LVMWD Project No. 2563.00

June 2014

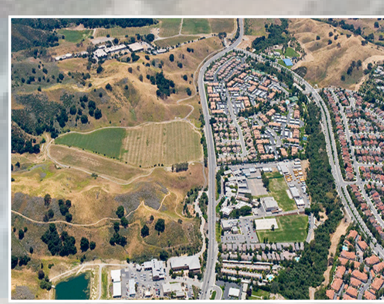
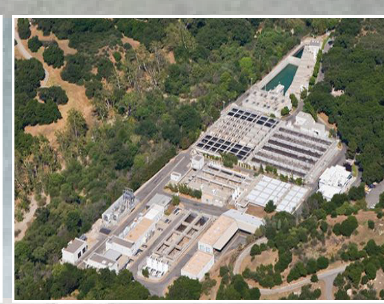
FINAL REPORT

Integrated Master Plan Update 2014

for the

Joint Powers Authority of:

Las Virgenes Municipal Water District & Triunfo Sanitation District

KJ Project No. 1389005*00

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Integrated Master Plan Update 2014

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Section 1 – Introduction and Summary

Section 1: Introduction and Summary

This Integrated Master Plan summarizes and synthesizes the results of three recently completed master plan documents:

1. *The Potable Water Master Plan, 2014 Update*, prepared for the Las Virgenes Municipal Water District (LVMWD)

2. *The Sanitation Master Plan, 2014 Update*, prepared for the Joint Powers Authority (JPA) of LVMWD and Triunfo Sanitation District (TSD)

3. *The Recycled Water Master Plan, 2014 Update*, prepared for the LVMWD/TSD JPA and for Calleguas MWD

The different utilities involved in these master plans reflect the differing ownerships of the water and wastewater facilities analyzed in these studies. These jointly-owned facilities and these planning studies also typify the cooperative relationship of water utilities in the area, which goes back several decades. Forward-thinking water planning has produced reliable, efficient regional systems that are the envy of other utilities, including:

- A recycled water (RW) system that makes effective use of every drop of wastewater in the summer and 75 percent of wastewater produced year round,

- A potable water system that provides reliable service to a geographically challenging area, including a reservoir and treatment plant capable of meeting system-wide needs following a major earthquake, and

- A wastewater treatment system that produces useful compost and achieves nutrient limits in its effluent through innovative treatment methods

This Integrated Master Plan serves as an executive report, providing an overview of the three systems, their capabilities and limitations, and issues relevant to their future performance. A particular focus of this report is how each system affects the others; how the recycled system relieves demands from the potable system; how the potable system supplements the recycled system; and how the wastewater system affects and is affected by how much water is recycled. This report is intended for a relatively non-technical reader. Those who seek technical information and discussion will find this in the primary master plan report documents. A general list of Acronyms and Abbreviations is included in Appendix A.

1.1 The Potable Water, Recycled Water and Wastewater Systems of Las Virgenes MWD

The Las Virgenes Municipal Water District (LVMWD, District) is located on the western edge of Los Angeles County and includes the cities of Agoura Hills, Calabasas, Hidden Hills, and Westlake Village, as well as adjacent unincorporated areas of LA County. The District provides potable water, recycled water, and wastewater treatment services to roughly 71,000 people within a 122-square mile service area.

The District is geographically widespread, stretching from the northern end of the San Fernando Valley to the southern slopes of the Santa Monica Mountains, serving the area in between the City of Los Angeles and Ventura County, just north of the City of Malibu. The District is also topographically rugged, spanning the ridges, summits, canyons and valleys of the Santa Monica

Mountains. While the majority of District customers reside in communities along the 101 Freeway corridor at an elevation of roughly 1000 feet, high-lift pump stations deliver water to service areas above 2500 feet. Because of this geography, providing water and wastewater services within this area is challenging, with hundreds of miles of pipes and dozens of pump stations and water storage tanks needed to serve some relatively sparsely populated areas.

The areas served by LVMWD 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. This imported water is delivered by the Metropolitan Water District of Southern California (MWDSC). The only reliable and relatively abundant local source of water for LVMWD is recycled water.

An additional challenge to operating a water/wastewater utility in this area is created by the inland location of the wastewater treatment facility. For seven months of the year, discharges of treated wastewater to Malibu Creek are prohibited. This has created an additional need to maximize the use of recycled water, whenever and wherever it is feasible.

LVMWD initiated the Backbone Improvement Program in 2008 to address both current and projected future deficiencies in system storage, transmission and treatment capacity that create risks of low pressure, water outages, inadequate emergency supplies and inadequate fire flows. The program consists of transmission mains in Agoura Hills completed in 2012, transmission mains in Calabasas completed in 2014, a five million gallon storage tank under construction in Westlake Village, expansion of the Westlake Filtration Plant and modernization of the Westlake Pump Station. Construction of many of these facilities is necessary to correct the system deficiencies and ensure reliable water service. The analysis of the potable water system in this master plan was based on these improvements being completed. If they are not completed, as planned, many of the conclusions in this report will no longer be valid.

1.1.1 The Wastewater and Recycled Water Systems of the JPA

For wastewater treatment, LVMWD is partnered with Triunfo Sanitation District (TSD) as co-owners of the Tapia Water Reclamation Facility (Tapia WRF). Approximately two-thirds of the water treated at Tapia WRF originates in LVMWD with the other third coming from the community of Oak Park and the Westlake portion of Thousand Oaks. The Tapia WRF service areas are generally within the Malibu Creek watershed, but Tapia WRF also receives water from portions of Calabasas that are naturally tributary to the Los Angeles River. This latter wastewater must be pumped to the top of the Calabasas Grade, where it then flows downhill to the treatment plant. The Tapia WRF is located where Malibu Creek and Cold Creek meet near the intersection of Malibu Canyon Road and Piuma Road.

The JPA's sanitation system also includes the Rancho Las Virgenes Composting Facility for processing sludge pumped from Tapia WRF, 3.8 miles away. At this facility, sludge is dewatered using a centrifuge, anaerobically digested, then mixed with wood chips or other organic amendments. When completed, the compost is approved for both commercial use and distribution to JPA customers.

Not all wastewater generated in the two districts is treated at Tapia WRF due to practical limits in constructing collection and conveyance systems. Flows from some customers are delivered to the City of Los Angeles for treatment. Others rely on individual septic systems. Figure 1-1 shows the LVMWD potable water service area, as well as the TSD and LVMWD areas from which wastewater is collected for treatment.

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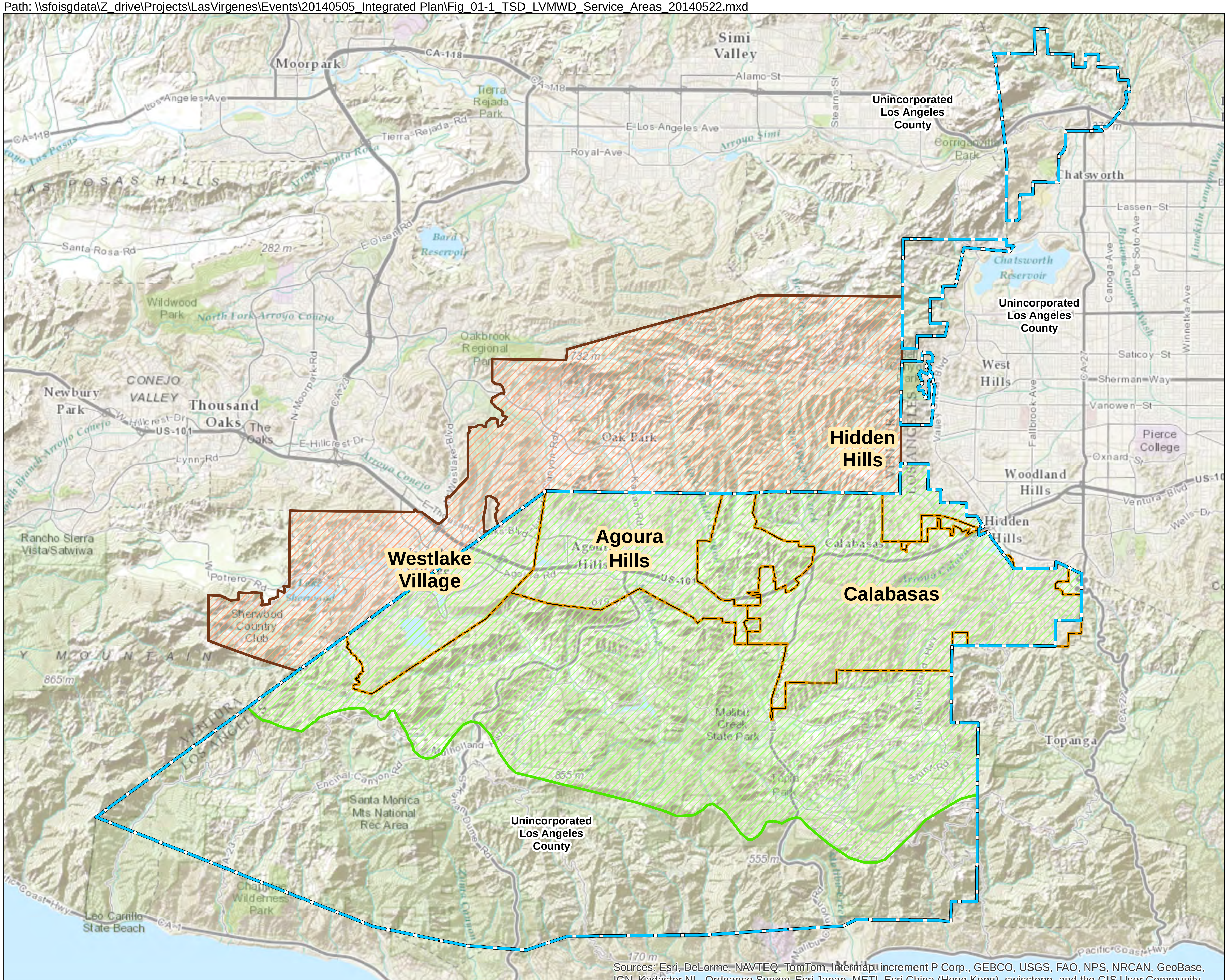

Legend

- LVMWD Potable Water Service Area
- LVWMD Sewer Service Area
- Triunfo Sanitation District
- City Limits

N

0 9,000 18,000

Scale: Feet

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Integrated Water Master Plan Update 2014
Los Angeles, County, CA

LVMWD/TSD Service Areas

KJ/ 1389005.00

Figure 1-1

The JPA of LVMWD and TSD also owns and operates a recycled water system 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 during the summer has been beneficially reused. Together with a connecting system owned by Calleguas MWD (CMWD), the JPA system serves recycled water from Calabasas to North Ranch and to Lake Sherwood, providing water for irrigation of schools, parks, golf courses, street medians, homeowner associations, and other uses, primarily within the communities of Calabasas, Agoura Hills, Westlake Village, Thousand Oaks, and Oak Park.

1.2 Water Planning by LVMWD and the JPA

These potable water, recycled water, and wastewater systems are the result of decades of forward-thinking, long-range planning, and commitment. Approximately every 5 to 10 years, starting in 1962, LVMWD has written or updated various water system master plans. Updates to master plans for the Potable Water, Recycled Water, and Sanitation Master Plans were completed earlier this year (2014). To the extent that these master plans have addressed the wastewater treatment and recycled water systems owned by the JPA, TSD has also participated in these studies. This year, TSD has been a very active participant in the master planning process, as well as Calleguas MWD, who funded the development of a computer model for the recycled water system in Ventura County.

As implied by the title of this report, a particular focus is how the three systems function together:

- Treated wastewater becomes the supply for the recycled water system,
- The recycled water system relieves demands from the potable water system,
- The potable water system provides supplemental water to the recycled water system, in order to meet peak demands, and
- The recycling of water helps the wastewater treatment plant meet restrictions of effluent discharge.

The major topics of this report are:

- **Water and wastewater service demands**. How has water demand changed historically in LVMWD and how much is needed in the future? The primary drivers of demand are: 1) land development and associated increases in population, 2) weather conditions, and 3) economic conditions. Thanks to water conservation programs and other factors, LVMWD's demands have leveled off in recent years, but they are expected to ramp up with an improved economy and as land development resumes. With only a small amount of land suitable for development remaining, the era of rapidly increasing demands from large new residential tracts appears to have passed. New demands will come largely from in-fill development and some redevelopment.

- **Water supply**. Nearly all water consumed in LVMWD comes from the State Water Project. A significant portion of this water is used twice within the District. The portion that becomes wastewater is likely to be recycled for irrigation. A small amount of District water also comes from two wells in Westlake Village. An even smaller amount of supply comes from surface runoff captured in the District's Las Virgenes Reservoir, but the quantity of reservoir capture is roughly the same as what is lost to evaporation and seepage. This 10,000 acre-ft reservoir serves as a seasonal storage facility, allowing the District to purchase less water in the summer. The reservoir also provides the only dependable source of water when the supply from MWDSC is interrupted, such as during planned outages and following a major earthquake.

- **Facilities analyses**. The rugged topography of the potable water service area has necessitated a complex system, where 24 pump stations and 25 water storage tanks are used to supply water to 22 main pressure zones or subsystems. Nearly all these facilities receive water directly or indirectly from the main “backbone” system (the 1235-ft zone), which extends along the 101 Freeway. The highest water storage tank in the system is at 2513 feet. To fill this reservoir, water must be pumped through two separate pump stations.

  Though not as complex, the recycled water system pumps water from Tapia WRF (elevation 490 feet) to five different zones, with the highest tanks located in Oak Park and Calabasas at over 1500 feet in elevation. Located just east of LVMWD’s Headquarters, the 45 acre-ft. Reservoir 2 buffers between the demands of recycled water customers and the supply from Tapia WRF, providing about two days of water supply during peak demands.

  To assure that these systems function well now and into the future, hydraulic analyses were performed using computer models which examined various scenarios involving peak summer demands, fire flows, and various growth projections. Based on these analyses, improvements have been recommended to address both current and projected future deficiencies. Master planning for these facility improvements is performed to promote an orderly expansion of these utility systems. Facilities constructed to meet current demands also have the capability of meeting future demands.

- **Integration opportunities**. Deficiencies in the potable water systems can sometimes be addressed by expanding the recycled water system. Likewise, deficiencies in the recycled water system can sometimes be addressed by strategic supplements from the potable water system. Expansion of the recycled water system is also an important strategy for minimizing the costs associated with water disposal at Tapia WRF. By considering such opportunities during the analysis of each system, the overall solutions can be optimized.

  A reservoir for seasonal storage of surplus recycled water would provide benefits to all three systems. As a means of reducing or eliminating wastewater disposal costs, it would benefit the wastewater system. It also would help relieve demand on the potable system, by eliminating the need for recycled water system supplements. A seasonal storage reservoir would also improve the recycled water system, by providing a larger, nearly drought-proof source of water.

- **Possible capital improvements**. A seasonal storage reservoir for recycled water is just one of many possible improvements to be considered over the next several decades. Other possible recycled water system improvements include ambitious system extensions into the City of Thousand Oaks and into the City of Los Angeles, as well as more modest extensions to serve current and future customers within the LVMWD and TSD service areas. Extensions outside the JPA’s service area will need to be balanced with the JPA's own needs and benefits. Because the District has been very proactive in extending the recycled system within its own area, highly attractive potential recycled water customers are essentially non-existent, but with changing rules, more frequent water shortages, and escalating costs for imported water, decisions related to the cost effectiveness of expanding recycled water systems are being revisited.

For the potable water system, the story is similar. Most of the “Backbone Improvements” identified in the 2007 Master Plan will be completed within a few short years. Once this occurs, the pace of construction for major new facilities will significantly slow. Considering that much of LVMWD’s vacant land is in the more rugged areas of the Santa Monica Mountains, the need for other major improvements may take decades to materialize.

Improvements to the water reclamation system will likely be driven by regulations. While the hydraulic capacity of the treatment plant is generally adequate to handle the expected future flows, with each permit renewal cycle, the Regional Water Quality Control Board develops more stringent requirements, many of which generate the need for new or improved systems of treatment.

In addition to system improvements to meet capacity needs or regulatory requirements, additional improvements will be required over the next few decades simply because the infrastructure is aging and portions will wear out. Much of the infrastructure was constructed in the mid-1960s and is now a half century old. As pipeline breaks become more common, mains will need to be replaced. At an average cost of several hundred dollars per foot, this expense will be significant. Pumps, control systems, compressors, blowers, and other equipment all have finite lives counted in years, not decades. In the future, replacement and rehabilitation projects will likely be the primary elements of infrastructure investments, with an emphasis on energy conservation and resource sustainability.

Section 2 –Demands for Potable Water, Recycled Water and Wastewater Services

Section 2: Demands for Potable Water, Recycled Water and Wastewater Service

2.1 Estimating Service Area Demands

To determine the optimum sizes of the pipelines, pump stations, water storage tanks, and treatment facilities, future demands for water and wastewater services must be estimated. This is generally done by examining the approved use of each parcel of land in the service areas, and assigning it a rate of demand that is appropriate for the approved use. For instance, if a parcel is permitted for a single-family house, the usage estimated for that parcel would be based on how much water is typically consumed and how much wastewater is typically generated by similarly sized single-family residences in the same area.

2.1.1 Estimating Future Potable Water Use in LVMWD

LVMWD is unusual compared to neighboring water utilities to the extent that large areas of privately-held land are still undeveloped. In the neighboring areas of Oak Park and Thousand Oaks, very little unrestricted, undeveloped land remains. While these communities are surrounded by empty land areas, these areas are largely dedicated as “open space” and cannot be developed. LVMWD, on the other hand, still has many undeveloped private parcels, particularly in the southern half of the service area.

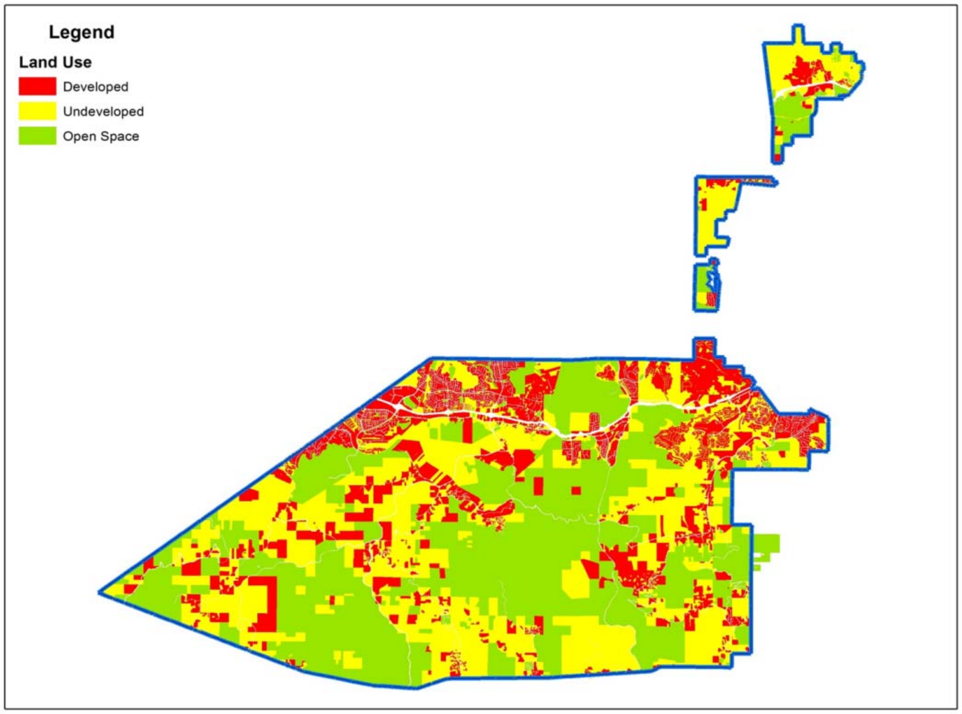
These parcels have not been developed largely due to the topography of the land. To develop many of these parcels, extensive grading would be needed, plus access roads and pipelines would need to be constructed along the ridges and across the rugged ravines of the Santa Monica Mountains. Designing and constructing these facilities is difficult enough; obtaining permits to do so is even tougher. Because of these difficulties, an increasing amount of this land is being deeded to the National Park Service, the State of California, and various land conservancies. However, many undeveloped, unrestricted parcels remain, and must be accounted for as these parcels have a right for services if requested. The implications of this particular development issue have the greatest potential impact on LVMWD’s Seminole/Latigo and Saddle Peak water pressure zones.

Figure 2-1 shows land inLVMWD's service area grouped in three categories: developed, undeveloped, and dedicated open space. The yellow areas are parcels that currently do not receive water from LVMWD, but potentially could in the future. While many of these parcels may never develop, and the maximum allowed development density is generally quite low (e.g., 1 dwelling unit per 10 acres), considerable potential for new water demands exists and are therefore incorporated in this and previous master plans, and other long-range water planning demand projection activities.

Areas of particular concern are:

- The 101 Freeway corridor, where permitted densities are relatively high and potential for redevelopment also exists
- The southwest portion of the district, where water facilities are already operating at capacity, yet a large potential for new demand exists

Figure 2-1. Developed, Undeveloped, and Dedicated Open Space Land in LVMWD



2.1.2 Estimating Future Recycled Water Use in the JPA

Planning for recycled water system has its own unique challenges. To serve recycled water to a customer, a second pipeline must be constructed, and the cost of the second pipeline is often considered prohibitively expensive. Utilities must therefore make decisions regarding who to serve based on a benefit/cost analysis. The primary benefit of expanding the RW system is a reduction in the cost of water purchased from MWDSC, but there are other benefits that also must be considered. These include the benefits of lessened demands on the potable water system and a reduction in the disposal of unused treated wastewater.

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. Main recycled water pipelines to these customers generally make economic sense. Along the way, these mains may also serve other customers (homeowners associations, commercial facilities, and roadway landscaping), but these smaller customers are seldom the drivers for a new recycled water main. Within the JPA's service areas of Calabasas, Agoura Hills, Westlake Village and Oak Park, there is little untapped potential for additional recycled water use. This is because prior planning efforts at optimizing RW use have been quite successful. Virtually all the schools, parks and golf courses within LVMWD and Oak Park Water Service are currently connected to the RW system. 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. On the other hand, in the Westlake and North Ranch portions of Thousand Oaks (areas served by California Water Service Company), there are several small parks and schools that could be economically connected to the recycled water system. While there are many single-family residences with substantial irrigation demands within the JPA areas, serving single-family residences entails added operational costs (training, testing, and paperwork) required by state health officials.

2.1.3 Estimating Demands for Wastewater Services in the JPA

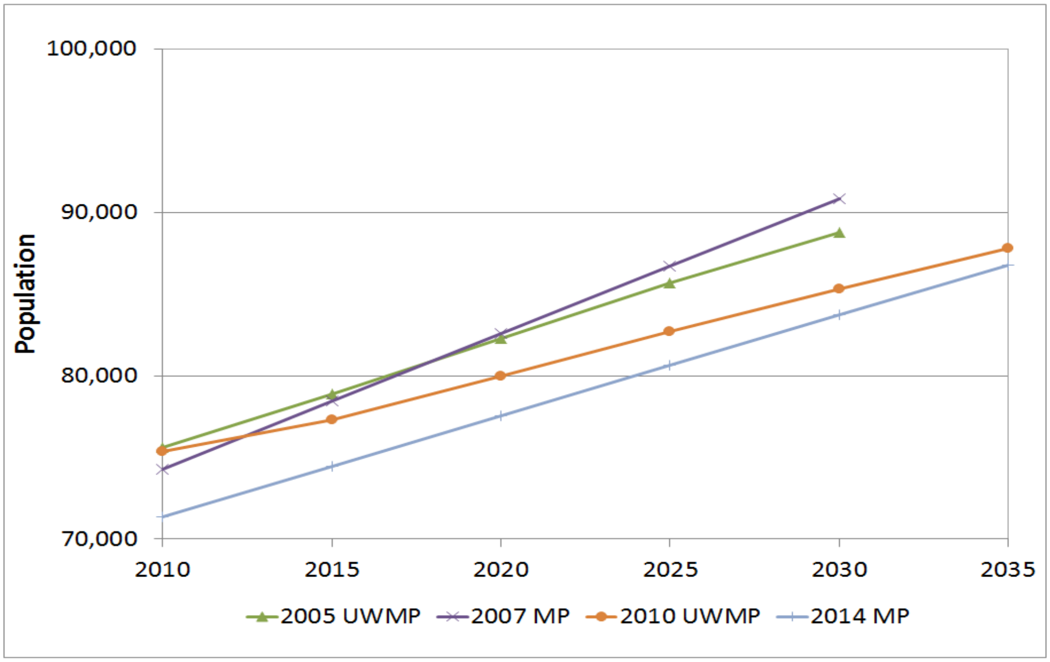
Estimating the demands for future wastewater service is probably the most straight-forward of the three systems. If a development occurs within the area that drains toward the Tapia WRF, the wastewater generated by the development is assumed to be collected and conveyed to Tapia for treatment. Wastewater from remote properties is very often economically handled with on-site septic system, rather than by constructing a sewer pipe to the property. However, as infill occurs and these properties become less remote, conversion from an on-site septic system to the local sewer system would be expected and should be considered in the plan.

Even if all developed property in the watershed is eventually connected to Tapia WR, there are some areas where LVMWD potable water customers will never be connected to Tapia WRF. Specifically, the south facing slopes of the Santa Monica Mountains, where water drains towards Malibu (and no treatment currently exists), and the properties along the north and west side of the San Fernando Valley, where wastewater naturally flows to Los Angeles treatment facilities.

2.2 Projections of Future Population

Historically, the primary driver of increasing demand for water and wastewater services has been population. As the Cities of Calabasas, Hidden Hills, Agoura Hills and Westlake Village were established and filled in, demands for water and wastewater service developed. Figure 2-2 shows the expected population figures for Las Virgenes, as found in various studies, including the 2014 Water Master Plan ("KJ Projection"). As more and more land in the District has become dedicated open space, projects have tapered. The original projections from the 1960s estimated a future population of nearly 140,000, compared to the most recent projection of roughly 87,000. The current population in the LVMWD service area is a little more than 71,000.

Figure 2-2. Population Projections for LVMWD



Legend: UWMP = Urban Water Management Plan; MP = Master Plan

For an agency like LVMWD, whose service area encompasses multiple cities and unincorporated areas, one of the major planning challenges is the collection and integration of land use data from several different sources. In general, agencies develop and manage information in different ways or platforms, compile data differently, and utilize different definitions to describe their information and data. Within LVMWD's service area each agency has its own unique land use categories and definitions. Another common issue associated with master planning is the unquantifiable pace of growth within a service area. While land use planning and other data provide a reasonable nexus for where growth will occur, the pace at which that growth will occur is dependent on many factors that are difficult to predict.

2.3 Regulatory Requirements

A backdrop to the development of water master plans is the regulatory framework for operating and managing a publicly owned water system. There are a number of state and federal requirements that are established to assure public safety, performance, and water quality. While these regulations are constantly being updated, LVMWD and the JPA have developed ongoing programs and procedures to comply with the core regulatory requirements.

Among the main regulations that affect water utilities are the criteria that must be used to evaluate the operation of the potable water distribution facilities. California Code of Regulations Title 22 states that, "At all times, a public water system's source(s) shall have the capacity to meet the system's maximum day demand." Fire flow requirements are established by the Los Angeles County Fire Department Regulation No. 8. The type and size of structures served by the potable water system determine the fire flows. The potable water system is required to sustain the required flow rate for the prescribed duration at a residual pressure of 20 pounds per square inch (psi). Wastewater utilities must likewise meet regulations regarding the quality of the water that is disposed to surface waters and recycled for irrigation and other use. Other regulations dictate where and how recycled water may be used.

Enacted in 2009, Senate Bill x7-7 (SBx7-7) requires a statewide 20 percent reduction in urban per capita water use by year 2020. It requires that urban water retail suppliers determine baseline water use and set reduction targets according to specified requirements. Failure to achieve the goals renders a water utility ineligible for state grants and loans.

While not directly affecting this planning effort, an additional issue facing LVMWD's water systems is the cost implications of the Bay Delta Conservation Plan (BDCP) and associated Delta Habitat Conservation and Conveyance Plan. The cost of water purchased from Metropolitan Water District of Southern California (MWDSC) may escalate sharply as a result of projects to improve water conveyance through the delta and lessen the environmental effects.

2.4 Topography and Climate

The climate in LVMWD's service area is semi-arid with mild winters, warm summers and moderate rainfall, consistent with coastal Southern California. This usually mild climatological pattern is interrupted infrequently by periods of extremely hot weather, winter storms, or dry hot Santa Ana winds. Summers are quite dry with an average temperature of about 76°F, and almost no rain. Winters are generally cool and wet with an average temperature of about 67°F. August is generally the warmest month.

Within the LVMWD/JPA service area, considerable climate variability exists, creating large differences in water demands and summertime peaks. As one moves away from the coast, summertime water demands increase considerably, with seasonal peaks in the hottest areas more than twice the peaking level that is found nearer to the coast.

2.5 Historical and Future LVMWD Potable Water Demands

Figure 2-3 shows historical potable water consumption within LVMWD along with significant milestones in the system's construction. Construction of the first major infrastructure began in the early 1960s with the Calabasas 8 MG tank and associated transmission pipelines. These facilities are still in use, and a project to rehabilitate this tank is currently underway. In the late 1970s, the source water changed from the Colorado River Aqueduct ("CRA") to the State Water Project ("SWP").

This growth in demand follows closely the development and growth of the District, but two remarkable drop-offs in demand are seen, the first starts in the late 1980s and is concurrent with three events, an economic downturn, mandatory water restrictions due to a shortfall in supply from the State Water Project, and the completion of the Western Recycled Water System, which removed considerable demand from the system. The second drop-off starts around 2008 and corresponds to the start of the "Great Recession" and implementation of mandatory water restrictions due to a shortfall in supply from the State Water Project. The various ups and downs in this graph reflect other factors, including the amount of rainfall that occurs in the wet season and the severity of summertime temperatures.

Figure 2-3. Historical Potable Water Use in LVMWD

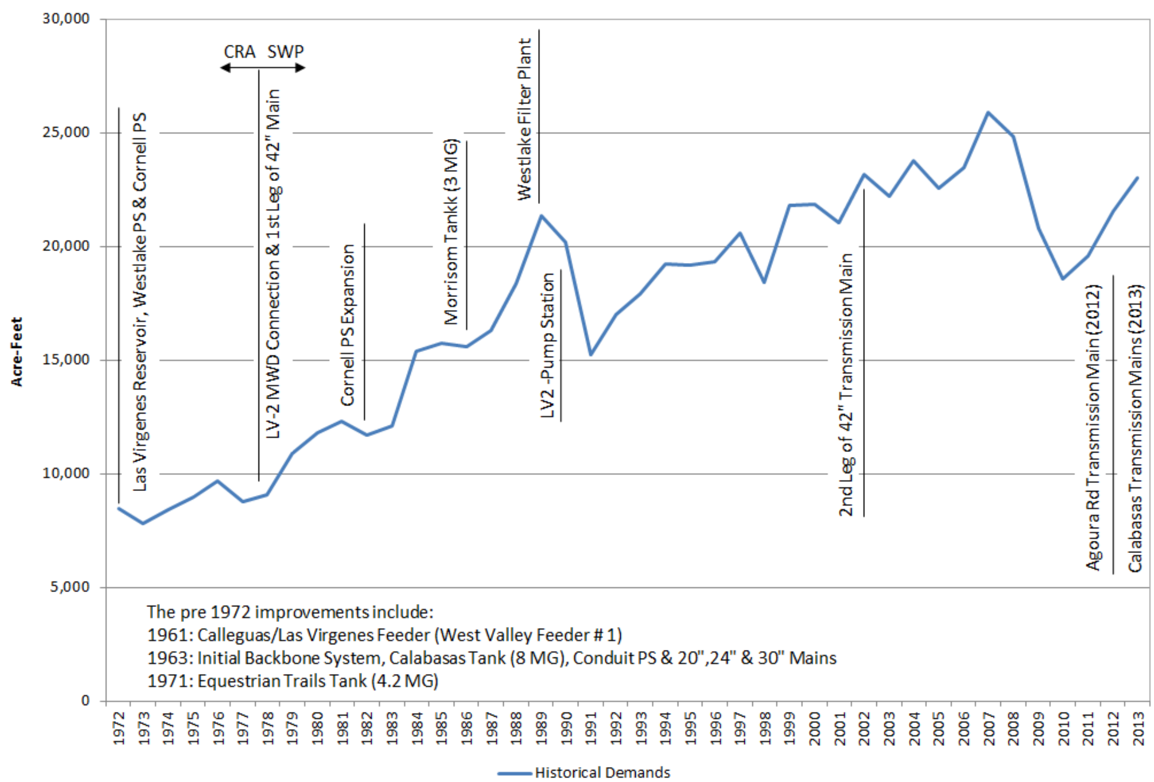
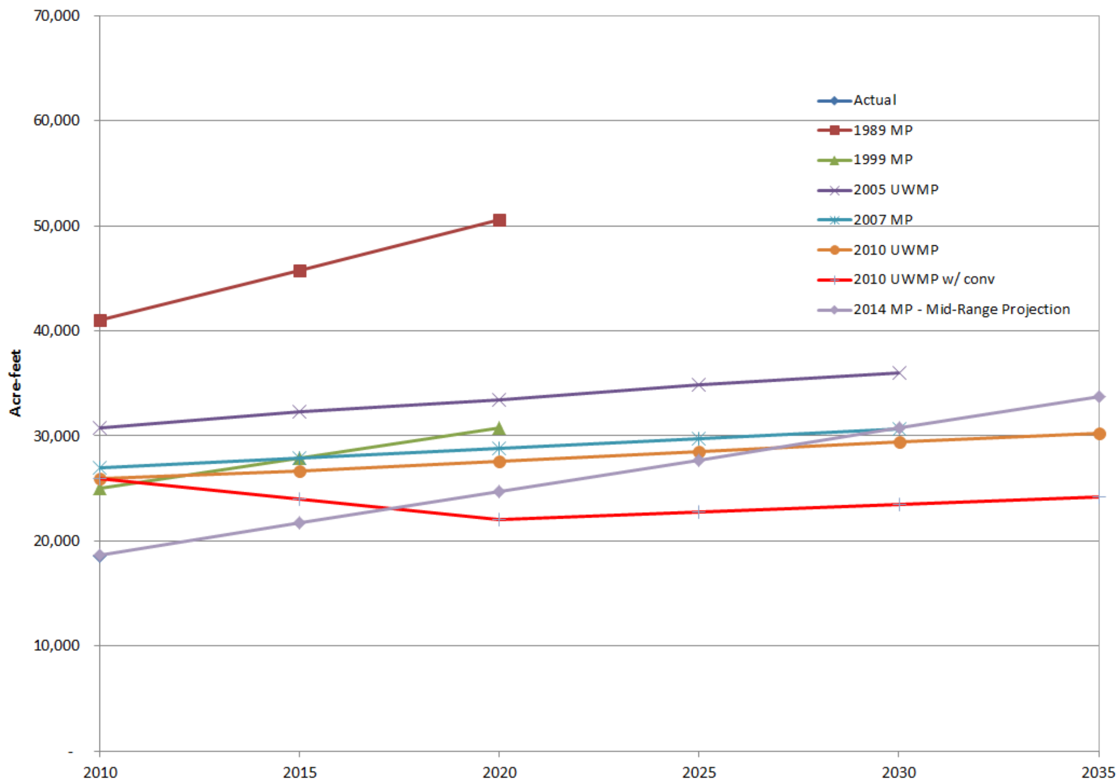


Figure 2-4 presents a compilation of various potable water projections including the most recent projection of future water demands made by Kennedy-Jenks Consultants for the 2014 Potable Water Master Plan. As part of its forecast, Kennedy-Jenks performed a statistical analysis which showed that the state of the economy, in particular the area-wide unemployment rate, was highly correlated to water demands. As the unemployment rate drops over the next few years, water demands are expected to recover to their pre-2008 level and then continue to climb. As such, the most recent forecast suggests a rebound in demands will likely occur as the economy recovers. Each of these forecasts ends at “build out”, the point when all developable land in the District is used up. For planning purposes, “build out” is projected to occur around 2035, but will actually occur sometime beyond that planning period.

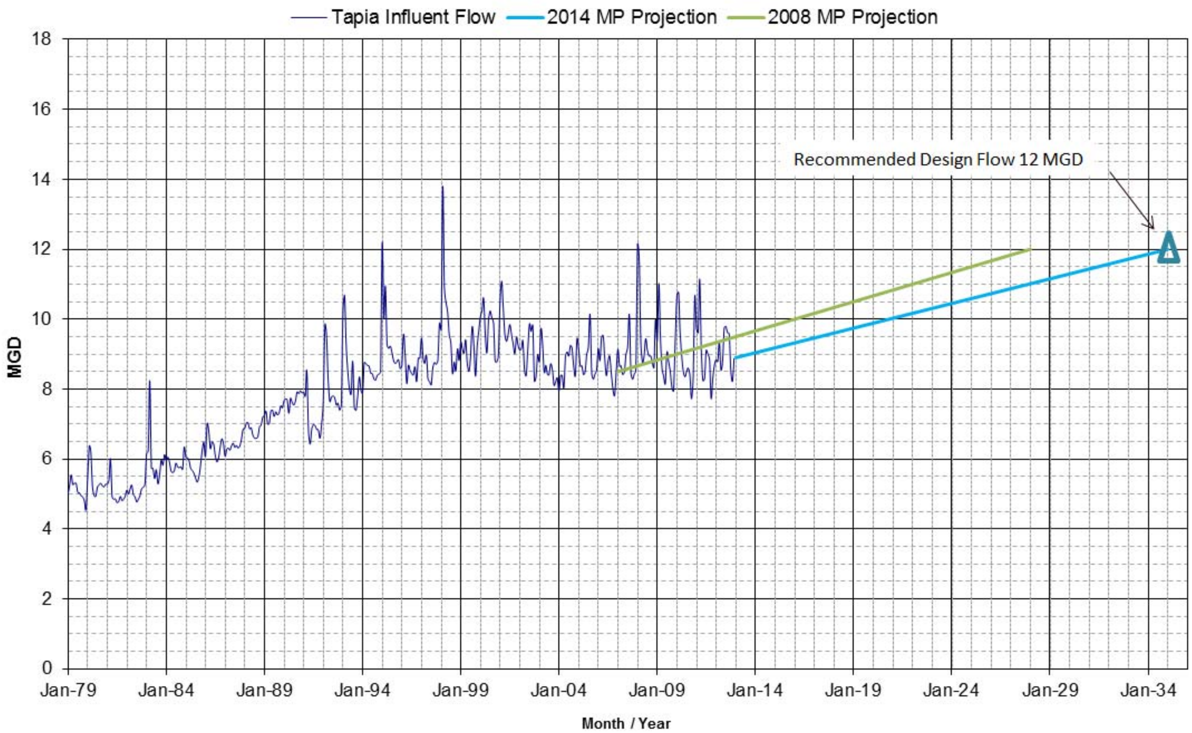
Figure 2-4. Potable Water Demand Projections



2.6 Historical and Future Demands for Wastewater Services

Figure 2-5 shows historical and projected flows of wastewater to the Tapia WRF. This treatment plant was originally constructed in 1965 and has undergone several upgrades and expansion through the years. The last major expansion occurred in the 1990’s provided a hydraulic capacity of 16 million gallons per day (MGD). However, because the plant must now remove nitrogen and other nutrients in addition to meeting the criteria for which it was originally constructed (e.g., “BOD”, biological oxygen demand), the plant is currently able to treat a maximum of about 12 MGD on a typical dry-weather day. At present, the average dry-weather flow is a little more than 9 MGD.

Figure 2-5. Historical and Projected Wastewater Flows at Tapia WRF

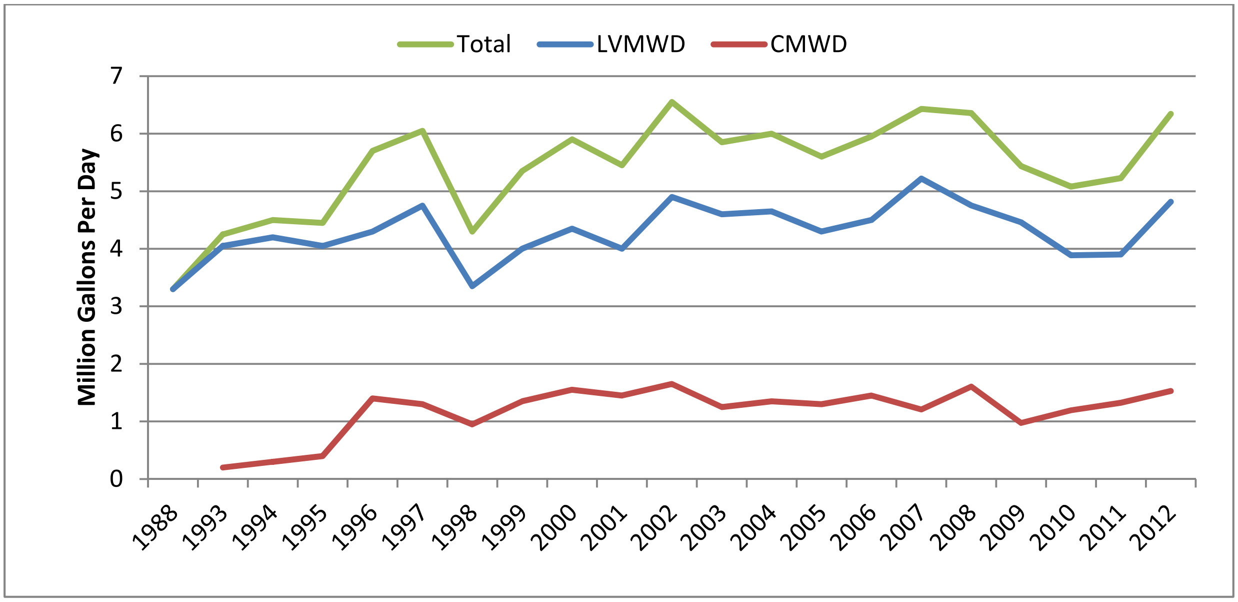


This chart shows a definite flattening of wastewater flows beginning in 1995. Interior water conservation programs such as low-flow toilets, shower heads, washing machines, and other appliances implemented by LVMWD and TSD account for a large part of this change. This chart also shows several peak flows well above the average. These correspond to large rain events, when water flows into the collection system through manhole lids, leaks in pipes, and inappropriate connections of roof drains or other catchments to the sewer system.

2.7 Historical and Future Demands for Recycled Water

Overall records of recycled water sales are shown in Figure 2-6. There has been an upward trend in sales since the system's inception in 1988, with two noticeable dips in demand. The first one, occurred in 1998 and corresponded to unusually wet "El Niño" year, and a second smaller dip in 2005, when near-record rainfall was also experienced. Higher demands in the early 1990s may also 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. While cooler weather and the economic downturn in the 2008 to 2010 time period have affected recycled water sales, an increase in usage in 2011 and 2012 from an improved economy and hotter, drier weather has returned recycled water sales to near historical highs for the JPA.

Figure 2-6. 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 wastewater customers in Ventura County account for about one-third of the recycled water produced, but recycled water sales to TSD, CalWater, and Lake Sherwood customers in Ventura County account for 25 percent or less of recycled water usage.

An important observation from the information shown in Figure 2-6 is that the JPA has essentially doubled its usage of recycled water since this service began, some 28 years ago. This is particularly noteworthy in light of the importance and scarcity of water supplies in Southern California. Today, approximately 75 percent of the average dry-weather wastewater received at the Tapia WRF is reused through the JPA's extensive recycled water system.

To maintain or increase the portion of treated wastewater that is used by the recycled water system will be more difficult than in the past. Since infill development is limited and there are minimal new opportunities to serve the typical major recycled water customers (schools, parks, and golf courses), LVMWD, Oak Park Water Service, and other local retail water purveyors 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.

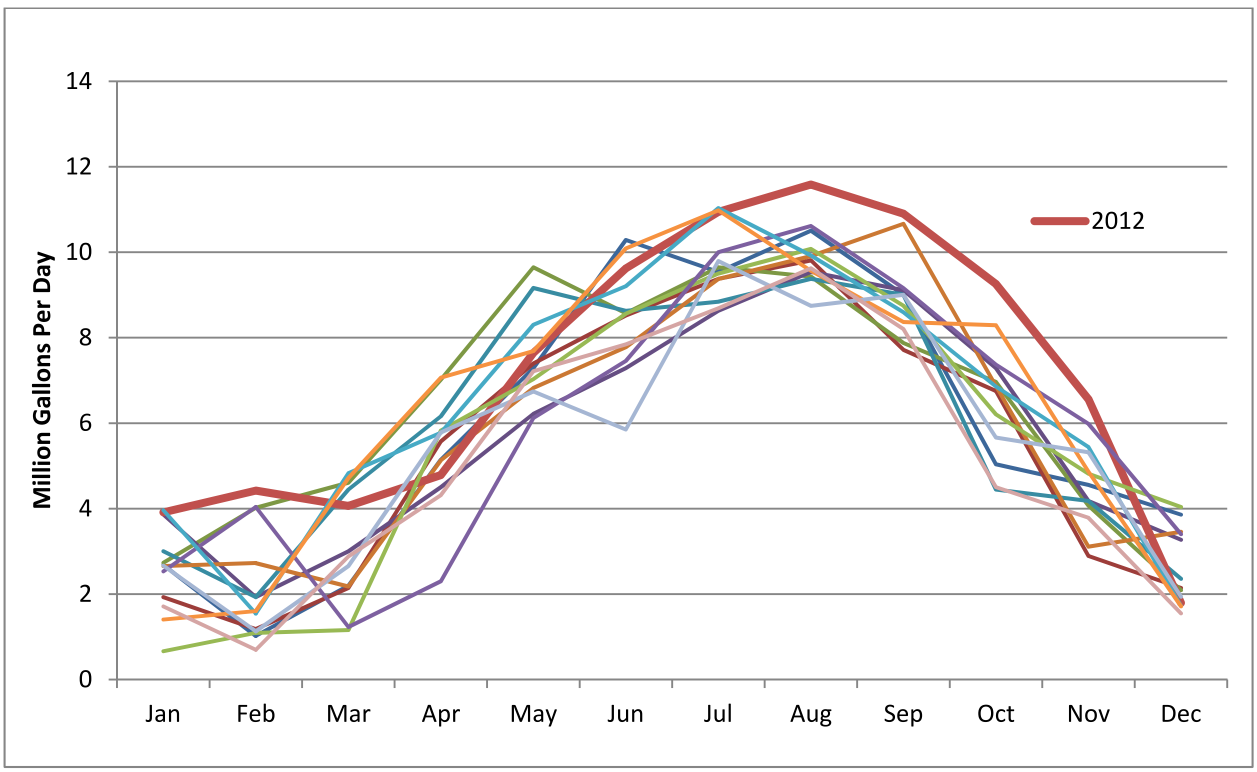
Moving forward, the majority of potential growth in recycled water usage will have to come from proposed extensions to the recycled water system. The vast majority of the Recycled Water Master Plan analysis consisted of assessing the hydraulic and economic feasibility of building various recycled water system extensions. These main extensions, summarized in Section 4, would largely serve existing customers both within and outside of the JPA service areas, converting a portion of existing potable water demand to recycled water use.

2.8 Seasonal Variations in Water Demand

As one would expect, demands for water vary considerably with the season; summer usage is often two to three times higher than winter water usage. Seasonal peaking is particularly pronounced for the recycled water system which is used for little else but irrigation in the JPA areas. In wet years in particular, sales in January and February can be miniscule, then sharply escalate as temperatures increase and the rain disappears.

Figure 2-7 shows the variability in monthly recycled water sales over the last 12 years, with 2012 graphically emphasized. It appears that higher sales in the winter, summer and fall of 2012 contributed to a near-record recycled water sales year. This large uptick in total annual sales was previously shown in Figure 2-6. This review of the seasonal 2012 demands suggests that the recent increase in usage may partially diminish when wetter winters and cooler weather returns. On the other hand, as discussed by Kennedy Jenks in the 2014 Potable Water Master Plan Update, since the state of the economy tends to have a greater influence on water usage than the weather; even higher recycled water usage may occur with continued economic improvement.

Figure 2-7. Average Monthly Recycled Water Sales



An important element of integrated planning is the seasonal imbalance of recycled water demands and the availability of treated wastewater (supply). The supply is relatively constant but the demand is anything but constant. This seasonal imbalance is discussed in the following section of this report.

Section 3 – Water Supplies

Section 3: Water Supplies

Located in the Santa Monica Mountains, LVMWD has limited availability of natural water resources and is currently limited to four sources: treated, potable water imported from Metropolitan Water District of Southern California (MWDSC), recycled water from the Tapia Water Reclamation Facility, groundwater from the “Westlake Wells” (Russell Valley Basin, used to supplement Tapia WRF), and surface runoff into Las Virgenes Reservoir. The imported water supplied to LVMWD originates from the State Water Project (SWP).

Although not a subject of this study, the water supply to TSD is similar, with MWDSC water being supplied through the Ventura County wholesale agency, Calleguas Metropolitan Water District (CMWD) and recycled water from Tapia WRF.

3.1 Imported Water - MWDSC

Imported water is the primary water source and supplies virtually all potable water demands. LVMWD’s imported water supplier is MWDSC, which imports water from northern California through the SWP and the Colorado River to meet the needs of 26 member agencies across six Southern California counties. MWDSC also supplies water to CMWD, which supplies water to TSD and other Ventura County water utilities.

LVMWD and CMWD are two of MWDSC’s 26 member agencies. Currently, the configuration of MWDSC’s distribution system provides LVMWD and CMWD solely with SWP water originating from northern California through the Sacramento-San Joaquin Bay-Delta. This may change; in response to the current severe drought, MWDSC has indicated that Colorado River Water may soon return to LVMWD and CMWD. Should this occur, it is projected to be a temporary water supply condition.

The SWP water is treated at the Jensen Filtration Plant in Granada Hills prior to delivery to LVMWD. LVMWD maintains three connections to the MWDSC system, all on the eastern side of the District. The most important connection is “LV-2”, a metering and pumping facility located in Old Town Calabasas. LV-2 supplies more than 90 percent of the MWDSC water consumed by the District, while the remaining 10 percent is supplied by the LV-1 and LV-3 connections.

3.2 Groundwater – Russell Valley Basin

Groundwater underlying the JPA service areas is of poor quality and is not currently used for the potable water supply systems. Currently, the JPA operates two groundwater wells in the Russell Valley groundwater basin (Basin): Westlake Well 1 and Westlake Well 2, near the intersection of Lindero Canyon and Lakeview Canyon Road. Both wells pump water from the Russell Valley. The combined capacity of these two wells is approximately 1.15 MGD (800 gallons per minute (gpm)), but extended reliable production averages about 0.75 MGD (500 gpm), when run for several consecutive summer months.

Due to high levels of iron and manganese in this basin, groundwater pumped from these wells would require treatment to be used for drinking water. To avoid the cost of a separate treatment facility, the pumped groundwater is discharged into the sewer collection system. After mixing with wastewater, this water is treated at the Tapia WRF and used to supplement needed recycled water system production in the summer, when demands for recycled water exceed the normal supply from Tapia WRF.

3.3 Other Sources of Water

Las Virgenes Reservoir is a key facility for the LVMWD system, as it provides both seasonal and emergency storage. The reservoir allows LVMWD to purchase water from MWDSC in the winter and store it for summer. The storage capacity for this reservoir is 9600 acre-feet. While the Las Virgenes Reservoir is not truly a “source” of water, it is the primary water supply when the MWDSC supply is interrupted for maintenance or emergency conditions. It is also used to meet peak summer demands, enabling smaller transmission pipes and pumping facilities, by providing a source of water on the west side of the District, balancing the MWDSC supplies on the east side. The Las Virgenes Reservoir is located in the hills just south of Westlake Village.

In addition to serving as a seasonal storage facility, the Las Virgenes Reservoir also provides emergency storage capacity during imported water outages. Although LVMWD also utilizes a connection to the Los Angeles Department of Water and Power (LADWP) System during scheduled MWDSC outages, following a major earthquake, the Las Virgenes Reservoir is the only source of supply that the District can count on. Lake Bard in the CMWD system provides a similar function for TSD and other Ventura County utilities.

While these reservoirs watersheds do not supply a significant source of water in most years, runoff does help offset evaporative and seepage losses. In very wet years, significant inventories have been realized. Based on an assumed watershed area of 550 acres, the Las Virgenes Reservoir watershed is estimated to receive about 770 AF annually. Average evaporation losses are estimated at about 700 AFY.

In addition to the connection to the LADWP system, Las Virgenes has a small connection to Ventura County Waterworks District No. 8, which supplies a few customers in the Box Canyon area. A large intertie connection with Calleguas MWD has been studied several times, including during the 2014 Potable Water Master Plan. This connection would provide mutual benefit, particularly during times of emergency. LVMWD also occasionally supplies water to Malibu and Oak Park through small connections.

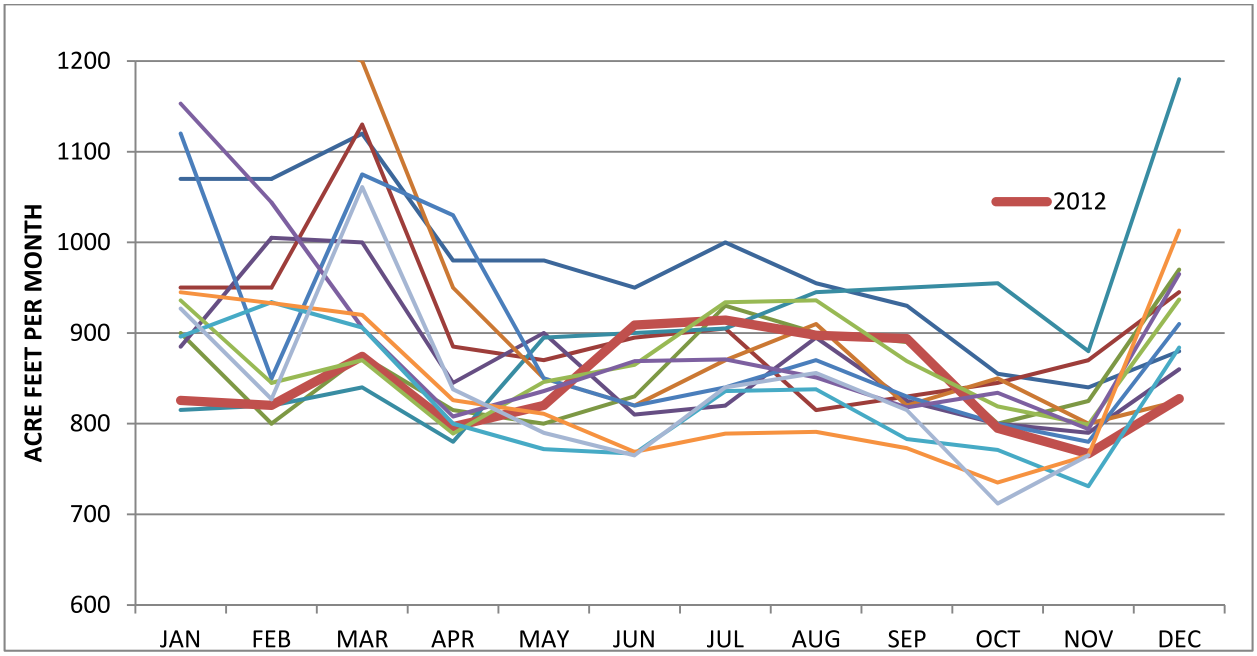
3.4 Recycled Water Supply

The year-round supply of recycled water to the JPA’s Recycled Water System is tertiary-treated wastewater produced at the Tapia WRF. 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 and lower demands for imported water.

Figure 3-1 shows the monthly variation in Tapia WRF inflow from 2000 to 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. Since this is the seasonal period when sales of RW water are low, this water is excess to the recycled system and has limited value to the JPA at this time.

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. 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. Inflow peaks with rain, but decreases shortly after the rain event ends.

Figure 3-1. Historical RW Production at Tapia WRF, 2000 through 2012



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

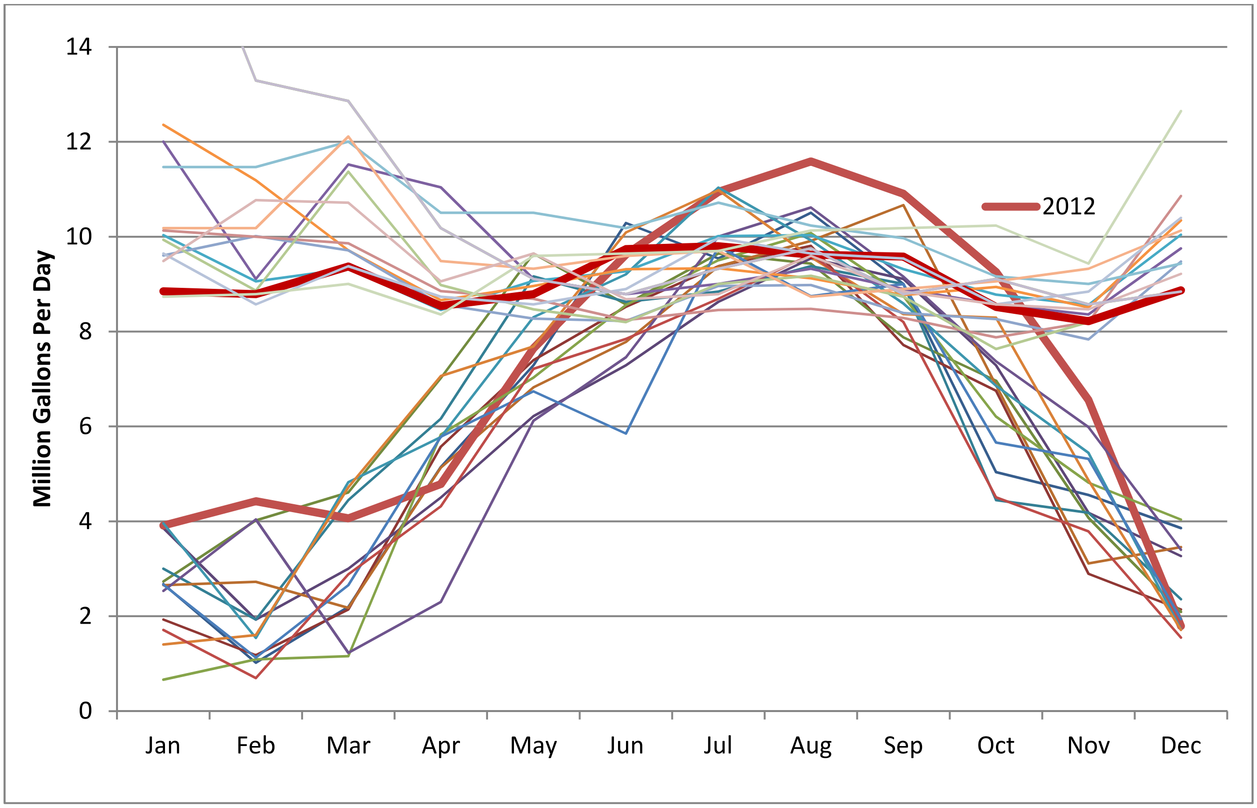
The flows shown in Figure 3-1 include the water pumped from the Westlake Wells. This water is discharged to the sewer system and is processed through Tapia WRF and thus is recorded by the influent meter. Other supplemental sources of water are provided at various points in the recycled water distribution system and are not shown in this figure.

3.5 Supply vs. Demand

Figure 3-2 compares monthly recycled water sales with available recycled water for the years 2000 through 2012. This figure shows that recycled water sales in the summer significantly exceed recycled water availability, even when water from the Westlake Wells was provided. This means that considerable potable water supplement is needed, starting in late June and continuing into October.

Potable water is supplied to the recycled water system through various “air gaps” which prevent the backflow of water from the recycled water system into the potable water system. Las Virgenes has such facilities within each of its RW pressure zones. A similar supplemental facility has been suggested for the Oak Park RW system, to increase its reliability and improve its ability to supply a major extension into Thousand Oaks, if such an extension is implemented.

Figure 3-2. Comparison of Monthly RW Sales and Supply, 2000 through 2012



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

An alternative to the use of the Westlake Wells and potable water to supplement the RW system would be to store surplus RW in the winter for use in the summer. Such seasonal storage has been evaluated in several studies, but the current and foreseeable future demands are insufficient to make a seasonal reservoir economically viable. There are also considerable environmental and regulatory difficulties associated with permitting an open-reservoir storage project. Such a project would likely be controversial, necessitating substantial public outreach and education. At this time, the storage of surplus RW in groundwater basins in the area has been determined to be unfeasible due to limited capacities and environmental concerns.

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.

3.5.1 “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 of year 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 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. Disposal through this facility is relatively inexpensive, although it requires pumping the water to a relatively high elevation. Additional testing and monitoring for the NPDES permit is also needed.

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.

3.5.2 Potable Water Reuse

As water supplies in California and elsewhere have become more constrained, there has been increasing focus on using advanced treated purified water (ATPW) as a supply for potable water systems. Indirect reuse is where ATPW is discharged to a lake or groundwater basin in locations that are relatively removed from water intakes or wells. The time required for the water to travel from discharge point to intake enables additional natural treatment to occur as well as allows a time buffer, in case of a malfunction of the treatment process. Indirect reuse already occurs in several systems throughout the United States and California. Direct reuse is where ATPW is used as a supply to a potable water treatment plant or directly used in a potable water distribution system. Direct reuse is currently not permitted in California, but studies are underway with the goal of developing regulations for its future implementation. Direct reuse is currently being implemented in Texas.

In order to use RW as a source of producing ATPW either directly or indirectly in the LVMWD or TSD systems, additional treatment involving ultra-filtration, reverse osmosis, and disinfection using UV and peroxide would likely be required. At the current time, this is not practical because such treatment produces a concentrated brine, which would need to be discharged to the ocean or through deep-well injection. Constructing an ocean outfall extending from Tapia through Malibu and into the ocean would be a very expensive project, and would result in considerable opposition. Calleguas MWD is currently constructing such a brine disposal pipeline which has an ocean outfall near Port Hueneme. The Calleguas pipeline should eventually extend to Moorpark and Simi Valley, but this pipeline would still be a considerable distance from the JPA recycled water system. Connecting to this pipeline would be an expensive project, but probably not as controversial as an outfall through Malibu Canyon.

Should a brine disposal method ever be developed (and with anticipated changes in regulation), advanced treated RW could possibly be discharged to the Las Virgenes Reservoir, which would provide both seasonal buffering and dilution.

Brine disposal and potable reuse would also make a seasonal storage reservoir much more attractive. A larger reservoir would capture all excess RW for reuse, not just the portion needed for irrigation customers.

3.6 Possible Future Discharge Limits

In November 2005, the LA RWQCB issued a new NPDES permit for the TWRF. The new permit consolidated the Malibu Creek and Los Angeles River discharge and monitoring requirements under a single permit. A nitrogen requirement of 8 mg/L nitrate, based on the EPA TMDL, was specified. An associated TSO provides less stringent, interim limits until the final compliance date of May 18, 2010. Facilities needed to comply with the nitrogen requirement have been constructed and have been in operation since late 2009. In addition to the nitrogen requirement described above, the permit also includes requirements for other constituents. A 3 mg/L total phosphorus limit as a monthly average, based on historical plant performance, is unchanged in the new permit from the previous 1997 permit. However, the daily maximum value is more restrictive, changing from 6 mg/L to 4 mg/L. Compliance has generally been achieved since the end of 2011.

It should be noted that discharge limitations for some of the mineral-based constituents, like total dissolved solids and chlorides, are actually more stringent to the LA River than to Malibu Creek. Since mineral removal at Tapia WRF would be a high cost addition to the plant, it is recommended that the JPA continue to monitor mineral constituents for trends in increased loadings. Moreover, given the potential significant cost of mineral removal for LA River discharges emphasizes the long-term benefit of maintaining the ability to discharge to Malibu Creek. While there are limits for other toxic materials, these are not anticipated to pose compliance problems based on recent plant performance.

The current permit also includes a provision for an annual Reasonable Potential Analysis (RPA) that may trigger new limits for priority pollutants that have a reasonable potential to cause, or contribute to an excursion above any State Water Quality Standard. Some of these pollutants include those discussed previously. In the first RPA conducted under the new permit, seven pesticide chemicals triggered reasonable potential. A reopener provision in the permit allows the LA RWQCB to reopen the permit to allow inclusion of new numeric limitations for constituents that exhibit reasonable potential. No treatment facilities are planned to remove these constituents. The current permit also retained the Malibu Creek discharge prohibition from April 15 to November 15 except during treatment plant upsets and operational emergencies, qualifying storm events, and creek flow augmentation.

The JPA anticipates the next discharge permit will be issued in the fall of 2015. With each renewal, there's a significant chance expensive plant upgrades will be required. In the Tapia Effluent Alternatives (TEA) Study of 2005 (LVMWD Report No. 2321.03), Kennedy/Jenks explored dozens of alternatives to Malibu Creek discharges, but found that complete creek avoidance would be very costly. In the meantime, prudent expansions of the RW system offers a sound approach to efficiently maximize the use of this local water resource, meet the complex regulatory requirements of seasonal discharges to Malibu Creek, and provide a financial hedge against the rising costs of imported water.

Section 4 – Analysis of System Facilities

Section 4: Analysis of System Facilities

An important part of the Potable Water, Recycle Water, and Sanitation Master Plan updates is the need to develop various computer models to analyze the capabilities of these systems to meet current and anticipated future demands. The criteria used for the analyses were derived from regulatory requirements, standard operational practices for water, recycled, and wastewater systems, and long-established local standards.

These analytical models included:

- A computer network analysis model of the potable water system. This model was an update of an earlier model, developed for the 1999 Master Plan, and previously updated in 2007.

- A computer network analysis of the recycled water system. This model was essentially new. Geographical information system (GIS) data from LVMWD, TSD, and CMWD were used to generate a model that, for the first time, included the Ventura County portions of the system and was linked to customer billing records. This new model architecture provides additional accuracy and promotes efficient future updates.

- A computer biological simulation model of the wastewater treatment system.

Validation of these models was performed by comparing modeling results with data from existing system operations. These validation tests showed good agreement between expected results for current conditions and data recorded by the District's SCADA (supervisory control and data acquisition) system and other applicable data sets. Because the model findings compared very well with actual existing operations, there is a high confidence in using these models to analyze system responses to various demand scenarios and ascertain appropriate solutions to identified deficiencies. In addition to these computer models, spreadsheet analyses were also performed to determine whether existing facilities had sufficient capacities to reliably meet current and future requirements.

4.1 Analysis of Potable Water System

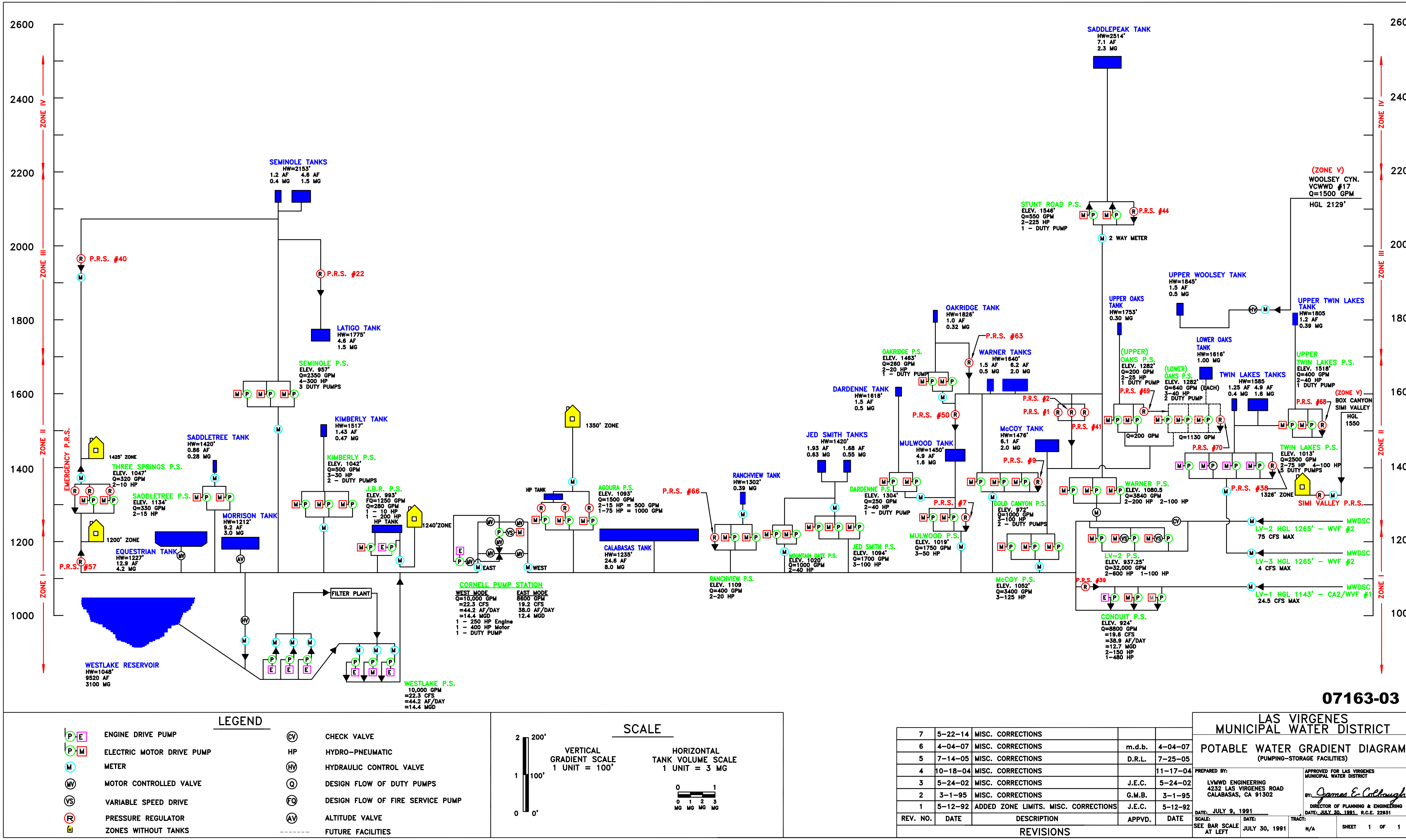
An analysis of the potable water system is summarized in the following subsections.

4.1.1 Description of LVMWD Potable Water System

The potable water system owned and operated by LVMWD is shown schematically in Figure 4-1 and is generally described below:

- Water originates at three "turnouts" on the MWDSC system. LVMWD's principal turnout is LV-2, which provides more than 90 percent of the water consumed by its customers.

- LV-2 pumps water into the "backbone system", which denotes the transmission, pumping and storage facilities along the 101 Freeway corridor. This system feeds water directly to many customers, and indirectly to nearly everyone else, via various pump stations that draw water from this system or zone.



Schematic of LVMWD Potable Water System
Figure 4-1

- Water is conveyed to LV-2 via MWDSC's Calabasas Feeder, a prestressed concrete cylinder pipe (PCCP). While this pipe material rarely fails, historical failures have been substantial. To minimize the risk of PCCP failures, MWDSC has an active program for evaluating the condition of these pipes, and has targeted the Calabasas Feeder for rehabilitation within the next decade.

- The LV-1 turnout was the original source of MWDSC water and has largely been displaced by LV-2. LV-1 can provide supply to the West Hills area and supplements supply to the "backbone" system, via the Conduit Pump Station.

- The LV-3 turnout provides supply to the Twin Lakes Subsystem at the northwest corner of the San Fernando Valley. This subsystem is hydraulically isolated from the rest of the District, but plans to construct an interconnecting pipeline have been drafted. The Twin Lakes Subsystem in turn supplies the Upper Twin Lakes and future Deerlake Highlands Subsystems.

- At the western end of the Backbone System is the Las Virgenes Reservoir, Westlake Filtration Plant, and Westlake Pump Station. These facilities provide a source of emergency supply, as well additional supply to cost effectively meet peak summer demands. Construction of a new 5MG tank, expansion of the filtration plant, and improvements to the pump station are currently underway, which will enhance the supply capabilities of these facilities and provide additional system reliability and emergency flow capabilities.

- Other key facilities in the Backbone System are the Calabasas Tank, Equestrian Trails Tank, Morrison Tank and Cornell Pump Station. These facilities help balance the flows and demands of customers between Calabasas and Westlake Village.

- 22 distinct subsystems are supplied from the backbone system, via pump stations and tanks which supply customers at various elevations throughout the Santa Monica Mountains. The operations of these facilities is coordinated to optimize flows in pipelines, conserve emergency supplies, maintain good water quality, and minimize the cost of energy to provide meet system needs.

4.1.2 Potable Water System Analysis – Results and Recommendations

After the model was verified, projections of future water demands throughout the system were added and the system performance was analyzed under peak-hour and fire flow conditions during the summer's maximum day demands. In addition to the use of the updated hydraulic model, the District's storage and pumping facilities were evaluated against maximum day demand conditions to ensure that the system can operate properly. The latter analysis determines if the facilities have sufficient capacity to accommodate off-peak pumping, when energy costs are the lowest. The storage and pumping facilities were evaluated together, as off-peak pumping requires both more pumping capacity and more storage.

Recommendations to address the findings of the potable water system analysis are divided into three categories: piping, storage, and pumping. A summary of the findings and recommended improvements for each of these areas of the system follows:

4.1.2.1 Potable Water Pipelines - Findings and Recommendations

Pipeline deficiencies were prioritized based on discussions with District staff as follows:

- Priority 1 - are projects that address significant existing capacity deficiencies
- Priority 2 - are projects that address less significant existing capacity deficiencies, many of which occur in older parts of the system due to changes in standards from when annexed systems were acquired.
- Priority 3 - are projects that address small capacity deficiencies
- Priority 4 - are deficiencies that were less than 10 percent of capacity requirements. These deficiencies do not merit inclusion in the capital improvement program, but have been retained in the report for use in future master plan analyses.

The improvements needed to correct current and future deficiencies are summarized in Tables 4-1 and 4-2.

Table 4-1. Pipeline Improvements for Existing Demand Conditions

Existing CIP Priority	Length (Ft)	Estimated Cost
1	2,400	$927,450
2	13,297	$4,575,150
3	3,913	$1,410,750
Total	**19,611**	**$6,913,350**

Table 4-2. Pipeline Improvements for Future Demand Conditions

Future CIP	Length (Ft)	Estimated Cost
Total	28,975	$13,548,600

Note: Approximately $10.7M is associated with new Seminole System pipelines.

4.1.2.2 Potable Water Storage - Findings and Recommendations

The findings of the storage analysis in the 2014 Potable Water Master Plan update were comparable to the findings in the 2007 Potable Water Master Plan and confirmed the need for the new 5 MG tank in the main zone. Other current deficiencies exist in the Jed Smith and Upper Oaks systems. Based on the degree of deficiency and discussions with District staff, only the Jed Smith storage deficit is considered for improvement under existing demands. The estimated cost (including contingencies) to meet the 0.8 MG storage deficit in this zone is shown in Table 4-3.

Table 4-3. Storage Projects for Existing Demand Conditions

Pressure Zone	Storage Needed (gallons)	Estimated Cost
Jed Smith	820,000	$1,912,000

Under full-build-out future demand conditions, storage deficits occur in eight pressure zones. A summary of these findings is included in Table 4-4. In this table, the storage deficit for the Jed Smith system is in addition to the storage needed for existing demand conditions.

Table 4-4. Storage Projects for Future Demand Conditions

Pressure Zone	Total Storage Needed (gallons)	Estimated Cost
Jed Smith	1,430,000(1)	$1,403,000
McCoy	300,000	$699,000
Mulwood	180,000	$423,000
Seminole	1,170,000	$3,951,000
Twin Lakes	1,510,000	$3,504,000
Upper Oaks	150,000	$360,000
Upper Woolsey	470,000	$1,098,000
Warner	1,040,000	$2,415,000
Total	**6,250,000**	**$13,853,000**

Notes:
(1) The 1.4 MG in total storage need includes existing deficit. Future-only need is 600,000 gallons.

4.1.2.3 Potable Water Pump Stations - Findings and Recommendations

The analysis pumping facilities revealed no significant deficiencies for existing demand conditions. However, there are several pump stations that do not appear to have standby pumps. Standby pump deficiencies are summarized in Table 4-5.

Table 4-5. Potential Standby Pumping Needs for Existing Conditions

Pressure Zone	Standby Pumping Needed (hp)	Standby Pumping Needed (gpm)	Estimated Cost
McCoy	69	1133	$959,900
Mulwood	39	750	$540,850
Total			**$1,500,750**

Notes: : Existing pumping capacity appears sufficient for Oak Ridge, Saddle Tree, Upper Oaks, and Upper Twin Lakes pumping facilities.

To assure analysis and recommendation consistency, the storage and pumping for each zone were analyzed together to determine the pumping needs for each zone. Table 4-6 summarizes the capacity deficiencies identified for future demand conditions.

Table 4-6. Pumping Needs for Future Conditions

Pressure Zone	Pumping Needed (hp)	Pumping Needed (gpm)	Estimated Cost
Jed Smith/Mountain Gate	47	987	$653,950
Mulwood	25	485	$348,000
McCoy	60	981	$804,750
Seminole	79	2934	$1,059,950
Twin Lakes	163	1878	$1,890,800
Total			**$4,757,450**

4.1.3 Backbone Improvements Program

LVMWD initiated the Backbone Improvement Program in 2008 to address both current and projected future deficiencies in system storage, transmission and treatment capacity that create risks of low pressure, water outages, inadequate emergency supplies and inadequate fire flows. The program consists of transmission mains in Agoura Hills completed in 2012, transmission mains in Calabasas completed in 2014, a five million gallon storage tank under construction in Westlake Village, expansion of the Westlake Filtration Plant and modernization of the Westlake Pump Station. Construction of many of these facilities is necessary to correct the system deficiencies and ensure reliable water service.

The analysis of the potable water system in this master plan was based on these improvements being completed. If they are not completed, as planned, many of the conclusions in this report will no longer be valid.

4.2 Analysis of Recycled Water System

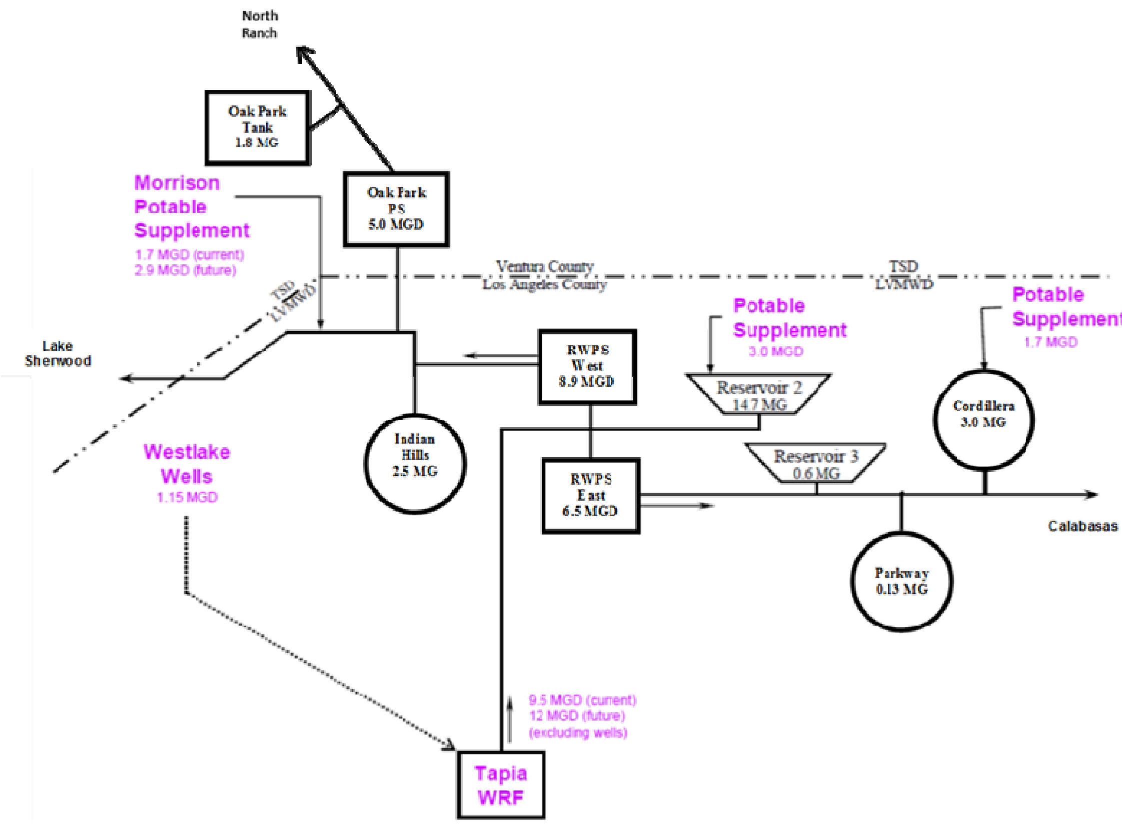
An analysis of the recycled water system is summarized in the following subsections.

4.2.1 Description of JPA/Calleguas MWD RW System

The recycled water system owned and operated by the JPA and Calleguas MWD is shown schematically in Figure 4-2. A general description of this system follows.

- The recycled water is produced at Tapia WRF, at the southern end of the system. The source water is wastewater treated at the facility mixed with well water discharged into the sewer system, when supplemental water is required.
- Water is pumped to Reservoir 2, a 45 acre-ft facility located adjacent to LVMWD headquarters. Additional supplemental potable water is often added at this facility, during times when RW demands exceed RW supply.
- The Recycled Water Pump Station (RWPS), also located adjacent to LVMWD headquarters, pumps water to the eastern and western systems.
- Cordillera Tank is the primary storage facility in the eastern system, which serves recycled water to Calabasas and adjacent areas.
- The small Parkway Pump Station draws water from the Eastern System for storage in the Parkway Tank. This subsystem serves the Oaks of Calabasas subdivision.

Figure 4-2. Schematic of JPA and Calleguas RW Systems



- Indian Hills Tank is the primary storage facility in the western system. This system serves recycled water to Agoura Hills, Westlake Village, Lake Sherwood and adjacent areas. This system also provides RW to the Oak Park Pump Station.

- The Morrison Pump Station draws potable water from the Morrison Tank, one of the primary storage facilities in the LVMWD potable water backbone system. Through this facility, additional potable water supplement is provided.

- Recycled water entering Ventura County along Kanan Road is pumped by the Oak Park Pump Station to the Oak Park Tank. The systems in Ventura County are owned and operated by Calleguas MWD, who sells the recycled water to Oak Park Water Service and Cal Water Service Company. The Oak Park Pump Station and Tank serve customers in the community of Oak Park and the North Ranch neighborhood of Thousand Oaks.

- Another pipeline into Ventura County serves Lake Sherwood Golf Course and a few customers in the Westlake portion of Thousand Oaks.

- Not shown in this figure is Discharge Facility 005, which discharges RW from the Eastern System to a Los Angeles River storm drain. This facility is used when discharges to Malibu Creek are prohibited and water supply exceeds water demands.

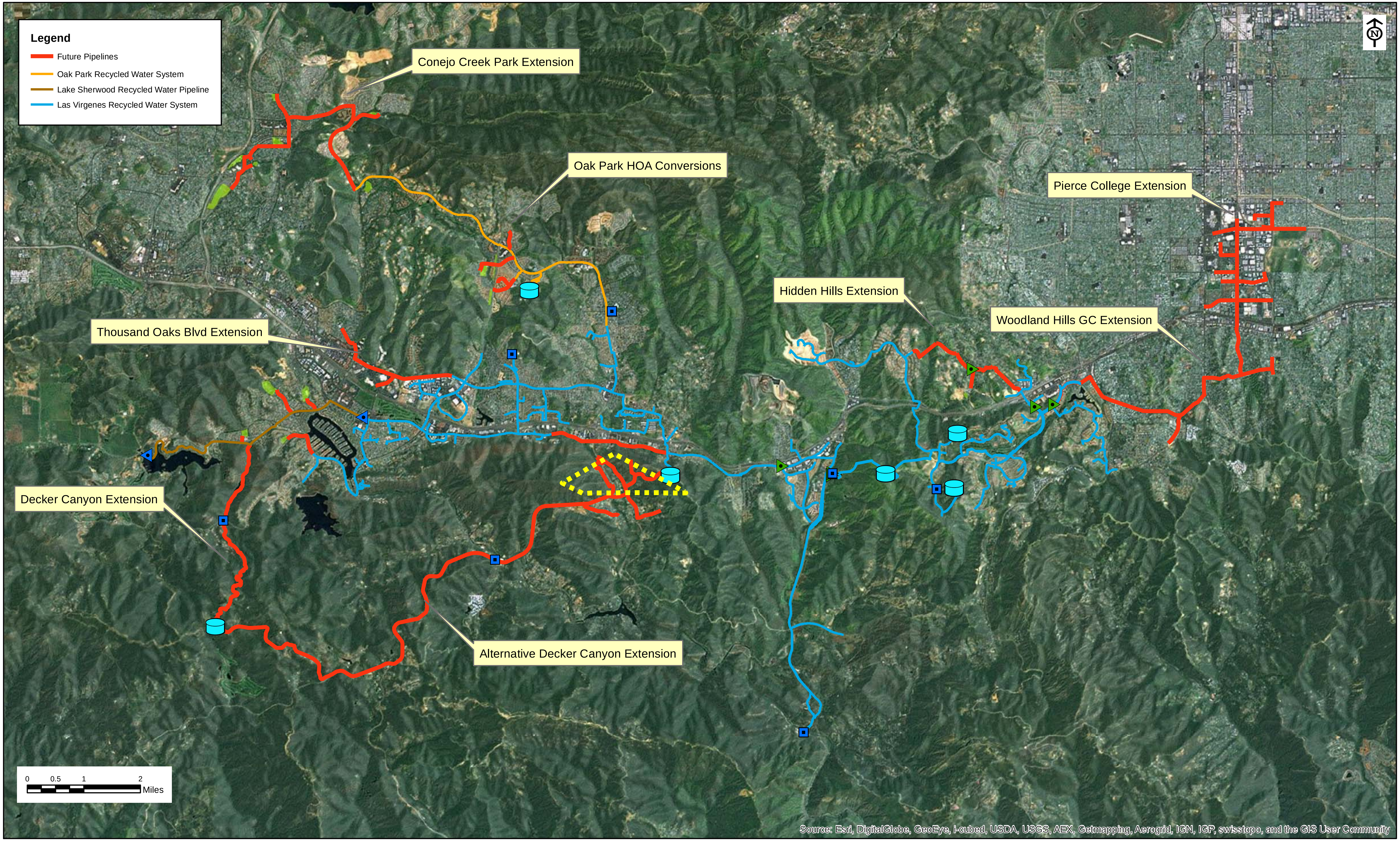
- Also not shown in this figure are the spray fields used to dispose of surplus water. These fields are located along Las Virgenes Road, between the Tapia WRF and LVMWD headquarters.

4.2.2 Possible RW System Extensions

The model developed in the Recycled Water Master Plan Update 2014 was used to evaluate various future scenarios. The future scenarios that were modeled included a general increase in recycled water demands from in-fill development, plus a number of system extensions targeted to serve specific existing water consumers. The water main extensions that were analyzed include large irrigation uses both inside and outside the JPA service areas, as shown in Figure 4-3 and summarized in Table 4-7.

Table 4-7. Recycled Water Main Extensions Analyzed

Possible RW Main Extension	Description
Thousand Oaks Boulevard Extension	Would serve Cal Water customers along the eastern end of Thousand Oaks Boulevard. Over two dozen customers have been identified along this route. The largest are Baxter Pharmaceutical, Westlake High School, and Russell Park.
Oak Park HOA Conversions	These extensions would serve common irrigation areas maintained by several homeowners associations and a few multi-family apartment complexes, as well as greenbelts along Lindero Canyon Boulevard and the North Ranch Playfield.
Lake Sherwood Pipeline Future Customers	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.
Conejo Creek Park Extension	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.
Decker Canyon Extension	The primary user would be the Malibu Golf Club, the largest potable water user in the LVMWD service area.
Alternative Decker Canyon Extension	This extension would likewise serve the Malibu Golf Club, as well as a proposed new development (Triangle Ranch) and conversion of Medea Valley ranchettes to RW use.
Hidden Hills Extension	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.
Woodland Hills GC Extension	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.
Pierce College Extension	This main further extends the Woodland Hills project, ultimately reaching Pierce College.



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Future RW Pipeline Extensions

Figure 4-3

4.2.3 Recycled Water System Analysis – Results and Recommendations

The conclusions derived from the Master Plan system analyses are as follows.

1. With the exception of the Pierce College extension, the existing system should be capable of serving the proposed expansions and demands from infill development, with only modest upgrades.
2. To serve Pierce College, upgrades to much of the Eastern recycled water system would be required.
3. Some amount of pressure degradation may be noticed by some customers, but there are several strategies to overcome these future problems.
4. As part of an extension to the Conejo Creek Parks, an "air-gap" facility at the Oak Park Tank should be considered to provide additional supplemental potable water.
5. Existing supplemental facilities are adequate to serve all other future demand scenarios

4.2.4 Economic Evaluation of Proposed Main Extensions

Generally, if a deficiency exists in the potable water system, a correction is recommended, because service to all customers is required.[1] "Deficiencies" in the recycled water system are not as clearly defined. The JPA decides whom to serve, based on whether the benefits are greater than the costs. Recycled water systems also don't need to meet the same reliability standards as potable systems, as the water is not needed for drinking, sanitation, and ongoing fire safety.

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 basic alternative – the cost of pumping water over the Tehachapi Mountains to Southern California. The low commodity costs and relatively low pumping costs mean that recycled water is the economically and environmentally preferred option to meet applicable demands when it is available.

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 recycled water to where it can be used. Most potable water consumers are served by a single pipeline, which provides water for drinking, irrigation, sanitation, and fire-fighting. For a potable water customer to receive recycled water, a second pipeline is required, essentially doubling the cost of providing water on that particular street and to that particular customer. The cost of such 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 pipeline.

For the RW Master Plan, the costs of various main extensions were estimated and evaluated in terms of how much additional recycled water would be sold annually. The results are shown in Table 4-8 below. Generally, if the cost per acre-ft is less than $8,000, the project is considered economically feasible on its own merits, and those costing more than $50,000 per AFY are

[1] The obligation to serve customers is not unlimited. Customers may need to construct main, pump stations, and tanks in order to receive water from the system.

unattractive. The division between what is affordable and what is not is not a clear line—it depends of various specific conditions, but $20,000 is a estimated point of division. [Those projects matching this criterion are 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, as discussed later in this section. If grants or other sources of funding are available, these projects can become even more attractive.

Table 4-8. 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 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
North Ranch Park / Lindero Greenbelts	CalWater	$844,000	58	$14,600
Capris Tract / Lindero 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	Thousand Oaks	$5,500,000	206	$26,900
Sherwood Executive Golf Course	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

Red = project cost < $20,000 per AFY

4.3 Analysis of Wastewater Treatment System

The results of the biological process simulations of the Tapia WRP found that many of the systems are only marginally capable of meeting current permit limitations. These limitations will need to be addressed if significant flow increases occur, or if more stringent permit limitations are imposed. A summary of the Sanitation Master Plan Update 2014 findings are:

- The aerobic treatment volume is marginal with regard to nitrogen removal,
- There is insufficient carbon to fully complete the de-nitrification process,
- The existing oxygen transfer is inefficient,

- The percent solids in the feed sludge to the digesters is limited by the capabilities of the transfer line from Tapia to Rancho. The dilute concentration of the feed sludge impacts the hydraulic capacity of the digesters. Sludge thickening at the composting facility should be considered prior to digestion,
- With the two existing operational digesters, there is insufficient redundancy to perform required maintenance. A third digester is currently under construction, and
- Another tank would be helpful to equalize centrate flows and provide needed redundancy for centrate treatment.

The projected total cost of these improvements is approximately $19.7 Million.

4.4 Integration Opportunities

In implementing capital improvements to the water, recycled water, and wastewater systems, the effects these systems have on each other should also be considered. In general, an expanded use of recycled water is beneficial because it relieves demands from the potable water system and makes it easier to achieve treatment plant discharge permit limitations. Expanded use of recycled water also helps in achieving compliance with the water conservation goals of SBx7-7.

Conversely, the recycled water system also places high demands on the potable system in the locations where supplemental water is added. Currently, supplemental water is added at Reservoir 2 and the Morrison Pump Station; additional supplemental facilities exist at Cordillera Tank and Parkway Tank. In reviewing the three master plans together, there are several potential integration opportunities to be considered.

4.4.1 Seminole Zone Improvements

In Section 4.1.2, future Seminole Zone improvements are shown, including a new transmission pipeline, new pump station, and new tank, costing over $16 million. These costs would occur if the Seminole Zone (in the southwest quadrant of the LVMWD service area) continues to develop. In recent years, pumping capacity was added to this system, but the pipeline capacity is now at its maximum. If potable water demands continue to increase, a major investment in infrastructure would be needed for this area. Even if only a modest increase in demands occur and the facilities were sized exactly as needed, the length of pipelines, the rugged topography, and the high-lift pumping required would result in a project costing at least $12 million.

An alternative to reduce the cost of constructing a long pipeline, high-lift pump station, and tank for the potable water system is to construct similar facilities for the recycled water system. The potential Decker Canyon Project would accomplish this, serving the Malibu Golf Course, the largest potable water user in the LVMWD area. Although this $12.1 Million recycled water project is no guarantee that potable water improvements might not eventually be needed for the Seminole Zone, if improvements are needed, they would be further delayed. Due to the ruggedness of the topography and associated difficulties in constructing access roads, pipelines, and houses in the Seminole Zone, development of this area will likely never reach full built-out potential.

To further enhance the economics of this recycled water project, constructing RW facilities rather than potable water facilities often has the advantage of grant funding from the State. The Local Water Resource Program of MWDSC is also a source of funding for projects such as this.

4.4.2 Jed Smith Zone Improvements

The Jed Smith Pressure Zone serves Hidden Hills and the Mountain Gate Estates areas of LVMWD, and has been the subject of various capital improvements over 15 years. Originally designed to serve equestrian properties in Hidden Hills, the facilities in this zone became over-taxed as many of these properties were converted to well-irrigated estates. Moderate-cost pumping and pipeline improvements have already been implemented, but facility capacities are still less than desirable. More water storage is acutely needed, but the only available tank site is already fully occupied by District tanks. Squeezing more storage onto the site would likely involve constructing an oddly shaped tank, which is doable, but requires existing tanks to be taken off line during construction—this is not feasible. Pumping upgrades are also needed. In Section 4.1.2, approximately $5 million in improvements have been identified for this zone.

A possible alternative to these projects is an extension of the RW system into Hidden Hills. The RW Master Plan outlines a pipeline through Hidden Hills that would serve various front-yards along the main as well as Round Meadow School. On its own merits, the benefits of these pipelines do not warrant the $3.7 million estimated cost, but if the project relieves enough demands to delay or negate the need for Jed Smith Zone improvements, this could be an attractive project. The proposed main is sized to serve as a “backbone” main. Future lateral mains could be constructed to serve other streets. Similar to the Decker Canyon Project, grant funding may also be available to improve the economics of this recycled water extension.

4.4.3 Oak Park and Westlake RW Extensions

Recycled Water System extensions in the Oak Park Community and the Westlake portion of Thousand Oaks would also relieve potable water demands in these areas. Since these areas are served by Cal Water and Oak Park Water Service and not part of LVMWD’s Potable Water Master Plan, potable water capacity-deficiencies were not assessed and associated integration benefits are therefore not known. However, with any reduction in potable water demand, these agencies would benefit in its their ability to comply with the water conservation goals of SBx7-7.

4.4.4 RW Main Extensions to Thousand Oaks and LADWP

The Recycled Water Master Plan also investigated possible extensions of the system beyond the JPA’s boundaries. Evaluations included western service extensions to the Conejo Creek parks in Thousand Oaks and easterly extensions to the Woodland Hills Country Club and Pierce College in Los Angeles. These projects would certainly help these agencies meet their water conservation goals and help generate regional benefits to by reducing the need for imported water. Other benefits to the potable water systems in Thousand Oaks and LADWP are not known, as these were not included in the breadth of these Master Plan studies.

If these projects go forward, during their preliminary design phases, the construction of new potable water supplemental facilities should be considered. Such supplemental facilities would draw water from the Thousand Oaks and LADWP systems, rather than the LVMWD system. The benefits of these supplemental facilities being provided by other agencies are:

- **LVMWD SBx7-7 compliance**. If additional potable water is provided by LVMWD, these demands would be added to the LVMWD water usage values and would count against LVMWD in meeting its water use efficiency goals.

- **Facility sizing and energy**. Adding the water closer to the customer reduces the need to convey it long distances, which may reduce facility sizes and pumping costs.

- **Redundancy**. In many situations, supplemental facilities can be constructed at low-cost, but act like a much more expensive tank, providing a ready source of water to outlying areas. These are particularly valuable for system maintenance and emergencies, when facilities outages occur.

Section 5 – Conclusions

Section 5: Conclusions

Growth in the LVMWD and TSD areas has leveled off, and is not expected to return to the rapid growth conditions that occurred when major subdivisions were being constructed. Most growth will stem from infill development. Although both agencies' service areas appear to be largely developed, when scrutinized at a parcel level, both will have additional needs for utility services.

Even without the impact of new development, demands for service are expected to increase with improving economic conditions. However the need for major capital improvements to the LVMWD "Backbone System" and other primary JPA facilities is concluding. Recent estimates of future demands are in line with the 2007 Master Plan and other studies, and reflect the changing designations in land use and ongoing water conservation programs and activities.

The LVMWD and JPA systems work well today due to a series of plans developed over the last 50 years. Customers receive reliable service. The JPA's recycled water system is the envy of its neighbors, serving nearly all schools, parks, and golf courses in the area. Every drop of wastewater produced in the summer and fall is effectively recycled. While there is adequate potable water system capacity to keep up with increasing recycled water demands, escalating costs and potential supply limitations may limit the future use of this treated water supply.

Integration opportunities include the construction of specific recycled water improvements, which relieve demands from the potable system, and make the wastewater system more easily managed. Integration could expand greatly through the advanced treatment of recycled water and its seasonal storage, but projects to implement these ideas face technical, economic, and other challenges.

Since the recycled water system is very well developed and the "low-hanging fruit" is gone, why should LVMWD and the JPA conduct new potable water, recycled water, and sanitation master plans? The reasons are several:

- **Changing economics**. With the cost of imported water ever increasing, the benefits of certain investments will increase. In fact, recent information on the Bay Delta Conservation Plan (BDCP) suggests that imported water costs will have to essentially double to fully fund the debt service obligations for this $15 Billion project.

- **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 water 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 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. Future permit requirements will not be less restrictive than the current requirements, and likely be more stringent.

Master planning is a way of looking toward the future, determining what scenarios could and are likely to occur, and developing possible responses in advance of those conditions becoming reality. No one can fully predict the future, but all of us must plan for it. A water utility is no different.

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Section 6: References

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Appendix A - Acronyms and Abbreviations

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AF, AFY	acre-feet, acre-feet per year
CalWater	California Water Service Company
CIP	capital improvement plan or program
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
HGL	hydraulic grade line
HP	horsepower
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
SBx7-7	Senate Bill x7-7, which mandates a 20 percent reduction in per capita water consumption
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