Las Virgenes Municipal Water District

Triunfo Sanitation District

Las Virgenes - Triunfo Joint Powers Authority

Recycled Water Seasonal Storage | September 2016

BASIS OF DESIGN REPORT

Prepared by:

MWH® now part of Stantec

Joint Powers Authority
Las Virgenes Municipal Water District
Triunfo Sanitation District

Basis of Design Report

September 2016

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Executive Summary

ES.1 INTRODUCTION

The objective of the Basis of Design Report (BODR) is to conduct parallel evaluations of two seasonal recycled water storage scenarios to help maximize the beneficial reuse of recycled water for the Las Virgenes-Triunfo Joint Powers Authority (JPA). With the assistance of the JPA and other agencies, available information has been collected and reviewed on the facilities and operational parameters affecting the two scenarios. From this information, detailed investigations have been conducted to determine, with the help of the JPA staff, the viability of both the Las Virgenes Reservoir Indirect Potable Reuse (IPR) (Scenario 4) and Encino Reservoir Recycled Water Storage (Scenario 5) options.

ES.2 BACKGROUND

The JPA considers recycled water a valuable resource to be beneficially used. The JPA produces recycled water at its Tapia Water Reclamation Facility (Tapia WRF) by treating wastewater flows from its service area, with surplus recycled water discharged to Malibu Creek. Increasing regulatory and environmental requirements, especially reduced Total Maximum Daily Loads (TMDLs) on nitrogen and phosphorus, are making continued seasonal stream discharges to Malibu Creek problematic. At the same time, imported drinking water supplies are increasingly unreliable and costly due to drought. To avoid more stringent future discharge regulations and promote beneficial reuse, the JPA has decided to pursue a project that beneficially reuses the surplus recycled water.

On June 2, 2014, the JPA Board of Directors (Board) adopted a set of guiding principles, creating a framework for the next steps in maximizing beneficial reuse. Due to the complexity of the project, a Plan of Action was created on June 19, 2015 to create a clearer road map after a yearlong Plan of Action study. The study considered six different scenarios for maximizing beneficial reuse of the JPA's surplus recycled water. After four stakeholder public workshops and greater analysis, the JPA selected Scenario 4 and 5 as the alternatives for further investigation and the basis of the Plan of Action.

The two selected conceptual scenarios, Scenarios 4 and 5, consist of IPR through surface water augmentation at Las Virgenes Reservoir, and re-purposing Encino Reservoir for seasonal storage of recycled water, respectively. The Plan of Action outlined the objectives, strategies, and initial actions to move forward on a parallel path for both scenarios until a decision could be made on a preferred alternative.

The BODR is one of the initial steps to develop Scenarios 4 and 5 through various engineering and economic analysis, and serves as the record of the parallel investigation of the two scenarios. The analyses include developing reservoir management strategies for both Encino and Las Virgenes Reservoirs; hydraulic analysis for conveyance and pumping facilities; siting studies for new facilities; regulatory investigation; and detailed schedule and cost development. The study identifies potential issues in their implementation and possible fatal flaws. Four additional workshops conducted at regular Board meetings are part of the BODR development in order to keep the Board fully informed of the progress, issues, and flaws of the two scenarios as well as continue to engender the input of the stakeholders during scenario development.

ES.3 SUPPLY AND DEMAND

The parameters of both scenarios are determined by the supply and demand of recycled water and the projected availability into the future. Supply analysis included looking at 15 years of historical flows at Tapia WRF. Recycled water production has trended downward in the last 15 years, with a significant decrease in production over the last three years due to drought conditions and increased conservation of water.

Recycled water demand analysis included historical recycled water sales of the JPA to customers in the LVMWD and TSD service areas. Recycled water sold consists of the water produced at the Tapia WRF (which includes treated wastewater and well water supplement) as well as the potable supplement added to the recycled water system from the JPA's imported water connections. Supplement from the wells and the imported potable water connection are used to augment the recycled water supply during peak months when there is not enough supply to satisfy demand. The JPA has typically seen an increase in recycled water sales each year as the recycled water network and customer base expand. There is a high level of seasonal variability in recycled water sales; demand in December and January is typically low, then sharply escalates during summer months as temperatures increase.

Figure ES-1 presents the supply versus demand for 2013 through 2015, which shows the summer surplus and winter deficit of supply relative to demand.

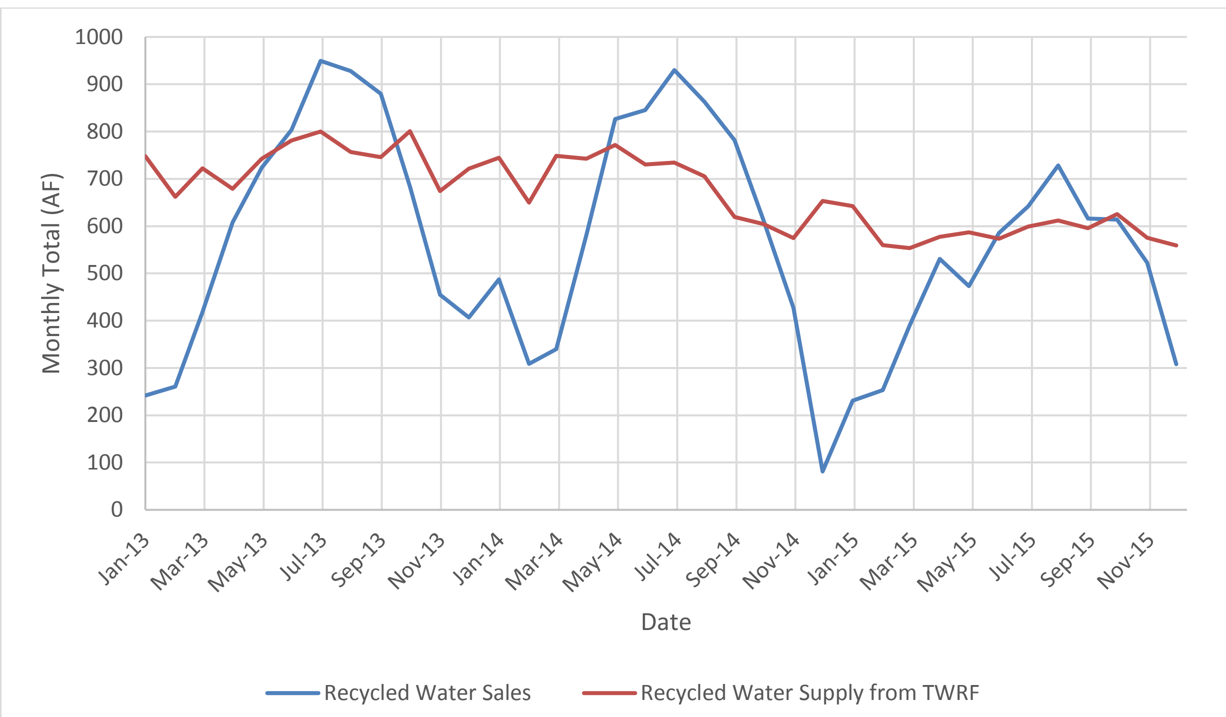

Figure ES-1
Recycled Water Supply versus Sales

Future supply and demand conditions are necessary in both scenarios to predict future plant sizing, reservoir operations, costs, and project viability. In order to predict future flow conditions, a supply and demand forecast was developed.

Table ES-1 shows the projected supply from 2016 to 2035. Two methods of projections are used. The first method assumes 2016 flows remain at the same level as 2015 and are projected forward based on the *2014 Sanitation Master Plan* applying economic, drought, and inflow/infiltration (I/I) factors. The second method assumes 2016 flows return to the 15-year average of 9,363 AF and are projected forward using the same factors, but without a drought recovery factor. The two methods result in a "low" and "high" projected range. An average of these two methods is used in the analysis.

Table ES-1
Projected Supply

	Low Range Flow (MGD)	Low Range Flow (AFY)	Average Flow (Used for future cost) (MGD)	Average Flow (Used for future cost) (AFY)	High Range Flow (MGD)	High Range Flow (AFY)
2015	6.3	7,060	6.3	7,060	6.3	7,060
2016	6.3	7,060	-	9,363*	8.3	9,363
2035	9.5	10,590	10.3	11,460	11.0	12,320

*Based on Historical Average from 2001-2015

Future recycled water demands will vary for each scenario. Scenario 4 assumes no additional growth in the recycled water system, as there is no longer an incentive to sell surplus water at a recycled water rate. Thus, the historical average demand of 6,547 acre-feet per year (AFY) will remain constant from 2016 into the future for Scenario 4. For Scenario 5, growth in recycled water demand is beneficial and a total of 2,395 AFY of demand growth is projected by 2035, for a total demand of 8,942 AFY.

Based on the future projections for both supply and demand, the gross available storage for each scenario in 2035 was calculated. **Table ES-2** shows the gross available water for each scenario considering both the low and high range for available water in 2016 and 2035.

Table ES-2
Available Recycled Water Projections for Scenarios 4 and 5

Scenario 4				
Year	**Supply (AF)**	**Supply plus Average Calculated Imported Supplement (AF)**	**Demand (AF)**	**Gross Surplus Recycled Water (AF)**
2016	7,060 – 9,363	7,347 – 9,650	6,547*	800 – 3,102
2035	10,590 – 12,320	10,877 – 12,607	6,547*	4,330 – 6,060
Scenario 5				
Year	**Supply (AF)**	**Supply plus Average Calculated Imported Supplement (AF)**	**Demand* (AF)**	**Gross Surplus Recycled Water (AF)**
2016	7,060 - 9,363	7,347 – 9,650	6,547*	800 – 3,102
2035	10,590 – 12,320	10,877 – 12,607	8,942	1,935 – 3,665

* Based on 15-year average of RW demand

ES.4 SCENARIOS

ES.4.1 Scenario 4

In Scenario 4, surplus recycled water produced at the Tapia WRF will be conveyed to a new advanced water treatment (AWT) facility that will further treat and pump the water to Las Virgenes Reservoir for IPR by surface water augmentation. Once the water is treated and stored in Las Virgenes Reservoir with the requisite detention time, mixing, and dilution, it will be equivalent in use to stored imported water. When treated through the Westlake Filtration Plant (FP), it can be used to meet potable and/or recycled water supplement demands. This scenario is based on draft regulations for surface water augmentation. Review and consultations with the Department of Drinking Water (DDW) has concluded that Scenario 4 appears to be in general compliance with all aspects of the draft regulations.

Figure ES-2 below illustrates a flow schematic for Scenario 4, with new facilities highlighted in yellow. Scenario 4 will require construction of (1) a new AWT facility, (2) new intake piping into the AWT facility, (3) new piping to connect the AWT facility to Las Virgenes Reservoir, and (4) new piping for a new brine discharge line from the AWT facility to the point of disposal. The lengths of these pipelines will vary depending on the final site of the AWT facility and brine disposal option selected.

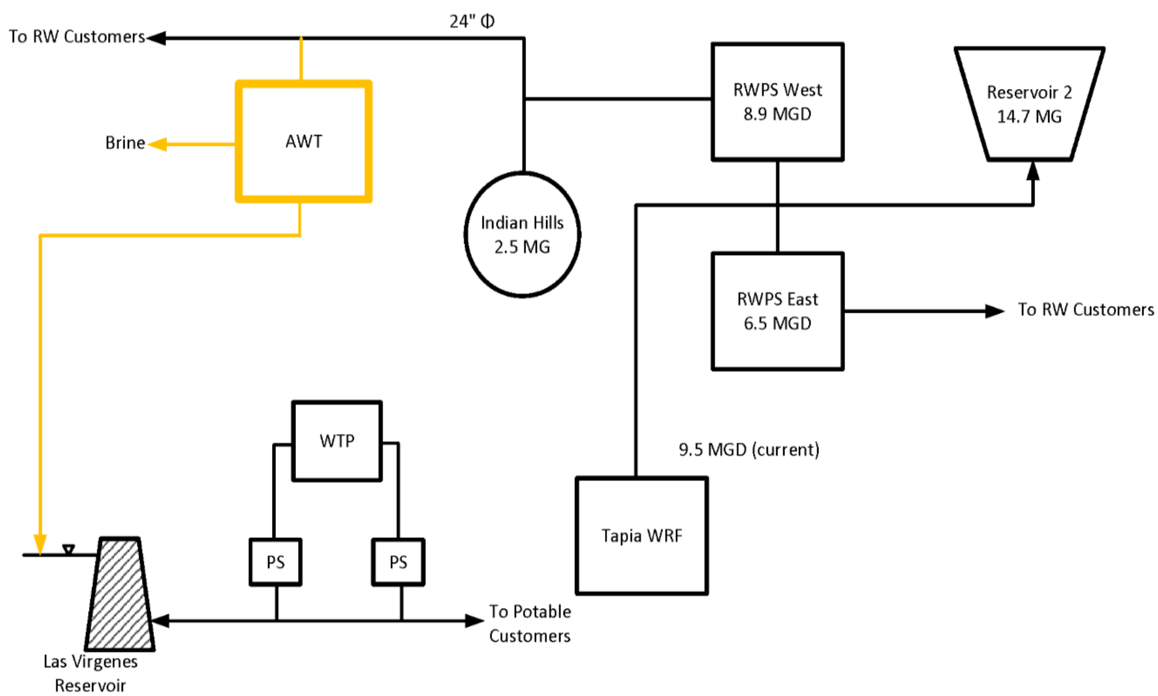

Figure ES-2
Scenario 4 Schematic

A viable means of brine disposal is a critical element of Scenario 4. The construction of a brine line will hinge on an agreement with either Calleguas Municipal Water District (CMWD) for disposal of brine to the Salinity Management Pipeline (SMP), or the City of Thousand Oaks for disposal of brine through the Hill Canyon Wastewater Treatment Plant. Without an agreement, there is no viable alternative for disposal of the brine and advanced treatment of the recycled water would not be possible. Discussions with CMWD and City of Thousand Oaks on this and other issues are on-going.

The proposed AWT facility will treat effluent from the Tapia WRF and will be sized to produce up to 6 mgd of advanced purified water to be sent to the Las Virgenes Reservoir. AWT processes have been selected to comply with draft IPR surface water augmentation regulations. The AWT treatment train includes membrane filtration (MF), 3-stage reverse osmosis (RO) for high recovery (85%), and UV advanced oxidation (UV/AOP), before it is stabilized and chlorinated prior to pumping to the Las Virgenes Reservoir, then dechlorinated prior to discharge.

Nine locations have been investigated for the two acre AWT facility site and research has been conducted to determine ownership, property type, and preliminary pros and cons of each. However, additional sites may be considered at a later date. For a final selected AWT site location, the length and alignment of the new inlet, outlet, and brine pipelines would need to be adjusted in order to accommodate the preferred site.

Coordination with various State and Local Agencies will be required to implement Scenario 4. This coordination may involve regulatory approval, encroachment permits, negotiation of agreements to provide services, and other items from the following agencies: CMWD, City of Thousand Oaks, DDW, Regional Water Quality Control Board (RWQCB), City of Westlake Village, Camrosa Water District, Department of Transportation (Caltrans).

ES.4.2 Scenario 5

In Scenario 5, surplus recycled water produced at the Tapia WRF will be pumped to Los Angeles Department of Water and Power's (LADWP) Encino Reservoir for seasonal storage. Some of this water will be pumped back to supplement summertime recycled water demands, while the remainder is either stored for future use, used to meet demand from new recycled water customers, or potentially delivered to LADWP.

As shown in the schematic diagram presented in **Figure ES-3**, Scenario 5 will require construction of approximately 15 miles of new 24-inch pipeline extending east from the Recycled Water Pump Station (RWPS) East to Encino Reservoir. The existing RWPS East must be expanded and a new 12 mgd pump station will need to be constructed at Encino Reservoir to return recycled water to the distribution system. Additional improvements at Encino Reservoir will also be required to maintain water quality.

An agreement with LADWP for use of the Encino Reservoir facility is the critical element of Scenario 5. Without an agreement, there is no available alternative for storage of seasonal recycled water. The willingness to agree will depend in large part on LADWP's position on maintaining the reservoir for emergency water storage, concerns regarding capacity for storm water runoff, and the need to conduct a seismic study of the dam. Discussions with LADWP on this and other issues are on-going.

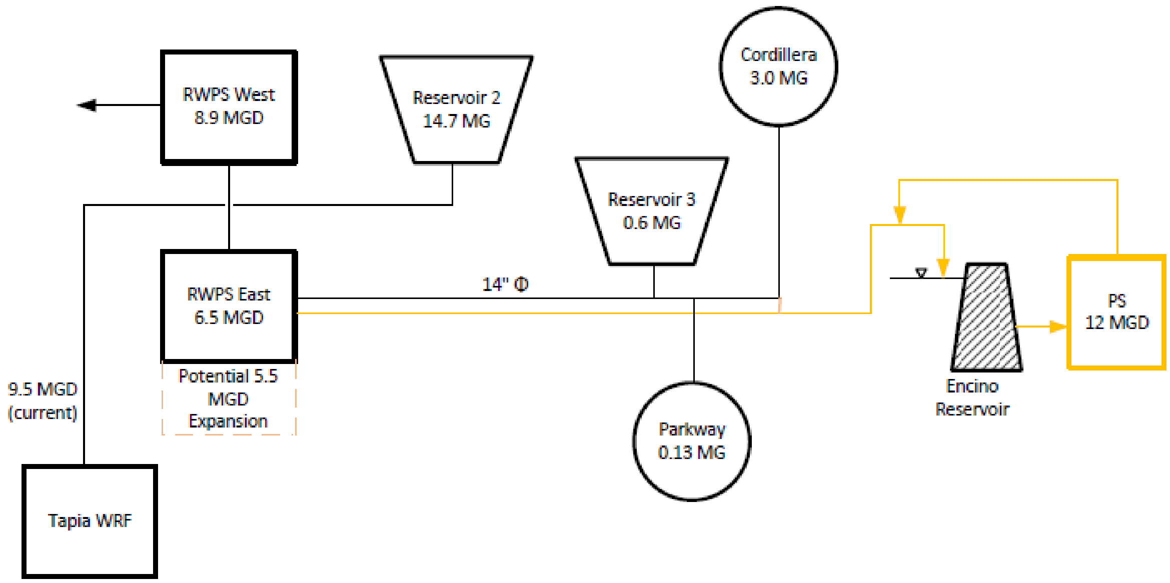

Figure ES-3
Scenario 5 Schematic

Coordination with various State and Local Agencies will be required to implement Scenario 5. This coordination may involve regulatory approval, encroachment permits, negotiation of agreements to provide services, and other items. The following agencies will require coordination in order to successfully implement Scenario 5: RWQCB, LADWP, City of Calabasas, Los Angeles County Department of Public Health (LACDPH), Los Angeles Sanitation (LASAN), Division of Safety of Dams (DSOD).

ES.5 COSTS

ES.5.1 Construction Costs

Scenario 4

Construction costs for Scenario 4 were calculated for the AWT facility, recycled water pipelines, brine discharge pipeline and the mixing system at the reservoir and are presented in **Table ES-3**. The construction cost of the AWT facility is a sum of the costs needed for land acquisition, process equipment, equipment installation, pumping and storage and the plant building itself. Additionally, contingencies were added for contractor overhead and profit, scope and estimating, and engineering and administrative fees.

The following costs also assume that the brine will be discharged to the SMP. Construction costs for the pipeline extension to the SMP include construction for a discharge facility, per CMWD requirements. Due to seasonal stratification in the reservoir, a mixing system will be required and is assumed as a lump sum cost, as the exact type of mixing system would require a more detailed analysis. The total construction cost of Scenario 4 is estimated at approximately $95,312,000.

Scenario 5

Scenario 5 construction costs were calculated for expansion of the RWPS East, new conveyance pipelines, Encino Reservoir Pump Station, strainers and chlorination system, and reservoir mixing system. To accommodate future growth, a capacity of 12 mgd will the required at both the RWPS East and the new Encino Reservoir Pump Station to convey peak seasonal flows. No construction cost is included for the JPA's use of LADWP's Encino Reservoir or for any seismic studies that are required for its continued use. The total construction cost of Scenario 5 is estimated at approximately $80,962,000.

Table ES-3
Construction Costs

Description	Scenario 4	Scenario 5
Estimated Total Construction Costs (rounded)	**$95,313,000**	**$80,962,000**

ES.5.2 O&M Costs

Scenario 4

Table ES-4 presents the operations and maintenance (O&M) costs for Scenarios 4 and 5 for the first year of operation. O&M costs include operation of the AWT facility, RWPS West Pump Station, Westlake FP, mixing system, and the brine discharge facility and associated brine discharge fees. Based on these assumptions, O&M costs for the first year of operation are estimated to be approximately $2,663,000. However, the advanced treated water discharged into the reservoir decreases the need to buy imported water from Metropolitan Water District of Southern California (MWDSC) resulting in estimated savings of $2,373,000. After incorporating the imported water savings, the net O&M cost for the first year of operation is approximately $290,000.

Unit costs per acre foot were also calculated for each scenario during the first year of operation assuming the 2001 – 2015 calculated surplus average. For Scenario 4, the unit cost per acre foot incorporates an annualized construction cost, first year O&M, and imported water savings. The unit cost per acre foot for Scenario 4 is approximately $1,724.

Scenario 5

O&M costs for Scenario 5 include the operation of the RWPS East, Encino Reservoir Pump Station, mixing system, strainers, and chlorination system. Based on these costs, the estimated O&M for the first year of operation is approximately $909,700. It is assumed there is no O&M cost for the JPA to use LADWP's Encino Reservoir. Scenario 5 would result in increased recycled water sales, as increased supply would be available. Implementation of this scenario would decrease the amount of potable supplement purchased, resulting in an imported water savings in the first year of operation of $260,100. Recycled water sales to the Woodland Hills Extension and El Caballero Country Clubs are also assumed to occur within the first year of operation, resulting in a savings of $453,500. The imported water savings and savings due to increased recycled water sales total $713,600. The net O&M, after incorporating savings, for the first year of operation is approximately $196,100.

The unit cost per acre foot calculated for Scenario 5 incorporates an annualized construction cost, first year O&M costs, as well as both imported water savings and savings due to recycled water sales. The unit cost per acre foot for Scenario 5 in its first year of operation assuming the 2001 – 2015 calculated surplus average is approximately $1,411.

Table ES-4
O&M Costs

Description	Scenario 4 O&M	Scenario 5 O&M
Estimated Total O&M (rounded)	**$2,663,000**	**$909,700**
Imported Water Savings	($2,373,000)	($713,600)
Net Total O&M (rounded)	**$290,000**	**$196,100**

ES.5.3 Present Worth

A present worth analysis was conducted for both scenarios. The following parameters were used in calculating the present worth analysis:

- 30-year analysis period
- 2% per annum inflation rate applied to O&M costs
- 7% per annum escalation rate of MWDSC imported water rate and recycled water rate, composed of a 2% inflation rate and 5% increase of rates
- 5% discount rate of future values to determine present value, composed of a 2% inflation rate and 3% interest rate.

For each scenario and in each future year, the annual cost used in calculating present worth is the sum of the *cost* of O&M in that year less the *savings* generated from the reuse of the surplus recycled water in that year. In either scenario, the value of water escalates at a greater rate than O&M costs, and the savings soon exceed the costs. This results in a net savings in annual costs. The results of both present worth analyses are shown in **Table ES-5.**

The present worth of Scenario 4 annual operations results in a savings of $80,685,000. After subtracting this amount from the construction cost of $95,313,000, the net present worth is approximately $14,629,000.

In Scenario 5, the present worth of the annual operations over the 30-year period results in a savings of $21,243,000. This annual savings is a result of both the savings generated from the elimination of the potable water supplement and increased sale of recycled water to new customers. No value is associated with excess water stored in Encino Reservoir as it currently does not have a customer. With a construction cost of $80,962,000, the net present worth of Scenario 5 is estimated at $59,719,000.

Table ES-5
Present Worth Comparison

	Scenario 4	Scenario 5
Construction Cost	$95,313,000	$80,962,000
Present Worth of Annual Costs (Savings)	($80,685,000)	($21,243,000)
Net Present Worth (Rounded)	**$14,629,000**	**$59,719,000**

ES.6 SCHEDULE

Preliminary schedules for both scenarios are presented in **Figure ES-4**, illustrating the various tasks and sequence required to implement this project. No start or end dates have been defined but the schedule does provide indication of the minimum time required to implement each scenario, assuming no delays beyond the JPA's control. The schedule also does not account for securing funding sources or regulatory deadlines related to TMDL compliance.

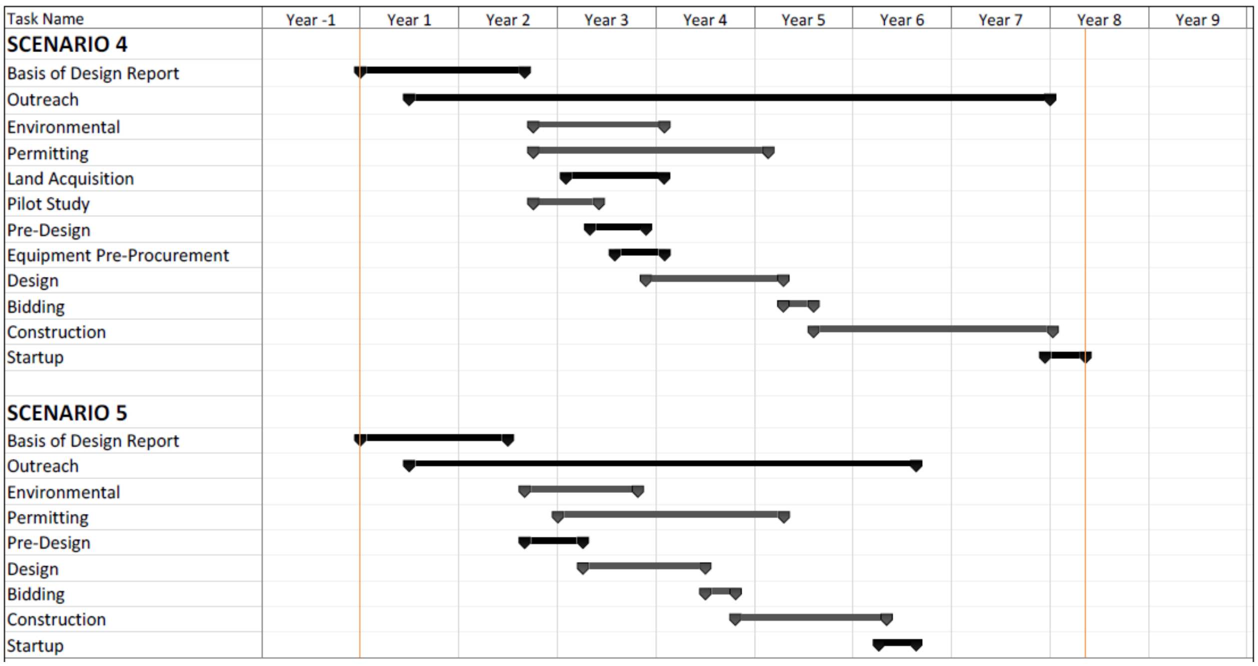

Figure ES-4
Scenario Schedules

ES.7 RECOMMENDATION

Both scenarios offer value to the JPA for addressing the objectives of this project. However, Scenario 4 embodies the following compelling advantages:

- Indirect potable reuse (IPR) is visionary and forward-thinking.
- Scenario 4 involves the best and highest use of the JPA's water resources and retains the full benefit of the resources for the JPA customers.
- Potential risks, as identified by the stakeholders, are more effectively avoided with Scenario 4.
- Stakeholder polling identified Scenario 4 as the preferred alternative.
- By offsetting the escalating cost to purchase imported water, Scenario 4 provides substantially greater long term economic value.
- Scenario 4 can be completed in sufficient time to achieve compliance with the anticipated terms for implementation of the *2013 Malibu Creek and Lagoon TMDL for Sedimentation and Nutrients to Address Benthic Community Impact.*

It is recommended that the JPA select Scenario 4 as the preferred project.

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Section 1 – Introduction

Section 1
Introduction

This section of the Seasonal Storage Basis of Design Report (BODR) provides an overview, including a brief description of the project purpose, background, and acknowledgements. A listing of abbreviations and definitions used in this report are also included in this section.

1.1 PURPOSE OF REPORT

The purpose of this project is to conduct parallel evaluations of two seasonal recycled water storage scenarios to help maximize the beneficial reuse of recycled water for the Las Virgenes-Triunfo Joint Powers Authority (JPA). The scope of this project consists of completing a BODR that summarizes the evaluations and compares the viability of the two scenarios.

With the assistance of the JPA and other agencies, available information has been collected and reviewed on the facilities and operational parameters affecting the two scenarios. From this information, detailed investigations have been conducted to determine, with the help of the JPA staff, the viability of both the Las Virgenes Reservoir Indirect Potable Reuse (Scenario 4) and Encino Reservoir Recycled Water Storage (Scenario 5) options.

1.2 BACKGROUND

The JPA considers recycled water a valuable resource to be beneficially used. The JPA produces recycled water at its Tapia Water Reclamation Facility (Tapia WRF) by treating wastewater flows from its service area, with surplus recycled water discharged to Malibu Creek. While the amount of recycled water produced at the Tapia WRF is relatively constant throughout the year, the recycled water demands fluctuate significantly on a seasonal basis. The JPA first started developing the recycled water system in the 1970s. Since the initial installation of the Las Virgenes Valley system, the recycled water system has grown to provide service in both Los Angeles and Ventura counties.

Increasing regulatory and environmental requirements, especially reduced Total Maximum Daily Loads (TMDLs) on nitrogen and phosphorus, are making continued seasonal stream discharges to Malibu Creek problematic. At the same time, imported drinking water supplies are increasingly unreliable and costly due to drought and imported water supply challenges. To avoid more stringent future discharge regulations and promote beneficial reuse, the JPA has decided to pursue a project that beneficially reuses the surplus recycled water.

1.2.1 Recycled Water Seasonal Storage

Seasonal storage of recycled water has been considered in many planning documents, beginning with the 1973 Recycled Water Master Plan. In the simplest terms, the concept is to store excess recycled water produced in the winter for use in the summer when demands are the highest and exceed production. This approach requires not only seasonal storage but also increased demands. Seasonal storage has little or no value unless it is matched with demands to empty the reservoir in the summer to make room for winter excess. The approach would significantly reduce the need to discharge but cannot eliminate discharges altogether because of high flows into Tapia WRF during rain events and a shrinking market for traditional “purple pipe” recycled water use. However, non-traditional uses, such as residential use or the emerging concept of indirect or direct potable reuse, may expand the potential demand for recycled water, leveraging the value of seasonal storage.

1.2.2 Guiding Principles and Plan of Action

On June 2, 2014, the JPA Board of Directors (Board) approved the guiding principles found in **Appendix A**, creating a framework for the next steps in developing seasonal storage for recycled water to maximize beneficial reuse. Due to the complexity of the project, having a clear road map or plan of action was deemed necessary by the Board and staff. To this end, through a series of stakeholder-driven workshops, a plan of action was developed to focus on two conceptual scenarios: indirect potable reuse (IPR) at Las Virgenes Reservoir, and re-purposing Encino Reservoir for seasonal storage. The Plan of Action outlines the objectives, strategies and initial actions to move forward on a parallel path for both scenarios until a decision can be made to focus on one. The plan includes a table showing the planned activities for each scenario over the next four quarters. Each action is then referenced in the one-year schedule showing the sequence of events. An overall project schedule for both scenarios is also included. The Plan of Action should be considered a “living” document, so as actions are accomplished and Board decisions are made, the Plan will be updated.

1.2.3 Basis of Design Report

One of the initial actions in the plan is to complete the BODR, which will develop Scenarios 4 and 5 through various engineering and economic analyses. These include reservoir management for both Encino and Las Virgenes Reservoir, hydraulic analysis for conveyance and pumping facilities, siting studies for new facilities, regulatory investigation, and detailed schedule and cost development. The study will also identify potential issues in each scenario’s implementation and identify fatal flaws. Four distinct workshops and updates at regular JPA meetings are included to keep the Board fully informed of the progress, issues and flaws.

1.2.4 Summary of Work Previously Completed

The JPA has commissioned previous studies addressing storage of recycled water and strategies to solve the seasonal imbalance of recycled water supply and demand. Prior to the Basis of Design report for Scenarios 4 and 5, the JPA contracted MWH Americas, Inc. (MWH) to complete a Recycled Water Seasonal Storage Plan of Action. The Plan of Action was completed on June 19, 2015, and considered six different scenarios for maximizing beneficial reuse of the JPA’s recycled water resource. As a result of this project, the JPA selected Scenario 4 and 5 as the preferred alternatives for further investigation based on four public workshops and analysis.

Prior to the work by MWH, the JPA commissioned studies primarily considering recycled water storage, the most recent of which was the Recycled Water Seasonal Storage Project Feasibility Study, completed by RMC Engineers in June 2012. This feasibility study considered three possible locations for a new storage reservoir in the JPA service area and made recommendations for how to accomplish the required seasonal storage to reuse all or most of the excess recycled water lost during the winter season.

During the current project cycle, the JPA has also conducted some related studies that have been referenced in this report, including the *Summary of Pipeline Diameter Alternatives for Woodland Hills Water Recycling Project, Hydraulic Evaluation and Modeling for Woodland Hills Water Recycling Project, Woodland Hills Water Recycling Expansion Concept – Concept Development,* and *Woodland Hills Water Recycling Expansion Concept Evaluation* technical memoranda completed by RMC Engineers. All of these studies, as well as previous planning documents such as the recycled water, wastewater, and water master plans were all considered for this project and are referenced where appropriate.

1.2.5 Data Sources

In preparation of this BODR, Las Virgenes Municipal Water District (LVMWD) staff provided several reports, maps, electronic files, and additional sources of information. Los Angeles Department of Water and Power (LADWP) provided historical data, reports, reservoir bathymetry and other relevant data pertaining to Encino Reservoir. In addition, material was obtained from City of Los Angeles Bureau of Sanitation (LASAN), and the Calleguas Municipal Water District (CMWD). Pertinent material included planning and development information, aerial photography, and sewer geographic information system (GIS) information. A complete list of data requested from various agencies can be found in **Appendix B**. In addition, multiple meetings and extended interactions with LVMWD staff were conducted throughout the process to obtain a thorough understanding of the District's information and needs.

Various reference documents including previous studies that were used for the preparation of this report are provided in the Appendices.

1.3 REPORT ORGANIZATION

This report was developed to summarize the findings of the evaluations of both scenarios and contains the following sections:

- **Section 1** – Introduction
- **Section 2** – Existing Conditions
- **Section 3** – Recycled Water Supply and Quality
- **Section 4** – Scenario 4
- **Section 5** – Scenario 5
- **Section 6** – Workshops and Recommendation

1.4 ACKNOWLEDGEMENTS

MWH wishes to acknowledge and thank all LVMWD and Triunfo Sanitation District (TSD) staff for their support and assistance in completing this project. Special thanks to LADWP, LASAN, and CMWD for their assistance in providing available data, input and guidance relative to

numerous inquiries throughout the course of preparation of this report. Lastly, the assistance of all the Stakeholder groups that participated in the Project Workshops and added their insights to the Project is gratefully acknowledged.

1.5 ACRYONYMS AND ABBREVIATIONS

Abbreviations have been used in this report to conserve space and improve readability. Each abbreviation has been spelled out the first time it is used in each report section. Subsequent usage of the term is usually identified by its abbreviation.

Table 1-1
List of Abbreviations

Abbreviation	Description
AF	Acre-feet
AFY	Acre-feet per year
AOP	Advanced Oxidation Process
AS	Analysis Scenario
AWT	Advanced Water Treatment
BAC	Biologically Active Carbon
BIM	Building Information Management
BOD	Biological Oxygen Demand
BODR	Basis of Design Report
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CIP	Clean In Place
CMWD	Calleguas Municipal Water District
CWSRF	Clean Water State Revolving Fund
DCTWRP	Donald C. Tillman Water Reclamation Plant
DDW	Department of Drinking Water
DOGGR	Division of Oil, Gas & Geothermal Resources
DSOD	Division of Safety of Dams
DU	Dwelling Unit
DW	Drinking Water
EED	Electrical equivalent dose
EIR	Environmental Impact Report
ES	Executive Summary
EPA	Environmental Protection Agency
FP	Filtration Plant
ft	Feet
I/I	Inflow/Infiltration
IBC	Intermediate Bulk Container
IPR	Indirect Potable Reuse
GIS	Geographic Information System
gpm	Gallons per minute
HCF	Hundred Cubic Feet

Abbreviation	Description
HDPE	High Density Polyethylene
HOA	Homeowners Association
HP	Horsepower
IRWD	Irvine Ranch Water District
JPA	Joint Powers Authority
kW	Kilowatt
kW-hr/kgal	Kilowatt-hour per thousand gallons
LACDPH	Los Angeles County Department of Public Health
LADWP	Los Angeles Department of Water and Power
LASAN	Los Angeles Sanitation
LF	Linear feet
LRP	Loan Repayment Program
LS	Lump Sum
LVMWD	Las Virgenes Municipal Water District
LV	Las Virgenes
MF	Microfiltration
MG	Million gallons
mg/L	Milligrams per liter
MGD	Million gallons per day
MPWS	Multipurpose Water Storage
MWD	Municipal Water District
MWDSC	Metropolitan Water District of Southern California
MWH	MWH Americas, Inc.
N/A	Not Applicable
NEPA	National Environmental Policy Act
NGO	Nongovernmental Organization
NIMBY	Not In My Backyard
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
NWRI	National Water Research Institute
OPCC	Opinion of Probable Construction Cost
PFD	Process Flow Diagram
psi	Pounds per square inch
PVC	Polyvinyl Chloride
RFP	Request for Proposal
RO	Reverse Osmosis
ROW	Right of Way
RW	Recycled Water
RWPS	Recycled Water Pump Station
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
SMP	Salinity Management Pipeline
SWP	State Water Project

Abbreviation	Description
SWRCB	State Water Resources Control Board
SWSAP	Surface Water Source Augmentation Project
TDS	Total Dissolved Solids
TEPS	Tapia Effluent Pump Station
TMDL	Total Maximum Daily Load
TSD	Triunfo Sanitation District
TTO	Total Toxic Organics
μg/L	Micrograms per liter
UF	Ultrafiltration
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
WQCB	Water Quality Control Board
WRF	Water Reclamation Facility
WRFP	Water Recycling Funding Program
WRP	Water Recycling Project
WW	Wastewater
WWTP	Wastewater Treatment Plant

Section 2 –
Existing Conditions

Section 2
Existing Conditions

This section describes the Joint Powers Authority (JPA) existing service area. A discussion of geography, wastewater, recycled water and water systems, and existing facilities within the service area is presented in this section.

2.1 GEOGRAPHICAL BACKROUND AND GOVERNANCE BOUNDARIES

The size of the JPA service area is approximately 110,080 acres, or 172 square miles. A large extent of this area is undeveloped open space within the Santa Monica Mountains, which does not require water services. However, the existence of the Santa Monica Mountains within the service area leads to a large change in elevation and the need for extensive water and wastewater systems within the service area. The rest of the service area is mainly residential and small commercial usage. In total, the JPA serves over 100,000 people. The wastewater, potable and recycled water systems are owned and operated by various entities as described in **Section 2.1.1**. The total service area of the JPA is shown in **Figure 2-1**.

2.1.1 Governance of Service Area

Las Virgenes – Triunfo Joint Powers Authority

The Las Virgenes – Triunfo JPA was formed in 1964 to construct, operate and maintain a joint sewer system to serve the Malibu Canyon drainage area. The Board of the JPA consists of the Boards of the Las Virgenes Municipal Water District (LVMWD) and Triunfo Sanitation District (TSD). A quorum of the JPA Board consists of at least three members of the Boards of LVMWD and TSD. Action by the JPA requires the affirmative vote of not less than three members of the Boards of LVMWD and TSD. LVMWD serves as the Administering Agent of the JPA.

Wastewater System

LVMWD's wastewater service area comprises the cities of Agoura Hills, Calabasas, Hidden Hills, and Westlake Village, as well as unincorporated portions of Los Angeles County. The majority of the LVMWD collection system is operated by the Los Angeles County Consolidated Sewer Maintenance District. Interceptors and trunk sewers are owned and operated by the JPA.

TSD's wastewater service area comprises portions of Oak Park, Lake Sherwood, Bell Canyon, and the Westlake Village and North Ranch portions of the City of Thousand Oaks.

The two service areas, LVMWD and TSD, comprise the complete service area tributary to the JPA's Tapia Water Reclamation Facility (WRF). The JPA's sanitation system includes the Tapia WRF, Rancho Las Virgenes Composting Facility and 60 miles of trunk sewers. Not all wastewater stays within the JPA service area as the east side of the TSD service area, including the Bell Canyon area, and LVMWD's West Hills and Chatsworth service areas drain easterly to the City of Los Angeles, rather than to the Tapia WRF, for wastewater treatment and disposal.

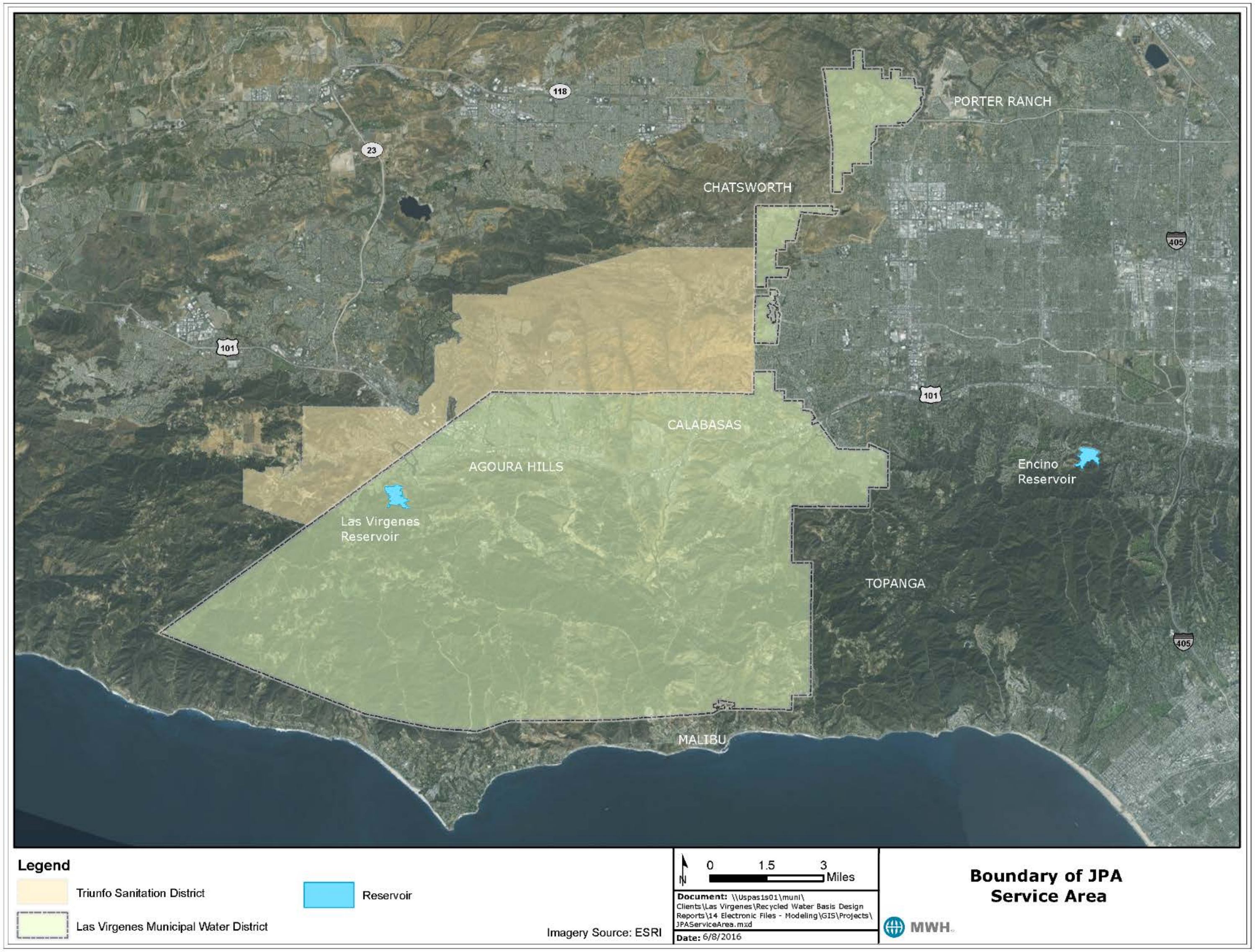

Figure 2-1
JPA Service Area

Recycled Water System
Within the recycled water system, the JPA owns and operates a complex distribution system, consisting of pipelines, pump stations, tanks and reservoirs, and associated appurtenances to deliver the recycled water to areas of Los Angeles and Ventura Counties. The JPA produces the recycled water and wholesales it to the two JPA partners, LVMWD and TSD.

Within Los Angeles County, recycled water is served to LVMWD customers in the cities of Calabasas, Hidden Hills, Agoura Hills and Westlake Village, and adjacent unincorporated areas. When the recycled water enters Ventura County, TSD sells it to Calleguas Municipal Water District (CMWD), which wholesales to the Oak Park Water Service (a public utility operated by TSD), California Water Service Company (CalWater), and Lake Sherwood Community Services District. These utilities sell and distribute the water to customers in the Oak Park Community, the Lake Sherwood Golf Course, and to the Westlake and North Ranch portions of the City of Thousand Oaks.

Potable Water System
LVMWD's potable water service area includes the incorporated cities of Agoura Hills, Calabasas, Hidden Hills, and Westlake Village, as well as unincorporated portions of Los Angeles County. LVMWD owns and operates their potable water system. LVMWD is a Metropolitan Water District of Southern California (MWDSC) member agency and receives 100 percent of its potable water supply from MWDSC.

TSD owns and operates the Oak Park Water Service, which receives potable water from the MWDSC via CMWD. Potable water is also provided in the TSD service area by Thousand Oaks, Ventura County Waterworks District and the California Water Service.

2.2 DESCRIPTION OF EXISITING FACILITIES

2.2.1 Tapia WRF

The JPA owns the Tapia WRF, which treats wastewater from the service area with tertiary treatment and disinfection prior to discharge for beneficial reuse. The facility is located along Malibu Canyon Road in unincorporated Los Angeles County as seen in **Figure 2-2**.

Treatment begins with wastewater flowing through bar screens and a grit chamber to remove inert material. The water is then pumped to primary sedimentation tanks to allow for separation before the biological treatment. From primary sedimentation, the wastewater flows to aeration tanks and then to secondary sedimentation. After the secondary treatment, the water receives tertiary treatment as extremely small particles are removed in a filtering process. Finally, the water is disinfected with chlorine and neutralized before entering the recycled water distribution system. This process is depicted in **Figure 2-3.**

Tapia WRF has a design capacity of 16.1 million gallons per day (mgd) but typically processes about 7 mgd of incoming wastewater to produce high quality recycled water for non-potable uses within the service area, such as landscape irrigation and commercial uses.

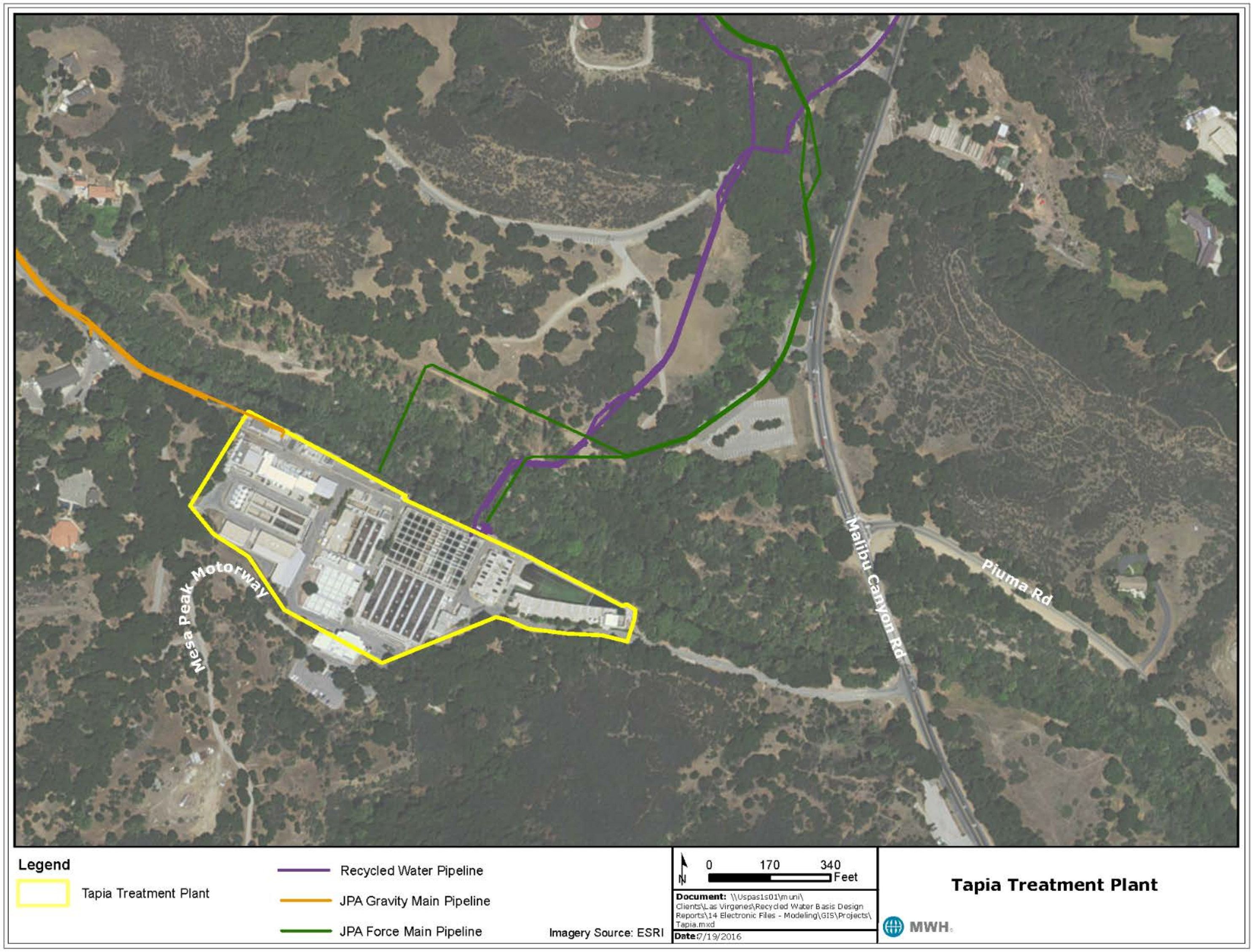

Figure 2-2
Tapia Water Reclamation Facility

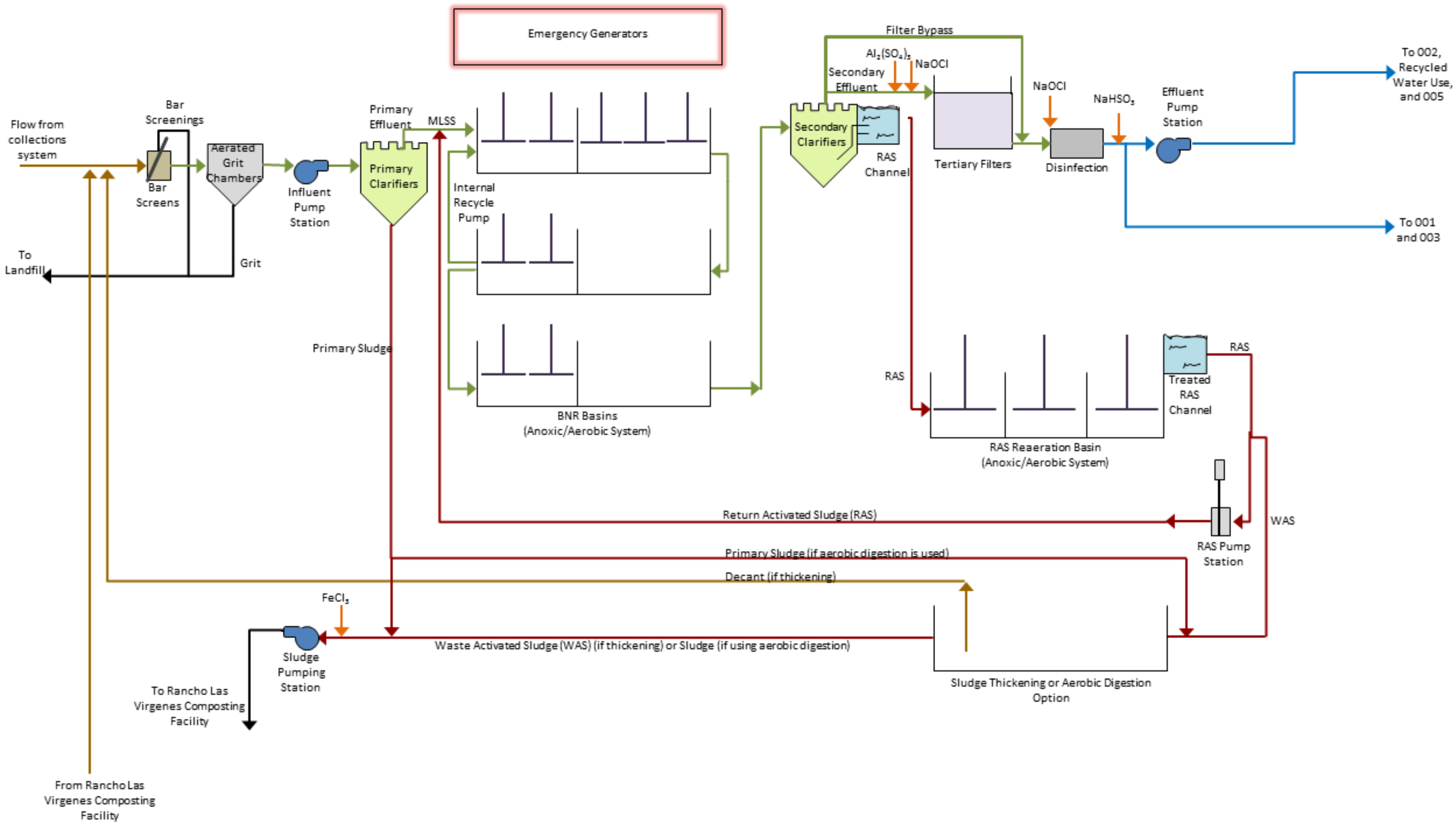

Figure 2-3
Tapia WRF Process Flow Diagram

2.2.2 Wastewater Collection System

Wastewater for the JPA service area is conveyed through an interconnected system of pipelines and lift stations. Wastewater flows are treated at the Tapia WRF with about two-thirds of the demand coming from LVMWD's wastewater collection system, which services the cities of Agoura Hills, Calabasas, Hidden Hills and Westlake Village and unincorporated areas of Los Angeles County. The eastern portion of the LVMWD service area within the Los Angeles River watershed is pumped over the Calabasas Grade and then flows downhill to the Tapia WRF. The TSD collection system services the cities of Oak Park, Lake Sherwood, Bell Canyon, and the Westlake Village and North Ranch portions of Thousand Oaks.

Not all of the wastewater in the service area is treated at Tapia WRF due to practical constraints. Wastewater flows in these areas are delivered to the City of Los Angeles for treatment.

Figure 2-4 displays all of the wastewater collection system facilities and infrastructure that will be discussed in greater detail below.

Pipelines

In total, the LVMWD and TSD own and operate over 180 miles of pipelines and six lift stations that can convey over 32 mgd to the Tapia WRF. There are no expansions to the system planned at this time. The wastewater system includes approximately 60 miles of trunk sewers (about 45 miles of gravity main and about 15 miles of force main) that collect wastewater from TSD and LVMWD. Of these facilities, approximately 49 miles are owned by the JPA and 11 miles are owned by the LVMWD.

TSD

The TSD system consists of 120 miles of pipelines and four lift stations that typically convey 2.6 mgd annually to the Tapia WRF. Sewage flows by gravity from the Ventura/Los Angeles county line to Tapia WRF. The system is also supported by half a mile of pressure force pipes which help pump sewage from low areas into the trunk system.

LVMWD

The LVMWD owns and operates approximately 11 miles of sewer force and gravity mains. The system is supported by two lift stations that transport sewage from the Los Angeles River watershed to the Malibu Creek watershed, and the remainder of sewage flows by gravity to the Tapia WRF.

I/I Summary

Inflow/infiltration (I/I) is the addition of flows into the wastewater collection system that may dilute the sewage and result in larger volumes of wastewater flow. Inflow is the result of surface and storm water entering the sewer system through manhole lids. This type of flow increases with rain events. Infiltration is the result of groundwater seeping into cracks in the sewers. This could be due to a higher water table or additional groundwater flow caused by storm events.

A rate of about 4% is typically attributed to I/I flows to predict future wastewater flows. Dry weather tends to decrease I/I but the rate is variable from year to year.

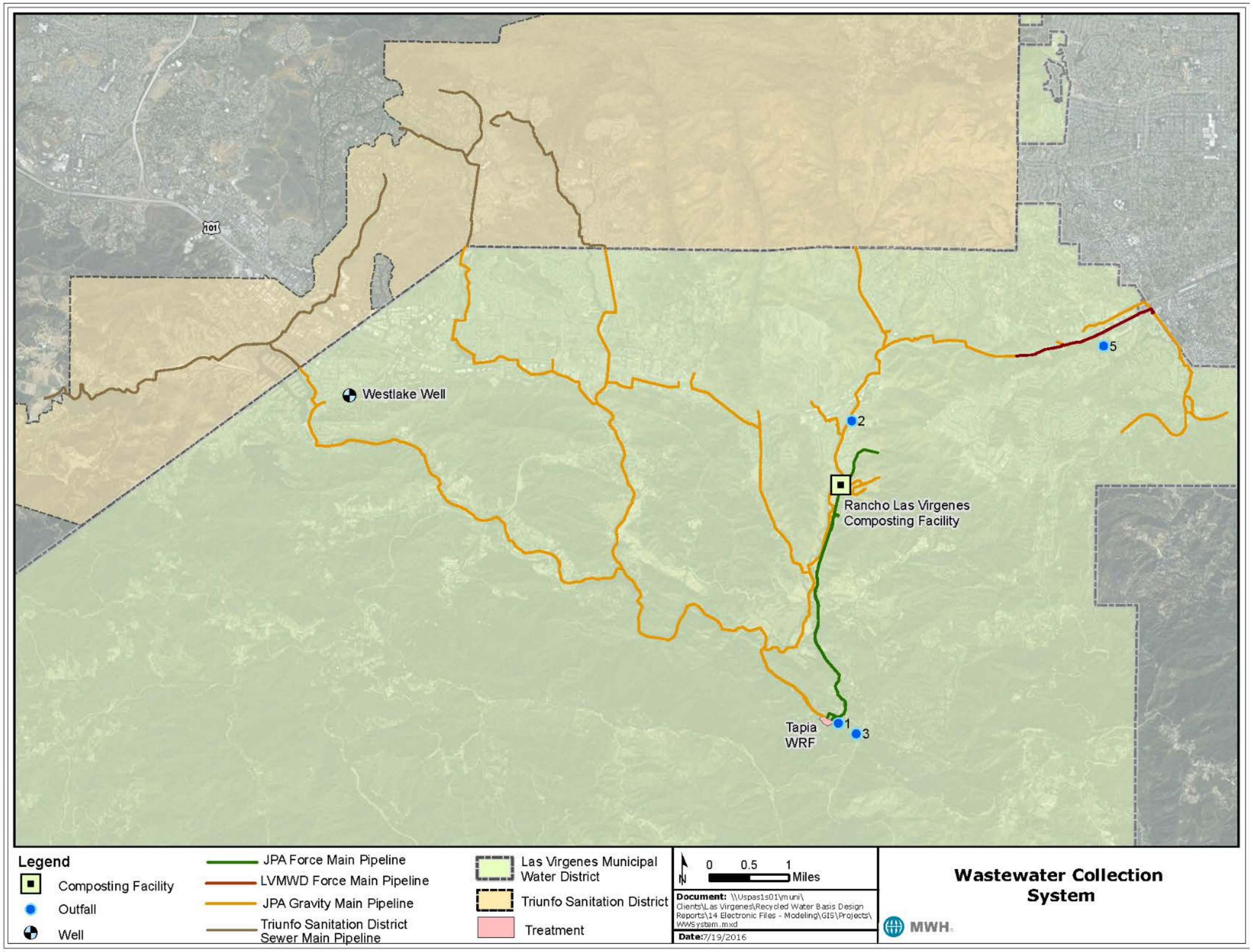

Figure 2-4
Wastewater Collection System

Emergency Outfall to LASAN
There is the potential for direct discharge of raw sewage from the JPA to Los Angeles Sanitation (LASAN) for eventual treatment. This would be accomplished through the JPA's existing connection to LASAN in Calabasas.

Sewer Collection Source Control Program
The LVMWD receives waste from an industrial user specializing in metal finishing and has local effluent limits on the following constituents in **Table 2-1**.

Table 2-1
Effluent Quality Limitations

Constituents	Local Effluent Limits (mg/L)
Arsenic (Total)	0.05
Beryllium	0.005
Boron	1.50
Cadmium (Total)	0.02(4)
Chloride	175(4)
Chromium (Total)	0.07(4)
Copper (Total)	0.30(4)
Cyanide (Total)	0.02(4)
Cyanide (Amenable) (3)	--
Dissolved Sulfide	0.10
Fluoride	1.20(4)
Lead (Total)	0.20(4)
Mercury	0.002
Nickel (Total)	0.50(4)
Oil & Grease	100(4)
pH Range	6-10(4)
Selenium	0.02(4)
Silver (Total)	0.08(4)
Sulfate	325(4)
Temperature	140°F(4)
Total Dissolved Solids (TDS)	1,000(4)
Total Toxic Organics (TTO)	--
Zinc (Total)	0.50(4)

2.2.3 Recycled Water System

The recycled water system maintained by the JPA has been widely recognized throughout California as an example of how effective wastewater recycling can be. The Tapia WRF treats wastewater from the service area with tertiary treatment and disinfection prior to beneficial reuse such as landscape irrigation and commercial uses. The distribution system consists of approximately 68 miles of pipeline, two storage tanks, three open reservoirs and five pump stations. **Figure 2-5** displays all of the recycled water system facilities and infrastructure, and **Figure 2-6** displays a simple schematic of the system, which is discussed in further detail below.

Recycled water is served to LVMWD customers in the cities of Calabasas, Hidden Hills, Agoura Hills, Westlake Village and unincorporated areas of Los Angeles County. After purchase from the JPA, TSD sells recycled water to CMWD, which wholesales to the Oak Park Water Service (a public utility operated by TSD), CalWater, and Lake Sherwood Community Services District for retail sales. Surplus recycled water not used in the system is released to the Malibu Creek after dechlorination during the months of December through March.

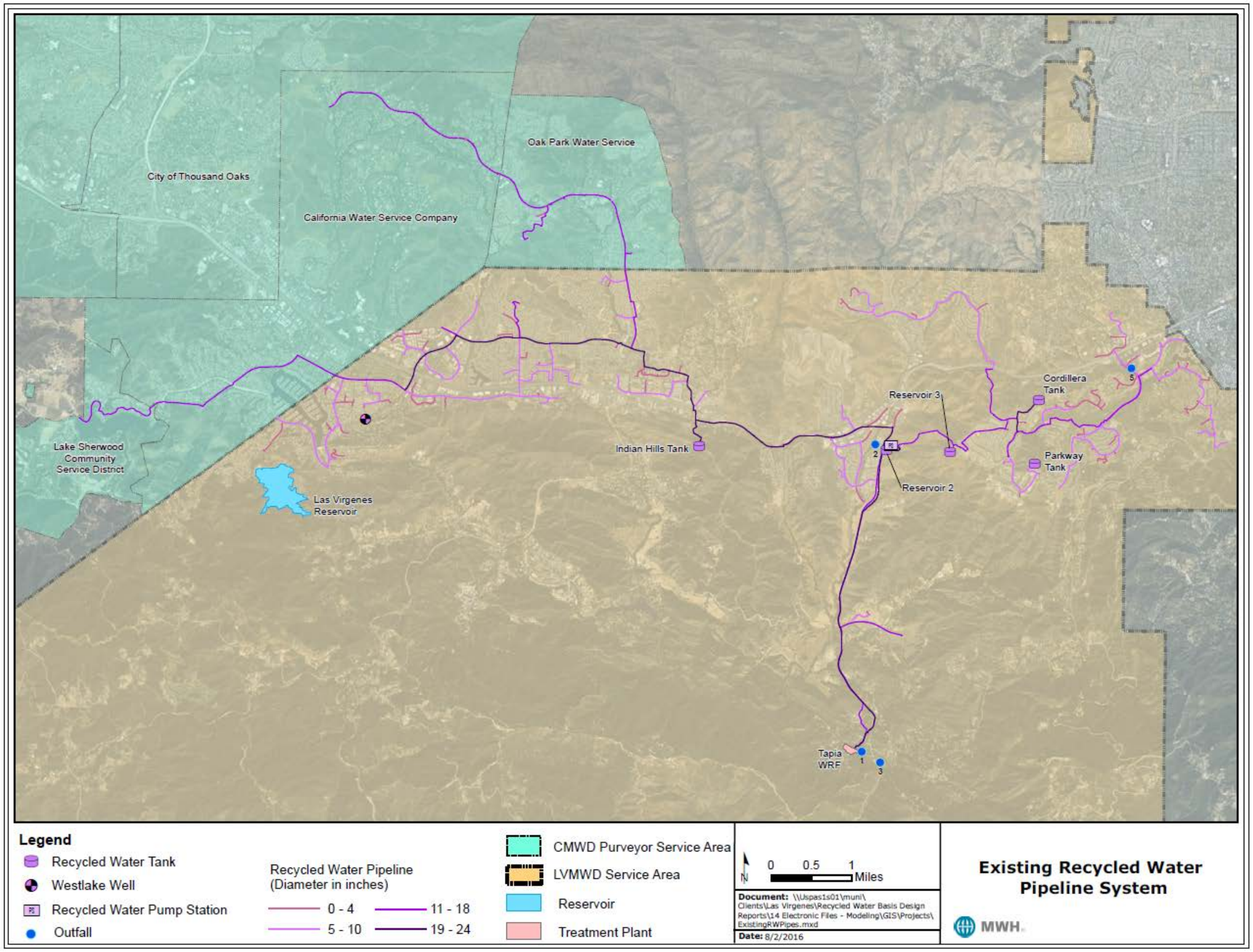

Figure 2-5
Recycled Water System

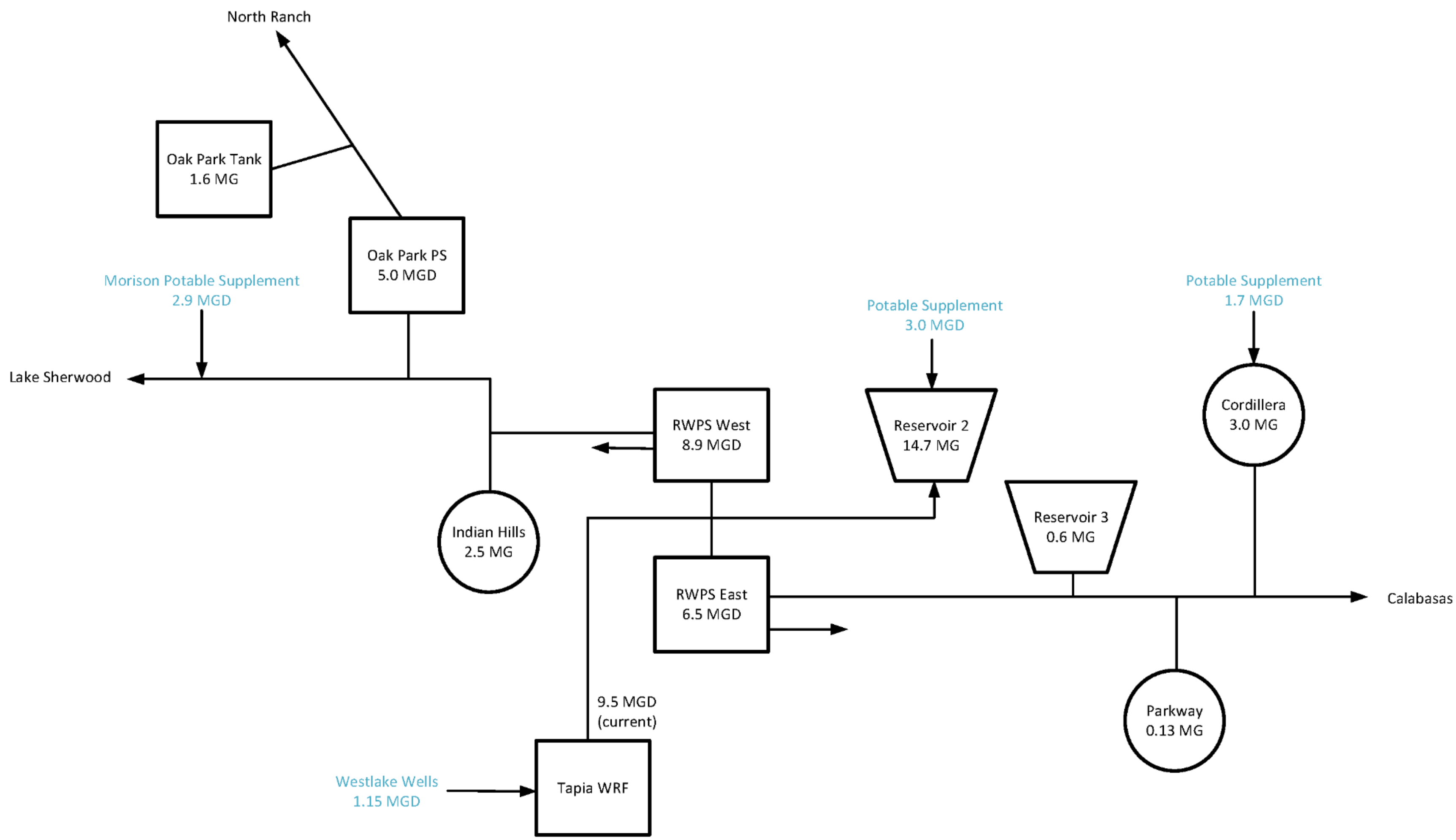

Figure 2-6
Schematic of JPA and Calleguas Recycled Water System

Pipelines

The distribution system consists of a total of approximately 68 miles of pipelines. **Table 2-2** presents the total lengths of the different sized pipes within the recycled water collection system. **Table 2-3** shows the total length of pipe by pipe material.

Table 2-2
Recycled Water Pipeline by Diameter

Diameter (in.)	Total Length (miles)
1	0.20
1.5	0.01
2	1.23
3	0.02
4	12.05
6	11.78
8	11.21
10	4.79
12	3.40
14	3.21
16	3.55
18	3.37
20	1.47
24	11.76
Total	**68.05**

Table 2-3
Recycled Water Pipeline by Material

Material	Total Length (miles)
Asbestos Cement	5.47
Copper	0.13
Ductile Iron	0.76
Polyvinyl Chloride (PVC)	29.50
Steel	32.19
Total	**68.05**

Storage

There are four storage tanks and three open reservoirs used for storage in the recycled water system. Treated water is pumped from Tapia WRF to Reservoir 2, a 45 acre-feet (AF), or 14.7 million gallons (MG), reservoir that is located next to LVMWD headquarters. Water is then pumped from Reservoir 2 to Cordillera Tank (3.0 MG) in the eastern system. Recycled water is also pumped to Indian Hills Tank (2.5 MG) in the western system. There are smaller recycled water subsystems not owned and operated by the JPA, such as LVMWD's Parkway subsystem which includes the Parkway Pump Station and Parkway Tank (0.13 MG) in the east and the Oak Park system owned by CMWD that includes the Oak Park Pump Station and the Oak Park Tank (1.8 MG) in the west.

Westlake Wells

The JPA owns and operates two, 400 gallon per minute (gpm) groundwater wells in Westlake Village. The wells have a combined capacity of around 1.5 mgd and run for several months over the summer. Historically, the wells directly supplemented the recycled water system but due to high iron and manganese content of the water, direct supplementation has stopped. The groundwater is now conveyed through the wastewater collection system to Tapia WRF for blending and treatment so it can eventually be supplemented into the recycled water system. Since the wells are used as supplement, they are only operated to meet peak recycled water demands.

Connections from Potable System

Reservoir 2, Cordillera Tank and Morrison Supplemental Facility are all locations where potable water may be added to the recycled water system to supplement low supplies. Reservoir 2 can provide 3.0 mgd, Cordillera Tank can provide 1.7 mgd and the Morrison Supplemental Facility can provide 2.9 mgd. There are no supplemental facilities in the TSD service area. **Figure 2-7** shows the amount of supplement to the recycled water system from 2013 to the middle of 2015.

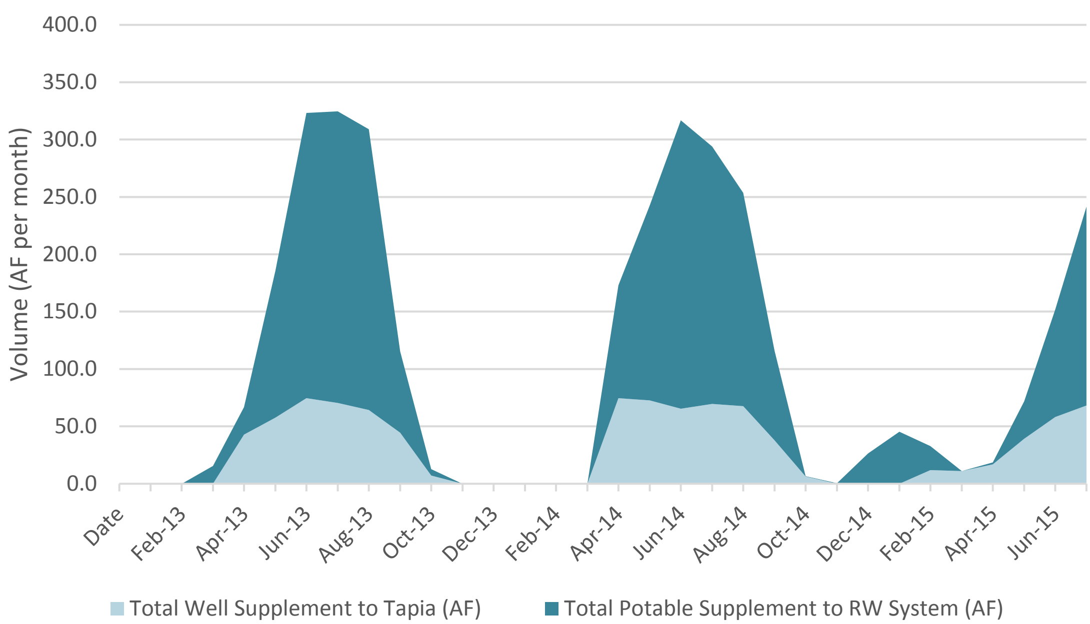

Figure 2-7
Supplements to Recycled Water System

Pump Stations

Once the water has been treated at Tapia WRF, it is pumped through the Tapia Effluent Pump Station (TEPS) to Reservoir 2. The Recycled Water Pump Station (RWPS) East, also located near LVMWD headquarters, pumps water from Reservoir 2 to Reservoir 3 and then to Cordillera Tank in the eastern system. RWPS East has a total capacity of 6.5 mgd. Also in the eastern system is the Parkway Pump Station (0.5 mgd) which pumps water to the Parkway Tank.

The RWPS West (8.9 mgd), collocated with RWPS East, pumps recycled water to Indian Hills Tank in the western system, and Oak Park Pump Station (5.0 mgd) pumps water to Oak Park Tank in the west. Up to 1.7 mgd of water can be taken from the pipeline that feeds Morrison Tank and pumped by the Morrison Pump Station into the distribution system regulated by Indian Hills Tank.

Outfalls

There are a few outfall options to dispose of surplus recycled water including discharge to Malibu Creek or the Los Angeles River and spray field application.

Malibu Creek

Surplus recycled water not used in the system may be released to the Malibu Creek after dechlorination at Tapia WRF. Discharge into Malibu Creek can only occur from November 16 to April 14 due to National Pollutant Discharge Elimination System (NPDES) restrictions.

Spray Fields

The JPA owns several fields near the Rancho Las Virgenes Composting Facility where irrigation systems are used during shoulder months (months between peak and off-peak seasons). Water is applied through spray application onto grass which is then harvested. This disposal alternative is fairly expensive due to the labor costs for setting up and operating the irrigation system along with harvesting the grass.

Los Angeles River

Water can also be discharged to Discharge Point 005, which is a storm drain outfall near Calabasas Road and Park Granada. It discharges to the Los Angeles River through the Arroyo Calabasas, a tributary of the Los Angeles River.

2.2.4 Potable Water System

LVMWD

LVMWD's potable water system is primarily supplied from imported water from MWDSC, which imports and treats water from the State Water Project (SWP). The potable water system consists of 22 main pressure zones that require 24 pumping stations, 25 water storage tanks, over 400 miles of pipelines and over 75 pressure regulating stations to deliver water throughout the service area. The complexity of the system stems from the difficult topography and linearity of the area.

TSD

TSD owns and operates the Oak Park Water Service potable water system. It is a much smaller system and consists of four water storage tanks, three pump stations and 41 miles of pipeline to deliver potable water to approximately 14,000 residents.

Imported Connections

Imported water from MWDSC is LVMWD's primary water supply for almost all potable water demands. There are three connections to the MWDSC system which have a total capacity of over 47 mgd.

Interconnections

Besides the connection to MWDSC, LVMWD also receives treated imported water from a connection with the City of Simi Valley and the Ventura County Waterworks District 8. There is also a potential connection to CMWD at Lindero Canyon Rd. on the west side of LVMWD's service area.

Westlake Filtration Plant

Potable water stored in an open reservoir must undergo additional disinfection and filtration before distribution into the system. The Westlake Filtration Plant (Westlake FP), constructed in 1990, provides this further treatment for water in the Las Virgenes Reservoir. Water is pumped from the reservoir and treated with filtration to remove primarily algae. The water is then disinfected with chloramines to maintain the quality of the water throughout the distribution system. The Westlake FP has a treatment capacity of 13 mgd and only operates during summer months of high demand.

Located near the Westlake FP is a 5 MG finished water tank which provides additional storage capacity of treated water. The tank was constructed as part of the 2008 Backbone Improvement Program.

Las Virgenes Reservoir

The Las Virgenes Reservoir provides seasonal and emergency storage for the LVMWD system. The reservoir is located in the hills just south of Westlake Village. During low demand, imported water from MWDSC recharges the reservoir and during high demand, water can be drawn from the reservoir to meet the increased potable demands. The total capacity of the reservoir is 9,600 AF but typically the reservoir contains around 7,300 AF and can drop as low as 4,000 AF during dry months. Las Virgenes Reservoir becomes the main water source for the service area when the MWDSC supply is interrupted for maintenance or emergency conditions. The reservoir's watershed area provides enough water to offset evaporative losses.

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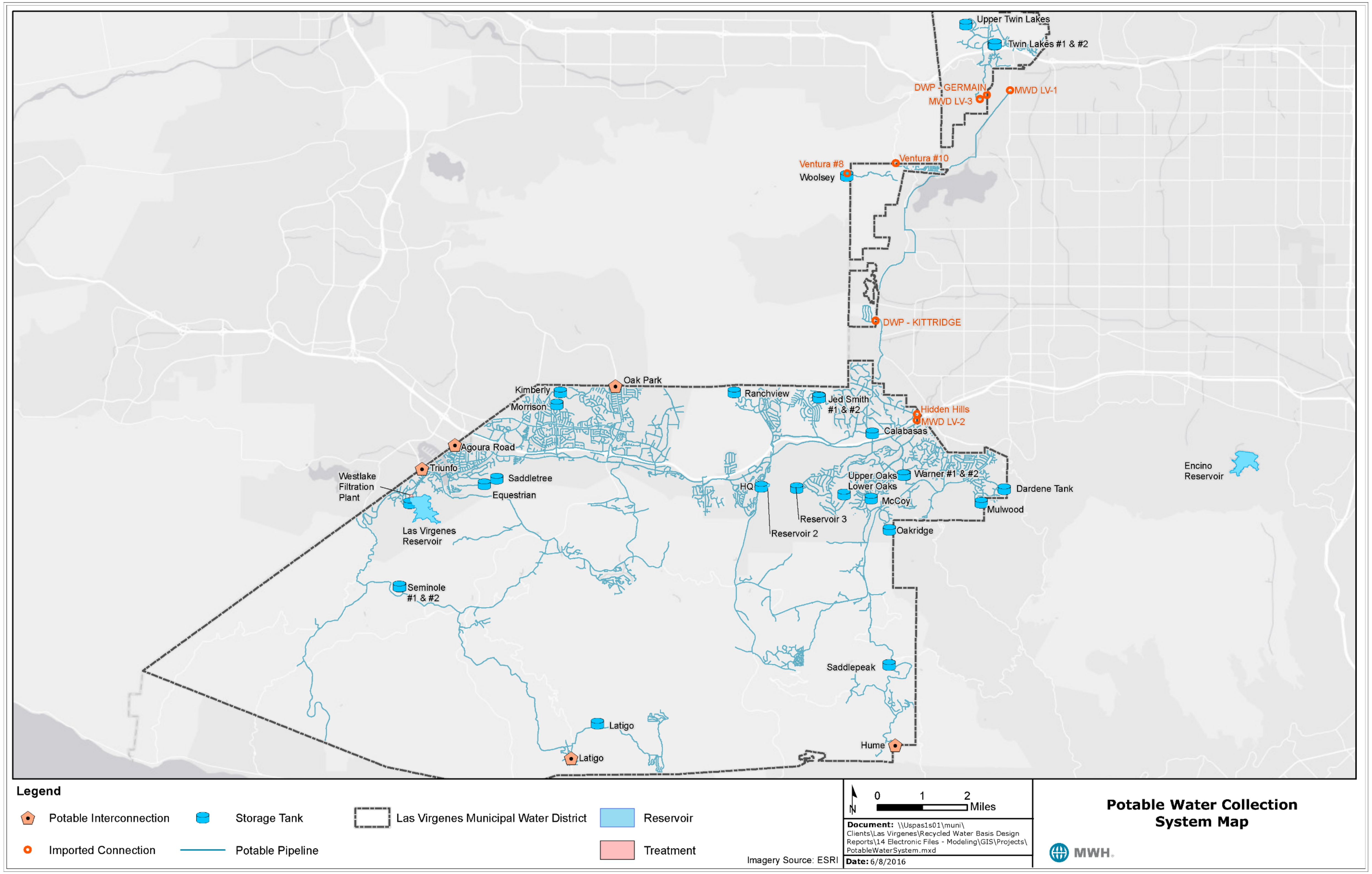

Figure 2-8
Potable Water System

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Section 3 –

Recycled Water Supply and Quality

Section 3
Recycled Water Supply and Quality

3.1 RECYCLED WATER SUPPLY AND DEMANDS

The Joint Powers Authority (JPA) operates and maintains a trunk sewer collection system and wastewater treatment facility that serve portions of Los Angeles and Ventura Counties. The Tapia Water Reclamation Facility (Tapia WRF) provides tertiary treatment and disinfection to the wastewater prior to beneficial reuse for irrigation of golf courses, green belts, parks, schools, and homeowners association (HOA) common areas. While the supply of recycled water from the wastewater system and Tapia WRF remains relatively constant throughout the year, the demand for recycled water fluctuates greatly between the summer peak season and the winter season.

Due to this seasonal imbalance, there is a deficit of recycled water supply relative to demand during the late spring, summer, and early fall, and a surplus of recycled water during late fall, winter, and early spring. Surplus recycled water that is not beneficially reused is released to Malibu Creek after it is dechlorinated. Stringent water quality requirements have made discharging this water increasingly costly for the JPA, and future regulatory actions will require additional major upgrades to the Tapia WRF. In addition, the JPA must pay for potable water to supplement the recycled water system in order to make up for deficits in the summer.

3.1.1 Historical Supply

For this Basis of Design Report (BODR), supply is analyzed by looking at 15 years of historical record for the flows at Tapia WRF. All data and calculations for supply and demand analyses are found in **Appendix C**. **Figure 3-1** shows the monthly historical averages of recycled water produced at Tapia WRF based on JPA records going back 18 years to 1998. As shown in **Figure 3-1**, recycled water production has trended downward in the last 15 years, with a significant decrease in production over the last three years due to drought conditions and increased conservation of water. The last 15 years of record is selected for this investigation as it reflects the size of the system today while still capturing a long enough time period to show trends in supply and demands.

Figure 3-2 shows the monthly recycled water production for Tapia WRF in acre-feet (AF) over each of the last 15 years. As shown in **Figure 3-2**, seasonal flow patterns are relatively consistent, while production has varied over a relatively wide range. Years 2013, 2014, and 2015 are the lowest flow years in the 15-year period. Wastewater flows are generally higher in winter months due to inflow and infiltration (I/I) from wet weather events.

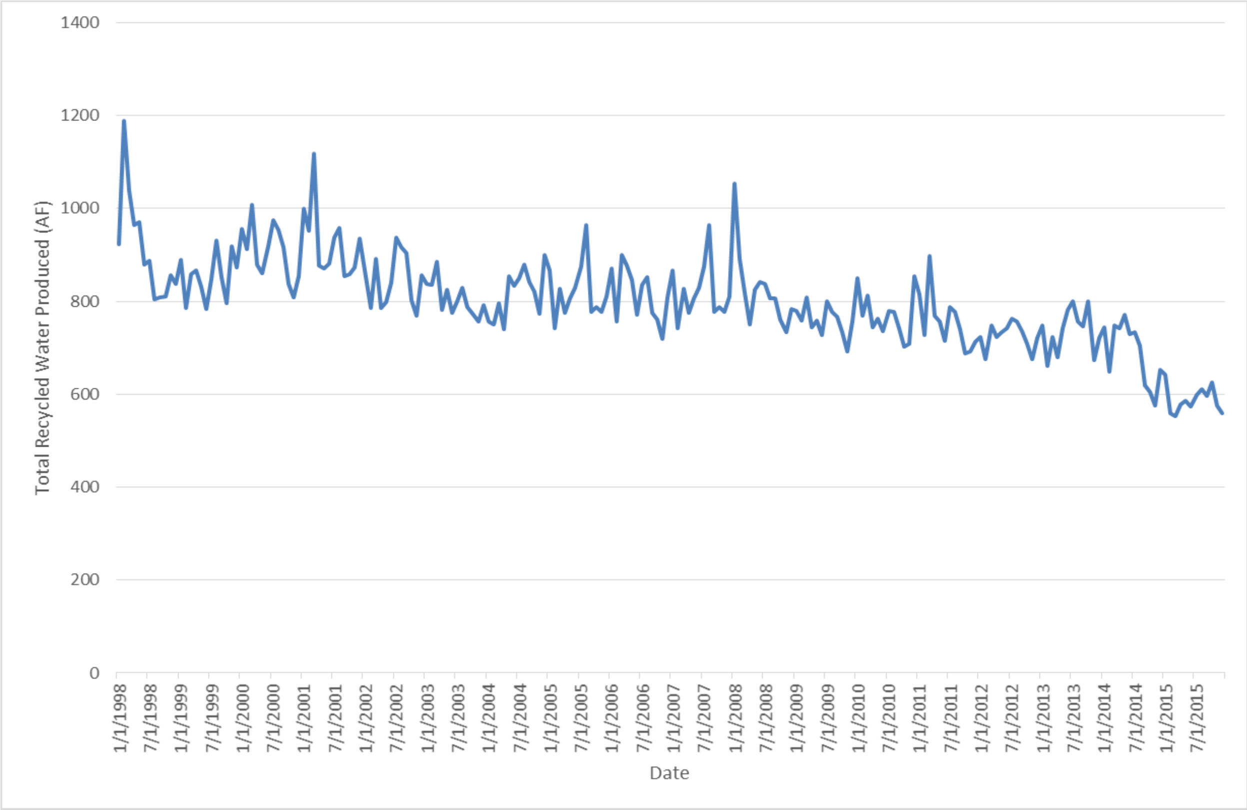

Figure 3-1
Tapia WRF Historical Recycled Water Production

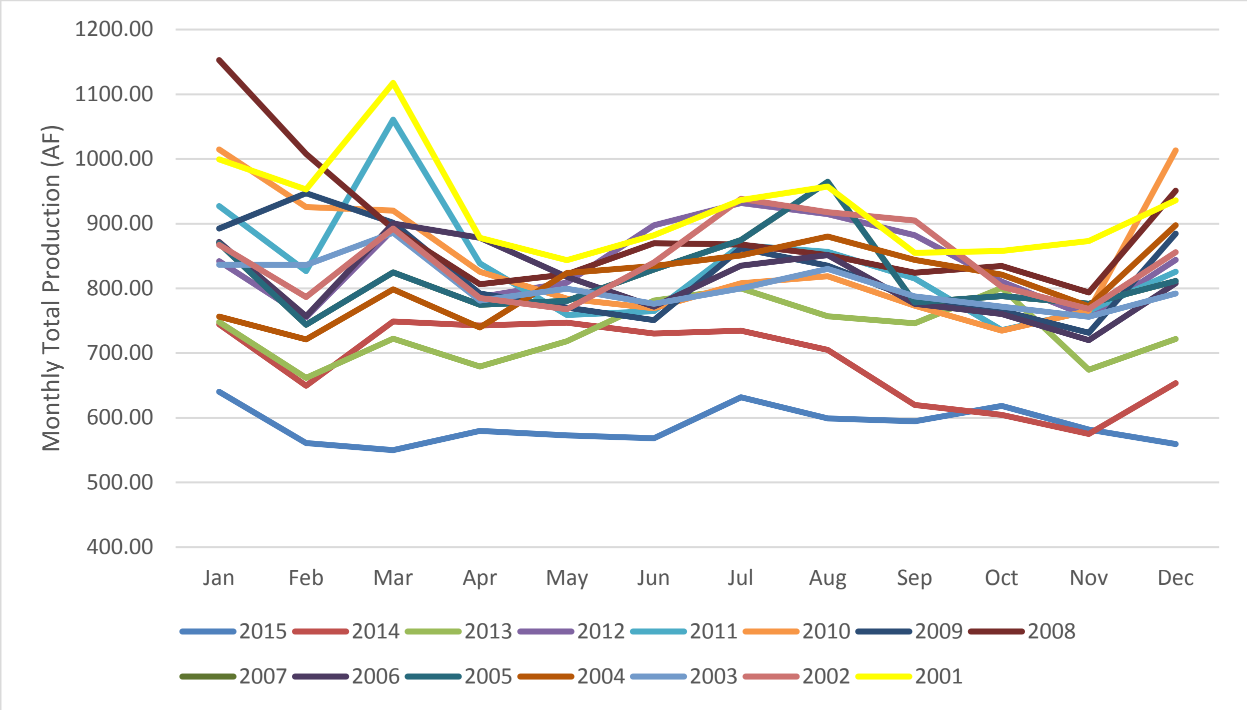

Figure 3-2
Tapia WRF Monthly Recycled Water Production

Well Supplement

In addition to the wastewater collected from the JPA's trunk collection system, the supply of recycled water is also supplemented by water from the JPA's wells in Westlake Village. Water pumped from these wells is sent through the collection system to the Tapia WRF. The pumps for these wells are monitored and the total flow pumped is recorded. The averages in **Figure 3-1** and **Figure 3-2** include this well supplement, and the future supply analysis includes these flows as a continued source of supplement for the JPA. **Figure 3-3** shows the well supplement to the Tapia WRF for 2013-2015. As shown in the figure, this supplement occurs mainly in summer months to reduce the need to add potable water to the recycled water system.

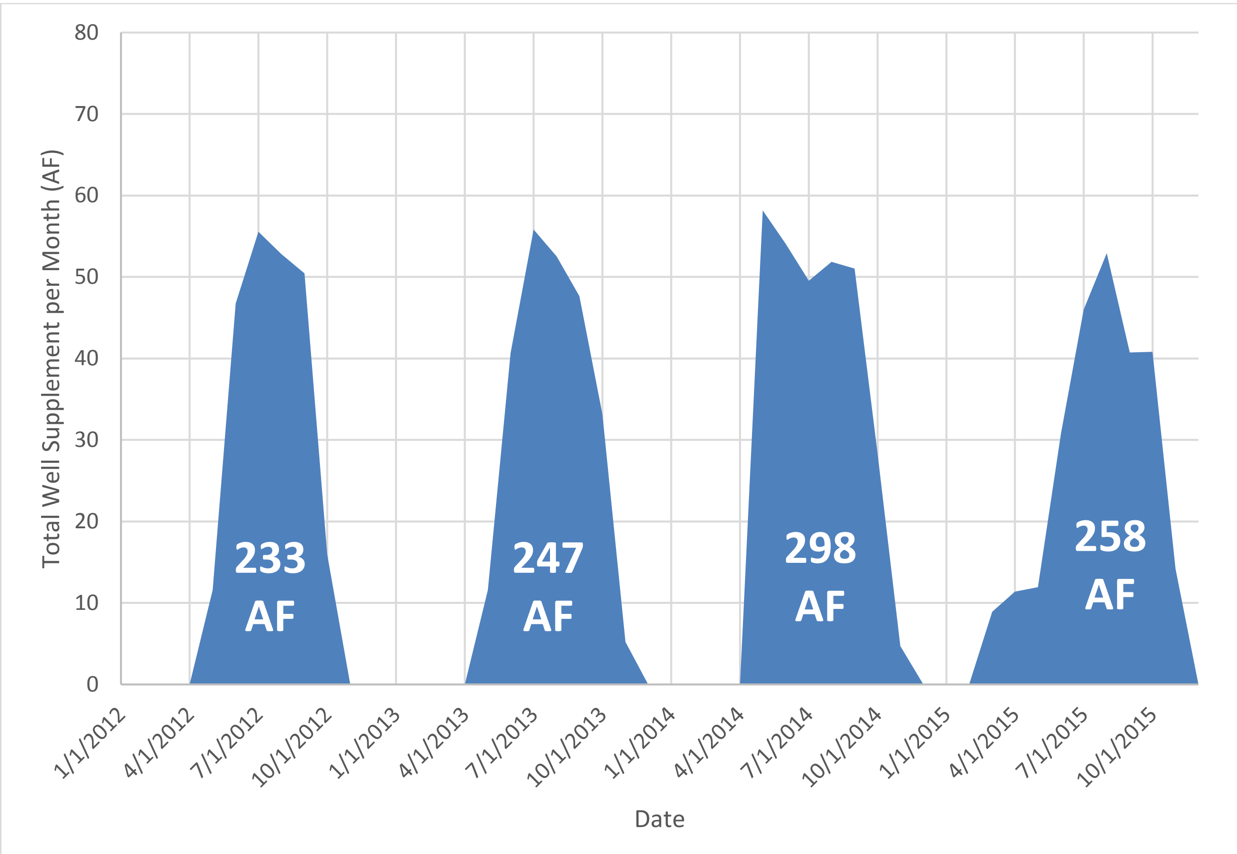

Figure 3-3
Well Supplement to Recycled Water System

Supply Analysis

The JPA provided MWH daily flows for the Tapia WRF. Since the wells are discharged into the collection system, the totals from the Tapia WRF include well supplement into the system. This daily data is used to analyze the average available supply for the JPA recycled water system over the past 15 years. A 15-year period is chosen as it accounts for years of high flow such as El Nino years and the years of low flow due to drought. **Table 3-1** shows the yearly average effluent from the Tapia WRF for 2001 through 2015**.** For this supply and demand analysis, and for the purpose of projecting future flows discussed later in this section, an average supply of 9,363 AF is used.

Table 3-1
Yearly Average Tapia WRF Recycled Water Production

Year	Total Effluent from Tapia WRF (AF)	Total Effluent from Tapia WRF (MGD)
2001	11,118	9.9
2002	10,156	9.1
2003	9,679	8.6
2004	9,798	8.7
2005	9,840	8.8
2006	9,775	8.7
2007	9,840	8.8
2008	9,908	8.8
2009	9,126	8.1
2010	9,238	8.2
2011	9,081	8.1
2012	8,705	7.8
2013	8,834	7.9
2014	8,279	7.4
2015	7,060	6.3
Maximum	**11,118**	**9.9**
Minimum	**7,060**	**6.3**
Average	**9,363**	**8.4**

3.1.2 Historical Demand

Recycled water demand is calculated from the historical recycled water sales for the JPA. Recycled water sales comprise water sold to customers in the Las Virgenes Municipal Water District (LVMWD) and Triunfo Sanitation District (TSD) service areas. Recycled water sold includes the water produced at the Tapia WRF (which includes treated wastewater and well water) as well as the potable supplement added to the recycled water system, which is discussed in more detail in the next subsection.

As the JPA has expanded its recycled water network and customer base, it has typically seen an increase in recycled water sales year over year. However, 2015 saw a decline in recycled water demand, likely due to conservation of recycled water during the drought. **Table 3-2** shows the recycled water sales for the last three years, which highlights the decline in sales for 2015, as well as the seasonal variability in recycled sales over a typical year. **Figure 3-4** shows the recycled water demands for the years 2001-2015. **Figure 3-4** also demonstrates the seasonal variability in recycled water sales and the recent decline in total sales seen in 2015. The seasonal variability is evident in the fact that in wet years, sales in December and January can be low, then sharply escalate during summer months as temperatures increase and the evaporation rates increase. Lastly, **Figure 3-5** shows the total recycled water sales from 2001-2015 on a monthly basis to highlight the seasonal variability seen year to year.

Table 3-2
Recycled Water Sales

Month	Recycled Water Sold (AF)		
	2013	2014	2015
Jan	242.0	487.1	231.2
Feb	261.0	308.6	253.3
Mar	418.2	339.7	389.8
Apr	607.7	580.8	530.8
May	723.8	826.2	472.9
June	803.7	845.1	585.4
July	949.4	930.2	641.8
Aug	927.7	863.2	728.1
Sept	879.7	781.7	615.9
Oct	683.3	613.4	613.7
Nov	454.7	427.1	522.8
Dec	406.6	81.1	308.3
TOTAL	**7,358**	**7,084**	**5,894**

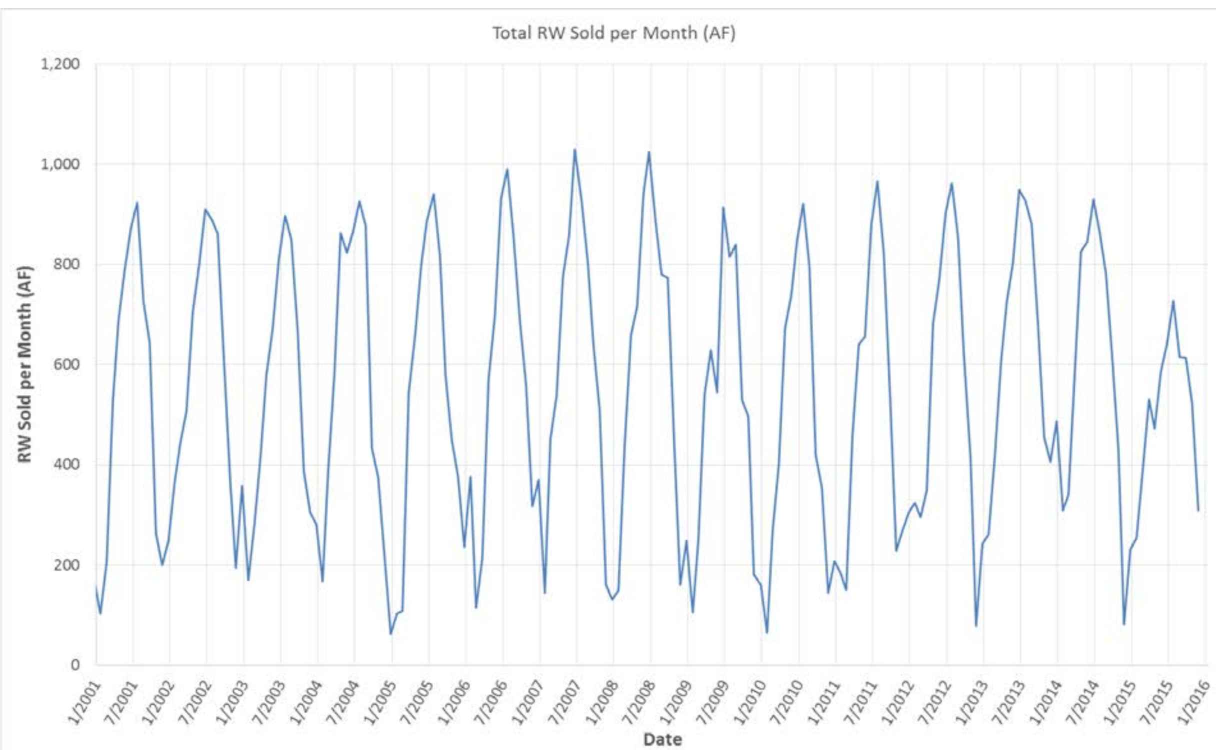

Figure 3-4
Historical Recycled Water Sales

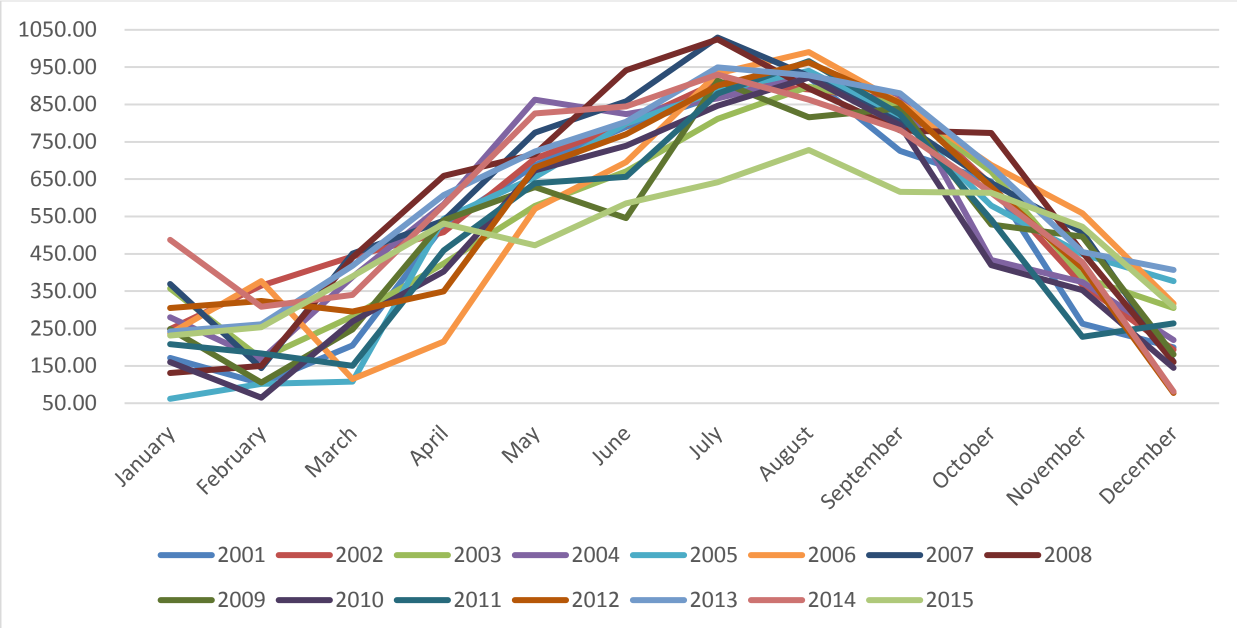

Figure 3-5
Monthly Recycled Water Sold

Demand Analysis

Analysis of the recycled water demand utilized the last 15 years of data (2001-2015). Unlike supply data from the Tapia WRF for which daily totals of flow was available, monthly recycled water sales from LVMWD and TSD were used to calculate average demands over the 15-year period. This data includes potable water supplement but excludes well water supplement that was included in the supply. Therefore, these monthly totals were applied uniformly on a daily basis to quantify the amount of surplus or deficit recycled water was available from the Tapia WRF. **Table 3-3** and **Figure 3-6** present the total yearly sales from 2001 to 2015. Based on this data and the monthly totals shown in **Figure 3-4** and **Figure 3-5**, the maximum and minimum total yearly sales between 2001 and 2015 are 5,790 AF and 7,358 AF, respectively. An average month sales during this period was 546 AF, and the average yearly sales was roughly 6,547 AF.

Table 3-3
Average Yearly Recycled Water Sales

Year	Total Effluent from Tapia WRF (AF)
2001	6,111
2002	6,924
2003	6,402
2004	6,800
2005	6,318
2006	6,551
2007	7,202
2008	7,123
2009	6,091
2010	5,790
2011	5,997
2012	6,562
2013	7,358
2014	7,084
2015	5,894
Maximum	**7,358**
Minimum	**5,790**
Average Yearly	**6,547**
Average Monthly	**546**

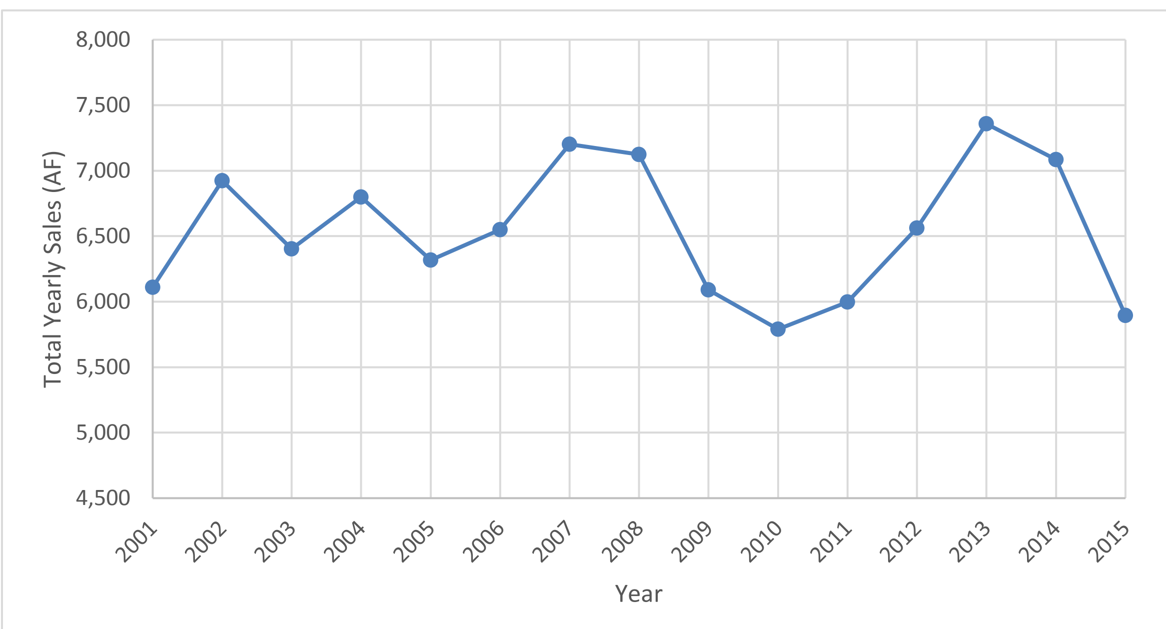

Figure 3-6
Total Yearly Recycled Water Sales

3.1.3 Imported Potable Water Supplement

In order to meet summer time demand, the JPA supplements the recycled water system with imported potable water. The previous discussion of demand looked at recycled water sales, which includes imported potable supplement to the recycled water system in addition to demand met by the Tapia WRF. For this analysis, average imported potable supplement was calculated by taking the daily amount of recycled water produced by the Tapia WRF, and subtracting the recycled water sold by the JPA, which were monthly totals distributed evenly into daily amounts. For any days that showed a deficit of recycled water supply relative to demand, it was assumed that this deficit was met by imported potable supplement. **Table 3-4** shows the calculated supplement to the recycled water system to meet demand based on this methodology, which shows an average yearly imported supplement of 287 AF of water. This value is contrasted with the actual amount of water added from the JPA's imported connection in the far right column. It is noted that even though it appears that not enough supplement was added to the system in some years, this is due to the methodology of creating daily values for recycled demand from monthly totals. The overall average potable supplement added over the last 15 years from the records is 368 AF, as compared to the 287 AF calculated based on a day-to-day accounting. In most years, the extra supplement actually added was greater than the amount calculated as needed due to daily fluctuations in supply as well as operational consideration such as storage being unavailable or the need to cycle a tank for water quality concerns. 287 AF was used to calculate cost as this number is what has been calculated as actually needed on average.

Table 3-4
Calculated Imported Potable Supplement from Supply minus Demand

Year	Calculated Potable Supplement (AF)	Actual Potable Added to Recycled Water System (AF)
2001	12	170
2002	35	111
2003	168	177
2004	166	139
2005	103	137
2006	320	194
2007	259	239
2008	392	508
2009	208	355
2010	283	60
2011	362	214
2012	498	573
2013	512	998
2014	706	1,021
2015	281	530
Average Supplement	**287**	**368**

3.1.4 Supply and Demand Comparison

The JPA has an average supply from the Tapia WRF of 9,363 AF per year along with an average calculated supplement of 287 AF. Subtracting an average recycled water demand of 6,547 AF per year gives a total surplus of 3,102 AF. **Figure 3-7** plots Tapia WRF supply versus sales for 2001 and 2015. This figure shows the seasonal nature of the demand versus supply. While there is excess supply relative to demand over a year on average, additional storage is needed in order to apply the wintertime excess during summertime peaks. This also shows how the demand in 2015 is more flat (less of a peak) when compared to 2001. **Figure 3-8** plots the supply versus demand for 2013 through 2015, which further shows the summer surplus and winter deficit of supply relative to demand, and the 2015 decrease in both supply and demand.

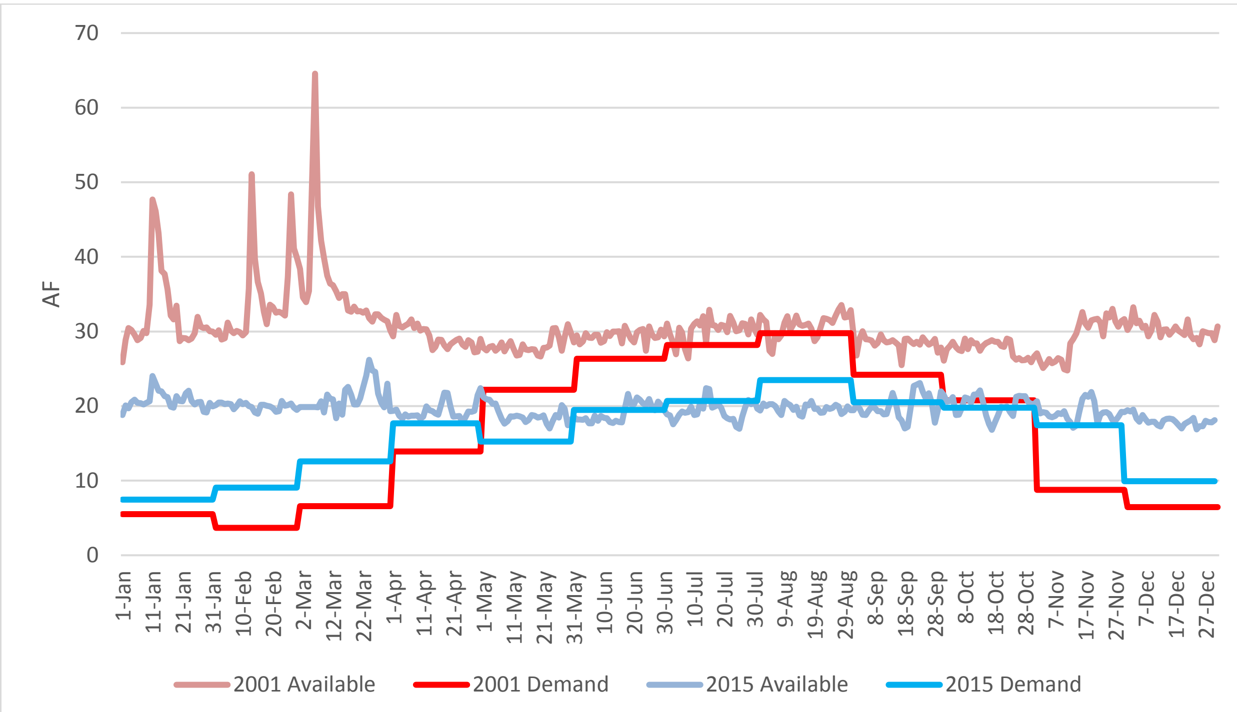

Figure 3-7
Recycled Water Supply versus Sales for 2001 and 2015

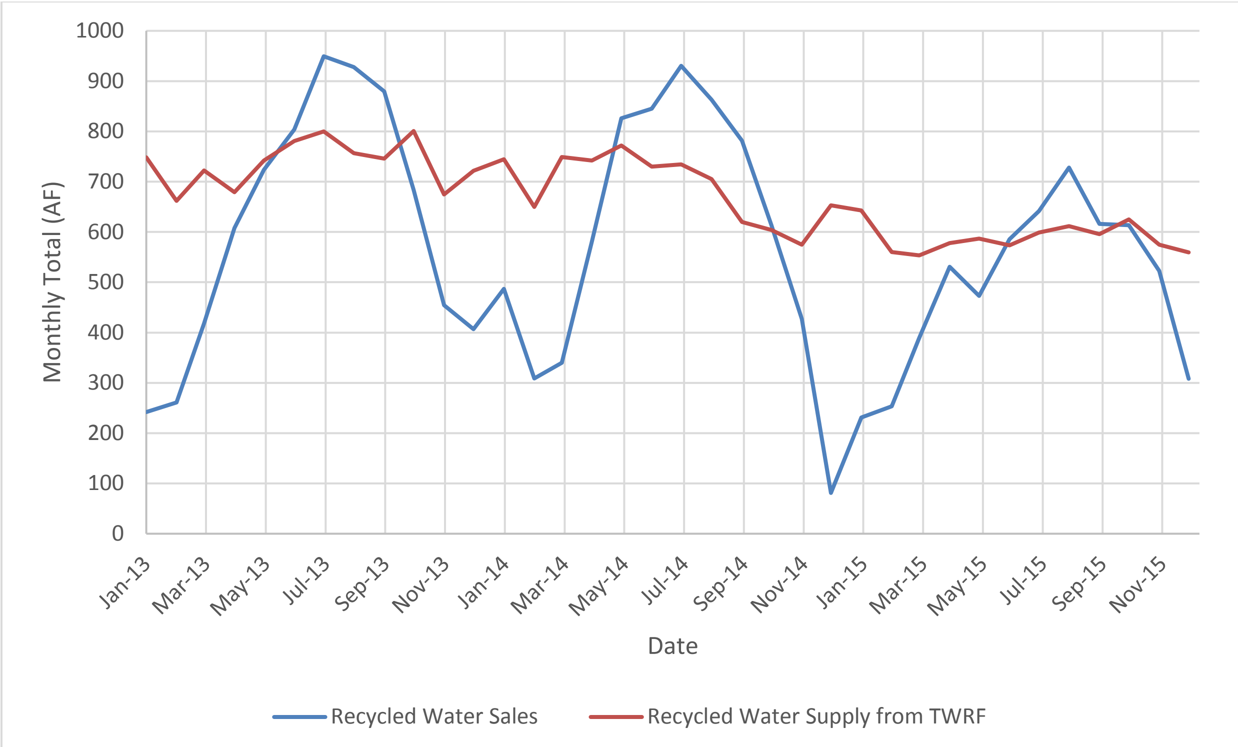

Figure 3-8
Recycled Water Supply versus Sales 2013 through 2015

3.1.5 Future Conditions

Future supply and demand conditions are important in both scenarios to predict future plant sizing, reservoir operations, project viability (i.e., if the reservoirs are large enough to accommodate the expected future flows), costs and many other factors. In order to predict future flow conditions, a supply and demand forecast was developed and is discussed below.

Recycled Water Supply

The *2014 Sanitation Master Plan* (2014 Master Plan) projected future wastewater flows to the Tapia WRF based on several factors. The projected supply was based on using the average supply from 2010-2012 and adding in four sources of growth:

- Additional flows from projected growth based on 2,209 new dwelling units (DU) and 435 septic tank conversions in the LVMWD service area, and 1,391 new DU's in the TSD service area for an additional 1.08 additional MGD of flow by 2035
- Economic growth factor (13%)
- Drought recovery factor (9%)
- I/I factor (4%).

Table 3-5 shows the 2035 projected flows as presented in the 2014 Master Plan.

Table 3-5
Flow Projections presented in 2014 Sanitation Master Plan for 2035

Description	LVMWD	TSD
Total Water Usage (HCF)	7,059,749	N/A
Total Water Usage (MGD)	14.47	N/A
March/April Water Usage (MGD)	11.21	N/A
Current Annual WW Generation (MGD)	6.14	2.61
Ratio of WW/Winter Water	0.55	N/A
WW Generation/Account (Gal/Day)	376	244
WW Generation/DU (Gal/Day)[a]	280	244
Approximate Number of DU 2012[a]	21,913	10,712
Projected New DU by 2035[a]	2,644	1,391
Additional WW Generation by 2035 (MGD)	0.74	0.34
Current Annual WW Generation (MGD)	6.14	2.61
Total WW Generation by 2035 (MGD)	6.88	2.95
JPA Total WW Generation (MGD)	**9.83**	
2035 WW Generation w/ Economic Factor (MGD)[b]	**11.11**	
2035 WW Generation w/ Drought Recovery (MGD)[c]	**12.11**	
2035 WW Generation w/ Provision for I/I[d]	**12.59**	

Notes:
Water and Wastewater values shown are for calendar year 2012.
(a) TSD # of Accounts assumed identical to TSD # of Units; maximum range used herein.
(b) Economic Factor of 13 percent
(c) Drought Recovery Factor of 9 percent
(d) Infiltration and Inflow Factor of 4 percent

Since the 2014 Master Plan, updated flow information that includes drought years of 2013-2015 was available, and projections for this BODR incorporated that data. In order to be consistent with the work done in the previous master plan, the same growth in dwelling units and growth factors were used to predict 2035 flows; however they were applied to a lower base flow given the new data now available. In addition, two scenarios for 2016 flow were assumed and carried forward to 2035, presenting a range of possibilities for future flow conditions. In order to calculate costs later in this report, the average value of this range in 2035 was used.

Table 3-6 and **Figure 3-9** shows the projected flows from 2016 to 2035 along with the historical supply at the Tapia WRF from 1990 to 2015. Flows for 2016 were assumed to either remain at the same level as 2015, or return to the 15-year average of 9,363 AF (e.g., the “low” and “high” range, respectively). The low range was projected forward by adding the same 1.08 MGD of flow due to additional DUs projected in the 2014 Master Plan, and then applying the economic, drought, and I/I factors to that flow. The high range was projected forward using the 1.08 MGD of DU growth, but then escalated by only applying the economic and I/I factor, as it was assumed that a return to the average would constitute a drought recovery in 2016.

Table 3-6
Projected Supply

Year	Low Range Flow (MGD)	Low Range Flow (AFY)	Average Flow (Used for future cost) (MGD)	Average Flow (Used for future cost) (AFY)	High Range Flow (MGD)	High Range Flow (AFY)
2015	6.3	7,060	6.3	7,060	6.3	7,060
2016	6.3	7,060	-	9,363*	8.3	9,363
2035	9.5	10,590	10.3	11,460	11.0	12,320

*Based on Historical Average from 2001-2015

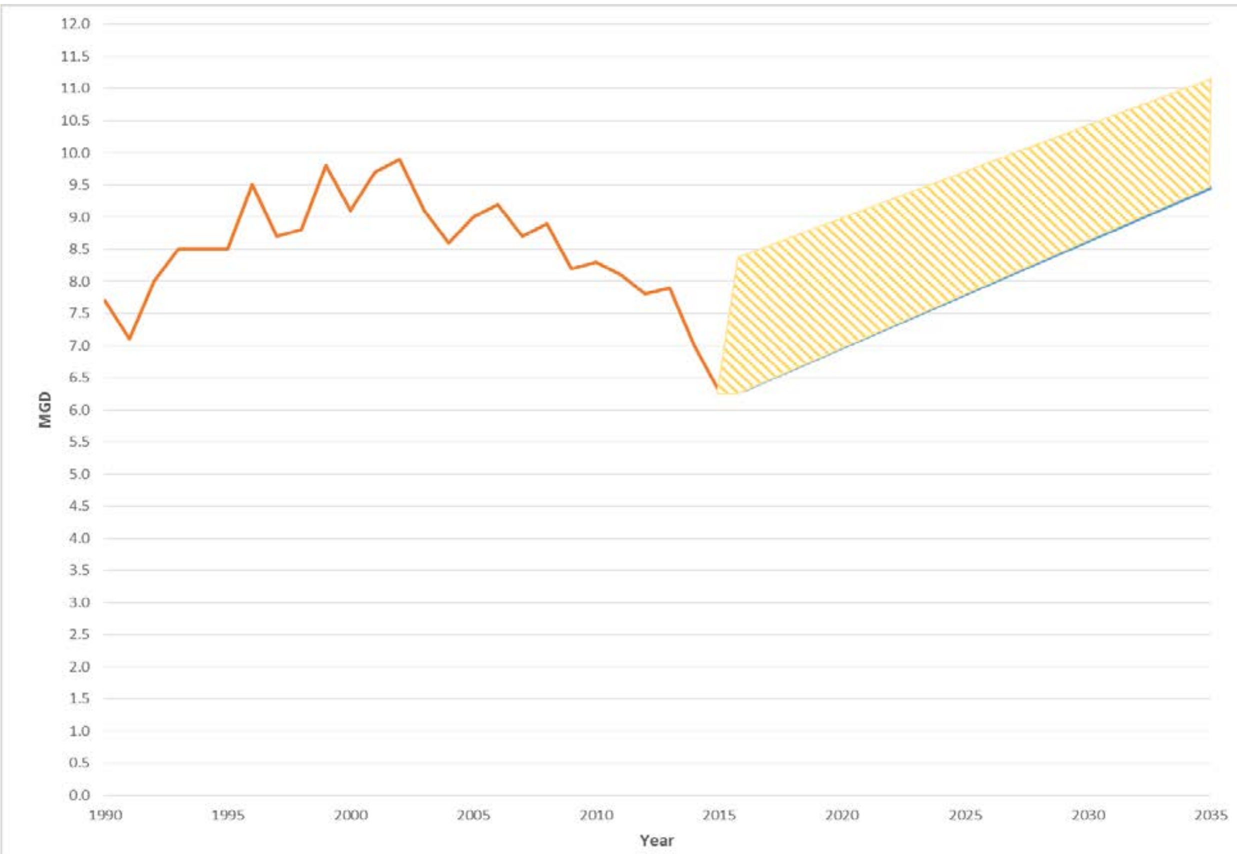

Figure 3-9
Supply Projection Range to 2035

Recycled Water Demands

Future recycled water demands are dependent on each individual Scenario. Scenario 4 assumes no additional growth in the recycled water system. Since Scenario 4 creates water that can be used in the potable water system, there would no longer be an economic incentive to add recycled water customers. Therefore, the 15-year average demand of 6,547 AF is assumed to continue from 2016 into the future.

Scenario 5 makes more recycled water available by adding storage and assumes that the recycled water demand will increase based on Analysis Scenarios AS-2, as shown in Table 5-10 of the *2014 Recycled Water Master Plan* (RW Master Plan) and summarized in **Table 3-7** below. A total of 2,395 AF of demand is anticipated to be added in Scenario 5, for a total demand of 8,942 AF in 2035. Future projections for both scenarios are depicted in **Figure 3-10** and listed on **Table 3-8**.

Table 3-7
Additional Recycled Water Demands

New Demand Source	Additional Demand by 2035 (AF)
Infill Demand	740
Thousand Oaks Boulevard Extension	251
Oak Park HOA Conversions(3)	207
Westlake Conversions (schools/parks)	130
Woodland Hill Extension	477
El Caballero Country Clubs	590
Total	**2,395**

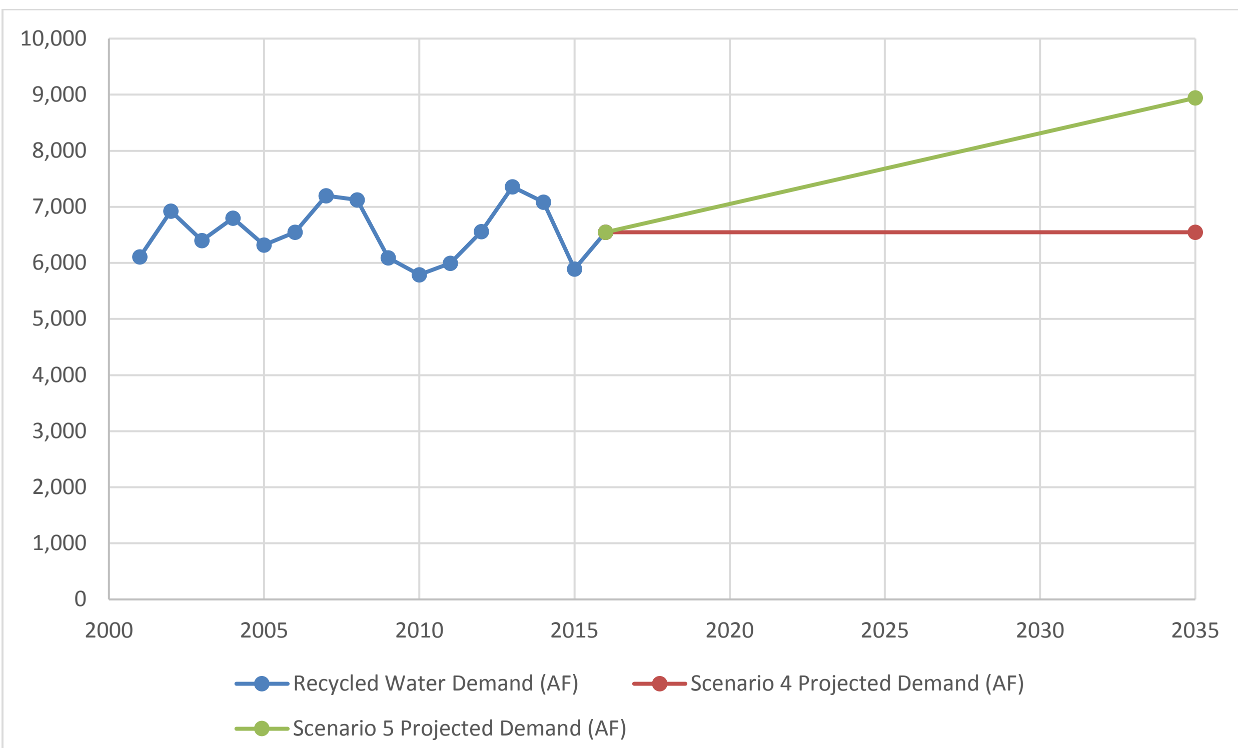

Figure 3-10
2035 Demand Projections

Table 3-8
Recycled Water Yearly Totals and Projections

Year	Recycled Water Demand (AF)
2001	6,111
2002	6,924
2003	6,402
2004	6,800
2005	6,318
2006	6,551
2007	7,202
2008	7,123
2009	6,091
2010	5,790
2011	5,997
2012	6,562
2013	7,358
2014	7,084
2015	5,894
2016 (15-year average)	6,547
Scenario 4 2035 Projections	6,547
Scenario 5 2035 Projections	8,942

3.1.6 Storage Projections

Based on the future projections for both supply and demand, analysis was completed to project the gross available storage for each scenario in 2035 without consideration of any losses, such as brine loss, seepage, or evaporation, which will be discussed in **Section 4** and **Section 5** of this report. Based solely on the supply and demand, and assuming the continued added average imported supplement of 287 AF discussed in **Section 3.1.3**, **Table 3-7** shows the gross available water for each scenario considering both the low and high range for available water in 2016 and 2035.

Table 3-9
Available Recycled Water Projections for Scenario 4 and 5

Scenario 4				
Year	**Supply (AF)**	**Supply plus Average Calculated Imported Supplement (AF)**	**Demand* (AF)**	**Gross Available Recycled Water (AF)**
2016	7,060 – 9,363	7,347 – 9,650	6,547*	800 – 3,102
2035	10,590 – 12,320	10,877 – 12,607	6,547*	4,330 – 6,060
Scenario 5				
Year	**Supply (AF)**	**Supply plus Average Calculated Imported Supplement (AF)**	**Demand* (AF)**	**Gross Available Recycled Water (AF)**
2016	7,060 - 9,363	7,347 – 9,650	6,547*	800 – 3,102
2035	10,590 – 12,320	10,877 – 12,607	8,942	1,935 – 3,665

* Based on 15-year average of recycled water demand

3.2 RECYCLED WATER QUALITY

Recycled water quality is important in both scenarios as it will dictate either the treatment needs and expected brine losses (Scenario 4) or the water quality considerations for surface storage (Scenario 5). The following sections describe the regulations pertaining to recycled water discharged from the Tapia WRF as well as the historical quality as monitored by the JPA.

3.2.1 Title 22 Regulations

Title 22 of California's Water Recycling Criteria refers to California state guidelines for how treated and recycled water is treated and used. The standard requires the California Department of Public Health (CDPH) to develop bacteriological and treatment standards, based on human contact with the recycled water, for each level of treated water that is recycled or reused. Title 22 lists specific uses allowed with disinfected tertiary recycled water, disinfected recycled water and disinfected secondary recycled water.

3.2.2 Recycled Water Quality from Tapia WRF

Tapia WRF provides tertiary treatment of wastewater for recycled water uses. **Table 3-8** summarizes recent water quality of Tapia WRF effluent. Tapia WRF's 2010 National Pollutant

Discharge Elimination System (NPDES) permit includes limits of 8 milligrams per liter (mg/L) of nitrogen and 3 mg/L of phosphorous The nitrogen limit was based on the 2003 U.S. Environmental Protection Agency (EPA) Nutrient Total Maximum Daily Load (TMDL) for the Malibu Creek Watershed and the phosphorous limit was performance based.

Any excess effluent not used to meet recycled water demands is discharged to Malibu Creek or the Arroyo Calabasas, a tributary to the Los Angeles River. However, Tapia WRF is prohibited from discharging surplus effluent to Malibu Creek between April 15 and November 15 every year. In 2013 the EPA established the Malibu Creek and Lagoon TMDL for Sedimentation and Nutrients to Address Benthic Community Impairments. This TMDL recommend significantly lower discharge limits for nitrogen and phosphorous that when included in Tapia WRF's NPDES permit would trigger very expensive treatment upgrades.

Table 3-10
Water Quality of Tapia WRF Effluent[1]

Parameter	Units	Average	Max
Ammonia (as N)	µg/L	97	440
BOD (5-day @ 20° C)	mg/L	1.7	4.6
Boron	mg/L	0.39	0.48
Chloride	mg/L	160	182
Copper (Total Recoverable)	µg/L	4.974	16
Cyanide	µg/L	1.82	10
Nickel (Total Recoverable)	µg/L	3.5	5
[Nitrate + Nitrite] (as N)	mg/L	7	9.9
Orthophosphate (as P)	mg/L	2.3	3.4
Sulfate	mg/L	192	281
TDS	mg/L	744	860
Total Suspended Solids	mg/L	1.69	9.9
Turbidity	NTU	<1	7

[1] Data summarizes Tapia WRF effluent concentrations recorded at Tapia Effluent Pump Station (TEPS) between November 2010 and December 2014.
NTU = Nephelometric Turbidity Unit
µg/L = micrograms per liter

Section 4 –
Scenario 4

Section 4
Scenario 4

4.1 SCENARIO DESCRIPTION

In Scenario 4, surplus recycled water produced at the Tapia Water Reclamation Facility (Tapia WRF) will be conveyed to a new advanced water treatment (AWT) facility that would further treat the water producing advanced purified water, then pump the water to Las Virgenes Reservoir for indirect potable reuse (IPR). Once the water is treated and stored in Las Virgenes Reservoir with the requisite detention time, mixing, and dilution, it will be equivalent in use to stored imported water. When treated through the Westlake Filtration Plant (FP), it can be used to meet potable demand or supplement for the recycled water system. This alternative is based on draft regulations for surface water augmentation.

The State of California Water Quality Control Board, Division of Drinking Water (DDW), is currently drafting regulations as part of Title 22 to allow recycled municipal wastewater to be placed in a surface water reservoir used as a source of domestic drinking water supply. The Surface Water Source Augmentation Project (SWSAP) regulations are expected to be finalized in December 2016. These proposed regulations will allow recycled water from the Tapia WRF to be placed in Las Virgenes Reservoir, provided conditions of the regulations are satisfied and written approval is obtained from the Regional Water Quality Control Board (RWQCB).

The draft regulations include the following general requirements for SWSAP:

- Recycled municipal wastewater in compliance with Title 22
- Approved industrial pre-treatment and pollutant source water control program
- Continuous full advanced treatment, including reverse osmosis and advanced oxidation, to meet specific pathogen and oxidation treatment requirements
- Monitoring and reporting of source water, advanced treated water, and reservoir water quality
- Outreach program and public hearing
- A suitable surface water reservoir, with at least five years of operating history and under the control of the responsible agency
- A reservoir with a theoretical retention time of no less than six months
- Reservoir dilution that achieves at least 10 percent dilution of recycled water
- Submittal of a Concept Plan addressing all elements of the regulations for review and approval

These requirements have been reviewed in consultation with DDW, and it appears that Scenario 4 is in general compliance with all aspects of the draft regulations. **Figure 4-1** below illustrates a flow schematic for Scenario 4, with new facilities highlighted in yellow. Scenario 4 will require construction of (1) a new AWT facility, (2) new intake piping into the AWT facility, (3) new piping to connect the AWT facility to Las Virgenes Reservoir, and (4) new piping for a new brine discharge line from the AWT facility to the point of disposal. The lengths of these pipelines will vary depending on the final site of the AWT facility and brine disposal option selected.

The determination of a viable means for brine disposal is a critical variable associated with Scenario 4 requiring definition. The construction of a brine line hinges on an agreement with either Calleguas Municipal Water District (CMWD) (for disposal of brine to the Salinity Management Pipeline [SMP] in Ventura County, CA) or the City of Thousand Oaks (for disposal of brine through the Hill Canyon Wastewater Treatment Plant [WWTP] or the SMP). Without an agreement, there is no viable alternative for disposal of the brine and Scenario 4's advanced treatment of the recycled water from Tapia WRF would not be possible. Discussions with the City of Thousand Oaks and CMWD on this and other issues are on-going.

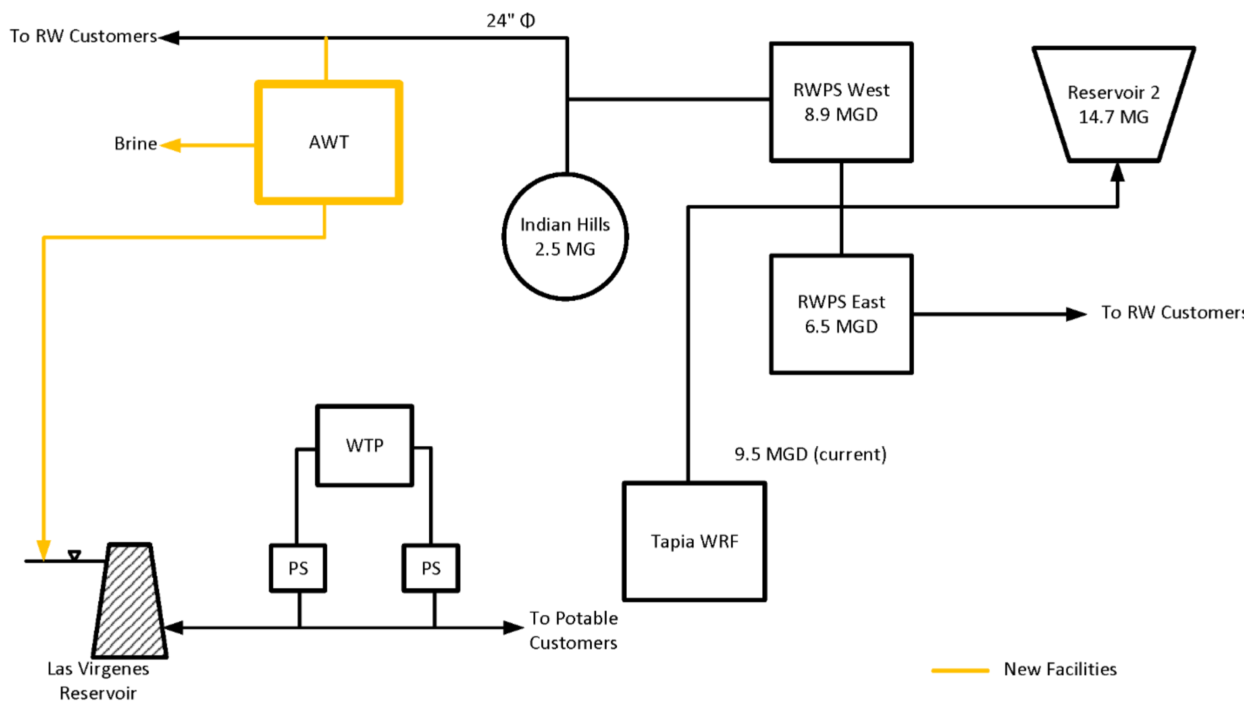

Figure 4-1
Scenario 4 Flow Schematic

4.2 AVAILABLE RECYCLED WATER ANALYSIS

A detailed analysis was conducted in **Section 3** to determine the amount of surplus recycled water available under Scenario 4. The analysis started with daily recycled water production at the Tapia WRF for the period from 2001 to 2015. For the same period, the average monthly recycled water demand for each month was distributed evenly as daily values. The daily recycled water demand was then subtracted from the Tapia WRF production to determine the amount of surplus water available daily. For any days that show surplus water, it is assumed that that water will be pumped to the AWT facility and then to Las Virgenes Reservoir for storage and eventual distribution. It is assumed that treatment at the AWT facility would result in a 15% loss as brine; this loss has been incorporated in the analysis.

The results of this analysis are shown in **Table 4-1** for each of the 15 years of record. The data is separated into columns representing recycled water surplus and deficit. Deficit are days when the Tapia WRF supply is less than the recycled water demand; if Scenario 4 were to be implemented, this deficit could be met by the water in Las Virgenes Reservoir or with imported water. There is considerable variation between years, and this reflects the range of operation that can be expected from Scenario 4. It is anticipated that a minimum of 1,231 acre feet (AF) and a maximum of 4,359 AF can be stored on an annual basis, with an average amount of 2,617 AF. This equates to the 3,179 AF of water calculated as surplus in **Section 3** with 15% of brine loss applied.

Table 4-1
Net Seasonal Surplus and Deficit for Scenario 4

Year	Surplus (AF)	Deficit (AF)
2001	4,606	10
2002	2,832	30
2003	2,877	143
2004	2,598	141
2005	3,122	87
2006	2,824	272
2007	2,239	220
2008	2,385	333
2009	2,635	197
2010	3,049	162
2011	2,684	308
2012	1,743	1,116
2013	1,076	1,127
2014	795	1,414
2015	1,036	239
Minimum	1,230	**10**
Average	2,637	**387**
Maximum	4,266	**1,414**

The volumes of net recycled water are displayed graphically in **Figure 4-2.** There is a trend toward lower surplus water volumes seen in the historical record, which is likely due to efforts in the service area towards water conservation, as well as economic conditions and drought.

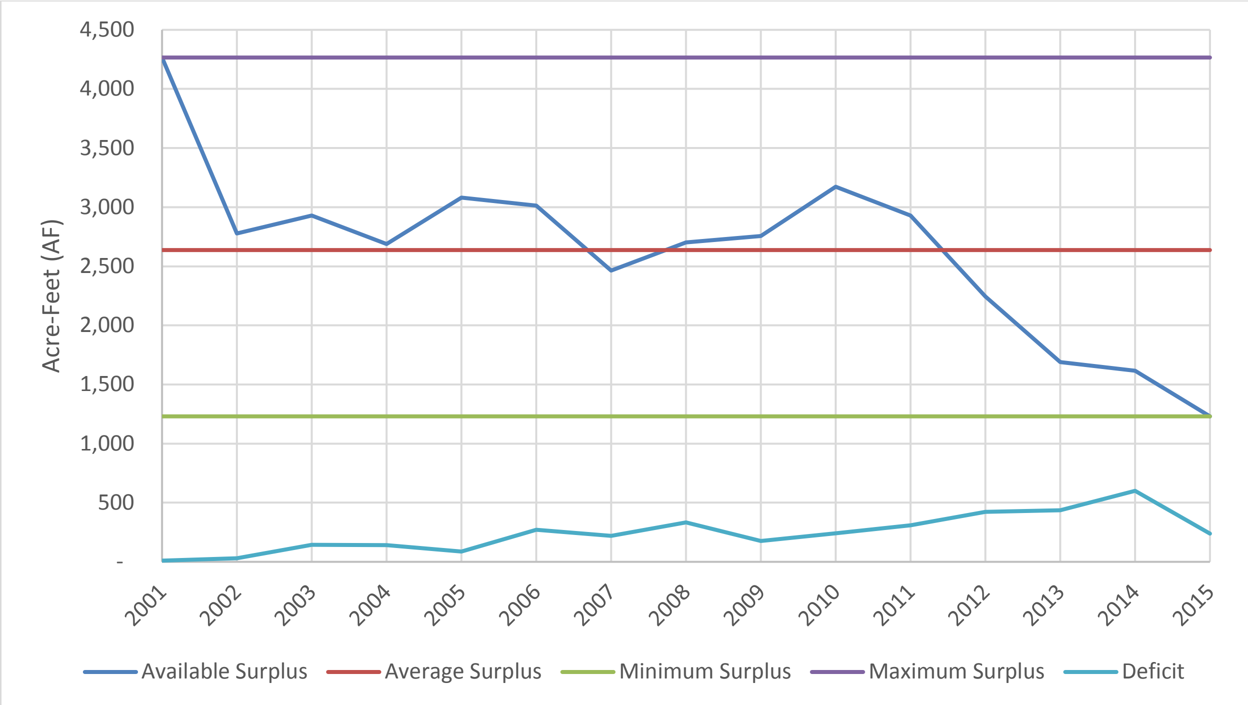

Figure 4-2
Scenario 4 Available Storage

4.2.1 Future Recycled Water Supply

The amount of water available to the Joint Powers Authority (JPA) is an important part of predicting future reservoir operations, AWT facility operations, Westlake FP operations, and anticipated costs. An analysis of future supply is discussed in **Section 3.1.5**. That analysis determined the values presented in **Table 4-2** below. This table adds a column for Net Available Recycled Water (e.g. the advanced purified water), which is the Gross Available Recycled Water minus a 15% loss to brine which would be experienced when sending the water through the AWT facility.

Table 4-2
Future Gross and Net Available Recycled Water

Scenario 4					
Year	**Supply (AF)**	**Supply plus Average Calculated Imported Supplement (AF)**	**Demand* (AF)**	**Gross Available Recycled Water (AF)**	**Net Available Recycled Water (15% brine loss) (AF)**
2016	7,060 – 9,363	7,347 – 9,650	6,547	800 – 3,102	680 – 2,637
2035	10,590 – 12,320	10,877 – 12,607	6,547	4,330 – 6,060	3,681 – 5,151

*Based on the 2001-2015 average

4.3 ADVANCED WATER TREATMENT PLANT REQUIREMENTS

The proposed AWT facility will treat effluent from the Tapia WRF and will be sized to produce up to 6 mgd of advanced purified water to be sent to the Las Virgenes Reservoir. AWT processes have been selected to comply with draft IPR surface water augmentation rules.

4.3.1 Similar Facilities

The most similar facility to what is proposed in Scenario 4 is the Miramar supply augmentation project being completed under the Pure Water Program in San Diego. The project concept is to use surface water augmentation to provide 30 mgd of purified water to the 5,600 AF Miramar Reservoir. Due to the high flow rate and small size of the reservoir, this project does not fully comply with the proposed draft surface water augmentation regulations. In order to permit the project, additional treatment processes have been incorporated into the AWT facility, including ozone disinfection and biologically active carbon (BAC) filtration. These processes are in addition to the standard AWT treatment processes of membrane filtration, reverse osmosis (RO), and ultraviolet/advanced oxidation process (UV/AOP). Scenario 4 will not require these additional processes due to the larger reservoir size and smaller flow rate.

Discussions with those involved with the Pure Water Program have provided insight in identifying any potential concerns regarding the use of surface water augmentation with Las Virgenes Reservoir. The Pure Water Program has advanced to the level of predesign of facilities and is therefore a valuable example in the implementation of a similar project and should be monitored for additional insights on Scenario 4.

4.3.2 Source Water Quality Program

A key aspect of the SWSAP regulations is the implementation of an approved industrial pre-treatment and pollutant source water control program. The JPA currently samples and analyzes a variety of chemicals from the effluent of Tapia WRF to ensure that they are in compliance with their permits. This includes constituents from the two industrial users tributary to the Tapia WRF. However, the new regulations may require additional chemicals to be monitored, which will require an updated monitoring plan. A full list of chemicals required to be sampled by the SWSAP regulations is included in **Appendix D**.

4.3.3 Title 22/IPR Treatment Process Requirements and Water Quality Criteria

DDW is in the process of defining regulations surrounding surface augmentation as it is an acceptable recycled water use. Based on draft regulations, the advanced treatment criteria and water quality criteria are anticipated to be similar to the existing regulations for groundwater reuse replenishment projects. The draft criteria includes treatment of entire recycled water flow with RO and AOP. **Table 4-3** presents a summary of the select, expected criteria.

Table 4-3
Expected Treatment Process and Water Quality Criteria[1]

Parameter	Criteria
Pathogen Removal	8-7-8 log removal credits (enteric virus, *Giardia*, *Cryptosporidium*) using at least three treatment barriers – if dilution is 1% advanced purified water to reservoir volume
	9-8-9 log removal credits (enteric virus, *Giardia*, *Cryptosporidium*) using at least three treatment barriers – if dilution is 10% advanced purified water to reservoir volume
Oxidation	0.5 log removal of 1,4-Dioxane, minimum
Drinking Water Standards	Meet all drinking water maximum contaminant levels (MCLs) in advanced purified water; quarterly for primary MCLs; annually for secondary MCLs

[1]Based on NWRI "Final Panel Meeting Report #5: Surface Water Augmentation – IPR Criteria Review", July 2, 2015.

Pilot Study

A pilot AWT facility demonstration program will be developed with the goals of assessing treatment performance, establishing design criteria and minimizing project costs. Results from the pilot project will enable the JPA to move forward with implementation of full-scale advanced treatment systems to significantly increase water reliability in the service area. The demonstration facility will play an important role in public outreach for Scenario 4.

4.3.4 AWT Facility Production

In order to determine the production requirements of the AWT facility, the historical surplus discussed above was used to calculate how much of the available surplus the AWT facility would be able to capture. Fifteen years (2001-2015) of historical daily data was used to determine the peak flow rate required to capture surplus water availability. Using this analysis, **Figure 4-3** was produced showing treatment plant capacity versus surplus water available for capture. The data shows that a 6 mgd AWT facility (water production capacity – 7.4 mgd influent) would capture 95% of daily surplus recycled water. This would mean that for 88% percent of the historical days, all flow would have been captured by the AWT facility. This value has been used to confirm the sizing of the plant and estimation of cost. For days in which Tapia WRF production would exceed the plant's influent capacity of 7.4 mgd, excess influent could be stored in Reservoir 2 and Indian Hills Tank to balance peak flows.

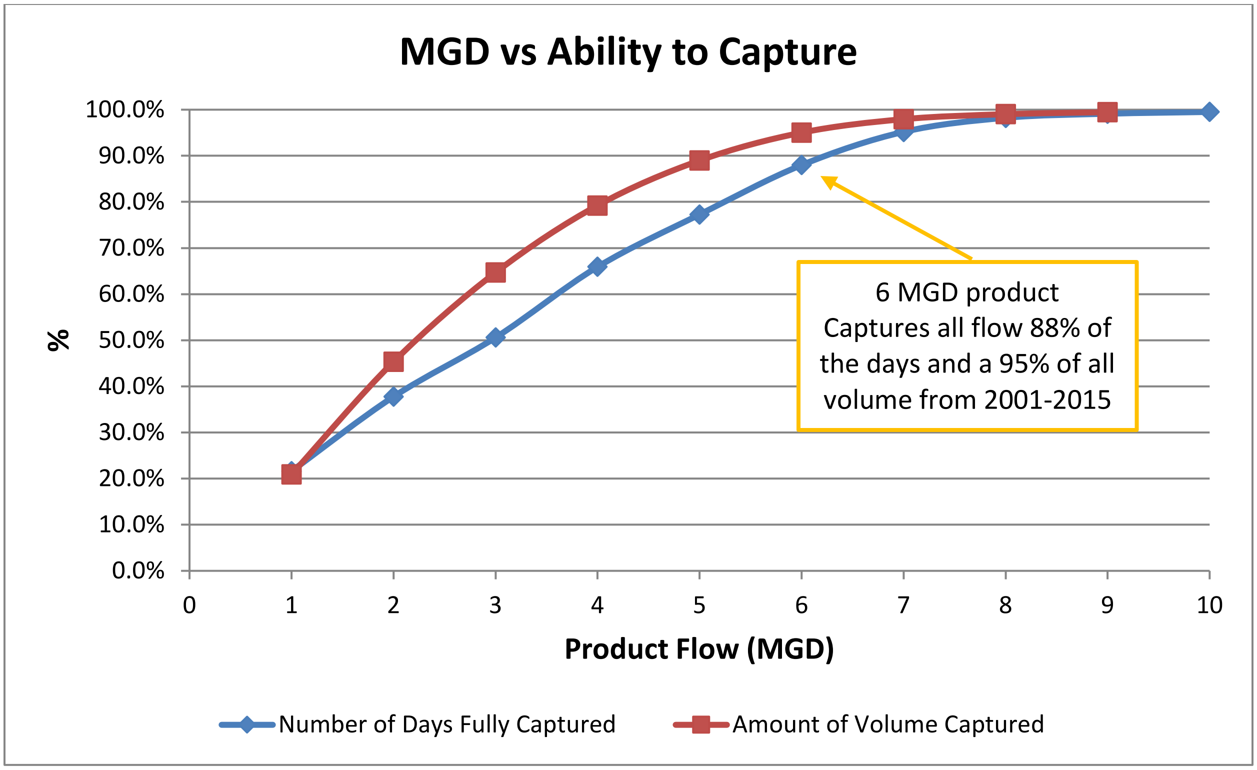

Figure 4-3
Las Virgenes Reservoir Capture Rate

4.3.5 Treatment Processes and Equipment

Figure 4-4 provides details on the proposed treatment process. The AWT treatment train includes microfiltration/ultrafiltration membranes (MF/UF), 3-stages RO for high recovery (85%), and UV/AOP, before it is stabilized and chlorinated prior to pumping to the Las Virgenes Reservoir. For each process, the expected design flow and recovery are summarized in **Table 4-4**, assuming 6 mgd of produced finished water. All calculations for the AWT facility are found in **Appendix C**.

Table 4-4
Process Flow and Recovery Table

Process	Influent Design Flow (mgd)	% Recovery
MF	7.44	95%
RO	7.1	85%
UV/AOP	6.0	100%

Membrane Filtration
The MF system will use microfiltration/ultrafiltration membranes to remove particulate matter from the feed water that would otherwise foul the RO membranes. MF is also anticipated to achieve 4-log removal of Cryptosporidium and Giardia. Various membrane technologies (e.g.,

hollow fiber, multi-bore) and module configurations (e.g., submerged, pressurized) exist. This conceptual design has been based on pressurized hollow fiber membrane systems.

Differences between suppliers include the size, type, and number of membrane modules and skids, the ancillary equipment and chemicals used, and other system components. The feed water to the membranes is pumped through strainers to remove large particles. The membrane backwash system consists of pumps and an air scour system. For chemical cleaning of the membranes, a clean-in-place (CIP) system will be included.

Reverse Osmosis

The RO system will remove a significant portion of the dissolved solids, organics, and pathogens that remain after the MF system. The RO system is expected to achieve 1.5 log removal of Cryptosporidium, Giardia, and virus each. The conceptual design is based on thin-film composite polyamide membranes, a three-stage configuration, and an overall system recovery of 85%. Other configurations and proprietary RO systems are available and should be evaluated for the pilot facility and full scale design.

The RO system has multiple components. Transfer pumps will convey water from an RO feed tank through cartridge filters upstream of the membranes for protection against suspended particulates and colloids. Chloramines will be added upstream of the MF system for prevention of biological fouling on the surface of the membranes. Acid and antiscalant will be added upstream of the RO membranes for prevention of inorganic scaling. RO feed pumps, equipped with variable frequency drives (VFDs), will provide and maintain the feed pressure to the RO membranes. Booster pumps/energy recovery devices will provide flux balance among the stages. RO flush pumps will be used to flush the RO trains with RO permeate before and after CIPs, or during system shut downs. A CIP system will be provided for periodic cleaning of the membranes.

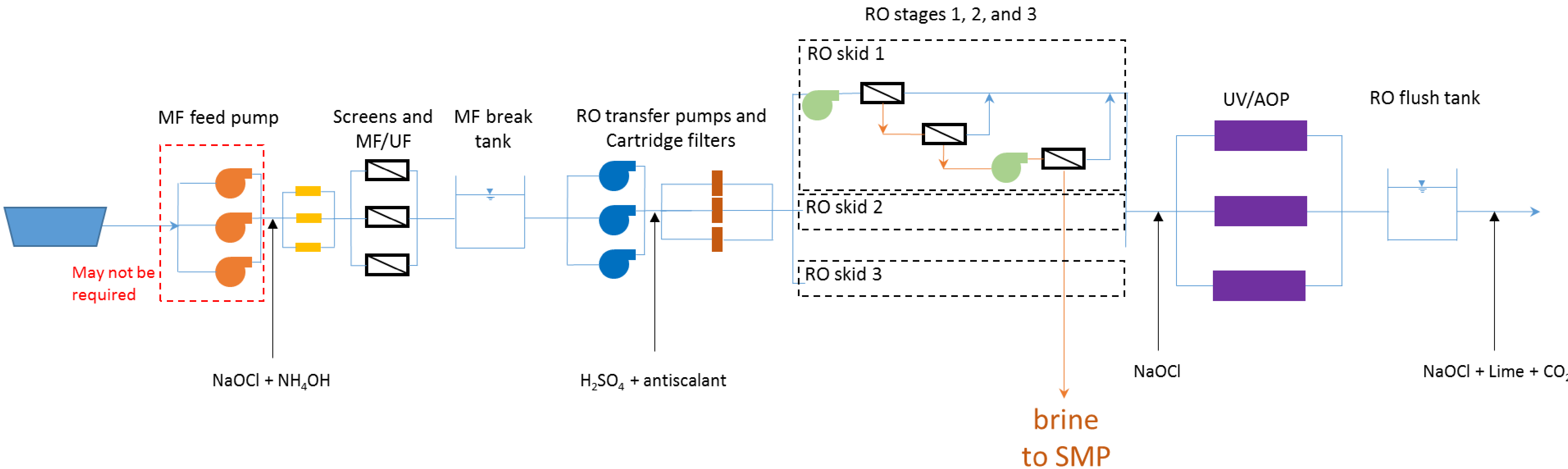

Figure 4-4
AWT Process Flow Diagram

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UV/AOP

The UV/AOP consists of the dosing of an oxidizing agent, after which the water is exposed to UV light in a reactor. The water must be sufficiently clear for the UV light to penetrate (as measured by UV transmittance), which is why the UV/AOP process is typically downstream of membrane treatment. The combined effect of the oxidant and ultraviolet light is to create hydroxyl radicals, which attack any trace organic constituents or pathogens in the influent water. The UV/AOP system is expected to achieve both destruction of trace organics, targeting 0.5 log removal of a 1,4-dioxane as surrogate constituent; and disinfection, targeting 6.0 log removal each of virus, Cryptosporidium, and Giardia.

The conceptual design is based on commercially-available UV reactors, including both low-pressure and medium-pressure alternatives. The oxidant can be either hydrogen peroxide, dosed at 6-10 milligrams per liter (mg/L); or free chlorine, dosed at 4-5 mg/L. Note that chlorine-based UV/AOP requires an influent pH of 5.5 or below to shift the speciation of hypochlorous acid towards the HOCl form.

One UV reactor with 9 medium-pressure lamps could treat the full 6 mgd plant flow, with sufficient turndown to cover the range of lower flow rates. This turndown is achieved by varying the number of lamps online and the percent of full power fed to the lamps. The medium-pressure alternative would have lower construction cost for the equipment, but with greater power consumption – the reactor size would be approximately 90 kilowatts (kW) for an electrical equivalent dose (EED) of 0.36 kilowatt-hours per thousand gallons (kW-hr/kgal).

Two UV reactors, each with 144 low-pressure lamps, is an alternative configuration. These reactors would treat up to 3 mgd each, with some turndown available by varying the power input. The low-pressure alternative would have higher construction cost, but it would achieve power savings compared to the medium-pressure alternative: the low-pressure reactors would be around 37 kW each (74 kW total), for an EED of 0.30 kW-hr/kgal.

Post-stabilization and chlorination

Post-stabilization is an important element of any potable reuse system that includes RO. Because RO permeate is very low in total dissolved solids (TDS), hardness, and alkalinity, it may be aggressive and chemically unstable. In surface water augmentation applications, this can lead to pipe corrosion in the conveyance system for the product water, and can affect the water quality in the receiving surface water.

Most facilities producing RO product water practice pH and/or alkalinity adjustment for corrosion control. Lime and CO_2 addition is recommended in this conceptual design to reach target goals for hardness, alkalinity, and pH. Lime addition increases alkalinity, pH, and hardness. CO_2 addition lowers the pH without affecting the alkalinity and helps target the treated water quality pH goal.

Sodium hypochlorite is used for chlorination of the final effluent. This addition of hypochlorite break-points any remaining chloramine and maintains a free chlorine residual in the distribution system.

Chemical System and Storage

The treatment processes summarized above require the dosing of various reagents, as shown in **Figure 4-4**. The AWT facility will have an area dedicated to chemical storage, along with equipment for injection of each chemical feed. The continuous chemical feeds, along with typical equipment for injection, are summarized in **Table 4-5**.

Table 4-5 Chemical System Summary

Reagent	Injection Point	Purpose	Equipment	Dose Range (mg/L)
Sodium Hypochlorite	MF Feed	Chloramine residual	Plastic tank and peristaltic pumps	2 to 5*
	UV/AOP Feed	Oxidant (alternative)		4 to 5*
	Product Water	Chlorine residual		0.5 to 3*
Ammonia	MF Feed	Chloramine residual	Plastic tank / IBC totes and peristaltic pumps	0.7 to 1.6**
Sulfuric Acid	RO Feed	Scaling control	Steel tank and diaphragm pumps	0 to 100
	UV/AOP Feed	pH control for Cl_2 AOP		0 to 15
Antiscalant	RO Feed	Scaling control	Plastic tank / IBC totes and peristaltic pumps	1 to 5
Hydrogen Peroxide	UV/AOP Feed	Oxidant (alternative)	Plastic tank and peristaltic pumps	6 to 10
Carbon Dioxide	Product Water	Post-stabilization	Gas tank and side-stream saturator	0 to 50
Lime	Product Water	Post-stabilization	Lime silo, batch tank, and slurry injection	60 to 100

* mg/L as Cl_2
** mg/L as N

In addition to the chemical feeds in **Table 4-5**, there are various other chemical feeds that are required intermittently. These chemicals will also be stored in the chemical area and transfer pumps will be provided to convey them. These additional chemicals include:

- *Sodium Hypochlorite* for MF system cleaning cycles.
- *Citric Acid* for low-pH MF system and RO system cleaning cycles. Proprietary cleaning solutions can also be used for this purpose.
- *Sodium Hydroxide* for high-pH MF system and RO system cleaning cycles, as well as to neutralize low-pH cleaning solutions.
- *Sulfuric Acid* to neutralize high-pH cleaning solutions.
- *Sodium Bisulfite* to quench residual oxidant as water is pulled from the RO Flush Tank to flush the RO skids; and to make up pickling solutions for long-term storage of the MF or RO skids when the AWT facility is offline.

4.3.6 Operations

Normal Operations

As recycled water demand varies by season, the AWT facility will normally operate seasonally, when surplus recycled water is available. This process is illustrated in **Figure 4-5** for 2013-2015. However, the treatment plant will also be able to run continuously throughout the year if required, especially if the system grows and there is a greater supply of recycled water to the AWT facility. Continuous fill/draw allows for emergency wintertime operations and can help stabilize the reservoir level throughout the year.

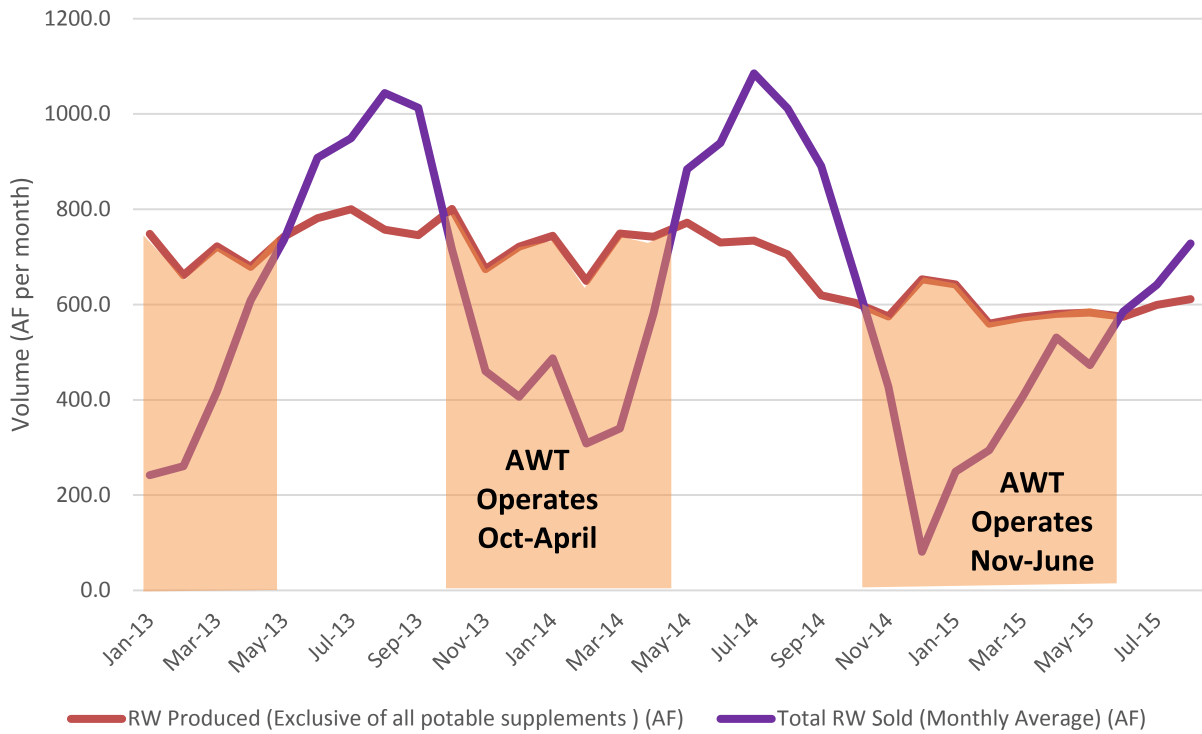

Figure 4-5
AWT Facility Seasonal Operations

As flows vary throughout the year, treatment processes at the AWT facility will be able to run at different discrete flow rates (e.g., 2, 4, or 6 mgd) to accommodate supply changes. Stepwise increases and decreases in total flow processed can be accomplished using on-site storage at the AWT facility and at Reservoir 2 to equalize variable hourly, daily, or weekly flows.

Operating the AWT facility as an on/off plant should not affect the life of the treatment equipment, provided that proper shutdown procedures are followed. Each time the AWT facility is taken offline or brought back online following a shutdown, the operators will need to follow a set of procedures for each treatment process. There are additional steps required if the plant is to be stored offline for an extended period of time. An example of these procedures is provided in **Table 4-6**.

Table 4-6
AWT Facility Shutdown Requirements

Treatment Process	Steps for Shutdown	Requirements for Long-Term Storage
MF/UF	• Run a CIP cycle • Rinse the system and neutralize the CIP solution • Flush the system again before it comes back online	• Store in a pickling solution of ~1000 mg/L sodium bisulfite in utility water • Replace the solution every few months to maintain pH 3.0-6.0
RO	• Run a CIP cycle • Run a flush cycle to fill the vessels with RO permeate • Flush the system again before it comes back online	• Store in a pickling solution of ~1000 mg/L sodium bisulfite in RO permeate • Replace the solution every few months to maintain pH 3.0-6.0
UV/AOP	• Run a cleaning cycle for the lamp surfaces • Clean again before the system comes back online	• Drain reactors: dry reactors can easily stay offline for months
Chemical Feeds	• Flush concentrated chemical out of all chemical feed lines • Refill the chemical feed lines with chemical stock before they come back online	• Store chemical feed systems with lines full of utility water to prevent precipitation / clogging

Off-Spec Operations

In instances where treatment is not in compliance with regulatory requirements, "off-spec" water can be temporarily held on-site for up to several hours or held in Reservoir 2 for up to several days. Water stored on-site would be returned to the front of the AWT facility once compliance is restored and normal operation resumes. If operation cannot be restored within several days, water in Reservoir 2 may need to be released provided that Tapia WRF's National Pollutant Elimination Discharge System (NPDES) permit allows for this discharge at current recycled water quality. The off-spec water could also be released to the sanitary sewer flowing to Tapia WRF becoming influent.

Emergency Operations

Under long-term or emergency occurrences, recycled water that cannot be treated at the AWT facility can be discharged through Discharge Point 005. Discharge Point 005 is an outfall of the recycled water system that leads to the Arroyo Calabasas, a tributary of the Los Angeles River. Discharge Point 005 has a maximum capacity of 6 mgd, but due to concerns about channel capacity, the operational capacity is closer to 4 mgd. Additional expenditures may be required if channel rehabilitation is required for discharges in excess of this amount. These costs are not included in the cost analysis for Scenario 4.

4.3.7 Brine Quantity and Quality

The AWT facility is expected to produce up to 1 mgd of brine from RO. The expected brine quality is shown in **Table 4-7**. Values were determined using Tapia WRF effluent water quality data and making the following conservative assumptions (worst case scenario):

- Minimum instantaneous rejected flow conditions occurs when 15% of the total treated flow in rejected as RO concentrate (85% recovery)
- All constituents are completely removed by the AWT processes and end-up in the RO concentrate

Brine quality projections are attached in **Appendix E**.

Table 4-7
AWT Facility Brine Quality

Parameter	Units	Average	Maximum
BOD (5-day @ 20° C)	mg/L	8	31
Settleable Solids	mg/L	--	0.67
Total Suspended Solids	mg/L	11	66
Turbidity	NTU	--	47
Ammonia (as N)	µg/L	648	2,933
Boron	mg/L	2.57	3.20
TDS	mg/L	5000	6080
Sulfate	mg/L	1280	1873
Chloride	mg/L	1067	1213
[Nitrate + Nitrite] (as N)	mg/L	44	66
Nitrite (as N)	mg/L	0.15	0.60

µg/L = micrograms per liter
NTU = Nephelometric Turbidity Unit

4.3.8 AWT Facility Layout

The entire AWT facility footprint is estimated to be a little over two acres and includes the process building, tanks, parking and access roads. The footprint also includes room for future expansions. **Figure 4-6** depicts a proposed layout for the AWT facility.

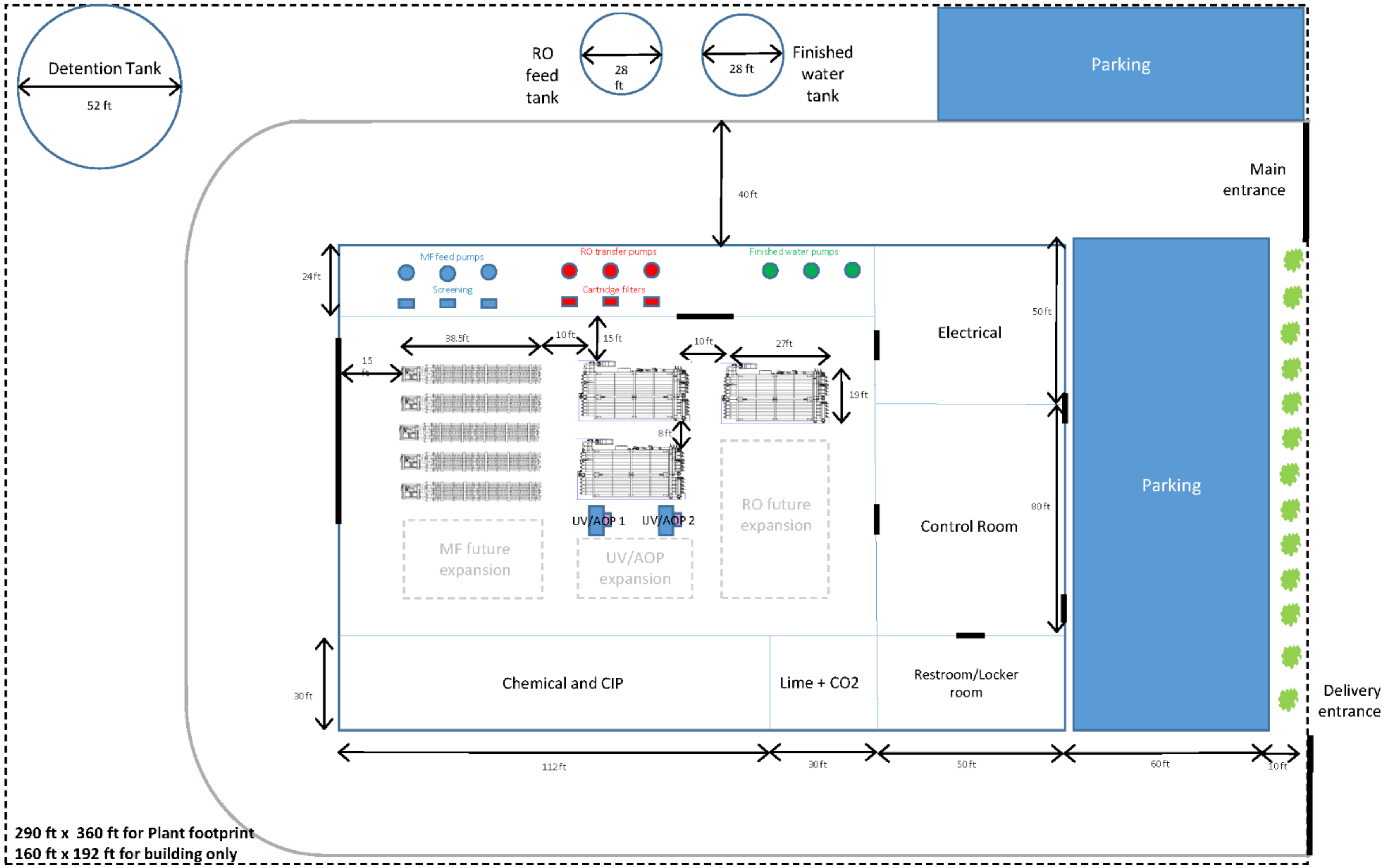

Figure 4-6
AWT Facility Layout

4.3.9 AWT Facility Siting Alternatives

The new AWT facility will be located at a site that is still to be chosen. Nine locations have been investigated for the two acre AWT facility site; however, there are other sites that can be included in a future detailed siting study. **Table 4-8** provides additional information on the nine potential AWT facility sites, including ownership, property type, and preliminary pros and cons of each. It is beyond the scope of this report to recommend a final site selection. This will require additional environmental, community, ownership, and utility research.

For any site chosen, there will be required new pipelines into the AWT facility, from the AWT facility to Las Virgenes Reservoir and the new brine line. For a final selected AWT facility site location, the length and alignment of these new pipelines would need to be adjusted in order to accommodate the preferred site. The cumulative lengths of these pipelines between the nine different sites are assumed to be comparable for the cost analysis included in this report. The nine potential sites have been identified for the AWT facility and are shown on **Figure 4-7**. It is noted that for Potential Site #8 (Triunfo Canyon Rd. near Kanan Rd.), the required length of new piping would likely be significantly greater and more complex (as a portion of the pipeline is outside of public right-of-way) than what is presented in this report.

Table 4-8
Potential AWT Facility Sites

Parcel Name	Owner	Property Class	Pros	Cons
1. Lindero Canyon	Las Virgenes Unified School District	Residential Vacant Land	-No Critical Habitats -Plenty of land for growth -Close to Power Lines	-Close to School
2. Lindero Country Club	City of Agoura Hills	Residential Vacant Land	-Close to Power Lines -No Critical Habitats	-Close to School and Residences
3. Triunfo Canyon Road	Mountains Recreation and Conservation Authority	Vacant Land	-Near Reservoir -Near trunk sewer	-Critical Habitat for *Lyons Pentachaeta* -Small parcel
4. Westlake Golf Course	Westlake Golf Course LLC	Golf course	-Near existing utilities -No Critical Habitats	-Decrease Size of Golf course - Expensive land
5. Mortuary	Pierce Brothers	Cemetery/ Mausoleum	-Away from Residential Area -Near existing utilities -No Critical Habitats	-Small Parcel
6. Agoura Road	Agoura Hills Center Properties	Single Family Residence	-Away from Residential Area -No Critical Habitats	-Close to Residences, would require rezoning
7. Las Virgenes Reservoir	Las Virgenes Municipal Water District	Government Owned Property	-Away from Residential Area -Near LV Reservoir	-Critical Habitat for *Lyons Pentachaeta*
8. S Triunfo Canyon Rd. near Kanan Rd.	Private ownership	Residential Vacant Land	- Large parcel, remote site, near trunk sewer	-Long brine line -All new piping from Indian Hills Tank
9. Lindero Cyn, Ventura County side	Rancho Simi Recreation and Park District	Vacant Publically Owned	- Near truck, sewer and power lines, AWT would be co-located with future CMWD pump station	- Near school

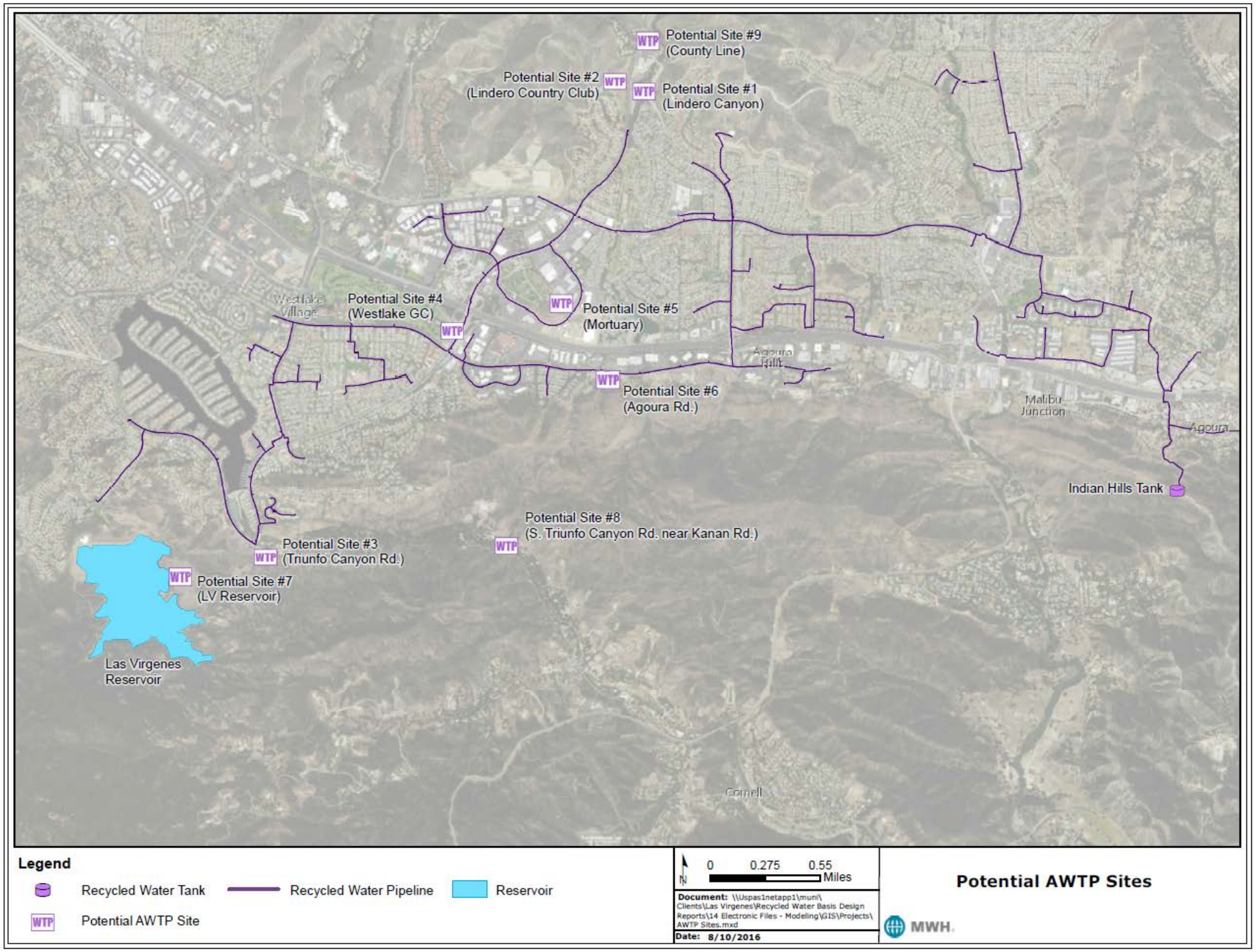

Figure 4-7
Potential AWT Facility Sites

4.4 RECYCLED WATER CONVEYANCE

Recycled water must be conveyed to the AWT facility and the advanced purified water effluent conveyed on to Las Virgenes Reservoir. This conveyance will utilize existing infrastructure, as well as new pipelines to fully connect the facilities to the existing recycled water system.

4.4.1 Existing and New Piping Requirements

Recycled water from Tapia WRF will be delivered to the new AWT facility through the existing 24-inch recycled water pipeline that travels north from Tapia WRF on Las Virgenes Rd., and then over to Agoura Rd. and Thousand Oaks Blvd. The 24-inch line terminates at the intersection of Thousand Oaks Blvd. and Lindero Canyon Rd. From that intersection, the 24-inch pipeline would have to be extended to the inlet of the new AWT facility. The length of this additional piping is dependent on the location of the AWT facility and various lengths are given in **Table 4-9**.

Once the recycled water has been advanced treated at the AWT facility, it must be conveyed to Las Virgenes Reservoir. This will require a 20-inch diameter pipeline with the length again dependent on the AWT facility location. **Table 4-9** also addresses lengths of this outlet pipeline for various site locations.

4.4.2 Existing and New Pumping Requirements

Currently, recycled water from Tapia WRF is delivered to customers through two pump stations; RWPS West and RWPS East. RWPS West would be affected by Scenario 4 and would incur greater operation and maintenance (O&M) costs for the additional recycled water it would be pumping to the new AWT facility. A full discussion of these and other costs is found in **Section 4.7.1**.

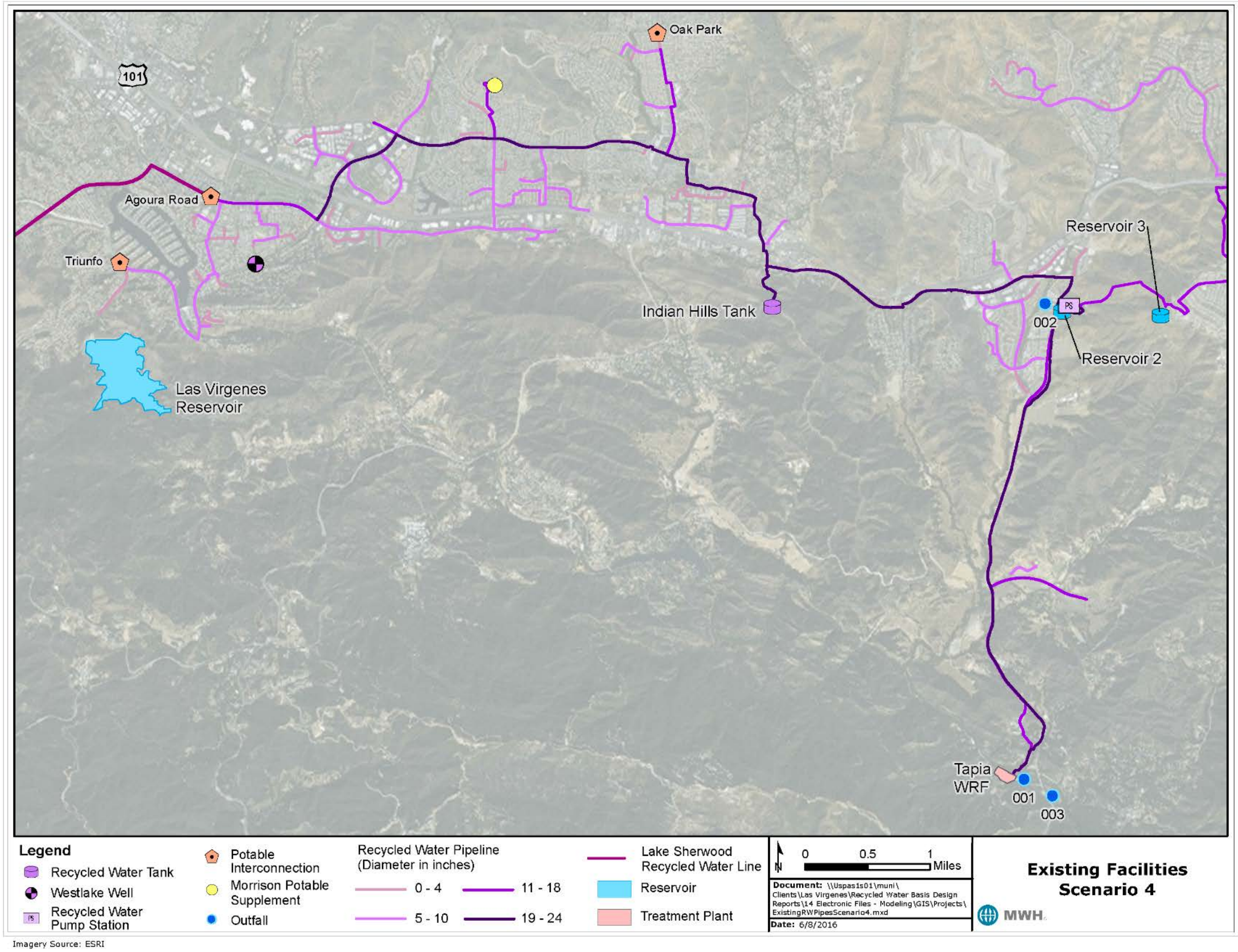

Figure 4-8
Scenario 4 Existing Facilities

4.4.3 Conveyance Alternatives

Four of the proposed AWT facility sites were chosen to demonstrate differences in the recycled water and brine pipelines, as shown in **Figure 4-9**. The four facilities are Lindero Canyon (Site #1), Westlake Golf Course (Site #4), Mortuary (Site #5) and Las Virgenes Reservoir (Site #7). Selecting four sites can help provide estimates of pipe lengths that could be expected during design. **Table 4-9** provides the pipeline characteristics for each of the four sites.

Table 4-9
Conveyance Characteristics

	AWT Inlet Pipe Diameter (in.)	AWT Inlet Pipe Length		AWT Outlet Pipe Diameter (in.)	AWT Outlet Pipe Length		Brine Line Diameter (in.)	Brine Line Length	
		(LF)	(miles)		(LF)	(miles)		(LF)	(miles)
Site #1	24	4,500	0.8	20	20,000	3.8	8	60,000	11.4
Site #4	24	4,700	0.9	20	12,000	2.3	8	61,000	11.6
Site #5	24	3,300	0.6	20	17,000	3.2	8	59,000	11.2
Site #7	24	16,100	3.1	20	1,000	0.2	8	72,000	13.6

4.4.1 Utility Research

A DigAlert search was conducted to locate possible utilities along the 24-inch recycled water conveyance pipeline and the pipeline from the AWT facility to the Reservoir. A list of these utilities from DigAlert is found in **Appendix F**. Once the predesign for these elements is initiated, full As-Built and Atlas Map records of the utilities found in these alignments will need to be obtained from the identified utilities. It is recommended that this process take place as close to pre-design as possible so information used to design the final alignments are as up-to-date as possible.

4.4.1 Geotechnical Investigation

A preliminary geotechnical investigation was conducted to assess soil characteristics, fault lines and significant geological formations in the area concerned by Scenario 4. Reports and maps from the State of California's Department of Conservation were assessed and can be found in **Appendix G**. It appears that the alignment for the new brine line will pass through a small area with historical occurrences of liquefaction which may require mitigation efforts.

There is also one fault line that crosses the proposed brine alignments. The Sycamore Canyon fault has a slip rate of less than 0.2 millimeters per year (mm/year) and is considered moderately constrained, which means that there is uncertainty as to the direction, amount or timing of displacement of the fault.

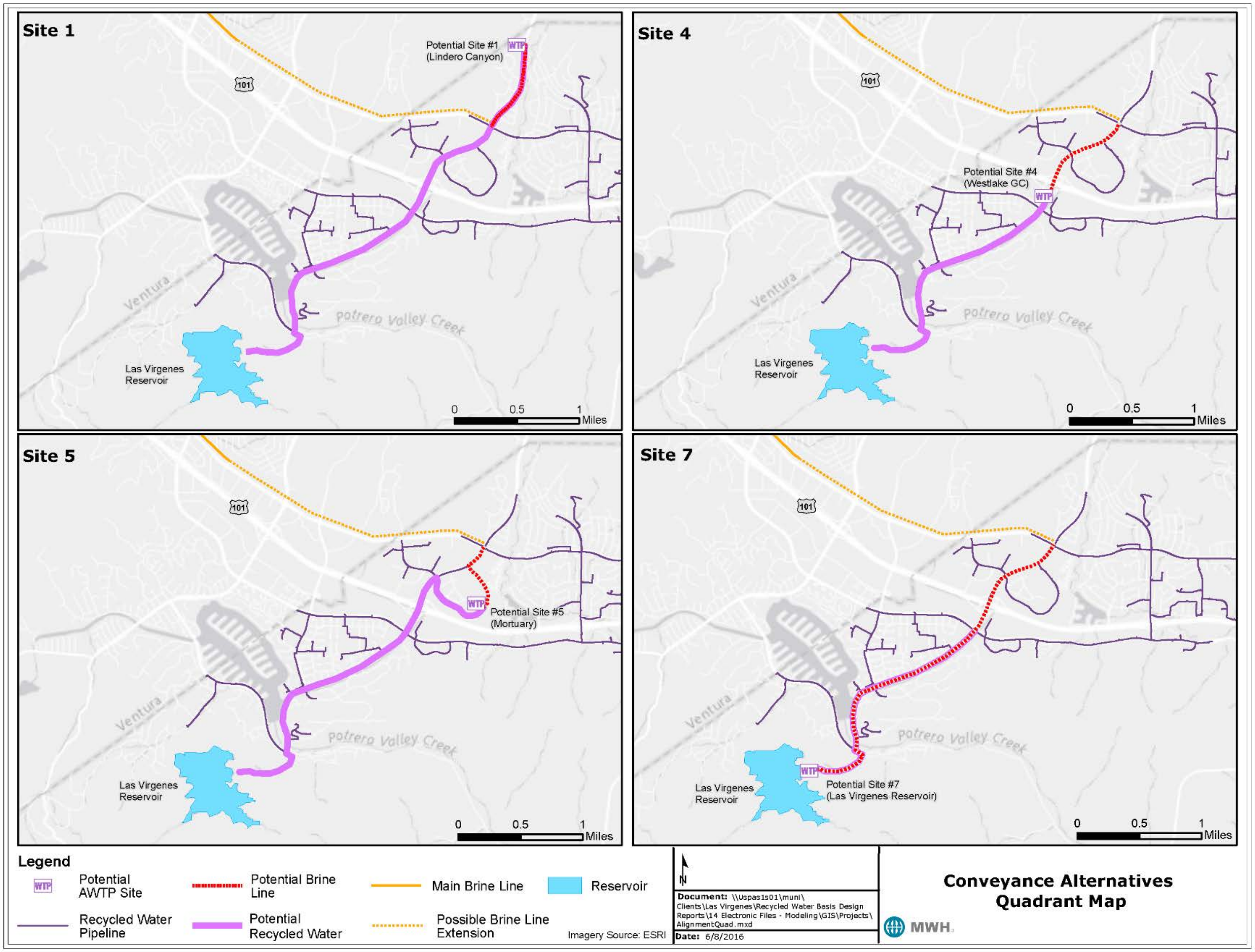

Figure 4-9
Conveyance Alternatives

4.5 BRINE DISPOSAL AND ALIGNMENT

4.5.1 Disposal Alternatives

The AWT facility will produce up to 1 mgd of brine, which requires proper disposal. Multiple alternatives for disposal were considered, including conveyance and discharge to the SMP, conveyance to Hill Canyon WWTP, deep well injection, direct ocean discharge, trucking off-site or on-site drying.

SMP

The preferred brine disposal option is the conveyance and discharge into the SMP, which collects brine from groundwater desalting facilities and conveys it to the Pacific Ocean at Port Hueneme Beach. The SMP is owned by CMWD. An evaluation of relevant water quality regulations determined that there are no anticipated compliance concerns for this option; the expected brine quality meets all SMP Discharge Limits. This option would require a new conveyance pipeline to reach the SMP from the AWT facility, and alignment alternatives are listed below.

Hill Canyon

Another option for brine disposal is to send the brine from the AWT facility to the Hill Canyon WWTP in the City of Thousand Oaks for treatment and discharge. This would require a new 8-inch brine pipeline connection into the Thousand Oaks sewer system.

An evaluation of relevant water quality regulations determined that brine disposal into Hill Canyon WWTP's intake may impede the facility's ability to comply with its NPDES discharge limits in the future. If brine from the AWT facility were treated at Hill Canyon WWTP, the concentrations of various contaminants in Hill Canyon's treated effluent would increase. While the concentrations of all contaminants would still meet Hill Canyon's current NPDES discharge limits, the concentrations of chloride and TDS would begin to approach their respective limits. This is particularly a concern for chloride, as the current chloride limit is a temporary interim limit which is expected to become more stringent in the future. Camrosa Water District has an agreement with the City of Thousand Oaks for subsequent use of Hill Canyon WWTP effluent and are very concerned about increasing chloride levels.

Past and future NPDES permits have been investigated in consultation with staff from the City of Thousand Oaks. Changes to the Hill Canyon WWTP permit are not expected until 2019 at the earliest and in all likelihood would have an extended implementation schedule. According to City of Thousand Oaks staff, the current focus of permit discussions are on contaminants of emerging concern (CECs) and pharmaceuticals.

Deep Well Injection

Deep well injection of the brine was considered, which would require a Class I Injection Well as classified by the U.S. Environmental Protection Agency (EPA). Class I wells are designed to inject the brine thousands of feet below the lowermost underground source of drinking water. Injection wells are regulated under the EPA's Underground Injection Control (UIC) program – the top federal environmental regulator. In California, the Department of Conservation's Division of Oil, Gas & Geothermal Resources (DOGGR) regulates injection wells under the EPA's oversight, and in collaboration with the State Water Resources Control Board (SWRCB). These agencies must adhere to multiple state and federal water quality laws, including the California Water Code, the Federal Clean Water Act, and the Safe Drinking Water Act (SDWA). The SDWA has strict requirements for injection well construction, operation, testing, and monitoring. This would require detailed geologic studies to prove that deep injection is feasible and an analysis of the surrounding area to identify other wells that may allow fluid to move out of the injection zone. Injection wells require multiple casings and continuous monitoring and recording devices. Given the rigorous and expensive permitting requirements, uncertainty in successful permitting, and current public concerns over hydraulic fracking, this option was not considered further.

Malibu – Direct Ocean Discharge

Direct ocean discharge through Malibu was considered and has been ruled out as a viable option due to the fact that there are currently no ocean discharges in Malibu. A new discharge line would have to be constructed from the AWT facility to Malibu which would be costly. The ability to permit such a disposal option is questionable.

Trucking

The quantity of brine produced by the AWT facility makes trucking an unsuitable option for brine disposal as trucks would have to haul brine multiple times a day, even if additional concentration is provided. By example, 1 mgd of brine would require at least 90 tankers per day.

On-Site Drying

Another option for brine disposal is on-site drying beds at the AWT facility. This would require a large amount of land for adequate drying, and although the AWT facility site has not yet been chosen, many of the site options have space limitations surrounding them.

4.5.2 Alignment Alternatives

The most viable alternative for brine disposal is discharge to the SMP which has sufficient capacity to accommodate the expected brine. Discharge to the SMP will require coordination with CMWD.

Under this alternative, the brine will discharge through a newly constructed 8-inch conveyance line. While the exact alignment will depend on where the AWT facility is located, **Figure 4-10** demonstrates potential alignments using a proposed AWT facility site. There is the possibility that proposed local groundwater de-salters may also discharge into the proposed brine line. The alignments connect into Phase 4 of the SMP, which is expected to be constructed by 2022. Only the initial 4.2 miles of brine pipeline would be required to connect to the City of Thousand Oaks sewer system leading to the Hill Canyon WWTP, but an additional 7 miles are of pipeline are necessary to connect this pipeline to the SMP. A more in-depth alignment study will be required if Scenario 4 is chosen as the preferred option.

4.5.3 Pumping Requirements

Brine is discharged from the AWT facility under pressure, so no brine pumping will be required at the AWT facility. In fact, for either brine disposal alternative, the brine would be flowing downward in elevation, which would lead to additional head in the pipeline. This may allow portions of the brine pipeline to be reduced in size, depending on alignment.

4.5.4 Utility Research

A DigAlert search was conducted to locate possible utilities along the brine alignment. A list of these utilities from DigAlert and the corresponding Thomas Guide grids are found in **Appendix F**.

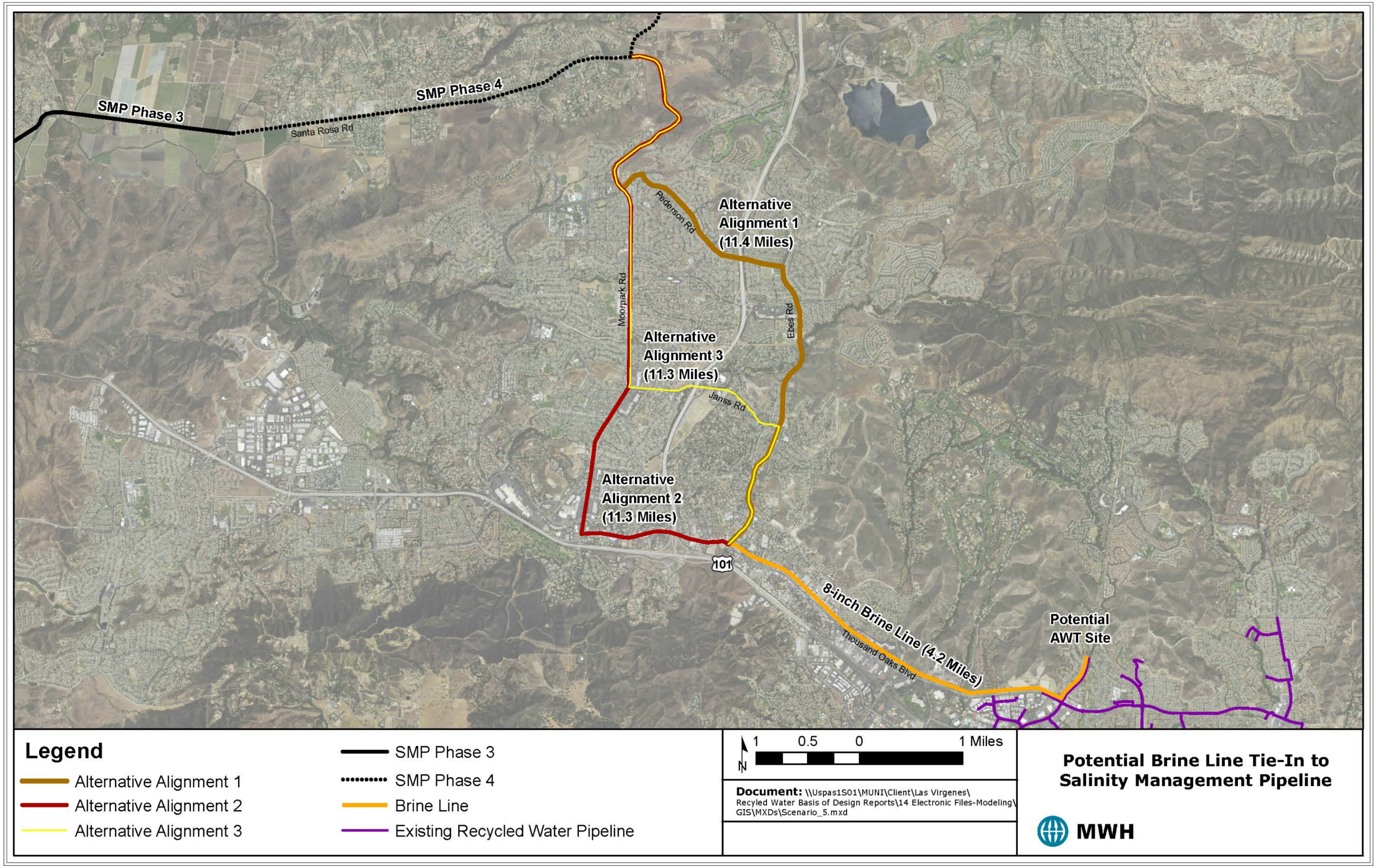

Figure 4-10
Brine Discharge to SMP Alignments

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4.6 LAS VIRGENES RESERVOIR

Las Virgenes Reservoir is located in the southwestern corner of Westlake Village. The reservoir is owned by Las Virgenes Municipal Water District (LVMWD) and is filled with imported water from Metropolitan Water District of Southern California (MWDSC), as needed. The reservoir has an estimated watershed area of 550 undeveloped acres that is under the control of the LVMWD. Precipitation and runoff from the surrounding area is roughly equal to seepage and evaporation in normal years. Las Virgenes Reservoir has a total capacity of roughly 9,500 AF to the spillway crest.

The Westlake Dam was constructed at Las Virgenes Reservoir in 1972 and is routinely inspected by the Division of Safety of Dams (DSOD). The Dam is considered sound and meets all established standards. Characteristics of both the Las Virgenes Reservoir and the Westlake Dam are found in **Table 4-10** below. It is noted that the capacity listed by DSOD for the dam at the spillway crest is less than that shown by the elevation capacity tables provided by LVMWD. It is recommended that a bathymetry and survey study of the reservoir are completed in order to verify the volume of the reservoir at different water surface elevations.

Table 4-10
Las Virgenes Reservoir and Westlake Dam Characteristics

Dam Type	Earth
Status	Certified
Year Built	1972
Hazard Class	4B
Dam Height	158 ft.
Crest Width	25 ft.
Dam Length	1,400 ft.
Crest Elevation	1,056 ft.
Spillway Crest Elevation	1,048 ft.
Volume	1,600,000 yd^3
Total Freeboard	8 ft.
Operational Freeboard	8 ft.
Drainage Area	0.9 mi^2
Mean Annual Precipitation	19.5 in.
Reservoir Area	156 acres
MPWS Elevation	1,048 ft msl
MPWS Reservoir Capacity	9,200 AF

Source: California Natural Resources Agency, Department of Water Resources, Division of Safety of Dams

4.6.1 Reservoir Operations

Historical Operation

Las Virgenes Reservoir is not a true source of water for LVMWD but becomes the primary water supply when the MWDSC imported water supply is shut down for maintenance or emergencies. It currently provides seasonal storage to balance the differences between supply and demand in the potable water system. The reservoir is filled during times of low demand and withdrawn and retreated by the Westlake FP when demands increase. **Table 4-11** shows the minimum and maximum lake levels and volumes over a 10-year period from 2006 to 2015, as well as the maximum level and volume for the dam crest and spillway crest. **Figure 4-11** is a graphical representation of the 10-year minimum and maximum for the reservoir, and shows the maximum and average utilization volumes for the reservoir for a one-year period.

Table 4-11
Las Virgenes Minimum and Maximum Historical Lake Levels

Description	Elevation (ft msl)	Volume (AF)
Dam Crest Elevation	1,056	10,696
Spillway Crest Elevation	1,048	9,521
Maximum Level 2015	1,048	9,468
Minimum Level 2015	1,039	8,098
Maximum Level 2014	1,040	8,330
Minimum Level 2014	1,032	7,176
Maximum Level 2013	1,047	9,366
Minimum Level 2013	1,032	7,204
Maximum Level 2012	1,046	9,281
Minimum Level 2012	1,035	7,528
Maximum Level 2011	1,046	9,218
Minimum Level 2011	1,036	7,770
Maximum Level 2010	1,045	9,096
Minimum Level 2010	1,033	7,368
Maximum Level 2009	1,044	8,860
Minimum Level 2009	1,030	6,952
Maximum Level 2008	1,046	9,167
Minimum Level 2008	1,030	6,835
Maximum Level 2007	1,036	7,782
Minimum Level 2007	1,020	5,670
Maximum Level 2006	1,043	8,675
Minimum Level 2006	1,027	6,443
10 year minimum	**1,020**	**5,670**
10 year maximum	**1,048**	**9,468**

Proposed Reservoir Operations

The recommendation to permit Las Virgenes Reservoir as continuous fill/draw allows the JPA to operate the reservoir similarly to how it has been operated in the past. The reservoir can be filled with excess advanced purified water from the AWT facility during months when the demand is less than the supply, and then the reservoir can be drawn down when there is more recycled water demand than supply. The total amount of reservoir capacity that will be utilized in Scenario 4 will likely be greater than the historical usage shown in **Figure 4-11** since the amount of surplus water from Tapia WRF over a year as calculated in **Section 4.2** is greater than the historical amount of water added to the reservoir from imported connections. An analysis of this difference is presented in the following section.

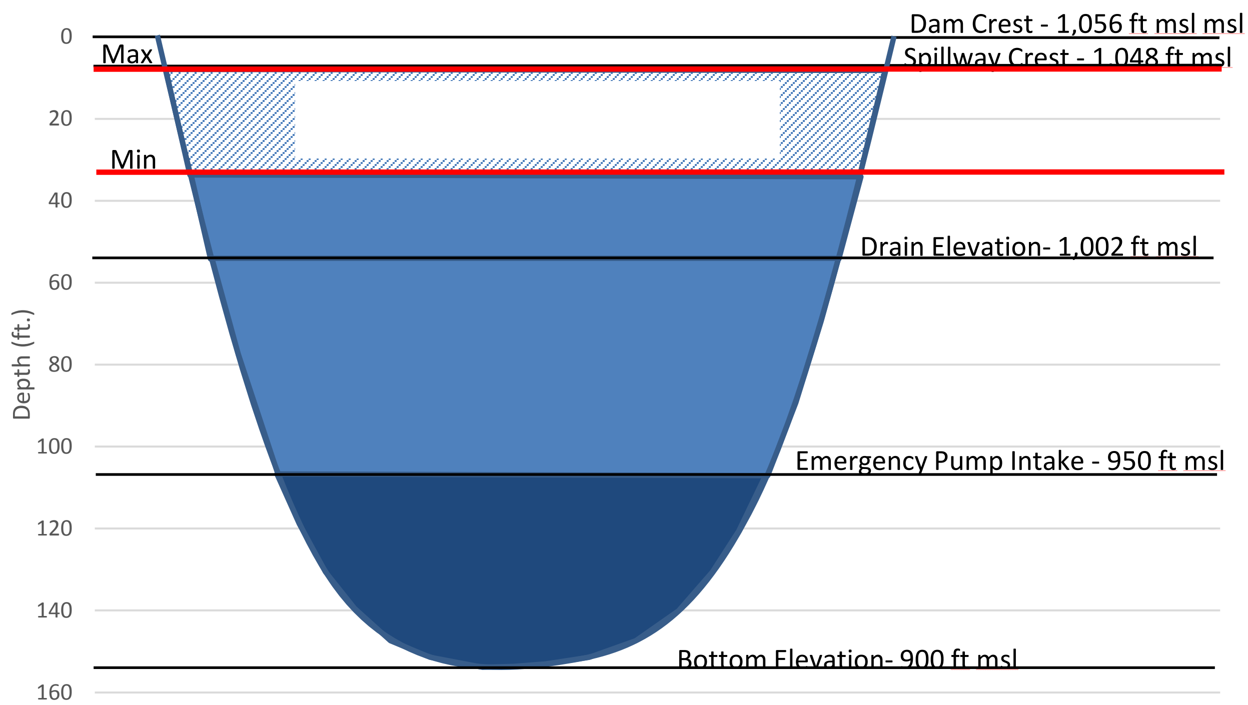

Figure 4-11
Las Virgenes Reservoir Historical Operations

An operations model was created to document historical operations and help plan how the reservoir can be operated in the future. The model was created using historical data from the reservoir collected by the LVMWD, including inflows from MWDSC, outflows by the Westlake FP, precipitation, evaporation, and estimated seepage. The inflows were added and the outflows were subtracted from the beginning capacity of the reservoir each day to calculate a new reservoir storage volume. This reservoir volume was used as the beginning volume for the following day. The daily storage volumes were compared to the daily measurements of reservoir volume taken by LVMWD staff. The measured volumes were provided in the reservoir reports and are calculated by taking the water elevation of the reservoir and matching it to the elevation capacity tables. This process of comparing a mass balance calculated volume to the measured reservoir volume was used to calibrate the operations model. The model has a calibration error less than 1% and is provided as part of this Basis of Design Report (BODR). The model will be useful to LVMWD staff for future operations planning and as an input to a quality and mixing model for the reservoir.

4.6.1 Westlake Filtration Plant Operations

Westlake FP typically operates on a seasonal basis in the late summer to support LVMWD's western portion of the potable water service area. Westlake FP is a Diatomaceous Earth filtration plant that treats water in Las Virgenes Reservoir with additional filtration and disinfection prior to distribution to customers. The existing capacity of the plant is 9,000 gpm (13 mgd), and is currently being expanded to 11,800 gpm (17 mgd). The Westlake FP is located immediately adjacent to the Las Virgenes Reservoir dam, on the west abutment.

In Scenario 4, the plant will operate more frequently as more water will enter Las Virgenes Reservoir from the AWT facility than is currently being sent through the LVMWD's imported water connection. The increased usage of the reservoir will reduce the need for filling the reservoir with imported water from MWDSC.

Table 4-12 shows the historical influent flow to Westlake FP. The historical average of 1,416 AF of reservoir water is dependent on the change in reservoir level, the amount of water sent to the reservoir from the LVMWD's imported connection, as well as rainfall, runoff, evaporation, and seepage. The projected change in the average amount of water being treated by the Westlake FP is accounted for as an additional cost for Scenario 4.

Table 4-12
Historical Influent Flow for Westlake FP

Year	Influent to Westlake Filtration Plant (AF)
2014	821
2013	1,682
2012	1,943
2011	1,619
2010	477
2009	1,496
2008	1,935
2007	2,359
2006	760
2005	673
2004	1,817
Average	**1,416**

Planned and Emergency Shutdowns

In addition to its normal function of supplementing potable water supply in the late summer, LVMWD uses Las Virgenes Reservoir as an emergency supply in case of planned or unplanned outages. Planned outages may happen at the discretion of MWDSC and can be due to instances such as repair, improvement, quality concerns or operational consideration. Emergency shutdowns can occur due to pipe breaks, seismic events, or any other unplanned events that cause MWDSC to be unable to deliver water to LVMWD.

If Scenario 4 were to be run in a seasonal storage mode, the Westlake FP would need to wait 24 hours after the AWT facility shuts down before it could begin to pull water from the Las Virgenes Reservoir for treatment and distribution into the potable water system. Any planned or emergency shutdown of the MWDSC imported connection would require shutdown of the AWT facility, and recycled water from Tapia WRF would need to be stored in Reservoir 2, recycled water tanks, or wasted through the connection to the Los Angeles River or the spray fields. For longer periods of shutdown, this strategy would likely not be sustainable. For this reason, it is recommended that the JPA pursue a permit for surface water augmentation that supports continuous fill/draw operation, allowing the AWT facility and Westlake FP to operate simultaneously, so that recycled water from the Tapia WRF can still be sent to the AWT facility while potable water is being served from the Westlake FP.

Additional Demand on Westlake Filtration Plant

In order to quantify the change in amount of water processed by the Westlake FP when the AWT facility is in operation, the average amount of water that has historically been sent to the reservoir must be assessed. By looking at the change in amount of water sent to the reservoir, the change in influent to the Westlake FP can be assessed independent of the quantities of rainfall, seepage, or evaporation, which are each subject to error. **Table 4-13** shows the amount of water sent to the reservoir from 2004 through 2014, the average value of which is 2,139 AF. Based on the average amount of anticipated to be produced by the AWT facility, the 2,617 AF shown in **Table 4-1**, the differential amount of water treated by the Westlake FP will be 478 AF. This additional amount of water assumes that, on average, what is put into the reservoir by the AWT facility is equal to what is treated by the Westlake FP after the contribution from rainfall and runoff, and minus the seepage and evaporation from the reservoir (i.e., that the lake is maintained at a constant level, on average, over a year). It also assumes that the historical levels of rainfall, runoff, evaporation, and seepage remain similar into the future, over the long term. This differential loading to the Westlake FP of 478 AF is accounted for as an additional cost in the cost evaluation presented later in this section.

Table 4-13
Westlake Reservoir Refill from Imported Connection

Year	Input from Imported Connection (AF)
2014	2,158
2013	1,704
2012	1,081
2011	1,916
2010	2,333
2009	1,101
2008	3,330
2007	2,859
2006	2,123
2005	739
2004	4,190
Average	**2,139**

4.6.2 Reservoir Water Quality

Water Quality Compliance

Full advanced treatment under Scenario 4 will consist of MF, RO, UV/AOP, and final disinfection with chlorine. The chlorine will be quenched prior to discharge to Las Virgenes Reservoir. The regulations provide for lower pathogen removal requirements if 1 percent dilution in the reservoir can be demonstrated. However, as a conservative approach, it is assumed that only a 10 percent dilution will be obtained in Las Virgenes Reservoir and any additional treatment requirements will be obtained by demonstrating removal credits from the Tapia WRF tertiary filters.

The maximum volume of Las Virgenes Reservoir is about 9,500 AF. The theoretical retention time is determined by dividing the reservoir volume by the maximum outflow on a monthly basis. Thus, the maximum monthly outflow from Las Virgenes Reservoir under the proposed SWSAP regulations (summarized in **Section 4.1**) would be 1,600 AF, or 17 mgd, on average. This current maximum capacity of the Westlake FP is 13 mgd, so there is no current limitation on plant operations when the reservoir is full. However, on a monthly average basis, production from the Westlake FP could be curtailed at reservoir levels below about 7,300 AF and when advanced purified water is being added. During summer or fall months when no surplus recycled water is available, there would be no capacity limitation regardless of reservoir level.

Mixing and Diffusion

A key component of the draft surface water augmentation regulations is the need for dilution of the advanced purified water from the AWT facility as it enters Las Virgenes Reservoir to ensure complete mixing. For there to be complete mixing in the horizontal direction, it is recommended that water enter the reservoir through a diffuser that will spread the water evenly over an extended distance perpendicular to the direction of travel. A reservoir water quality model can be used to predict how mixing will occur in the reservoir during different times of the year and the location of the best point of addition of the advanced purified water. An important parameter of a reservoir water quality model is the temperature profile of the reservoir, specifically how the temperature profile changes seasonally. **Figure 4-12** shows this seasonal change on the average temperature of the entire reservoir.

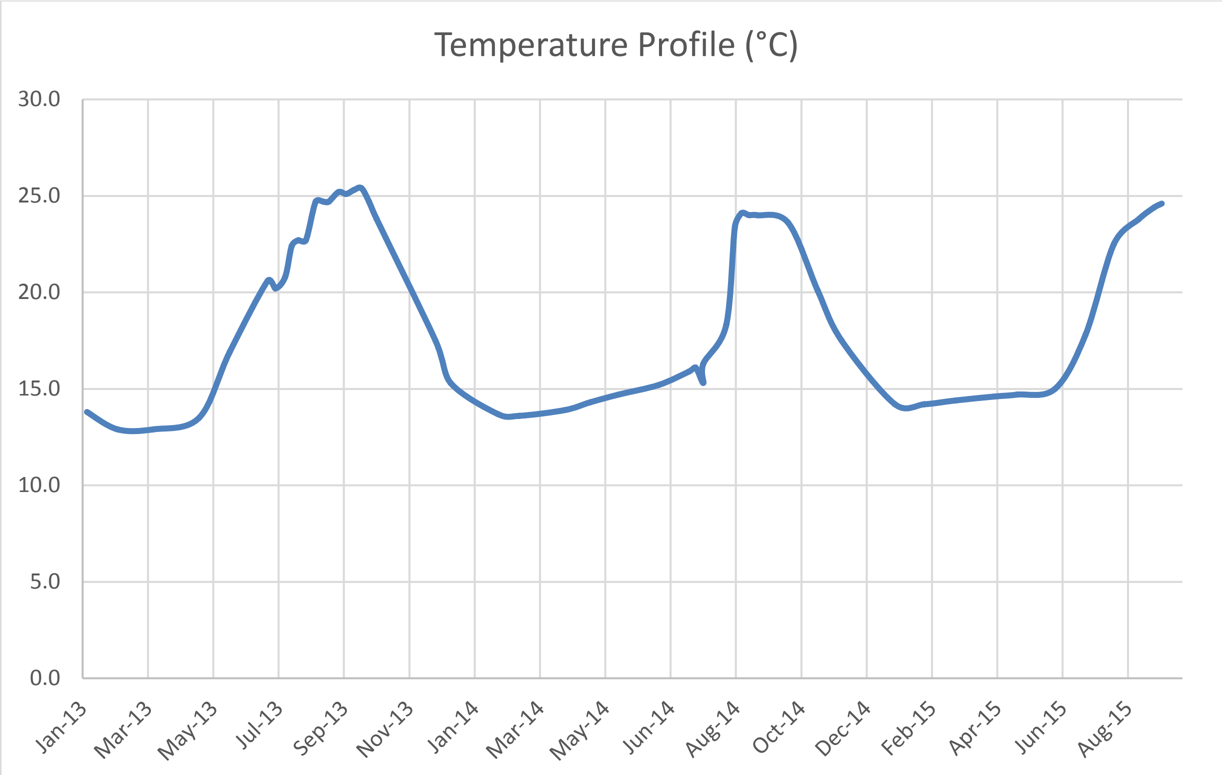

Figure 4-12
Las Virgenes Reservoir Seasonal Average Temperature

There is also a seasonal temperature variation within the reservoir that results in seasonal stratification and the formation of a thermocline. A thermocline is a transitional layer between cooler water near the reservoir bottom and warmer water at the water surface. In the winter, the reservoir is fully mixed and water temperature is fairly constant throughout the water column. However, as the air temperature increases into summer, a thermocline develops and its depth increases. This can be seen in **Figure 4-13**, which shows four months in 2015 and how the temperature varies within the reservoir at different elevations. In early winter, the thermocline will fully dissipate and the reservoir will turn over, resulting in a return to a fully mixed condition.

The point of addition of the advanced purified water may be dependent on how the reservoir stratifies to encourage more mixing as the water is diffused into the reservoir. The wind on the surface of the reservoir can also create more mixing but this does not reach the lower depths when a thermocline is present. During periods when the thermocline is more pronounced, additional mechanical mixing may be necessary to achieve dilution requirements.

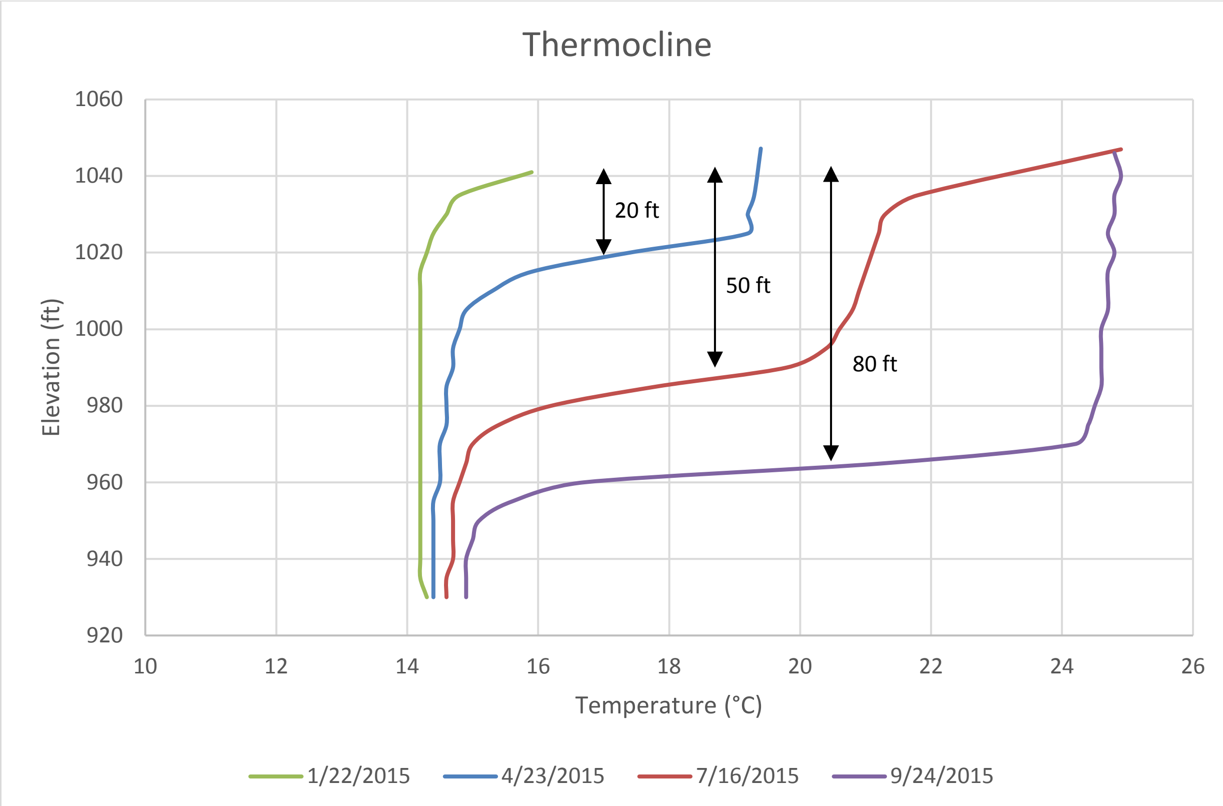

Figure 4-13
Las Virgenes Reservoir Temperature Profiles

Variations in TDS between water stored in the reservoir and the influent advanced purified water will also impact mixing. Currently, the reservoir TDS roughly matches the TDS of water supplied by MWDSC and is typically around 400 mg/L, as presented in **Figure 4-14**. The TDS of the advanced purified water entering the reservoir is about 150 mg/L. This water will be less dense than the current reservoir water quality and will have a tendency to rise and impact mixing and dilution. Also, reservoir water quality is expected to gradually become similar to the advanced purified water. More sensitive users may detect the softer, lower TDS water but no other significant changes are anticipated. Operational criteria at Westlake FP may require slight adjustments (e.g., pH) to ensure water sent to customers remains noncorrosive after treatment. Once bathymetry information is obtained, water quality, temperature, and introduction of advanced purified water can be modeled.

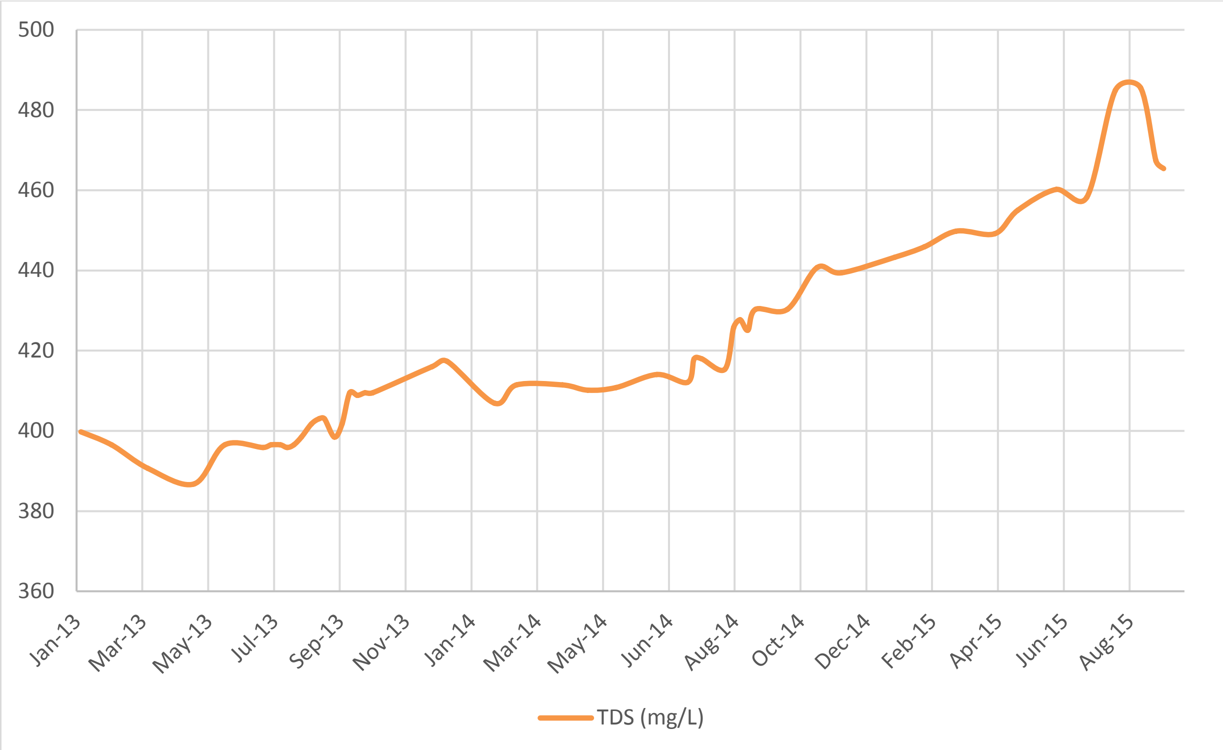

Figure 4-14
Las Virgenes Reservoir TDS Concentration

Water Quality Model

In order to confirm the operations of Las Virgenes Reservoir and the ability of the reservoir to meet dilution requirements, a two-dimensional (2D) water quality model will be required. As part of this BODR, initial steps of this process were completed, including the creation of an operations model that will be used as the input for calibration of the 2D model. In order to fully build the model, updated bathymetry and survey data for the reservoir is needed. This will ensure accurate elevations for the bottom of the reservoir and a more accurate representation in the model. Once the model is set up, temperature profiles, TDS concentrations, and the operations model can be used to calibrate the model to historical conditions. This model will be used to predict supplemental mixing requirements and amount of dilution achieved to meet the regulations.

4.7 IMPLEMENTATION

4.7.1 Costs

Cost estimations for Scenario 4 were developed considering the construction and annual O&M costs. Conceptual costs have been prepared based on the facilities and water volumes presented in the earlier sections of this report. The Las Virgenes Reservoir, Westlake FP and the potable water distribution in Los Angeles County are owned and operated by LVMWD. It will be necessary to determine how these LVMWD only facilities costs are shared among the JPA partners.

Construction Costs

Construction costs were calculated for the AWT facility, recycled water pipelines, brine discharge pipeline and the mixing system at the reservoir, and are presented in **Table 4-14**. A lump sum (LS) was assumed for the land acquisition necessary for the AWT facility. The construction cost of the AWT facility is a sum of the costs needed for process equipment, equipment installation, pumping and storage and the plant building itself. A number of these fees were developed from vendor quotes specific to the requirements of the AWT facility, while equipment installation costs were determined as a percentage of equipment costs. Additionally, contingencies were added for contractor overhead and profit, scope and estimating, and engineering and administrative fees. **Appendix H** includes a comprehensive list of construction costs considered for the AWT facility.

All pipelines were sized based on the AWT facility located at potential site #1, Lindero Canyon Country Club. This location requires 4,000 linear feet (LF) of 24-inch diameter pipeline to connect the AWT facility to the existing 24-inch diameter recycled water pipeline. Effluent from the facility will be discharged through a 20-inch diameter 20,000 LF pipeline to Las Virgenes Reservoir. The following costs also assume that the brine will be discharged to the SMP through an 8-inch pipeline spanning 60,000 LF. Construction costs for the pipeline extension to the SMP include construction for a discharge facility. Due to seasonal stratification in the reservoir, a mixing system will be required and is assumed as a lump sum cost, as the exact type of mixing system would require a more detailed analysis. The total construction cost of Scenario 4 is estimated at approximately $95,313,000.

Table 4-14
Scenario 4 Construction Costs

Description	Quantity	Unit Price	Estimated Cost
AWT Facility	--	Lump Sum	$46,721,000
Land Acquisition	--	Lump Sum	$2,000,000
AWT Inlet Pipeline	4,000 LF of 24”	$365/LF	$1,460,000
AWT Outlet Pipeline	20,000 LF of 20”	$320/LF	$6,400,000
Brine Line	60,000 LF of 8”	$175/LF	$10,500,000
Mixing System	--	Lump Sum	$1,000,000
Subtotal			*$68,081,000*
Contingency (25%)			$17,020,000
Engineering & Admin (15%)			$10,212,000
Estimated Total Construction Costs (rounded)			**$95,313,000**

O&M Costs

O&M costs were categorized into fixed and variable costs, as shown in **Table 4-15**. Fixed costs are classified as ones that would not change significantly if the system were to grow. These include labor and maintenance costs at the AWT facility, along with the reservoir mixing system. Variable costs are directly impacted by growth in the system thus resulting in an increase in water produced by the AWT facility. Variable costs include energy and chemical costs at the AWT facility and energy costs at the RWPS West. The brine discharge fee is directly dependent on the quantity of brine production. A brine discharge facility maintenance cost is also needed, as cited in CMWD's *Information for Potential Dischargers* document. Additionally, an increase in reservoir fill from the AWT facility would result in greater use of the Westlake FP, thus increasing O&M costs.

O&M costs for Year 1 of operation are based largely on current supply and demand values. Based on these assumptions, O&M costs for the first year of operation are estimated to be approximately $2,663,000. However, the advanced treated water discharged into the reservoir decreases the need to buy imported water from MWDSC and this results in estimated savings of $2,373,300 which produces a net O&M cost of approximately $290,000 for the first year of operations.

Table 4-15
Scenario 4 O&M Costs

Description	Quantity (AF)	Unit Price ($/AF)	Estimated Cost
Fixed Costs			
AWT (fixed)	2,637	$365	$962,500
Mixing System	9,500	$25	$237,500
Brine Discharge Facility		Lump Sum	$45,000
Fixed Subtotal			$1,245,000
Contingency (10%)			$124,500
Estimated Total Fixed Costs (Rounded)			*$1,369,500*
Variable Costs			
RWPS West	3,102	$25	$77,600
AWT (variable)	2,637	$300	$791,100
Westlake Filtration Plant	498	$150	$74,700
Brine Discharge Fee	465	$500	$232,500
Subtotal			$1,175,900
Contingency (10%)			$117,590
Estimated Total Variable Costs (Rounded)			*$1,293,500*
Estimated Total O&M (rounded)			**$2,663,000**
Imported Water Savings	2,637	$900	($2,373,300)
Net Total O&M (rounded)			$290,000

Cost per AF

During the first year of operations, the cost per AF was calculated assuming imported water savings. This unit cost is the sum of the first year's projected O&M costs and the annualized construction cost (30 years at 2% interest), as shown in **Table 4-16**.

Table 4-16
Unit Cost per AF

	With Imported Water Savings
Annualized Construction Cost	$4,256,000
Year 1 O&M Cost	$290,000
Total Annual Cost	*$4,545,000*
Total AF Produced	2,637
Unit Cost per AF	**$1,724**

Cost per Customer

The additional rate impact of this project to JPA customers cannot be fully assessed at this time. A financial consultant has been hired to look into possible funding opportunities for this project so that any rate increase to customers can be minimized.

Present Worth

A present worth analysis was conducted for Scenario 4. This analysis was conducted for the project first assuming no growth in the system and then assuming growth in the system as discussed in **Section 3**. The following parameters were used in calculating the present worth analysis:

- 30 year analysis period
- 2% per annum inflation rate applied to O&M costs
- 7% per annum escalation rate of MWDSC imported water rate, composed of a 2% inflation rate and 5% increase of rates
- 5% discount rate of future values to determine present value, composed of a 2% inflation rate and 3% interest rate.

The growth projections for Scenario 4 assumes constant demand and an addition of approximately 89 AF per year in recycled water supply to the system. Additional recycled water supply is due to expected growth in population, as this results in increased wastewater flows to be treated at Tapia WRF. This scenario assumes there would be no expansion of the existing recycled water distribution system. Existing recycled water customers would be supplied, but addition of new recycled water customers would be limited. The growth in supply increases both the variable O&M costs and the imported water savings.

The annual cost used in calculating present worth is the sum of (1) the *cost* associated with AWT facilities O&M combined with (2) the *savings* generated from the reduction of water purchases from MWDSC by using AWT advanced purified water. Initially, the O&M costs slightly exceed the savings generated by recycled water. However as the projected cost of MWDSC water escalates at a greater rate than O&M costs, the savings soon exceed the costs. This results in a net savings. The results of both present worth analysis are shown in **Table 4-17.** Assuming no growth, the present worth of the annual operations results in a savings of $40,408,000 over the 30-year period. These savings, combined with the construction cost of $95,313,000, result in a net present worth of $54,905,000. After incorporating projected growth, the present worth of annual operations results in a savings of $81,809,000. After considering the construction cost of $95,313,400, the net present worth with growth is approximately $13,504,000.

Table 4-17
Present Worth Comparison

	Present Worth Comparison	
	Without Growth	**With Growth**
Construction Cost	$95,313,000	$95,313,000
Present Worth of Annual Costs (Savings)	($40,716,000)	($80,685,000)
Net Present Worth (Rounded)	$54,597,000	$14,629,000

Both with and without growth, the net present worth of Scenario 4 will decrease over time due to imported water savings as shown in **Figure 4-15**.

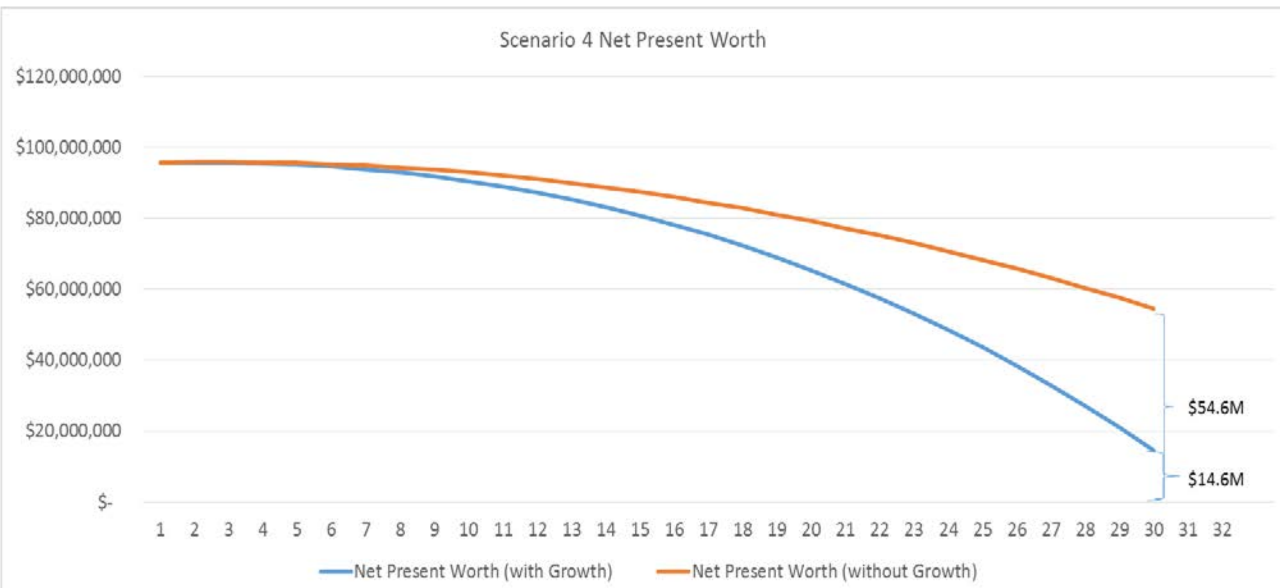

Figure 4-15
Scenario 4 Present Worth Comparison

4.7.2 Schedule

A preliminary schedule for Scenario 4 is presented in **Figure 4-16**, illustrating the various tasks and sequencing required to implement this project. The schedule assumes earliest possible completion, which is expected to span almost seven years from the beginning of the BODR until Startup. No start or end dates have been defined, but the schedule does provide indication of the minimum time required to implement Scenario 4 assuming no delays beyond the JPA's control. The schedule also does not account for securing funding sources or regulatory deadlines related to total maximum daily load (TMDL) compliance.

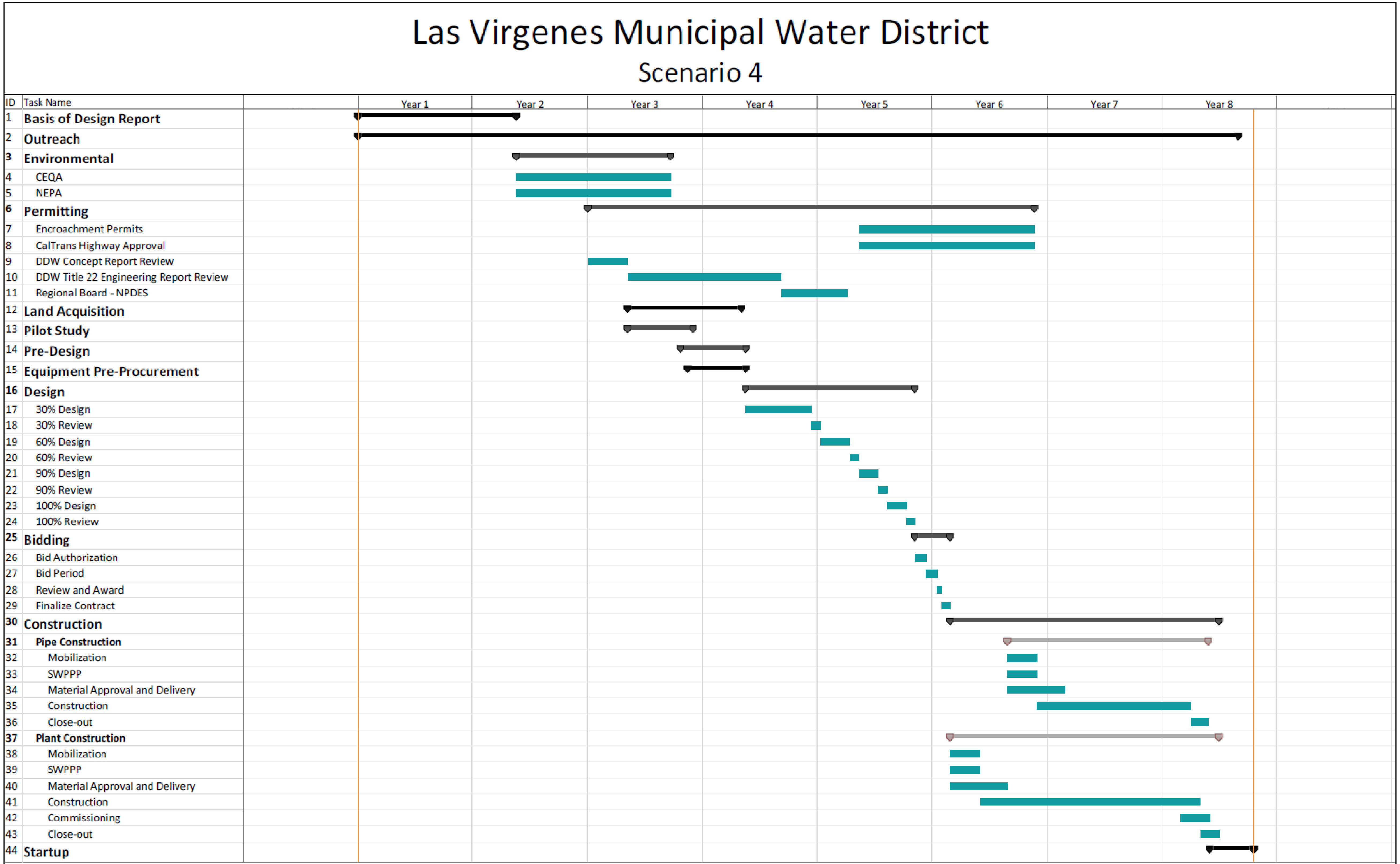

Figure 4-16
Scenario 4 Schedule

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4.7.3 Interagency Coordination

Coordination with various State and Local agencies will be required to implement Scenario 4. This coordination may involve regulatory approval, encroachment permits, negotiation of agreements to provide services, and other items. A summary of coordination needs with each key agency is presented below. Meeting notes from meetings with various agencies are found in **Appendix I.**

Calleguas Municipal Water District
CMWD is the owner and operator of the SMP, which is the primary option for disposal of AWT brine. All brine must meet water quality discharge requirements for the SMP. Coordination with CMWD will also be needed for water supply exchanges.

City of Thousand Oaks
An encroachment permit will be needed from the City of Thousand Oaks for brine pipeline construction. In addition, the City may have an interest in participating in the brine pipeline construction, as they are currently considering several wellhead treatment systems to remove salt from brackish groundwater. If brine cannot be discharged to the SMP, an agreement would be needed to allow discharge of brine to the City's wastewater collection system, and for treatment of the brine at the Hill Canyon WWTP. Preliminary discussions with the City indicate this would be similar to an industrial discharge agreement, but complications may arise due to downstream water use by Camrosa Water District.

WQCB, Division of Drinking Water
DDW regulates potable reuse and will serve as the lead agency in approving Scenario 4. The typical steps needed for approval include preparation of a Concept Study and a Title 22 Engineering Report in coordination with the California Environmental Quality Act (CEQA).

Regional Water Quality Control Board
The Regional Water Quality Control Board (RWQCB) has final approval over the NPDES discharge permit, as well as the final permit for IPR by surface water augmentation with incorporation of DDW's recommendations.

City of Westlake Village
The AWT facility pipeline(s) will need to pass through the City of Westlake Village to reach Las Virgenes Reservoir. An encroachment permit will be needed to construct these pipelines, including traffic control plans. The AWT facility site may also be in the City of Westlake Village, although the AWT facility would be exempt from local building codes and planning ordinances input from the City is necessary.

City of Agoura Hills
If the AWT facility is located in the City of Agoura Hills, pipelines will need to be installed in public streets requiring an encroachment permit. Input from the City will be necessary, although the AWT facility would be exempt from local building codes and planning ordinances.

Camrosa Water District

The City of Thousand Oaks has an existing agreement with Camrosa Water District for use of the Hill Canyon WWTP effluent. This agreement does not prohibit the City from accepting brine, but may be an issue requiring resolution should brine disposal to the SMP not be possible.

Department of Transportation (Caltrans)

Depending on the selected location of the AWT facility, an encroachment permit will be needed to cross Highway 101 for either a 20-inch effluent pipeline, 24-inch recycled water or an 8-inch brine pipeline, depending on the location of the AWT facility. This crossing will likely be in the vicinity of Lindero Canyon Rd. and require tunneling.

4.7.4 Funding

Scenario 4 could be eligible to receive state and federal funding in the form of loans and grants to help cover costs of planning, design, and construction of water treatment facilities. The Water Recycling Funding Program (WRFP) implemented by the California State Water Resources Control Board (SWRCB) aims to promote the increased use of recycled municipal wastewater in order to increase the amount of available freshwater. WRFP distributes funds from three sources: (1) Proposition 1, (2) Proposition 13, and (3) the Clean Water State Revolving Fund (CWSRF). Additional funding can be secured through the U.S. Bureau of Reclamation's WaterSMART program, which offers competitive grants for projects involving advanced water treatment as well as for efforts to improve water and energy efficiency.

Other funding opportunities are available at both the state and federal levels to help finance the proposed project. Many of these opportunities are based on revolving funds, meaning that funding would take the form of low-interest loans to ensure a constant funding source for future projects.

The JPA has hired a Financial Consultant to assess these and other possible sources of funding for Scenario 4.

4.7.5 Public Outreach

As part of the BODR process and during the previous project cycle (i.e., the Recycled Water Seasonal Storage Plan of Action), the JPA took a proactive approach to stakeholder engagement and involved a long list of interested parties during the development phases of this project. The JPA intends to continue this proactive approach, continuing to engage their stakeholders, develop project champions, and begin public outreach and education relative to the issues that surround Scenarios 4 and 5. The JPA has retained the services of Katz and Associates, a communication firm specializing in water programs. The firm will assist the JPA in involving the community, NGOs and local leaders to help navigate the political, social, and technical hurdles that will need to be overcome in order to realize either of the scenarios described in this BODR.

4.7.6 Environmental

A very preliminary environmental review was conducted for the potential AWT facility sites. Using the Information for Planning and Conservation (IPaC) planning tool, critical habitats were identified for two of the sites; potential sites #3 and #7. The critical habitat is for *Lyons*

Pentachaeta, which is a native plant and is listed by the State of California and the Federal Government as endangered. Information from this review can be found in **Appendix J**.

Once a scenario has been selected, an environmental consultant will be brought on to conduct a full Environmental Impact Report focused on both CEQA and the National Environmental Policy Act (NEPA) to assess the impacts Scenario 4 may pose to the environment. The report would include the impact of the new AWT facility, new recycled water piping, new advanced purified water piping and brine pipeline and include measures to mitigate the impacts.

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Section 5 –

Scenario 5

Section 5
Scenario 5

5.1 SCENARIO DESCRIPTION

In Scenario 5, surplus recycled water produced at the Tapia Water Reclamation Facility (Tapia WRF) will be pumped to Los Angeles Department of Water and Power's (LADWP) Encino Reservoir for seasonal storage. Some of this water will be pumped back to supplement summertime recycled water demands in the Las Virgenes Municipal Water District (LVMWD) and Triunfo Sanitation District (TSD) service areas, while the remainder is either stored for future use, used to meet demand from new recycled water customers in all three service areas, or potentially delivered to the Donald C. Tillman Water Reclamation Plant (DCTWRP) for use in Los Angeles' proposed groundwater replenishment project.

As shown in the schematic diagram presented in **Figure 5-1**, Scenario 5 will require construction of approximately 15 miles of new 24-inch pipeline extending east from Recycled Water Pump Station (RWPS) East to Encino Reservoir. The existing RWPS East must be expanded and a new 12 million gallons per day (mgd) pump station will need to be constructed at Encino Reservoir to return recycled water to the distribution system. Additional improvements at Encino Reservoir will also be required to maintain water quality.

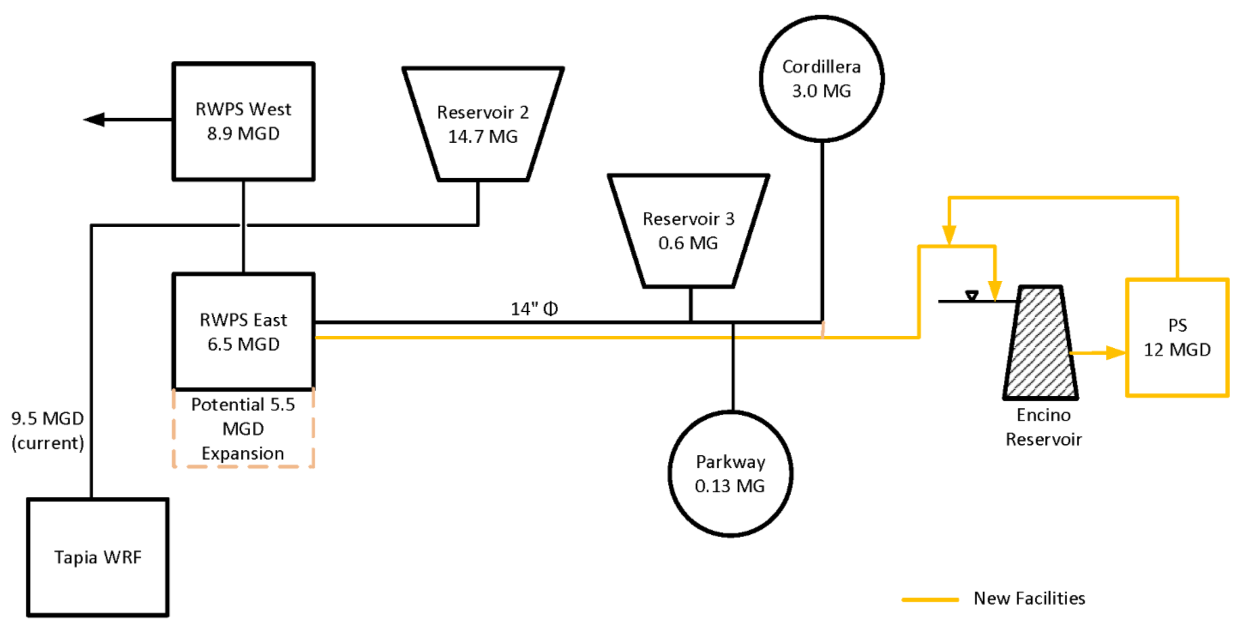

Figure 5-1
Scenario 5 Flow Schematic

An agreement with LADWP for use of the Encino Reservoir facility is the critical element of Scenario 5. This agreement is required to provide the needed storage capacity for excess recycled water available on a seasonal basis. The ability to reach agreement will depend in large part on LADWP's position related to maintaining the reservoir for emergency water storage, maintaining adequate storage capacity for storm events and completing a seismic stability study of the dam. Governance, ownership of facilities, shared cost, if any, and other terms also need to be negotiated. Discussions with LADWP on this and other issues are on-going.

5.2 AVAILABLE RECYCLED WATER ANALYSIS

A detailed analysis was conducted in **Section 3** to determine the amount of surplus recycled water available under Scenario 5. The analysis started with daily recycled water production at the Tapia WRF for the period from 2001 to 2015. For the same period, the total monthly recycled water sold (demand) for each month was distributed evenly as daily values. These daily recycled water demand values were then subtracted from the Tapia WRF production to determine the amount of surplus water available daily. For any days that show surplus water, it is assumed that that water will be pumped to Encino Reservoir for storage and eventual distribution. For any days where demand exceeded supply, the system was in deficit and the average amount of yearly deficit from 2001 to 2015 was used to estimate how much water would be brought back from the reservoir to satisfy peak demand.

The results of this analysis are shown in **Table 5-1** for each of the 15 years of record, including range of data and average. The data is separated into columns representing recycled water in gross surplus and deficit. There is considerable variation between years, and this reflects the range of operation that can be expected for Encino Reservoir. From the 15 years of record an average amount of 3,102 acre-feet (AF) of gross surplus was calculated. The amount of water that will be pumped back to meet summertime recycled water demand, or the deficit in **Table 5-1**, averages 280 AF over the 15 years of record.

The volumes of gross surplus and deficit are displayed graphically in **Figure 5-2.** There is a trend toward lower surplus water volumes seen in the historical record, which is likely due to efforts in the service area towards water conservation, as well as economic conditions and drought.

Table 5-1
Gross Seasonal Surplus and Deficit

Year	Surplus (AF)	Deficit (AF)
2001	5,018	12
2002	3,267	35
2003	3,445	168
2004	3,164	166
2005	3,625	103
2006	3,544	320
2007	2,898	259
2008	3,177	392
2009	3,243	208
2010	3,732	283
2011	3,446	362
2012	2,641	498
2013	1,988	512
2014	1,901	706
2015	1,448	12
Minimum	**1,448**	**12**
Average	**3,102**	**280**
Maximum	**5,018**	**706**

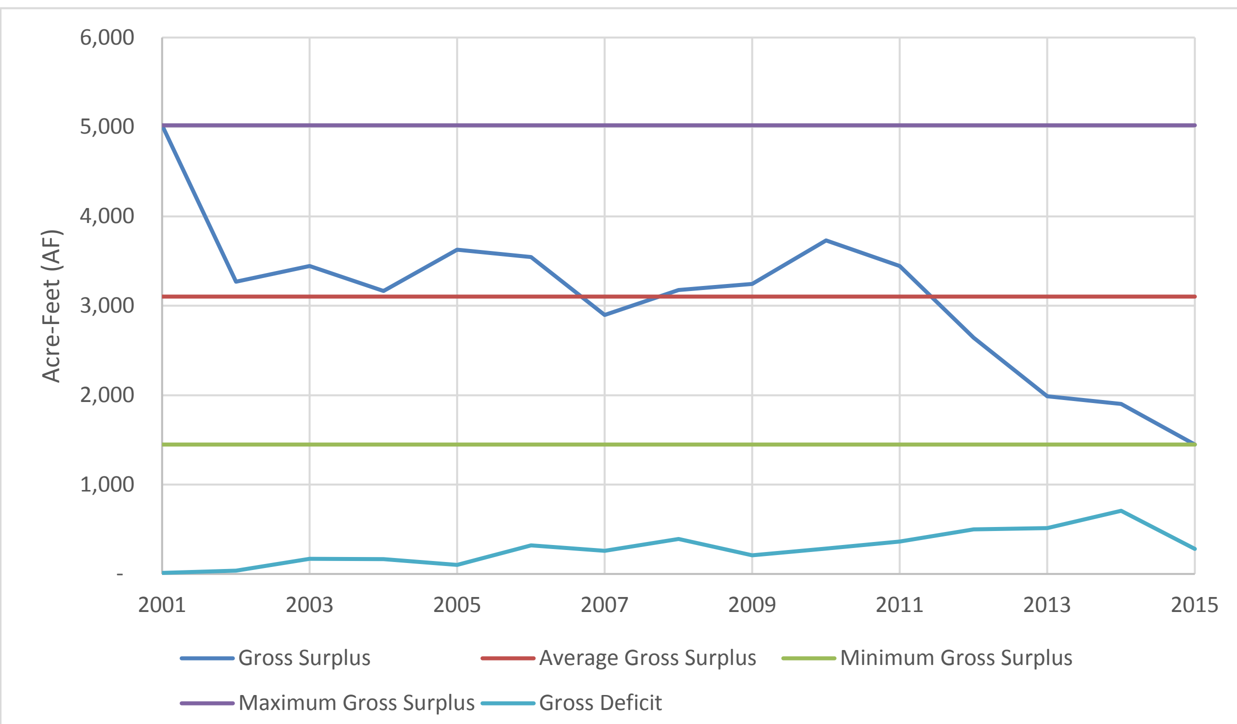

Figure 5-2
Scenario 5 Available Storage

5.2.1 Evaporation and Seepage

Once water is stored in Encino Reservoir, the JPA will have to account for new losses associated with an open surface reservoir. In general, water is added to an open surface reservoir via precipitation and runoff, while water is lost via evaporation and seepage. No recent records of reservoir inflows and outflows are available from LADWP and it was necessary to estimate their contribution to the yearly water balance. The rate of evaporation is assumed to be about equal to the rate of precipitation and runoff over the long term. However, this may not always be the case during times of drought or wet weather when the amount of water gained or lost may vary substantially. Seepage is dependent on the size of the reservoir and the soil characteristics, and for the purposes of this analysis was estimated to be 400 AFY. This seepage loss was subtracted from the surplus amounts above to find a net available recycled water surplus.

5.2.2 Future Recycled Water Supply

The amount of water available to the JPA is an important part of predicting future reservoir operations and anticipated costs. An analysis of future supply is discussed in **Section 3.1.5**. That analysis determined the values presented in **Table 5-2** below. This table adds a column for net surplus recycled water, which is the gross surplus recycled water minus a 400 AFY loss to seepage. **Table 5-2** shows how the net surplus recycled water in 2016 and 2035 can vary greatly depending on the amount of available supply. Future demand was estimated in **Section 3.1.5** as an additional 2,395 AFY of demand added over the next 20 years, and was based on specific new customers within the LVMWD and TSD service areas, as well as new customers in the City of Los Angeles that could be served from the new pipeline to Encino Reservoir. This analysis is important to how the reservoir will be operated in the future to ensure that reservoir levels remain relatively constant and how much excess water will be available to sell to additional customers nearby.

Table 5-2
Current and Future Recycled Water

Scenario 5					
Year	**Recycled Water Supply from Tapia WRF (AF)**	**Supply plus Average Calculated Imported Supplement (AF)**	**Demand* (AF)**	**Gross Surplus Recycled Water (AFY)**	**Net Surplus Recycled Water (AFY)**
2016	7,060 - 9,363	7,347 – 9,650	6,547*	800 – 3,102	400 – 2,702
2035	10,590 – 12,320	10,877 – 12,607	8,942**	1,935 – 3,665	1,535 – 3,265

*Based on the 2001-2015 average
**Additional 2,395 AF demand anticipated from infill demand, Thousand Oaks Boulevard Extension, Oak Park HOA Conversions, Westlake Conversions, Woodland Hills Extension, El Caballero Country Clubs

5.3 TREATMENT REQUIREMENTS

There is little treatment involved in Scenario 5 for reuse since the water coming from Tapia WRF has already been treated to Title 22 recycled water standards. However, storage within an open reservoir will require that the water be strained and chlorinated before use.

5.3.1 Straining

Recycled water withdrawn from the reservoir will need to be passed through self-cleaning strainers to remove any small debris that could clog irrigation systems. These units would also likely be housed in the new Encino Reservoir Pump Station, discussed in **Section 5.4**. The strainers are designed to be self-cleaning, and generate a small amount of waste wash water that would be discharged to the on-site sewer.

5.3.2 Chlorination

Following pumping, chlorine will be added to control biological growth in the recycled water pipelines. A new liquid chlorine system could be incorporated into the new Encino Reservoir Pump Station, or if possible, an arrangement made with LADWP to use the existing gaseous chlorine system already on-site. The LADWP system is designed to chlorinate the emergency release of water from the reservoir, and can easily meet the relatively smaller chlorine needs of Scenario 5.

5.4 CONVEYANCE AND NEW FACILITIES

In order for recycled water to be stored at Encino Reservoir, it will have to be first pumped from Tapia WRF to Reservoir 2 and then to Cordillera Tank through RWPS East. These are all existing facilities that will continue to be maintained and used as-is except RWPS East, which will have to be upgraded to handle the additional flows. A new recycled water pipeline parallel to existing recycled water pipelines and extending to the reservoir will have to be constructed. New facilities at Encino Reservoir will include a new pump station, aeration and mixing system, strainers, and chlorine system. These have only periodic needs for operation or maintenance, and could be monitored remotely, so there would be no need for permanent staff; just weekly site visits. Access to the reservoir site would need to be coordinated with LADWP.

5.4.1 Recycled Water Conveyance

Existing facilities for recycled water conveyance in Scenario 5 include Tapia WRF, Reservoir 2, RWPS East, Cordillera Tank and Encino Reservoir. There is also an existing network of recycled water pipelines, some of which must be upgraded along with the addition of new pipelines to extend the system towards the reservoir. The recycled pipelines that currently connect RWPS East to the rest of the recycled water system would be interconnected to a new 24-inch diameter conveyance pipeline to accommodate the higher flows being sent to the reservoir.

Woodland Hills Water Recycling Project

The Woodland Hills Water Recycling Project is a current project that may deliver recycled water from the LVMWD recycled water system to customers within the LADWP service area. The project begins at Parkway Calabasas and ends at Serrania Avenue Park as shown in **Figure 5-3**. This pipeline can be utilized in Scenario 5 to help convey flows to Encino Reservoir, if it is upsized from its local service capacity to a 24-inch diameter pipeline.

Under a separate task order, RMC Water and Environment completed a Technical Memorandum, the *Woodland Hills Water Recycling Expansion Concept Evaluation.* The memorandum:

1. Evaluated potential pipeline alignments.
2. Identified and described demand characteristics for the Braemar and El Caballero Country Clubs, two additional recycled water customers along the alignment.
3. Described approaches to sizing storage delivery facilities.
4. Evaluated and identified hydraulic limitations within the JPA system.
5. Described the methodology for sizing the pipeline to Encino Reservoir.
6. Provided a conceptual level cost estimate for the alignments.
7. Identified potential connection points to convey excess recycled to DCTWRP via sanitary sewers.

The memorandum is included as **Appendix K**.

Pipeline Alignments

There are two alternatives for the piping alignment to Encino Reservoir; Wells Alignment and Mulholland Alignment. Both alignments would extend roughly 15 miles from Reservoir 2 to Encino Reservoir, and are described in detail below. Calculations for both pipeline alignments are found in **Appendix C**. **Figure 5-4** depicts both alignments.

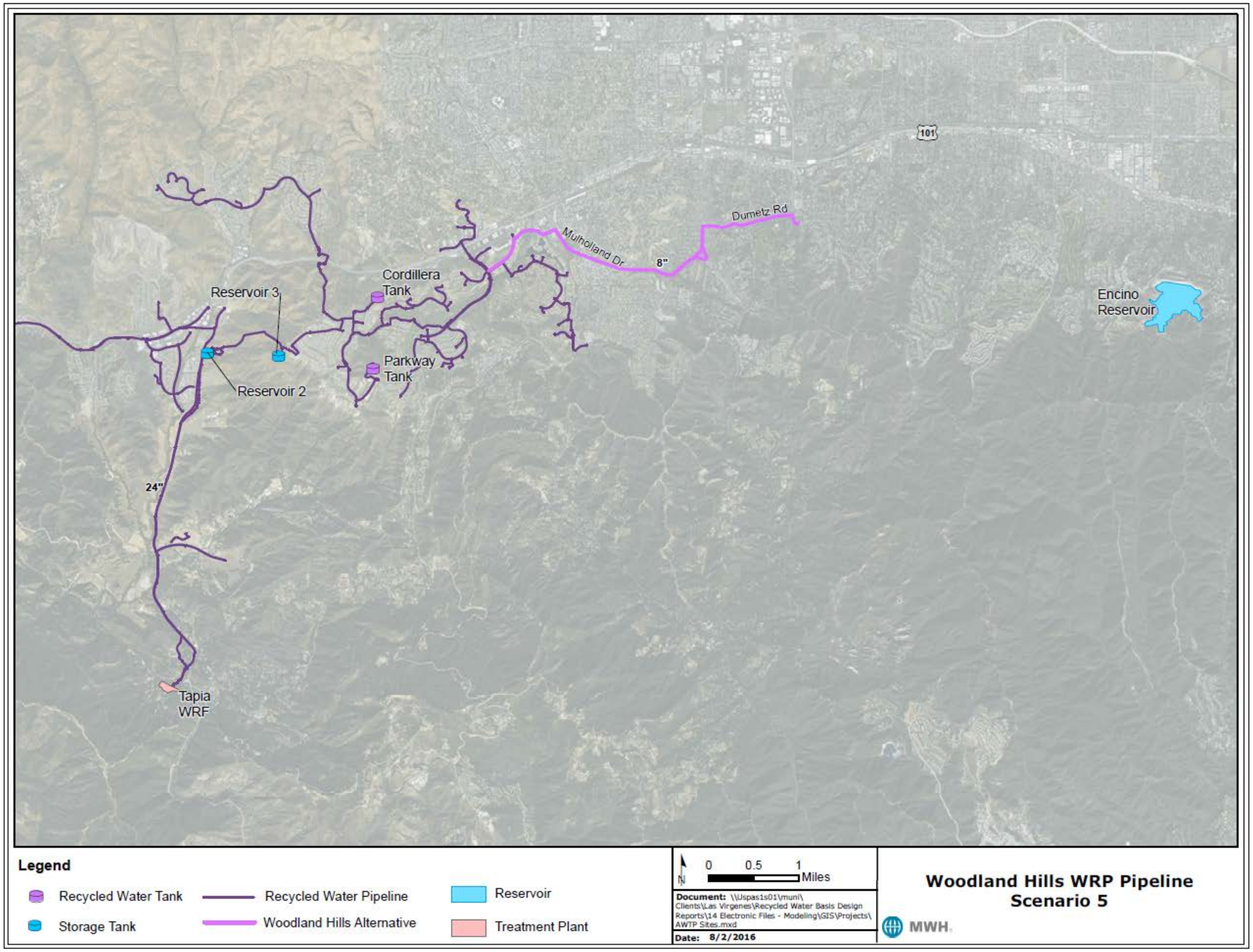

Figure 5-3
Woodland Hills Water Recycling Project Pipeline

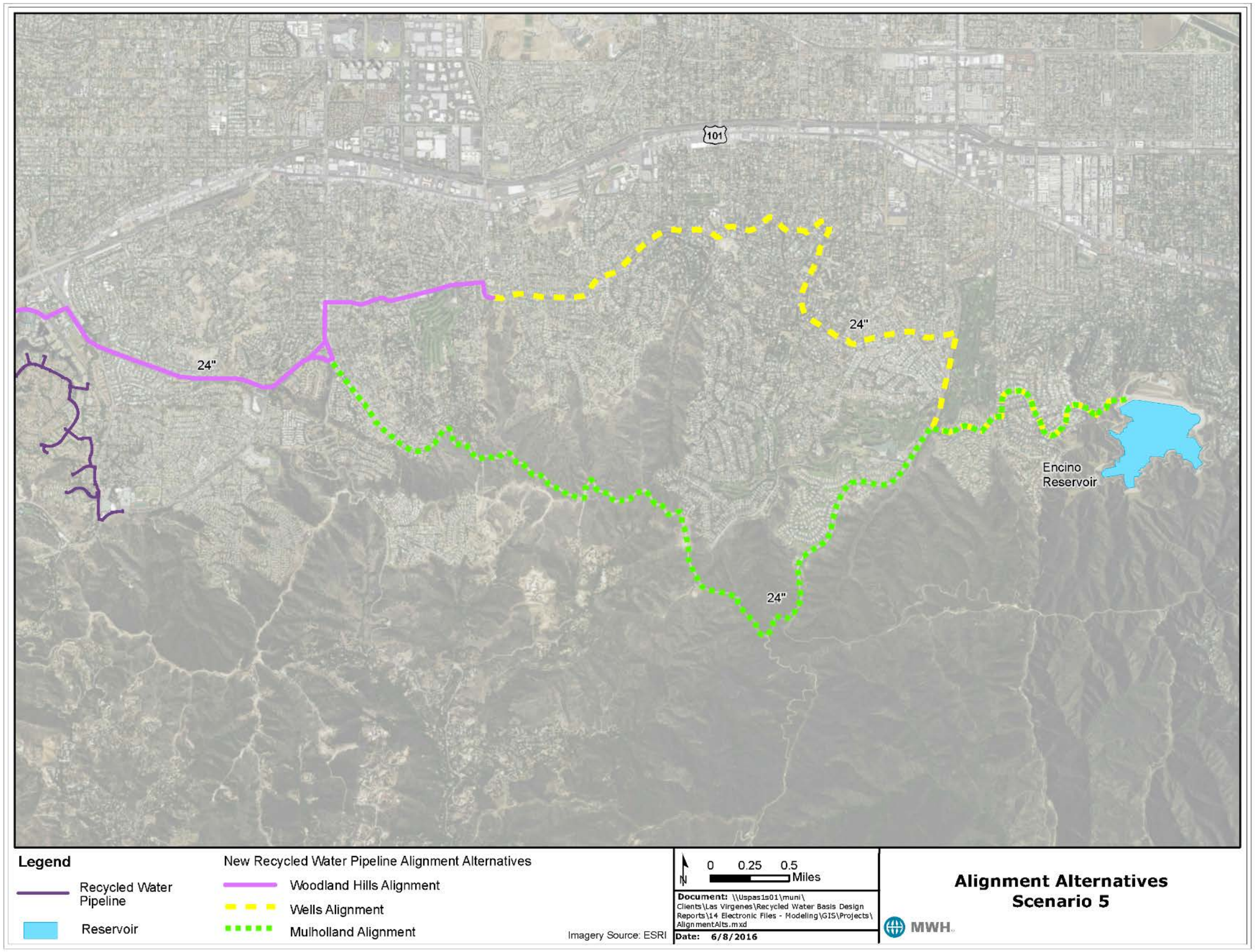

Figure 5-4
Pipeline Alternative Alignments

Wells Alignment

The Wells Alignment will utilize more of the proposed pipeline in the Woodland Hills Extension. However, this alignment will run through residential neighborhoods in Encino that may have opposition to the alignment. It will also require upgrades of RWPS East along, with a new 1,800 horsepower (hp) pump station at Encino Reservoir.

The Wells Alignment hydraulic profile is depicted in **Figure 5-5**. Due to areas of high pressures in the pipeline, this alignment will require around 27,500 linear feet (LF) of high pressure rated pipeline.

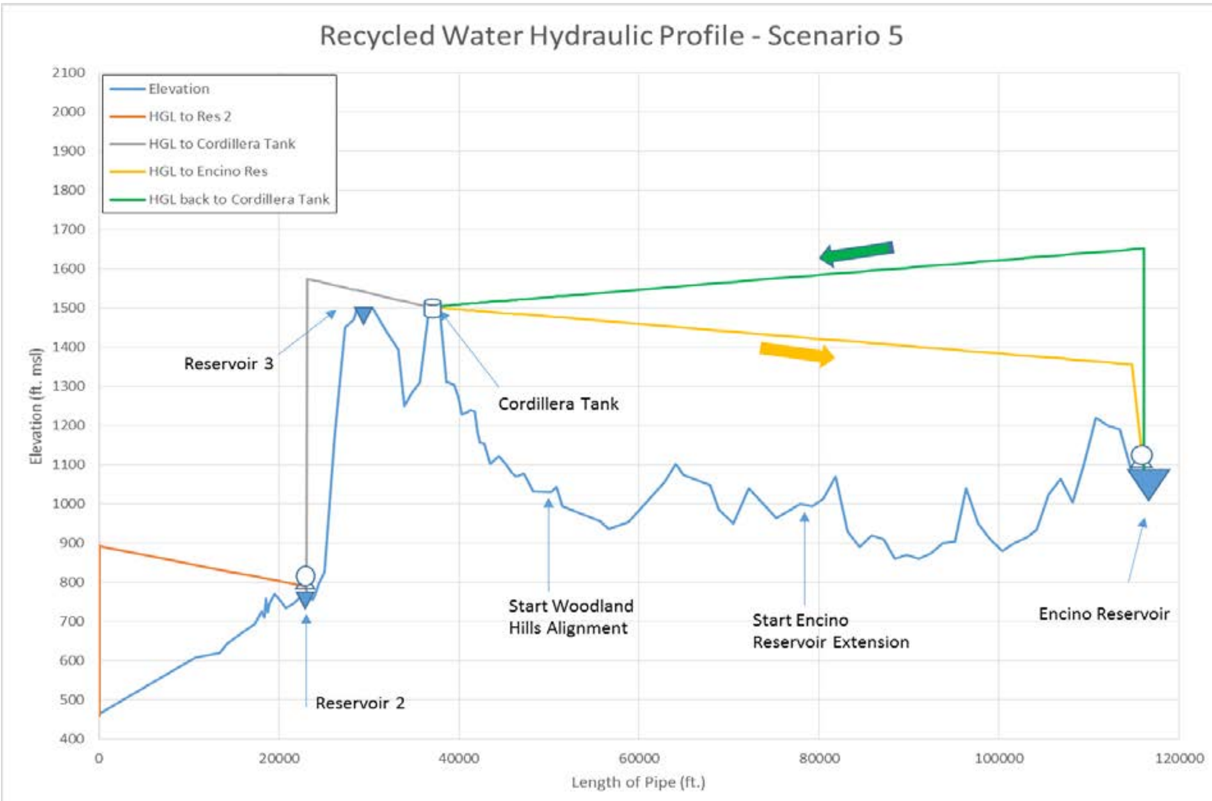

Figure 5-5
Wells Alignment Hydraulic Profile

Mulholland Alignment

The Mulholland Alignment will avoid many of the residential neighborhoods in Encino that the Wells Alignment would impact. However, because the Mulholland Alignment extends farther south and utilizes less of the proposed Woodland Hills Extension, it would require roughly 900 feet (ft) of additional new piping to connect the Woodland Hills Extension to Encino Reservoir.

The Mulholland Alignment has a higher maximum elevation as seen in **Figure 5-6**. The high pressures resulting from this elevation requirement would necessitate higher pressure rated pipes in portions of the alignment. This alignment would also require a 1 million gallon (MG) water tank at the highest point and at least one additional 1,200 hp pump station to convey water to the new tank. Based on roughly 600 ft of elevation drop into Encino Reservoir, there is a possibility of energy generation for the Mulholland Alignment. The new pump station at the reservoir was sized to at least 2,200 hp to account for the 790 ft of elevation grade that must be overcome for pumping back to the East recycled water system. Upgrades to the RWPS East will also be required for this alignment.

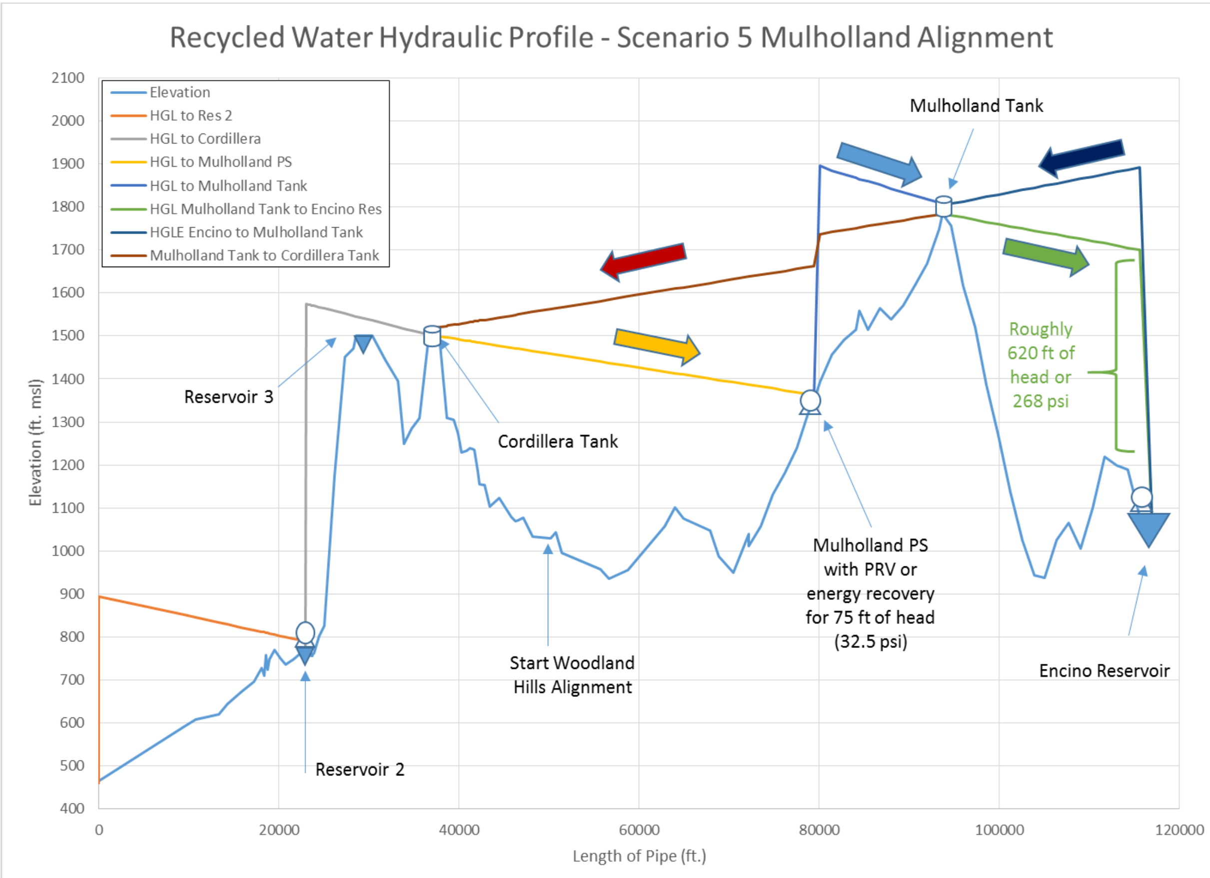

Figure 5-6
Mulholland Alignment Hydraulic Profile

The pipeline from Reservoir 2 to Encino Reservoir will need to be 24 inches in diameter, and it is assumed that all new piping will be provided for either alignment the full distance. However, when the hydraulic head in either alignment is greater than 600 ft (and thus the pressure in the pipeline is estimated to exceed 260 pounds per square inch [psi]), thicker-walled (more costly) piping is required to handle the higher pressures. The Mulholland Alignment requires more high pressure piping due to the greater elevation differences over a longer distance, which is reflected in **Table 5-3**.

Land acquisition costs and additional facility costs are also incurred for the Mulholland Alignment to accommodate the additional pump station and new tank. These costs are included in **Table 5-3** as well. There is roughly a $24M difference between the two alignments. Due to the significant difference in cost, the Wells Alignment is analyzed in the section.

Table 5-3
Alignment Comparison

Item	Unit Price	Wells Alignment		Mulholland Alignment	
		Quantity	Cost	Quantity	Cost
Standard Pressure Pipeline	$450/LF	52,400 LF	$23,580,000	28,300 LF	$12,735,000
High Pressure Pipeline	$500/LF	27,500 LF	$13,750,000	52,500 LF	$26,250,000
Pump Station on Mulholland Rd.	$6,000/HP	--	--	4x300 HP	$7,200,000
Mulholland Tank	Lump Sum	--	--	1 MG	$3,000,000
Pump Station at Encino Reservoir	$6,000/HP	4x600 HP	$15,000,000	5x600 HP	$18,000,000
Regeneration at Encino Reservoir	Lump Sum	--	--	2x400 HP	$1,500,000
Land Acquisition	Lump Sum	--	--	1 acre	$1,000,000
Subtotal		$52,600,000		$69,685,000	
Contingency (25%)		$13,150,000		$17,421,250	
Engineering and Admin (15%)		$7,890,000		$10,452,750	
Total Construction Cost (rounded)		**$73,640,000**		**$97,559,000**	

Note: Financial savings due to energy recovery are not shown in the above table

Pump Stations

Scenario 5 requires upgrades to RWPS East and the construction of at least one new pump station at the reservoir. Due to the additional flow through the East recycled water system, the RWPS East will need to be expanded from 6.5 mgd to up to 12 mgd. The additional 5.5 mgd will require an extra 1,000 hp of power.

Water from the reservoir will also have to be pumped out to either customers or for other uses, as described in **Section 5.6**. 12 mgd is the peak amount of flow during winter when recycled water demands are low and most of the surplus water from Tapia WRF will be stored in Encino Reservoir. With an elevation head constraint of 650 ft and an assumed efficiency of 75%, the new pump station at Encino Reservoir must be sized for at least 1,800 hp to meet peak demand. The new pump station may be sited as shown in **Figure 5-7**.

Figure 5-7
Proposed Encino Reservoir Pump Station

5.4.2 Utility Research

A DigAlert search was conducted to locate possible utilities along the Wells Alignment. A list of utilities from DigAlert is found in **Appendix F**. Once the predesign for these elements is initiated, full As-Built and Atlas Map records of the utilities found in these alignments will need to be obtained from the identified utilities. It is recommended that this process take place as close to pre-design as possible so information used to design the final alignments are as up-to-date as possible.

5.4.3 Geotechnical Investigation

A preliminary geotechnical investigation was conducted to assess soil quality, fault lines and significant geological formations in the area concerned by Scenario 5. Reports and maps from the State of California's Department of Conservation were assessed and can be found in **Appendix G**. No fault lines were detected in the project area and since the pipeline alignment passes through residential areas, there are no major geotechnical concerns for the pipeline.

5.5 ENCINO RESERVOIR

Encino Reservoir is located within the City of Los Angeles south of Ventura Blvd., just north of Topanga State Park. The reservoir is owned by LADWP and is currently used as emergency water storage for the surrounding area. The reservoir has watershed area of roughly 800 acres as listed in the Division of Safety of Dams (DSOD) reports. Encino Reservoir has a total capacity of 9,789 AF but typically maintains a volume of about 7,300 AF. In 2005, work was completed on a new filtration plant and pumping station next to the reservoir to meet new surface water treatment regulations.

The Encino Dam was constructed at Encino Reservoir in 1924 and is routinely inspected by the DSOD. Characteristics of both the Encino Reservoir and the Encino dam are found in **Table 5-4** below.

Table 5-4
Encino Reservoir and Dam Characteristics

Dam Type	Earth
Status	Certified
Year Built	1924
Hazard Class	4C
Dam Height	168 ft.
Crest Width	30 ft.
Dam Length	1,850 ft.
Crest Elevation	1,088 ft.
Spillway Crest Elevation	1,048 ft.
Volume	3,158,406 yd^3
Total Freeboard	13 ft.
Operational Freeboard	13 ft.
Drainage Area	1.4 mi^2
Mean Annual Precipitation	20 in.
Reservoir Capacity	9,789 AF

Source: California Natural Resources Agency, Department of Water Resources, DSOD

5.5.1 Dam Seismic Study and Drain

Encino Reservoir was taken out of regular service in 2002, thus resulting in minimal inflow and outflow. A seismic stability study is currently on hold for Encino Dam, and is not critical due to the reduced water level. Increased water level and use of Encino Reservoir would necessitate the completion of the seismic stability study, which may result in additional rehabilitation required before full use. However, there are currently no known seismic issues with the dam.

There is no dedicated blow-off or drain line for the reservoir that could take water directly to the Los Angeles River or storm drain in case of an emergency. In the event of an emergency, Encino Reservoir would be drained by releasing water into the local potable water system. Encino Reservoir is currently designated by LADWP as an emergency supply reservoir for use during severe seismic events or other catastrophic water system failures. If converted to recycled water, it is unclear if Encino Reservoir could continue to serve in this emergency supply role.

5.5.2 Reservoir Operations

Encino Reservoir is currently out of service but is equipped with a microfiltration (MF) water treatment plant that is capable of producing up to 10 mgd of potable water to supplement the drinking water system. It is also considered to be a source of emergency water use. **Figure 5-8** shows the historical low volume as measured from 2011-2013. The reservoir is typically operated at a level around 7,300 AF, well below the spillway crest.. If stormwater raises the level of the reservoir, it will be drained down to the safety level. Due to concerns over dam safety and the fact that the reservoir is not normally used to serve customers, LADWP has historically kept the reservoir at a lower level. Should the reservoir be used in Scenario 5, it would likely be necessary to operate the reservoir at more variable water levels based on the amount of surplus recycled water produced at Tapia WRF and used in the subsequent season.

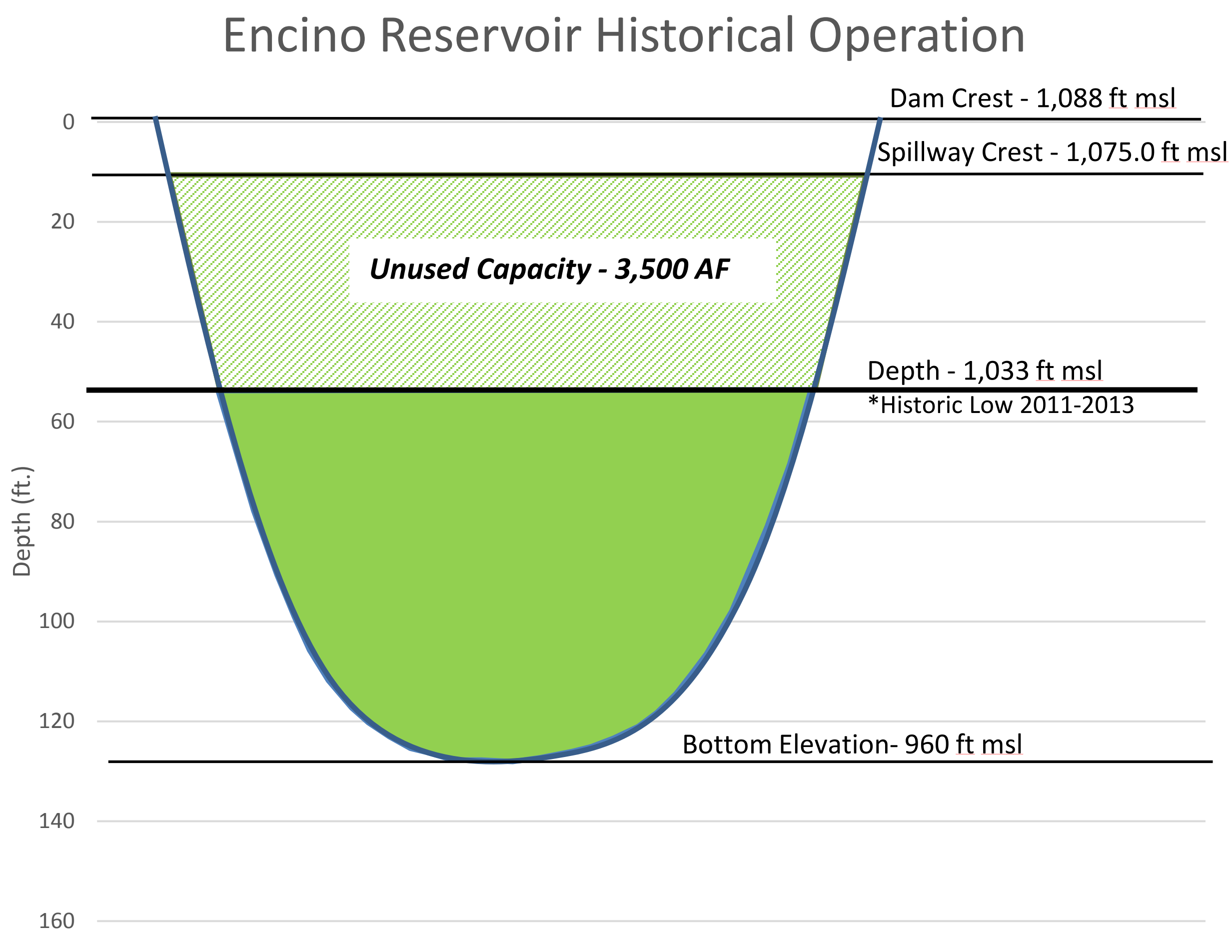

Figure 5-8
Encino Reservoir Historical Operations

Proposed Reservoir Operations

As Tapia WRF produces recycled water, it will be pumped through RWPS East over to Encino Reservoir. Depending on the season or demand in the area, some of the recycled water will be sent to customers in the LVMWD and TSD service areas, especially during the summer. However, in lower demand months, the majority (if not all) of the recycled water will be stored in Encino Reservoir and would be pumped back into the recycled water system or out of the reservoir for other uses described in **Section 5.6** below. Therefore, the amount of surplus recycled water being stored in the reservoir will vary throughout the year, which could create more fluctuating reservoir water levels. A reservoir operations model can help predict how much recycled water will be entering the reservoir so that water levels remain relatively constant from year to year.

To create a complete reservoir operations model, recent data, such as pumping data, daily reservoir volumes and accurate precipitation and evaporation data is required. This data was not available for Encino Reservoir; however, an incomplete operations model was still created to document historical operations and predict how the reservoir can be operated in the future, especially during times of peak supply. The model was created using a fiscal year (2000-2001) of historical data from Encino Reservoir and evaporation and rainfall data from its neighboring reservoir, Las Virgenes Reservoir. While this model will be a useful tool for estimating the amounts of water that will need to be withdrawn each year in order to accommodate the following year's surplus, more recent monitoring of the reservoir and data is necessary in order to further calibrate the operations model.

Based on the supply and demand analysis discussed in **Section 3** and **Section 5.2**, the average amount of capacity required in Encino Reservoir to store surplus recycled water would be 3,102 AF. This amount could be as high as 5,018 AF and as low as 1,448 AF based on the last 15 years of historical records. It will be vital for the JPA and LADWP to have a robust operations model and projections of anticipated supply and demand in order to anticipate the amount of necessary capacity in the reservoir from year to year based on the large fluctuations of available surplus.

A concern for the operation of Encino Reservoir is when recycled water supply is much greater than recycled water demand. This means that the reservoir could be fully utilized in its storage capacity. However, if the reservoir is close to exceeding its capacity, due to the addition of too much recycled water or a large storm event that increases stormwater runoff into the reservoir, then the surplus water would have to be drained to the sewer system or the Los Angeles River.

5.5.3 Reservoir Water Quality

Despite the high quality of Tapia WRF recycled water, there are still some nutrients and organic materials present, and with long term storage, this could lead to potential water quality issues that need to be addressed.

Similar Facilities for Storage of Recycled Water

MWH investigated similar facilities in the southwest region to identify potential water quality, operational and maintenance issues for storage of recycled water. Irvine Ranch Water District (IRWD) operates three recycled water storage reservoirs, totaling 4,800 AF in storage capacity. Discussion with the operations staff at IRWD identified the need for reservoir aeration to maintain oxygenated conditions throughout the water column. This helps to control the growth of algae and reduce potential odors. Also, straining of particulates and rechlorination is needed to help maintain the recycled water distribution system. Vector control may or may not be needed depending on reservoir conditions and the proximity of housing developments. The JPA and LADWP may need to address vector control by installing insect mitigation measures along the shore of the reservoir.

Water Quality Compliance

The Tapia WRF produces a high quality recycled water that meets all Title 22 requirements. The recycled water still has organic content that will exert an oxygen demand during storage in Encino Reservoir. To help meet this oxygen demand and prevent anoxic conditions from developing into an algae, odor, or similar water quality issues, the installation of an aeration and mixing system is recommended for Encino Reservoir. This will help minimize any nuisance conditions and maintain water quality for subsequent recycled water uses.

A reservoir water quality model can be used to predict how mixing will occur in the reservoir during different times of the year and the best point of addition of the treated recycled water within the reservoir. An important parameter of a reservoir water quality model is the temperature profile of the reservoir, specifically how the temperature profile changes seasonally.

While no data was collected from LADWP for the temperature variations within the reservoir, it can be assumed that the thermocline will form similarly to that of the Las Virgenes Reservoir, which was discussed in **Section 4**. In the winter, the reservoir is expected to be fully mixed and water temperature to be fairly constant throughout the water column. However, as the air temperature increases into summer, a thermocline will develop and its depth will increase over the summer months. In early winter, the thermocline will fully dissipate and the reservoir will turnover, resulting in a return to a fully mixed condition. The point of addition of the recycled water may be dependent on how the reservoir stratifies to encourage more mixing as the water is discharged into the reservoir. The wind on the surface of the reservoir can also create more mixing but this does not reach the lower depths when a thermocline is present. However, during periods when the thermocline is more pronounced, additional mechanical mixing and aeration may be necessary to deal with water quality issues.

Various types of aeration and mixing systems could be considered, but for now it is assumed the system consists of two air compressors, a conveyance pipeline to Encino Reservoir, and a grid of distribution piping anchored just above the reservoir bottom. The extent of the distribution grid will need to be determined by further study, but would typically extend for several acres around the reservoir outlet. The compressors would likely be housed in the proposed Encino Reservoir Pump Station at the base of the dam to contain and control noise, and are assumed to operate year-round.

Currently, total dissolved solids (TDS) data for Encino Reservoir is not available. In order to implement Scenario 5, it is important that TDS readings be taken from Encino Reservoir during construction of the infrastructure. It is assumed that the TDS concentration of the reservoir is less than the influent flow from Tapia WRF, which averages about 750 milligrams per liter (mg/L) TDS. Based on a yearly addition of 3,102 AF of recycled water from Tapia WRF on average per year, and assuming complete mixing of the reservoir over a year, the TDS concentration of the reservoir would be expected to reach 750 mg/L in less than four years. Over this period of time, the reservoir water quality is expected to gradually become similar to the recycled water. During this transition, slight adjustments may need to be made to ensure proper mixing and to provide proper treatment before recycled water is discharged from the reservoir.

Water Quality Sampling Plan

When LADWP constructed the treatment facilities at Encino Reservoir, a water quality monitoring plan was put in place in compliance with drinking water regulations. This monitoring plan was discontinued when the treatment plant was taken out of service. If Scenario 5 is implemented, a new water quality monitoring plan should be created to monitor recycled water in the reservoir and ensure that quality is being maintained and not degraded. It is also recommended that the monitoring plan include sampling of recycled water at the discharge of the proposed Encino Reservoir Pump Station to ensure compliance with Title 22 requirements.

Water Quality Model

A water quality model will allow the JPA and LADWP to assess the impacts of mixing the new water quality of recycled water from Tapia WRF with the stored water that is currently in the reservoir. In order to set up a water quality model, bathymetry of Encino Reservoir was provided which shows the elevation and contours of the bottom of the reservoir. This information was used to set up a CE-QUAL-W2 model. CE-QUAL-W2 is software developed by Portland State University to use as a water quality and hydrodynamic model in two dimensions (longitudinal-vertical) for rivers, estuaries, lakes, reservoirs and river basin systems. Due to the lack of current operational data for the reservoir, such as inputs, outputs, reservoir levels, and temperature profiles, there is not currently enough information to calibrate this model to current conditions. It is recommended that prior to executing Scenario 5, more operations data be gathered for the reservoir so that this model can by developed further and used for future mixing analysis and quality implications.

5.6 OPTIONAL USES FOR UNALLOCATED SURPLUS RECYCLED WATER

Water stored in Encino Reservoir will be used to meet recycled water demands, including both peak summertime needs and future demand growth. However, these needs will not fully utilize the net surplus water stored in the reservoir. This unallocated surplus recycled water will remain in the reservoir until a customer is identified or discharge is required to maintain reservoir water level. There are multiple options for how this unallocated surplus water can be addressed, including new recycled water customers, discharge to the sewers, or discharge to the Los Angeles River.

5.6.1 Raw Wastewater Connection

The JPA currently has a connection in Calabasas that ties into the City of Los Angeles' wastewater collection system. This connection has a capacity of roughly 1 mgd and allows for the JPA to send wastewater generated in the eastern portion of the LVMWD service area directly to the City's system. When this connection is used to convey wastewater to Los Angeles Sanitation's (LASAN) system, the influent to Tapia WRF is reduced resulting in less effluent. If Scenario 5 is pursued and there is an exchange of water with LADWP as part of the agreement, it is recommended that this connection be utilized and possibly expanded in order to allow the JPA to send wastewater to the LASAN's system. However, it is anticipated that the current connection would not be large enough to satisfy the entire unallocated recycled water surplus and should only be considered a part of an overall operations strategy.

5.6.2 Alternatives for Recycled Water Connection

Multiple alternatives to connect Encino Reservoir to the surrounding recycled water system were investigated by RMC in their Technical Memorandum, *Woodland Hills Water Recycling Expansion Concept Evaluation.* These and other alternatives have been investigated, including a direct connection into the recycled water system, direct connection to the DCTWRP, discharge to the sewer or discharge to the Los Angeles River. A number of these alternatives are summarized in **Figure 5-9** and in the following sections.

Alternative A: Discharge to DCTWRP

The surplus recycled water could be delivered to the DCTWRP for additional reuse by LADWP. The alignment, shown in **Figure 5-9**, is approximately 4.4 miles and involves crossing both Highway 101 and the Los Angeles River. The disadvantage of this approach is the cost of the pipeline and that Title 22 recycled water would be discharged back to a sewer for retreatment.

Alternative B: Discharge to Sewer

Surplus recycled water could be discharged directly to the sewer system where it will be conveyed to DCTWRP for retreatment and delivery to LADWP customers. This could be done by constructing pipelines from Encino Reservoir to suitable trunk sewers in the area, as exampled in **Figure 5-9**. The advantage of this approach is it would avoid pumping. Alternatively, water could be released from the recycled water transmission system directly to trunk sewers that it crosses on its way from the JPA service area to the reservoir. The advantage of this approach is that no major infrastructure is required and no disruption to neighborhoods will occur. However, pumping energy would be lost. In either case, Title 22 recycled water will be retreated.

Alternative C: Connection to Sepulveda Recycled Water System

A direct connection to the Sepulveda recycled water system could be made through a new alignment extending east and then north from Encino Reservoir. The alignment would go through Balboa Golf Course to connect to the existing 30-inch diameter recycled water pipeline, as shown in **Figure 5-9**. The alignment is approximately 2.7 miles and involves crossing Highway 101.

Alternative D: Connection to New Customers

Connecting new customers could be planned and implemented to achieve full use of the unallocated surplus recycled water. Examples of potential customers may include Pierce College and the Warner Center, or other unserved recycled water needs in the vicinity. This would require planning and implementation of a new recycled water conveyance system.

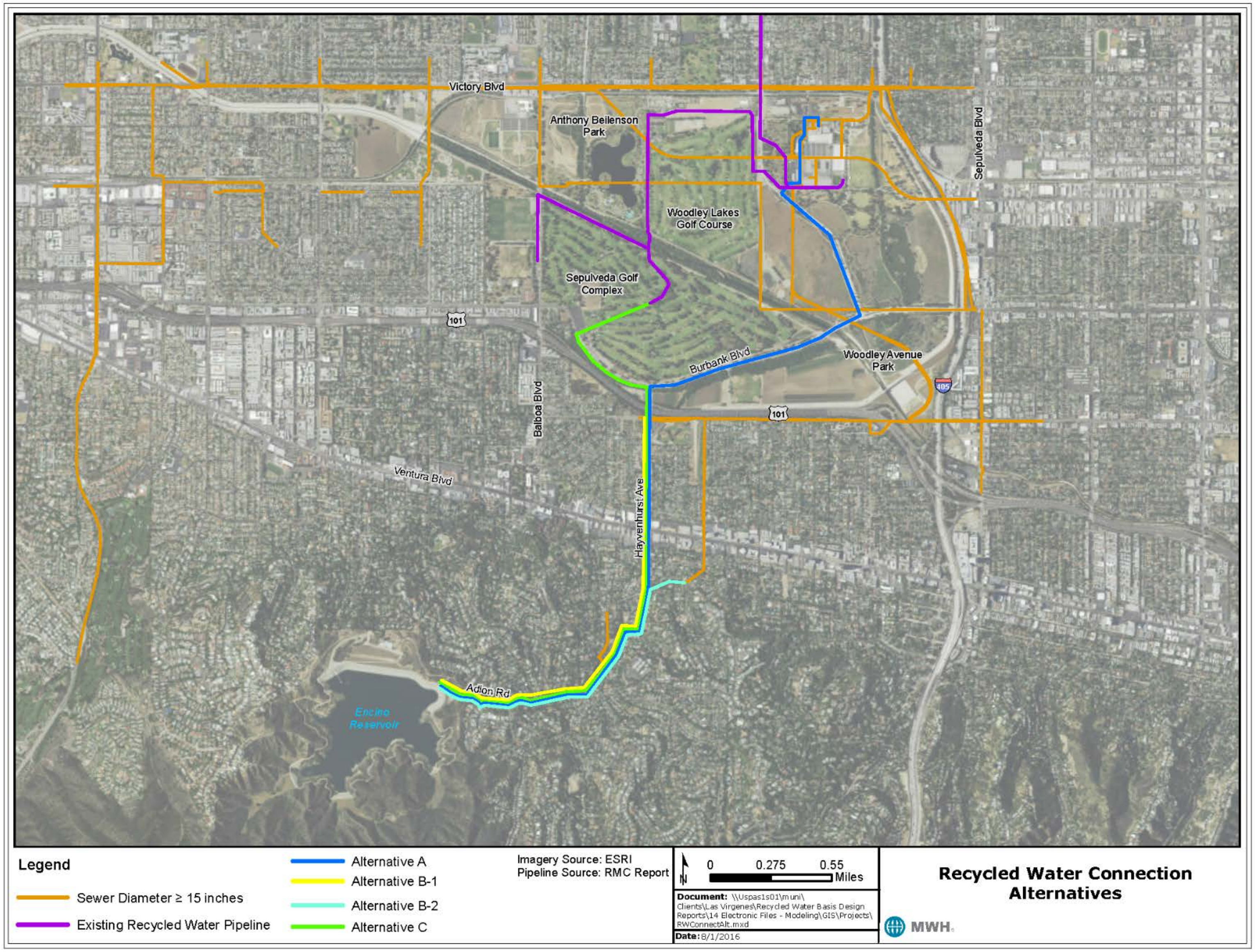

Figure 5-9
Alternative Recycled Water Connections

Storm Drain to Los Angeles River

The Los Angeles River currently receives almost half its flow during the dry season from treatment plant effluent. Sending additional water to the river could be advantageous as it could help supplement the requirements of DCTWRP to discharge effluent in support of the river's habitat. The surplus water from the reservoir could be discharged to the Los Angeles River through Discharge Point 005 in Calabasas. Discharge Point 005 is an outfall of the recycled water system that leads to the Arroyo Calabasas, a tributary of the Los Angeles River. This option would occur in the alignment before pumping begins, which would help reduce conveyance and pumping costs.

Alternatively, there is currently an existing 73-inch fill/drain line from Encino Reservoir extending north that could allow for discharge to the Los Angeles River. This line would need to be modified before use, but would also provide a critical need of meeting DSOD requirements for meeting an emergency reservoir drain.

There is a risk that water quality requirements for discharge to the Los Angeles River may change in the future triggering additional treatment requirements at Tapia WRF.

5.7 NO RESERVOIR OPTION

As part of the investigation into Scenario 5, the option of not using the Encino Reservoir was also considered. In this alternative, a pipeline would be built from the RWPS East to a suitable trunk line sewer in LASAN's service area. This option would likely be less costly due to not using Encino Reservoir for storage, nor a treatment and pumping facility to bring the water back to the JPA service area. However, the JPA would lose control of their recycled water resource and the ability to meet summertime deficits, which would continue to be met by imported water. Since this option relinquishes a large amount of resource control, this is not considered a viable option and, as such, detailed cost analyses were not completed.

5.8 IMPLEMENTATION

5.8.1 Costs

Cost estimates for Scenario 5 were developed using construction and annual operation and maintenance (O&M) costs. Conceptual costs have been prepared based on the facilities and water volumes presented in prior sections of this report. The methodology for converting these cost estimates into a present worth value is also presented in this section of the report and all cost calculations can be found in **Appendix H**.

Construction Costs

Construction costs were calculated for the upgrades to RWPS East, recycled water pipelines, pump station at Encino Reservoir, reservoir treatment and the mixing system at the reservoir and are presented in **Table 5-5**. The construction cost of the RWPS East upgrade estimates the amount needed to increase the facility capacity an additional 5.5 mgd. The pipeline from Reservoir 2 to Encino Reservoir will need to be 24 inches in diameter; however, when the hydraulic head is greater than 600 ft and pressure in the pipeline exceeds approximately 260 psi, thicker-walled piping is required to handle the higher pressures. This results in a need for both standard pressure and high pressure pipelines. The new pump station at Encino Reservoir is sized for a total capacity of 12 mgd, to provide enough capacity during the winter season when there is no recycled water demand and all surplus water from Tapia WRF is stored in the reservoir. Treatment and mixing at the reservoir were considered as lump sum costs. In total, the estimated construction cost of Scenario 5 is estimated at approximately $80,962,000.

Table 5-5
Scenario 5 Estimated Construction Costs

Description	Quantity	Unit Price	Estimated Cost
RWPS East Upgrade	2 x 500 HP	$4,000/HP	$4,000,000
Standard Pressure Pipeline	52,400 LF of 24”	$450/LF	$23,580,000
High Pressure Pipeline	27,500 LF of 24”	$500/LF	$13,750,000
Pump Station at Encino Reservoir	5 x 500 HP	$6,000/HP	$15,000,000
Strainers and Chlorination System	--	Lump Sum	$1,000,000
Mixing System	--	Lump Sum	$500,000
Subtotal			*$57,830,000*
Contingency (25%)			$14,457,500
Engineering & Admin (15%)			$8,674,500
Estimated Total Construction Costs (rounded)			**$80,962,000**

O&M Costs

O&M costs were separated into fixed and variable costs, as shown in **Table 5-6**. Fixed costs are those independent of quantity of water and thus not effected by potential growth in the system. In Scenario 5, the mixing system is the only fixed O&M cost. Variable costs are classified as those that would change with the quantity of water conveyed in the system. In this scenario, variable costs include treatment costs at Encino Reservoir as well as operation costs at RWPS East and Encino Reservoir Pump Station. The increased operation of RWPS East is the result of an increase in water from Tapia WRF and change in demand over time.

O&M costs for Year 1 of operation are calculated based on current supply and demand values. Based on these assumptions, O&M costs for the first year of operation are estimated to be approximately $909,700. However, the storage of recycled water decreases the need to buy imported water from Metropolitan Water District of Southern California (MWDSC), resulting in estimated savings of $260,100. Sales of recycled water to select golf courses is assumed to also occur in Year 1, producing a savings of approximately $453,500. Sales of additional recycled water is assumed to grow every year, reaching 2,395 AF in Year 20 and continuing at the same rate until Year 30. In total, the net O&M cost of Scenario 5 is approximately $196,100 for the first year of operations.

Table 5-6
Scenario 5 Estimated O&M Costs

Description	Quantity (AF)	Unit Price ($/AF)	Estimated Cost
Fixed Costs			
Mixing System	6,000	$25	$150,000
Fixed Subtotal			$150,000
Contingency (10%)			$15,000
Estimated Total Fixed Costs			*$165,000*
Variable Costs			
RWPS East Pump Station	3,102	$105	$325,710
Treatment	2,702	$60	$162,120
Encino Reservoir Pump Station	2702	$70	$189,200
Subtotal			$677,000
Contingency (10%)			$67,700
Estimated Total Variable Costs			*$744,700*
Estimated Total O&M (rounded)			**$909,700**
Imported Water Savings	289	$900	($260,100)
Additional RW Sales	119.75	$425	($453,500)
Net Total O&M (rounded)			$196,100

Cost per AF

During the first year of operations, the cost per AF was calculated to include water savings, due to recycled water sales and avoidance of using imported water to meet summer deficits. These unit costs are shown in **Table 5-7**. This unit cost is the sum of the first years' projected O&M costs and the annualized construction cost (30 years at 2 % interest).

Table 5-7
Unit Cost per AF

Description	Cost
Annualized Construction Cost	$3,615,000
Year 1 O&M Cost	$197,900
Total Annual Cost	*$3,813,000*
Total AF Produced	2,702
Unit Cost per AF	**$1,411**

Cost per Customer

The additional rate impact of this project to JPA customers cannot be fully assessed at this time. A financial consultant will need to be retained to look into possible funding opportunities for this project so that any rate increase to customers can be minimized.

Present Worth

A present worth analysis was conducted for Scenario 5. This analysis was conducted for the project assuming growth in the system, as discussed in **Section 3**. The following parameters were used in calculating the present worth analysis:

- 30 year analysis period
- 2% per annum inflation rate applied to O&M costs
- 7% per annum escalation rate of MWDSC imported water rate, composed of a 2% inflation rate and 5% increase of rates
- 5% discount rate of future values to determine present value, composed of a 2% inflation rate and 3% interest rate.

The growth projections for Scenario 5 assumes growth in demand and supply of recycled water to the system. Total supply is expected to increase at a rate of approximately 105 AF per year, resulting in a total supply of 5,197 AF in Year 20 and continuing at the same rate until Year 30. Expected demand is assumed to increase approximately 66 AF per year, resulting in an additional 2,395 AF demand by Year 20 and increasing at the same rate until Year 30. This additional growth in supply and demand effects both the O&M for this scenario as well as the savings from sales of recycled water.

The annual cost used in calculating present worth is the sum of (1) the *cost* associated with the facilities' O&M combined with (2) the *savings* generated from the sales of recycled water and the reduction of water purchases from MWDSC. Initially the O&M cost slightly exceed the savings generated by the sale of recycled water. However as the projected cost of MWDSC water escalates and sales of recycled water increase, the savings soon exceed the costs. This results in a net savings. The results of this present worth analysis are shown in **Table 5-8**. The present worth of the annual operations results in a savings of $21,243,000 over the 30-year period. These savings, combined with the construction cost of $80,962,000, result in a net present worth of $59,719,000.

Table 5-8
Present Worth Table

Description	Net Present Worth
Construction Cost	$80,962,000
Present Worth of Annual Costs (Savings)	($21,243,000)
Net Present Worth	$59,719,000

Valuing Unallocated Surplus Recycled Water

The analysis currently assumes that unallocated surplus recycled water has no value, as currently no customers have been identified. This unallocated surplus water is estimated to increase at a rate of approximately 39 AF per year as supply increases faster than identified demand. Assuming that this unallocated surplus recycled water can be fully allocated to a customer and sold for current recycled water rates ($425/AF with 7% escalation) the net present worth changes, as shown in **Table 5-9**. However, value of this quantity of water is not certain and is therefore not included in the net present worth analysis above or in other portions of the Basis of Design Report (BODR).

Table 5-9
Valuing Excess Surplus Recycled Water

Description	Full Allocation
Construction Cost	$80,962,000
Year 1 O&M Cost	($497,000)
Present Worth of Annual Costs (Savings)	($59,378,000)
Net Present Worth	$21,584,000

5.8.2 Construction Schedule

A preliminary construction schedule for Scenario 5 is presented in **Figure 5-10**, illustrating the various tasks and sequence required to implement the facilities in this project. The schedule assumes earliest possible completion, which is expected to span at least 5.5 years from the beginning of the BODR until Startup. No start or end dates have been defined but the schedule does provide indication of the minimum time required to implement Scenario 5 assuming no delays beyond the JPA's control. The schedule also does not account for securing funding sources or regulatory deadlines related to total maximum daily load (TMDL) compliance.

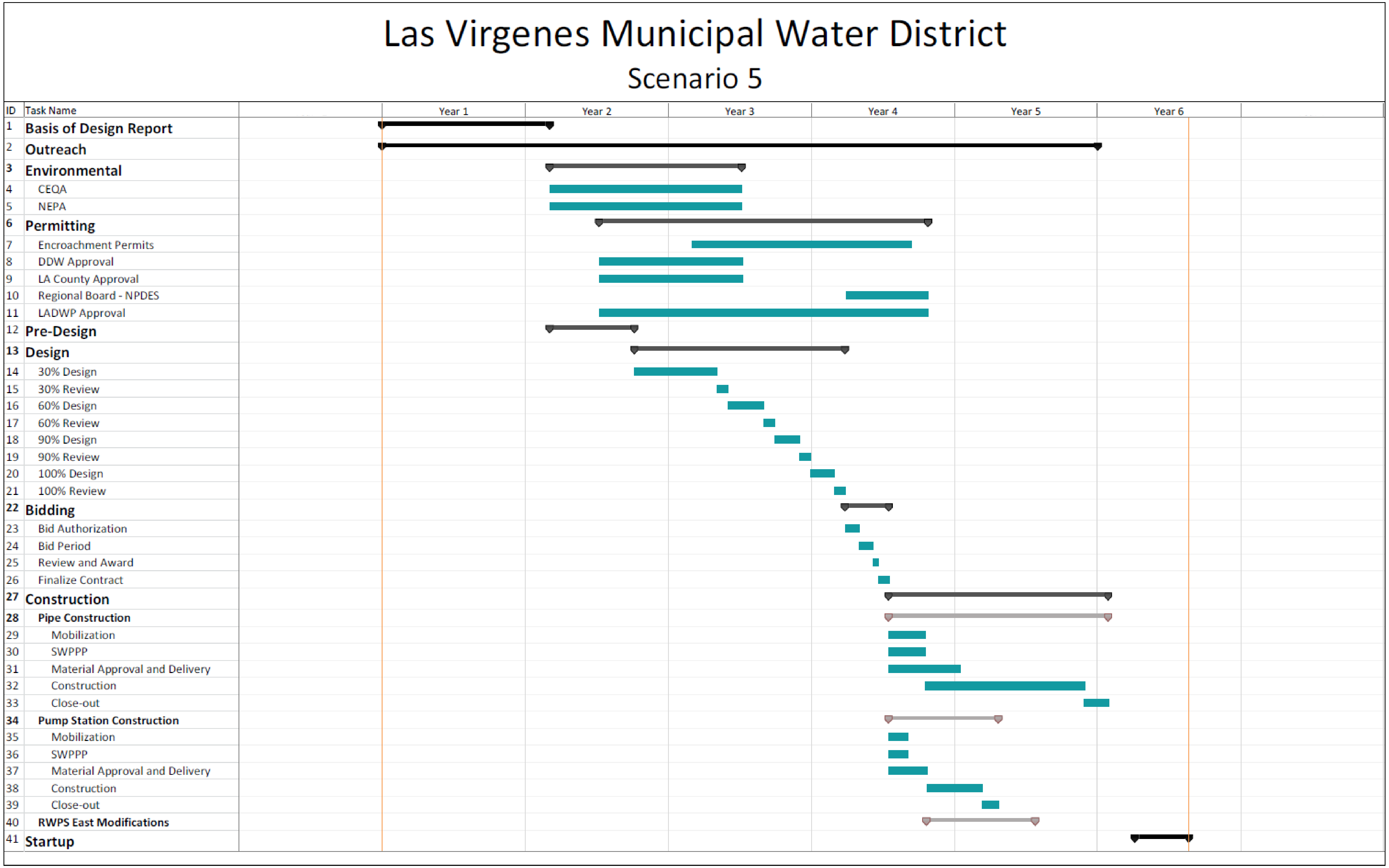

Figure 5-10
Scenario 5 Schedule

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5.8.3 Interagency Coordination

Coordination with various State and Local agencies will be required to implement Scenario 5. This coordination may involve regulatory approval, encroachment permits, negotiation of agreements to provide services, and other items. A summary of coordination needs with each key agency is presented below. Meeting notes from meetings with various agencies are found in **Appendix I.**

Regional Water Quality Control Board

The Regional Water Quality Control Board (RWQCB) has final approval over the NPDES discharge permit to Malibu Creek that would be modified for recycled water discharge to Encino Reservoir. Discharge of unallocated surplus recycled water to the Los Angeles River or other locations would also require a permit from RWQCB. The RWQCB will be involved in the Waste Discharge Requirements (WDRs) for the distribution and use of recycled water by the new customers.

City of Los Angeles - Department of Water and Power

An agreement with LADWP for use of the Encino Reservoir facility is the cornerstone of Scenario 5. This agreement is required to provide the needed seasonal storage of surplus recycled water. Discussions with LADWP on this and other issues are on-going.

If LADWP agrees in concept to the use of Encino Reservoir for Scenario 5, additional coordination will be needed to resolve at least the following items:

- Negotiations on governance, ownership of facilities, shared costs if any and other terms would be required.
- Pipelines to and from the reservoir will require encroachment permits, traffic control plans, etc. in the LADWP service area and on the reservoir site itself.
- A pump station will need to be constructed on the reservoir site to convey recycled water back to the JPA service area. A new electrical service may also be needed.
- Ancillary facilities including strainers, reservoir mixing system, and chlorination facilities will also be constructed. If possible, it may be advantageous to utilize LADWP's existing chlorination system.
- The reservoir may require completion of the seismic study, which is currently on-hold at LADWP.
- The reservoir piping may require modification to provide an emergency drain to the Los Angeles River.

Los Angeles County Department of Public Health

New uses of recycled water will fall under the jurisdiction of the Los Angeles County Department of Public Health, and approval will be needed for the final plan

WQCB, Division of Drinking Water

The Division of Drinking Water (DDW) regulates LVMWD and LADWP's potable systems. Changes to the potable system such as the conversion of Encino Reservoir to seasonal storage, will require DDW's approval.

City of Los Angeles - Sanitation

There are also potential options for discharge of excess JPA water to LASAN, including direct discharge of sewage or recycled water for treatment at the DCTWRP.

Division of Safety of Dams

The DSOD is under the California Department of Water Resources and works to protect people against damages from dam failures. DSOD will require completion of the Encino Dam seismic study before this scenario can fully progress.

City of Calabasas

Many of the infrastructure improvements connecting existing LVMWD pipelines to Encino Reservoir would require construction through the City of Calabasas. The JPA will need to coordinate with the engineering departments of the City of Calabasas in order to plan how these improvements would be made and which streets would off the best right-of-way for the new pipeline.

Department of Transportation (Caltrans)

An encroachment permit will be needed from Caltrans to install the recycled water pipeline crossing Highway 27 Topanga Canyon Blvd.

5.8.4 Funding

Scenario 5 could be eligible to receive state and federal funding in the form of loans and grants to help cover costs of planning, design, and construction of water treatment facilities. The Water Recycling Funding Program (WRFP) implemented by the California State Water Resources Control Board (SWRCB) aims to promote the increased use of recycled municipal wastewater in order to increase the amount of available freshwater. WRFP distributes funds from three sources: (1) Proposition 1, (2) Proposition 13, and (3) the Clean Water State Revolving Fund (CWSRF). Additional funding can be secured through the U.S. Bureau of Reclamation's WaterSMART program, which offers competitive grants for projects involving advanced water treatment as well as for efforts to improve water and energy efficiency.

Other funding opportunities are available at both the state and federal levels to help finance the proposed project. Many of these opportunities are based on revolving funds, meaning that funding would take the form of low-interest loans to ensure a constant funding source for future projects.

The JPA has retained a Financial Consultant to assess these and other possible sources of funding for Scenario 5.

5.8.5 Public Outreach

As part of the BODR process and during the previous project cycle (i.e., the Recycled Water Seasonal Storage Plan of Action), the JPA took a proactive approach to stakeholder engagement that involved a long list of interested parties during the development phases of this project. The JPA intends to continue this proactive approach, continuing to engage their stakeholders, develop project champions, and begin public outreach and education relative to the issues that surround Scenarios 4 and 5.

In addition, the JPA has retained a communication firm specializing in water programs. The firm will assist the JPA in involving the community, non-governmental organizations (NGOs) and local leaders to help navigate the political, social, and technical hurdles that will need to be overcome in order to realize either of the scenarios described in this BODR.

5.8.6 Environmental

Once a scenario has been selected, an environmental consultant will be selected to conduct an Environmental Impact Report (EIR) to assess the impacts the scenario may pose to the surrounding environment for the pipeline alignments and at the reservoir.

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Section 6 –

Workshops and Recommendation

Section 6
Workshops and Recommendation

This Basis of Design Report (BODR), along with the previous Recycled Water Seasonal Storage Plan of Action (Plan of Action), engaged key stakeholders who helped define the project goals and define key metrics for evaluating alternatives. **Appendix L** lists the stakeholder organizations that participated. These stakeholders participated in a series of workshops with the JPA Board of Directors (Board), Las Virgenes Municipal Water District (LVMWD) and Triunfo Sanitation District (TSD) staff, and MWH Americas, Inc. (MWH) facilitators to guide the project alternatives from conception to the two scenarios presented in this BODR. The first four stakeholder workshops during the Plan of Action helped identify six distinct project alternatives and assisted the Board in selecting two preferred scenarios for further investigation. During this first phase, a plan of action was also developed to guide the next phase of work. This section presents a review of the four workshops conducted as part of the BODR project cycle, a recommendation of the preferred project scenario, an update to the original plan of action, engineering next steps for the JPA, and a revised plan of action for the next project phase.

6.1 WORKSHOP 1

Workshop 1 was held on September 14, 2015, and provided a summary of the Plan of Action and an overview of Scenario 4 and Scenario 5. The workshop included a "PESTLE" exercise, which asked Board members and stakeholders to identify risks associated with each scenario and group them into categories: Political, Economic, Social, Technical, Legal and Environmental. A total of 159 risks were documented and sorted by both their PESTLE category and an overarching risk category (i.e., Agency Coordination, "Not in My Backyard" [NIMBY], Project Cost, etc.). Mitigation strategies and an owner were identified for each risk. **Table 6-1** shows the number of the risks identified for each PESTLE category and risk category, **Table 6-2** shows the owner for each of the identified risks, and **Table 6-3** present the results from the PESTLE exercise.

Table 6-1
Pestle Group Summary

	Capital Cost	Engineering	Legal	Operation Cost	Outreach	Political	Regulatory	GRAND TOTAL
Political	1		4		17	9	4	**35**
Economic	17	5	1	7				**30**
Social	1	6	2		17	1	1	**28**
Technical		26			2	1		**29**
Legal		1	3		4		9	**17**
Environmental		9		1	3		7	**20**
GRAND TOTAL	**19**	**47**	**10**	**8**	**43**	**11**	**21**	**159**

Table 6-2
Mitigation Strategy Owner

Lead	Quantity
FINANCE	20
GM'S	14
MWH	58
OUTREACH	37
PROJECT MANAGER	30
GRAND TOTAL	**159**

Table 6-3
Risk Categories and Quantities

Category	Quantity of Items
Agency Coordination	17
AWT Facility Cost	2
Brine	7
CEQA	7
Customer	1
Demand	11
Drought	3
DW Standards	8
Earthquake	2
Elections	2
Habitat	2
Idle Facilities	2
Land Cost	4
Liability	1
NIMBY	26
Operations	4
Partners	1
Politics	6
Power	4
Project Cost	12
Regulatory	2
System Cost	1
Technology	4
Waste of Money	1
Water Quality	10
Water Rights	5
Yuck	8
ROW/Land	6
GRAND TOTAL	**159**

The results show that the most recognized risks had to do with the community's perception of the project and opposition to construction considered as NIMBY. For either scenario, it has been recommended that the JPA take a proactive approach to these concerns with a public outreach program, for which they have already retained the services of a public outreach consultant. There were also many risks identified as technical or engineering-related. These risks were addressed in the following workshops and will continue to be addressed throughout the project lifecycle.

6.2 WORKSHOP 2

Workshop 2 was held on January 7, 2016 and presented the results from the PESTLE exercise in Workshop 1. Each scenario was discussed in greater detail as more research and evaluation had occurred since the last workshop. For Scenario 4, a site layout was proposed for the advanced water treatment (AWT) facility and emergency operations of the facility were addressed. A seasonal operation for Las Virgenes Reservoir was discussed along with brine disposal compliance. Potential partners identified during that time were City of Thousand Oaks, Calleguas Municipal Water District (CMWD), Camrosa Water District, City of Westlake Village, Metropolitan Water District of Southern California (MWDSC), and the State of California.

The discussion of Scenario 5 included considerations for Encino Reservoir, such as the seismic study of the dam, pump station construction, vector control, and mixing and aeration of the reservoir. Emergency operations and normal operations were also discussed along with additional distribution options such as discharging to Donald C. Tillman Water Reclamation Plant (DCTWRP), a tie-in to the Los Angeles Department of Water and Power's (LADWP) recycled water distribution system, or adding new recycled water customers in the JPA service area, such as country clubs and golf courses. Potential partners for Scenario 5 were identified as LADWP, Los Angeles Sanitation (LASAN), MWDSC, and the State of California.

A visual presentation or "fly over" of each of the options was also presented to provide the JPA Board and stakeholders a real world view of what the impacts of construction and project implementation might be. This visual presentation was produced in Google Earth and gave a street view perspective of the full alignment of both scenarios. Finally, estimated capital and operations and maintenance (O&M) costs were presented for both scenarios based on information available at the time of the workshop.

The workshop concluded with an evaluation criteria exercise that asked the Board and stakeholders to rate the importance of 14 evaluation criteria on a scale from 0 (not important) to 9 (very important). The evaluation criteria were chosen from the guiding principles, previous evaluation criteria from the Plan of Action project, the PESTLE exercise from the previous workshop, and discussions with the Board and stakeholders. The results from this exercise are presented in **Figure 6-1** and **Table 6-4**.

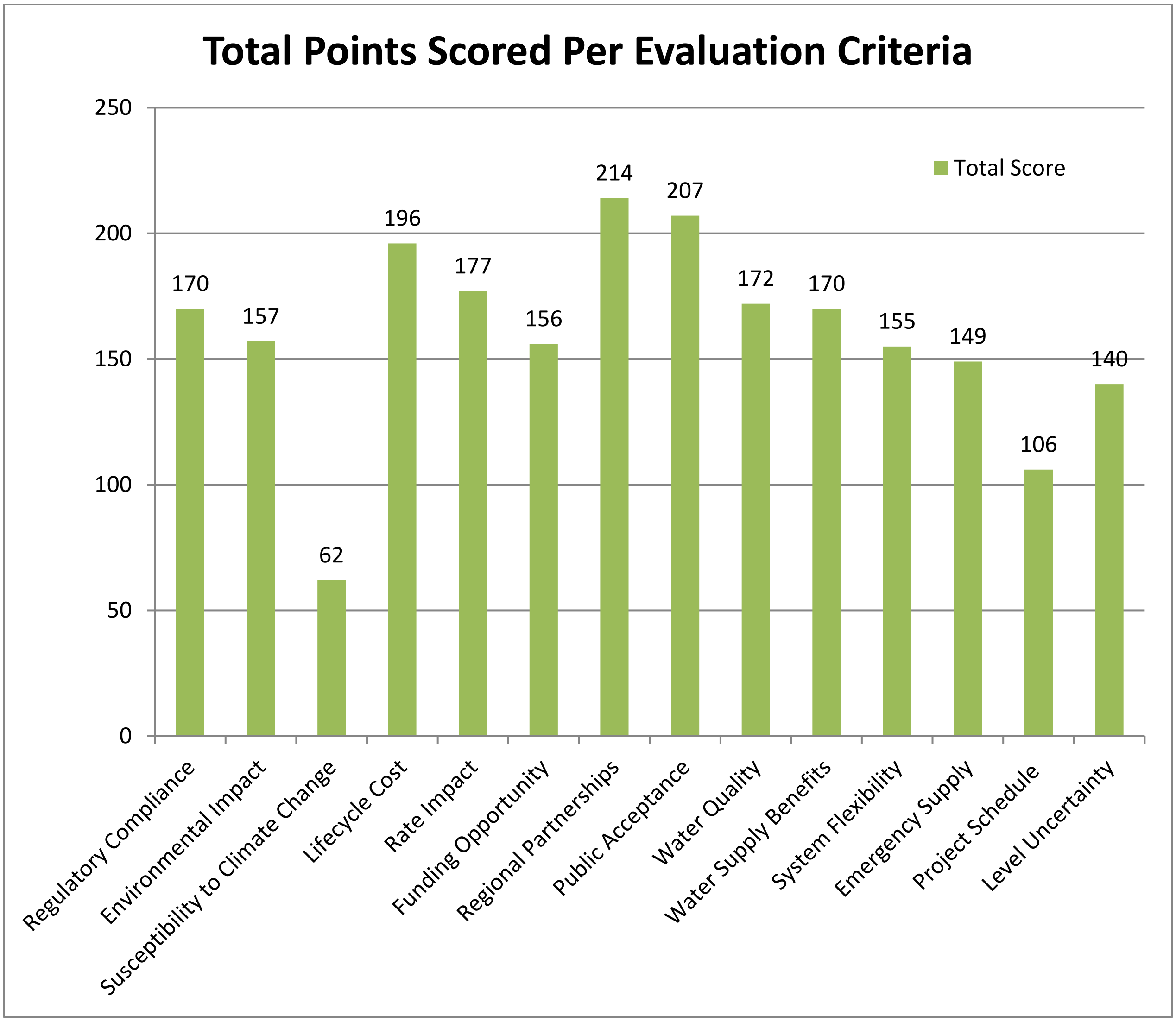

Figure 6-1
Total Points Scored per Evaluation Criteria

Table 6-4
Evaluation Criteria Results

Score	Regulatory Compliance	Environmental Impact	Susceptibility to Climate Change	Lifecycle Cost	Rate Impact	Funding Opportunity	Regional Partnerships	Public Acceptance	Water Quality	Water Supply Benefits	System Flexibility	Emergency Supply	Project Schedule	Level Uncertainty
0	1	1	9	1		1				1		1	1	2
1	1	1	5		2	2					1	5	5	2
2	1	2	4			1				2	3		3	4
3	2	1	3		3	1	2	1	5	2		2	2	3
4	2	4	2		3	2	1	2	4	2	3	1	7	1
5	3	2	2	5		5		2	4	2	6	3	3	3
6	5	5		2	5	2	1	2	1	6	7	5	5	1
7	2	7	2	8	3	8	6	5	4	3	2	3		4
8	5	1	1	5	5	6	6	5	3	5	4	4	2	4
9	6	4		7	7		12	11	7	5	2	4		4
Total Weighted Score	**170**	**157**	**62**	**196**	**177**	**156**	**214**	**207**	**172**	**170**	**155**	**149**	**106**	**140**

6.3 WORKSHOP 3

During Workshop 2, the Board asked several technical questions that needed further clarification. Workshop 3, held on March 15, 2016, was intended to answer all of these questions and present new information that had been gathered since the previous workshop. Workshop 3 was held just for Board members so all remaining concerns and questions since the last workshop could be answered. During the workshop, MWH presented prepared slides and took questions until the Board's concerns had been addressed. A packet was sent out to the Board prior to the workshop to state and address the questions brought up since the last workshop and give Board members an opportunity to come up with any new questions. The packet also contained brief summaries of both scenarios that described existing and new facilities, water quality and treatment requirements, reservoir operations, interagency coordination and permitting, costs and schedules.

Workshop 3 concentrated on technical information and was meant to be a Question & Answer, or Q&A, style discussion where the Board could ask any questions they had. This led to a more discussion-based workshop, where all questions were addressed and any outstanding questions were captured to be researched for the next workshop.

6.4 WORKSHOP 4

Workshop 4 was the final workshop for stakeholders and Board members before a preferred scenario was chosen. This workshop again summarized each scenario with updated information since the last workshop. Engineering updates were presented for Las Virgenes Reservoir operations, Division of Drinking Water (DDW) surface water augmentation regulations, future supply/demand projections and brine discharge. The new future supply/demand projections provided new net present worth values for both scenarios. These new numbers concluded that Scenario 4 will have a declining project cost over a 30-year period due to water savings that will increase more as supply in the system continues to grow and the cost of imported water escalates. The future value of Scenario 5 is dependent on the value of the excess water in Encino Reservoir and the exchange that the JPA can receive for it, either with LADWP, LASAN or additional recycled water customers.

MWH also presented an assessment (**Figure 6-2**) of the risks identified in Workshop 1 based on their knowledge of both scenarios. Board members and stakeholders were then asked to complete a polling exercise in which they chose which scenario they preferred based on a series of criteria defined from the previous workshops, the previous project cycles, and the JPA Board's adopted guiding principles. These criteria were categorized into guiding principles, objectives and risk concerns, and the results are shown in **Table 6-5**. As shown in the table, Scenario 4 was the preferred alternative based on both MWH's evaluation of risk concerns, and the stakeholder and Board evaluation of the multiple evaluation criteria presented in the polling exercise.

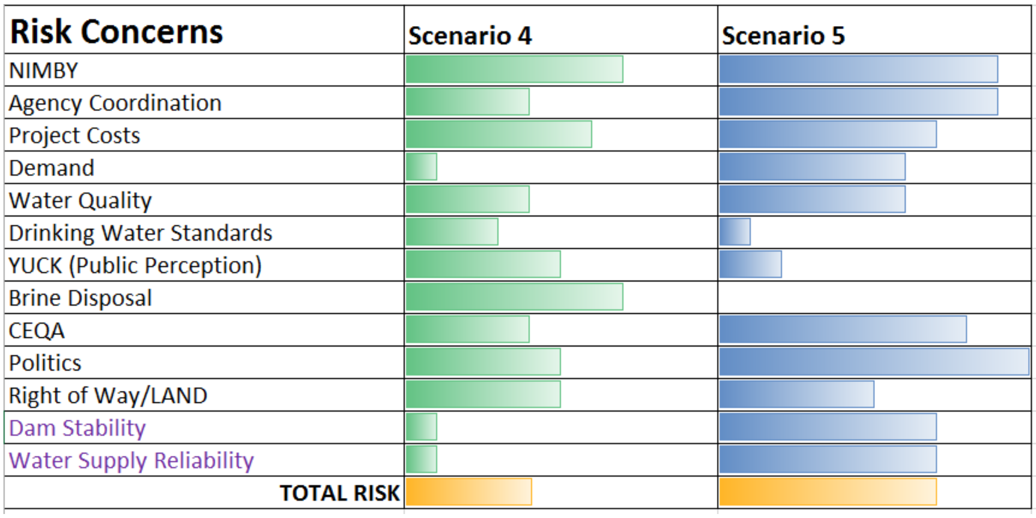

Figure 6-2
Risk Management

Table 6-5
Seasonal Storage Project Evaluation Results

	Scenario 4	Scenario 5
Guiding Principles		
Maximize Beneficial Reuse	22	5
Seek Cost Effective Solutions	22	11
Seek Partnerships beyond JPA	15	12
Gain Community Support	23	5
Govern with a Partnership	14	10
Be Forward Thinking	32	1
Subtotal	**128**	**44**
Average	**21**	**7**
Objectives		
Reuse 100% of Our Water	25	7
Regional Partnerships	12	15
Public Support for Project	16	14
Cost/Benefit	21	9
Beneficial to Water Users Including Rate Payers	25	6
Maximize Funding Sources	16	12
Public Perception and Acceptance	12	18
Eliminate Unreasonable Use and Waste of Water	20	8
Transparency	18	6
Seasonal and Diurnal Equalization	17	8
Balance of Supply and Demand (Right Balance)	26	4
Reduce Reliance on Imported Water	30	2
Regulatory Constraints and Framework	7	19
TMDL Compliance in Malibu Creek and Santa Monica Bay	14	6
Regulations	9	18
Sustainability	26	5
Siting of Reservoirs and other Infrastructure	16	11
Protecting Beneficial Uses in Malibu Creek	16	4
Environmental Stewardship and Leadership	23	3
Subtotal	**349**	**175**
Average	**18**	**9**
Risk Concerns		
NIMBY	19	7
Agency Coordination	25	5
Project Costs	8	21
Demand	27	3
Water Quality	25	6
Drinking Water Standards	20	11
YUCK (Public Perception)	15	18
Brine Disposal	14	18
CEQA	18	6
Politics	21	5
Right of Way/LAND	17	10
Subtotal	**209**	**110**
Average	**19**	**10**
Grand Total	**686**	**329**
n	**36**	**36**
Average	**19**	**9**

6.5 RECOMMENDATION

Both scenarios offer value to the JPA, as both address the objectives of this project. However, Scenario 4 has the following advantages over Scenario 5:

- Indirect potable reuse (IPR) is visionary and forward-thinking, consistent with the JPA Board's adopted Guiding Principles.
- Scenario 4 involves the best and highest use of the JPA's water resources and retains the full benefit of the resources for the JPA customers.
- Potential risks, as identified by the stakeholders, are more effectively avoided with Scenario 4.
- Stakeholder polling identified Scenario 4 as the preferred alternative.
- By offsetting the escalating cost to purchase imported water, Scenario 4 provides substantially greater long term economic value.
- Scenario 4 can be completed in sufficient time to achieve compliance with the anticipated terms for implementation of the *2013 Malibu Creek and Lagoon TMDL for Sedimentation and Nutrients to Address Benthic Community Impacts*, whereas timing of Scenario 5 is uncertain.

It is recommended that the JPA select Scenario 4 as the preferred project alternative, and retain Scenario 5 as a back-up option should at any point Scenario 4 become infeasible.

6.6 PLAN OF ACTION UPDATE

At the completion of this BODR, the initial Plan of Action from the Recycled Water Seasonal Storage Plan of Action Study has been updated to indicate which actions have been completed and which actions can be completed once a preferred scenario is chosen. **Table 6-6** displays the items from the Plan of Action that were completed at the conclusion of this BODR. Based on the new information garnered during the BODR project, the following sections provides a more detailed summary of next steps to be completed should the JPA move forward with Scenario 4.

Table 6-6
Completed Plan of Action Items

Completed Plan of Action Items
Board adoption of the Plan of Action
Initiate exploratory meetings with LADWP
Negotiate agreement for BODR
Prepare Request for Proposal for selection of funding consultant
On-going negotiation with Regional Water Quality Control Board (RWQCB) for Tapia WRF discharge permit
Prepare draft engagement plan for Stakeholders
Board approval of BODR agreement
Initiate exploratory meetings with DDW
Initiate RW operational storage study at Las Virgenes Reservoir
Initiate RW operational storage study at Encino Reservoir
Select and negotiate agreement with funding consultant
Board update of project, and approval of funding consultant agreement
Prepare summary of water quality data and supplemental sampling plan
Prepare supply and demand summary for facility sizing
Identify potential sites for new pump stations, tanks, and/or treatment facilities
On-going negotiation with RWQCB for Tapia WRF discharge permit, including reservoirs
Workshop #1
Initiate discussions with Calleguas MWD on use of brine line and recycled water supply
Conduct literature search of operational issues for recycled water storage facilities
Conduct initial treatment analysis for meeting potable reuse regulations
On-going meetings with LADWP
Formulate facility alternatives for each scenario
Prepare preliminary project descriptions for coordination with funding efforts
Prepare initial water savings model
Board update of project
On-going negotiation with RWQCB for Tapia WRF discharge permit, including reservoirs
On-going meetings with LADWP
Finalize water savings model
On-going discussions with DDW and Calleguas MWD
Prepare schedule and cost analysis for each scenario
Workshop #2
Prepare RFP for selection of environmental consultant
Prepare annual update to the Plan of Action
Workshop #3

6.7 ENGINEERING NEXT STEPS

At the August 1, 2016 JPA Board meeting, the Board selected Scenario 4 as the preferred scenario. The following tasks and studies are recommended to continue the progress started in this BODR. These combined tasks make up a 20-30% Pre Design of reservoir facilities, the AWT facility and pipeline alignments. The next steps presented below focus on the technical details of Scenario 4, and should be completed in parallel with Outreach, Environmental, and Funding/Financing investigations.

- **Reservoir Facilities**
  - **Dilution and Transport Modeling.** Data collection, setup, calibration, simulation, and delivery of a model to mimic the internal hydrodynamics of the reservoir.
    - **Bathymetry.** Gather bathymetry data for Las Virgenes Reservoir that will be used in future modelling efforts of the reservoir.
  - **Impacts on Water Treatment.** Evaluate any impact on operations of the Westlake Filtration Plant (FP) due to the addition of advanced purified water to the Las Virgenes Reservoir.
  - **Diffusion and Mixing Requirement.** Determine the location, depth, and configuration of piping and diffusion facilities to disperse purified water into Las Virgenes Reservoir and meet requirements for reservoir dilution. Determine if supplemental mixing is required to achieve dilution requirements.
  - **Management and Monitoring Plan.** Prepare plan to monitor water quality and address reservoir management concerns such as vector control, algae, and aquatic plants.

- **AWT Pre Design**
  - **Pilot Plant.** Demonstrate the proposed treatment process for the AWT facility at pilot scale. The Pilot Plant will aid in achieving regulatory and public acceptance of the project, and provide opportunities for development and training of LVMWD's operations staff. The data from the Pilot Plant will also be used to confirm the design criteria for the full scale facility.
  - **Site Selection.** Review of nine proposed sites for the AWT facility. The study will address possible pros and cons for each site, such as location, length of new pipelines, site ownership, land acquisition costs, availability of utilities, and community concerns.
  - **Water Quality**
    - **Source Control.** Develop recommendations to update Tapia WRF's existing testing and monitoring protocol to comply with the AWT treatment regulations. A review will be completed of the chemical and contaminant monitoring requirements pursuant to Wastewater Source Control within the upcoming Title 22 Regulations for Surface Water Augmentation of Recycled Water for IPR.
    - **Log Removal.** Demonstrate the additional 1.0 log removal specified in the draft regulations for IPR using Surface Water Augmentation, assuming

modeling shows only 90% dilution is achieved. Meetings with DDW and LVMWD staff will be conducted to discuss findings and seek approval on the proposed process train and testing plan.

- **AWT Definition.** Develop full design criteria, schematic diagram, hydraulic profile and control narrative for the advanced water treatment facilities in accordance with draft DDW regulations.
- **Utilities.** Summarize electrical, natural gas, sewer, water, communications, storm drainage, and agency communication platform to be incorporated into facility plans.
- **Civil Site Work.** Develop ingress and egress, facility layout, grading and paving, yard piping, facility maintenance, and storm water runoff quantities based on the selected AWT facility site.
- **BIM Model Development.** Develop Building Information Management (BIM) model for design development, visualization, and discipline coordination at an appropriate level for proposed project implementation.
- **Hydraulics and Surge Analysis.** Prepare hydraulic profiles and complete surge analysis. Surge tank size will be determined sufficient to protect equipment and pipeline.
- **Facility Implementation**
  - **Opinion of Probable Construction Cost (OPCC) (Class IV).** Prepare Class IV OPCC.
  - **Schedule.** Develop construction schedule for the AWT facility.

- **Pipeline Alignments**
  - **Alignment Alternatives**
    - **AWT Inlet Pipeline.** Analyze up to three alternatives and recommend a final alignment for the 24-inch recycled water pipeline connection from the existing recycled water system to the new advanced water treatment (AWT) facility. New pipeline alignments are dependent on the site selected for the new AWT facility.
    - **AWT Outlet Pipeline.** Analyze up to three alternatives and recommend a final alignment for the 20-inch recycled water pipeline to convey the AWT effluent to the diffusion piping at Las Virgenes Reservoir. New pipeline alignments are dependent on the site selected for the new AWT facility.
    - **Brine Discharge Line.** Analyze up to three alternatives and recommend a final alignment for the 8-inch brine pipeline which will convey brine discharge from the AWT facility to Phase 4 of the Salinity Management Pipeline (SMP) at the intersection of Santa Rosa Rd. and Moorpark Rd. in the City of Thousand Oaks.
  - **Geotechnical.** Conduct geotechnical investigation of the selected pipeline alternatives to identify any geological constraints such as soil type, rock outcroppings, expansive soils, fault location, and unstable conditions. Conduct

borings adjacent to major highway crossings (101 and 23) for jack and bore/directional drill planning.

- **Corrosion Study.** Investigate corrosion effects on pipelines, structures, and valves to make a recommendation of preferred materials.
- **Survey.** Surveying is required for the design and layout of the proposed pipeline alignments, which includes aerial mapping of alignment topography and collection of title reports and public records related to the proposed routes.
- **Utility Investigation.** Contact utilities based on updated DigAlert report along the proposed alignments and pothole along the alignments to verify utility locations.
- **Traffic Control.** Develop a traffic control plan along the proposed alignments.
- **Plan and Profile.** Prepare preliminary plan and profile drawings for preferred alignments. Identified utilities, crossings, and key locations will be shown on the both plans and profiles.
- **Pipeline Appurtenances.** Identify provisions for air release, blow offs, pipeline drainage, isolation valves, and similar appurtenances, as needed, for pipeline operations.
- **Hydraulics and Surge Analysis.** Prepare hydraulic profiles and complete surge analysis. Surge tank size will be determined sufficient to protect equipment and pipeline.
- **Facility Implementation**
  - **OPCC (Class IV).** Preparation Class IV OPCC.
  - **Schedule.** Develop construction schedule for the AWT facility.

6.8 REVISED PLAN OF ACTION

Table 6-7 recommends a new Plan of Action for the JPA to continue their progress moving forward with a preferred scenario. The new Plan of Action is not a complete list and would need to be further developed as implementation towards a project begins.

Table 6-7
New Plan of Action

Revised Plan of Action
Board adoption of the Preferred Scenario
Conduct environmental constraints analysis
Prepare draft public outreach program for project, including NGO engagement
Identify State and Federal grant funding opportunities
Develop branding plan for project
Create website for project to continue public engagement
Conduct quarterly briefings with Division of Drinking Water
Meet with Metropolitan for coordination of water supply and LRP funding opportunities
Meet with Calleguas MWD to coordinate brine line alignment, SMP connection requirements and water exchange
Meet with City of Thousand Oaks to review and refine brine line alignment and advantageous connections
Meet with City of Westlake Village to review and refine pipeline alignments
Meet with City of Agoura Hills to coordinate pipeline alignments
On-going negotiation with RWQCB for Tapia WRF discharge permit
Secure support and grant funding for demonstration plant
Complete financial analysis
Confirm final DDW surface water augmentation regulations
Initiate AWT Demonstration Plant
Perform bathymetry on Las Virgenes Reservoir
Create reservoir water quality and dilution model
DDW review of reservoir modeling
Begin AWT demonstration study with coordinating public outreach
Perform site selection study for AWT sites
Initiate pipeline alignment and hydraulic studies
Prepare funding applications
Apply for grants, loans, etc.
On-going negotiation with RWQCB for Tapia WRF discharge permit, including reservoirs
Conveyance alignment study for outlet recycled water pipeline
Conveyance alignment study for brine discharge pipeline
Begin environmental review (CEQA)
Apply for encroachment permits
Apply for Caltrans Highway Approval
Update source water control plan at Tapia WRF to comply with AWT treatment regulations
Prepare Reservoir Management and Monitoring Plan
Create marketing materials for project
Publicize project as part of public outreach efforts
Perform log removal strategy study at Tapia WRF
Perform impact study at Westlake FP
Ensure continued agreement of compliance with DDW regulations
Land acquisition of selected AWT facility site
Update website and conduct public outreach event

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