

Section 1

Introduction

This report summarizes the results of the City of San Diego (City) Advanced Water Purification (AWP) Facility Study, conducted as part of the City's multi-faceted Water Purification Demonstration Project (Demonstration Project). The Demonstration Project evaluated the feasibility of indirect potable reuse through reservoir augmentation (IPR/RA) to provide safe and reliable water for San Diego.

The AWP Facility Study included two primary elements: (1) the design, installation, operation, and testing of a 1 million gallon per day (mgd) Demonstration Facility located at the North City Water Reclamation Plant (North City) and (2) a conceptual design and cost estimate for a potential Full-Scale Facility (18-mgd capacity and 15-mgd annual average purified water production), which would be located north of North City. This introduction section includes background information on both the overall Demonstration Project and the AWP Facility Study, as well as an overview of this AWP Facility Study Report.

1.1 Demonstration Project Background

The City has limited local water sources and relies on importing approximately 85 percent of its annual water supply. In the past, importing water from the Colorado River and Northern California has been a reliable option, but environmental stresses, court-ordered pumping restrictions in Northern California, and a historic dry period and drought on the Colorado River have reduced the amount of water that can be delivered to San Diego. These circumstances and the possibility of further limitations have intensified the need for new sources of water that are under local control.

One such source being considered is the use of IPR/RA. IPR/RA is a multi-step process that uses water purification technologies to produce purified water from a wastewater source, sending this purified water to the San Vicente Reservoir to blend with existing water in the reservoir, treating the blended water at a drinking water plant, and then distributing the drinking water to City water customers. This form of potable reuse is considered "indirect" because of the environmental buffer and natural treatment which occur within the reservoir before the water is used as a source of drinking water supply.

The potential benefits of implementing an IPR/RA program in San Diego could include:

- Providing a local and sustainable supply of high-quality drinking water for San Diego,
- Improving the quality of water in the San Vicente Reservoir,
- Decreasing dependence on imported water,
- Increasing utilization of recycled water,
- Providing a supply of water that uses less energy than imported water, and
- Having a positive impact on the environment by producing less discharge into the ocean and working toward lower carbon emissions.

The IPR/RA concept for the City is shown in Figure 1-1. For the Demonstration Project, the one-mgd Demonstration Facility treats recycled water (tertiary effluent prior to chlorination) from North City using membrane filtration (microfiltration [MF] and ultrafiltration [UF]), reverse osmosis (RO), and ultraviolet (UV) light disinfection and advanced oxidation to produce purified water. During the demonstration phase, the purified water is returned to the North City recycled water system and is used for irrigation and industrial purposes.

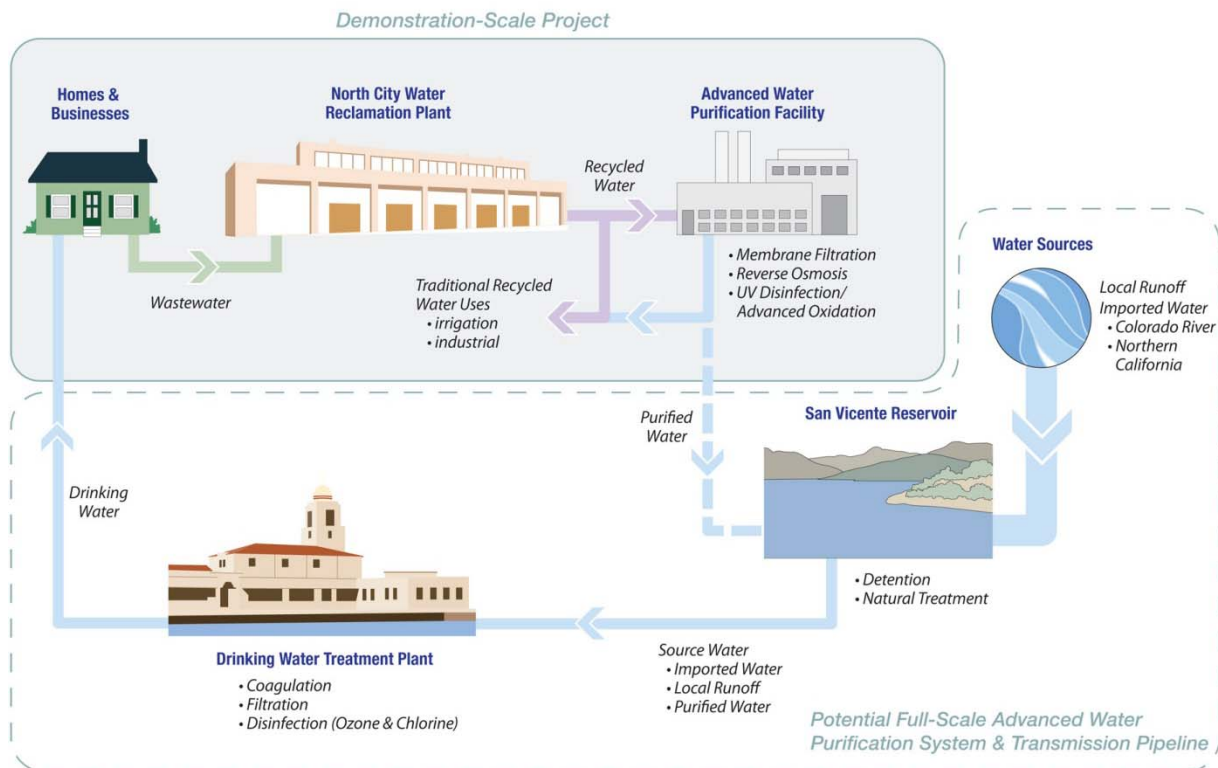


Figure 1-1
Demonstration-Scale and
Potential Full-Scale IPR/RA Projects Schematic

The City has initiated the Demonstration Project to evaluate the feasibility of using IPR/RA to provide a new source of local water to meet future water supply needs. The Demonstration Project is the second phase of the City's three-phase Water Reuse Program, which seeks to maximize the reuse of recycled water and purified water. The three phases are as follows:

- Phase I:** In 2006, the City completed the Water Reuse study, which identified a series of strategies that could be implemented to increase water reuse in San Diego. The Water Reuse Study stakeholders and the San Diego City Council (City Council) independently identified augmentation of the City's San Vicente Reservoir with purified wastewater as their preferred alternative to meet the City's water reuse goals. On July 19, 2006, the City's Natural Resources and Culture Committee (NR&C) accepted the Final Draft Report of the Water Reuse Study (Phase I) as fulfilling City Resolution R-298781. On October 29, 2007, the City Council voted to accept the Water Reuse Study and directed the Mayor and City staff to implement actions to

demonstrate the feasibility of the IPR/RA concept. Through this and other City Council directives, the components of the Demonstration Project were clarified.

- **Phase II:** This phase of the City’s Water Reuse Program is the Demonstration Project, in which the feasibility of augmenting San Vicente Reservoir supplies with purified water is being examined.
- **Phase III:** If IPR/RA is deemed feasible and approved by the Mayor and City Council, then Phase III will involve implementation of a full-scale IPR/RA project to augment the San Vicente Reservoir with purified water. The full-scale IPR/RA project would include construction of an 18-mgd Full-Scale Facility located north of North City and an approximately 23-mile pipeline that will transport the purified water to San Vicente reservoir for blending and retention prior to distribution to the region’s drinking water treatment plants for further treatment. Implementation of the full-scale IPR/RA project is contingent on Mayoral and City Council authorization.

The majority of the costs associated with the Demonstration Project were funded by a temporary water rate increase, which was approved by City Council in November 2008. This temporary rate increase was in effect from January 2009 to August 2010 and collected funds to pay for the project. In addition, the Demonstration Project was partially funded by grants from the California Department of Water Resources’ Integrated Regional Water Management Program through Proposition 50, and the United States Bureau of Reclamation in the approximate amount of \$1.07 million and \$2.95 million, respectively. The Demonstration Project has a total estimated cost of \$11.8 million.

Components of the Demonstration Project include the following:

1. **Conduct a public outreach and education program:** In 2010, the City launched a comprehensive public outreach and education program for the Demonstration Project. The program included tours of the City’s Demonstration Facility to educate City leadership, regulators, public, and other interested parties about advanced water purification and how a full-scale IPR/RA project would benefit the City.
2. **Design, construct, operate, and test a Demonstration Facility at North City:** This component of the Demonstration Project is included in the AWP Facility Study detailed in this report.
3. **Conduct a Limnology and Reservoir Detention Study for the San Vicente Reservoir:** A study of the San Vicente Reservoir was conducted to test the key functions of reservoir augmentation and to determine the viability of a full-scale project. The study evaluated dilution and established residence time and short-circuiting conditions of purified water in the reservoir.
4. **Define the regulatory requirements for a full-scale IPR/RA project:** Since the full-scale IPR/RA project would be the first of its kind in California, the regulatory requirements were defined as part of the Demonstration Project. The City has conducted meetings with the California Department of Public Health (CDPH) and the San Diego Regional Water Quality Control Board (Regional Board) to understand both the anticipated regulatory requirements and the approval process for the Full-Scale Facility.

5. **Convene an Independent Advisory Panel (IAP):** An IAP provided oversight on project research to determine (1) if the purification system satisfies all water quality, safety and regulatory requirements of the CDPH, and (2) the behavior of the reservoir and what will happen if the purified water is added. For the Demonstration Facility, the IAP reviewed and commented on the testing and monitoring plan, the testing results, and this AWP Facility Study report.
6. **Perform a pipeline alignment (water conveyance) study:** The Purified Water Conveyance System Final Conceptual Design Report was prepared to present the alignment and costs for conveying the purified water from the Full-Scale Facility to the San Vicente Reservoir.
7. **Perform an independent energy and economic analysis for water supply options in the City's Long-Range Water Resources Plan:** The City is updating their 2012 Long-Range Water Resources Plan (CDM Smith, 2012) to evaluate the City's water supply options. As part of this plan, IPR/RA was confirmed to be a cost-effective water supply option.

Through implementation of the steps outlined above, the Demonstration Project is being completed in 2012. The Demonstration Project Report will summarize all of the elements of the project and include a summary of the reports completed for the individual tasks:

- AWP Facility Study Report (the report presented herein)
- Limnology and Reservoir Detention Study
- Purified Water Conveyance System Final Conceptual Design Report
- 2012 Long-Range Water Resources Plan

At the conclusion of the Demonstration Project, the Demonstration Project Report will be presented to the Mayor and City Council. If deemed technically and financially feasible and following Mayoral and City Council authorization, a full-scale IPR/RA project would be implemented.

1.2 AWP Facility Study Background

The purpose of the AWP Facility Study was to provide operational information from a one-mgd Demonstration Facility, identifying recommendations for energy optimization and scale-up considerations for a future 18-mgd Full-Scale Facility, and developing a conceptual design and cost estimate for this Full-Scale Facility. The following specific objectives were defined for the project:

- Demonstrate the feasibility of an AWP Facility to reliably produce purified water that is consistently in compliance with all drinking water quality standards.
- Implement a monitoring plan for constituents of emerging concern (CECs) that is tailored to the wastewater received at North City.
- Demonstrate integrity monitoring techniques and performance reliability measures for the treatment equipment.
- Generate data to be able to make conclusions on maintaining reservoir water quality. Assess energy consumption and develop energy conservation opportunities.

- Develop recommendations for design and operation of a Full-Scale Facility that assures only safe purified water leaves the plant.
- Develop a cost estimate for a Full-Scale Facility.
- Educate the public about the Demonstration Project through community outreach, informational materials, and AWP Facility tours.

The one-mgd Demonstration Facility was designed, installed, operated, and tested between 2010 and 2012. During operation of the Demonstration Facility, the water was tested to evaluate the effectiveness of the treatment processes in removing constituents; operational data was gathered and analyzed to refine operation and maintenance (O&M) estimates for a Full-Scale Facility; and tours conducted as part of the public outreach effort.

The Demonstration Facility treats recycled water (tertiary wastewater effluent prior to chlorination) from North City to produce purified water. The Demonstration Facility uses water purification processes, including membrane filtration (MF and UF), RO, and UV disinfection and advanced oxidation. During the demonstration phase, the purified water was returned to the North City recycled water system and was used for irrigation and industrial purposes. No purified water was sent to the reservoir during the demonstration phase.

Figure 1-2 summarizes the schedule for design, testing, and operation of the Demonstration Facility. The facility was started up over a 1.5 month period (mid-June 2011 through the end of July 2011) and was tested for one year (August 2011 through July 2012). The results and conclusions from this 13.5-month period are the focus of this report. The Demonstration Facility is continuing to operate after the end of the testing period for tours.

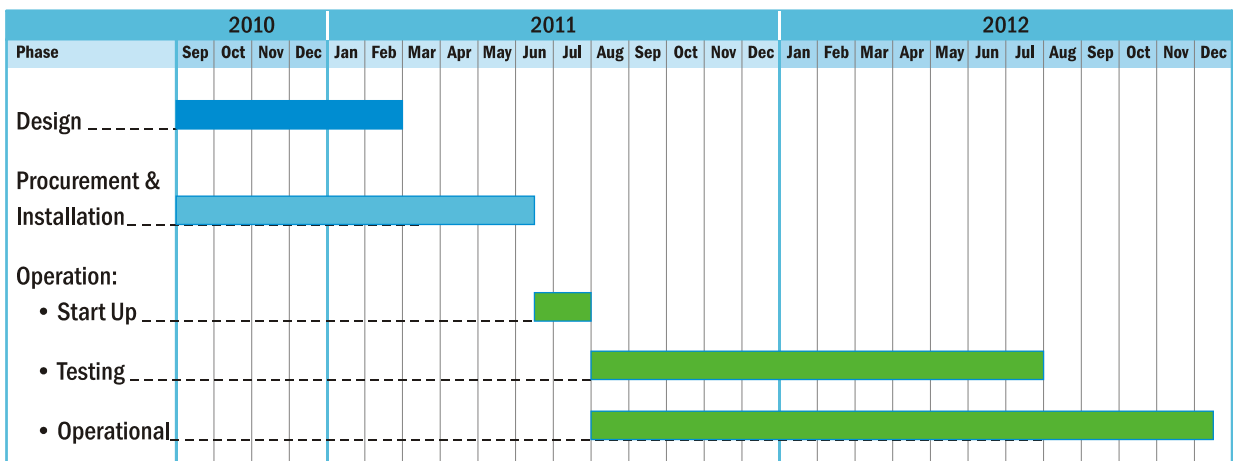


Figure 1-2
Demonstration Facility Schedule

1.3 Coordination with Other Activities and Deliverables

As a major component of the Demonstration Project, the AWP Facility Study was closely coordinated with other Demonstration Project activities and deliverables. The information was coordinated with the other project elements as follows:

- **Demonstration Project Report:** this AWP Facility Study Report is summarized in the Demonstration Project Report.
- **Purified Water Conveyance System Final Conceptual Design Report:** the Purified Water Conveyance System Final Conceptual Design Report presents the conceptual design for the purified water pump station and the approximate 23-mile pipeline to convey the purified water from the Full-Scale Facility to the San Vicente Reservoir. Information about the purified water pump station is included in Section 4. The pump station footprint is included on the Full-Scale Facility site plan (Figure 4-4) and the design criteria are included with the overall Full-Scale Facility design criteria (Figures 4-5 and 4-6).
- **Full-Scale Reservoir Augmentation Capacity Analysis Technical Memorandum:** the sizing of the Full-Scale Facility is documented in the Full-Scale Reservoir Augmentation Capacity Analysis Technical Memorandum. This document is included as an appendix to this AWP Facility Study Report for reference.

1.4 AWP Facility Study Report Overview

This report provides information on the Demonstration Facility and a conceptual design and cost estimate for the potential Full-Scale Facility. This AWP Facility Study Report is summarized in and appended to the Demonstration Project Report, which summarizes the overall results of the Demonstration Project. The remaining sections of this AWP Facility Study Report are organized into the following sections:

- Section 2 Demonstration Facility Description and Observations
- Section 3 Full-Scale Facility Considerations
- Section 4 Full-Scale Facility Conceptual Design
- Section 5 Full-Scale Facility Estimated Costs
- Section 6 References
- Appendices
 - A – Testing and Monitoring Plan
 - B – Quarterly Testing Report No. 4
 - C – Full -Scale Reservoir Augmentation Capacity Analysis Technical Memorandum
 - D – Estimated Capital Cost Process Area Breakdown
 - E – Estimated O&M Cost Process Area Breakdown
 - F – Demonstration Facility Power Consumption