Section F: Full-Scale Project Considerations

Full-Scale Reservoir Augmentation Considerations

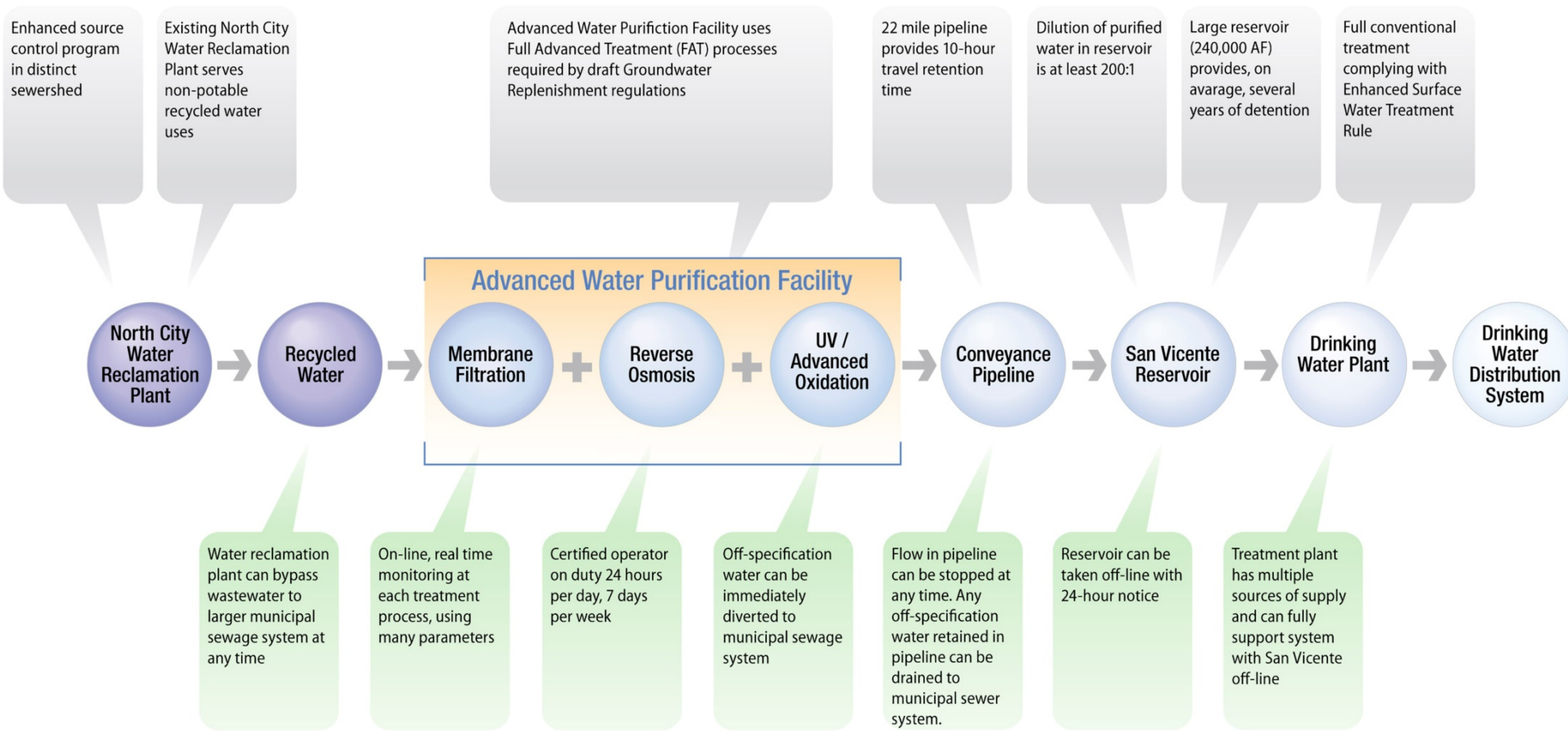
- Full-Scale Components of a Multiple Barrier Strategy
- Source Control Enhancement
- North City Water Reclamation Plant
- Advanced Water Purification Facility
- Pipeline System
- AWP Facility and Pipeline System Cost Estimates

The City must fully understand all potential implications of a reservoir augmentation project at San Vicente Reservoir prior to deciding whether or not to implement such a project. The Demonstration Project included an assessment of the full-scale project components that would be required, and an evaluation of potential operational requirements and other considerations associated with each component. The results of that assessment are summarized in this section.

Full-Scale Components of a Multiple Barrier Strategy

A reservoir augmentation project at San Vicente Reservoir would require a series of water purification components, focused on achieving a multiple barrier strategy, as required for regulatory approval. A multiple barrier strategy protects public health by incorporating safeguards to ensure that a failure or error at any given treatment step would not compromise public health. The components of a multiple barrier strategy that would be implemented for reservoir augmentation at San Vicente Reservoir are illustrated in Figure F-1 and described in further detail below. Please note that, although a full-scale project's multiple barrier strategy includes San Vicente Reservoir and a municipal drinking water treatment plant such as the Alvarado Water Treatment Plant, these facilities would not require modification. As such, those steps of the multiple barrier strategy are not addressed in this section.

Figure F - 1: Components of a Multiple Barrier Reservoir Augmentation Project at San Vicente Reservoir



Source Control Enhancement

The first step in the multiple barrier strategy for reservoir augmentation at San Vicente Reservoir would be source control, which refers to the prevention of contaminants from entering the wastewater stream. All wastewater systems have source control programs. The City's source control program, referred to as IWCP, was implemented in 1982 to regulate industrial discharges into the San Diego Metropolitan Sewage System (Metro System). The program was required as part of the NPDES permitting process for Point Loma, and the South Bay Water Reclamation Plant (SBWRP). The IWCP applies and enforces federal pretreatment regulations set forth by the EPA, and it satisfies the following objectives:

- To protect and improve receiving water quality;
- To prevent the discharge of toxic and potentially harmful pollutants in concentrations which would interfere with treatment plant operations or pass through the plant to the receiving waters;
- To protect system personnel and plant facilities by limiting discharges of potentially hazardous, harmful, or incompatible pollutants;
- To prevent contamination of treatment plant sludge in order to maximize beneficial reuse options for biosolids;
- To protect the quality of recycled water.

The City participates in the "No Drugs Down the Drain" program, which alerts California residents about problems associated with flushing medications down the drain. This program is an example of the City's existing source control efforts.

The City's IWCP is designed to support the existing discharge to the ocean via Point Loma, and goes beyond typical source control programs by implementing an EPA- and Regional Board-approved Urban Area Pretreatment Program (UAPP). The City has taken the following steps in implementing the UAPP that extend beyond typical source control programs:

- Developed local limits that comply with UAPP provisions of the Ocean Pollution Reduction Act; local limits are re-evaluated annually.
- Implemented Industrial Management Practices to minimize the discharge of toxic pollutants, such as Batch Discharge approvals, and solvent management plan requirements at all laboratories, including research and development, medical, and analytical laboratories.
- Include prohibitions on the discharge of pharmaceutically-active ingredients, including unused pharmaceuticals, expired pharmaceuticals, rejected batches or lots, and

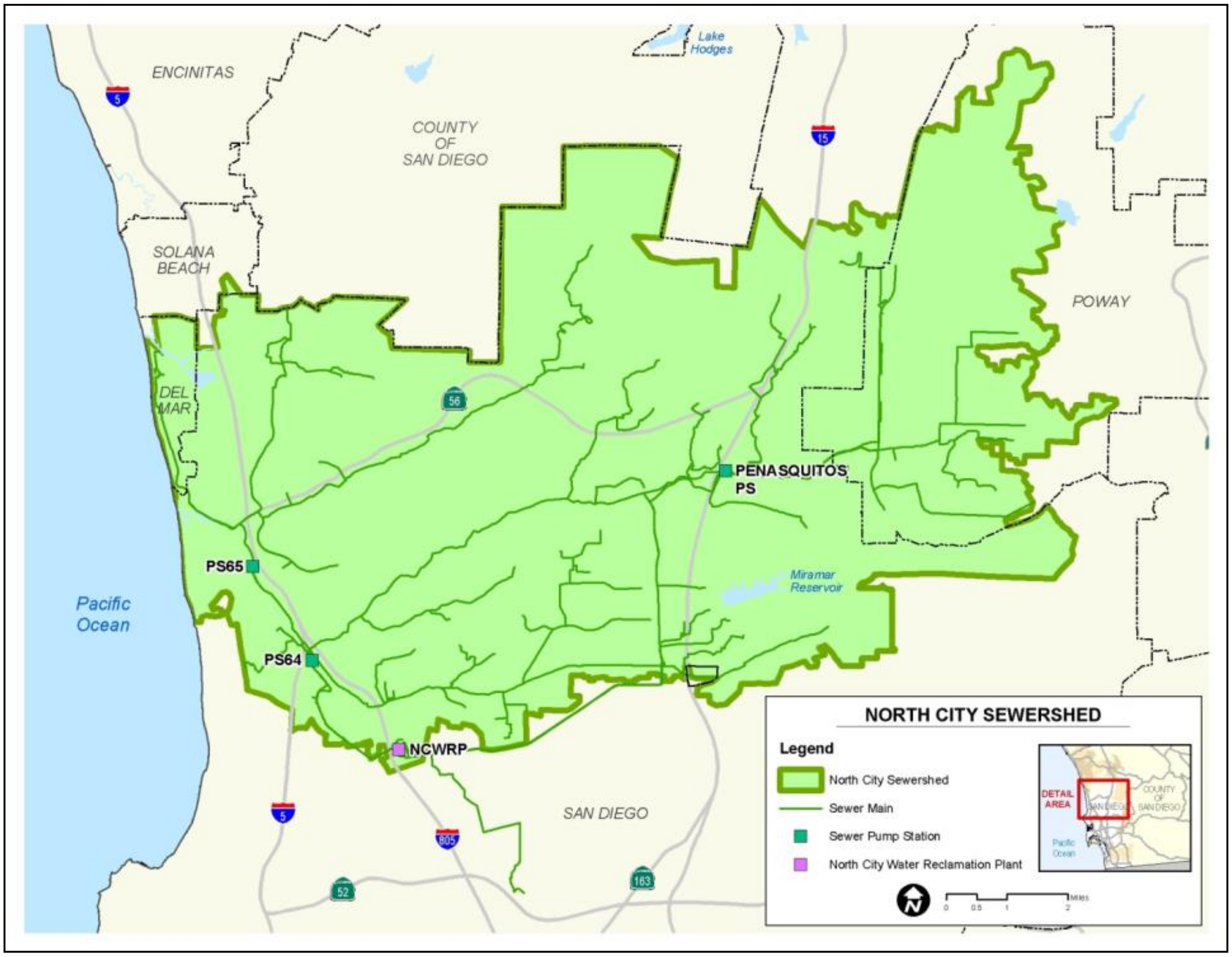
pharmaceuticals received in take-back programs in new and renewal permits for medical and biotech facilities tributary to North City.

- Require facilities that generate biohazardous waste to comply with the July 2005 California Medical Waste Management Act and revisions and amendments thereto, set forth in the California Health and Safety Code, Sections 117600 – 118360. Facilities must certify every six months as to compliance with the pharmaceutical discharge prohibition and biohazardous waste management requirements. The Program has procedures in place to evaluate the need for additional controls, and to develop and enforce new local limits and facility or sector-specific Industrial Management Practices as needed to ensure and maintain required effluent quality.

For projects where purified water would enter the drinking water system via groundwater or surface water augmentation, CDPH requires that source control programs be augmented to address residential and commercial discharges and consider an expanded set of contaminants that may have public health relevance, such as industrial chemicals, pharmaceuticals, and personal care product residuals sometimes found in wastewater.

Because the source of purified water for potential reservoir augmentation at San Vicente Reservoir is North City, that facility's service area would be the focus of an enhanced source control program. Figure F-2 depicts the North City service area.

Figure F - 2: North City Service Area



In order to identify potential supplements to the City's IWCP to address possible regulatory requirements associated with a potential reservoir augmentation project, the City reviewed the existing source control program being implemented by OCSD. OCSD's Source Control Program was enhanced to support the currently operational Orange County GWRS, which employs water purification processes similar to those that would be implemented for reservoir augmentation at San Vicente Reservoir. Comparison with OCSD's program illustrated that the City's existing program is robust and goes beyond applicable regulatory requirements for ocean discharges. However, based on that review and the heightened vigilance required to protect drinking water systems, it was concluded that the following components should be considered, should the City pursue reservoir augmentation at San Vicente Reservoir.

- **Chemical Inventory Program and GIS Tracking.** The City may need to implement an expanded industrial and commercial discharger chemical inventory database, which is linked to discharger locations that are tracked using GIS.
- **Pollutant Prioritization Program.** The City may be expected to develop a program to prioritize pollutants through sampling and characterization of CECs at the full-scale AWP

facility and determine if pollutants can be controlled through targeted source control for individual dischargers or commercial sectors.

- **Local Limits Evaluation.** To support a full-scale reservoir augmentation project at San Vicente Reservoir, a local limits evaluation may need to be performed for the North City service area, taking into consideration compliance criteria established by regulatory agencies. Local limits are wastewater limitations that apply to commercial and industrial facilities that discharge to a common treatment plant. They are developed to meet the source control program objectives and site-specific needs of the local treatment plant and its receiving waters. The evaluation would consider including additional pollutants of concern (POCs) on North City's list of local limits, and potentially lowering the limit of pollutants already on the list. An annual re-evaluation of the limits may be necessary to ensure compliance with new and evolving regulations for purified water. This evaluation could be done in conjunction with the annual local limits evaluation for Point Loma.

North City Water Reclamation Plant

North City would be a key component of a reservoir augmentation project at San Vicente Reservoir, providing conventional wastewater and tertiary water treatment technologies to water feeding the AWP facility. North City has been operating since 1997, and has a current design capacity of 30 mgd based on an annual average daily inflow rate; however, North City was master-planned for expansion to 45 mgd (City of San Diego 2012b). The IAP noted that North City already has complex reliability features, including conservative operating criteria and flow equalization, to support a reservoir augmentation project at San Vicente Reservoir.

North City is an existing facility that would serve as a key component of a full-scale reservoir augmentation project by providing recycled water to a full-scale AWP Facility.

No physical modification would be necessary for North City as part of a reservoir augmentation project at San Vicente Reservoir, although some operational adjustments could be made, including use of different chemicals and adjustment of certain operating procedures to complement the operation and performance of the full-scale AWP facility.

Full-Scale Advanced Water Purification Facility

As explained in Section B, Advanced Water Purification Facility*,* the City operated the AWP Facility for one year, producing one mgd of purified water using the same process components that would be used in a full-scale AWP facility. Operating the AWP Facility enabled the City to identify recommendations for design of a full-scale AWP facility (CDM Smith and MWH, 2013a). The full-scale components and design considerations identified as part of the Demonstration Project are summarized below.

Facility Components

The full-scale AWP facility would include the same general process components as the AWP Facility, as well as additional components necessary to address water quality and testing results from the AWP Facility. Table F-1 identifies the necessary full-scale AWP facility components and identifies which components were demonstrated at the one-mgd AWP Facility.

Production Capacity

An analysis was conducted to define an initial capacity for the full-scale AWP facility. That analysis evaluated the overall capacity of North City and recycled water availability considering existing irrigation and industrial users. Due to the seasonal variation in demand from existing recycled water users (more irrigation demand occurs in the summer months), more purified water would be available to augment San Vicente Reservoir during winter months. The initial full-scale AWP facility production capacity was determined to be 18 mgd. Average production (15 mgd) is expected to be slightly lower than maximum treatment capacity (18 mgd) because production will vary throughout the year due to seasonal fluctuations in recycled water demand and routine maintenance requirements. During periods of low recycled water demand, production would reach full production capacity, while in months of peak recycled water demand, it will be less than capacity, averaging approximately 15 mgd on a year-round basis.

Based on the full-scale capacity analysis, preliminary design criteria were developed for an 18-mgd capacity facility. The capital cost estimates presented later in this section are based on an 18-mgd maximum treatment capacity, because the infrastructure needs to be sized to be capable of delivering the maximum production of 18 mgd. The operations and maintenance (O&M) cost estimates are based on an annual average production of 15 mgd, because this is the average expected production for which annual, ongoing expenses will be incurred.

This production capacity analysis is summarized in the Full-Scale Reservoir Augmentation Capacity Analysis Technical Memorandum (RMC, 2011). The City updated this technical memorandum in January 2013.

Site Location and Layout

The full-scale AWP facility would be located on 10.3 acres of vacant City-owned property immediately north of North City. The site layout for the full-scale AWP facility was developed to locate the administrative building on the south side of the facility for visitor access. Process areas not enclosed in a building would be installed under canopies. A pipe gallery/access tunnel would be provided under Eastgate Mall Road, connecting North City to the full-scale AWP facility just west of the guard shack. Figure F-3 presents the preliminary site layout and location for the full-scale AWP facility.

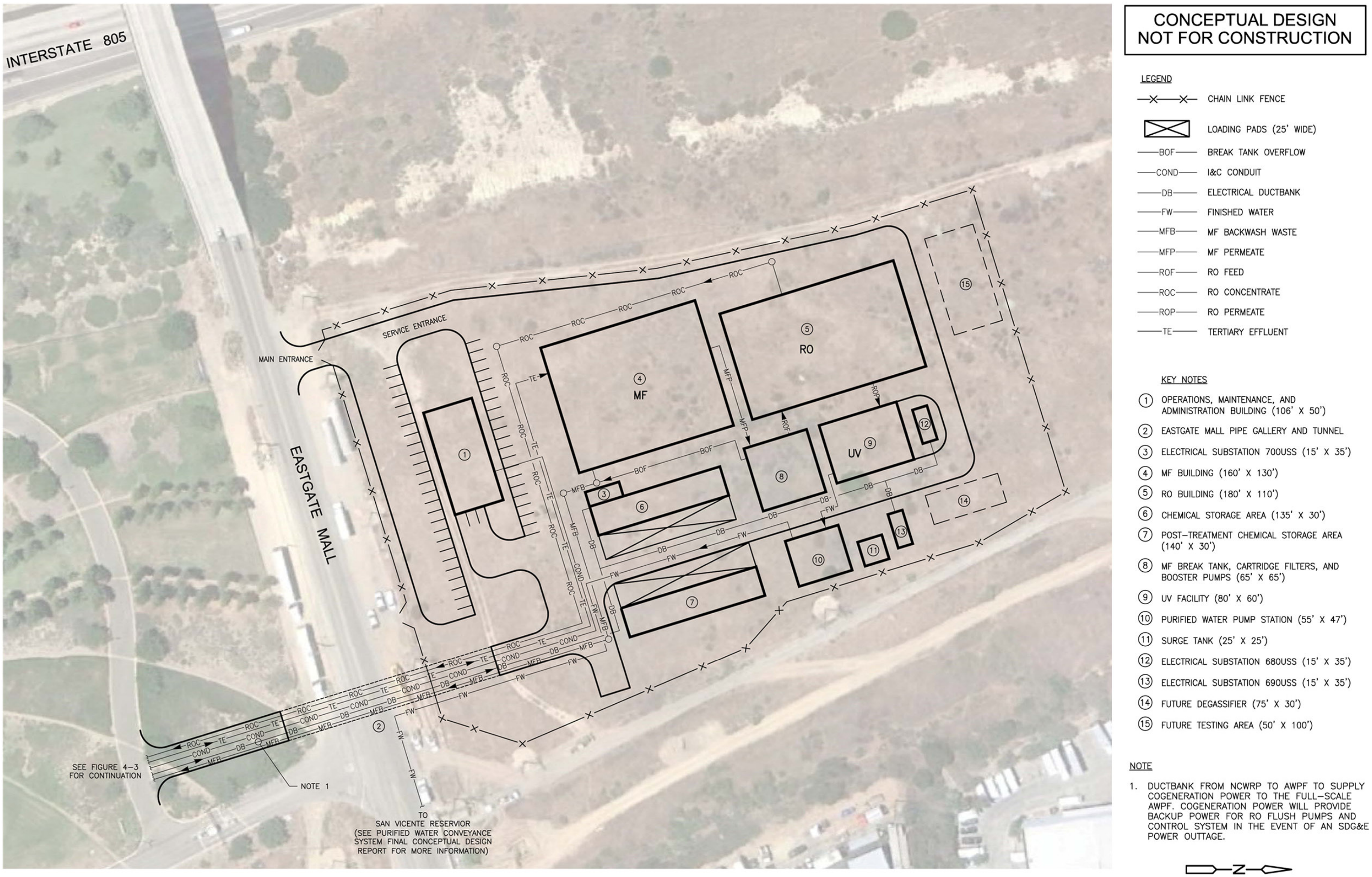
Table F - 1: Full-Scale AWP Facility Components

Full-Scale AWP Facility Component	Demonstrated at 1- mgd AWP Facility?	Purpose
Pump station to send North City water to the full-scale AWP facility	No	A new pump station would need to be constructed to pump water from North City to the full-scale AWP facility site.
Pre-treatment chemical addition	Yes	Pre-treatment would continue to be applied for the full-scale system to reduce contaminants that may harm the AWP Facility equipment.
Membrane filtration (either microfiltration or ultrafiltration)	Yes	Membrane filtration would continue to be the first stage in the water purification process for the full-scale AWP facility.
Membrane filtration break tank	Yes	A membrane filtration "break tank" would continue to be used to hold water before it is sent to the reverse osmosis system. This will help to stabilize flows.
Reverse osmosis booster pumps	Yes	"Booster pumps," pump stations used to move water from the membrane filtration to the reverse osmosis process, would continue to be used.
Reverse osmosis pre-treatment chemical addition	Yes	Pre-treatment before the reverse osmosis stage would continue to be applied to reduce contaminants that may harm the reverse osmosis membranes.
Cartridge filters	No	Cartridge filters would be added to help protect the reverse osmosis membranes.
Reverse osmosis feed pumps	Yes	"Feed pumps," send water into the reverse osmosis system would continue to be used to directly control the pressure of water entering the reverse osmosis system.
Reverse osmosis system	Yes	A reverse osmosis system would continue to be the secondary and main stage in the water purification process for the full-scale AWP facility.
UV disinfection/advanced oxidation using UV light with hydrogen peroxide	Yes	An UV disinfection/advanced oxidation system would continue to be the third and final stage in the water purification process for the full-scale AWP facility.
Post-treatment/ stabilization chemical addition	No	Post-treatment would be added for the full-scale AWP facility system. This step will include adding treatment chemicals to stabilize the purified water and ensure that it does not have corrosive properties that could potentially damage the conveyance pipeline to San Vicente Reservoir.
Purified water pump station	No	A purified water pump station would be added to transport purified water from the full-scale AWP facility to San Vicente Reservoir.
Operations Center	No	An operations center building would be added to conduct necessary operations and testing procedures for the full-scale AWP facility.

Footnotes:

1. Yes indicates the component was demonstrated by the AWP Facility. No indicates that, while not demonstrated by the AWP Facility, the component would be necessary for a full-scale facility.

Figure F - 3: Preliminary Layout and Location for the Full-Scale AWP Facility



System Controls, Reliability, and Redundancy

North City treats wastewater flows that would otherwise be treated at Point Loma. Flows to North City can be diverted to Point Loma, allowing North City to be shut down or taken "offline" any time. Point Loma can therefore serve as a back-up system, where flows can be sent from the North City service area when needed. The full-scale AWP facility would be able to be taken offline by halting delivery of recycled water from North City. Although the full-scale AWP facility would have the ability to be shut down at any time, facility design would need to include standard redundancy features that would allow the full-scale AWP facility to continue to operate at its optimal capacity when a particular process unit was offline for maintenance or cleaning.

Continuous monitoring and the ability to immediately shut down the full-scale AWP facility are critical components of the overall reliability of water purification processes. Instrumentation and automation would be provided to continuously verify that processes are operating as expected. The control system would include electronic monitoring that would automatically shut down the facility if a problem was detected. This would prevent water that does not meet the water quality requirements from being introduced into San Vicente Reservoir. Manual checks would also be performed on each system to identify operational trends and detect anomalies that require attention. These electronic systems controls and manual procedures, together with critical control point monitoring (see Section B, Advanced Water Purification Facility), would assure that only the highest quality water leaves the full-scale AWP facility.

Pipeline System Components

The City's Water Repurification Project efforts in the 1990s generated a conceptual pipeline (conveyance) system for a reservoir augmentation project that would convey purified water from North City to San Vicente Reservoir. However, because conditions have changed substantially since the Water Repurification Project was completed, a new conveyance study was required to analyze how water could be conveyed from the full-scale AWP facility (North City) to San Vicente Reservoir. In 2012, a conceptual design study was completed to update recommendations for the purified water conveyance system, including potential pipeline alignments and pump station specifications (RMC, 2012). The new conveyance study also comprehensively analyzed conditions that have changed since the Water Repurification Project was completed. In addition, the conceptual design provided estimates of the associated capital and operations and maintenance costs for the pipeline system components.

Components of the purified water pipeline system would include:

- Purified water pump station
- Purified water pipeline
- Reservoir inlet structure

An overview of the findings from the conceptual design study, including potential pipeline alignments and operational features of the pipeline and purified water pump station, are provided below.

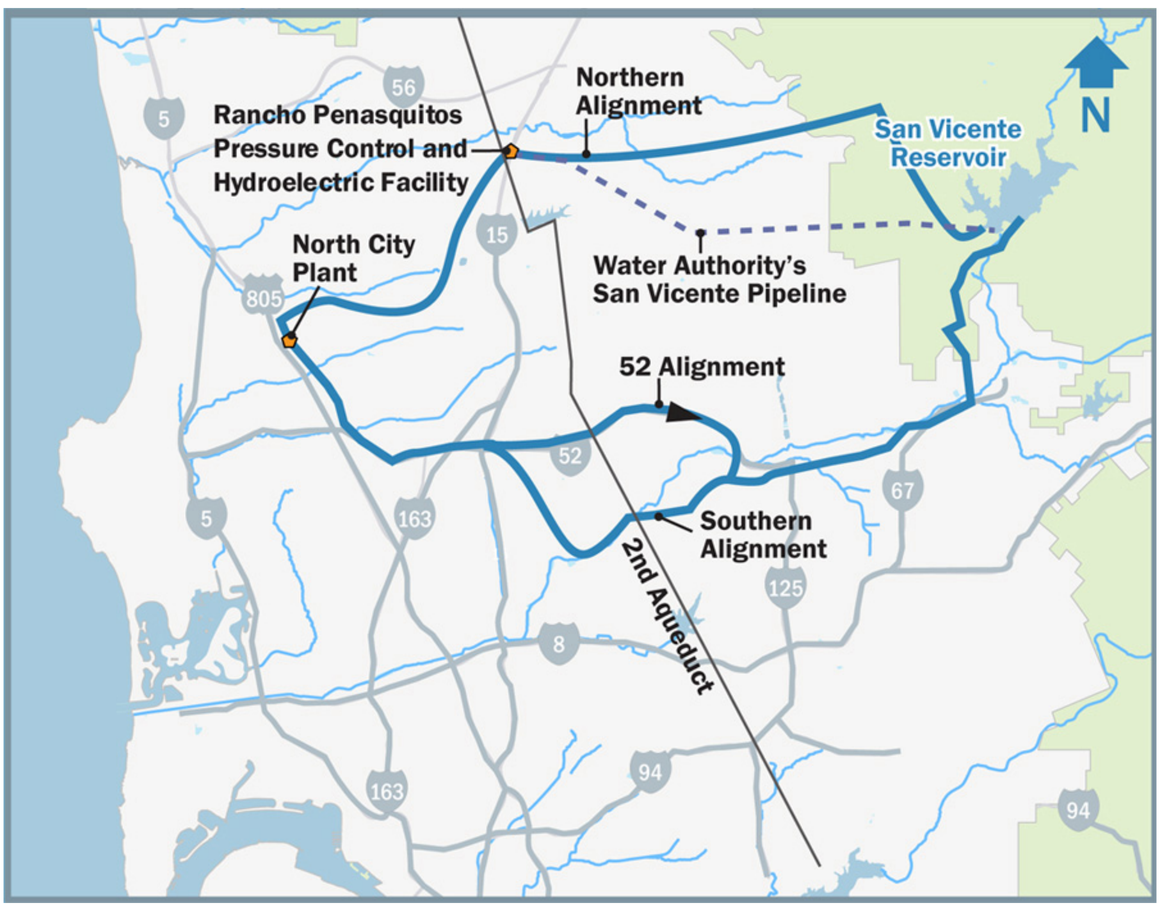
Purified Water Pump Station

A new pump station would be required at the full-scale AWP facility to transport purified water through the pipeline to San Vicente Reservoir. The capacity of this pump station would match the operating range of the AWP facility, with the potential to expand as necessary. Preliminary recommendations for pump types and clear well capacity (needed to counterbalance AWP facility production and pump station operation) were also provided in the conveyance conceptual design study.

Purified Water Pipeline

A series of alternative pipeline alignments to convey purified water from the full-scale AWP facility to San Vicente Reservoir were evaluated. These alignments are described below, and the potential location of these alignments is illustrated in Figure F-4.

Figure F - 4: Potential Purified Water Pipeline Alignments



<u>Northerly Alignments</u>

Two northerly alignments were considered to transport purified water to San Vicente Reservoir, referred to as the northern alignment and the San Vicente Pipeline alignment. The northern alignment, originally evaluated during the Water Repurification Project, is approximately 24 miles long, and follows city streets from North City to the Water Authority's Rancho Peñasquitos

Pressure Control and Hydroelectric facility, which is adjacent to the Second Aqueduct near Mercy Road and Black Mountain. From there, the alignment travels along Pomerado Road to Spring Canyon Road to Scripps Poway Parkway, then south along Highway 67, with a purified water inlet structure near the First Aqueduct inlet structure at San Vicente Reservoir. The close proximity of the purified water inlet to the First Aqueduct inlet structure could pose a challenge, as it would reduce reservoir retention time and blending, which are required to satisfy regulatory requirements. The alignment also traverses challenging terrain, and an encroachment permit would be required from Caltrans to place the pipe in the Highway 67 right-of-way. This alignment should be studied further in the preliminary design phase.

San Vicente Pipeline Alignment

The second northern alignment, the San Vicente Pipeline, is a connection to an existing pipeline that is operated by the Water Authority as part of the region's Emergency Storage Project. The Emergency Storage Project was implemented to connect a network of reservoirs, pipelines, and other facilities that can be used to store and move water throughout the San Diego region in the event of a natural disaster such as an earthquake or drought. The San Vicente Pipeline is 11 miles in length, and connects the Second Aqueduct, which supplies imported water to the west side of San Diego County, to San Vicente Reservoir. Due to the proximity of the San Vicente Pipeline to North City, the fact that it connects to San Vicente Reservoir, and the expected limited use of this pipeline (expected to be used primarily under emergency conditions), this pipeline was considered as a potential pipeline option for a reservoir augmentation project at San Vicente Reservoir. Approximately 10 miles of new pipeline would be needed to connect to the existing 11-mile San Vicente Pipeline.

Through meetings with the Water Authority, it was determined that the San Vicente Pipeline not only conveys water to San Vicente Reservoir, but is also used to convey water directly to the Morena Pipeline and Helix Water District Pipeline, both of which supply imported water directly to the Helix Water District's Levy Water Treatment Plant. Due to this direct connection to the Levy Water Treatment Plant (lacking an environmental buffer), use of the San Vicente Pipeline to convey purified water to San Vicente Reservoir could not be considered during the Demonstration Project.

It is recognized that, should the Water Authority and Helix Water District make other arrangements to transport water from the Second Aqueduct to the Levy Water Treatment Plant, a purified water conveyance strategy including the San Vicente Pipeline could be feasible from a regulatory standpoint. Should the City decide to proceed with a full-scale project, it is recommended that this option be further explored. Further, in the event that regulatory conditions change such that an environmental buffer is no longer required between a purified water source and a drinking water system, use of the San Vicente Pipeline could become feasible from a regulatory perspective.

Southerly Alignments

Purified water conveyance research conducted during the Water Repurification Project in the 1990s focused primarily on a southerly alignment. This alignment included use of the existing recycled water pipeline serving the Metropolitan Biosolids Center and other customers to the southeast of

North City. In addition, it relied on a longitudinal encroachment of a Caltrans right-of-way along State Route 52 (SR-52) and construction of a pipeline along Mast Boulevard in the Santee area. This alignment was re-evaluated as part of the Demonstration Project. Significant changes have occurred along this pipeline alignment since the 1990s. As a result of these changes, the City investigated two alternative southerly alignments for a purified water pipeline: the original approximately 22-mile alignment, including a SR-52 encroachment, and an approximately 23-mile alternative alignment through Mission Gorge that avoids SR-52. Based on the updated analysis conducted as part of the Demonstration Project, a southerly alignment appears to provide the best opportunity to convey purified water from North City to San Vicente Reservoir. Consequently, the cost estimate presented in the following section is representative of a southerly alignment. At the current level of planning and cost estimation, there is no appreciable difference in costs between the two southerly alignments.

Construction Impacts

Construction along any of the potential alignments would require stream crossings and analyses of adjacent native habitat and cultural resources. In addition, construction could potentially generate traffic, noise, and other environmental impacts, depending on its location and magnitude. Moving forward, additional environmental analyses will be required to determine specific features of each alignment such as potential impacts to biological, cultural, and other resources, which would make one alternative superior over the other from an environmental impact point of view.

Pipeline Draining

CDPH would require that purified water from a full-scale AWP facility be captured and prevented from entering San Vicente Reservoir in the unlikely event of a problem at the full-scale AWP facility. The pipeline transporting purified water to the reservoir would be generally on an uphill slope, facilitating the capture and diversion of flows away from San Vicente Reservoir if necessary. In a reservoir augmentation project at San Vicente Reservoir, drain lines would be included in the pipeline system design to enable off-specification flows to be diverted to local sewer systems. Along a southern alignment, this reliability feature would require the diversion of flows to both Santee and San Diego sewer systems.

Purified Water Inlet Structure

The purified water inlet structure would enable purified water to be released from the conveyance pipeline into San Vicente Reservoir. The inlet structure would be positioned at an elevation that would always remain above the surface of the water in the reservoir, and it would include a spillway. Engineering studies conducted in the 1990s provided a preliminary design for this inlet structure, which was reviewed as part of the Demonstration Project. This inlet structure is still feasible.

A series of purified water inlet locations were studied as part of the Reservoir Study conducted by Flow Science (refer to Section C, San Vicente Reservoir Study for more information). While all locations studied were determined to meet regulatory requirements for blending and travel time, a conservative location on the southeast edge of the reservoir (the Design Purified Water Inlet Location) was used as the basis for estimating conveyance pipeline costs.

AWP Facility and Pipeline System Costs

AWP facility and pipeline system costs were evaluated in terms of overall capital and O&M costs; unit costs, which reflect the capital and O&M costs spread over the project life and presented in terms of cost per AF of water produced; and effects on an average monthly household water bill. Avoided wastewater system costs were also quantified. These costs are described below.

Capital and O&M Costs

Capital and O&M costs for the AWP facility and purified water pipeline system are presented in Tables F-2 and F-3, respectively. These cost estimates were based on preliminary facility engineering, and would be updated during final design should the City decide to move forward with a full-scale project. Costs for the purified water pipeline system were developed as part of the Conveyance Conceptual Design Study, and costs for the full-scale AWP facility were developed as part of the Advanced Water Purification Facility Study (CDM Smith and MWH, 2013a). Total capital costs for a reservoir augmentation project at San Vicente Reservoir are estimated to be approximately $369 million, with O&M costs estimated to be $15.5 million per year.

Table F - 2: AWP Facility and Purified Water Pipeline System Preliminary Capital Cost Estimate

Parameter	Capital Cost[1]
AWP Facility Construction Costs	
AWP Facility Influent Pump Station	$2,800,000
Site Civil/Yard Piping	$5,800,000
Operations, Maintenance, and Administration Building	$1,600,000
Membrane Filtration Break Tank and Pump Station	$4,000,000
Chemical Storage Area #1 (Pre-Treatment Chemical Facility)	$2,400,000
Membrane Filtration Facility	$25,300,000
Reverse Osmosis Facility	$21,300,000
UV Disinfection and Advanced Oxidation System	$9,900,000
Chemical Storage Area #2 (Post-Treatment Chemical Facility)	$2,100,000
AWP Facility Construction Subtotal	**$75,200,000**
Contingency (30% of Construction Total)	$22,600,000
Insurance, Bonds, Overhead & Profit	$12,700,000
AWP Facility Construction Total	***$110,500,000***
AWP Facility Implementation Costs	
Engineering & Pre-Construction (20% of Total Construction Cost)[2]	$22,100,000
Environmental Documentation and Mitigation	$1,000,000
Construction Management (10% of Total Construction Cost)	$11,100,000
AWP Facility Implementation Total	***$34,200,000***
Total AWP Facility Capital Cost (Construction Total + Implementation Total)	**$144,700,000**
Purified Water Pipeline System Construction Costs	
Purified Water Pump Station	$8,000,000
Purified Water Pipeline	$114,200,000
Pipeline System Construction Total	***$122,200,000***
Pipeline System Implementation Costs	
Contingency (30% of Construction Total)	$36,700,000
Engineering & Construction Management (30% of Construction Total)[2]	$36,700,000
Environmental Documentation and Mitigation	$24,400,000
Land Acquisition	$4,500,000
Pipeline System Implementation Total	***$102,300,000***
Total Pipeline System Capital Cost (Construction & Implementation)	**$224,500,000**
Total Capital Cost (Construction + Implementation + Source Control)	**$369,200,000**

1. Costs for the purified water pipeline system were developed as part of the conveyance conceptual design study, and costs for the full-scale AWP facility were developed as part of the Advanced Water Purification Facility Study (CDM Smith and MWH, 2013a).
2. Includes costs associated with regulatory compliance and permitting.

Table F - 3: AWP Facility and Purified Water Pipeline System Preliminary O&M Cost Estimate

Parameter	Annual O&M Cost[1]
Power Costs	
AWP Facility Influent Pump Station	$306,000
Membrane Filtration System	$43,000
Reverse Osmosis System	$1,614,000
UV Disinfection and Advanced Oxidation System	$185,000
Miscellaneous Equipment	$7,000
Buildings	$481,000
Purified Water Pump Station	$1,657,000
Power Costs – Subtotal	***$4,293,000***
Chemical Costs	
Membrane Filtration Pretreatment	$223,000
Reverse Osmosis Pretreatment	$431,000
Hydrogen Peroxide for Advanced Oxidation	$216,000
Post Treatment	$358,000
Membrane Cleaning	$103,000
Chemical Costs – Subtotal	***$1,331,000***
Replacement of Consumables	
Membrane Filtration Membranes	$441,000
Reverse Osmosis Cartridge Filters and Reverse Osmosis Membranes	$319,000
UV Lamps and Ballasts	$281,000
Replacement of Consumables – Subtotal	***$1,041,000***
AWP Facility Maintenance Costs	***$1,409,000***
Treatment at North City to Support AWP Facility[2]	***$3,965,000***
Purified Water Pump Station Maintenance Costs	***$228,000***
Purified Water Pipeline Maintenance Costs	***$1,500,000***
Other Annual Costs (Compliance Testing and Security)	$310,000
Annual Labor Costs	$1,418,000
Total Annual O&M Cost	**$15,495,000**

1. Costs for the purified water pipeline system were developed as part of the conveyance conceptual design study, and costs for the full-scale AWP facility were developed as part of the Advanced Water Purification Facility Study (CDM Smith and MWH, 2013a).
2. Cost to increase North City tertiary water production above what is needed to meet non-potable recycled water demands.

Auxiliary Program Costs

Additional auxiliary program costs to support a full-scale project are presented in Table F-4. These cost estimates were based on preliminary cost estimates for a source control program and a public outreach program. Costs for the Source Control Program were developed as part of the Enhanced Source Control Plan for the Full-Scale Advanced Water Purification Facility Technical Memorandum (RMC, 2013).

Table F - 4: Auxiliary Program Cost Estimate

Parameter	Auxiliary Cost
Auxiliary Upfront Cost	
Source Control Program Upfront Cost[1]	$500,000
Auxiliary Annual Cost	
Source Control Program Annual Costs[2]	$50,000
Public Outreach Annual Program Costs[3]	$700,000

1. Source control upfront costs include a chemical inventory program and GIS tracking database (approximately $50,000), a pollutant prioritization program to be completed by existing City staff (approximately $50,000 for initial set-up work), and a local limits evaluation for North City (approximately $400,000). For additional information on source control program costs, refer to the Enhanced Source Control Plan for the Full-Scale Advanced Water Purification Facility Technical Memorandum (RMC, 2013).
2. Source control annual costs include $25,000/yr for annual updates to the chemical inventory program and GIS tracking database, an average of $10,000/yr for periodic updates to the pollutant prioritization program, and $15,000/yr, on average, for updates to the local limits analysis. For additional information on source control program costs, refer to the Enhanced Source Control Plan for the Full-Scale Advanced Water Purification Facility Technical Memorandum (RMC, 2013).
3. Public outreach annual costs include initial start-up of outreach efforts. Annual public outreach costs will be scaled back following full-scale reservoir augmentation project operations.

Unit Costs

A net present value analysis was performed on the capital and O&M costs presented above. Based on this analysis, the unit cost of a reservoir augmentation project as San Vicente Reservoir would be approximately $2,000/AF, as shown in Table F-5. Key assumptions of this analysis included:

- The project life is 50 years.
- Financing would be received through rates, revenue bonds, and State Revolving Funds.
- The Water Authority's Local Resource Program (LRP) credits would continue. The uncertain future of these credits was addressed by applying a credit that reflects a midpoint between favorable and unfavorable conditions. Under favorable conditions, the credit is expected to be $450/AF of water produced, while under unfavorable conditions it is expected to be $100/AF. The average of $275/AF was used in estimating the overall cost of reservoir augmentation.
- Grant funding in the amount of 20 percent of capital costs would be received. Such grants are typical for water recycling projects.

Table F - 5: Projected Unit Costs

Project Component	Projected Unit Cost[1]
AWP Facility	$1200/AF
Purified Water Pipeline System	$700/AF
Source Control	$50/AF
Public Outreach	$50/AF
Total	$2,000/AF

1. Assumes a project life of 50 years, financing through both revenue bonds and State Revolving Funds, LRP credits of $275 / AF, and grant funding in the amount of 20% of capital costs.

The projected unit cost of $2,000/AF is consistent with projections developed for the Indirect Potable Reuse - Phase I project evaluated in development of the 2012 LRWRP, which was estimated to cost approximately $2,100/AF, including initial capital and annual operating costs (including energy). A key difference between the costs developed for the LRWRP and the costs presented in this Project Report is that the LRWRP costs do not reflect any potential grant funding or low-interest loans. Neither the costs developed for this study nor the LRWRP costs reflect any cost savings from reduced wastewater treatment and disposal (see Avoided Wastewater Costs section, below).

Household Water Bill

The anticipated effect of a reservoir augmentation project at San Vicente Reservoir on an average monthly household water bill was also calculated. Assuming an average residential usage volume of 14 hundred cubic feet per month, an average untreated water supply cost to the City of approximately $962/AF, and an average total water use of approximately 194,000 AFY, a reservoir augmentation project at San Vicente Reservoir with an average flow of 15 mgd and a unit cost of $2,000/AF would result in an increase of approximately $6.87 per month on an average residential water bill. For comparison, the average residential water bill (fiscal year 2012-2013) was approximately $72.03 per monthly billing cycle (water charges only).

This projected increase does not take into consideration projected increases in monthly water bills expected as the result of increasing imported water supply costs that would occur with or without a reservoir augmentation project at San Vicente Reservoir. It should also be recognized that such a project would provide value to the customer in increased supply reliability and reduced reliance on imported water.

Avoided Costs

The implementation of a reservoir augmentation project at San Vicente Reservoir would result in avoided wastewater system costs, as well as savings related to reduced salinity in the City's water supplies. Avoided wastewater system costs result from the elimination of costly capital improvement needs and in reduced operations and maintenance costs. In order to determine what capital improvements could be avoided as a result of implementing full-scale reservoir augmentation, the

September 2011 Metro Wastewater Plan (Plan) was referenced. The facility requirements described in the Plan correspond to Point Loma remaining a chemically-enhanced primary treatment plant. There are several projects included in the Plan's long-term capital program. Among these projects is the construction of a seven-million-gallon wet weather storage facility that would be needed to attenuate flows to Point Loma. In the absence of full-scale reservoir augmentation, this facility would need to be operational by the year 2022. Its estimated capital and operating costs are $123 million and $6.2 million per year, respectively.

Implementation of a reservoir augmentation project at San Vicente Reservoir would also reduce the flows conveyed to and treated at Point Loma. Annual operations and maintenance savings related to reduced treatment and conveyance, respectively, are approximately $2.2 million and $450,000 per year.

The TDS (a measure of salt content) of purified water produced at the AWP Facility was approximately 15 mg/L. This is in contrast to imported water TDS, which is approximately 500 mg/L and has occasionally exceeded 600 mg/L (City of San Diego, 2012a, City of San Diego, 2012g). The estimated monetary savings to a drinking water system due to reduced salinity was evaluated by MWD and the Bureau of Reclamation in the late 1990s. They found that reduced salinity correlates with longer useful lives of downstream treatment facilities. Savings related to the extended lives of retail customers' plumbing fixtures would also be expected. The savings associated with reduced salinity were further evaluated in Water Reuse Study (City of San Diego, March 2006) specifically for the City's setting and determined to equal $250/AF. The Recycled Water Study (City of San Diego, July 2012) re-evaluated the savings and conservatively applied $100/AF in its financial analysis. While it is anticipated that salt reduction benefits would be observed as a result of a reservoir augmentation project at San Vicente Reservoir, this benefit has not been analyzed as part of the Demonstration Project, and has not been monetized.

These avoided costs, summarized in Table F-6, yield an associated net unit cost of $1,000/AF.

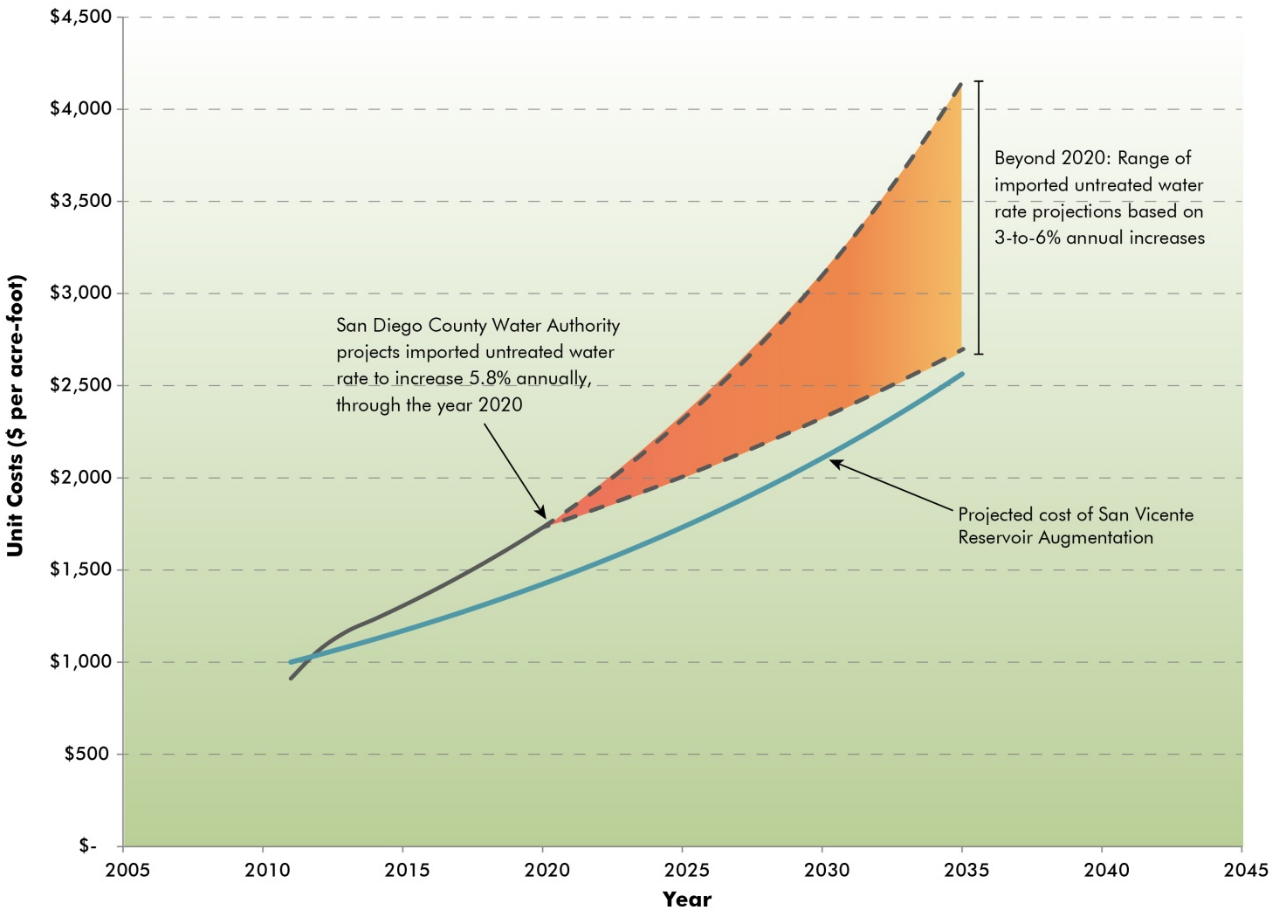
Table F - 6: Avoided System Costs

Benefit	Avoided Cost	Avoided Cost per AF
Point Loma Wet Weather Storage Facility	$123,000,000 (Capital) $6,150,000 (Annual O&M)	$1,000
Reduced Treatment at Point Loma	$2,200,000 (Annual O&M)	
Reduced Pumping at Pump Stations No. 2	$450,000 (Annual O&M)	
Reduced Salinity in Water Supplies		Not monetized
Total Avoided Costs/Savings		$1,000

The current cost of untreated imported water as of January 2013 is $1,039/AF. Imported water costs are expected to increase at a rate of 5.8 percent per year through 2020, and between three and six percent per year after 2020. Figure F-5 presents the current and projected cost of imported water compared to the net cost of water from a reservoir augmentation project at San Vicente Reservoir.

As shown in this figure, the unit cost of imported water supplies exceeds the net unit cost of supplies from a reservoir augmentation project at San Vicente Reservoir.

Figure F - 5: Current and Projected Cost of Water Supplies



For additional cost information, please refer to Section 8.4 of the City of San Diego Recycled Water Study (City of San Diego, 2012b), provided in Appendix G.

Energy

An energy analysis requested by City Council for water supply options will be completed by the consultant preparing the City's 2012 LRWRP. The report is anticipated to be submitted for City Council review and acceptance in early 2013.

Because no single water supply option can meet all goals of the 2012 LRWRP, a range of options (including conservation, groundwater, non-potable reuse, reservoir augmentation, rainwater, gray water, ocean desalination, and imported water) was considered to form eight portfolios and diversify the approach to meet the objective of the plan. Over 20 performance measures were used to comprehensively evaluate each portfolio, which were ranked in terms of their cumulative performance.

Based on these rankings, and their climate change adaptation benefits, three portfolios consistently ranked highest. All three of these highest ranked portfolios included reservoir augmentation at San Vicente Reservoir as a common resource option. The inclusion of a full-scale (15-mgd average flow) reservoir augmentation project as a resource option in all three of the highest ranked portfolios is significant because, if approved by the public, City Council and CDPH, reservoir augmentation at San Vicente Reservoir would be validated based on cost, energy footprint, and other criteria as a recommended near term resource strategy.

One quantitative performance measure for "energy footprint" of the City's water sources is the cumulative carbon dioxide emissions. Energy use can be illustrated by kWh /AF or tons of carbon dioxide emissions per AF. Reporting of greenhouse gas emissions (of which carbon dioxide is considered the largest, or primary component) by major source is required by the California Global Warming Solutions Act (AB 32, 2006). The City's reliance on imported water that originates hundreds of miles away and requires energy-intensive pumping contributes significantly to greenhouse gas emissions.

Greenhouse gas emissions are calculated based on typical per unit energy requirements for each source of water supply, including energy requirements for distribution and wastewater treatment if applicable. The energy (kWh/AF) of each water supply option in the 2012 LRWRP was converted to carbon dioxide equivalents (San Diego, 2012c). Carbon dioxide emissions are a reflection of the energy required to produce water, not the type of energy used, for each water resource. While imported water sources have different sources of energy than local water resources, it is assumed that all water resources use the same energy resource for simplicity.

The 15-mgd reservoir augmentation project at San Vicente Reservoir (estimated to require 2,500 kWh of energy per AF) would produce approximately 1.0 metric tons of greenhouse gases/AF. By comparison, imported water requires a range of 2,000 kWh/AF to 3,300 kWh/AF of energy, depending on the blend of water from the Colorado River or the Bay-Delta in Northern California, respectively. This corresponds to a range of 0.8 to 1.3 metric tons of greenhouse gases/AF (City of San Diego, 2012c). Since 2003, the blend delivered to the Water Authority has averaged approximately two-thirds Colorado River and one-third water from the Bay-Delta. Future imported water energy consumption will vary depending on actual blend. However, for practical purposes, the reservoir augmentation project at San Vicente Reservoir energy consumption is equivalent to that of imported water.

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