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CALLEGUAS MUNICIPAL WATER DISTRICT

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FINAL REPORT

Recycled Water Master Plan Update 2014

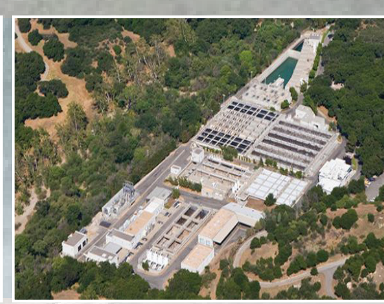
for the

Joint Powers Authority of:

Las Virgenes Municipal Water District and Triunfo Sanitation District

and

Calleguas Municipal Water District



KJ Project No. 1389005*00

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Recycled Water Master Plan Update 2014

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Table of Contents

List of Figures

Section 1 – Introduction and Summary

Section 1: Introduction and Summary

1.1 Introduction: the need for recycled water planning

The recycled water system that is jointly owned and operated by the Las Virgenes Municipal Water District (LVMWD), Triunfo Sanitation District (TSD), and the Calleguas Municipal Water District (CMWD) is recognized throughout California as a model for how wastewater can be effectively recycled. For well over a decade, all water reaching the Tapia Water Reclamation Facility (Tapia WRF) during the summer has been beneficially reused. This achievement is the result of forward-thinking, long-range planning, and commitment. This master plan is one of a series of recycled water master plans, dating to the 1980s, when ambitious concepts for a regional system were first developed. This system currently serves customers ranging from Calabasas in the east to Thousand Oaks in the west.

The system begins at the Tapia WRF, which is owned by the Joint Powers Authority (JPA) of LVMWD and TSD, where up to 10 million gallons per day (MGD) of wastewater is currently treated to a high level, allowing it to be distributed for non-potable uses such as landscape irrigation and various commercial uses. The JPA also 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. Master Plans for this distribution system were prepared in 1985, 1988, and 1999 and updated in 2007.

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, it is sold to CMWD, which distributes it to 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, to Lake Sherwood Golf Course, and to the Westlake and North Ranch portions of the City of Thousand Oaks.

Water recycling is particularly beneficial in this region of Southern California. The areas served by LVMWD and TSD have almost no native water sources. Natural surface water is only seasonal and groundwater basins are shallow and generally of poor quality. Essentially all water consumed in this area is imported through the Sacramento delta, where environmental issues and droughts have restricted the amount of water available for export. The only reliable and relatively abundant local source of water for LVMWD and TSD is recycled water.

As a commodity, the recycled water produced by Tapia WRF is virtually free to the JPA partners. Whether the water is reused or discharged, the cost of treatment is the same. The only major variable cost is pumping. To distribute the water, it must be pumped from an elevation of less than 500 feet (Tapia WRF) to various distribution tanks, ranging in elevation from 1225 feet to 1752 feet. While the cost of energy to pump the water is significant, it is far less than the cost of pumping water out of the Sacramento River and over the Tehachapi Mountains to Southern California. The low commodity costs and relatively low pumping costs means that recycled water is economically and environmentally preferred, wherever it is available and can be used.

Availability is the key word. What limits recycled water availability? The primary limit is the affordability of the distribution system—the pumps, tanks and pipelines needed to convey water to where it can be used. Most water consumers are served by a single pipeline, which provides water for drinking, irrigation, sanitation, and fire fighting. For a water customer to receive recycled water, a second pipeline is required, essentially doubling the cost of distributing water on that particular street and to that particular customer. The cost of such water infrastructure is not negligible. For the construction of a second main to be economical, it generally must generate sufficient revenue to recoup the cost of the additional pipe.

The other limitation is supply; the JPA already sells all of its recycled water in the summer, but there are two good reasons for adding more customers. First, during the fall, winter and spring, much of the recycled water goes unused, and goes to waste. Second, the supply of recycled water is expected grow over the next few decades, so new customers are needed to keep pace with supply. To bridge gaps between recycled water supplies and demands and thus to optimize the use of recycled water, other sources of water must be added to the system judiciously.

The primary focus of recycled water planning is to develop concepts for distribution systems that make economic sense; systems that will distribute enough water to pay for the added infrastructure. Traditional users of recycled water are schools, parks, golf courses, and similar irrigation users, where a large amount of water is consumed through a small number of meters. Mains to these customers often make economic sense. Along the way, the mains may serve others too (homeowners associations, commercial facilities, and roadway landscaping), but these smaller customers are seldom the drivers for a main extension.

Planning for expansions of the JPA's recycled water system is not simple. Within the JPA's service areas of Calabasas, Agoura Hills, Westlake Village and Oak Park, there is little low-hanging fruit. Prior planning efforts have been successful in connecting virtually all the schools, parks and golf courses. The notable exceptions are Alice Stele School/Freedom Park in Calabasas and the Malibu Golf Course in the Santa Monica Mountains, and neither one is easily reached by the current system. Within these areas, there are many single-family residences with substantial irrigation demands, but serving single-family residences entails added operational costs (training, testing, and paperwork) required by state health officials. The other challenge involved in expanding the JPA system is hydraulic capacity. To make the system economical, the existing pipes were often sized for the customers they currently serve. Adding new customers, particularly large new customers, could result in diminished service to existing customers, if proper planning does not occur.

So why write a new master plan, if the low-hanging fruit is gone and the system is already maximized? The reasons are several:

- **Changing economics**. With the cost of imported water ever increasing, the benefits of certain investments will increase.
- **Regulatory incentives**. There are new state-mandated requirements to reduce per capita water consumption (i.e., SBX7-7, the "20x2020" law). These provide incentives for investment in recycled water infrastructure.
- **Potable water cost avoidance**. In cases where the potable systems are overtaxed, investments in recycled water pipelines may be more attractive than new potable pipelines. For LVMWD in particular, investments in recycled water system extensions could help avoid or postpone potable water system upgrades in the Seminole/Latigo and Jed Smith Subsystems.
- **Resource diversification**. Greater use of local resources reduces some of the risks over which a utility has little control, including risks associated with imported water and climate change.

- **Discharge reduction**. The JPA is prohibited from discharging water to Malibu Creek during certain months of the year. When surplus recycled water exists during these periods, the JPA incurs various costs for disposing of this water using spray fields and pumping to the Los Angeles River drainage.
- **Revenue**. Expansion of the system eastward (to the City of Los Angeles) and westward (to new areas of Thousand Oaks) generates new revenue for the JPA, while possibly helping these neighboring utilities achieve their conservation goals.

1.2 Background

As a subconsultant to Kennedy Jenks Consultants, HDR is under contract to the JPA to provide an update to the 2007 Recycled Water Master Plan. Under a separate agreement, HDR is under contract with CMWD to develop a hydraulic model of the recycled system in Ventura County, and analyze various system extensions. Because the JPA and CMWD systems must function together, a single hydraulic model was developed and the CMWD scenarios were analyzed in concert with this master planning effort. The results of both the JPA and CMWD analyses are provided herein. Completing these projects concurrently was both more efficient and more accurate than approaching these assignments as separate efforts. The products (this report and the hydraulic model) are also more comprehensive. For similar reasons, the analyses of the JPA's recycled water and wastewater systems has been concurrent with the master planning of LVMWD's potable water system. Each of these systems affects the other in terms of supply and demand.

This coordination of recycled water modeling within both Ventura County and Los Angeles County is a departure from previous master planning efforts. While TSD has participated in the 1999 and 2007 master plans, the earlier scopes of work did not include development and analysis of models for the CMWD portions of the system or investigating potential new customers in Ventura County. Instead, demands within Ventura County were modeled as point loads at the county line and future demand projections came from TSD staff. By modeling both portions of the recycled water system, how the operations of one system effect the other can be more clearly discerned. In addition to this report, both the JPA and CMWD will receive copies of the recycled water hydraulic model, which includes notes that document how the system was modeled.

This report is intended as an update to the last master plan for recycled water, following a similar outline and including some of the same information, where appropriate. This update is being undertaken to account for new information and changed conditions, and to allow the JPA to refine its capital improvement program and its strategic outlook. Among the changed conditions is the State of California's Water Conservation Act of 2009 (also referred to as "SBX7-7") which set a goal of 20 percent reduction in urban per capita water use by 2020 (i.e., the "20x2020 Rule"). Failure to meet this goal could have significant repercussions regarding future grant funding opportunities.

In contrast to earlier master plans, only a few changes to the system have occurred since the last update in 2007:

- A project that doubles the capacity of the Eastern Recycled Water Pump Station has been completed. This project enables greater disposal of excess recycled water to the Los Angeles River, which saves costs in operating spray fields for water disposal. Equally important, the larger pumping capacity provides greater flexibility to balance demands and supply between the eastern and western RW systems and makes possible extensions of the RW distribution system into the City of Los Angeles.

- Another important system upgrade was the completion of a new RW transmission pipeline from Tapia WRF to Mulholland highway. This improves the reliability of the system and enables better operational efficiency.
- In the design stage is a project that will cover and line the sides of Reservoir No. 2. This should improve the quality of RW as seen by customers at their sprinkler heads.
- As part of the Hidden Ridge development, the system was extended into a portion of Hidden Hills.

As with earlier master planning efforts, this master plan aims to economically maximize the use of recycled water. In doing so, the JPA partners and CMWD achieve:

- **Reduction in water imported** from the Sacramento Delta, via the State Water Project. The cost of these imports has grown rapidly in recent years due to environmental restrictions and shortage of supplies. Even higher costs are anticipated.
- **Greater local control** over water supply. Recycled water is the most reliable source of water. The quantity varies little with the season and the weather.
- **Revenue from sales** to other utilities. For the JPA partners, the water is virtually free. All revenues that exceed the cost of pumping are essentially operating income. [The cost of treating the water is essentially the same, whether it is reused or discharged.]
- **Reduced costs for water disposal**. Discharge prohibitions on the Tapia WRF during the spring and fall result in costs to dispose of water through pumping and spraying alternatives. Unless the use of recycled water increases, these costs will escalate when the supply grows or discharge restrictions increase, or both.

1.3 Report Summary

This Master Plan Update comprises the following sections:

Section 2 – Purpose and Scope

This section presents a summary of the project purpose and scope. The contract scopes of work generally included identifying potential recycled water system extensions, determining which extensions were economically feasible, and analyzing the facilities needed to meet those demands.

Among the system extensions that have been analyzed are: (a) Thousand Oaks Boulevard (to the Westlake High School and the Baxter Pharmaceutical Facility), (b) Decker Canyon (Malibu Golf Course), (c) residential areas within Hidden Hills, (d) several parks in the City of Thousand Oaks, (e) Alice Stelle School, (f) Woodland Hills Golf Course and (g) Pierce College. In addition to these system extensions, it was assumed that infill development would increase water demands on the recycled system by about 20 percent (reflecting the increase in flows to Tapia WRF). This is in recognition of assertive efforts by LVMWD staff in requiring new commercial customers, multi-family residential customers, homeowner associations, and estate-size single residential customers to make use of this important resource.

The analysis focused on Maximum Day and Peak Hour Demands during the summer period, which is the critical period for establishing the need for capital facilities or operational changes. Flows during off-peak periods were not modeled. How existing customers are affected by system extensions is a particular concern.

Because the original hydraulic model was constructed over 15 years ago, a completely new model was constructed using information from LVMWD's and CMWD's geographical information systems (GIS). This means that the facilities are more accurately located, elevations are more precise, and bases for the model are clearer, allowing future analysts to readily update the model and test different scenarios. Within the LVMWD system, customer demands can now be directly loaded to the model because the account numbers on the billing records and meter numbers in the GIS share common codes.

Section 3 – Evaluation Criteria

Evaluation Criteria describes the parameters used in modeling and analyzing the recycled water system. It describes the planning period through the year 2035, how pumping and storage capacity are to be evaluated, and details on parameters used in the model, such as maximum velocity in a pipeline, peaking factors, pump operation, etc. Section 3 also presents the cost estimating factors used to derive opinions of probable costs for capital projects.

Section 4 – Existing Facilities

Existing Facilities describes the JPA's and CMWD's existing recycled water facilities. Five pressure zones in the distribution system are defined: the Las Virgenes Valley System, the Western System, the Eastern System, the Parkway Subsystem, and the Oak Park System.

Section 4 further describes the existing infrastructure of over 55 miles of pipelines within LVMWD and 8 miles of pipelines within CMWD.[1] The purposes and features of the existing pumping stations, tanks/reservoirs, sources of potable water supplement, and pressure reducing stations are described, with capacities and operating parameters for each.

Section 5 – Supply and Demand

Supply presents a discussion of the existing and projected supply of recycled water and how it compares with various potential future demands. Since the availability of recycled water is dependent on the amount of wastewater coming into Tapia WRF, it is important to project this amount of expected influent for future years. As buildout of the LVMWD system occurs and septic systems are converted to sewers, the amount of RW is expected to increase.

Section 5 discusses estimated future demands from infill development and system extensions to: various homeowner associations and parks near the CMWD portion of the system, Malibu Golf Course, Baxter Pharmaceutical, Westlake HS, Hidden Hills, Woodland Hills Golf Course, and Pierce College.

Section 5 also discusses in detail the various sources of supplemental water, including well water, potable water, and water from a possible seasonal storage reservoir.

Section 6 – Hydraulic Analysis

This section discusses how a new hydraulic model was developed and validated, including how peaking factors and patterns for each of the service areas and several of the major customers were derived.

[1] TSD also owns some short sections of pipeline extending from the CMWD main to various customers.

The new model was used to evaluate the RW system's ability to serve various future scenarios, ranging from simple infill to ambitious extensions into Thousand Oaks and Los Angeles.

With the exception of Pierce College, the existing system is capable of serving the proposed expansions, along with demands from infill development, with only modest upgrades:

- An upgrade to Morrison Pump Station air-gap facility is recommended prior to extensions to Decker Canyon or Conejo Creek Park. The proposed upgrade would boost PS capacity from 1300 gpm to 2000 gpm.
- Additional parallel pipelines are needed in Park Granada, if an extension to Woodland Hills GC is constructed

To serve Pierce College, much of the Eastern RW system would need to be upgraded, including:

- New parallel pipelines from RWPS East to the eastern end of the system
- Suction pipeline upgrades for the RWPS
- A larger main extension to Woodland Hills GC

Some amount of pressure degradation may be noticed by some customers. Strategies to overcome any problems include, rescheduling irrigation timers and modifications to customer irrigation systems (the addition of pumps or reconfiguration of systems).

Section 9 – Potential Capital Improvements

This section provides budgetary estimates for the various facilities that could be constructed to make more extensive use of recycled water and reduce disposal of Tapia WRF effluent. Each of the proposed system expansions is also evaluated in terms of capital cost per acre ft of water provided.

Several economically attractive main extensions were identified, including:

- A modest extension of the system to serve the Capris Tract in Oak Park
- Extensions to several parks and one school in the Westlake area of Thousand Oaks
- Extensions and lateral connections to serve green belts, play fields, and parks in the North Ranch area of Thousand Oaks

More ambitious system extensions also appear to be viable, if added funding sources are available. An extension to Woodland Hills Golf Course, for instance, may be constructed due funding from the Los Angeles Department of Water and Power.

In addition to the system improvements needed for these possible expansions, the following upgrades are also recommended:

- Completion of the 8-inch pipeline in Agoura Road, west of Liberty Canyon, as opportunities present themselves. This main will improve system operations, as well as serve development along Agoura Road
- Improvements to Reservoir No. 2, including a shade-ball "cover" and synthetic membrane liner. These improvements are needed for conformance with permit provisions, but will also improve water quality experienced by customers.

- Upgrade to the air-gap facility at Morrison PS. This facility is important for improving supply and pumping capacity, and is recommended for expansions to Malibu Golf Course and Conejo Creek Park.

* * *

A similar report for LVMWD's Potable Water System is also being completed, as well as a report for the JPA's wastewater system. An integrated report will follow, which is condensed version of these reports that focuses more specifically on the interrelationships between the systems.

Section 2 – Purpose and Scope

Section 2: Purpose and Scope

2.1 Overview

The Joint Powers Authority (JPA) of Las Virgenes Municipal Water District (LVMWD) and Triunfo Sanitation District (TSD) are committed to providing high-quality recycled water, primarily for use in irrigating landscaped areas, such as golf courses, schools, parks, medians, businesses, and common green areas not irrigated by individual householders. Within Los Angeles County, the water is sold by LVMWD directly to customers within its service areas, primarily within the cities of Calabasas, Agoura Hills and Westlake Village. Within Ventura County, Calleguas MWD wholesales the water two retail utilities: TSD and California Water Service Company (CalWater). Triunfo serves the Oak Park community and Lake Sherwood community. CalWater provides water to the Westlake and North Ranch areas of the City of Thousand Oaks, including the North Ranch Golf Course.

The JPA is a recognized leader in water recycling, being one of the first major purveyors to determinedly develop a recycled water system.[2] The percentage of wastewater recycled is among the highest in the state. This long history of recycled water use means a substantial amount of background data are available for planning and analysis. The volume of data aids in the accuracy of the study results.

The existing service areas within LVMWD boundaries are primarily along the Ventura Freeway corridor in the cities of Calabasas, Agoura Hills, and Westlake Village. Within Ventura County, the current service areas include Lake Sherwood, Oak Park and North Ranch. Service area expansions being considered include the Malibu Golf Course, various customers along the easterly portion of Thousand Oaks Boulevard within the City of Thousand Oaks, the Conejo Creek Park area of Thousand Oaks, Hidden Hills, and Woodland Hills.

Throughout this report, the year 2012 will be referenced as a base year for establishing typical demand rates. This year was selected because it was the most recent year where complete data were available, plus it appears to exhibit high usage patterns. In 2012, the JPA sold 8,000 acre-feet of recycled water. Of this amount, 81 percent came from wastewater, 12 percent came from well water, and 7 percent came from supplemental potable water. More than 70 percent of the total wastewater going to Tapia was recycled—on average more than seven million gallons per day (MGD).

On those days when recycled water demand exceeds the Tapia WRF supply, one hundred percent of the Tapia supply is used in the recycled system, and the deficit comes from two sources: storage within the system and supplemental water. Storage from Reservoir No. 2 and the various tanks that serve the system can bridge the gaps produced by small, short-term deficits, but supplemental water—typically water from the potable system and wells—is needed during prolonged periods of high demands.

Seasonal storage has been previously studied, but firm plans have never developed. This is partly due to the difficulties associated with siting, permitting, and constructing a dam and impoundment area, but cost is also a major factor. With current and foreseeable demands on

[2] Originally, the JPA used the term “reclaimed water.” In the 1990’s, the nomenclature was statutorily changed to “recycled water.” The California Department of Public Health advises that “recycled water” is the “current appropriate term” and it is used throughout this report as reference is made to current or future activities.

the recycled water system, the benefits of seasonal storage have not outweighed the costs. While the idea of using seasonal storage to reduce creek discharges is very appealing, the existing distribution system would need to nearly double in size, to deliver enough water each year to make room for more seasonal storage. Had seasonal storage been available in 2012, approximately 80 percent of JPA wastewater could have been recycled—but this is not necessarily typical, 2012 was unusually dry. Demands were higher than normal and supply was lower than normal.

The demand for recycled water has steadily increased and is expected to increase in the future. This increase is due to continued development within the JPA's service area and the various advantages of using recycled water in these developments; it is also due to the JPA's and CMWD's proactive stances toward marketing of recycled water, a stance driven by the desire to maximize the use of recycled water, minimize imports, and reduce discharges from the Tapia WRF to Malibu Creek and other waterways. The recycling of wastewater for irrigation and other uses conserves a valuable resource—potable water—which would otherwise be used for those purposes. The beneficial use of recycled water reduces dependence on imported potable water and helps meet the goals of the Metropolitan Water District's Integrated Resource Plan, which emphasizes conservation of potable water through the use of recycled water.

In light of various changes that have occurred, there is a need to re-evaluate the projected recycled water supply and demand relationship and to evaluate the ability of the existing infrastructure system to meet new demands, particularly during the peak-demand summer months. The most recent master planning activities of the JPA's recycled water system within LVMWD were conducted in 1989, 1990, 1998, and 2007. Each planning cycle has accounted for changes that have occurred in demographics, regulations, environmental planning, and water supply. Early on, the planning emphasis was on meeting the demands of a growing region. Since the 1990's, as development has slowed, the planning emphasis has shifted to achieving the most economical and environmentally sound delivery system. With the passage of new legislation and greater concerns about water scarcity, finding new ways to use recycled water has received new attention. Typically, the focus is on conversion of existing potable customers to recycled water use rather than meeting the needs to new developments. While infill development of the LVMWD system will continue for several more years, the era of developments with more than hundreds of homes within the area tributary to Tapia WRF is over.

2.1.1 Discharge Permit Restrictions and the Use of Recycled Water

Discharge permit requirements for the Tapia WRF have been a significant driver of many decisions regarding the recycled water system. Beginning in 1997, discharges to Malibu Creek have been prohibited between April 15 and November 15 of each year, except under special circumstances. This prohibition has prompted the JPA to implement various methods to dispose of excess water, often at considerable expense. Because of these costs, JPA staff has redoubled efforts to maximize the use of recycled water wherever practical.

A threat exists that the creek discharge prohibition could be extended to the entire year, unless nutrients within the effluent are reduced to unprecedented levels. In recognition of these potential changes, the JPA produced the "Tapia Effluent Alternatives" (TEA) Study in December 2005 (LVMWD Report No. 2321.03), which studied a wide-range of options for avoiding discharges to Malibu Creek. Alternatives to winter discharges included seasonal storage, exporting recycled water to other watersheds or direct discharge to the ocean; however, none were economically feasible.

Partly due to the JPA's efforts in addressing the discharge issues in a proactive manner, a NPDES[3] permit was issued in November of 2005, which did not contain the restrictions that had been predicted. However, the JPA must still adhere to the discharge prohibition period that was imposed earlier, and was required to upgrade the Tapia WRF by May 17, 2010, to reduce nutrients in any effluent discharged to Malibu Creek or the Los Angeles River. The new limits include maximum monthly average concentrations of 8 mg/l for nitrate plus nitrite, and 2.3 mg/l for ammonia. These reductions in concentrations were achieved through a project completed in 2010 involving biological nutrient removal processes for both the wastewater and the centrate[4], before it returns to the plant. The new facilities were designed for an average dry weather flow at buildout of 12.0 MGD.

2.1.1.1 "Shoulder Month" Strategies

In the operation of the JPA system, a chief concern is how best to dispose of water in the "shoulder months". This is the time when the supply of recycled water exceeds demands, and the excess water cannot be discharged to Malibu Creek due to the permit restrictions. This occurs in the spring (April 15 through mid-June) and late fall (mid-October to November 15). Disposing of this excess water creates added costs for the JPA.

The supply of recycled water is relatively constant, because the generation of wastewater is essentially the same in the winter, spring, summer or fall. During rainy periods, supplies may increase due to rainwater and groundwater that infiltrates into the collection system, but when this occurs, the JPA has the ability to discharge. Recycled water demands, on the other hand, are anything but constant, with summer peaks that can be several times higher than typical spring and fall demands (see figures in Section 5). During cool, damp weather, the shoulder-month demands can go even lower, making the disposal of water more urgent.

The JPA has disposed of water during these shoulder-month periods through a combination of strategies:

- **Give away**. During the shoulder months, recycled water customers are encouraged to use water above their normal requirements at no added cost. This disposal method is very cost-effective. The only added cost to the JPA is the cost to pump the water to the customer and the administrative cost of figuring out what portion is free and what is to be billed.
- **Spray fields**. The JPA owns several nearby fields where irrigation systems are set up during the shoulder months and water is applied through spray application. Disposal occurs through evaporation and consumption by grass that is then harvested. This disposal alternative is relatively expensive due to the labor intensive work of setting up and operating the irrigation systems and harvesting the grass.
- **Los Angeles River**. The JPA has a discharge permit that allows water to be discharged to a stormwater conduit in Calabasas that drains to the Los Angeles River. In 2008, the capacity of this "005 Discharge Point" was increased as well as the capacity of the Eastern Recycled Water Pump Station (RWPS-East). Disposal through this facility is relatively inexpensive, although it requires pumping the water through the Cordillera zone (HWL = 1529 feet) and additional testing and monitoring for the NPDES permit.

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[3] National Pollutant Discharge Elimination System

[4] Centrate is the water removed from digested sludge. In the JPA's system, sludge (solids removed during wastewater treatment) is digested and composted at a separate facility located approximately 3.5 miles from the Tapia WRF.

This year, NPDES permit requirements for this discharge point have resulted in issues regarding excessive turbidity and the subsequent need to install a cover on Reservoir No. 2.

LVMWD also has the ability to divert a portion of Calabasas-area wastewater flows to the City of Los Angeles sewer system. While these diversions were frequent in the past—and expansion of this capability was once studied—this is now a costly strategy due to the charges by Los Angeles to accept these flows.

2.2 Master Plan Project Goals

The Recycled Water System Master Plan is one part of an overall Master Plan that will also include a Wastewater and Potable Water System Master Plan. Separate reports are being prepared for each system that will ultimately be incorporated into a final Integrated Master Plan Report. The integration will take into consideration the interrelationships between the systems (e.g., the use of recycled water lowers the demand for potable water; potable water is used seasonally to supplement the recycled water supply). This interrelationship is particularly important as it applies to how much transmission capacity is needed in each system, where supplemental potable water should be added, and how to deal with growing demands in the southwest quadrant of LVMWD.

The goals and objectives of this Recycled Water Master Plan Report are to:

- Provide a complete “fresh look” at master planning, particularly the effects of lower estimates of the build-out population and water demands
- Analyze both the potable and recycled water systems simultaneously, providing synthesized solutions.
- Integrate the master plans for the three systems into one executive-style report.
- Cover the planning period to the year 2035, utilizing the current general plans of the cities and Los Angeles County.
- Update the model of the recycled water system, including pipelines four inches and larger, pumping stations, storage reservoirs, and pressure-reducing stations.
- Evaluate infrastructure improvements needed to reach new customers and address capital facility replacement needs.
- Tie infrastructure improvements and associated costs to identify “trigger points” such as demand, percent of capacity, or similar measurable parameters so that funding can be scheduled accordingly.

2.2.1 Scopes of Work

2.2.1.1 JPA Recycled Water Master Plan

As a subconsultant to Kennedy Jenks Consultants, HDR is obligated to perform the contract scope of work for the Recycled Water Master Plan project as follows:

Task 2 – Recycled Water Master Plan

The 2013 Recycled Water System Master Plan will be updated to reflect existing system conditions, current recycled water demands with new projections, demand and supply comparisons, update of the hydraulic model, identification and evaluation of system improvements and future expansions. The Recycled Water Master Plan Update will be implementation-focused to guide the District's capital expenditures into the future. The following tasks will be included as part of this plan.

Task 2.1 - Review Recycled Water Data

The consultant will use a variety of readily available information sources as a basis of the preparation of the Recycled Water Master Plan and obtain appropriate GIS data related to land use, vacant land, parcels, streets, digital contours, and water line coverage's from the District. Data acquisition and review will include review of seasonal storage reservoir reports, Reservoir No. 2 Alternative Improvement Study, billing data for current and potential future RW customers like Malibu GC, Woodland Hills GC etc., General Plan, atlas maps, topographic maps, most recent Urban Water Management Plan and Water Master Plan, current mapping of land use among others. SCADA data at peak demands conditions will also be reviewed for various reservoirs and pump stations facilities like Tapia Pump station, Reservoir No. 2, RWPS East and West, Cordillera Tank, Indian Hills Tank, Supplemental Facilities at Reservoir No. 2, Cordillera, and Morrison PS, Oak Park PS, Oak Park Reservoir, Westlake Wells, and the metering stations at La Venta, Oak Park, and Lake Sherwood extension.

Task 2.2 - Perform Market Assessment and Supply vs Demand Comparison

As part of this task, the current and future supply/demands at maximum day demand (MDD) and on annual basis will be compared for various scenarios and combinations. The approach to this task is to develop a "bookend" of demands. The baseline projected demand conditions will be derived based on modest organic increases in demands, which will occur from commercial and multi-family developments proximate to the distribution system. Aerial photos and land planning documents will be used to estimate these demands.

The "aggressive" bookend future demand conditions will be derived based on several factors, but predominantly from new significant recycled water system extensions that would be required to serve new large customers/areas (see Task 2.4). In this demand assessment, we will reassess market demands from current billing data, estimate new estimated residential demands from aerial photography to estimate front-yard acreage and demands, and derive new non-residential demands from discussions with other agencies and available demand data.

Supplemental water required from LVMWD system will be evaluated and incorporated into the potable water system demand analysis. Pumping and storage analysis will be performed by updating prior spreadsheet analysis to reflect latest demands and best forecast. Seasonal storage analysis will also be performed as part of this task. The working volumes needed for a seasonal storage reservoir, based on various scenarios, will be evaluated and a summary of the recommended volume will be provided based on these evaluations and findings.

Task 2.3 - Update Existing Recycled Water Hydraulic Model

We will work closely with the District's staff to update the current RW model to the latest software version. Based on the data gathered from previous tasks, we will contrast the model with GIS to include all pipes not in the current model and refresh the model with changes in pipe diameter, age, material and other appropriate attributes. The updates will also include adding any expansion of the system, verifying operational settings and system parameters provided by the District, addressing connectivity issues, updating demand sets for ADD and MDD scenarios; diurnal patterns and peaking factors based on District's billing data, and updating pump curves. Model demands will be updated for future scenarios based on the projections performed in previous tasks. Facility updates will include adding new pipes including the 24-inch pipeline on LV Road, adding Oak Park and Lake Sherwood systems among others.

Task 2.4 - Perform Recycled Water System Hydraulic Analysis

Once the model has been updated and validated, it will be used to evaluate the recycled water system. The hydraulic analysis will include system extension evaluations comparable to prior planning efforts for system extensions outside the JPA to the City of LA, City of Thousand Oaks, CalWater Service Company, and the Malibu Golf Course. We propose the following investigations:

- Perform hydraulic analysis and provide recommendations for pipe sizes and upgrades.
- Determine sources of supplemental water.
- Estimate cost of system extension and determine cost per AF of water supplied annually.
- Residential Use Evaluation will also be carried out as part of the recycled water hydraulic analysis.
- Extensions to Hidden Hills, Upper Oaks, Foxfield Drive area, North Ranch, Old Agoura, and Medea Valley will be evaluated. We propose the following as part of this evaluation:
- Select pipeline routes based on assessment of hydraulic capacity, demands, and preliminary costs.
- Estimate cost of system extension and determine cost per AF of water supplied annually.

Task 2.5 - Develop CIP

Based on our system evaluation and discussions with the staff on results of the analysis, we will recommend CIP projects for system improvements. In a broad sense, the CIP will be based on the overall strategy for the recycled water system relative to modest or aggressive water use and SBx7-7 compliance strategy. At the project or program level, it will incorporate the District's decisions related to new service area extensions, shoulder month storage, and other overall infrastructure improvements. Conceptual level cost and cost per acre-ft of RW delivered annually will be prepared using up-to-date unit costs taken from recent bids. A brief summary of the benefits and triggers for the RWMP will be provided.

Task 2.6 - Prepare Recycled Water Master Plan Report

A draft Recycled Water Master Plan Update report which summarizes and documents the work developed during the master planning effort will be developed and submitted in a *.pdf file format for easy distribution by the District. The report will incorporate and integrate evaluations from previous studies, supply/demand comparisons, review of regulatory requirements, hydraulic evaluation aspects and provide a comprehensive look at the District current conditions and future CIP recommendations. Based on comments received from the District, and discussion during the Draft Recycled Water Master Plan Update review meeting, a Final Recycled Water Master Plan Update will be prepared. Ten hard copies and one electronic copy in Adobe Acrobat (PDF) format will be provided.

Task 2.7 - Conduct Recycled Water Workshop Sessions

Workshops sessions will be an integral part of the three master plans. These will serve to facilitate key direction and decisions for the recycled water master plan. Many of these workshops will be held in conjunction with Potable MP workshops, if at all possible. Somewhat unique for the recycled water system, will be the need for meetings with LADPW, CalWater, and Thousand Oaks to discuss specific challenges and opportunities for recycled water use in their service areas.

2.2.1.2 CMWD Recycled Water System Modeling

Under an agreement with Calleguas Municipal Water District, HDR is obligated to perform the following contract scope of work:

1. Model development. Add the Oak Park and Lake Sherwood systems to the existing hydraulic model. Subtasks include:
    a. Use available topographic, parcel, GIS, and other maps to develop network
    b. Obtain from Calleguas MWD and incorporate into the model the pump station and tank set points.
    c. Obtain from TSD billing data for existing recycled water customers.
    d. Calculate average day, maximum day, and peak-hour demands, and associated peaking factors.
2. Hydraulic Analysis
    a. Model current maximum day demand. Compare results with CMWD SCADA data (tank levels, pump station flows, and pump station suction/discharge pressures). Make model adjustments, as needed.
    b. Model up to 3 future scenarios involving either system extensions or infill demands, including residential (front-yard) irrigation along streets in Oak Park where RW mains currently exist.
        i. Residential demands will be based on acreage calculations from aerial photographs and unit demands.
        ii. Other extensions will be based on actual usage (where billing data are available) or from aerial photography.
        iii. Use unit demands already developed for the 2007 JPA Master Plan.

    Prior to performing the model runs, HDR will submit a memorandum for review by CMWD and TSD showing the parameters to be used in the modeling.

3. Deliverables. Incorporate the findings as part of the JPA Recycled Water Report being prepared for TSD and LVMWD. Draft and final copies will be provided. Meetings and workshops will be held as part of the JPA project and their cost is included in the JPA Master Plan budget. At the conclusion of the project, deliver updated model to the JPA.

Assumptions and Exclusions

1. The existing JPA Model runs adequately without any warning messages. The model is balanced and converges for all runs.
   a. No operational (facility control settings) adjustments to this model are expected when adding the TSD system
   b. No model demand adjustments are expected to analyze the TSD system
2. The required data (e.g., topography, parcel, background, pipeline, tank, and pump station, and other GIS infrastructure data) are furnished in electronic format compatible with GIS.
3. TSD will provide electronic billing data for the last three years in an easily managed digital format.
4. Hourly SCADA data for the major facilities are available and will be provided in a digital format that can be readily analyzed
5. No meetings beyond those budgeted for the JPA master planning project will be required.

2.2.1.3 Deviations from contract scopes of work

- **New computer model**. Upon review of the existing computer hydraulic model, it was determined that the JPA and CMWD would be best served through the construction of a new model, utilizing GIS files from both systems. In the case of LVMWD, billing records could be directly linked to the GIS, allowing for very precise demand allocations. Development of this model also involved the development of new demand patterns through the analysis of SCADA data at various meters.
- **Scenario development and selection**. The main extensions modeled for both the JPA and CMWD work scopes were based on workshops with staffs and meetings with neighboring utilities. The scenarios were submitted, reviewed and approved prior to modeling.

2.3 List of Acronyms

List of Acronyms and Abbreviations	
ADD	average daily demand (the average amount of water used)
AF, AFY	acre-feet, acre-feet per year
cfs	cubic feet per second
CalWater	California Water Service Company
CIP	capital improvement plan or program

List of Acronyms and Abbreviations	
CMWD	Calleguas Municipal Water District
DPH	Department of Public Health
ft	feet
GIS	geographical information system
gpm	gallons per minute
GC	golf course or golf club
hp or HP	horsepower
HOA	homeowners association
HWL	high water level
HGL	hydraulic grade line
HP	horsepower
I/I	infiltration and inflow
JPA	Joint Powers Authority of LVMWD and TSD
LA	Los Angeles
LADWP	City of Los Angeles, Department of Water and Power
LV	Las Virgenes (Road or MWD)
LVMWD	Las Virgenes Municipal Water District
MDD	maximum daily demand (the maximum amount of water used in one day)
MG, MGD	million gallons, million gallons per day
MP	Master Plan
MWDSC	Metropolitan Water District of Southern California
NPDES	National Pollutant Discharge Elimination System
OPWS	Oak Park Water Service
PHD	peak hourly demand (the maximum amount of water used in one hour)
PS	pump station
psi	pounds per square inch
PW	potable water
RW	recycled water
RWPS	Recycled Water Pump Station (the main pump station at LVMWD headquarters, also referred to as RWPS-East and RWPS-West)
SCADA	supervisory control and data acquisition (the automated system used to control and monitor water system operations)
SWP	State Water Project
TO	The City of Thousand Oaks
TSD	Triunfo Sanitation District
TWRF	Tapia Water Reclamation Facility
WW	wastewater
005	Discharge facility 005, used for disposal of water to the Los Angeles River

Section 3 – Evaluation Criteria and Modeling Parameters

Section 3: Evaluation Criteria and Modeling Parameters

This section describes the criteria and parameters used for modeling. The criteria are also applicable to the analysis and design of system facilities.

3.1 Planning Horizon and Potential for RW Use

The planning period for this master plan is through the year 2035, which is considered "buildout."

Projections for populations, water supply, and water demands are found in the Potable and Wastewater System Master Plans that are companions to this report, and are derived from the land-use general plans of the various planning agencies and other published planning agency reports.

Specific to recycled water planning, future projections of wastewater flows are important as these represent the available supply of recycled water. Specific development plans are also important as a way of identifying potential recycled water customers. At this time, no large new developments are foreseen proximate to the recycled water system, with the exception of "Triangle Ranch" a proposed 61-home development in Agoura Hills. No new schools, public parks, golf courses, or similar traditional users of recycled water have been identified.

The Oak Park area and the Westlake area of Thousand Oaks (both within Ventura County) are considered to be essentially "built out". Very few undeveloped, unrestricted parcels exist in these communities. Within the LVMWD service area, considerable undeveloped, unrestricted parcels do still exist, but these are mostly in topographically challenging areas, such that development, if and when it occurs, will generally be sparse and sporadic. Many of these topographically challenging areas are also not easily reached by the RW system.

3.2 Trigger Points

Where system upgrades are identified, the schedule for their implementation has been linked to specific system conditions or other identifiable events. Generally, improvement trigger points are the proposed system extensions to serve large new areas, such as Decker Canyon, Conejo Creek Park, Pierce College, or Woodland Hills.

3.3 Supply and Pumping Capacity

The supply for the recycled water system in the JPA area is primarily tertiary treated wastewater from the Tapia Water Reclamation Facility. This source is supplemented as demands dictate: first by the JPA's Westlake Wells and second by the addition of potable water at several selected locations in the distribution system.

The addition of groundwater from the Westlake Wells is assumed for all alternatives considered during modeling of the recycled water system, whereas the amounts of potable supplement and the location of that supplement vary with the particular alternative. Without the supplement of potable water into the distribution system, the summer peak demands could not currently be met. If potable water supplement were not used, the choices would be to:

- Reduce the number of customers or the amount of water delivered to customers.

- Have individual customers provide for their own peak summer demands by providing potable water to supplement the available recycled water.

As a general policy, LVMWD has favored the use of potable water supplement instead of requiring customers to reduce their demands, even though this means that potable water is often sold at a discount. Using potable supplemental water during peak demand periods keeps the system "customer friendly", encouraging its use, and thereby promoting greater sales of recycled water during the non-peak periods. This reduces the duration of time and the amount of water that must be disposed of in the shoulder months [the periods in the spring and fall when surplus recycled water exists but cannot be discharge to Malibu Creek due to NPDES restrictions]. There are also significant Department of Public Health concerns when recycled water and potable water systems are used for irrigation at the same location. It is difficult to assure regulatory compliance if customers must switch from one water source to another.

At a minimum, pumping facilities are sized to meet the Maximum Daily Demand (MDD) including the potable supplement needed to fully supply that demand.

3.4 Operational Considerations

There are many differences between how potable and recycled water systems are designed and operated. The main ones are highlighted below:

- The JPA recycled water system is not designed to provide water for fire protection. Therefore, tank volumes do not include storage for fire flows, pump stations do not include back-up or stand-by pumps, or emergency power, and pipe sizes are often smaller.
- Recycled water systems in general are not designed for the same reliability as potable water systems. While operational outages are never desirable, they are more tolerable if the water is used principally for landscape irrigation.
- Because reliability is less important, a recycled system will generally be configured as a "spine and ribs" system, with water flowing by only one possible route to each customer. An interruption anywhere along the route will render all customers served by that route out of service. [In potable systems, a piping network is favored, allowing water to flow through many different routes to most customers. In a network system, service problems on most pipelines only affect a small portion of customers.]
- The recycled water system is not subject to the same water quality regulations as the potable water system. Therefore, the recycled water distribution systems can more readily be configured with long, non-looping pipes to serve remote customers.
- Because the water is assumed to be undrinkable, there are many restrictions on where and when it can be used. This means that each customer connected to the system has to be educated and their on-site plumbing and irrigation systems must be tested. It also means that nearly all irrigation with recycled water must occur at night, when the schools, parks, and golf courses are not occupied. Because of these requirements, serving recycled water to very small users is often cost prohibitive.
- The recycled water system cannot receive potable water directly. To avoid cross-connections, air-gaps or other special provisions must be included between the systems where supplemental potable water is required to meet peak recycled water demands.

To meet peak demands in the JPA system during the summer, potable water supplies are used to supplement the recycled water. Potable water can be added directly to the system at various air gap facilities including Reservoir No. 2, Cordillera Tank, and Morrison Pump Station. A small air gap facility is also located at Parkway Tank. Potable water can also be supplied indirectly by switching a recycled water customer to potable water temporarily to relieve demand on the recycled system. This is readily done at some golf courses, where water is stored on site in ponds or tanks, then pumped into the irrigation system. These storage facilities are generally configured to receive both RW and potable water (delivered through an air gap).

3.5 Modeling Parameters

Described below are the parameters and assumptions used for evaluating the existing facilities and estimating sizes for new facilities.

3.5.1 Dimensional Units

Table 3-1 displays the dimensional units that are considered current and applicable to this master plan. Also for convenience of use, equivalent units are sometimes shown in graphics and text (i.e. acre-feet and MGD).

Table 3-1 Dimensional Units

Pipeline Length	feet (ft)
Pipeline Diameter	inches (in)
Pipeline Flow Rate	gallons per minute (gpm)
Pipeline Headloss	feet (or ft per 1000 ft of pipe)
Junction (node) Hydraulic Grade Line	feet
Junction (node) Elevation	feet
Junction (node) Pressure	pounds/square inch (psi)
Pipeline Velocity	feet per second (fps)
Junction (node) Demand	gallons per minute (gpm)
Land area	acres
Annual water consumption	acre-ft per year (AFY)

3.5.2 System Limits

For evaluation purposes, certain parameters, such as pipeline velocities, headloss rates and pressures, should not exceed the values shown in Table 3-2.

Table 3-2 Computer Simulation Conditions

Parameter	Limit	Remarks
Pump stations	≤ 6 on-off cycles per hour	Model using current set points. Adjust as needed.
Tank levels	Daily refill required	
Minimum pressure	20 psi	≥50 psi is desired for irrigation, but lower pressures are allowed with on-site pump
Maximum static pressure	150 psi	Higher pressure OK with pressure reducing valve to protect piping and appurtenances
Maximum pipeline flow velocity – new pipes	5 fps	
Maximum pipeline flow velocity – existing pipes	10 fps	
Maximum pipeline headloss – new pipes	5 ft/100 ft (or 2.2 psi/1000 ft)	
Maximum pipeline headloss – existing pipes	None	Evaluate how existing customers are affected by higher head losses.

3.5.3 Peaking Factors

“Peaking Factors” are the ratios of a demand condition (such as Maximum Day Demand) and the Average Day Demand (ADD), which is the total yearly demand divided by 365 days. There are wide variations in demand between summer and winter, so ADD is not typical for either season.

There are several important differences between recycled water and potable water systems:

- The demand in recycled water has a greater reduction in the winter than potable water because the recycled water is predominantly used for landscape irrigation and is more influenced by weather. In some recycled water systems, such as in the West Basin Municipal Water District in Los Angeles, where there are significant commercial and industrial customers, the demand remains relatively constant during the course of a year. This is not the case for the JPA’s service area.
- Most recycled water demands occur at night, between the hours of 10 p.m. and 8 a.m. This is reflective of the types of areas irrigated with recycled water and regulatory use restrictions: many areas support public recreation during daytime periods.

System-wide peaking factors for the JPA’s Recycled Water Distribution System are discussed in detail in Section 5. The peaking factors below are to be applied for the analysis of individual developments. These parameters can be used for general guidance; specific diurnal patterns have been developed for each portion of the system and have been incorporated into the model.

Average Day Demand (ADD)	1.0
LVMWD Maximum Day Demand (MDD)	2.5 x ADD
TSD Maximum Day Demand (MDD)	
Oak Park/North Ranch	2.6 x ADD
Lake Sherwood	3.5 x ADD
Peak Hour Demand (PHD) / MDD	2.0 (minimum)

The peak hour factor can vary greatly, depending on how the customer usage occurs. In the prior master plan, factors as high as 10 were reported.

For new customers, peak flow rates should be estimated using Figure 1 found in LVMWD Report No. 2267, "Western Reclaimed Water Distribution System, Phase 2, Report on Pipeline Alignment West of Lewis Road." A copy of this is found in Appendix D. Also found in Appendix D is a graph showing the increase in peaking factors that occurs with smaller average flows.

3.5.4 Modeling Assumptions for Hydraulic Grade Lines (HGL) and High Water Levels (HWL)

Unless otherwise noted, extended-time simulations assume that tanks are to refill each day, to the maximum operating level. These and other hydraulic grade line assumptions are listed below.

- Reservoir/Tank HGL
  - ADD — maximum operating level
  - MDD — maximum operating level
- Storage Refill — overflow level
- Pump Suction HGL — source zone HGL on MDD
- Pressure Regulating Valve
  - Operational Setting — as existing
  - Headloss "k" Factor — 5.0

3.5.5 Pump Operations – Modeling Parameters

Pumping operations were modeled to closely approximate the existing system. Pump curves are based on new (or newly rebuilt) conditions. In performing the analysis, a margin of error or safety factor must be maintained to allow for pump wear and inaccuracies in the data and estimates.

Pump Curves	
Single Pumps	Existing head/capacity curves furnished by the LVMWD or CMWD
Multiple Pumps	Existing head/capacity curves furnished by the LVMWD or CMWD
Pump Sequencing	As existing (or improved if needed)
Pumping duration	Avoid pumping more than 18 hours/day, if feasible
All Pumps are Operating	Yes, except Tapia PS with 2 duty Units (Duty) and 1 standby

With the exception of the Parkway RW Pump Station, the JPA and CMWD pumping facilities are not designed to take advantage of lower electrical rates during off-peak periods. In fact the opposite is sometimes true, with pumping scheduled to occur during the day, when customer demands are light. In this way, tanks are filled during the afternoon and evening, in preparation for the demands that occur at night.

3.5.6 Pipeline Friction Factors (Hazen-Williams "C")

Pipeline friction factors are based on standard factors.

Table 3-3 Pipeline Friction Factors (Hazen-Williams "C")

a. Polyvinyl Chloride (PVC) or High-Density Polyethylene (HDPE) Pipe	140
b. Asbestos Cement Pipe	120
c. Mortar-lined Ductile Iron or Steel Pipe	120

Because the system has been constructed since the 1980s, there are no unlined cast iron or unlined steel pipes in the RW system.

3.5.7 Unit Demand Factors for Irrigation

Unit demand factors are used for estimating potential consumption of recycled water for landscape irrigation. The actual consumption of water varies greatly by type of user. Shown below are the estimated yearly demands for different types of users, as determined by an analysis of billing records for 42 LVMWD customers, performed for the 2007 Master Plan.

HOA landscaping[5]	2.8 AFY/acre
Commercial/Industrial	5.8 AFY/acre

[5] Common area landscaping within a residential community, maintained by a homeowners' association (HOA).

Schools	2.7 AFY/acre
Agriculture (minimum)	3 AFY/acre
Golf Courses	3.5 AFY/acre
Roadway landscaping[6]	5.5 AFY/acre

3.5.8 Existing Demands

Demands for existing customers were derived from billing records for 2011 and 2012—the last two years where complete records were available.

- **LVMWD demands** were directly tied to meter locations. The billing records and GIS meter locations had common reference numbers.

- **Oak Park Community demands**. TSD billing records had no direct ties to meters. The demands for the 15 customers with the highest demands were loaded into the model based on billing addresses. The demands for the smaller users were spread evenly on the transmission pipeline between system meters. Water into and out of the OPWS is measured via three meters:
  - Oak Park Pump Station
  - Oak Park Lateral at Conifer Street (on suction side of pump station)
  - Lindero Canyon Boulevard (tracks water flows to CalWater North Ranch)

- **Lake Sherwood demands** were based on billing records provided by TSD and CMWD.
  - Flows to Lake Sherwood Golf Course are measured at a 10-inch meter at the Lake Sherwood Fire Station
  - Flows to 5 small customers within the Lake Sherwood Community are measured at individual meters

- **CalWater demands** were based on billing records provided by CMWD. Demands were placed on the model as follows:
  - All flows registered at the Lindero Canyon Boulevard meter were assigned to North Ranch Golf Course
  - Flows to 13 small municipal meters supplying irrigation to roadway landscaping in the Westlake area of City of Thousand Oaks were evenly distributed along the pipeline within the City of Thousand Oaks. These flows were calculated as the difference between the flows at the County line (as measured by a 10-inch meter located on Agoura Road and La Venta Drive) and the Lake Sherwood flows.

Demands for specific main extension scenarios were also taken from various earlier studies, as discussed in Section 5.

[6] Parkways and medians along streets and sidewalks.

3.5.9 Hydraulic Analysis Parameters

Other modeling parameters included:

PRV zones modeled simultaneously with parent zone	Yes
Future analysis to include improvements identified for prior years	Yes
Extended period analysis at MDD, including PHD	All
Pipelines modeled	4" and Larger

3.5.10 Storage Analysis Parameters

Storage analysis assumes that virtually all the tank or reservoir is useful storage.

Operational Storage	
Demand flow used	Maximum daily demand
Duration	Per diurnal curve
Usable Tank Storage	80% of total volume
Reservoir Refill	Daily, if possible
Emergency Storage	None
Minimum Storage	As needed to meet peaks

3.5.11 Supply Analysis Parameters to Meet MDD

Sources of supply are as follows:

Tapia WRF Average Summer Flows	Yes
Westlake Wells Supplement	Yes – 1st Priority
Potable Supplement	Yes – 2nd Priority
Source of potable supplement	Minimize air gap headloss and maximize hydraulic efficiency

3.6 Demand Conditions

Recycled water master plans can be more difficult than potable water master plans, because there are more decisions to be made about which customers to serve and under what conditions they will be served.

The demand used for analyzing the existing system is straight forward. For this report, existing demands were based on utility billing records for the years 2011 and 2012. Although wetter than 2013, 2012 was a drier than normal year, so demands in the winter, spring and fall were higher than normal. Demands in the summer were believed to be fairly normal.

The future demand from infill development was assumed to increase existing demands by up to 20 percent within the LVMWD portions of the system. This amount is based on the estimated increase in flows to Tapia WRF. The assumption is that as infill development occurs and additional recycled water is produced, new customers will also be added in roughly the same proportion. Customers that connect to the wastewater system are generally within reach of a recycled water pipeline, and connecting to the recycled water system is often a condition of development approval. Significant increases in recycled water demands due to infill development in Oak Park, Thousand Oaks and Lake Sherwood are not anticipated. These areas are considered to be essentially built out, and no significant redevelopment is foreseen in the currently served areas within the planning horizon.

In addition to the additional demand from infill development, demands for several system extension projects were considered, along with demands for specific infill areas, such as along Agoura Road.

3.7 Replacement Schedules and Economic Lives

The approximate useful lives of recycled water distribution facilities vary greatly depending upon many factors including: loading conditions, amount of use, maintenance, construction quality, material quality, material properties, and environmental conditions. Table 3-4 provides estimates of operational lives for key facilities before large-scale repair, replacement or refurbishment is needed. These estimated lives are based on *Las Virgenes MWD Asset Lives Memorandum* by Brown and Caldwell (dated September 11, 2006).

Table 3-4. Schedule of Approximate Useful Lives for Various RW Assets

Asset Description	Useful life (years)
A. Major buried pipelines	
1. Sewers, all materials	100
2. Potable and recycled, all materials	75
B. Tanks and reservoirs	
1. Concrete reservoirs	50
2. Welded steel storage tanks (except coating)	50
C. Pump stations (except pumps and electrical)	50
D. Tapia WRF facilities	50
E. Facility piping, appurtenances, services, roads	
1. Piping, valves and fittings/buried valves	35
2. Site work/roads/small structures	35
3. Potable water meter boxes, services, vaults, fire hydrants	35
4. Recycled water meter boxes, services, vaults, fire hydrants	35
F. Large equipment	

Asset Description	Useful life (years)
1. Potable and recycled water pumps	25
2. Sanitation pumps, conveyors, centrifuges, large electrical	25
3. Sanitation control systems, electrical, chemical, grinders	25
4. Electrical and control facilities at pump stations and storage facilities	25
G. Small equipment and miscellaneous	
1. Tank coatings	15
2. Potable and recycled water meters	15
3. Special vehicles, portable generators and pumps	10
4. Sanitation meters, lab equipment, small tools, radios, SCADA equipment	10

3.8 Cost Estimating Factors

Unless specifically noted otherwise, all cost and economic figures used in this report are based on applicable current rates, in 2014 dollars.

Table 3-5 provides unit costs for estimating purposes. The values are based on previous construction bid costs and include all work and appurtenances associated with the construction. It should be noted that generally, smaller pipelines are PVC or HDPE, where the larger (16 inches and larger) pipelines are generally steel.

Table 3-6 shows the budgetary cost estimating criteria for pump stations, and is also based on previous construction. Pump station estimates do not include associated pipelines that are outside of the buildings or the cost of land. This table is based on cost curves included in the previous master plans, escalated to current dollars.

The costs associated with right-of-way acquisition for facilities that are not in current public right-of-way can vary significantly. An allowance estimated between $5 and $40 per square foot should be allocated for the fee parcels, depending on whether the land has development potential. For easements, approximately half the value of the fee title cost should be assumed.

An allowance of 20 to 30 percent of the construction cost has been added for engineering and related services. The lower amount applies to larger projects and the higher amount applies to smaller projects, with project complexity and other factors also considered.

Table 3-5. Pipeline Cost Estimating Criteria

Diameter (inches)	**Existing Development**[2] ($/LF)	**New Development**[3] ($/LF)	**Diameter** (inches)	**Existing Development**[2] ($/LF)	**New Development**[3] ($/LF)
4	$ 190	$ 100	14	$ 310	$ 160
6	$ 220	$ 110	16	$ 320	$ 170
8	$ 240	$ 120	18	$ 350	$ 200
10	$ 270	$ 140	20	$ 360	
12	$ 290	$ 150			

Notes:

1. All costs are 2014 dollars (October 2013 ENR Construction Cost Index/Los Angeles = 11,321)
2. Pipeline costs for developed areas are based on analysis of historic costs for public bid projects in California. Costs include all pipeline related items, including mobilization, excavation, backfill, appurtenances, services, casings, and paving, but exclude engineering, right-of-way, and environmental permitting and mitigation.
3. Pipeline costs for undeveloped areas are based on industry estimating guides and include an allowance for typical appurtenances, but do not include paving and mobilization

Table 3-6. Estimating Guide for Pump Stations

Size (HP)	**Construction Cost** ($/HP, 2013)	**Size** (HP)	**Construction Cost** ($/HP, 2013)
50	10,000	400	6,000
100	9,000	500	5,000
200	8,000	600	4,500
300	7,000		

The opinions of probable cost provided in this report are concept-level estimates for general budgetary purposes. They represent the opinion of HDR Engineering as a design professional and are supplied for the general guidance of the District. These cost opinions do not account for site-specific or market conditions that will affect actual costs. The general margin of error is approximately +20 percent, -15 percent.

3.9 Hydraulic Modeling Software

The model used for hydraulic analysis of this master plan is WaterGEMS by Haestad Methods. The model is similar to the models used in the analysis for the 1999 and 2007 Recycled Water Master Plan and is based on EPA Net, a hydraulic analysis system developed by the United States Environmental Protection Agency and used for most hydraulic analysis software in North America. Facility information such as pump curves and tank sizes generally came from the earlier model. GIS information provided by LVMWD and CMWD were used to create the piping network. Pipeline elevation information came from a public source digital terrain model and is considered accurate to within 10 feet. Elevations for tanks and pump station facilities derive from record drawings.

Section 4 – Existing Facilities

Section 4: Existing Facilities

The system begins at the Tapia WRF, which is owned by the Joint Powers Authority (JPA) of LVMWD and TSD, where up to 10 million gallons per day (MGD) of wastewater is currently treated to a high level, allowing it to be distributed for non-potable uses such as landscape irrigation and various commercial uses. The JPA also 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.

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, it is sold to CMWD, which distributes it to 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, to Lake Sherwood Golf Course, and to the Westlake and North Ranch portions of the City of Thousand Oaks.

The current recycled water system was mostly planned and designed in the late 1980s, serving various irrigation customers, from the North Ranch Golf Course on the west, to the City of Calabasas on the east. While several upgrades and expansions to the system have occurred since then, the current system was essentially designed for the customers it now serves. It was not designed with allowances for future expansions.

While extensions to the system are possible, there are practical limitations on the size and location of customers that can be added. These limitations are primarily due to pipeline sizes—only a certain amount of water can be pushed through a pipeline without significantly reducing the pressure provided to existing customers. These hydraulic restrictions can sometimes be overcome by: (1) scheduling customer usage such that major customers are staggered, (2) providing supplemental water or storage near areas of high demand, and (3) using on-site pumps or irrigation system redesigns to overcome low pressures at customer meters.

This section describes the existing facilities, their functions and their capacities, and how these capacities affect the system.

4.1 Supply Facilities

The primary supply of recycled water to the JPA is the Tapia Water Reclamation Facility (Tapia WRF). Various supplemental supplies are used when needed when the supply from Tapia WRF alone is not sufficient to meet the recycled water demand. This occurs frequently during the summertime. Section 5 discusses the balance of supply and demand in greater detail.

4.1.1 Tapia Water Reclamation Facility

The Tapia WRF is operated jointly by Las Virgenes Municipal Water District (LVMWD) and Triunfo Sanitation District (TSD). The plant is located on Malibu Canyon Road and provides tertiary treatment for wastewater contributed by both LVMWD and TSD. The plant was earlier designed for a hydraulic capacity of 16 million gallons per day (MGD), but due to permit limitations on nutrients, its current treatment capacity is on the order of 12 MGD.[7]

The plant underwent a major upgrade in 2009 in order to meet a regulatory deadline set for May 2010. The upgrade included modifications to the activated sludge system and construction of a separate system to treat centrate. These new facilities were intended to treat an average dry-weather flow at buildout of 12 MGD and have successfully treated up to 9.5 million gallons of wastewater on an average dry-weather day. Currently, the plant processes about 9 MGD, which is less than the 10 MGD that was processed five years ago. The drop in flows is attributed to water conservation and the slow-down in the economy. [A more detailed discussion of historic and estimated flows at Tapia WRF is found in the 2013 Wastewater Master Plan.]

It is important to note that the new plant nutrient limitations apply to monthly averages—thus short-term excursions above these maximum limits are allowed. The permit also only applies during times when Tapia WRF is discharging water to Malibu Creek or the Los Angeles River. During summer when 100 percent of the water is being recycled, nutrient loading can be higher.

4.1.2 Westlake Wells

The JPA owns and operates two groundwater wells in Westlake Village near the intersection of Lindero Canyon and Lakeview Canyon Road. Each well has a nominal capacity of approximately 400 gpm. Combined, they have a maximum total capacity of approximately 1.15 MGD, but extended reliable production averages about 0.75 MGD, when run for several consecutive summer months.

The wells have been used to directly supplement the recycled water system in the past, but the iron and manganese content of the water resulted in staining of concrete structures such as walls or sidewalks; therefore, use of the wells was discontinued as a direct supplement to the recycled water system. With proper blending or treatment, the water is otherwise suitable to use in the recycled water system. The JPA has provided such blending and treatment by conveying the groundwater to Tapia WRF via existing trunk sewers. After processing, the groundwater enters the recycled water system with other water treated at Tapia WRF.

The wells are only used when supplemental water is needed to meet peak demands. Timing and control of well operation requires careful planning and coordination so that surplus flow is not mistakenly developed at Tapia WRF, especially during the creek discharge prohibition period of November 15 through April 15.

4.1.3 Supplemental Potable Water

There are three locations within LVMWD where potable water may be added to the recycled water system, as shown in Table 4-1. Figure 4-1 shows schematically the sources of potable supplement and other sources of supply.

[7] The critical discharge limits are monthly average concentrations of 8 mg/l for nitrate plus nitrite, and 2.3 mg/l for ammonia.

Table 4-1. Potable Water Supplement Facilities Capacities

Location	Description	Max. gpm
Reservoir No. 2 LV Valley System	Via a permanent buried pipe from 1235-ft potable system. Air gap into stand-pipe at reservoir.	400*
	Via a temporary pipe on surface from 1235-ft potable system. Air gap at pipe end at spillway into reservoir.	2,100
Cordillera Tank Eastern System	Via a dedicated buried pipeline from 1640-ft potable system. Automatic flow control. Permanent air gap into tank.	1,200
Morrison Supplemental Facility Western System	Via an air-gap facility that feeds a low-lift pump station (see below for a more complete description).	1,300 (current) 2,000 (future)
Total Potable Water Supplemental Available (maximum – excludes 400 gpm at Reservoir No. 2)		4,600 (current) 5,300 (future)

* Originally designed for 1,000 gpm. Air containment at the pump station reduces capacity to 400 gpm. This facility is rarely used.

At Parkway Tank, there is also an air gap through which potable water can be supplemented. This feature is only expected to be used during maintenance activities.

There are no comparable supplemental facilities in the TSD service area, primarily because TSD uses less RW than it produces. Supplemental potable water can be used to fill the water storage reservoirs and ponds at Lake Sherwood and North Ranch Golf Course, which are then used to irrigate the courses. For better system reliability and flexibility, a supplemental system may be desired for the TSD service area. A logical location is at the Oak Park RW tank, where a small pump could be installed at the TSD's Savoy Tank, which would then pump water through an air-gap into the Oak Park RW Tank. [Several years ago, when the RW transmission pipeline was being replaced through Oak Park, a temporary system was set up that did this.] The Savoy Tank and Oak Park RW Tank are on the same hill, but the Oak Park Tank is at a higher elevation.

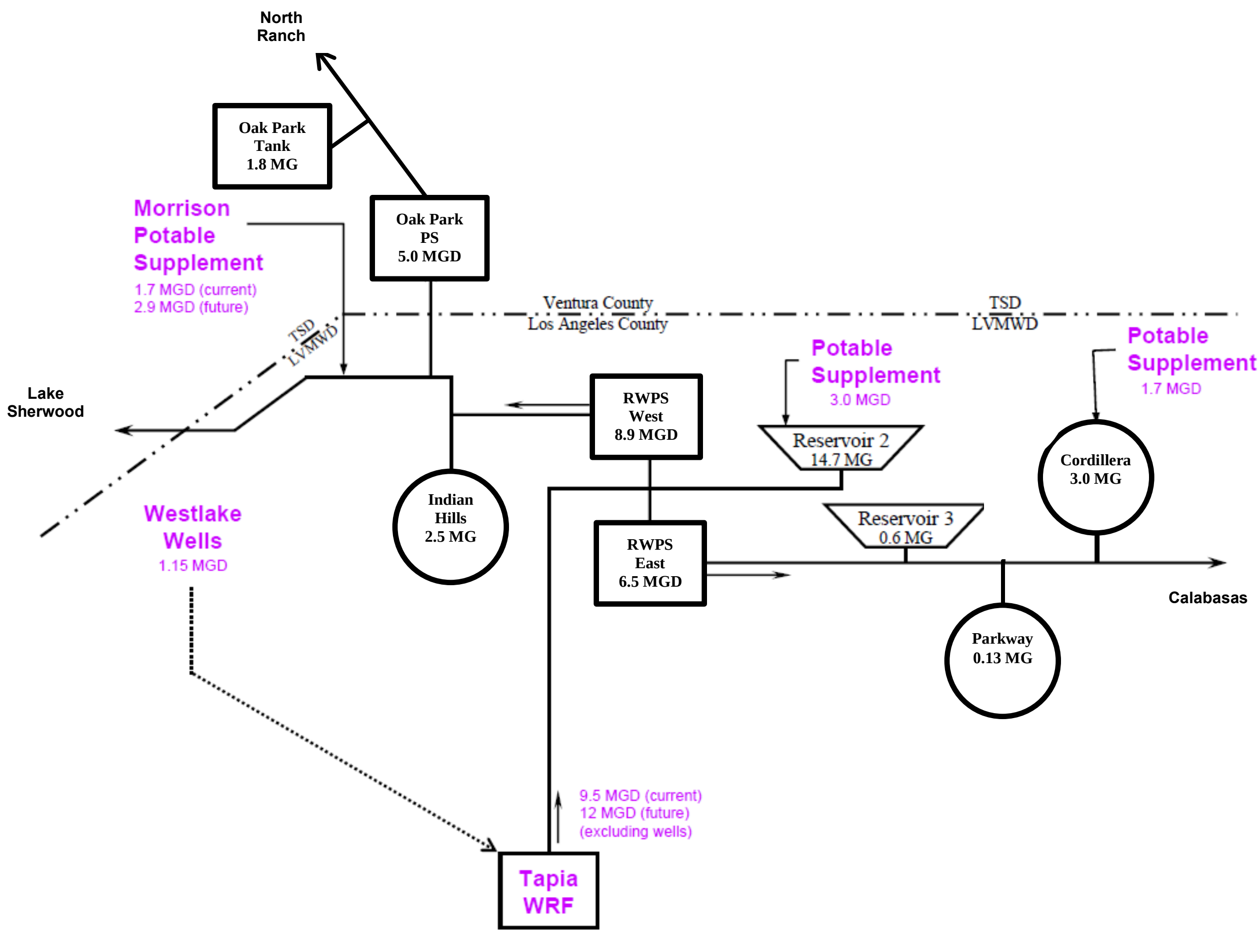


Figure 4-1. Schematic of JPA and Calleguas RW Systems.

4.1.3.1 Morrison Supplemental Facilities

The Morrison Supplemental Facility is located in Agoura Hills, near Reyes Adobe Road, north of the 101 Freeway. It was constructed in 2001 to provide energy-efficient potable water supplement to the Western Recycled Water System. Water is taken from the inlet/outlet pipeline that feeds Morrison Tank (HWL = 1212 feet) and flows through an air gap into a covered concrete sump (HWL = 1180 feet). This sump serves as an intake reservoir for a pump station that pumps the water into the distribution system, which is regulated by Indian Hills Tank (1225 feet). The pump station is equipped with 2 pumps, and has a nominal capacity of 2000 gpm, but currently only one pump can be run at a time, because of size limitations on the Morrison Tank inlet/outlet pipeline. The station is also equipped with a bypass line and check valve that allows unpumped (i.e., gravity) flow of water from the air-gap sump. This occurs when gradients in the western system dip below 1180 feet, which happens quite frequently.

Because of the small difference in hydraulic grade between the Morrison Tank and the air-gap sump, the Morrison facility is a very energy efficient way of providing supplemental water. The facility was also envisioned as a way of avoiding more costly upgrades to the transmission system between the RWPS-West and the western portions of the system. The facility serves essentially as another RWPS-West pump.

4.2 Pressure Zones

There are four pumped pressure zones within LVMWD and a fifth pressure zone in the Oak Park area, which has a tank and pump station owned and operated by Calleguas MWD. [For a hydraulic profile of the system, see Appendix E.]

4.2.1 Las Virgenes Valley System (HGL = 795 ft)

The Las Virgenes Valley Recycled Water System consists primarily of a pipeline from the Tapia WRF to Reservoir No. 2, located at LVMWD headquarters. This system supplies recycled water to the other systems and supplies users located within Las Virgenes Valley, south of LVMWD headquarters. The largest user in the Las Virgenes Valley System is Pepperdine University, which uses up to 45 million gallons of recycled water from Tapia WRF per year. However, their use of JPA water is somewhat sporadic since they have another source of recycled water. Other large users in the Las Virgenes Valley System include the Mountains Recreation and Conservancy Agency (King Gillette Ranch) and the Las Virgenes Unified School District (A.E. Wright School). The JPA itself is a large user—employing recycled water for various uses at the JPA composting facility and Tapia WRF. LVMWD also uses RW at its headquarters and at the Dog Park.

The Las Virgenes Valley System also supplies the spray field operations (next to the composting facility), where recycled water is disposed of during the shoulder months.

4.2.2 Eastern Recycled Water System (HGL = 1592 ft)

The Eastern Recycled Water System consists of the headquarters Recycled Water Pump Station East (RWPS East), a 14-inch pipeline to Reservoir No. 3 and Cordillera Tank, and numerous pipelines throughout the Calabasas area south of the Ventura Freeway. Major users in this area are the Calabasas Golf Course and the Calabasas High School. This system also connects to the Mountain Gate and Mont Calabasas service areas north of the Ventura Freeway. (The Eastern System is sometimes also referred to as the Calabasas System.)   The Eastern System also provides water to the Parkway System, which provides RW to various users in the Oaks of Calabasas Subdivision (formerly New Millennium).

The Eastern RW System also supplies Discharge Point 005, through which water is discharged to a storm drain that flows to the Los Angeles River.

4.2.3 Western Recycled Water System (HGL = 1225 ft)

The Western Recycled Water System consists of the headquarters Recycled Water Pump Station West (RWPS West), the Morrison Supplement Facility (Morrison Pump Station), 24-inch and 20-inch pipelines that connect to the Indian Hills Tank, and many smaller diameter pipelines that serve many users within the Western System.

The Western System also is the source of supply to the Oak Park system and Lake Sherwood system, which are operated by Calleguas MWD and provides water to TSD, CalWater, and Lake Sherwood customers.

4.2.4 Oak Park Recycled Water System (HGL = 1422 ft)

Most RW customers in the Oak Park community receive water that is pumped from the Oak Park RW Pump Station (next to Mae Boyar Park) to the Oak Park Tank, with a high water level of 1422 feet. In addition to serving parks, schools, and HOAs in the Oak Park Community, this system also provides water to the North Ranch area of Thousand Oaks, supplying the North Ranch Golf Course, a customer of CalWater.

4.2.5 Parkway System (HGL = 1752 ft)

The Parkway Recycled Water System was constructed in 2005, and consists of a small pump station and tank within the Oaks of Calabasas subdivision. It draws water from the Eastern System and serves the higher elevations within the development at a maximum gradient of 1752 feet. Facilities include the Parkway Pump Station and Parkway Tank. The primary customer is the Homeowners' Association, which irrigates a small park and various common areas.

4.3 Pipelines

Within the Las Virgenes Valley System, two pipelines convey water from Tapia WRF. South of Mulholland Highway an older 18-inch diameter was recently paralleled with a 24-inch pipeline. North from Mulholland Highway to Reservoir No. 2, there is an original 16-inch pipeline which was paralleled with a 24-inch pipeline in 1989.

Within the Eastern System, the major existing pipeline is 14 inches in diameter from RWPS East to Reservoir 3. With development of Tract 35596 (New Millennium), a new pipeline was installed from Reservoir 3 to Cordillera Tank. The size of this replacement pipe was increased to 18 inches in diameter. Also within the last 10 years, an existing temporary aboveground pipe from Tract 35596 to the Ventura Freeway was increased in size and buried.

Within the Western System the major pipeline is 24 inches in diameter and extends from RWPS West to the intersection of Lindero Canyon and Agoura Road. From this intersection to the TSD connection at the County line on Agoura Road, the pipeline is 16 inches in diameter. A 14-inch pipeline in Kanan Road, which extends from Thousand Oaks Boulevard to near the County line, supplies the connection to Oak Park/North Ranch in TSD's service area.

The existing 24-inch pipeline commencing at the RWPS West is rated at 250 psi. Westerly reaches of this pipe are progressively rated at lower pressures. This pressure class becomes a limiting factor when considering new or expanded pumping facilities. This was one reason that Morrison Pump Station was constructed, rather than expanding RWPS-West.

In the last two master plans, a future 8-inch pipeline in Agoura Road had been proposed, extending westward from Lewis Road towards Ladyface Circle. This pipeline would bridge a gap in the system, providing modest redundancy in transmission of water to the west. It would also serve various commercial properties along Agoura Road, several of which have yet to develop. A portion of this pipeline was recently designed, taking advantage of the City of Agoura Hills plans for reconstruction of the roadway.

4.4 Pump Stations

The JPA's recycled water system has five pumping stations and CMWD's system has another. Since the last master plan, the RWPS East underwent a major expansion. The project, which was completed in 2008, increased the pump station capacity to 4,500 gpm with all 3 pumps in operation. This was accomplished by replacing the existing 200 HP pumps with 500 HP units. All pump stations in the recycled system are vertical turbine pumps, powered by electricity.

Table 4-2 summarizes the pumping facilities.

Table 4-2. Existing Recycled Water Pump Stations

PS Name Location Nominal Suction HGL Nominal Discharge HGL	**Pump # and Combination**	**Motor Size** (HP)	**Nominal Capacity** (gpm)
Tapia Effluent Pump Station	1	800	4,200
Tapia WRF	2	800	4,200
Suction: 468 ft	3	900	6,200
Discharge: 795 ft	1 and 3 or 2 and 3	-	9,400
RWPS East	1	500	2,000
LVMWD Headquarters	2	500	2,000
Suction: 795 ft	3	500	2,000
Discharge: 1529 ft	2 pumps	-	3,500
	3 pumps	-	4,500
RWPS West	1	300	2,200
LVMWD Headquarters	2	300	2,200
Suction: 795 ft	3	300	2,200
Discharge: 1225 ft	2 pumps	-	4,300
	3 pumps	-	6,200
Morrison			
Ridgebrook Dr., Agoura Hills	1	20	1,300
Suction: 1180 ft	2	20	1,300
Discharge: 1225 ft	Both pumps	-	2,000*
Parkway	1	20	180
Parkway Calabasas	2	20	180
Suction: 1529 ft	Both pumps		350
Discharge: 1750 ft			
Oak Park	1	150	1,300
Conifer Street	2	150	1,300
Suction: 1225 ft	3	150	1,300
Discharge: 1442 ft	4	150	1,300
	2 pumps		2,500
	3 pumps		3,500

* The use of two pumps at Morrison Pump Station will require additional modifications of the potable supply system.

It should also be noted that it is not possible to simultaneously run all three pumps at RWPS East and all three pumps at RWPS West, due to limitations in the size of the suction pipeline. It also had been impossible to run all three pumps at Tapia Effluent Pump Station due to pipeline pressures, but this limitation was removed with completion of a new outlet pipeline completed in 2010. Under normal circumstances, however, there should not be a need to run all three pumps at Tapia WRF.

4.4.1 Pumping Controls

During normal operations, the pump stations are controlled as follows:

- **RWPS East** starts and stops are controlled by the water level in Cordillera Tank. During normal current operations, only two pumps run, but during the shoulder months, a third pump will be activated to maximize flows through the 005 Discharge Facility. All three pumps may be needed, if the system is expanded to Woodland Hills GC and Pierce College. [See analysis in Section 6.]
- **RWPS West** starts and stops are controlled by the water level in Indian Hills Tank.
- **Morrison PS** starts and stops are controlled by the water level in Indian Hills Tank. A single pump at Morrison starts well after the RWPS West pumps have started. If pressure in the system drops quite low, water flows by gravity from the air-gap sump, bypassing the pump station. As a supplemental facility, Morrison PS is deactivated during times of the year when potable supplement is not needed.
- **Parkway PS** starts and stops are controlled by the water level in Parkway Tank.
- **Tapia PS** starts and stops are controlled by the water level in pump station wet well. Because the wet well is relatively small, pumps cycle on and off many times each day. Reservoir No. 2, which receives the water from Tapia, buffers between the flows produced at Tapia and the demands of customers.
- **Oak Park PS** starts and stops are controlled by the water level in Oak Park Tank.

To help balance flows in the system, these pump stations are often programmed to normally operate during the day time, when little RW is being used. The differences between pump station flows and customer demand must then be supplied from the system's tanks and reservoirs.

4.5 Tanks and Reservoirs

There are seven existing tanks and reservoirs in the JPA system and another in the CMWD system, but two (Reservoirs No. 1 and 3) are not normally used. Some customers—particularly Lake Sherwood GC and North Ranch GC—also have storage. The locations, capacities, and other information for the utility-owned tanks and reservoirs are summarized in **Table 4-3**.

Plans are currently underway to cover Reservoir No. 2 with shade balls and to line the earthen sides with a synthetic membrane. The goal of this project is to reduce turbidity in the reservoir caused by algae growth and release of sediment from the sides. Turbidity has caused NPDES permit issues at the 005 Discharge Facility.

Table 4-3. Summary of Existing Recycled Water Tanks and Reservoirs

Name Location System	Type	Capacity (MG)	High Water Elev. (ft)	Bottom Elev. (ft)
Reservoir No. 1[(1)] Tapia WRF	open earthen sides & bottom	4.0 (12.3 AF)	716	
Reservoir No. 2 LVMWD HQ Las Virgenes Valley	open concrete bottom earthen sides	14.66 (45 AF)	795	768
Reservoir No. 3[(2)] Calabasas Eastern	open concrete bottom concrete sides	0.60 (1.8 AF)	1529	1516
Cordillera Tank Calabasas Eastern	covered welded steel tank	3.0 (9.2 AF)	1533	1503
Indian Hills Tank Agoura Hills Western	covered welded steel tank	2.5 (7.7 AF)	1225	1195
Tapia PS Wet Well Tapia WRF	covered concrete tank	0.1 (0.3 AF)	470	
Parkway Tank Calabasas Parkway (Western)	covered welded steel tank	0.13 (0.4 AF)	1752	1737
Oak Park Tank Oak Park Oak Park	covered above-ground concrete reservoir	1.8 (5.5 AF)	1422	1394

(1) Reservoir No. 1 is not currently used due to siltation. It serves as a back-up for Tapia WRF plant water.
(2) Reservoir No. 3 is not currently used for storage. It however, remains in service to act as a backup for Cordillera Tank.

4.6 Pressure Reducing Stations and Pressure Sustaining Valves

Currently, there are three active pressure reducing stations and two pressure sustaining valves. Their locations, HGLs, and other information are summarized in Table 4-4.

Table 4-4. Existing Pressure Reducing and Pressure Sustaining Valves / Stations

PRS No. or Name Location System	**Station Elev. (ft)**	**Inlet HGL (ft)**	**Outlet HGL (ft)**	**Size (Inches)**	**Max. Capacity (gpm)**
PRV 51 Agoura Road at Shadow Hills Rd Western System	809	1,225	940	4	600
Parkway Calabasas (1) near Park Sorrento Eastern System	-	1,529	1,298	4	600
Pump Suction PRV (2) RWPS East and West Las Virgenes Valley	754	795±	<795	16	4,500 (4)
PRV 58 pressure sustaining (3) Agoura Road at La Venta Drive Western System	891	1,140 min 1,225 max	1,130	10	3,600
Lake Sherwood GC Tank pressure sustaining (5) Lake Sherwood system	960	1225	1160	10	2000

(1) The function is to limit downstream pressure to maximum of 125 psi.
(2) Valve originally used to promote circulation, in Reservoir No. 2. Closed at low flows, open at high flows.
(3) TSD facility. Used to maintain HGL>1140' in Western System.
(4) Capacity inadequate for future flows. Most hydraulic model runs made as if valve removed.
(5) Prevents high flows during tank filling from degrading pressures in the Westlake area.

4.6.1 Discharge Facility 005

At Discharge Facility 005, a cone valve is used to reduce and sustain pressure, allowing high flows into the storm drain system, which carries the water to the Los Angeles River. This facility is located on Parkway Calabasas, between Park Granada and Park Sorrento, in the City of Calabasas.

This facility is used only during shoulder month operations and is thus not considered in modeling maximum daily demand conditions.

The approximate maximum flow through this facility is 4 MGD (2800 gpm).

Section 5 – Supply and Demand

Section 5: Supply and Demand

This section examines the balance between recycled water supply and demand for both current conditions and future conditions.

5.1 Supply

The year-round supply of recycled water to the JPA's Recycled Water System is tertiary-treated wastewater produced at the Tapia Water Reclamation Facility. Supplies of groundwater from the Westlake Wells and potable water are also used to supplement the recycled water to meet peak demands. These supplemental sources allow a greater volume of wastewater to be recycled during non-peak periods which results in greater overall usage of recycled water.

The amount of supplemental water required has varied greatly over the past 25 years (the approximate timeframe when facilities have been available to provide supplemental water). With continued development of the service area, the amount of available recycled water has increased, but so have the numbers of customers who use the water. Unfortunately, the infill development that is likely to occur over the next few decades will have few (if any) of the major customers (schools, parks, and golf courses) that have traditionally used most of the JPA's recycled water. For demands to keep up with the increasing supply, therefore, Las Virgenes MWD, Oak Park Water Service and other retail purveyors of water in the area will need to make a concerted effort to maximize the use of recycled water whenever new developments occur. The conversion of estate-sized residential customers to recycled water user may also be needed.

Over the years, the amount of recycled water demand has generally increased, although the increase has not been steady or uniform. In 1998 and 2005, in particular, the demand for recycled water was significantly depressed due to unusually wet weather. With the economic downturn in 2008 through 2010, recycled water sales were suppressed, as were potable water sales. More recently, unusually dry and warm conditions through the winter months have stimulated greater use of recycled water in normal periods of low demand. Other factors, such as the operational preferences of some large users (e.g., golf courses) and whether or not large grading projects are underway (where RW is used for dust control), can also result in significant variations in recycled water demand.

An alternative to the use of the Westlake Wells and potable water to supplement the recycled water system and meet peak summer demands would be to store surplus recycled water in the winter and have it available in the summer for those peak demands. As discussed later in this section, seasonal storage has been evaluated in several studies, but the current and foreseeable future demands are insufficient to make a seasonal reservoir economically attractive. There are also considerable environmental and regulatory difficulties associated with getting a groundwater storage or open-reservoir storage project approved for construction.

Table 5-1 shows the monthly water supply processed at Tapia WRF for 2012, the most recent full year for which data were available. Even though the year saw very little rain, wastewater flows to the plant were markedly higher in the winter than in the summer. Wastewater (WW) flow to the plant averaged 8.7 MGD, with a winter peak of 9.4 MGD and an autumn low of 7.8 MGD.

In summer, wastewater flows were supplemented by up to 0.8 MGD of Westlake well water pumped into the sewer. By pumping this well water to the sewer, objectionable iron and manganese in the water is treated through blending, oxidation, and filtration.

It is noteworthy that minimum dry weather flows were estimated at 9.0 MGD for the 2007 Master Plan, based on an analysis of the previous seven years of data. This figure appears to still apply during the months of June through September, when all wastewater is going to Tapia WRF. If well water is included, base supply increases to approximately 9.6 MGD.

Of the wastewater processed at Tapia WRF, about two-thirds derives from the LVMWD service area in Los Angeles County and one-third comes from the TSD service areas in Ventura County. Each of these utilities is entitled to recycled water in proportion to their wastewater contribution.

Table 5-1. 2012 Monthly Average Recycled Water Supply at Tapia WRF

Month	**Total Plant Influent** (MGD)	**Westlake Wells Supplement** (MGD)	**Net WW Influent** (MGD)	**LV WW Flows** (MGD)	**TSD WW Flows** (MGD)
Jan	8.85	0.00	8.85	6.22	2.65
Feb	8.79	0.00	8.79	6.14	2.65
Mar	9.37	0.00	9.37	6.68	2.69
Apr	8.54	0.00	8.54	5.76	2.78
May	8.79	0.15	8.63	6.00	2.63
June	9.43	0.69	8.74	6.14	2.60
July	9.80	0.78	9.02	6.48	2.54
Aug	9.62	0.74	8.88	6.29	2.59
Sept	9.58	0.74	8.84	6.24	2.60
Oct	8.52	0.23	8.28	5.73	2.55
Nov	8.22	0.00	8.22	5.67	2.55
Dec	8.87	0.00	8.87	6.33	2.54
Averages	**9.03**	**0.28**	**8.75**	**6.14**	**2.61**
	100%	**3.1%**	**96.9%**	**68.0%**	**28.9%**

5.1.1 Historical Recycled Water Supply

The average daily wastewater flows to Tapia WRF are fairly constant, but do show some seasonal variation. Flows are generally highest in the wintertime after rain, due to inflow and infiltration (I/I) into the sewer pipelines. Infiltration is the result of water entering joints or cracks in the sewers from the ground either due to a high water table or due to interflow in the ground (interflow refers to storm water, which enters the ground and flows through the soils). Infiltration tends to increase wastewater flows throughout the winter period with some variation. Inflow is a result of storm water entering manhole lids, illegal storm-water cross connections, or from other surface features. It peaks with rain, but decreases shortly after the rain.

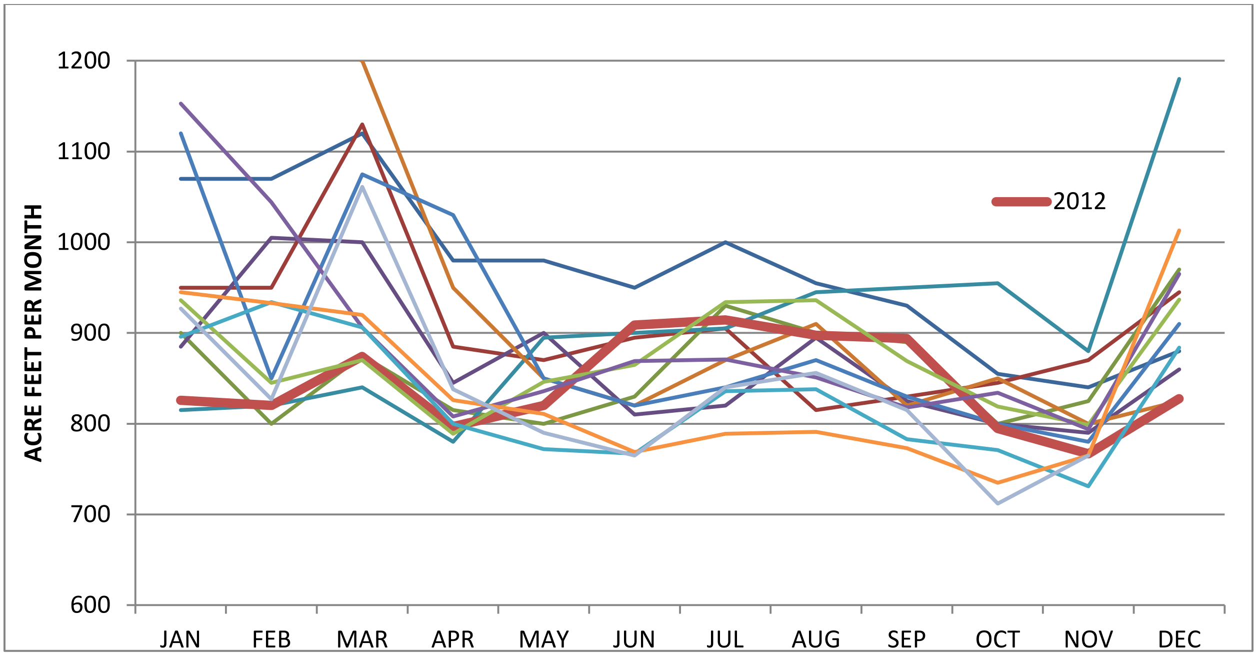
Table 5-2 shows the monthly average amount of recycled water supply available at Tapia WRF. These totals include water added to the system through the Westlake wells.

Table 5-2. Historical RW Production at Tapia WRF (last 13 years)

	ACRE FT PER MONTH												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
JAN	1070	950	900	885	815	1700	1120	936	1153	896	945	927	826
FEB	1070	950	800	1005	820	1240	850	845	1044	934	933	827	820
MAR	1120	1130	875	100	840	1200	1075	470	906	906	920	1061	874
APR	980	885	815	845	780	950	1030	689	808	800	826	838	797
MAY	980	870	800	900	895	850	850	846	836	772	811	790	820
JUN	950	895	830	810	900	820	820	865	869	767	769	765	909
JUL	1000	905	930	820	905	870	840	934	871	836	789	840	914
AUG	955	815	900	895	945	910	870	936	851	838	791	856	898
SEP	930	830	890	825	950	820	830	869	818	783	773	815	894
OCT	855	845	800	800	955	850	800	819	834	771	735	712	795
NOV	840	870	825	790	880	800	780	799	794	731	765	765	767
DEC	880	945	970	860	1180	825	910	937	965	884	1013	826	828
Total	13,630	12,891	12,337	11,538	12,869	13,840	12,781	11,952	12,757	11,927	12,080	12,033	12,154

Note: the above amounts include water discharged to the creek or disposed of in other ways and water from the Westlake wells

Figure 5-1 shows the monthly variation in Tapia WRF inflow from 2000 to 2006 and 2012, with January generally being the largest inflow month. This figure shows that recent flows have been somewhat lower than in previous years. The flows in the traditionally wet weather period of December through March have been markedly lower, but this water is excess to the recycled system. It occurs at a time when sales of RW water are low. No doubt the dry weather that has reduced I/I has also increased RW sales.



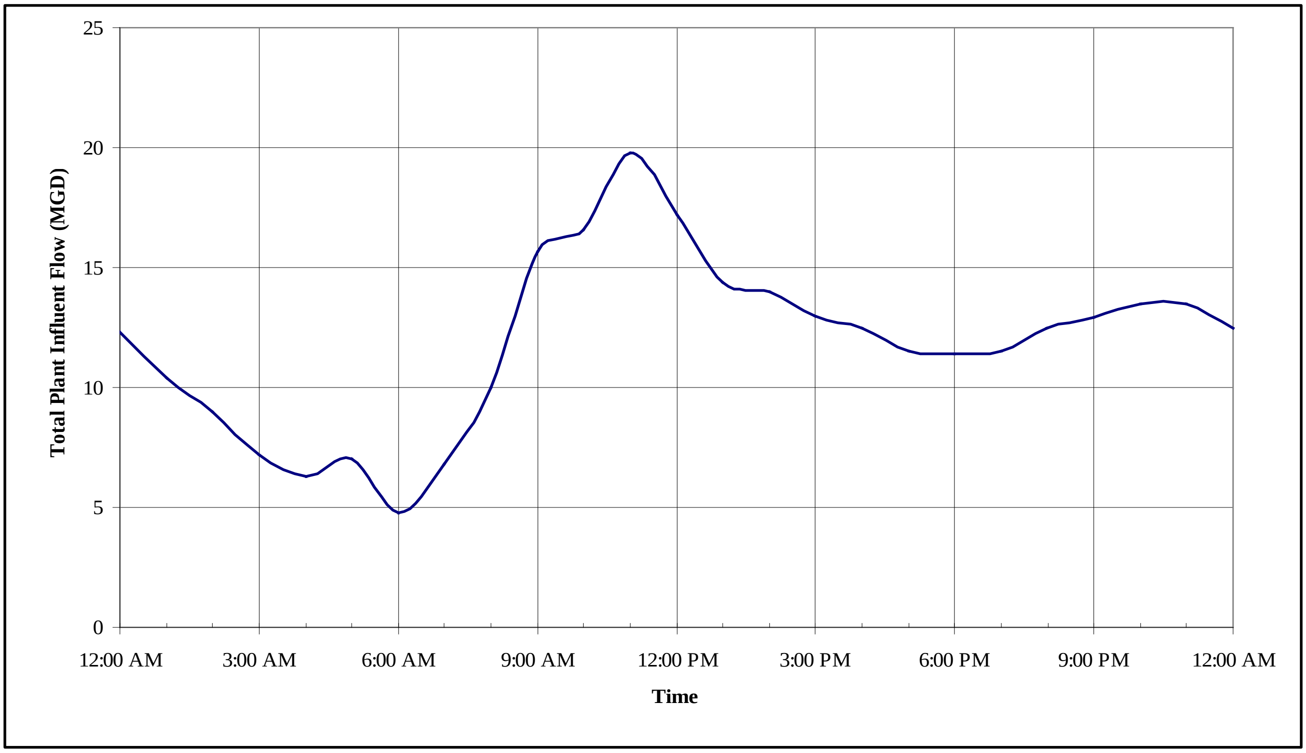
Note: Flows include supplemental water from the Westlake wells (typically June through September)

Figure 5-1. Historical RW Production at Tapia WRF, 2000 through 2012

Flows to Tapia WRF during the shoulder months (the time of year when water disposal is a concern) currently can be lowered by diverting up to 1.1 MGD of Calabasas wastewater to the City of Los Angeles sewer system rather than pumping it over the hill for treatment at Tapia WRF. In recent years, this capability has not been utilized due to the price charged by Los Angeles for treating this water. Several years ago, LVMWD studied alternatives for diverting even more flow to the City of Los Angeles, including the construction of a 5-mile pipeline to convey wastewater to a point where the City of Los Angeles system had capacity to accept the essentially all the LVMWD wastewater produced on the east side of the Calabasas Grade.

Because there is no long-term capability to store the excess recycled water and because the recycled water demands in winter are significantly below the availability of plant production, the presence of I/I is inconsequential in terms of the design of the recycled water distribution system. I/I cannot be relied upon as a source of water due to its tremendous variability from one year to the next. Should long-term creek discharge avoidance ever become an objective, then the I/I portion of flow would need to be considered in the design of any seasonal storage. However, even under a “no-discharge” plan, an exemption for very wet weather will need to exist.

Figure 5-2 shows that on a daily basis, peaks in the production at Tapia WRF can be much more pronounced. These peaks have essentially no effect on how water is used in the system. Reservoir No. 2 has the ability to store more than two days of supply, so it buffers between the daily production and daily demands. The Tapia Pump Station must handle peak flows from Tapia during the period (April 15 through November 15) when discharges to Malibu Creek are prohibited. There is limited storage at Tapia WRF for recycled water. Water must be pumped from Tapia WRF to Reservoir No. 2 as it is produced.



Source: "Technical Memorandum No. 1, Tapia Water Reclamation Facility Master Plan", January 14, 2002, by Montgomery Watson Harza.

Figure 5-2. Diurnal Wastewater Processing at Tapia WRF

5.1.2 Estimated Future Recycled Water Supply

Because the focus of the Master Plan is on meeting the MDD condition, the flows available in the summer period are the ones that are critical. These flows essentially derive from wastewater produced by domestic, commercial, and industrial customers of Tapia WRF. The JPA's 2014 Wastewater Master Plan examines land use, population projections, and septic system conversion and estimates average dry-weather wastewater flow at buildout.

Based on their analysis, Kennedy-Jenks is recommending that the Tapia WRF be planned and designed to accommodate peak dry weather flows up to 12 MGD at buildout. This is significantly lower than original projections, when the plant was first designed. The current plant was originally designed for 16 MGD, but estimates of buildout flows have fallen as more and more land has been set aside as open space and parks, and water conservation has reduced per capita usage. Current limitations on nitrogen concentrations in the effluent currently limit plant production to no more than 12 MGD. Because the planning number of 12 MGD is for peak dry weather flows, and because summer flows are often lower (even in very dry years such as 2012), for estimating reliable RW availability, we are assuming that future dry weather production at summer peak will be only approximately 11 MGD.

Table 5-3 shows the historical and estimated *dry-weather* Tapia WRF production for years 2006, 2012, 2020, and 2035. These flows are in terms of the average daily flows during the highest recycled water demand period, which is July and August. It should be noted that the flows in winter (in terms of averages) create excess recycled water when compared to the demand.

Table 5-3. Historical and Estimated Recycled Water Production During Summer (MGD)

	2006	2012	2020	2035
Wastewater flow in summer	8.8	8.8	~10	~11
Westlake Wells supplement	0.8	0.8	0.8	0.8
Total RW available without potable supplement	9.6	9.6	~11	~12

To the above totals, supplemental potable water can be added using existing facilities at Reservoir No. 2, Cordillera Tank, and Morrison Pump Station. Through use of these facilities, the flows shown in Table 5-4 can be delivered through the recycled water system. Additionally, potable water supplement can be added through the on-site storage systems at Lake Sherwood and North Ranch Golf Course.

The sources of water shown in Table 5-4 are ranked in terms of general preference below:

- Westlake Well water is preferred over potable water, because the marginal cost is only the cost of pumping and treating the water, which is very low compared to imported Metropolitan Water District water.
- Morrison PS supplemental water is preferred over other sources of potable water, because there is very little pumping cost due to the small differential between the HGLs of the recycled water and potable water systems at this location.
- Cordillera Tank supplemental water is preferred over Reservoir No. 2 supplemental water, because there is less pumping energy lost.

Other considerations in use of RW supplements include:

- Water added at Morrison PS reduces the need for additional RW transmission piping west of the RWPS
- Water added at Cordillera Tank reduces the need for additional RW transmission piping east of the RWPS

Table 5-4. Sources and Quantities of RW Supply

	Current Capacity (MGD)	**Future Capacity** (MGD)
Wastewater flow in summer	8.6	11
Westlake Wells supplement	0.8	0.8
Morrison PS potable supplement	1.8	2.9
Cordillera Tank potable supplement	1.7	1.7
Reservoir No. 2 potable supplement	3.6	3.6
Total available system supply	**16.5**	**20** (rounded)

Other sources of future supplemental flows could also include:

- Pumping water (~1000 gpm) from Savoy Tank to Oak Park Tank (~1.4 MGD)
- 3000 AF seasonal storage reservoir (~11 MGD)

5.2 Recycled Water Demands

To properly analyze future flows throughout the recycled water system, it is first necessary to understand the existing demands throughout the distribution system and then to project flows that will likely occur in the future. Recycled water demands vary greatly over the course of a day. Peak demands for recycled water generally occur during the night, with significant reductions in demand during the day. Recycled water demands also vary greatly over the seasons (more so than potable water demands), and are greatly affected by droughts and wet weather periods.

Depending on the operation of the system, the demands on an individual component, such as a pump station, may have a different flow pattern over 24 hours than the demand of the customers. For example, pumping to a reservoir may occur during the day when recycled water use is low, while recycled water flows to customers at night. The demand may also vary significantly for different types of users and different geographic areas. With advanced hydraulic modeling software and techniques, such as the model used in this master plan, it is possible to model the projected flows through a distribution system with a fair degree of accuracy.

5.2.1 Current demands and demand patterns

An extensive, customer-by-customer analysis of consumption records was performed as part of this master plan. Records from 2011 and 2012 were analyzed. These records were used for determining both overall demands, and for assigning demands to specific points in the hydraulic model. Generally, the billing records provided bi-monthly data, which are useful in determining average consumption but not peak-day or peak-hour usage.

Demand patterns were derived using data from the SCADA systems of LVMWD and CMWD. By comparing the data from meters with changes in water levels in tanks and reservoirs, patterns of usage in various zones could be computed. Hourly meter data were available from the various pump stations and where water was transmitted across jurisdictions. Hourly data came from RWPS East, RWPS West, Parkway PS, Oak Park PS, Morrison PS, Reservoir No. 2, Cordillera Tank, Indian Hills Tank, Parkway Tank, Oak Park Tank, and system meters installed at Lindero Canyon Boulevard and Lake Sherwood. [Unfortunately SCADA data were not available from the system meter at La Venta Drive.] From these sources of data, unique usage patterns were computed for the Eastern System, Western System, Parkway Subsystem, Oak Park System, North Ranch Golf Course, and Lake Sherwood Golf Course. These patterns are discussed in Section 6.

5.2.2 Historical Demand

Overall records of recycled water sales are shown in Figure 5-3, which shows a generally upward trend in sales since the inception of the system in 1988. A dip occurred in 1998, which was an unusually wet "El Niño" year, and a smaller dip was seen in 2005, when similar near-record rainfall was experienced. It may also be that high demands in the early 1990s reflect a large amount of grading activity in the district, or some other factor which stimulated a temporary demand for recycled water that then ceased at about the same time as the "El Niño" year. With cooler weather and the economic downturn in the 2008 to 2010 time period, sales dipped considerable, but an uptick in sales is seen in 2011 and 2012, as the economy improved and hotter, drier weather prevailed.

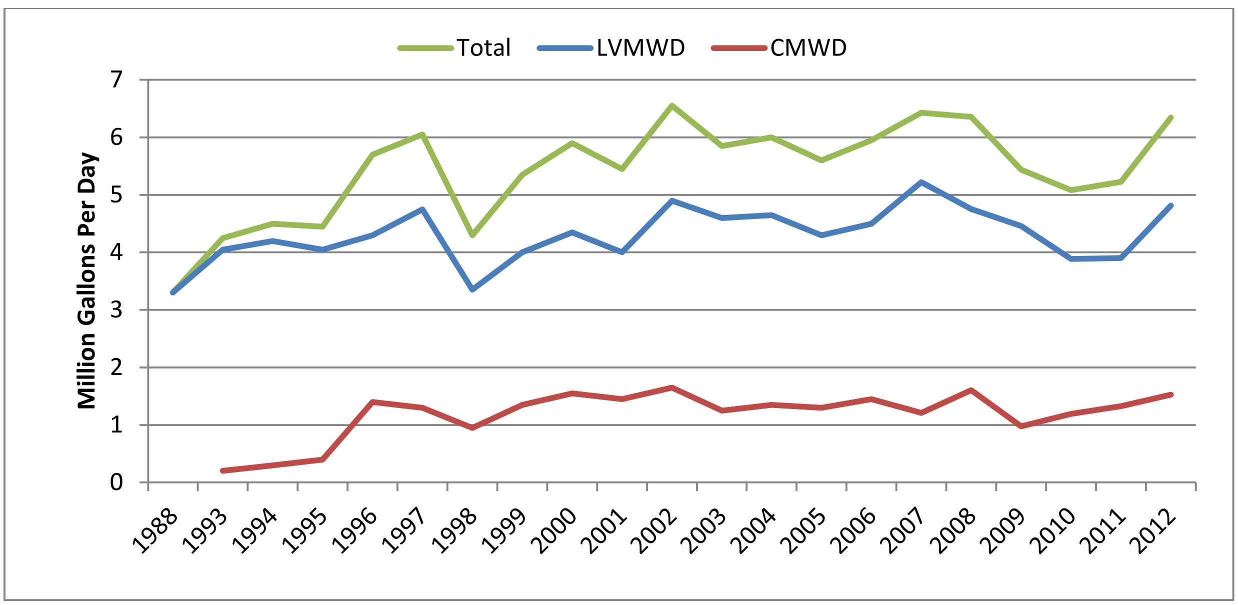


Figure 5-3. Historical Recycled Water Sales

In general, Ventura County sales (i.e., "CMWD") have been proportionally lower than Los Angeles County sales (i.e., "LVMWD"). As noted earlier, TSD customers in Ventura County account for about one-third of the recycled water produced, but sales to TSD, CalWater, and Lake Sherwood customers in Ventura County account for 25 percent or less of recycled water sales.

From Figure 5-3, it can be seen that the JPA has increased recycled water production by about 100 percent in the last 28 years – a significant increase, particularly important in Southern

California where water supplies are scarce. Average annual sales of recycled water are now approaching average annual wastewater flows. As shown in Tables 5-1 and 5-4, base wastewater flows to Tapia WRF in the summer are currently about 8.8 MGD, only 2.5 MGD above the total annual sales of recycled water in 2012.

5.2.3 Seasonal variations in demand

As one would expect, demands for recycled water vary considerably with the season, such that summer sales are several times higher than winter sales. In wet years in particular, sales in January and February can be miniscule, then sharply escalate as temperatures increase and the weather dries out. Figure 5-4 shows the variability in monthly sales, for 2000 through 2004, plus 2011 and 2012. It appears that higher sales in the winter, summer and fall in 2012 contributed to a near-record sales year and the large uptick in total annual sales seen in Figure 5-3. This indicates that the recent increase in sales could partly disappear when wetter winters and cooler weather returns. On the other hand, as discussed by Kennedy Jenks in the 2014 Potable Water Master Plan Update, the state of the economy has a possibly greater influence on water sales than the weather; with continued improvement to the economy, even higher RW sales may occur.

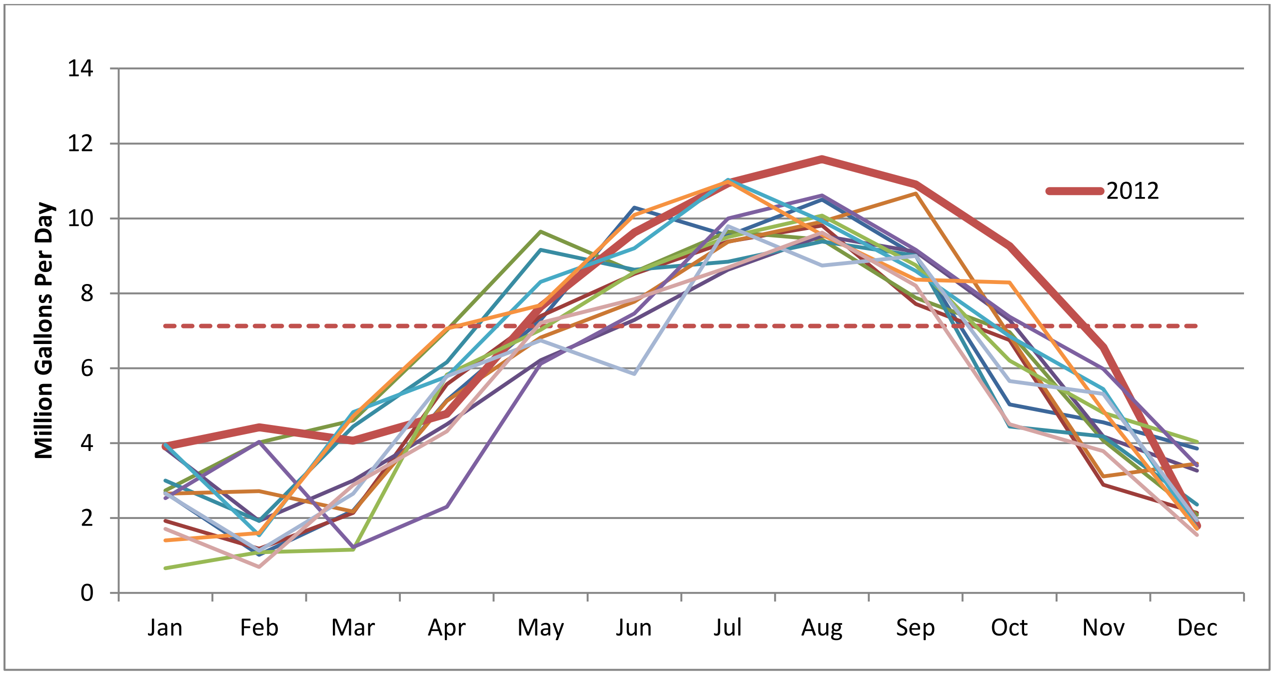


Figure 5-4. Average Monthly RW Sales

5.2.4 Diurnal variations and peaking factors

The horizontal dashed line in Figure 5-4 is the average monthly RW deliveries for 2012, which were 7.1 MGD.[8] Peak monthly sales in 2012 were 11.6 MGD, as measured by the meters at Tapia WRF and the supplemental water sources. This yields a peaking factor of 1.9 for MDD.

[8] Deliveries were calculated as Tapia PS flows plus potable supplement flows, minus discharges through 005. The differences between the 7.1 MGD average shown here and the 6.3 MGD sales figure reported by the District is attributed to operations at the spray fields as well as miscellaneous losses.

In Section 6.1, diurnal peaking patterns for various portions of the system are presented, based on an analysis of SCADA data from the system. This analysis shows PHD peaking factors ranging from 2.0 for the Parkway Subsystem to 2.4 for the Western System.

For design and analysis, somewhat more conservative peaking factors are recommended, as shown in **Table 5-5**. These are more consistent with prior analysis, and consistent with the recommendations of earlier master plans. By using conservative peaking factors, a small margin is provided for demands that are somewhat higher.

Diurnal variability across the system and in some of the subsystems is artificially suppressed by scheduling some pump station operations and some customer deliveries to occur at times of the day when demands are low (e.g., Oak Park PS and Lake Sherwood GC both use water during the day, rather than at night). Seasonal peaks during the last few years has also been significantly reduced due to much drier than normal winter weather.

For small portions of the system, a PHD peaking factor of 3.0 is appropriate, which assumes that all deliveries occur within an 8-hour window during the night (10PM to 6AM).

For individual customers, peaking can be much higher. The charts in Appendix D provide guidance for estimating peak flow rates based on the amount of acreage to be irrigated.

Table 5-5. System-Wide Peaking Factors

	Estimated 2012 Peaking Factors	Recommended Peaking Factors
MDD/ADD	1.9	2.0
PHD/MDD	1.5	2.5
PHD/ADD	2.9	5.0

Recycled water in the JPA service area is primarily used for irrigation, so use is much higher during the night than during the day. The State of California Department of Public Health (DPH) and California-Nevada Section of AWWA, which publishes a document titled *Guidelines for Distribution of Nonpotable Water*, recommend that irrigation with recycled water be done overnight rather than during the day in order to minimize the potential for people to come in direct contact with the recycled water. In some instances, this is mandated. Certain users, such as the Calabasas Landfill, Rancho Las Virgenes, and construction users, use the water during the day for dust control, compaction, and other uses. The Tapia Water Recycling Facility and the Rancho Las Virgenes Composting Facility also use recycled water constantly during the day for various operations that generally do not involve human contact.

For the 2007 Master Plan, a system-wide diurnal curve was calculated. Figure 5-5 (next page) shows the results of these calculations, derived from SCADA data for July 13, 2006, the day when the greatest consumption occurred within the system in 2006. The flows shown were based on pump stations flows, tank levels, reservoir levels and potable water supplement flows collected from the various District facilities. Total hourly demand in each of the systems was calculated by taking the flow through the appropriate pump station, adding or subtracting, as appropriate, the volume of water lost from or added to any tanks or reservoir, and adding any potable supplement. (The up-and-down waviness of the chart is due to the fact that tank-level changes are recorded in very rough increments of 0.1 feet.)

The curve indicates that the peak hour for recycled water is near midnight and the minimum demand occurs near 6PM. For the current master plan, similar peaking patterns were created for each of the subsystems, based on SCADA data from various meters and tanks. These are presented and discussed in Section 6. For most subsystems, a diurnal peaking factor of 2.5 is appropriate.

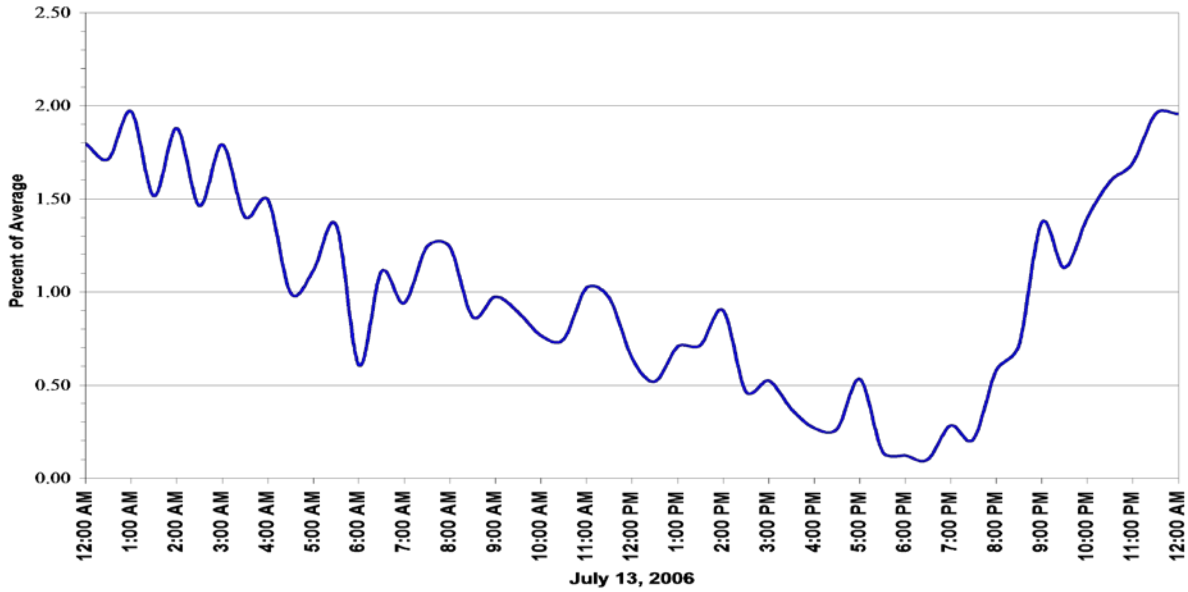
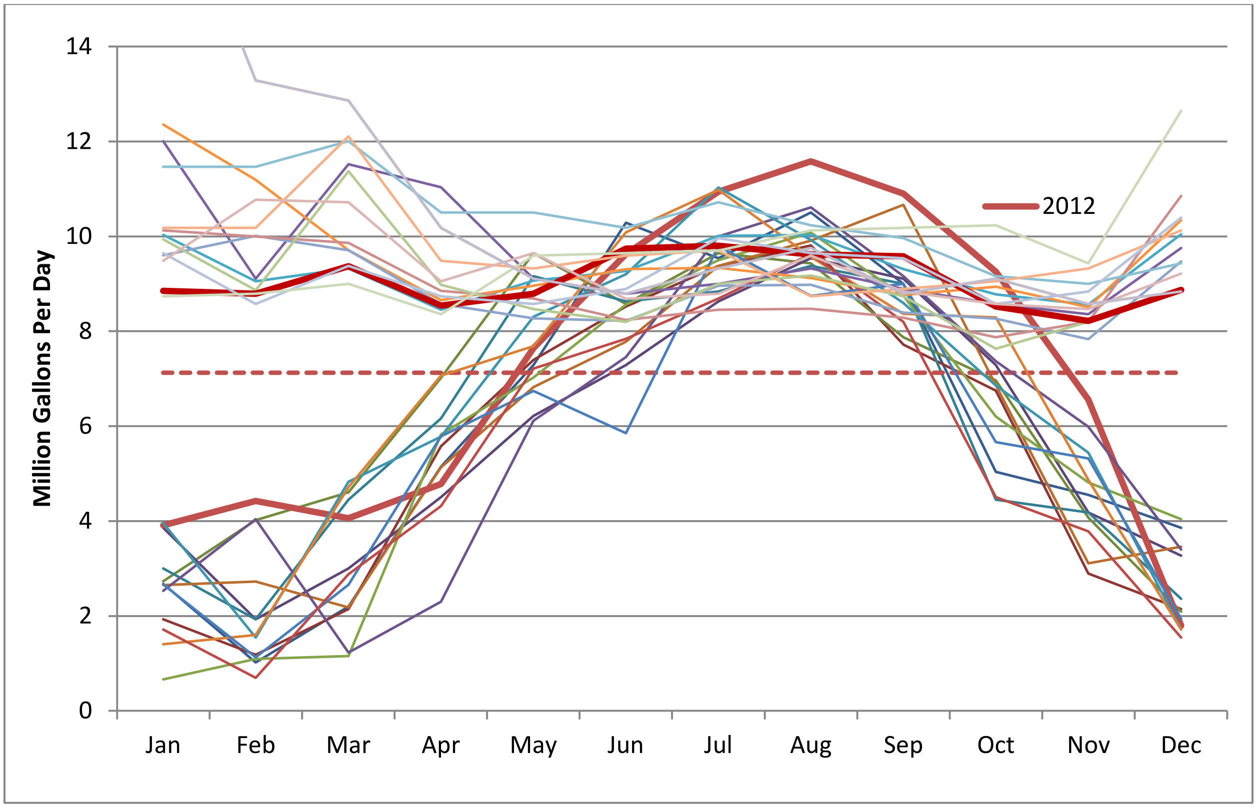


Figure 5-5. Diurnal curve calculated for 2007 Master Plan

5.3 Supply vs. Demand

Figure 5-6 compares monthly average recycled water demands and with monthly average sales for several recent years, including 2012, the most recent period with complete data. This figure shows that recycled water sales in the summer significantly exceeded recycled water availability, even when water from the Westlake Wells was provided. This meant that considerable potable water supplement was needed, starting in late June and continuing to early November.



Note: Flows include supplemental water from the Westlake Wells, but not potable water supplement

Figure 5-6. Comparison of Monthly RW Sales and Supply, 2000 through 2012

5.3.1 Supplemental Water

Table 5-6 shows the supplemental potable water used in 2011 and 2012. The supplemental facilities at Cordillera Tank were not used during this period, so are not shown. The usage of Morrison PS during March was to facilitate cleaning of Indian Hills Tank and was not driven by water use.

Table 5-6. Potable Water Supplement for 2011 and 2012

	Reservoir No. 2 (Million Gallons)		Morrison PS (Million Gallons)		Total Potable Supplement (Million Gallons)		Total Potable Supplement (MGD)	
	2011	2012	2011	2012	2011	2012	2011	2012
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	1.6	2.3	1.6	2.3	0.05(1)	0.08(1)
Apr	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0
Jun	0	0	1.1	3.7	1.1	3.7	0	0.12
Jul	14.5	28.8	1.1	13.4	15.6	42.2	0.51	1.39
Aug	25.8	54.7	9.8	13.7	35.6	68.4	1.17	2.25
Sep	55	38.9	6.2	6.2	61.2	45.1	2.01	1.48
Oct	5.5	8.7	0	2.5	5.5	11.2	0.18	0.37
Nov	0	0	0	0.8	0	0.8	0	0.03
Dec	0	0	0	0	0	0	0	0
Avg	8.4	10.9	1.7	3.6	10.1	14.5	0.33	0.48

(1) Note: March supplement used for tank cleaning, not for water supply shortage

Table 5-1 showed the supplemental water supplied by the Westlake wells. The well water is not used directly in the system, but is discharged to a sanitary sewer, where it blends with wastewater and is processed through the Tapia WRF; which improves its quality. In 2012, the Westlake wells provided 0.37 MGD on average, with peak usage occurring in July, when an average of 0.8 MGD was produced.

Table 5-7 provides a summary of all supplemental water used in 2012, including potable water and Westlake well water. On average, over the year, 0.85 MGD of supplemental water was provided. This is equivalent to 950 acre-ft of water. During the month of August, 3.1 MGD of supplemental water was used, compared to 8.8 MGD of wastewater, accounting for 26 percent of total RW sales.

Table 5-7. Summary of Supplemental Water Used in 2012

	Westlake Wells Supplement (MGD)	**Potable Supplement** (MGD)	**Total Supplement** (MGD)
Jan	0	0	0
Feb	0	0	0
Mar	0	0.08	0.08
Apr	0	0	0
May	0.76	0	0.76
Jun	0.78	0.12	0.90
Jul	0.67	1.39	2.06
Aug	0.80	2.25	3.05
Sep	0.76	1.48	2.24
Oct	0.72	0.37	1.09
Nov	0	0.03	0.03
Dec	0	0	0
Avg	**0.37**	**0.48**	**0.85**

5.3.2 Balancing of Recycled Water Supply and Demand

Table 5-8 shows the various sources of recycled water and what portion of sales they represent.

Table 5-8. Sources of Recycled Water Sold in 2012

	Acre feet	**MGD**	**Portion of Total Sales**	**Portion of Base Wastewater**[(1)]
Wastewater	7000	6.28	88%	72%
Well water	420	0.37	5%	n/a
Potable water	530	0.48	7%	n/a
Total sales	7980	7.12	100%	82%

[(1)] Note: Base wastewater flow was taken as 8.7 MGD, the average produced in June thru October of 2012

This table shows that a seasonal storage facility could be beneficial in reducing the amount of potable water that is used for supplement and reducing the amount of water that must be disposed of through discharge to Malibu Creek, discharge to the LA River, and spray-field application. Had a seasonal storage facility been available, 950 AF of water otherwise discharged could have been recycled. In reviewing these results, however, it should be noted that 2012 was not a typical year; it saw very little rain, and the summer months were markedly warmer than the years that preceded it.

5.4 Estimated Future Recycled Water Demands

Planning for expansions of the JPA's recycled water system is not simple. Within the JPA's service areas of Calabasas, Agoura Hills, Westlake Village and Oak Park, there is no low-hanging fruit. Prior planning efforts have been successful in connecting virtually all the schools, parks and golf courses. The notable exceptions are Alice Stelle Middle School/Freedom Park in Calabasas and the Malibu Golf Course in the Santa Monica Mountains, but neither of these customers are easily connected to the system. While there are many residential areas with substantial irrigation demands, serving single-family residences entails added operational costs (training, testing, and paperwork) required by state health officials. The other challenge involved in expanding the JPA system is capacity. To make the system economical, the pipes in particular were sized essentially for the customers they currently serve. Adding new customers, particularly large new customers, may result in diminished service to existing customers.

HDR's scope of work was to analyze the system considering two "book ends". One book end is simple organic growth. How much water will the system be required to deliver simply through infill development within the JPA service areas. The other book end entails bold extensions of the system into neighboring areas (Thousand Oaks and Woodland Hills) and conversion of landscape irrigation at some single-family residences to recycled water.

5.4.1 Future demands from infill development

The future demand from infill development was assumed to add up to 20 percent to the existing demands within the LVMWD portions of the system. This amount is based on the estimated increase in flows to Tapia WRF. The assumption is that as infill development occurs and additional recycled water is produced, new customers will also be added in roughly the same proportion. Customers that connect to the wastewater system are also likely to be within reach of a recycled water pipeline. Connecting to the recycled water system is often a condition of development approval. In addition to the demand from infill development, demands for several system extension projects were considered, along with demands for specific infill areas, such as along Agoura Road.

Increased recycled water demands from infill development in Oak Park, Thousand Oaks and Lake Sherwood are not anticipated to add significant demands to the system. These areas are considered essentially built out, and no significant redevelopment is foreseen in the currently served areas within the planning horizon. In fact, these areas have been largely built out for almost two decades, which explains the lack of growth in CMWD recycled water sales since the late-1990s.

5.4.2 Future demands from recycled water main extensions

The majority of potential growth in RW demand stems from proposed extensions to the recycled water system, and the bulk of HDR's analysis consisted of assessing the hydraulic and economic feasibility of building various RW main extensions. The main extensions would largely serve existing customers both within and outside of the JPA service areas, converting a portion of existing potable water demand to RW use. Figure 5-8 provides an overview of these proposed main extensions. Figures 5-9 through 5-17 show each extension in greater detail. [These figures are found in the back of Section 5.]

These main extensions and how they were analyzed are briefly described below. Section 6 will present the results of the hydraulic analyses for these extensions. The economic analyses are provided in Section 7. The analysis of the main extensions shown in Figures 5-9 through 5-12 (within Ventura County) was partly funded by Calleguas MWD.

5.4.2.1 Thousand Oaks Boulevard Extension (Figure 5-9)

This main extension would serve customers of the California Water Service Company (CalWater), within the Westlake portion of Thousand Oaks, and was the subject of a 2003 study by Boyle Engineering. Over two dozen customers have been identified along this route. The largest are Baxter Pharmaceutical, Westlake High School, and Russell Park.

The project would be constructed primarily in Thousand Oaks Boulevard, with a few side mains to serve customers located off the boulevard. In some cases, additional pipelines may be needed on the customer sides of the meters, as well as small irrigation pumps, because the existing pressures received by these customers are considerably higher than what the RW system will provide.

The economic feasibility of this project increases if the extension to Russell Park is deferred or deleted, and the main stops at Lakeview Canyon Road.

Demands for this project come from the 2003 report.[9]

5.4.2.2 Oak Park HOA Conversions (Figure 5-10)

These extensions would serve common irrigation areas maintained by several homeowners associations and a few multi-family apartment complexes. The proposed conversions within the Oak Park community are currently served potable water by Oak Park Water Service, and were identified as relatively attractive based on a preliminary study by TSD staff.

In addition to serving Oak Park HOAs, these extensions would also serve greenbelts along Lindero Canyon Boulevard and the North Ranch Playfield. These greenbelts and the play field are currently customers of CalWater.

Demands for the HOAs were taken from the billing records of Oak Park Water Service. Demands for the greenbelts and the North Ranch Playfield were calculated by applying the demand figures of Section 3.5.7 to estimated irrigated acreage taken from aerial photographs.

Although Figure 5-10 shows several other HOAs and one other park (Eagle View Park), main extensions to these customers are not considered economically attractive.

5.4.2.3 Lake Sherwood Pipeline Future Customers (Figure 5-11)

There are several customers along the existing main serving Lake Sherwood that are highly attractive, each requires a short main extension. The attractive potential customers are: Westlake Hills Elementary, Triunfo Community Park, and Evenstar Park. Less attractive is Southshore Hills Park, where a longer main extension would be required.

Demands for this analysis were calculated by applying the demand figures of Section 3.5.7 to estimated irrigated acreage taken from aerial photographs.

This analysis did not include the Sherwood Lake Club (also described as the “Lake Sherwood Executive Course”). Although this 3-par golf course would otherwise be attractive, the only

[9] A meeting was held with Doug Varney, Westlake District Manager for Cal Water Service Company, the utility that currently serves these customers, but updated demands were not provided.

feasible pipeline alignment would be via a subaqueaous pipeline through the lake. Although this is technically possible, it needs to be studied further before it is added to the plan.

5.4.2.4 Conejo Creek Park Extension (Figure 5-12)

This extension would convey water to areas currently served by the City of Thousand Oaks, irrigating several parks maintained by the Conejo Recreation and Parks District. The basic concept of this extension was identified during the 2007 Master Plan, but has not been analyzed previously.

For the economic analysis presented in Section 7, service to Lang Ranch Community Park was not included, and the “alternative alignment” has been assumed because it is shorter and likely more economical.

Demands for this analysis were calculated by applying the demand figures of Section 3.5.7 to estimated irrigated acreage derived from aerial photographs. In addition to the demands from areas shown in Figure 5-12, the hydraulic analysis has also included North Ranch Park (on Kanan Road, near Westlake Boulevard). Although this Cal Water customer is adjacent to an existing main, it is currently not connected to the system. This conversion would add approximately 40 AFY of demand.

The installation of a small pumping station to convey up to 500 gpm from the nearby Savoy Tank to the Oak Park RW Tank should be considered as part of this project. This facility would provide a Ventura County source of supplemental water and valuable redundancy for times when the Oak Park PS or portions of the transmission system are out of service. [Analysis of the potable water system serving Oak Park was outside the scope of this study, but with conversion of customers within Oak Park to recycled water, some additional capacity should exist within the Savoy pressure zone.]

5.4.2.5 Decker Canyon Extension (Figure 5-13)

This extension was planned, permitted, designed, bid, but never constructed, because the bid prices substantially exceeded available funding. The primary user would be the Malibu Golf Club, the largest potable water user in the LVMWD service area. The 2007 Master Plan advocated that serving the golf course with RW might be an important strategy for relieving eventual stress on the potable water system.

Updates to demands for this extension are based on a recent study by AECOM, which investigated construction of a conference facility on the golf club property. Average demands at the golf course have been considerably lower than was used in previous reports. For this reason, the cost per AFY is now considerably higher.

5.4.2.6 Alternative Decker Canyon Extension (Figure 5-14)

This extension would likewise serve the Malibu Golf Club, via a longer pipeline that would also serve other demands along the way. In addition to the golf club, significant RW demands are expected to come from a new development (Triangle Ranch) and conversion of Medea Valley ranchettes to RW use.

5.4.2.7 Hidden Hills Extension (Figure 5-15)

This extension would create a “backbone” pipeline through the Hidden Hills community, from which other mains could be extended. The main would serve the front yard irrigation of houses along the route as well as the irrigation needs of Round Meadows School. It would also create a loop in the system, which provides redundancy to existing customers in Mountain View Estates, the LA Pet Cemetery, and areas of Calabasas.

Demands for this analysis were calculated by applying the demand figures of Section 3.5.7 to estimated irrigated acreage taken from aerial photographs.

An extension of the system into Hidden Hills could be a way of relieving stress on the Jed Smith Subsystem of the LVMWD potable system.

5.4.2.8 Woodland Hills GC Extension (Figure 5-16)

This main extension would serve Woodland Hills Golf Course, Louisville High School, and Serrania Park, within the City of Los Angeles. Along the way, a lateral would extend southwest, conveying RW to Freedom Park and Alice Stelle Middle School within the LVMWD service area. Demands for this extension are taken from a 2011 report by AECOM.

5.4.2.9 Pierce College Extension (Figure 5-17)

This main further extends the Woodland Hills project, ultimately reaching Pierce College. Demands for this main are based on a report by RMC/CDM for the City of Los Angeles. To serve these demands, major system upgrades stretching back to Reservoir No. 2 (next to the LVMWD Headquarters facility) are needed. A larger-sized main extension between Las Virgenes and Woodland Hills would also be needed.

5.4.2.10 Other Residential Use

Conversions of other large areas of existing residential customers to recycled water were considered in the 2007 master plan, but the demands from these areas have not been explicitly included in demand projections. This is due to the poor economics that are foreseen for large-scale conversion projects (as seen later in this report for the Hidden Hills extension). However, there are many instances where the economics of small extensions may be quite favorable. The demands generated by these conversions are assumed to be a part of the infill development allocation. The small amount of additional demand these small extensions represent should not significantly impact the analyses that have been performed.

5.4.3 Summary of Future Demands

Table 5-9 summarizes the future demands for estimated infill and main extensions. This table also shows how these demands compare to those predicted in the previous master plan.

Table 5-9. Estimated RW Demands for Various Alternatives

	2007 Master Plan Estimate (AFY)	**2014 Master Plan Estimate** (AFY)
Existing demands plus infill development	7,530	6,940
Thousand Oaks Boulevard Extension	251	251
Capris Tract / So. Lindero Greenbelt	45	55
Montenegro Community Ctr Extension	0	4
North Ranch Park / No. Lindero Greenbelts	0	58
Hillcrest Tract / Oak Park North	0	21
Conejo Creek Parks Extension	0	206
Decker Canyon Project	294	229
Alternative Decker Canyon Project	524	459
Hidden Hills Extension	0	50
Woodland Hills GC Extension	0	324
Pierce College Extension	0	666
Westlake Hills Elementary School	0	15
Triunfo Community Park	0	60
Evenstar Park	0	42
Southshore Hills Park	0	14
North Ranch Neighborhood Park	0	30
Totals	8,350	9,195

Note: Total amounts exclude Decker Canyon Project, because it is redundant with Alternative Decker Canyon Project. Total also does not include Eagle View Park and some other potential Oak Park customers who are not economically feasible.

5.4.4 Future Demands and Supplies

Table 5-10 shows one concept for how implementation of these main extensions might occur. Five analyses scenarios (AS-1 thru AS-5) were developed ranging from modest to ambitious. This grouping into scenarios was done merely for the purpose of testing the hydraulic capabilities of the system. It is recognized that there are many possible sequences in which these system expansions might occur. The supply scenarios assume that demands and supplies balance. In all cases, there are more supplies than necessary; the full capacity of supplemental water at Reservoir No. 2 is never used.

Table 5-10. Future Demand and Supply Scenarios

Future Demands	Analysis Scenarios (AS) (demands in AFY)				
	AS-1	**AS-2**	**AS-3**	**AS-4**	**AS-5**
0. Existing system demands[(1)]	6200	6200	6200	6200	6200
1. Infill development within LVMWD	740	740	740	740	740
2. Thousand Oaks Boulevard Extension		251	251	251	251
3. Oak Park HOA Conversions[(3)]		207	207	207	207
4. Westlake Conversions (schools/parks)		130	130	130	130
5. Conejo Creek Park Extension				234	234
6. Decker Canyon Extension			229		
7. Alternative Decker Canyon Extension				459	459
8. Hidden Hills Extension				50	50
9. Woodland Hills GC Extension			324	324	324
10. Pierce College Extension					666
Average Demands (AFY)	**6940**	**7528**	**8081**	**8595**	**9261**
Average Day Demand (MGD)	6.2	6.7	7.2	7.7	8.3
Maximum Day Demand (MGD)[(2)]	**15.5**	**16.8**	**18.0**	**19.2**	**20.7**
Supplies (MGD)					
Tapia WRF (wastewater only @ base flows)	11	11	11	11	11
Westlake wells supplement	0.8	0.8	0.8	0.8	0.8
Morrison PS - potable supplement	1.8	1.8	2.9	2.9	2.9
Cordillera Tank -potable supplement	0	1.7	1.7	1.7	1.7
Reservoir No. 2- potable supplement	1.9	1.5	1.6	2.8	2.8
Oak Park Tank - potable supplement					1.5
Total Supplies (mgd - peak)	**15.5**	**16.8**	**18.0**	**19.2**	**20.7**

Notes: (1) Average of 3 recent years. This may not be conservative. 2012 demands were significantly higher than other years.
(2) MDD peaking factor used in this analysis was 2.5, which is conservative
(3) Modeling included demands from Eagle View Park and other marginal Oak Park potential customers, so totals are slightly different than Table 5-9.

The above analysis shows that existing sources of supplemental water should be adequate to support all of the main extensions under examination, but the following should be considered:

- The air-gap facility at Morrison Pump Station should be upgraded prior to completion of the Decker Canyon Project, the Alternative Decker Canyon Project, or Conejo Creek Extension. This would increase system reliability and remove stress from the RWPS West.

- A potable water supplement at Oak Park Tank should be considered as part of the Conejo Creek Extension project. This would be accomplished by pumping water from the Savoy Tank. Even a small supplement (e.g., 500 gpm) would significantly improve reliability of this system.
- Supplemental water within the LADWP system should be considered before extending mains to Pierce College. This could save on infrastructure and water purchase costs.
- A seasonal storage reservoir would replace the need for most or all the supplemental water, by providing up to 11 MGD on peak demand days.

5.5 Seasonal Storage Supplemental Water

As presented in this section, demands for recycled water are much lower during the winter months, particularly during rainy periods when the Tapia WRF flows are the greatest. During much of the summer, recycled water demands exceed the amount of water that is available from Tapia WRF, even with the use of the Westlake Wells. If an aggressive program of main extensions is implemented, a greater and greater portion of the water in the RW system will need to come from supplemental sources, rather than directly from the Tapia WRF. One option would be to store some or the entire winter surplus for use in the summer, rather than discharging it to Malibu Creek or the LA River.

In 2005, the "Tapia Effluent Alternatives Study" (LVMWD Report No. 2321.03) looked at many of the issues relating to seasonal storage and determined that it was not a practical alternative for the foreseeable future. Among the issues identified with any seasonal storage options were:

- The amount of supplemental water currently needed to meet recycled water demands was relatively low. Demands would need to increase substantially for any seasonal storage project to be worth considering.
- To achieve a zero-discharge condition (i.e., no discharge at any time to Malibu Creek), demands would need to nearly double.
- There are no groundwater basins that can be used for seasonal storage of recycled water within or near the service area. As such, aboveground storage would be needed.
- The volume of seasonal storage needed would be larger than can be practically provided with tanks. Therefore an aboveground, dam-impounded reservoir appears to be the only option.
- Extensive environmental studies would be required, and considerable opposition would be expected before a reservoir project in or near the service area would be approved.
- The highly variable nature of recycled water demands would create operational challenges. Specifically, it would be necessary to predict the expected winter surplus and provide sufficient storage space within the reservoir. This will be particularly difficult if discharge of water into creeks is not allowed even during wet weather.

In 2012, RMC Water and Environment prepared the "LVMWD Recycled Water Seasonal Storage Feasibility Study" (LVMWD Report No. 2500.00), which examined several alternatives for constructing a dam and reservoir for seasonal storage use. The basic concept behind the RMC study was to store surplus "shoulder month" water and apply it to beneficial use. RMC calculated that each of three reservoir alternatives (designated April Canyon, Stokes Canyon, and Hope Site) could provide approximately 2,000 AF of working storage, which would be sufficient to absorb the shoulder-month surplus for summer-time use.

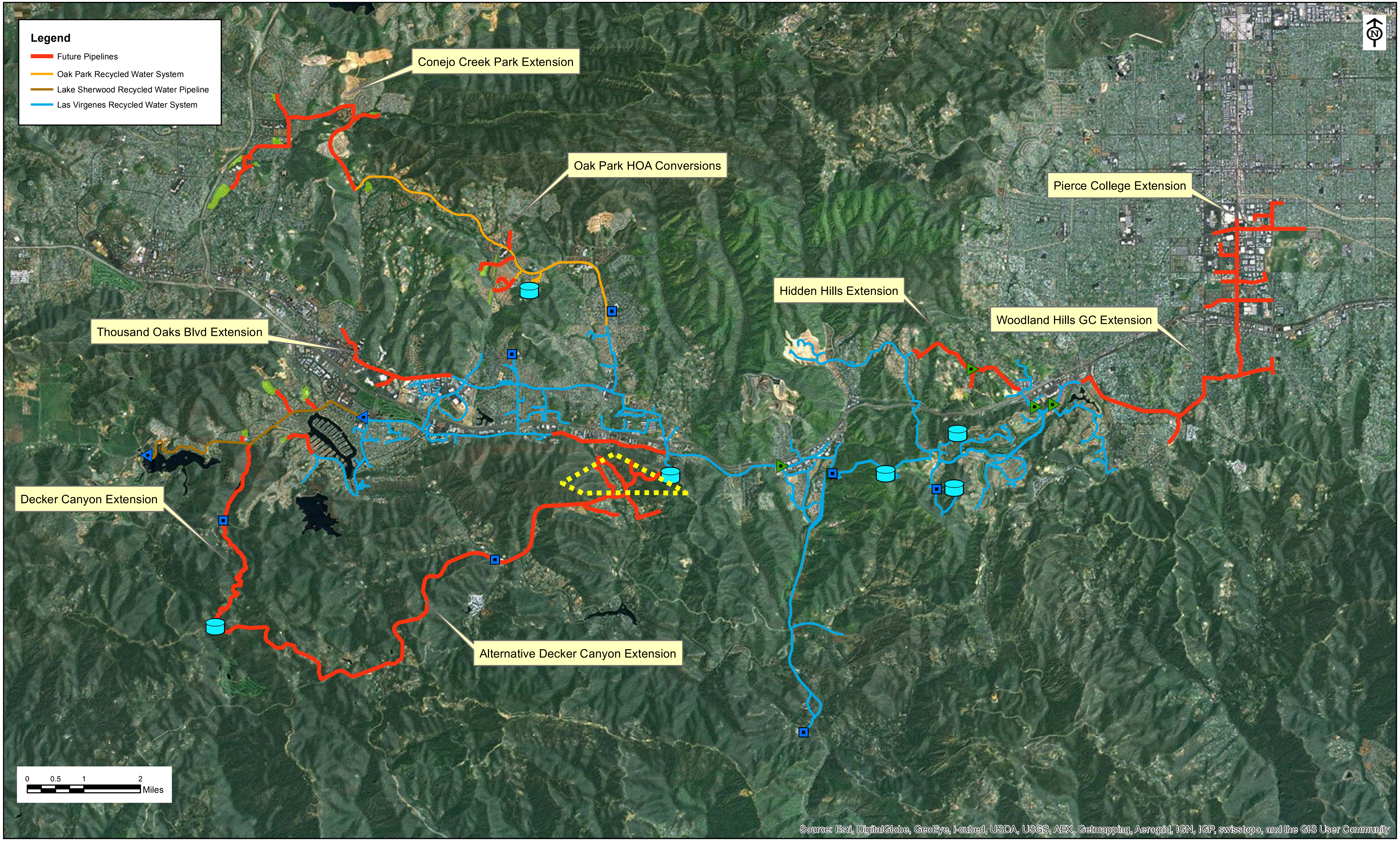
In light of the high recycled water demands experienced during the last two years, perspectives on seasonal storage may be altered somewhat. The following observations come from the preceding analysis of demands and supply:

- In 2012, 530 acre-feet of potable water was used to supplement the recycled water system. This amount was much higher than any previous year. With the current MWDSC Tier 2 rate near $1,000/AF and climbing, the value of avoiding these purchases is $0.5 million per year and climbing.
- If all the main extensions identified in Table 5-10 were implemented, demands would increase by about 48 percent over their current levels, while supply from Tapia would only increase by 20 percent. The need for and cost of supplemental water could easily triple.
- Seasonally stored recycled water would be essentially drought-proof. Even in very dry years, there should be enough surplus recycled water to fill the reservoir. Other sources or supplemental water are much more vulnerable.

5.6 Conclusions Regarding Supply and Demand

The following conclusions are drawn from the foregoing analysis:

- Near-record sales of recycled water sales were seen in 2012, as a dry winter and spring were coupled with improved economic conditions. On average, recycled water sales were approximately 82 percent of wastewater flows to Tapia WRF. However, due to misbalances caused by summer peaking, the actual amount of wastewater that was recycled was 72 percent. Water from the Westlake Wells and potable supplement made up the difference.
- Recycled water supply is expected to grow moderately over the next two decades, driven primarily by infill development of the LVMWD service area and the connection of some septic systems to sewers. Current supply is about 8.7 MGD. This could average about 11 MGD at buildout, with peaks of around 12 MGD.
- Infill development would generate modest growth in demands. Many of the new customers who generate flows to Tapia WRF could be expected to also be users of recycled water.
- Proposed extensions to the system range from modest to ambitious. Even if all the ambitious extensions outlined here are constructed, the existing supplies (including potable water supplement) will be sufficient.
- The cost of adding potable water to the system is currently about $0.5 million annually. This cost could escalate significantly, depending on how many new customers are added and how quickly MWDSC prices rise. Seasonal storage would negate the need for potable water supplement.



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Future Pipeline Extensions Overall Map

Figure 5-8

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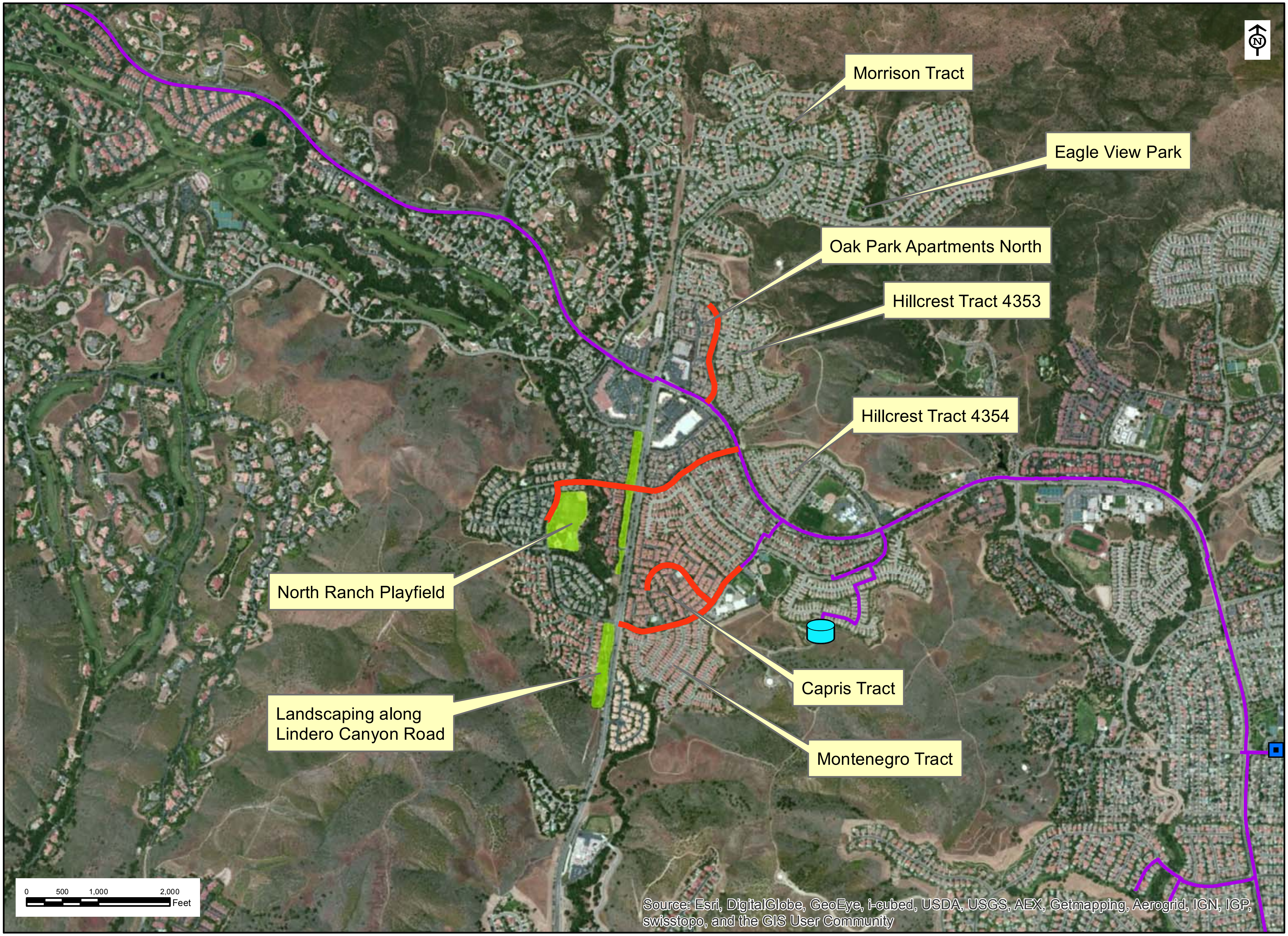
Thousand Oaks Blvd Extension
Figure 5-9



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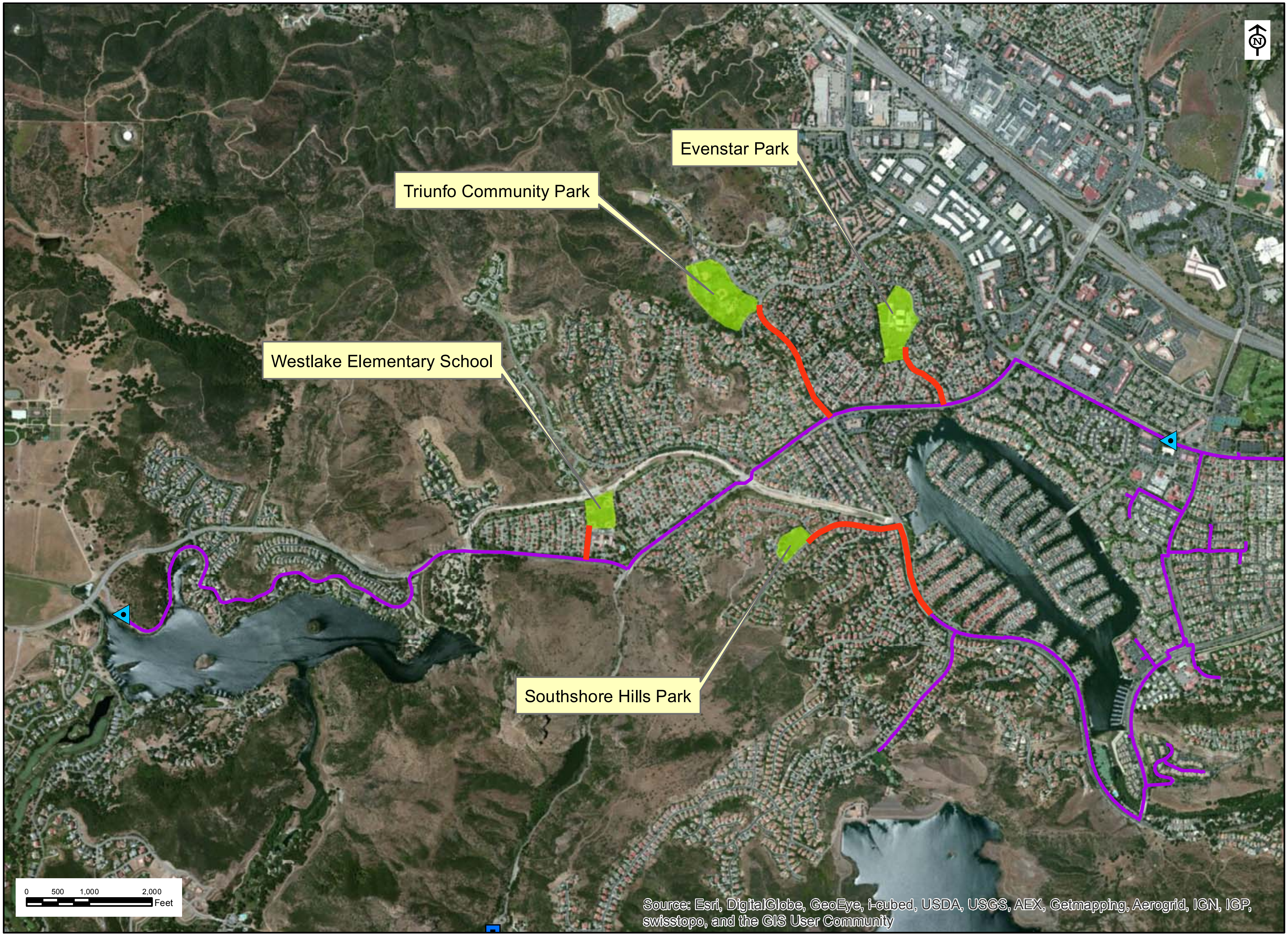
Oak Park HOA Conversions
Figure 5-10



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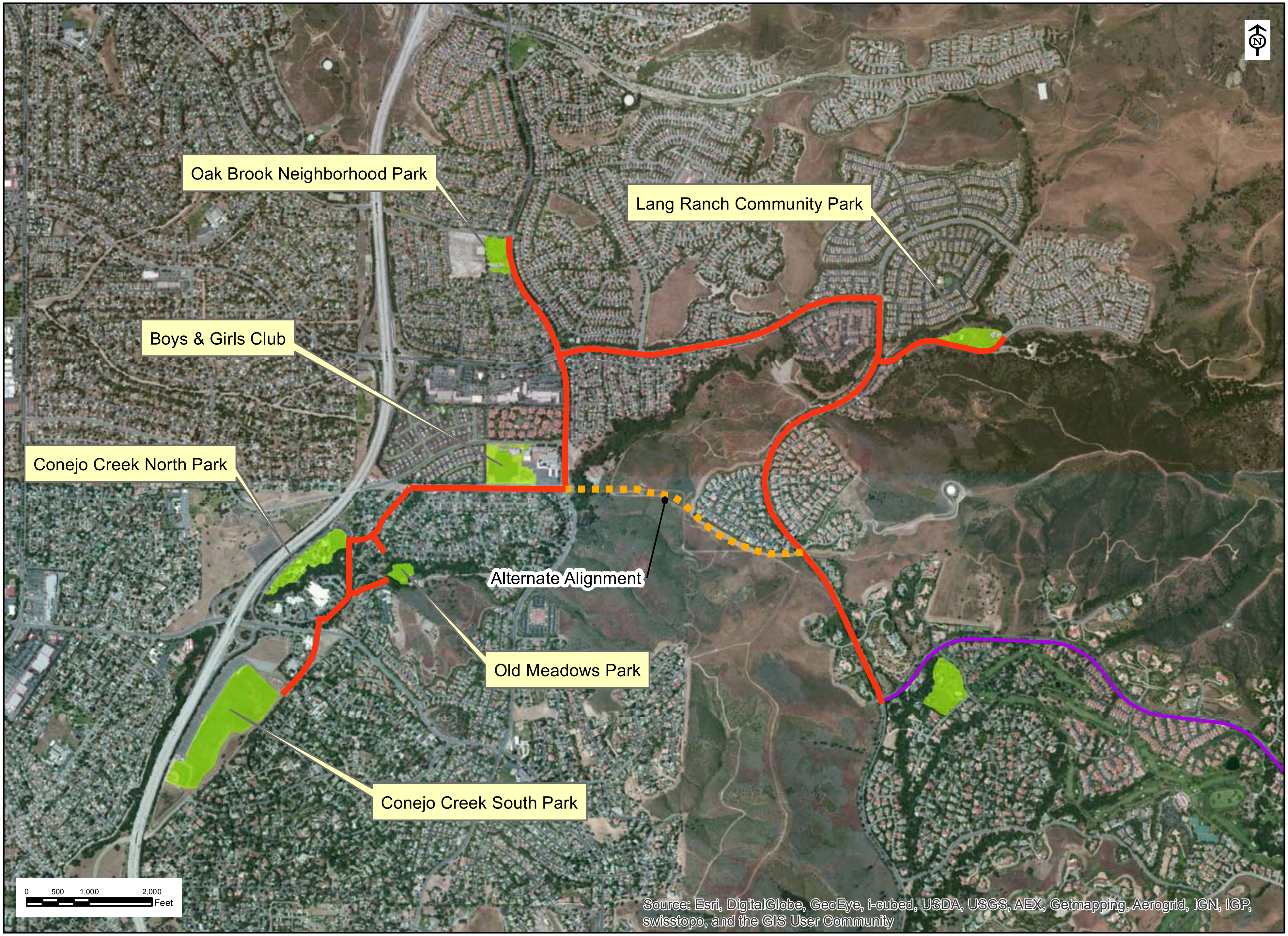
Lake Sherwood Pipeline Future Customers
Figure 5-11



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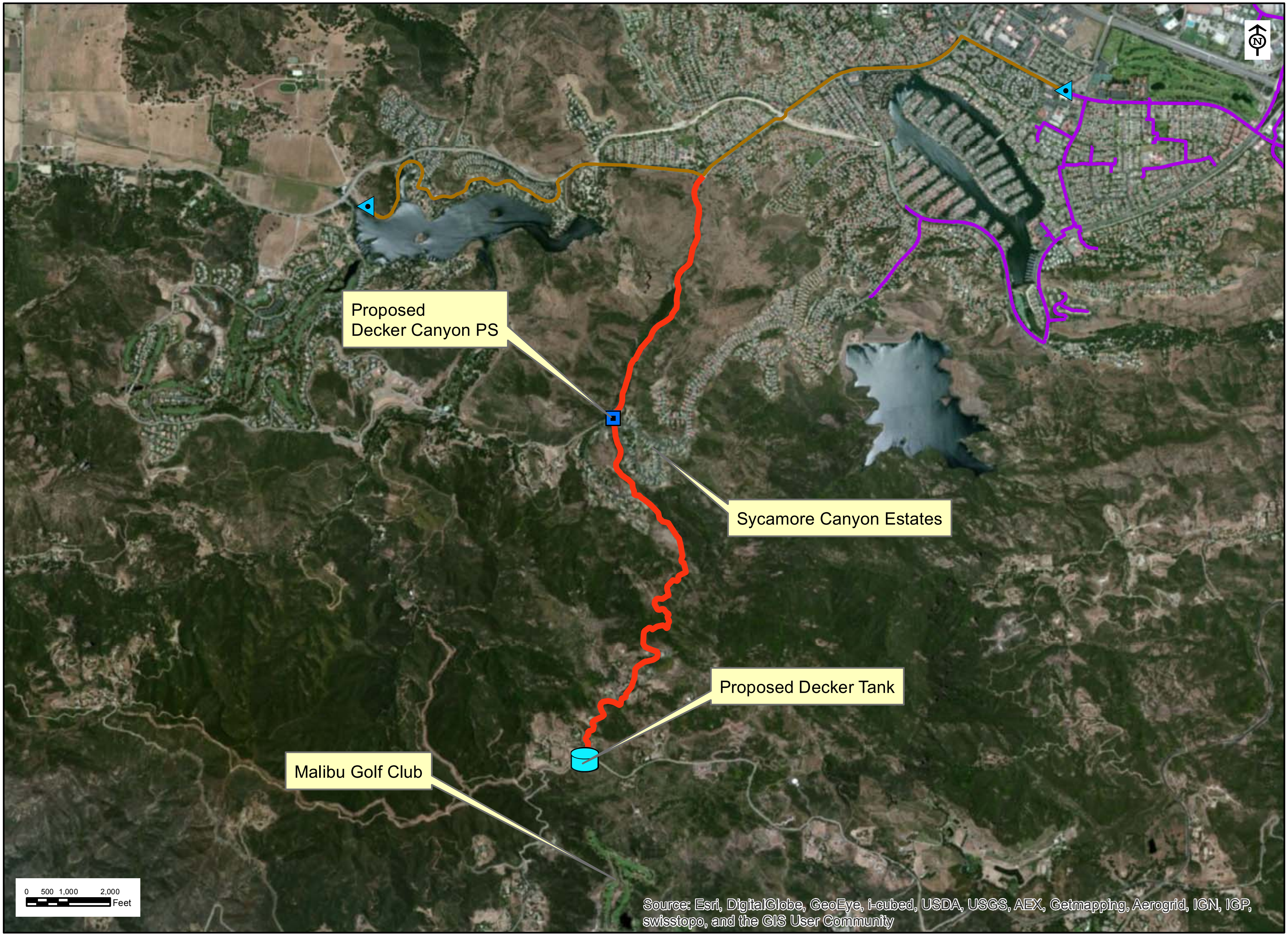
Conejo Creek Park Extension
Figure 5-12



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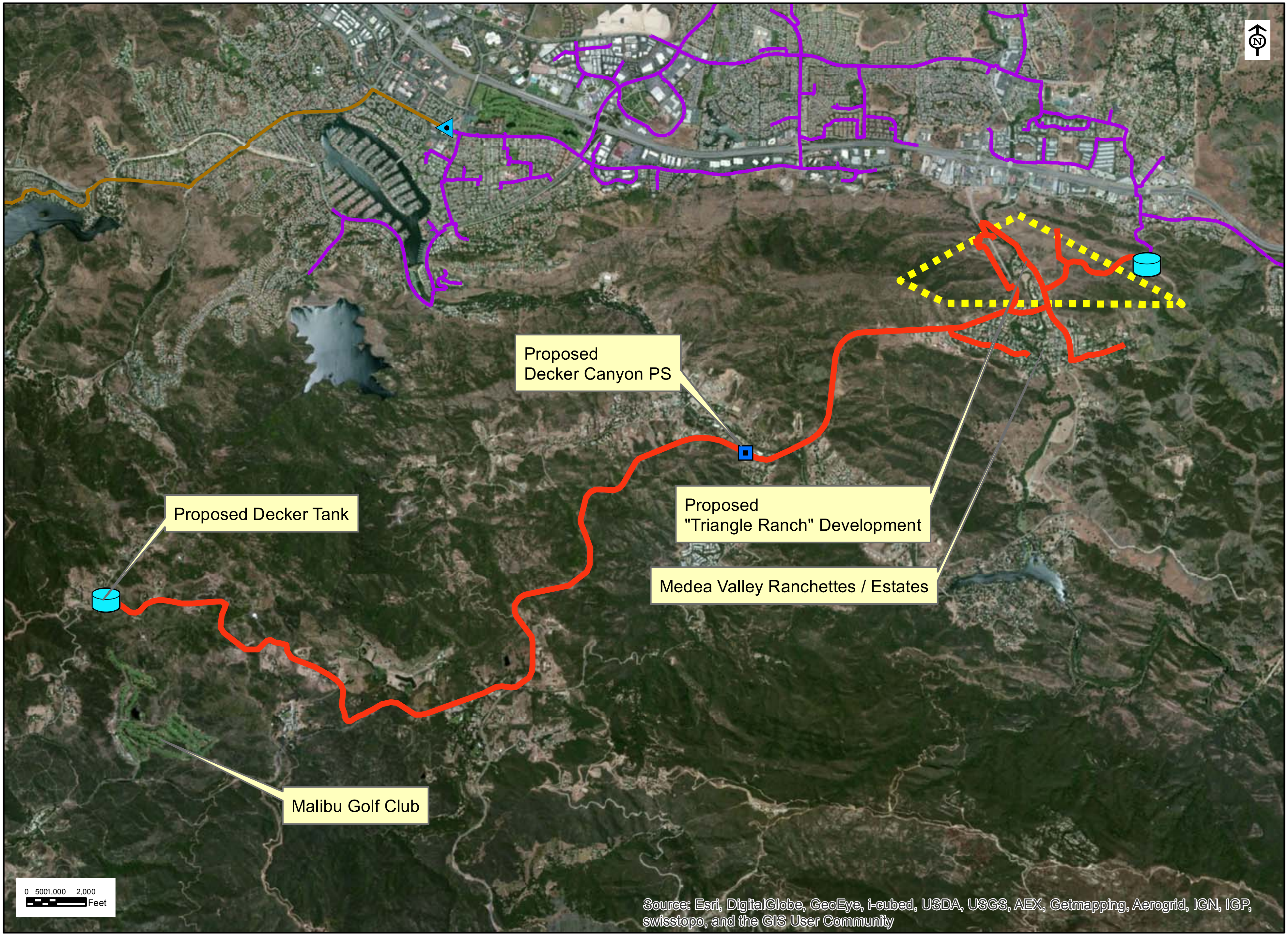
Decker Canyon Extension
Figure 5-13



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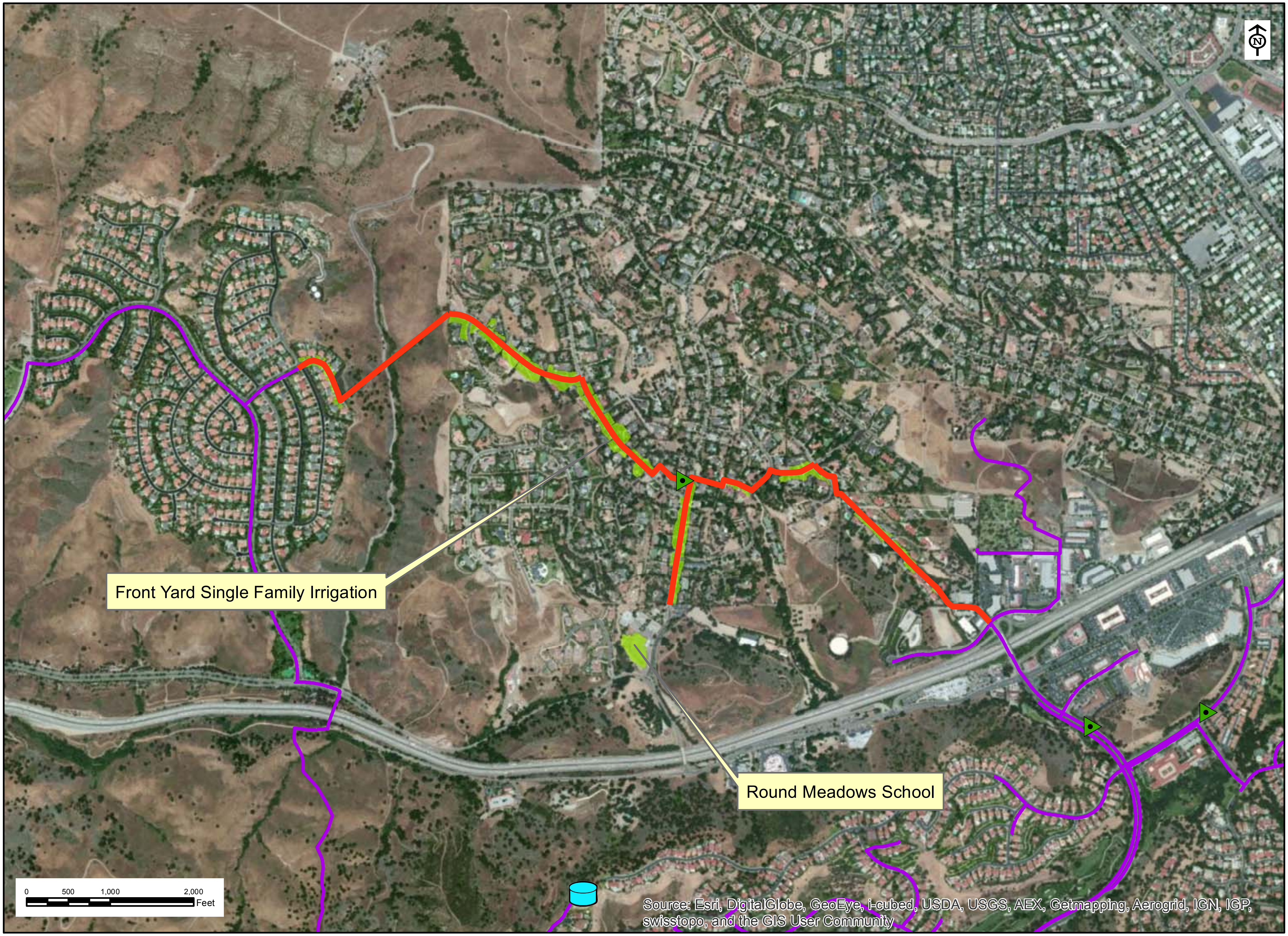
Alternative Decker Canyon Extension
Figure 5-14



Hidden Hills Extension
Figure 5-15


Serrania Avenue Elementary School
Pacific Lodge Boys Home
Motion Picture Hopsital
Church
Serrania Park
Woodland Hills GC
Louisville High School
Medians along Mulholland Dr
Alice Stelle Middle School and Freedom Park
0 500 1,000 2,000
Feet
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Pratt & Whitney Rocketdyne
The Village at Westfield
Pierce College
Warner Ranch Park
Kaiser Permanente (Woodland Hills)
FomerLitton Ind., Inc.
0 500 1,000 2,000
Feet
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Section 6 – Hydraulic Analysis

Section 6: Hydraulic Analyses

For the 2014 Master Plan, a new hydraulic model was developed. The earlier model was built in 1998 by digitizing the JPA's "400-Scale" atlas drawings, using spot elevations taken throughout the Los Angeles County portion of the system. Spatially, this earlier model was only approximate; this did not affect the accuracy of the hydraulic computations, but was a limitation on how readily it could be updated. Furthermore, the earlier model ended at the County line. The portions of the system within Ventura County were modeled as nodal demands; it was not possible to accurately assess extensions to the system in Ventura County and their impacts on existing customers. And as with any old model that had gone through several updates, there was ample room for "clean up". The model contained dozens of different scenarios which had no relevance to what was currently constructed.

The new model was constructed using the GIS of both CMWD and LVMWD, which depict the real system to a high degree of accuracy. Because the model is GIS-based, there are several advantages over the old model:

- Updates to the piping network can be readily accomplished by periodically comparing the model to the latest GIS
- Demand updates are more easily accomplished, particularly in the LA County portion where billing records and GIS meter nodes utilize a common customer identifier
- Pipelines and other assets depicted in the model can be directly traced through the GIS to as-built drawings and other records

6.1 Model Details

Software: WaterGems by Haestad Methods

Piping Network: GIS-based provided by LVMWD and CMWD

Pipe attributes in LA County: GIS-based

Pipe attributes in Ventura County: based on as-built drawings provided CMWD

Topography: public source, digital terrain model, with 10-ft accuracy

Pump curves: derived from factory-performance pump tests

- Extracted from existing model for LA County
- Oak Park PS curves provided by CMWD

Operational set points: based on interview with LVMWD operations supervisor

Demands: taken from 2011 and 2012 billing records provided by LVMWD, CMWD, and TSD

Demand locations: as described in Section 3.5.8

- LVMWD customer demands directly linked
- TSD / CMWD large customer demands located using meter addresses
- TSD / CMWD small customer demands allocated uniformly

Seasonal peaking: calculated using SCADA data for two weeks

- August 13 through August 17, 2012
- August 27 through August 31, 2012.

Pipe friction factors and other modeling parameters: as described in Section 3

6.1.1 Peaking patterns

Diurnal peaking patterns were developed for each portion of the system where SCADA-connected meters could track flows. **Figures 6-1 through 6-6** show the peaking patterns developed for the subsystems shown in **Table 6-1**. These patterns were developed by summing the flows into and out of the subsystem and by accounting for changes in tank water levels. In addition to these subsystems, patterns were also calculated for Lake Sherwood and North Ranch Golf Courses.

Table 6-1. Subsystem Definitions and Facilities

Subsystem	Facilities Included	Outflows from System
Eastern System	RWPS East Cordillera Tank Cordillera Supplement	Parkway PS
Western System	RWPS West Indian Hills Tank Morrison PS	Oak Park PS Lake Sherwood GC(1)
Parkway System	Parkway PS Parkway Tank(2)	
Oak Park System	Oak Park PS Oak Park Tank	North Ranch GC

Notes: (1) SCADA not available for the system meter at La Venta Drive and Agoura Road
(2) Supplemental facilities at Parkway Tank not in use

A peaking pattern was not developed for the Las Virgenes Valley System, defined as that portion of the system which includes the Tapia RW Pump Station, Reservoir No. 2, and supplemental facilities at Reservoir No. 2, because SCADA data were not available. The hydraulics for this part of the system are not a particular concern—ample pumping and pipeline capacity exists. This part of the system is not included in the hydraulic model.

For the model, Reservoir No. 2 was modeled as an infinite water source, with water at an elevation of 775 feet, which corresponds to an approximate average level, as determined from SCADA data. The validity of this assumption was verified through analysis of supply vs. demand for the system and examination of SCADA data for Reservoir No. 2. As shown in Table 5-10, a combination of recycled water from Tapia WRF and potable water supplement at various sources is adequate to supply all of the future scenarios under consideration.

For new irrigation customers, a generic night-time irrigation pattern was applied, which assumes that watering is performed for 8 hours, between 10PM and 6AM. This produces a peaking factor of 3.0 and the pattern shown in Figure 6-7.

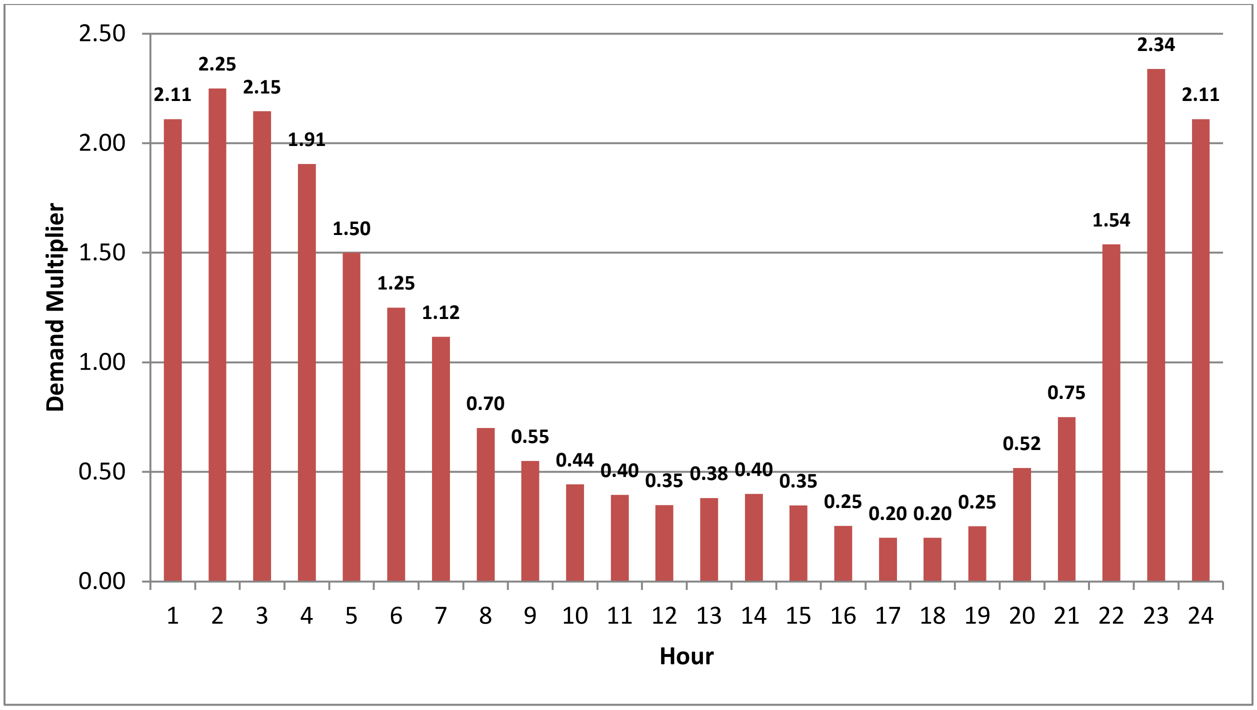


Figure 6-1. Eastern RW System Diurnal Demand Pattern

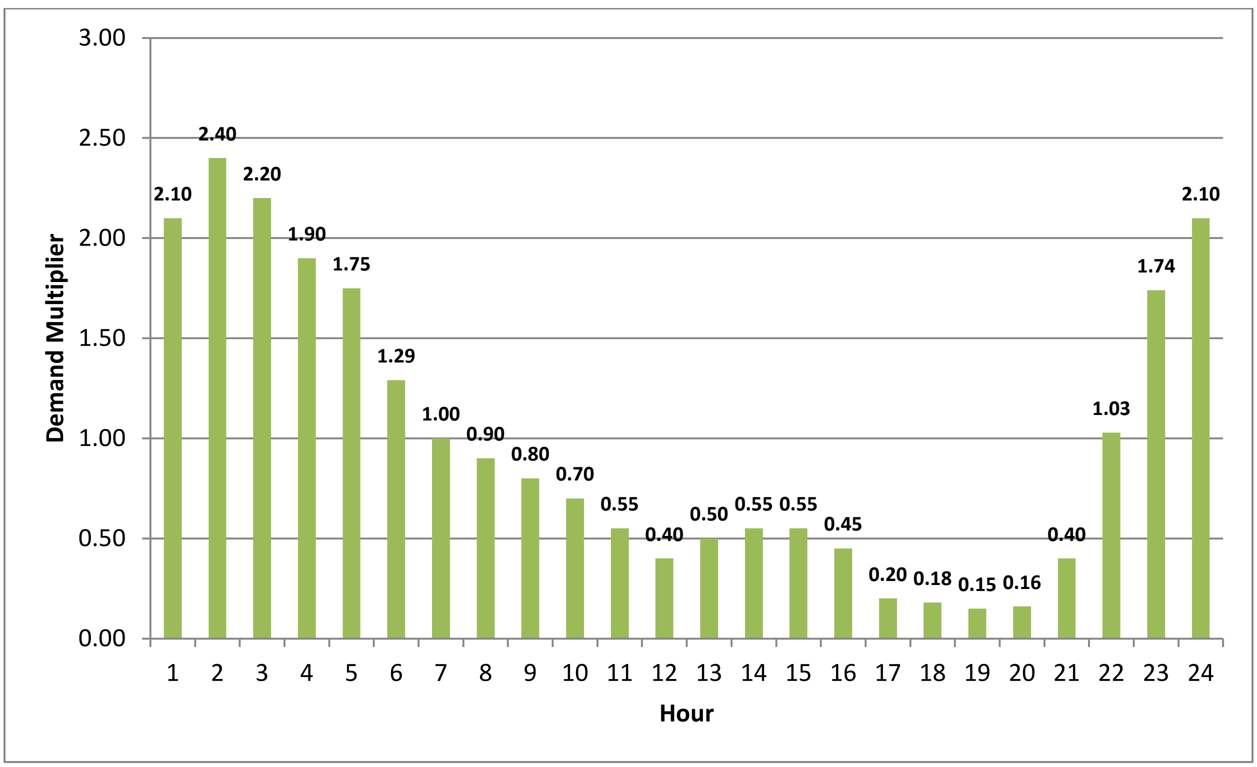


Figure 6-2. Western RW System Diurnal Demand Pattern

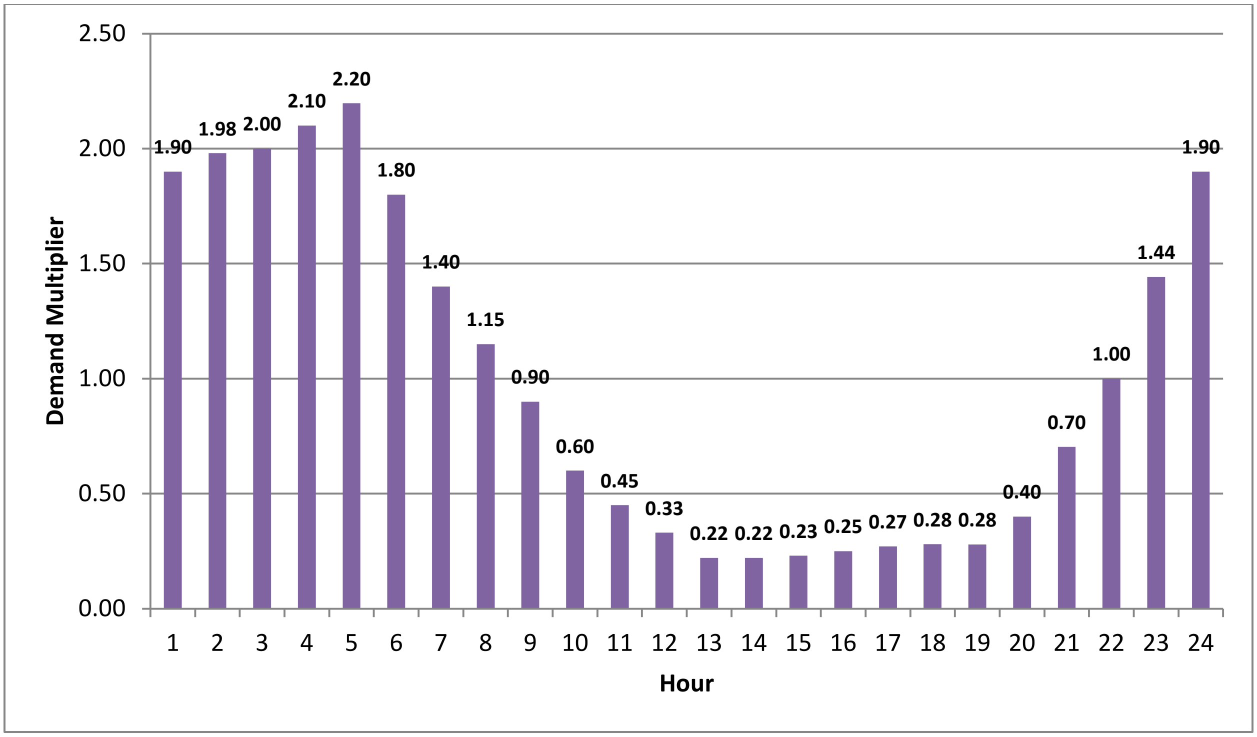


Figure 6-3. Oak Park RW System Diurnal Demand Pattern

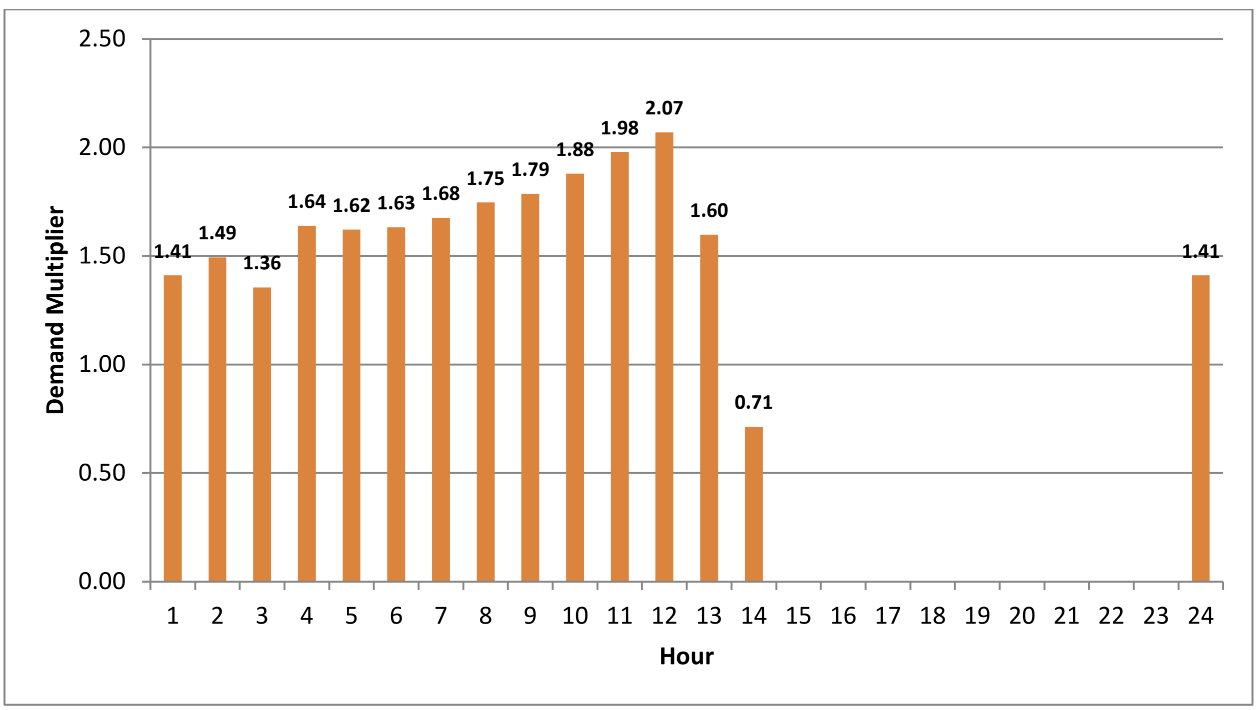


Figure 6-4. North Ranch GC Diurnal Demand Pattern

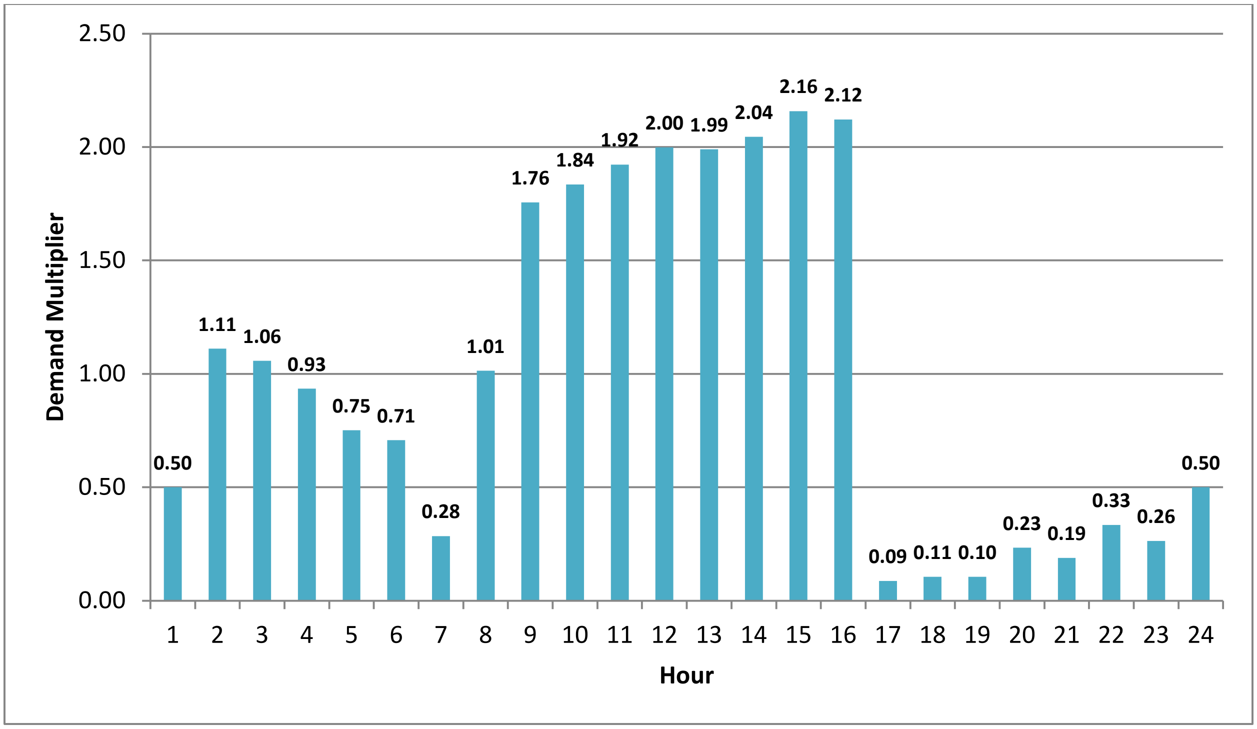


Figure 6-5. Lake Sherwood GC Diurnal Demand Pattern

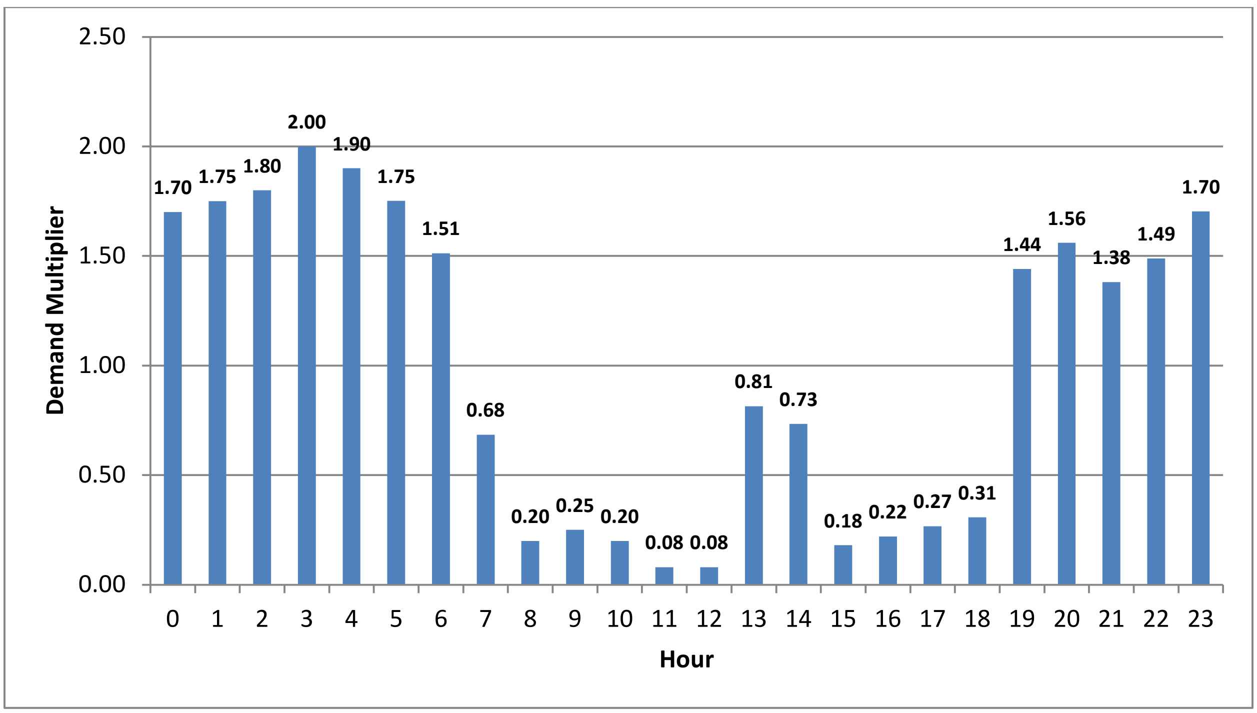


Figure 6-6. Parkway RW System Diurnal Demand Pattern

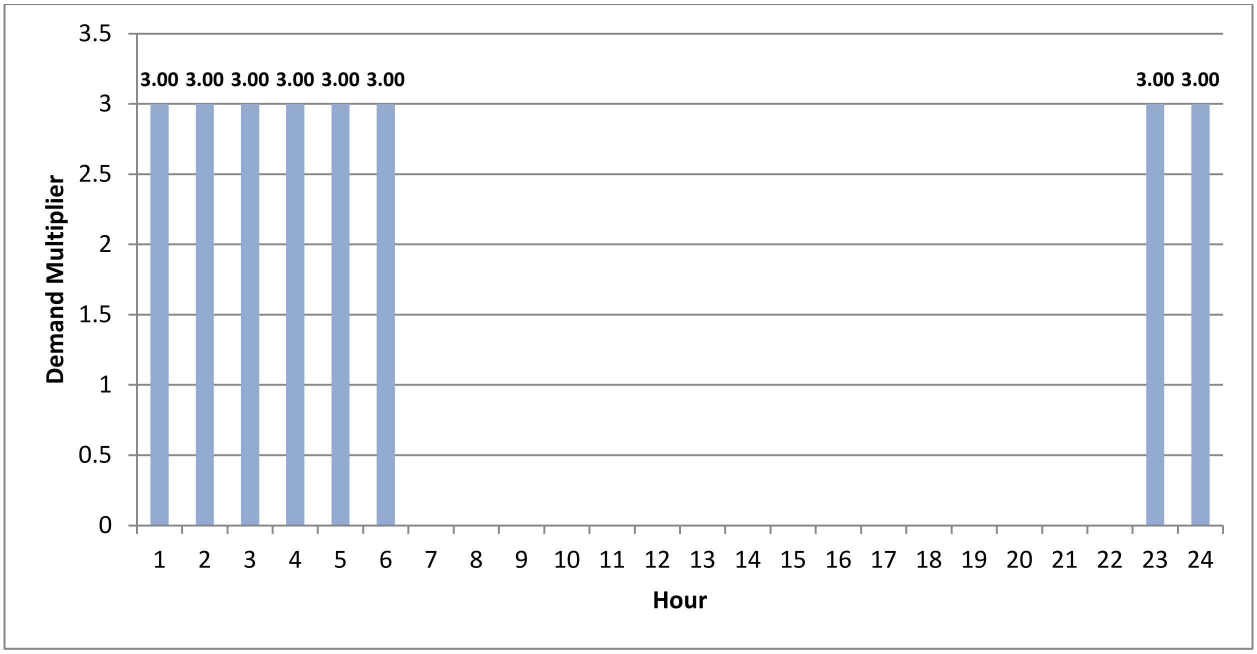


Figure 6-7. Generic diurnal demand pattern used for 8-hour night-time irrigation

6.2 Model Validation

Model accuracy was tested by comparing SCADA data from each of the pump stations, reservoirs, tanks, and metering stations with comparable modeling results for existing peak summer conditions. The date of comparison was August 15, 2012, a date where high demands occurred.

After several iterations and adjustments to the model, extremely close correspondence was obtained between SCADA data and model results. Graphs comparing SCADA data and model simulation results are found in Appendix B. The comparison included flow data, tank water levels, PS suction pressures, and PS discharge pressures.

The following discrepancies between the model and the SCADA results were noted. Each of these is considered relatively inconsequential or likely to produce conservative outcomes:

- Actual flows from RWPS East are higher than modeled flows. The pump station is providing higher flows than its rated capacity.
- The real pump starts and stops for various pump stations occur at slightly different times than the model. This is attributable to time-of-use restrictions that were not included in the model.
- Although PS pressure data generally corresponded in pattern, differences in the reported values sometimes occurred due to differences in instrument elevations. Additionally, differences in patterns occurred where pump starts and stops did not match.

The conclusion: the model closely mimics current hydraulic performance, so should be able to predict future performance under various demand and main extension scenarios.

6.3 Evaluation of Future System

The infill development and potential system expansions described in Section 5.4 were evaluated using the hydraulic model. To serve these potential future demands, main upgrades and main extensions will be required as described in Table 6-2. Additional details are found in the budgetary estimates found in Appendix C.

Table 6-2. Pipelines Needed for Future Demands

Future Demand Condition	Main Extensions Required	Existing System Pipeline Upgrades Required
1. Infill development	As dictated by development	None
2. T.O. Blvd. Extension	10-inch and smaller	None
3. Oak Park HOAs, Lindero Cyn greenbelts and North Ranch Playfield	4-inch and 6-inch	None
4. Westlake area conversions (school and parks)	4-inch and 6-inch	None
5. Conejo Creek Parks	12-inch and smaller	None
6. Decker Canyon	10-inch and 8-inch	None
7. Alternative Decker Canyon	10-inch and 8-inch	None
8. Hidden Hills Extension	6-inch and 4-inch	None
9. Woodland Hills Extension	14-inch and 12-inch	12 and 14-inch parallel pipe, in Park Granada to El Canon
10. Pierce College Extension	20-inch and smaller	16-inch parallel pipeline from RWPS East to El Canon

As noted earlier, planned upgrades to the Morrison Pump Station are also recommended prior to (or as part of) main extensions to Decker Canyon or Conejo Creek Park.

Additionally, to serve both the Woodland Hills Golf Course and Pierce College expansions, upgrades to the RWPS pump station will be required. Although the pump station has enough pumping capacity, pump cavitation will occur if all 6 pumps are run simultaneously. [The analyses that support this conclusion are found in the preliminary design report for the 2006 RWPS-East Expansion Project.]

6.3.1 Extended-time hydraulic analysis

To evaluate the impact of these possible future demands on existing customers and system operations, extended-time MDD simulations were performed, applying the 5 analysis scenarios presented earlier in Table 5-10. These analysis scenarios are:

Table 6-3. Analysis Scenarios Used in Extended Time Hydraulic Analysis

AS-1	Existing demands plus 20 percent organic (infill) growth within LVMWD. No infill assumed for TSD and CalWater areas.
AS-2	AS-1 plus: • Thousand Oaks Boulevard extension • Oak Park HOA conversions • Lindero Canyon Boulevard greenbelts • North Ranch Play Field
AS-3	AS-2 plus • Decker Canyon extension • Woodland Hills extension
AS-4	AS-2 plus: • Conejo Creek Park extension • Alternative Decker Canyon extension • Hidden Hills extension • Woodland Hills extension
AS-5	AS-4 plus Pierce College

6.3.1.1 Tank Refilling

Figures 6-1 to 6-4 show the anticipated effects of these scenarios on the water levels in the system's various tanks. Although the higher demands cause tank levels to dip considerably lower, no tanks completely empty and all are refilled at the end of the day. This is important, otherwise service would degrade with several high-demand days. As noted earlier, unlike potable water systems, there is no minimum storage level needed in recycled water tanks. Storage for fires and emergencies is not required in RW systems. Also, pumps are generally selected to cover a range of hydraulic conditions, which include maximum and minimum levels in both the suction and discharge tanks. So as long as tanks do not empty, adequate suction pressure should exist at the pump stations. However, specific concerns about pressure would not necessarily be identified with the hydraulic model.

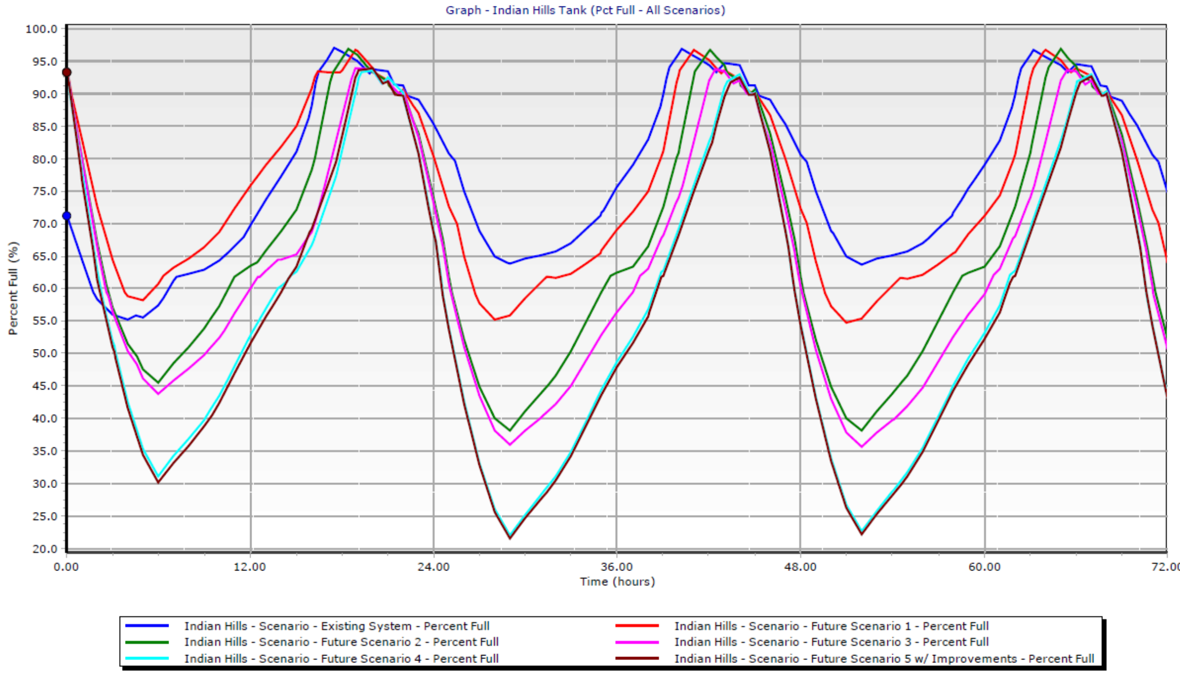


Figure 6-8. Analysis of Indian Hills Water Level

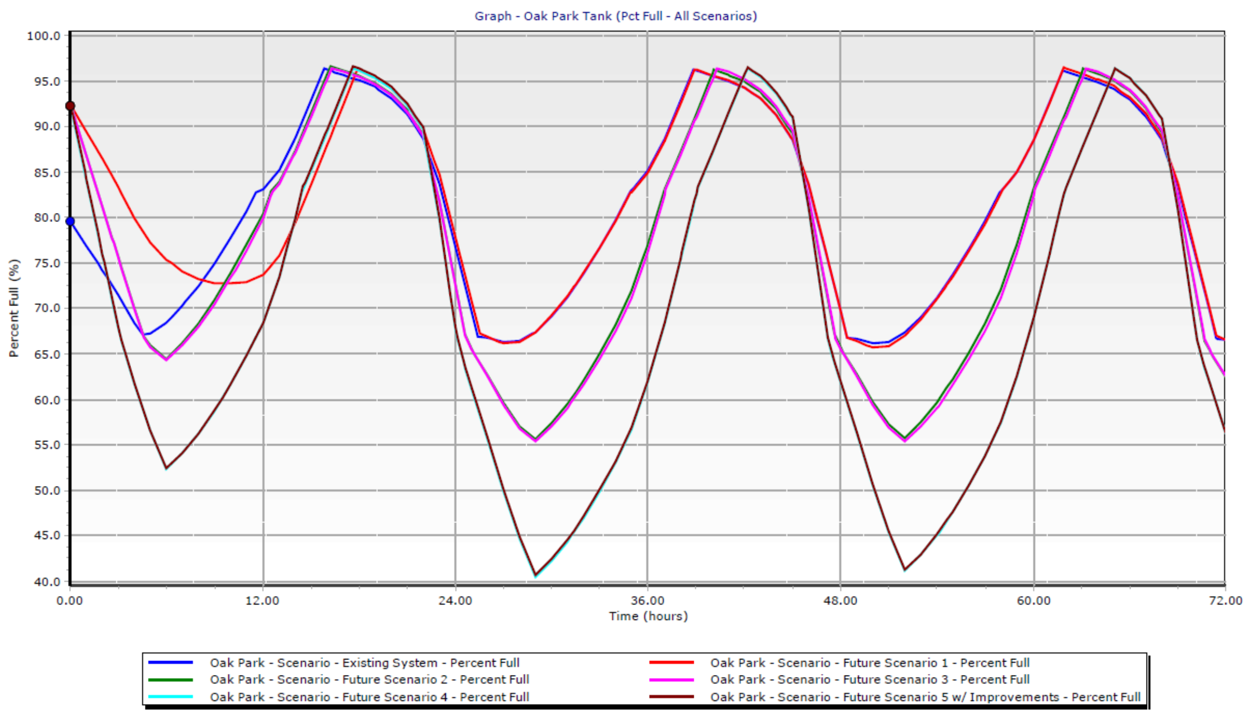


Figure 6-9. Analysis of Oak Park Tank Water Level

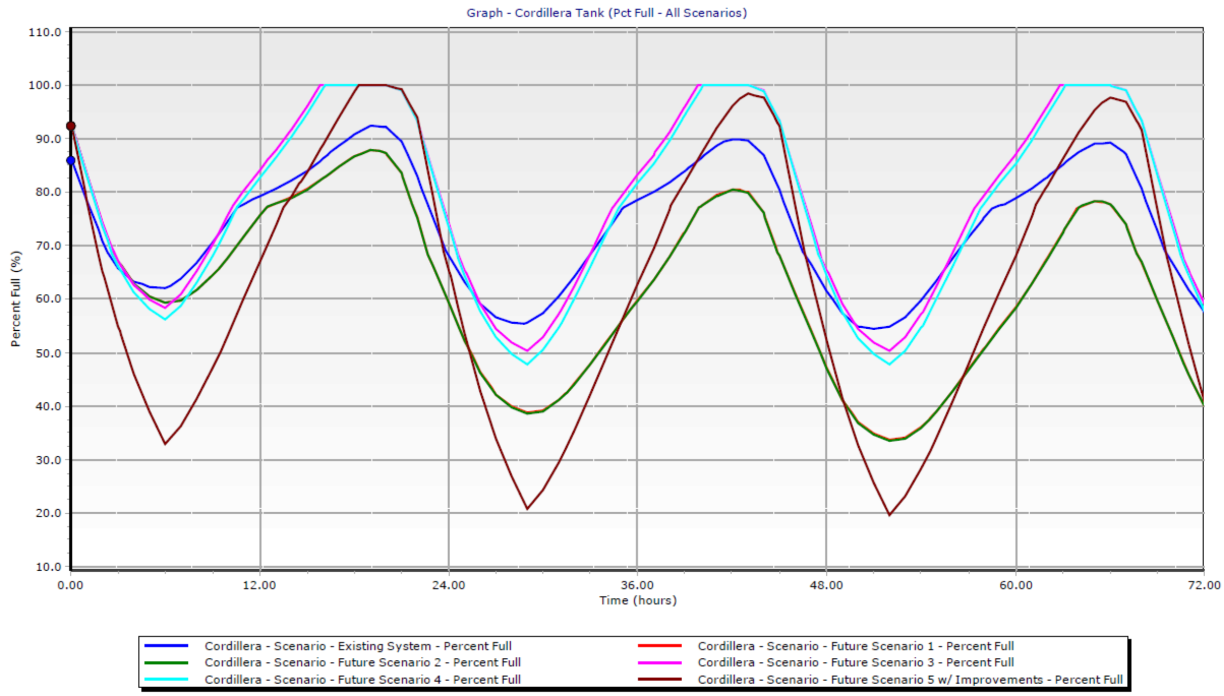


Figure 6-10. Analysis of Cordillera Tank Water Level

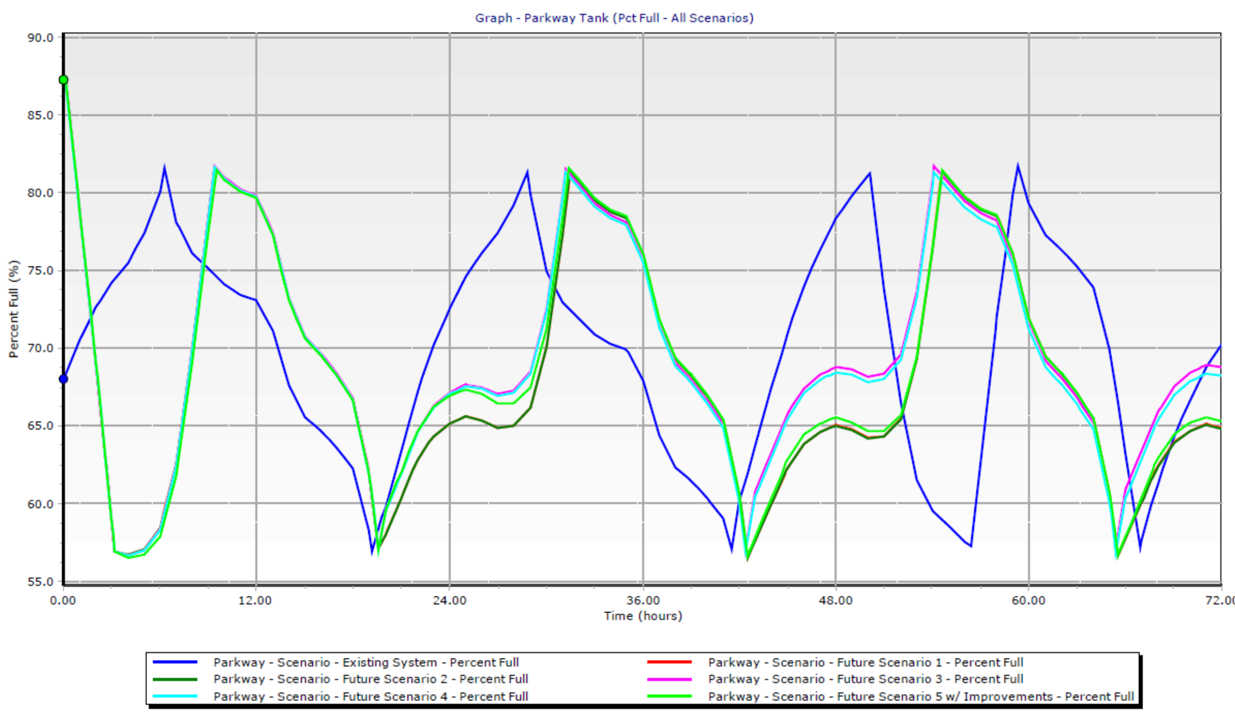


Figure 6-11. Analysis of Parkway Tank Water Levels

In Scenarios AS-3, AS-4, and AS-5, all three pumps at RWPS-East were employed. The modeler chose to run one pump continuously, while cycling the others on and off per the existing settings. This explains why the tank stays full for several hours at a time. In practice, the third pump would be programmed to start and stop at various water levels in the tank.

As mentioned earlier, all 6 pumps should not run simultaneously at the main Recycled Water Pump Station due to concerns about pump cavitation. If the Woodland Hills extension is constructed without an upgrade to RWPS suction piping, the system might need to be programmed so that the Cordillera potable supplement is automatic when the tank level dips below a minimum—essentially acting like another pump.

In any event, an additional investigation of suction pressures at RWPS-East is recommended. This can be accomplished by running all six pumps for a short duration, while monitoring and recording the suction pressure, then comparing the results to the net positive suction head requirement for the pumps. This should be done for various Tapia PS flow scenarios and with water in Reservoir No. 2 at a moderately low level.

6.3.1.2 Impacts on existing customers

Even when customers receive relatively good pressure, if their irrigation systems are designed for higher pressures, they can be adversely impacted when large demands are added to the system. Table 6-4 summarizes the tank water levels and minimum pressures seen at various points in the system during the extended-time simulations. These points were picked because they are at the extreme levels in the system or are critical for pressure control.

Table 6-4. Tank Water Levels and Pressures for Different Future Analysis Scenarios

Item	Exising System	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
HWL Elevation in Indian Hills Tank (ft)	29.1	29.03	29.06	28.17	28.08	28.16
LWL Elevation in Indian Hills Tank (ft)	16.55	16.43	11.43	10.69	6.63	6.47
HWL Elevation in Cordillera Tank (ft)	24.03	24	24	26	26	26
LWL Elevation in Cordillera Tank (ft)	14.14	8.74	8.7	13.08	12.42	5.09
HWL Elevation in Oak Park Tank (ft)	25.05	25.07	25.11	25.06	25.06	25.1
LWL Elevation in Oak Park Tank (ft)	17.22	17.1	14.46	14.39	10.53	10.58
Minimum Pressure at La Venta Meter / Valve (psi)	97	90.8	70.1	67.6	69.2	69.7
Minimum Pressure at Lake Sherwood GC (psi)	72.4	66.2	44.7	41.9	43.8	44.4
Minimum Pressure at North Ranch GC (psi)	73.5	72.7	71.9	71.8	53.9	53.9
Minimum Pressure at Calabasas HS 22855 W. Mulholland Hwy (psi)	143.9	121.8	121.3	73.8	76.7	121.7
Minimum Pressure at intersection of Park Sorrento/Park Ora (psi)	187.2	167.1	166.6	119.2	122	167
Minimum Pressure at Woodland Hills GC (psi)	n/a	n/a	n/a	124.5	127.4	170.8

Figures 6-5 through 6-9 show graphically the pressures at Lake Sherwood GC, North Ranch GC, and Mulholland HS and how they compare to existing conditions. Although significant pressure drops in these areas are experienced when compared to the base case (existing system), no fatal flaws were seen. It appears that the system would allow service to the proposed new customers, without serious compromise of service to existing customers, provided certain conditions are met, as discussed below.

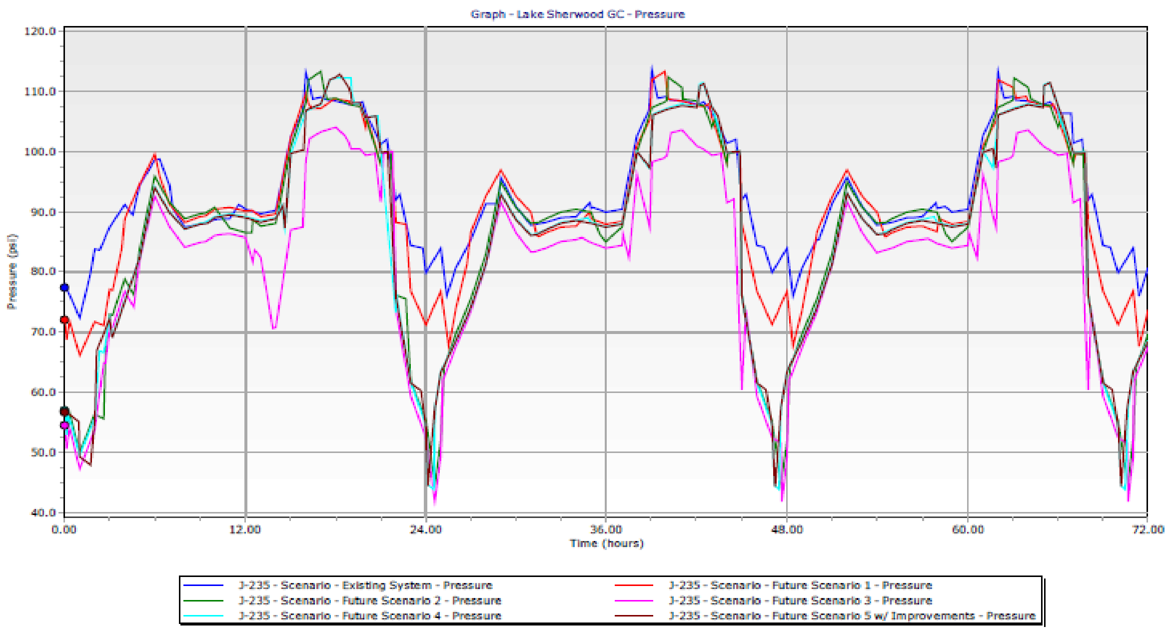


Figure 6-12. Modeling Results at Lake Sherwood GC

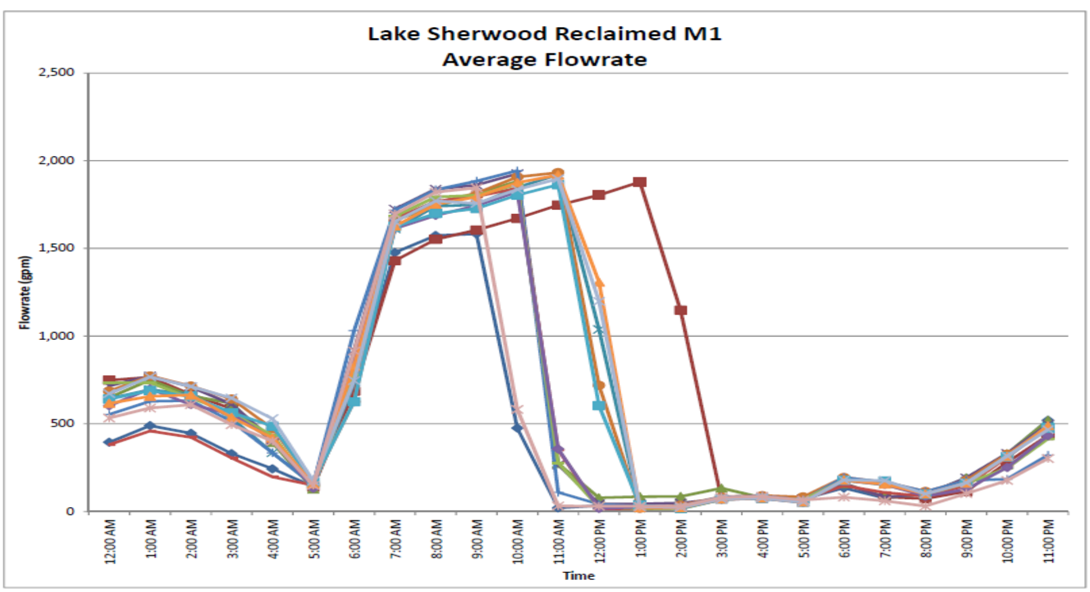


Figure 6-13. Existing Flow Pattern at Lake Sherwood

Lake Sherwood GC. During the time when Lake Sherwood GC normally fills its on-site tank (8AM through 1PM), little pressure degradation would occur with any of these scenarios. The golf course would see minimal impact on tank filling times, even from the Decker Canyon Project, which would draw water directly from the Lake Sherwood main. To achieve this result, the proposed Decker Canyon PS was modeled to operate from 2PM to 10PM. Operating during this period would have little impact on Lake Sherwood GC and other customers in the Western System.

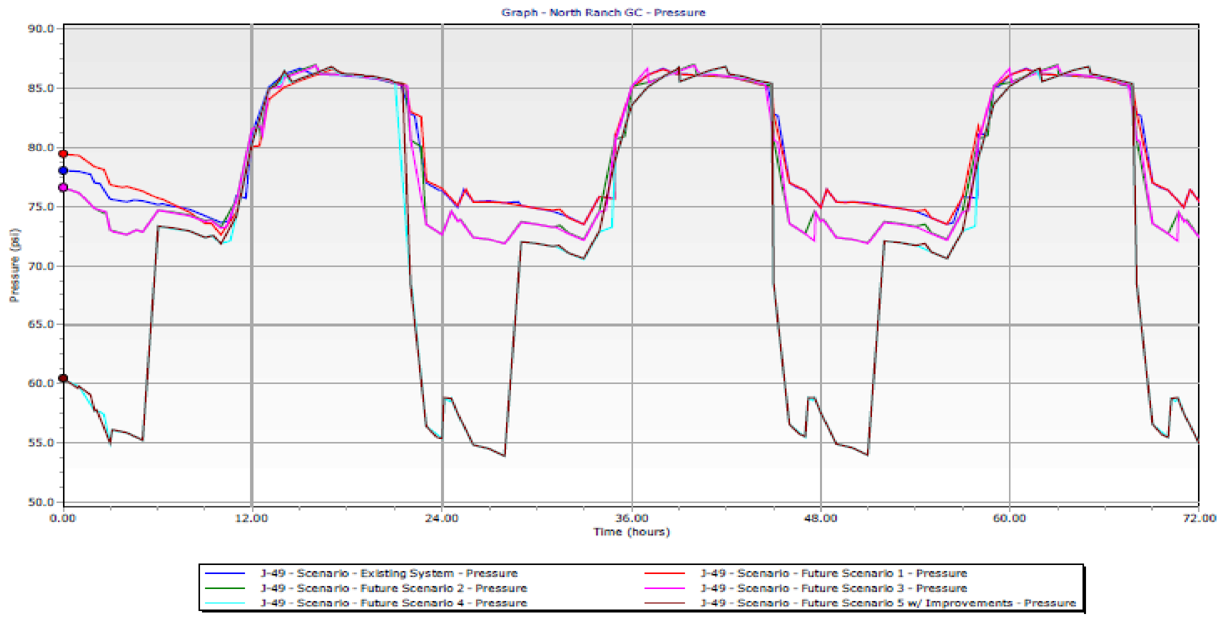


Figure 6-14. Modeling Results for North Ranch GC

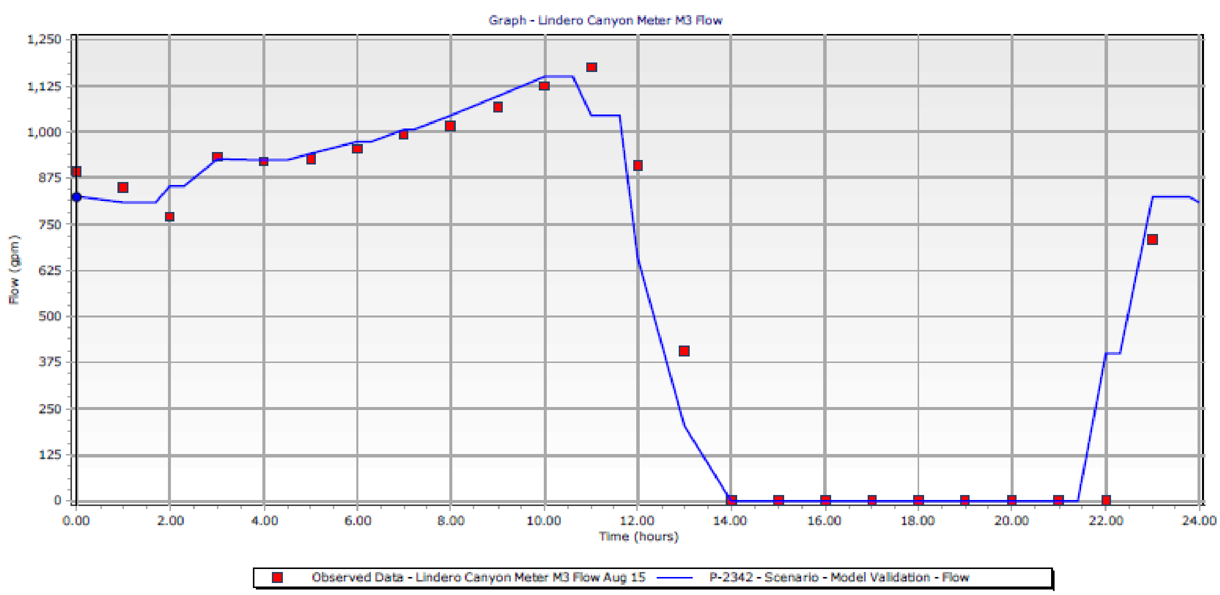


Figure 6-15. Recorded and Modeled Flows at North Ranch Golf Course

North Ranch Golf Course. The addition of the Conejo Parks extension causes significant pressure degradation at North Ranch GC. It was assumed that the parks would be irrigating between 10PM and 6AM, which corresponds with the period when North Ranch GC is also taking water (Figure 6-9). This conflict could be solved by directing the North Ranch GC to take recycled water via their on-site ponds rather than directly on the course. Alternatively, storage could be built at Conejo Creek (perhaps a water feature). Either strategy should allow one of these customers to take day time deliveries, when ample pressure should exist.

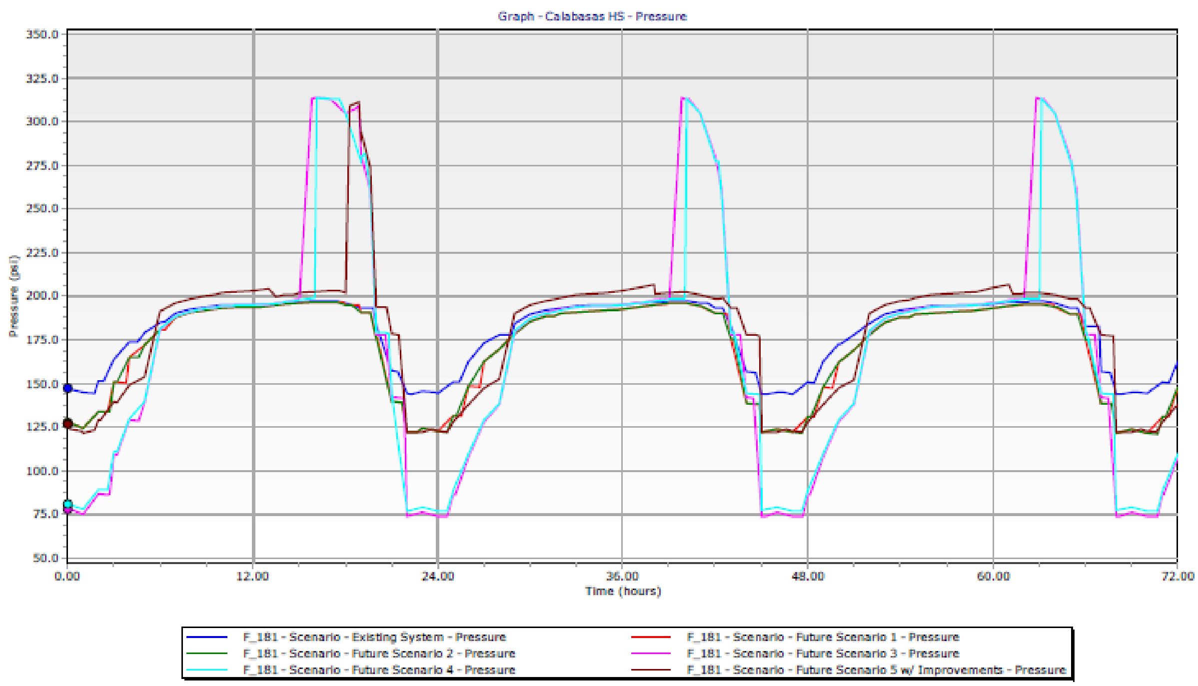


Figure 6-16. Modeling Results at Calabasas High School

Calabasas High School. The results at Calabasas HS show significant pressure drops between 10PM and 2AM for Scenarios AS-4 and AS-5. Although the pressures at the high school are still relatively high, nearby customers at higher elevations could be adversely impacted. If this is the case, there seems to be ample pressure later in the night, so rescheduling irrigation timers might solve such an issue. [The pressure spikes seen in this graph for Scenarios AS-3 through AS-5 are a consequence of running one of the RWPS pumps continuously and is not significant.]

As part of the *Woodland Hills Country Club Recycled Water Service Study* (LVMWD Report No. 2467, prepared in 2011), pressures were monitored at the high school and at two other points in Calabasas and compared to results from the old hydraulic model. The new model achieves a better match with recorded minimum pressures (120 psi) than did the older model. The new model predicts a minimum pressure at the high school of 143 psi, whereas the old model predicted 161 psi. At the other two points in the system, both models matched recorded pressures very closely.

6.4 Analysis of the Main Recycled Water Pump Station

Table 6-5 summarizes the capacity of the existing RWPS East and West facility. This analysis shows that the existing facility is adequate for all scenarios except AS-5 (expansion to Pierce College). Although pumping capacity is adequate, the suction pressure at the pump station is not believed to be adequate to run all 6 pumps simultaneously.

Table 6-5. Capacity Analysis for RWPS East and West

		RWPS – East (MGD)	RWPS – West (MGD)
Current flows on maximum day		3.4	6.9
Case 1 – No Pierce Extension	Additional MDD flows from AS-1 thru AS-5	0.7	2.9
	Total future MDD flows for AS-1 thru AS-5	**4.1**	**9.9**
	Current PS capacity (2 eastern pumps and 3 western pumps)	4.7	8.9
	Capacities of Morrison PS and Cordillera Supplement	1.7	2.9[(1)]
	Total current PS capacity plus supplement	**6.4**	**11.8**
Case 2 – Includes Pierce Extension	Additional MDD flows from AS-1 thru AS-6	2.9	2.9
	Total future MDD flows for AS-1 thru AS-6	**6.3**	**9.9**
	PS capacity with upgrade to suction pipeline (3 eastern pumps and 3 western pumps)	6.5	8.9
	Capacities of Morrison PS and Cordillera Supplement	1.7	2.9[(1)]
	Total current PS capacity plus supplement	**8.2**	**11.8**

(1) Assumes Morrison PS air gap is upgraded to 2000 gpm

The above analysis shows that to serve Pierce College along with the other main extensions and infill demands, one of the following must occur:

- Pump station suction piping must be upgraded to allow operation of all 6 pumps[10], OR
- A study of the PS (including performance testing) must demonstrate adequate suction pressures to avoid cavitation, OR
- The system must be programmed such that the potable supplement facility at Cordillera Tank is automatically activated (essentially serving as the 6th pump)

Because the third alternative would provide capacity that is only marginally sufficient, it is not recommended.

10 The Preliminary Design Report for the Eastern Recycled Water Pump Expansion Project (LVMWD Report 2357.00, March 2006, Boyle Engineering) indicated a net positive suction head (NPSH) of 38 feet when total pump station flow is 4800 gpm and the water elevation in the reservoir is 760 feet. Higher flows would result in lower NPSH, which could cause damage to pumps, unless larger or parallel pipes are installed on the suction side of the pump station. At a minimum, a parallel pipeline from the check valve to the pump station should be assumed.

6.5 Conclusions from Hydraulic Analysis

From the foregoing analyses, the following conclusions can be drawn:

- With the exception of Pierce College, the existing system is capable of serving the proposed expansions and demands from infill development, with only modest upgrades
    - An upgrade to the Morrison Pump Station air-gap facility is recommended prior to extensions to Decker Canyon or Conejo Creek Park. The proposed upgrade would boost PS capacity from 1300 gpm to 2000 gpm.
    - Additional parallel pipelines are needed in Park Granada, if an extension to Woodland Hills GC is constructed
- To serve Pierce College, much of the Eastern RW system would be required, including:
    - New parallel pipelines from RWPS east to the eastern end of the system
    - Suction pipeline upgrades for the RWPS
    - A larger diameter main extension to Woodland Hills GC
- Some amount of pressure degradation may be noticed by some customers. Strategies to overcome any problems include:
    - Rescheduling irrigation timers
    - Modifications to customer irrigation systems (the addition of pumps or reconfiguration of irrigation systems)
    - Use of on-site storage

Section 7 – Potential Capital Improvements

Budget-level opinions of cost are found in Appendix C for the main extensions and other potential projects discussed in the preceding sections. Due to the high cost of serving small, remote customers, not every conceivable project is listed, and many of those shown will be difficult to justify unless the other funding sources are secured.

These projects involve extensions and upgrades to the system for the primary purpose of serving RW to existing potable water customers, both inside and outside the JPA service areas. In addition to these customer conversions, “organic” growth in demand is expected as vacant parcels continue to be developed, primarily in the Las Virgenes system. This organic growth is expected to be relatively minor, since no new parks, golf courses, or schools are planned.

Table 7-1 provides a summary of the analysis that is presented in this report. The estimated demands come from various sources, as described in Section 5. The costs are based on budgetary estimates, applying unit costs derived from a variety of projects. Allowances for engineering are included, but not project administration. The allowances for engineering vary from 20 to 25 percent, depending on the size and complexity of the project.

The column on the far right of Table 7-1 shows the estimated capital cost per acre-ft of additional water that would be delivered annually as a result of the potential improvement. This parameter provides general guidance regarding the affordability of a project. Currently, projects that cost less than $8,000 per AFY are considered economically viable, and those costing more than $50,000 per AFY are unattractive.[11] [For reader convenience, those projects with a cost per AFY of less than $20,000 have been highlighted in red.]

The economic feasibility of many recycled water projects is expected to increase, as the cost of imported water increases, and due to the need to conserve potable water for SBX7-7 compliance. Recycled water projects may also be attractive as a way of avoiding expenditures where deficiencies exist in the potable water system. For example, construction of the Decker Canyon project, although not particularly attractive economically, could delay or eliminate the need to construct similar improvements to the potable system in the southwest portion of the Las Virgenes service area. If grants or other sources of funding are available, projects can also become economically feasible.

Table 7-1 presents the projects in the order that they are discussed, and not based on priority. The discussion follows the same order as the Figures which have been presented earlier. The table also shows the retail utility that currently serves the customers who would be converted from potable water use to recycled water.

[11] The $8,000 figure is derived from the benchmark cited in the 2007 Master Plan, with adjustment for general inflation. However, because the cost of water imported by MWDSC has been increasing more rapidly than general inflation, a higher benchmark is warranted. A preliminary analysis using currently Tier 2 MWDSC rates results in a benchmark figure of about $20,000.

Table 7-1. Summary of Potential RW Projects

System Extension Projects	Retail Utility	Estimated Cost	Acre feet per Year (AFY)	$/AFY
T.O. Boulevard Extension	CalWater	$ 5,140,000	251	$ 20,500
T.O. Blvd Extension - Shorter Version	CalWater	$ 3,810,000	215	$ 17,700
Westlake Hills Elementary	CalWater	$ 125,000	15	$ 8,300
Triunfo Community Park	CalWater	$ 611,000	60	$ 10,200
Evenstar Park	CalWater	$ 364,000	42	$ 8,700
Southshore Hills Park	CalWater	$ 790,000	14	$ 56,400
No. Ranch Playfield / Lindero greenbelts	CalWater	$ 844,000	58	$ 14,600
North Ranch Park	CalWater	$ 31,000	30	$ 1,000
Capris Tract w/o Lindero Cyn greenbelt	TSD	$ 431,000	30	$ 14,400
Capris Tract w/Lindero Cyn. greenbelt	TSD / CalWater	$ 864,000	55	$ 15,700
Montenegro Community Ctr Extension	TSD	$ 219,000	4	$ 54,800
Hillcrest Tract / Oak Park North	TSD	$ 300,000	21	$ 14,300
Conejo Creek Parks Extension[12]	Thousand Oaks	$ 5,500,000	206	$ 26,900
Sherwood Executive GC	Thousand Oaks	$ 4,000,000	23	$ 170,000
Decker Canyon Project	LVMWD	$ 12,130,000	229	$ 53,000
Alternative Decker Canyon Project	LVMWD	$ 18,280,000	459	$ 39,800
Hidden Hills Extension	LVMWD	$ 3,700,000	50	$ 74,000
Woodland Hills GC Extension	LADWP	$ 9,790,000	324	$ 30,200
Pierce College Extension	LADWP	$ 20,900,000	666	$ 31,400
Other Projects				
Morrison Pump Station Upgrades		$ 345,000	N/A	N/A
Reservoir No. 2 Improvements		$ 1,100,000	N/A	N/A
Agoura Road Pipeline		$ 1,100,000	N/A	N/A
Seasonal Storage Reservoir		$ 68,000,000	1500	$ 45,300

Red = project cost < $20,000 per AFY

A description of the potential RW main extensions is found in Section 5.4.2, along with figures depicting the pipeline routes. The cost estimates found in Appendix C provide further details regarding the pipelines, their sizes and approximate lengths. The pipeline sizes are those used for the modeling.

The JPA is currently investigating the extension to Woodland Hills GC, with LADWP paying for much of the cost. The potential for a future extension to Pierce College needs to be considered in planning for the Woodland Hills extension. Should the system ever be extended to Pierce College, a larger pipeline to Woodland Hills would be needed.

In addition to the potential main extensions, the following other potential projects need to be considered:

[12] Includes $500,000 for Savoy Potable Supplement Pump Station.

- **Completion of the 8-inch pipeline in Agoura Road**, west of Liberty Canyon. This main will improve system operations, as well as serve development along Agoura Road. Portions of this main should be completed as development occurs along Agoura Road, and as other opportunities arise.

- **Improvements to Reservoir No. 2**, including a shade-ball "cover" and synthetic membrane liner. These improvements are needed for conformance with NPDES permit provisions, but will also improve water quality experienced by customers. This project should be completed as soon as possible to avoid the assessment of penalties related to NPDES discharges.

- **Upgrade to the air-gap facility at Morrison PS**. This facility is important for improving supply and pumping capacity, and is recommended for expansions to Malibu Golf Course and Conejo Creek Park.

- **Construction of a seasonal storage reservoir**. The attractiveness of this project is dependent upon the cost of imported water, the cost for disposing of excess recycled water, and the availability of outside funding sources.

Section 8 – References

Section 8: References

1. "Recycled Water Master Plan Update, 2007", LVMWD Report No. 2389.1, Boyle Engineering Corporation, October 2007.
2. "Recycled Water Master Plan for Las Virgenes Municipal Water District – Triunfo Sanitation District Joint Venture", LVMWD Report No. 2096.00, by Boyle Engineering Corporation, April 1999.
3. "Master Plan for Potable and Reclaimed Water Systems, Phase 1, Demand Projections" LVMWD Report # 1671, by Boyle Engineering Corporation, March 1989.
4. "Master Plan for Calabasas Reclaimed Water System," LVMWD Report #1684, by Boyle Engineering Corporation, March 1989.
5. "Master Plan for Potable and Reclaimed Water Phase IIIB, Western Reclaimed Water System and Seasonal Storage Peaking Alternatives," LVMWD Report #1714, by Boyle Engineering Corporation, February 1990.
6. "Woodland Hills Country Club Reycled Water Service Study," LVMWD Report No. 2467, AECOM Technical Services, Inc., January 2011.
7. "Feasibility Study for Expansion of the Joint Venture's Reclaimed Water System to a Portion of the City of Thousand Oaks," for Triunfo Sanitation District, by Boyle Engineering Corporation, September 1995.
8. "City of Los Angeles, Recycled Water Master Planning," report for the Los Angeles Department of Water and Power by RMC and CDM Smith, October 2012.
9. "Westlake Wells Alternative Use Analysis" LVMWD Report #2070, by Boyle Engineering Corporation, June 1997.
10. "Las Virgenes Municipal Administrative Code," Titles 3, 4, & 5.
11. "Preliminary Water Design Report for Tentative Tract No. 52419 Triangle Ranch" LVMWD Report #2257.00, by Boyle Engineering Corporation, March 2004.
12. "Preliminary Water System Design Report for Malibu Institute Development", LVMWD Report No. 2506.00, AECOM Technical Services, Inc., February 2012.
13. "Preliminary Design Report, Eastern Recycled Water Pump Station Expansion", LVMWD Report No. 2357.00, Boyle Engineering Corporation, March 2006.
14. "Preliminary Design Memorandum Western Recycled Water System Morrison Potable Supplement" LVMWD Report #2151.00, by Boyle Engineering Corporation, March 2001.
15. "Malibu Golf Course Recycled Water Service Study" LVMWD Report #2163.00, by Boyle Engineering Corporation, September 2001.
16. "Tapia Effluent Alternatives Study" LVMWD Report #2321.03, by Kennedy/Jenks Consultants, December 2005.
17. "Potable Water and Sewer Capacity Fee Report" LVMWD Report #2254.00, by C. Eugene Talmadge and Mike Brown, September 2003.
18. "Technical Memorandum No. 1, Tapia Water Reclamation Facility Master Plan," January 14, 2002, by Montgomery Watson Harza.

Appendices

A. Demand Calculations

B. Model Validation Graphs

C. Opinions of Cost

D. Peak Estimating Flow Guide

E. Hydraulic profile schematic of RW system

Appendix A – Demand Calculations

	Customers	Location	Demands (AF/Yr)	Demand (gpm)	Max Month (gpm)	Peak Hour (gpm)
Future LVMWD RW						
1	Existing LVMWD RW Customers	Within LV District (LA County)	Current	2891.3	5435.55	
2	In-fill LVWMD Development		+20%	578.3	1087.11	
	Total Future LVMWD RW					
Future Oak Park/North Ranch System						
1	Triunfo (Oak Park Water System)	Within Oak Park Community (Ventura Co)	Existing	394.9	675.23	
2	Cal Water (North Ranch area of T.O.)	Within City of Thous. Oaks (Ventura Co.)	Existing	-	568.30	
	Total Oak Park / North Ranch					
Future Lake Sherwood System						
1	Lake Sherwood Golf Course	Meter at GC Tank	Existing	193.7	331.14	
2	Pixton Meters	Potrero Road at Pixton	Existing	33.2	56.72	
3	Other Lake Sherwood	Potrero Road at Lake Sherwood Dr	Existing	45.3	77.51	
	Total Lake Sherwood System					
Thousand Oaks Boulevard Extension						
1	Hidden Canyon HOA	Via Colinas and Thousand Oaks Blvd.	4.6	2.9	5.42	16.25
2	Public Works Lands Maintenance	Thousand Oaks Blve & Via Colinas	0.9	0.6	1.06	3.18
3	NR Corp CTR-Owners	4590 Thousand Oaks	12.2	7.6	14.37	43.11
4	NR Corp CTR-Owners	4580 Thousand Oaks	11	6.8	12.96	38.87
5	NR Corp CTR-Owners	4640 Thousand Oaks	15.6	9.7	18.37	55.12
6	Wellpoint Health NE	1 Wellpoint Way	4.1	2.5	4.83	14.49
7	Wellpoint Health NE	1 Wellpoint Way	1	0.6	1.18	3.53
8	Baxter	Via Merida	40.7	25.2	47.94	143.81
9	Baxter	112 Lakeview Canyon	1.2	0.7	1.41	4.24
10	Los Robles Hospital	150 Via Merida	5.4	3.3	6.36	19.08
11	Los Robles Hospital	150 Via Merida	0.7	0.4	0.82	2.47
12	Baxter	1 GTE Place	11.8	7.3	13.90	41.70
13	Baxter	1 GTE Place	41	25.4	48.29	144.87
14	Baxter	1 GTE Place	29.8	18.5	35.10	105.30
15	WLK#23 Main. District (WLK HS)	Westlake HS	2.9	1.8	3.42	10.25
16	WLK#23 Main. District (WLK HS)	Westlake HS	3.6	2.2	4.24	12.72
17	WLK#23 Main. District (WLK HS)	Westlake HS	1.7	1.1	2.00	6.01
18	WLK#23 Main. District (WLK HS)	Westlake HS	6.7	4.2	7.89	23.67
19	WLK#23 Main. District (WLK HS)	Westlake HS	5.2	3.2	6.12	18.37

	Customers	Location	Demands (AF/Yr)	Demand (gpm)	Max Month (gpm)	Peak Hour (gpm)
20	Baxter	1 GTE Place	15	9.3	17.67	53.00
21	Promenade Off Park	4195 Thousand Oaks	4.1	2.5	4.83	14.49
22	Public Works Land Maintenance	Thousand Oaks, 565 ft west of Lakeview	1.4	0.9	1.65	4.95
23	Promenade Off Park	4165 Thousand Oaks	3.9	2.4	4.59	13.78
24	K2M2, LC	4035 Thousand Oaks	0.7	0.4	0.82	2.47
25	North Ranch Atrium	4035 Thousand Oaks	0.5	0.3	0.59	1.77
26	Conejo Parks and Rec.	Russell Park	17.2	10.7	20.26	60.78
27	CV Unified School District	Westlake Elem	8.5	5.3	10.01	30.04
	Total Thousand Oaks Blvd Extension		251.40	155.85	296.11	888.33
Oak Park HOA Conversions						
1	Hillcrest Tract 4354	21.06	1.34	0.8	1.39	4.17
2	Hillcrest Tract 4353		6.55	4.1	6.78	20.34
3	Capris Tract		35.31	21.9	36.53	109.60
4	Montenagro Tract		9.13	5.7	9.45	28.35
5	Oak Park Apts North		13.17	8.2	13.63	40.88
6	Eagle View Park		4.41	2.7	4.56	13.68
7	Morrison Tract		28.93	17.9	29.93	89.80
8	North Ranch Playfield		28.35	17.6	33.39	100.18
9	North Ranch Neighborhood Park		30.1	18.7	35.45	106.36
10	Landscaping along Lindero Canyon Road		50.05	31.0	58.95	176.85
	Total Oak Park HOA Conversions		207.34	128.54	230.07	690.21
Conejo Creek Park Extension						
1	Lang Ranch Community Park		28	17.4	32.98	98.94
2	Boys and Girls Club		24	14.8	28.14	84.43
3	Old Meadows Park		8	4.8	9.15	27.46
4	Conejo Creek Park North and South		134	82.9	157.56	472.68
5	Oak Brook Neighborhood Park		16	9.9	18.85	56.54
6	Miscellaneous HOA Conversions		25	15.5	29.45	88.34
	Total Conejo Creek Park Extension		234.44	145.33	276.13	828.38
Decker Canyon Extension						
1	Malibu Golf Club	Proposed Decker Cyn Tank	193	119.6	227.32	681.97
2	Sycamore Canyon Estates	Proposed Decker Cyn PS	24	14.9	28.27	84.80
3	Other Ranchettes	Proposed Decker Cyn Tank	12	7.4	14.13	42.40

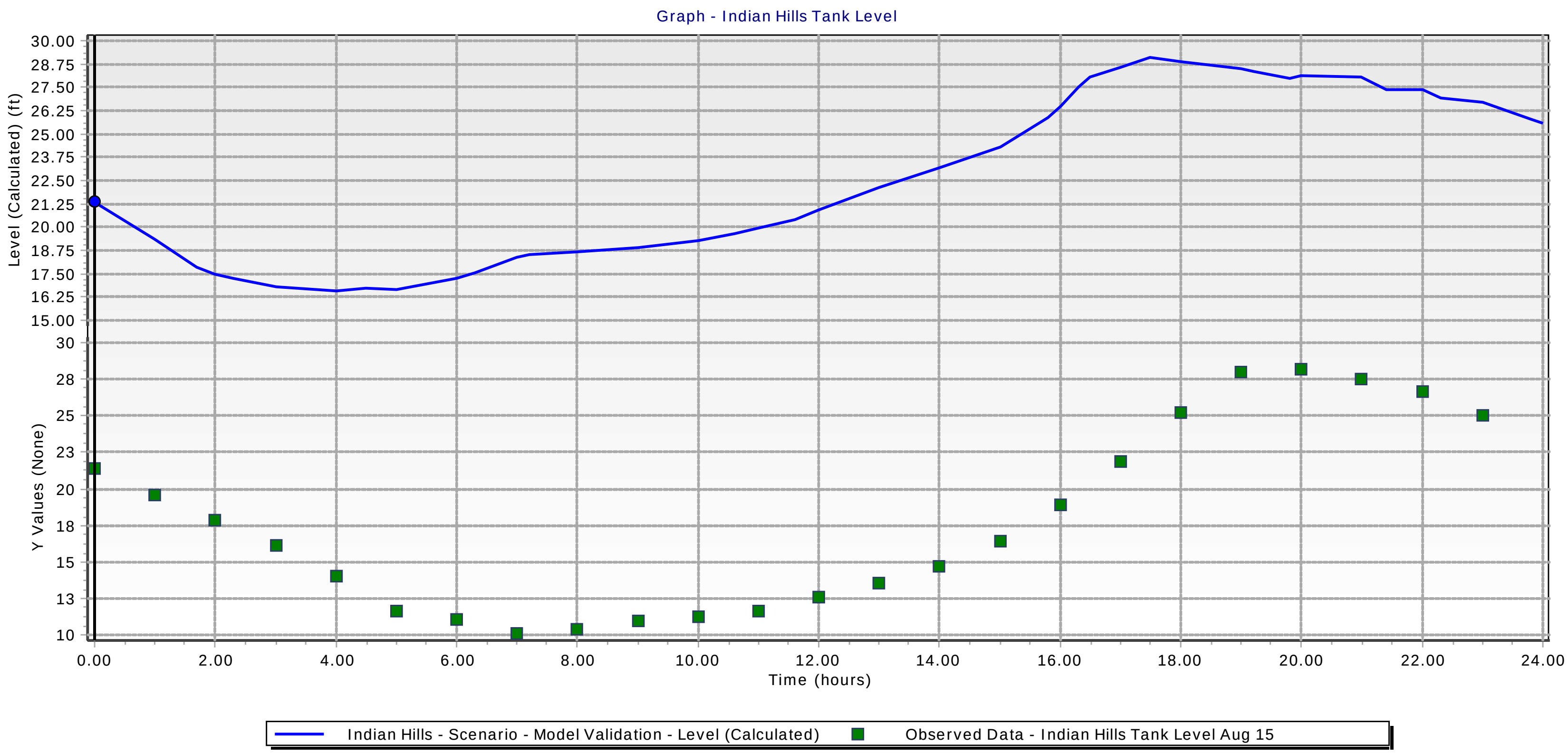
Customers	Location	Demands (AF/Yr)	Demand (gpm)	Max Month (gpm)	Peak Hour (gpm)
Total Decker Canyon Extension		229.00	141.96	269.73	809.18
Decker Canyon Extension - Alternative					
1 Malibu Golf Club	Proposed Decker Cyn Tank	193	119.6	227.32	681.97
2 Triangle Ranch Development		216	133.9	254.41	763.24
3 Medea Valley Ranchettes/Estates		50	31.0	58.89	176.68
Total Alternative Decker Canyon Extension		459.00	284.54	540.63	1,621.89
Hidden Hills Extension					
1 Front Yard Single Family Irrigation	Properties along pipeline route	44	27.5	52.17	156.52
2 Round Meadows School	5151 Round Meadow Road	6	3.4	6.52	19.56
Total Hidden Hills Extension		49.83	30.89	58.69	176.08
Woodland Hills GC Extension					
1 Woodland Hills GC		230	142.6	270.90	812.71
2 Louisville HS	22300 Mulholland	25	15.5	29.45	88.34
3 Serrania Park		30	18.6	35.34	106.01
4 Alice Stelle Middle School/Freedom Park		20	12.4	23.56	70.67
5 Church	Mulholland Drive and Deseret	6	3.7	7.07	21.20
6 Motion Picture Hospital	Between El Canon & Mulholland	5	3.1	5.89	17.67
7 Pacific Lodge Boys Home		1	0.6	1.18	3.53
8 Serrania Avenue Elementary School		2	1.3	2.54	7.63
9 Medians along Mulholland Drive		5	3.1	5.89	17.67
Total Woodland Hills GC Extension		324.16	200.95	381.81	1,145.43
Pierce College Extension					
1 Pierce College		190	117.8	223.79	671.37
2 Litton Industries, Inc.		75	46.5	88.34	265.01
3 Pratt & Whitney Rocketdyne		41	25.4	48.29	144.87
4 Kaiser Permanente (Woodland Hills)		35	21.7	41.22	123.67
5 Warner Ranch Park		34	21.1	40.05	120.14
6 The Village at Westfield		34	21.1	40.05	120.14
7 Blue Cross of California		19	11.8	22.38	67.14
8 Warner Woodlands Townhomes		19	11.8	22.38	67.14
9 Douglas Emmett Realty Fund		19	11.8	22.38	67.14
10 Warner Village III Condominiums		18	11.2	21.20	63.60
11 LACMTA		15	9.3	17.67	53.00
12 Health Net of California		10	6.2	11.78	35.34

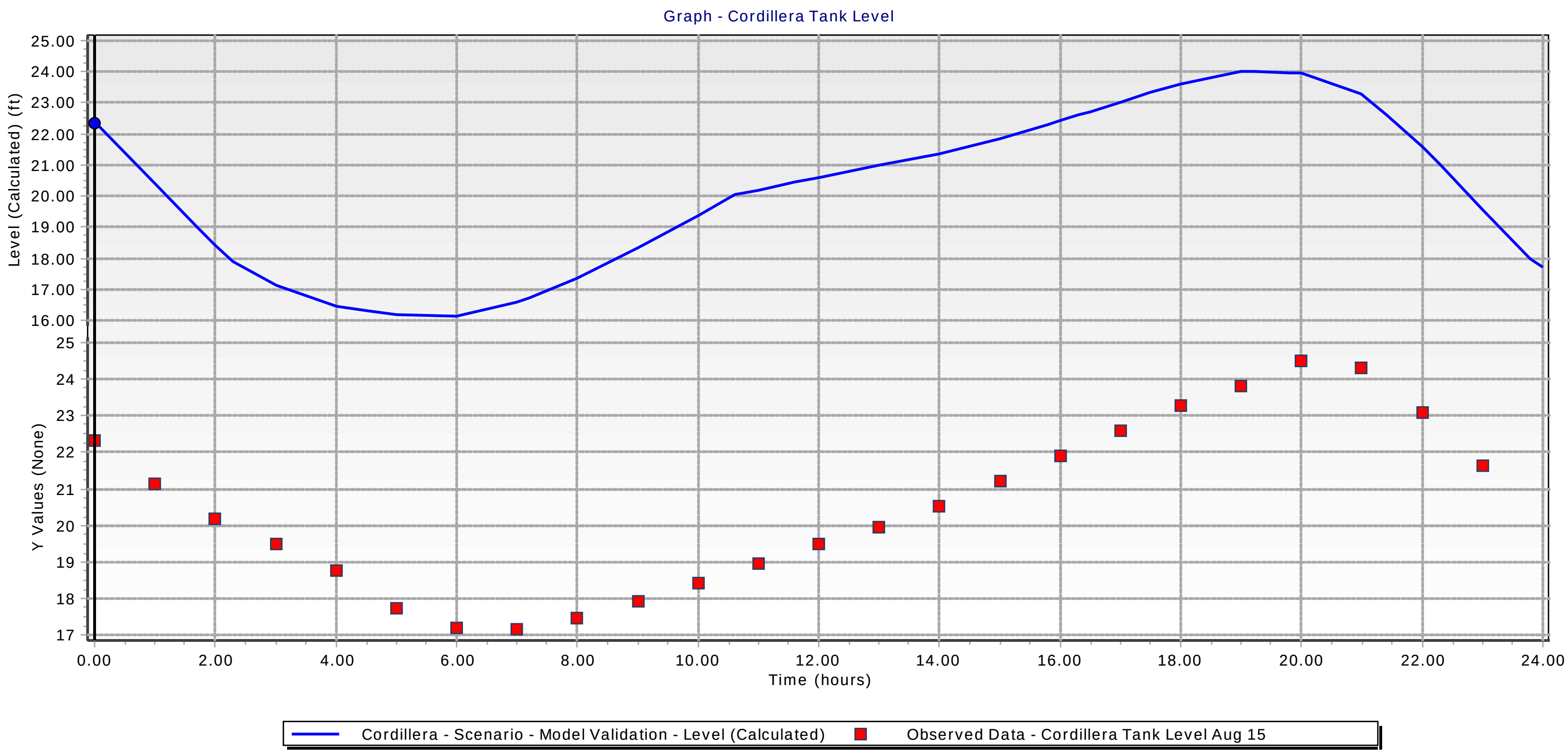
Customers	Location	Demands (AF/Yr)	Demand (gpm)	Max Month (gpm)	Peak Hour (gpm)
13 Hines Warner Center		10	6.2	11.78	35.34
14 LA Fitness International, LLC		10	6.2	11.78	35.34
15 Americana Independence LTD		9	5.6	10.60	31.80
16 Chan Soo Kim DBA Santa Fe		9	5.6	10.60	31.80
17 Douglas Emmett Realty		9	5.6	10.60	31.80
18 Warner Center Marriot		8	5.0	9.42	28.27
19 Steve Needleman DBA Kids from the Valley III		8	5.0	9.42	28.27
20 Carr NP Properties LLC		8	5.0	9.42	28.27
21 Hilton Woodland Hills		8	5.0	9.42	28.27
22 IGE Inc		7	4.3	8.24	24.73
23 21st Century Insurance Company		7	4.3	8.24	24.73
24 Zenith INS CO ATTN: Facilities		7	4.3	8.24	24.73
25 Americana Warner Center Apts		7	4.3	8.24	24.73
26 Warner Center		7	4.3	8.24	24.73
27 Paul B Morgen		6	3.7	7.07	21.20
28 REPFUND Arbors Apartments		6	3.7	7.07	21.20
29 WEN-ER Farms LLC		6	3.7	7.07	21.20
30 Waterford Warner Center LLC		5	3.1	5.89	17.67
31 Douglas Emmett Realty Fund		5	3.1	5.89	17.67
32 Equity Residential Properties		5	3.1	5.89	17.67
33 Warner Gateway PRTNR		5	3.1	5.89	17.67
34 Union Towers Management		5	3.1	5.89	17.67
Total Pierce College Extension		666.00	412.87	784.44	2,353.33

Lake Sherwood Pipeline Future Customers

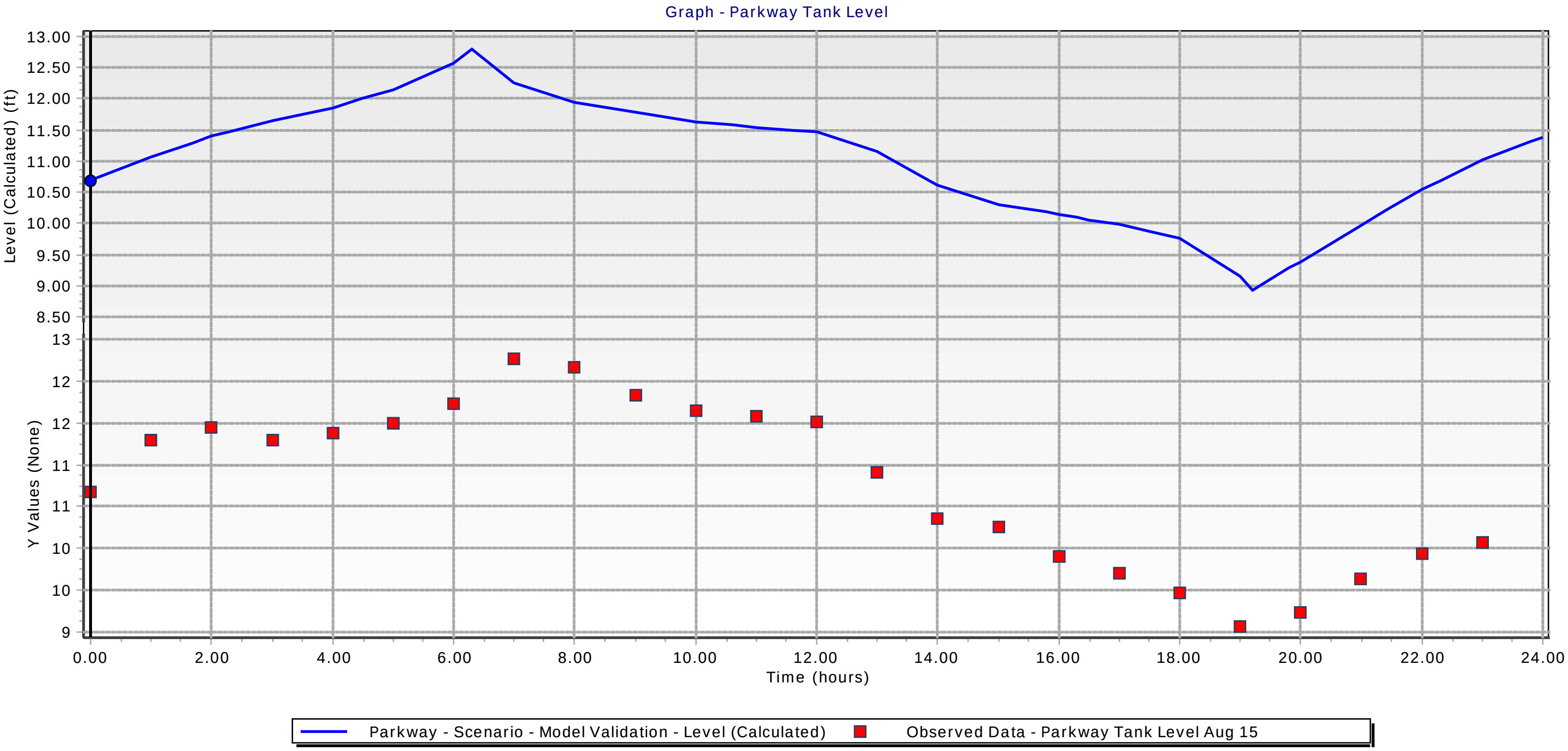
1 Westlake Elementary School		14.85	9.2	17.49	52.47
2 Triunfo Community Park		59.5	36.9	70.08	210.25
3 Evenstar Park		41.615	25.8	49.02	147.05
4 Southshore Hills Park		14	8.7	16.49	49.47
Total Lake Sherwood Pipeline Future Customers		129.97	80.57	153.08	459.24

Appendix B – Model Validation Graphs

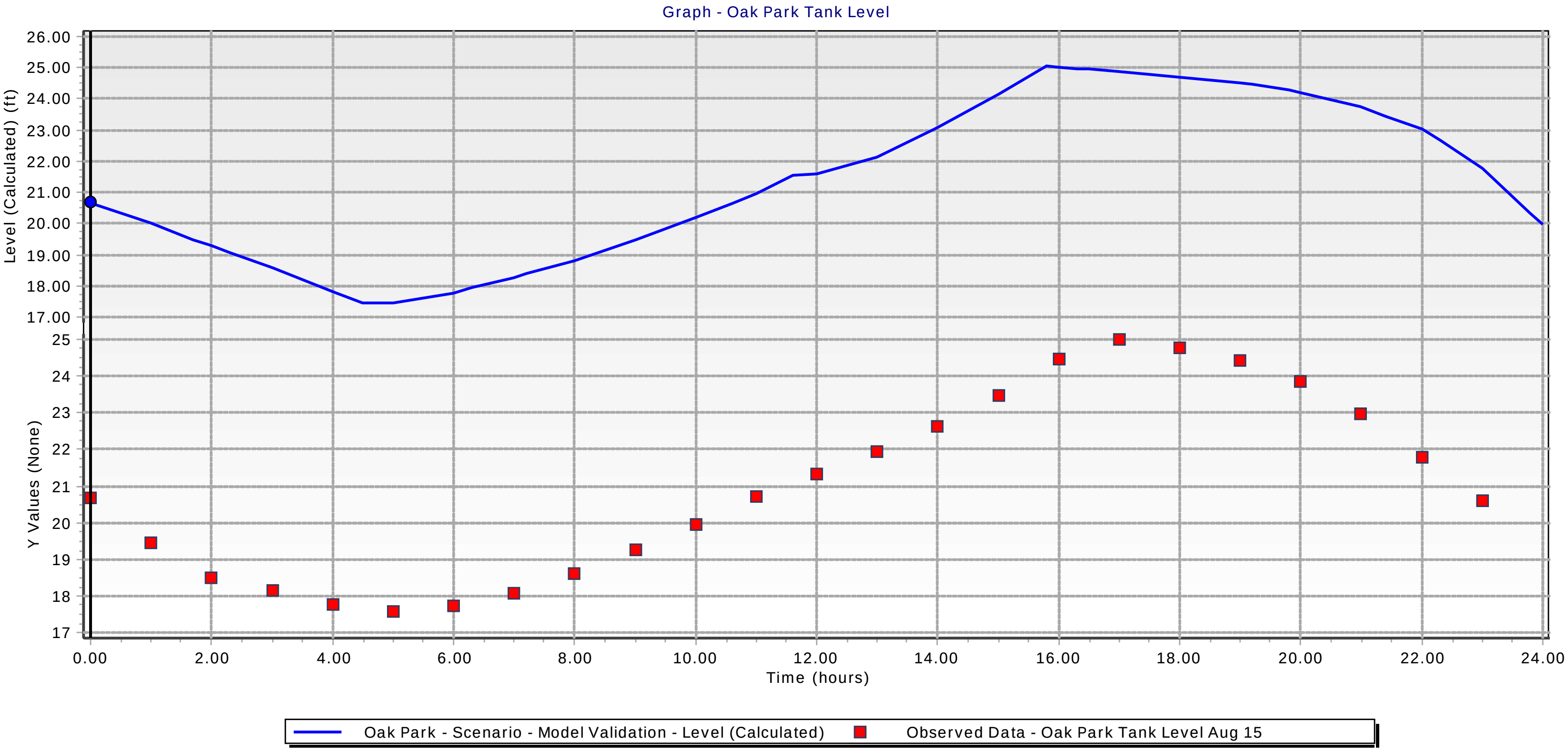

Graph - Indian Hills Tank Level
Level (Calculated) (ft)
30.00
28.75
27.50
26.25
25.00
23.75
22.50
21.25
20.00
18.75
17.50
16.25
15.00
Y Values (None)
30
28
25
23
20
18
15
13
10
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
Indian Hills - Scenario - Model Validation - Level (Calculated)
Observed Data - Indian Hills Tank Level Aug 15



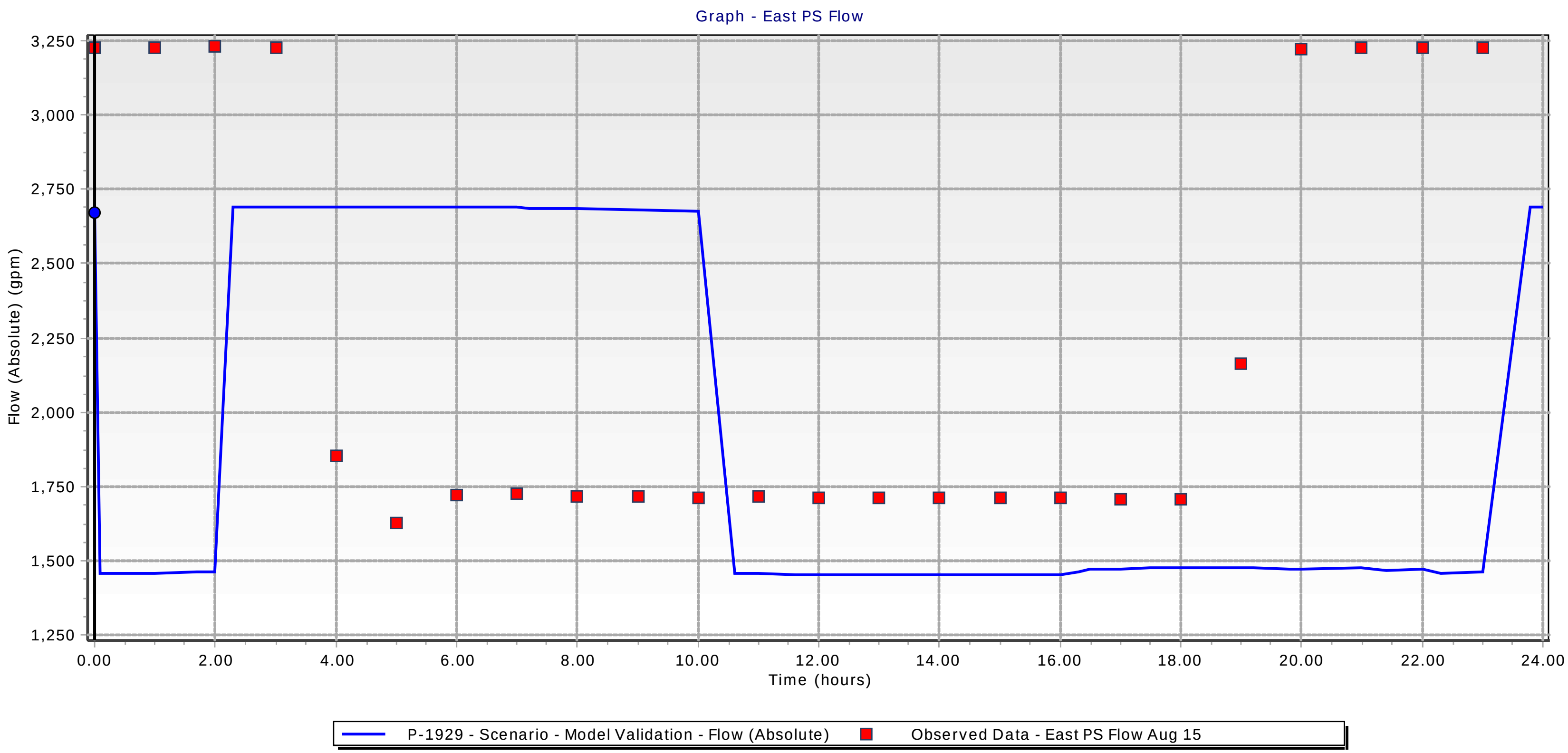
Graph - Cordillera Tank Level
Level (Calculated) (ft)
25.00
24.00
23.00
22.00
21.00
20.00
19.00
18.00
17.00
16.00
Y Values (None)
25
24
23
22
21
20
19
18
17
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
Cordillera - Scenario - Model Validation - Level (Calculated)
Observed Data - Cordillera Tank Level Aug 15

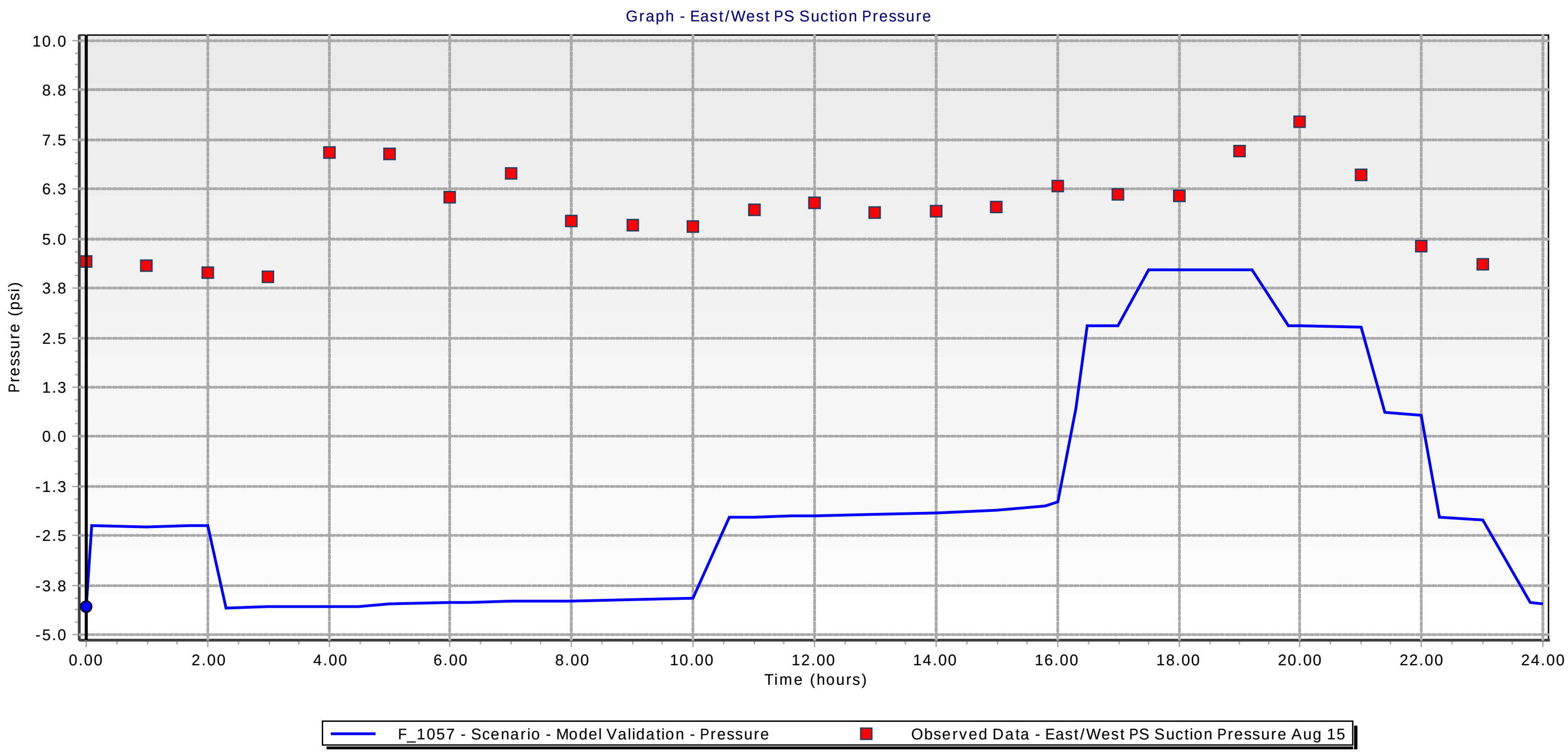


Graph - Parkway Tank Level
Level (Calculated) (ft)
13.00
12.50
12.00
11.50
11.00
10.50
10.00
9.50
9.00
8.50
Y Values (None)
13
12
12
11
11
10
10
9
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
Parkway - Scenario - Model Validation - Level (Calculated)
Observed Data - Parkway Tank Level Aug 15



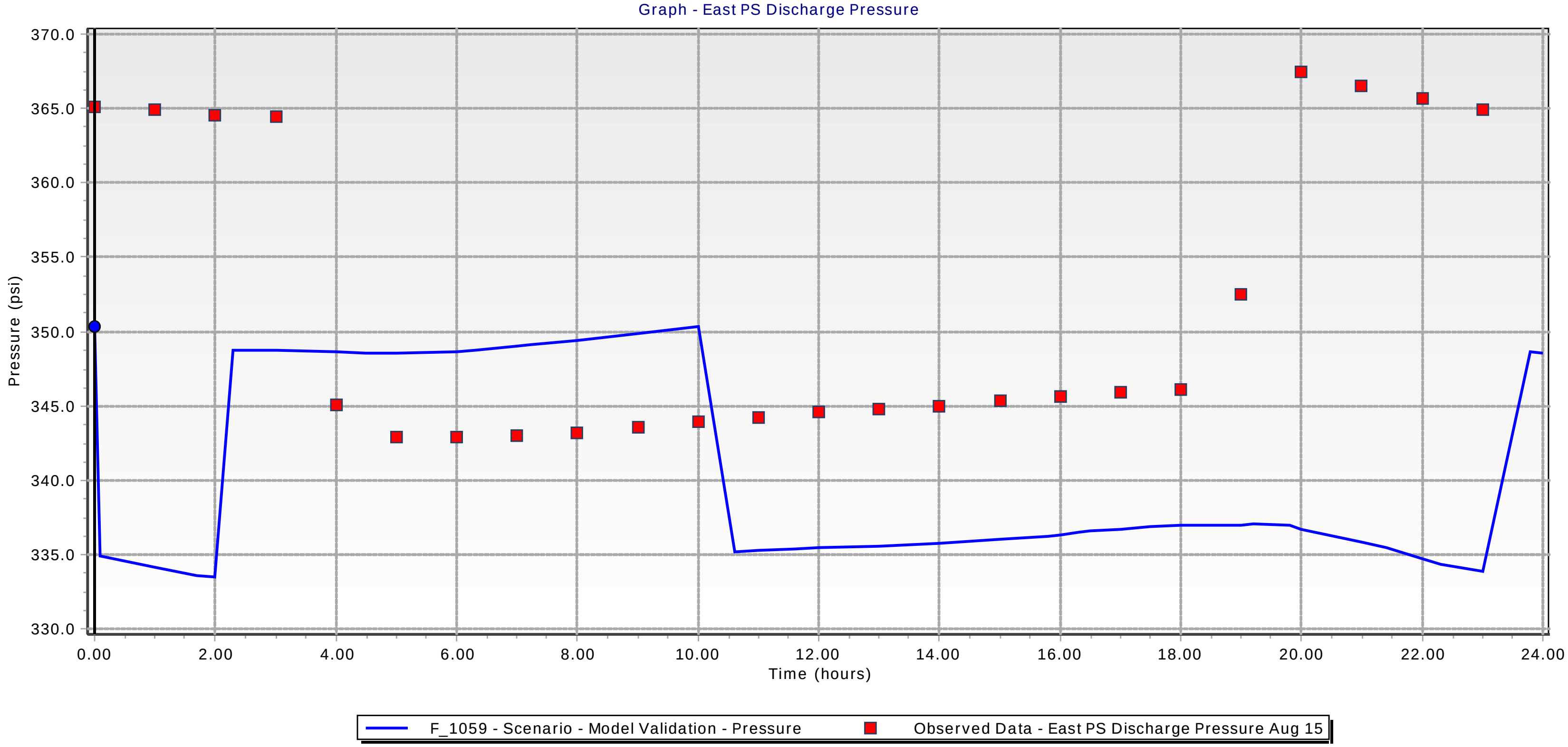
Graph - Oak Park Tank Level
26.00
25.00
24.00
23.00
22.00
21.00
20.00
19.00
18.00
17.00
Level (Calculated) (ft)
25
24
23
22
21
20
19
18
17
Y Values (None)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
Oak Park - Scenario - Model Validation - Level (Calculated)
Observed Data - Oak Park Tank Level Aug 15

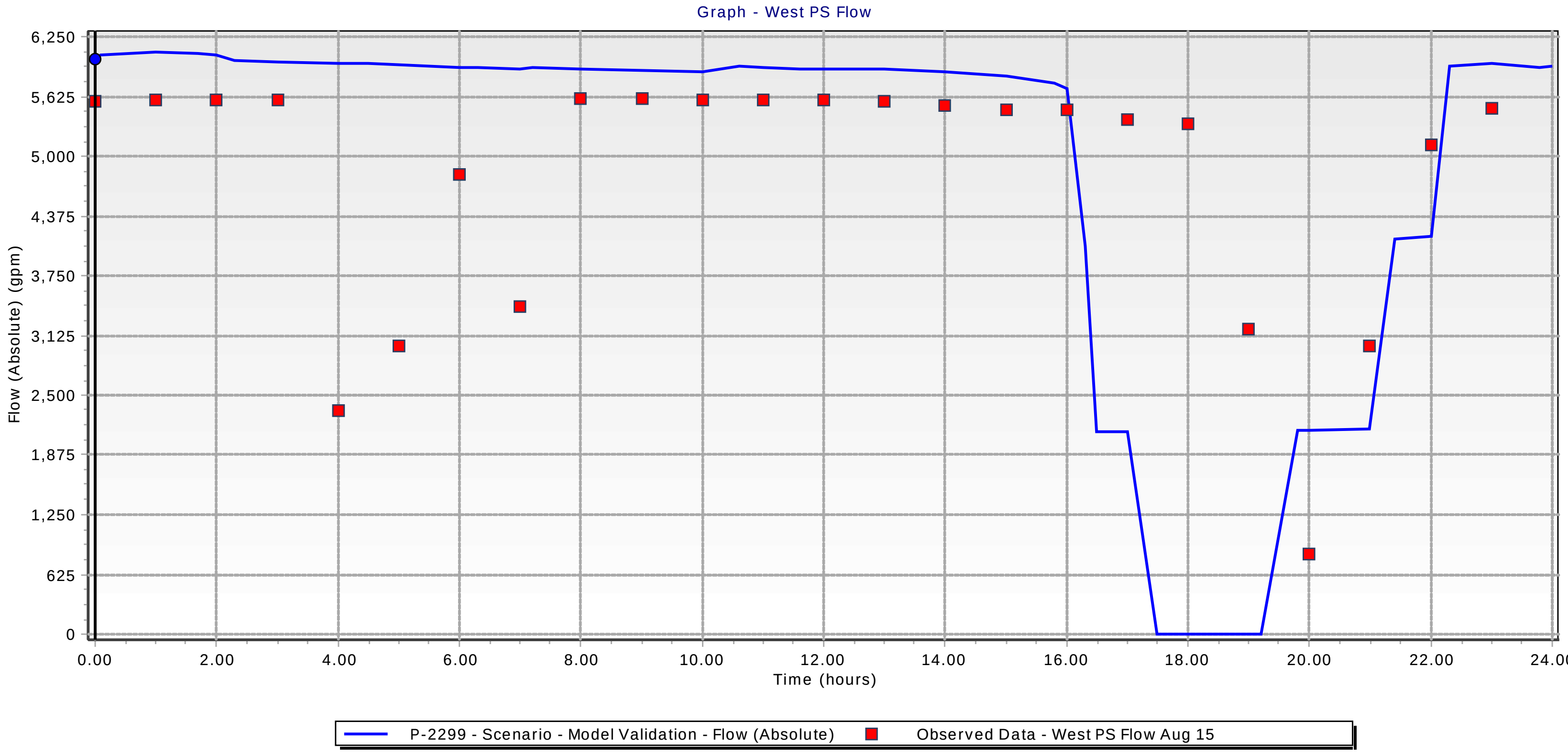

Graph - East PS Flow
3,250
3,000
2,750
2,500
2,250
2,000
1,750
1,500
1,250
Flow (Absolute) (gpm)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
P-1929 - Scenario - Model Validation - Flow (Absolute)
Observed Data - East PS Flow Aug 15



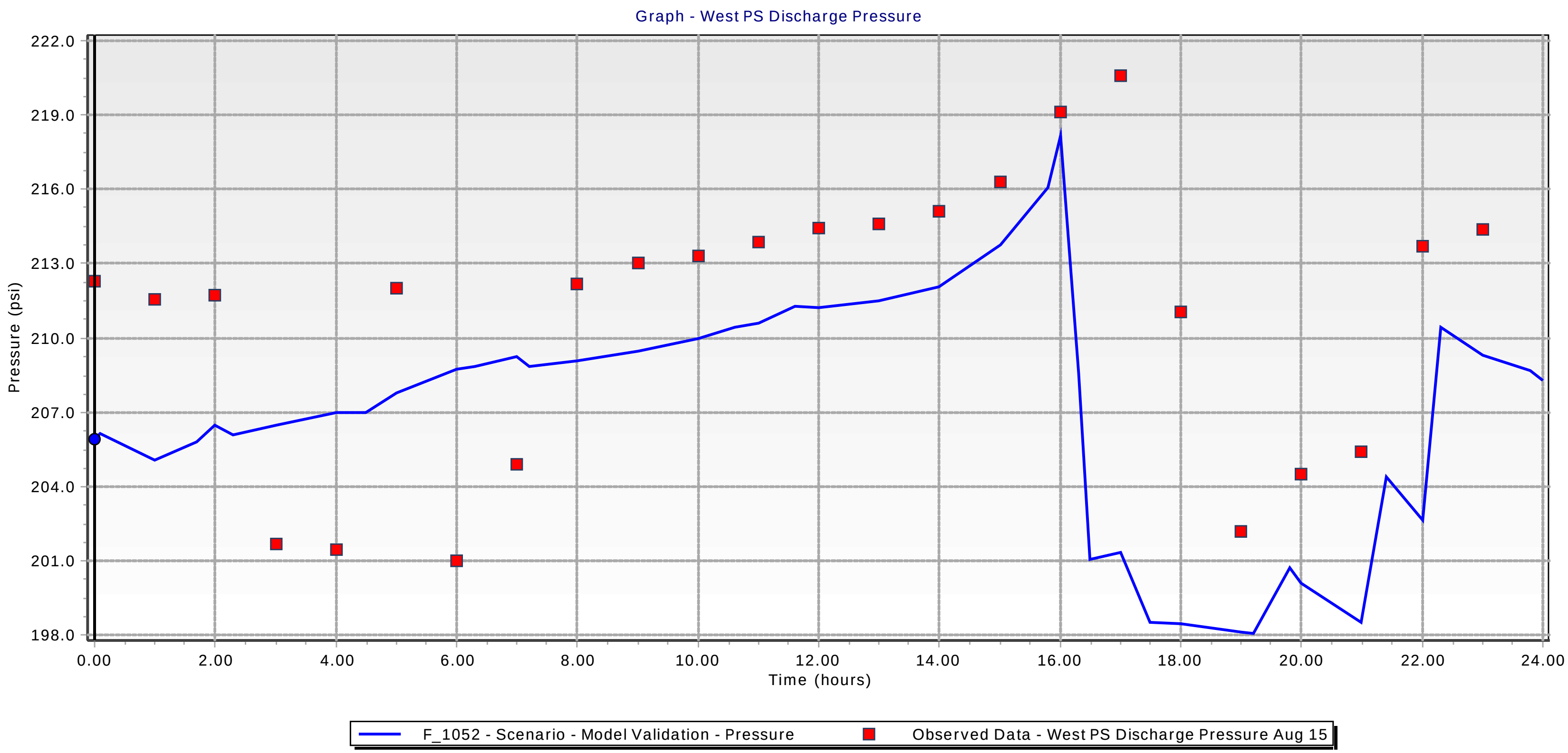
Graph - East/West PS Suction Pressure
Pressure (psi)
10.0
8.8
7.5
6.3
5.0
3.8
2.5
1.3
0.0
-1.3
-2.5
-3.8
-5.0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
F_1057 - Scenario - Model Validation - Pressure
Observed Data - East/West PS Suction Pressure Aug 15

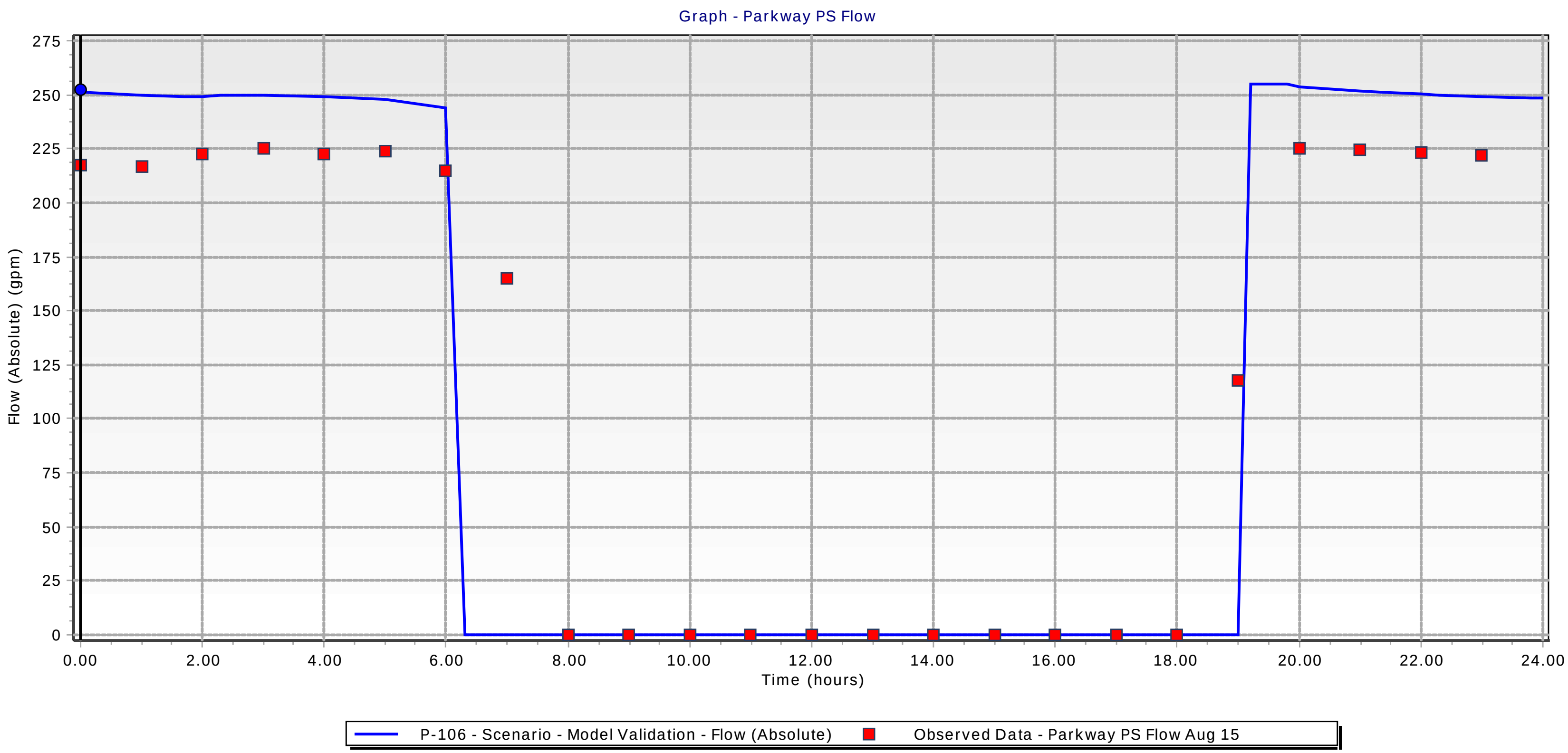
Graph - East PS Discharge Pressure





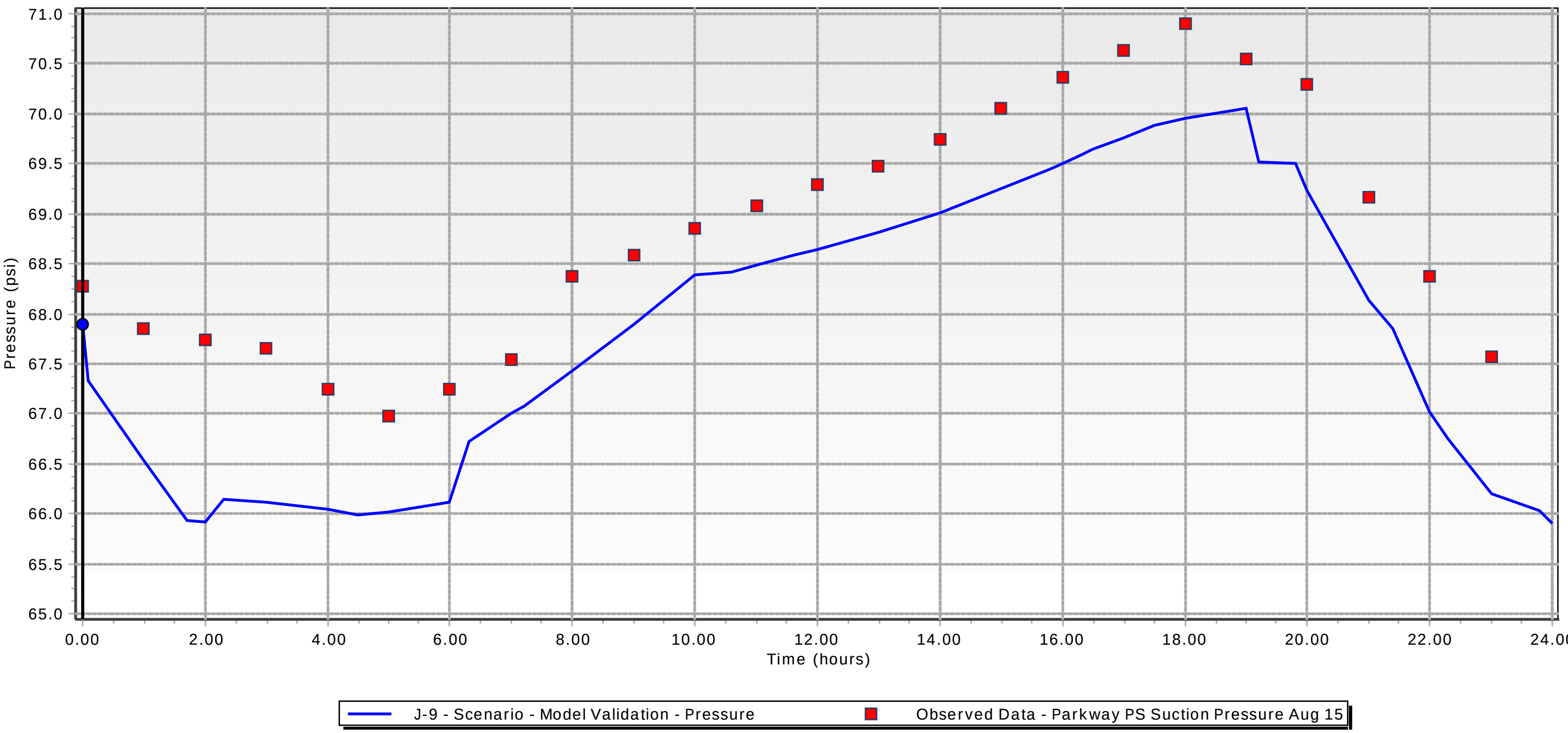
Graph - West PS Flow
6,250
5,625
5,000
4,375
3,750
3,125
2,500
1,875
1,250
625
0
Flow (Absolute) (gpm)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
P-2299 - Scenario - Model Validation - Flow (Absolute)
Observed Data - West PS Flow Aug 15

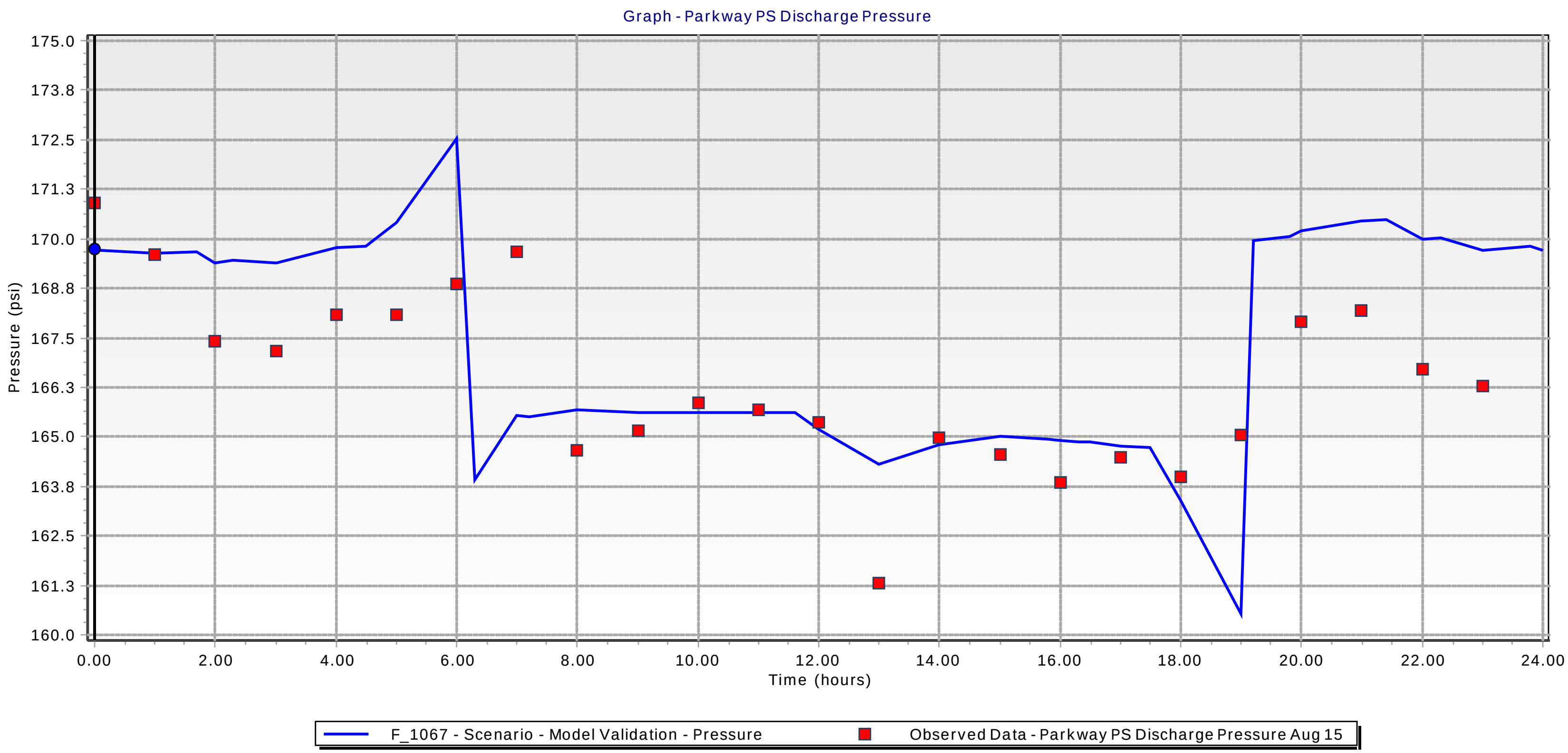

Graph - West PS Discharge Pressure
222.0
219.0
216.0
213.0
210.0
207.0
204.0
201.0
198.0
Pressure (psi)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
F_1052 - Scenario - Model Validation - Pressure
Observed Data - West PS Discharge Pressure Aug 15



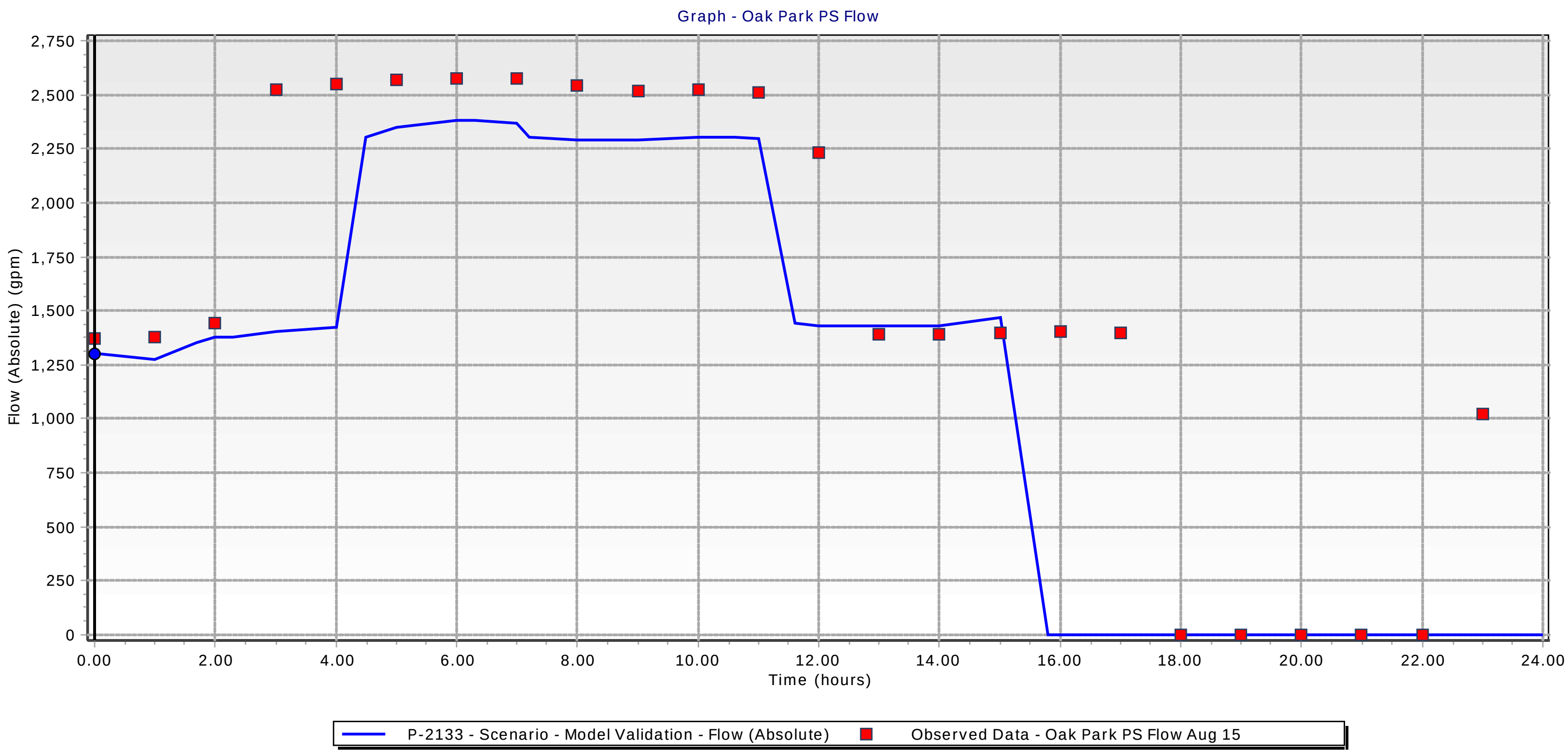
Graph - Parkway PS Flow
Flow (Absolute) (gpm)
275
250
225
200
175
150
125
100
75
50
25
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
P-106 - Scenario - Model Validation - Flow (Absolute)
Observed Data - Parkway PS Flow Aug 15

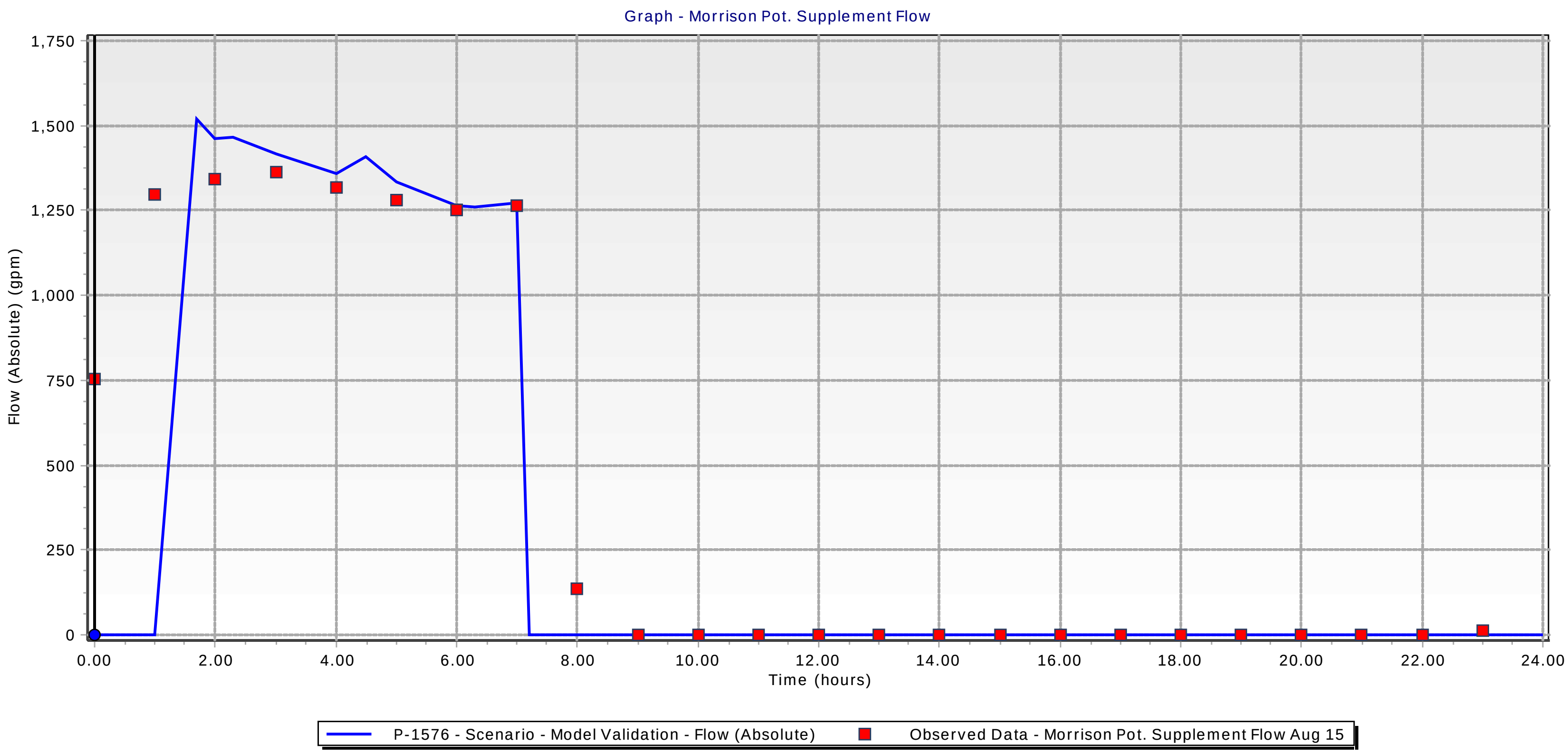
Graph - Parkway PS Suction Pressure

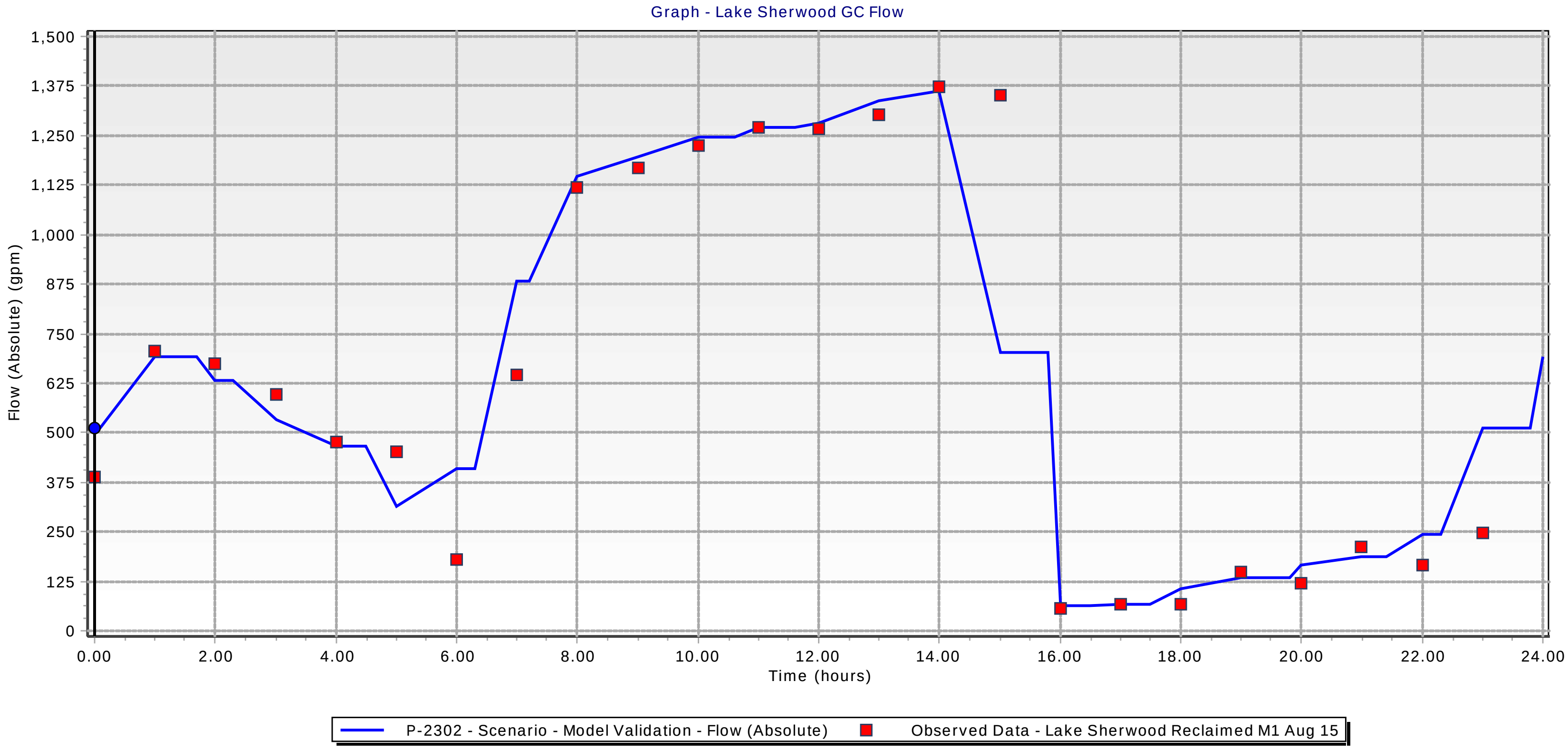


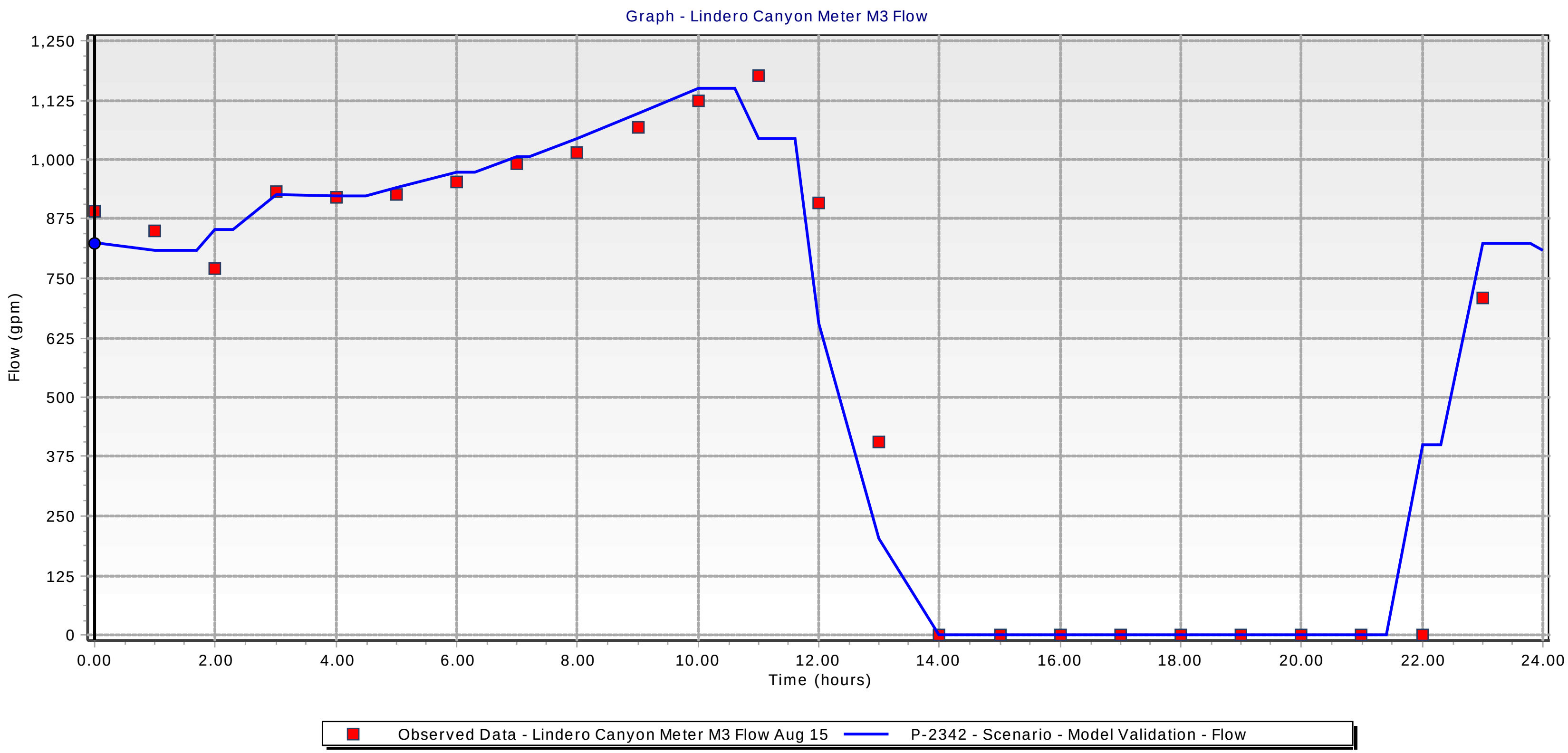


Graph - Parkway PS Discharge Pressure
Pressure (psi)
175.0
173.8
172.5
171.3
170.0
168.8
167.5
166.3
165.0
163.8
162.5
161.3
160.0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
F_1067 - Scenario - Model Validation - Pressure
Observed Data - Parkway PS Discharge Pressure Aug 15


Graph - Oak Park PS Flow
Flow (Absolute) (gpm)
2,750
2,500
2,250
2,000
1,750
1,500
1,250
1,000
750
500
250
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
P-2133 - Scenario - Model Validation - Flow (Absolute)
Observed Data - Oak Park PS Flow Aug 15


Graph - Morrison Pot. Supplement Flow
Flow (Absolute) (gpm)
1,750
1,500
1,250
1,000
750
500
250
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
P-1576 - Scenario - Model Validation - Flow (Absolute)
Observed Data - Morrison Pot. Supplement Flow Aug 15


Graph - Lake Sherwood GC Flow
Flow (Absolute) (gpm)
1,500
1,375
1,250
1,125
1,000
875
750
625
500
375
250
125
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
P-2302 - Scenario - Model Validation - Flow (Absolute)
Observed Data - Lake Sherwood Reclaimed M1 Aug 15


Graph - Lindero Canyon Meter M3 Flow
Flow (gpm)
1,250
1,125
1,000
875
750
625
500
375
250
125
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
Time (hours)
Observed Data - Lindero Canyon Meter M3 Flow Aug 15
P-2342 - Scenario - Model Validation - Flow

Appendix C – Opinions of Probable Cost

Recycled Water Master Plan
2014 Update
BUDGETARY ESTIMATE

PROJECT SUMMARY

System Extension Projects	Estimated Cost	Acre feet/ Year (AFY)	$/AFY
T.O. Boulevard Extension	$ 5,140,000	251	$ 20,500
T.O. Boulevard Extension - Short Version	$ 3,810,000	215	$ 17,700
Capris Tract / Lindero Greenbelt (south)	$ 864,000	55	$ 15,700
Capris Tract w/o Lindero Greenbelt	$ 431,000	30	$ 14,400
Montenegro Community Ctr Extension	$ 219,000	4	$ 54,800
North Ranch Park / Lindero Greenbelts	$ 844,000	58	$ 14,600
Hillcrest Tract / Oak Park North	$ 300,000	21	$ 14,300
Lateral Connection to North Ranch Park	$ 31,000	30	$ 1,000
Conejo Creek Parks Extension	$ 5,550,000	206	$ 26,900
Decker Canyon Project	$ 12,130,000	229	$ 53,000
Alternative Decker Canyon Project	$ 18,280,000	459	$ 39,800
Hidden Hills Extension	$ 3,700,000	50	$ 74,000
Woodland Hills GC Extension	$ 9,790,000	324	$ 30,200
Pierce College Extension	$ 20,900,000	666	$ 31,400
Westlake Elementary	$ 125,000	15	$ 8,300
Triunfo Community Park	$ 611,000	60	$ 10,200
Evanstar Park	$ 364,000	42	$ 8,700
Southshore Hills Park	$ 790,000	14	$ 56,400
Sherwood Executive GC	$ 4,000,000	23	$ 170,000
Other Projects			
Morrison Pump Station Upgrades	$ 345,000	N/A	
Reservoir 2 Improvements	$ 1,100,000	N/A	
Seasonal Storage Reservoir	$ 68,000,000	1500	$ 45,300

THOUSAND OAKS BLVD PROJECT

Item	Description	Unit	Quantity	Unit Costs		Item Cost
1	10-inch pipelines	FT	5725	$ 270	$	1,545,750
2	8-inch pipelines	FT	5030	$ 240	$	1,207,200
3	6-inch pipelines	FT	4390	$ 220	$	965,800
4	4-inch pipelines	FT	1750	$ 190	$	332,500
5	Customer coversions	EA	12	$ 5,000	$	60,000
	Subtotal - Construction Cost				$	4,111,250
	Engineering			25%	$	1,030,000
	Total				$	5,140,000

Note: Based TO Blvd Study, documented in Tapia Effluent
Alternatives Study (LVMWD Report No. 2321.03)

THOUSAND OAKS BLVD PROJECT - SHORT VERSION

Item	Description	Unit	Quantity	Unit Costs		Item Cost
1	10-inch pipelines	FT	5725	$ 270	$	1,545,750
2	8-inch pipelines	FT	3030	$ 240	$	727,200
3	6-inch pipelines	FT	2390	$ 220	$	525,800
4	4-inch pipelines	FT	1150	$ 190	$	218,500
5	Customer coversions	EA	7	$ 5,000	$	35,000
	Subtotal - Construction Cost				$	3,052,250
	Engineering			25%	$	760,000
	Total				$	3,810,000

CAPRIS TRACT / LINDERO GREENBELT (SOUTH PORTION)

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	6-inch pipeline in Rockfield St., from Red Oak Elem across Lindero Cyn	FT	1800	$ 220	$ 396,000
2	4-inch pipelines	FT	1500	$ 190	$ 285,000
3	Customer conversions	EA	2	$ 5,000	$ 10,000
	Subtotal - Construction Cost				$ 691,000
	Engineering			25%	$ 173,000
	Total				$ 864,000

EXTENSION TO MONTENEGRO COMMUNITY CTR

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	4-inch pipeline in Bayport Way, from Rockfield St.	FT	750	$ 220	$ 165,000
3	Customer conversions	EA	2	$ 5,000	$ 10,000
	Subtotal - Construction Cost				$ 175,000
	Engineering			25%	$ 44,000
	Total				$ 219,000

NORTH RANCH PLAYFIELD AND LINDERO GREENBELTS NEAR BOWFIELD

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	6-inch pipeline in Bowfield, from Kanan to play field meter in Rockfield St.	FT	3000	$ 220	$ 660,000
3	Customer conversions	EA	3	$ 5,000	$ 15,000
	Subtotal - Construction Cost				$ 675,000
	Engineering			25%	$ 168,750
	Total				$ 844,000

HILLCREST AND OAK PARK NORTH APARTMENTS

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	4-inch pipeline in Golden Eagle Drive from Kanan Road to Golden Nugget Way	FT	1000	$ 220	$ 220,000
3	Customer conversions	EA	4	$ 5,000	$ 20,000
	Subtotal - Construction Cost				$ 240,000
	Engineering			25%	$ 60,000

	Total				$ 300,000

CAPRIS TRACT w/o LINDERO GREENBELT

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	6-inch pipeline in Rockfield St., from Red Oak Elem to Tuscany Drive	FT	400	$ 220	$ 88,000
2	4-inch pipelines	FT	1300	$ 190	$ 247,000
3	Customer conversions	EA	2	$ 5,000	$ 10,000
	Subtotal - Construction Cost				$ 345,000
	Engineering			25%	$ 86,000
	Total				$ 431,000

LATERAL CONNECTION TO NORTH RANCH PARK

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	Lateral pipe and connection	LS	1	$ 20,000	$ 20,000
2	Customer conversions	EA	1	$ 5,000	$ 5,000
	Subtotal - Construction Cost				$ 25,000
	Engineering			25%	$ 6,000
	Total				$ 31,000

WESTLAKE HILLS ELEMENTARY

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	4-inch pipeline	FT	450	$ 190	$ 85,500
2	Customer conversion	LS	1	$ 10,000	$ 10,000
	Subtotal - Construction Cost				$ 95,500
	Engineering			30%	$ 29,000
	Total				$ 125,000

TRIUNFO COMMUNITY PARK

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	6-inch pipeline	FT	2200	$ 220	$ 484,000
2	Customer conversion	LS	1	$ 5,000	$ 5,000
	Subtotal - Construction Cost				$ 489,000
	Engineering			25%	$ 122,000
	Total				$ 611,000

EVENSTAR PARK

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	6-inch pipeline	FT	1300	$ 220	$ 286,000
2	Customer conversion	LS	1	$ 5,000	$ 5,000
	Subtotal - Construction Cost				$ 291,000
	Engineering			25%	$ 73,000
	Total				$ 364,000

SOUTHSHORE HILLS PARK

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	4-inch pipeline	FT	3300	$ 190	$ 627,000
2	Customer conversion	LS	1	$ 5,000	$ 5,000
	Subtotal - Construction Cost				$ 632,000
	Engineering			25%	$ 158,000
	Total				$ 790,000

Recycled Water Master Plan
2014 Update
BUDGETARY ESTIMATE

CONEJO CREEK PARK

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	12-inch pipelines - paved (Westlake Blvd to B&G Club)	FT	2700	$ 290	$ 783,000
2	12-inch pipelines - unpaved (Westlake Blvd to B&G Club	FT	5000	$ 150	$ 750,000
3	8-inch pipelines (Boys & Girls Club to Conejo Park North	FT	3000	$ 240	$ 720,000
4	8-inch pipelines (extensions to Conejo Park South)	FT	2600	$ 240	$ 624,000
5	6-inch pipelines (extensions to Oak Brook Park)	FT	3900	$ 220	$ 858,000
6	4-inch pipeline (extension to Old Meadows Park)	FT	800	$ 190	$ 152,000
7	Customer conversions	EA	5	$ 10,000	$ 50,000
8	Supplemental pump station at Savoy Tank	HP	20	$ 25,000	$ 500,000
	Subtotal - Construction Cost				$ 4,437,000
	Engineering			25%	$ 1,109,000
	Total				$ 5,550,000

Recycled Water Master Plan
2014 Update
BUDGETARY ESTIMATE

DECKER CANYON PROJECT

Item	Description	Unit	Quantity		Unit Costs		Item Cost
1	Pipelines (10-inch and 8-inch)	LS	1	$	6,140,000	$	6,140,000
2	Concrete Water Tank	LS	1	$	2,110,000	$	2,110,000
3	Pump Station	LS	1	$	780,000	$	780,000
4	Pressure Reducing Station	LS	1	$	160,000	$	160,000
5	General Contractor OH & Profit				10%	$	919,000
	Subtotal - Construction Cost					$	10,109,000
	Engineering				20%	$	2,022,000
	Total					$	12,130,000

Note: Based on actual bid prices, as documented in Tapia Effluent Alternatives Study (LVMWD Report No. 2321.03)

ALTERNATIVE DECKER CANYON PROJECT

Item	Description	Unit	Quantity		Unit Costs		Item Cost
1	10-inch Pipelines	FT	40,000	$	270	$	10,800,000
2	Concrete Water Tank	LS	1	$	2,110,000	$	2,110,000
3	Pump Station	LS	1	$	780,000	$	780,000
4	Pressure Reducing Station	LS	1	$	160,000	$	160,000
5	General Contractor OH & Profit				10%	$	1,385,000
	Subtotal - Construction Cost					$	15,235,000
	Engineering				20%	$	3,047,000
	Total					$	18,280,000

Recycled Water Master Plan
2014 Update
BUDGETARY ESTIMATE

HIDDEN HILLS EXTENSION

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	6-inch pipelines	FT	11,200	$ 220	$ 2,464,000
2	4-inch pipelnes	FT	1,800	$ 190	$ 342,000
3	Customer conversions	EA	30	$ 5,000	$ 150,000
	Subtotal - Construction Cost				$ 2,956,000
	Engineering			25%	$ 739,000
	Total				$ 3,700,000

WOODLAND HILLS

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	14-inch pipelines	FT	19,000	$ 310	$ 5,890,000
2	12-inch pipelines	FT	5300	$ 290	$ 1,537,000
3	Customer conversions	EA	10	$ 10,000	$ 100,000
	Subtotal - Construction Cost				$ 7,527,000
	Engineering			30%	$ 2,258,000
	Total				$ 9,790,000

Note: Based Woodland Hills GC Study, documented in LVMWD Report No. 2467.00

PIERCE COLLEGE

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	20-inch pipeline	FT	19,000	$ 360	$ 6,840,000
2	Less 14-inch pipeline for Woodland Hills Extension	FT	19,000	$ (310)	$ (5,890,000)
3	16-inch pipeline, RWPS East to El Canon	FT	27,000	$ 320	$ 8,640,000
4	18-inch pipeline in LA	FT	5800	$ 350	$ 2,030,000
5	14-inch pipelines	FT	3500	$ 310	$ 1,085,000
7	12-inch pipelines	FT	7500	$ 290	$ 2,175,000
8	6-inch pipelines	FT	2190	$ 220	$ 481,800
9	Customer conversions	EA	34	$ 10,000	$ 340,000
10	Upgrade RWPS East	LS	1	$1,000,000	$ 1,000,000
	Subtotal - Construction Cost				$ 16,702,000
	Engineering			25%	$ 4,175,500
	Total				$ 20,900,000

Note: Based partially on LADWP Recycled Water Master Plan Study by RMC Waterv/ CDM

SHERWOOD EXECUTIVE COURSE (SHERWOOD LAKE CLUB)

Demand Estimate

Measured turf area (sf)		236,612	SF
Add 10% for other turf		260,273	SF
Acres of turf		6.0	Acres
Demand factor		3.5	per section 3.5.7
Annual demand		20.9	AFY
Add 10% for trees		23.0	

Cost Estimate

Subqueous pipeline through lake		6000	ft
cost/ft	$	500	
allowance for other		20%	
construction costs	$	3,600,000	
right-of-way/permitting/engineering	$	400,000	
Total	$	4,000,000	
cost/AF (rounded)	$	170,000	

Recycled Water Master Plan
2014 Update
BUDGETARY ESTIMATE

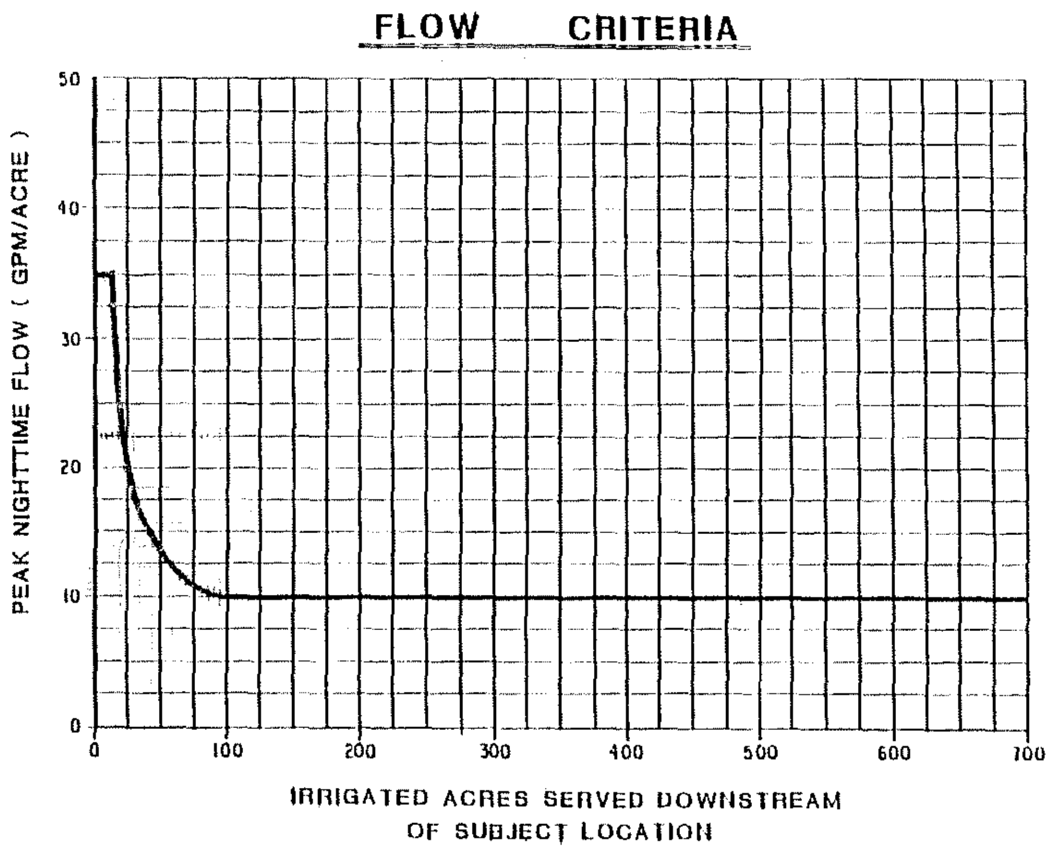
HOPE RESERVOIR PROJECT

Item	Description	Unit	Quantity	Unit Costs	Item Cost
1	Dam and miscellaneous	LS	1	$ 30,000,000	$ 30,000,000
2	Microsreen/PS/PRV facility	LS	1	$ 1,500,000	$ 1,500,000
3	Inlet/outlet pipeline and splillway	LS	1	$ 10,000,000	$ 10,000,000
4	Right-of-way	LS	1	$ 1,500,000	$ 1,500,000
5	Access road	LS	1	$ 500,000	$ 500,000
6	Permits	LS	1	$ 4,000,000	$ 4,000,000
7	Other items			20%	$ 9,500,000
	Subtotal - Construction Cost				$ 57,000,000
	Engineering			20%	$ 11,400,000
	Total				$ 68,000,000

Note: Based on Recycled Water Seasonal Storage Study, LVMWD Report No. 2500.00

HDR

Appendix D – Peak Flow Estimating Guide



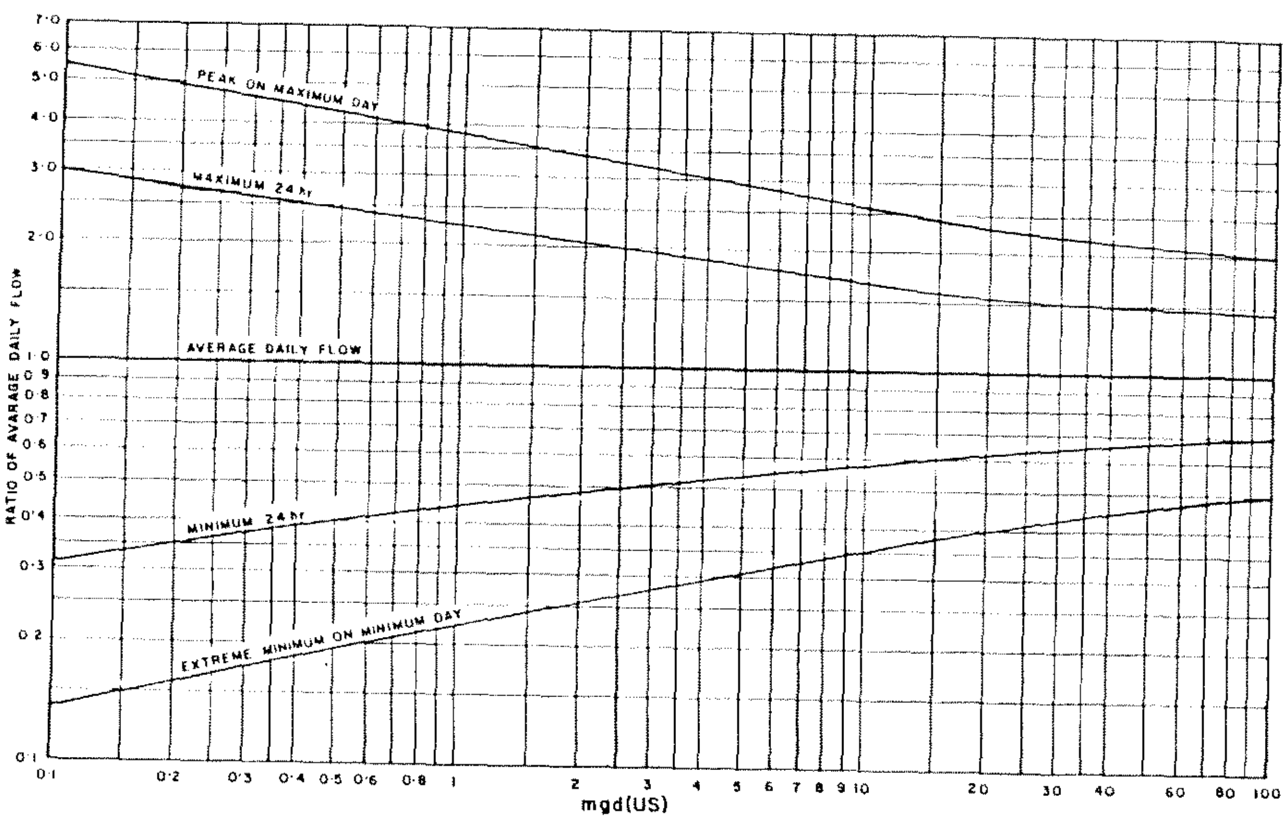
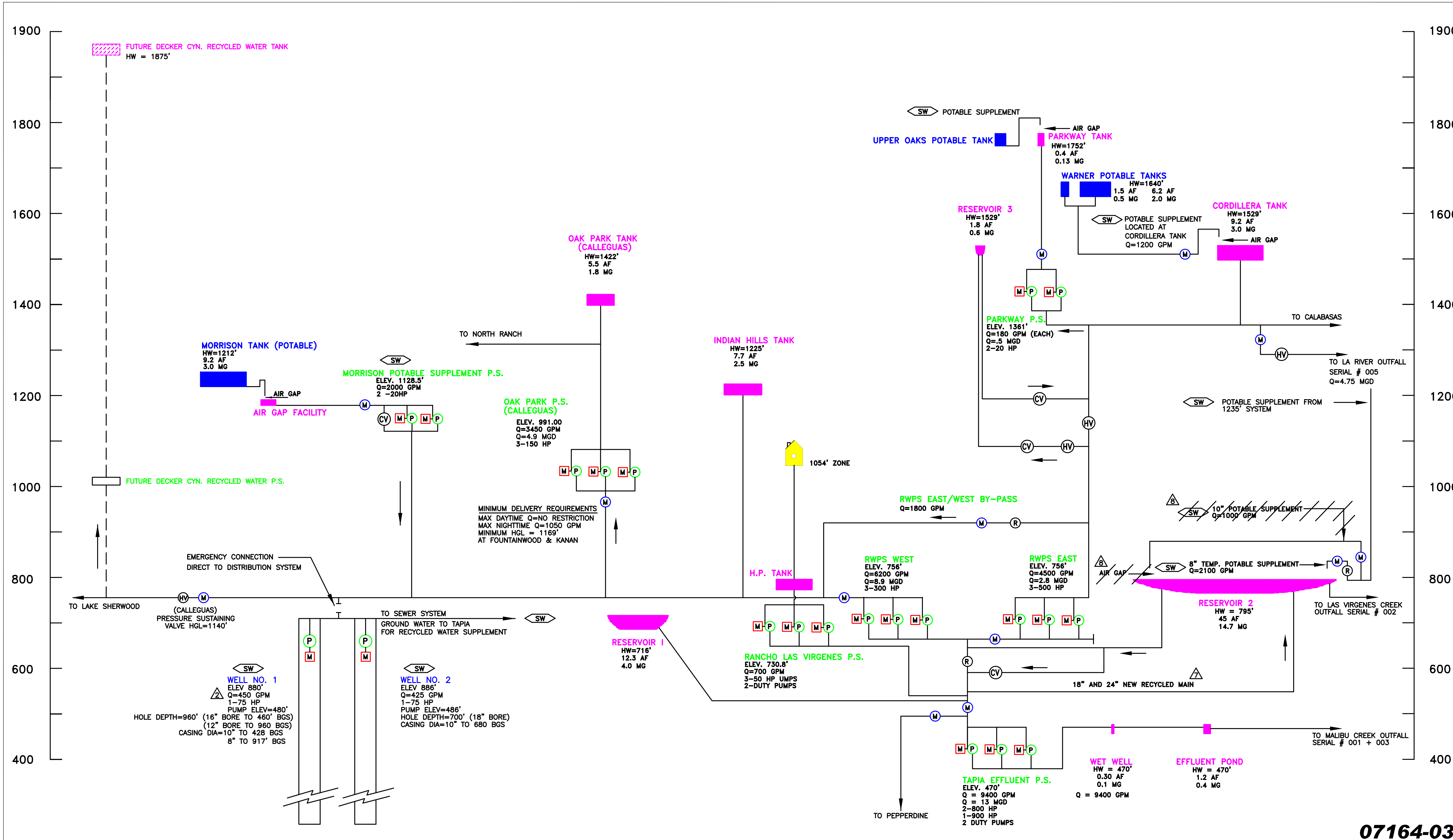


FIGURE 1-5 Ratio of Extreme Flows to Average Daily Flow
(Courtesy, Water Pollution Control Federation)

Appendix E – Hydraulic Profile Schematic of RW System

Las Virgenes MWD Recyled Water System Gradient drawing



07164-03

LEGEND

P E	ENGINE DRIVE PUMP	CV	CHECK VALVE
P M	ELECTRIC MOTOR DRIVE PUMP	HP	HYDRO-PNEUMATIC
M	METER	HV	HYDRAULIC CONTROL VALVE
MV	MOTOR CONTROLLED VALVE	R	PRESSURE REGULATOR
VS	VARIABLE SPEED DRIVE	BGS	BELOW GROUND SURFACE
Q	DESIGN FLOW	SW	SUPPLEMENTAL WATER
	ZONES WITHOUT TANKS	-----	FUTURE FACILITIES

SCALE

VERTICAL GRADIENT SCALE
1 UNIT = 100'
(2 200', 1 100', 0 0')

HORIZONTAL TANK VOLUME SCALE
1 UNIT = 3 MG
(0 MG, 1 MG, 2 MG, 3 MG)

REV. NO.	DATE	DESCRIPTION	APPVD.	DATE
8	11-14-11	AIR GAP AND 10" POTABLE SUPPLEMENT NO LONGER IN USE. PIPELINE STILL IN FIELD.		
7	11-14-11	UPDATED RESERVOIR AND RWPS BY-PASS INFORMATION		
6	6-21-11	MODIFICATIONS TO RWPS EAST AND WELL NO. 2		
5	7-6-05	UPDATED ACCEPTANCE OF PARKWAY P.S. AND PARKWAY TANK	D.R.L.	7-25-05
4	1-30-03	ADDED SUPPLEMENT POTABLE TANKS, NEW AND FUTURE P.S.	J.E.C.	1-30-03
3	5-28-98	UPDATED; ADDED FLOW REFERENCE TO PERCOLATION PONDS	B.W.W.	5-28-98
2	10-17-96	UPGRADED FLOW FOR WELL NO. 1 FROM 400 TO 440 GPM	J.E.C.	10-17-96
1	12-15-92	ADDED WELLS, MISC. CORRECTIONS	J.E.C.	12-15-92

REVISIONS

LAS VIRGENES MUNICIPAL WATER DISTRICT

RECYCLED WATER GRADIENT DIAGRAM

(PUMPING-STORAGE FACILITIES ONLY)

PREPARED BY:
LVMWD ENGINEERING
4232 LAS VIRGENES ROAD
CALABASAS, CA 91302
DATE: OCTOBER 27, 1992

APPROVED FOR LAS VIRGENES MUNICIPAL WATER DISTRICT
BY: James E. Colbaugh
DIRECTOR OF PLANNING & ENGINEERING
DATE: OCTOBER 27, 1992 R.C.E. 22931

SCALE:	DATE:	TRACT:	
SEE BAR SCALE AT LEFT	OCTOBER 27, 1992	N/A	SHEET 1 OF 1