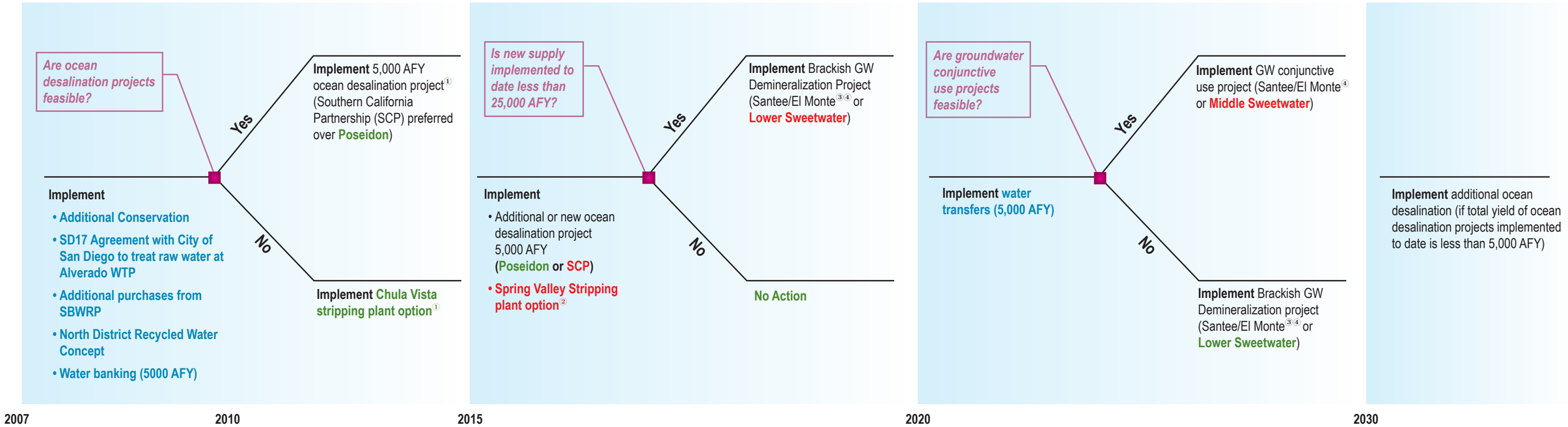
The implementation strategy developed in the IRP will help OWD to confront the uncertainties surrounding imported water supplies by reducing their dependence on imported water. The plan will help the OWD achieve its objectives of achieving reliability, maintaining affordability, increasing flexibility, increasing diversity, and addressing environmental and institutional constraints.

LEGEND

Implement Project

Minimal Capital Cost Project

Maximum Capital Cost Project



NOTES

① If ocean desalination projects and stripping options are not feasible, implement Santee/El Monte brackish groundwater demineralization (with the use of the LMSE).

② If Chula Vista stripping plant is not already in place.

③ If not already in place.

④ Assumes use of LMSE pipeline.

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Figure ES-4
OWD IRP Implementation Plan

Section 1
Introduction

1.1 Project Background

1.1.1 District Characteristics

The Otay Water District (OWD) is located within San Diego County, east of the City of San Diego on the U.S. – Mexican border in Southern California. OWD has a planned service area of 143 square miles (126 square miles within its boundaries and 17 square miles within its area of influence). OWD provides water and wastewater service to parts of the following communities: Bonita, Chula Vista, Eastlake, El Cajon, Jamul, La Mesa, Otay Mesa, Rancho San Diego, and Spring Valley. Figure 1-1 shows the OWD service area.

Figure 1-1
Otay Water District Service Area

The OWD was formed in 1956 by local residents and landowners in response to the need to address declining quality and quantity of water supplies in the arid region of San Diego County. Since that time, OWD has been managing water and wastewater services to meet the needs of its growing population of customers. The population served by the OWD in 1980 was 48,300 people, and in 2005 the population was 179,000 (OWD et. al., 2005). The San Diego Association of Governments (SANDAG) estimates that the population served by OWD in the year 2030 will be 273,150.

The long term population growth rate has historically been about 3 percent per year. The growth rate has been faster in recent years due to development in eastern Chula Vista, and growth is expected to continue at an accelerated rate for another five to ten years. In the long-term future, the growth rate is expected to slow as the amount of undeveloped land decreases (OWD et. al., 2005).

According to OWD's 2005 Urban Water Management Plan (UWMP), approximately 90% of OWD's customers are single-family residences, and much of the anticipated development will also be single-family residential. The relative composition of OWD's customers is expected to remain constant, since the commercial, industrial, and institutional sectors will grow proportionally in order to support the residential development.

The climate in San Diego County is characterized as Mediterranean, with mild temperatures and low annual rainfall. Temperatures are mild on the pacific coast year-round, and tend to be slightly more extreme inland at OWD – with warmer temperatures in the summer and cooler temperatures in the winter. Average annual rainfall for OWD is approximately 9.4 inches.

1.1.2 Imported Water Supply

OWD is a member agency of the San Diego County Water Authority (SDCWA), which is in turn a member of the Metropolitan Water District of Southern California (MWD). Together, SDCWA and MWD provide imported water from Northern California and the Colorado River to their member agencies throughout Southern California. MWD augments its imported water supplies with water transfers and groundwater banking programs. SDCWA augments its imported water supplies with water transfers and is planning other programs such as seawater desalination, additional transfers, and/or groundwater programs.

Currently, OWD relies on imported water to satisfy all of its potable water demands and most of its non-potable demands. This imported supply is delivered both treated and untreated (raw) through the SDCWA aqueducts. The raw water is treated at local water treatment plants through agreements with neighboring water agencies.

Reliability of Imported Water

Because OWD significantly relies on imported water to meet its water demands, it has greater risk in terms of potential droughts and seismic events that could reduce or terminate the amount of imported water available. Although both SDCWA and MWD have long-range water supply plans that indicate they will be able to meet full-service water demands of their member water agencies through 2025, these plans make a number of important assumptions, as explained below.

In 2003, MWD released its update to its 1996 Integrated Water Resources Plan (IRP). This IRP update concluded that MWD has enough water to meet full service demands through 2025.

However, this reliability assessment was based on the following assumptions:

1. Over 145,000 AFY of additional (beyond what was planned in the 1996 IRP) local water conservation implemented by 2020

2. Approximately 250,000 of additional (beyond what was planned in the 1996 IRP) local recycled water, groundwater recover and seawater desalination

3. Seventy-seven years of historical hydrology for determining the reliability of imported water from the State Water Project and Colorado River

4. An assumed solution for the Bay-Delta, the source of water for the State Water Project

5. Full implementation of the California Settlement for the Colorado River

Many of these assumptions have been invalidated by one of the worst droughts on record for the Western United States. Several reports prepared by the United States Geological Survey (USGS) indicate that the recent droughts in the West have been the worst in 500 years (based on tree ring analysis)[1]. This suggests that only using 77 years of historical hydrology to determine supply reliability might be inadequate in explaining the real risk of drought.

The recent drought for the Colorado River (1998-present) is the worst drought on record in terms of annual water supply. Prior to this drought, the average flow volume of the Colorado River was approximately 15 million acre-feet (for the last 30 years); while the flow volume of the Colorado River since 1999 has averaged only 7.1 million acre-feet[1].

Also, the CALFED record of decision, which will pave the way for the improvements to the State Water Project has faced legal challenges in the past and is likely to have some additional challenges in the future. This could result in even more local water supply development being necessary in Southern California.

If the recent drought experienced for the Colorado River, along with reduced State Water Project supplies due to legal challenges and increasing environmental restrictions were to occur in the future, MWD's assumption of 100 percent reliability for imported water may not hold true.

Therefore, it is prudent for OWD to explore expanding its local resources development as a way to hedge against supply risk for imported water.

[1] USGS Fact Sheet 2004-3062 (August, 2004).

Raising Costs of Imported Water

Because of the significant investments being made by MWD and SDCWA to improve supply reliability, imported water costs are expected to increase significantly. SDCWA's Draft Water Facilities Master Plan (December 2002) evaluated three alternatives for its CIP ranging from $2 to $6 billion. The most likely scenario is a $4 billion plus CIP that includes the emergency storage project, Twin Oaks Water Treatment Plant, and a seawater desalination plant. MWD's CIP is also about $4 billion, including several retrofits and expansions to its treatment plants, the Inland Feeder Project, and other major conveyance systems.

1.2 Problem Statement

Given the uncertainties surrounding imported water supplies as a result of potential drought shortages or emergency seismic conditions, as well as the rising costs of imported water, the reliance of OWD on imported water as their main supply source potentially poses challenges to fulfilling their organizational mission statement as stated below:

To provide safe, reliable water and wastewater services to our community with innovation, in a cost-efficient, water-wise and environmentally responsible manner.[2]

OWD, like many similar agencies in Southern California, is looking to reduce their dependence on imported water, and in doing so, to reduce operational costs and provide greater local control over their water resources and water management systems. To do this, OWD needs to systematically evaluate a number of supply options and define the best supply portfolio for the future.

1.3 Purpose of the Integrated Resources Plan

The Integrated Resources Plan (IRP) developed for OWD is a flexible, long-term strategy for the implementation of key facilities, management, and inter-agency agreements needed to expand and operate the OWD water system consistent with OWD's mission and values. An IRP is uniquely developed through the framework of a systematic decision making process which takes into account multiple system objectives and perspectives from multiple stakeholders. An IRP involves the identification of the values and objectives of an organization, and then looks at possible supply-side and demand-side water management options in a consensus-building process to develop a comprehensive plan to meet the defined objectives.

The IRP uses computer-based systems and decision models as tools in the planning process to simulate the operation of different supply options and then to quantify the relative performance of different combinations of options (portfolios) as measured against stated objectives.

[2] Source: 2005 OWD Urban Water Management Plan prepared by OWD and MWH Americas, Inc.

These modeling tools allow large amounts of data and complex system relationships to be incorporated into the decision process while also giving proper consideration to different, and often conflicting, values and perspectives among multiple stakeholders. The result is a defensible plan for the future development and management of the OWD that considers important objectives such as cost, reliability, environmental protection, and water quality and that provides flexibility for changes and adaptation in the future.

Section 2
Existing Water Supply

Supply for the OWD primarily comes from imported water provided by the SDCWA. Some local agreements with neighboring agencies allow for alternate water supplies in the case that treated water from the SDCWA aqueduct is unavailable. However, these alternate supplies themselves are heavily reliant on imported raw water. Currently, OWD does not use any local sources, such as groundwater or seawater, to meet potable customer demands. The only recycled supply currently available is from OWD's Ralph W. Chapman Water Reclamation Facility, although OWD has an agreement with the City of San Diego to receive effluent from the South Bay Water Reclamation Plant.

Upgrades and expansions to the current (2006) water supply system have already been planned, and implementation has begun. This includes some new, higher-capacity pipelines, larger pump stations in certain areas, and interconnection facilities between the subsystems of the service area. Given the goals of the IRP of identifying new supply options in the development of a long-term water supply strategy, planned facilities expansions and upgrades through the year 2010 were included in the baseline, or "existing", system, while the focus of this IRP was to identify and evaluate options that went beyond the already planned level of improvements for the system.

2.1 Water Supply Systems

The OWD service area is divided into five subsystems. These systems are known as: La Presa System, the Regulatory System, the Hillside System, the Central Area System, and the Otay Mesa System. The Presa, Regulatory, and Hillsdale systems are grouped together into what is known as the North District. The Central Area and Otay Mesa systems make up the South District.

For the purposes of modeling in this study, the OWD service area is considered to be divided into three systems: North, Central Area, and Otay Mesa. These systems are geographically separated and operationally distinct (See Figure 2-1 for the geographic locations). Each system receives imported water from one or more flow control facilities (FCF) on the SDCWA aqueduct. Each has its own storage and pumping facilities, as well as its own demands to serve.

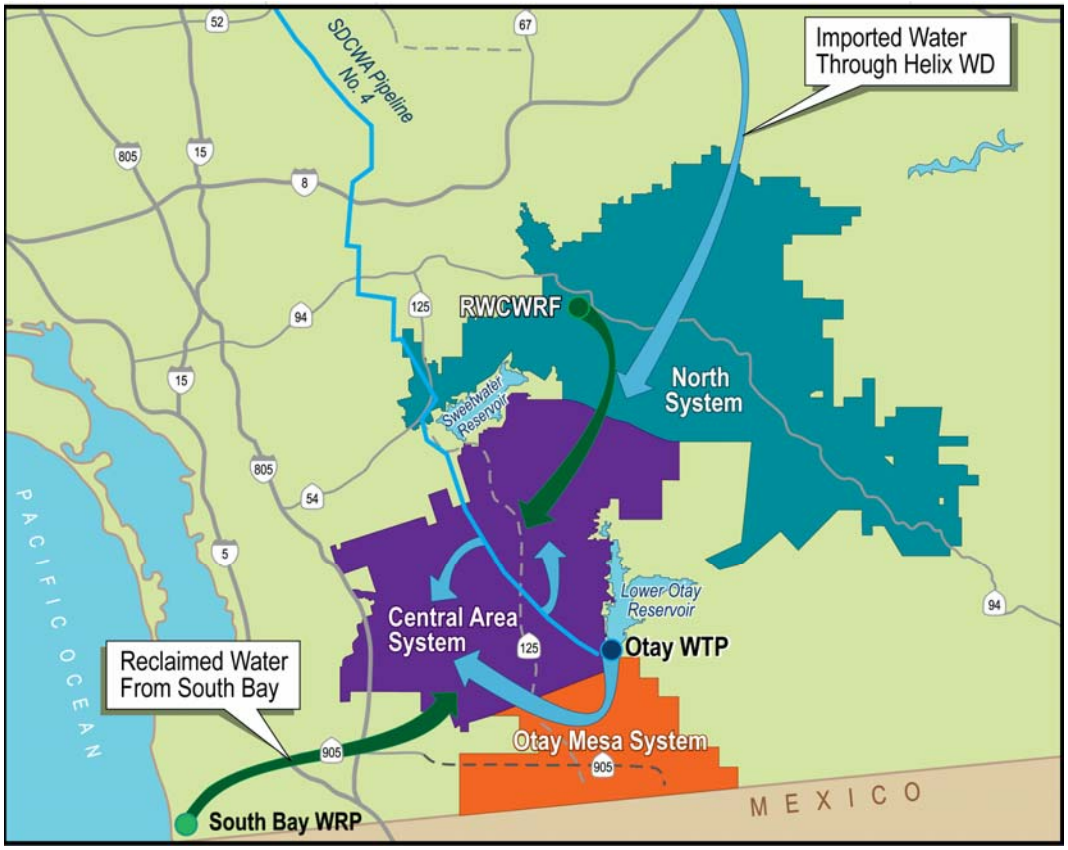


Figure 2-1
North, Central Area, and Otay Mesa Systems

Figure 2-2 shows a schematic of the entire OWD system as it is expected to exist in 2010. This schematic represents the major facilities and conveyance infrastructure from the source to system demands. For purposes of the IRP, details of the facilities associated with the distribution system are not shown on this schematic.

North System

The North System uses Flow Control Facility (FCF) No. 11 to divert water by gravity from San Diego County Water Authority (SDCWA) Pipeline No. 4 to the 640 and 520 reservoirs. Water then flows by gravity or is pumped from the reservoirs to La Presa, the Regulatory, and the Hillsdale systems of the service area. Flow Control Facility No. 11 has a meter capacity of 38.8 million gallons per day (MGD), or 60 cubic feet per second (cfs).

In addition to receiving treated imported water purchases through Pipeline No. 4, the North System can also receive water from Helix Water District's Levy Water Treatment Plant through a pipeline expected to replace the existing La Mesa-Sweetwater Extension (LMSE) by March 2010.

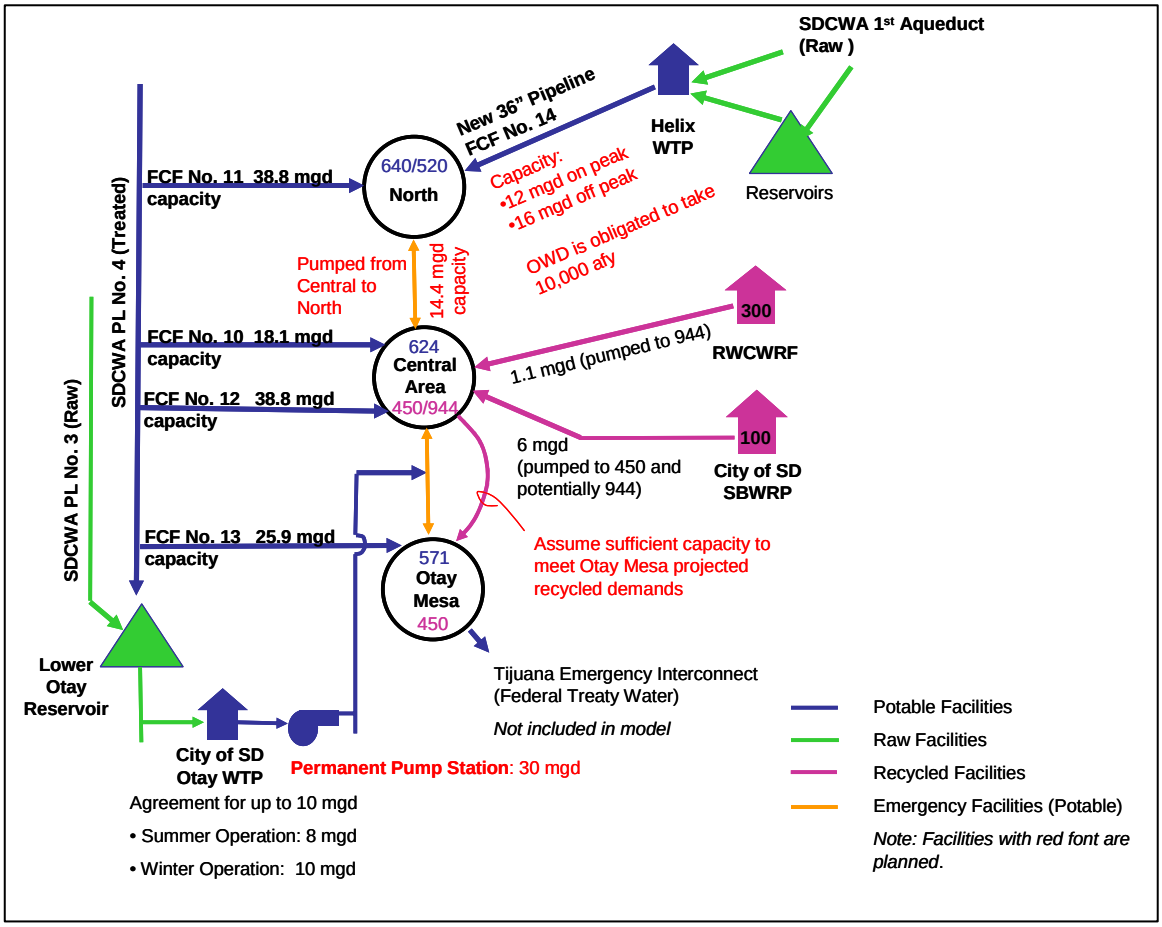


Figure 2-2
Baseline System Schematic

Central Area System

The Central Area System receives treated water from FCF No. 10 and FCF No. 12 on Pipeline No. 4 which is delivered to the 624 reservoirs. FCF No. 10 has a capacity of 18.1 MGD (or 28 cfs), and FCF No. 12 has a capacity of 38.8 MGD (or 60 cfs).

In addition, water treated at the City of San Diego's Otay Water Treatment Plant (WTP) can be delivered to the Central Area System. OWD has an agreement with the City of San Diego to treat 10 MGD of raw water purchased from the SDCWA at the Otay WTP. This agreement is discussed in more detail later in this section.

Otay Mesa System

The Otay Mesa System receives treated imported water from FCF No. 13 on Pipeline No. 4. This water flows by gravity into the 571 storage reservoir from which it is pumped to reservoirs at a higher elevation to serve water demands. FCF No. 13 has a capacity of 25.9 MGD (or 40 cfs).

Similar to the Central Area System, the Otay Mesa System also received water treated at the City of San Diego's Otay WTP.

Recycled Water Facilities

In addition to the potable water infrastructure described above, recycled water supplies are also delivered to the Central Area and Otay Mesa Systems through pipelines from the Ralph W. Chapman Water Reclamation Plant (owned and operated by OWD), and are expected to be delivered to these systems from the City of San Diego South Bay Water Reclamation Plant (SBWRP) by the spring of 2007. The recycled water system is also shown on the schematic in Figure 2-2, and is further described in Section 2.3 below. Currently there is no system for recycled water in the North System.

Alternative Supply/Emergency Interconnections

An interconnection pipeline between the Central Area and Otay Mesa Systems currently exists, and an interconnection between the Central Area and North District is expected to be in place after 2010. These interconnections permit the transfer of water between systems and provide flexibility in the management of demands in the case of an emergency, such as an earthquake, that disrupts the normal operation of the SDCWA aqueduct. The interconnections are not intended for normal operating conditions. Additionally there exists a 13 MGD emergency interconnect between OWD and the city of Tijuana in Mexico. This interconnect can be used to deliver international treaty waters to Mexico, but was not modeled in the IRP because the emergency transfer of water is not obligatory.

2.2 Potable Water Supply

2.2.1 San Diego County Water Authority Imported Supply

Imported water from SDCWA is the primary source of water for OWD. OWD takes both treated water and raw water from SDCWA. Treated water from SDCWA is directly delivered to OWD's reservoirs through four flow control facilities on Pipeline No. 4. Raw water from SDCWA is first delivered to the Helix Water District's Levy Water Treatment Plant (WTP) or the City of San Diego's Otay WTP for treatment and then it is conveyed to the OWD service area.

The SDCWA is a member agency of the Metropolitan Water District of Southern California (MWD). MWD is the regional water wholesaler for Southern California, providing supplemental water to over 17 million people in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura Counties.

MWD owns and operates the Colorado River Aqueduct (CRA), along with major reservoirs such as Diamond Valley Lake and Lake Skinner, 5 regional water treatment plants, and large transmission pipelines to move imported water to its 26 public member agencies. Over the last few years CRA supply, historically providing over 1.2 million AFY to the region, has been severely cut. This was due to the development of

the California Plan for Colorado River, which forces California to live within its 4.4 million AF entitlement of Colorado River. MWD does have programs in place and is working on others in order to maximize supplies from the CRA and in certain years get back to the 1.2 million AFY level.

MWD is also the largest State Water Contractor, with a contract of 2.0 million acre-feet for State Water Project (SWP) supply. The SWP is subject to extreme variability in hydrology due to a lack of storage. Although MWD has a contract for 2.0 million AF, it rarely has received that (only in the very wettest of years). Average deliveries have been closer to 1.2 million AFY. In severe droughts, SWP supplies to MWD have been less than 0.5 million AFY.

MWD augments its imported water from the CRA and SWP with stored water in water banks such as Semitropic and Arvin-Edison, conjunctive use storage in local basins, and voluntary water transfers during certain dry years. MWD's IRP (1996) and IRP Update (2003) indicate that MWD will have the supplemental water to meet all of its member agencies' water needs through 2025, even during a repeat of the 1987-1992 drought condition, although this is based on a number of assumptions that may not hold true as discussed in Section 1.

2.2.2 City of San Diego's Otay WTP

The City of San Diego's Otay WTP has a rated capacity of 40 MGD with an effective capacity of 34 MGD, of which 20 MGD is currently used by the City of San Diego. In 1999, OWD entered into an agreement with the City of San Diego to be provided with 10 MGD of treatment capacity from the Otay Water Treatment Plant, if such surplus is available. Typically, OWD receives only 8 MGD during summer months, in which water demands are the highest. Current trailer-mounted pumping facilities have capacity to deliver 6-20 MGD from the Otay plant to the OWD distribution system. Potential upgrades to a permanent pump station would allow for a conveyance capacity of 30 MGD.

OWD purchases raw water from the SDCWA for treatment at the Otay WTP.

2.2.3 Helix Water District's Levy WTP

A SDCWA Board of Directors commitment dating back to 1976 entitles OWD to be provided with 8 MGD of treated water by SDCWA through a pipeline known as the La Mesa-Sweetwater Extension (LMSE). To fulfill this obligation, SDCWA acquired capacity from the Helix Water District at their R.M. Levy WTP for treated water to be conveyed through the LMSE to OWD.

Although the current (2006) rated conveyance capacity of the LMSE is 12 MGD, the effective capacity is limited to 3.4 MGD due to hydraulic limitations. In the future, the LMSE pipeline is expected to either be converted for use in raw water delivery to Sweetwater Authority or else abandoned. In the case that the pipeline is abandoned, it was assumed that it could be used for conveyance in some of the supply options

described in Section 5. A new 36-inch pipeline that will replace the LMSE is planned to be operational by March 2010 with a conveyance capacity of 16 MGD. In addition, FCF No. 14 will be upgraded to a capacity of 16 MGD to convey water from Levy WTP to the new pipeline for delivery to OWD. Per the terms of the recent agreement between SDCWA and OWD regarding implementation of the East County Regional Treated Water Improvement Program (ECRTWIP), the supply to OWD from the Levy WTP via FCF No. 14 and the new pipeline will be up to 12 MGD on-peak and 16 MGD off-peak. Once the new pipeline is operational, the LMSE is expected to be abandoned or converted to raw water service by SDCWA.

Per the terms of the ECRTWIP, OWD must purchase a minimum of 10,000 acre-feet per year (AFY) of treated water from Helix's Levy WTP beginning in March 2010.

2.3 Recycled Water Supply

2.3.1 Ralph W. Chapman Water Reclamation Facility

OWD owns and operates the Ralph W. Chapman Water Reclamation Facility (RWCWRF). This facility provides tertiary treated wastewater effluent that meets Title 22 requirements for non-restricted impoundments, spray irrigation of food crops, and the broadest category of landscape irrigation. Wastewater treated at RWCWRF comes from the OWD and the Spring Valley Sanitation District. Effluent from this plant that is not further treated and put to beneficial re-use is disposed of via the Rancho San Diego Outfall. The RWCWRF has a current rated capacity of 1.3 MGD (approximately 1,460 AFY), although in terms of water quality, the reliable continuous treatment capacity of this facility is approximately 1.1 MGD (1,230 AFY) (OWD et. al., 2005).

2.3.2 City of San Diego South Bay Water Reclamation Plant

The South Bay Water Reclamation Plant (SBWRP) is owned and operated by the City of San Diego's Metropolitan Wastewater Department. The plant became operational in May 2002, and has a rated treatment capacity of 15 MGD with an effective capacity of approximately 14 MGD. The effluent receives either secondary treatment for discharge into the Pacific Ocean, or tertiary treatment to meet Title 22 requirements for reclaimed water use. The design allows for tertiary treatment of all flows (14 MGD); of which, 10 MGD is available for reclaimed use by other water agencies.

In October 2003, OWD entered into an agreement with the City of San Diego to receive at least 6 MGD of treated effluent from the SBWRP. In addition, the agreement presents a minimum purchase schedule for OWD on an annual basis. For purposes of this analysis, the supply from SBWRP to OWD was limited to 6 MGD.

Due to the seasonal fluctuation in reclaimed water demands, it should be noted that the supply from SBWRP will need to exceed 6 MGD during peak summer months in order to satisfy the minimum purchase agreement on an annual basis. However, any supply exceeding 6 MGD is not promised to OWD, and is not reliable for planning purposes. Therefore, the minimum annual purchases required in the agreement were

not enforced in this analysis. Rather, supply from SBWRP was limited to the minimum of reclaimed water demands or 6 MGD, whichever was lower.

2.4 Summary of Existing Supply

Upgrades and expansions to the current (2006) system have already been planned. These include some new, higher-capacity pipelines, larger pump stations in certain areas, and interconnection facilities between the subsystems of the service area. Table 2-1 compares the current (2006) system with the system as it is expected to exist in the year 2010.

Given the goals of the IRP to identify new supply options and develop a long-term water supply strategy, planned facilities expansions and upgrades through the year 2010 were included in the baseline, or "existing", system for purposes of the IRP. For reference, the baseline (2010) facilities in Table 2-1 are consistent with the system schematic in Figure 2-2.

Table 2-1
Comparison of 2006 and 2010 Water Facility Capacities and Agreements

Supply Source	2006 Current Yield	2010 baseline Yield
Imported		
Treated water from SDCWA through Pipeline # 4	121.5 MGD [Capacity]	121.5 MGD [Capacity]
City of San Diego's Otay WTP	10 MGD [Agreement]	10 MGD [Agreement]
Helix's Levy WTP	3.4 MGD [Capacity] 8 MGD [Agreement]	12 MGD On-Peak, 16 MGD Off-Peak [Agreement]
Recycled		
OWD's Chapman WRP	1.1 MGD [Capacity]	1.1 MGD [Capacity]
City of San Diego's South Bay WRP	0 MGD	6 MGD [Agreement]

Section 3
Projected Water Supply Gap

3.1 Future Water Demands

Future water demand projections provide the context for the evaluation of water supply alternatives, and support the development of the IRP. In addition, water demand projections can be used to schedule the timing of water supply investments in order to minimize unnecessary costs. The following is a description of the projected demands used for this IRP for the North, Central Area, and Otay Mesa Systems within OWD.

3.1.1 Annual Average Demand Projections

The total OWD water demand projections for potable and recycled uses are based on estimates in the OWD's 2005 Urban Water Management Plan (UWMP), and summarized in Table 3-1. These demands were prepared by the San Diego County Water authority (SDCWA) using the CWA-MAIN model, which applies input data for population, demographics, climate, economic forecasts, and other variables to estimate future water use. The total demand projections in the UWMP are higher than the demand projections estimated in the 2002 Water Resources Master Plan, but OWD has elected to use them for the IRP to maintain consistency with planning work by the SDCWA (OWD et. al., 2005).

Table 3-1
Otay Water District Total Demand Projections

Forecast Year	Potable Water Use	Recycled Water Use[2]	Total Water Use[1]
	afy	afy	afy
2005	35,288	3,485	38,773
2010	45,772	4,040	49,812
2015	52,349	4,684	57,033
2020	59,799	5,430	65,229
2025	66,560	6,294	72,854
2030	75,108	7,297	82,405

[1] Source: 2005 Urban Water Management Plan, page 15.
[2] Source: 2005 Urban Water Management Plan, pages 33-34.

For purposes of the IRP, the total OWD demands were divided into demands for the North, Central Area, and Otay Mesa Systems (described in Section 2) based on demand distributions delineated in the 2002 Water Resources Master Plan. The projected distribution of total demand to each system for the years 2016 and 2030 are shown in Table 3-2, and annual rates of change were assumed to be linear throughout the planning horizon. The resulting projected demands for each system (North, Central Area, and Otay Mesa) that were used for the IRP are shown in Figure 3-1.

Table 3-2
Projected Demand Distributions by System for Potable and Recycled Uses

Forecast Year	Potable[1]			Recycled[2]	
	NORTH	CENTRAL AREA	OTAY MESA	CENTRAL AREA	OTAY MESA
2006	41%	51%	8%	89%	11%
2016	37%	54%	9%	84%	16%
2035	33%	52%	15%	77%	23%

[1] Source: Adapted from 2002 Water Resources Master Plan, page 4-9.
[2] Source: Adapted from 2002 Water Resources Master Plan, page 11-12.

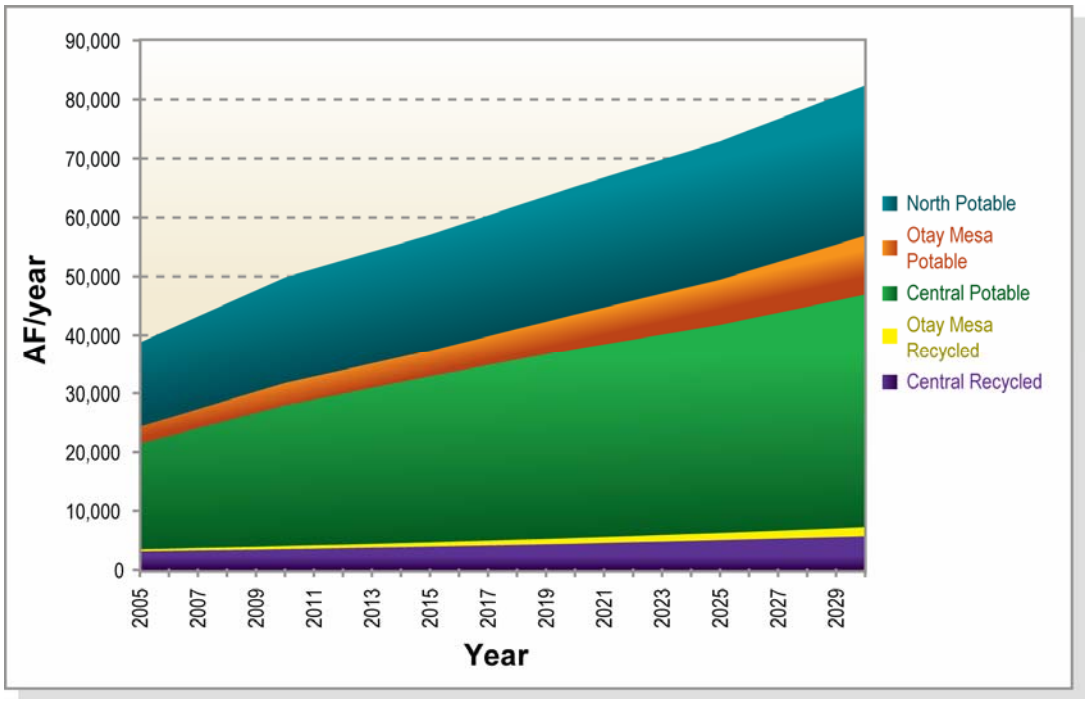


Figure 3-1
Otay Water District Projected Annual Demands

As shown in Figure 3-1, total OWD demands are anticipated to double in the next 25 years from approximately 40,000 AFY to over 80,000 AFY. This is due to the fact that a large percentage of undeveloped land is being converted from agricultural use to higher water consuming residential, commercial, and industrial uses. In addition, the current population of approximately 179,000 persons is expected to grow to approximately 273,000 persons at ultimate built-out conditions (OWD et. al., 2005). The land use changes and population growth translate into a significant increase in projected water demands through the year 2030.

It is also clear from Figure 3-1 that the Central Area System represents the majority of demands, and has the largest increase in demands over time. According to the 2005

UWMP, the Central area is comprised primarily of major residential developments, while the Otay Mesa area is expected to develop almost exclusively as industrial with very small commercial and residential land uses.

3.1.2 Weather Impacts and Peaking

Water demands are not uniform over time. Rather, water demands at nearly all municipal water agencies exhibit variability on an annual, monthly, and daily basis. Annual and seasonal changes in weather affect water demands, and people's lifestyles and business habits affect water demand throughout the day. This variability is subject to random processes, but inherent patterns can be observed over time and used in the planning and management of water supply systems. Annual, monthly, and daily water use patterns can be described; and although weather is unpredictable, understanding its range of effects can improve management of water resources.

3.1.2.1 Annual Weather Impacts

When projecting future water demands, it is important to recognize that demands fluctuate year-to-year based on local weather. Water demands are greater in dry-weather years than in average-weather years, due to increased landscape irrigation needs and other uses. Additionally, there is uncertainty due to weather and hydrology regarding the amount of imported water available from year to year. In order to account for the variability caused by different hydrological conditions, demand factors were generated. The factors are multipliers to be applied to the base demand projections (average annual value). A demand multiplier equal to 1.0 would represent the average annual hydrology condition, while a multiplier greater than 1.0 would apply to dry-weather years with higher demand. Inversely a demand multiplier less than 1.0 would represent wet-weather years with lower demand. These factors account for fluctuations in demand related to local weather and the availability of imported water supply.

Local weather factors for water demand were obtained from the Metropolitan Water District (MWD), which developed them statistically from their long-term planning efforts. These demand factors were shared with and reviewed by the SDCWA in previous studies.

Imported water from the SDCWA and MWD is one of the most variable sources of water supply. This variation is mainly due to hydrology in northern California, which is not always correlated to hydrology in San Diego County. The imported water variability from the Colorado River is tempered by the massive storage within the system (which has over 10 times the storage as the SWP system). Weather factors for imported water were also obtained by MWD.

The resultant factors, which account for fluctuation in demand due to local weather and imported water supply, were assigned to each year of hydrologic record and are shown in Figure 3-2. Of the 77 historical hydrologic years of record from 1922 to 1998, 38 years (or 49 percent) were normal, 21 years (or 27 percent) were dry, and 18 years (or 23 percent) were wet.

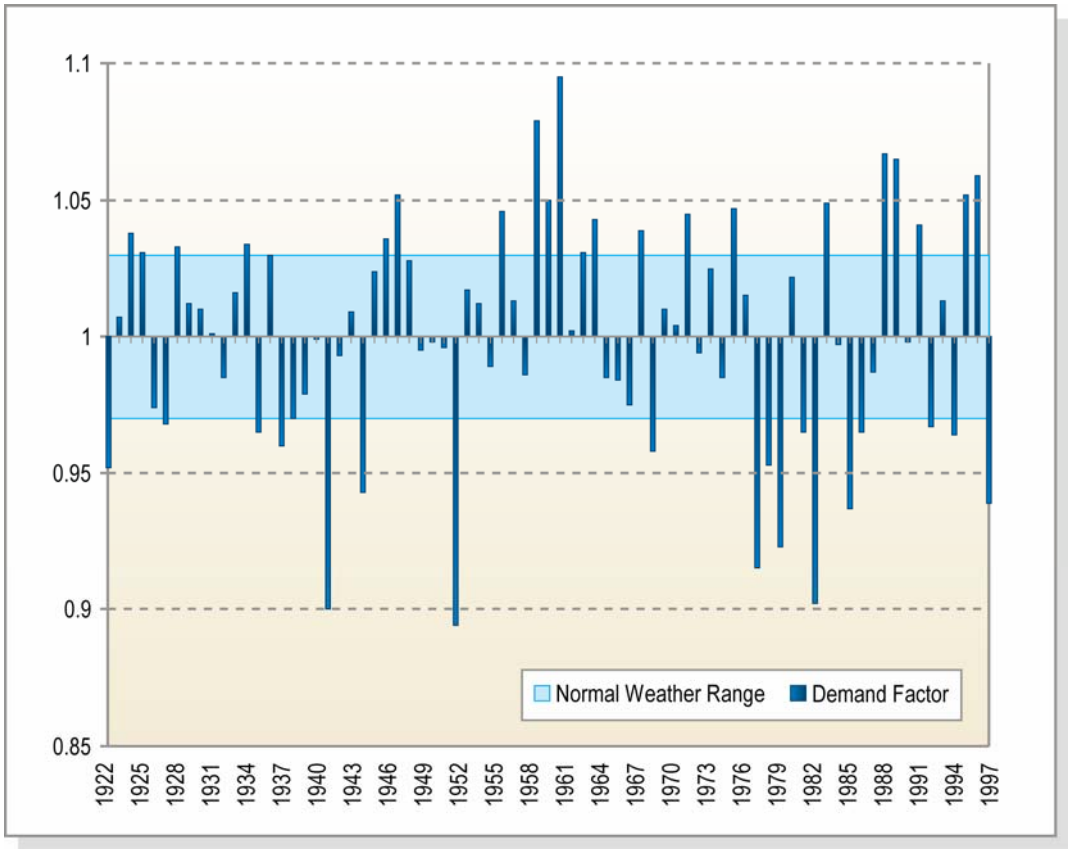


Figure 3-2
Annual Hydrologic Demand Factors

3.1.2.2 Seasonal (Monthly) Impacts

Water demands not only vary from year-to-year, but also from season-to-season (for instance, irrigation demands increase during dry summer months). To account for these seasonal fluctuations in demand, monthly demand factors were developed based on historical water use patterns for the OWD. The following is a description of the method for calculating the monthly demand factors.

OWD's historical monthly SDCWA purchases were available for the period from July 1992 through June 2005 for the North, Central Area, and Otay Mesa Systems. In addition, historical total recycled water demands were available from January 1996 through December 2005. Because historical recycled water demands have exceeded the potential supply from RWCWRF in the past, SDCWA treated water purchases have historically been used to meet recycled water demands.

In order to develop seasonal factors for potable demands only, historical monthly recycled water demands (assuming 1.1 MGD supply from OWD's RWCWRF) were subtracted from the total SDCWA purchases. The remaining SDCWA purchases were assumed for potable uses.

Monthly potable demand factors could then be calculated based on the ratio of monthly potable water use variations to the annual average month water use. The calculated potable monthly demand factors for each system are shown in Figure 3-3. The factors are multipliers to be applied to the base demand projections (average annual value). A demand multiplier equal to 1.0 would represent the average month demand, while a multiplier greater than 1.0 would apply to peak demand months. On the contrary, a demand multiplier less than 1.0 would represent low demand months. These factors account for fluctuations in demand related to seasonal water use patterns.

Monthly seasonal factors for recycled water demands were given in the 2002 Water Resources Master Plan, and are shown in Figure 3-4. These seasonal variations for recycled water demand originated from the City of San Diego Clean Water Program Reports.

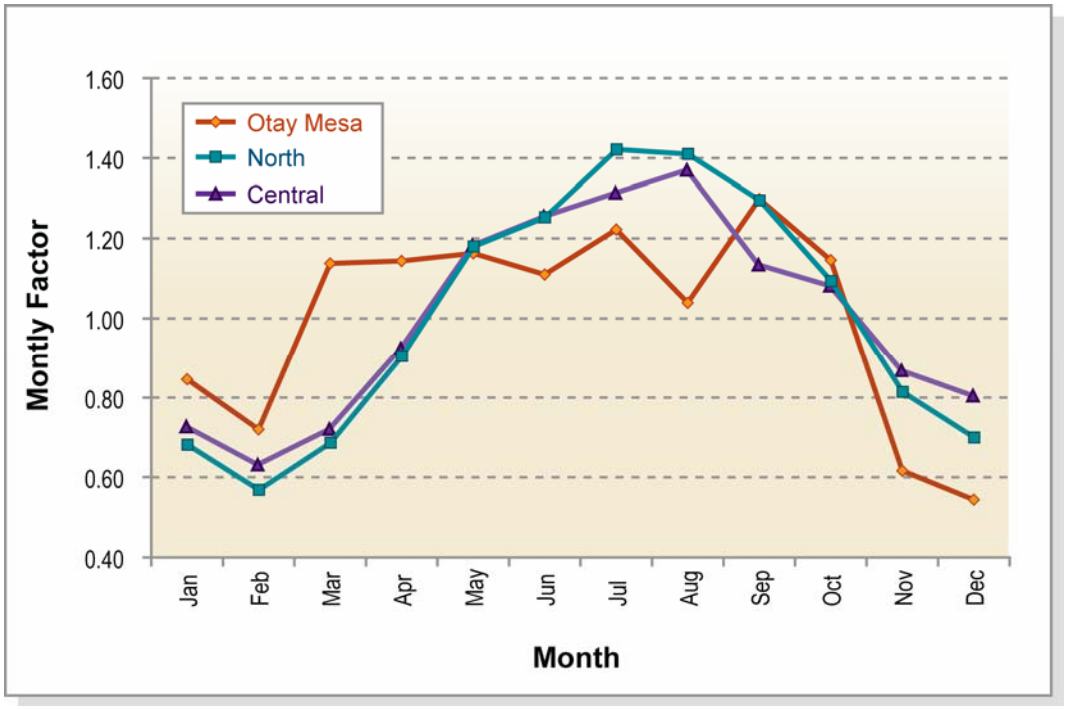


Figure 3-3
Monthly Seasonal Potable Demand Factors

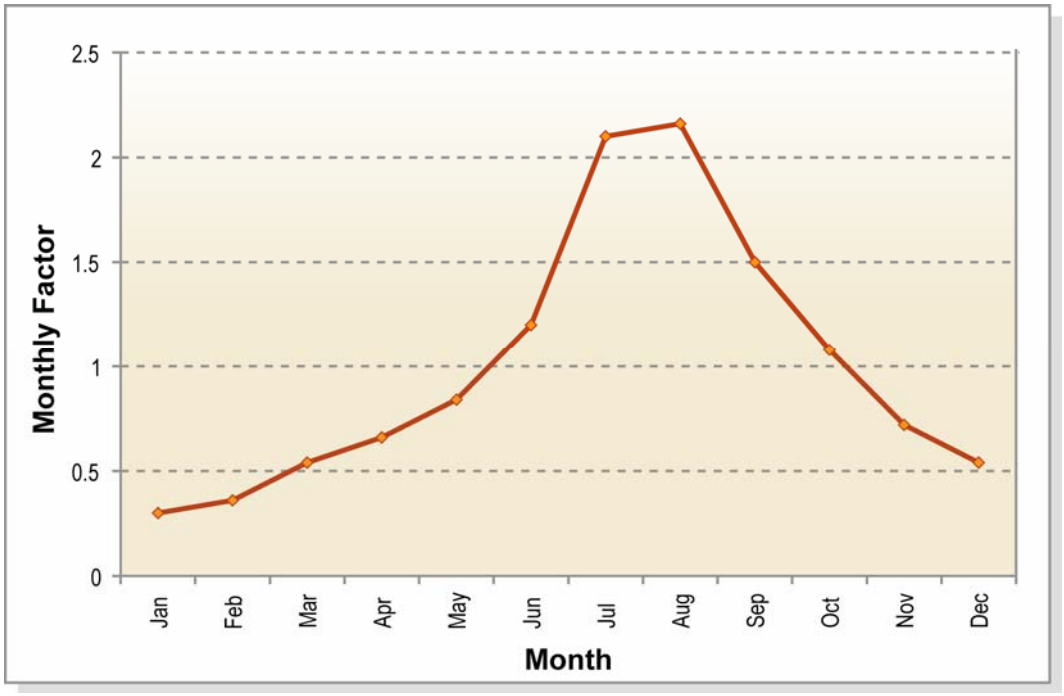


Figure 3-4
Monthly Seasonal Recycled Demand Factors

3.1.2.3 Peak Day Demands

The peak day factor for potable water demands was derived from *figure 4-1* in the 2002 Water Resources Master Plan, which illustrates the relationship between peak day factors and average annual demands. In general, peak day factors decrease as annual average demands increase. Since the annual average demand projections for each system increase over time, projected peak day factors were adjusted accordingly. Over the planning horizon, the North System peak day factor remains at 1.8, while the Central Area System peak day factor ranges between 1.75-1.8, and the Otay Mesa System peak day factor ranges from 1.9-2.2. The peak day factor for recycled water demands is given as 2.6 in the 2002 Water Resources Master Plan.

The total supply peak day demands are summarized in Table 3-3.

Table 3-3
Total Supply Peak Day Demand Projections

Forecast Year	Annual Total Demand	Average Annual Day Total Demand	Peak Day Total Demand[1]
	afy	mgd	mgd
2005	38,773	35	66
2010	49,812	44	84
2015	57,033	51	95
2020	65,229	58	108
2025	72,854	65	121
2030	82,405	74	136

[1] Potable demand peak factors for each system are based on Master Plan (Figure 4-1).
Peak factor of 2.6 for recycled water demands is based on Master Plan (page 11-7).

Because the capacity of existing water supply facilities discussed in Section 2 exceeds the estimated 2030 peak day total water demand, there are no projected peak day capacity shortages for OWD under normal operating conditions.

3.2 Supply Gap Analysis

There is currently sufficient capacity to meet all OWD future demands through purchases of imported water from SDCWA. In that sense, there is no projected supply gap. Figure 3-5 below shows the projected supply mix for OWD assuming the baseline water supply as discussed in Section 2, where imported water purchases are assumed to increase to meet system demands. As can be seen with this baseline case, most of the water used by OWD will come from imported SDCWA water. The OWD objectives for this IRP, however, which will be described further in Section 4, place emphasis on reliability, flexibility, and diversity and point toward decreasing the dependence on imported SDCWA water supplies. These three objectives and the potential issues associated with the reliability of imported supply (discussed in Section 1), create an opportunity for OWD to develop a more diverse water supply portfolio.

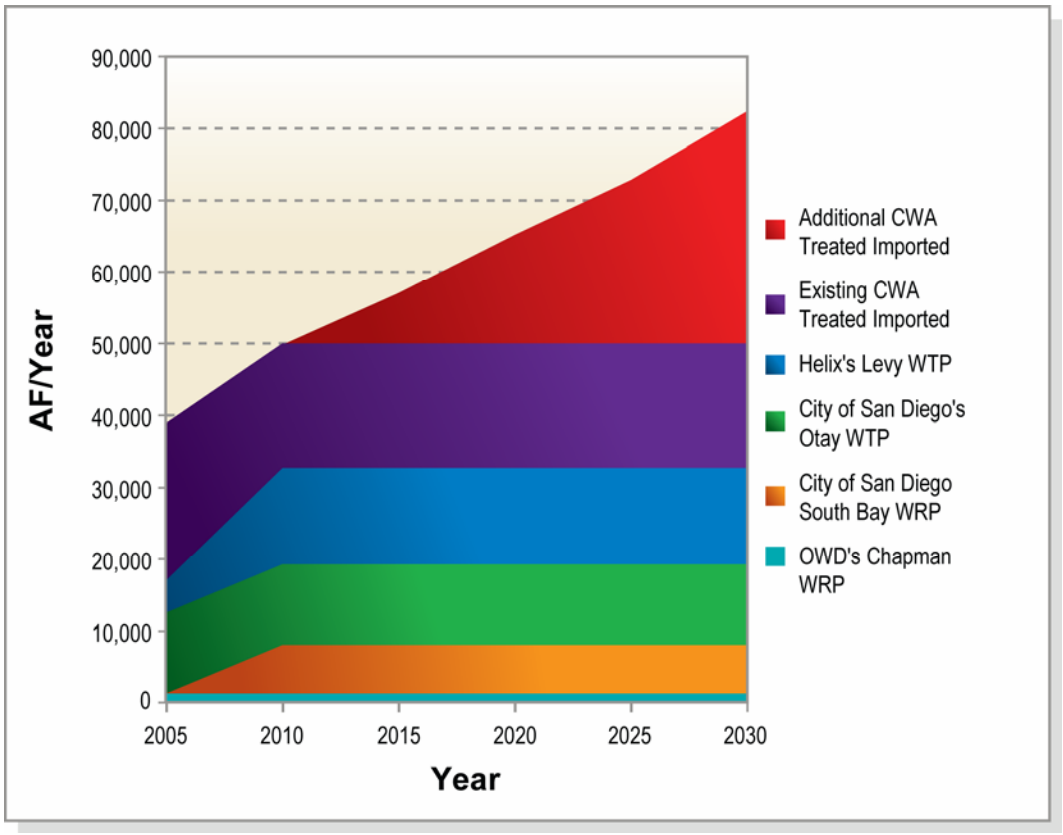


Figure 3-5
Projected Baseline Supply Mix over Time

Section 4
Evaluation Framework

4.1 Evaluation Process

The IRP proceeded initially along two parallel paths: the objectives path and the supply options path. The objectives path develops the *"why's"* in the IRP – *why is the planning being undertaken?, why would one option be selected over another?, etc.* These questions are answered by explicitly defining planning objectives. Planning objectives are of fundamental importance to a successful IRP as they describe, in this case, what OWD aims to achieve with regard to its long-term management of water resources.

The supply options path develops the *"how's"* in the IRP – these are the specific alternatives that OWD can choose from as means of meeting its water supply needs. Individual supply options can be projects, programs, or contracts with other agencies and the water supplies for these options can be from sources such as groundwater, recycled water, ocean desalination, etc. Since no single supply option is going to be able to meet all of OWD's objectives, separate supply options must be combined into portfolios. The portfolios, because of their multiple sources, can increase diversity and can better meet multiple objectives.

In order to be able to use the objectives and supply options together, there needs to be a means of quantifying the importance of the objectives relative to one another, as well as a means of quantifying how well different supply options satisfy those objectives. Characterizing the relative importance of the objectives is done by giving them weights. Quantifying the ability of the supply options to satisfy the objectives is done by defining performance measures, which are specific and measurable attributes related to the objectives.

All of the planning objectives, weights, and performance measures are put together in an IRP in what is known as a value model. Here, goals are explicitly stated and elaborated with the objectives, and the importance of the objectives relative to one another is characterized by the objective weighting. Portfolios (or different combinations of supply options) can be evaluated against the objectives through the specific performance measures. Ultimately, the analysis results in the selection of a preferred portfolio. Figure 4-1 depicts the generic process followed in an IRP. This process is further described in the sections that follow.

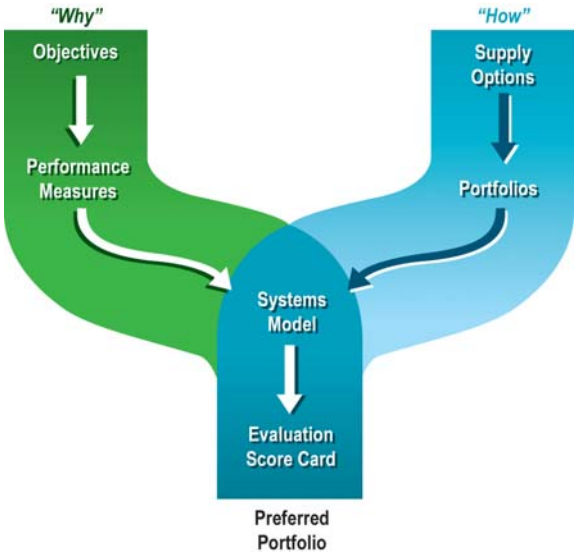


Figure 4-1
"Why" and "How" Parallel Paths in the IRP

4.1.1 Objectives and Performance Measures

As part of the IRP, the OWD Board and senior staff worked on defining planning objectives consistent with the OWD's strategic planning goals, but specific to the development of the IRP. The objectives serve as the goals or reasons "why" the IRP is being undertaken.

Objectives are usually categorized into primary and secondary (with the secondary objectives being termed *sub-objectives*). Primary objectives are more general; while secondary help define the primary objectives in more specific terms.

For each sub-objective, a performance measure is required. The performance measure is used to indicate whether an objective is being achieved.

The following example illustrates the hierarchy of objectives, sub-objectives, and performance measures.

Primary Objective	Sub-objectives	Performance Measures
Increase Diversity	Maximize number of sources	Total number of sources
	Reduce contribution of largest source	Percent contribution of the largest source to total supply

Principles of good decision-making indicate that primary objectives should be developed such that they are:

- ***Distinctive***: objectives should be developed to distinguish between one project (or portfolio) and another
- ***Measurable***: objectives should be able to be measured, either quantitatively or qualitatively, in order to determine if they are being achieved
- ***Non-Redundant***: objectives should not overlap with each other
- ***Understandable***: objectives should be easily explainable
- ***Concise***: objectives should be kept to manageable numbers

The objectives, sub-objectives and performance measures defined by OWD are shown in Table 4-1. Some of the objectives apply to the individual supply options (such as "Meet or Exceed Water Quality Standards and Guidelines" and "Address Environmental and Institutional Constraints") while other objectives are more applicable to the overall combination of supply options included in an specific portfolio. This distinction is represented in the analysis.

Table 4-1
OWD Objectives, Sub-objectives and Performance Measures

Objective	Sub-objective	Performance Measure
1) Meet or Exceed Water Quality Standards and Guidelines	1a) Meet current and future drinking water standards	Compliance
	1b) Address compatibility of new sources with current imported supply	Compatibility Score
	1c) Meet total dissolved solids (TDS) goals for recycled water, potable water and Basin Plan	Average TDS of all Potable Sources
		Average TDS of all Non-potable Sources
	1d) Minimize potential issues due to disinfection method	Disinfection By-Products (DBP) Score
2) Achieve Reliability	2a) Meet demands under average hydrology conditions	2030 Annual Deficit; evaluated under average hydrology conditions
	2b) Meet demands under drought imported shortage conditions	Cumulative Deficit over all shortage years;
	2c) Minimize impacts under emergency conditions	2030 Deficit during a three month emergency period
3) Maintain Affordability	3a) Minimize impacts to an average single-family customer	Present Value $/AF
	3b) Manage Capital Costs	Capital costs ($)
4) Increase Flexibility	4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points
5) Increase Diversity	5a) Maximize number of sources	Total Number of Contracts
	5b) Reduce contribution of largest source	2030 percent contribution of the largest source to total supply
6) Address Environmental and Institutional Constraints	6a) Minimize environmental permitting requirements	Permitting Score
	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score
	6c) Maximize customer acceptance	Customer Acceptance Score
	6d) Minimize regulatory constraints	Regulatory Constraints Score
	6e) Minimize technology uncertainty	Technology Uncertainty Score

4.1.2 Weighting Objectives

In any decision-making process, the objectives are generally not equally important for every stakeholder. Some objectives may be more relevant for one stakeholder than others (e.g., for a given individual, operational flexibility may be more important than environmental and institutional constraints). Thus, weighting objectives is necessary to better reflect the values and preferences of stakeholders and decision-makers.

For the IRP, the objectives were weighted using a method known as "forced-paired comparison." This method simplifies the comparison of numerous planning objectives by looking at the relative importance of only two objectives at a time. This relative comparison is performed for all the possible pairs of objectives, and the results can be aggregated using simple algorithms to determine the overall importance of every objective. Overall weights can be obtained for each individual participant, as well as for the group as a whole. For the case of the IRP, objectives were weighed individually by each stakeholder (see Appendix A for the results of this exercise). Each stakeholder's individual weightings for the objectives were preserved and used to rank portfolios (later described in Section 8).

Figure 4-2 presents an example result from this exercise for one stakeholder, where: (1) the vertical line represents the range of weights assigned to each objective by all stakeholders; (2) the horizontal line marker shows the average weight for all stakeholders; and (3) the diamond marker represents the weight for this example decision maker. The minimum and maximum weights of the group of stakeholders indicate that there is a very large spread in terms of objective importance.

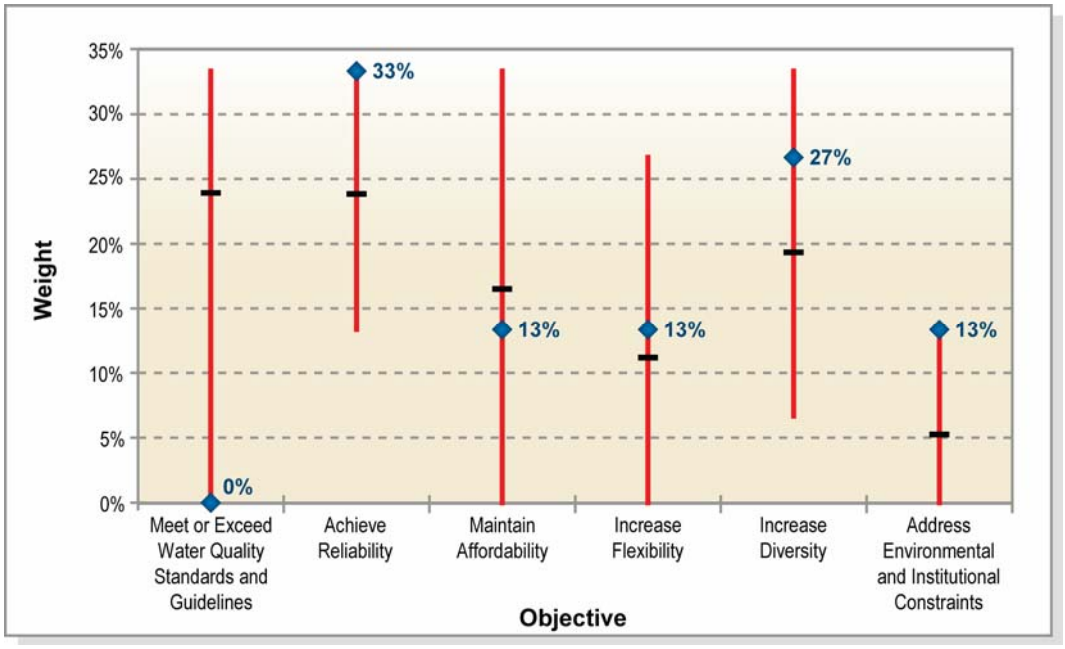


Figure 4-2
Example Objective Weighting for One Stakeholder

Since the results of the weighting exercise were maintained for each stakeholder, the IRP planning team developed 13 different (5 board members and 7 senior staff) profiles for the objective weightings. For comparison purposes only, the IRP planning team aggregated results into two set of weights: Board members and senior staff members (see Figure 4-3).

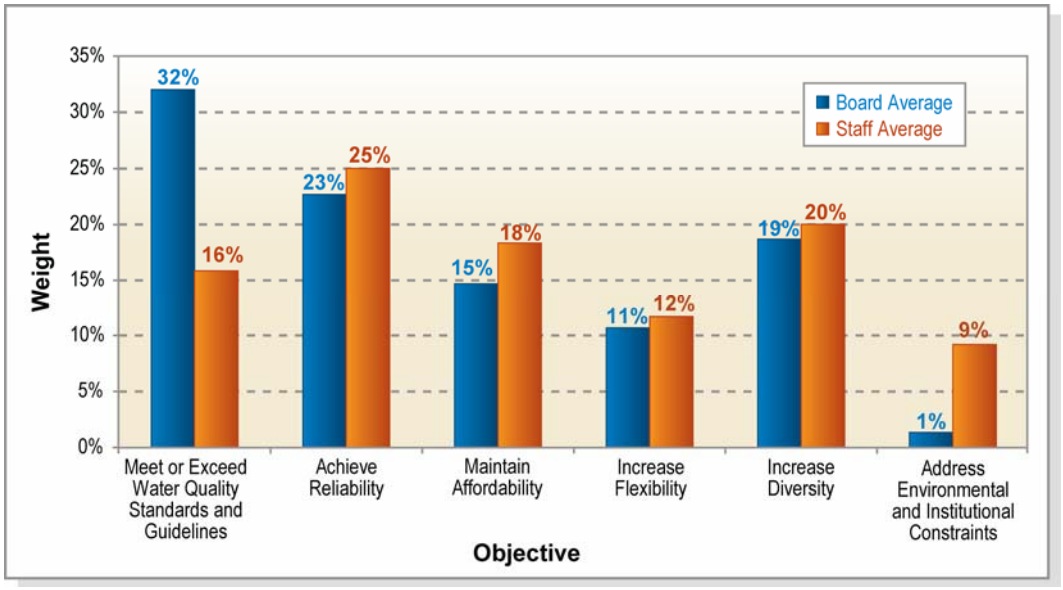


Figure 4-3
Comparison of Average Objective Weightings

In general, the weights appear to be similar for the Board members and the senior staff for issues related to reliability, affordability, flexibility, and diversity. There are however large differences between Board members and staff members regarding water quality and environmental and institutional constraints. These differences exhibit a consistency with the roles and responsibilities of each. For example, Board members, whose main responsibilities include setting policy, tend to be more interested in water quality, which is related to quality of life. In contrast, staff members, whose main responsibility is executing policy, tend to be more interested in implementation issues related to environmental permitting and institutional coordination.

4.1.3 Identify Options and Create Portfolios

The planning objectives represent essential reasons or purposes "why" OWD is undertaking the IRP; however, they do not specify "how" OWD should move forward to meet these objectives. Supply options represent the individual projects and programs that are the potential means for accomplishing the planning objectives. The IRP used these options as building blocks to develop integrated portfolios with the potential to meet the planning objectives.

Even with a relatively small number of options, the different combinations to form portfolios could be fairly large. Therefore, initial portfolios are developed that tend to push the boundaries of the objectives. In other words, the first round of portfolios is developed to optimize specific objectives. But since the purpose of an IRP is to find a solution that balances all the objectives, it is understood that these initial portfolios may not be the best overall performers.

By examining the performance of these initial portfolios, trade-offs can be seen, such as maximizing supply reliability but at very high cost. Understanding these trade-offs can be useful in developing final portfolios, which take the best elements from top-scoring initial portfolios in order to create better performing portfolios.

4.2 Portfolio Evaluation Method

After developing objectives and portfolios, the next step in the planning process is to evaluate each portfolio. The IRP planning team developed and used a systems model programmed with the commercial software STELLA® to evaluate the IRP portfolios. In general, the systems model simulates water demands and supplies under different hydrologic and operating scenarios. The systems model can output raw performance, such as supply reliability, cost, water quality, etc. in order to see how well a specific portfolio meets the objectives.

Because the systems model outputs raw performance measured in different units (e.g., reliability measured in AFY, cost measured in dollars, and water quality measured in milligram per unit volume), another decision tool is often needed to rank the portfolios.

The IRP planning team used the commercial software Criterium Decision Plus (CDP), developed by Infoharvest Inc., to rank the portfolios. This software tool converts raw performance measured in different units into standardized scores so that the performance measures can be added together in order to rank portfolios. This technique is called Multi-Attribute Rating and is illustrated in Figure 4-5.

Step 1 is to compare the raw performance of a given objective for all the portfolios. In this example, Portfolio 6 has a raw cost (or performance) of $10 million.

Step 2 standardizes the raw performance score for each objective into comparable numeric scores (the higher the score the better the performance). In this example, Portfolio 6 has relatively high costs when compared to the other portfolios, so the standardized score for this objective (between 0 and 10) is 3.4, a fairly low performance.

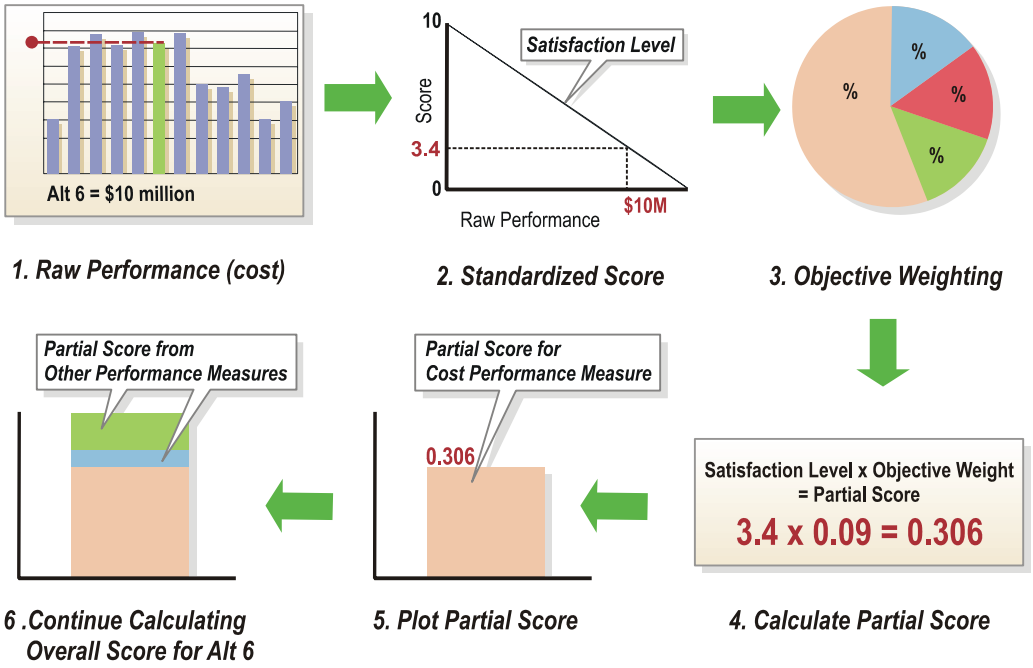


Figure 4-5
Multi-Attribute Rating Method

Steps 3 and 4 calculate the partial score for the portfolio, based on the standardized score and the weight for the objective being calculated. In this example, the cost objective was given a weight of 9 percent (out of a possible 100 percent). The partial score for this objective is represents the standardized score (3.4) multiplied by the objective weight (0.09) which equals 0.306.

Step 5 plots the partial score of 0.306 for Portfolio 6, and this procedure repeats for all of the other objectives for Portfolio 6 until a total score for the project is calculated [see Step 6].

The IRP planning team used this process to develop overall scores for each portfolio and using each stakeholder's unique objective weights in order to get 13 different rankings. In this way, the number of times a portfolio was ranked as the Top 1, 2,or 3 could be calculated to determine the top performing portfolios.

Section 5
Water Supply Options

Parallel to the definition and development of planning objectives, water supply options were identified that could be used by Otay Water District (OWD) to meet their long term water management objectives. The process of developing supply options was collaborative between OWD and CDM. Potential options were identified by both parties; and through discussion and refinement, a diverse list of realistic options was agreed upon. Supply options can be projects, programs, or contractual arrangements with other agencies; they are the building blocks for the water supply portfolios (discussed in Section 6). The potential options can be broken down into categories based on the source of the water and the processes required before the water can be used. The categories of supply options include: conservation, groundwater, water banking and water transfers, ocean desalination, and recycled water. Additionally, different options were identified for the expansion of treatment agreements with local agencies.

Following the identification of potential supply options, each option was characterized in terms of the conceptual mode of operation, facilities required for implementation, expected reliable yield, capital and operating costs, and issues related to water quality, environmental impact, and institutional coordination. It should be noted that the costs, yields, and other characteristics of the supply options are intended for planning level analysis and modeling. Although every attempt was made to obtain reasonable data, in some cases, certain estimates had to be made based on prior studies and/or professional engineering judgment. Before any supply option is actually implemented, a detailed investigation may be required.

In the sections that follow, the potential supply options are described. A list of all the options evaluated, along with information regarding their yields and costs, is provided in a summary table located in Appendix B. Specific and detailed cost estimates for each option can be found in Appendix C.

In addition to developing yields and costs, each supply option was evaluated for its performance with respect to two of the planning objectives (i.e. "Water Quality" and "Addressing Environmental and Institutional Constraints"). The option scores for performance measures of "Water Quality" and "Environmental and Institutional Constraints" are shown in Appendix B.

The supply option ratings summarized in Appendix B are later used to calculate overall scores for the water supply portfolios.

Option Unit Cost Calculation

The unit cost (dollar per acre-foot) was calculated for each option, and incorporates both capital and operation and maintenance (O&M) costs. The method used to calculate option unit cost differs from the method to calculate portfolio unit cost

discussed in Section 7. For options, in order to compare them independently for portfolio development, the unit cost is calculated based on the entire potential yield of the option. Also, the operation and maintenance in today's dollars was used, rather than inflating the O&M costs over time. The option capital cost was amortized at a 6% interest rate, assuming a payment period of 30 years. The total annual cost (capital and O&M) was then divided by the option's potential annual yield to calculate the unit cost in dollars per acre-foot.

For portfolios, several options are used in conjunction with each other to meet future demands, and a particular option may not necessarily be used to its full capacity at all times. In order to account for varying use of options over time, the unit cost of the portfolios was calculated assuming the net present value of incremental costs of new water over the entire planning horizon.

Imported Water Costs

Imported water from the San Diego County Water Authority (SDCWA) is currently OWD's only potable water supply. OWD purchases both treated and raw (untreated) imported water. The cost of imported water is greatly influenced by the capital improvement programs of the Metropolitan Water District of Southern California (MWD) and the SDCWA. MWD's capital improvement program has been estimated to be between $1 and $2 billion over the next 20 years. SDCWA's capital improvement program has been estimated to range between $2 and $4 billion. Rising energy costs and O&M costs for conveyance of water from the Bay-Delta and regional treatment are also expected to increase imported water costs.

The SDCWA imported water rates in 2007 are shown in the table below.

Table 5-1
SDCWA 2007 Imported Water Rates

	Purchase Rate [$/AF]	Transport Rate [$/AF]	Total [$/AF]
Untreated M&I supply rate	365	60	425
Treated M&I supply rate	515	60	575
Untreated groundwater replenishment rate	238	60	298

For OWD, the total commodity rate that would have to be paid for purchasing treated imported water would be $575/acre-foot ($60 transportation rate + $515 treated supply rate). OWD also has to pay its share of SDCWA's fixed costs, which include: customer service charge; storage charge; infrastructure access charge; and a parcel or standby charge.

MWD offers a discount in its water rates, of which the SDCWA can take advantage of, for groundwater storage. Currently the SDCWA directly passes this water rate to any local agency that can replenish groundwater and store the water for a period of at least one year. The SDCWA transportation rate would be added to this groundwater

replenishment rate. A number of the groundwater conjunctive use options that OWD is exploring could take advantage of MWD's discounted water rate, which would reduce imported water costs.

SDCWA has projected treated M&I water rates to the year 2016, which indicate that there will be a 72 percent increase over current rates.[1] To project SDCWA water rates from 2017 to 2040, CDM used rate projections from MWD and SDCWA, as well as CIP costs for both agencies to determine an annual percentage increase which would be applied to the 2016 SDCWA projected water rate. These annual percentage increases in water rates are:

Transportation rate	3.5 percent annual increase
Treated M&I supply rate	6.7 percent annual increase
Untreated M&I supply rate	8.0 percent annual increase
Untreated groundwater replenishment	3.5 percent annual increase

These water rate projections include inflation, which is currently averaging 2.5 percent per year. Projecting water rates more than 30 years into the future is highly uncertain, but based on current SDCWA and MWD CIPs, it is certain that imported water costs will increase much faster than inflation. Figure 5-1 summarizes the projections for the total treated, untreated, and groundwater replenishment water rates including transportation charges.

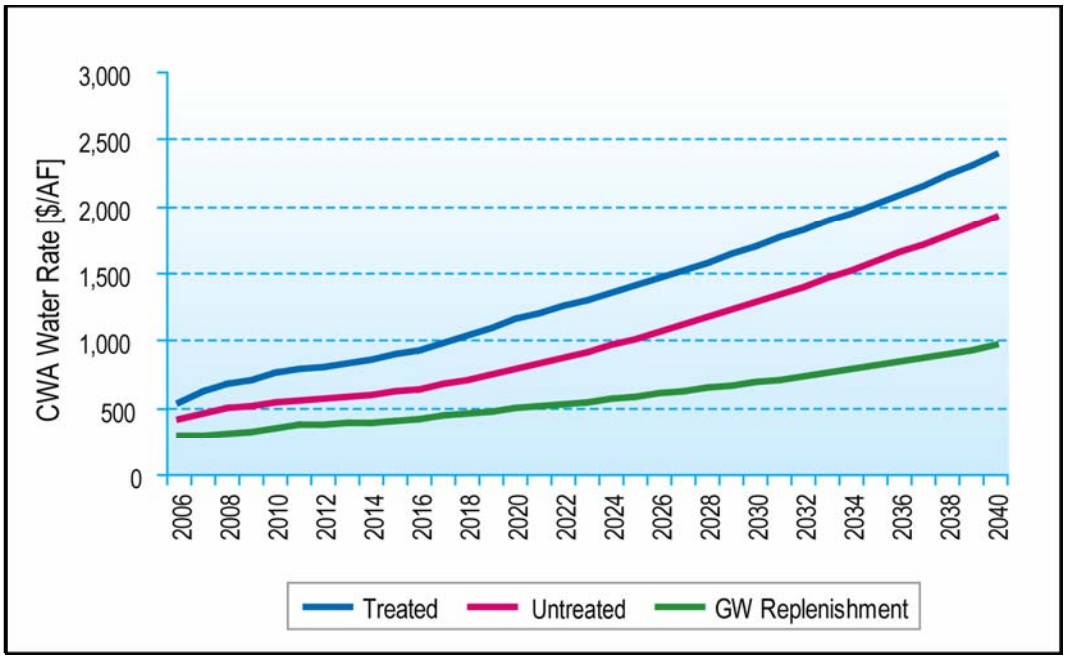


Figure 5-1
Projected SDCWA Imported Water Rates (including transportation charges)

[1] Projections of SDCWA water rates provided by Mr. Jeff Garvey of the Water Authority on July 6, 2006.

5.1 Water Conservation

In 1992, OWD adopted a Memorandum of Understanding (MOU) from the California Urban Water Conservation Council (CUWCC) that includes Best Management Practices (BMPs) for reducing long-term urban water demands (OWD et. al., 2005). The 14 BMPs are aimed at conserving water by reducing consumption, providing incentives for consumers to participate (i.e. rebates on plumbing retrofits), establishing education and information programs about the importance of water conservation, as well as addressing conservation at the institutional and managerial levels.

During Fiscal Year 2005, OWD is estimated to have saved approximately 1,087 acre-feet of water. Current water conservation programs implemented by OWD include (OWD et. al., 2005):

- Cash for Plants Landscape Retrofit Program
- Signage Grant Received to Highlight Waterwise Model Homes
- Water Conservation Programs for New Homes
- Outreach Efforts to Otay Customers
- Commercial Water Conservation Programs
- Large Landscape Programs
- Residential ULFT Program-$75 and $95 Vouchers
- Residential High Efficiency Clothes Washer Program
- School Education Program
- Residential Weather-Based Irrigation Controller (WBIC) Incentive Program

The future conservation goals for OWD are provided in the 2005 UWMP, and were distributed to the North, Central Area, and Otay Mesa Systems based on land use projections in the 2002 Master Plan. The cost per acre-foot saved for each BMP was obtained from OWD staff members. The projected conservation goals and corresponding costs for each system are shown in Figures 5-2 and 5-3, respectively.

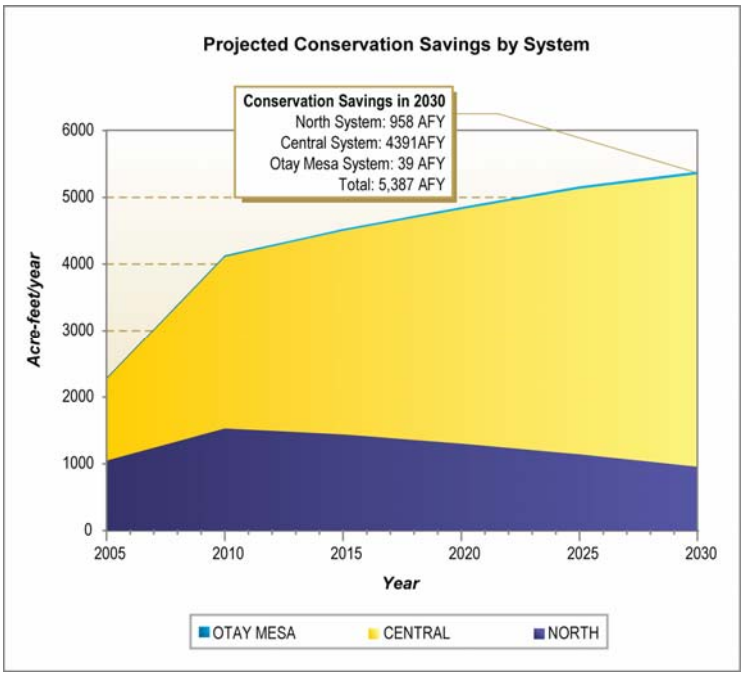


Figure 5-2
Projected Conservation Water Savings by System

Figure 5-2 shows the conservation savings in the North System decreasing over time, even though the total overall savings are increasing. This is because the Central Area System currently represents 50% the single-family residential sector, while the North System represents the other 50%. In future build-out conditions, the single family sector is anticipated to gradually transition to only 11% in the North System, and 89% in the Central Area System. This projected decrease of the single family residential sector from 50% to 11% in the North System explains why the projected savings in the North System decrease, since a majority of total conservation savings come from BMP's associated with the single-family residential sector and landscape irrigation.

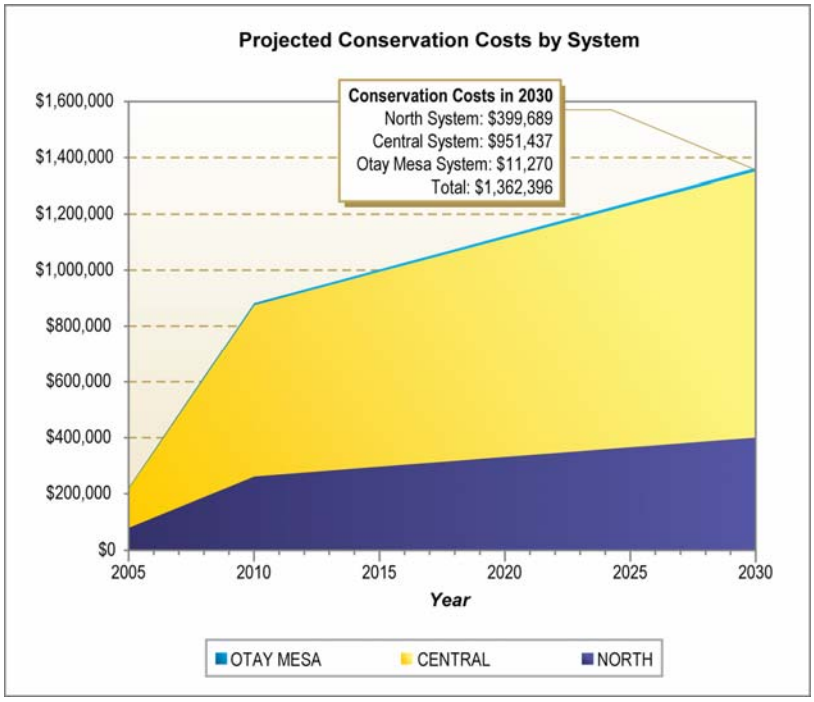


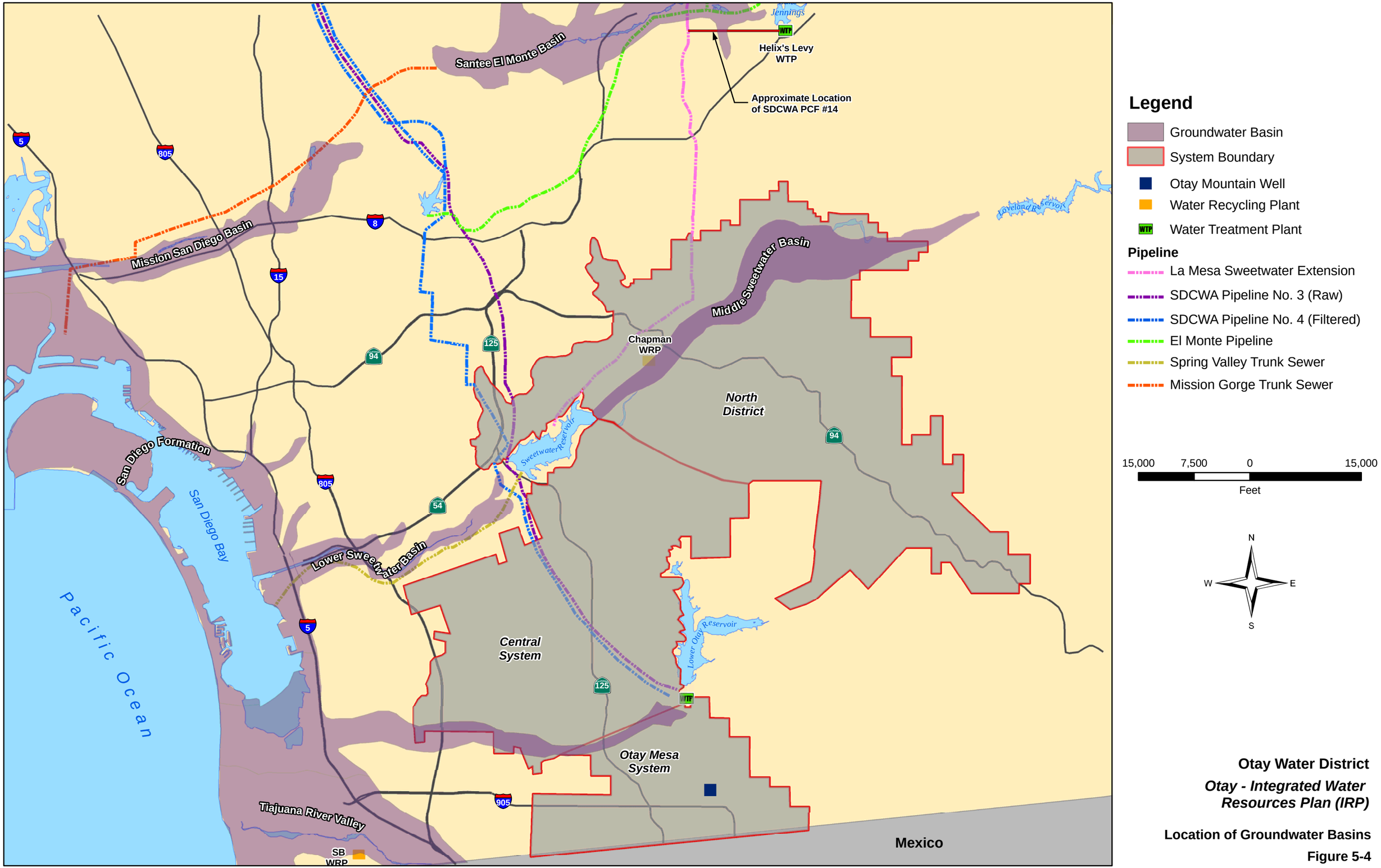
Figure 5-3
Projected Conservation Costs by System

5.2 Groundwater Options

Groundwater resources are a promising local supply option, providing more localized control and potentially lower treatment and conveyance costs. Two general types of groundwater options were considered: 1) safe-yield groundwater extraction with demineralization, and 2) conjunctive-use storage of imported water providing a dry year supply. Groundwater extraction and demineralization will provide OWD with a new local water source, improve system reliability, and contribute toward a gradual improvement in the quality of the basin. Conjunctive use consists of recharging imported water during periods of high availability and lower cost (by taking advantage of MWD's replenishment rates) and recovery during high-demand periods (i.e. summer months), drought, or emergency conditions. This type of project will enhance the reliability of the OWD system.

Several basins were considered for potential groundwater projects because of their proximity to Otay Water District. These include: the Middle Sweetwater basin, the Lower Sweetwater basin, the Santee/El Monte basin, the San Diego Formation aquifer, and the Tijuana River Valley aquifer. Figure 5-4 shows the location of the basins in relation to the OWD service area. Additionally, a number of small well projects were considered. These include a new well northeast of the Otay Mesa Yard well, the Rancho del Rey Well, the Daley Ranch well, and the Otay Mountain well site. The Daley Ranch well, new well northeast of Otay Mesa Yard well, and the Rancho del Rey well were eliminated from further consideration however, due to institutional concerns, their high unit cost, and/or poor water quality.

A schematic figure showing the relationship between the groundwater supply options and the OWD water supply system is shown in Appendix B.



Otay Water District

Otay - Integrated Water Resources Plan (IRP)

Location of Groundwater Basins

Figure 5-4

CDM

5.2.1 Middle Sweetwater Conjunctive Use

The Middle Sweetwater basin is defined as the 17-mile reach of the Sweetwater River between Loveland and Sweetwater Reservoirs. The basin is located mostly within the OWD service area. This is an alluvial aquifer with a thickness of 20-30 feet in the upstream section, 60-150 feet in the middle section, and 10-20 feet in the downstream sections. The depth to the water table is shallow. Its tributary system includes additional alluvial aquifers. The alluvial sediments in the basin are coarse sand and gravel having moderate to high permeability. The alluvium is bordered by slightly-fractured crystalline bedrock which is generally impermeable.

Alluvial storage is approximately 29,000 acre-ft: approximately 17,000 AF above Singing Hills Golf Course, and 12,000 AF downstream.

Recharge to the basin is from surface water, such as the Sweetwater River (approx 2,000 AFY) as well as stormwater and irrigation return flows (approx. 1,600 AFY). Boyle (1993) estimated a net recharge of 750 AFY. As of 1991, approximately 1,560 AFY were being extracted from the basin for golf course irrigation and residential use.

No recent water quality information has been obtained for the Middle Sweetwater basin. However in 1993, total dissolved solids (TDS) concentrations in the upper basin were under 600mg/l; and in the lower basin were between 500mg/l to 1500 mg/l. It is assumed that water quality has deteriorated over time, and that TDS concentrations would be higher at this time.

Potential Project

In this concept project, groundwater extraction would occur during dry years to help OWD meet demands in drought conditions. During this time, the water table would be allowed to drop so that the aquifer could be recharged with imported water at a later time. The advantage of this configuration would be that OWD could meet demand in extremely dry years and recharge with less expensive imported water using MWD replenishment rates. It is assumed that pumping efficiency decreases as the basin is depleted.

For planning purposes, it is assumed that a 5,000 AFY conjunctive use project may be implemented. Recovered water may be delivered to the North System of the service area. Filtered replenishment water may be obtained from the abandoned La Mesa-Sweetwater Extension (LMSE) if this option is available and proves less expensive, as it would require less conveyance infrastructure (see Section 2.2.3). Alternatively, unfiltered water from the San Diego Aqueduct Pipeline No. 3 could be obtained. For purposes of this analysis, it was assumed that recovered groundwater quality is sufficient for delivery without demineralization. A conceptual schematic of this option is shown in Figure 5-5.

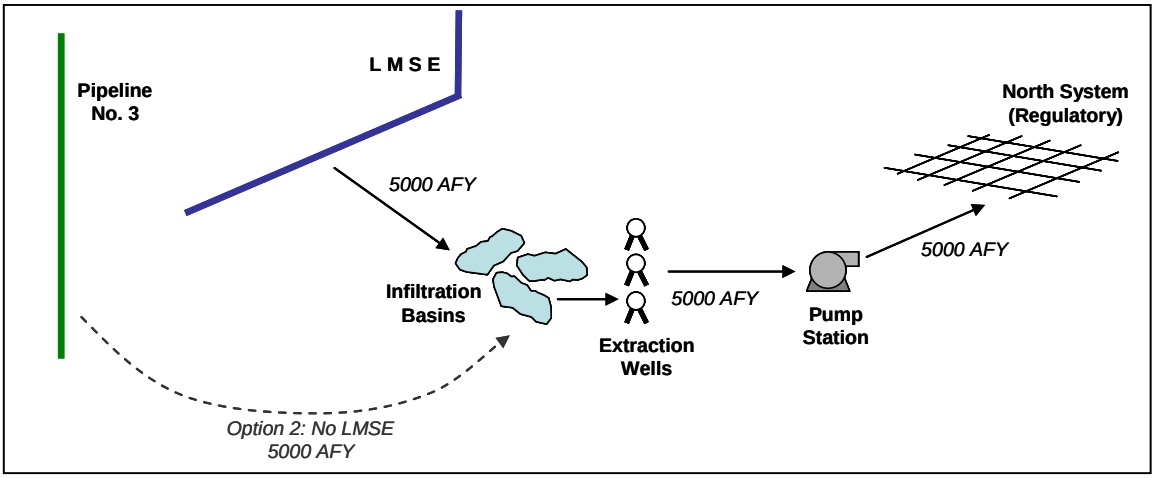


Figure 5-5
Middle Sweetwater Conjuntive Use Option Schematic

The facilities/project components required for this option include:

- Conveyance of water to Middle Sweetwater Basin for recharge
- Infiltration basins
- Extraction wells
- Monitoring wells
- Conveyance of recovered water (pipeline and pumping)
- Land acquisition
- Imported raw water purchases from SDCWA (at the groundwater replenishment rate)

Assuming the use of the LMSE to convey water for groundwater recharge, the total capital cost of this option is estimated at $44,950,000, and the annual operation and maintenance costs are approximately $2,655,000/year. The unit cost of this option is $1,184/AF.

If the LMSE is not available for use, additional conveyance infrastructure would be required to bring raw water from the SDCWA Pipeline No. 3 to the basin for recharge. In this case, the total capital cost of this option is estimated at $65,187,000, and the annual operation and maintenance costs are approximately $3,307,400/year. The unit cost of this option is $1,609/AF.

To implement this option, OWD would need to coordinate with the Sweetwater Authority to ensure that adverse impacts are not created, and potentially to discuss partnering opportunities. In addition, OWD would need to coordination with SDCWA for delivery of replenishment water at replenishment rates.

Potential issues to be considered include adverse impacts to Sweetwater Authority and private wells as well as adverse impacts to riparian habitat dependent on groundwater. In addition, it may need to be confirmed by more extensive research that recovered groundwater demineralization will indeed not be needed. Groundwater demineralization will increase cost and create the need for brine management.

5.2.2 Lower Sweetwater Brackish Groundwater Demineralization

The Lower Sweetwater basin is defined as the 8-mile reach of the Sweetwater River between Sweetwater Reservoir and San Diego Bay, and is located outside of the OWD service area. The basin consists of an alluvial aquifer and the underlying San Diego Formation. There is approximately 13,000 acre-ft of storage in the basin, including the underlying San Diego Formation. The alluvial aquifer consists of sand and gravel, and the depth to groundwater is in the range of 0-20 ft. The net recharge to the alluvial aquifer is estimated to be approximately 1,100 AFY. Boyle (1993) estimated that up to 1,500 AFY could be extracted from the basin.

Salinity in the alluvial aquifer varies from 1,700 to 3,100 mg/l, while TDS concentrations in the urban runoff recharge water is approx 2,500 mg/l.

Potential Project

Under this option, 1,500 AFY of brackish groundwater would be extracted and treated with reverse osmosis (RO). Assuming a treatment efficiency of 85%, 1,275 AFY of treated water would be conveyed to the Central Area System. The RO treatment would generate 225 AFY of brine which could be disposed of in the San Diego County's Spring Valley Trunk Sewer, which ultimately flows to the Point Loma Wastewater Treatment Plant. A conceptual schematic of this option is shown in Figure 5-6.

The facilities/project components required for this option include:

- Extraction wells
- Monitoring wells
- RO treatment plant
- Conveyance for treated water (pipeline and pumping)
- Conveyance for brine disposal
- Land acquisition

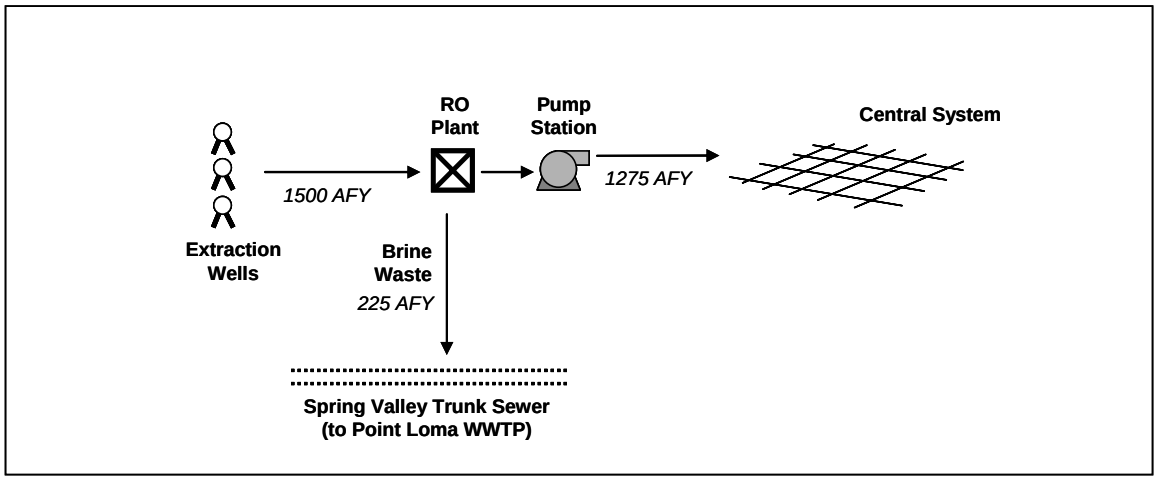


Figure 5-6
Lower Sweetwater Brackish Groundwater Demineralization Option Schematic

The total capital cost of this option is estimated at $11,250,000, and the annual operation and maintenance costs are approximately $942,000/year. The unit cost of this option is $1,184/AF.

Potential issues for the implementation of this project include the need to coordinate with Sweetwater Authority and possibly the City of Chula Vista to obtain access to the basin and locate the required facilities. In addition, OWD needs to coordinate with the City of San Diego and the County of San Diego for the use of the sewer system for brine disposal. Brine disposal may in turn impact the salinity of Point Loma effluent and require significant environmental review.

5.2.3 Santee/El Monte Basin

The Santee/El Monte basin is located outside of OWD's service area along the San Diego River and mostly in the City of Santee and Lakeside (Padre Dam Municipal Water District). See Figure 5-4. The basin includes an alluvial unit with total storage volume of 55,000 AF, composed of gravel, sand, silt and clay. This unit is capable of storing and transmitting large quantities of water. It is assumed that 50% of this volume would be available for potential storage use by OWD since use of the basin is also proposed by the City of San Diego and Padre Dam MWD. The thickness of the aquifer ranges from 50 to 230 feet. The water table is shallow (between 15 and 30 feet below the surface).

Groundwater has in the past been pumped by Helix WD, Lakeside WD and Riverview WD; however, recent groundwater production information has not been obtained.

The most recent water quality information obtained (1985) indicates that TDS concentrations in the eastern portion of the basin are in the order of 500 mg/l, although much higher concentrations (1,500 mg/l) have been observed.
Water quality in the western portion of the basin is worse, with TDS concentrations ranging from 1,500 to 2,000 mg/l.

Estimates of the safe yield of the basin range from 1,650 to 5,500 AFY.

Previous studies have estimated that between 8,700 and 11,700 AFY of imported water could be stored in the eastern portion of the basin (Woodward-Clyde 1990, Black and Veatch 1994). The most favorable conditions for recharge and storage appear to be near Lakeside, Moreno Valley and El Monte.

Three supply options for the OWD IRP were considered: imported water conjunctive use, brackish groundwater demineralization, and a combined project of both conjunctive use and brackish demineralization.

5.2.3.1 Santee/El Monte Conjunctive Use

With this option, 5,000 AF of imported water would be recharged to the basin in wetter years and recovered during high demand periods, droughts, or emergency conditions. Recharge water could be obtained from one of the following sources: 1) raw water from the San Vicente Reservoir via the El Monte Pipeline; 2) raw or treated water from the Second San Diego Aqueduct (Pipeline No. 3 raw water or Pipeline No. 4 treated water); or 3) La Mesa Sweetwater Extension (LMSE). Of these options, the El Monte pipeline and the LMSE are closer to the basin and would require less conveyance infrastructure. However, there may be limitations due to conveyance capacity.

For cost estimating purposes, it was assumed that the basin would be recharged with raw water from the San Vicente Reservoir conveyed via the El Monte pipeline. The replenishment water would percolate into the ground through infiltration basins and then be extracted and conveyed to the Regulatory System in the North System. It is assumed that pumping efficiency decreases as the basin is depleted.

Recovered water could be conveyed to OWD through any of the three conveyance facilities (i.e. San Diego Aqueduct, El Monte pipeline, LMSE); each with relative advantages and disadvantages. Pipeline No. 4 and the LMSE convey treated water, so the recovered water could go to one these two lines. However, conveyance to Pipeline No. 4 would require significant pumping to pressurize the new water to the operating pressure of the aqueduct. The LMSE has a capacity of 12 MGD, but is currently constrained to 3.4 MGD due to hydraulic limitations (OWD, 2002). The LMSE pipeline is to be converted to raw water conveyance for Sweetwater Authority or else abandoned by 2010. If it is abandoned, it was assumed that the pipeline would be available for options considered in the IRP. For cost estimating purposes, conveyance via the LMSE was used for this option, and it was assumed that current hydraulic

limitations will be eliminated when this option is implemented. Because OWD does not own the LMSE and its use is proposed by other new water supply options, cost estimates were also developed assuming the LMSE is not available for use. A conceptual schematic of this option is shown in Figure 5-7.

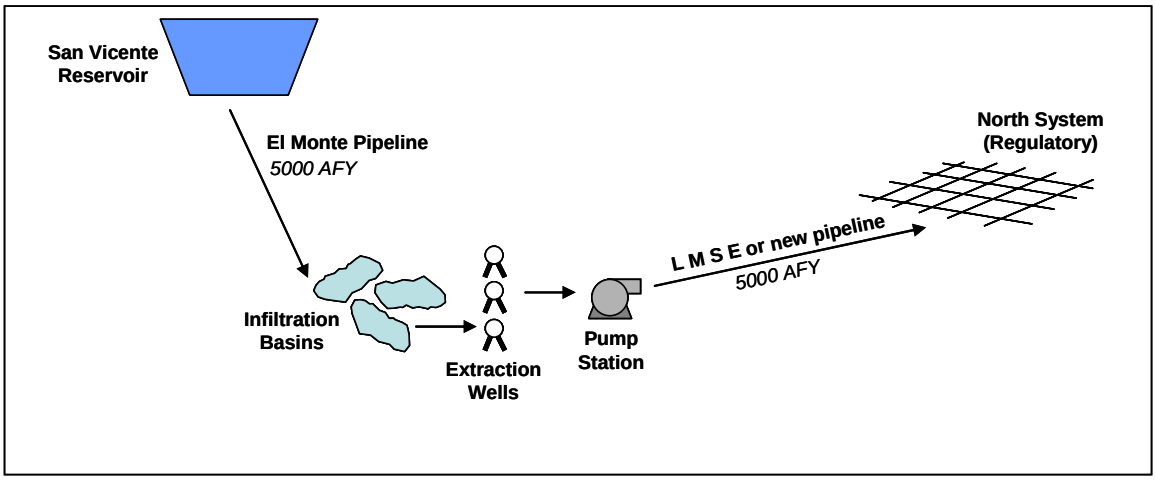


Figure 5-7
Santee/ El Monte Conjunctive Use Option Schematic

The facilities/ project components required for this option include:

- Conveyance of replenishment water
- Infiltration basins
- Extraction wells
- Monitoring wells
- Conveyance of recovered water (pipeline and pumping)
- Land acquisition
- Imported raw water purchases from SDCWA (at the groundwater replenishment rate)

Assuming the use of the LMSE to convey recovered water to the North System, the total capital cost of this option is estimated at $41,950,000, and the annual operation and maintenance costs are approximately $2,675,000/year. The unit cost of this option is $1,145/AF.

If the LMSE is not available for use, additional conveyance infrastructure would be required from the basin to the North System. In this case, the total capital cost of this

option is estimated at $64,009,600, and the annual operation and maintenance costs are approximately $3,160,000/year. The unit cost of this option is $1,562/AF.

Given the distance from the basin to OWD's service area and the need to convey wet water, OWD could consider partnering with other water districts for the implementation of projects in a way in which OWD participates financially but receives in-lieu water from a different source.

Potential implementation issues for this concept project include the need to coordinate with the city of San Diego, Padre Dam MWD and other jurisdictions located within the basin for the use of the basin and to address any potential water rights issues. Coordination with SDCWA will also be required for obtaining replenishment water and for potentially using some of its infrastructure.

5.2.3.2 Santee/El Monte Brackish Groundwater Demineralization

This concept project entails extracting and treating brackish groundwater throughout the year. According to available literature, the safe yield of the basin ranges from 1,650 to 5,500 AFY. Approximately 5,600 AFY of groundwater is currently being extracted from the basin by municipal (1,600 AFY) and agricultural users (4,000 AFY). Under this option it is assumed that 5,000 AFY will be extracted from the ground and treated by reverse osmosis (RO). Assuming a treatment efficiency of 85% for brackish demineralization, 4,250 AFY would be delivered to the OWD distribution system and 750 AFY of brine concentrate could be disposed of in the City of San Diego Metropolitan Wastewater District (Metro) Mission Gorge Sewer Line, and ultimately discharge at the Point Loma Ocean Outfall.

The treated groundwater would be delivered to the North System either by the LMSE, if available for use, or by new conveyance facilities. A conceptual schematic of this option is shown in Figure 5-8.

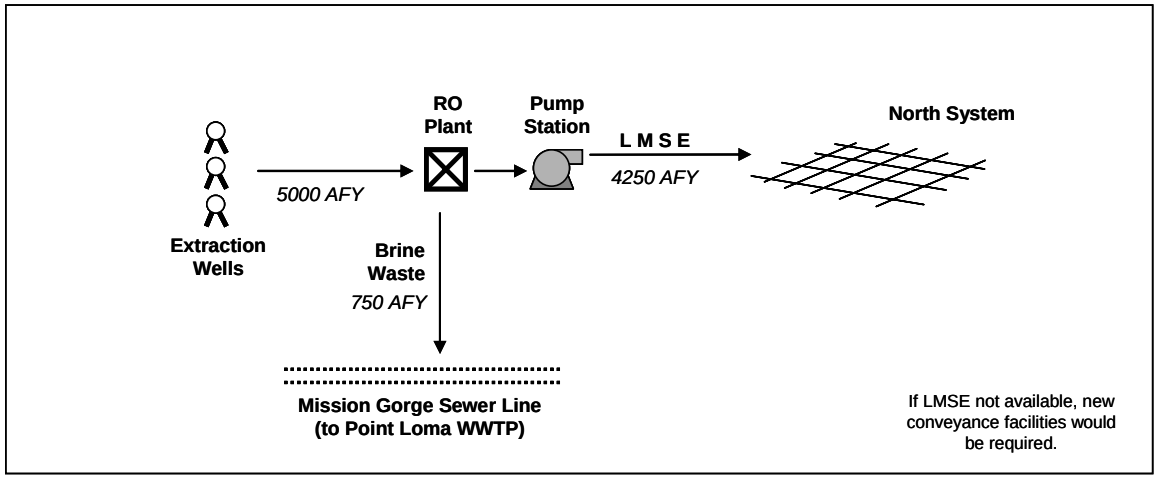


Figure 5-8
Santee/El Monte Brackish Groundwater Demineralization Option Schematic

The facilities/project components required for this option include:

- Extraction wells
- RO treatment plant and brine disposal facilities
- Conveyance of treated water (pipeline and pumping)
- Monitoring wells
- Land acquisition

Assuming the use of the LMSE to convey recovered water to the North System, the total capital cost of this option is estimated at $32,390,000, and the annual operation and maintenance costs are approximately $2,863,000/year. The unit cost of this option is $688/AF.

If the LMSE is not available for use, additional conveyance infrastructure would be required from the basin to the North System. In this case, the total capital cost of this option is estimated at $63,702,000, and the annual operation and maintenance costs are approximately $3,593,000/year. The unit cost of this option is $1,084/AF.

The ability for OWD to extract and treat groundwater would depend on the actual current safe yield and use of the basin. Additionally, there might be water rights issues precluding OWD from obtaining this water. This issue might be resolved by extracting brackish groundwater for demineralization and replenishing the aquifer with better-quality imported water. This configuration will over time improve the quality of the aquifer.

Given the distance from the basin to OWD's service area and the need to convey water, OWD could consider partnering with other water districts for the implementation of projects in a way in which OWD participates financially but receive in-lieu water from a different source.

Brine disposal will be an important consideration for project implementation and will require significant environmental review and coordination with the city of San Diego Metropolitan Wastewater Department. Also of concern is the high cost for capacity through the Metropolitan Wastewater Department.

5.2.3.3 Santee/El Monte Brackish Combined Conjunctive Use and Brackish Groundwater Demineralization

This option combines the Conjunctive Use and Brackish Groundwater Demineralization projects described above, although each project would operate independently of the other. As there would be no shared infrastructure (other than the conveyance to the North System), the capital and O&M costs for a combined project would essentially be a summation of the total costs for the conjunctive use project and the total costs for the groundwater demineralization project. By having a mechanism for replenishment water recharge, this configuration could address

potential site need and water rights issues associated with a stand-alone demineralization project.

If the use of the LMSE is not available for use, the new conveyance infrastructure required to bring product water to the North System should be sized for the combined flow of the Conjunctive Use and Brackish Groundwater Demineralization projects.

5.2.4 San Diego Formation Brackish Groundwater Demineralization

The San Diego Formation aquifer underlies the South Bay and extends approximately two miles north and inland to Mission Bay. The aquifer is outside of the OWD service area. Refer to Figure 5-4 for the groundwater basin location.

The aquifer is between 800-2400 ft thick, with transmissivity between 2100-5300 ft2/day. Well yields in the basin range from 400-800 gpm/well (Boyle 1999). However, the aquifer is highly heterogeneous, so large variation in individual well yields exist.

Salinity ranges from 500-2100 mg/l; and thus, extracted water would likely require demineralization for potable use. The capacity of a demineralization project would depend on the safe yield of the aquifer.

The option considered for the IRP is to extract 2,500 AFY of groundwater from the San Diego formation for demineralization by reverse osmosis, of which 2,125 AFY would be delivered by pipeline to the Central Area System, and 375 AFY would be disposed of as brine concentrate. The brine waste would be sent to the San Diego County's Spring Valley Outfall, and ultimately discharge at the Point Loma Ocean Outfall.

A conceptual schematic of this option is shown in Figure 5-9.

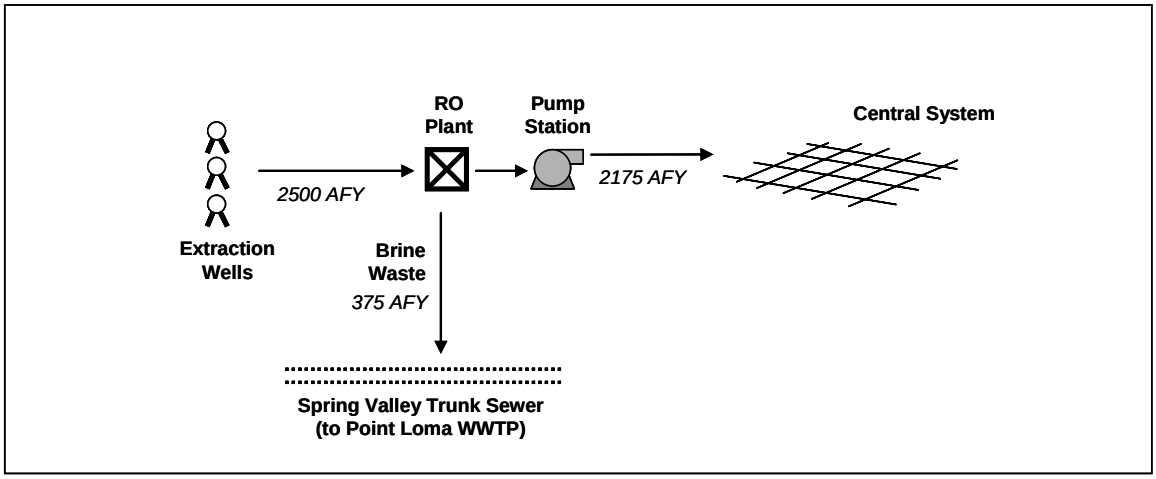


Figure 5-9
San Diego Formation Brackish Groundwater Desalination Option Schematic

The facilities/project components required for this option include:

- Extraction wells
- RO treatment plant (with brine disposal facilities)
- Conveyance to distribution system (pipeline and pumping)
- Monitoring wells
- Land acquisition

The total capital cost of this option is estimated at $22,525,000, and the annual operation and maintenance costs are approximately $1,679,000/year. The unit cost of this option is $1,362.

Potential issues for project implementation include seawater intrusion, interference with other users of the basin, such as Sweetwater Authority, and brine disposal. Additional extraction from the Formation has been considered by Sweetwater Authority and the City of San Diego. Brine may affect the salinity of the Point Loma effluent.

Brine disposal will be an important consideration for project implementation and will require significant environmental review and coordination with the city of San Diego Metropolitan Wastewater Department.

5.2.5 Tijuana River Valley Aquifer Reclaimed Water Storage

The Tijuana River basin is a coastal alluvial aquifer located north of the U.S./Mexico border in the City of San Diego (see Figure 5-4). This site was initially considered for the storage of reclaimed water from the City of San Diego's South Bay Water Reclamation Plant for use during peak summer months. The amount of available storage would be in the order of 500 AF. If this water is recovered over a 6-month period, the basin could produce approximately 1 MGD of reclaimed water.

This option was eliminated from further consideration due to a number of factors. First, water quality is an issue in terms of salinity and runoff in the Tijuana River. TDS concentrations in the aquifer range from 850 to 9,000 mg/l. Extraction without artificial replenishment may result in seawater intrusion, further degrading the quality of the aquifer. The potential for storage of high quality imported water would be limited by the amount of storage availability.

Additionally, there are some issues that would complicate the implementation of this project. The California Department of Health Services (DHS) requires recharge reclaimed water to have TDS and total organic carbon (TOC) concentrations lower that those of the South Bay effluent. If a waiver cannot be obtained, effluent would require membrane treatment prior to recharge, thus significantly increasing the cost of the project.

5.2.6 Other Groundwater Wells

Four smaller, local groundwater well projects were initially considered in the IRP. These projects included groundwater extraction wells and conveyance facilities to the OWD distribution system from the following sites: Rancho del Rey well, Daley Ranch well, northeast of the Otay Mesa Yard well, and the Otay Mountain well site. For the Rancho del Rey, and northeast of Otay Mesa Yard well sites, limited information was available, but there was strong concern about poor water quality (in the form of high TDS concentrations) at those sites. Advanced treatment with reverse osmosis would be required for these wells, which is very expensive for such a small yield. For the Daley Ranch site, there was concern about institutional coordination and wildlife losses. For these reasons, these three well projects were eliminated from further analysis in the IRP. The Otay Mountain wells site was considered for evaluation.

5.2.6.1 Otay Mountain Well

Information for the Otay Mountain well site is based on an agreement between OWD and D&D Landholdings for the exploration, production, and sale of potable water and water rights. The Otay Mountain well is located near the intersection of Otay Mesa Rd. and Alta Rd. The water quality at this well is characterized by high TDS and would thus require demineralization treatment before the water could be used.

Under this option, 1,612 AFY of water would be extracted from the ground and treated by reverse osmosis for use in the non-potable supply for OWD. Assuming a treatment plant efficiency of 85%, 1,370 AFY of treated water would be conveyed to the 860 reservoir for recycled water use in the Otay Mesa System. Also, 242 AFY of brine concentrate would be produced. It is assumed that this waste can be disposed of either in a sanitary sewer close to the location of the well, or else via a dedicated brine disposal line connected to the City of San Diego's South Bay Ocean Outfall. Initially in the analysis, brine disposal in a local sanitary sewer was assumed; a dedicated brine line would add to the cost of the option and decrease its attractiveness. The performance of this option in later analysis indicated that even without the added cost of the dedicated brine line, this option was not favored.

The facilities/project components required for this option include:

- Extraction well
- RO treatment plant (with brine disposal facilities)
- Conveyance to 860 Reservoir (pipeline and pumping)
- Land acquisition

The total capital cost of this option is estimated at $12,380,000, and the annual operation and maintenance costs are approximately $970,000/year. The unit cost of this option is $1,364.

Brine disposal will be an important consideration for project implementation and will require significant environmental review and coordination with the City of San Diego Metropolitan Wastewater Department.

5.3 Additional Recycled Options

Recycled or reclaimed water can be used to meet select irrigation demands in place of potable water at considerable cost savings and while utilizing an otherwise discarded resource. Otay Water District currently owns and operates the Ralph W. Chapman Water Reclamation Facility (RWCWRF) which produces 1,230 AFY of recycled water. Additionally, OWD has entered into agreement with the City of San Diego to receive approximately 6,700 AFY of recycled water from the South Bay Water Reclamation Plant (SBWRP). Recycled water supplies can be used for the irrigation of golf courses, municipal parks, school grounds, highway medians, housing developments, and other large landscaped areas.

As part of the IRP process, OWD considered options for expanding its use of recycled water by identifying further demands and additional supplies. It is estimated that OWD's demand for recycled water uses in 2005 was 3,485 AF (OWD et. al., 2005). This value will continue to grow into the future (refer to Section 3 for projected recycled water demands). There are, however, limitations on the application of recycled water to the land within OWD's service area. According to the Water Resources Master Plan (OWD et. al., 2001):

> *"The use of recycled water within any watershed tributary to surface water storage reservoirs that provide supply for potable domestic water uses is prohibited by the San Diego Regional Water Quality Control Board (RWQCB) to protect water quality in the reservoirs. These land areas include the entire North District* [or North System] *and a portion of the South District* [mainly the Central Area System]. *The three surface water storage reservoirs that restrict the size of the recycled water irrigation area are the Sweetwater Reservoir, Upper Otay Reservoir, and Lower Otay Reservoir. The tributary land areas are consequently excluded from the recycled water planning area."*

Types of options for expanding OWD's use of recycled water include: the expansion of existing recycled water facilities or agreements, the construction of or purchase agreement for wastewater stripping plants, and potential extension of recycled supply for demands in the North System. The use of recycled water to meet irrigation demands in the North System would be conditional upon the permitting decision of the RWQCB and the California DHS, per reasons stated above.

A schematic figure showing the relationship between the additional recycled supply options and the OWD water supply system is shown in Appendix B.

5.3.1 Spring Valley Stripping Plant

Under this potential supply option, OWD would construct a 5 MGD (5600 AFY) stripping plant in the Sweetwater Valley along the San Diego County's Spring Valley Outfall. Wastewater would be siphoned off the trunk sewer and treated to produce recycled water for re-use in the Central Area System and a waste stream that would be returned to the trunk sewer.

The wastewater in the trunk sewer currently flows from the City of Chula Vista to the Point Loma WWTP where it is treated. Chula Vista is expected to need additional wastewater capacity that exceeds the current system capacity by 5 MGD, and this option would help to alleviate the capacity problem by removing wastewater flows in the system. As such, it is assumed that OWD could be compensated by other agencies for providing the benefit of removing flows from the wastewater system.

Infrastructure required for this option includes:

- 5 MGD stripping plant
- Pump station and 24-inch transmission pipeline to convey recycled water from the Spring Valley Stripping Plant to the Central Area System
- Land acquisition

The unit cost of this option is $1,117/AF. Total capital costs would be approximately $63,900,000 with annual O&M costs of about $1,600,000.

Execution of this option would require coordination with the City of Chula Vista, the City of San Diego, the County of San Diego, Lemon Grove, and Spring Valley Sanitation District for taking wastewater from the sewer and returning a smaller but more concentrated flow after treatment.

5.3.2 Chula Vista Stripping Plant

This option is similar to the Spring Valley Stripping Plant option described above except that this option assumes that the treatment plant would be owned by Chula Vista and Otay would only purchase recycled water but not be responsible for the construction or operation of the stripping plant. Treated effluent from this plant would be delivered to serve the Central Area System's recycled water demands.

Infrastructure required for this option includes a pump station and a transmission pipeline to convey recycled water from the CVSP to the Central Area System.

The unit cost of this option is $756/ AF. Total capital costs would be approximately $12,500,000 with annual O&M costs of about $3,300,000.

This option would require coordination with the City of Chula Vista, the City of San Diego, as well as the County of San Diego.

5.3.3 Additional Purchases from South Bay WRP

Otay Water District has an existing agreement with the City of San Diego to receive at least 6 MGD of recycled water produced at the SBWRP[2] (refer to Section 2 for a description of the existing agreement). Under this option, OWD would acquire an additional 4 MGD (4,500 AFY) of SBWRP recycled water (for a total of 10 MGD). The SBWRP currently has a recycled water production capacity of 15 MGD; of which, 10 MGD is available for reclaimed use by other water agencies.

The City of San Diego is providing OWD with transmission capacity in a 4,000 foot, 30 inch transmission system through the Dairy Mart Road Bridge -- which is assumed to be sufficient for the additional flows. OWD is responsible for the construction of conveyance infrastructure from the City's pipeline to the 450 Zone Reservoirs, per the terms of the existing agreement.

No infrastructure would be required for the additional purchase of recycled water from SBWRP; however, a one-time capacity charge would be exacted in order to augment the allotment of plant capacity for OWD's use. Annual purchase and operation costs would also exist, which are equivalent to costs incurred for the existing agreement on a per unit basis.

The unit cost per acre-foot for this option is estimated at $633. Total capital costs would be approximately $2,400,000 with annual O&M costs of about $2,700,000.

Additional coordination would be required with the City of San Diego for this option.

5.3.4 Expansion of South Bay WRP

This option is similar to the Additional Purchases from South Bay WRP option. However, under this option OWD would contribute funds to the cost of an expansion of the SBWRP in order to obtain rights to an additional 4 MGD (4,500 AFY) of recycled water capacity. Implementing this option would provide OWD with a total of 10 MGD of recycled water from the City of San Diego SBWRP. Per the terms of the existing agreement (refer to Section 2), the City of San Diego is providing OWD with transmission capacity in a 4,000 foot, 30 inch transmission system through the Dairy Mart Road Bridge -- which is assumed to be sufficient for this option's expanded flow. OWD is responsible for constructing conveyance infrastructure from the pipeline to the 450 Zone Reservoirs.

[2] The existing agreement between the City of San Diego and Otay Water District for reclaimed water from SBWRP is a 20 year agreement. For the purposes of planning and modeling supply options, it was assumed that this agreement would be extended under the same terms through the end of the IRP planning horizon (i.e. 2030). For reference, see the agreement in Appendix D of the 2005 Urban Water Management Plan (OWD et. al., 2005).

Costs for this option are associated with the expansion of the SBWRP to provide 4 MGD to OWD, and operational (pumping) costs for conveyance to OWD. It is assumed that OWD would have rights to the additional 4 MGD of effluent, and would not have to pay a purchase fee to the City of San Diego for use of the source.

The unit cost of this option is $1,137/ AF. Total capital costs would be approximately $40,000,000 with annual O&M costs of about $2,200,000.

Coordination would be required with the City of San Diego for this option.

5.3.5 Ralph W. Chapman Water Reclamation Facility (RWCWRF) and /or Spring Valley Stripping Plant Recycled Water to Lower Sweetwater Basin and Downstream Well Recovery

The Lower Sweetwater Basin is defined as the 8-mile reach of the Sweetwater River between Sweetwater Reservoir and San Diego Bay, and is located outside of the OWD service area. The basin consists of an alluvial aquifer and the underlying San Diego Formation. The alluvial aquifer consists of sand and gravel. The basin has approximately 13,000 acre-ft of storage, including the underlying San Diego Formation. Depth to groundwater is in the range of 0-20 ft. Net recharge to the alluvial aquifer is estimated at approximately 1100 AFY. Salinity in the alluvial aquifer varies from 1700 to 3100 mg/l, while TDS concentration in the urban runoff recharge water is approx 2500 mg/l.

Groundwater could be recharged with recycled water from 1) OWD's RWCWRF or 2) a new stripping plant along the Spring Valley Outfall (if constructed). The recharged effluent would be traded with Sweetwater Authority for extraction and treatment at their groundwater demineralization facility. In exchange, Sweetwater Authority would provide potable water to OWD from another source.

This option was eliminated from further consideration since there is no real incentive for Sweetwater Authority to participate in this type of agreement. This option is not likely to be implemented in terms of inter-agency coordination.

5.3.6 North District Recycled Water Concept

Under this option, OWD would identify 1.1 MGD of recycled water demands in the North System, which would be served by Otay Water District's existing Ralph W. Chapman Water Reclamation Facility (RWCWRF). A description of the existing RWCWRF is provided in Section 2. Effluent from the RWCWRF is currently pumped by OWD to irrigate golf courses, parks and open space in Eastern Chula Vista, which is in the Central Area System and at a higher elevation than the North System. This option would reduce the conveyance costs that are currently incurred in pumping recycled water from the RWCWRF to Eastern Chula Vista. Existing recycled water users in Chula Vista would have to be provided with an alternate supply.

Infrastructure required for this option includes conveyance to the North System.

The unit cost of this option is $711/AF. Total capital costs would be approximately $7,900,000 with annual O&M costs of about $300,000. Note that these values do not accurately reflect the true costs of the option, as the costs for an alternative water supply to the users in Eastern Chula Vista are not included.

Inter-agency coordination will be required for this option with the Regional Water Quality Control Board, DHS, and Sweetwater Authority. Additionally, coordination with the City of Chula Vista would be required.

5.3.7 Expansion of Ralph W. Chapman Water Reclamation Facility (RWCWRF) and Sewer Collection System

This option involves an expansion of the production capacity of the Otay Water District's RWCWRF in order to obtain additional recycled water. The RWCWRF currently has a reliable Title 22 treatment capacity of 1.1 MGD (total capacity 1.3 MGD), as discussed in Section 2. This option includes expanding the RWCWRF in 1.3 MGD increments up to an ultimate capacity of 3.9 MGD. This is a long term option given that the sewer collection generation growth rate is less than 1% per year. The ultimate capacity is estimated based on the total projected ultimate OWD tributary sewer flow (3.2 MGD) and a portion of the ultimate Spring Valley tributary sewer flow (0.853 MGD). Implementation would be carried out in two phases. Phase One would be an expansion to a capacity of 2.6 MGD, and Phase Two would expand capacity to the ultimate 3.9 MGD. The total additional yield from this option is 2.6 MGD (3,000 AFY). Any additional sewer flows beyond the 3.9 MGD to be treated at RWCWRF will be bypassed to the Point Loma Treatment Plant.

The infrastructure required for this option includes the two phases of plant facilities expansion and a pipeline to convey the additional volume of recycled water from RWCWRF.

The unit cost of this option is $1,036/AF. Total capital costs would be approximately $30,500,000 with annual O&M costs of about $800,000.

5.4 Ocean Desalination Options

Desalination is the process whereby dissolved mineral (salts and others) are removed from seawater or brackish groundwater. Historically, desalination technology was focused on removal of salts from seawater and used in countries where no other solutions were feasible. Given other alternatives, the cost of desalination in the United States was considered too high. However, because of new technologies, desalination is being examined by coastal water agencies around the country. Desalination offers improved water quality (low salinity), and, as a more local source, can help protect against supply vulnerabilities due to droughts and earthquakes.

Although seawater is a seemingly unlimited resource, the high cost of developing this supply tends to restrict the total capacity developed. Issues such as siting, energy availability, environmental impacts, and the distribution costs needed to move the water from treatment to delivery all impose constraints on how much seawater can be treated. Of primary concern in all desalination projects is the disposal of the concentrated brine solution which is left over after treatment. Managing the brine waste can add considerable cost to desalination projects. Typical disposal methods include large evaporation ponds (land-intensive with environmentally concerns) or disposal by ocean outfall (costly to construct and maintain). Regionally, these issues are becoming more pronounced as more brine waste is produced and existing outfalls reach their capacities.

Although OWD is close to the Pacific Ocean, it is not immediately on the coast, and so conveyance costs for ocean desalination projects can be high. This fact motivates the cooperation between water agencies in the region. Several of the desalination options considered in the IRP involve OWD entering into agreements with other agencies to be provided with in-lieu water from their respective desalination plants. Under these agreements, OWD would either pay for capacity in a desalination plant or simply for a volume of product water. The desalinated water would be used to meet demands local to the plant, and other water from a different source would be provided to OWD in exchange.

For planning level purposes, conceptual desalination options or exchanges were considered and it was assumed that coordination with the necessary agencies would be possible in the future. The seawater desalination option concepts evaluated include:

- OWD purchases desalinated seawater from another agency (where OWD does not contribute to the construction of the desalination plant). This concept was evaluated with the Poseidon's Carlsbad Seawater Desalination Plant.

- OWD partners with other local agencies to construct a regional seawater desalination plant. This concept was evaluated assuming an agreement with the Sweetwater Authority and the City of San Diego (i.e. South Bay Project).

- OWD partners with Mexican water agencies to construct a seawater desalination plant in Mexico, by which OWD would receive Colorado River water in-lieu. This concept was evaluated assuming a bi-national partnership to construct a seawater desalination plant in Rosarito, Mexico.

A schematic figure showing the relationship between the ocean desalination supply options and the OWD water supply system is shown in Appendix B.

5.4.1 Poseidon's Carlsbad Seawater Desalination Project

This option represents the concept that OWD would purchases seawater from another agency, and OWD would not contribute to the construction of a desalination plant. For evaluation purposes, the Poseidon's Seawater Desalination Project was considered.

Poseidon Resources is a private corporation in the process of developing a desalination plant in the City of Carlsbad. The proposed plant has a design capacity of 50 MGD which is planned to serve the cities of Carlsbad and Oceanside. Additional capacity will also be available for other communities in the region who would like to participate. Under this option, OWD would pay to have 10 MGD (11,200 AFY) of potable water delivered to their distribution system from a third party, such as SDCWA. In exchange, the third party would receive an equal amount of desalinated water from the plant at a different point in their system.

Conveyance infrastructure may be necessary for the third party to receive the desalinated water. It is assumed that OWD would receive in-lieu water through the SDCWA treated water Pipeline No. 4.

A per-acre-foot unit cost of $1,300 was assumed for this option. This includes the operational seawater treatment costs and the in-lieu exchange transportation costs. There would be no capital costs associated with this option. Conveyance costs may be necessary to deliver the desalinated water to the third party, but are not included for this evaluation.

This option would require considerable inter-agency coordination for implementation, including coordination among: Poseidon Resources, the potential exchange partners (such as SDCWA), and any other project participants (Carlsbad Municipal Water District, Valley Center Municipal Water District, Ricon Diablo Municipal Water District, Olivenhain Municipal Water District, and Sweetwater Authority).

The desalination plant still needs to obtain a permit from the California Coastal Commission.

5.4.2 Southern California Partnership: Sweetwater/City of San Diego South Bay Project

This option would involve other local agencies to construct a regional seawater desalination plant. This option was evaluated assuming a potential agreement with Sweetwater Authority and the City of San Diego in the construction of a desalination plant at the South Bay site. Otay Water District would contribute funds to the construction of the plant proportional to a capacity of up to 20 MGD (22,400 AFY) for their use. A pipeline and pump station would need to be constructed to convey the desalinated ocean water from the South Bay plant to OWD's service area. In addition, there would be capital and O&M costs for brine disposal.

The unit cost of this option is approximately $2,800/AF. Assuming an agreement for 20 MGD, the total capital costs would be approximately $186,164,400 with annual O&M costs of about $49,185,000. Cost estimates were also developed for projects involving plant capacities of 5 MGD and 10 MGD. These estimates can be found Appendix C.

Siting and permitting of this plant would require extensive environmental review, especially as it relates to the construction of an ocean intake and an outfall for brine disposal. Originally, it was envisioned that the desalination plant could share the intake and outfall of an existing power generation plant in the South Bay. However, this plant may be taken out of operation in the near future.

5.4.3 Bi-National Partnership: Rosarito Financial Partnership with In-lieu Colorado River Water

Under this option, OWD would help to fund the construction of an ocean desalination plant in Rosarito, Mexico. Desalinated ocean water would be used locally but Mexico would provide a volume of its Colorado River water allotment to OWD in exchange – in an amount equal to OWD's capacity at the desalination plant. The in-lieu water from the Colorado River would have to be conveyed through the MWD and SDCWA systems to be delivered to OWD through their turnouts on Pipeline No. 4, and would be subject to those agencies' transportation and wheeling charges.

For this option, an initial plant capacity to provide 5MGD (5,600 AFY) would be supported by funds from OWD with the possibility to expand in the long-term. A conceptual schematic of this option is shown in Figure 5-10.

This option would not require any infrastructure other than OWD paying for its portion of the capacity of the desalination plant. All of the necessary conveyance infrastructure for the in-lieu exchange from the Colorado River is already in place.

The operational and maintenance costs for the seawater plant are approximately $870/AF. It was assumed that OWD would pay this unit O&M cost to Mexico -- minus the cost of transportation, wheeling, and treatment costs which it would pay to SDCWA to receive the in-lieu Colorado River water.

The overall unit cost of this option is $897 / AF. Total capital costs would be approximately $36,349,000 with annual (2006) O&M costs of about $4,865,555.

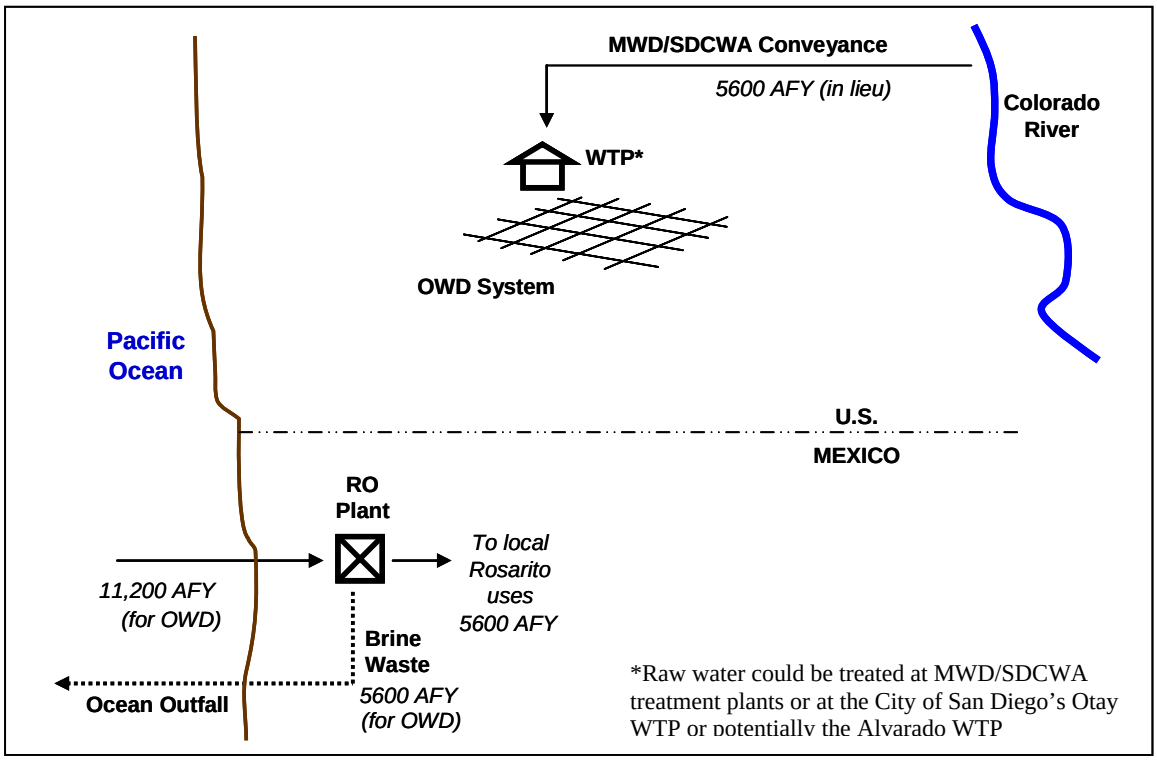


Figure 5-10
Bi-National Partnership: Rosarito Financial Partnership with In-lieu Colorado River Water Option Schematic

This option would require considerable coordination among numerous local, state, and national agencies in both countries. The exchange of Colorado River water will require significant negotiation efforts. The desalination plant will need to comply with all Mexican regulatory standards.

5.4.4 Other Desalination Options

Two other potential desalination supply options initially considered were a joint facility with Rosarito, Mexico and a partnership with Sweetwater/City of San Diego for the treatment of water from ocean wells on the Otay River. However, both of these options were eliminated from consideration.

The joint facility with Rosarito would have involved OWD jointly owning and operating a desalination plant in Rosarito, Mexico. Ocean water would be treated at the plant in Rosarito and a portion of the product water would have been conveyed across the border to OWD. This option was deemed to have too many regulatory and inter-agency coordination issues to be feasible—particularly with drinking water crossing an international border.

The ocean wells project with Sweetwater/City of San Diego would have involved extracting seawater from the ground at the mouth of the Otay River, treating the seawater, and conveying the treated effluent to OWD. Due to the proposed inland location of these wells, there may be difficulties in obtaining the required yield from those wells. Therefore, this option was determined infeasible, and eliminated from further evaluation.

5.5 Additional Imported Water Options with Local Treatment Agreements

Otay Water District currently has agreements with neighboring water agencies to receive SDCWA water treated by such agencies. Agreements exist for up to 12 MGD (on-peak) of treatment at Helix Water District's Levy WTP and up to 10 MGD of treatment at the City of San Diego's Otay WTP.

As part of the IRP process, options for obtaining additional treated imported water from neighboring agencies for normal operational use were identified. These local treatment options included: expanding agreements for Helix Water District's Levy WTP and the City of San Diego' Otay WTP, forming agreements with Sweetwater Authority for treated water from their Perdue WTP and with the City of San Diego for water from its Alvarado WTP.

Although these options still rely on imported SDCWA water as a source, they could provide more system flexibility for OWD, and in some cases, could utilize existing infrastructure.

Refer to Figure 5-1 for the projected imported raw water purchase rates from SDCWA, which are discussed in the following sections. A schematic figure showing the relationship between the additional imported supply options and the OWD water supply system is shown in Appendix B.

5.5.1 Expansion of Capacity Rights from Helix Water District's Levy WTP

Under this option, OWD would obtain rights to an additional 4 MGD, beyond the existing agreement for 12 MGD on-peak, 16 MGD off-peak capacity (refer to Section 2). For this option it is assumed that the treated Levy WTP water would be conveyed to the Regulatory Site 520 reservoir in the North District using FCF #8 and the LMSE pipeline (which are scheduled to be abandoned when FCF #14 is on-line).

Costs for this option would include the expanded plant capacity participation purchase at Levy WTP, and the cost for imported SDCWA purchases treated at Levy which is equivalent to the SDCWA treated water rate. The unit cost of this option is $744 / AF. Total capital costs would be approximately $12,300,000 with annual O&M costs for the purchase of imported water of about $2,400,000.

5.5.2 Expansion of Capacity at City of San Diego's Otay WTP

Under this option, OWD would contribute funds for the expansion of the City of San Diego's Otay WTP. The current effective capacity of the Otay WTP is 40 MGD; of which, the City of San Diego typically uses 20 MGD for its own demands. Otay Water District currently has an agreement with the City of San Diego for 10 MGD from the Otay WTP; however, typical operations currently provide approximately 8 MGD in high-demand summer months and 10 MGD in winter months (refer to Section 2). Expansion of the facility would provide up to an *additional* 20 MGD to OWD. Water from the Otay WTP is currently supplied to the Otay Mesa and Central Area Systems via a temporary pump station with a capacity ranging between 6-21 MGD. A permanent pump station is already planned, which will have a capacity of 30 MGD (OWD et. al., 2002). It is assumed that there will be sufficient conveyance capacity already in place before implementation of this option.

For this option, a plant capacity to provide 20MGD (22,400 AFY) would be supported by funds from OWD. This option would not require any infrastructure other than OWD paying for its portion of the capacity expansion of Otay WTP. It is assumed that there will be sufficient conveyance capacity already in place for this option.

Operational costs associated with this option include imported raw water purchases from SDCWA, and pumping conveyance costs from Otay WTP to the OWD distribution system.

The unit cost of this option is $694 / AF. Total capital costs would be approximately $49,000,000 for with annual O&M costs of about $12,000,000.

It is important to note that this option is mutually exclusive with Alvarado WTP option because the City does not have enough water demands or funding to justify expansion of two water treatment plants.

5.5.3 Imported Water from Sweetwater Authority's Perdue WTP

Under this option, OWD would purchase additional raw water from SDCWA and pay the Sweetwater Authority for treatment at the Perdue WTP. Under this option, 4 MGD of treatment capacity would be available to OWD. Otay Water District would pump treated water from Perdue WTP into the existing 36-inch transmission main to the North System via a new pump station and 24-inch pipeline (OWD et. al., 2002).

Capital costs associated with this option include the participation charge for 4 MGD of treatment capacity at Perdue WTP, and the 24-inch pipeline and pump station for conveyance to the existing 36-inch transmission main.

Operation and maintenance costs include treatment costs, pipeline maintenance, pumping (energy) costs for conveyance, and imported raw water purchases from SDCWA.

The net present value unit cost of this option is $878 / AF. Total capital costs would be approximately $16,200,000 with annual O&M costs of about $2,700,000.

5.5.4 Imported Water from the City of San Diego's Alvarado WTP

Under this option, OWD would purchase additional raw water from SDCWA and pay the City of San Diego for treatment at the Alvarado WTP. Capacity available for purchase could be up to 30 MGD. The treated water from Alvarado WTP would be delivered to OWD through SDCWA Pipeline No. 4. Otay Water District diverts water from SDCWA Pipeline No. 4 at a number of points, including: FCF No. 11 to the North System, FCF No. 10 and 12 to the Central Area System, and FCF No. 13 to the Otay Mesa System.

Capital costs associated with this option include the SD17 pump station and the participation purchase for 30 MGD capacity at Alvarado WTP. The operational costs for this option are imported raw water purchases from SDCWA, treatment at Alvarado WTP, and energy costs at the SD17 pump station.

The unit cost of this option is $733 / AF. Total capital costs would be approximately $82,400,000 with annual O&M costs including the purchase of imported water of about $18,600,000. *[Information since the IRP analysis has indicated that there would be no participation/purchase cost for the Alvarado imported water option. This supply option performed well regardless of the initially assumed participation cost, and its newer lower cost would only help its performance.]*

It is important to note that this option is mutually exclusive with Otay WTP option because the City does not have enough water demands or funding to justify expansion of two water treatment plants.

5.6 Imported Raw Water from SDCWA Pipeline No. 3 for Irrigation

SDCWA Pipeline No. 3 provides raw water to Sweetwater Authority's Perdue WTP, Sweetwater Reservoir, City of San Diego Otay WTP, and Lower Otay Reservoir. Under this option, Otay Water District would construct diversion facilities and purchase additional raw water to meet irrigation demands in their service area currently being met with treated water. For this option it is assumed that the yield would be 5 MGD over 6 months to help meet irrigation needs in high-demand summer months. The raw water would be diverted from SDCWA Pipeline No. 3 into the 680 Reservoir for delivery to OWD customers.

It is assumed that there is sufficient capacity in Pipeline No. 3 for this option. The SDCWA Pipeline No. 3 right of way is located adjacent to the 680 pressure zone reservoir. It was assumed that the turnout would be located near this point at an elevation above 680 ft and that no pumping and only a small length of pipe would be required. Filtering of the raw water may be required, but for this analysis it was assumed that the water could be used directly. The uncertainty of treatment

requirements was captured in this option's Compatibility Score (see Section 4). A more detailed analysis would be required if this option were to be implemented.

OWD would need to construct a tie-in to Pipeline No. 3 for diversions. In addition, because the proposed flow for this option is relatively small compared with the large capacity of SDCWA Pipeline No. 3, several modifications would be necessary to control the flow in Pipeline No. 3. The size of the current valves and other appurtenances are too large to allow only 5 MGD to pass through. Necessary modifications to SDCWA facilities include flow balancing structures on SDCWA Pipelines No. 3 & 4, as well as modifications to the San Diego 5 take-off structure. It should be noted that these modifications would only be necessary if the flow from this option in Pipeline No. 3 was not supplemented by other flows being delivered downstream for other uses. There are seasonal storage flows in Pipeline No. 3 that would prevent the need for the modifications. However, these occur during October through May, which is not when irrigation demands are high. For purposes of this analysis, it was assumed that this option could be operated independently from other flows.

Operational costs for this option include the imported raw water purchases from SDCWA, which are shown in Figure 5-1. The SDCWA requires a minimum flow of 2 CFS be discharged to Lower Otay Reservoir, to ensure that the pipeline is operating correctly. It is conceivable that OWD could treat this flow at the City of San Diego's Otay WTP through an agreement in the future. However, this required minimum flow was added to the imported raw water purchases for this option, and considered a "sunk" cost for OWD in this analysis.

The unit cost of this option is $590/AF. Total capital costs would be approximately $2,400,000 with annual O&M costs including the purchase of imported water of about $1,500,000.

5.7 Imported Treated Water from SDCWA Pipeline No. 4

In this analysis, treated water purchases from SDCWA are the default supply option used to meet any remaining demands after all other supply options have been exhausted. It is also considered the baseline supply source that could meet OWD's projected future water demands, under normal conditions, if no other options are implemented. The capacity of Pipeline No. 4 is sufficient to meet OWD's demands through the planning year 2030. However, OWD is interested in reducing its reliance on imported water supplies, gaining greater local control of their water resources, and avoiding uncertainty about the cost and reliability of imported water in the future.

There are no capital costs for this option, since all the necessary infrastructure is already in place. The projected purchase rates of imported treated water from the SDCWA are discussed at the beginning of this section, and shown in Figure 5-1.

5.8 Water Transfers and Water Banking

OWD could engage in water transfers to increase their water supply. Water transfers are the voluntary exchange of water between a willing buyer and a willing seller. Both State and Federal law contain provisions that authorize, acknowledge, and support water transfers. The California Water Code protects legal users of water during water transfers through the "no injury rule," which states that a change in a water right may not cause injury to any legal user of the water involved. The Water Code also requires that a transfer: (1) avoid any unreasonable effects to fish and wildlife; and (2) does not cause unreasonable economic impacts to the county from which the water is transferred.

Water transfers can be short-term or long-term. Short-term water transfers are typically a one-time purchase of water, usually on an as-needed basis to offset the effects of drought. Short-term transfers are generally exempt from CEQA; the Water Code relies on notice to the affected parties and findings made by the State Water Resources Control Board (SWRCB). Long-term transfers are those that take place over a period of more than 1 year. Long-term transfers are subject to the requirements of CEQA and must also comply with the standard SWRCB public noticing and protest process. The California Water Bank, established during the 1988-92 drought, is an example of a short-term water transfer.

Short-term and long-term transfers can be made through an options agreement, where buyers have the "option" to purchase a certain amount of water any time during the life of the agreement. An "option" payment would be made each and very year to secure the right to transfer the water. When the water is called, then the buyer would pay the water transfer cost for that amount of supply needed in that year.

Water transfers can occur through various mechanisms including stored water purchases, groundwater substitution, or crop idling agreements. Water can be purchased from water districts north of the Sacramento-San Joaquin Delta, in the Central Valley, or the Colorado River Basin. OWD would have to negotiate a price, transfer amount, and delivery schedule with the seller.

OWD could also participate in a water banking agreement. Water banking involves storing water underground for future use, especially during dry periods. Several water agencies have established a formal groundwater bank. Semitropic Water District in Kern County operates a groundwater bank with a storage capacity in excess of 1 million acre-feet. Multiple agencies already participate in the bank, including MWD and Santa Clara Valley Water District. Semitropic Water District is currently increasing their banking operation and has storage and pumpback capacity available for new banking partners. The Kern Water Bank, is another example of an established water bank. And finally, the San Bernardino Municipal Water District is also a potential water banking partner.

For the purposes of OWD's IRP analysis, three general types of water transfers were explored: (1) short-term, North of Delta; (2) Land fallowing or Option, in the Central Valley or Colorado River Basin; and (3) Groundwater banking in the Central Valley (or Southern California region). There are advantages and disadvantages to each of these types of transfers, which include:

Water Transfer	Advantage	Disadvantage
Short-Term, North of Delta (e.g., California Water Bank)	Lowest cost, no CEQA required	Any Bay-Delta restrictions would likely affect these supplies as well
Land Fallowing or Option Contracts, Central Valley or Colorado River Basin (e.g., Palos Verdes Irrigation District)	High reliability, lots of flexibility in cost structure and how/when transfer water is taken	Third party impacts could be high, CEQA issues likely, and negotiations more complex
Groundwater Banking, Central Valley (e.g., Semitropic Banking Program)	Highest reliability, especially if a pumpback provision is made	CEQA issues, ensuring adequate pumpback capability, and highest up front costs (for capital)

Costs

Estimating costs for water transfers is extremely speculative due to the nature of the water transfer market. The more sellers of water transfers, the lower the expected costs, while the fewer sellers, the greater the expected costs. The California water market is ever changing. However, for this IRP analysis, water transfer costs were estimated based on most recent water transfers involving MWD, SDCWA, Palos Verdes Irrigation District, Imperial Irrigation District, and Semitropic Water Bank.

The current water transfer costs (in 2007 dollars) were estimated to be:

Water Transfer	Fixed Cost ($/AF) (capital or option payment)	Variable Cost ($/AF)
Short-Term Transfers	None	$80
Land Fallowing	$100	$150
Groundwater Banking	$180	$100

In addition to water transfer costs, there are costs associated with delivery and treatment of the water. Delivering the transferred water would require the use of other agencies water conveyance infrastructure, also known as wheeling.[3] Other infrastructure usually involved in the transfer of water includes: State Water Project (SWP), Central Valley Project (CVP), MWD, and SDCWA. The California Water Code states that an agency must allow wheeling if excess capacity is available, given that fair compensation is paid for use of the system. For this analysis, it was assumed that any water transfer to OWD would involve paying both SDCWA and MWD for wheeling. The current wheeling costs for 2007 are estimated to be:

MWD Wheeling [4]	$260/acre-foot
SDCWA Wheeling [5]	$60/acre-foot
Total Wheeling	$320/acre-foot

Figure 5-11 shows the projected water transfer costs for the three types of transfers that include the fixed, variable and wheeling costs.

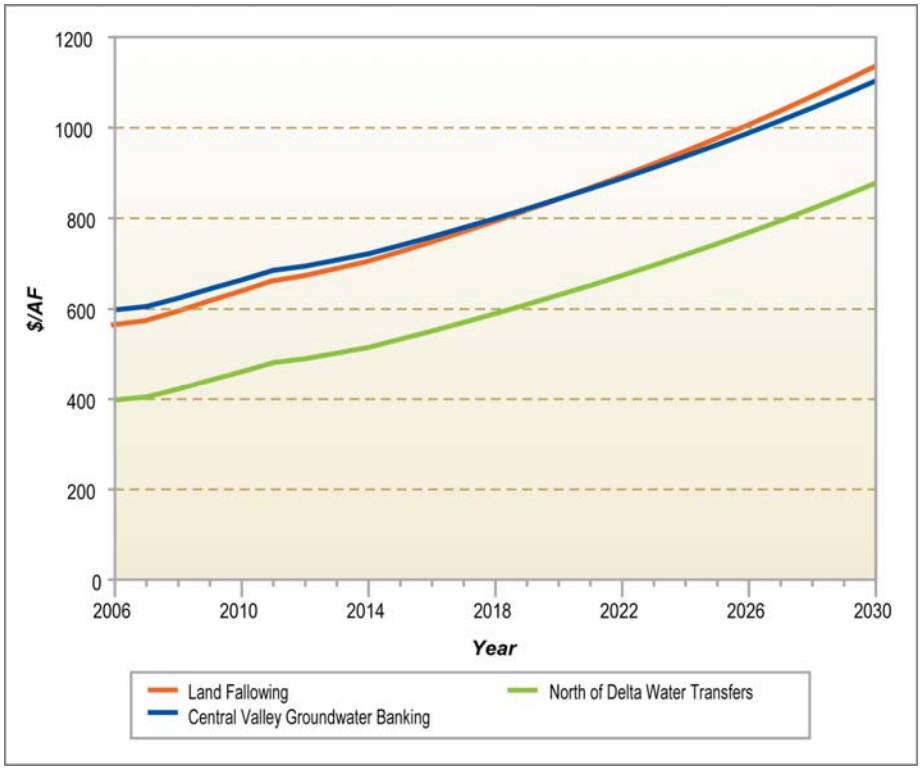


Figure 5-11
Projected Water Transfers Costs

[3] Wheeling is the use of an agency's distribution system to move non-agency water between a willing seller and buyer.
[4] Based on MWD's Long Range Finance Plan (July 23, 2004, Table 6).
[5] Based on SDCWA transportation rate (http://www.sdcwa.org/news/finances.phtml#current)

The transferred water could be treated by the City of San Diego at the Otay WTP or potentially the Alvarado WTP, or else treated by MWD with payment of the treatment surcharge. The cost of treatment at Otay WTP is approximately $90/AF. In addition, OWD would need to pay approximately $25/AF for pumping conveyance from Otay WTP to OWD's distribution system. It was assumed that the treatment cost for water transfers would be the same as imported raw water purchases from SDCWA.

If the transfers are delivered through Pipeline No. 4 assuming treatment by MWD, the treatment surcharge was assumed as the difference between the SDCWA treated and raw water purchase rate projections, which are shown in Figure 5-1.

North of Sacramento-San Joaquin Delta Water Transfers
The transfers from north of the Delta are considered the least expensive transfers. However, they are likely the least reliable since the water must be conveyed through the Bay-Delta area, which is prone to environmental restrictions and drought uncertainty. For this analysis, it was assumed that OWD would purchase up to 5,000 AFY of transfers from north of the Delta groundwater. The use of this supply source would be only during extreme drought years when the SDCWA could potentially impose imported water supply reductions.

Central Valley Groundwater Banking
The Central Valley groundwater is considered the most reliable source of transfers. It is estimated that approximately 200,000-500,000 afy is available for use through the Central Valley Water Project and agricultural projects in the Delta. For this analysis, it was assumed that a yield of up to 15,000 AFY would be purchased throughout the planning horizon and used in dry years. The Central Valley groundwater banking opportunities appear attractive due to reliability in drought conditions, but they are generally more expensive than other transfer/banking opportunities.

Land Fallowing in Central Valley or the Colorado River Basin
Land fallowing refers to an agricultural rotating crop program, which would make agricultural water rights available for other uses on an as-needed basis. Potential suppliers of water through land fallowing could be in the Central Valley, or the Imperial Irrigation District, or the Pales Verdes Irrigation District. This water is more reliable than north of Delta short-term transfers, but has more complexities in negotiations due to potential third party impacts, CEQA issues, and political obstacles. Transfers along the Colorado Basin may also be difficult to acquire since the Coachella Valley Water District, SDCWA and MWD have first priority for purchase before other water agencies. For this analysis, it was assumed that up to 15,000 AFY would be purchased throughout the planning horizon and used in dry years.

Other Transfers/Banking Options Considered
Other potential types of water transfers include purchasing or leasing Indian water rights and regional water transfers/banking. Indian water rights are generally the

most senior water rights in California. They are also likely the most expensive and difficult to negotiate. Few examples of Indian water rights being transferred to urban water districts exist. However, OWD should engage a water rights attorney to conduct a search to see if such rights might be available.

Regional water transfers may also present an opportunity for OWD. The most promising is the San Bernardino Valley Municipal Water District, which has significant water storage potential in the Bunker Hill Basin and is also a State Water Contractor. OWD might be able to purchase a water storage account in the basin to store SWP water, transfer water or purchased groundwater.

Section 6
Water Supply Portfolio Development

This section describes the water supply portfolio development process followed in the IRP, and lists the final set of portfolios used for ranking.

Portfolio Development Process

The process followed the basic approach described in Section 4, and illustrated in Figure 4-1. The portfolio development process is iterative, in that supply options, portfolios, and performance measures are refined after initial evaluation. The initial portfolio results show "why" and "how" a portfolio did well, or poorly, in meeting performance measures. The iterative process allows for adjustment and fine-tuning in order to create better performing portfolios and also to ensure that the best performance measures are being used to compare portfolios.

There are several methods that can be used to develop portfolios. For this IRP, the portfolios were developed with an objective-based method, where each portfolio is based on a specific IRP objective defined in Section 4. With this method, the new supply options that maximize a specific IRP objective are grouped together in a portfolio. For example, one of the objectives is "Flexibility." To create a portfolio with emphasis in this objective, supply options are grouped together that would increase OWD's operational flexibility by increasing the number of take points into the system.

Portfolios were developed for all of the objectives, except for the objective to "Address Environmental and Institutional Constraints." This objective was not used for a portfolio since it was not weighted heavily by the group of stakeholders.

In order to compare the objective-based portfolios with the "no project" scenario, the baseline condition was also evaluated as a portfolio.

In this IRP, the CDM planning team developed initial portfolios and discussed them with OWD senior staff prior to systems analysis and ranking. With consensus of the initial portfolios and portfolio development method, the initial portfolios were evaluated and the results were reviewed collaboratively by the CDM planning team and OWD staff. The initial results provided insight needed to refine the analysis, and final portfolios were developed for evaluation.

Summary of Portfolios

The following is a description of the portfolios that were included in the final evaluation. A matrix summary of the supply options included in each portfolio is shown Table 6-1, with the portfolios across the top of the matrix. A list of the available supply options and their corresponding yields is shown on the left side of the matrix.

The supply options included in each portfolio are indicated within the matrix by their potential yields (in acre-feet per year). If a cell within the matrix is blank, it means the

option was not included in the portfolio. Note that the existing, or baseline, supply was included in every portfolio along with the potential water supply options.

For reference, a schematic of the portfolios and a list of the options included in each portfolio are included Appendix D.

Water Quality A: This portfolio was developed with the objective of improving water quality by minimizing the potential for presence of disinfection by-products (DBP's).

Water Quality B: Options included in this portfolio were intended to improve water quality by minimizing the concentration of Total Dissolved Solids (TDS) in the system.

Reliability A: The objective of this portfolio was to increase reliability under drought conditions that could result in imported water shortages.

Reliability B: Options included in this portfolio were intended to increase reliability under seismic conditions. The assumed seismic condition involves an interruption of imported water supply caused by SDCWA Pipelines No.3 and No. 4 being offline. In addition, all recycled water supply is assumed to be offline.

Affordability: This portfolio was developed with the lowest cost options based on their dollar per acre-foot unit cost.

Baseline: This portfolio represented the "no project" scenario, and utilized all of OWD's existing (or already planned) supply sources, as they would exist in the year 2010.

Diversity A: The objective of this portfolio was to increase the diversity of supply sources.

Diversity B: This portfolio was developed with the objective of increasing the diversity of supply sources, and also focuses on expanded the use of existing (or already planned) sources.

Flexibility: The objective of this portfolio was to increase OWD's operational flexibility by increasing the number of take points into the system.

The performance of these portfolios against the IRP objectives, as well as the comparison of their performance against each other, is discussed in Section 8. The top scoring portfolios were used to select water supply options in an implementation strategy described in Section 9.

Table 6-1
Matrix of Supply Option Yields (in AFY) included in Portfolios

			Portfolios								
Supply Option	**Annual Yield [AFY]**	**Peak Day [MGD]**	**Water Quality A: DBP**	**Water Quality B: TDS**	**Reliability A: Drought**	**Reliability B: Seismic**	**Affordability**	**Baseline**	**Diversity A**	**Diversity B: Expand Existing**	**Flexibility**
I. Existing Supply (Baseline = 2010 System)											
Ia. Imported											
SDCWA Pipeline # 4	Up to capacity of existing turnouts [136,106 AFY].	Up to capacity of existing turnouts [121.5 MGD].	Use as last priority source	Use as last priority source	Use as last priority source	Use as last priority source	Use as last priority source	Use as last priority source	Use as last priority source	Use as last priority source	Use as last priority source
City of San Diego's Otay WTP	10,100 AFY	10 MGD in winter, 8 MGD in summer	10,100	10,100	10,100	10,100	10,100	10,100	10,100	10,100	10,100
Helix's Levy WTP	13,400 AFY base load. Minimum of 10,000 AFY.	12 MGD	13,400	13,400	13,400	13,400	13,400	13,400	13,400	13,400	13,400
Ib. Recycled											
OWD's Ralph W. Chapman WRP	1230 AFY	1.1 MGD	0	1,232	0	1,232	0	1,232	1,232	0	1,232
City of San Diego's South Bay WRP	6,720 AFY	6 MGD	6,722	6,722	6,722	6,722	6,722	6,722	6,722	6,722	6,722
II. Potential Additional Supply Options											
IIa. Additional Imported/Local Treatment Agreements											
Helix's Levy WTP	4,480 AFY	4 MGD								**4,480**	**4,480**
Sweetwater Authority's Perdue WTP	4,480 AFY	4 MGD							**4,480**		**4,480**
City of San Diego's Otay WTP	22,400 AFY	20 MGD								**22,400**	
SD17 Agreement with City of San Diego to treat raw SDCWA water at Alvarado WTP	33,600 AFY	30 MGD							**33,600**		**33,600**
IIb. Additional Non-Potable											
Imported Water from Pipeline No. 3. (Raw)	2,800 AFY	5 MGD over 6 months	**2,800**		**2,800**				**2,800**		**2,800**
Spring Valley Stripping Plant (along Sweetwater River)	5,600 AFY	5 MGD							**5,600**		
Chula Vista Stripping Plant	5,600 AFY	5 MGD			**5,600**					**5,600**	
South Bay WRP (Additional Purchase Only)	4,480 AFY for additional purchase only. Potential to expand SBWRP to obtain more effluent.	4 MGD			**4,480**		**4,480**			**4,480**	
Expansion of South Bay WRP											
RWCWRF and/or Spring Valley Stripping Plant effluent bypassing Sweetwater Res and pumped at Sweetwater's Demineralization Plant for In-lieu exchange	RWCWRF: 1230 AFY SVSP: 5,600 AFY	Chap: 1.1 MGD SVSP: 5 MGD									
North District Recycled Water Concept (uses existing RWCWRP capacity)	Shift 1230 AFY supply from Central Area to North. Central Area demands would need to be met by another source.	1.1 MGD	**1,230**		**1,230**		**1,230**			**1,230**	
Expansion of RWCWRF and Sewer Collection System	1,681 AFY 3,137 AFY	1.5 MGD 2.8 MGD	**3,137**						**3,137**	**3,137**	

Table 6-1
Matrix of Supply Option Yields (in AFY) included in Portfolios

			Portfolios								
Supply Option	**Annual Yield [AFY]**	**Peak Day [MGD]**	**Water Quality A: DBP**	**Water Quality B: TDS**	**Reliability A: Drought**	**Reliability B: Seismic**	**Affordability**	**Baseline**	**Diversity A**	**Diversity B: Expand Existing**	**Flexibility**
IIc. Groundwater											
Middle Sweetwater Groundwater Conjunctive Use	5,000 AFY Recharge for 6 months in winter of wet years, extract for 6 months in summer of drought years	8.9 MGD	**5,000**		**5,000**	**5,000**			**5,000**		**5,000**
Lower Sweetwater Brackish Groundwater Demineralization	1,500 AFY	1.3 MGD	**1,500**	**1,500**		**1,500**			**1,500**		
Santee/ El Monte Conjunctive Use	5,000 AFY Recharge for 6 months in winter of wet years, extract for 6 months in summer of drought years	8.9 MGD	**5,000**		**5,000**	**5,000**	**5,000**				
Santee/El Monte Brackish Groundwater Demineralization	4,250 AFY extract year-round		**4,250**	**4,250**		**4,250**			**4,250**		
San Diego Formation Brackish Groundwater Demineralization	2,125 AFY (assumes 85% RO efficiency)	1.897 MGD	**2,125**	**2,125**		**2,125**			**2,125**		
Otay Mountain Well for Recycled Use	1,370 AFY (assumes 85% RO efficiency)	1.22 MGD (1000 gpm)	**1,370**								**1,370**
IId.Ocean Desalination											
SDCWA or Poseidon (in-lieu)	Assume 28,000 AFY available to OWD	Up to 25 MGD (to OWD)			**11,200**						
Binational Partnership: Rosarito Joint Facility in lieu CR	Assume 28,000 AFY available to OWD	Up to 25 MGD (to OWD)				**5,600**				**5,600**	
Southern California Partnership: Sweetwater/City of SD's South Bay project	Assume 28,000 AFY available to OWD	Up to 25 MGD (to OWD)	**5,600**	**11,200**		**22,400**			**5,600**		**5,600**
IIe. Conservation											
Conservation			**5,390**		**5,390**	**5,390**			**5,390**	**5,390**	
IIf. Transfers											
North of Delta Banking	Up to 5,000 AFY	Up to 4.5 MGD							**5,000**		
Central Valley Groundwater	Up to 15,000 AFY	Up to 13.4 MGD			**7,500**		**15,000**		**5,000**	**5,000**	
Land Fallowing	Up to 15,000 AFY	Up to 13.4 MGD			**7,500**		**15,000**		**5,000**		

Section 7
Systems Simulation Model

A systems model was created to simulate the performance of OWD's water resources portfolios for the next 25 years, until the planning year 2030. The systems model is built on the STELLA® programming environments. STELLA (Systems Thinking Experimental Learning Laboratory with Animation), developed by Isee Systems, Inc. is a systems modeling standard. This modeling platform was selected because of its flexible and relatively simple programming environment.

In STELLA, models are constructed by dragging and dropping pre-defined elements of a system and it can be used to represent one or several elements of a water resources system. A model in STELLA can be as complex or simple as the user wants and can represent several different types of systems interactively working together, such as a water flow model combined with a mass balance for water quality. In addition, the STELLA software provides graphical interfaces that create an engaging virtual environment, increasing the ability of the programmers to share their understanding of the system with technical staff, decision-makers, and stakeholders.

7.1 Conceptual Model

This model is designed to simulate a 25 year sequential time series from 2005 through 2030, with calculations performed on a monthly time step to analyze the seasonality elements of supply and demand for OWD's system. In addition, the model evaluates peak-day demands versus system capacity throughout the planning horizon. The model may be simulated with four different types of hydrologic sequences: critical dry, dry, normal, and wet.

For the purposes of modeling in this study, the OWD service area is considered to be divided into three systems: North, Central Area, and Otay Mesa, which are discussed in Section 2. These systems are geographically separated and operationally distinct (See Figure 2-1 for the geographic locations and Figure 2-2 for the system schematic). Each system has its own demands to serve, and its own existing and potential future supply options.

7.2 Model Elements

The model elements include: projected water demands (refer to Section 3), baseline water supplies (refer to Section 2), potential water supply options (refer to Section 5), and all portfolio performance measures, such as cost and water quality (refer to Section 4).

7.2.1 Demands

The projected annual average potable and recycled water demands described in Section 3 (see Figure 3-1) were modeled for each of the three systems (North, Central

Area, and Otay Mesa). Annual and seasonal fluctuations were applied, as well as a peak day demand factor, to annual average potable and recycled demands.

Annual hydrologic demand factors were generated for each year on record, which are illustrated in Figure 3-2. In order to test the system with various demand fluctuations, four types of hydrologic sequences and their corresponding demand factors were extracted from the period of record: critical dry, dry, normal, and wet:

- Dry: 1967 - 1996
- Critical Dry: 1986-1998, 1922-1938 (wrapped sequence)
- Normal: 1951 - 1980
- Wet: 1956 – 1985

The annual demand factors apply to both potable and recycled water demands, as well as the additional conservation option (if it is included in the portfolio).

Seasonal demand factors used in the model are shown in Figure 3-2 and 3-4, and the peak day demands are shown in Table 3-3.

7.2.2 Water Supply

One of the key attributes of the model is that it incorporates many water resources components (water treatment plants, groundwater wells, wastewater treatment plant effluent, etc.) into one model. All of the components, and their inter-relationships, are programmed with the use of three main types of variables in systems dynamics software:

- Stocks: used to represent elements that can accumulate over time (such as groundwater basins with conjunctive use projects)
- Flows: used to represent elements that feed or drain stock, and elements that can be represented as rates (such as groundwater well extractions from the aquifer, or treated water deliveries from the SDCWA Pipeline No. 4)
- Converters: used to establish more detailed mathematical relationships between stock and flows, and used for constants or independent variables

In STELLA, stocks are represented as rectangles, flows are represented as arrows with a circular valve, and converters are simply a circle. Figure 7-1 is a screenshot of a simple stock/flow system that conceptually represents the Middle Sweetwater groundwater basin with recharge and pumping.

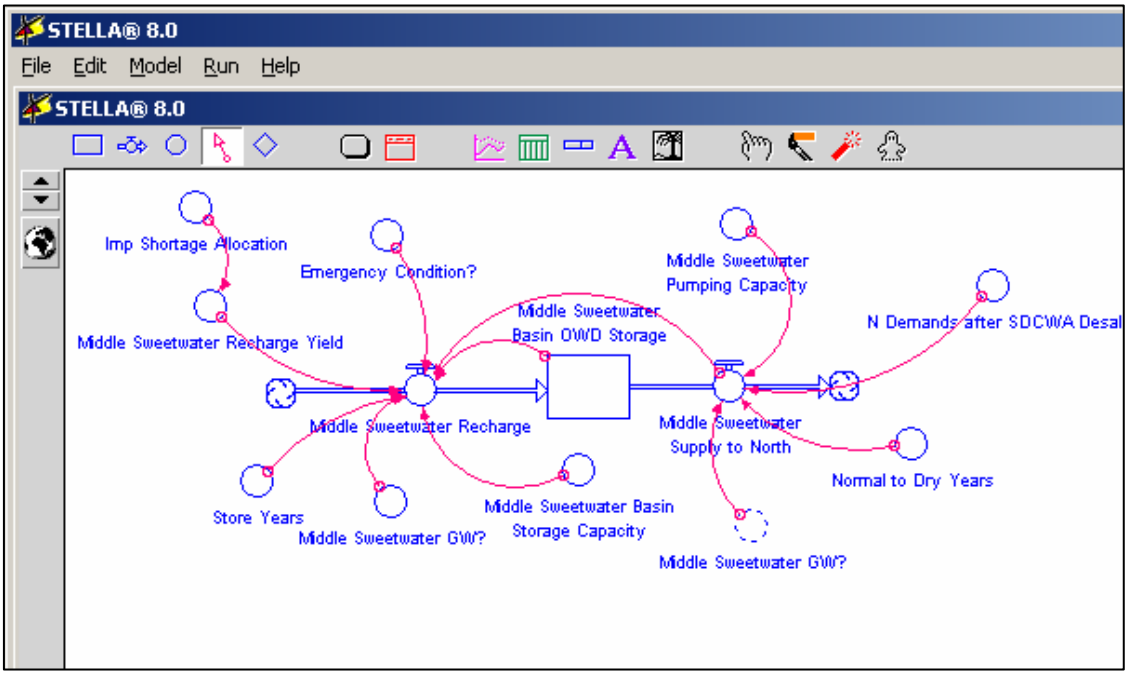


Figure 7-1
Model Representation of a Groundwater Basin

The red arrows in the figure (called "connectors" in STELLA) indicate the relationship between variables. For example, the variable "Middle Sweetwater Pumping Capacity" is a function of "Middle Sweetwater Supply to North" as indicated by the red connector.

Baseline System

The baseline water supply system, as it is expected to exist in 2010, was programmed into the model. The baseline system in the model is illustrated schematically in Figure 2-2, and is represented by the following supply options in table 7-1. The potential yield modeled for each of these existing supply options is also listed in Table 7-1.

Table 7-1
Potential Baseline Supply Yield in System Model

Baseline Supply Option	Potential Yield
Imported	
Treated water from SDCWA through Pipeline # 4	121.5 MGD [Capacity]
City of San Diego's Otay WTP	10 MGD in winter months, 8 MGD in summer months
Helix's Levy WTP	12 MGD
Recycled	
OWD's RWCWRF	1.1 MGD
City of San Diego's South Bay WRP	6 MGD

The "potential yield" is representative of the constraining factor among the facility capacity, contractual agreements, or typical availability based on operational patterns. It should be mentioned that the potential yield does not necessarily represent the calculated actual supply from each option in the model, since supply from each option in a water supply portfolio is a function of demand. The priority order in which supply options are used to meet demands is discussed below.

To evaluate calculations on a monthly time step, the daily potential yield in MGD was converted to a monthly yield in acre-feet per month (AFM). For the baseline supply options, the yield was assumed to be available at a constant rate. Therefore, they are all represented by "flow" variables in the system model.

New Supply Options
New water supply options discussed in Section 5 were also programmed into the model. A list of all of the new supply options, along with their potential yield, is provided in Appendix B. Again, to evaluate calculations on a monthly time step, the daily potential yield in MGD was converted to a monthly yield in acre-feet per month (AFM).

The system served (North, Central Area, or Otay Mesa) by each option can be seen in the schematics included in Appendix B. Options that propose the use of SDCWA Pipeline No. 4 for treated water conveyance can potentially serve all three systems.

All options, except for Middle Sweetwater Conjunctive Use and Santee/El Monte Conjunctive Use, are represented by "flow" variables in the system model. In order to track groundwater recharge and recovery over time, the groundwater conjunctive use projects were modeled with "stock" variables.

The conjunctive use projects follow an annual schedule indicating which years to "recharge" and "recover" water, depending on the hydrology condition of that year. In general, water is recharged in wetter years, and recovered in drier years.

Similarly, two of the water transfers and water banking options follow an annual schedule for use. The Central Valley and Land Fallowing transfer options are used only in dry years of the hydrology sequences. However, this schedule of use is overruled by the drought imported shortage condition, discussed later in Section 7.1.3. In this case, transfer options may be used in *any* year there is a deficit under drought imported shortage conditions.

The North of Delta transfer option does not follow the annual use schedule, and should be used only to meet remaining deficits during an imported water shortage condition.

Prioritization of Supply Use
Each system (North, Central Area, and Otay Mesa) was modeled with its own demands. Accordingly, as shown schematically in Figure 2-2 and Appendix B, each

system also was model with its own supply options. Priorities were set to establish an order in which supply options (existing and new) are used to satisfy each system's demand. This is necessary for the model to cease using additional supply once it has satisfied demand, and compute the portfolio's supply mix and output for performance measures. Tables 7-2 and 7-3 show the prioritization of supply options used to meet recycled and potable demands that was programmed in the model for each system.

The priorities for the use of the water supply options are generally based on the typical operating cost per unit volume, as well as the type of supply option considering OWD's interest in reducing dependence on imported water supply.

Table 7-2
System Model Prioritization for Use of Non-Potable Supply Options *

	North System	**Central Area System**	**Otay Mesa System**
1	North District Recycled Water Concept	RWCWRF	RWCWRF
2	N/A	Spring Valley Stripping Plant	Spring Valley Stripping Plant
3	N/A	Chula Vista Stripping Plant	Chula Vista Stripping Plant
4	N/A	South Bay WRP	South Bay WRP
5	N/A	Otay Mountain Well	Imported Raw Water from Pipeline No. 3 for Irrigation
6	N/A	Potable Supply Option	Potable Supply Option

*Options described in Section 5 that were eliminated from further evaluation were not programmed in system model.
N/A No option available.

Table 7-3
System Model Prioritization for Use of Potable Supply Options*

	North System	**Central Area System**	**Otay Mesa System**
1	Conservation	Conservation	Conservation
2	Helix's Levy WTP	City of San Diego's Otay WTP	City of San Diego's Otay WTP
3	SD17 Agreement with City of San Diego (Alvarado WTP)	SD17 Agreement with City of San Diego (Alvarado WTP)	SD17 Agreement with City of San Diego (Alvarado WTP)
4	Central Valley and Land Fallowing Transfers (via Pipeline No. 4)	Central Valley and Land Fallowing Transfers (first via City of San Diego's Otay WTP, then via Pipeline No. 4)	Central Valley and Land Fallowing Transfers (first via City of San Diego's Otay WTP, then via Pipeline No. 4)
5	Sweetwater Authority's Perdue WTP	Poseidon Ocean Desalination (via Pipeline No. 4)	Poseidon Ocean Desalination (via Pipeline No. 4)
6	Poseidon Ocean Desalination (via Pipeline No. 4)	Southern California Ocean Desalination Partnership: Sweetwater Authority/City of San Diego South Bay Project	Bi-national Partnership: Rosarito Ocean Desal in-lieu Colorado River (first via Otay WTP, then via Pipeline No. 4)
7	Middle Sweetwater Groundwater Conjunctive Use	Bi-national Partnership: Rosarito Ocean Desal in-lieu Colorado River (first via Otay WTP, then via Pipeline No. 4)	Imported Treated water purchases from SDCWA
8	Santee/El Monte Groundwater Conjunctive Use and/or Brackish GW Demineralization	San Diego Formation Brackish GW Demineralization	North of Delta Transfers (first via City of San Diego's Otay WTP, then via Pipeline No. 4)

Table 7-3 (cont.) System Model Prioritization for Use of Potable Supply Options*			
	North System	**Central Area System**	**Otay Mesa System**
9	Bi-national Partnership: Rosarito Ocean Desal in-lieu Colorado River (via Pipeline No. 4)	Rancho Del Ray Well*	N/A
10	Imported Treated water purchases from SDCWA	Lower Sweetwater Brackish GW Demineralization	N/A
11	North of Delta Transfers (via Pipeline No. 4)	Imported Treated water purchases from SDCWA	N/A
12	N/A	North of Delta Transfers (first via City of San Diego's Otay WTP, then via Pipeline No. 4)	N/A
*Options described in Section 5 that were eliminated from further evaluation were not programmed in system model. N/A No option available.			

Emergency Interconnects between Systems
The baseline system includes bi-directional interconnects to convey water between the systems (refer to Figure 2-2). However, these interconnect pipelines are intended for emergency use only. For purposes of the IRP, the use of the interconnect pipelines was only activated in the seismic emergency condition, which is discussed in Section 7.1.3. During a seismic emergency condition, any remaining "unused" supply from each system may be transferred to meet supply deficits in other systems.

7.2.3 Performance Measures

Performance measures are used to indicate whether an objective is being achieved. They generally answer the question "How well is a portfolio meeting the objectives?" and can be either quantitative or qualitative in nature. Refer to Table 4-1 for a list of the objectives and associated performance measures that were established for this IRP. The following discussion explains how the portfolio score was calculated for the performance measures, both qualitatively and quantitatively.

7.2.3.1 Qualitative Performance Measures

For the model to provide output for the qualitative performance measures, a scoring system was established to quantify the performance measure.

Qualitative scores were used for the following performance measures: Compatibility, Disinfection By-Product (DBP) potential, Environmental Permitting, Institutional Coordination, Customer Acceptance, Environmental Compliance, and Technological Uncertainty. The qualitative performance measure has a rating scale of 1-5 (1 being the worst and 5 being the best). The portfolio score for the qualitative performance measures is calculated as the weighted average of the ratings (or scores) for the options.

The weighted average is based upon the annual potential yield of the options included in the portfolio. See Appendix B of the individual options ratings.

$$PortfolioScore = \frac{(Score)_{Option(1)} * (Flow)_{Option(1)} + ... + (Score)_{Option(N)} * (Flow)_{Option(N)}}{\sum_{i=1}^{N} (Flow)_{Option(i)}}$$

7.2.3.2 Quantitative Performance Measures

The calculation methods of the portfolio scores for the quantitative performance measures differ from one another, and are discussed as follows:

Potable and Non-potable Total Dissolved Solids (TDS)

A TDS value in mg/L is calculated for the potable and non-potable supply in each portfolio, based on a mass balance. The TDS concentration assigned to a particular water supply option is multiplied by the option's simulated monthly supply, to calculate the monthly TDS load. The supply from each option is dependent on the projected water demands, and the priority of use to meet demands in relation to other supply options.

The total monthly TDS load was then divided by the portfolio's water supply (total potable or non-potable) to obtain the TDS concentration. The following formula was used to calculate the TDS of the potable and non-potable supply in the portfolio:

$$PortfolioTDS = \frac{(TDS)_{Option(1)} * (Flow)_{Option(1)} + ... + (TDS)_{Option(N)} * (Flow)_{Option(N)}}{\sum_{i=1}^{N} (Flow)_{Option(i)}}$$

The non-potable and potable TDS values represent the average TDS values over time, and the average of the simulated hydrology conditions (critical dry, dry, normal, wet) since the use of some supply options are hydrology-dependent, as mentioned in Section 7.1.2.

2030 Annual Deficit under Average Conditions

The monthly deficit, or water supply shortage relative to demands, was calculated to measure reliability of each portfolio. The monthly deficits that occur in 2030 are added together to calculate the annual deficit (in acre-feet), and the average annual deficit is calculated among the four hydrology conditions.

It should be mentioned that all portfolios are capable of meeting demands under average conditions through the 2030 planning year, with imported water purchases from SDCWA. Therefore, this performance measure was essentially a "non-discriminator" in terms of decision-making. To put more emphasis on performance

measures that differentiate the portfolios, the average condition performance measure was not given any weight under the reliability objective in the decision model. Instead, all of the weight for the reliability objective was placed on the performance of the portfolio measured by imported water shortage conditions and seismic emergency conditions.

Cumulative Deficit under Imported Water Shortage Conditions
The system reliability of the portfolio was evaluated under imported water shortage conditions with critically dry hydrology. The portfolio's monthly deficit (in acre-feet) was calculated over time, and summed at the end of the simulation.

Though the 2030 planning year, the imported water shortages during critically dry hydrology years are assumed to be up to 30% of imported water purchases (treated or raw) from SDCWA. This reduction applies to any existing or new supply option that relies on imported water from SDCWA as a source. The assumed projected imported water reductions vary year-to-year depending on the forecast year and the historical hydrology year modeled in the critically dry time series. For purposes of the model, the largest imported water shortage (30% reduction) was assumed to occur in the 2030 planning year. The imported water shortage condition assumes that shortages will be distributed proportionally to demands of all member agencies, and do not account for preferential rights.

2030 Deficit during a Three-Month Emergency Period
Reliability of the system during a three-month emergency period was measured by the cumulative monthly supply deficit (in acre-feet), assuming 2030 planning year demands under normal hydrology conditions. The assumed seismic condition is defined as an interruption of raw and treated imported water supply caused by SDCWA Pipelines No. 3 (raw) and No. 4 (treated) being completely out of service. Therefore, there is no supply from existing or new supply options that rely on these SDCWA facilities for transportation. In addition, there is no supply from recycled water options in this scenario. The measured supply deficit does not assume any mitigation by SDCWA that would be provided from the Emergency Storage Project.

Net Present Value $/AF
To evaluate the affordability of each portfolio, the net present value (NPV) unit cost in $/AF was calculated. The NPV unit cost is representative of the incremental cost of water over the entire planning horizon, and includes both capital and operation and maintenance (O&M) costs.

For purposes of portfolio comparison, implementation of the supply options was assumed to occur at the same time, and at the start of the planning period. Therefore, the NPV capital costs for the options are equivalent to today's dollars.

An annual inflation rate of 3% was assumed for the O&M costs of all options, except imported SDCWA water purchases and transfers/banking purchases. The projected purchase rates for imported SDCWA water and transfer/banking options are

anticipated to increase at a different rate, as discussed in Section 5. The total annual O&M costs were discounted back to today's dollars at an annual rate of 6% to calculate the NPV annual O&M costs, and the cumulative NPV O&M costs accrued over the entire planning horizon.

Similarly, a discount rate of 6% was used to calculate the NPV of the total annual yield, and the cumulative NPV total yield over the planning horizon.

To calculate the $/AF unit cost, the sum of the NPV capital and cumulative NPV O&M costs were divided by the NPV cumulative yield over the planning horizon.

Capital Costs
This performance measure for affordability was calculated by adding the capital cost (in today's dollars) of all new supply options included in the portfolio.

Total Number of Take Points
System flexibility of the portfolio was measured by the number of take points, or major conveyance routes, to receive water. In some cases, several sources of water may be conveyed by one pipeline for delivery. For example, all supply options that rely on SDCWA Pipeline No. 4 for treated water conveyance have one take point.

Total Number of Contracts
System diversity of the portfolio was measured by the number of contractual agreements for water. For options that involved the expanded use of an existing supplies (i.e. Additional purchases from the City of San Diego's South Bay WRP), the expanded use contract was not counted as a separate agreement. In other words, only one contractual agreement was counted for both the existing contractual supply and the new (expanded use) supply option.

2030 Percent Contribution of Largest Source to Total Supply
Diversifying the supply sources can help OWD in the event that one of the supply sources is unavailable, such as imported water purchases from SDCWA. By increasing the number of sources for OWD, the reliance on one particular source is reduced. This performance measure is calculated as the percentage of the largest potential annual yield from a source to the total annual supply, assuming critically dry hydrology conditions in the 2030 planning year. For this performance measure, all imported water purchases from SDCWA (raw or treated) are considered one source, regardless of where the water is treated.

7.3 Simulation Process

The input process for the systems model is facilitated by the use of a graphical interface based on switches that turn options ON and OFF. Figure 7-2 shows a portion of the graphical management panel developed for the systems model.

The management decisions required selection of:

- Hydrologic condition (critical dry, dry, normal, wet)
- Imported water shortage condition (switch ON or OFF)
- Emergency condition (switch ON or OFF)
- Water supply options and associated yields to be included in the portfolio (groundwater, ocean desalination, additional imported water with local treatment agreements, water transfers/banking, additional recycled water, and conservation).

To run the model, the user selects the desired options for simulating the portfolio by clicking the appropriate buttons (the green square in the middle of the switch indicates that the option is ON. Each portfolio has a unique set of inputs to the model, represented by different combinations water supply options, that is entered into the model with use of the management panel.

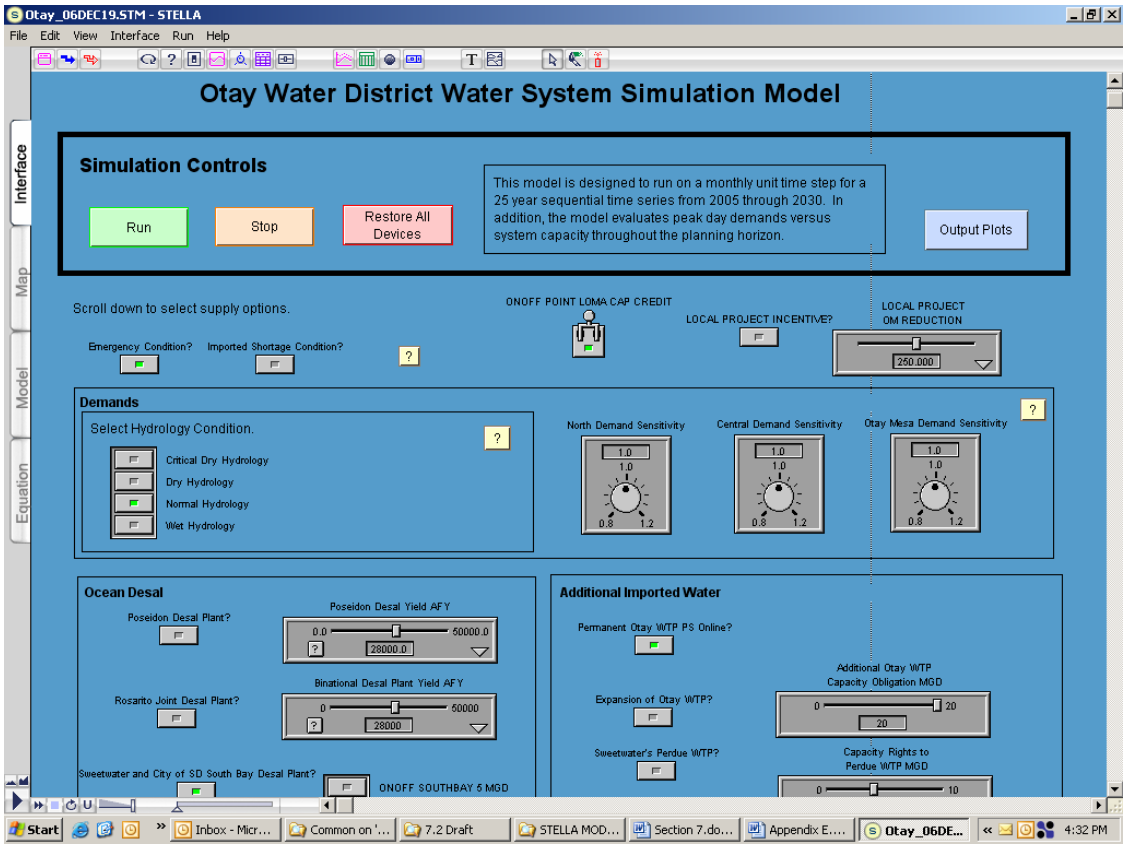


Figure 7-2
Portion of the System Model Management Panel

Each portfolio is simulated under the following conditions, in order to generate results for every performance measure evaluated:

- Critical Dry Hydrology with Imported SDCWA Water Shortage Conditions
- Dry Hydrology Condition
- Normal Hydrology Condition
- Wet Hydrology Condition
- Normal Hydrology Condition with a Three month Seismic Emergency Condition in 2030

The model output is translated into an Excel spreadsheet that can be updated at the end of each simulation, processed further, and linked dynamically to the scorecard summary file. The scorecard summary file is then input to the decision model to rank the portfolios based the stakeholders' objective weightings.

Section 8 presents a comparison of the raw performance of the portfolios based on the systems model results, and then discusses the rankings of the portfolios.

Section 8
Portfolio Evaluation and Screening

8.1 Evaluation Process Overview

Water supply portfolios were evaluated and ranked using the approach described in Section 4. A systems model was developed for OWD and was the primary tool for determining the raw performance of each portfolio in terms of supply reliability, cost, water quality, diversity, flexibility, and other objectives.

This information from the systems model was then standardized using a multi-attribute rating tool in order to determine a portfolio's overall score. Finally, portfolios were compared and ranked. Figure 8-1 illustrates the portfolio evaluation process. Initial portfolios were evaluated first, and based on their performance; final portfolios were developed and evaluated.

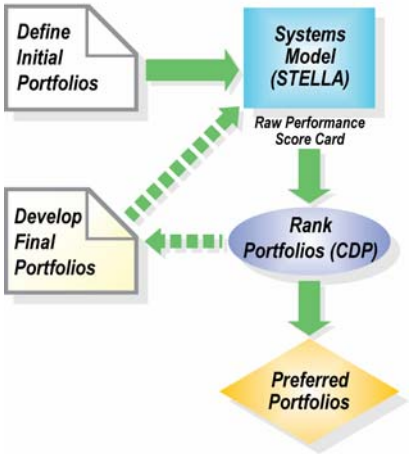


Figure 8-1
Portfolios Evaluation Process

8.2 Portfolio Evaluation Results

This section describes the raw performance of the portfolios, regardless of the stakeholder's importance or weight placed on the planning objectives. Later, Section 8.3 describes how the raw portfolio performance is used in conjunction with the objective weights to rank the portfolios. Appendix D presents the summary of the raw performance of each portfolio.

It is important to recognize that the portfolio results are not predictive, but are rather a measure of their *relative* performance under various conditions.

8.2.1 Water Quality Evaluation

For this IRP, the water quality objective was considered in four ways: (1) meeting current and future water regulations, (2) salinity management, (3) compatibility with other sources for blending prior to distribution, and (4) potential for disinfection by-products.

Current and Future Water Regulations

For the first performance measure, it is assumed that all supply options will be designed to comply with all current and future water regulations. In this case, all portfolios will receive the same score.

Salinity Management

In the systems model, each water supply option has an average salinity, measured in total dissolved solids (TDS), which can be tracked. Refer to Appendix B for the assumed TDS levels of each option. Using mass-balance calculations, the overall salinity of the potable and non-potable water supply can be estimated for any portfolio.

Figure 8-2 shows the average salinity for potable and non-potable supply, measured in total dissolved solids. Again, these values are not predictive. They are simply used to accurately compare the performance of the portfolios against each other.

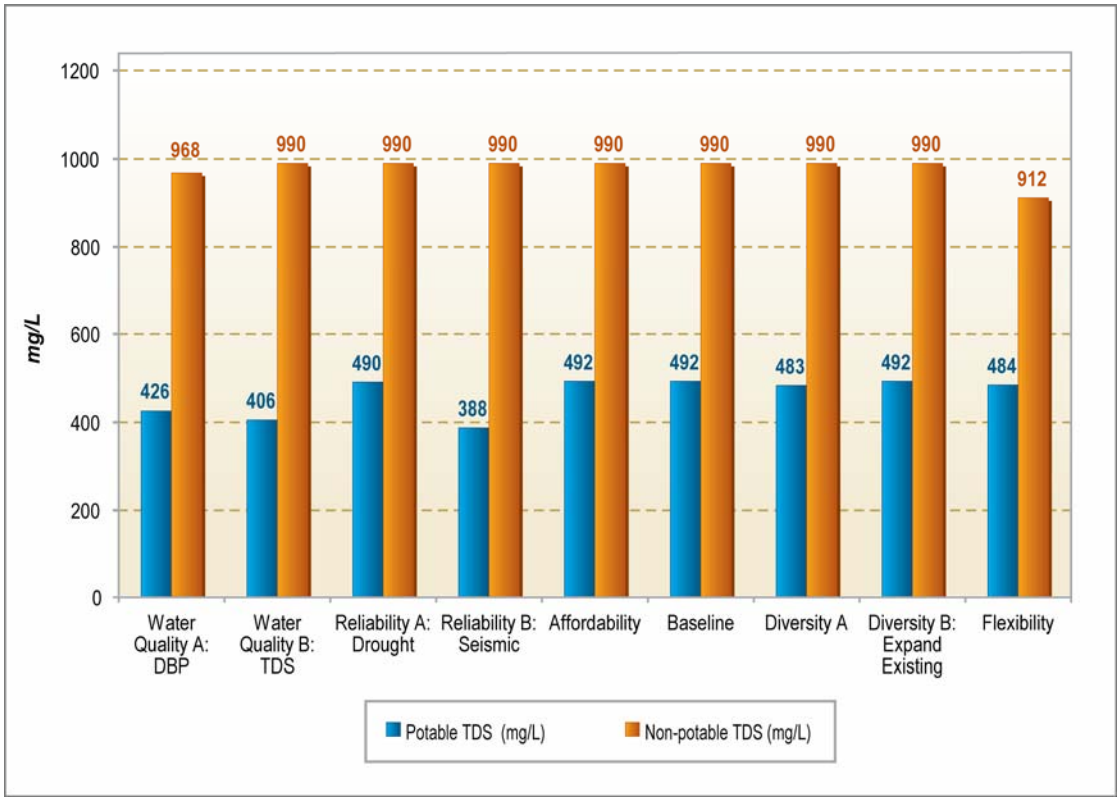


Figure 8-2
Portfolio Salinity (Total Dissolved Solids)

It is apparent in Figure 8-2 that the salinity is relatively the same for all portfolios. The Flexibility portfolio has a slightly lower non-potable TDS level because it includes the Raw Water from Pipeline No. 3 for Irrigation option, which comes from imported water purchases through SDCWA. The TDS levels of raw imported water (approximately 500 mg/L) are much lower than wastewater treatment plant effluent, which typically has a TDS of approximately 900-1000 mg/L in Southern California.

The Water Quality B and Reliability B portfolios have slightly lower potable TDS levels because they include a significant supply from the local ocean desalination

partnership with Sweetwater Authority and/or the City of San Diego (South Bay Project).

Compatibility with Other Sources and Potential for Disinfection By-products
The performance of portfolios for salinity management was measured quantitatively—meaning that performance could be measured on a continuous scale. However, not all performance can be measured quantitatively. Some of the IRP objectives had to be measured using a constructed scale or more qualitative measurement. This is not to say that these performance measures are less important, but merely that at the time of the IRP analysis, they could not be precisely measured on a continuous scale.

Qualitative scales are described in Section 7, and the qualitative scores for each supply option are summarized in Appendix B. The qualitative scores for each option were used to calculate an overall portfolio score based on the weighted average of the annual potential yield of the options included in the portfolio.

Figure 8-3 illustrates the qualitative scores for water quality related to (1) compatibility with OWD's existing water supply system, and (2) the potential for disinfection by-products based on the supply mix in the portfolio. The results show that all portfolios score well in terms of supply compatibility. The Reliability B portfolio scored slightly lower because it has a large supply from the local ocean desalination partnership with Sweetwater Authority and/or the City of San Diego (South Bay Project), as well as brackish groundwater demineralization options in the Lower Sweetwater, Santee El/Monte, and San Diego Formation Basins. These projects scored lower in terms of compatibility because they introduce new source water (desalinated seawater and groundwater) into the distribution system, which currently only contains imported water from SDCWA. The compatibility of desalinated seawater and groundwater with imported water is unknown and further investigation may be required prior to implementation.

In terms of potential disinfection by-products, all of the portfolios scored on the higher end of the scale. The portfolios that scored better for the DBP performance measure include more supply from groundwater projects, and/or the local ocean desalination partnership with Sweetwater Authority and/or the City of San Diego (South Bay Project). In other words, the portfolios that scores well rely less on supply from surface water treatment.

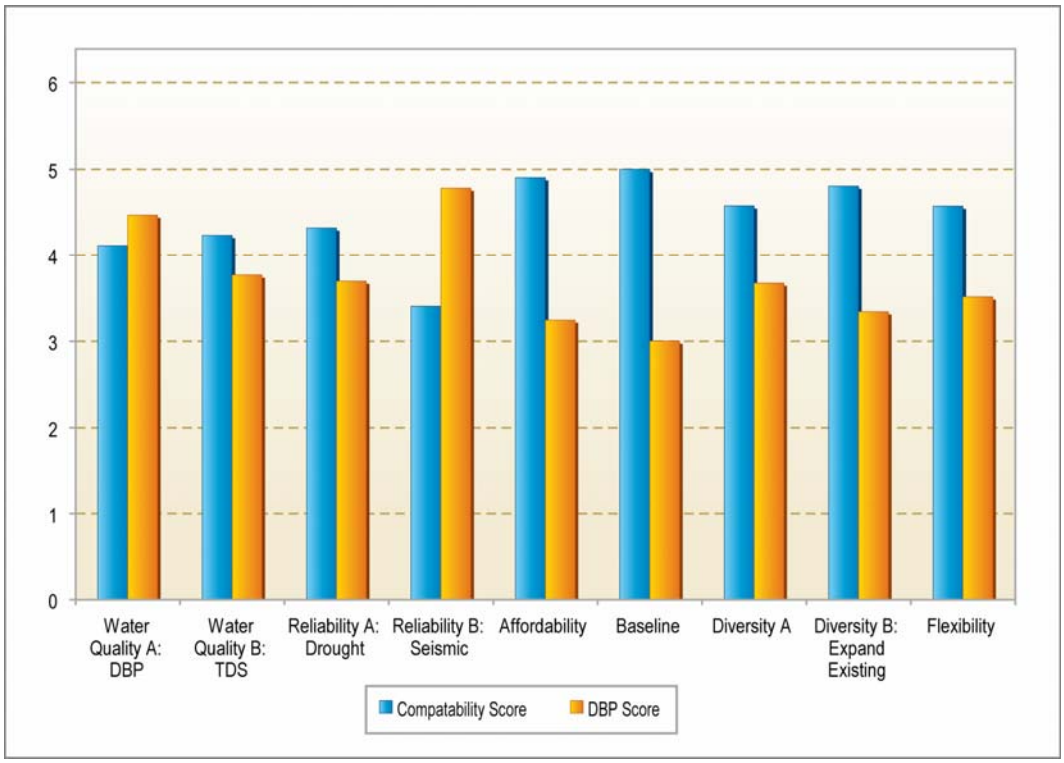


Figure 8-3
Portfolio Compatibility and DBP Scores

Disinfection by-products, such as tri-halomethane (THM) and haloacetic acid (HAA), are created when water that is high in bromate or total organic content (TOC) receives treatment from a plant that uses chlorine as a primary disinfection method. Most surface water treatment plant in the Southern California region that supply water to OWD already have, or are planning to, upgrade to include ultraviolet (UV) or ozone disinfection methods to comply with safe drinking water standards. Therefore, none of the supply options had a DBP score less than 3, on a qualitative scale of 1 to 5 (with 5 being the best score).

8.2.2 Water Supply Reliability Evaluation

One of the main objectives of the IRP is to improve supply reliability. The ability of each portfolio to meet projected future demands was evaluated under various hydrology conditions. In addition, portfolios were evaluated under extreme drought conditions involving imported water shortages, as well as emergency seismic conditions in which the SDCWA Second San Diego Aqueduct (Pipelines No. 3 and No. 4) that conveys raw and treated water are offline.

Initial portfolio results shows that all portfolios could reliably meet demands on the peak day, and also under "average" conditions (meaning normal hydrology, non-emergency conditions). OWD currently has enough system capacity to meet projected

2030 demands through imported water purchases from SDCWA. In this case, the peak day reliability performance measure is considered a "non-discriminator" in terms of decision-making, since all portfolios could meet the peak day demand. Therefore, the peak day performance was not used for final evaluation.

Similarly, all portfolios were capable of meeting demands under normal hydrology, non-emergency conditions through imported water purchases from SDCWA. Therefore, the performance measure to reliably meet demands under "average" conditions was not used to rank the portfolios, since all of the portfolios would have the same score.

For final evaluation, all of the importance to score portfolios on their reliability was instead placed on meeting demands under (1) extreme drought conditions (with imported water shortages) and (2) seismic emergency conditions.

Deficits under Extreme Drought Conditions with Imported Water Shortages
Water demands are typically higher under critically dry conditions than normal hydrology conditions, since natural rainfall is not available for irrigation. The evaluated extreme drought condition accounts for these annual increases in demands based on historical correlations between demands and hydrology for the San Diego area, which are discussed in Section 3.

In addition to higher demands, it was assumed that under extreme drought conditions annual imported water supply from SDCWA would be reduced by up to 30% of the baseline, or "no project," throughout the planning horizon. The estimated reductions vary over time depending on the planning year and the corresponding historical hydrology year in the time series. The reductions apply to all purchases of raw or treated imported water from the SDCWA, even if it is treated locally.

It should be noted that this evaluation does not predict future imported water shortages, but rather is for purposes of relative comparison of portfolio performance in a given shortage scenario. The assumption is that the percentage of shortage would be distributed equally to all member agencies, and preferential rights would not be enforced. In addition, this analysis does not include any drought supply from sources such as the Emergency Storage Project.

Figure 8-4 shows the cumulative deficit over all shortage years in the critically dry hydrology sequence. Water supply drought reliability increases under each portfolio relative to the No Project Portfolio. All portfolios can be considered drought reliable except for the Water Quality A, Water Quality B, and the Baseline Portfolios. The smaller drought deficits can be considered negligible, since they could probably be met through system operational decisions to optimize the available supply, or through drought emergency sources such as the Emergency Storage Project.

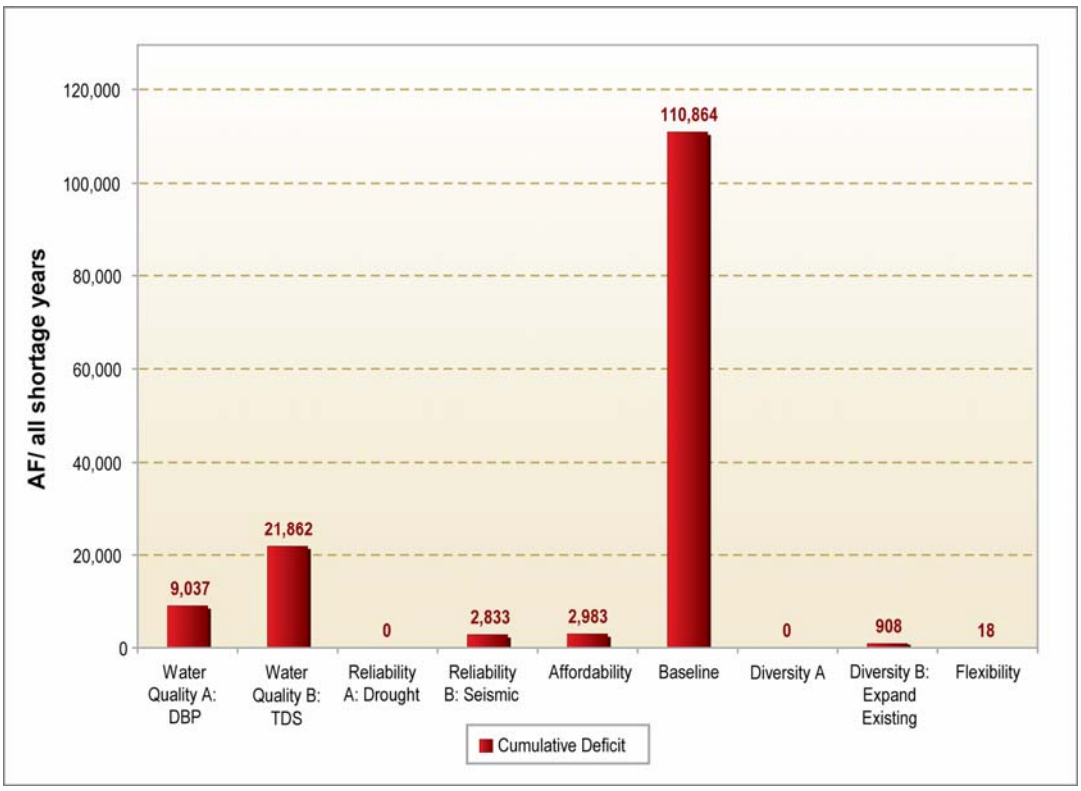


Figure 8-4
Cumulative Deficit under Extreme Drought Conditions (a measure of Portfolio Reliability)

The portfolios that performed well in this scenario have a large portion of supply from local sources, such as groundwater, seawater, recycled, and conservation savings. In addition, portfolios with water transfer and water banking options would benefit in this scenario.

Deficits under Emergency Seismic Conditions

The evaluated seismic emergency condition assumed that all supply options relying on conveyance through the SDCWA Second San Diego Aqueduct would be offline. This means there would be no supply from options that use raw water from Pipeline No. 3 or treated water from Pipeline No. 4, even if it is treated locally through agreements with neighboring agencies. In addition, all recycled water supply would be offline, since there would be a potable water supply emergency shortage.

The deficit under the seismic emergency condition was evaluated over a three month period, assuming 2030 projected demands under normal hydrology conditions. Figure 8-5 shows the deficit over the three month period for each portfolio. Although there is a large deficit in every portfolio, the size of the deficit is the smallest in the Reliability B Portfolio. This portfolio includes several groundwater projects and the local ocean desalination partnership with Sweetwater Authority and/or the City of

San Diego (South Bay Project), which do not propose the use of the SDCWA Second San Diego Aqueduct for conveyance.

The Baseline Portfolio fails completely to meet demand under the assumed seismic emergency condition, since most supply comes from imported raw and treated water purchase through SDCWA, and a small recycled water supply from OWD's Ralph W. Chapman WRP and the City of San Diego's South Bay WRP.

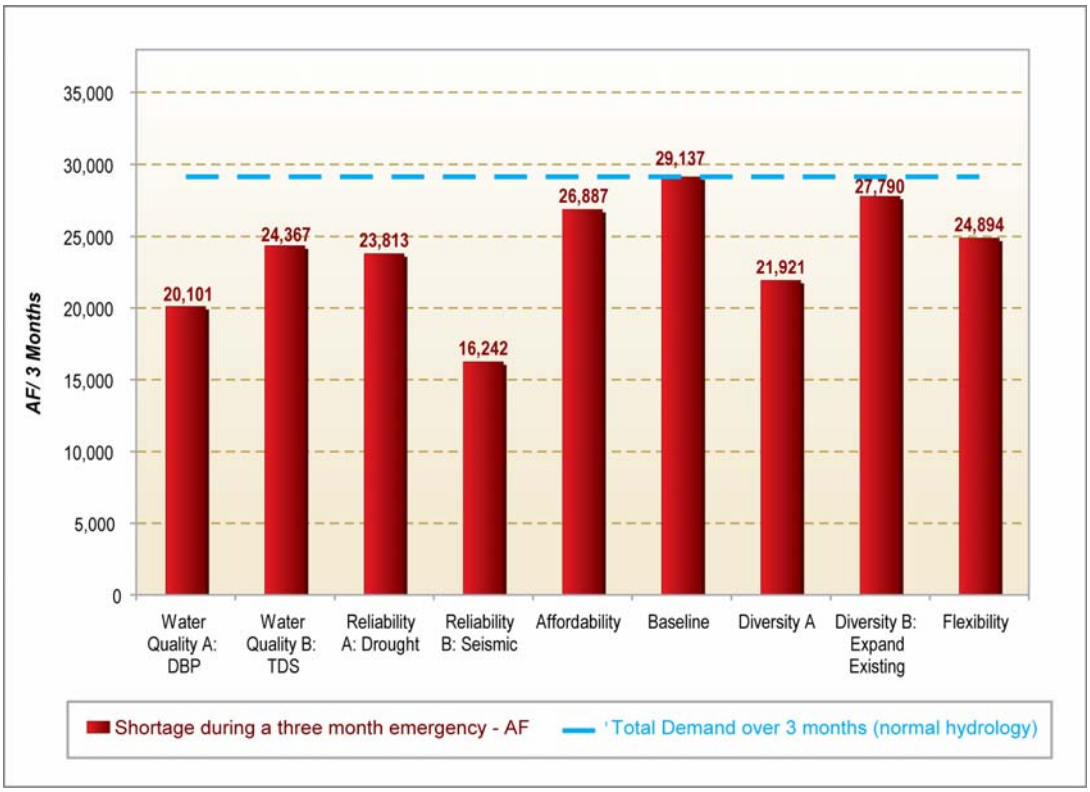


Figure 8-5
Portfolio Reliability under Emergency Seismic Conditions

The portfolios that performed well in the seismic scenario have a large portion of supply from local sources that do not use SDCWA conveyance facilities, such as groundwater and conservation savings. The only seawater project that provides benefit in this scenario is the partnership with Sweetwater Authority and the City of San Diego to build a local desalination plant, since the other seawater options rely on in-lieu water conveyed through SDCWA Pipeline No. 4.

8.2.3 Cost Evaluation

The performance of the portfolios in terms of affordability was measured with total capital costs, as well as the net present value (NPV) unit cost in dollars per acre-foot ($/AF). For portfolio comparison purposes, it was assumed that all projects would be implemented at the same time. Therefore, the capital costs are presented in today's

dollars (without inflation). Once the preferred portfolios have been selected, the timing of project implementation will be evaluated, to help minimize costs and develop the implementation plan described in Section 9.

For purposes of portfolio evaluation, any existing or planned capital costs associated with the baseline (2010) system were not included in the cost of the water supply portfolio. Therefore, only the capital costs incurred with new supply options are shown. The total capital costs for each portfolio are presented in Figure 8-6.

The portfolios with the highest capital costs are the Reliability B and Diversity A Portfolios, which perform very well in terms of reliability under extreme drought conditions and emergency seismic condition. These portfolios are very reliable, but at a high capital cost, because they include groundwater projects which require new conveyance infrastructure and demineralization plants, and they include the construction of a new ocean desalination plants. Although the Diversity A has a much smaller ocean desalination supply than Reliability B, it has more supply from non-potable options and additional imported options (through local treatment agreements), which have a high cumulative capital cost.

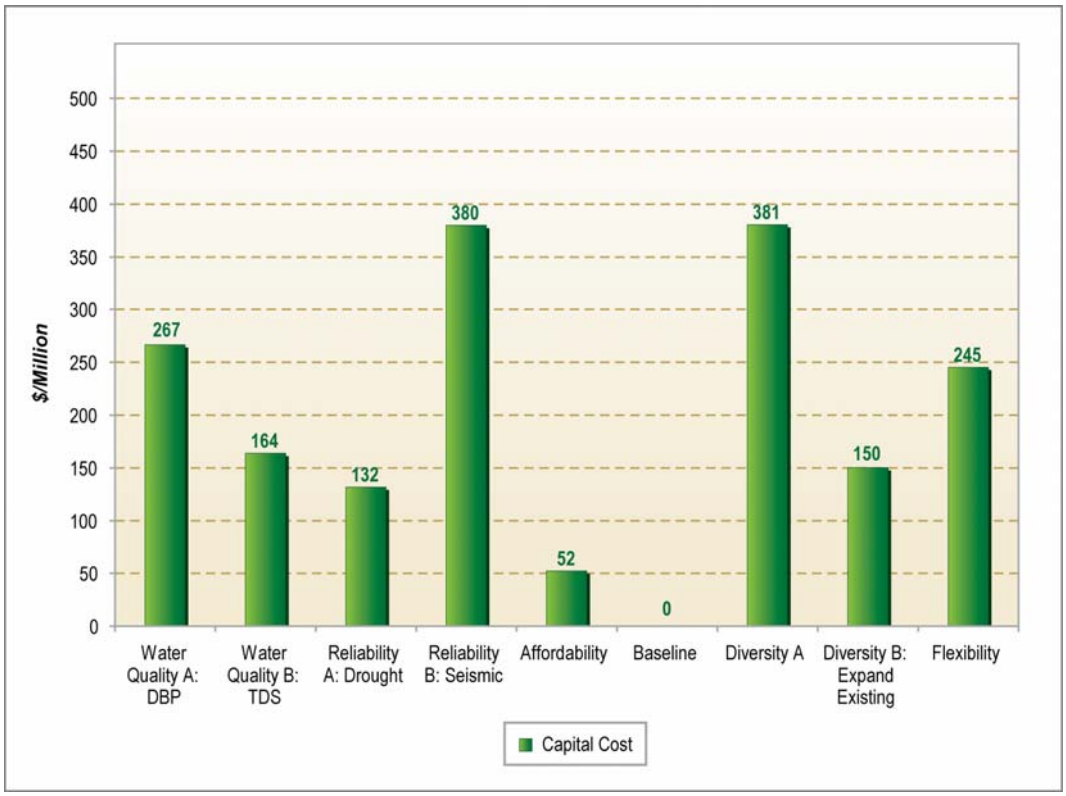


Figure 8-6
Portfolio Capital Costs

The net present value (NPV) unit cost is representative of the cost of new water over the entire planning horizon, and includes both capital and O&M costs. In order to calculate the NPV unit costs, the annual cost of new water is calculated, as well as the cumulative cost over time; then, the cumulative costs are discounted at a rate of 6%, and divided by the cumulative supply, which is also discounted at the same rate.

The annual capital cost is calculated with a debt financing plan over 30 years, assuming a 6% annual interest rate. The annual O&M costs are inflated annually at 3% over time. The annual costs also include imported water purchases from SDCWA and water transfer/banking purchases, which increase at a different assumed rate (see Section 5). A more detailed discussion of the NPV unit cost of portfolio is provided in Section 7.

The NPV unit cost of each portfolio is shown in Figure 8-7. The results show that the Baseline portfolio is the least expensive in terms of $/AF, but the Affordability portfolio is the least expensive reliable portfolio. The Affordability portfolio performs very well under extreme drought conditions (when there are imported water shortages from SDCWA), while maintaining a relatively low capital cost and NPV unit cost. This is because the Affordability portfolio includes a substantial supply from water transfers or water banking opportunities. The water transfers and water banking options do, however, rely on the SDCWA 2nd Aqueduct for conveyance; and therefore, do not perform well under seismic emergency conditions.

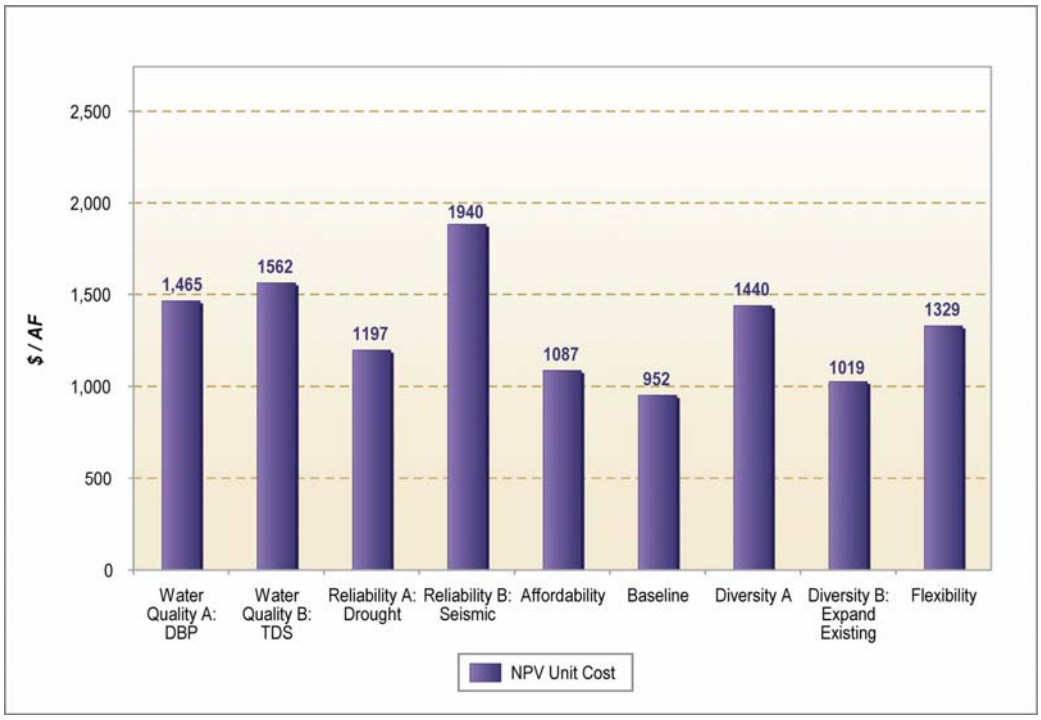


Figure 8-7
Portfolio NPV Unit Cost

The portfolio with the highest NPV unit cost is the Reliability B portfolio, which also has a very high capital cost. For portfolios with a very high capital cost, it is anticipated that the NPV unit cost could be significantly reduced with careful scheduling of project implementation. The annual capital cost for a new option does not contribute to the NPV unit cost until it is implemented, which may not be required until the long-term, especially if other options are implemented in the near-term.

It is interesting to see that the NPV unit cost for the Diversity A portfolio is significantly lower than the Reliability B portfolio, since these portfolios had approximately the same capital cost. This means that the annual O&M cost of the Reliability B portfolio is much higher that of the Diversity A portfolio, which can be attributed to the annual O&M cost for the local ocean desalination partnership with Sweetwater Authority and/or the City of San Diego (South Bay Project). This project is very expensive to operate since it involves seawater desalination with typically high power costs, pumping conveyance costs to the OWD's distribution system, and high-priced brine disposal costs.

8.2.4 Diversity and Flexibility Evaluation

System diversity and flexibility are important attributes of a water supply portfolio. These objective help to improve overall operational reliability by increasing the number of water sources, contractual rights for water use, and take points into the system. Diversity and flexibility reduce the system's dependence on one source or facility, respectively. If a source or facility is offline, overall water system could still potentially satisfy all demands with the use of other supply options in the portfolio.

The flexibility of the portfolio was measured by the number of take points into the system. The diversity was measured in two ways: (1) number of contracts for water use, and (2) percent contribution of largest source to total supply. The portfolio scores for these performance measures are shown in Figures 8-8 and 8-9.

In Figure 8-8, it is clear that all portfolios increase the number of take points and number of contracts over the Baseline Portfolio. The portfolio with the largest number of take points and contracts is the Diversity A portfolio. The supply options included in this portfolio are listed in Table 6-1 and Appendix D.

Figure 8-9 shows that all portfolios reduce the percent contribution of the largest source from the Baseline Portfolio. In this case, a lower percentage is viewed as a better score. The portfolios that scored well in this performance measure typically relied less on imported raw and treated water purchases from SDCWA, since imported water purchases are counted as a single source regardless of where the water is treated.

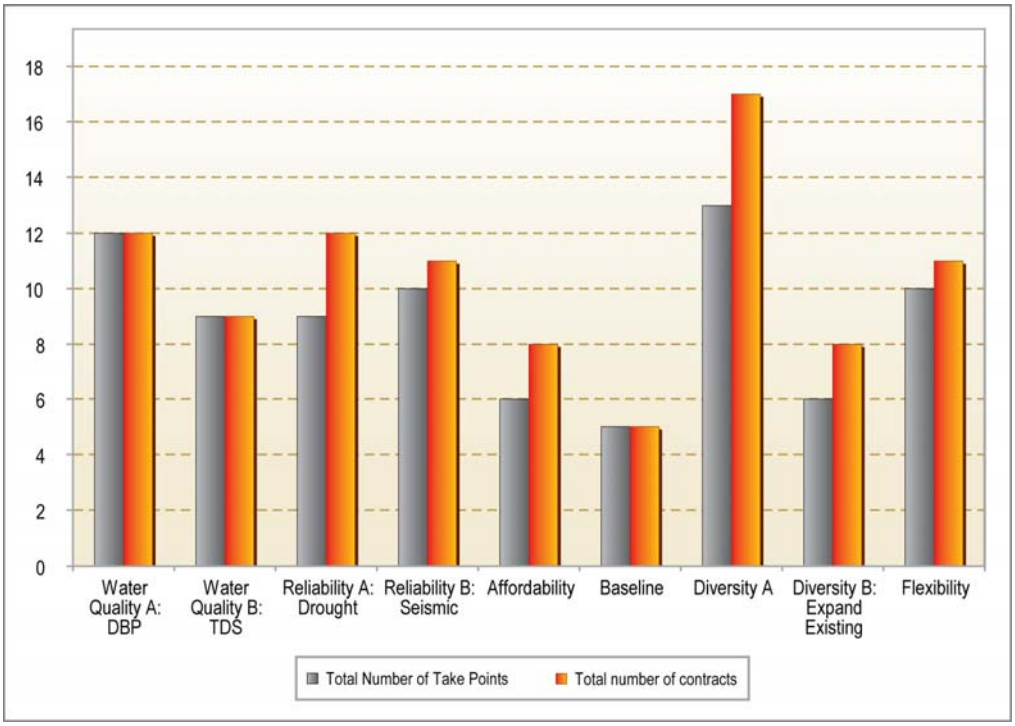


Figure 8-8
Number of Take Points and Contracts in Portfolio

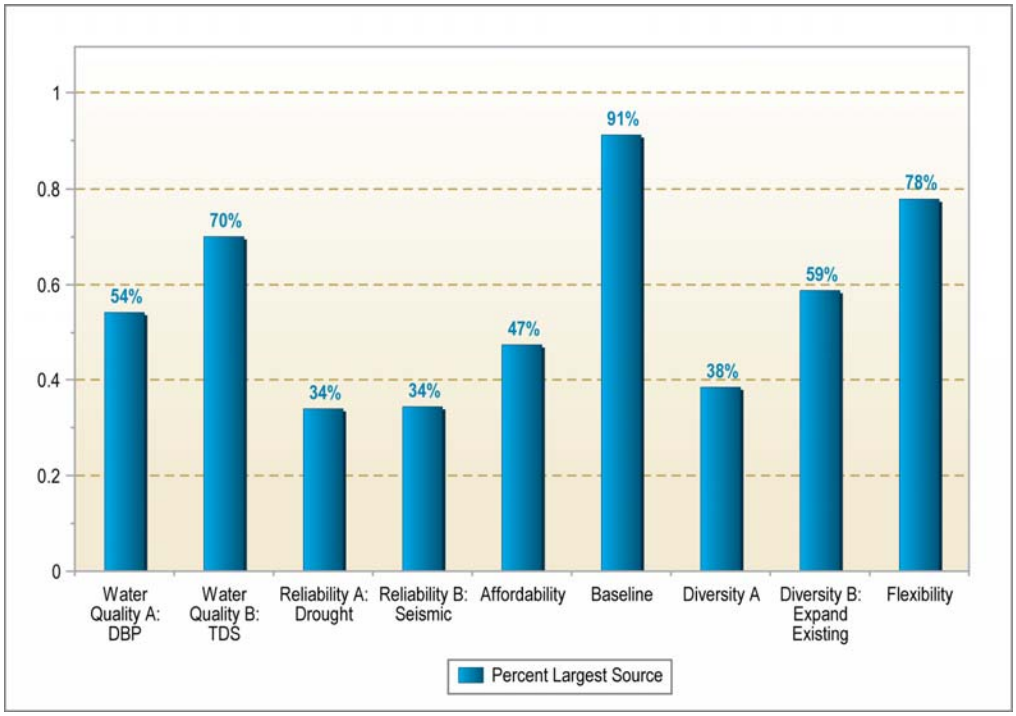


Figure 8-9
Percent Contribution of Largest Source to Total Supply in Portfolio

8.2.5 Environmental and Institutional Constraints Evaluation

For this objective, five performance measures were evaluated to compare the portfolios: (1) minimize environmental permitting requirements, (2) minimize institutional coordination, (3) maximize customer acceptance, (4) minimize regulatory constraints, and (5) minimize technological uncertainty. A qualitative scale was used for these performance measures, as discussed in Section 7, and a higher score indicates that the portfolio performed well. The scores for these performance measures are shown in Figure 8-10.

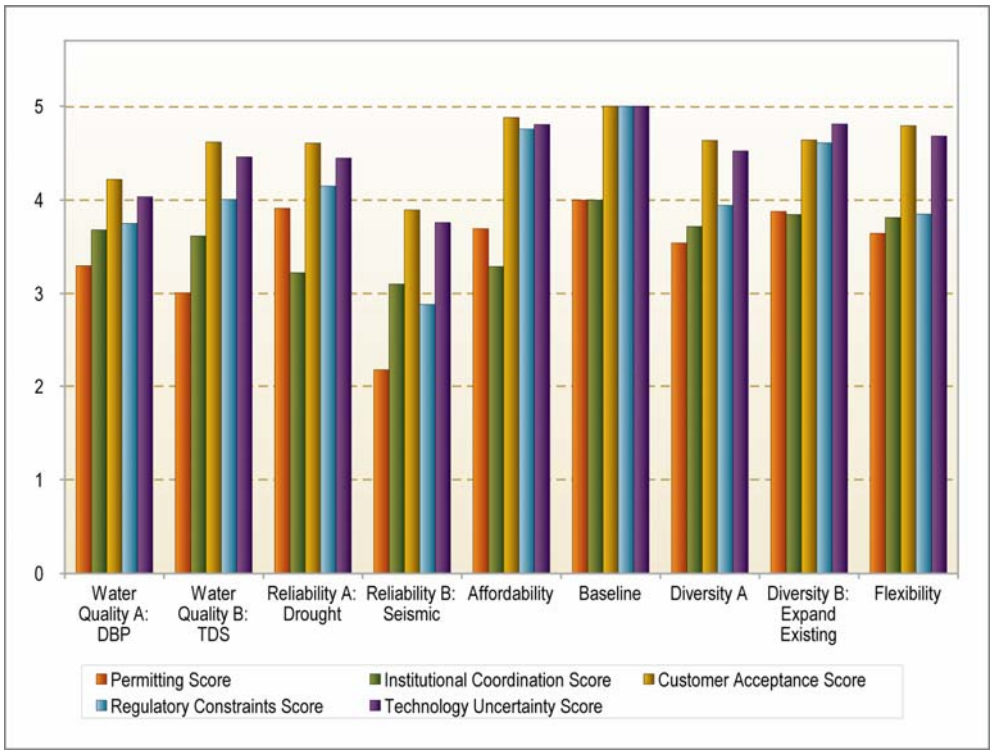


Figure 8-10
Portfolio Scores for Environmental and Institutional Constraints

In general, most of the portfolios score well for these performance measures. However, the Reliability B portfolio has the lowest score in every case and clearly scores poorly for environmental permitting obstacles. The qualitative scores are related to the potential annual yield of the options. Therefore, the large portion of supply from ocean desalination projects in the Reliability B portfolio is impacting the environmental permitting score. The local ocean desalination partnership with Sweetwater Authority and/or the City of San Diego (South Bay Project) has a very low score for environmental permitting, primarily because it requires approval from the California Coastal Commission the San Diego County Regional Water Quality Control Board, and the California DHS.

8.2.6 Portfolio Performance Summary

A summary of the raw performance scores for every portfolio is presented in Table 8-1, as shown at the end of this section. Section 8.3 discusses how these raw scores were used in conjunction with stakeholder's objective weightings (refer to Section 4) to rank the portfolios.

8.3 Portfolios Ranking

Using the portfolio raw performance scores in Table 8-1, the portfolios were ranked with the multi-attribute rating method described in Section 4. A ranking of the portfolios was developed for each stakeholder, based on the raw performance measures discussed in Section 8.2 and the relative weights that the stakeholder placed on each objective. This method allows individual results to be tracked in order to see where consensus was reached. This approach can be very powerful, as a majority of stakeholders can arrive at the same conclusion for very different reasons. If an overall average weight for each objective was used for all stakeholders and applied to the raw performance, one single ranking of portfolios would result. In this case it would be difficult to know for sure if the results actually represented any stakeholder's individual preferences.

Figure 8-11 shows the rankings of portfolios for the average weightings of the entire group of stakeholders, and illustrates how the ranking results are created for one set of weights. The figure not only indicates which portfolio had the greatest overall score, but also the make-up of that score. Each color segment represents the major objectives discussed in Section 4.

Two factors determine the size of each color segment for a given bar, or portfolio: (1) the raw performance of the portfolio for that objective; and (2) the weight of the objective assigned by the stakeholders. In general, if the color segment is larger, then the raw performance was better, and the objective was given a relatively high weight of importance. However, if the color segment is smaller, it could be because of poor performance, or a low weight of importance, or both.

The top three portfolios for the average of the stakeholders are:

- Diversity A
- Reliability A
- Water Quality A

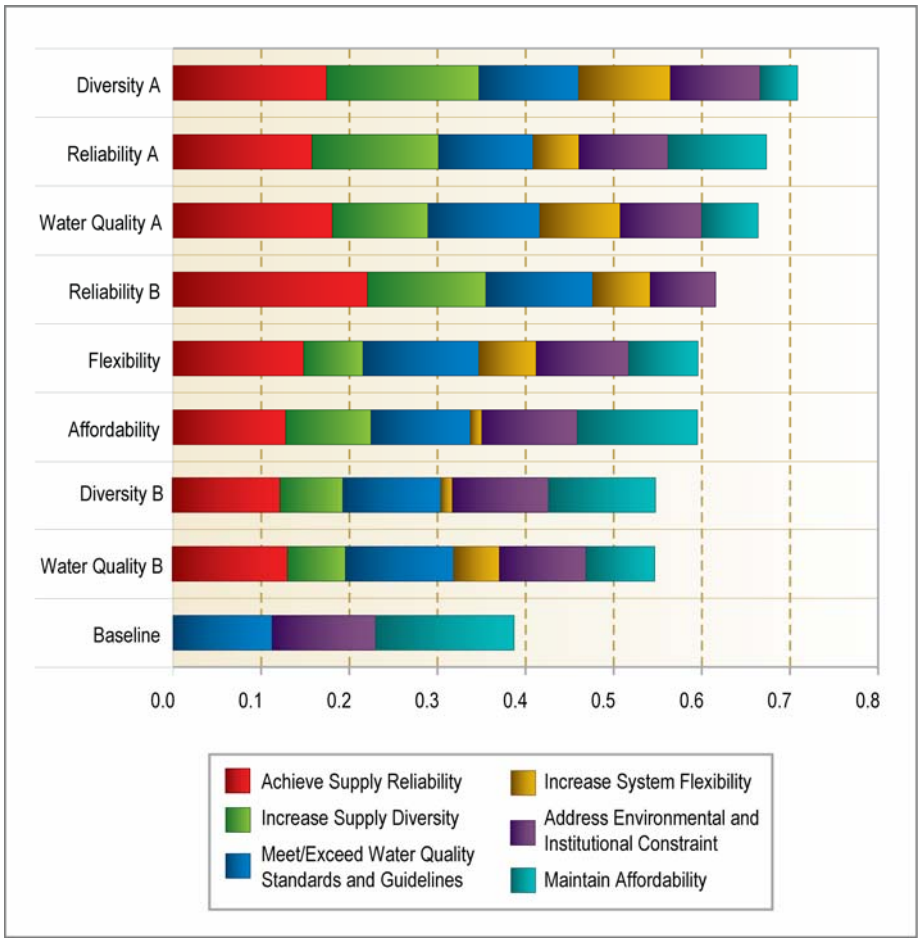


Figure 8-11
Portfolio Ranking for Average Stakeholder Weights

8.4 Preferred Portfolios

The chart shown in Figure 8-11 illustrates how ranking results are created for one set of weights. In order to determine the preferred portfolio and see if consensus truly exists among stakeholders, analysis is required of all of the individual stakeholders' rankings. To do this, the number of times a portfolio was ranked number 1, number 2, or number 3 by all stakeholders was counted[1]. This is shown in Figures 8-12 and 8-13.

The top three preferred portfolios in Figure 8-13 are clearly Diversity A, Reliability A, and Water Quality A. In this case, the results are the same as those obtained from the average stakeholder weights.

[1] In one stakeholder's case, the Reliability B portfolio was tied with Water Quality A for the number 3 ranking. Therefore, they were both counted as being ranked number 3. This is why the total number of times counted in Figure 8-13 does not equal 39 (which is the product of 13 stakeholders x 3 portfolios counted per stakeholder).

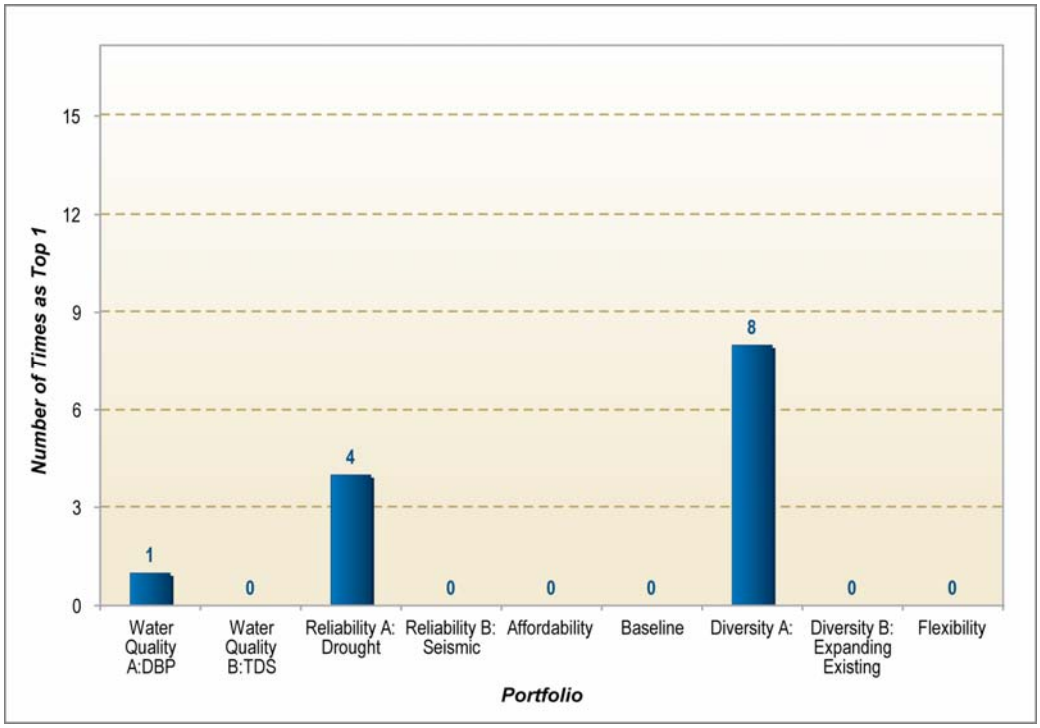


Figure 8-12
Number of Times a Portfolio was Ranked Number 1

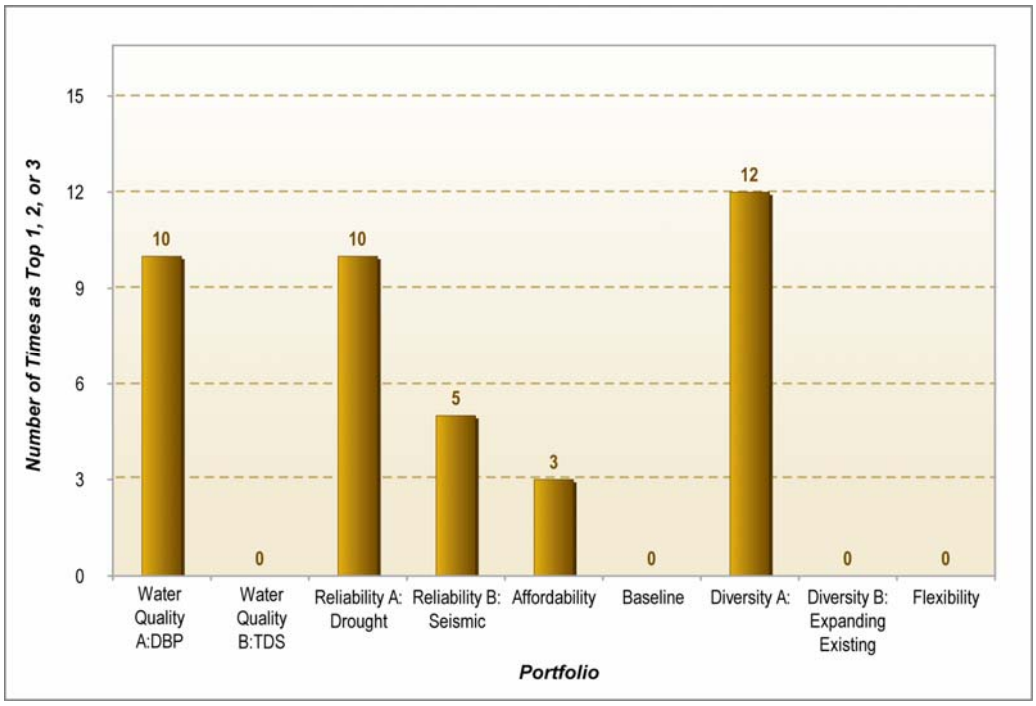


Figure 8-13
Number of Times a Portfolio was Ranked Number 1, 2, or 3

8.5 Sensitivity Analysis

In the development of this IRP, two of the greatest concerns for OWD are the indefinite reliability and increasing cost associated with imported water purchases (raw or treated) from the SDCWA. The sensitivity of these two factors was analyzed to determine how the rankings would change if (1) imported water reductions under drought conditions were not as severe, and (2) the projected cost of imported water was not as high.

If the imported water reductions over time were only up to 15% (instead of 30%) of the baseline demand for raw or treated water purchases, the top 3 ranked portfolios would not change. In other words, by improving the performance of portfolios that had deficits under extreme drought conditions, the rankings of the preferred portfolios would remain the same.

Similarly, if the cost of projected imported water costs was reduced by up to 20%, the top 3 ranked portfolios would not change. In this case, portfolios which rely on imported water purchases from SDCWA would have a lower NPV unit cost, but the rankings of the preferred portfolios would still remain the same.

Therefore, it is concluded that the portfolio rankings are robust.

8.6 Common Elements among the Preferred Portfolios

The options that consistently show up in the top ranked portfolios should be considered for implementation. The following options are included in at least two of the top three preferred portfolios:

- Additional Conservation
- Central Valley and Land Fallowing Transfers
- Groundwater projects (Demineralization and Conjunctive Use)
- 5-10 MGD Ocean Desalination (Poseidon, or Sweetwater/City of SD's South Bay project)
- Raw CWA imported water for Irrigation Use
- Stripping Plant along Spring Valley Trunk Line
- North District Recycled Water Concept
- Expand Ralph W. Chapman Water Reclamation Facility

Other options that could be considered for implementation are those that were in at least one of the top three performing portfolios. These options are:

- Perdue WTP
- SD17 Agreement with City of San Diego to treat raw water at Alvarado WTP
- Additional Purchases from South Bay WRP
- North of Delta Transfers

The options listed above are projects, programs and contractual agreements that have shown to best accomplish OWD's goals when combined in a supply mix for the future. Therefore, these projects are recommended for consideration in the IRP implementation plan, which is presented in Section 9.

Table 8-1
Portfolio Performance Summary

Objective/Sub-objective	Performance Measure	Water Quality A: DBP	Water Quality B: TDS	Reliability A: Drought	Reliability B: Seismic	Affordability	Baseline	Diversity A	Diversity B: Expand Existing	Flexibility
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines										
1a) Meet current and future drinking water standards	All portfolios will comply	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
1b) Address compatibility of new sources with current imported supply	Compatability Score	4.1	4.2	4.3	3.4	4.9	5.0	4.6	4.8	4.6
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS (mg/L)	426	406	490	388	492	492	483	492	484
	Non-potable TDS (mg/L)	968	990	990	990	990	990	990	990	912
1d) Minimize potential issues due to disinfection method	DBP Score	4.5	3.8	3.7	4.8	3.2	3.0	3.7	3.3	3.5
Objective 2 – Achieve Reliability										
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	251	455	0	118	68	1066	0	113	1
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	9037	21862	0	2833	2983	110864	0	908	18
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	20101	24367	23813	16242	26887	29137	21921	27790	24894
Objective 3 – Maintain Affordability										
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,465	1,562	1,197	1,940	1087	952	1,440	1,019	1,329
3b) Manage Capital Costs	NPV Capital costs -- $	266,585,000	163,975,000	131,906,000	380,065,000	52,092,000	-	380,707,000	150,341,000	245,265,000
Objective 4 – Increase Flexibility										
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	12	9	9	10	6	5	13	6	10
Objective 5 – Increase Diversity										
5a) Maximize number of sources	Total number of contracts	12	9	12	11	8	5	17	8	11
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	54%	70%	34%	34%	47%	91%	38%	59%	78%
Objective 6 – Address Environmental and Institutional Constraints										
6a) Minimize environmental permitting requirements	Permitting Score	3.3	3.0	3.9	2.2	3.7	4.0	3.5	3.9	3.6
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.7	3.6	3.2	3.1	3.3	4.0	3.7	3.8	3.8
6c) Maximize customer acceptance	Customer Acceptance Score	4.2	4.6	4.6	3.9	4.9	5.0	4.6	4.6	4.8
6d) Minimize regulatory constraints	Regulatory Constraints Score	3.8	4.0	4.1	2.9	4.8	5.0	3.9	4.6	3.8
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.0	4.5	4.4	3.8	4.8	5.0	4.5	4.8	4.7

Section 9
Implementation Plan

It is important to have a flexible and adaptive water resources implementation strategy to react to future opportunities and changes. The implementation strategy defined for OWD's IRP and described in this section proposes a phased implementation of projects over the planning horizon to meet growing future water demands, while making adjustments as necessary to respond to changing technology, supply levels, regulations, market conditions, costs, or partnership opportunities.

The evaluations described in Section 8 compare the performance and rankings of several water supply portfolios. The results of the rankings are dependent on the raw portfolios performance and the planning objective weightings, which were developed by the group of OWD stakeholders.

The three top-scoring portfolios were Diversity A, Reliability A, and Water Quality A. These portfolios are described in Section 6. Section 8.6 discusses the recommended water supply options that consistently showed up in the top ranked portfolios and should be considered for implementation. These options combined into water supply portfolios are likely to help OWD achieve the objectives defined in the IRP.

While reviewing the results of the portfolio rankings, OWD staff members expressed concern regarding the feasibility of some water supply options that were included in top three ranked portfolios. These supply options were not included in implementation plan for reasons described below:

- Raw CWA imported water for Irrigation Use – This option was not included in the implementation plan due to the OWD's concern with water quality compatibility with other water sources in the recycled water distribution system.

- Expand Ralph W. Chapman Water Reclamation Facility (RWCWRF) - This option was not included in the implementation plan due to the OWD's concern that there would not be sufficient wastewater flows into the RWCWRF unless OWD allocates resources to wastewater collection system expansions.

- Perdue WTP - This option was not included in the implementation plan due to the OWD's concern that there would not be sufficient capacity at Perdue WTP.

The options that consistently showed in the top ranked portfolios and that were ultimately considered feasible include the following:

- Additional Conservation

- Central Valley and Land Fallowing Transfers

- Groundwater projects (Demineralization and Conjunctive Use)

- 5-10 MGD Ocean Desalination (Poseidon, or Sweetwater/City of SD's South Bay project)
- Stripping Plant along Spring Valley Trunk Line
- North District Recycled Water Concept
- SD17 Agreement with City of San Diego to treat raw water at Alvarado WTP
- Additional Purchases from South Bay WRP
- North of Delta Transfers

9.1 Strategic Implementation of Projects

With the implementation of this integrated water resources plan, OWD will be taking significant steps to achieve its objectives of improving system reliability, flexibility, and diversity. In order for this to occur, it is important for OWD to revise its current CIP to reflect the recommended supply options, and begin assessing the feasibility of projects to meet phased targets proposed in the implementation plan. The top ranked portfolios represent a long-term vision for OWD, and the implementation strategy represents a feasible way to achieve that vision.

The implementation strategy is presented in Figure 9-1. The strategy is based on actions, triggers, and decisions followed by new actions, all of which span a timeline of 25 years. Triggers are related to the feasibility to implement ocean desalination, the development of demands compared to the supply available in between 2015 and 2020, and the feasibility and need to implement groundwater conjunctive use projects.

At some points in the implementation, OWD could be faced with the impossibility or impracticability to implement a specific project. In those cases the implementation strategy delineates alternative projects. In other cases, OWD will have the possibility to implement more than one project when only one is necessary. In those cases, conditions at the time will dictate which project is more convenient, cost effective and practical. This results in different possible scenarios of investment.

The different implementation paths could result in a maximum capital investment of approximately $318 million, and the minimum exposure would be around $117 million. If conditions allow for the implementation of the least costly option, the resulting portfolio would be essentially the Reliability A portfolio (See Table 6-1 for a list of options included in each portfolio), with a yield of approximately 72,000 AFY. Conversely, if conditions were such that the highest level of investment is required, the resulting portfolio would be closer to the Diversity A portfolio, with lower capital costs and slightly lower annual yield (about 76,000 AFY vs. 88,000 AFY). What is important to recognize is that any of the resulting paths in the implementation strategy would include projects, programs, and contractual agreements that have

shown to best accomplish OWD's goals when combined in a supply mix for the future.

9.2 Short-Term Actions

The three top performing portfolios, Diversity A, Water Quality A and Reliability A, represent viable and desirable future water supply mixes for OWD. The implementation strategy shows different ways to obtain that supply mix and accounts for future uncertainty on project implementation. The strategy, however, is clear in the short-term. Projects presented in Figure 9-1 as short-term implementation projects will require concrete steps for implementation that OWD will need to take to develop the foundations of the future supply mix. Projects, programs and contractual arrangements included in the short-term actions are:

- Additional conservation
- SD17 agreement with the City of San Diego
- Additional purchases from SBWRP
- North District recycled water concept
- Water banking agreements

Implementing these short-term projects constitutes the largest step in the implementation strategy, but they are considered more likely to be achieved in the short-term than the complex and capital-intensive projects scheduled later in the strategy, since opportunity currently exists for partnerships and agreements and, in some cases, the implementation has already begun with minimum capital improvements required. These initial projects represent the most achievable projects in the short-term to firm the supply for OWD and improve system flexibility, diversity and cost efficiency.

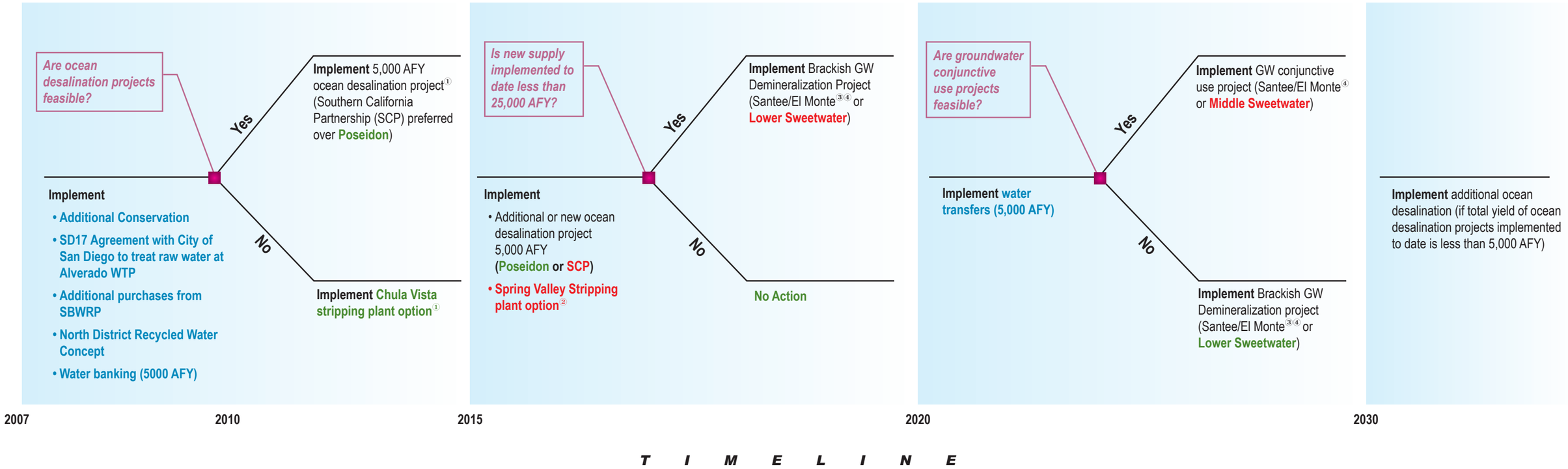
The strategy presented in Figure 9-1 was designed to achieve OWD's goals under any of the resulting implementation scenarios. The projects implemented by OWD under this strategy will result in portfolios that have shown by the IRP analysis to be the most likely to accomplish OWD's objectives for the future.

LEGEND

Implement Project

Minimal Capital Cost Project

Maximum Capital Cost Project



NOTES

① If ocean desalination projects and stripping options are not feasible, implement Santee/El Monte brackish groundwater demineralization (with the use of the LMSE).

② If Chula Vista stripping plant is not already in place.

③ If not already in place.

④ Assumes use of LMSE pipeline.

CDM

Figure 9-1
OWD IRP Implementation Plan

Section 10
References

Boyle Engineering Corporation, 1993. *Lower Sweetwater River Basin Groundwater Studies*. Prepared for Sweetwater Authority.

Boyle Engineering Corporation, 1999. *Aquifer Storage and Recovery Project: San Diego Formation. Phase I Technical Report.* Prepared for the San Diego County Water Authority.

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Appendix A

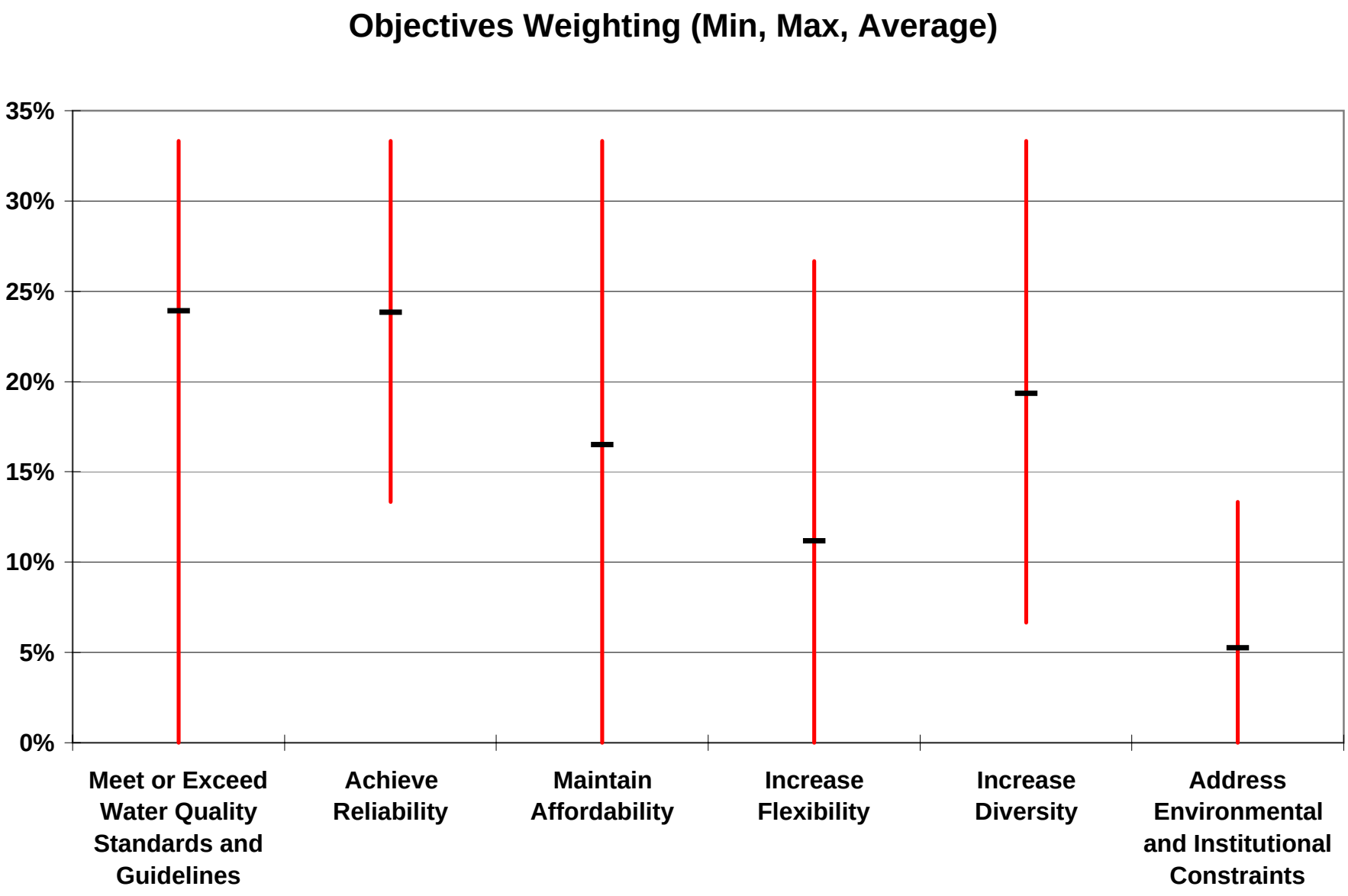
Objectives Weighting Results

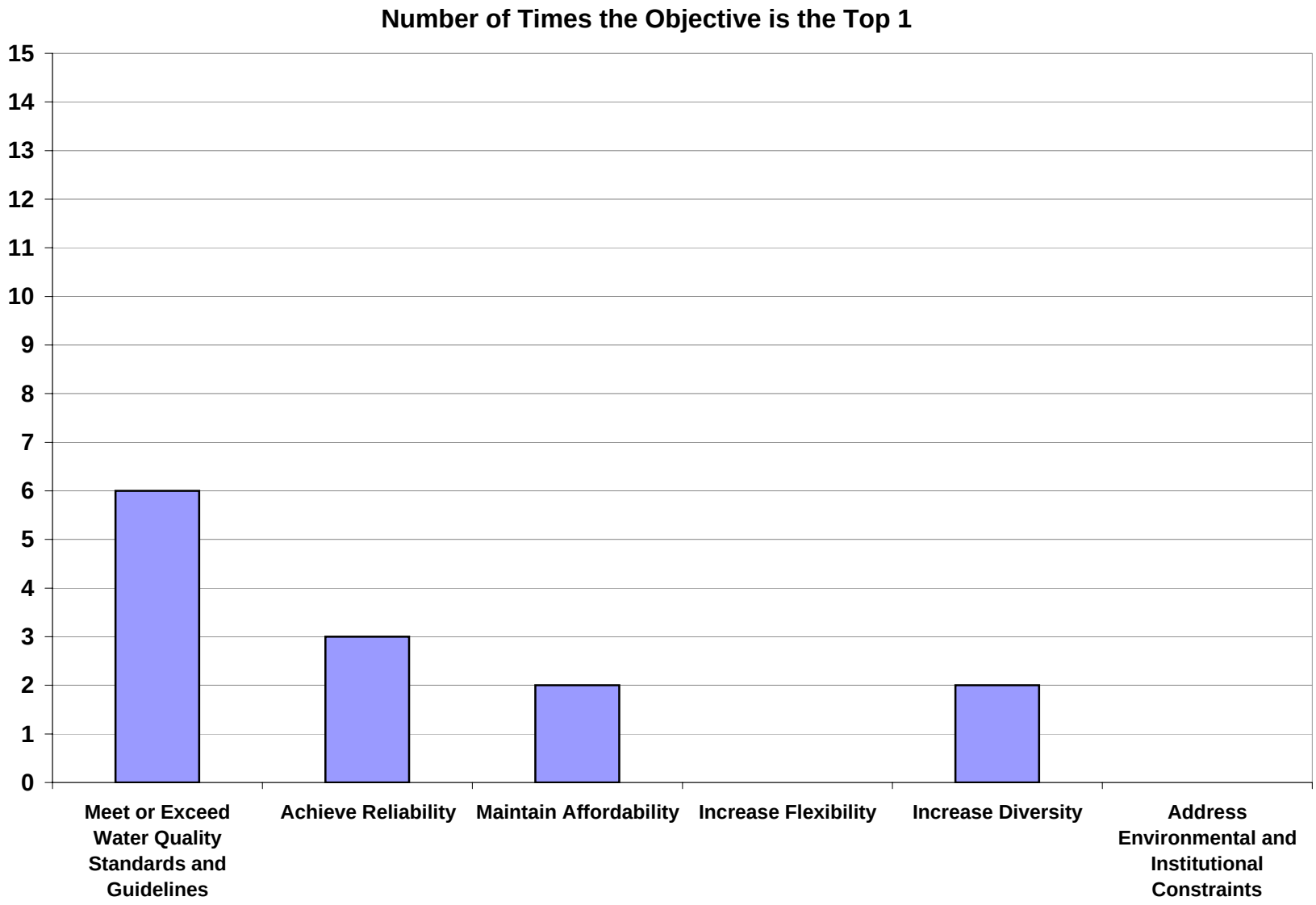
Appendix A
Objectives Weighting Results

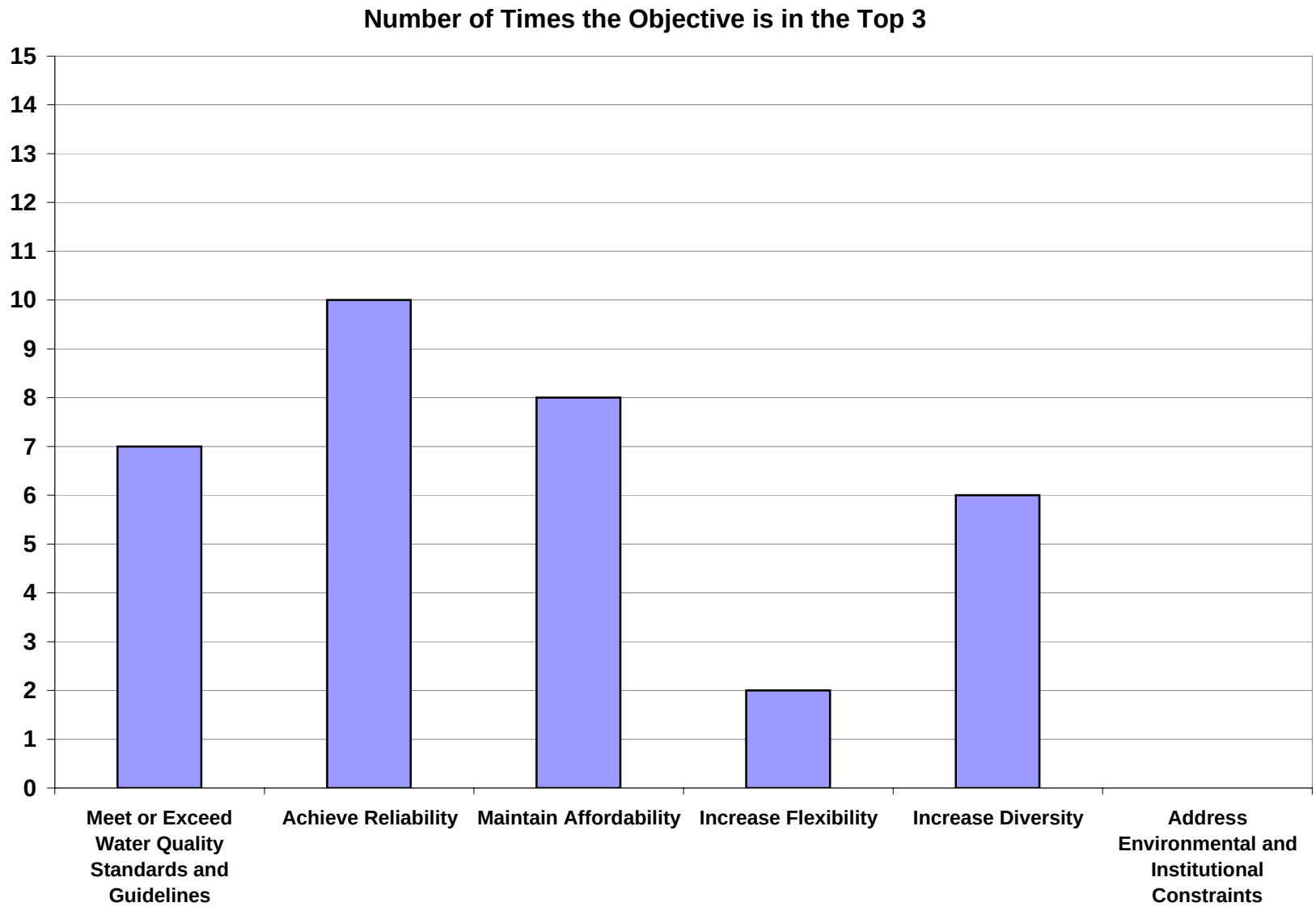
Appendix A presents the overall objectives weighting results for the group of OWD stakeholders, and the individual weighting results for each stakeholder. The stakeholders included both OWD senior staff and the Board of Directors. The objectives were weighted using a method known as "forced-paired comparison." This method consists of comparing the relevant importance of two objectives in all the possible pair of objectives.

The individual stakeholder results were used to calculate the minimum, maximum, and average weight of each objective for the group of stakeholders, as shown in the stock chart on the next page. On average, "Water Quality", Reliability", and "Diversity" objectives are the three most important. However, the minimum and maximum results show that there is a very large spread in terms of objective importance among the stakeholders. Therefore, the average may not be representative of any individual preferences.

In order to show overall group results that accurately reflect individual preferences, the number of times an objective was determined as the Top 1 (or most important) objective was counted for each stakeholder. Similarly, the number of times an objective was within the Top 3 most important objectives were counted. The results in the bar charts show that the **"Water Quality", "Reliability", and "Affordability"** objectives are rated the three most important objectives among all of the stakeholders.


Objectives Weighting (Min, Max, Average)
35%
30%
25%
20%
15%
10%
5%
0%
Meet or Exceed Water Quality Standards and Guidelines
Achieve Reliability
Maintain Affordability
Increase Flexibility
Increase Diversity
Address Environmental and Institutional Constraints


Number of Times the Objective is the Top 1
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Meet or Exceed Water Quality Standards and Guidelines
Achieve Reliability
Maintain Affordability
Increase Flexibility
Increase Diversity
Address Environmental and Institutional Constraints


Number of Times the Objective is in the Top 3
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Meet or Exceed Water Quality Standards and Guidelines
Achieve Reliability
Maintain Affordability
Increase Flexibility
Increase Diversity
Address Environmental and Institutional Constraints

Name: Stakeholder 1

Weighting Grid - Objectives

	1	2	3	4	5	
1 Meet or Exceed Water Quality Standards and Guidelines						
2 Achieve Supply Reliability	1					
3 Maintain Affordability	1	2				
4 Increase System Flexibility	1	2	3			
5 Increase Supply Diversity	1	5	5	5		
6 Address Environmental and Institutional Constraints	1	2	3	4	5	

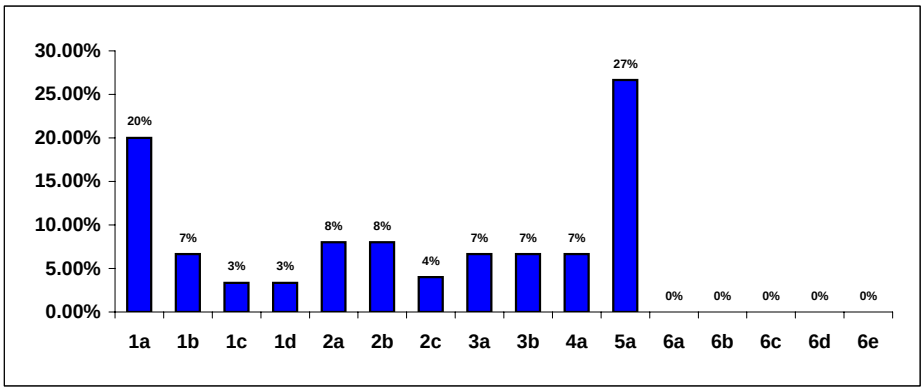
To be completed by CDM

Objective Number	1	2	3	4	5	6
Number of Times Circled (Total = 15)	5	3	2	1	4	0
Percentage of All Matches	33%	20%	13%	7%	27%	0%

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Meet or Exceed Water Quality Standards and Guidelines	33%
Increase Diversity	27%
Achieve Reliability	20%
Maintain Affordability	13%
Increase Flexibility	7%
Address Environmental and Institutional Constraints	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
60	1a) Meet current and future drinking water standards
20	1b) Address compatibility of new sources with current imported supply
10	1c) Meet TDS goals for recycled water, potable water and Basin Plan
10	1d) Minimize potential issues due to disinfection method
Total Pts	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
40	2a) Meet demands under normal conditions
40	2b) Meet demands under drought conditions
20	2c) Minimize impacts under emergency conditions
Total Pts	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
50	3a) Minimize impacts to an average single-family customer
50	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase number of take points and alternative flow routes
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
10	6a) Minimize environmental permitting requirements
10	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
50	6c) Maximize customer acceptance
10	6d) Minimize regulatory constraints
20	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 2

Weighting Grid - Objectives

	1	2	3	4	5	
1						Meet or Exceed Water Quality Standards and Guidelines
2	1					Achieve Supply Reliability
3	1	2				Maintain Affordability
4	1	2	4			Increase System Flexibility
5	1	5	5	5		Increase Supply Diversity
6	1	2	3	4	5	Address Environmental and Institutional Constraints

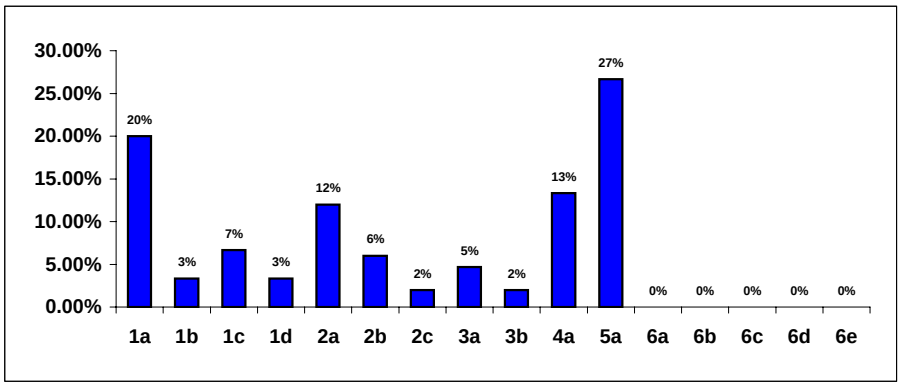
To be completed by CDM

1	2	3	4	5	6	Objective Number
5	3	1	2	4	0	Number of Times Circled (Total = 15)
33%	20%	7%	13%	27%	0%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Meet or Exceed Water Quality Standards and Guidelines	33%
Increase Diversity	27%
Achieve Reliability	20%
Increase Flexibility	13%
Maintain Affordability	7%
Address Environmental and Institutional Constraints	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
60	1a) Meet current and future drinking water standards
10	1b) Address compatibility of new sources with current imported supply
20	1c) Meet TDS goals for recycled water, potable water and Basin Plan
10	1d) Minimize potential issues due to disinfection method
Total Pts	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
60	2a) Meet demands under normal conditions
30	2b) Meet demands under drought conditions
10	2c) Minimize impacts under emergency conditions
Total Pts	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
70	3a) Minimize impacts to an average single-family customer
30	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase number of take points and alternative flow routes
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
30	6a) Minimize environmental permitting requirements
20	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
30	6c) Maximize customer acceptance
10	6d) Minimize regulatory constraints
10	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 3

Weighting Grid - Objectives

	1	2	3	4	5	6	
1							Meet or Exceed Water Quality Standards and Guidelines
2	1						Achieve Supply Reliability
3	1	2					Maintain Affordability
4	1	2	4				Increase System Flexibility
5	1	5	5	5			Increase Supply Diversity
6	1	2	3	4	6		Address Environmental and Institutional Constraints

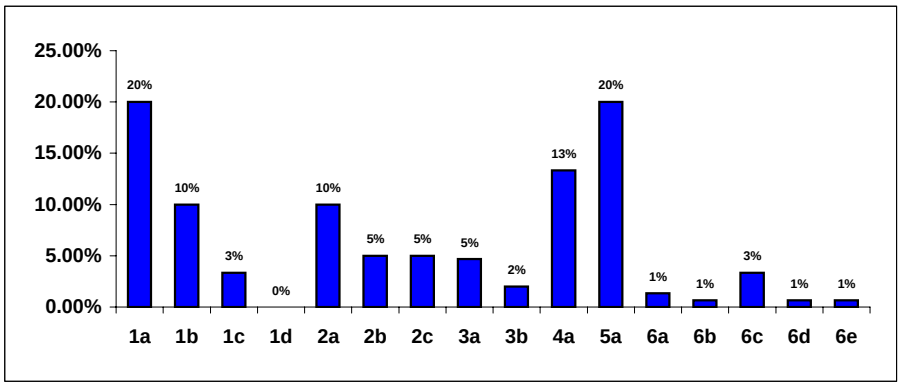
To be completed by CDM

1	2	3	4	5	6	Objective Number
5	3	1	2	3	1	Number of Times Circled (Total = 15)
33%	20%	7%	13%	20%	7%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Meet or Exceed Water Quality Standards and Guidelines	33%
Achieve Reliability	20%
Increase Diversity	20%
Increase Flexibility	13%
Maintain Affordability	7%
Address Environmental and Institutional Constraints	7%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
60	1a) Meet current and future drinking water standards
30	1b) Address compatibility of new sources with current imported supply
10	1c) Meet TDS goals for recycled water, potable water and Basin Plan
0	1d) Minimize potential issues due to disinfection method
Total Pts	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
50	2a) Meet demands under normal conditions
25	2b) Meet demands under drought conditions
25	2c) Minimize impacts under emergency conditions
Total Pts	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
70	3a) Minimize impacts to an average single-family customer
30	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase number of take points and alternative flow routes
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
20	6a) Minimize environmental permitting requirements
10	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
50	6c) Maximize customer acceptance
10	6d) Minimize regulatory constraints
10	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 4

Weighting Grid - Objectives

						1 Meet or Exceed Water Quality Standards and Guidelines
					2	**2** Achieve Supply Reliability
1	2					**3** Maintain Affordability
1	2	3				**4** Increase System Flexibility
1	2	3	4			**5** Increase Supply Diversity
1	2	3	4	5		**6** Address Environmental and Institutional Constraints

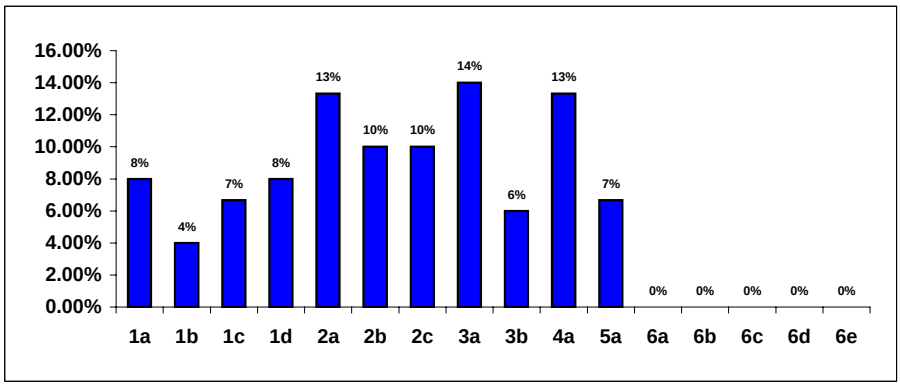
To be completed by CDM

1	2	3	4	5	6	Objective Number
4	5	3	2	1	0	Number of Times Circled (Total = 15)
27%	33%	20%	13%	7%	0%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Achieve Reliability	33%
Meet or Exceed Water Quality Standards and Guidelines	27%
Maintain Affordability	20%
Increase Flexibility	13%
Increase Diversity	7%
Address Environmental and Institutional Constraints	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
30	1a) Meet current and future drinking water standards
15	1b) Address compatibility of new sources with current imported supply
25	1c) Meet TDS goals for recycled water, potable water and Basin Plan
30	1d) Minimize potential issues due to disinfection method
Total Pts	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
40	2a) Meet demands under normal conditions
30	2b) Meet demands under drought conditions
30	2c) Minimize impacts under emergency conditions
Total Pts	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
70	3a) Minimize impacts to an average single-family customer
30	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase number of take points and alternative flow routes
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
10	6a) Minimize environmental permitting requirements
10	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
40	6c) Maximize customer acceptance
15	6d) Minimize regulatory constraints
25	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 5

Weighting Grid - Objectives

	1	2	3	4	5	6
1 Meet or Exceed Water Quality Standards and Guidelines						
2 Achieve Supply Reliability	1					
3 Maintain Affordability	1	3				
4 Increase System Flexibility	1	2	3			
5 Increase Supply Diversity	1	2	3		5	
6 Address Environmental and Institutional Constraints	1	2	3	4	5	

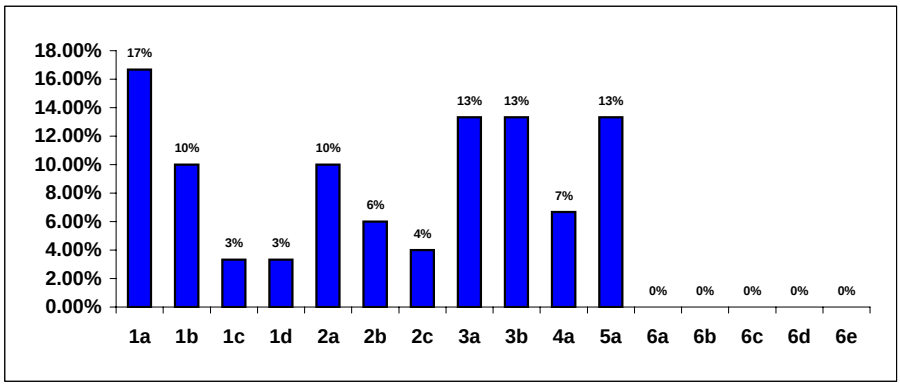
To be completed by CDM

1	2	3	4	5	6	Objective Number
5	3	4	1	2	0	Number of Times Circled (Total = 15)
33%	20%	27%	7%	13%	0%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Meet or Exceed Water Quality Standards and Guidelines	33%
Maintain Affordability	27%
Achieve Reliability	20%
Increase Diversity	13%
Increase Flexibility	7%
Address Environmental and Institutional Constraints	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
50	1a) Meet current and future drinking water standards
30	1b) Address compatibility of new sources with current imported supply
10	1c) Meet TDS goals for recycled water, potable water and Basin Plan
10	1d) Minimize potential issues due to disinfection method
Total Pts	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
50	2a) Meet demands under normal conditions
30	2b) Meet demands under drought conditions
20	2c) Minimize impacts under emergency conditions
Total Pts	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
50	3a) Minimize impacts to an average single-family customer
50	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase number of take points and alternative flow routes
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
20	6a) Minimize environmental permitting requirements
10	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
50	6c) Maximize customer acceptance
10	6d) Minimize regulatory constraints
10	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 6

Weighting Grid - Objectives

	1	2	3	4	5	6
1 Meet or Exceed Water Quality Standards and Guidelines						
2 Achieve Reliability	2					
3 Maintain Affordability	3	2				
4 Increase Flexibility	4	2	4			
5 Increase Diversity	5	2	5	5		
6 Address Environmental and Institutional Constraints	6	2	3	6	5	

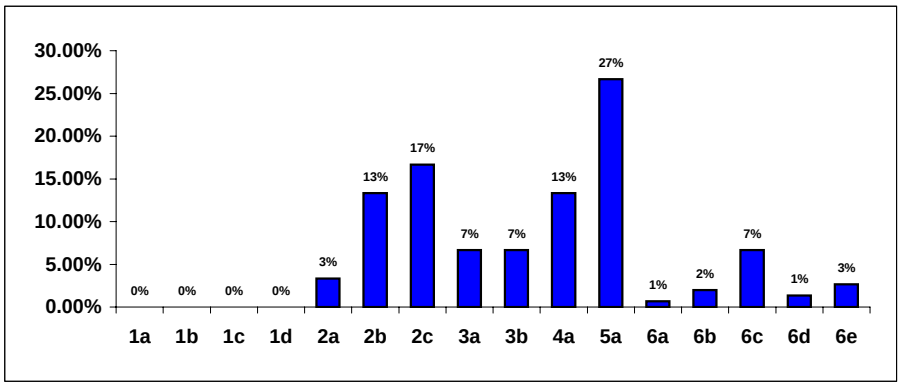
To be completed by CDM

1	2	3	4	5	6	Objective Number
0	5	2	2	4	2	Number of Times Circled (Total = 15)
0%	33%	13%	13%	27%	13%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Achieve Reliability	33%
Increase Diversity	27%
Maintain Affordability	13%
Increase Flexibility	13%
Address Environmental and Institutional Constraints	13%
Meet or Exceed Water Quality Standards and Guidelines	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
25	1a) Meet current and future drinking water standards
25	1b) Address compatibility of new sources with current imported supply
25	1c) Meet TDS goals for recycled water, potable water and Basin Plan
25	1d) Minimize potential issues due to disinfection method
Total Pts	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
10	2a) Meet demands under normal conditions
40	2b) Meet demands under drought conditions
50	2c) Minimize impacts under emergency conditions
Total Pts	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
50	3a) Minimize impacts to an average single-family customer
50	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
5	6a) Minimize environmental permitting requirements
15	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
50	6c) Maximize customer acceptance
10	6d) Minimize regulatory constraints
20	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 7

Weighting Grid - Objectives

	1	2	3	4	5	6
1 Meet or Exceed Water Quality Standards and Guidelines						
2 Achieve Reliability	1					
3 Maintain Affordability	1	3				
4 Increase Flexibility	1	2	3			
5 Increase Diversity	1	5	3	5		
6 Address Environmental and Institutional Constraints	1	2	3	4	5	

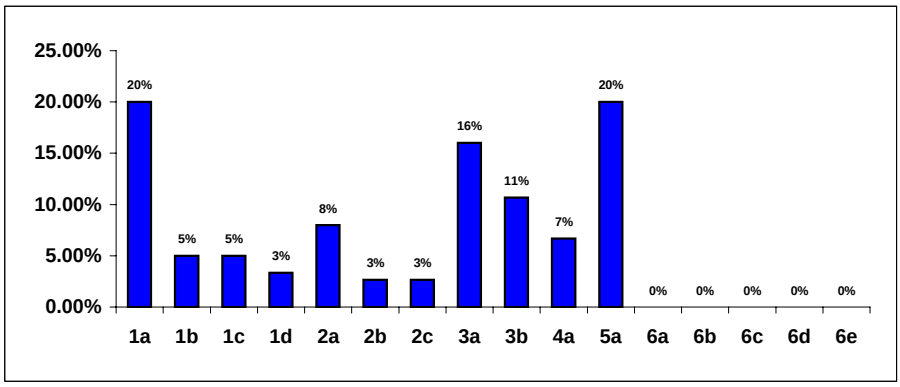
To be completed by CDM

1	2	3	4	5	6	Objective Number
5	2	4	1	3	0	Number of Times Circled (Total = 15)
33%	13%	27%	7%	20%	0%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Meet or Exceed Water Quality Standards and Guidelines	33%
Maintain Affordability	27%
Increase Diversity	20%
Achieve Reliability	13%
Increase Flexibility	7%
Address Environmental and Institutional Constraints	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
60	1a) Meet current and future drinking water standards
15	1b) Address compatibility of new sources with current imported supply
15	1c) Meet TDS goals for recycled water, potable water and Basin Plan
10	1d) Minimize potential issues due to disinfection method
Total Pts 100	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
60	2a) Meet demands under normal conditions
20	2b) Meet demands under drought conditions
20	2c) Minimize impacts under emergency conditions
Total Pts 100	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
60	3a) Minimize impacts to an average single-family customer
40	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
25	6a) Minimize environmental permitting requirements
25	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
15	6c) Maximize customer acceptance
25	6d) Minimize regulatory constraints
10	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 8

Weighting Grid - Objectives

1						Meet or Exceed Water Quality Standards and Guidelines
	2				2	Achieve Reliability
		3		3	3	Maintain Affordability
			4	3	2	Increase Flexibility
				5	5	Increase Diversity
					6	Address Environmental and Institutional Constraints
1	2	3	4	5		

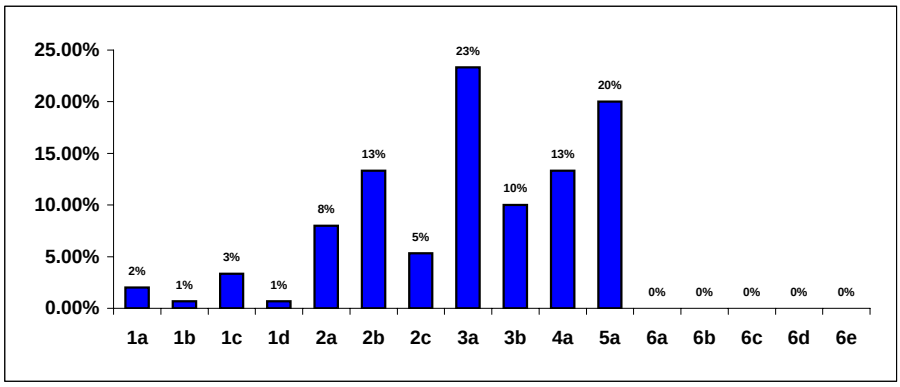
To be completed by CDM

1	2	3	4	5	6	Objective Number
1	4	5	2	3	0	Number of Times Circled (Total = 15)
7%	27%	33%	13%	20%	0%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Maintain Affordability	33%
Achieve Reliability	27%
Increase Diversity	20%
Increase Flexibility	13%
Meet or Exceed Water Quality Standards and Guidelines	7%
Address Environmental and Institutional Constraints	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
30	1a) Meet current and future drinking water standards
10	1b) Address compatibility of new sources with current imported supply
50	1c) Meet TDS goals for recycled water, potable water and Basin Plan
10	1d) Minimize potential issues due to disinfection method
Total Pts 100	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
30	2a) Meet demands under normal conditions
50	2b) Meet demands under drought conditions
20	2c) Minimize impacts under emergency conditions
Total Pts 100	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
70	3a) Minimize impacts to an average single-family customer
30	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
20	6a) Minimize environmental permitting requirements
10	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
30	6c) Maximize customer acceptance
20	6d) Minimize regulatory constraints
20	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 9

Weighting Grid - Objectives

	1	2	3	4	5	6
1						
2	2					
3	2	3				
4	1	2	3			
5	5	5	5	5		
6	2	3	6	5		

1 Meet or Exceed Water Quality Standards and Guidelines
2 Achieve Reliability
3 Maintain Affordability
4 Increase Flexibility
5 Increase Diversity
6 Address Environmental and Institutional Constraints

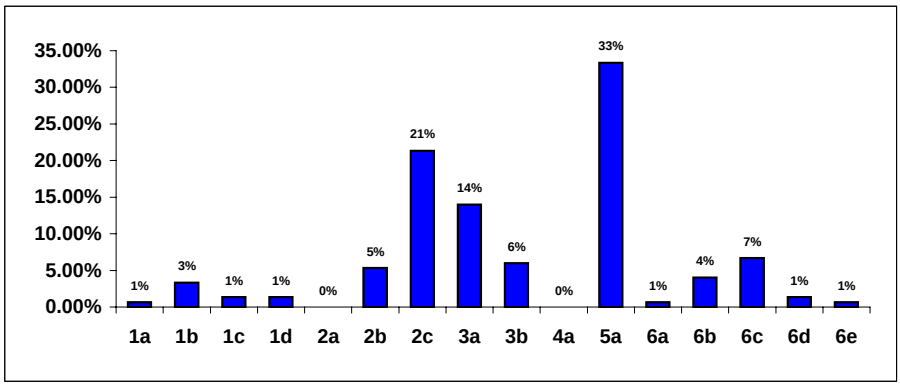
To be completed by CDM

1	2	3	4	5	6	Objective Number
1	4	3	0	5	2	Number of Times Circled (Total = 15)
7%	27%	20%	0%	33%	13%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Increase Diversity	33%
Achieve Reliability	27%
Maintain Affordability	20%
Address Environmental and Institutional Constraints	13%
Meet or Exceed Water Quality Standards and Guidelines	7%
Increase Flexibility	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
10	1a) Meet current and future drinking water standards
50	1b) Address compatibility of new sources with current imported supply
20	1c) Meet TDS goals for recycled water, potable water and Basin Plan
20	1d) Minimize potential issues due to disinfection method
Total Pts 100	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
0	2a) Meet demands under normal conditions
20	2b) Meet demands under drought conditions
80	2c) Minimize impacts under emergency conditions
Total Pts 100	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
70	3a) Minimize impacts to an average single-family customer
30	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
5	6a) Minimize environmental permitting requirements
30	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
50	6c) Maximize customer acceptance
10	6d) Minimize regulatory constraints
5	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 10

Weighting Grid - Objectives

	1	2	3	4	5	6
1 Meet or Exceed Water Quality Standards and Guidelines						
2 Achieve Reliability	2					
3 Maintain Affordability	3	2				
4 Increase Flexibility	4	4	4			
5 Increase Diversity	5	5	5	5		
6 Address Environmental and Institutional Constraints	6	2	6	4	5	

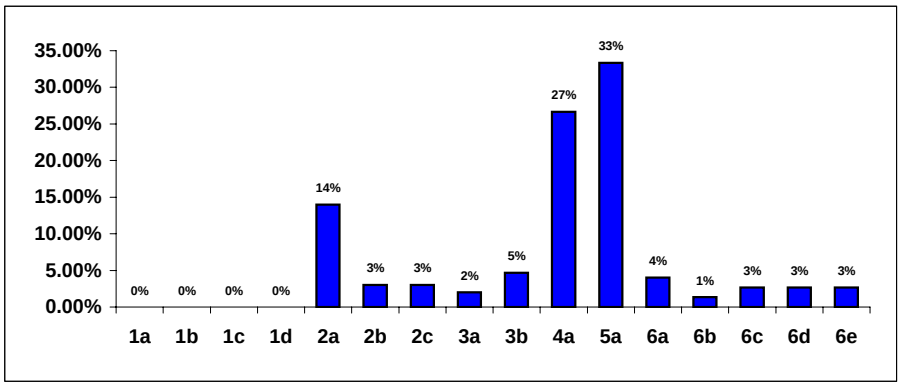
To be completed by CDM

1	2	3	4	5	6	Objective Number
0	3	1	4	5	2	Number of Times Circled (Total = 15)
0%	20%	7%	27%	33%	13%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Increase Diversity	33%
Increase Flexibility	27%
Achieve Reliability	20%
Address Environmental and Institutional Constraints	13%
Maintain Affordability	7%
Meet or Exceed Water Quality Standards and Guidelines	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
10	1a) Meet current and future drinking water standards
80	1b) Address compatibility of new sources with current imported supply
5	1c) Meet TDS goals for recycled water, potable water and Basin Plan
5	1d) Minimize potential issues due to disinfection method
Total Pts 100	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
70	2a) Meet demands under normal conditions
15	2b) Meet demands under drought conditions
15	2c) Minimize impacts under emergency conditions
Total Pts 100	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
30	3a) Minimize impacts to an average single-family customer
70	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
30	6a) Minimize environmental permitting requirements
10	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
20	6c) Maximize customer acceptance
20	6d) Minimize regulatory constraints
20	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 11

Weighting Grid - Objectives

1 Meet or Exceed Water Quality Standards and Guidelines					
1	**2** Achieve Reliability				
1	2	**3** Maintain Affordability			
1	2	4	**4** Increase Flexibility		
1	2	5	4	**5** Increase Diversity	
1	2	6	4	6	**6** Address Environmental and Institutional Constraints

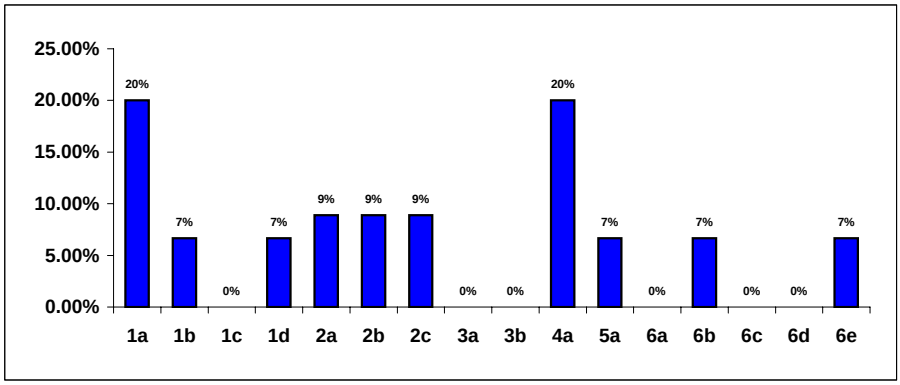
To be completed by CDM

1	2	3	4	5	6	Objective Number
5	4	0	3	1	2	Number of Times Circled (Total = 15)
33%	27%	0%	20%	7%	13%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Meet or Exceed Water Quality Standards and Guidelines	33%
Achieve Reliability	27%
Increase Flexibility	20%
Address Environmental and Institutional Constraints	13%
Increase Diversity	7%
Maintain Affordability	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
60	1a) Meet current and future drinking water standards
20	1b) Address compatibility of new sources with current imported supply
0	1c) Meet TDS goals for recycled water, potable water and Basin Plan
20	1d) Minimize potential issues due to disinfection method
Total Pts 100	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
33.333	2a) Meet demands under normal conditions
33.333	2b) Meet demands under drought conditions
33.333	2c) Minimize impacts under emergency conditions
Total Pts 100	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
80	3a) Minimize impacts to an average single-family customer
20	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
0	6a) Minimize environmental permitting requirements
50	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
0	6c) Maximize customer acceptance
0	6d) Minimize regulatory constraints
50	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 12

Weighting Grid - Objectives

1 Meet or Exceed Water Quality Standards and Guidelines					
2	2 Achieve Reliability				
3	2	3 Maintain Affordability			
1	2	4	4 Increase Flexibility		
1	2	5	5	5 Increase Diversity	
1	2	3	4	6	6 Address Environmental and Institutional Constraints

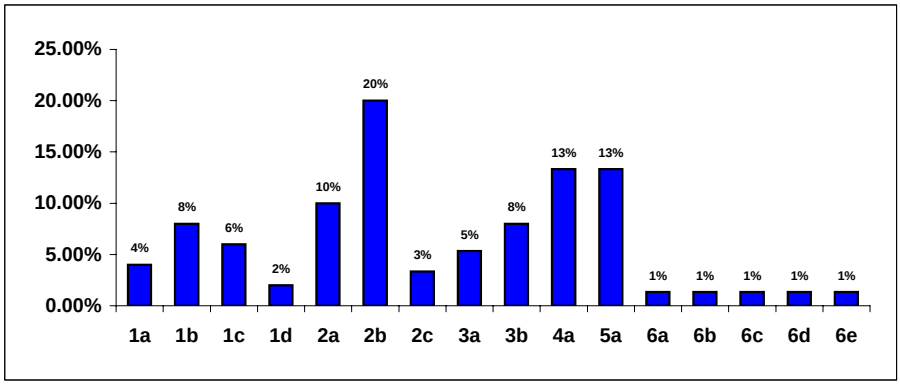
To be completed by CDM

1	2	3	4	5	6	Objective Number
3	5	2	2	2	1	Number of Times Circled (Total = 15)
20%	33%	13%	13%	13%	7%	Percentage of All Matches

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Achieve Reliability	33%
Meet or Exceed Water Quality Standards and Guidelines	20%
Maintain Affordability	13%
Increase Flexibility	13%
Increase Diversity	13%
Address Environmental and Institutional Constraints	7%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
20	1a) Meet current and future drinking water standards
40	1b) Address compatibility of new sources with current imported supply
30	1c) Meet TDS goals for recycled water, potable water and Basin Plan
10	1d) Minimize potential issues due to disinfection method
Total Pts 100	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
30	2a) Meet demands under normal conditions
60	2b) Meet demands under drought conditions
10	2c) Minimize impacts under emergency conditions
Total Pts 100	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
40	3a) Minimize impacts to an average single-family customer
60	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
20	6a) Minimize environmental permitting requirements
20	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
20	6c) Maximize customer acceptance
20	6d) Minimize regulatory constraints
20	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Name: Stakeholder 13

Weighting Grid - Objectives

	1	2	3	4	5	6
1 Meet or Exceed Water Quality Standards and Guidelines						
2 Achieve Reliability	1					
3 Maintain Affordability	3	3				
4 Increase Flexibility	1	2	3			
5 Increase Diversity	1	2	3	5		
6 Address Environmental and Institutional Constraints	1	2	3	6	6	

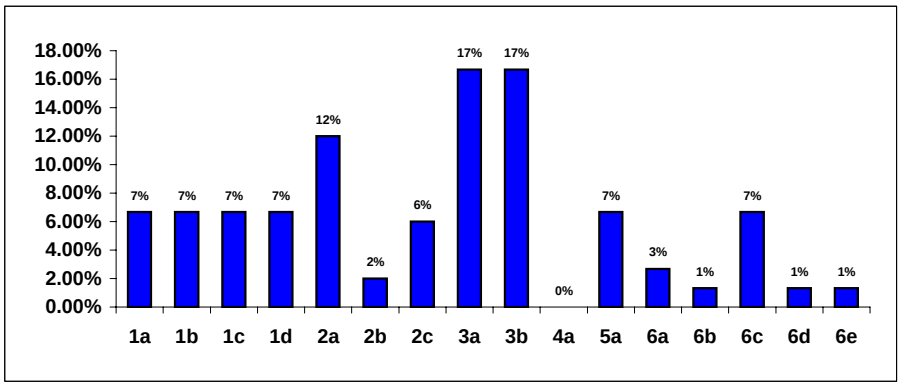
To be completed by CDM

Objective Number	1	2	3	4	5	6
Number of Times Circled (Total = 15)	4	3	5	0	1	2
Percentage of All Matches	27%	20%	33%	0%	7%	13%

Objective/Sub-Objective Weighting Results
These results seem to indicate that the objectives and sub-objectives for you rank as follows:

Maintain Affordability	33%
Meet or Exceed Water Quality Standards and Guidelines	27%
Achieve Reliability	20%
Address Environmental and Institutional Constraints	13%
Increase Diversity	7%
Increase Flexibility	0%

The chart below shows the weights you have assigned by sub-objective



Weighting - Sub-Objectives

Objective 1 - Meet or Exceed Water Quality Standards and Guidelines

Points	Sub-objective
25	1a) Meet current and future drinking water standards
25	1b) Address compatibility of new sources with current imported supply
25	1c) Meet TDS goals for recycled water, potable water and Basin Plan
25	1d) Minimize potential issues due to disinfection method
Total Pts 100	(Must equal 100)

Objective 2 - Achieve Reliability

Points	Sub-objective
60	2a) Meet demands under normal conditions
10	2b) Meet demands under drought conditions
30	2c) Minimize impacts under emergency conditions
Total Pts 100	(Must equal 100)

Objective 3 - Maintain Affordability

Points	Sub-objectives
50	3a) Minimize impacts to an average single-family customer
50	3b) Manage capital costs
Total Pts 100	(Must equal 100)

Objective 4 - Increase Flexibility

Points	Sub-objectives
100	4a) Increase system redundancy
Total Pts 100	(Must equal 100)

Objective 5 - Increase Diversity

Points	Sub-objectives
100	5a) Maximize number of sources and/or reduce contribution of largest source
Total Pts 100	(Must equal 100)

Objective 6 - Address Environmental and Institutional Constraints

Points	Sub-objectives
20	6a) Minimize environmental permitting requirements
10	6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)
50	6c) Maximize customer acceptance
10	6d) Minimize regulatory constraints
10	6e) Minimize technology uncertainty
Total Pts 100	(Must equal 100)

Appendix B

Supply Options Rating and Schematics

Table B-1 Supply Options Rating											
Supply Source	**Description**	**Water Quality**			**Yield**	**Affordability/Cost[4]**	**Environmental/ Institutional Scores[3]**				
		TDS[1,2] [mg/L]	**Compat. Score[3]**	**DBP Score[3]**	**[AFY]**	**TC = Total Capital, OM = operation,/ maint. IW = Imported Purchases UN= unit (per acre-ft)**	**Permitting**	**Institut. Coord.**	**Customer Acceptance**	**Regulatory Constraints**	**Technolog. Uncertainty**
I. Existing Supply											
Ia. Imported											
SDCWA Pipeline # 4	Turnout #11 (40 MGD) supplies the North Xystem. Turnouts #10 (18 MGD) and #12 (40 MGD) supply the Central System. Turnout #13 (26 MGD) supplies the Otay Mesa System. (OWD, 2002 Figure 5-1)	492	N/A	N/A	Up to capacity of existing turnouts.	UN = $545 /AF	N/A	N/A	N/A	N/A	N/A
City of San Diego's Otay WTP	The current effective capacity of the Otay WTP is 34 MGD, of which the City of San Diego's typical demand is 20 MGD. OWD has an agreement with the City of San Diego for 10 MGD from the Otay WTP. Water is supplied to the Otay Mesa and Central systems via a temporary pump station with a capacity ranging between 6-21 MGD. Current operations typically provide up to 8 MGD in summer months and 10 MGD in winter months to OWD. (OWD, 2002 pg. 1-5)	492	N/A	N/A	11,200 AFY	UN = $535 /AF Two payments: one for SDCWA raw water ($420/AF); the other for treatment ($115/AF)	N/A	N/A	N/A	N/A	N/A
Helix's Levy WTP	The Levy WTP supplies water to the North System. SDCWA is obligated to provide 12 MGD on-peak, and up to 16 MGD off-peak to OWD through a new pipeline that will replace the LMSE and expected to be operational by 2010. (Helix Agreement)	492	N/A	N/A	13,440 AFY base load. Minimum of 10,000 AFY.	UN = $545 /AF	N/A	N/A	N/A	N/A	N/A
Ib. Recycled											
OWD's Chapman WRP	Recycled water supply is pumped to the Central system. The Chapman WRP capacity is approximately 1.1 MGD. (OWD, 2002 pg. 11-3)	990	N/A	N/A	1230 AFY	Fixed OM: $700,000/year Variable OM: $250/AF	N/A	N/A	N/A	N/A	N/A
City of San Diego's South Bay WRP	OWD has a contract to receive at least 6 MGD from the SBWRP. The capacity of the SBWRP is 15 MGD. (SBWRP Agreement)	990	N/A	N/A	6,720 AFY	$595/AF	N/A	N/A	N/A	N/A	N/A
II. Potential Supply Options											
IIa. Additional Imported/Local Treatment Agreements											
Helix's Levy WTP	Obtain additional 4 MGD water rights, beyond the current 12 MGD, to supply North District. Assume LMSE can be used for conveyance in this option.	492	5	3	4,480 AFY	TC = $12,227,000 OM =$0/year IWP= $2,442,000/year UN = $744 /AF	4	4	5	5	5
Sweetwater Authority's Perdue WTP	Obtain 4 MGD water rights to supply North System. SDCWA Pipeline No. 3 supplies raw water to Perdue WTP. OWD would pump water from Perdue WTP into the existing North District 36 inch transmission main via a new pump station and 24 inch pipeline (OWD 2002 p 8-3)	492	5	3	4,480 AFY	TC = $16,233,000 OM =$872,000/year IWP=$1,882,000/year UN = $878 /AF	4	4	5	5	5
City of San Diego's Otay WTP	Contribute to expansion of the Otay WTP to 60 MGD capacity, and gain an additional 20 MGD of water rights to supply Otay Mesa and Central systems. A permanent pump station is planned for conveyance, which will have a capacity of 30 MGD. (OWD, 2002 pg. 1-5,6)	492	5	3	22,400 AFY	TC = $49,001,000 OM =$2,576,000/year IWP=$9,409,000/year UN = $694 /AF	4	4	5	5	5

[1] TDS values shown are not predictive. They are for comparison purposes only. On average, current TDS levels from the Combined Skinner Plants and the Helix Levy WTP are 501 mg/L and 435 mg/L, respectively, per the 2006 OWD Consumer Confidence Report. According to OWD staff members, TDS levels have ranged up to 650 mg/l periodically.

[2] TDS values are those assumed after treatment, i.e. the TDS value of water supplied to the OWD distribution system from each source.

[3] Qualitative Scale of 1-5, with 1 being the worst and 5 being the best.

[4] All costs are in current dollars.

N/A Not applicable. Qualitative scores were only applied to new supply options.

Table B-1 Supply Options Rating											
Supply Source	**Description**	**Water Quality**			**Yield**	**Affordability/Cost[4]**	**Environmental/ Institutional Scores[3]**				
		TDS[3,4] [mg/L]	**Compat. Score[3]**	**DBP Score[3]**	**[AFY]**	**TC = Total Capital, OM = operation,/ maint. IW = Imported Purchases UN= unit (per acre-ft)**	**Permitting**	**Institut. Coord.**	**Customer Acceptance**	**Regulatory Constraints**	**Technolog. Uncertainty**
SD17Agreement with City of San Diego to treat raw SDCWA water at Alvarado WTP	Raw water purchased from SDCWA would be treated at Alvarado WTP through an agreement with the City of San Diego. Treated water would be delivered via SDCWA Pipeline No. 4.	492	5	3	33,600AFY	TC = $82,445,000 OM =$4,537,000/year IWP=$14,114,000/year UN = $733 /AF	4	4	5	4	5
Imported Water from Pipeline No. 4	Buy filtered water from SDCWA to meet demands throughout the District's service area.	492	5	3	Up to capacity of existing turnouts.	See Imported Water Projected Rate Schedule Section 5	4	4	5	5	5
IIb. Additional Non-potable											
Imported Water from Pipeline No. 3	Buy raw water from SDCWA to meet irrigation demands in the Central System.	492	3	5	2,800 AFY	TC = $2,438,000 IWP =$1,476,000/year UN = $590 /AF	5	4	5	4	5
Spring Valley Stripping Plant	OWD would construct a 5 MGD stripping plant along the Spring Valley sewer trunk upstream of the Point Loma WWTP, to alleviate the existing capacity limitation. This is not in conjunction with the City of Chula Vista's plan for a stripping plant.	990	5	3	5,600 AFY	TC = $63,900,000 OM =$1,600,000/year UN = $1,117 /AF	2	4	5	3	4
Chula Vista Stripping Plant	OWD would obtain effluent rights to the City of Chula Vista's proposed stripping plant along the Spring Valley trunk sewer.	990	5	3	5,600 AFY	TC = $12,480,000 OM =$3,328,750/year UN = $756 /AF	2	4	5	3	4
City of San Diego's South Bay WRP Additional purchases only	Obtain up to 4 MGD additional delivery of SBWRP effluent.	990	5	3	4,480 AFY	Purchases Only: TC = $2,412,000 OM =$2,663,000/year UN = $633 /AF	5	4	5	5	5
City of San Diego's South Bay WRP Plant Expansion	Contribute funds to the expansion of SBWRP, to receive an additional 4 MGD of effluent.	990	5	3	4,480 AFY	TC = $40,000,000 OM =$2,190,000/year UN = $1,137 /AF	3	4	5	3	5
North District Recycled Water Concept	Create up to 1 MGD of recycled water demands in North District, which would be served by the OWD Chapman WRP. This would reduce conveyance costs that are currently incurred by pumping effluent from the Chapman WRP to the Central system. Current demands met by the Chapman WRP in the Central system would need to be satisfied by another supply option.	990	5	5	Shift 1230 AFY supply from Central to North.	TC = $7,920,000 OM =$301,125/year UN = $711 /AF	4	3	4	3	5
Expansion of Chapman WRP and sewer collection system (RWCWRP)	Expand plant from 1.1 to 2.6 MGD capacity, and ultimately 3.9 MGD capacity.	990	5	5	2,910 AFY (phase I) 4,370 AFY (phase II)	TC = $30,500,000 OM =$801,750/year UN = $1,036 /AF	4	5	4	4	5
Chapman or SVSP effluent bypassing Sweetwater Reservoir with in-lieu exchange *(This option was not evaluated in model.)*	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx

[1] TDS values shown are not predictive. They are for comparison purposes only. On average, current TDS levels from the Combined Skinner Plants and the Helix Levy WTP are 501 mg/L and 435 mg/L, respectively, per the 2006 OWD Consumer Confidence Report. According to OWD staff members, TDS levels have ranged up to 650 mg/l periodically.

[2] TDS values are those assumed after treatment, i.e. the TDS value of water supplied to the OWD distribution system from each source.

[3] Qualitative Scale of 1-5, with 1 being the worst and 5 being the best.

[4] All costs are in current dollars.

[N/A] Not applicable. Qualitative scores were only applied to new supply options.

Table B-1 Supply Options Rating											
Supply Source	**Description**	**Water Quality**			**Yield**	**Affordability/Cost[4]**	**Environmental/ Institutional Scores[3]**				
		TDS[5,6] [mg/L]	**Compat. Score[3]**	**DBP Score[3]**	**[AFY]**	**TC = Total Capital, OM = operation,/ maint. IW = Imported Purchases UN= unit (per acre-ft)**	**Permitting**	**Institut. Coord.**	**Customer Acceptance**	**Regulatory Constraints**	**Technolog. Uncertainty**
IIIc. Groundwater											
Middle Sweetwater	Conjunctive use of basin for drought groundwater storage. Recharge imported raw water purchased from SDCWA in wetter years. Extract groundwater in drier years.	492	4	5	5,000 AFY – (over 6 months)	**w/ LMSE** TC = $44,950,000 OM =$2,655,000/year IWP = $2,100,000/year UN = $1,184 / AF **No LMSE** TC = $62,200,000 OM =$3,300,,000/year IWP = $2,400,000/year UN = $1,600 / AF	3	3	4	3	3
Lower Sweetwater	Brackish groundwater demineralization.	200	3	5	1,275 AFY (assumes 85% plant efficiency)	TC = $11,250,000 OM =$942,000/year UN = $1,184 / AF	2	3	4	3	3
Santee/ El Monte Conjunctive Use	Conjunctive use of basin for drought groundwater storage. Recharge imported raw water purchased from SDCWA in wetter years. Extract groundwater in drier years.	492	4	5	5,000 AFY (over 6 months)	**w/ LMSE** TC = $41,950,000 OM =$2,675,000/year IWP = $2,100,000/year UN = $1,145 / AF **No LMSE** TC = $64,000,000 OM =$3,160,000/year IWP = $2,100,000/year UN = $1,562 / AF	3	3	4	3	3
Santee/El Monte Brackish Groundwater Demineralization	Brackish groundwater demineralization.	200	3	5	4,250 AFY (assumes 85% plant efficiency)	**w/ LMSE** TC = $32,390,000 OM =$2,863,000/year UN = $688 / AF **No LMSE** TC = $63,702,000 OM =$3,593,000/year UN = $1,084 / AF	2	3	4	3	3
San Diego Formation Brackish Groundwater Demineralization	Brackish groundwater demineralization.	200	3	5	2,175 AFY (assumes 85% plant efficiency)	TC = $22,525,000 OM =$1,679,000/year UN = $1,362 / AF	2	3	4	3	3
Otay Mountain Well for Recycled Use	Minimum yield of 1000 gpm (1,612 AFY) , per Agreement between OWD and D&D Landholdings.	200	3	5	1,612 AFY	TC = $12,380,000 OM =$970,000/year UN = $1,364 / AF	3	4	4	3	3
Tijuana River Valley Aquifer Reclaimed Water Storage And Recovery *(This option was not evaluated in model)*	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
New well NE of Otay Mesa Yard Well *(This option was not evaluated in model)*	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx

[1] TDS values shown are not predictive. They are for comparison purposes only. On average, current TDS levels from the Combined Skinner Plants and the Helix Levy WTP are 501 mg/L and 435 mg/L, respectively, per the 2006 OWD Consumer Confidence Report. According to OWD staff members, TDS levels have ranged up to 650 mg/l periodically.

[2] TDS values are those assumed after treatment, i.e. the TDS value of water supplied to the OWD distribution system from each source.

[3] Qualitative Scale of 1-5, with 1 being the worst and 5 being the best.

[4] All costs are in current dollars.

[N/A] Not applicable. Qualitative scores were only applied to new supply options.

Table B-1 Supply Options Rating											
Supply Source	**Description**	**Water Quality**			**Yield**	**Affordability/Cost[4]**	**Environmental/ Institutional Scores[3]**				
		TDS[7,8] [mg/L]	**Compat. Score[3]**	**DBP Score[3]**	**[AFY]**	**TC = Total Capital, OM = operation,/ maint. IW = Imported Purchases UN= unit (per acre-ft)**	**Permitting**	**Institut. Coord.**	**Customer Acceptance**	**Regulatory Constraints**	**Technolog. Uncertainty**
Rancho Del Rey Well *(This option was not evaluated in model)*	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Daley Ranch Well (North District) *((This option was not evaluated in model)*	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
IIId. Ocean Desalination											
Poseidon's Carlsbad Seawater Desalination Project (in lieu)	OWD to participate in regional desalination project. Purchase water from Poseidon Resources desal plant to be delivered "in lieu" as SDCWA water through Pipeline No. 4.	492	3	3	11,200 AFY	UN = $1,300/AF	5	2	5	4	5
Southern California Partnership: Sweetwater/City of SD's South Bay project next to power plant	OWD to participate in regional desalination project. Contribute funds for capacity at South Bay desal plant. Conveyance infrastructure required. Varying degrees of participation possible – 20 MGD assumed here.	200	3	5	***Varies*** 22,400 AFY 11,200 AFY or 5,600 AFY	***20 MGD*** TC = $186,164,400 OM =$49,185,000/year UN = $2,800 /AF ***10 MGD*** TC = $98,509,600 OM =$24,700,076/year UN = $2,850 /AF ***5 MGD*** TC = $55,307,200 OM =$12,460,038/year UN = $2,950 /AF	1	3	4	2	4
Binational Partnership: Rosarito Financial Partnership with In-lieu Colorado River water	OWD to contribute funds for capacity at Rosarito desalination plant. Ocean water would be treated and used locally in Rosarito. OWD would be provided with in lieu water from Mexican allocation of Colorado River water.	492	3	3	5,600 AFY	TC = $36,349,000 OM =$4,865,555/year UN = $897 /AF	3	2	4	4	5
Binational Partnership: Rosarito Joint Facility *(This option was not evaluated in model)*	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Southern California Partnership: Sweetwater/City of SD Otay River ocean wells *(This option was not evaluated)*	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
IIIe. Conservation	Reduce long-term urban water demands by reducing consumption, providing incentives for consumers, establishing education/information programs, and addressing conservation at institutional/managerial levels.	200	5	5	See Water Conservation Section 5.1	See Water Conservation Cost Schedule Section 5.1	5	5	3	5	4
IIIf. Water Transfers/Banking	Long term water exchanges during dry years.										
North of Delta Banking	Least expensive, yet potentially unreliable due to conveyance through environmentally sensitive Bay-Delta.	492	5	3	5,000 AFY	See Imported Water Projected Rate Schedule Section 5	5	3	5	5	5
Central Valley Groundwater	Generally more expensive, but also more reliable. Exchange water available from agricultural programs.	492	5	3	Up to 15,000 AFY		4	3	5	5	5
Land Fallowing	Annual availability of agricultural water rights for other uses. Generally reliable, but OWD would not have priority access.	492	5	3	Up to 15,000 AFY		3	3	5	5	5

References

OWD. 2005. Urban Water Management Plan.
OWD. 2002. Water Resources Master Plan.
"Helix Agreement." 2005. Agreement between the San Diego County Water Authority and Otay Water district Regarding Implementation of the East County Regional Treated Water Improvement Program.
"SBWRP Agreement." 2003. Agreement between the Otay Water District and the City of San Diego for Purchase of Reclaimed Water from the South Bay Water Reclamation Plant.

[1] TDS values shown are not predictive. They are for comparison purposes only. On average, current TDS levels from the Combined Skinner Plants and the Helix Levy WTP are 501 mg/L and 435 mg/L, respectively, per the 2006 OWD Consumer Confidence Report. According to OWD staff members, TDS levels have ranged up to 650 mg/l periodically.

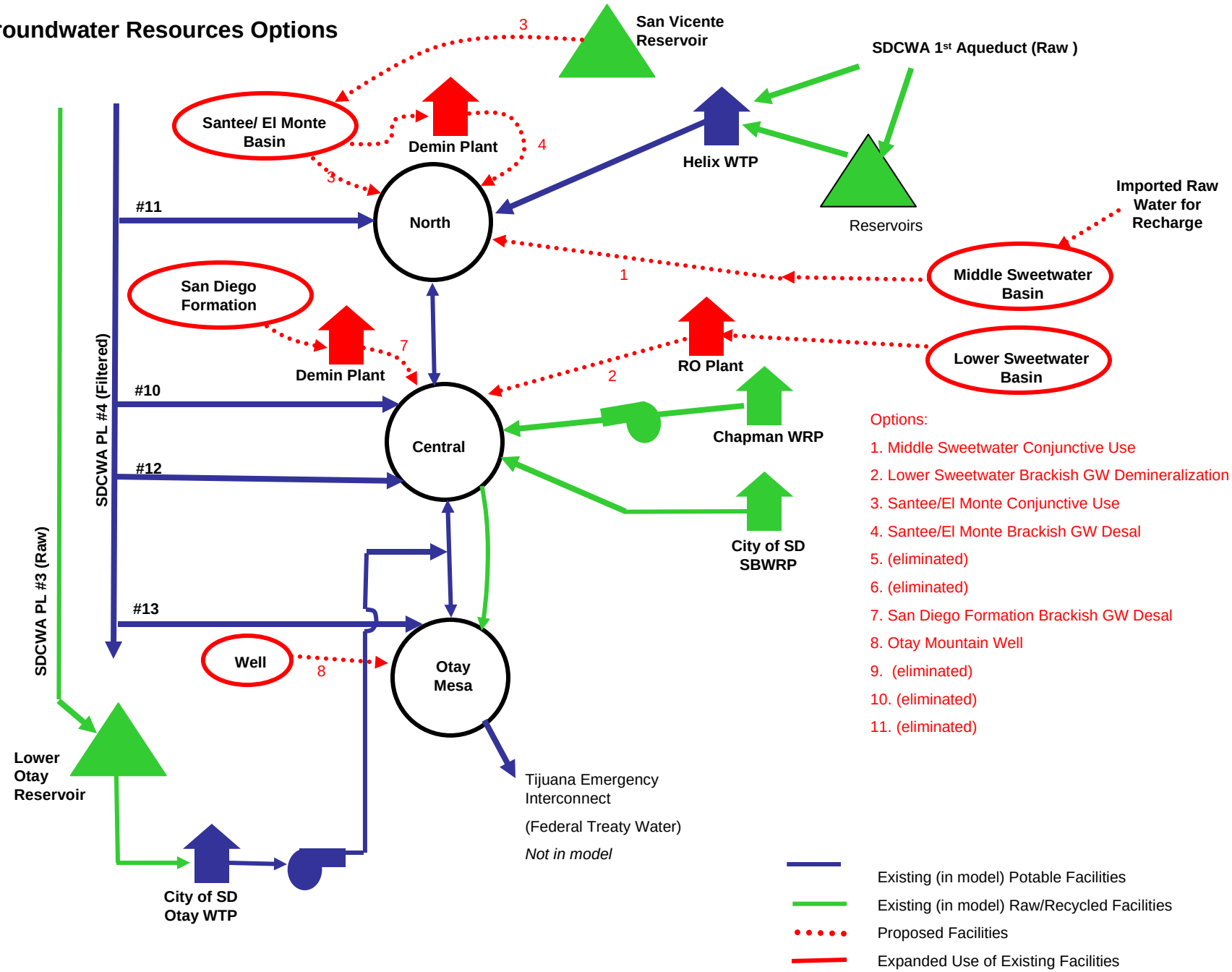
[2] TDS values are those assumed after treatment, i.e. the TDS value of water supplied to the OWD distribution system from each source.

[3] Qualitative Scale of 1-5, with 1 being the worst and 5 being the best.

[4] All costs are in current dollars.

[N/A] Not applicable. Qualitative scores were only applied to new supply options.

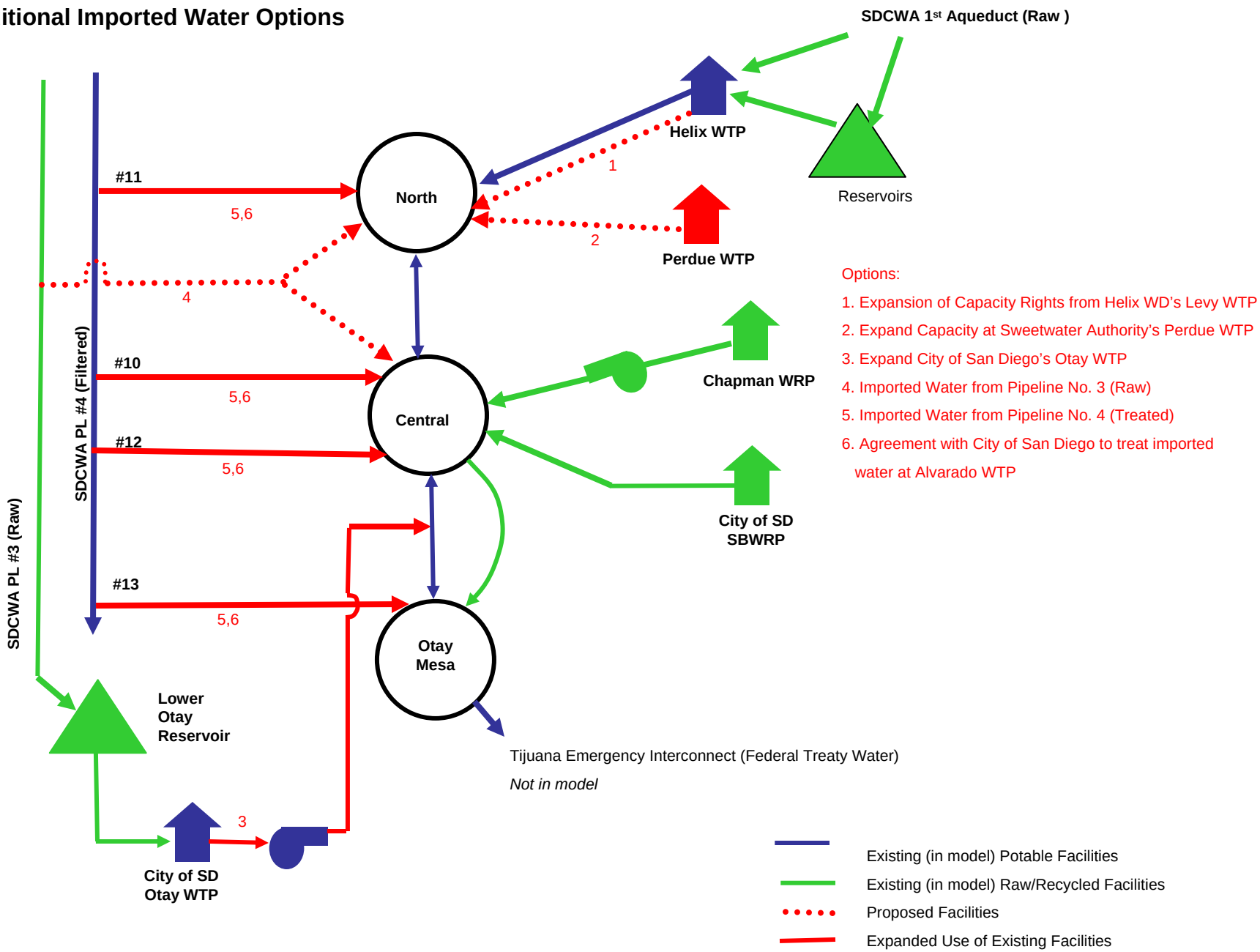
Groundwater Resources Options



Options:

1. Middle Sweetwater Conjunctive Use
2. Lower Sweetwater Brackish GW Demineralization
3. Santee/El Monte Conjunctive Use
4. Santee/El Monte Brackish GW Desal
5. (eliminated)
6. (eliminated)
7. San Diego Formation Brackish GW Desal
8. Otay Mountain Well
9. (eliminated)
10. (eliminated)
11. (eliminated)

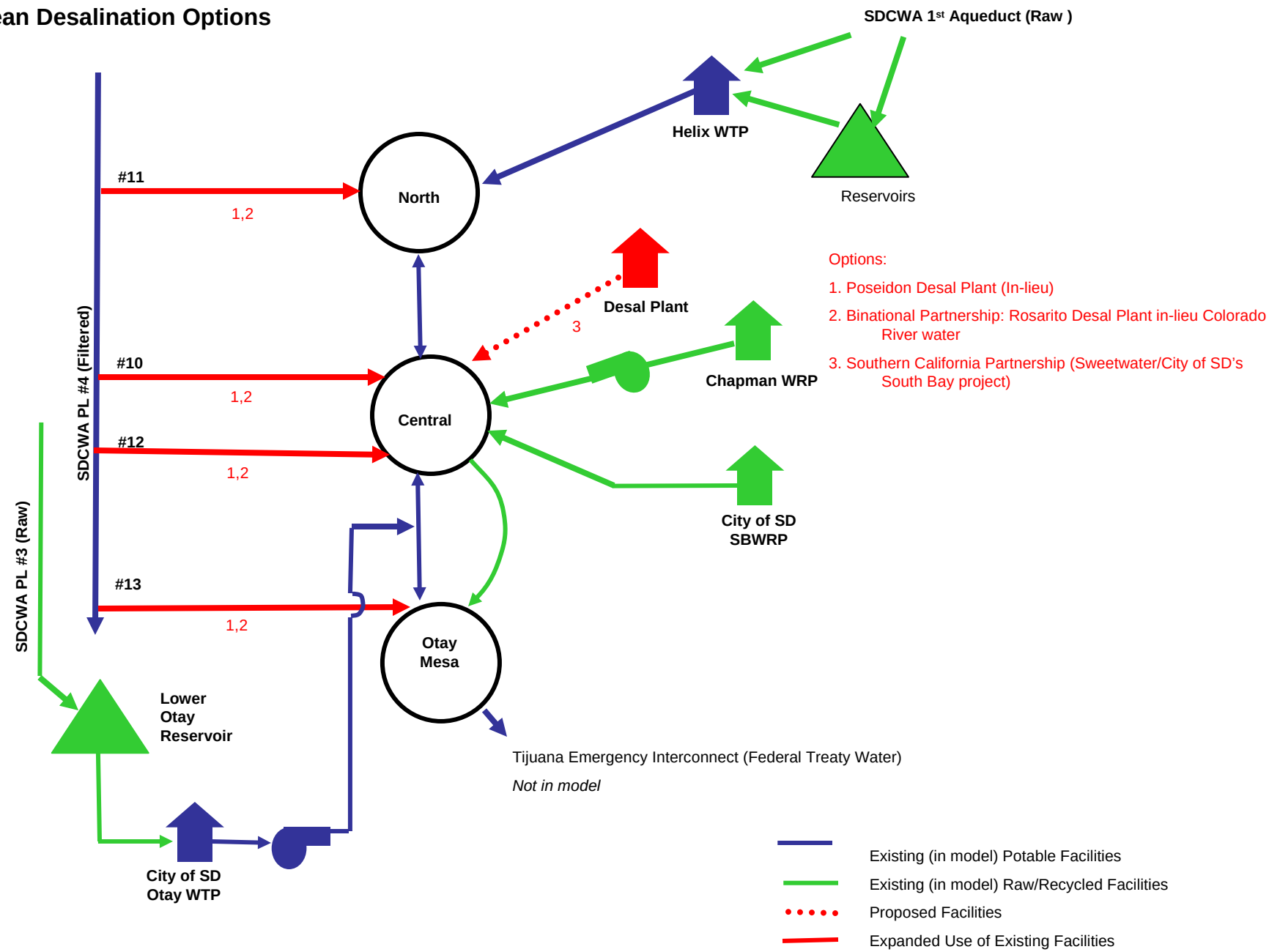
Additional Imported Water Options



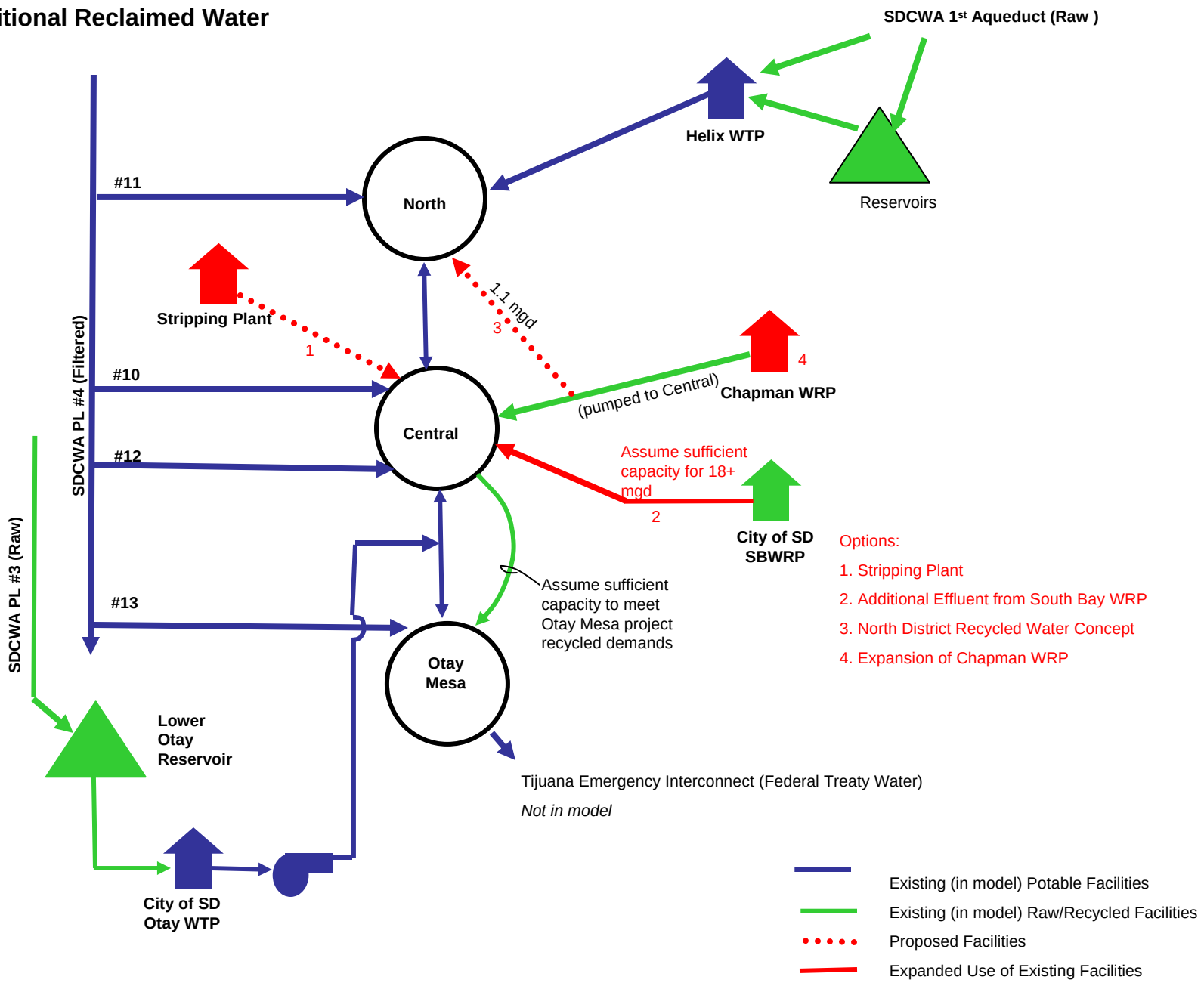
Options:

1. Expansion of Capacity Rights from Helix WD's Levy WTP
2. Expand Capacity at Sweetwater Authority's Perdue WTP
3. Expand City of San Diego's Otay WTP
4. Imported Water from Pipeline No. 3 (Raw)
5. Imported Water from Pipeline No. 4 (Treated)
6. Agreement with City of San Diego to treat imported water at Alvarado WTP

Ocean Desalination Options



Additional Reclaimed Water



Appendix C

Supply Option Cost Estimates

Appendix C
Supply Option Cost Estimates

Planning level cost estimates were developed for all of the supply options considered in the IRP. For each option, the costs of major infrastructure and facilities components were estimated, including: conveyance (pipelines, pumping), storage, treatment and waste disposal, and service connections and meters. Additionally, operational costs were estimated, including: imported water purchases, energy costs, and capacity fees. In the sections that follow, the major facilities and infrastructure required for the supply options are tabulated with their respective capital and annual O&M costs. Relevant notes concerning the specific cost estimates are also included.

The cost estimates for other options were developed using recent experience with similar projects for the given facility or piece of infrastructure (i.e. pipelines, pump stations, RO plants, ocean outfalls, etc.). Table C-1 shows a list of the major unit cost assumptions used in the estimates.

Table C-1
Per unit Cost Assumptions

Capital Cost Assumptions	
$20	per inch diameter, per foot of pipe (loaded)
$2,500	per horsepower capacity
$3	per gal per day of brackish groundwater RO treatment (loaded)
$6	per gal per day of ocean RO desalination treatment (loaded)
$750,000	per new extraction well (excluding site acquisition costs)
$1,435	per meter of ocean outfall line
$700,000	per acre for land acquisition
85%	Efficiency of RO treatment for brackish groundwater desalination
50%	Efficiency of RO treatment for ocean desalination
O&M Cost Assumptions	
2%	of Capital cost for pipe maintenance
2%	of Capital cost for pump maintenance
$0.11	per kw-hr pumping costs
$400	per AFY of brackish groundwater RO treatment (loaded)
$850	per AFY of ocean RO desalination treatment (loaded)
$725,000	per MG (operating cost for brine discharge)

Option Unit Cost Calculation

The unit cost (dollar per acre-foot) was calculated for each option, which incorporates both capital and operation and maintenance (O&M) costs. The method used to calculate option unit cost differs from the method later discussed in Section 7 to calculate portfolio unit cost. For portfolios, several options are used in conjunction with each other to meet future increasing demands, and a particular option may not necessarily be used to its full capacity at all times. In order to account for varying use of options over time, the unit cost of the portfolios was calculated assuming the net present value of incremental costs of new water over the entire planning horizon.

For options, in order to compare them independently for portfolio development, the unit cost is calculated based on the entire potential yield of the option. Also, the operation and maintenance in today's dollars was used, rather than inflating the O&M costs over time. The option capital cost was amortized at a 6% interest rate, assuming a payment period of 30 years. The total annual cost (capital and O&M) was then divided by the option's potential annual yield to calculate the unit cost in dollars per acre-foot.

Imported Water Costs
See Section 5 for a discussion on imported water costs.

C.1 Conservation of Water

See discussion in Section C.1.

C.2 Groundwater Options

C.2.1 Middle Sweetwater Conjunctive Use

The La Mesa Sweetwater Extension (LMSE) is a pipeline that runs from Helix Water District's Levy WTP through OWD's North District and to the Sweetwater Reservoir. Currently the LMSE delivers potable water from the Levy plant to OWD as an alternative source when Pipeline No. 4 is out of service. In the future, the LMSE may become available for use with other supply options, including: Middle Sweetwater and Santee/El Monte.

Assuming the use of the LMSE to convey water for groundwater recharge, the total capital cost of this option is estimated at $44,950,000, and the annual operation and maintenance costs are approximately $2,655,000/year. The unit cost of this option is $1,184/AF.

If the LMSE is not available for use, additional conveyance infrastructure would be required to bring raw water from the SDCWA Pipeline No. 3 to the basin for recharge. In this case, the total capital cost of this option is estimated at $65,187,000, and the annual operation and maintenance costs are approximately $3,307,400/year. The unit cost of this option is $1,609/AF.

The capital and O&M components of the options with and without use of the LMSE are presented in Table C-2 and Table C-3.

Table C-2 Cost Summary: Middle Sweetwater Conjunctive Use (with LMSE)			
	unit description	**Capital [$]**	**O&M [$/yr]**
Conjuctive Use			
Conveyance to Middle Sweetwater Basin	*16,000 ft of 24 in pipe*	$7,680,000	$150,000
Infiltration Basins	*2 basins, 40 acres*	$1,480,000	$30,000
Extraction			
Extraction Wells	*6 @ 1,000 gpm*	$4,500,000	$210,000
Conveyance of Recovered Water	*2,500 ft of 22 in pipe; 300 HP pump*	$1,850,000	$125,000
Monitoring Wells	*2 @ 4 in dia.*	$40,000	$40,000
Land Acquisition	*42 acres*	$29,400,000	
Cost of Imported Water	*5,000 AFY*		$2,100,000
TOTAL		**$44,950,000**	**$2,655,000**

Table C-3 Cost Summary: Middle Sweetwater Conjunctive Use (No LMSE)			
	unit description	**Capital [$]**	**O&M [$/yr]**
Conjuctive Use			
Tie-in to Pipelin No. 3	*1*	$500,000	
Conveyance to Middle Sweetwater Basin	*54,900 ft of 24 in pipe*	$26,357,760	$530,000
Infiltration Basins	*2 basins, 40 acres*	$1,480,000	$30,000
Extraction			
Extraction Wells	*6 @ 1,000 gpm*	$4,500,000	$210,000
Conveyance of Recovered Water	*5,280 ft of 24 in pipe; 150 HP pump*	$2,909,400	$97,500
Monitoring Wells	*2 @ 4 in dia.*	$40,000	$40,000
Land Acquisition	*42 acres*	$29,400,000	
Cost of Imported Water	*5,714 AFY*		$2,399,901
TOTAL		**$65,187,160**	**$3,307,401**

C.2.2 Lower Sweetwater Brackish Groundwater Demineralization

The total capital cost of this option is estimated at $11,250,000, and the annual operation and maintenance costs are approximately $942,000/year. The unit cost of this option is $1,184/AF. The capital and O&M components of the option are presented in Table C-4 below.

Table C-4 Costs Summary: Lower Sweetwater Brackish Groundwater Demineralization			
	unit description	**Capital [$]**	**O&M [$/yr]**
Desalination			
Extraction Wells	*1 @ 1,000 gpm*	$750,000	$50,000
RO Plant	*1.1 MGD*	$3,410,000	$510,000
Conveyance of Recovered Water	*5,000 ft of 10 in pipe; 80 HP pump*	$1,200,000	$64,000
Brine Removal (0.2 MGD)	*5,000 ft of 4 in pipe; 20 HP pump*	$4,467,067	$298,000
Land Acquisition	*2 acres*	$1,400,000	
Monitoring Wells	*1 @ 4 in dia.*	$20,000	$20,000
TOTAL		**$11,247,067**	**$942,000**

C.2.3 Santee/El Monte Basin

The La Mesa Sweetwater Extension (LMSE) is a pipeline that runs from Helix Water District's Levy WTP through OWD's North District and to the Sweetwater Reservoir. Currently the LMSE delivers potable water from the Levy plant to OWD as an alternative source when Pipeline No. 4 is out of service. In the future, the LMSE may become available for use with other supply options, including: Middle Sweetwater and Santee/El Monte.

C.2.3.1 Santee/El Monte Conjunctive Use

Assuming the use of the LMSE to convey recovered water to the North system, the total capital cost of this option is estimated at $41,950,000, and the annual operation and maintenance costs are approximately $2,675,000/year. The unit cost of this option is $1,145/AF.

If the LMSE is not available for use, additional conveyance infrastructure would be required from the basin to the North system. In this case, the total capital cost of this option is estimated at $64,009,600, and the annual operation and maintenance costs are approximately $3,160,000/year. The unit cost of this option is $1,562/AF.

The capital and O&M components of the options with and without use of the LMSE are presented in Table C-5 below and Table C-6 on the following page.

Table C-5
Cost Summary: Santee/El Monte Conjunctive Use (with LMSE)

	unit description	Capital [$]	O&M [$/yr]
Conjunctive Use			
Conveyance to Basin*,**	*2,500 ft of 24 in pipe*	$1,200,000	$20,000
Infiltration Basins	*2 basins, 40 acres*	$1,480,000	$30,000
Extraction Wells	*6 @ 1,000 gpm*	$4,500,000	$250,000
Conveyance of Recovered Water**	*8,500 ft of 24 in pipe; 500 HP pump*	$5,330,000	$235,000
Cost of Imported Water	*5,000 AFY*		$2,100,000
Land Acquisition	*42 acres*	$29,400,000	
Monitoring Wells	*2 @ 4 in dia.*	$40,000	$40,000
TOTAL		**$41,950,000**	**$2,675,000**

* Assume zero costs for existing infrastructure
** Assume pumping costs are zero for existing infrastructure

Table C-6 Cost Summary: Santee/El Monte Conjunctive Use (No LMSE)			
	unit description	**Capital [$]**	**O&M [$/yr]**
Conjunctive Use			
Conveyance to Basin*,**	*2,500 ft of 24 in pipe*	$1,200,000	$20,000
Infiltration Basins	*2 basins, 40 acres*	$1,480,000	$30,000
Extraction Wells	*6 @ 1,000 gpm*	$4,500,000	$250,000
Conveyance of Recovered Water**	*56,000 ft of 24 in pipe; 200 HP pump*	$27,389,600	$720,000
Cost of Imported Water	*5,000 AFY*		$2,100,000
Land Acquisition	*42 acres*	$29,400,000	
Monitoring Wells	*2 @ 4 in dia.*	$40,000	$40,000
TOTAL		**$64,009,600**	**$3,160,000**

* Assume zero costs for existing infrastructure
** Assume pumping costs are zero for existing infrastructure

C.2.3.2 Santee/El Monte Brackish Groundwater Demineralization

Assuming the use of the LMSE to convey recovered water to the North system, the total capital cost of this option is estimated at $32,390,000, and the annual operation and maintenance costs are approximately $2,863,000/year. The unit cost of this option is $688/AF.

If the LMSE is not available for use, additional conveyance infrastructure would be required from the basin to the North system. In this case, the total capital cost of this option is estimated at $63,702,000, and the annual operation and maintenance costs are approximately $3,593,000/year. The unit cost of this option is $1,084/AF.

The capital and O&M components of the options with and without use of the LMSE are presented in Table C-7 and Table C-8 on the following page.

Table C-7 Cost Summary: Santee/El Monte Brackish Groundwater Demineralization (with LMSE)			
	unit description	**Capital [$]**	**O&M [$/yr]**
Desalination			
Extraction Wells	*3@ 1,000 gpm*	$2,250,000	$120,000
RO Plant	*3.8 MGD*	$11,380,000	$1,700,000
Conveyance of desalinated water	*10,000 ft of 16 in pipe; 60 HP pump*	$3,350,000	$83,000
Brine Removal (0.7 MGD)	*4,000 ft of 6 in pipe; 40 HP*	$13,970,225	$920,000
Land Acquisition	*2 acres*	$1,400,000	
Monitoring Wells	*2 @ 4 in dia.*	$40,000	$40,000
TOTAL		**$32,390,225**	**$2,863,000**

Table C-8 Cost Summary: Santee/El Monte Brackish Groundwater Demineralization (No LMSE)			
	unit description	**Capital [$]**	**O&M [$/yr]**
Desalination			
Extraction Wells	*3@ 1,000 gpm*	$2,250,000	$120,000
RO Plant	*3.8 MGD*	$11,380,000	$1,700,000
Conveyance of desalinated water	*57,520 ft of 30 in pipe; 60 HP pump*	$34,662,000	$813,000
Brine Removal (0.7 MGD)	*4,000 ft of 6 in pipe; 40 HP*	$13,970,225	$920,000
Land Acquisition	*2 acres*	$1,400,000	
Monitoring Wells	*2 @ 4 in dia.*	$40,000	$40,000
TOTAL		**$63,702,225**	**$3,593,000**

C.2.3.2 Santee/El Monte Brackish Combined Conjunctive Use and Brackish Groundwater Demineralization

This option combines the Conjunctive Use and Brackish Groundwater Demineralization projects described above, although each project would operate independently of the other. As there would be no shared infrastructure (other than the conveyance to the North system), the capital and O&M costs for a combined project would essentially be a summation of the total costs for the conjunctive use project and the total costs for the groundwater desalination project.

If the use of the LMSE is not available for use, the new conveyance infrastructure required to bring product water to the North system should be sized for the combined flow of the Conjunctive Use and Brackish Groundwater Demineralization projects.

C.2.3 San Diego Formation Brackish Groundwater Desalination

The total capital cost of this option is estimated at $22,525,000, and the annual operation and maintenance costs are approximately $1,679,000/year. The unit cost of this option is $1,362. The capital and O&M components of the option are presented in Table C-9 below.

Table C-9 Cost Summary: San Diego Formation Brackish Groundwater Desalination			
	unit description	**Capital [$]**	**O&M [$/yr]**
Desalination			
Extraction Wells	*3 @ 500 gpm*	$4,500,000	$210,000
RO Plant	*1.9 MGD*	$5,690,000	$850,000
Conveyance of Recovered Water	*18,500 ft of 10 in pipe; 100 HP pump*	$3,950,000	$115,000
Brine Removal (0.3 MGD)	*2,500 ft of 4 in pipe; 20 HP pump*	$6,945,112	$464,000
Land Acquisition	*2 acres*	$1,400,000	
Monitoring Wells	*2 @ 4 in dia.*	$40,000	$40,000
TOTAL		**$22,525,112**	**$1,679,000**

C.2.4 Tijuana River Valley Aquifer Reclaimed Water Conjunctive Use

This option was not evaluated. See Section C.2.4.

C.2.5 Other Groundwater Wells

C.2.5.1 Otay Mountain Well

The total capital cost of this option is estimated at $12,380,000, and the annual operation and maintenance costs are approximately $970,000/year. The unit cost of this option is $1,364. The capital and O&M components of the option are presented in Table C-10 below.

Table C-10
Cost Summary: Otay Mountain Well

	unit description	Capital [$]	O&M [$/yr]
Extraction Wells	*1 @ 1,000 gpm*	$750,000	$40,000
RO Treatment	*1.2 MGD*	$3,670,000	$550,000
Conveyance of Recovered Water	*12,200 ft of 10 in pipe; 200 HP pump*	$2,940,000	$90,000
Brine Removal (0.2 MGD)	*assume disposal sanitary sewer*	$4,317,008	$290,000
Land Acquisition	*1 acre*	$700,000	
TOTAL		**$12,377,008**	**$970,000**

C.3 Additional Recycled Options

C.3.1 Spring Valley Stripping Plant

The unit cost of this option is $1,117/AF. Total capital costs would be approximately $63,900,000 with annual O&M costs of about $1,600,000. The capital and O&M components of the option are presented in Table C-11 below.

Table C-11
Cost Summary: Spring Valley Stripping Plant

	unit description	Capital [$]	O&M [$/yr]
Stripping Plant	*5 MGD*	$50,000,000	$1,368,750
Land Acquisition	*2 acres*	$1,400,000	
Piping to Central System	*26,000 ft of 24 in pipe*	$12,480,000	$249,600
TOTAL		**$63,880,000**	**$1,618,350**

C.3.2 Chula Vista Stripping Plant

The unit cost of this option is $756/ AF. Total capital costs would be approximately $12,500,000 with annual O&M costs of about $3,300,000. The capital and O&M components of the option are presented in Table C-12.

Table C-12 Cost Summary: Chula Vista Stripping Plant			
	unit description	**Capital [$]**	**O&M [$/yr]**
Purchase of RW from City of Chula Vista	*5,600 AFY*		$1,960,000
24-inch piping to Central System	*26,000 ft of 24 in pipe*	$12,480,000	$1,368,750
TOTAL		**$12,480,000**	**$3,328,750**

C.3.3 Additional Purchases from South Bay WRP

The unit cost per acre-foot for this option is estimated at $633. Total capital costs would be approximately $2,400,000 with annual O&M costs of about $2,700,000. The capital and O&M components of the option are presented in Table C-13 below.

Table C-13 Cost Summary: Additional Purchases from South Bay WRP			
	unit description	**Capital [$]**	**O&M [$/yr]**
Agreement with City of San Diego		$0	$0
Purchase of RW from SBWRP	*4,480 AFY*		$1,568,000
Capacity Reservation Charge (One Time)	*4,480 AFY*	$2,412,000	$0
Pumping from SBWRP to Reservoir 450-1	based on $1.50/1000 gallons--half of flow		$1,095,000
TOTAL		**$2,412,000**	**$2,663,000**

C.3.4 Expansion of South Bay WRP

The unit cost of this option is $1,137/ AF. Total capital costs would be approximately $40,000,000 with annual O&M costs of about $2,200,000. The capital and O&M components of the option are presented in Table C-14 below.

Table C-14 Cost Summary: Expansion of South Bay WRP			
	unit description	**Capital [$]**	**O&M [$/yr]**
South Bay Plant Expansion	*4 MGD*	$40,000,000	$1,095,000
Pumping from SBWRP to Reservoir 450-1	based on $1.50/1000 gallons--half of flow		$1,095,000
TOTAL		**$40,000,000**	**$2,190,000**

C.3.5 Chapman WRP and /or Spring Valley Stripping Plant Recycled Water to Lower Sweetwater Basin and Downstream Well Recovery:

This option was not evaluated. See Section C.3.5.

C.3.6 North District Recycled Water Concept

The unit cost of this option is $711/AF. Total capital costs would be approximately $7,900,000 with annual O&M costs of about $300,000. Note that these values do not

accurately reflect the true costs of the option, as the costs for an alternative water supply to the users in Eastern Chula Vista are not included. The capital and O&M components of the option are presented in Table C-15 below.

Table C-15
Cost Summary: North District Recycled Water Concept

	unit description	Capital [$]	O&M [$/yr]
Piping to Central System	*33,000 ft of 12 in pipe*	$7,920,000	$301,125
TOTAL		**$7,920,000**	**$301,125**

C.3.7 Expansion of Chapman WRP and Sewer Collection System

The unit cost of this option is $1,036/AF. Total capital costs would be approximately $30,500,000 with annual O&M costs of about $800,000. The capital and O&M components of the option are presented in Table C-16 below.

Table C-16
Cost Summary: Expansion of Chapman WRP and Sewer Collection System

	unit description	Capital [$]	O&M [$/yr]
R.W. Chapman Plant Expansion- Phase 1	*1.3 MGD*	$13,000,000	$355,875
R.W. Chapman Plant Expansion- Phase 2	*1.3 MGD*	$13,000,000	$355,875
Parallel piping	*18,750 ft of 12 in piping*	$4,500,000	$90,000
TOTAL		**$30,500,000**	**$801,750**

C.4 Ocean Desalination Options

C.4.1 Poseidon's Carlsbad Seawater Desalination Project

A per-acre-foot unit cost of $1,300 was assumed for this option. This includes the operational seawater treatment costs and the in-lieu exchange transportation costs. There would be no capital costs associated with this option. Conveyance costs may be necessary to deliver the desalinated water to the third party, but are not included for this evaluation.

C.4.2 Southern California Partnership: Sweetwater/City of San Diego South Bay Project

Three levels of participation were considered for this option: 20 MGD, 10 MGD, and 5 MGD. Cost estimates were developed for each of these levels and are presented in the tables that follow.

Table C-17 Cost Comparison for Different Levels of Participation in the Southern California Partnership: Sweetwater/City of San Diego South Bay Project			
Level of Participation	**Unit Cost ($/AF)**	**Capital Cost ($)**	**O&M Cost ($/yr)**
20 MGD	$2,800	$186,164,400	$49,185,153
10 MGD	$2,850	$98,509,600	$24,700,076
5 MGD	$2,950	$55,307,200	$12,460,038

Table C-18 Cost Summary: Southern California Partnership: Sweetwater/City of San Diego South Bay Project (20 MGD)			
	unit description	**Capital [$]**	**O&M [$/yr]**
RO Plant	*20 MGD*	$130,000,000	$19,042,342
Brine Disposal	*20 MGD*	$0	$26,637,811
Conveyance			
Pipeline	*47,520 ft of 36 in pipe*	$34,214,400	$680,000
Pumping	*4000 HP*	$21,250,000	$2,825,000
Land Acquisition	*2 acres*	$700,000	
TOTAL		**$186,164,400**	**$49,185,153**

Table C-19 Cost Summary: Southern California Partnership: Sweetwater/City of San Diego South Bay Project (10 MGD)			
	unit description	**Capital [$]**	**O&M [$/yr]**
RO Plant	*10 MGD*	$65,000,000	$9,521,171
Brine Disposal	*10 MGD*	$0	$13,318,906
Conveyance			
Pipeline	*47,520 ft of 24 in pipe*	$22,809,600	$460,000
Pumping	*8500 HP*	$10,000,000	$1,400,000
Land Acquisition	*1 acre*	$700,000	
TOTAL		**$98,509,600**	**$24,700,076**

Table C-20 Cost Summary: Southern California Partnership: Sweetwater/City of San Diego South Bay Project (5 MGD)			
	unit description	**Capital [$]**	**O&M [$/yr]**
RO Plant	*5 MGD*	$32,500,000	$4,760,585
Brine Disposal	*5 MGD*	$0	$6,659,453
Conveyance			
Pipeline	*47,520 ft of 18 in pipe*	$17,107,200	$340,000
Pumping	*2000 HP*	$5,000,000	$700,000
Land Acquisition	*1 acre*	$700,000	
TOTAL		**$55,307,200**	**$12,460,038**

C.4.3 Bi-National Partnership: Rosarito Financial Partnership with In-lieu Colorado River Water

The unit cost of this option is $897 / AF. Total capital costs would be approximately $36,349,000 with annual (2006) O&M costs of about $4,865,555. The capital and O&M components of the option are presented in Table C-21 below.

Table C-21
Cost Summary: Bi-National Partnership: Rosarito Financial Partnership with In-lieu[1] Colorado River Water

	unit description	Capital [$]	O&M [$/yr]
RO Plant	*5 MGD*	$32,500,000	$4,760,585
Ocean Outfall	*8,000 ft of 12 in outfall*	$3,499,000	$104,970
Land Acquisition	*1 acre*	$350,000[2]	
TOTAL		**$36,349,000**	**$4,865,555**

[1]In-Lieu water deliveries are subject to SDCWA transport and wheeling charges. See Section 5.
[2]Assumes the cost of land in Mexico is 50% of the cost of land in the United States.

C.5 Additional Imported Water Options with Local Treatment Agreements

Refer to Figure 5-1 for the projected imported raw water purchase rates from SDCWA, which are discussed in the following sections.

C.5.1 Expansion of Capacity Rights from Helix Water District's Levy WTP

Costs for this option would include the expanded plant capacity participation purchase at Levy WTP, and the cost for imported SDCWA purchases treated at Levy which is equivalent to the SDCWA treated water rate. The unit cost of this option is $744 / AF. Total capital costs would be approximately $12,300,000 with annual O&M costs for the purchase of imported water of about $2,400,000.

Table C-22
Cost Summary: Expansion of Capacity Rights from Helix Water District's Levy WTP

	Capital [$]	O&M [$/yr]
Levy WTP Supply Participation/Purchase	$12,276,911	
Imported Treated Water from SDCWA		$2,441,900
TOTAL	**$12,276,911**	**$2,441,900**

C.5.2 Expansion of Capacity at City of San Diego's Otay WTP

The unit cost of this option is $694 / AF. Total capital costs would be approximately $49,000,000 for with annual O&M costs of about $12,000,000.

Table C-23
Cost Summary: Expansion of Capacity at City of San Diego's Otay WTP

	Capital [$]	O&M [$/yr]
Otay WTP Capacity Increase	$49,000,817	
Imported Raw Water		
Treatment at Otay WTP		$2,016,248
Pumping from Otay WTP to Cent. and OM		$560,069
Purchases from SDCWA		$9,409,157
TOTAL	**$49,000,817**	**$11,985,474**

C.5.3 Imported Water from Sweetwater Authority's Perdue WTP

The net present value unit cost of this option is $878 / AF. Total capital costs would be approximately $16,200,000 with annual O&M costs of about $2,700,000.

Table C-24
Cost Summary: Imported Water from Sweetwater Authority's Perdue WTP

	Capital [$]	O&M [$/yr]
Pipeline from Perdue WTP to existing 36-inch transmission main (24 in)	$1,695,622	
Perdue WTP pump station (3000 gpm)	$2,260,830	
Perdue WTP Capacity Participation/Purchase	$12,276,911	
Imported Raw Water		
Purchases from SDCWA		$1,881,831
Treatment at Perdue WTP		$358,444
Conveyance (energy for pumping)		$313,639
Maintenance		$199,795
TOTAL	**$16,233,364**	**$2,753,709**

C.5.4 Imported Water from the City of San Diego's Alvarado WTP

The unit cost of this option is $733 / AF. Total capital costs would be approximately $82,400,000 with annual O&M costs including the purchase of imported water of about $18,600,000.

Table C-25 Cost Summary: Imported Water from the City of San Diego's Alvarado WTP		
	Capital [$]	**O&M [$/yr]**
Alvarado WTP Supply Participation/Purchase*	$69,445,131	
Pump Station SD17**	$13,000,000	
Imported Raw Water		
Purchases from SDCWA		$14,113,736
Treatment Fee at Alvarado WTP		$3,024,372
Conveyance (energy for pumping SD17)		$1,512,186
TOTAL	**$82,445,131**	**$18,650,293**

* Information since the IRP analysis has indicated that there would be no participation/purchase cost for the Alvarado imported water option. This supply option performed well regardless of the initially assumed participation cost, and its newer lower cost would only help its performance.
** The City of SD estimated the cost of SD17 to be $20M. However, they have been issued grant funding. Assume OWD would contribute $8M (per Jim Peasley).

C.6 Imported Raw Water from SDCWA Pipeline No. 3 for Irrigation

The unit cost of this option is $590/AF. Total capital costs would be approximately $2,400,000 with annual O&M costs including the purchase of imported water of about $1,500,000.

Table C-26 Cost Summary: Imported Raw Water from SDCWA Pipeline No. 3 for Irrigation		
	Capital [$]	**O&M [$/yr]**
Modifications to Flow Balancing Structure: Pipelines No. 3 & 4	$812,500	
Modifications to San Diego 5 Take off structure	$812,500	
Tie-in to Pipeline No. 3	$812,500	
Imported Raw Water Purchases from SDCWA		$1,176,145
Min Flow Requirement to Lower Otay Reservoir		$299,901
TOTAL	**$2,437,500**	**$1,476,045**

C.7 Imported Treated Water from SDCWA Pipeline No. 4

There are no capital costs for this option, since all the necessary infrastructure is already in place. The projected purchase rates of imported treated water from the SDCWA are discussed at the beginning of this section, and shown in Figure 5-1.

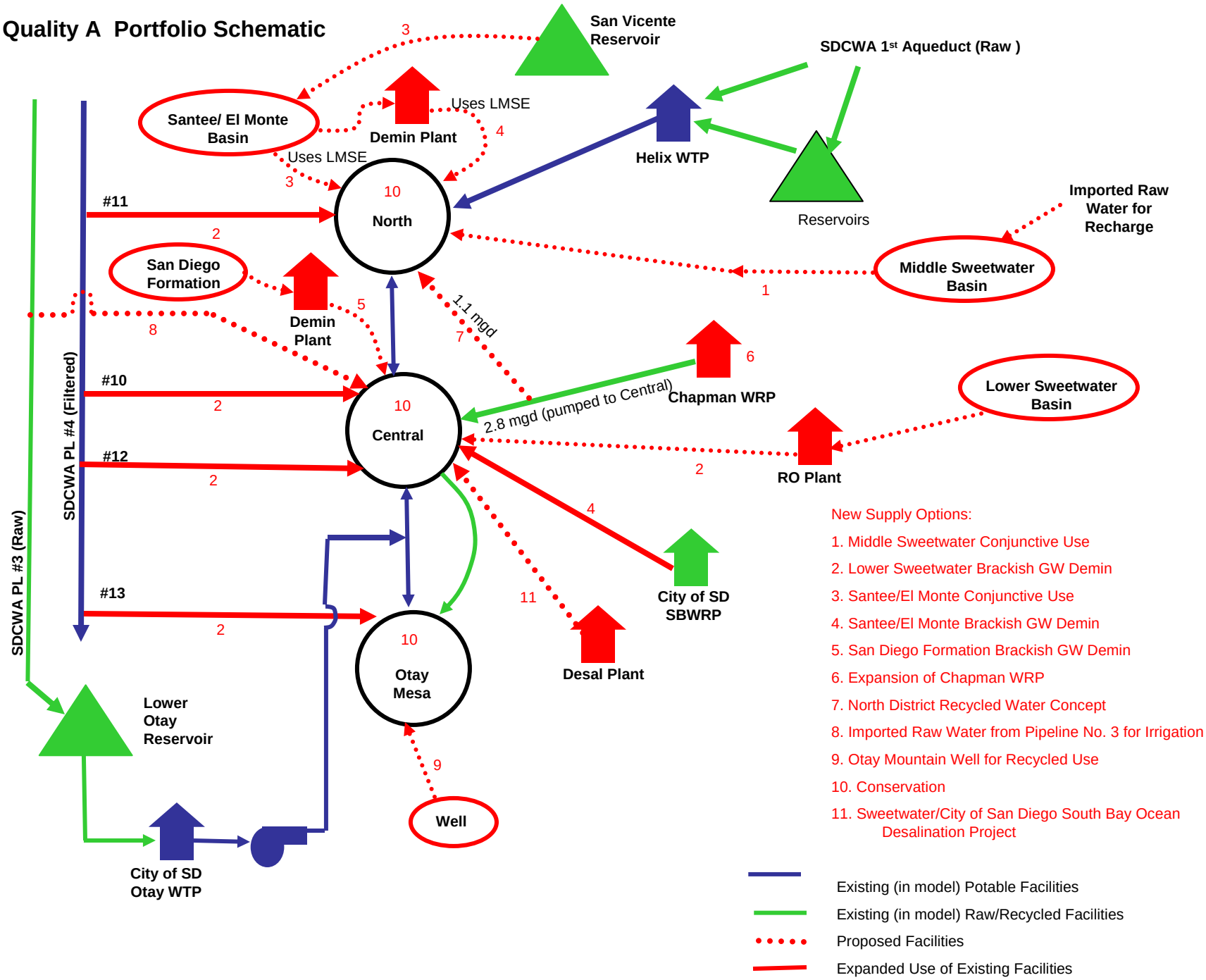
C.8 Water Transfers and Water Banking

See discussion in Section C.8.

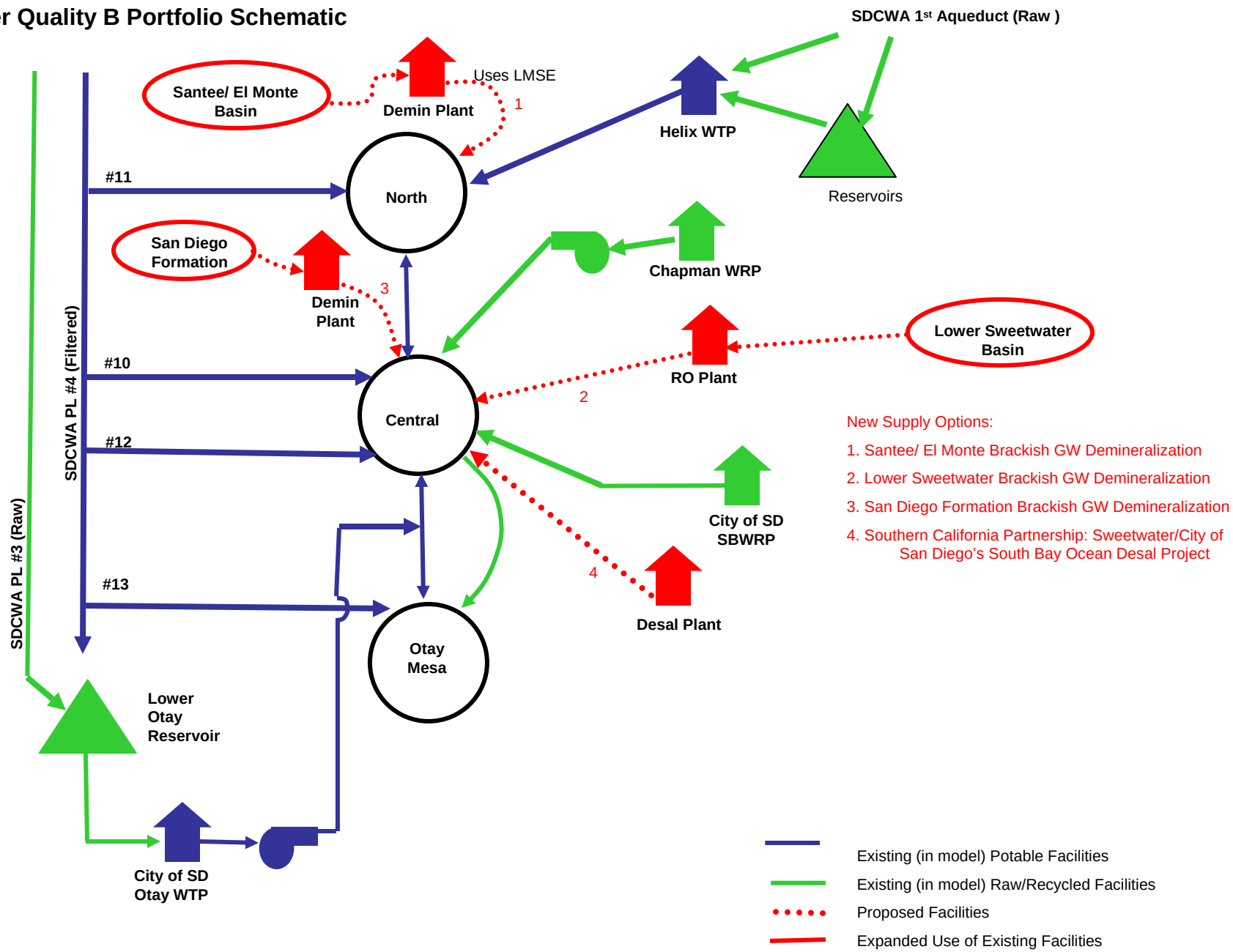
Appendix D

Portfolio Summary and Performance

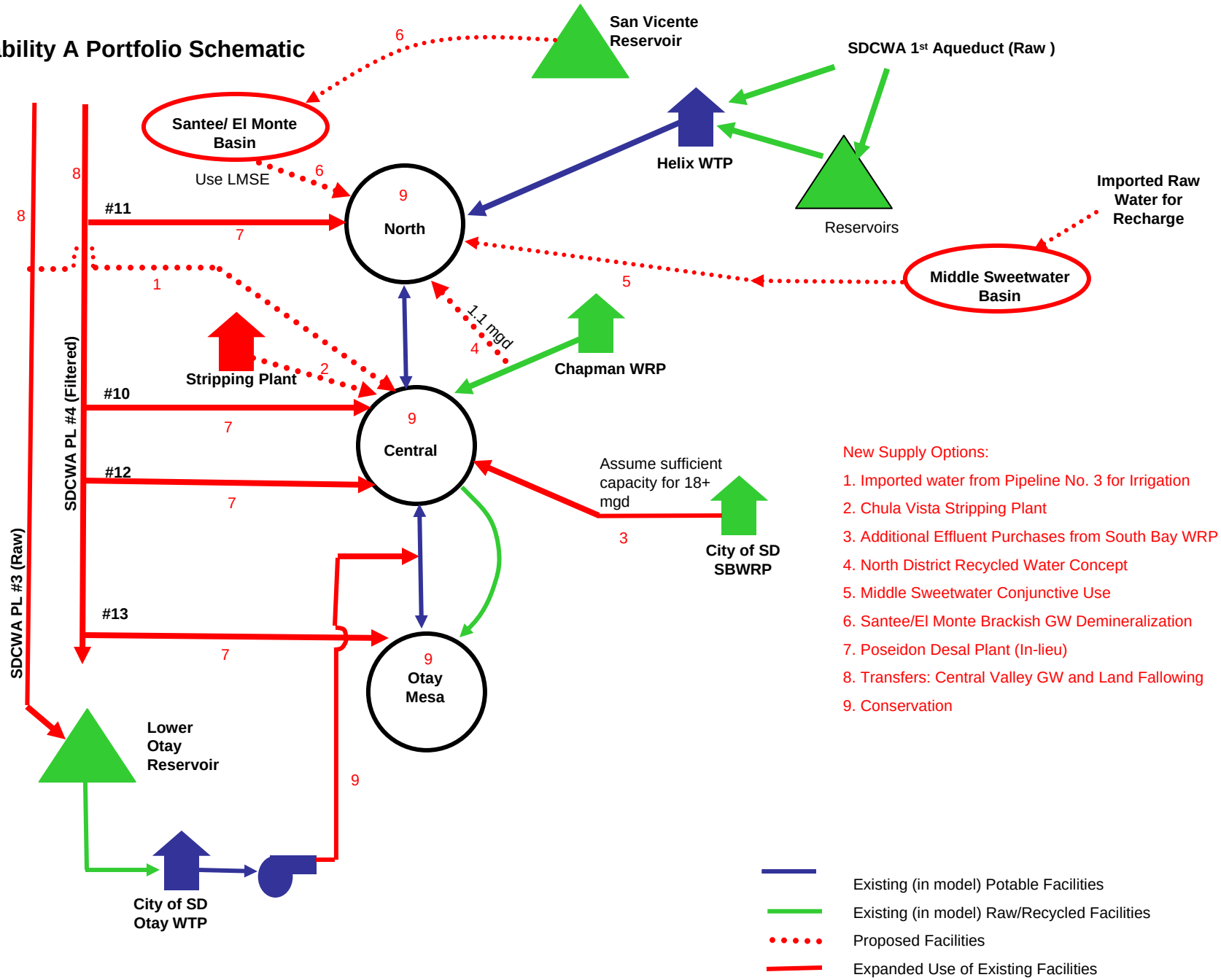
Water Quality A Portfolio Schematic



Water Quality B Portfolio Schematic



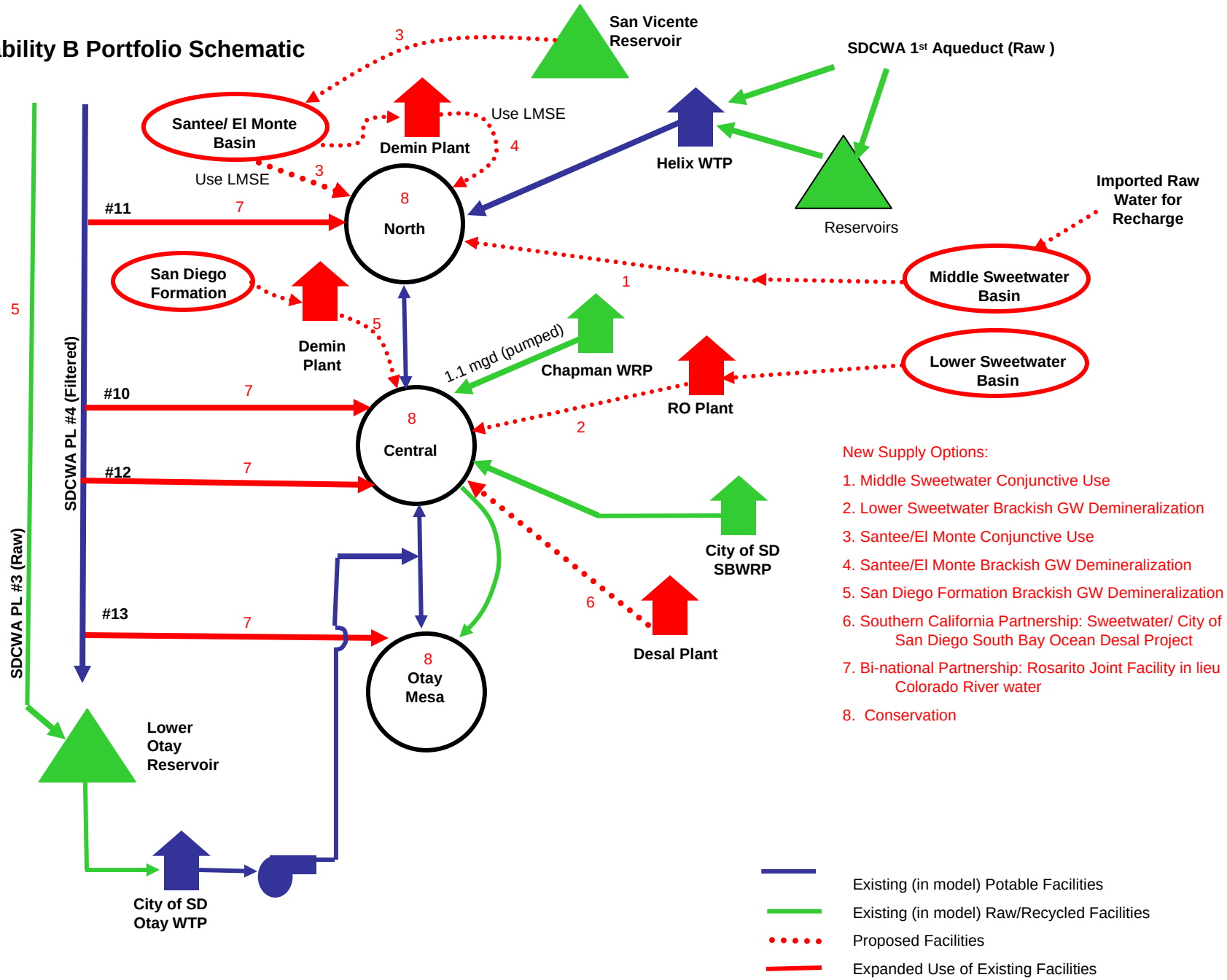
Reliability A Portfolio Schematic



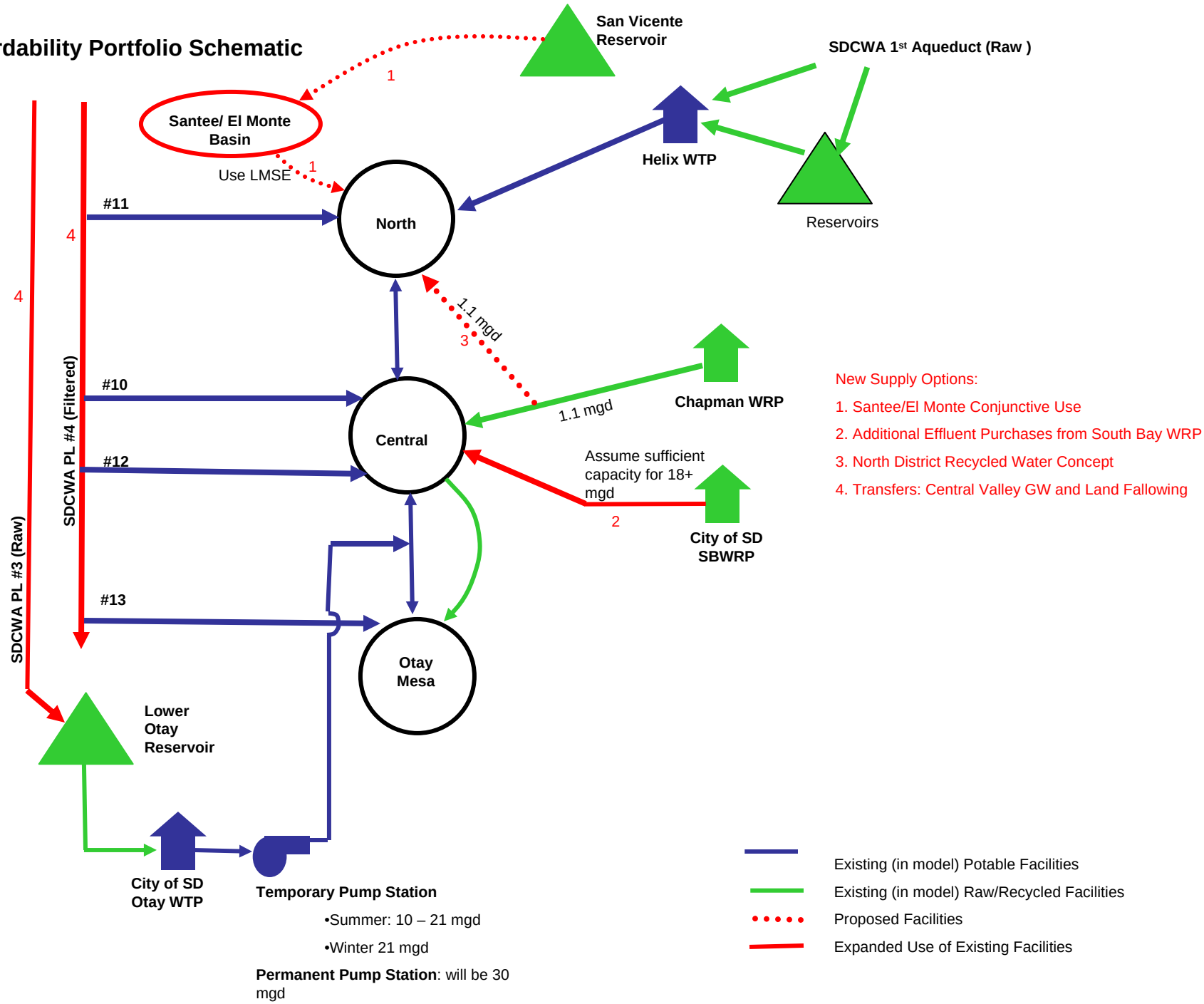
New Supply Options:

1. Imported water from Pipeline No. 3 for Irrigation
2. Chula Vista Stripping Plant
3. Additional Effluent Purchases from South Bay WRP
4. North District Recycled Water Concept
5. Middle Sweetwater Conjunctive Use
6. Santee/El Monte Brackish GW Demineralization
7. Poseidon Desal Plant (In-lieu)
8. Transfers: Central Valley GW and Land Fallowing
9. Conservation

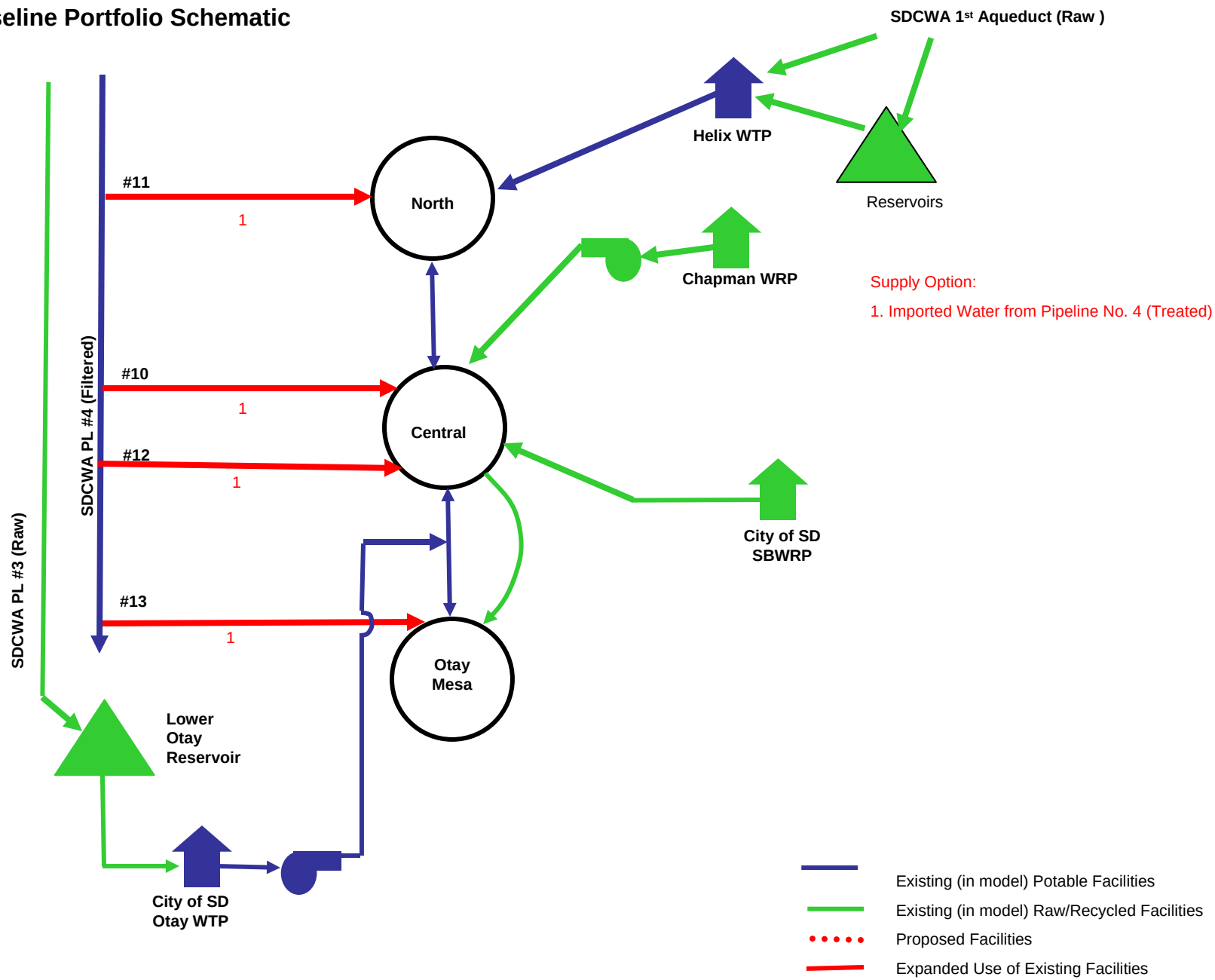
Reliability B Portfolio Schematic



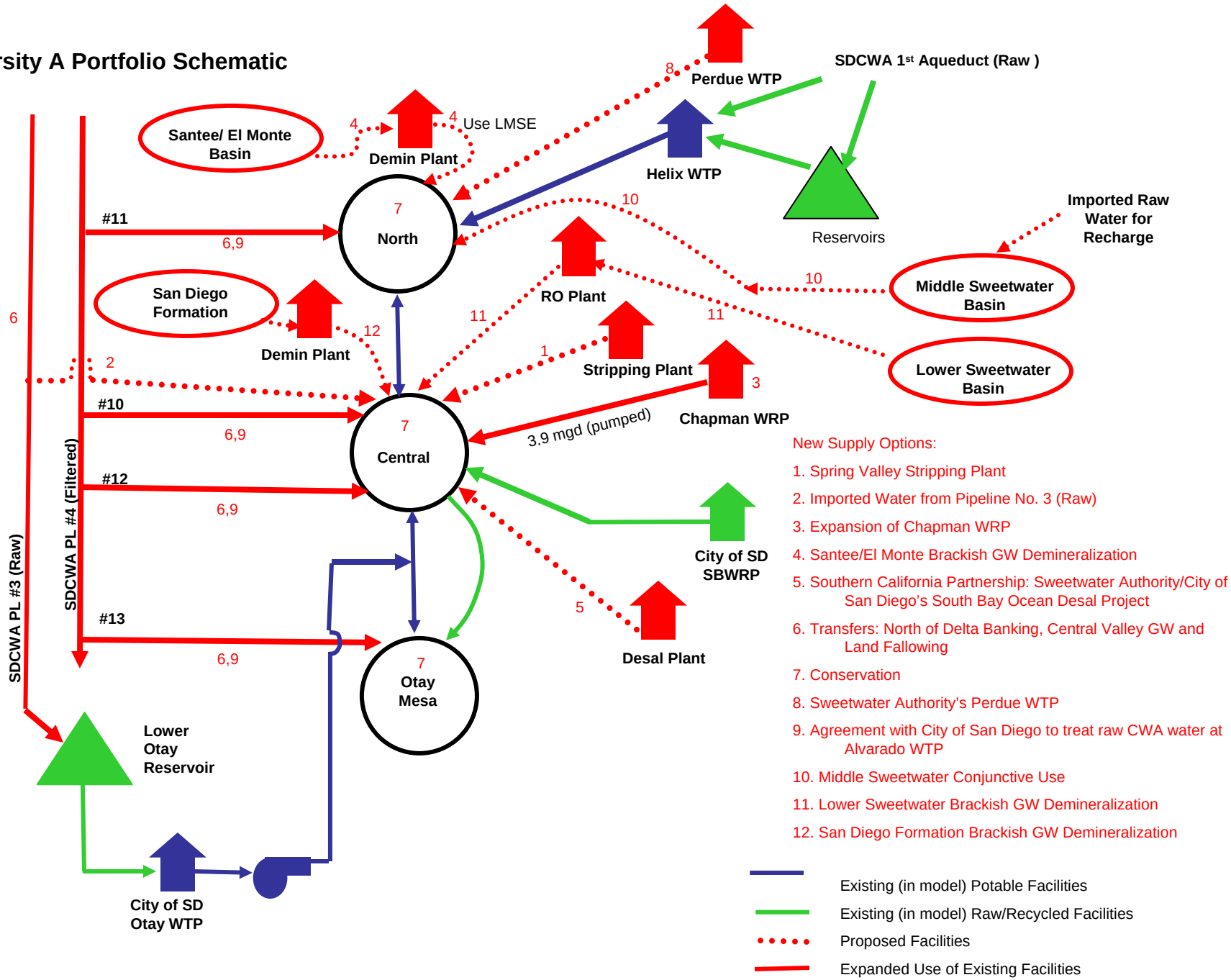
Affordability Portfolio Schematic



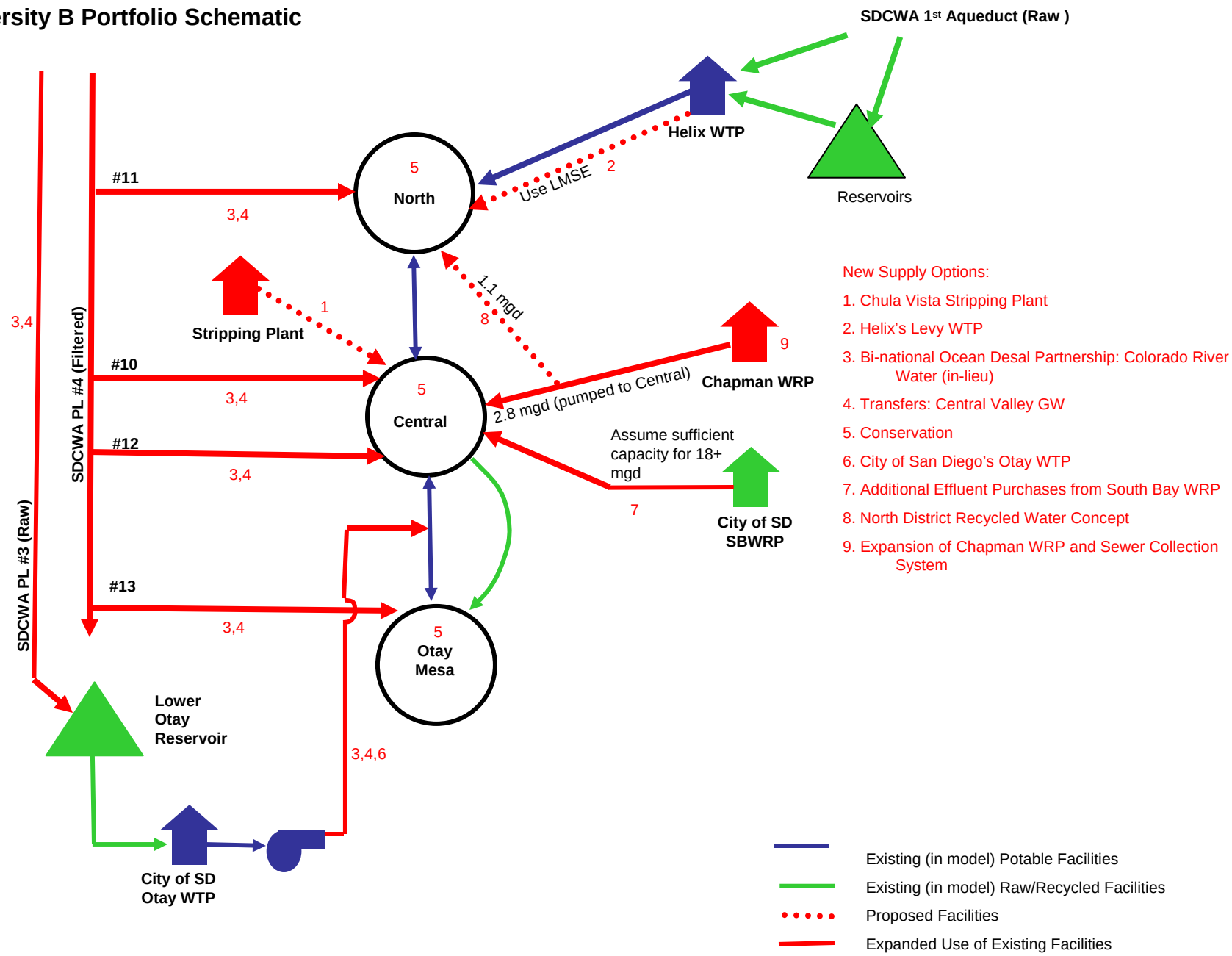
Baseline Portfolio Schematic



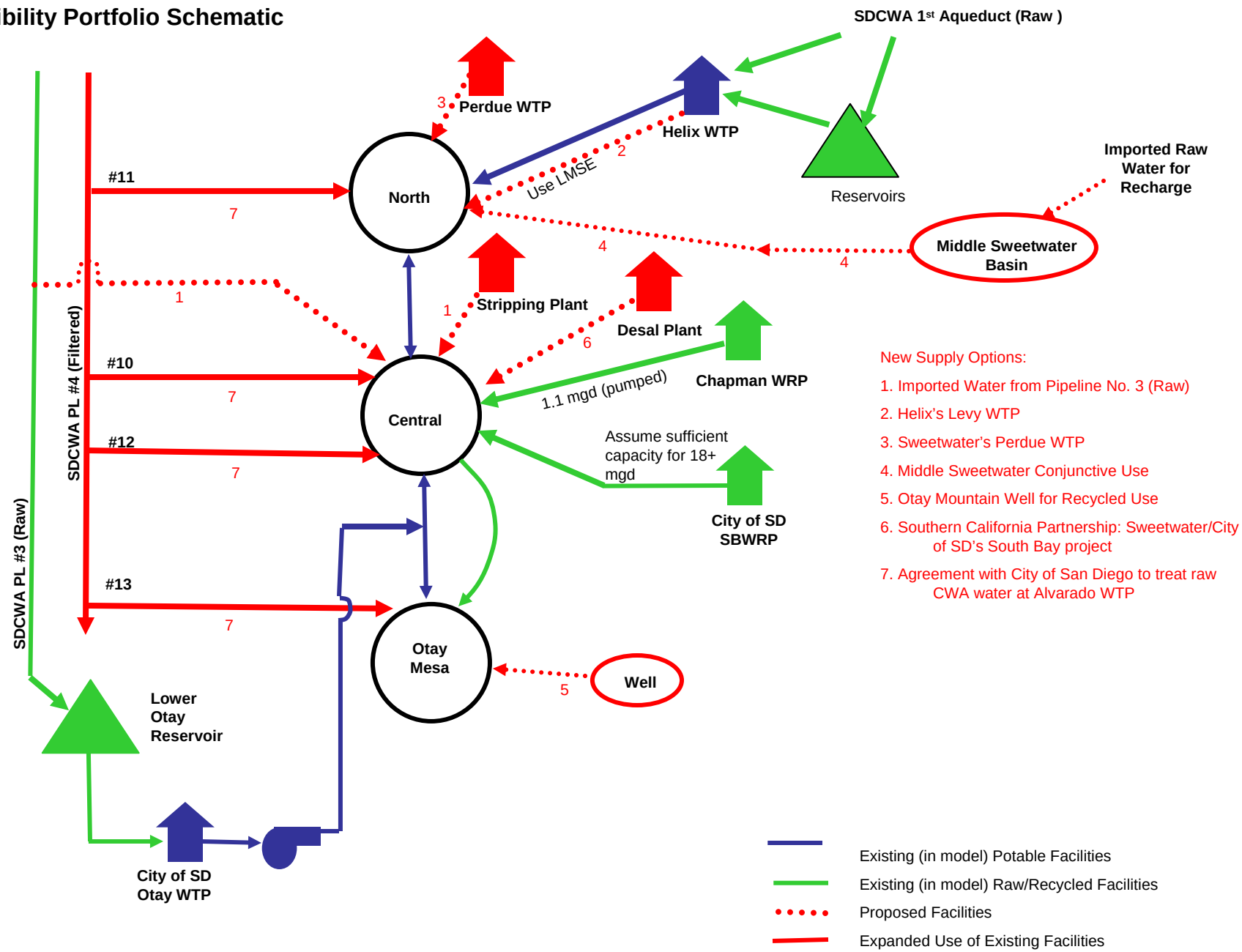
Diversity A Portfolio Schematic



Diversity B Portfolio Schematic



Flexibility Portfolio Schematic



Otay WD IRP
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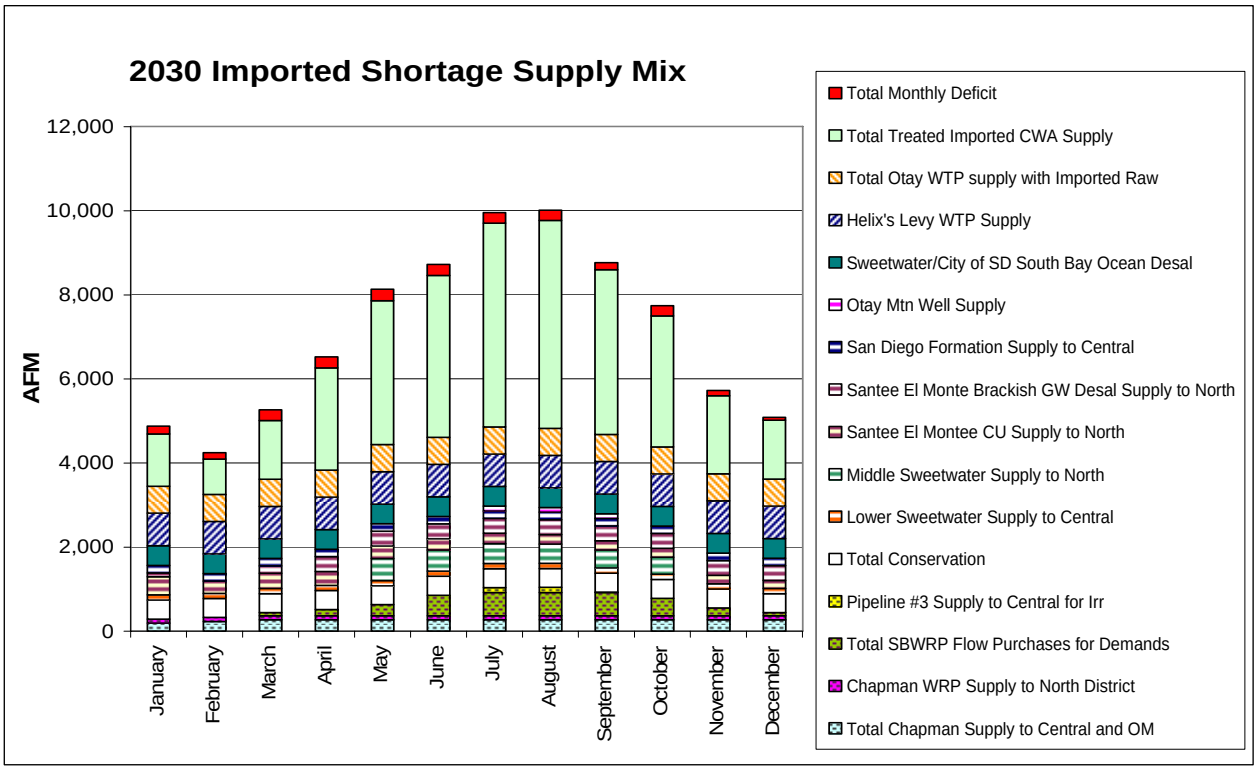
Water Quality A: DBP Portfolio

This portfolio was developed with the objective of improving water quality by minimizing the potential for disinfection by-products (DBP's). The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY
II. New Supply Options in Portfolio	**Annual Yield**
IIa. Potable	
▪ Middle Sweetwater Groundwater Conjunctive Use	5,000 AFY in dry years
▪ Lower Sweetwater Brackish Groundwater Desalination	1,500 AFY
▪ Santee/El Monte Combined Conjunctive Use – Brackish Groundwater Desalination	4,250 AFY plus additional 5,000 AFY in dry years
▪ San Diego Formation Brackish Groundwater Desalination	2,125 AFY
▪ Sweetwater/City of San Diego's South Bay Ocean Desalination Project	5,600 AFY
▪ Additional Conservation	5,390 AFY (2030 savings)
IIb. Recycled	
▪ North District Recycled Water Concept	1,230 AFY
▪ Imported Raw CWA Water from Pipeline No. 3 for Irrigation	2,800 AFY (over 6 months)
▪ Expansion of Chapman WRP and Sewer Collection System	3,140 AFY
▪ Otay Mountain Well for Recycled Use	1,370 AFY



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Water Quality A: DBP Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	4.1
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	426
	Non-potable TDS (mg/L)	968
1d) Minimize potential issues due to disinfection method	DBP Score	4.5
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	251
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	9,036
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	20,101
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,465
3b) Manage Capital Costs	NPV Capital costs -- $	266,585,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	12
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	12
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	54
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	3.3
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.7
6c) Maximize customer acceptance	Customer Acceptance Score	4.2
6d) Minimize regulatory constraints	Regulatory Constraints Score	3.8
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.0

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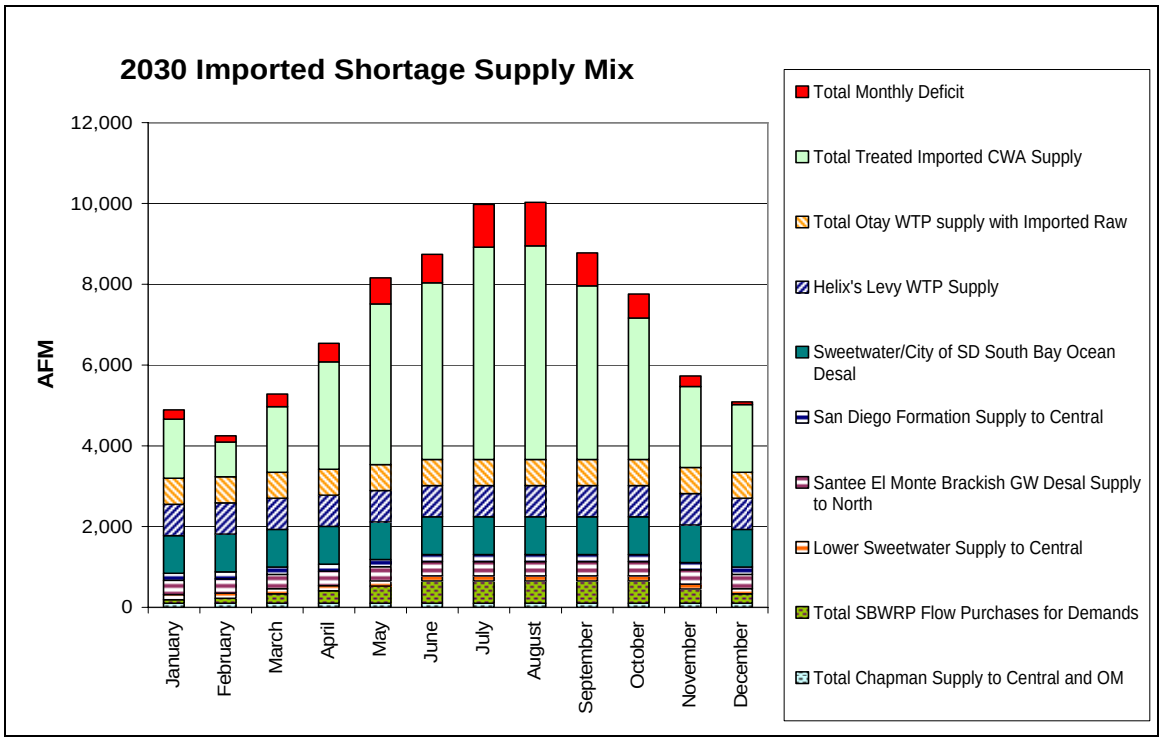
Water Quality B: TDS Portfolio

This portfolio was developed with the objective of improving water quality by minimizing the potential for Total Dissolved Solids (TDS). The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY

II. New Supply Options in Portfolio	Annual Yield
IIa. Potable	
▪ Lower Sweetwater Brackish Groundwater Desalination	1,500 AFY
▪ Santee/ El Monte Brackish Groundwater Desalination	4,250 AFY
▪ San Diego Formation Brackish Groundwater Desalination	2,125 AFY
▪ Sweetwater/City of SD's South Bay Ocean Desal project	11,200 AFY
IIb. Recycled	
▪ None	



Water Quality B: TDS Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	4.2
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	406
	Non-potable TDS (mg/L)	990
1d) Minimize potential issues due to disinfection method	DBP Score	3.8
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	455
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	21,862
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	24,367
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,562
3b) Manage Capital Costs	NPV Capital costs -- $	163,975,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	9
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	9
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	70
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	3.0
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.6
6c) Maximize customer acceptance	Customer Acceptance Score	4.6
6d) Minimize regulatory constraints	Regulatory Constraints Score	4.0
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.5

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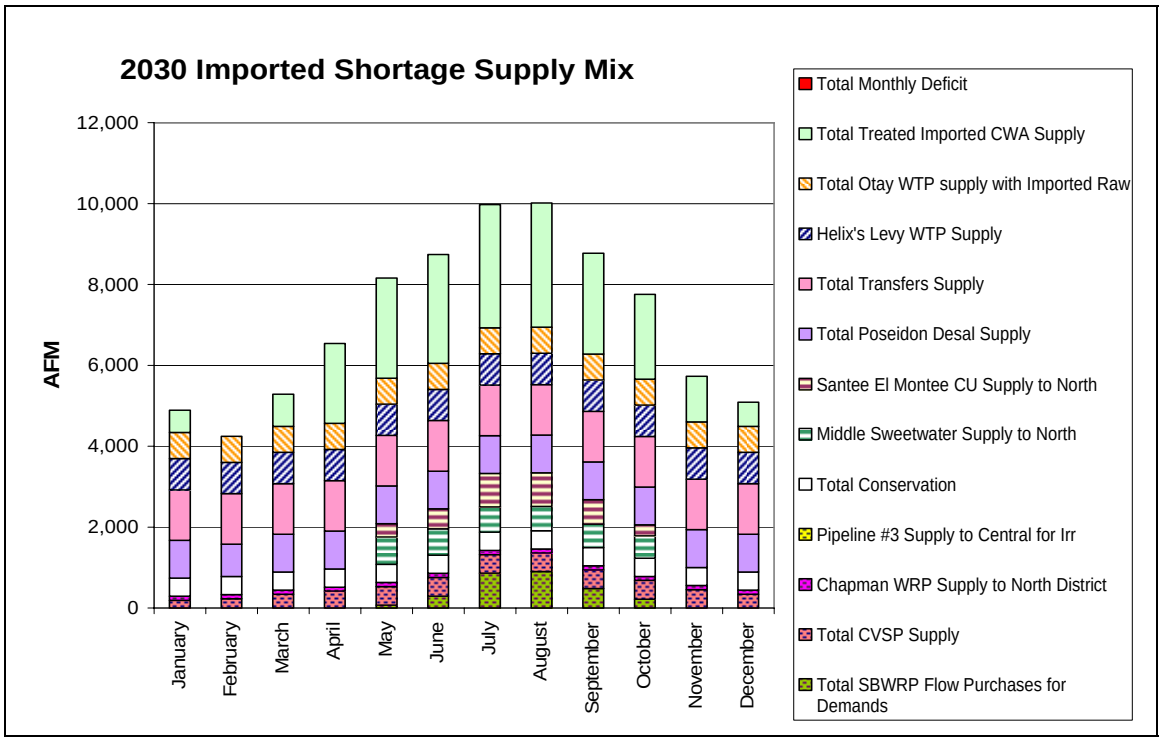
Reliability A: Drought Portfolio

This portfolio was developed with the objective of increasing reliability under drought conditions involving imported water shortages. The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY
II. New Supply Options in Portfolio	**Annual Yield**
IIa. Potable	
▪ Middle Sweetwater Groundwater Conjunctive Use	5,000 AFY in dry years
▪ Santee/El Monte Groundwater Conjunctive Use	5,000 AFY in dry years
▪ Poseidon Ocean Desalination (in-lieu)	11,200 AFY
▪ Additional Conservation	5,390 AFY (2030 savings)
▪ Transfers : Central Valley Groundwater	7,500 AFY
▪ Transfers : Land Fallowing	7,500 AFY
IIb. Recycled	
▪ Imported Raw CWA water from Pipeline No. 3 for Irrigation	2,800 AFY (over 6 months)
▪ Chula Vista Stripping Plant	5,600 AFY
▪ South Bay WRP (Additional Purchase Only)	4,480 AFY
▪ North District Recycled Water Concept	1,230 AFY



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Reliability A: Drought Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	4.3
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	490
	Non-potable TDS (mg/L)	990
1d) Minimize potential issues due to disinfection method	DBP Score	3.7
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	0
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	0
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	23,813
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,197
3b) Manage Capital Costs	NPV Capital costs -- $	131,906,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	9
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	12
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	34
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	3.9
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.2
6c) Maximize customer acceptance	Customer Acceptance Score	4.6
6d) Minimize regulatory constraints	Regulatory Constraints Score	4.1
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.4

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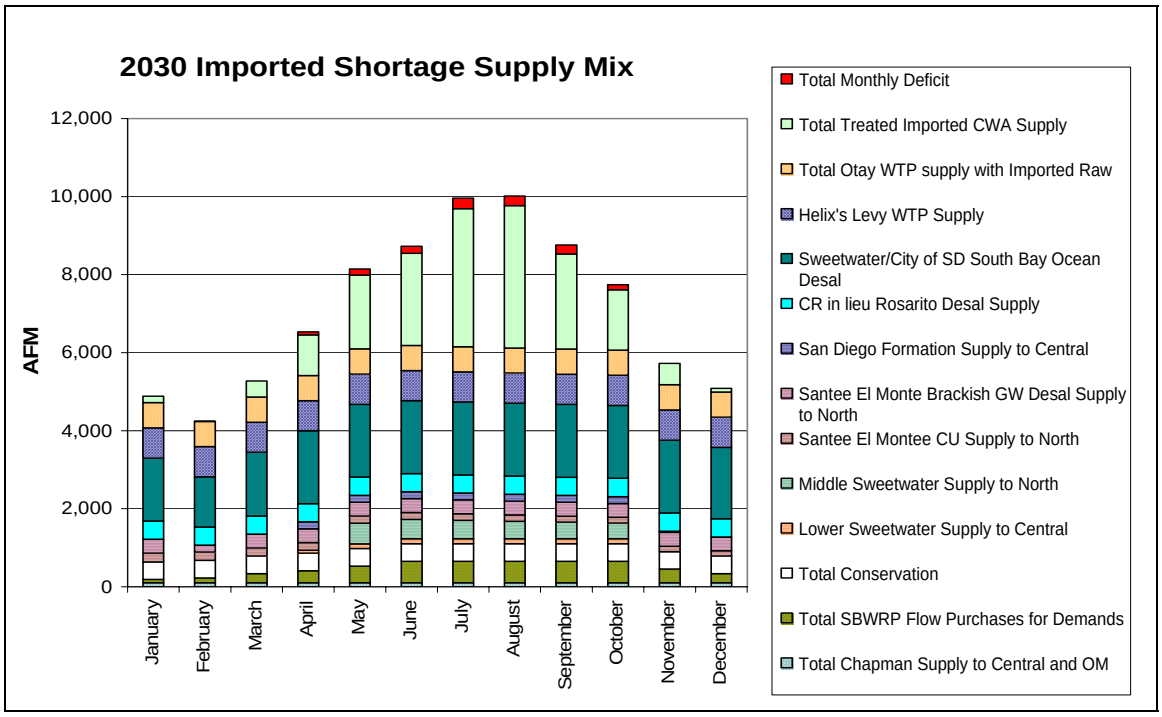
Reliability B: Seismic Portfolio

This portfolio was developed with the objective of increasing reliability under seismic conditions. The assumed seismic condition involves an interruption of imported water supply caused by SDCWA Pipelines No.3 and No. 4 being offline. The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY
II. New Supply Options in Portfolio	**Annual Yield**
IIa. Potable	
▪ Middle Sweetwater Groundwater Conjunctive Use	5,000 AFY in dry years
▪ Lower Sweetwater Brackish Groundwater Desalination	1,500 AFY
▪ Santee/El Monte Combined Conjunctive Use – Brackish Groundwater Desalination	4,250 AFY plus additional 5,000 AFY in dry years
▪ San Diego Formation Brackish Groundwater Desalination	2,125 AFY
▪ Bi-national Ocean Desalination Partnership: Colorado River Water (in-lieu)	5,600 AFY
▪ Sweetwater/City of SD's South Bay Ocean Desal project	22,400 AFY
▪ Additional Conservation	5,390 AFY (2030 savings)
IIb. Recycled	
▪ None	



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Reliability B: Seismic Portfolio

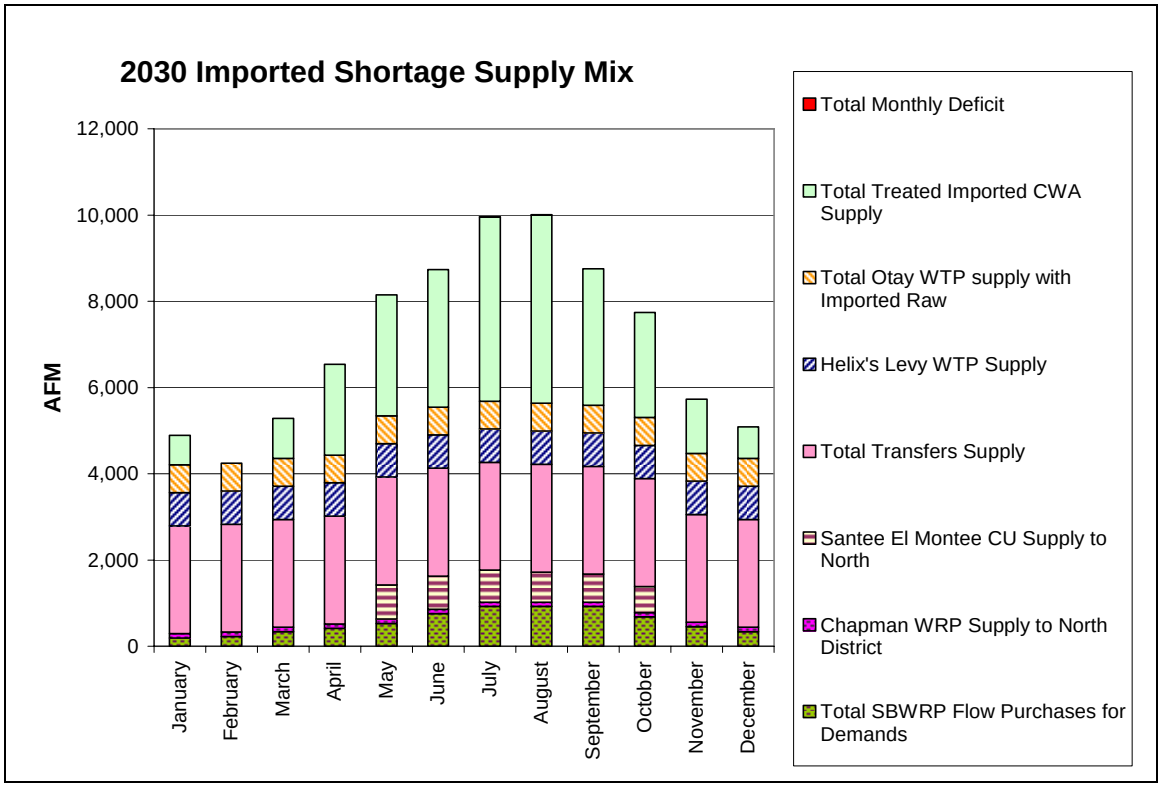
Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	3.4
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	388
	Non-potable TDS (mg/L)	990
1d) Minimize potential issues due to disinfection method	DBP Score	4.8
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	118
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	2,833
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	16,242
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,940
3b) Manage Capital Costs	NPV Capital costs -- $	380,065,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	10
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	11
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	34
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	2.2
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.1
6c) Maximize customer acceptance	Customer Acceptance Score	3.9
6d) Minimize regulatory constraints	Regulatory Constraints Score	2.9
6e) Minimize technology uncertainty	Technology Uncertainty Score	3.8

Affordability Portfolio

This portfolio was developed with the lowest cost options based on their dollar per acre-foot unit cost. The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY

II. New Supply Options in Portfolio	Annual Yield
IIa. Potable	
▪ Santee/ El Monte Groundwater Conjunctive Use	5,000 AFY in dry years
▪ Transfers : Central Valley Groundwater	15,000 AFY
▪ Transfers : Land Fallowing	15,000 AFY
IIb. Recycled	
▪ South Bay WRP (Additional Purchase Only)	4,480 AFY
▪ North District Recycled Water Concept	1,230 AFY



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Affordability Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	4.9
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	492
	Non-potable TDS (mg/L)	990
1d) Minimize potential issues due to disinfection method	DBP Score	3.2
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	68
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	2,983
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	26,887
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,087
3b) Manage Capital Costs	NPV Capital costs -- $	52,092,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	6
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	8
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	47
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	3.7
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.3
6c) Maximize customer acceptance	Customer Acceptance Score	4.9
6d) Minimize regulatory constraints	Regulatory Constraints Score	4.8
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.8

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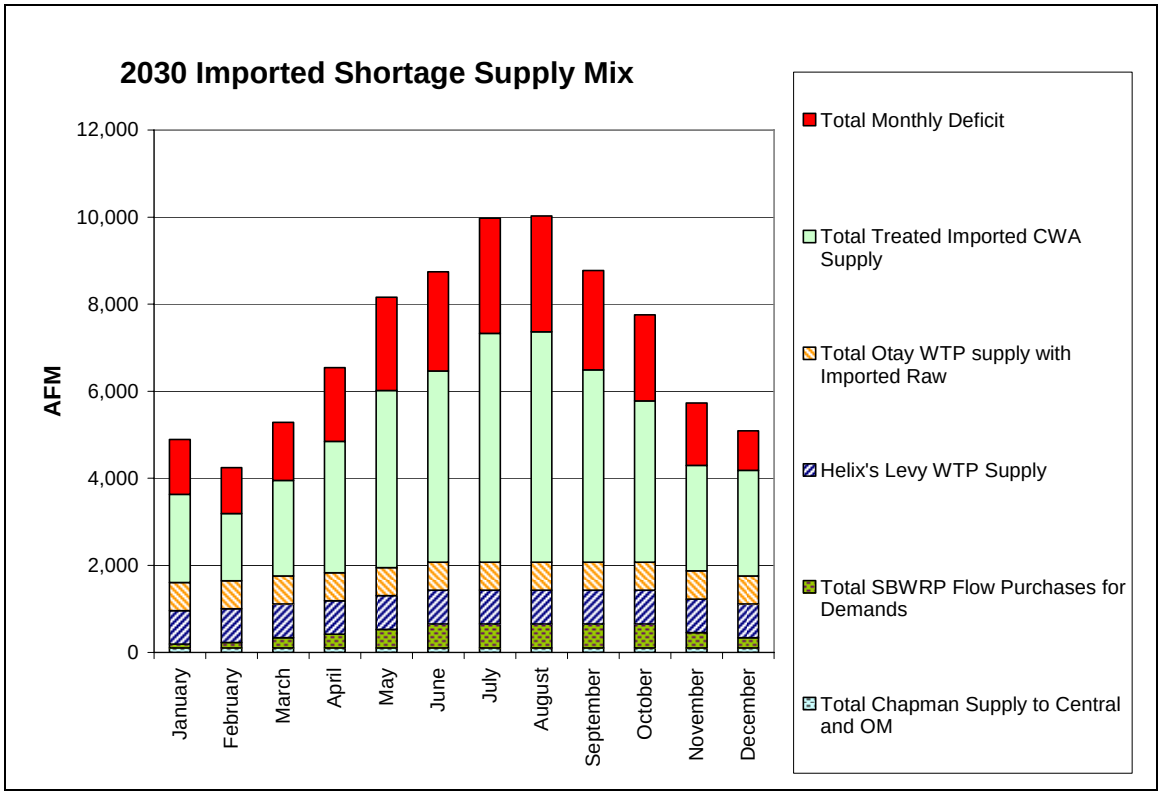
Baseline Portfolio

This portfolio represents the 'No Action' condition, and utilizes all of the District's existing (or already planned) supply sources. The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY

II. New Supply Options in Portfolio	Annual Yield
IIa. Potable	
▪ None	
IIb. Recycled	
▪ None	



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Baseline Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	5.0
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	492
	Non-potable TDS (mg/L)	990
1d) Minimize potential issues due to disinfection method	DBP Score	3.0
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	1,066
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	110,864
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	29,137
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	952
3b) Manage Capital Costs	NPV Capital costs -- $	0
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	5
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	5
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	91
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	4.0
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	4.0
6c) Maximize customer acceptance	Customer Acceptance Score	5.0
6d) Minimize regulatory constraints	Regulatory Constraints Score	5.0
6e) Minimize technology uncertainty	Technology Uncertainty Score	5.0

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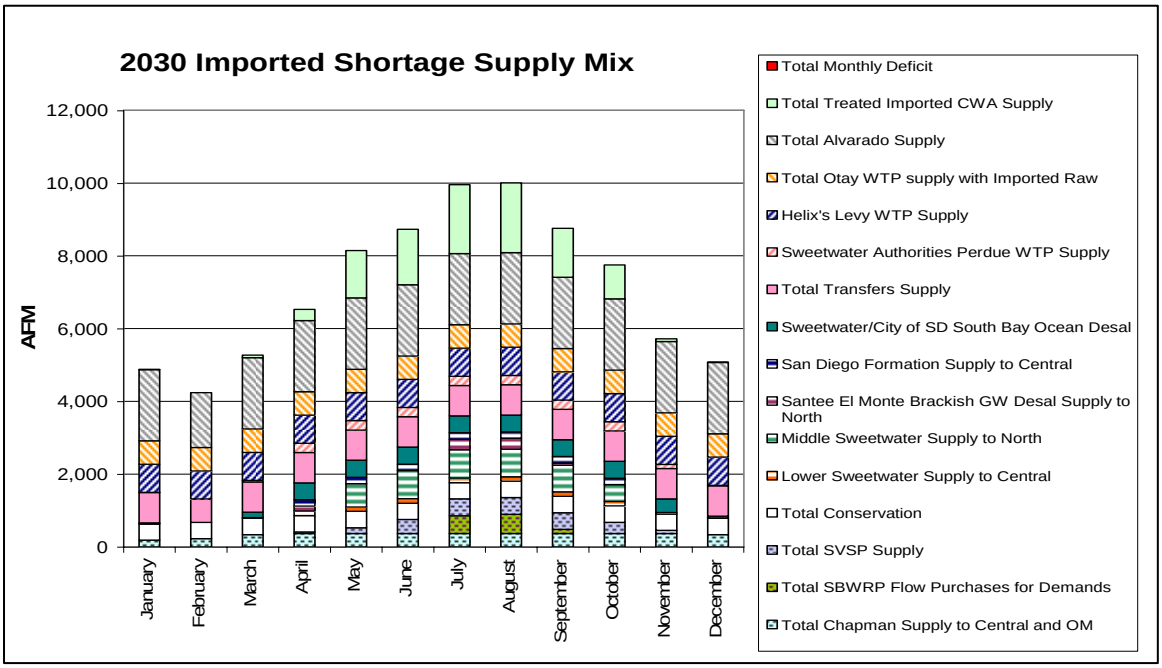
Diversity A Portfolio

This portfolio was developed with the objective of increasing the diversity of supply sources. The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY
II. New Supply Options in Portfolio	**Annual Yield**
IIa. Potable	
▪ Middle Sweetwater Groundwater Conjunctive Use	5,000 AFY in dry years
▪ Lower Sweetwater Brackish Groundwater Desalination	1,500 AFY
▪ Santee/El Monte Brackish Groundwater Desalination	4,250 AFY
▪ San Diego Formation Brackish Groundwater Desalination	2,125 AFY
▪ Sweetwater/City of San Diego's South Bay Ocean Desal project	5,600 AFY
▪ Conservation	5,390 AFY (2030 savings)
▪ Transfers : North of Delta Banking	5,000 AFY
▪ Transfers : Central Valley Groundwater	5,000 AFY
▪ Transfers : Land Fallowing	5,000 AFY
▪ Sweetwater Authority's Perdue WTP	4,480 AFY
▪ SD17 Agreement with City of San Diego to treat raw CWA water at Alvarado WTP	33,600 AFY
IIb. Recycled	
▪ Imported Raw CWA Water from Pipeline No. 3 for Irrigation	2,800 AFY (over 6 mo)
▪ Spring Valley Stripping Plant	5,600 AFY
▪ Expansion of Chapman WRP and Sewer Collection System	3,140 AFY



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Diversity A Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	4.6
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	483
	Non-potable TDS (mg/L)	990
1d) Minimize potential issues due to disinfection method	DBP Score	3.7
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	0
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	0
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	21,921
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,440
3b) Manage Capital Costs	NPV Capital costs -- $	380,707,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	13
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	17
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	38
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	3.5
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.7
6c) Maximize customer acceptance	Customer Acceptance Score	4.6
6d) Minimize regulatory constraints	Regulatory Constraints Score	3.9
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.5

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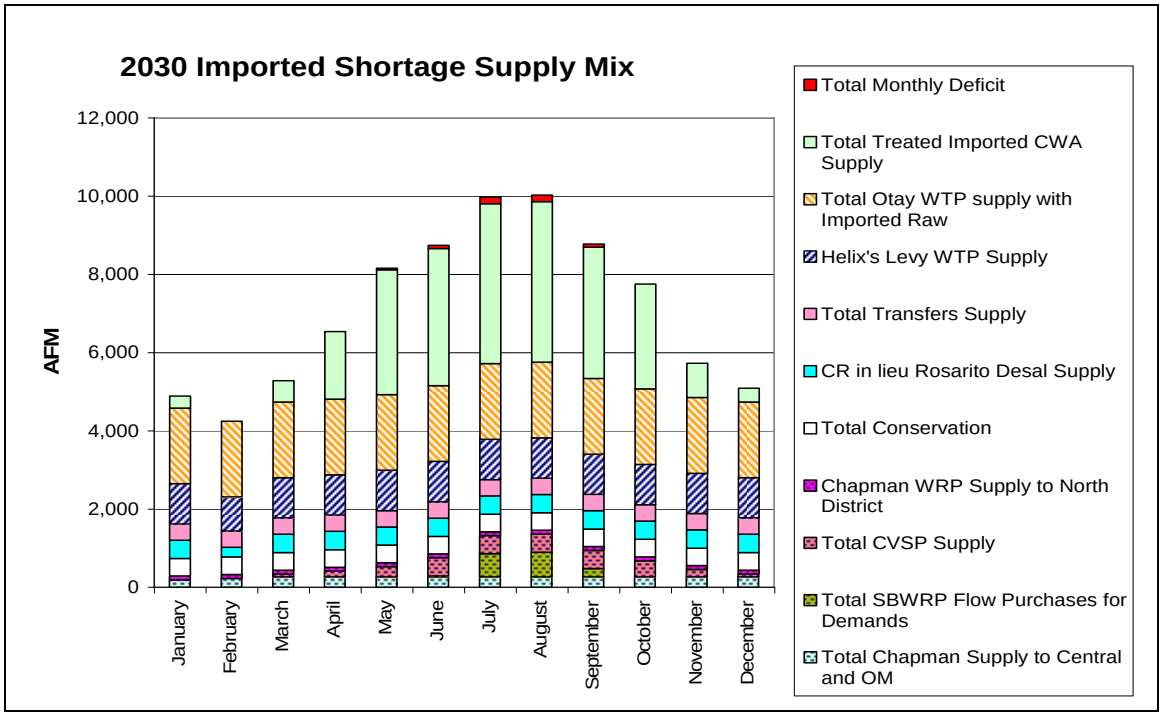
Diversity B Portfolio

This portfolio was developed with the objective of increasing the diversity of supply sources and expanded use of existing (or already planned) sources. The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY
II. New Supply Options in Portfolio	**Annual Yield**
IIa. Potable	
▪ Helix's Levy WTP	4,480 AFY
▪ City of San Diego's Otay WTP	22,400 AFY
▪ Bi-national Ocean Desalination Partnership: Colorado River Water (in-lieu)	5,600 AFY
▪ Conservation	5,390 AFY (2030 savings)
▪ Transfers : Central Valley Groundwater	5,000 AFY
IIb. Recycled	
▪ Chula Vista Stripping Plant	5,600 AFY
▪ South Bay WRP (Additional Purchase Only)	4,480 AFY
▪ North District Recycled Water Concept	1,230 AFY
▪ Expansion of Chapman WRP and Sewer Collection System	3,140 AFY



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Diversity B Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	4.8
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	492
	Non-potable TDS (mg/L)	990
1d) Minimize potential issues due to disinfection method	DBP Score	3.3
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	113
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	908
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	27,790
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,019
3b) Manage Capital Costs	NPV Capital costs -- $	150,341,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	6
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	8
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	59
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	3.9
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.8
6c) Maximize customer acceptance	Customer Acceptance Score	4.6
6d) Minimize regulatory constraints	Regulatory Constraints Score	4.6
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.8

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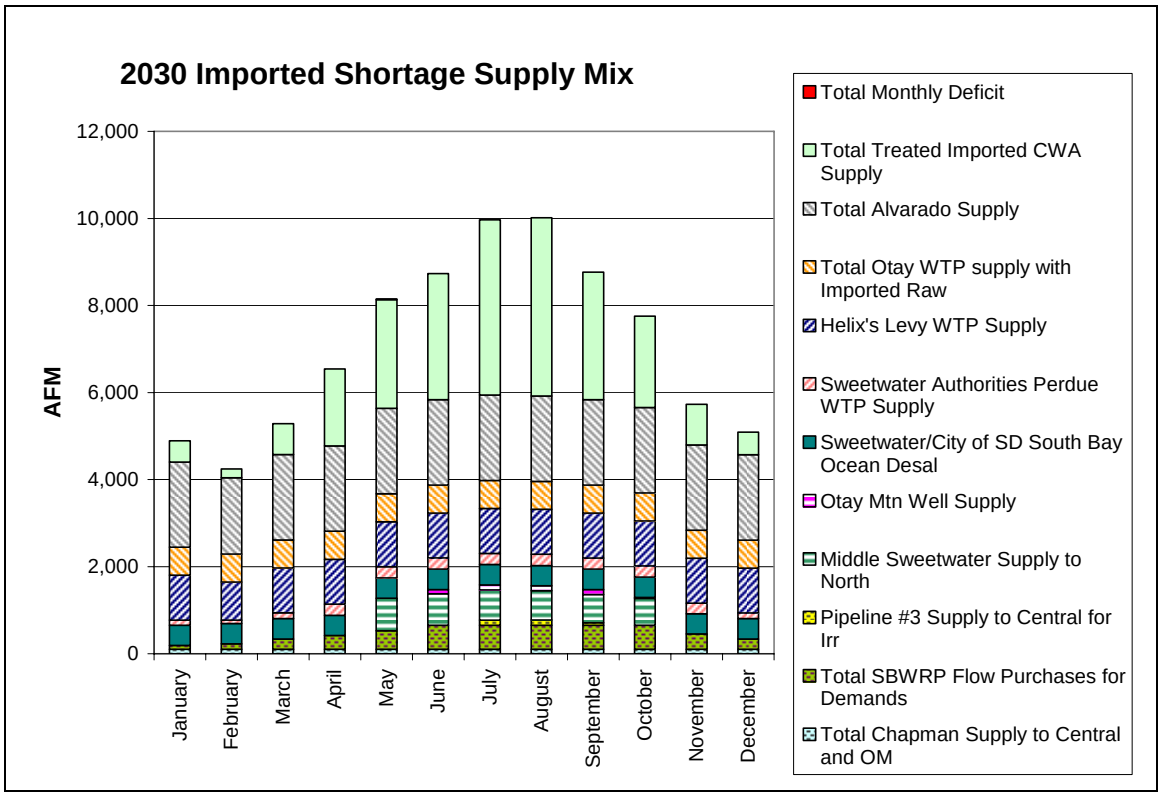
Flexibility Portfolio

This portfolio was developed with the objective of increasing the District's operational flexibility by increasing the number of take points into the system. The supply options included in this portfolio include:

I. Existing Supply Source	Annual Yield (2010)
Ia. Potable	
▪ Imported Water from Pipeline No. 4 (treated)	136,000 AFY (capacity)
▪ City of San Diego, Otay WTP	10,100 AFY
▪ Helix's Levy WTP	13,400 AFY
Ib. Recycled	
▪ OWD's Chapman WRP	1,200 AFY
▪ City of San Diego, South Bay WRP	6,700 AFY
II. New Supply Options in Portfolio	**Annual Yield**
IIa. Potable	
▪ Helix's Levy WTP	4,480 AFY
▪ Sweetwater Authority's Perdue WTP	4,480 AFY
▪ SD17 Agreement with City of San Diego to treat raw CWA water at Alvarado WTP	33,600 AFY
▪ Middle Sweetwater Groundwater Conjunctive Use	5,000 AFY in dry years
▪ Sweetwater/City of SD's South Bay Ocean Desal project	5,600 AFY
IIb. Recycled	
▪ Imported Water from Pipeline No. 3 (raw) for Irrigation	2,800 AFY (over 6 mo)
▪ Otay Mountain Well for Recycled Use	1,370 AFY



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Flexibility Portfolio

Objective/Sub-objective	Performance Measure	Score
Objective 1 -Meet or Exceed Water Quality Standards and Guidelines		
1a) Meet current and future drinking water standards	All portfolios will comply	3.0
1b) Address compatibility of new sources with current imported supply	Compatibility Score	4.6
1c) Meet TDS goals for recycled water, potable water and Basin Plan	Potable TDS - (mg/L)	484
	Non-potable TDS (mg/L)	912
1d) Minimize potential issues due to disinfection method	DBP Score	3.5
Objective 2 – Achieve Reliability		
2a) Meet demands under average hydrology conditions	Average Annual Deficit (AFY)	1
2b) Meet demands under drought imported shortage conditions	Cumulative Deficit (AF/ all shortage years)	18
2c) Minimize impacts under emergency conditions	Shortage during a three month emergency - AF	24,894
Objective 3 – Maintain Affordability		
3a) Minimize impacts to an average single-family customer	NPV Unit costs -- $/AF	1,329
3b) Manage Capital Costs	NPV Capital costs -- $	245,265,000
Objective 4 – Increase Flexibility		
4a) Increase Number of Take Points and Alternative Flow Routes	Total Number of Take Points	10
Objective 5 – Increase Diversity		
5a) Maximize number of sources	Total number of contracts	11
5b) Reduce contribution of largest source	2030 contribution of the largest source to total supply - %	78
Objective 6 – Address Environmental and Institutional Constraints		
6a) Minimize environmental permitting requirements	Permitting Score	3.6
6b) Minimize institutional coordination and implementation requirements (local/State/Federal/International)	Institutional Coordination Score	3.8
6c) Maximize customer acceptance	Customer Acceptance Score	4.8
6d) Minimize regulatory constraints	Regulatory Constraints Score	3.8
6e) Minimize technology uncertainty	Technology Uncertainty Score	4.7

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