THE CITY OF SAN DIEGO

REPORT TO THE CITY COUNCIL

DATE ISSUED: March 11, 2013 REPORT NO: 13-27

ATTENTION: Natural Resources and Culture Committee, Agenda of

SUBJECT: Water Purification Demonstration Project, *Project Report*

REFERENCE:

1) Resolution Number R-303095 of the City Council accepting the 2006 Water Reuse Study, adopted December 3, 2007.
2) Resolution Number R-303237 of the City Council requesting that the Mayor adopt the San Diego Integrated Regional Water Management Plan, approved December 18, 2007.
3) Report to City Council Number 08-167, November 7, 2008, Proposed Water Rate Increase… to fund An Indirect Potable Reuse Demonstration Project. Resolution Number R-304434 of the City Council approving Water Rate Increases pursuant to increases in the wholesale cost of water and for funding Indirect Potable Water Reuse Demonstration Project, adopted November 25, 2008.
4) Resolution Number R-304764 of the City Council authorizing execution of an agreement to conduct a study for the Indirect Potable Water Reuse/Reservoir Augmentation Demonstration Project with Flow Science Incorporated, adopted April 1, 2009.
5) Resolution Number R-305584 of the City Council authorizing execution of a consultant contract with RMC Water and Environment for Indirect Potable Water Reuse/Reservoir Augmentation Demonstration Project - Project Management and Public Outreach, adopted February 8, 2010.
6) Resolution Number R-306069 of the City Council authorizing execution of an agreement with CDM Smith (formerly Camp Dresser & McKee) for the Indirect Potable Water Reuse/Reservoir Augmentation Demonstration Project - Advanced Water Purification [AWP] Facility, adopted August 5, 2010.

REQUESTED ACTION:

This action is to adopt the Water Purification Demonstration Project, *Project Report* in fulfillment of the elements outlined in Council actions approved in 2007 and 2008. These previous actions directed staff to conduct the Indirect Potable Reuse/Reservoir Augmentation Demonstration Project, which evaluated the feasibility of augmenting San Vicente Reservoir with advanced treated purified water.

STAFF RECOMMENDATION:

Approve the requested action.

SUMMARY:

In January 2004, the City Council approved a study to evaluate options to increase the use of recycled water produced at the City's two water reclamation plants (R-298781). The Water Reuse Study (March 2006) outlines the process undertaken to develop six options to maximize reuse, provides details on stakeholder involvement and outreach efforts, and the water quality research undertaken to assess public health impacts. The Water Reuse Study can be viewed at www.sandiego.gov/water/waterreuse/waterreusestudy. Water Reuse Study stakeholders identified Reservoir Augmentation of the City's San Vicente Reservoir, also known as the NC-3 option, as the preferred reuse strategy.

In October and December of 2007, the City Council voted (R-303095) to proceed with the Indirect Potable Reuse/Reservoir Augmentation (IPR/RA) Demonstration Project (Demonstration Project) to evaluate the feasibility of implementing this concept on a full-scale basis. A temporary water rate increase to fund the Demonstration Project was approved by the City Council (R-304434) in November 2008, went into effect on January 1, 2009, and concluded on September 1, 2010. Beginning in 2009 the Demonstration Project staff procured consultant services and equipment, and conducted studies to implement the project elements identified by the City Council. The Advanced Water Purification Facility, formerly referred to as the Advanced Water Treatment Demonstration Plant, began operating in June 2011. It continues to operate, and is open for public tours.

San Vicente Reservoir Augmentation Concept

The Demonstration Project evaluated the feasibility of conveying 15,000 acre-feet per year (AFY) of purified water to San Vicente Reservoir to augment existing water supplies in the reservoir. San Vicente Reservoir is located near Lakeside and is owned and operated by the City. San Vicente Reservoir is predominately used for municipal water supply purposes and also supports limited recreational activities. As part of the Emergency Storage Project, the San Diego County Water Authority has constructed new conveyance facilities that allow San Vicente Reservoir to serve water treatment plants operated by water agencies throughout the region. The Emergency Storage Project has raised San Vicente Dam by 117 feet, increasing the reservoir's capacity from 90,000 acre-feet to 247,000 acre-feet. Refilling the reservoir will begin in mid-2013 and is expected to take three to five years, depending on the availability of imported water.

Figure 1[1] shows how the reservoir augmentation concept would be implemented on a full-scale basis. Wastewater from homes and businesses would undergo multiple rounds of treatment, including advanced water treatment which renders the water "purified" and similar in quality to distilled water. The purified water would then be sent to the San Vicente Reservoir where it would blend with local runoff and imported supplies. The water would receive one last round of treatment at a drinking water treatment plant before being distributed as drinking water.

A full-scale reservoir augmentation project at San Vicente Reservoir would consist of the following:

- *Enhanced industrial waste control program.* Through this program unwanted constituents are prevented from entering the wastewater stream.

[1] Figures are at the end of this staff report.

- *Primary, secondary, and tertiary treatment at the North City Water Reclamation P*lant (North City). This treatment renders the water safe for irrigation and industrial (non-drinking) purposes.
- *Advanced water purification process consisting of membrane filtration, reverse osmosis, and ultraviolet light/advanced oxidation.* This treatment produces water of a quality similar to distilled water.
- *Residence time and blending with other supplies in the reservoir.* Note that during the Demonstration Project, no purified water was sent to the San Vicente Reservoir. Instead, the purified water was combined with recycled water produced at North City to serve irrigation and industrial demands.
- *Conventional water treatment.* Blended reservoir water would be treated at a drinking water treatment plant prior to distribution to residents and businesses.

Figure 2 shows the locations of proposed treatment and conveyance facilities associated with a full-scale reservoir augmentation project at San Vicente. The full-scale advanced water purification facility (AWP Facility) and conveyance pump station would be located on a vacant parcel of City-owned land across Eastgate Mall from North City. The 22-mile pipeline to San Vicente would be located in the City of San Diego, the City of Santee, the community of Lakeside, and unincorporated County of San Diego.

Figure 2 also shows the areas in the City and the region that would receive purified water produced by a full-scale project.

Figure 3 shows the multiple treatment barriers provided by a full-scale reservoir augmentation project at San Vicente Reservoir. This multiple barrier approach will protect the health and safety of the public water supply by using redundant treatment steps to ensure all unwanted constituents are removed from the water.

Components of the Demonstration Project

In accordance with Council Resolutions R-303095 and R-304434, seven primary tasks – or components - were undertaken for the Demonstration Project. The seven components of the Demonstration Project were:

1. Convene an Independent Advisory Panel to provide independent expert review of the technical, scientific, and regulatory aspects of the project;
2. Design, install, operate, and test a one-million-gallon-per-day demonstration-scale Advanced Water Purification Facility at North City;
3. Conduct a Limnology and Reservoir Detention Study of San Vicente Reservoir to assess residence time and dilution of the purified water, and to assess water quality in the reservoir;
4. Define the State's regulatory requirements for a full-scale reservoir augmentation project at San Vicente Reservoir;
5. Perform an energy and economic analysis;
6. Perform a pipeline alignment study; and
7. Conduct a public outreach and education program.

Figure 4 graphically displays the seven components of the Demonstration Project and the key tasks, meetings, reports, and outcomes, from the start of the project in 2007 through project completion in 2013. The major components of the project are shown along the bottom of the figure, and tasks, meetings, reports, and outcomes of each component are in columns. Important linkages between tasks, reports, or outcomes are shown by arrows.

Project Implementation

Implementation of the Demonstration Project was undertaken by the Public Utilities Department's Long-Range Planning and Water Resources Division. The Division assembled a team of City staff and consultants to execute the various Demonstration Project tasks.

Available Documents

The Water Purification Demonstration Project – *Project Report),* which details the entire process undertaken to implement the Demonstration Project, is included herein as Attachment 1.

Two other key project documents are the *Advanced Water Purification Facility Study Report* and the *Limnology and Reservoir Detention Study of San Vicente Reservoir* (Attachments 2 and 3, provided on companion CD). The former provides a full description of the AWP Facility, the testing and monitoring plan with results, and cost estimates for a full-scale facility. The latter details the studies addressing dilution and retention of purified water in the reservoir, and water quality effects. Because of the size of these reports only a limited number were printed and distributed. However, these reports and other supporting documents are available at the project website (www.purewatersd.org) or can be viewed in City offices at 600 B Street, Suite 600, by contacting project staff at (619)533-4112.

Convene an Independent Advisory Panel

The City contracted with the National Water Research Institutes (NWRI) to form an Independent Advisory Panel (IAP) to provide expert oversight of the key activities and results of the Demonstration Project. The City formed this IAP at the direction and recommendation of the California Department of Public Health (CDPH). The IAP created for the Demonstration Project was similar to expert panels of the Orange County Groundwater Replenishment Project and the City's Water Reuse Study. NWRI assembled a ten-member IAP comprised of academics and professionals with extensive expertise in the science of water reuse, water and wastewater technology, public health, epidemiology, toxicology, water quality, environmental science, public utilities, and regulations.

Over the course of the Demonstration Project, the City and IAP met in a workshop-style setting on numerous occasions to discuss the IAP's advice and perspective on key project milestones. The IAP meetings provided a forum in which the IAP could give feedback to the City and project consultants, who in turn incorporated it into subsequent project work. A total of ten meetings were conducted throughout the course of the project. Representatives from CDPH, California Regional Water Quality Control Board, the San Diego Region (San Diego Water Board), and the County of San Diego Department of Environmental Health regularly attended these meetings and interacted with the IAP, City staff, and project consultants.

In their letter to the City dated November 16, 2012, the IAP stated, *"The Panel believes that the Water Purification Demonstration Project Final Report (October 2012) and supporting documents are responsive to the directives set forth by the City Council. The Panel is also pleased with the responsiveness of the City's staff and consultants to the comments and recommendations made by the Panel."*

Design, Install, Operate, and Test a One-million-gallon-a-day Demonstration-Scale Advanced Water Purification Facility

The primary objectives of the AWP Facility were to:

1. Demonstrate the ability of the treatment process to reliably produce purified water that meets all regulatory standards pertaining to public water supplies; and
2. Demonstrate that continuous and daily monitoring of each water purification process can assure the integrity of the process and that only safe water is produced.

The AWP Facility has the capacity to produce one million gallons per day (mgd) utilizing the same three-step treatment process used at Orange County Water District's 70 mgd Groundwater Replenishment Project. The supply to the AWP Facility is recycled water from North City which is used to serve non-potable recycled water demands in the northern part of the City. The AWP Facility treatment process begins with membrane filtration, followed by reverse osmosis (RO), and ends with ultraviolet light/advanced oxidation (UV/AOP). The *Advanced Water Purification Facility Study Report* (Attachment 2) provides a full description and details of the AWP Facility.

AWP Facility Testing Approach

Testing at the AWP Facility spanned a 12-month period (July 2011 – August 2012). The City prepared a Testing and Monitoring Plan that prescribed the frequency and type of water quality tests to perform on the water processed through the AWP Facility. The Testing and Monitoring Plan included measurements for 342 constituents and parameters (231 regulated constituents and 111 non-regulated constituents)[2]. These constituents and parameters were measured before and after each treatment step and in the imported water aqueduct delivered through the regional aqueduct system. In total, the Testing and Monitoring Plan prescribed more than 9,000 individual water quality tests. The IAP and regulators reviewed and commented on the Draft Testing and Monitoring Plan, and the City finalized it based on their feedback.

The regulated constituents and parameters that apply to this project are represented in Table 1. Two agencies set the water quality standards and goals for the project. CDPH is responsible for protecting the drinking water quality in California. The San Diego Water Board is responsible for protecting the water quality in surface waters from an environmental perspective. As Table 1 indicates, the purified water met all applicable standards and goals for the 231 regulated constituents and parameters.

[2] A constituent is a dissolved chemical element or compound, or a suspended material that is carried in the water (e.g., sodium). A parameter is a physical property whose value can predict the behavior of the water (e.g., temperature).

Table 1 – Water Quality Testing - Regulated Constituents			
Regulations or Guidelines	**Number of Constituents and Parameters**	**Purified Water Results**	**Comments**
California Department of Public Health Goals			
Primary Drinking Water Maximum Contaminant Levels	90	Meets All Regulations	Primary Maximum Contaminant Levels are established to address public health
Secondary Drinking Water Maximum Contaminant Levels	18	Meets All Regulations	Secondary Maximum Contaminant Levels are established to address aesthetics such as color, taste, and odor
Microbial	4	Not Detected	
Notification Levels	30	Meets All Regulations	Drinking Water Notification Levels and Response Levels December 2010. Notification levels are health-based advisory levels established by CDPH for chemicals in drinking water that lack maximum contaminant levels
Groundwater Replenishment Criteria	142	Meets All Regulations	CDPH Groundwater Replenishment Reuse draft Regulation 2011 criteria used in absence of regulations for surface water augmentation.
San Diego Water Board goals for reservoir augmentation (projected)			
Reservoir Limits	143	Meets All Regulations	EPA Numeric Criteria for Priority Pollutants and San Diego Basin Plan Numeric Objectives.
Total	**231**	Unique constituents and parameters because some are in multiple regulations/guidelines.	

Additional testing for 111 non-regulated constituents at various locations in the purification process was performed. These constituents are primarily grouped into two main categories: those included in the USEPA 2012 Unregulated Contaminant Monitoring Rule, which consists of 30 contaminants monitored in drinking water for occurrence information; and constituents of emerging concern (also known as CECs), which are manufactured chemicals, such as pharmaceuticals, personal care products, and pesticides, that have been found in treated wastewater. Results showed the reverse osmosis and advanced oxidation processes were effective at removing the majority of these constituents present in North City recycled water. Of these 111 non-regulated constituents, six were quantifiably detected (above the laboratory reporting limit) in the purified water during at least one sampling event. These six constituents are bromochloromethane, used in fire-extinguishing fluid; hexavalent chromium, formed by

oxidation of chromium in the advanced oxidation process; strontium, a naturally occurring metal and dietary supplement; acesulfame-K, a widely used artificial sweetener; iohexal, a contrasting agent used in X-ray procedures; and triclosan, an antibacterial agent used in handsoap and toothpaste.

Since these non-regulated constituents do not have regulatory limits, the best way to determine the significance of measured concentrations is to compare them to the constituent's Drinking Water Equivalent Level (DWEL) or the USEPA identified Health Reference Level. DWELs and Health Reference Levels both represent an acceptable concentration in drinking water assuming an average person consumes two liters of water per day for 70 years. The measured concentration of these six constituents in the purified water was 100 million times to 18 times lower than associated DWELs and Health Reference Levels.

In general, water quality testing shows the purified water is exceptionally pure, similar to distilled water. For example, TDS (a measure of salt and mineral content) in purified water is about 15 mg/L, compared to TDS in San Diego's source water and drinking water at about 500 mg/L. As a second example, TOC (a measure of carbon that is bound to organic molecules) in purified water is about 0.1 mg/L compared to a TOC of 3.0 mg/L in San Diego's source water and 2.5 mg/L in San Diego's drinking water.

AWP Facility Equipment Integrity Monitoring

Verifying the integrity and reliability of the treatment equipment is critical to assuring the health and safety of the water produced. A critical control point monitoring plan was implemented to identify any changes in performance of the treatment processes that could adversely affect water quality. The plan identified the parameters to be monitored and critical limits which, if exceeded, would either initiate an alarm to alert operators or automatically shut down the process. Parameters and critical limits were established for each treatment step. The critical control point monitoring showed that the equipment maintained its integrity, met the intended treatment performance on a continuous basis, and was reliable throughout the operational period.

AWP Facility Key Findings

Tests for 342 different constituents and parameters showed the purified water met all regulatory limits and had concentrations similar to distilled water. The testing results showed that only safe water is produced.

The operational data gathered during the 12-month testing period validated the concept that continuous and daily monitoring of each water purification process can assure the integrity of the treatment process.

Enhanced Industrial Waste Control Program

An enhanced industrial waste control program serves as the first barrier to protecting public health by preventing undesirable constituents from entering the wastewater stream. The City currently maintains a comprehensive Industrial Waste Control Program, which complies with unique and stringent requirements imposed in the discharge permit for the Point Loma Wastewater Treatment Plant. Further, the City recognizes the prevalence of pharmaceutical research in the North City sewer shed. The City currently prohibits discharges of any pharmaceutical manufacturing products or wastes, including incidental wash water or other pharmaceutical residues, to the sewer.

During the Demonstration Project the City's Industrial Waste Control Program was compared to Orange County Sanitation District's program, which was enhanced to support implementation of Orange County Water District's 70 mgd Groundwater Replenishment System. The Groundwater Replenishment System is indirect potable reuse wherein the purified water is conveyed to a groundwater basin rather than a surface water reservoir as in the City's IPR/RA concept. The two industrial waste control programs are similar. Three potential enhancements were identified for the City to consider implementing should a full-scale reservoir augmentation project at San Vicente Reservoir be implemented:

- *Chemical Inventory Program and Geographic Information System (GIS) Tracking.* Expand the industrial and commercial discharger chemical inventory database linking it to discharger locations that are tracked using GIS software.
- *Pollutant Prioritization Program.* Prioritize pollutants through sampling and characterization of constituents of emerging concerns (CEC's) 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.* Local limits are wastewater limitations that apply to commercial and industrial facilities that discharge effluent to a wastewater treatment plant like North City. They are developed to meet the industrial waste control program objectives and site-specific needs of the treatment plant and it's receiving waters. The evaluation would consider including additional pollutants of concern on North City's list of local limits, and potentially lowering the limit of pollutants already on the list. It is anticipated that this evaluation could be done in conjunction with the annual local limit evaluations for the Point Loma.

Conduct a Limnology and Reservoir Detention Study of San Vicente Reservoir

Although water purification technology is widely recognized as capable of purifying recycled water into drinkable water, CDPH requires that purified water be retained in an environmental buffer, such as a groundwater basin or a surface water reservoir, before it is used in a drinking water system. Cycling purified water through an environmental buffer is part of the multiple barrier strategy to protect public health through dilution with other water sources and holding time for natural treatment.

The *Limnology and Reservoir Detention Study of San Vicente Reservoir* (San Vicente Reservoir Study) is a component of the Demonstration Project conducted to establish that the reservoir would provide the dilution and retention required by CDPH. Retention is the length of time the purified water is held in the reservoir before it is withdrawn and delivered to the drinking water treatment plant. Dilution is the degree to which purified water is blended with other sources of water. The core of the San Vicente Reservoir Study is a computer-based three-dimensional hydrodynamic model of the reservoir. The model was developed at the University of Western Australia and customized for this project by a team of expert staff and consultants. The model was calibrated and validated using data measured at San Vicente Reservoir[3]. The model was

[3] *Calibration* is the process of aligning the terms and coefficients of the model to the unique conditions at San Vicente Reservoir, using a set of real-world measurements. *Validation* compares the output of a model run to a different set of real-world measurements to confirm the model can accurately predict conditions in the reservoir.

used to assess retention and dilution of the purified water in San Vicente Reservoir and for selecting the best location of the purified water inlet. The model's performance was reviewed and endorsed by the Demonstration Project's IAP. The *Limnology and Reservoir Detention Study of San Vicente Reservoir* (Attachment 3) provides a full description of the model, details of the modeling scenarios, and the results.

The model results demonstrated that the addition of purified water to San Vicente Reservoir would not affect the natural hydrologic characteristics of the reservoir; that is to say, it would not affect the natural stratification, blending, and retention in the reservoir. Dilution and retention of purified water in San Vicente Reservoir would constitute a substantial environmental barrier, sufficient to meet regulatory requirements.

For all anticipated reservoir operating scenarios and purified water inlet locations, the reservoir would dilute the purified water by at least a factor of 200 to one at all times. The modeling work showed that, while it is not possible to calculate a simple metric of the time the purified water resides in the reservoir, the reservoir provides more than adequate retention of purified water to meet all regulatory requirements.

The San Vicente Reservoir Study also assessed water quality in the reservoir. The addition of purified water would not negatively affect any aspect of water quality in San Vicente Reservoir. The dam raise and reservoir enlargement, which are independent of this project, will improve overall water quality in the reservoir by reducing nutrients that cause water quality issues. The addition of purified water will not substantially change these improvements.

Define the State's Regulatory Requirements for a Full-scale Reservoir Augmentation Project at San Vicente Reservoir

The CDPH and the San Diego Water Board would be responsible for establishing the permit requirements for a full-scale reservoir augmentation project at San Vicente Reservoir.

The CDPH would have the authority over the public water supply aspect of a full-scale reservoir augmentation project at San Vicente Reservoir, and would establish the corresponding regulatory criteria. Because the purified water would be considered a "discharge" into the San Vicente Reservoir, the San Diego Water Board would have authority over this aspect of the project and would evaluate any potential effects on water quality in the reservoir. Ultimately, the San Diego Water Board would issue a permit that contains the regulatory requirements of both agencies. Because of each agency's unique interest in, and authority over, a potential full-scale reservoir augmentation project at San Vicente Reservoir, the City engaged separately with CDPH and the San Diego Water Board. Both agencies actively participated in the aforementioned IAP meetings.

Coordination with CDPH

At this time there are no CDPH regulations for IPR/RA. By State law, CDPH is required to adopt reservoir augmentation regulations by the end of 2016. However, in advance of adopting regulations, CDPH can approve reservoir augmentation projects on a case-by-case basis. Therefore, defining the regulatory criteria for San Diego's full-scale reservoir augmentation project at San Vicente Reservoir was one of the Demonstration Project's key objectives. The

City solicited input from CDPH during preliminary work leading up to the Demonstration Project (2005 through 2008) and continued to engage CDPH throughout project execution. The City submitted a proposal for a full-scale reservoir augmentation project at San Vicente Reservoir to CDPH in March 2012. The proposal articulated specific public health protections provided by the City's reservoir augmentation concept, summarized the Demonstration Project's technical results as vetted by the IAP, and suggested a regulatory framework for San Diego's project. On September 7, 2012, the City received a concept approval letter from CDPH stating that the City's project "will not compromise the quality of the water derived from San Vicente Reservoir." Further, the letter reads "Therefore, CDPH approves the San Vicente Reservoir Augmentation Concept."

Coordination with the San Diego Water Board

Throughout the Demonstration Project the City held a series of meetings with the San Diego Water Board that focused on clarifying their regulatory framework for permitting a reservoir augmentation project. On October 12, 2011, the San Diego Water Board adopted Resolution No. R9-2011-0069 whereby they expressed support for a reservoir augmentation project at San Vicente Reservoir. In August 2012, the City submitted to the San Diego Water Board a document titled *Proposed Regional Water Quality Control Board Compliance Approach for San Vicente Reservoir Augmentation.* This document summarizes the key permitting issues and proposes a regulatory pathway the San Diego Water Board could follow to approve a full-scale reservoir augmentation project at San Vicente Reservoir. This process was similar to that undertaken with CDPH. On February 7, 2013, the City received a letter of regulatory concurrence from the San Diego Water Board that stated that "...it strongly supports the efforts of the City to develop the San Vicente Reservoir Augmentation Project and concurs with the City's preferred NPDES permit pathway..."

Perform a Pipeline Alignment Study

Facilities that include a pump station and pipeline will be needed to convey the purified water to San Vicente Reservoir. There is sufficient space on the future AWP Facility site to accommodate the pump station. A study was conducted to identify probable alignments for a 36-inch pipeline to convey purified water from the AWP Facility to San Vicente Reservoir located about 22 miles to the east.

Figure 2 shows the two alignments that were evaluated. The two alignments head in a southerly direction from the potential full-scale AWP Facility located at North City, before going east to San Vicente Reservoir. Both alignments tie into the existing recycled water pipeline that serves the Metropolitan Biosolids Center and other customers southeast of North City. Both pipeline alignments traverse through the City of Santee and the community of Lakeside before reaching San Vicente Reservoir.

- *State Route 52 (SR-52) Alignment.* This alternative runs alongside of SR-52, within the CalTrans right-of-way. An encroachment permit would be required.
- *Mission Gorge Alignment.* This alternative avoids the SR-52 right-of-way and runs through Kearny Mesa and Tierrasanta before traveling to Lakeside via Mission Gorge Road.

Due to the length of this pipeline, the complexity of its construction, and the biological, cultural, and other natural resource values likely to be encountered, additional analysis will be required to refine the alignment. Further study is also required to detail the requirements associated with obtaining a CalTrans encroachment permit, followed by further refinement of the project schedule and cost estimate.

Conduct a Public Outreach and Education

A major component of the Demonstration Project was to educate and inform the public about the need for and the benefits of purified water. The first step to achieving this goal was to develop a plan to guide public outreach activities and ensure those activities were implemented throughout the City in an all-inclusive and comprehensive manner.

Realizing this goal required a communication plan that outlines an outreach strategy with objectives, goals, tools, and a dedicated outreach team. In addition to City staff, consultants were enlisted to aid in outreach, media, and multi-cultural communications.

The communication plan encouraged involvement and dialogue among elected officials, community leaders, stakeholders, residents, and the media. Outreach activities included a speaker's bureau, informational materials (including those for multicultural audiences), stakeholder interviews, AWP Facility tours, community events participation, research surveys, social media, videos, and a dedicated website. Outreach efforts began in 2009, and, since that time, the City conducted 132 presentations throughout the City, hosted informational booths at 42 community events, and hosted 3,244 visitors to the AWP Facility tour as of December 31, 2012.

The concept of the AWP Facility tour is based on the "urban water cycle," a sped-up version of nature's water cycle. The tour divides the water purification process into three areas of interest (membrane filtration, reverse osmosis and UV disinfection) for ease of comprehension and discussion. By providing a tangible facility to demonstrate the science behind water purification, the process is demystified, the multiple layers of oversight are explained, and inaccurate perceptions are corrected.

To gauge the progress of the outreach program, research studies were conducted by Rea & Parker Research and SDSU research students. With a history of public opposition to water purification as a possible water supply option for San Diego, using research to bolster outreach efforts was essential to ensure the messaging and outreach methods were as effective as possible. Polls conducted in 2004, 2011, and 2012 found a steady increase in residents favoring the use of recycled water to diversify the City's water supply. Figure 5 displays the results of these polls.

Outreach efforts have garnered positive coverage both locally and nationally. On January 23, 2011, the San Diego Union-Tribune published an editorial in which the editorial board wrote that it had come to accept the science behind water purification technology and encouraged the rest of San Diego to do the same. Soon after this editorial came a front page cover story in USA Today (March 3, 2011) and, most notably, an article on the cover page of the New York Times (February 10, 2012).

Perform an Energy and Economic Analysis

The *2012 Long-Range Water Resources Plan* (City of San Diego, 2012), which is a separate effort, provides much of the information used for the energy and economic analysis for the Demonstration Project. Other sources of energy and economic information are described in the discussions that follow.

The Long-Range Water Resources Plan is a high-level strategy document that evaluates water supply options for the City through a 2035 planning horizon. The City convened an 11-member stakeholder committee that has provided guidance and input on alternative strategies for meeting San Diego's future water needs. The Long-Range Water Resources Plan addresses population growth, water resource diversification, climate change and other issues that affect water reliability. Various supply options such as conservation, desalination, groundwater, potable and non-potable reuse, local surface water, rainwater harvesting or capture, gray water, and imported water were considered and compiled into supply portfolios. The portfolios were rated against 20 performance measures ranging from affordability and energy footprint, to increased supply reliability and local control, and protecting the environment. The three highest-ranking portfolios all included the full-scale San Vicente IPR/RA concept, and the economic analysis found the full-scale reservoir augmentation project at San Vicente Reservoir to be an advantageous water supply option for the City. The 2012 Long-Range Water Resources Plan is being finalized and will be brought forward for City Council consideration in Spring 2013.

The 2012 Long-Range Water Resources Plan also included an estimate of greenhouse gas emissions, which are a function of energy requirements, for each of the supply options. Indirect potable reuse was found to produce less greenhouse gas emissions than ocean desalination and some groundwater supply options. The energy consumption associated with a full-scale reservoir augmentation project at San Vicente Reservoir is approximately equivalent to that of imported water.

Full-scale San Vicente Reservoir Augmentation Costs

The key components of a full-scale reservoir augmentation project at San Vicente Reservoir would include enhancements to the existing industrial waste control program, a full-scale 15 mgd AWP Facility, and conveyance facilities to deliver the purified water to San Vicente Reservoir.

The estimated gross cost of augmenting San Vicente Reservoir with 15 mgd of purified water is $2,000 per acre-foot. The capital cost and operating and maintenance costs included in the estimate are:

Table 2 – Estimated Capital Costs and Operating and Maintenance Costs[1]		
Cost Item	***Capital Cost***	***Annual Operating and Maintenance Cost***
Advanced Water Purification Facility	$144,700,000	$8,145,000
Increased tertiary production at North City to supply AWPF	$0	$3,965,000
Conveyance Facilities	$224,500,000	$3,385,000
Total	*$369,200,000*	*$15,495,000*
Auxiliary Program Costs		
Initial Enhanced Source Control		$500,000
Annual Enhanced Source Control		$50,000
Annual Public Outreach		$700,000
Total		*$1,250,000*
[1] costs are estimated in 2012 dollars		

The estimate was prepared utilizing a net present value analysis for 50 years. Other key assumptions include:

- Financing through both revenue bonds and State Revolving Loan Funds.
- Continuation of local resource program credits (LRP) from the San Diego County Water Authority and the Metropolitan Water District (MWD) of Southern California. The uncertain future of these credits was addressed by applying a credit that reflects average conditions (i.e. between favorable and unfavorable conditions). Under favorable conditions, the credit is expected to be $450 per acre-foot of water produced, while under unfavorable conditions it is expected to be $100 per acre-foot. The average of $275 per acre-foot was used in estimating the overall cost of reservoir augmentation.
- Grant funding in the amount of 20% of capital costs. Such grants are typical for reuse projects.

Avoided Costs and Other Cost Benefits

The implementation of a full-scale reservoir augmentation project at San Vicente Reservoir will result in avoided wastewater system costs. In order to determine what wastewater system costs could be avoided as a result of implementing full-scale reservoir augmentation, the September *2011 Metro Wastewater Plan* (City of San Diego, 2011) was referenced. The facility requirements described in the Metro Wastewater Plan correspond to Point Loma remaining a chemically-enhanced primary treatment plant. There are several projects included in the Metro Wastewater 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. It is estimated that capital and operating costs are, respectively, $123 million and $6.15 million annually. By implementing a full-scale reservoir augmentation, the need for wet weather storage could be eliminated.

A full-scale reservoir augmentation project at San Vicente Reservoir will reduce the flows conveyed to Point Loma. This will reduce annual operations and maintenance costs at Point Loma as well as at Pump Station No. 2 which conveys flows to Point Loma. The 15 mgd flow reduction will reduce these costs, by $2,210,000 and $450,000, respectively.

Table 3 - Avoided Costs and Savings

	Avoided Cost, $	***Avoided Cost, $ per acre-foot***
Point Loma Wet Weather Storage Facility	$123,000,000 (Capital) $6,150,000 (Annual O&M)	$1,000
Reduced Influent Flows at Point Loma	$2,210,000 (Annual O&M)	
Reduced Pumping at Pump Stations No. 2	$450,000 (Annual O&M)	
Total Avoided Costs/Savings	$123,000,000 (Capital) $8,810,000 (Annual O&M)	$1,000

The *net cost* of a full-scale reservoir augmentation project at San Vicente Reservoir after accounting for avoided costs and savings is estimated to be $1,000 per acre-foot of purified water produced and delivered to the reservoir. Figure 6 shows how the projected cost of the water compares to the projected cost of imported water.

In addition to avoided wastewater costs, there may also be savings resulting from reduced salinity in the City's water supply. The salinity of purified water produced at a full-scale AWP Facility after final conditioning will be approximately 50 milligrams per liter. By comparison, imported water has a salinity level of 300 to 600 milligrams per liter. The addition of purified water to San Vicente Reservoir is expected to reduce the salinity level in the reservoir. The estimated savings due to reduced salinity was evaluated by the MWD and United States Bureau of Reclamation in the late 1990s. They found that reduced salinity correlates with longer useful lives of downstream treatment facilities. Further analysis is needed to quantify the salinity benefits resulting from this 15 mgd project at San Vicente Reservoir; and they are not included here. Note also, that savings related to the extended lives of retail customers' plumbing fixtures are also expected; however, these are difficult to quantify and were thus also excluded from the estimated savings.

Demonstration Project Budget and Expenditures

The Demonstration Project budget was established at $11,811,000. Table 4 shows how this was distributed among the project tasks. Actual expenditures through Fiscal Year 2013 are expected to total $11,393,230; this is $417,770 less than the initial budget.

Table 4
Project Budget and Expenditures

Project Task	*Contractor*	*Original Budget*	*Actual Contract*	*Projected Expenditures thru FY 2013*
Program Management	RMC Water Environment	$1,688,000	$1,781,742	$1,635,537
Independent Advisory Panel	National Water Resources Institute	$250,000	$250,000	$217,074
Demonstration-scale Advanced Water Purification (AWP) Facility		$7,400,000	$7,400,000	$7,146,897
Facility	*CDM Smith*		*$6,600,000*	*$6,600,000*
Pad/Canopy	*Ahrens Corporation*		*$600,000*	*$430,439*
Electricity	*NA*		*$200,000*	*$116,458*
Energy and Economic Analysis	Performed in independent project: *City of San Diego Long Range Water Resources Plan, 2012*			
Limnology and Reservoir Detention Study for the San Vicente Reservoir	Flow Sciences, Inc.	$385,000	$420,000	$419,457
Pipeline Alignment Study	RMC Water Environment	$50,000	Included in Program Management Contract	
Public Outreach and Education Program	RMC Water Environment/ Katz & Associates	$1,700,000	$1,499,611	$1,645,866[3]
Contingency		$338,000	$459,647	$328,399
Regulatory Staff Charges[1]				*$122,075*
Non-personnel Expenses[2]				*$206,324*
Contracts Total		**$11,811,000**	**$11,811,000**	**$11,393,230**

[1]Regulatory staff participated in project IAP meetings and reviewed and commented on the AWP Facility Testing and Monitoring Plan. Charges shown are for staff time on these activities.
[2]Non-personnel expenses were incurred in support of above project tasks; majority of expenses were due to production of outreach materials.
[3]Supports extended outreach activities through December 31, 2013

Project funding was obtained through a temporary rate increase approved by City Council in 2008 and was in effect from January 1, 2009 to September 1, 2010; the rate increase raised $10,738,165. The remaining $1,072,835 of the $11,811,000 was obtained through Proposition 50 grant funding. The State has reimbursed the full grant amount less a 10% retention that is typically released after the project is completed.

Subsequent to the rate increase and Proposition 50 grant, the Bureau of Reclamation awarded the City $2,952,750 for project-related expenses. The City has received $2,852,704 in reimbursements from this grant and expects to receive the remaining $100,046 by the end of

June 2013. City project staff expenditures at project completion are estimated to be $1,813,112. Staff positions had already been included in the Department budget and thus were not included in the temporary rate case that funded the contracts. The Bureau of Reclamation grant has gone towards reimbursing these expenditures. Also, the AWP Facility will continue to operate through the end of June 2013; this is eleven and three months, respectively, beyond the 12-month testing period and expiration of the contract the City has with CDM Smith. The estimated cost of extended operations is $200,000 and will also be fully reimbursed via the Bureau of Reclamation grant. The unspent Bureau of Reclamation grant funds plus the under-budget contract expenditures are expected to total $1,357,408 (Table 5). These funds could be applied to initial tasks associated with full-scale implementation if approved by the Mayor and the City Council.

Table 5 ***Bureau of Reclamation Grant and Unspent Project Funding thru FY 2013***	
Bureau of Reclamation Grant	***Amount***
City project staff costs	$1,813,112
Extended AWP Facility Operations	$200,000
Total Bureau of Reclamation Grant Expenditures	**$2,013,112**
Unspent Funds	
Unspent Bureau of Reclamation Grant Funds	$939,638
Unspent Contract Funds (see previous page)	$417,770
Total Unspent Project Funds	**$1,357,408**

Implementation Considerations

Should the Mayor and Council decide to implement a full-scale reservoir augmentation project at San Vicente Reservoir, the next steps would include:

1. Determine Local Resource Funding Policy. Because a full-scale reservoir augmentation project at San Vicente Reservoir will benefit both water and wastewater systems, it is expected that these funding sources will be utilized to support implementation. The proportional sharing of costs must be determined in order to prepare separate water and wastewater rate cases to fund the project. The recently-completed Recycled Water Study also identified this as a critical next step to begin in FY13. The estimated consultant cost for this work is $180,000, with work anticipated to continue through FY 14.

2. Determine the Contracting Mode. There are a number of options for contracting out the design and construction of full-scale IPR/RA facilities. Typical options include design-bid-build, design-build, and design-build-operate. The timing of project expenditures will differ among the options, and this must be accounted for in preparing the financing plan and rate cases to support a full-scale reservoir augmentation project at San Vicente Reservoir. The estimated consultant cost to determine the contraction mode is $60,000, with work anticipated to begin in FY14.

3. Refine the Pipeline Alignment. The conveyance system represents 60% of the estimated capital cost of a full-scale reservoir augmentation project at San Vicente Reservoir. Further, the last 7,000 feet of pipeline to reach the reservoir represents 40% of the estimated pipeline cost; the high cost is driven by difficult construction access and tunneling through granitic rock. Alternative alignments for this difficult portion of the pipeline should be investigated for potential cost reductions. If a lower-cost option requires moving the reservoir inlet,

reservoir modeling will also be needed to confirm that the reservoir would still provide the buffering described earlier in this report. The estimated consultant cost is $50,000 to refine the pipeline alignment, and $100,000 to $125,000 for the reservoir modeling to confirm the inlet location. This work is anticipated to begin in FY14 or FY15.

4. Coordinate with Regional Wastewater and Reuse Objectives. The City's recent Recycled Water Study developed reuse program alternatives to divert flows away from Point Loma, thereby addressing regional wastewater issues. The full-scale San Vicente Reservoir augmentation concept that is the subject of this Demonstration Project would be the initial project in all five of the Recycled Water Study's program alternatives. Some of the alternatives call for expanding the AWP Facility at North City beyond the initial 15 mgd capacity, while others do not. Although the Recycled Water Study did not identify a preferred alternative, one needs to be determined so that the scope of conveyance and treatment facilities can be established prior to initiating their designs in FY16.

   Point Loma's discharge permit will be up for renewal in 2015, and it is expected that long-term regional wastewater and reuse plans will be a key aspect of negotiations with the USEPA over Point Loma's discharge permit renewal. City staff will be involved in the coordination effort, and consultant costs are not anticipated for this work.

5. Monitor Development of Direct Potable Reuse Regulations. As communities throughout California explore indirect potable reuse (IPR) options for both groundwater replenishment and reservoir augmentation, it is recognized that a more direct pathway to replenishing a drinking water system with purified water (known as direct potable reuse or DPR) could reduce capital costs and accelerate implementation timelines in some settings. DPR would rely on engineered water purification processes for public health protection, eliminating the need for an intermediary environmental buffer such as a groundwater basin or a surface water reservoir. Senate Bill 918 was signed into law in 2010 and established December 31, 2016 as the time by which CDPH must report on the feasibility of developing regulatory criteria for DPR. Shortly after Senate Bill 918 was signed, California WateReuse Association formed a DPR committee to support CDPH in its investigation. A number of the California WateReuse Association's initiatives are complete or are underway; all are geared to providing guidance in establishing DPR regulatory criteria. In November 2012, the San Diego Integrated Regional Water Management Program selected a joint WateReuse-City project proposal to receive $2.1 million in grant funding. The project will utilize the City's Demonstration AWP Facility to study the effectiveness of DPR treatment and monitoring strategies, with grant-funded work to begin in 2014. There will be no City consultant cost anticipated for this work. The City will continue to monitor development of DPR regulations and will adapt the City's implementation plan based on these developing regulations.

EQUAL OPPORTUNITY CONTRACTING:
Not applicable at this time.

FISCAL CONSIDERATIONS:
Not applicable at this time. This will be pending City Council review and adoption of Water Purification Demonstration Project Report. When a decision is made to implement a Full-Scale IPR/RA project at San Vicente Reservoir, authorization for funding will be required.

PREVIOUS COUNCIL and/or COMMITTEE ACTION:
On October 29 and December 3, 2007, Council voted (R-303095, R-2008-382) to undertake the Demonstration Project. On December 4, 2007, Council directed (R-303237) the Public Utilities Department to add the Demonstration Project to the Integrated Regional Water Management Plan and grant application. On November 18, 2008, Council approved (R-304434) a temporary water rate increase to fund the Demonstration Project. On March 24, 2009 Council approved (R-304764) the Limnology Study of San Vicente Reservoir. On January 26, 2010 Council approved (R-305584) the Project Management and Public Outreach contract. On August 5, 2010 Council approved (R-306069) the Advanced Water Purification Facility contract. Staff provides monthly updates on the status of the Demonstration Project to the Natural Resources & Culture Committee (NR&C). This item will also be heard at NR&C prior to City Council.

COMMUNITY PARTICIPATION AND PUBLIC OUTREACH EFFORTS:
Throughout the duration of the Demonstration Project, the City sought to ensure information was presented in a clear, understandable, and accessible manner to residents in all areas of the City. Information about the Demonstration Project was provided through a variety of formats including direct contact with individuals, written and electronic materials, traditional and social media, group presentations, community events, and tours of the AWP Facility. Strategic planning, materials, activity tracking, and other items related to outreach were regularly presented to the Independent Rates Oversight Committee's Public Outreach and Communications Subcommittee. A CD containing supporting outreach materials accompanies the Project Report.

KEY STAKEHOLDERS AND PROJECTED IMPACTS:
The California Department of Public Health and the San Diego Water Board are the state agencies that would permit a full-scale reservoir augmentation project at San Vicente Reservoir. Staff provided regular updates to Independent Rates Oversight Committee regarding the AWP Facility and the Demonstration Project's public education and outreach efforts.

Roger S. Bailey
Director of Public Utilities

Attachments:

1. *Water Purification Demonstration Project – Project Report*
2. *Advanced Water Purification Facility Study Report* (on companion CD)
3. *Limnology and Reservoir Detention Study of San Vicente Reservoir* (on companion CD)

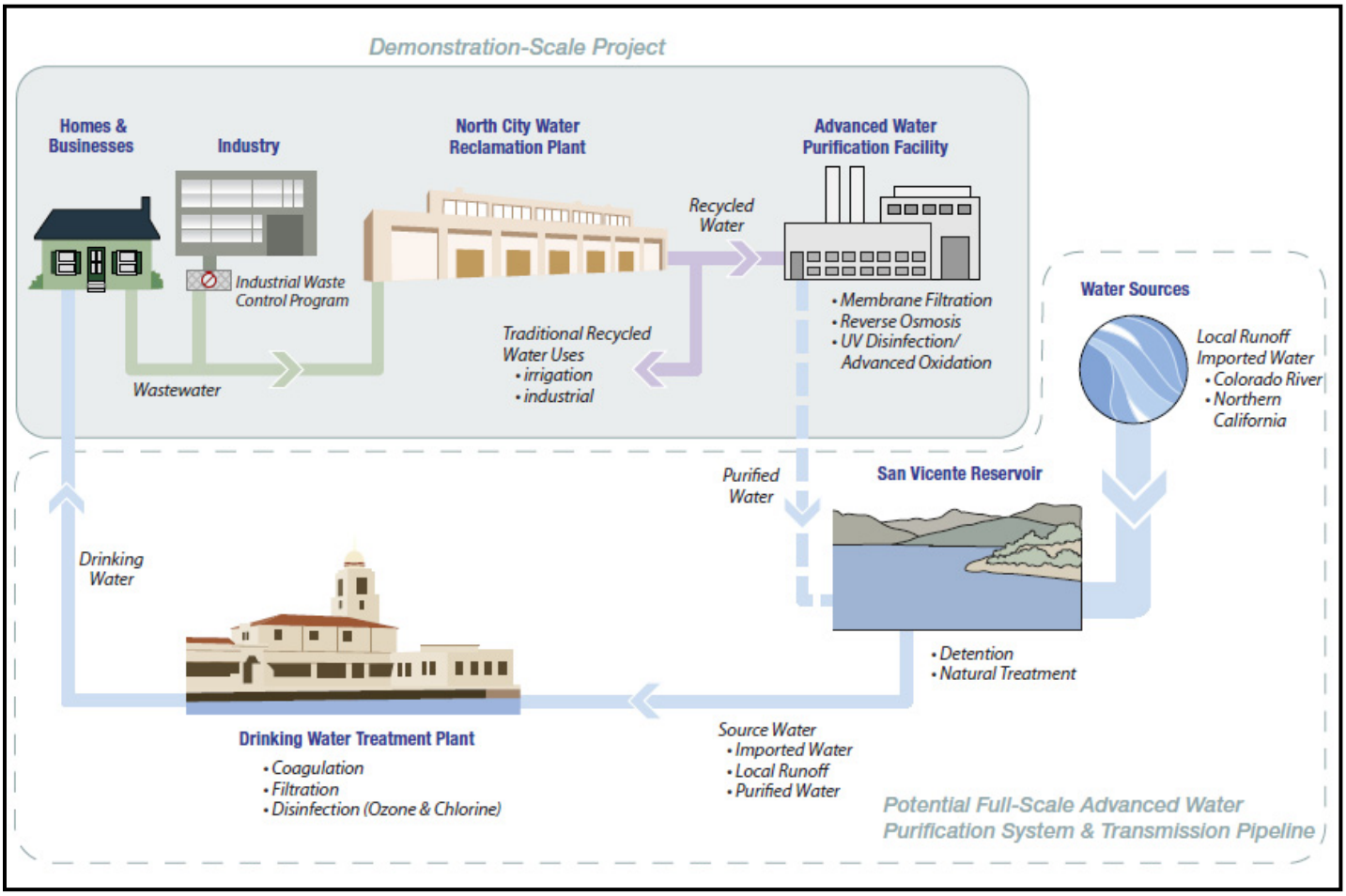


Figure 1 - Conceptof a full-scale reservoir augmentation projectat San Vicente Reservoir.

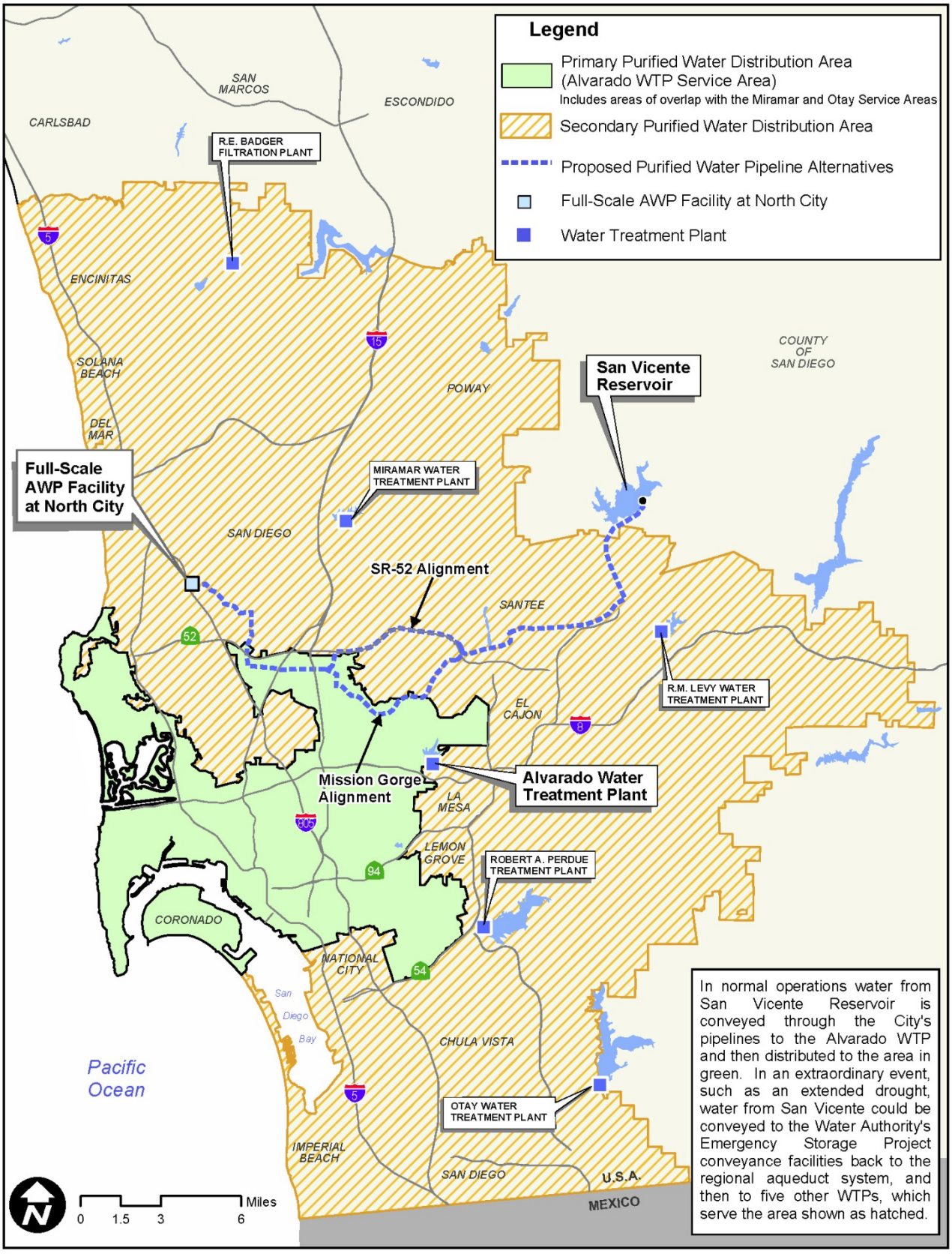


Figure 2 – Location map of a full-scale reservoir augmentation projectat San Vicente Reservoir.

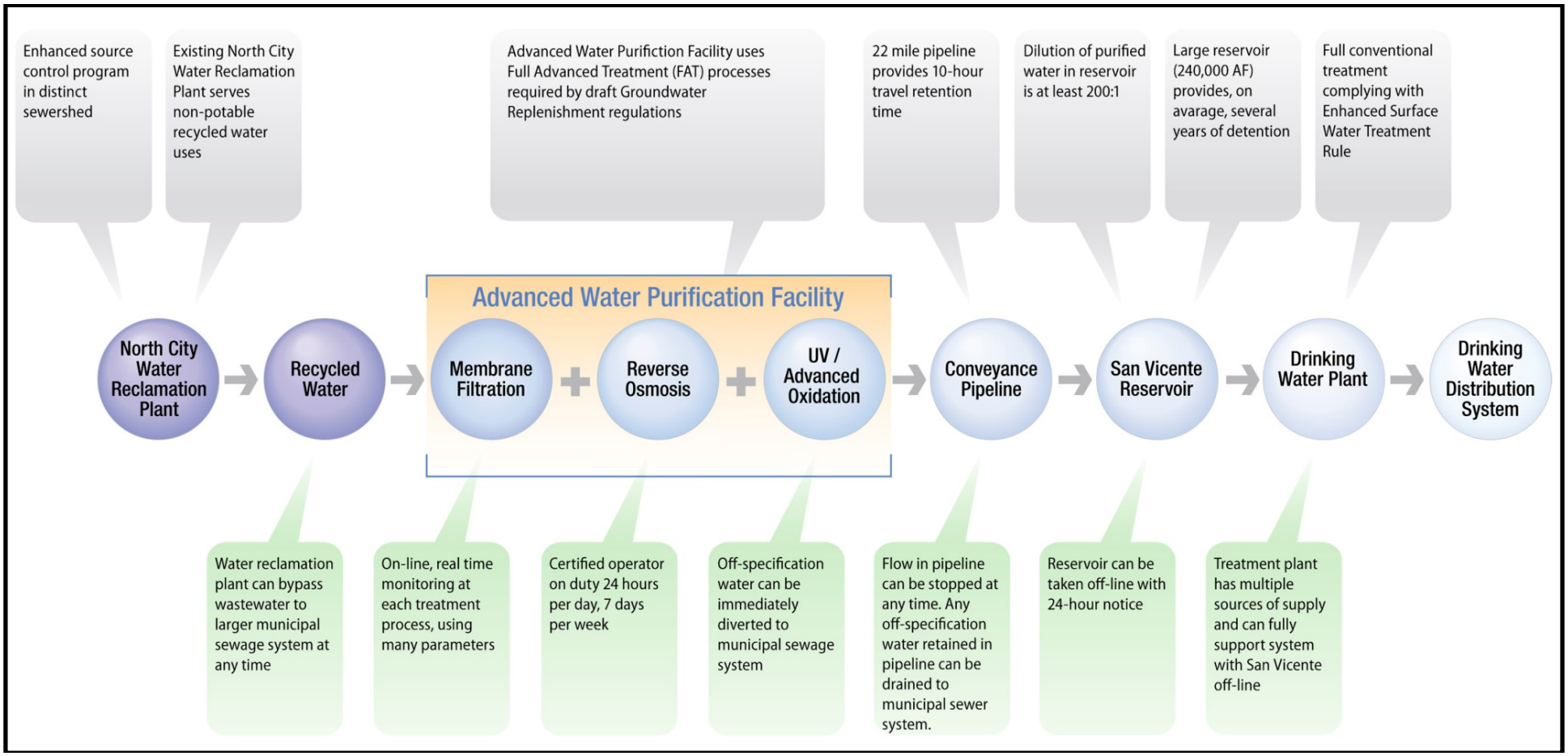
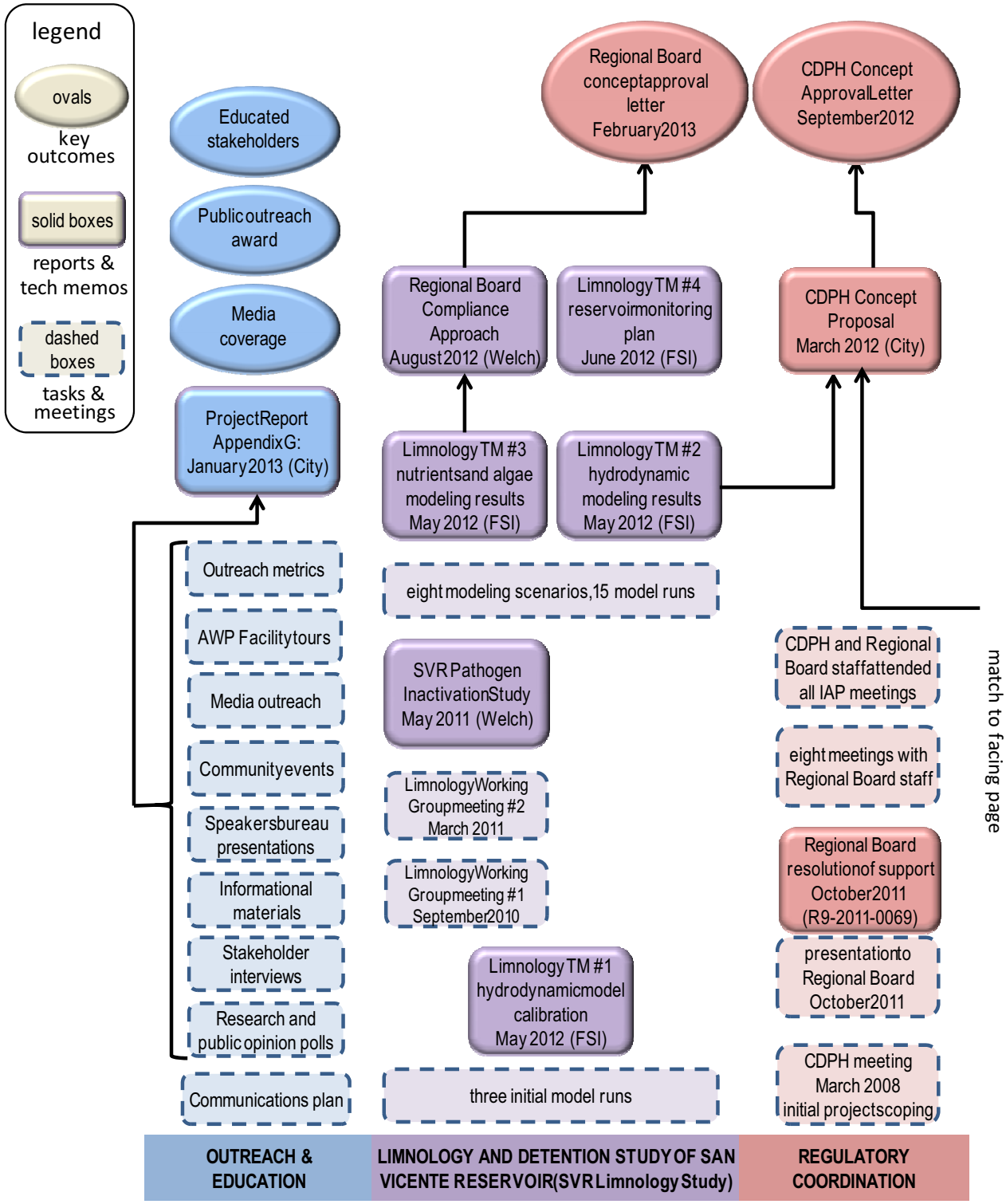
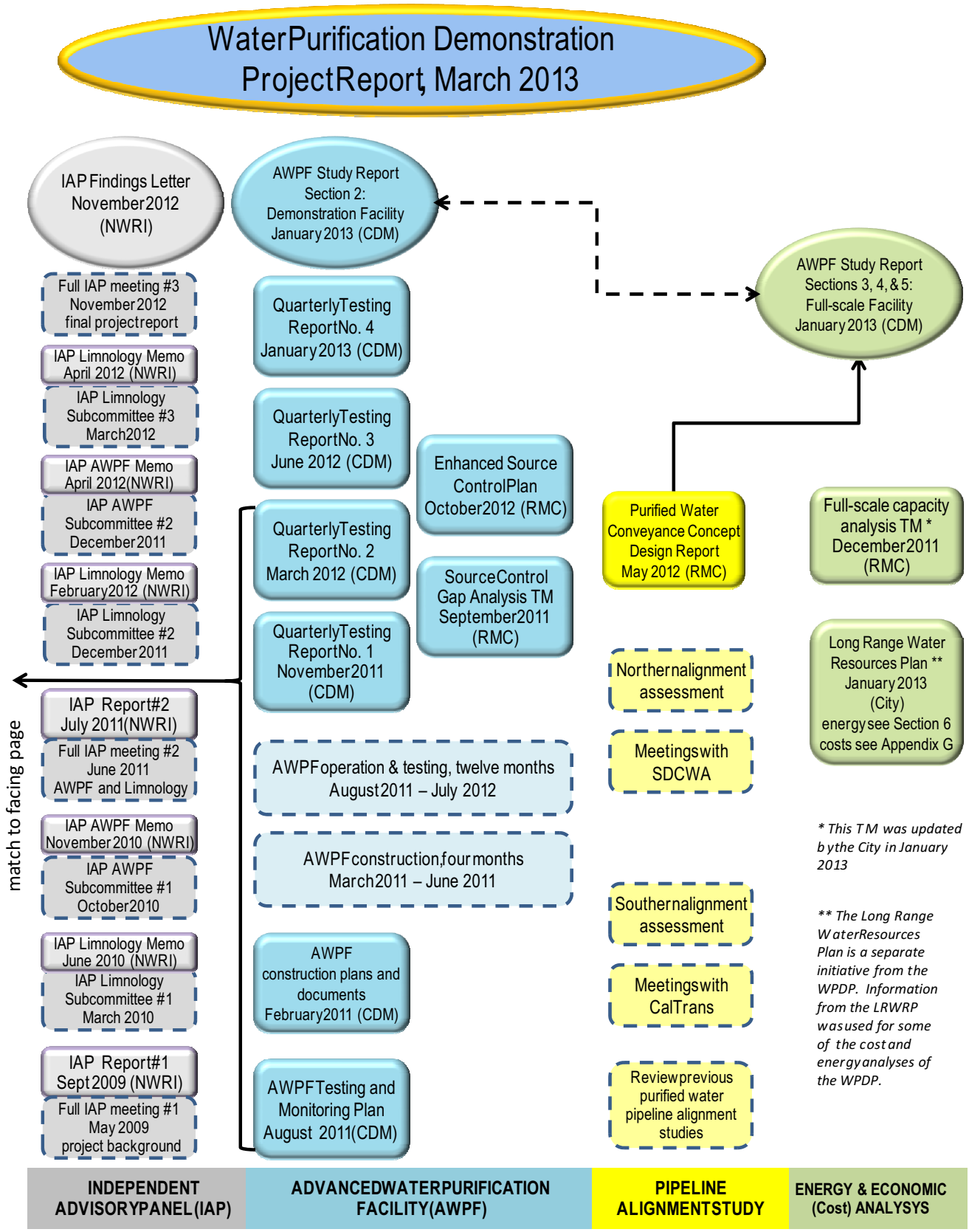


Figure 3 –The multiple treatmentbarriers provided by a full-scale reservoir augmentation projectat San Vicente Reservoir. The treatmentsteps, or barriers, are shown along the center of the diagram, beginning with wastewater on the left and culminatingwith potable water on the right. The text boxes along the top describe features of the multiple treatmentbarriers, while the lower textboxes show operational actions associated with the multiple barriers.

Figure 4: Key tasks, meetings, reports, and outcomes of the Water Purification Demonstration Project, from project start in 2009 through project completion in 2013




Water Purification Demonstration Project Report, March 2013
IAP Findings Letter November 2012 (NWRI)
AWPF Study Report Section 2: Demonstration Facility January 2013 (CDM)
AWPF Study Report Sections 3, 4, & 5: Full-scale Facility January 2013 (CDM)
Full IAP meeting #3 November 2012 final project report
IAP Limnology Memo April 2012 (NWRI)
IAP Limnology Subcommittee #3 March 2012
IAP AWPF Memo April 2012 (NWRI)
IAP AWPF Subcommittee #2 December 2011
IAP Limnology Memo February 2012 (NWRI)
IAP Limnology Subcommittee #2 December 2011
IAP Report #2 July 2011 (NWRI)
Full IAP meeting #2 June 2011 AWPF and Limnology
IAP AWPF Memo November 2010 (NWRI)
IAP AWPF Subcommittee #1 October 2010
IAP Limnology Memo June 2010 (NWRI)
IAP Limnology Subcommittee #1 March 2010
IAP Report #1 Sept 2009 (NWRI)
Full IAP meeting #1 May 2009 project background
match to facing page
Quarterly Testing Report No. 4 January 2013 (CDM)
Quarterly Testing Report No. 3 June 2012 (CDM)
Quarterly Testing Report No. 2 March 2012 (CDM)
Quarterly Testing Report No. 1 November 2011 (CDM)
Enhanced Source Control Plan October 2012 (RMC)
Source Control Gap Analysis TM September 2011 (RMC)
AWPF operation & testing, twelve months August 2011 – July 2012
AWPF construction, four months March 2011 – June 2011
AWPF construction plans and documents February 2011 (CDM)
AWPF Testing and Monitoring Plan August 2011 (CDM)
Purified Water Conveyance Concept Design Report May 2012 (RMC)
Northern alignment assessment
Meetings with SDCWA
Southern alignment assessment
Meetings with CalTrans
Review previous purified water pipeline alignment studies
Full-scale capacity analysis TM * December 2011 (RMC)
Long Range Water Resources Plan ** January 2013 (City) energy see Section 6 costs see Appendix G
* This TM was updated by the City in January 2013
** The Long Range Water Resources Plan is a separate initiative from the WPDP. Information from the LRWRP was used for some of the cost and energy analyses of the WPDP.
INDEPENDENT ADVISORY PANEL (IAP)
ADVANCED WATER PURIFICATION FACILITY (AWPF)
PIPELINE ALIGNMENT STUDY
ENERGY & ECONOMIC (Cost) ANALYSYS

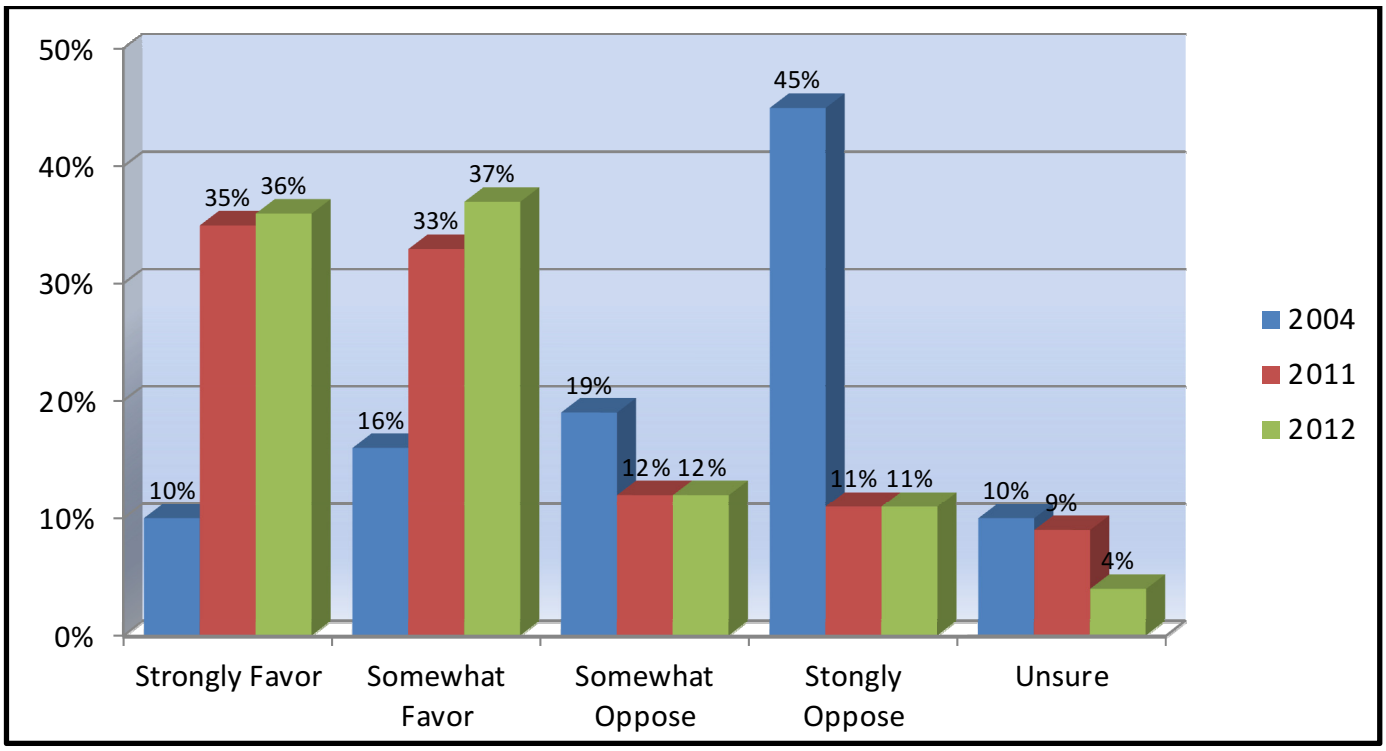


Figure 5 – Results of public opinion polls on the use of advanced treatedrecycled water as an addition to San Diego's drinking water supply (Rea & Parker Research, 2012 Public Opinion PollReport).

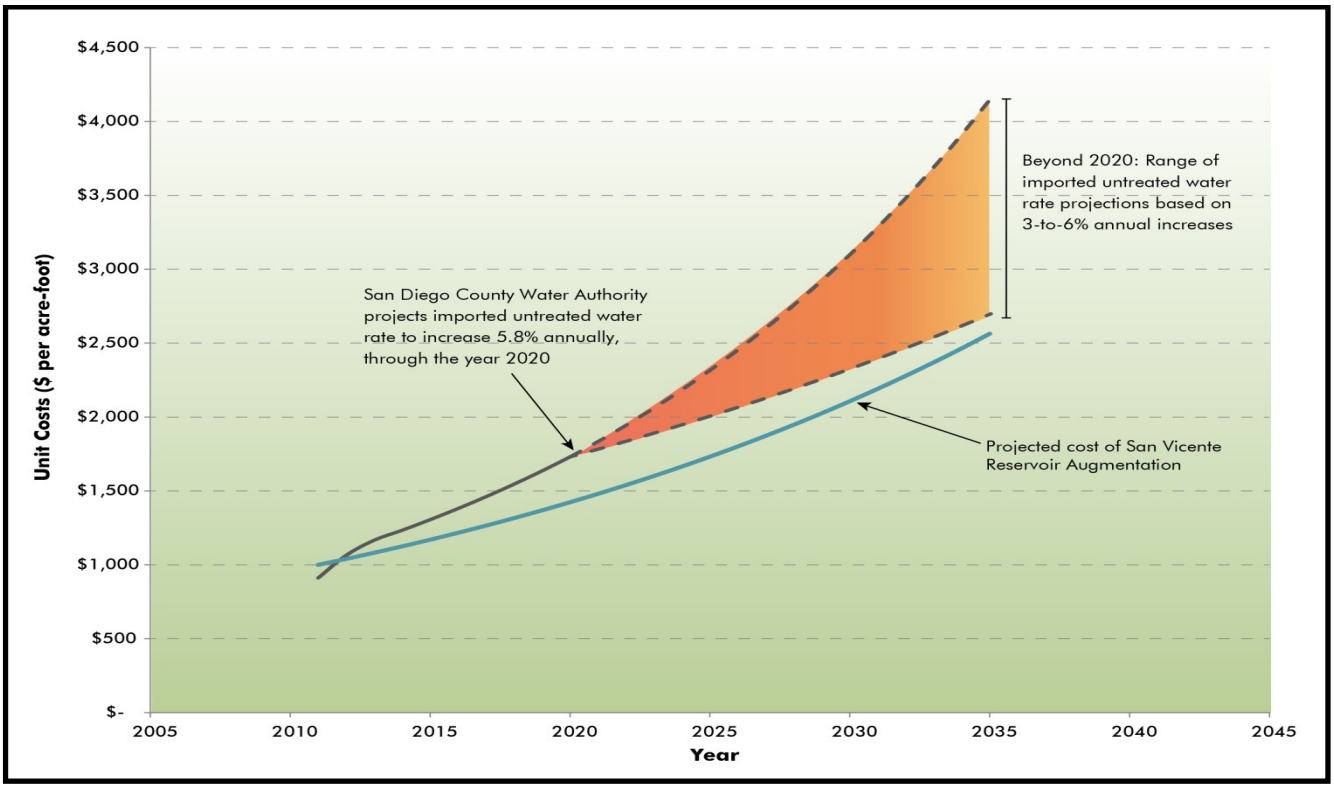


Figure 6 –Projected cost of purified water (solid line) of a full-scale reservoir augmentation projectat San Vicente Reservoir comparedto actualand projected costs of untreatedimported water (dashed lines).