City of Los Angeles

Recycled Water Master Planning

Los Angeles Department of Water and Power
and
Department of Public Works

Groundwater Replenishment Master Planning Report

Prepared by:

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Volume 3 of 3: Appendices H-M
March 2012

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Appendix H

DCT Dry Weather Flow Equalization Evaluation TM

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Summary of Modifications to "DCT Dry Weather Flow Equalization Evaluation TM" since Initial Publication on January 21, 2010

The Recycled Water Master Planning (RWMP) effort has spanned three years (April 2009 to March 2012). As is the nature of a planning project, assumptions are typically modified and refined as a project is further developed. The most recent assumptions related to the Groundwater Replenishment (GWR) master planning effort are presented in the GWR Master Planning Report. Assumptions and conclusions presented in this report supersede assumptions included in this technical memorandum (TM). The following table summarizes the modifications applicable to all RWMP TMs and those specifically applicable to this TM are described in the following sections.

Assumption	Modified	Original
Applicable to all RWMP TMs		
Recycled Water Goal	59,000 AFY by 2035 This goal reflects the 2010 LADWP Urban Water Management Plan that was adopted in early 2011, after the original RWMP goals were drafted	50,000 AFY by 2019
Name for Project and Master Planning Reports	Recycled Water Master Planning Documents GWR Master Planning Report NPR Master Planning Report	Recycled Water Master Plan GWR Master Plan NPR Master Plan
Introduction Section	This is superseded by the Introduction Sections in the GWR Master Planning Report.	This section was included in all initial TMs but the terms described have been replaced by the Introduction Section for the GWR Master Planning Report.
NPR Projects Terminology	To avoid confusion related to LADWP's water rate structure, the terms "Tier 1" and "Tier 2" are superseded with the terms "planned" and "potential," respectively. Both planned and potential projects would be considered for implementation by 2035.	"Tier 1" for NPR projects that were originally planned for design and construction by the year 2015. "Tier 2" for NPR projects that were originally being evaluated in the NPR Master Planning Report for potential future implementation after the year 2015.
Name for MF/RO/AOP treatment plant	Advanced water purification facility (AWPF)	Advanced water treatment facility (AWTF)
Name for water produced by AWPF	Purified recycled water	Advanced treated recycled water, highly purified recycled water, etc.
Treatment Plant Acronyms	DCTWRP LAGWRP	DCT LAG
GWR Project Phases	Phase 1 = 15,000 AFY annual recharge goal and 25 mgd AWPF product water capacity Phase 2 = 30,000 AFY annual recharge goal and 35 mgd AWPF product water capacity	Phase 1 = 20 mgd AWPF product water capacity Phase 2 = 40 mgd AWPF product water capacity

The DCTWRP primary flow equalization analysis has been updated and is superseded by Section 5.3.16 of the GWR Master Planning Report. The following are selected modifications specific to this TM.

TM References

Throughout this TM there are references to preliminary TMs that were prepared at the onset of the RWMP effort. Relevant information from these TMs has been updated and incorporated into the four RWMP documents: GWR Master Planning Report; NPR Master Planning Report; TIWRP Barrier Supplement and NPR Concepts Report; and Long-Term Concepts Report.

Section 2.1 Planned DCTWRP In-Plant Wet Weather Storage Project

The planned wet weather storage project now includes the planned conversion of six Phase II primary clarifiers, instead of the initial four primary clarifiers. This adds approximately 17.36 million gallons (MG) of storage to the DCTWRP, bringing the total wet weather storage volume to 20.6 MG. This project is anticipated to be completed in August 2012. The following are modifications to Table 2-1.

Table 2-1: Wet Weather Storage Volume Summary (Revised)

Description	Wet Weather Storage Volume (MG)	
	Initial	Modified
Existing Primary Equalization Storage Volume (Phase III Primary Clarifiers)	3.24	3.24
DCT In-Plant Wet Weather Storage Project		
Planned Conversion of Six Phase II Primary Clarifiers to Primary Equalization Storage Volume	1.44	2.16
Wet Weather Storage Basin 1	7.9	7.9
Wet Weather Storage Basin 2	7.3	7.3
Total Existing and Planned Wet Weather Storage Volume	**19.88**	**20.60**

Section 2.2 Existing and Planned Primary Flow Equalization Storage Volume

A total of nine Phase IV primary clarifiers were initially proposed to provide an additional 3.24 MG of primary equalization (EQ) storage volume and increase the overall volume to 7.92 MG. However, as part of the GWR Master Planning Report, it was determined that a total of 12.12 MG of primary flow EQ volume is needed to equalize influent wastewater flows to produce a constant secondary/tertiary effluent for Phase 2 of the GWR project. Therefore, 6.72 MG of additional EQ volume is required for Phase 2 of the GWR project in addition to 5.40 MG of EQ volume after BOS converts six of the Phase II clarifiers.

A total of thirteen Phase IV primary clarifiers have been proposed to provide an additional 7.02 MG of storage volume. The Phase IV primary clarifiers will be longer than the existing Phases I – III primary clarifiers and therefore provide more storage volume per clarifier. See Section 5.3.16, Tables 5-36 and 5-37, in the GWR Master Planning Report for more information. The following are modifications to Table 2-2.

Table 2-2: Primary Flow Equalization Storage Volume Summary (Revised)

Description	Primary Equalization Storage Volume (MG)	
	Initial	Modified
Existing and Planned Primary Equalization Volume		
Existing Primary Equalization Storage Volume (Phase III Primary Clarifiers)	3.24	3.24
DCTWRP In-Plant Wet Weather Storage Project – Planned Conversion of Six Phase II Primary Clarifiers to Primary Equalization Storage Volume	1.44	2.16
Total Existing and Planned Primary Equalization Volume	**4.68**	**5.40**
Potential Future Volume		
Phase IV Primary Clarifiers	3.24	7.02
Total Existing, Planned, and Potential Future Primary Equalization Volume	**7.92**	**12.42**

Section 2.3 Planned Tertiary Storage Volume

It was initially assumed that the existing Title 22 operational storage tank located at the Valley Generating Station (VGS) would be tied into the future Title 22 system, and that the operational storage would be expanded as required to provide sufficient operating flexibility within the Title 22 system. However, since the AWPF will be located at DCTWRP the 54-inch pipeline will be used to convey purified recycled water to the spreading grounds and to existing NPR customers. Therefore, the VGS storage tank will be tied into the purified recycled water distribution system. The NPR Master Planning Report includes conceptual plans for a separate Title 22 NPR system in the Sepulveda Basin, which would include a separate Title 22 storage tank.

Section 2.4 DCT Process Restrictions

Due to the process restrictions discussed in Section 2.4, primary flow equalization is needed to be able to treat the DCT average day treatment capacity of 80 mgd.

Section 3 Assumptions

Assumptions regarding the DCTWRP influent flow and tertiary effluent production were updated as part of the development of the GWR Master Planning Report. See the GWR Master Planning Report Section 3.7.

Section 3.3 Recycled Water (Tertiary Effluent) Demands

In the GWR Master Planning Report, the AWPF sizing is based on the assumption that all of the NPR demands would be served with purified recycled water. This assumption was made because it is the most conservative from a financial planning perspective. When the GWR and NPR projects are implemented, some of the NPR demands in the Sepulveda Basin may be served by a separate Title 22 NPR system. See the NPR Master Planning Report for more information.

Section 4 Results

Results of the flow equalization analysis has been updated and superseded by Section 5.3.16 in the GWR Master Planning Report. See Tables 5-36 and 5-37 in the GWR Master Planning Report for a summary of the required dry weather flow EQ storage volume.

The original TM follows so these modifications should be considered when reading this TM.

Technical Memorandum

Title:	**DCT Dry Weather Flow Equalization Evaluation**
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1. Introduction

With imported water supplies becoming ever more unpredictable, the Los Angeles Department of Water and Power (LADWP) adopted the Mayor's vision of Securing LA's Water Supply in May 2008, calling for 50,000 acre-feet per year (AFY) of potable supplies to be replaced by recycled water by 2019. To meet this near-term challenge and plan for expanding reuse in the future, LADWP has partnered with the City of Los Angeles Department of Public Works (LADPW) to develop the Recycled Water Master Plan (RWMP). The RWMP includes 7 major tasks: 1 Groundwater Replenishment (GWR) Master Plan, 2 Non-Potable Reuse (NPR) Master Plan, 3 GWR Treatment Pilot Study, 4 Maximum Reuse Concept Report, 5 Satellite Feasibility Concept Report, 6 Existing System Reliability Concept Report, and 7 Training.

The importance of additional water supply options for Los Angeles has become increasingly apparent with continuation of drought conditions, building contention for limited available water supplies both statewide and across the Southwest, and growing awareness of the critical nexus between quality of life/economic stability and available supplies of quality water. Significant attention has focused on the importance of indirect potable reuse given the multiple associated benefits, among them: local control; drought-resistant supplies; beneficial use of a critical, limited resource; sustained availability for future generations; existing infrastructure; lower investment and less environmental impact than other supply options; and demonstrated success nearby, across the nation and throughout the world.

1.1 Task 1 Overview

The purpose of Task 1 is to develop a GWR Master Plan that includes a capital improvement program to implement an advanced water treatment plant (AWTP) and groundwater replenishment using highly purified water in the San Fernando Valley in the Hansen, Pacoima, and possibly Tujunga spreading basins. The AWTP will be fed with effluent from the Donald C. Tillman Water Reclamation Plant (DCT). The GWR Master Plan will plan for in-service dates no later than June 30, 2018 to meet the minimum groundwater replenishment goal of 15,000 acre-feet/year (AFY) by June 30, 2019.

Task 1a includes the preliminary evaluations for the GWR Master Plan, including developing a regulatory approach, completing preliminary evaluations about the DCT plant, developing preliminary groundwater replenishment strategies, completing a technology assessment for the AWTP, selecting a preliminary site for the AWTP, and determining the maximum wastewater flow available for treatment at DCT. Task 1b, the GWR Master Plan document, will commence when Task 1a is complete and will incorporate the work completed as part of Task 1a.

1.2 TM Purpose

The purpose of this DCT Flow Equalization Evaluation TM is to provide an assessment of the primary flow equalization needs at DCT to meet the recycled water delivery goals for the DCT treatment plant. Due to process restrictions within the plant, primary flow equalization is needed to be able to treat the DCT average day treatment capacity of 80 million gallons per day (mgd).

This work is being completed as part of Task 1.6, the DCT Maximum Flow Assessment Evaluation. Task 1.6 assessed the maximum average dry weather flows that could be routed to the DCT plant from the Tillman Service Area (TSA) to determine the quantity of water available for existing uses and the expanded recycled water system, including both GWR and NPR.

The primary flow equalization requirements identified in this TM are based on preliminary assumptions for recycled water demands that were developed for the AWTP site assessment (Task 1.5). The primary equalization requirements and timing should be re-evaluated once the recycled water demands and implementation schedule are finalized.

LADPW is currently completing upgrades to the DCT tertiary filters. Upon completion of the filter upgrade project in 2010, it is expected that the plant will be operated at 80 million gallons per day (mgd) from April 15 through October 15, but will be restricted to 40 mgd from October 15 through April 15 to reserve one treatment phase (40 mgd) and the equalization basins for wet weather storage. In December 2009, the Bureau of Sanitation (BOS) decided to move forward with construction of the In-Plant Wet Weather Storage Project. Upon completion of the wet weather storage basins in December 2012, it is expected that DCT will be operated at 80 mgd year round.

1.3 Related TMs

The following TMs and other documents were developed in conjunction with or were used to develop this Draft DCT Dry Weather Flow Equalization Evaluation TM:

- Draft Donald C. Tillman Water Reclamation Plant Flow Equalization and Tertiary Filtration Concept Report (HDR, October 2007)
- Final Donald C. Tillman Water Reclamation Plant Flow Equalization and Tertiary Filtration Concept Report (HDR, January 2008)
- Draft DCT Data Summary TM (RMC/CDM, Task 1.2, September 1, 2009)
- Draft DCT Maximum Flow Assessment TM (RMC/CDM, Task 1.6, October 6, 2009)
- Draft Los Angeles River Flow Assessment Technical Memorandum (RMC/CDM, Task 4.1.4, November 2, 2009)
- Draft Site Assessment TM (RMC/CDM, Task 1.5, January 5, 2010)

1.4 TM Overview

The remainder of this TM is organized in the following sections:

- Section 2 – Existing and Planned DCT Facilities
- Section 3 – Background and Assumptions
- Section 4 – Results
- Section 5 – Summary

2. Existing and Planned DCT Facilities

The DCT plant is an 80-mgd water reclamation plant. The original design of the treatment facility called for five phases of construction each providing 40 mgd of treatment capacity. Phases 1 and 2 have been completed and are operational. The treatment processes includes grit removal and screening, primary equalization (Phase 3 primary clarifiers), primary clarification, secondary treatment with activated sludge and secondary clarification, tertiary filtration, disinfection, and dechlorination. The secondary treatment was recently upgraded for nitrification and denitrification (NdeN), which limits the plant's treatment capacity. Solids and sidestreams generated at DCT are returned to the sewer for treatment at the Hyperion Treatment Plant (HTP).

This section discusses the existing and planned facilities that impact the DCT treatment capacity and recycled water delivery, including the DCT In-Plant Wet Weather Storage Project, the existing and planned primary flow equalization storage volume, Title 22 operational storage, and DCT process restrictions.

2.1 Planned DCT In-Plant Wet Weather Storage Project

Because of the need to alleviate storm flows in the sewers downstream of DCT to prevent sewer surcharging, DCT only operates at 40 mgd during winter months to keep half of the facility tankage (primary clarifiers, aeration tanks, and secondary clarifiers) available for wet weather storage. To allow DCT to operate at capacity (80 mgd) year round, the Bureau of Engineering (BOE) has completed design of two open, lined storage basins for wet weather storage, as well as conversion of four primary clarifiers for additional primary equalization/wet weather storage volume. In December 2009, Bureau of Sanitation (BOS) decided to move forward with bidding this design/build project. Once construction is complete in December 2012, BOS will be able to operate DCT at 80 mgd year round.

The project will add approximately 16.6 million gallons (MG) of storage to DCT, bringing the total storage volume to just under 20 MG. The wet weather storage basins will be constructed in the grassy area on the eastern side of DCT, adjacent to the Phase 2 aeration tanks and secondary clarifiers (see **Figure 2-1**). The total and planned wet weather storage volume is shown in **Table 2-1**.

Table 2-1: Wet Weather Storage Volume Summary

Description	Wet Weather Storage Volume (MG)
Existing Primary Equalization Storage Volume (Phase 3 Primary Clarifiers)	3.24
DCT In-Plant Wet Weather Storage Project	
Planned Conversion of Four Phase 2 Primary Clarifiers to Primary Equalization Storage Volume	1.44
Wet Weather Storage Basin 1	7.9
Wet Weather Storage Basin 2	7.3
Total Existing and Planned Wet Weather Storage Volume	**19.88**

2.2 Existing and Planned Primary Flow Equalization Storage Volume

DCT uses the Phase 3 primary clarifiers as primary flow equalization storage volume for the plant. The Phase 3 primary clarifiers have a volume of approximately 3.24 MG. The DCT diurnal flow is less than 80 mgd between 1:00 am and 8:00 am and greater than 80 mgd the remainder of the day (the diurnal flow curves are presented in Section 3.2). The flow equalization basins are used to capture wastewater when the influent flow exceeds 80 mgd. The captured flow is drained back into the plant for treatment at night when the flows are less than 80 mgd.

As part of the DCT In-Plant Wet Weather Storage Project, BOS will be converting four of the Phase 2 primary clarifiers to equalization basins, which will provide an additional 1.44 MG of primary flow equalization capacity. Once this conversion is complete, DCT will have a total of 4.68 MG of primary flow equalization volume. As noted in the previous section, during winter storm events LADPW will be using the 4.68 MG of primary equalization volume as wet weather storage volume. Therefore, the 4.68 MG of flow equalization volume will need to be reserved for wet weather storage when storm events are anticipated. The City will need to reduce the recycled water delivery from the plant accordingly when the flow equalization volume is required as wet weather storage volume.

A logical future expansion of the primary flow equalization volume could be to construct the next phase of primary clarifiers, the Phase 4 primary clarifiers. This would provide an additional 3.24 MG of primary equalization storage volume and would increase the overall volume to 7.92 MG.

The flow equalization storage volumes are summarized in **Table 2-2**. The locations of the primary clarifiers, equalization basins, and new wet weather storage basins are shown in **Figure 2-1**.

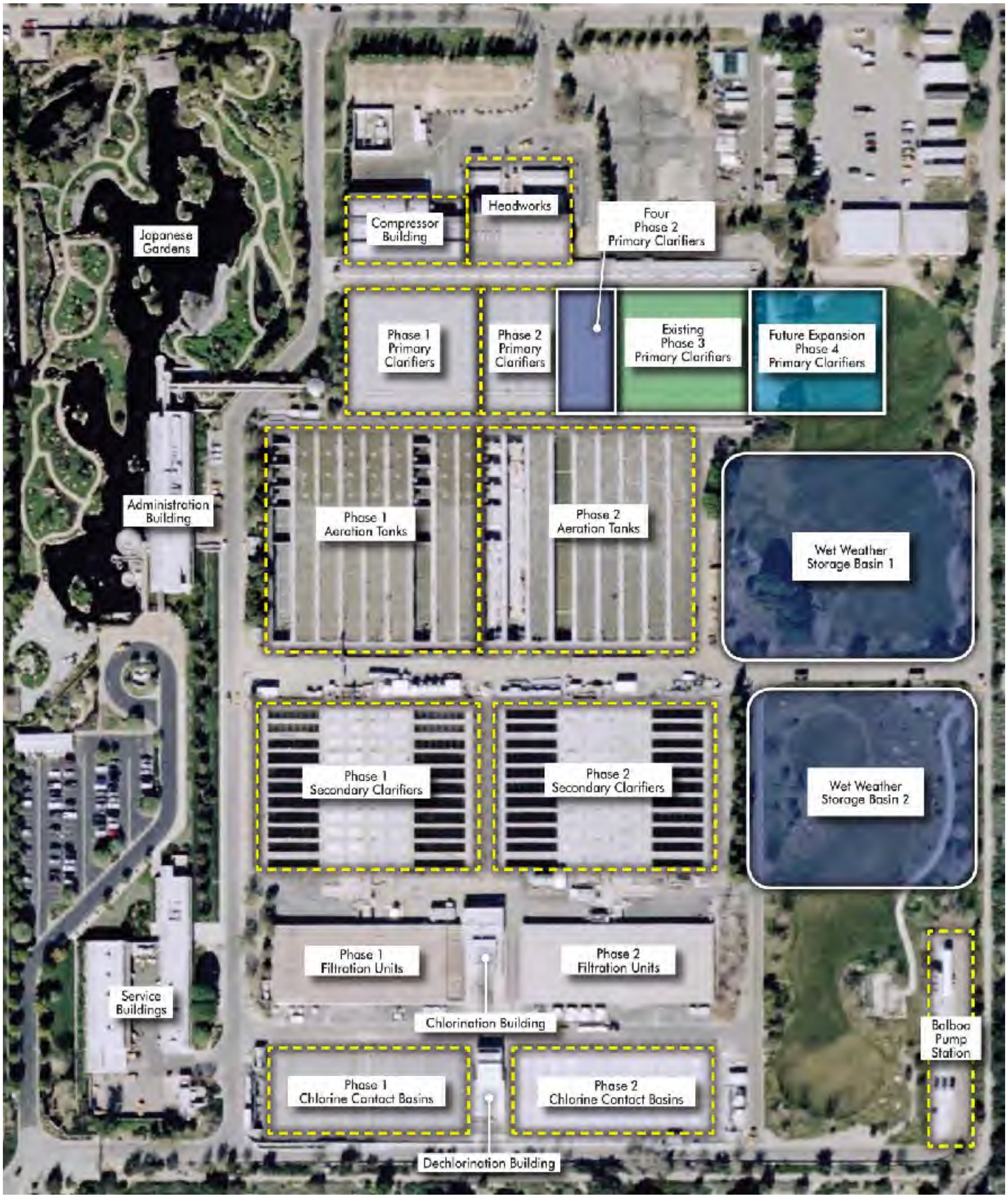
Table 2-2: Primary Flow Equalization Storage Volume Summary

Description	Primary Equalization Storage Volume (MG)
Existing and Planned Primary Equalization Volume	
Existing Primary Equalization Storage Volume (Phase 3 Primary Clarifiers)	3.24
DCT In-Plant Wet Weather Storage Project – Planned Conversion of Four Phase 2 Primary Clarifiers to Primary Equalization Storage Volume	1.44
Total Existing and Planned Primary Equalization Volume[a]	**4.68**
Potential Future Volume	
Phase 4 Primary Clarifiers	3.24
Total Existing, Planned, and Potential Future Primary Equalization Volume	**7.92**

Footnote:

a. Available for primary flow equalization during non-storm events.

Figure 2-1: Existing, Planned, and Possible Future Primary Equalization Basins



Footnotes:

b. For more information about DCT, see the Draft DCT Data Summary TM (RMC/CDM, Task 1.2, September 1, 2009).

c. Wet Weather Storage Basins 1 and 2 will be constructed and the four Phase 2 primary clarifiers will be converted to flow equalization storage volume as part of the DCT In-Plant Wet Weather Storage Project and are expected to be in service by December 2012.

2.2.1 Phase 4 Primary Clarifiers Estimated Planning-Level Construction and Total Project Costs

A construction cost estimate for the Phase 4 primary clarifiers is included in the Draft DCT Flow Equalization and Tertiary Filtration Concept Report (HDR, October 2007). The planning-level costs presented in that report were escalated to January 2010 dollars using the Engineering New Record (ENR) Construction Cost Index (CCI) for the City of Los Angeles (October 2007 = 9,216; January 2010 = 9,762). The estimated construction cost for the Phase 4 primary clarifiers is $12.1 million and the estimated total project costs are $15.7 million, which includes administration, engineering, construction management, environmental clearance, and legal costs in addition to the construction cost. These costs do not include the cost to relocate ductwork that is currently installed in the location of the Phase 4 primary clarifiers. This planning-level cost estimate will be used as part of the DCT alternatives in the integrated alternatives analysis (Task 2b) when additional flow equalization is required to meet projected tertiary effluent demands.

2.3 Planned Tertiary Storage Volume

As noted in Section 1.2, primary flow equalization is needed to treat an average day flow of 80 mgd at DCT due to process restrictions within the plant that require the plant to be operated at a rate of 80 mgd or lower. It is preferable to be able to store excess tertiary effluent during peak day flow conditions to be able to supplement non-potable recycled water uses at night during low wastewater flows; however, as discussed in the following section, the process restrictions within DCT require that flow equalization be upstream of the secondary treatment process. As a result, it is not possible to achieve the required flow equalization with tertiary effluent.

Therefore, it is assumed that the existing Title 22 operational storage tank located at the Valley Generating Station (VGS) would be tied into the future Title 22 system, and that the operational storage would be expanded as required to provide sufficient operating flexibility within the Title 22 system. This will be further evaluated as part of Task 2b.

2.4 DCT Process Restrictions

DCT limits the flow rate through the treatment plant to 80 mgd due to process restrictions within the plant. These restrictions include NdeN (aeration basins and clarifiers) as well as a permit restriction on the maximum flow rate allowed through the chlorine contact basins.

- **NdeN flow restrictions:** Once DCT was upgraded to NdeN, it was determined by BOS that 80 mgd is the maximum throughput achievable for safe and reliable nitrogen removal operations with a hydraulic residence time of approximately 5.3 hours, the aeration time in the range of 2-3 hours, and the ammonia as nitrogen (NH_3-N) hourly peak load in up to 65 milligrams per liter (mg/L). Therefore, the plant bypasses wastewater flows in excess of 80 mgd during the day.
- **Chlorine contact basins flow restrictions:** LADPW have estimated that the permit requirements for modal detention time (> 90 minutes) and contact time (CT) (> 450 milligram-minutes/liter) can be met for flow rates up to 43 mgd per phase, or 86 mgd for both phases. Therefore, the flow rate through the chlorine contact basins is limited to 86

mgd. Because of the restrictions upstream in the NdeN process and flow losses due to solids and sidestreams, the flow is less than 80 mgd at the chlorine contact basins.

Since the treatment plant cannot treat the daily peak flows and does not have enough primary equalization capacity to capture all of the daily peak flows, the average dry weather flow capacity for DCT is actually less than 80 mgd because of the minimum diurnal flows experienced at night.

3. Assumptions

This section presents the assumptions that were made for the DCT dry weather flow equalization evaluation. These include assumptions about the DCT influent flow and tertiary effluent production based on the Draft DCT Maximum Flow Assessment TM, and a description of the recycled water demand assumptions.

The recycled water demands for DCT and implementation plan will be determined as part of the integrated alternatives analysis, which will be conducted as part of Task 2b in early 2010. Since the demands are not known at this time, the recycled water demand assumptions made for the AWTP site assessment (Baseline Condition) were also used as the basis for this evaluation. Once the recycled water demands and implementation plan are established for DCT, then this evaluation should be updated as part of Task 1b to determine when additional primary equalization capacity is needed.

3.1 DCT Influent Flow and Tertiary Effluent Production

The projected average daily wastewater flows to DCT are presented in the Draft DCT Maximum Flow Assessment TM and are used in this flow equalization analysis. As described in the Draft DCT Maximum Flow Assessment TM (RMC/CDM, Task 1.6, October 6, 2009), the DCT flow estimates are based on the City's MIKE URBAN Model flow estimates for the Additional Valley Outfall Relief Sewer (AVORS) and the East Valley Interceptor Sewer (EVIS), the two outfall sewers that are tributary to DCT. In order to maximize the wastewater flow to DCT, the current diversions settings on the EVIS outfall sewer need to be modified to route wastewater to DCT instead of diverting wastewater to the outfall sewers downstream of DCT (current operations).

This flow equalization analysis was completed for 2018 and 2040 to estimate what the primary equalization requirements will be when the RWMP projects are scheduled to start operation (i.e., June 30, 2018) and for the project planning year (2040).

As noted in the Draft DCT Maximum Flow Assessment TM, Table 4-2, the DCT tertiary effluent production capacity is estimated to be approximately 87 percent of the influent flow rate. For example, at the maximum influent flow rate of 80 mgd (as limited by the secondary treatment process), the plant is expected to produce approximately 70 mgd of tertiary effluent.

Projected DCT flows are summarized in **Table 3-1**.

Table 3-1: DCT Projected Flows

Year	Influent Flow (mgd)	Tertiary Effluent Flow (mgd)
2018	81	70
2040	91	70

Source: Draft DCT Maximum Flow Assessment TM (RMC/CDM, Task 1.6, October 6, 2009)

3.2 Estimated DCT Diurnal Curves

The flow conditions analyzed in this TM include weekend and weekday flow patterns in 2018 and 2040. Since the plant currently operates at a lower flow rate of 40 mgd during the winter months both summer and winter conditions were evaluated as part of this study. However, the City has decided to move forward with the DCT In-Plant Wet Weather Storage Project which will eliminate the flow restriction during winter months and allow DCT to operate at 80 mgd year round upon completion of the project in December 2012.

Since wastewater has historically been bypassed around DCT to maintain a desired flow rate at the plant, DCT historical flow records could not be used to generate the diurnal curves. As part of the Draft DCT Maximum Flow Assessment TM, the estimated weekday and weekend diurnal flow curves for AVORS and EVIS were extracted from the MIKE URBAN Model and combined to produce an estimated overall diurnal curve for DCT. The estimated weekday and weekend diurnal DCT flow curves are shown in **Figures 3-1** and **3-2**, respectively.

Figure 3-1: Estimated DCT Weekday Diurnal Curve

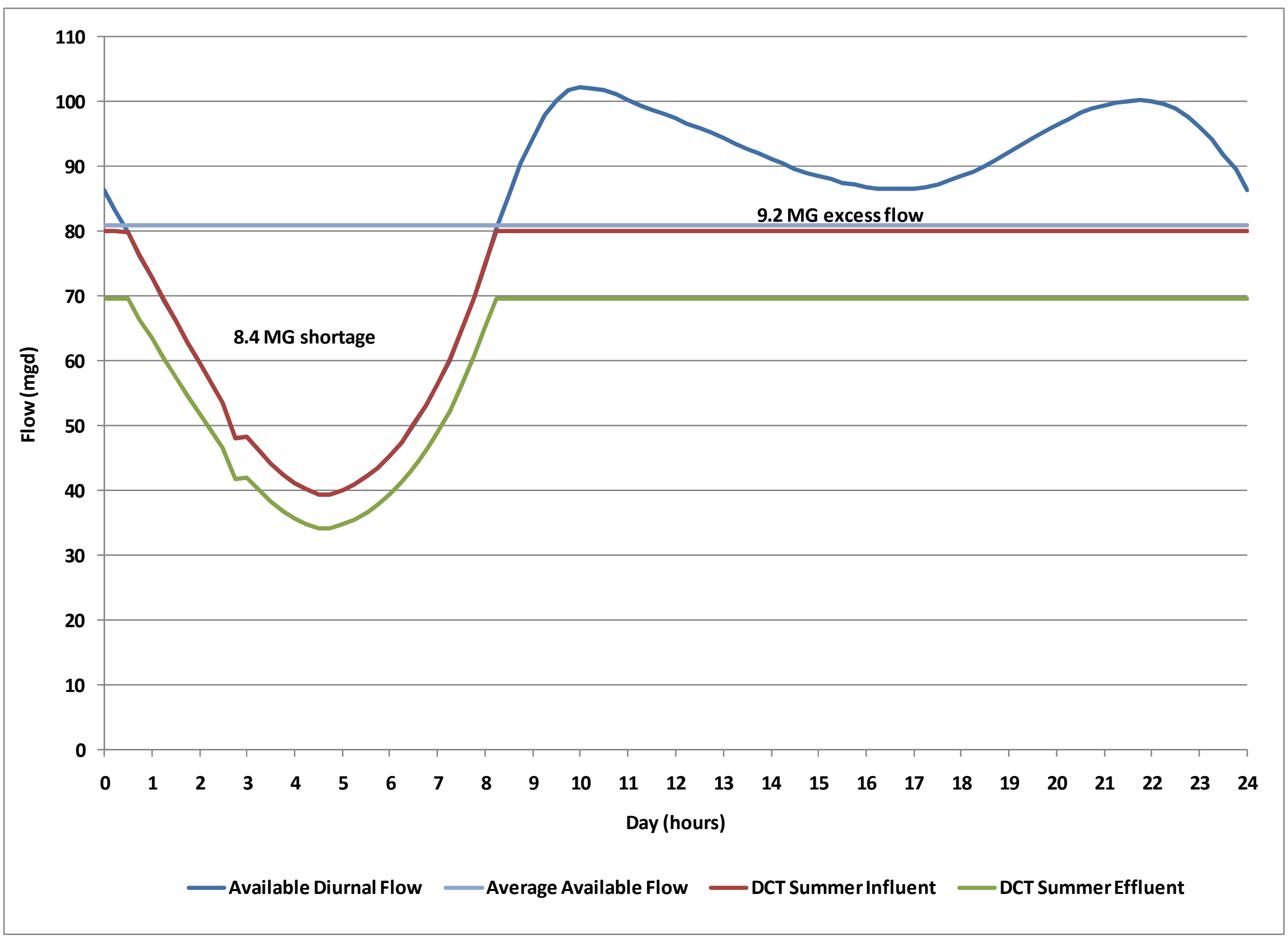
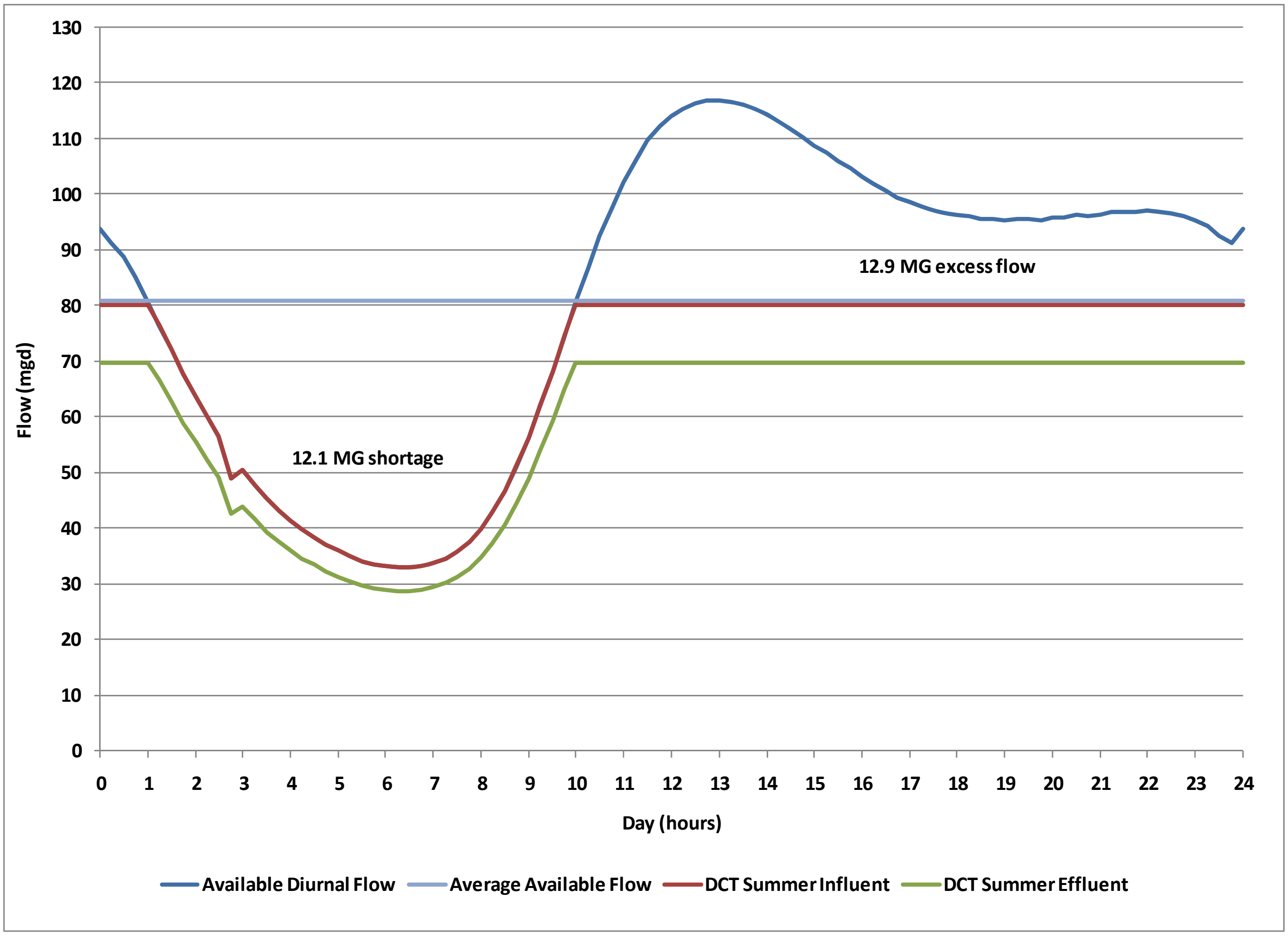


Figure 3-2: Estimated DCT Weekend Diurnal Curve



As shown in **Figure 3-1**, the estimated DCT diurnal flow curve has a significant drop in flow during nighttime hours, i.e., from 1:00 am to 8:00 am. This drop in flow/shortage in flow has been estimated to be 8.4 MG for weekday conditions. With unrestricted wastewater flow, the influent wastewater would have two daily peaks: the first in late morning at about 10:00 am and the second in the evening at about 9:45 pm. Excess flow resulting from these peaks has been estimated to be 9.2 MG for the weekday conditions. For the weekday diurnal curve, a maximum storage volume of 8.4 MG is needed to offset the minimum daily flow and allow the plant operate continuously at 80 mgd and produce a constant tertiary effluent flow of 70 mgd.

As shown in **Figure 3-2**, the flow shortage and excess flows are higher for the weekend flows because the minimum flow is lower than the weekday flows and the daily peak flows are higher than the weekday flows. The estimated shortage in flow for weekends is 12.1 MG and the excess flow is 12.9 MG. For the weekend diurnal curve, a maximum storage volume of 12.1 MG is needed to offset the minimum daily flow and allow the plant operate continuously at 80 mgd and produce a constant tertiary effluent flow of 70 mgd.

The seven-day average of the storage requirements is 9.4 MG (i.e., five days of the week require 8.4 MG and two days of the week require 12.1 MG). If the recycled water demands are 70 mgd, this would result in a tertiary effluent shortage on the weekends, but would achieve the constant effluent flow of 70 mgd during the week.

3.3 Recycled Water (Tertiary Effluent) Demands

Since the recycled water demands are currently in development for the Valley service area, demand assumptions were made for the AWTP site assessment, which are documented in Section 2.1 of the Draft Site Assessment TM (RMC/CDM , Task 1.5, January 5, 2010). Two flow scenarios were evaluated for the AWTP site assessment, including the Base Condition and Scenario 1. Since both flow scenarios use the same amount of tertiary effluent, the Base Condition was assumed for this evaluation.

The recycled water demands that will be served by DCT, and the phasing for those demands, will be confirmed as part of the integrated alternatives analysis that will be conducted as part of Task 2b. For example, the GWR project will be one of the major demands for the DCT plant and will be implemented in at least two phases, Phases 1 and 2, each of which will produce 15,000 AFY of high-quality recycled water for recharge that will result in a total future production capacity of 30,000 AFY. Phase 1 will start operation in 2018 and Phase 2 will start at a later date. Because the GWR demands will be phased in beyond 2018, it is likely that 70 mgd of tertiary effluent will not be reused by 2018. Until the recycled water demands are confirmed, the Base Condition demand assumptions are used for this evaluation. These demands are based on reusing a maximum amount of tertiary effluent from DCT (70 mgd) to estimate the maximum amount of equalization capacity that is needed at DCT. The primary equalization requirements and timing should be re-evaluated once the recycled water demands and implementation schedule are finalized.

The following AWTP site assessment assumptions were also made for this flow equalization analysis. The Base Conditions flows are summarized in **Table 3-1**.

- **Tertiary Effluent Production Capacity:** a maximum production of 70 mgd (87 percent of the influent flow rate) based on an average of 80 mgd wastewater treated through the plant (based on the secondary treatment process restrictions).
- **Flows for In-plant Reuse:** 2 mgd at the DCT maximum capacity of 80 mgd. (Note that in the Draft DCT Maximum Flow Assessment (RMC/CDM, Task 1.6, October 6, 2009) it was assumed that approximately 4.7 mgd of tertiary effluent would be required for in-plant reuse. Michael Bell, BOS, clarified at the October 2009 Monthly Management Meeting that the in-plant reuse demand is approximately 2 mgd at an influent wastewater flow of 80 mgd.)
- **Flows to Lakes and LA River:** Includes tertiary effluent flow to Lake Balboa, Wildlife Lake, and the Japanese Garden Lake, which all discharge into the LA River. The minimum flow assumed to the Lakes/LA River is 27 mgd. The flows to the Lakes and LA River are discussed further in the Draft Los Angeles River Flow Assessment Technical Memorandum (RMC/CDM, Task 4.1.4, November 2, 2009).
- **NPR:** Continue to meet the existing NPR demands and expand the system to serve Tier 1 customers, which combined will result in a total annual average of approximately 4 mgd. It is assumed that the NPR flows would peak at approximately 8 mgd (maximum day) in summer months and potentially drop to as low as 1 mgd in winter months.

- **GWR:** The remainder of the tertiary effluent (approximately 37 mgd) would be routed to the AWTP for groundwater replenishment. The AWTP would treat less tertiary effluent in the summer when NPR demands are high (approximately 33 mgd tertiary effluent) and more water in the winter when NPR demands are low (approximately 40 mgd tertiary effluent). Note that this flow accounts for both phases of the GWR project; at this time both Phases 1 and 2 of the project are envisioned to include 15,000 AFY of groundwater replenishment.

All of the recycled water demands are assumed to be constant demands throughout the day. The NPR system is assumed to have sufficient operational storage to allow the Title 22 water to be stored during the day so it can supplement the water supply at night to meet the peak demands.

Table 3-1. Base Condition Recycled Water Demands

Baseline Demands	Flow (mgd)
In-Plant Reuse [(a)]	2
Lakes [(a)]	27
NPR Existing and Tier 1 [(b)]	4
GWR (AWTP influent) [(c)]	37
Total Flow	**70**

Footnotes:

d. Based on existing demands.
e. Based on existing demand and expansion of the NPR system for Tier 1 customers. NPR demand varies seasonally and would be balanced with the GWR demand to maintain constant NPR plus GWR demand of 41 mgd.
f. Average annual demand. NPR demand varies seasonally and would be balanced with the GWR demand to maintain constant NPR plus GWR demand of 41 mgd.

NOTE: All the demands have been assumed to be constant for this analysis.

4. Results

The flow equalization analysis involves minimizing the nighttime flow shortage using primary equalization storage. Computation of the equalization basin volume is a key design component of this approach. As part of this analysis, the diurnal curve developed for the weekday and weekend curves (Section 3.2) was graphically superimposed with the tertiary effluent demands (Section 3.3). A cutoff line was drawn at the plant's maximum treatment capacity of 80 mgd. Flows above 80 mgd are assumed to be available for storage in the equalization basin to be used during low flow periods. As discussed in Section 3.2, a maximum of 8.4 MG (weekdays) and 12.1 MG (weekends) would be required to operate the plant at a constant rate of 80 mgd to produce a constant rate of 70 mgd of tertiary effluent. The second part of this analysis included determining the tertiary effluent flow shortage that can be obtained with DCT's current primary equalization volume of 3.24 MG, the planned equalization volume of 4.68 MG, and the possible future expansion of 7.92 MG.

4.1 80 mgd Plant Capacity

Figures 4-1 and **4-2** show the DCT effluent flow of 70 mgd with the tertiary effluent flow demands for the 2018 weekday and weekend diurnal flow conditions, respectively. The maximum daily flow for 2040 has been estimated to be 81 mgd. The figures show how the nighttime flow shortage is minimized with 3.24, 4.68, and 7.92 MG of storage, as well as the maximum storage requirement for the weekday and weekend conditions. The tertiary effluent flow shortages for the weekday, weekend, and average conditions are summarized in **Tables 4-1, 4-2,** and **4-3**, respectively. The following observations are made from the figures and tables:

- Based on the weekday diurnal flow curve, a total of 8.4 MG of primary equalization volume would be required to maintain a constant effluent flow of 70 mgd. Based on the weekend diurnal flow curve, a total of 12.1 MG of primary equalization volume would be required to maintain a constant effluent flow of 70 mgd. If a storage volume of 8.4 MG was provided, then the weekly average flow shortage would be 3.2 MG.
- With the planned expansion of the primary equalization volume to 4.68 MG, there will be a tertiary effluent shortage between 1:45 am and 7:15 am of 3.2 MG for weekday conditions and a shortage of 6.4 MG for weekend conditions. This would result in a weekly average shortage of 4.1 MG.
- Beyond the planned expansion to 4.68 MG, the flow equalization volume can be increased to 7.92 MG by constructing the Phase 4 primary clarifiers. For weekday conditions, this would minimize the nighttime flow shortage to 0.4 MG between 3:30 am and 6:00 am. For weekend conditions, this would reduce the flow shortage to 3.6 MG between 2:45 am and 8:45 am. This would result in a weekly average shortage of 1.3 MG.

This analysis was repeated for 2040, which is the RWMP planning year. The maximum daily flow to DCT for 2040 has been estimated to be 91 mgd. While the maximum tertiary effluent production under this condition is still 70 mgd because of the process limitations within the plant, the higher influent flow would decrease the tertiary effluent shortage at night and, therefore, reduce the equalization volume requirements. Thus equalization volume required for operating the plant at full treatment capacity is reduced to 6.9 MG during the weekday (as compared to 8.4 MG for 2018) and 10.6 MG for the weekend flow (as compared to 12.1 MG for 2018).

Figure 4-1: DCT Tertiary Effluent Uses and Flow Shortages – Weekday

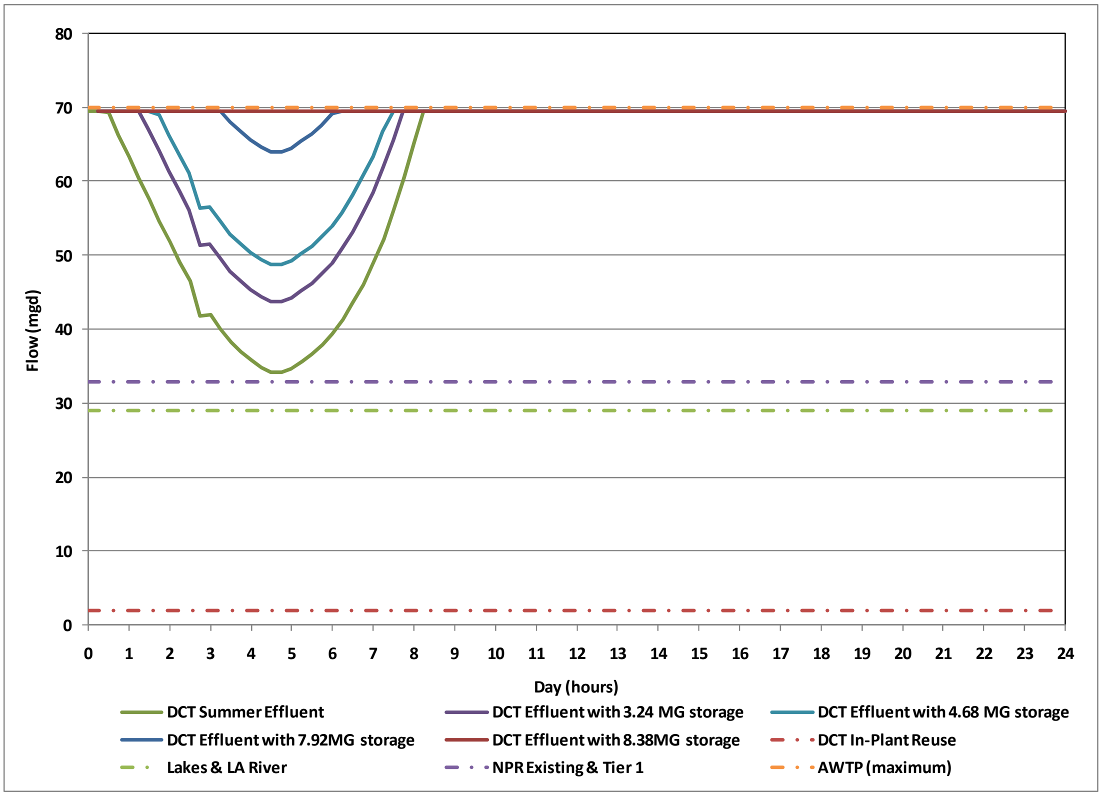


Figure 4-2: DCT Tertiary Effluent Uses and Shortages – Weekend

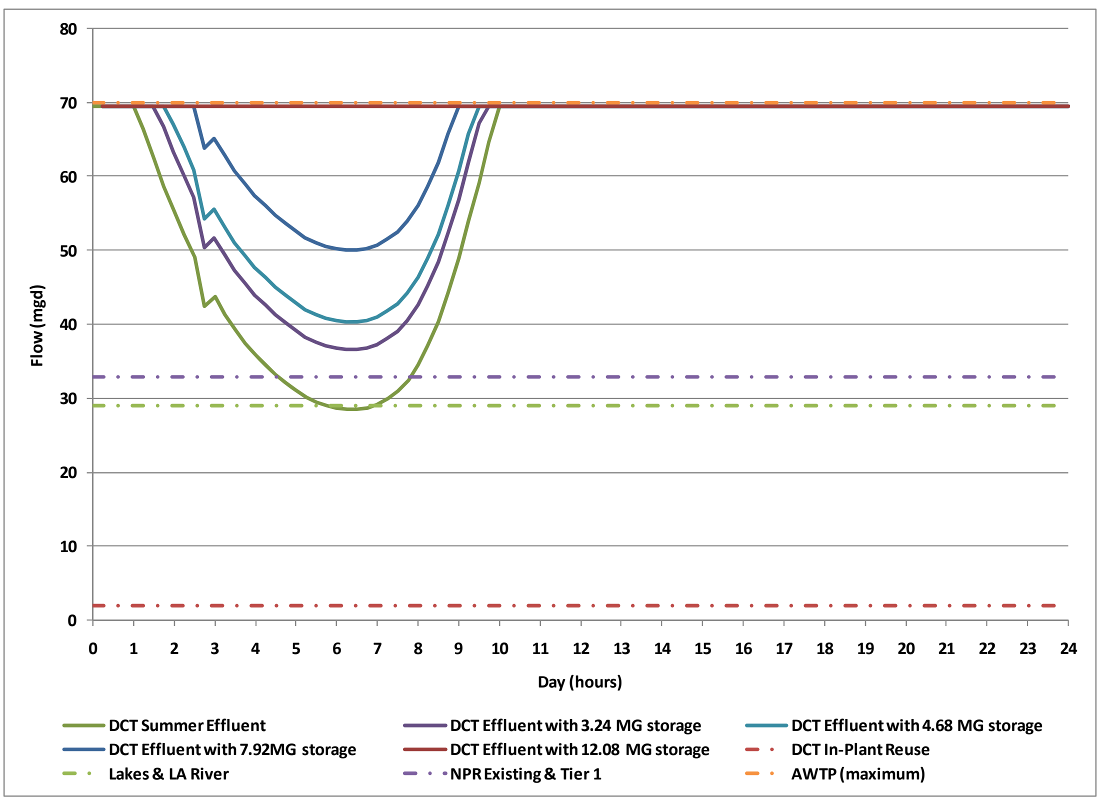


Table 4-1: DCT Tertiary Effluent Shortage and Required Primary Equalization Volume – Weekday

Primary Equalization Volume (MG)	Shortage in Tertiary Effluent Volume (MG)	Required Primary Storage Volume to Eliminate Shortage (MG)
0	7.3	8.4
3.24	4.5	5.1
4.68	3.2	3.7
7.92	0.4	0.5
8.4	0	0

Table 4-2: DCT Tertiary Effluent Shortage and Required Primary Equalization Volume – Weekend

Primary Equalization Volume (MG)	Shortage in Tertiary Effluent Volume (MG)	Required Primary Storage Volume to Eliminate Shortage (MG)
0	10.5	12.1
3.24	7.7	8.8
4.68	6.4	7.4
7.92	3.6	4.2
8.4	3.2	3.7
12.1	0	0

Table 4-3: Average Weekly DCT Tertiary Effluent Shortage

Primary Equalization Volume (MG)	Shortage in Tertiary Effluent Volume (MG)
0	8.2
3.24	5.4
4.68	4.1
7.92	1.3
8.4	0.9
12.1	0

4.2 40 mgd Plant Capacity

Under the current operating conditions of the DCT treatment facility, the plant capacity during winter months (October 15 to April 15) is limited to 40 mgd. In December 2009, the Bureau of Sanitation (BOS) decided to move forward with construction of the In-Plant Wet Weather Storage Project. Upon completion of the wet weather storage basins in December 2012, then DCT will be operated at 80 mgd year round. Therefore, this current winter treatment restriction will not impact meeting the recycled water goals.

5. Summary and Recommendations

In summary, due to process restrictions within DCT, primary equalization is required to achieve a tertiary effluent flow of 70 mgd. DCT currently has 3.24 MG of primary equalization storage that will be expanded to a total of 4.68 MG as part of the DCT In-Plant Wet Weather Storage Project. Once the recycled water program is expanded to fully utilize the tertiary effluent from DCT, then additional primary equalization storage volume beyond the 4.68 MG will be required to achieve a constant DCT output of 70 mgd. Expanding the equalization volume with the Phase 4 primary clarifiers would limit the tertiary effluent shortage to 0.4 MG on weekdays and 3.6 MG on weekends, for a weekly average shortage of 1.3 MG.

Following are recommendations for further investigation and future work to advance this evaluation and confirm the timing for equalization volume:

- Modify the diversion on the EVIS outfall sewer to allow the maximum flow to be routed to DCT. Confirm the estimated diurnal flow curves, and the variation between the weekday and weekend diurnal flows, with actual flow data. This is similar to a recommendation from the Draft DCT Maximum Flow Assessment TM to re-route the influent flows to DCT to confirm the maximum average day flow rate to the plant.
- Once the integrated alternatives analysis (Task 2b) is complete, update this analysis to determine the flow equalization requirements for the planned recycled water demands and the timing based on the implementation plan.
- Determine the cost-effectiveness of constructing additional primary equalization volume by comparing it with reduced availability of recycled water.
- Develop mitigation measures to accommodate the tertiary effluent flow shortage with both 4.68 and 7.92 MG of primary equalization volume when 70 mgd of the tertiary effluent is not being reused 24 hours per day, such as investigating the possibility of sending a reduced flow to the Lakes and LA River at night when the shortage occurs. Modifying the existing and future planned recycled water demands could offset the need for additional primary equalization.
- If the average weekly shortage with 7.92 MG of total primary equalization volume does not meet the planned recycled water demands, then evaluate primary equalization storage options beyond 7.92 MG.

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Appendix I

Source Control Summary Document

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IWMD INDUSTRIAL WASTE MANAGEMENT DIVISION

CLEAN WATER... MAKING IT HAPPEN

CITY OF LOS ANGELES INDUSTRIAL WASTE MANAGEMENT DIVISION SOURCE CONTROL PROGRAM - 2010

Introduction

For more than five decades, the Industrial Waste Management Division (IWMD) of the Bureau of Sanitation, Department of Public Works, has worked to protect local receiving waters (rivers, oceans, and groundwater) and the quality of wastewater products that are recycled (recycled water and biosolids) by regulating industrial wastewater discharges to the City of Los Angeles's (City's) sewer system and implementing source control and pollution prevention programs. These activities are conducted in accordance with the Los Angeles Municipal Code (LAMC) Section 64.30 Industrial Waste Control Ordinance and federal pretreatment regulations pursuant to 40 Code of Federal Regulations Part 403 (40 CFR 403) and the Clean Water Act (CWA). The City's Source Control Program was approved by the United States Environmental Protection Agency (USEPA) on June 30, 1983. In 1989, USEPA delegated the authority to administer pretreatment/source control programs in California to the State and Regional Water Boards. Data presented in this report are for Fiscal Year 2009-2010.

Wastewater Management

The City manages and operates the largest water reclamation/ treatment system on the west coast, which is comprised of over 6,520 miles of pipelines, 54 pumping plants and four treatment plants: Hyperion Treatment Plant (HTP), the Donald C. Tillman Water Reclamation Plant (DCT), the Los Angeles-Glendale Water Reclamation Plant (LAG), and the Terminal Island Water Reclamation Plant (TIWRP). The four plants process over 400 million gallons per day (mgd) of wastewater. The treated wastewater is either reused as recycled water or discharged to the Los Angeles River, Santa Monica Bay, or Los Angeles Harbor. In 2010, 100% of the biosolids generated from wastewater treatment was beneficially reused: 91% for agricultural land application; 7.4% for composing; and 1.6% for the Terminal Island Renewable Energy Project. The treatment plants are subject to the requirements and limitations of National Pollutant Discharge Elimination System (NPDES) permits, Waste Discharge Requirements (WDRs), and Water Recycling Requirements (WRRs), which are issued by the Los Angeles Regional Water Quality Control Board (RWQCB).

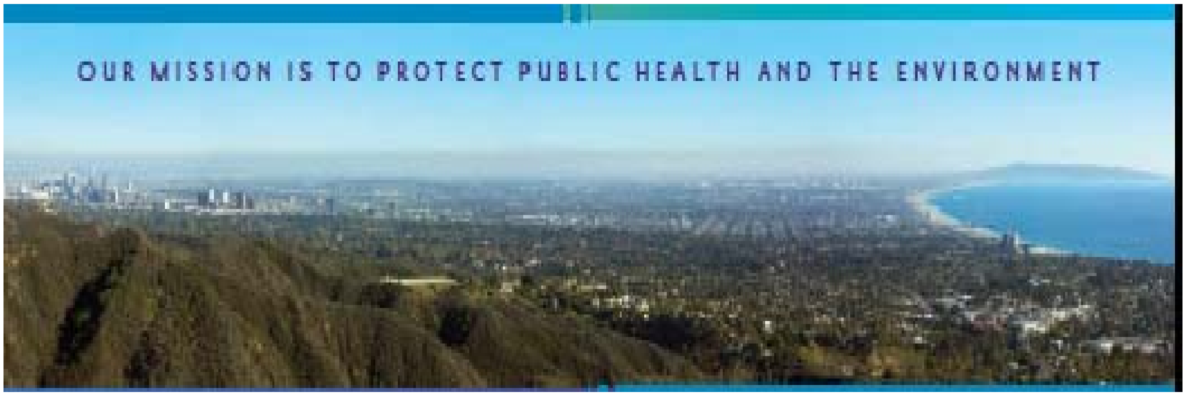
Wastewater management is divided into two treatment systems: 1) the Hyperion Treatment System; and 2) the Terminal Island Treatment System.

The Hyperion Treatment System consists of the wastewater collection system; HTP, DCT, and LAG; the City of Burbank's Water Reclamation Plant (Burbank WRP); and ocean outfalls. The Hyperion Treatment System collects, treats, and disposes of sewage from the entire City except the Wilmington-San Pedro Area, the strip north of San Pedro, and Watts, and from a number of "contract" cities and agencies under contractual agreements.[1] The contract cities and agencies operate their respective collection systems that are tributary to the City's main trunk lines. The collection system is designed to allow for diversion of influent flow from DCT, LAG, and the Burbank WRP to HTP in case of plant operational problems or during operational shutdowns for maintenance, process start-up, or construction.

Some contract cities and agencies also perform source control activities. The contractual agreements require the contract cities to ensure compliance with federal, state, and local regulations, including pretreatment regulations, and allow the City to enter an agency's jurisdiction if the agency fails to take action. IWMD oversees each contract city's compliance with federal pretreatment requirements and works with the cities on a regular basis ensuring their continued compliance. The contract agencies submit their compliance reports semi-annually and IWMD includes a status update of each contract city's compliance in semi-annual and annual reports provided to the RWQCB and USEPA. Approximately 85% of the sewage and commercial/industrial wastewater is generated within the City. The remaining 15% comes from the contract cities and agencies. Industrial wastewater represents approximately 5.3% of the total flow to the system.

The Terminal Island Treatment System consists of the wastewater collection system, the TIWRP, the TIWRP Advanced Water Treatment Facility (AWTF), and an outfall that discharges to the Los Angeles Outer Harbor. The Terminal Island Treatment System manages wastewater generated from over 550 businesses in the industrialized Los Angeles Harbor area and serves approximately 130,000 people in San Pedro, Wilmington, and a portion of Harbor City areas. Flow to the TIWRP consists of domestic, commercial and industrial wastewater. Industrial wastewater represents approximately 27% of the total flow to the TIWRP. Additional information on the City's four water reclamation/treatment plants is presented in the following table.

[1] The Cities of Beverly Hills, Burbank, Culver City, Glendale, El Segundo, San Fernando, West Hollywood, and Santa Monica.



	Treated wastewater in Fiscal Year 2009-2010	*Where the wastewater goes*
HTP – serves more than 4 million people, including 29 cities and agencies that contract for wastewater service	Over 109,000,000,000 gallons of wastewater – an average of 299 mgd[1]	Most of the treated water is discharged 5 miles offshore into the Santa Monica Bay at a depth of 200 feet. More than 16.8 billion gallons were recycled, including 12.4 billion gallons in partnership with the West Basin Municipal Water District.
DCT – serves residents and businesses in the northern and western San Fernando Valley	Over 11,000,000,000 gallons of wastewater – an average of 32 mgd	Approximately 9.5 billion gallons were recycled. The Japanese Garden lakes, Lake Balboa, and the Wildlife Lake received more than 8.2 billion gallons of recycled water, which ultimately is returned as supplemental flow to the Los Angeles River. Another 0.5 billion gallons of recycled water was used for cooling water and landscape irrigation and 0.7 billion gallons for in-plant uses.
LAG – serves residents and business in the east San Fernando Valley, and portions of the City of Glendale. This plant is owned jointly with the City of Glendale.	Over 6,000,000,000 gallons of wastewater – an average of 17 mgd	1.5 billion gallons of recycled water were used for landscape irrigation and cooling water. The remainder was returned as supplemental flow to the Los Angeles River.
TIWRP – serves the communities of San Pedro, Wilmington, and parts of Harbor City, and industries in the Los Angeles Harbor Area	Over 5,000,000,000 gallons of wastewater – an average of 16 mgd	More than 800 million gallons of recycled water (purified using microfiltration and reverse osmosis) were used for the Dominguez Gap Sea Water Intrusion Barrier or landscape irrigation. Tertiary-treated recycled water was used on-site or discharged to the Los Angeles Harbor.

1. Million gallons per day

Overview of Source Control Program

The City's source control program maintains a qualified staff of more than 140 individuals that provide permitting, inspections, sample collection, sample analysis, data analysis, review and response, enforcement, development of source control requirements, and administration (including record keeping and data management). The program's success can be attributed to rigorous up-front permitting and pretreatment requirements, intensive and extensive field presence by the inspection staff, aggressive enforcement actions for all violations, public outreach, and pollution prevention activities.

The program's overall objectives include:

- Protecting the treatment plants from interference with process operations and pass through of harmful pollutants to the environment;
- Protecting the life, health, and safety of operating and maintenance personnel;
- Ensuring the health, safety, and welfare of the public;
- Providing the opportunity for beneficial reuse of biosolids; and
- Providing the opportunity for water reclamation.

Regulated Industries/Permitting

Industrial facilities and certain commercial facilities that intend to discharge industrial wastewater to the City's sewage collection and treatment system are required to first obtain an industrial wastewater permit. Permits contain requirements including prohibitions specified in the Industrial Waste Control Ordinance, numeric discharge limits, and monitoring and reporting requirements.

There are two permit classifications for industries within the City's service area: 1) Significant Industrial Users (SIUs) and 2) Local Industrial Users (LIUs).

Per federal regulations, an SIU is defined as an industrial discharger that is either:

- Subject to Federal Categorical Pretreatment Standards (these SIUs are designated as Categorical Industrial Users or CIUs);
- Discharges 25,000 gallons or more per day of process wastewater;
- Contributes process wastewater that makes up 5% or more of the average dry weather hydraulic or organic capacity of one of the treatment plants; or
- Is designated by IWMD to have a reasonable potential to adversely affect operation of the City's treatment plants or violate pretreatment standards. This particular criterion provides IWMD with significant flexibility to determine which industries are regulated as SIUs and therefore subject to more stringent permitting and scrutiny than LIUs.

All other industries are classified as LIUs, and include automotive repair and maintenance shops, laboratories, medical and dental offices, restaurants, and wastehaulers.

A summary of the different classifications of industrial permittees is presented in the following table.

Classification	Number
SIUs	
• CIUs	128
• Non-categorical SIUs	93
Total	**221**
LIUs	
Total	**15,229**
Total Permittees	**15,450**

A listing of the CIUs by point source category is provided in the following table.

USEPA Category	40 CFR Regulation	Number of Permits
Metal Finishing	433	75
Electroplating	413	25
Pharmaceutical Manufacturing[2]	439	9
Electroplating, Metal Finishing	413, 433	6
Electrical and Electronic Components	469	3
Metal Finishing, Metal Molding and Casting	433, 464	2
Organic Chemicals, Plastics, & Synthetic Fibers	414	1
Petroleum Refining	419	1
Iron and Steel Manufacturing, Metal Finishing, Copper Forming	420, 433, 468	1
Iron and Steel Manufacturing, Nonferrous Metals Manufacturing and Metal Powders	420, 471	1
Steam Electric Power Generating	423	1
Metal Finishing, Nonferrous Metals Manufacturing and Metal Powders	433, 471	1
Centralized Waste Treatment	437	1
Coil Coating	465	1
Total		**128**

IWMD uses its enhanced Permit Information Management System (PIMS) to maintain the industrial inventory. PIMS is a relational data management system that supports pretreatment implementation and enforcement activities. It includes all pertinent information on industries, including Standard Industrial Classification (SIC) codes and geographical information system (GIS) geo-coding that enable tracking industries by type, pollutant group, location of industries and tributary treatment plant. Additional support is provided by on-line access to *The Merck Index,* a comprehensive reference source for information on chemicals, drugs, and biologicals. Thus, PIMS can also be used for chemical inventories as well as for pollutant source identification/control studies (see Pollutants of Concern (POCs) - Prioritization Framework).

The inventory of industries is updated using a multiple source identification system:

- YellowPages.com
- Verizon Telephone Book
- Inventory canvassing
- Inspections
- Review of permit applications and renewals[3]
- Characterization of an industry's wastewater discharge
- Periodic flow updates

[2] It is important to note that biotechnology products, including antigens, proteins, antibodies, and vaccines, are biodegradable (Fewson, 1988) and therefore are not persistent in biological treatment systems, including soil aquifer treatment systems. Reference: Fewson, A.C. 1988. Biodegradation of xenobiotic and other persistent compounds: the causes of recalcitrance. *Trends in Biotechnology*, 6:7 pp. 148-153.

[3] SIU permits have a maximum duration of three years from the date of initial issuance or reissuance. Applications for permit renewal must be filed a minimum of ninety days prior to the permit expiration date. Industrial wastewater permits are not transferable from one company or person to another. Whenever a change in ownership of a business occurs, the new company must obtain a new permit. LIU permits do not expire. They are terminated upon change of ownership. The new owner needs to apply for a new permit. LIU permits may be amended if there is a change of process in the facility.

- Facility audits
- Business licenses

This process involves the screening of names of industries to eliminate duplicate records, with inspections conducted on a geographical basis. Information collected during the inspections is used to determine if the facility should be permitted as an SIU (CIU or non-categorical SIU) or LIU. Addresses of cancelled permits are maintained in the PIMS database to identify locations of potential new industries (permits are not transferable). Any new industry must obtain a permit and submit information on its industrial processes and a list of constituents typical of its industrial waste discharge to assist in identifying pollutants that must be regulated and/or monitored.

IWMD must be notified whenever certain changes such as operations, process, flow, or pretreatment modifications occur in a facility. The permit may be amended as a result of any modifications.

Pollutants of Concern (POCs) - Prioritization Framework

The overall goal of the POC Prioritization Framework is to determine which constituents should be singled out for control and thus enable IWMD to optimize its use of resources. This is a critical approach given the large number of candidate compounds that might be considered for regulation and the need to target how resources are expended.

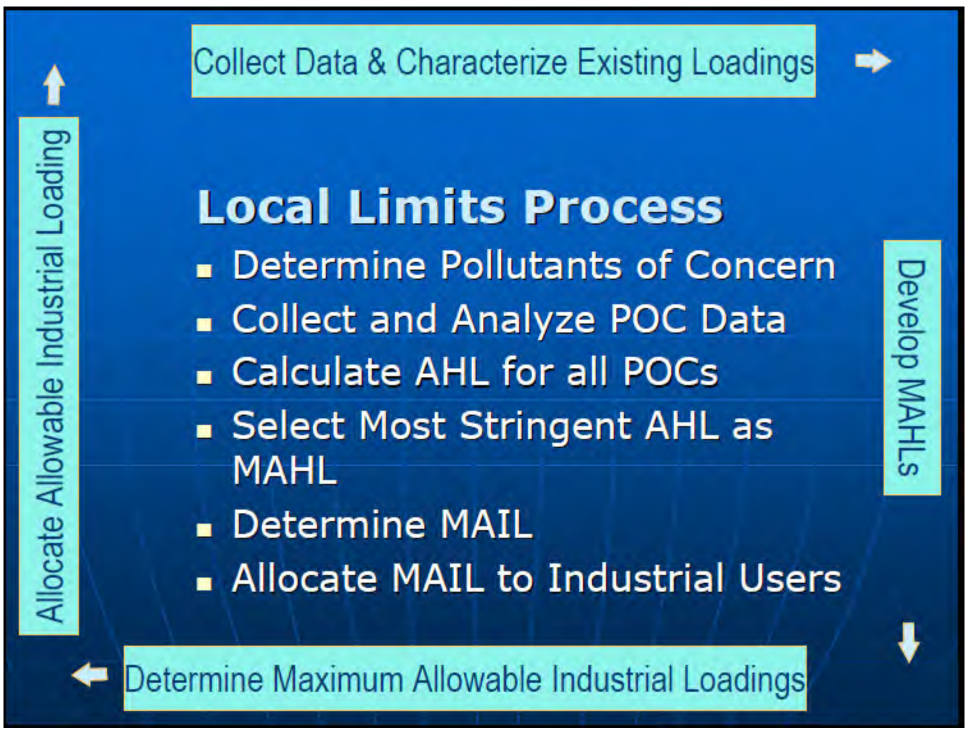
Control of POCs from industries is accomplished by establishing numerical pollutant concentration values that are not to be exceeded at any time or by imposition of management practices. The prioritization process takes place as part of developing and applying industrial discharge limitations. There are two types of discharge limitations that IWMD implements: Federal Categorical Standards and Local Limits as described below.

Factor	**Federal Categorical Standards**	**Local Limits**
Developed by:	USEPA	IWMD
Objective is to:	Provide uniform national control of certain industries	Protect receiving water, recycled water, biosolids, treatment plant operation and workers safety, public health
Regulates:	Industries specified in the CWA	All non-domestic dischargers
Pollutants:	Priority Pollutants[4]	Any pollutant
Basis:	Technology based	Technically based on site-specific factors
Limits apply at:	The end of the regulated industry process(es)	Depends on the development method
Flexibility for prioritizing and managing:	None	Considerable – enables IWMD to identify and prioritize POCs for control

[4] There are 126 priority pollutants (see Appendix A to 40 CFR 423). It was a negotiated list of toxics as part of a consent decree with USEPA and the National Resources Defense Council. It was ratified by Congress in 1977 and has been slightly modified over time. http://water.epa.gov/scitech/swguidance/methods/pollutants.cfm

Federal Categorical Pretreatment Standards are national standards for industrial wastewater discharges to publicly owned treatment works (POTWs) that are issued by USEPA under Title III of the CWA. The standards are technology-based (i.e., they are based on the performance of industrial treatment and control technologies and not on the risk or impacts upon receiving waters). Concentration-based, mass-based, or production-based numeric limits are established for the CWA Priority Pollutants. To date, USEPA has established standards for 56 different industrial categories. IWMD is obligated to implement and enforce these standards for applicable industries in its service area.

Local limits are established specifically by IWMD to protect the City's treatment plants, ensure compliance with permit limitations, enable reuse of recycled water and biosolids, and protect worker health and safety and the public. Local limits allow IWMD to identify and prioritize POCs for control at any time. The different types of local limits that can be applied include: 1) chemical specific concentration-based limits that uniformly apply to all industries within the City's service area (uniform local limits); 2) chemical specific concentration or mass-based limits that are established for specific industries or industrial categories on a case-by-case basis; 3) industry management practices or plans; and 4) prohibitions. The specific process followed in POC prioritization and local limit development is shown in the following figure.



Notes:
AHL = Allowable Headworks Loading
MAHL = Maximum Allowable Headworks Loading
MAIL = Maximum Allowable Industrial Loading

Regulated POCs are identified using the numeric and narrative limits in the City's NPDES permits, WDRs, and WRRs, and the observed pollutant concentrations in influent, effluent, AWTF product water, and biosolids monitoring results. The limits in NPDES and water reuse permits, established for wastewater, recycled water, and biosolids, are based on:

- CWA technology-based effluent limits.
- Water quality criteria in the California Toxics Rule.
- Water quality limits and objectives in the California Ocean Plan.

- Water quality objectives in the Los Angeles Water Quality Control Plan (Basin Plan) for surface water and groundwater (including drinking water maximum contaminant levels).
- Water Recycling Criteria (Title 22).
- Requirements from the California Department of Public Health (CDPH) regarding the use of recycled water for groundwater recharge.
- State plans and policies.
- USEPA biosolids regulations (40 CFR 503).

The most stringent of these regulatory requirements are used to derive the maximum allowable loading into the treatment plant, which is called the maximum allowable headworks loading (MAHL). The MAHL specifically takes into consideration treatment plant performance by considering influent and effluent concentrations for removal of POCs. This is critical for specific POCs, particularly disinfection byproducts, which can be formed as part of the treatment process. The MAHL is also adjusted by several factors, including a safety factor and a growth factor, to derive the maximum allowable industrial loading (MAIL). The MAIL can then be "allocated" to industrial dischargers using a uniform concentration for either the entire service area or the tributary treatment plant; by industrial user contributory flow; by WYNIWYG (what you need is what you get); using mass-based limits; and/or by applying selected industrial reduction that is accomplished using targeted management practices.

The current uniform chemical specific local limits for the City's service area are presented below.

Arsenic	3 mg/L
Cadmium	15 mg/L
Copper	15 mg/L
Cyanide (Total)	10 mg/L
Cyanide (Free)	2 mg/L
Dissolved Sulfides	0.1 mg/L
Lead	5 mg/L
Nickel	12 mg/L
pH Range	5.5-11
Silver	5 mg/L
Total chromium	10 mg/L
Zinc	25 mg/L
Dispersed oil and grease (Total)	600 mg/L
Floatable oil and grease	None Visible

An example of an industry specific local limit is the mass-based selenium limit established for ConocoPhillips, which discharges to the TIWRP. In lieu of establishing a uniform selenium local limit for the Terminal Island Service Area, IWMD elected to establish a specific limit for this industrial facility because it was the major contributor of selenium to the TIWRP. This special limit ensures that the selenium loading from ConocoPhillips to the plant is kept at adequate levels for protection of biosolids quality. A mass-based limit encourages waste minimization, water conservation, and recycling; adequately limits the mass loading into the treatment facility; deters compliance by dilution; and enables detection of changes at the industry via increased production.

An example of an industry specific reduction practice is the effort that was undertaken to reduce boron at the TIWRP AWTF. Recycled water used from the AWTF is regulated under two permits (R4-2003-0025 and R4-2003-0134). At the time the permits were issued, monitoring data from the AWTF indicated that boron was detected at concentrations greater than the Basin Plan groundwater objective of 1.5 mg/L. The U.S. Borax

Facility, which discharged to TIWRP, was suspected of contributing to the elevated boron concentrations. IWMD worked with U.S. Borax to implement a two-phase work plan to reduce/control the boron discharges by 59%:

- Phase I – installation of infrastructure (piping, storage, control valves) that allowed U.S. Borax to reuse its wastewater rather than discharge to the sewer system.
- Phase II – installation of a pretreatment system (if necessary) if Phase I could not achieve the needed reductions.

Phase I was completed in 2004 (two years ahead of schedule) and achieved the required reductions. Due to the innovative engineering changes implemented, U.S. Borax was able to reuse 90% of its process wastewater that was formerly discharged to the sewer and achieved an annual savings of over $100,000, which included a reduction of more than 2 million gallons per month in fresh water usage.

Local limits are evaluated annually to ensure that they are protective. The assessment is based on monitoring data and comparison to all existing permit requirements for each treatment/reclamation plant. Evaluations can also occur when permits are revised, at the request of the RWQCB or CDPH, or when IWMD determines that revisions are necessary. This determination takes into consideration USEPA Guidance for local limits, which recommends developing/revising local limits when the average plant influent loading exceeds 60% of the MAHL or the maximum daily influent loading exceeds 80% of MAHL. IWMD reviews treatment plant influent data at least quarterly. In addition, the Bureau of Sanitation annually reviews effluent data for the treatment plants to determine if any pollutants have the reasonable potential to cause or contribute to a violation of a water quality standard. If this should occur, IWMD initiates an investigation to evaluate the source and need for local limits.

POCs are identified and assessed for development of new local limits or modification of existing local limits through this local limits review process. If deemed necessary, the development of local limits for additional pollutants would follow the same process as used for currently regulated POCs. Unregulated POCs not selected for control may be placed on a “watch list” for further evaluation (monitoring or study) or ruled out for further consideration.

POC investigations can also be triggered to mitigate elevated levels of compounds of interest to the RWQCB or the CDPH. For example, if a chemical of interest was found in recycled water at levels of concern, an investigation would be initiated from the water reclamation plants through the regional sewers to identify where the compound is originating utilizing PIMS to identify the types of industries using the chemical for processing. This information would be used to identify the source, determine if it is coming from an industry (or not), and then take corrective action to control the release of the chemical if necessary.

Pollutant source identification/control studies typically entail one or more of the following steps:

- Perform a Source Identification Study
    - PIMS information/database that allows for linkage between industry SIC code and pollutant categories, and identification of suspect industries and locations for further evaluation is under development
    - Sewer monitoring
    - Monitor residential/background wastewater
    - Monitor tributary contract agencies
    - Monitor drinking water
    - Substantiate industries contributing the POC
    - Substantiate other sources of the POC

- Devise a plan to reduce POCs if feasible
    - For domestic sources, work with other source control agencies and professional organizations for potential solutions, including public outreach or legislative product bans (for example the ban on products containing lindane)
    - For industrial or commercial sources, determine the treatment and feasibility for removal to acceptable levels, alternative products, new local limits or requirements, develop an action plan, take enforcement action if necessary
    - For wastewater from a contract city/agency, determine the source in cooperation with the contract agency and develop and implement a plan to reduce the POC

Additional flexibility for control of POCs is afforded by implementation of the prohibitions contained in the Industrial Waste Control Ordinance. Examples of prohibited substances include:

- Flammable, reactive, explosive, corrosive, or radioactive substances
- Toxic substances
- Noxious or malodorous materials
- Medical or infectious wastes
- Solid or viscous materials which could cause obstruction to the flow or operation of the treatment plants
- Non biodegradable oils
- Pollutants which result in the emission of hazardous gases

Inspection and Monitoring

IWMD's inspection and monitoring program is conducted to ensure that industries are in compliance with the Industrial Waste Control Ordinance as well as each industry's individual permit requirements. Surveillance monitoring is conducted within the collection system to examine targeted areas in the City, to inventory industrial users that require permits, to identify illegal discharges, and to respond to treatment plant upsets or interference that may require investigations of industries upstream from the treatment plants. Industries are also required to perform self-monitoring as part of their permit requirements.

Highlights of the wastewater management program include:

- > 93,000 samples of water collected from the environment and treatment plants
- > 348,000 tests for metals, organics, toxicity, and other indicators of treatment performance
- > 28,000 inspections of industries
- > 23,000 samples of industrial wastewater

For SIUs, inspections and monitoring are conducted more frequently than the requirements in the Federal Pretreatment Regulations as shown in the following table.

Type of IU	Inspections/year		POTW Monitoring/year		IU Self Monitoring/year	
	Federal	IWMD	Federal	IWMD	Federal	IWMD
40 CFR 413 CIUs < 10,000 gpd	1	4	1	4	2	2
Other CIUs < 10,000 gpd	1	4	1	4	2	6
CIUs > 10,000 gpd	1	4	1	4	2	12
Other SIUs	1	4	1	2	2	2
LIUs	1		1		NA	

All other industries are inspected at least once per year. Changes that might occur at industries are identified as part of the annual inspections and by annually reviewing changes in wastewater discharge using the Department of Water and Power water consumption data, or data from discharge flow meters, or an approved registered engineer's water balance and analysis. If the routine inspections reveal a significant change in the amount of water consumption, then the wastewater discharge is updated in the permit records. Furthermore, industries are required by the Industrial Waste Control Ordinance and by permits to notify IWMD of 1) any wastewater discharge changes, and 2) any changes to the facility, process, discharge flow, production, or pretreatment system that may change the characteristics of the discharge and cause it to be different from that expressly allowed under the permit. All SIU flows are updated quarterly.

Inspections are conducted to update information, check for compliance/non-compliance with federal and local discharge standards and permit conditions, and identify and document any changes in operation or discharge. This process begins with a pre-inspection file review aimed at planning and preparing the inspector for the on-site inspection. The inspection focuses on six major areas (the 6 P's):

- PLANS – verify the facility plans against what is observed on site and determine if there are any changes (i.e., removal, replacement, relocation, etc.) of tanks, plumbing, flow directions, or other structures.
- PRODUCTS - determine if new products were produced other than expressly indicated in the permit.
- PROCESS – examine the process area thoroughly to see where process water in the facility comes into contact with products.
- POLLUTANTS – check the pollutants introduced into the process water during production and compare the pollutants observed against those indicated in the permit.
- PRETREATMENT – check the pretreatment system(s) used to remove/reduce pollutants in the wastestream(s).
- PARAMETERS – sample and test the discharged water to check if it meets the parameters set in the industry's permit.

Questionnaire forms are used to inspect the chemical and hazardous waste storage areas, chemical spill prevention methods, hazardous waste handling procedures, and monitoring and disposal records. A post-inspection interview is performed to inform the industry of any deficiencies noted during the inspection and on areas where improvements may be needed. The inspection and post-inspection interview are also used as means of directly providing outreach to industries regarding requirements, best management practices, pollution prevention, recycling initiatives, or issues related to watershed protection. IWMD has a formal industrial waste inspector training program. In addition, staff attends the California EPA Basic Inspector Academy.

Enforcement

Industrial facilities that do not comply with permit requirements are subject to enforcement action. IWMD utilizes an Enforcement Response Plan (ERP) and Enforcement Response Guide (ERG) to respond to violations in a consistent and timely manner. The objectives of the enforcement program are to 1) achieve and maintain consistent compliance; 2) subject repeat offenders to escalated enforcement actions; and 3) initiate the process at higher levels of enforcement for those industries that have been subjected to enforcement proceedings and that are still unable to maintain full and permanent compliance over the long term. In general, the City's enforcement program allows for a progressive enforcement approach. However, it is also intended to be flexible and thus provide the ability to use best professional judgment on a case-by-case basis depending on the nature and circumstances of the situation.

Violations are identified through site inspections and as the result of IWMD monitoring and industry self-monitoring. PIMS is used to support enforcement activities by generating standardized reports that show discharge and non-discharge (e.g., reporting) violations immediately, to IWMD. Enforcement activities and follow-up are also tracked through the PIMS enforcement module.

The types of enforcement actions that IWMD can impose are:

- Telephone Contacts or Verbal Notification
- Warning Notices
- Increased Monitoring and Inspection
- Short-Term Permits
- Notices of Violation
- Compliance Meetings
- Administrative Orders
- Cease and Desist Order
- Consent Orders
- Compliance Orders
- Permit Suspension Orders
- Imminent Hazard Suspension Orders
- Permit Revocation
- Termination of Sewer Service
- Publication of Significant Noncompliance[5]
- Recovery of City Incurred Costs
- Administrative Complaint/ Civil Penalties
- Civil Filing
- Criminal Prosecution
- Referral to USEPA or RWQCB

[5] The Federal Pretreatment Standards require IWMD to annually publish the list of industries deemed to be in "Significant Noncompliance" or SNC. The Standards defined SNC to include chronic violations, violations that impact the treatment plants, endanger public health, etc.

Increased attention to enforcement has underscored the effectiveness of IWMD's program. Since the implementation of the ERP**,** the percent compliance rate has increased from a low of 56% in 1990 to a current average of 94% for CIUs.

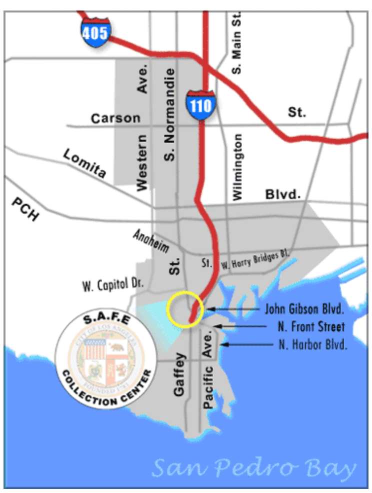
Outreach and Innovative Programs

IWMD's source control program has a number of unique, innovative, and effective components that have been implemented to achieve more effective pollution control and help raise public awareness on the importance of pollution prevention.

"No Drugs Down the Drain" (N3D) Program

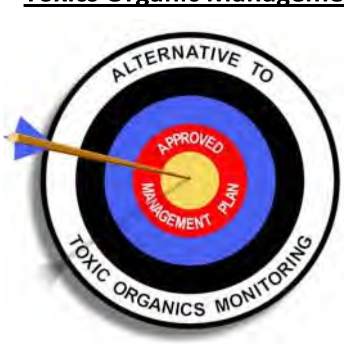
IMWD recognizes the need to divert waste medicines from the sewer to alternative, responsible disposal options and has elected to achieve diversions through education and outreach. The "No Drugs Down the Drain" (N3D) program was launched in March 2006 in partnership with the Los Angeles County Sanitation Districts (LACSD) and Orange County Sanitation District (OCSD). N3D is part of a public outreach campaign to disseminate information about the proper disposal of household medications. This program is also sponsored by the California Pharmacist Association, which supports this important awareness effort to provide consumers with sensible steps to safely reduce the amounts of medications in the home. During the implementation phase in April 2006, IWMD produced 1.5 million bilingual postcards (English and Spanish) and pharmaceutical fact sheets that were distributed to consumers through 800 local pharmacies. IWMD, in collaboration with LACSD and OCSD, also developed a website to provide more information on the N3D program at http://www.nodrugsdownthedrain.org/index.html. IWMD also participates in the Los Angeles County and statewide N3D campaigns.

Household Hazardous Waste Safe Centers



The City operates six household hazardous waste permanent collection sites throughout the City, known as S.A.F.E. (solvents/ automotive/flammables/electronics) Centers. The S.A.F.E. Centers are open every weekend and provide a timely and convenient way for the public to dispose of residential waste, including unwanted medications. In addition, the City sponsors periodic mobile collection events on weekends, where residents can drop-off their waste to be properly disposed. These mobile events are held in areas not readily served by the S.A.F.E. Centers. For Conditionally Exempt Small Quantity Generators, four of the six centers accept waste from businesses on an appointment only basis. Further information on the program is available at: http://www.lacitysan.org/solid_resources/special/hhw/safe_centers/index.htm

Toxics Organic Management Plant Checklist



Standards for certain federally regulated industrial categories include numeric limits for toxic organics. For three categories (Electroplating (40 CFR 413), Metal Finishing (40 CFR 433), and Electrical and Electronics Components (40 CFR 469)) that represent a majority of the active CIUs permitted in the City, the standards allow for compliance with the limits to be determined either by monitoring or by developing and submitting a certified Toxic Organic

Management Plan (TOMP). In preparing a TOMP, the USEPA requires an industry to identify all of the toxic and non-conventional organic constituents used in their processes and to describe in detail the procedures in place for ensuring that these constituents do not routinely spill or leak into the wastewater system. The TOMP also requires the industry to describe procedures enacted for controlling the formation of chlorinated byproducts. These requirements for preparing a TOMP have proven to be an involved and complex process such that few industries have elected to use this compliance method, which is more effective at controlling organics than routine monitoring. In an effort to streamline the overall preparation and approval process and thereby encourage the use and development of TOMPs, IWMD has adopted a simplified procedure that makes use of information already on file and updated on a regular basis. The streamlined TOMP consists of two single-page forms: the Request for TOMP Approval and the TOMP Checklist. The TOMP Checklist covers all of the USEPA requirements for obtaining a TOMP in an abbreviated, yet comprehensive and easy to complete format. The Request for TOMP Approval allows the industry to certify that their plan is being implemented and that they comply with TTO pretreatment standards.

Dental Offices and Clinics Control Program

Dental offices and clinics located in the City are required by Ordinance to obtain an Industrial Wastewater Permit and comply with Best Management Practices (BMPs). The BMPs were developed in cooperation with the California Dental Association to reduce the amount of dental amalgam (potentially containing mercury) and other dental wastes (silver from photographic X-ray processing and lead from foil shields) being discharged into the City's sewer system. Additional information on the program can be found at: http://lacitysan.org/iwmd/biz_industry/pre_treat_dental.htm

Dry Cleaner Control Program

The City's Dry Cleaner Control Program controls and regulates the management and disposal of solvents, solvent waste and separator water from dry cleaners. Under this program, dry cleaner facilities are required to either obtain an Industrial Wastewater Permit from the City if they intend to discharge to the sewer, or to self-certify that they do not discharge dry cleaning waste to the sewer. The program was developed to ensure that perchloroethylene (PERC) is not discharged to the sewer, storm drain, or ground. All wastewater containing perchloroethylene or other solvent contaminated liquids must be properly disposed of by evaporation, or removed from dry cleaning facility by a certified waste hauler (with records retained for verification). Additional information on the program can be found at: http://lacitysan.org/iwmd/biz_industry/pre_treat_dry_cleaner.htm

Fats, Oil and Grease (FOG) Control Program

The City's FOG Control Program regulates Food Service Establishments (FSEs) located in the City's service area. All FSEs that potentially generate waste grease are required to obtain an Industrial Wastewater Permit, and use BMPs to reduce grease discharged to the sewer system. Any FSE that is known to cause grease-related sewer overflows or fails to implement BMPs are required to install a grease interceptor or a grease trap when it is not feasible to install a grease interceptor. All new construction of FSEs must include installation of a grease interceptor. The success of the FOG Control Program, in conjunction with the aggressive sewer cleaning and maintenance program of the Bureau of Sanitation's Wastewater Collection

System Division, has reduced overall FOG-related sewer overflows by 85%.

Sewer Science Program

The City implemented the Sewer Science Program in 2003 to increase environmental awareness and stewardship. Sewer Science is an inter-disciplinary microbiology, chemistry, physics, and environmental curriculum designed to stress the importance of pollution prevention to high school and college students. Besides increasing environmental awareness, the program grooms future environmental professionals and leaders. The program also provides opportunities for volunteer mentors, comprised of City engineers, to network with students and practice public speaking and leadership skills, while serving the community.

The program advances environmental education by taking a mobile lab unit into high school and college classrooms to simulate the primary, secondary, and advanced wastewater treatment processes. Students and teachers perform hands-on instrumental analysis, and are introduced to other scientific concepts as a way to directly link pollution prevention efforts with the treatment of wastewater. Tests are performed at every stage of the treatment process and results are graphed to visually show the effects of treatment. These results are compared to treatment plant discharge standards to indicate that even the simplest treatment system can have a great impact on wastewater quality. To enhance environmental education learned in the classroom, the program offers teachers and students a tour of one of the City's wastewater treatment facilities. Students are also encouraged to enter the Sewer Science Technical Competition and practice what they learned in the classroom.

Watershed Protection Division

Additional outreach to industries is provided through the City's Watershed Protection Division, which is charged with the responsibility of managing storm water and reducing water pollution. The Division accomplishes this through: public education and outreach; private development plan approval; construction development activities inspection; and monitoring of the City's receiving water bodies.

The Division also provides input to IWMD on industries through:

- Commercial/industrial facilities inspection; and
- Illicit discharger and illicit dumping site investigations.

Compliance Outreach

IWMD conducts workshops for industries with information on pretreatment requirements and compliance methods. IWMD has also developed guidance manuals on permitting and discharge requirements (http://lacitysan.org/iwmd/biz_industry/pre_treat_fed_categorical.htm). Publications for all aspects of the source control program and wastewater management program are available on the IWMD website at: http://lacitysan.org/iwmd/resources/publications.htm and http://www.lacitysan.org/wastewater/publications/index.htm.

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Appendix J

Groundwater Replenishment Evaluation TM

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Technical Memorandum

Title:	**Groundwater Replenishment Evaluation TM**
Prepared for:	John Hinds, Project Manager, LADWP Doug Walters, Project Manager, BOS Eloy Perez, Task 1 Lead, LADWP Hiddo Netto, Task 1 Co-Lead, BOS
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Date:	March 2012
Reference:	Task 1b Groundwater Replenishment Master Planning Document Task 1.12 Groundwater Assessment Support Task 1.16 Additional Services Related to GWR Master Planning Document

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Abbreviations and Acronyms

AF	acre-feet
AFD	acre-feet per day
AFM	acre-feet per month
AFY	acre-feet per year
AOP	advanced oxidation process
As	arsenic
ASR	aquifer storage and recovery
AWT	advanced water treatment
AWPF	advanced water purification facility
bgs	below ground surface
BOE	Bureau of Engineering, City of Los Angeles
BOS	Bureau of Sanitation, City of Los Angeles
CDM Smith	CDM Smith Inc.
CDPH	California Department of Public Health
cfs	cubic feet per second
DCTWRP	Donald C. Tillman Water Reclamation Plant
DOC	dissolved organic carbon
DPW	Department of Public Works
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EPA	United States Environmental Protection Agency
EVWRP	East Valley Water Recycling Project
FRP	fiberglass reinforced plastic
ft	foot
GSIS	Groundwater Systems Improvement Study
GWR	groundwater replenishment, groundwater recharge
HFO	hydrous ferric oxides
HSG	Hansen Spreading Grounds
IAP	Independent Advisory Panel
IEUA	Inland Empire Utilities Agency
kg	kilogram
LACDPW	Los Angeles County Department of Public Works
LADWP	Los Angeles Department of Water and Power
MCL	maximum contaminant level
MODFLOW	Modular Three-Dimensional Finite-Difference Groundwater Flow Model
MG	million gallons
mg	milligrams
mg/L	milligrams per liter
mgd	million gallons per day
mm	millimeter
NPR	non-potable reuse
NRCS	Natural Resources Conservation Service (United States Department of Agriculture)
OCSD	Orange County Sanitation District

OCWD	Orange County Water District
ppb	parts per billion
PCE	tetrachloroethylene
PSG	Pacoima Spreading Ground
RI	Remedial Investigation
RMC	RMC Water and Environment
RO	reverse osmosis
ROW	right-of-way
RTWF	Rinaldi-Toluca wellfield
RW	recycled water
RWC	recycled water contribution
RWMP	Recycled Water Master Plan
RWQCB	Regional Water Quality Control Board
ORP	oxidation reduction potential
SB	Senate Bill
SFB	San Fernando Valley Groundwater Basin
SFBGM	San Fernando Basin Groundwater Model
TCE	trichloroethylene
TDS	total dissolved solids
TM	technical memorandum
TSG	Tujunga Spreading Ground
TWF	Tujunga wellfield
μg/l	microgram per liter
ULARA	Upper Los Angeles River Area
USGS	United States Geologic Survey
VOC	volatile organic compound
VGS	Valley Generating Station
WCP	Water Campus Project
WRF	WaterReuse Foundation
WY	water year
yrs	years

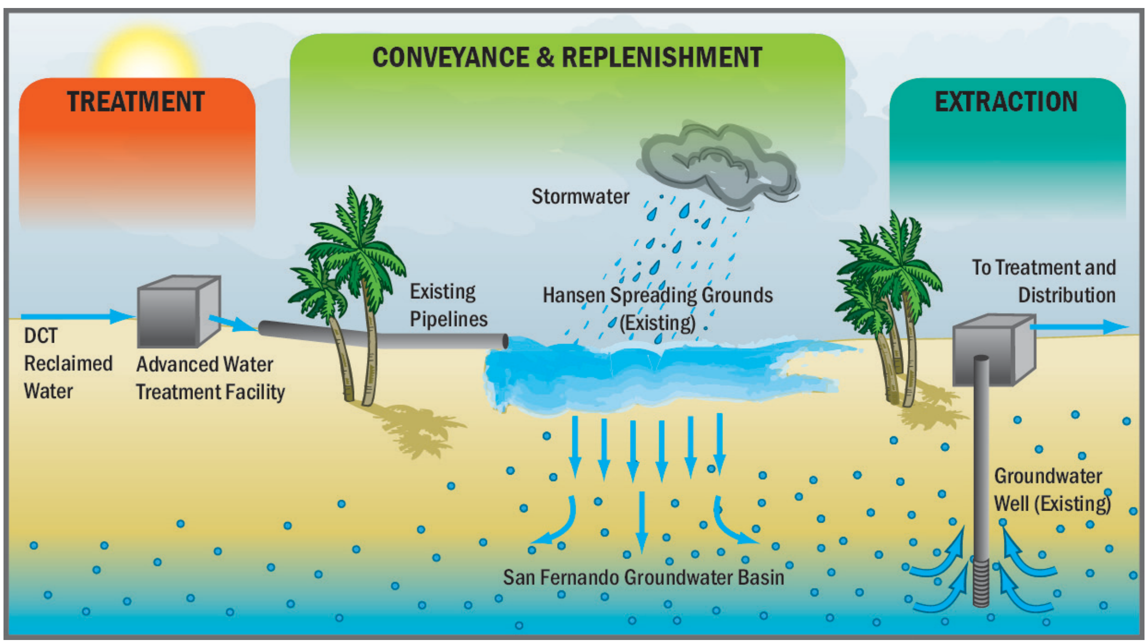
1. Introduction

The objectives of this Groundwater Replenishment Evaluation Technical Memorandum (TM) are to research and document conditions within the San Fernando Valley that could affect GWR activities in the area and provide detailed documentation of compliance with anticipated recycled water regulations based on the August 2008 California Department of Public Health (CDPH) draft Groundwater Recharge Regulations[1].

1.1 Overview of GWR Concept

GWR is a practical, proven way to increase the availability of a safe, reliable, locally-controlled water supply. As shown on **Figure 1-1**, using state-of-the-art technology, the GWR system would include treating recycled water from the Donald C. Tillman Water Reclamation Plant (DCTWRP) to near-distilled quality using AWT processes. This purified water would be conveyed to "spreading grounds," where it would percolate into the natural underground aquifer underlying the San Fernando Valley. This water replenishes the aquifer, to be used later to help meet the City's water needs. The water would be extracted (or pumped) from the existing groundwater basins for treatment and distribution to LADWP drinking water customers.

Figure 1-1: GWR Concept in the San Fernando Valley



[1] In late 2011, CDPH released new draft groundwater recharge regulations for public review and comment. The changes to the 2008 draft regulations and impacts on the proposed GWR activities are summarized in a separate TM entitled Update on Draft Groundwater Recharge Regulations. At this time it is uncertain when the groundwater recharge regulations will be finalized and, since CDPH is accepting public comments, the content of the final regulations is also uncertain. CDPH is accepting public comments on the 2011 draft regulations, which pursuant to Senate Bill (SB) 918 and its 2010 amendments to the California Water Code, CDPH is required to adopt final groundwater recharge regulations on or before December 31, 2013. However, as a result of the 2011/12 state fiscal year budget process, funding provided under SB 918 to enable CDPH to finalize the regulations was denied.

The water would be recharged into the San Fernando groundwater which represents over 90% of the valley fill portion of the Upper Los Angeles River Area (ULARA). The ULARA provides approximately 90 percent of the City's groundwater supplies. The San Fernando Basin is 112,000 acres and is replenished by deep percolation from rainfall, surface runoff, mountain-front recharge, captured stormwater, and from a portion of the water used (mainly from irrigation) in the basin. Due to increasing development and establishment of non-pervious facilities in the San Fernando Valley that has reduced natural recharge back into the SFB, there are opportunities to replenish the aquifer with additional sources of water, including stormwater and highly purified recycled water.

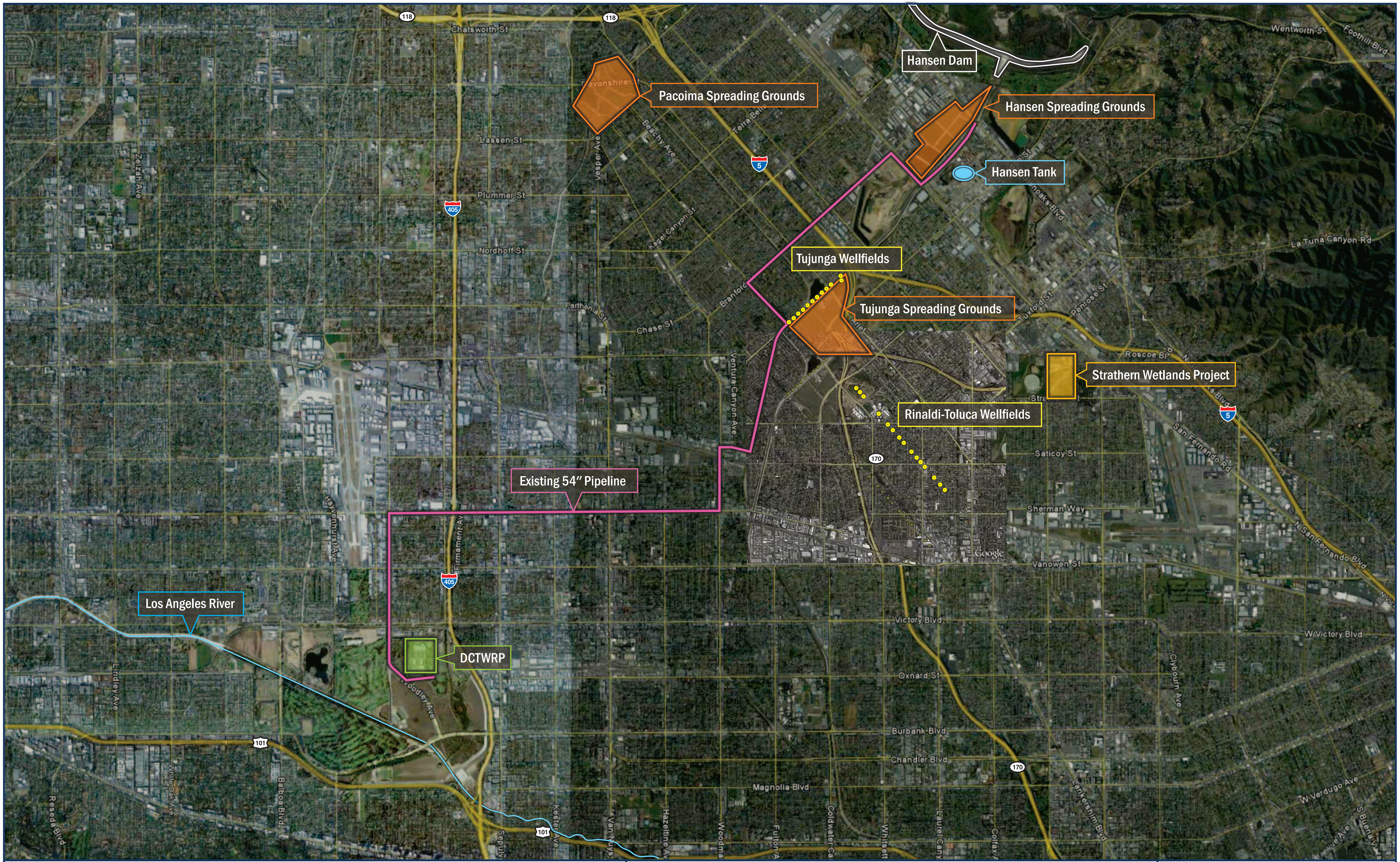
The Los Angeles County Department of Public Works (LACDPW) owns several spreading basins in the San Fernando Basin, including the Hansen Spreading Grounds (HSG), and the Pacoima Spreading Grounds (PSG), which are currently used to percolate stormwater into the San Fernando Basin. The LACDWP also operates the Tujunga Spreading Grounds (TSG) which is owned by LADWP. There is an existing 54-inch pipeline in place to convey recycled water to the Hansen storage tank, near the HSG. **Figure 1-2** shows the location of these existing facilities.

The City's GWR project concept, including a description of the advanced water treatment facilities and estimated project costs, is presented in the GWR Master Planning Report.

1.2 Document Organization

The remainder of this document presents the following information.

- Section 2 provides background information on the San Fernando groundwater basin, including existing precipitation, surface water, and groundwater data. The section also provides information on the operation of existing spreading grounds and groundwater production in the San Fernando Valley.
- Section 3 provides an analysis of Phases 1 and 2 of the proposed GWR projects in the San Fernando groundwater basin. This analysis includes a description of the numerical groundwater modeling simulations conducted and an assessment of anticipated travel time and recycled water contribution (RWC).
- Section 4 contains additional information that is potentially relevant to a GWR project in the San Fernando Valley including changes to groundwater levels, existing groundwater contamination issues, and the potential for the mobilization of arsenic with the recharge of recycled water.



City of Los Angeles
Recycled Water Master Planning

Figure 1-2:
Vicinity Map of GWR Facilities in the San Fernando Valley

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2. Background Conditions

This section provides background information on the San Fernando basin (SFB), including existing precipitation, surface water, and groundwater data. The section also provides information on the operation of existing spreading grounds and groundwater production in the San Fernando Valley.

2.1 Introduction

The City relies on groundwater for approximately 11% of its total water supply, both from the San Fernando Valley Groundwater Basin and the West Coast Basin (LADWP 2010 Urban Water Management Plan (UWMP), Exhibit 11c). The large majority of this groundwater is from the ULARA watershed, and specifically from the San Fernando Basin within the ULARA.

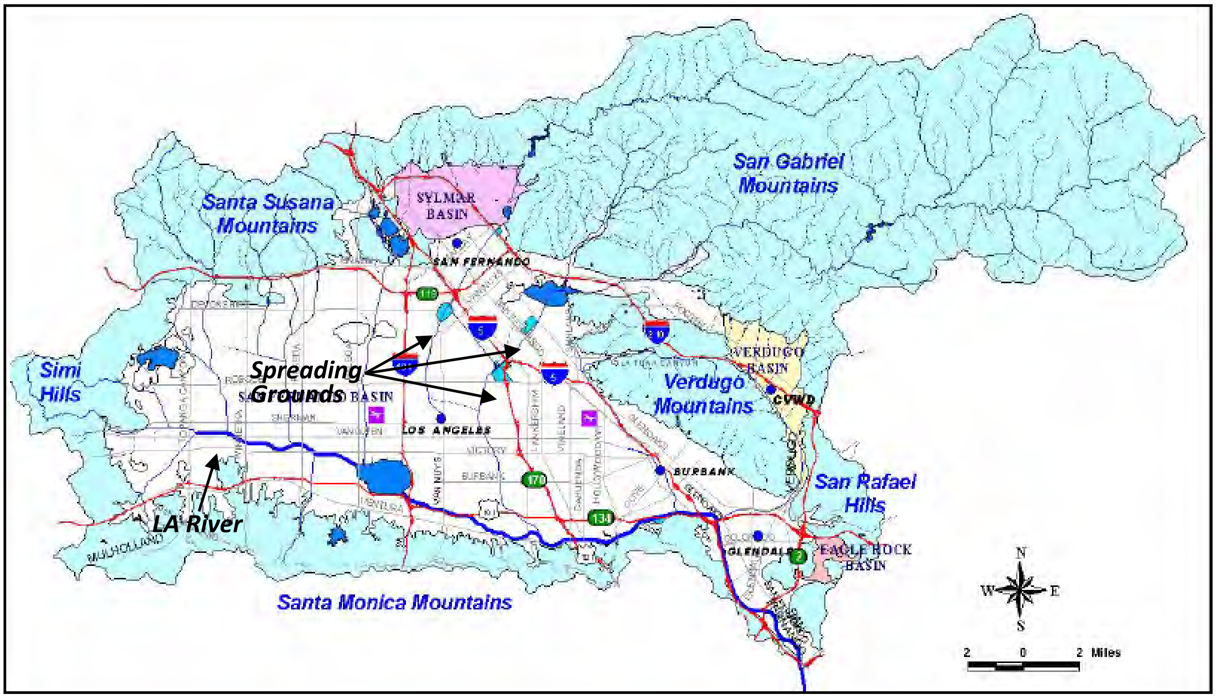
The ULARA is located in Los Angeles County, representing the northerly part of the greater Los Angeles area. The ULARA watershed, shown in **Figure 2-1**, covers approximately 328,500 acres bounded in the north by the Santa Susana and the San Gabriel Mountains, in the east by the Verdugo Mountains and the San Rafael Hills, in the south by the Santa Monica Mountains, and in the west by the Simi Hills.

In the center of the surrounding mountains and the hills is the San Fernando Valley. Underneath the valley lie four separate groundwater basins, collectively known as the San Fernando Valley Groundwater Basin. The four groundwater basins are shown on Figure 2-1 as shaded color-filled areas. The overlying surface areas of these basins are:

- Eagle Rock Basin: located in the southeast is approximately 800 acres.
- San Fernando Basin: the central portion of the valley is approximately 112,000 acres.
- Sylmar Basin: located in the north is approximately 5,600 acres.
- Verdugo Basin: located in the east is approximately 4,400 acres.

The San Fernando Basin (SFB) is the largest of the four basins, covering approximately 91.2% of the valley surface area. Within the SFB boundaries are several spreading grounds where stormwater is diverted and captured in the large basins and allowed to percolate into the ground, replenishing the aquifer below. The largest of these spreading facilities are the Tujunga Spreading Grounds (TSG), Pacoima Spreading Grounds (PSG), and Hansen Spreading Grounds (HSG). They are located in the eastern portion of the San Fernando Valley near the base of the San Gabriel and Verdugo Mountains, as shown in **Figure 2-1**. This TM discusses the potential use of these spreading grounds for GWR using water from the proposed Advanced Water Purification Facility (AWPF). While there are a few smaller spreading grounds in the SFB (e.g., Branford and Lopez), the project focused on TSG, PSG, and HSG.

Figure 2-1: The ULARA Watershed (Source: Watermaster 2009)



2.2 Surface Water

The recharge of surface water from the ULARA watershed is an important component of inflow to the groundwater aquifer in the SFB. The ULARA watershed includes, and is drained by, the upper half of the Los Angeles River and its tributaries. These tributaries originate in the ULARA watershed and drain to the Los Angeles River. The following sections describe both the precipitation and surface water flows within the ULARA watershed.

Figure 2-2: Location of Hansen, Pacoima, and Tujunga Spreading Grounds

2.2.1 Precipitation

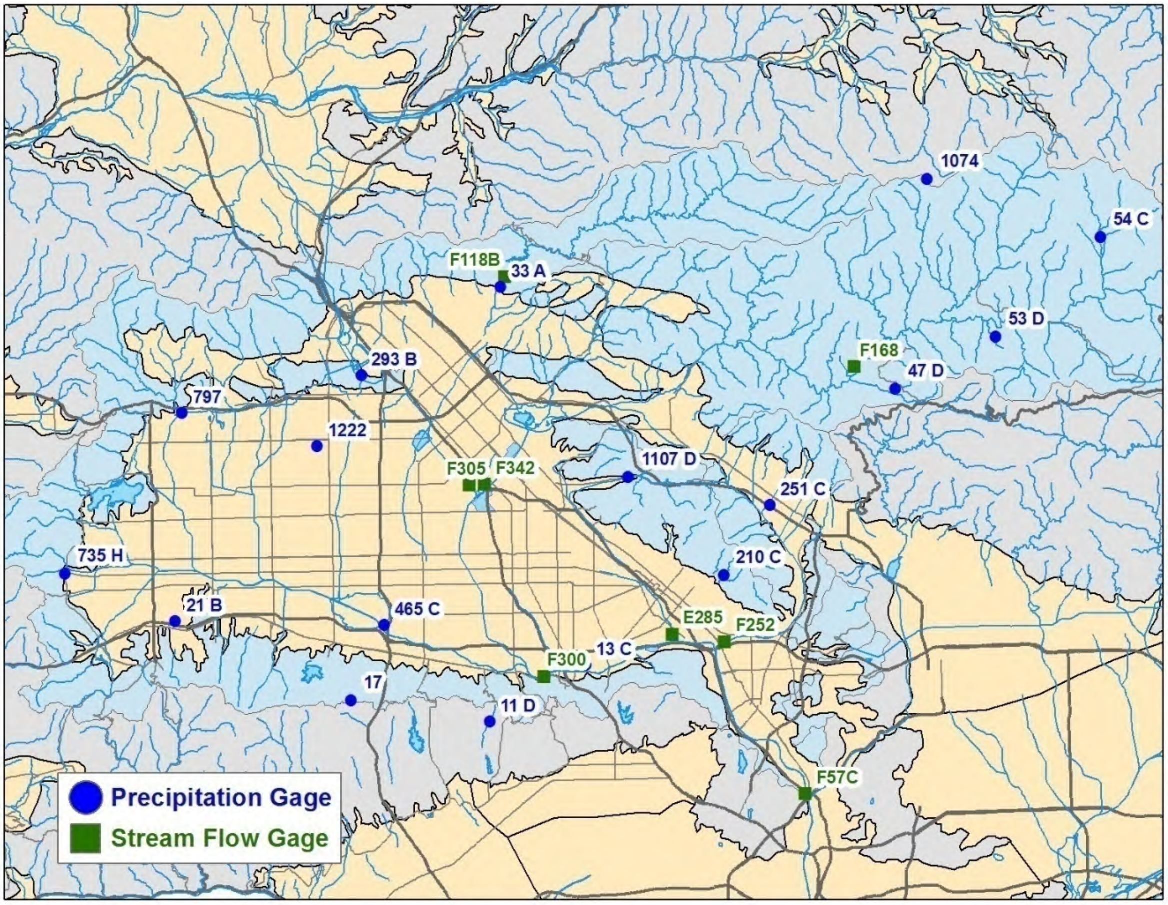
Approximately 80% of the annual precipitation into the ULARA watershed falls in the months from December through March. The average annual precipitation varies from 14 to 33 inches, depending on elevation. In the San Fernando Valley, the annual precipitation is typically 15 to 23 inches per year, with an annual average of 16.5 inches on the valley floor (Watermaster 2011). Precipitation also varies from year to year. From WY 2005-06 to WY 2009-10, annual precipitation on the valley floor ranged from 4.4 to 19.1 inches. There are numerous precipitation gage stations monitoring the San Fernando Valley and the surrounding mountain ranges. **Table 2-1** provides the annual precipitation data over the past five complete water years from 17 representative gages. The locations of these gages are shown in **Figure 2-3**.

Table 2-1: Precipitation Gages and Annual Totals

Gage No.	Location	Annual Precipitation Total (inches)					
		WY 2005-2006	WY 2006-2007	WY 2007-2008	WY 2008-2009	WY 2009-2010	100-Year Mean
Valley Floor Stations							
13C	North Hollywood-Lakeside	16.41	4.32	17.81	11.49	22.32	16.63
1107D	La Tuna Debris Station	16.18	5.15	12.76	10.04	17.60	14.98
465C	Sepulveda Dam	16.08	3.01	17.11	11.36	20.99	15.30
21B	Woodland Hills	15.15	5.21	13.77	10.91	16.32	14.60
735H	Chatsworth Reservoir	14.59	4.30	15.78	8.94	16.09	15.19
1222	Northridge-LADWP	14.32	3.52	7.87	10.85	11.91	15.16
251C	La Crescenta	22.61	7.41	20.60	15.15	27.68	23.31
293B	Los Angeles Reservoir	16.60	3.52	16.25	13.99	18.92	17.32
	Weighted Average	**16.46**	**4.39**	**15.10**	**11.64**	**19.08**	**16.48**
Hill and Mountain Stations							
11D	Upper Franklin Canyon Reservoir	19.33	4.14	20.65	13.34	24.71	18.50
17	Sepulveda Canyon at Mulholland	19.28	5.15	20.87	13.31	24.03	16.84
33A	Pacoima Dam	17.50	6.88	14.11	12.18	16.77	19.64
47D	Clear Creek - City School	31.12	10.31	32.57	19.62	35.88	33.01
53D	Colby's Ranch	26.01	6.68	21.7	14.45	27.84	29.04
54C	Loomis Ranch-Alder Creek	16.10	4.43	12.09	10.35	18.08	18.62
210C	Brand Parks	13.74	3.91	13.87	9.57	18.35	19.97
797	DeSoto Reservoir	15.61	4.09	18.89	17.52	18.05	17.52
1074	Little Gleason	22.52	6.66	17.92	21.79	18.55	21.79
	Weighted Average	**19.56**	**5.97**	**18.62**	**13.18**	**21.48**	**21.76**
Weighted Average of Valley/Mountain Areas		**17.42**	**5.36**	**17.27**	**12.58**	**20.55**	**19.64**

Notes:
Source: ULARA Watermaster Annual Reports, 2007 through 2011
A Water Year (WY) begins on October 1 and continues through September 30 of the following year.

Figure 2-3: Locations of Precipitation and Stream Flow Gages



2.2.2 Surface Water

As shown in **Figure 2-3**, there are also six stream flow gage stations in the ULARA region that record stream flow. Because stream flow in the ULARA region is driven primarily by precipitation, the recorded stream flows can vary from year to year. **Table 2-2** provides the annual stream flow at these six gauges for WY 2002-2003 through WY 2009-2010 as reported by the ULARA Watermaster. The annual stream flow volumes are presented in **Figure 2-4**.

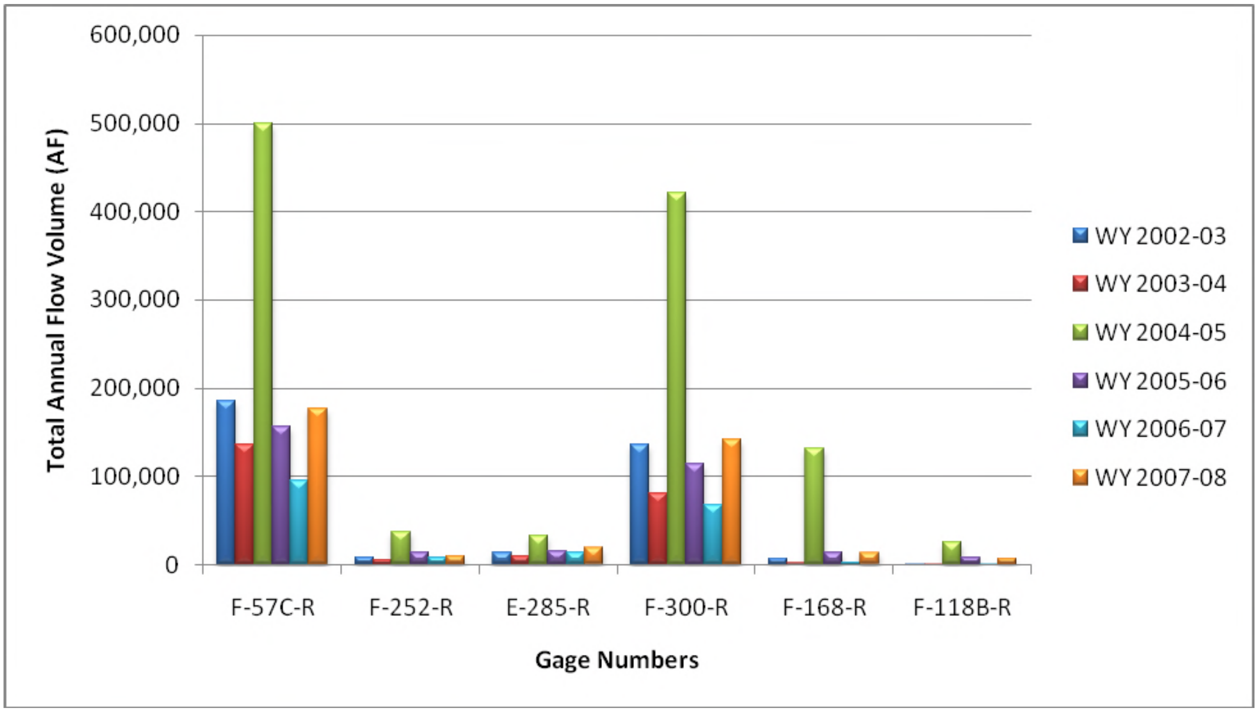
Table 2-2: Stream Flow for WY 2002-03 through WY 2009-10

Station	WY	Total Flow (AF)	Average Monthly Distribution of Flow	
F-57C-R **LA River Arroyo Seco**	2002-03	185,890	Jan	11%
	2003-04	135,860	Feb	18%
	2004-05	335,482	Mar	12%
	2005-06	156,760	Apr	10%
	2006-07	95,500	May	10%
	2007-08	176,740	Jun	5%
	2008-09	101,170	Jul	5%
	2009-10	155,760	Aug	5%
			Sep	5%
			Oct	6%
			Nov	5%
			Dec	8%
F-252-R **Verdugo Wash**	2002-03	8,350	Jan	16%
	2003-04	5,319	Feb	16%
	2004-05	37,072	Mar	10%
	2005-06	14,131	Apr	8%
	2006-07	8,033	May	14%
	2007-08	9,912	Jun	4%
	2008-09	4,816	Jul	5%
	2009-10	14,330	Aug	4%
			Sep	4%
			Oct	6%
			Nov	5%
			Dec	8%

Station	WY	Total Flow (AF)	Average Monthly Distribution of Flow	
E-285-R Burbank Storm Drain	2002-03	13,400	Jan	12%
	2003-04	9,334	Feb	15%
	2004-05	32,826	Mar	11%
	2005-06	15,842	Apr	9%
	2006-07	13,564	May	10%
	2007-08	18,781	Jun	6%
	2008-09	9,805	Jul	7%
	2009-10	14,924	Aug	5%
			Sep	6%
			Oct	7%
			Nov	5%
			Dec	8%
F-300-R LA River Tujunga Avenue	2002-03	135,440	Jan	11%
	2003-04	80,750	Feb	16%
	2004-05	421,030	Mar	11%
	2005-06	113,710	Apr	15%
	2006-07	67,520	May	11%
	2007-08	141,790	Jun	4%
	2008-09	68,280	Jul	4%
	2009-10	117,750	Aug	4%
			Sep	5%
			Oct	5%
			Nov	5%
			Dec	7%

Station	WY	Total Flow (AF)	Average Monthly Distribution of Flow	
F-168-R Big Tujunga Dam	2002-03	6,780	Jan	11%
	2003-04	2,115	Feb	11%
	2004-05	131,986	Mar	22%
	2005-06	13,821	Apr	10%
	2006-07	2,764	May	17%
	2007-08	13,230	Jun	8%
	2008-09	3,193	Jul	4%
	2009-10	27,938	Aug	3%
			Sep	1%
			Oct	4%
			Nov	4%
			Dec	6%
F-118B-R Pacoima Dam	2002-03	1,315	Jan	13%
	2003-04	25,552	Feb	15%
	2004-05	8,231	Mar	10%
	2005-06	138	Apr	15%
	2006-07	6,856	May	11%
	2007-08	6,856	Jun	4%
	2008-09	2,966	Jul	5%
	2009-10	10,461	Aug	6%
			Sep	1%
			Oct	1%
			Nov	6%
			Dec	12%

Figure 2-4: Annual Total Stream Volumes for Six Surface Water Monitoring Gages



As shown in **Table 2-2**, flow in the local streams and the LA River varies both seasonally and annually. At the locations where surface runoff is, or can be, diverted for recharge at the major spreading basins in the upper portions of the valley, there are no wastewater discharge locations and there is very limited dry weather urban runoff due to limited urbanized areas tributary to these locations. Flow in the river, on the other hand, is dependent on a number of factors, including runoff from precipitation, discharges of tertiary treated recycled water, dry weather nuisance runoff or base flow and rising groundwater. **Table 2-3** presents the estimated contribution of these components at two of the gages. The most significant contribution is runoff that results from precipitation that falls in the mountains and the valley, representing about 68%-77% of the total flow for the LA River Arroyo Seco monitoring station. Rising groundwater and wastewater effluent discharges are also factors, making up approximately 2%-22% and 30%, respectively.

Table 2-3: Estimated Components of Surface Flow in the ULARA Watershed

Gage No.	Location	Average Flow Volume(AF) Rising Groundwater	Wastewater Discharge	Storm Runoff	Total Outflow
F-57C-R	LA River Arroyo Seco	3,212	55,476	121,354	182,372
F-252-R	Verdugo Wash	2,522	-	9,047	11,724

Source: Watermaster 2011

2.3 Groundwater

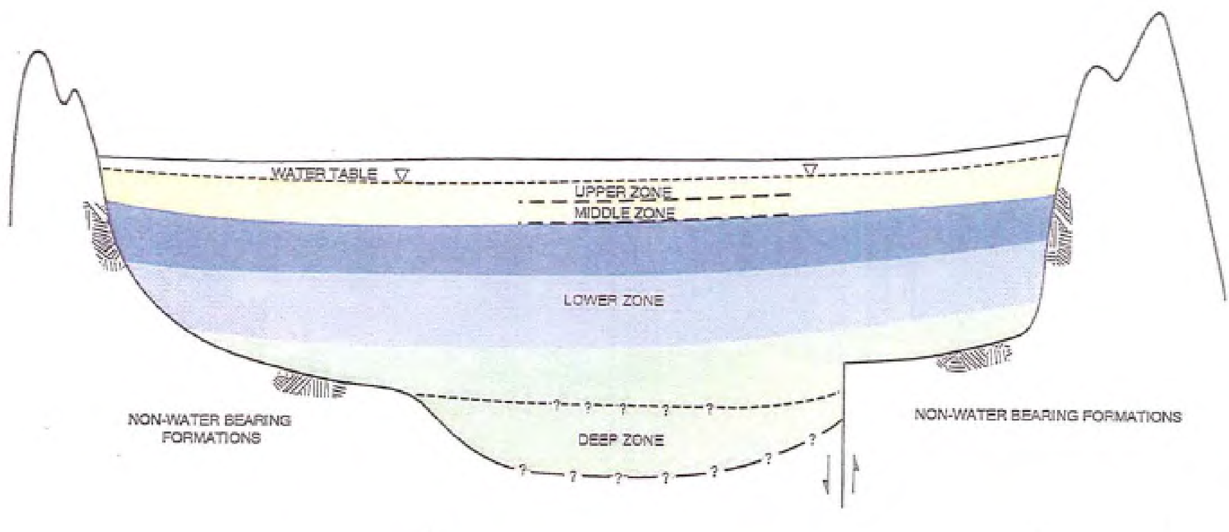
In addition to the surface water resources of the San Fernando Valley, groundwater provides an additional source of water. Groundwater is water that is "stored" in the pore spaces between the materials that comprise the aquifer beneath the San Fernando Valley. Approximately 3.2 million acre-feet (AF) of total groundwater storage capacity in the San Fernando Basin was estimated by the State Water Resources Control Board in the Report of the Referee for the Judgment over the ULARA (*City of Los Angeles vs. City of San Fernando, et. al., Superior Court Case No. 650079 – County of Los Angeles*). A combined storage volume of 470,000 AF is estimated for the Sylmar (310,000 AF) and Verdugo (160,000 AF) basins (MWD 2007). The storage capacity of the Eagle Rock basin is relatively small. Therefore, the combined storage volume of the San Fernando Valley Groundwater Basin (SFB) is estimated to be approximately 3,670,000 AF. The depth of the San Fernando basin is estimated to be between 0 and 1,200 feet. The producing zone within the basin is estimated to be from 58 to 800 feet below ground surface (MWD 2007).

2.3.1 San Fernando Basin

The general understanding of the SFB divides the basin into four aquifer zones vertically as shown in **Figure 2-5**. The Upper Zone is comprised of sand and gravel deposits and is open to surface recharge. In the east, this zone is comprised of coarser grained sands and gravels transitioning to finer grained sands and silts in the west. The thickness of the saturated portion of this zone varies spatially and throughout the year, depending on rainfall and groundwater pumping, from zero to 200 feet. The second zone, or the Middle Zone, is comprised of silt, sand and clay, with an estimated maximum thickness of 50 feet. The third, or Lower Zone, is much thicker than the Middle Zone with approximately 200 to 250 feet of coarse sands and gravels. This Lower Zone is the preferred groundwater storage and production zone for the eastern portion of the San Fernando Valley. The Deep Zone, the lowest zone, extends to the bottom of the basin, and there is much uncertainty as to the make-up of this layer due to the lack of wells that have been drilled to this depth.

Major sources of inflow to the SFB include the infiltration along the basin edges from adjacent groundwater basins (i.e., Sylmar, Eagle Rock, and Verdugo Basins), runoff off the mountains, and replenishment water from the spreading facilities located throughout the valley.

Figure 2-5: Aquifer Units within the SFB
(Source: LADWP 2009)

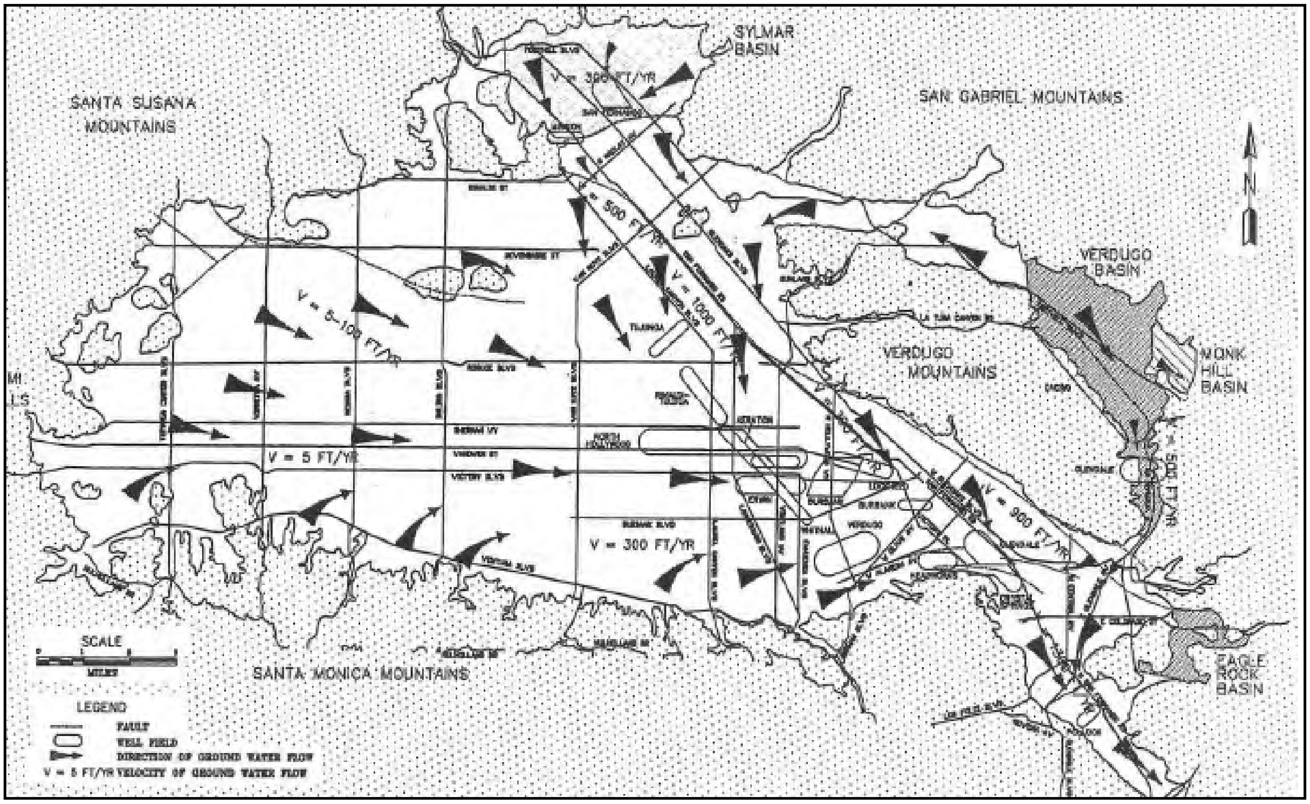


There are two major outflow pathways of groundwater out of the SFB. The first is from rising water entering the Los Angeles River through the Los Angeles River Narrows, in the southwestern portion of the ULARA watershed. The second major outflow is through pumping from the numerous well fields.

2.3.2 Groundwater Flow Patterns

In general, the groundwater flows from the boundaries of the basin towards the center and then east/southeast towards the southeastern portion of the SFB. The groundwater velocities shown in **Figure 2-6** (as published by the ULARA Watermaster) are estimated to vary from approximately 5 to 1,000 feet/year across the SFB.

Figure 2-6: Direction and Velocities of Groundwater Flow in the San Fernando Valley
(Source: Watermaster 2011)



Groundwater elevation contours from the regional groundwater model for Spring and Fall of 2008 (**Figures 2-7** and **2-8**) present how levels vary seasonally. Groundwater levels are monitored at numerous wells across the basin. **Figure 2-9** shows the locations of a subset of eleven monitoring wells distributed across the valley. **Figures 2-10, 2-11**, and **2-12** present the hydrographs for each of these eleven locations. The hydrographs depict several trends including a slight decline in groundwater levels for some wells and a stable trend at others.

Localized groundwater stresses affect flow patterns within the valley. For example, recharge at the spreading facilities (orange areas in **Figure 2-7**) can cause localized groundwater mounding. Groundwater production also affects flow patterns (east of Rt. 170 and south of I-5 in **Figures 2-7** and **2-8**). Numerous groundwater pumping well fields **(Figure 2-13)** in the eastern portion of the SFB cause localized groundwater elevation depressions. The Tujunga and Rinaldi-Toluca well fields are wells located closest to the spreading basins (HSG, TSG, and PSG) that are discussed in this TM. There are no other municipal or private domestic supply wells located closer to the basins. Fault lines throughout the valley floor affect the groundwater flow also, causing sharp changes in groundwater elevations. The Verdugo fault exists between the HSG and the TSG. This fault trends from northwest to southeast. The exact location of the fault is not known. Additional information on the influence of the fault on groundwater flow is presented in Section 3.4.2.

Figure 2-7: Simulated Water Levels, Spring (April) 2010

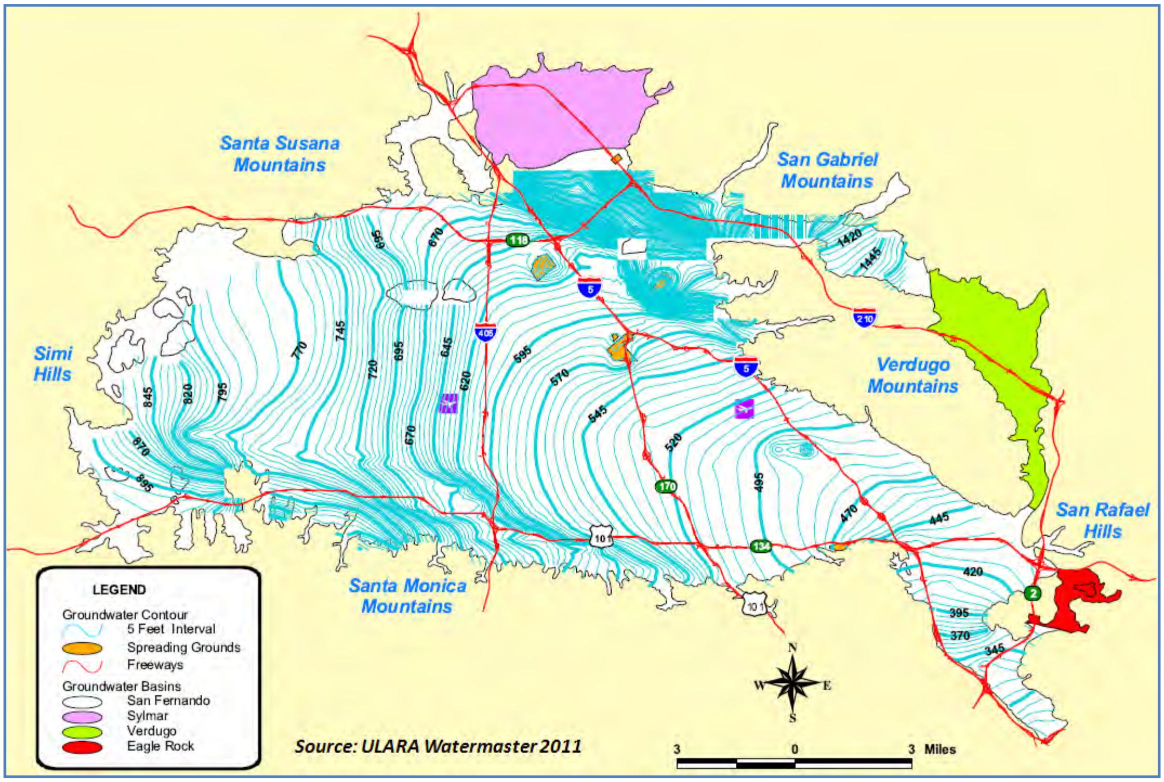


Figure 2-8: Simulated Water Levels, Fall (September) 2008)

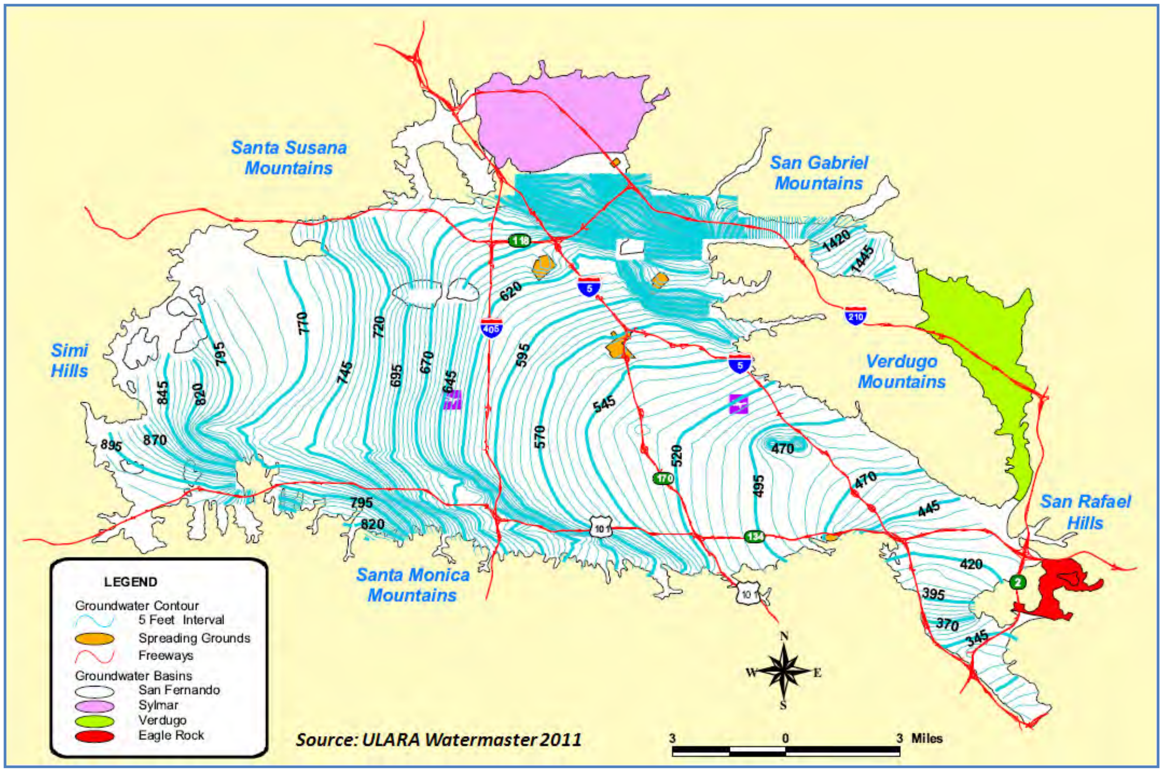


Figure 2-9: SFB Monitoring Wells for Groundwater Elevations

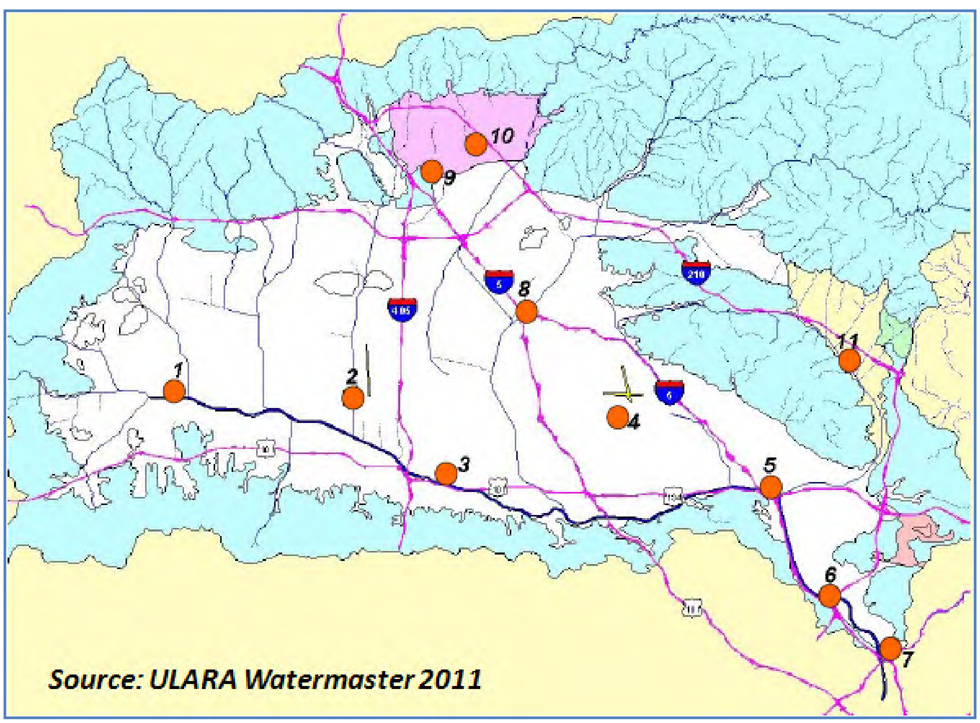


Figure 2-10: Historical Hydrographs for Monitoring Wells 1 through 4)

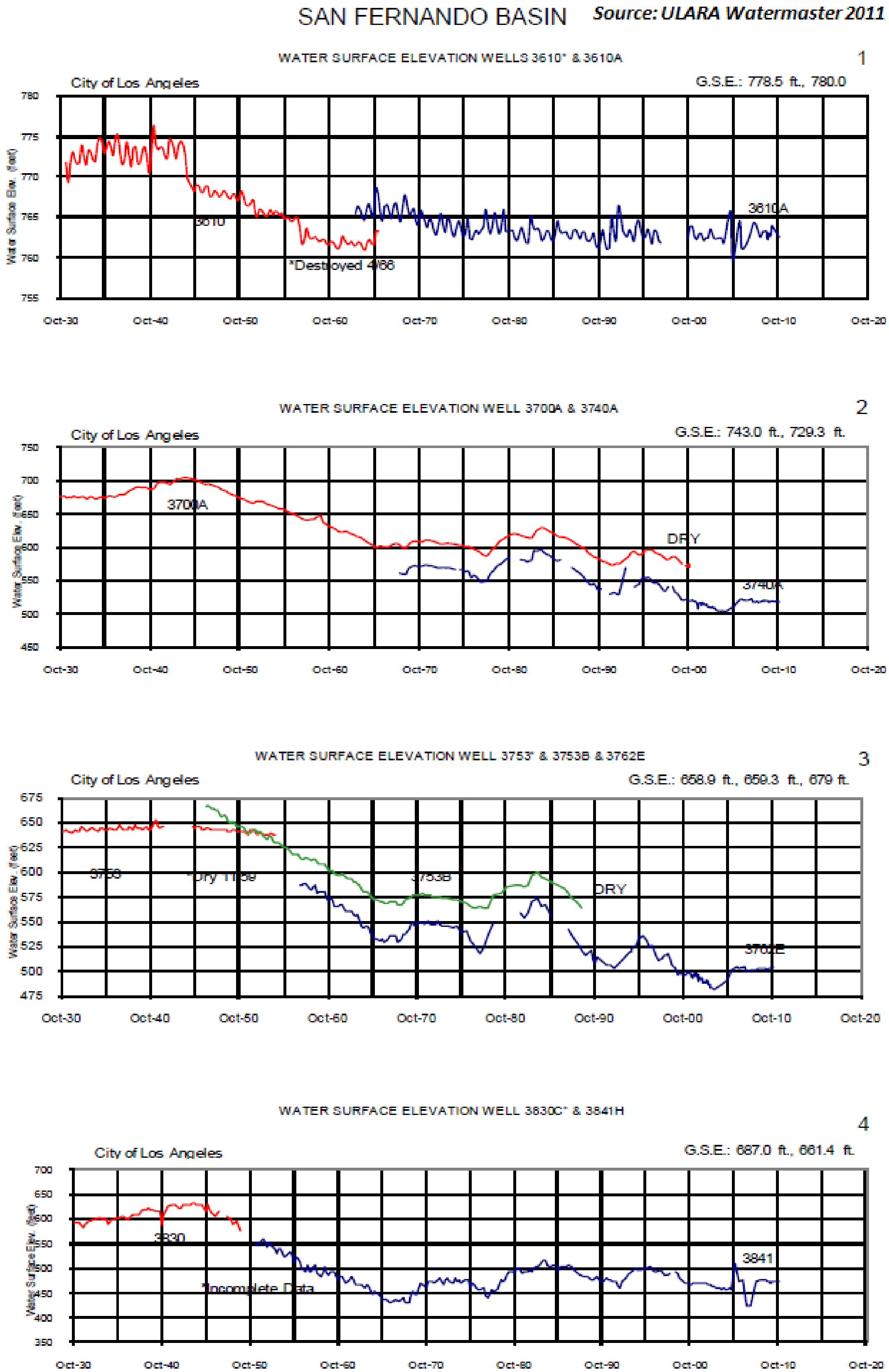


Figure 2-11: Historical Hydrographs for Monitoring Wells 5 through 8

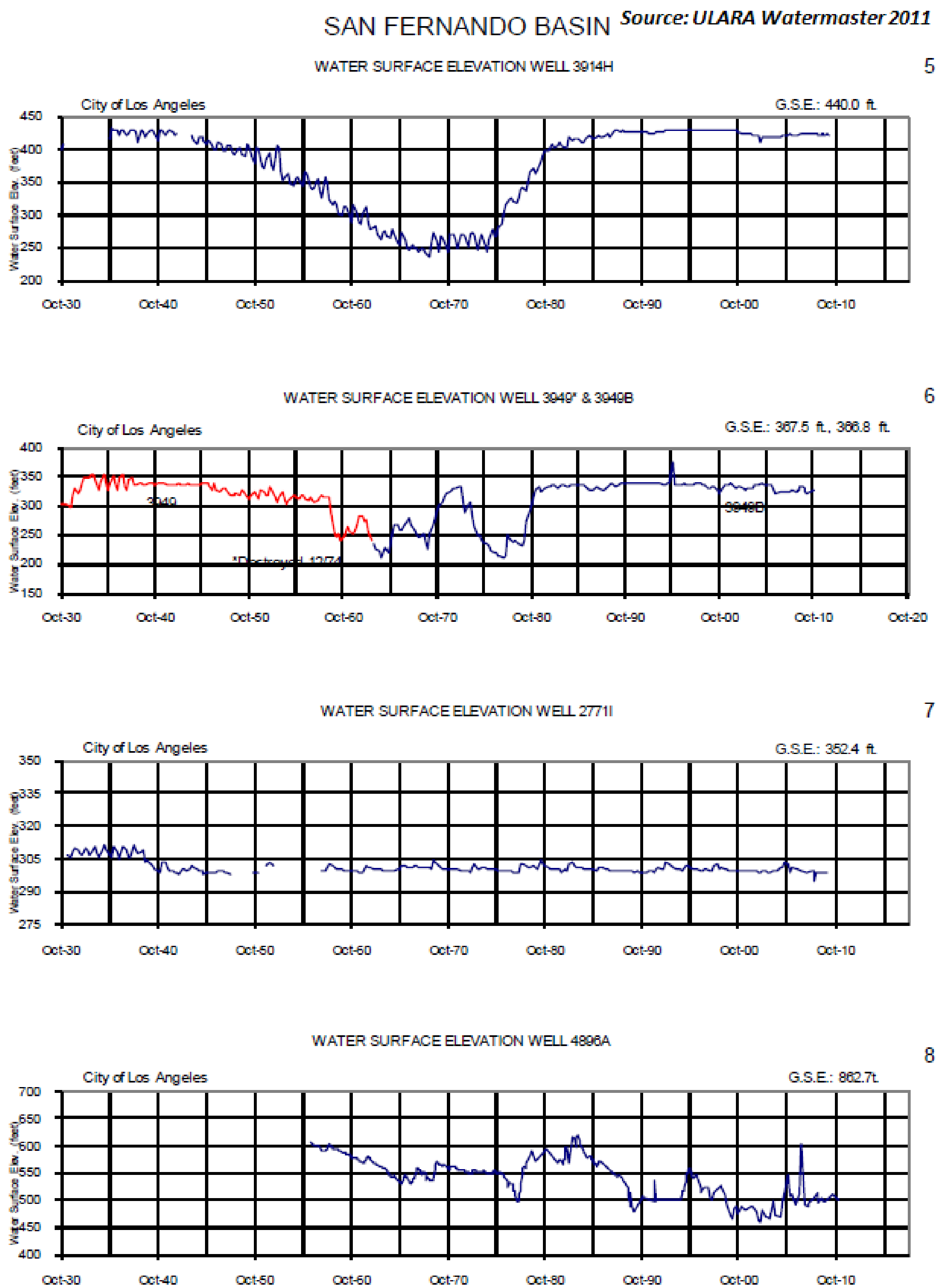
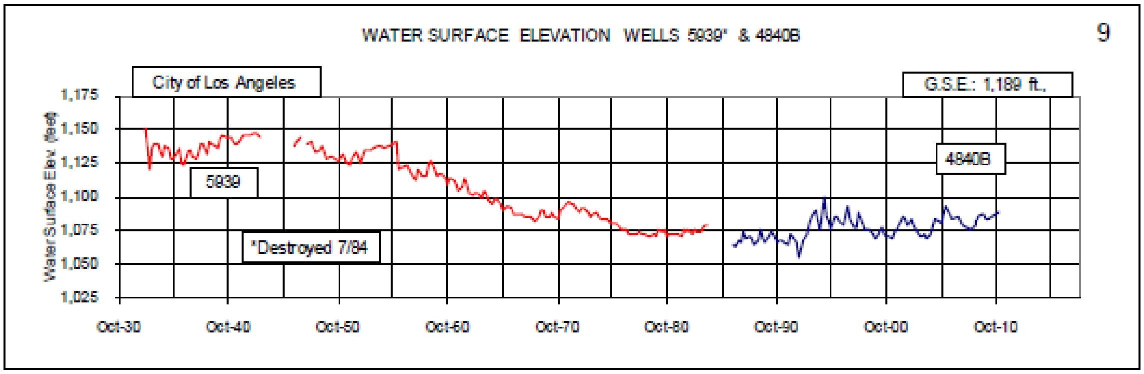
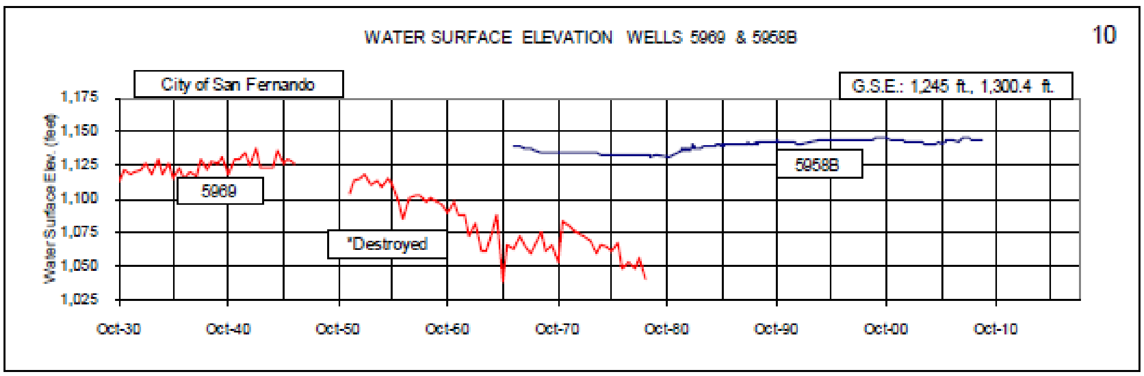


Figure 2-12: Historical Hydrographs for Monitoring Wells 9 through 11

Source: ULARA Watermaster 2011

SYLMAR BASIN





VERDUGO BASIN

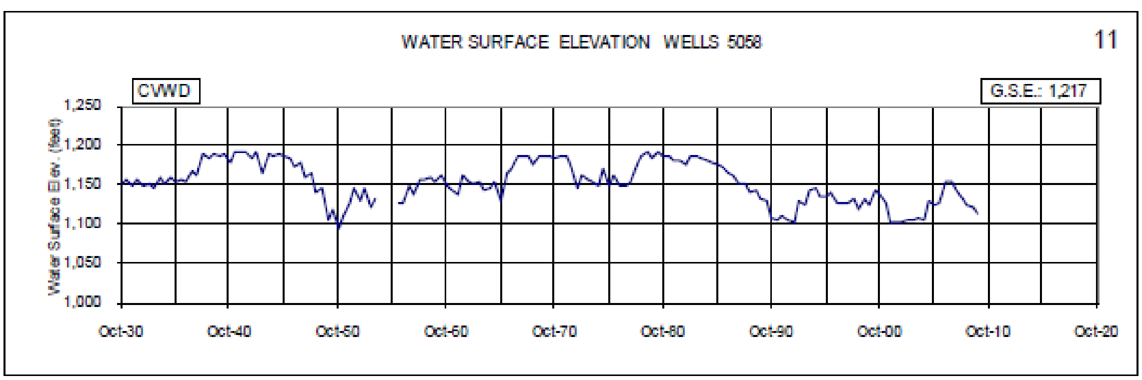
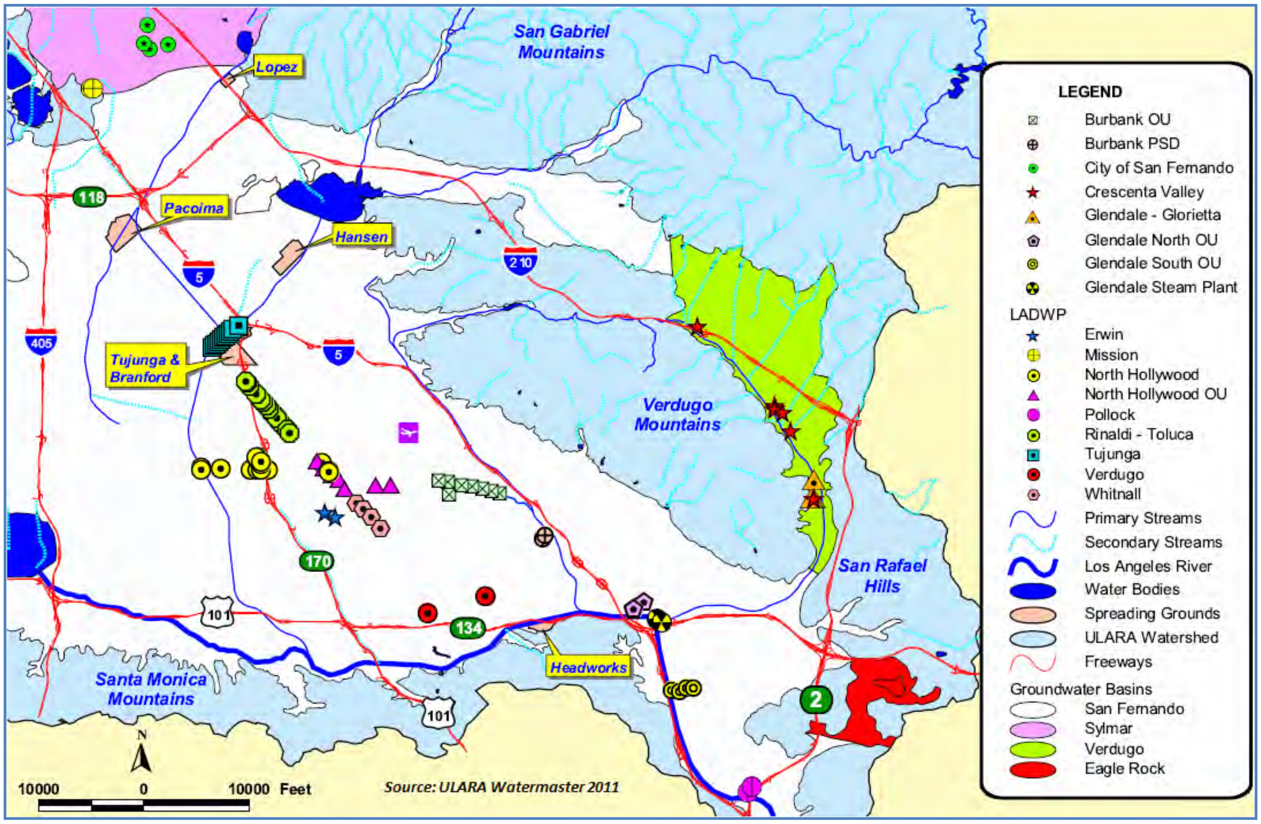


Figure 2-13: Major Well Fields in San Fernado Basin



2.3.3 Groundwater Quality

Groundwater quality in the SFB ranges from moderately hard to very hard. The western portion of the basin is dominated by calcium sulfate-bicarbonate while the eastern portion is dominated by calcium bicarbonate. The average total dissolved solids concentration (TDS), collected from 125 water supply wells in the watershed, is estimated at 499 mg/L and ranges from 176 to 1,160 mg/L (DWR 2003).

Within the majority of the basin the quality of this groundwater is below the Maximum Contaminant Levels under California Title 22 Drinking Water Standards for most constituents. However, there are significant exceptions related to compliance with maximum contaminant levels (MCLs) and the presence of other key contaminants including:

- Eastern SFB (where most of the municipal production wells are located): The groundwater in the eastern SFB has high concentrations of Tetrachloroethylene (PCE), trichloroethylene (TCE), hexavalent chromium, and nitrate. **Table 2-4** shows the relative prevalence of TCE in the SFB.
- Western SFB (where municipal production is minimal): The groundwater in the western SFB has excess concentrations of naturally occurring sulfate and TDS.

Table 2-4: Number of Wells in SFB that Exceed the California MCL for both TCE and PCE

Number of Wells in Well Field[2]	Number of Wells Exceeding Maximum Contaminant Level[1]													
	City of Los Angeles[3]									Sub-Total	Others[3]			Grand Total
	NH	RT	P	HW	E	W	TJ	V	AE		B	G	C	
	35	15	3	4	7	8	12	5	7	96	10	13	12	131
TCE Concentration														
5 – 20 ppb	7	3	1	-	1	1	4	1	2	20	1	0	0	21
20 – 100 ppb	0	0	0	-	0	0	4	0	3	7	3	3	0	13
> 100 ppb	0	0	0	-	0	0	0	0	0	0	4	3	0	7
Total	**7**	**3**	**1**	**-**	**1**	**1**	**8**	**1**	**5**	**27**	**8**	**6**	**0**	**41**
PCE Concentration														
5 – 20 ppb	1	0	1	-	0	1	3	0	4	10	0	3	0	13
20 – 100 ppb	0	0	0	-	0	0	2	0	0	2	1	1	0	4
> 100 ppb	0	0	0	-	0	0	0	0	0	0	7	2	0	9
Total	**1**	**0**	**1**	**-**	**0**	**1**	**5**	**0**	**4**	**12**	**8**	**6**	**0**	**26**

[1] Wells are categorized based on historic maximum TCE and PCE concentrations measured through WY 2009-2010.
[2] Includes active and stand-by wells
[3] Well fields:
NH: North Hollywood
P: Pollock
HW: Headworks
E: Enwin
W: Whitnall
RT: Rinaldi-Toluca
TJ: Tujunga
V: Verdugo
AE: LADWP Aeration Tower Wells
B: City of Burbank
G: City of Glendale
C: Crescenta Valley Water District

Source: Watermaster 2011

Additional information on groundwater quality with regard to the Los Angeles Basin Plan groundwater quality objectives is presented in Section 3.6.

Table 2-5 provides the average water quality for a number of parameters in wells located through the SFB and the adjacent groundwater basins (see **Figure 2-12**). **Figures 2-14** through **2-17** present the current distribution of PCE, TCE, nitrate, and chromium, respectively, in the SFB. Volatile organic compound (VOC) contamination also exists in the groundwater in the Pacoima area near the intersection of San Fernando Road and the Simi Valley Freeway (118 Freeway) approximately 2.5 miles north of and upgradient of the Tujunga wellfield (TWF). VOC concentrations have been increasing at the TWF. A remediation project is in place to remove the VOCs from the soil and eventually from the groundwater (ULARA Watermaster 2011).

LADWP is currently planning for the San Fernando Basin Groundwater Treatment Complex, a project that will focus on the treatment of legacy groundwater contamination in the SFB. The Groundwater Treatment Complex is anticipated to include both centralized treatment and individual wellhead treatment.

Table 2-5: SFB Groundwater Quality (Source: ULARA Watermaster 2011)

Well No.		Mineral Constituents (mg/L)												Spec. Cond. (µS/cm)	TDS (mg/L)	Hardness as $CaCO_3$ (mg/L)
		pH	Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3	F	B			
Western San Fernando Basin																
4757C (Reseda No. 6)	10/13/1983	7.8	115	31	43	2.1	-	301	200	33	2.6	0.31	0.24	944	595	416
Eastern San Fernando Basin																
3800 (No. Hollywood No. 33)	05/19/2004	7.8	82	27	134	4.9	0	204	336	66	3.3	0.4	0.5	-	781	317
3851C VO-8/Burbank No. 10	04/07/2009	7.9	92	25	31	4.5	<2.0	290	70	35	28	0.5	0.2	-	460	330
Glendale OU GN-1	FY 2009/10	7.9	110	28	45	-	200	250	140	-	39	-	0.3	-	550	390
San Fernando Basin - L.A. Narrows																
3959E (Pollock No. 6)	FY 2009/10	6.8	-	-	-	0	-	-	-	81	0	-	-	1,000	628	
Sylmar Basin																
4840K (Mission No. 6)	FY 2009/10	-	-	-	-	0	-	-	-	31	12	-	-	-	-	-
5969 (San Fernando No. 4A)	01/12/2009	7.8	58	11	33	4.4	0	240	47	0	19	23	0	500	320	190
Verdugo Basin																
3971 (Glorietta No. 3)	FY 2009/10	7.5	100	37	47	3.2	180	-	140	-	39	0.2	-	960	710	400
5069F (CVWD No. 14)	FY 2009/10	7.3	84	30	32	3.2	ND	190	110	71	47	0.3	69	812	530	320

Figure 2-14: PCE Contamination of the ULARA Watershed in 2009

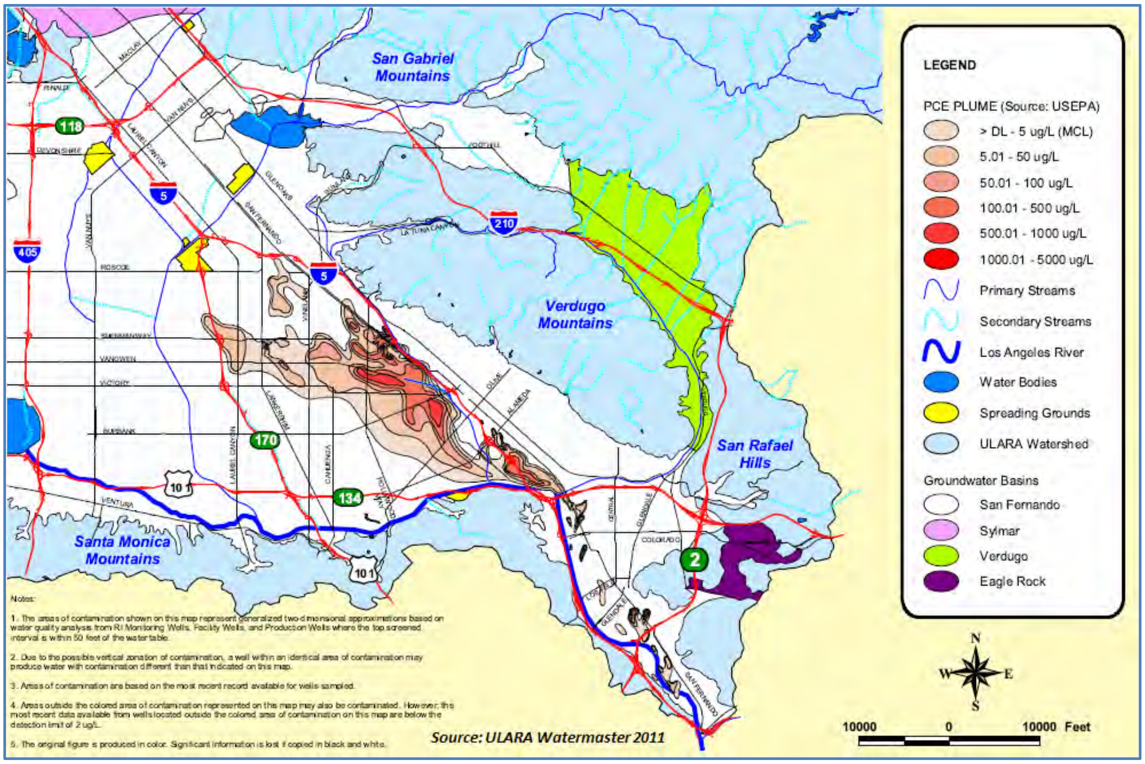


Figure 2-15: TCE Contamination of the ULARA Watershed in 2009

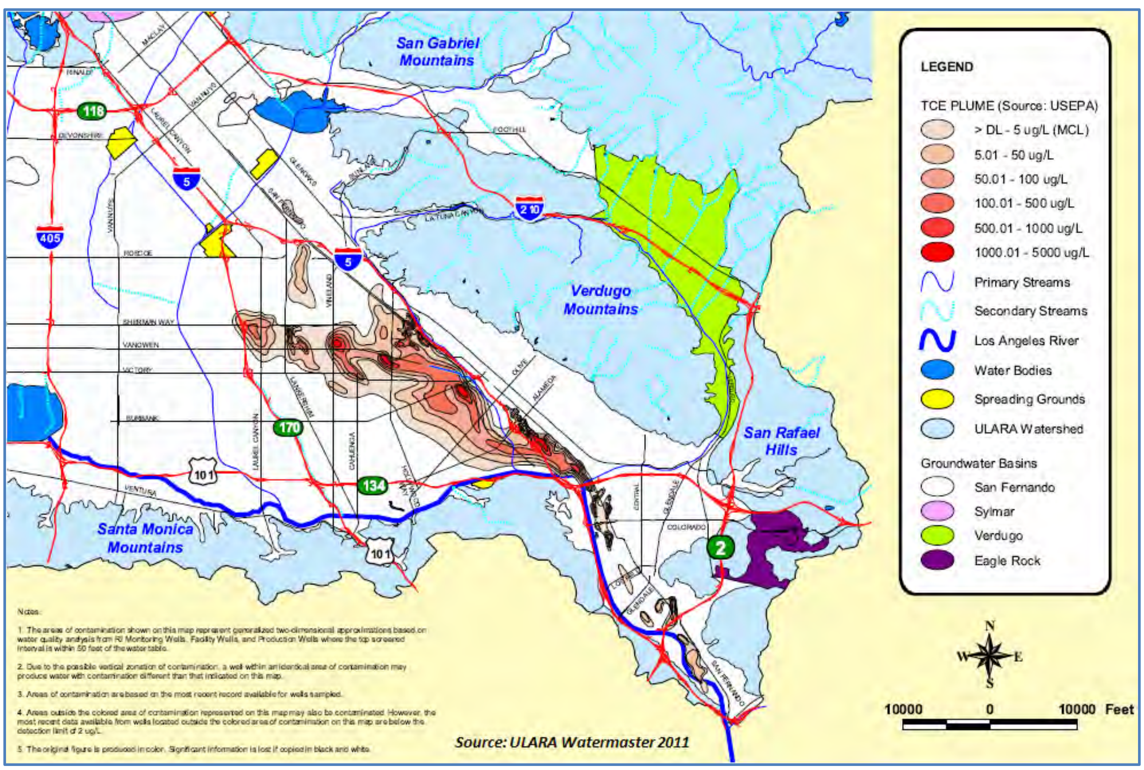


Figure 2-16: Nitrate Contamination of the ULARA Watershed in 2009

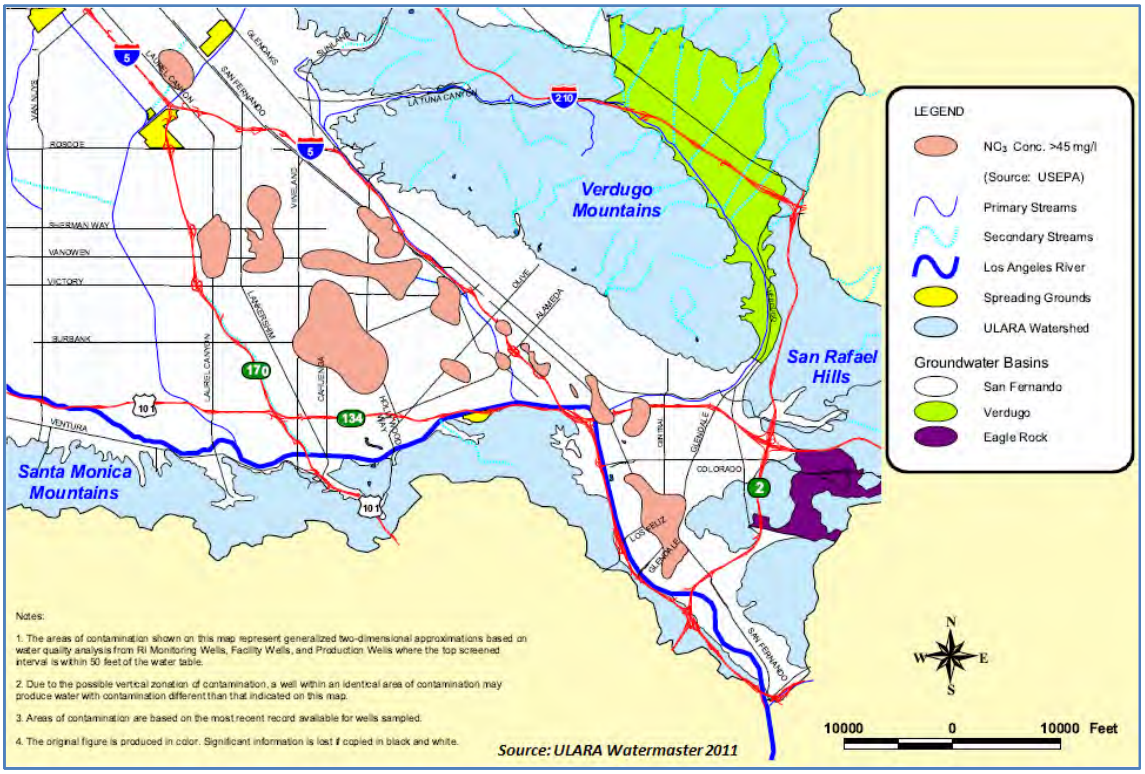
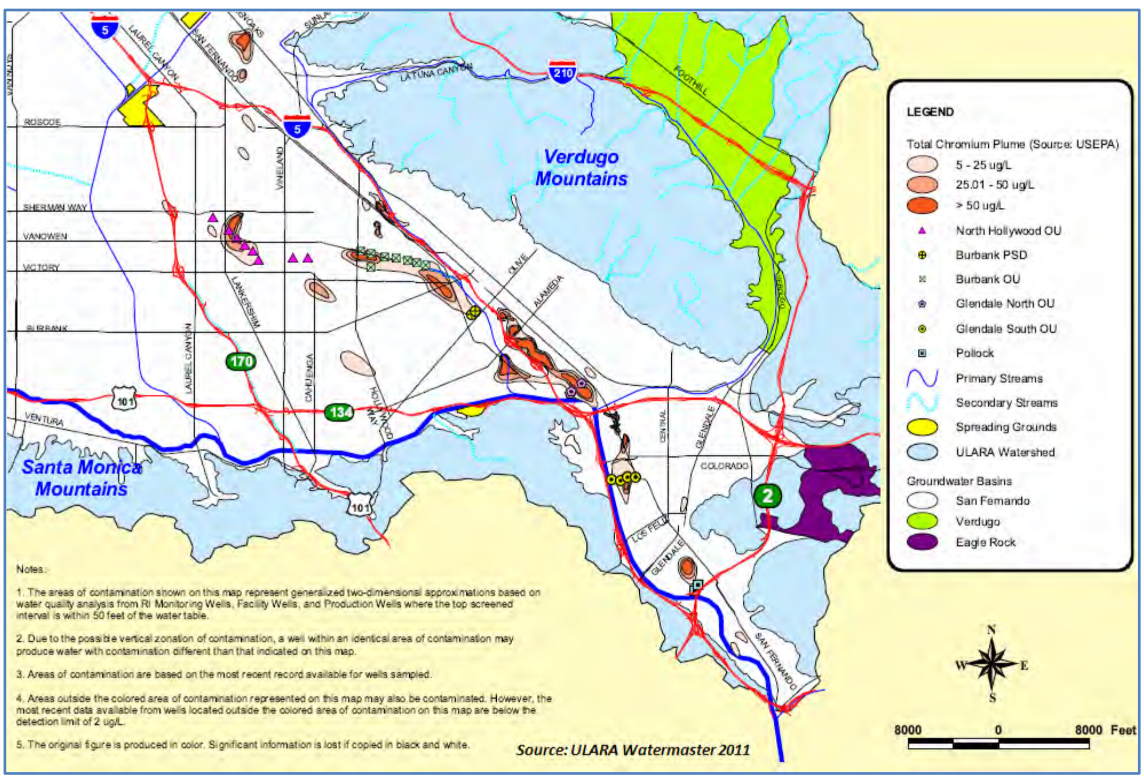
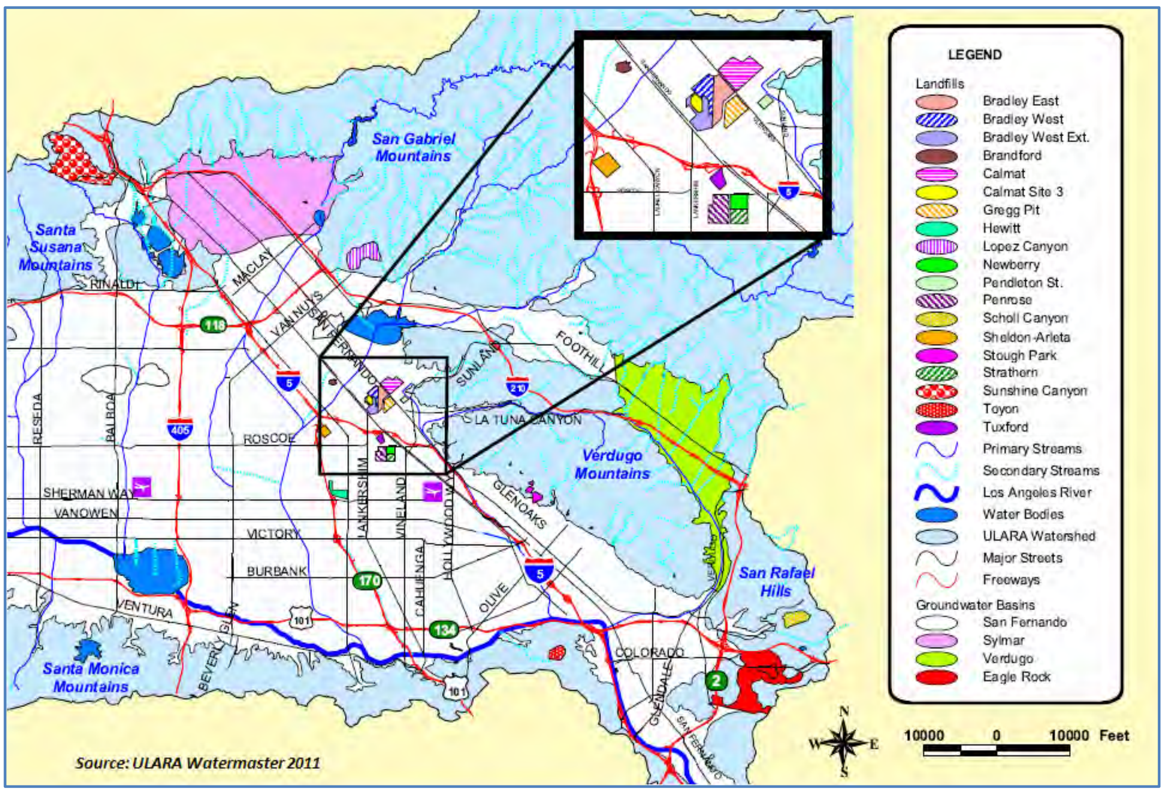


Figure 2-17: Total Dissolved Chromium Contamination of the ULARA Watershed in 2009



There are several landfills in the area, as shown in **Figure 2-18**. Four of these landfills are open, 15 closed, and one incomplete. There are several landfills adjacent or near the spreading grounds. These landfills include: The Sheldon-Arleta, Bradley East and West, Bradley West Extension, Gregg Pit, Calmat, Calmat Site 3, Branford, and Pendleton Street landfills. Of the landfills near the spreading grounds, all except the Calmat Site 3 landfill are closed. Continuous groundwater spreading will result in some mounding, and therefore localized increase in water levels, in the vicinity of the landfills and their containment systems. In particular, spreading has been limited in the past at the HSG to avoid the potential for impacts to the adjacent Bradley landfill under increased groundwater level conditions. There is also a limitation at the TSG due to a methane gas migration issue at the nearby Sheldon-Arleta landfill.

Figure 2-18: Landfill Locations in the ULARA Watershed



2.3.4 Groundwater Model

The San Fernando Basin Groundwater Model (SFBGM) is a comprehensive three-dimensional computer model that was developed originally for the USEPA during the Remedial Investigation (RI) Study of the San Fernando Valley (December 1992). The model was used to simulate basin recharge and pumping over an extended period to produce simulated groundwater elevation gradients and flow directions to derive capture zones for the various groundwater well fields.

During the RI process a comprehensive physical characterization of basin geology, hydrology, hydrogeology, and TCE and PCE contamination was derived. This data was used to develop the physical characterization of the groundwater basin for use in the SFBGM.

The SFBGM was developed in the MODFLOW (Modular Three-Dimensional Finite-Difference Groundwater Flow Model) code developed by the U.S. Geological Survey (McDonald, Harbaugh). The model consists of 64 rows, 86 columns, and four layers to reflect the varying characteristics of the various depth zones in the SFB. The model has a variable horizontal grid that ranges from 1,000 by 1,000 feet in the southeastern portion of the SFB, to 3,000 by 3,000 feet in the northwestern portion of this basin. LADWP regularly updates this model as the need arises.

The SFBGM was calibrated by simulating actual SFB operations to develop gradients that were compared to measured groundwater elevations and gradients that were a result of the actual SFB operations. A steady-state calibration (no net change in SFB storage) was performed for the year 1981-82. A transient calibration was performed that simulated a ten-year period beginning in the year 1981-82. Aquifer parameters in the SFBGM were adjusted in the calibration process to reduce the deviations between the simulated and measured head values throughout the SFB.

Since the completion of the RI, the SFBGM has been used by LADWP as an analytical and predictive tool in numerous applications including, but not limited to, the following:

- Evaluation of the East Valley Water Recycling Project (EVWRP);
- Evaluation of the Pollock Well Field and Headworks Well Field remediation projects;
- Annual Report and annual "Groundwater Pumping and Spreading Plan" for Watermaster Service of the Upper Los Angeles River Area (ULARA); and
- Drinking Water Source Assessment Program for Los Angeles Well Fields in the San Fernando Basin

The use of the model for the EVWRP in the mid- to late-1990s was a similar application as the project currently being considered. At that time the SFBGM was used during the permitting process to assess potential changes to groundwater flow and quality. The model's results were used to show that the EVWRP would meet California Department of Health Services (CDHS, now known as the California Department of Public Health or CDPH) permit requirements. That project was approved by CDHS, and a permit was issued by the Regional Water Quality Control Board (RWQCB). However, the City decided to not bring the project on line and the permit was later rescinded. More detail on the EVWRP and the use of the SFBGM for technical analysis to support the permitting process can be found in the LADWP's 1995 report (LADWP 1995). Additional information on the model is also contained in the Watermaster 2011 Groundwater Pumping and Spreading Plan for the Upper Los Angeles River Area, 2010-2015 Water Years (Watermaster 2011b) and in the 1992 RI.

2.4 Spreading Grounds

2.4.1 LACDPW Stormwater Capture

The LACDPW has a policy "to conserve the maximum possible amount of storm water consistent with runoff quantity and quality, capacities of the spreading facilities, and groundwater conditions." One of the main focuses of water conservation is the capture and recharge of stormwater at the HSG, PSG, and TSG. Stormwater runoff is of generally high quality, particularly with respect to TDS and nitrate levels, and is essentially "free" water. The LACDPW will allow

LADWP to recharge recycled water, but will always give highest priority to stormwater runoff when it is available.

2.4.2 Locations

To enhance groundwater replenishment in the SFB, several managed spreading facilities are operated throughout the valley. Surface water is captured and diverted into these facilities and allowed to percolate into the ground. The three largest spreading facilities in the San Fernando Valley of primary interest are described in this section.

These facilities, shown in **Figure 2-2**, are the:

- Hansen Spreading Grounds (HSG),
- Tujunga Spreading Grounds (TSG), and
- Pacoima Spreading Grounds (PSG).

The HSG and PSG are owned and operated by the Los Angeles County Department of Public Works (LACDWP). The TSG is owned by the City of Los Angeles and are operated by LACDPW in conjunction with the city.

Table 2-6 presents the physical attributes of each of the three spreading facilities including recent improvements completed at the HSG to create fewer, deeper basins as described in Section 2.4.4.

Table 2-6: Physcial Attributes of HSG, PSG, and TSG Facilities

Spreading Facility	Maximum Intake Rate (cfs[1])	Maximum Wetted Area (acres)	No. of Basins	Maximum Storage Volume (AF)	Percolation Rate	
					(cfs)	(AFD[2])
HSG	400	105	6	1,420	150 [3]	297 [3]
PSG	600	107	12	440	65	129
TSG	250	90	17	163	50 [4]	99 [4]

[1] CFS: cubic-feet per second
[2] AFD: acre-feet per day
[3] Percolation capacity is artificially limited to prevent high water levels at adjacent Bradley landfill. The percolation rate at HSG may be reduced to 100-120 cfs (200-240 AFD) during wet years when the aquifer upgradient of the Verdugo Fault is saturated.
[4] Percolation capacity is artificially limited to methane gas migration at adjacent Sheldon-Arleta landfill. Long term percolation rates at TSG could be 80-100 cfs (160-200 AFD).
Source: Tujunga Wash Watershed Groundwater Master Plan Phase 2

2.4.3 Historic Flows

Table 2-7 shows the historic volume of water captured and recharged at the HSG, TSG, and PSG based on annual data obtained from the Watermaster for WY 1969 through WY 2008. Monthly spreading volumes were available for WY 1997 through WY 2008 from LACDPW. The average monthly distribution of water during this period was calculated and is shown in **Tables 2-8** and **Figure 2-19**. This average monthly pattern was applied to historical annual volumes to develop an "average" monthly distribution of spreading within each of the spreading grounds for the entire 40 year record for use in subsequent calculations (Section 3). The synthetic average monthly volumes are shown in **Figures 2-20, 2-21,** and **2-22** for median historic, wet, and dry conditions.

Table 2-7: Historical Spreading Volumes

Water Year	Volume Spread (AF)			
	HSG	PSG	TSG	Total
2009-10	16,766	9,0808	12,849	**39,504**
2008-09	0	2,000	7,233	**9,940**
2007-08	10,517	5,025	4,892	**20,434**
2006-07	5,762	436	1,200	**7,398**
2005-06	20,840	7,346	14,895	**43,081**
2004-05	33,301	17,394	21,115	**71,810**
2003-04	6,424	1,731	1,322	**9,477**
2002-03	9,427	3,539	1,914	**14,880**
2001-02	1,342	761	101	**2,204**
2000-01	11,694	3,826	1,685	**17,205**
1999-00	7,487	2,909	2,664	**13,060**
1998-99	8,949	696	3,934	**13,579**
1997-98	28,129	20,714	11,180	**60,023**
1996-97	9,808	5,768	6,406	**21,982**
1995-96	8,232	4,532	7,767	**20,531**
1994-95	35,137	14,064	18,236	**67,437**
1993-94	12,052	3,156	4,129	**19,337**
1992-93	26,186	17,001	19,656	**62,843**
1991-92	15,461	12,914	9,272	**37,647**
1990-91	11,489	3,940	2,487	**17,916**
1989-90	2,029	1,708	0	**3,737**
1988-89	3,844	1,306	0	**5,150**
1987-88	17,252	4,520	0	**21,772**
1986-87	7,311	467	0	**7,778**
1985-86	18,188	6,704	0	**24,892**
1984-85	13,274	3,375	0	**16,649**
1983-84	10,410	3,545	0	**13,955**
1982-83	35,192	22,972	10,580	**68,744**
1981-82	14,317	5,495	0	**19,812**
1980-81	14,470	3,169	0	**17,639**
1979-80	31,087	15,583	0	**46,670**
1978-79	24,697	12,036	0	**36,733**
1977-78	28,123	20,472	12,821	**61,416**
1976-77	2,656	1,943	0	**4,599**
1975-76	3,128	1,308	0	**4,436**

Table 2-7: Historical Spreading Volumes (Continued)

Water Year	Volume Spread (AF)			
	HSG	PSG	TSG	Total
1974-75	5,423	2,476	0	**7,899**
1973-74	6,287	2,378	0	**8,665**
1972-73	9,272	6,343	2,274	**17,889**
1971-72	1,932	1,113	0	**3,045**
1970-71	11,657	4,049	0	**15,706**
1969-70	11,927	1,577	2,380	**15,884**
1968-69	32,464	14,262	13,052	**59,778**
Average	**14,179**	**6,564**	**4,349**	**25,092**
Median	**11,573**	**3,883**	**1,504**	**16,960**
Minimum	**1,342**	**436**	**0**	**1,778**
Maximum	**35,192**	**22,972**	**21,115**	**79,279**

Source: Watermaster 2011

Table 2-8: Typical Monthly Distribuion of Spreading

Month	WY 1997 - WY 2008[1] Historical Monthly Distribution (% of Annual)			
	HSG	PSG	TSG	Average
Oct	4%	2%	2%	3%
Nov	4%	3%	1%	3%
Dec	6%	6%	3%	6%
Jan	13%	17%	14%	14%
Feb	16%	21%	16%	17%
Mar	22%	22%	19%	22%
Apr	15%	12%	16%	14%
May	9%	9%	11%	9%
Jun	5%	6%	10%	6%
Jul	2%	2%	5%	3%
Aug	2%	0%	2%	2%
Sep	2%	0%	1%	1%

[1] Monthly data provided by LACDPW

Figure 2-19: Typical Monthly Distribuion of Spreading

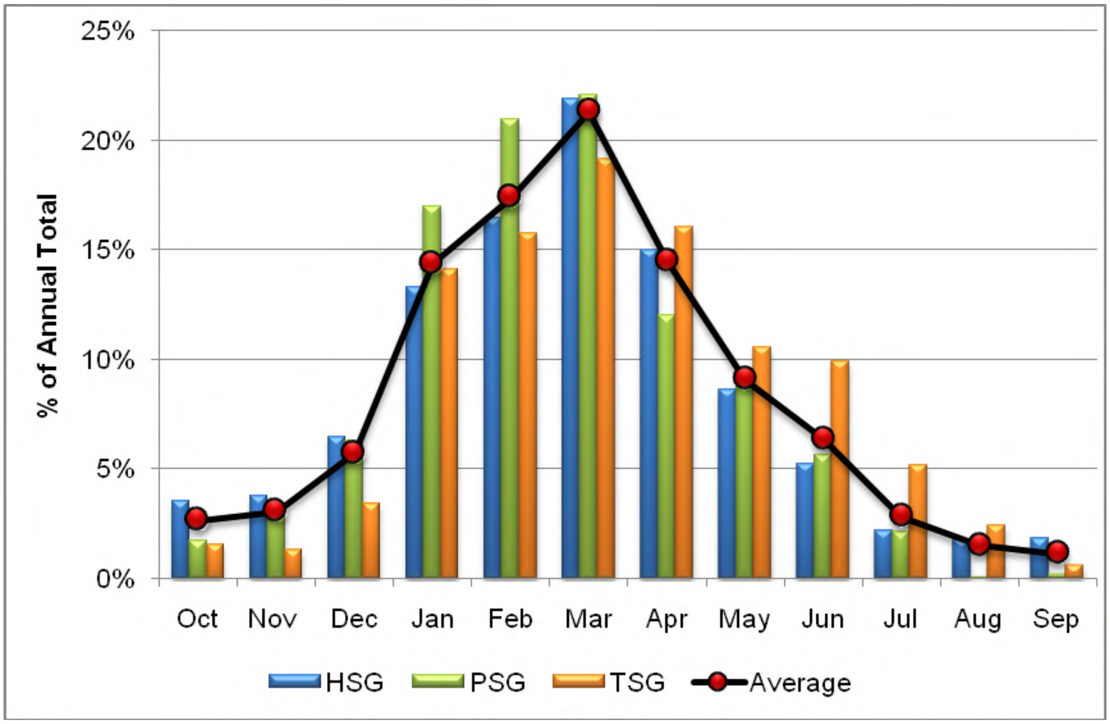


Figure 2-20: Historic Average Volume of Stormwater Captured, WY 1969-2008

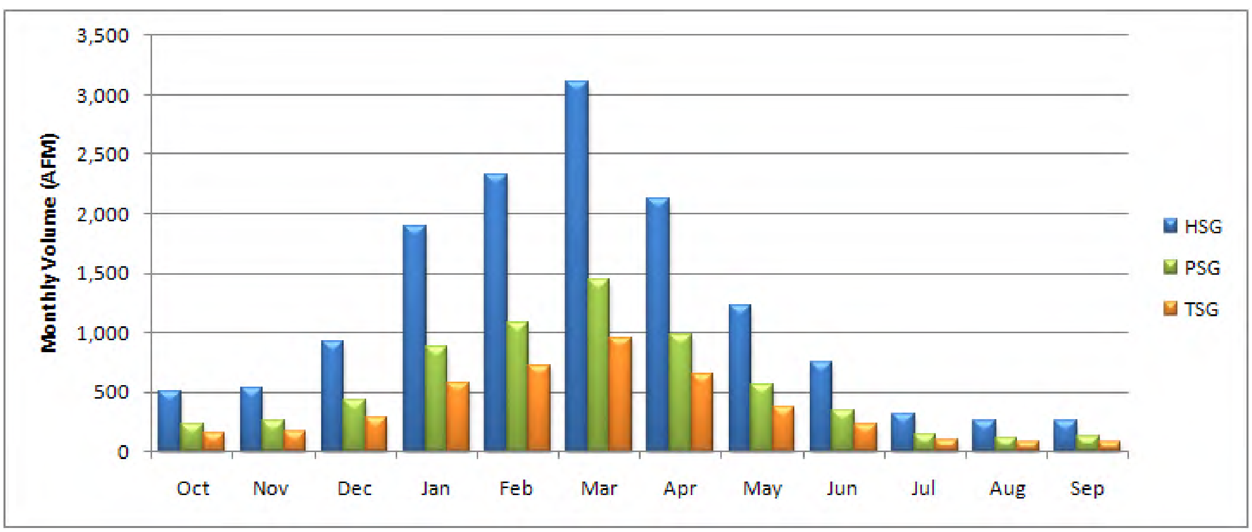


Figure 2-21: Historic Average Volume of Stormwater Captured, 2 Wettest Years (WY 1983, WY 2005)

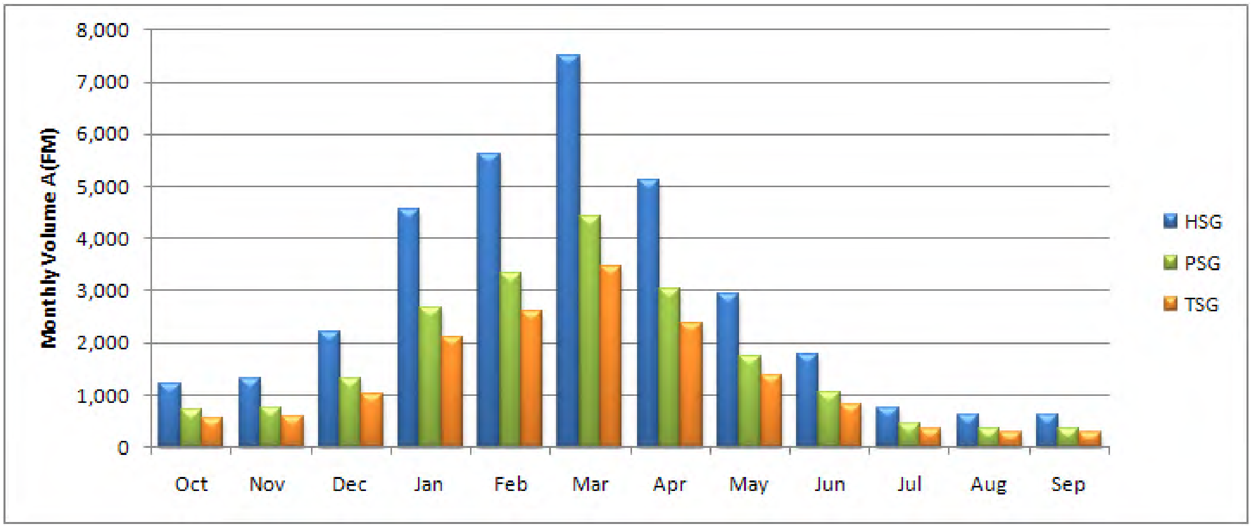
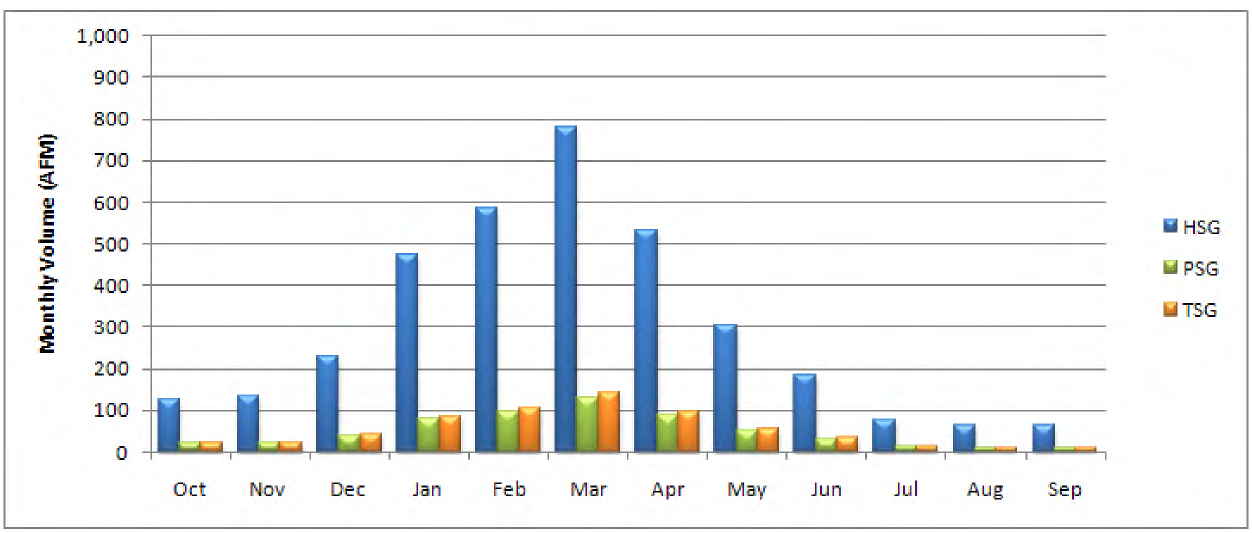


Figure 2-22: Historic Average Volume of Stormwater Captured, 2 Driest Years (WY 2003, WY 2007)



2.4.4 Recent Improvements

Over the past couple of years LACDPW and LADWP have implemented or are planning in the near future a number of capital improvements at the HSG, TSG, and PSG. The primary purpose of these projects is to increase the volume of native stormwater that can be diverted to and percolated at the spreading facilities. These improvements have consisted of improved diversion facilities, increased upstream retention, reconfiguration of basins with spreading grounds, and increased temporary storage volume in the basins to retain more stormwater runoff from storm events.

LACDPW provided modeling results showing the expected increase in stormwater capture due to the capital improvement projects. **Table 2-9** shows the projected average increase in volume spread at the three main spreading grounds.

Table 2-9: Estimated Increase in Stormwater Capture

Location	Average Annual Increase in Stormwater Capture
HSG	2,636 AF
PSG	1,296 AF
TSG	3,262 AF

A linear regression of LACDPW's modeling data was developed to estimate a simple percentage increase in spreading at each of the spreading grounds. **Table 2-10** shows the annual percentage increase. The actual increase will vary from year to year based on the hydrology of that year. However, due to the limited number of years analyzed by the LACDPW, it was not possible to determine increases that would be expected for different hydrologic periods. Therefore, the percentages shown in **Table 2-10** were used for all year types.

Table 2-10: Estimated Percent Increase in Stormwater Capture

Location	Average Annual Increase in Stormwater Capture
HSG	17%
PSG	30%
TSG	92%

2.4.5 Stormwater Runoff Captured

As discussed previously, the volume of stormwater infiltrated at each basin varies based on the hydrologic conditions (e.g., wet, average, dry, etc. as well as the duration, size and shape of hydrographs from individual storm events); and the physical constraints of the physical facilities. Data for the past 40 years of spreading volumes (WY 1969 – WY 2008) was analyzed and compared to the physical percolation capacity at each of the spreading grounds in question as discussed below.

Hansen Spreading Grounds

The historic volume of stormwater runoff diverted to the HSG for spreading was discussed in Section 2.4.3 (**Figures 2-20** through **2-22**). **Figures 2-23** and **2-24** show the historic average monthly volume of native stormwater captured at the HSG as compared to the physical percolation capacity of the basins. Information is shown for both long-term average conditions and for the wettest two years. The estimated increase in stormwater runoff capture due to the capital improvement projects is also shown on these figures. The driest years are not shown because the volume of water spread would be less than that in average conditions and does not pose any constraints on the use of the capacity of basins for recycled water spreading. The analysis indicates that on a monthly basis, there is normally significant unused capacity at the spreading grounds. Under long-term average conditions, there is approximately 5,900 (i.e., March) to 9,220 (i.e., September) acre-feet per month (AFM) (8,140 AFM average) of available percolation capacity at HSG. Under wet conditions there is approximately 740 to 8,800 AFM (6,180 AFM average) of available percolation capacity. This analysis is based on the percolation rates shown in Table 2-6. During wet periods an increase in the saturation of the aquifer beneath the spreading grounds, particularly near HSG, can cause the percolation capacity to drop. This analysis was conducted to assess the potential GWR project on a long-term basis.

It is important to note that the information presented in **Figure 2-23** is not intended to be used for the calculation of the recycled water contribution for recharging recycled water. The information in this figure represents the historical average flow, while the RWC is calculated on a moving average basis and needs to be recalculated each month. In addition the amount of recharge is expected to increase as a result of completion of the baseline projects. Details on the calculation of RWC will be discussed in Section 2.4.

However, what is not indicated in this analysis is the fact that for larger individual storm events and wetter periods, it is probable that there would be large enough volumes of stormwater runoff diverted to the spreading grounds for periods of time in the winter months during which the recycled water deliveries might have to be reduced or curtailed. While LACDPW will allow LADWP to spread recycled water in the spreading grounds to the maximum extent practical, the County's mandated goal is to always give first priority to the use of the spreading basins to capture and retain stormwater runoff. Thus the recycled water program will need to have the flexibility to reduce or halt deliveries to the spreading basins when the full capacity is devoted to retaining and recharging stormwater runoff.

Figure 2-23: Historic Average Volume of Stormwater Captured at HSG, WY 1969-2008; Maximum HSG Percolation Capacity

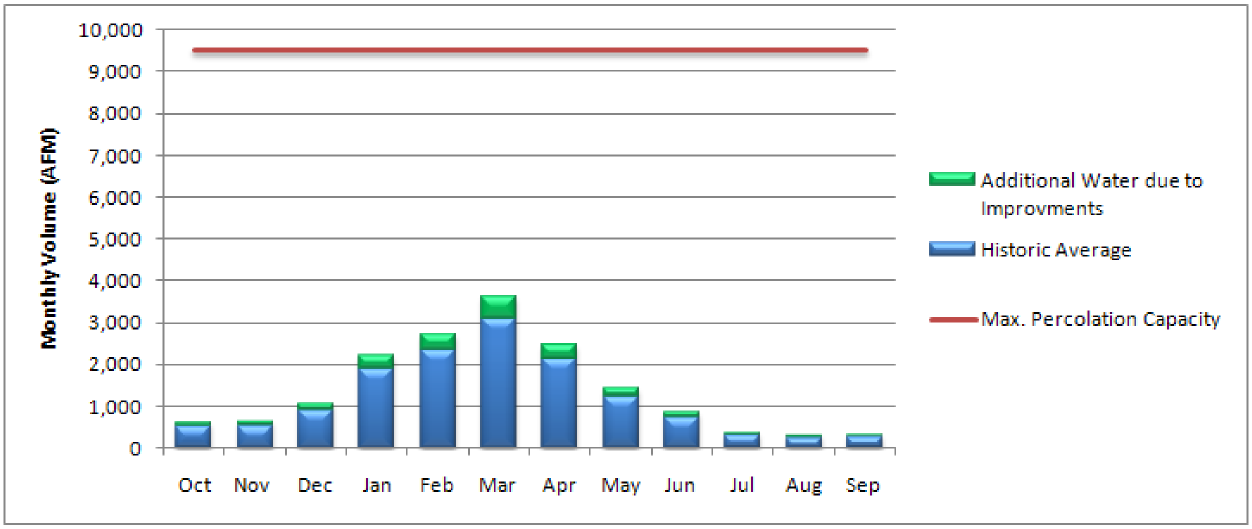
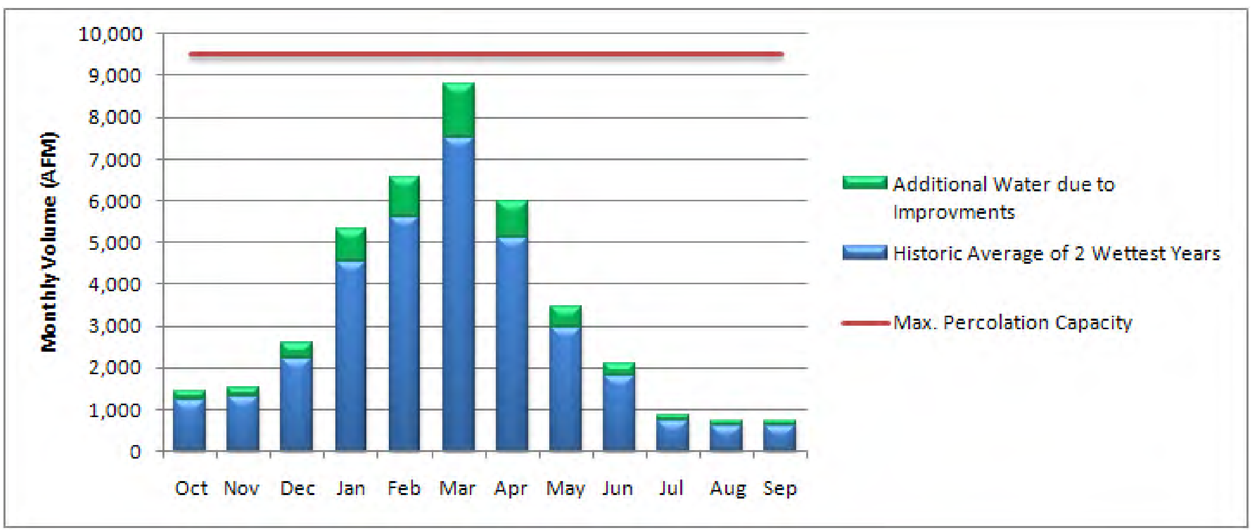


Figure 2-24: Historic Average Volume of Stormwater Captured at HSG, 2 Wettest Years (WY 1983, WY 2005); Maximum HSG Percolation Capacity



Tujunga Spreading Grounds

Similar to the figures in the previous section, **Figures 2-25** and **2-26** show the spreading versus the physical percolation capacity at the TSG. As is the case with HSG, the percolation capacity at TSG may vary during the year based on preceding conditions. A single value (from Table 2-6) was used in this analysis as a simplifying assumption. Similar to the analysis of HSG, the analysis indicates that on a monthly basis, there is significant unused capacity at the spreading grounds during normal years, and during dry months in any year, but the spreading grounds could have greater limitations during the rainy season of wet years. Under long-term median conditions there is approximately 1,150 (i.e., March) to 2,920 (i.e., September) AFM (2,280 AFM average) of available percolation capacity at TSG. Under wet conditions there is up to 2,430 AFM (i.e., September) of available percolation capacity. There are other months (i.e., January through June) where there is no available capacity at TSG. However, there is no intent to introduce recycled water to the TSG due to the very close proximity of the Tujunga Well Field that would likely preclude being able to meet the retention time requirement.

There are plans to update the TSG in the future. The design of the modifications would be jointly developed by LADWP and LACDPW. These modifications would increase the ability to percolate storm water at TSG. The timing of updates to TSG is dependent on the availability of funding and is not known at this time.

Figure 2-25: Historic Average Volume of Stormwater Captured at TSG, WY 1969-2008; Maximum TSG Percolation Capacity

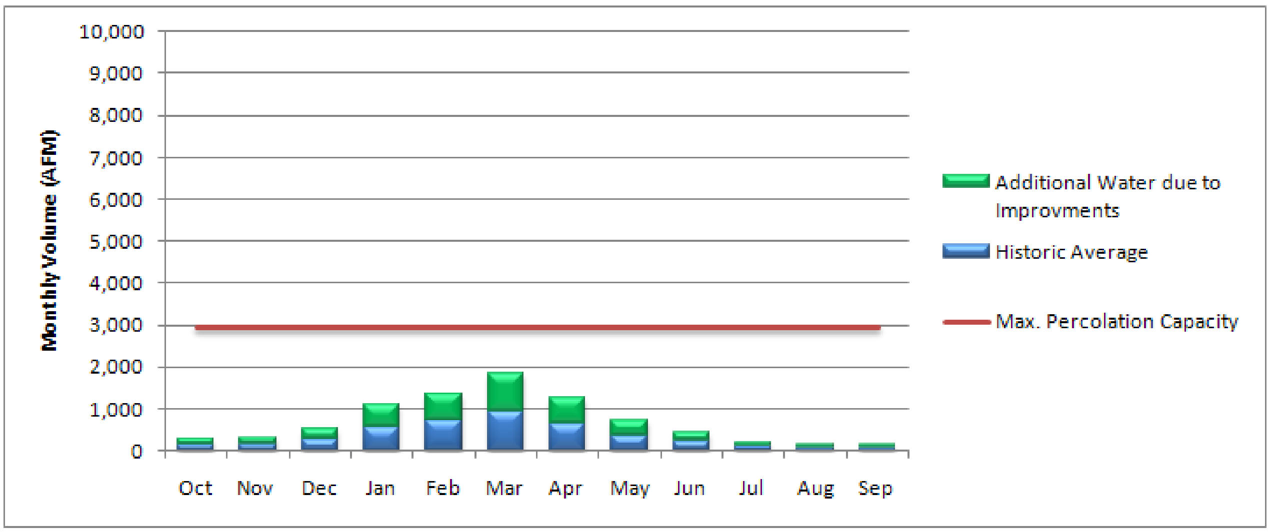
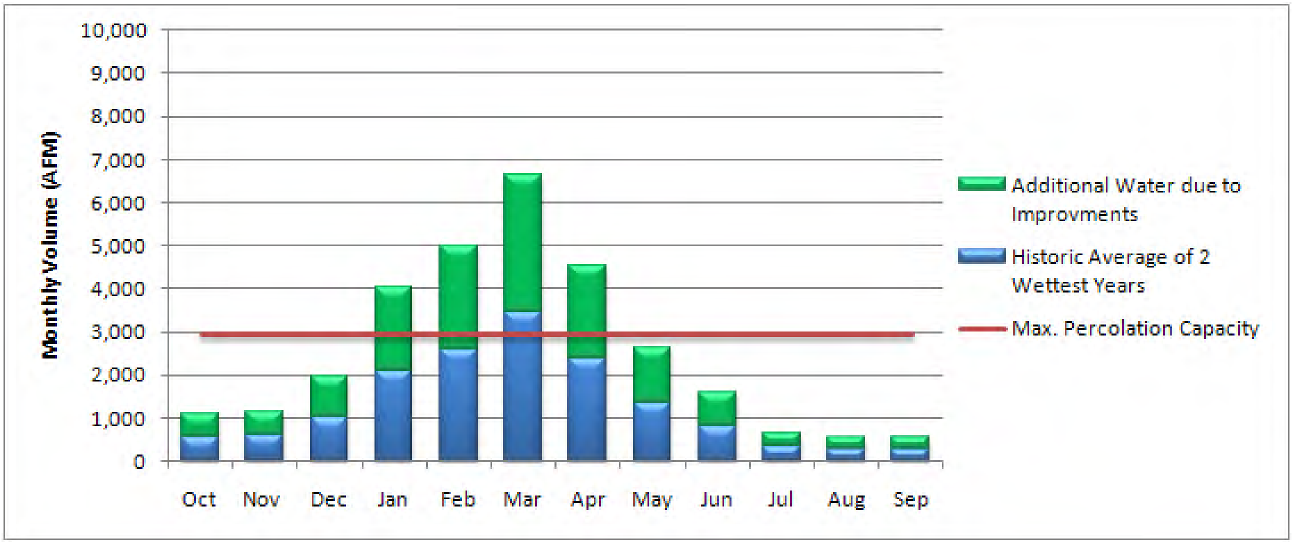


Figure 2-26: Historic Average Volume of Stormwater Captured at TSG, 2 Wettest Years (WY 1983, WY 2005); Maximum TSG Percolation Capacity



Pacoima Spreading Grounds

Similar to the figures in the previous section, **Figures 2-27** and **2-28** show the spreading versus the physical percolation capacity at the PSG. As is the case with HSG, the percolation capacity at PSG may vary during the year based on preceding conditions. A single value (from Table 2-6) was used in this analysis as a simplifying assumption. Similar to the analysis of HSG, the analysis indicates that on a monthly basis, there is significant unused capacity at the spreading grounds during normal years, and during dry months in any year, but the spreading grounds could have greater limitations during the rainy season of wet years. Under long-term median conditions there is approximately 2,000 (i.e., March) to 3,710 (i.e., September) AFM (3,160 AFM average) of available percolation capacity at TSG. Under wet conditions there is up to 3,390 AFM of available percolation capacity (i.e., March). Similar to TSG, there are month (i.e., February through April) when there is no available capacity. Similar operational considerations and constraints would exist when stormwater runoff is available at the PSG should DWP want to consider introducing recycled water at that location, thus if recycled water were to be introduced at the PSG, LADWP will need to have the flexibility to reduce or halt deliveries to the spreading basins when the full capacity is devoted to retaining and recharging stormwater runoff.

Figure 2-27: Historic Average Volume of Stormwater Captured at PSG, WY 1969-2008; Maximum PSG Percolation Capacity

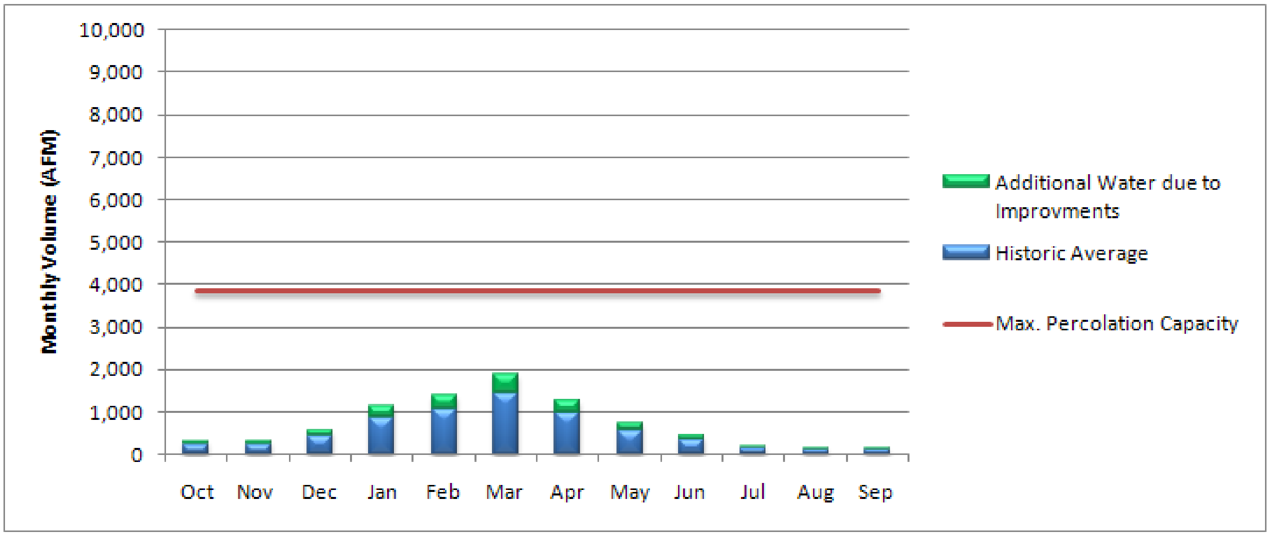
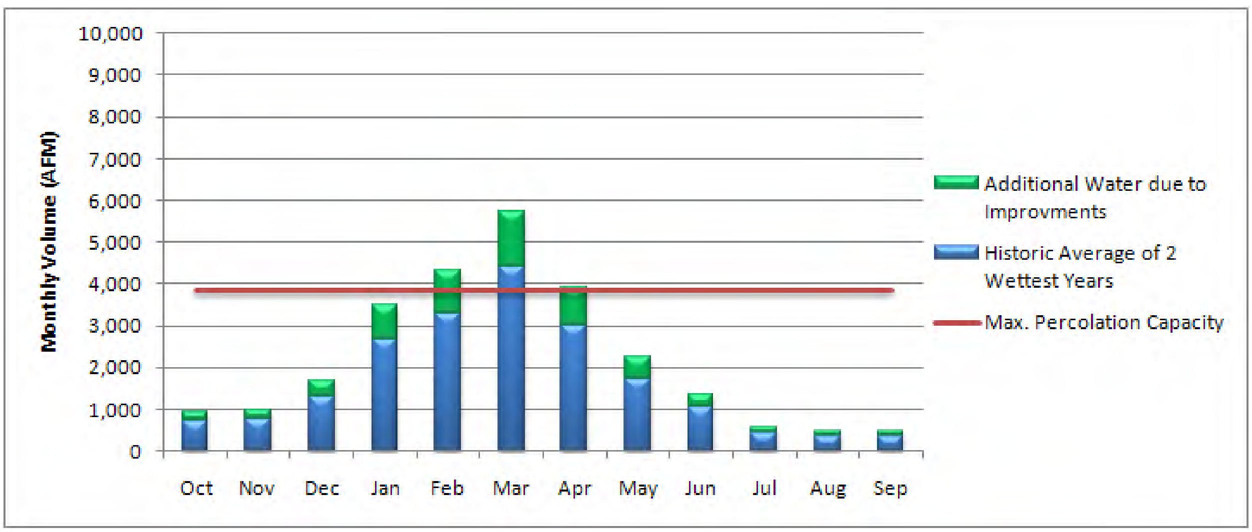


Figure 2-28: Historic Average Volume of Stormwater Captured at PSG, 2 Wettest Years (WY 1983, WY 2005); Maximum PSG Percolation Capacity



2.5 Groundwater Production

2.5.1 Location, Hydraulics

The major groundwater wellfields in the vicinity of the HSG, PSG, and TSG are shown in Figure **1-13**. Of these wellfields, the Tujunga Wellfield (TWF) and the Rinaldi-Toluca Wellfield (RTWF) are the closest wellfields downgradient of the spreading grounds. Both the TWF and the RTWF are operated by LADWP. No other wells are upgradient of, or closer to, the spreading grounds.

Both wellfields consist of a number of wells that are managed as a unit. Within a wellfield, the discharge from each of the wells is blended in a common header and delivered to a reservoir prior to being introduced to the water distribution system.

2.5.2 Historic and Future Operations

Groundwater production from the TWF and RTWF has averaged 11,387 AFY and 16,500 AFY, respectively, for WY 2004-05 through WY 2008-09. A forecast of groundwater production for the next 20 years was developed for use in the SFBGM. **Table 2-11** shows the projected annual groundwater production for the major wellfields in the SFB. The values for WY 2009-10 represent current conditions. The next 10 years of production have been forecasted by LADWP and include a significant reduction in pumping for several years while the San Fernando Basin Groundwater Treatment Complex, which will most likely include a centralized treatment facility and individual well head treatment, is developed. Production starting in WY 2019-20 is assumed to be constant for the SFBGM simulation, with 107,000 AFY being pumped annually from the LADWP wellfields. Projected conditions are used in the groundwater modeling discussed in the following section.

Table 2-11: Groundwater Pumping Assignments in SFBGM Simulation

Water Year	LADWP										Burbank			Glendale			Others		Total Extraction
	AE	EW	NH (West)	NH (East)	PO	RT	TJ	VD	WH	Total LADWP	Burbank PSD	Lockheed	Non-Burbank (VMP)	City of Glendale	Glendale OU - North	Glendale OU - South	Total (Non-LADWP)	Total (Non-Glendale [F. Lawn])	
2009-10	-1,357	-1,194	-10,612	0	-2,634	-16,935	-13,697	-1,728	-4,700	-52,857	0	-9,955	-300	-5	-4,745	-2,555	-1,818	-400	-72,635
2010-11	-1,380	-1,196	-6,172	0	-1,994	-7,099	-23,963	-2,549	-4,652	-49,005	0	-11,026	-300	-20	-4,745	-2,555	-1,818	-400	-69,869
2011-12	-1,937	0	-4,367	0	-2,178	-6,550	-15,674	-2,687	-8,607	-42,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-62,564
2012-13	-1,937	0	-2,967	0	-2,178	-4,451	-15,674	-2,687	-5,106	-35,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-55,564
2013-14	-1,937	0	-1,567	0	-2,178	-2,350	-15,674	-2,553	-1,741	-28,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-48,564
2014-15	-1937	0	-1211	0	-2,178	0	-15674	0	0	-21,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-41,005
2015-16	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2016-17	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2017-18	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2018-19	-4,923	0	-10,155	-5,620	-2,178	-15234	-25389	0	0	-63,499	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-83,504
2019-20	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2020-21	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2021-22	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2022-23	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2023-24	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2024-25	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2025-26	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2026-27	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2027-28	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2028-29	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
Total	**-64,638**	**-2,390**	**-345,951**	**-61,820**	**-43,832**	**-377,539**	**-481,737**	**-12,204**	**-24,806**	**-1,414,917**	**0**	**-206,489**	**-5,100**	**-460**	**-94,900**	**-51,100**	**-36,360**	**-8,000**	**-1,817,326**

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3. Evaluation of Proposed Project

This section provides an analysis of Phases 1 and 2 of the proposed GWR projects in the SFB. This analysis includes a description of the numerical groundwater modeling simulations conducted and an assessment of anticipated travel time and recycled water contribution (RWC).

3.1 Description

The purpose of GWR is the replenishment of the groundwater basin with AWPF product water via HSG, PSG, and, possibly, injection wells. This section focuses on the replenishment facilities required for implementing GWR. The proposed project is divided into phases as follows:

- Phase 1: Up to 15,000 AFY of GWR achieved via surface spreading at HSG
- Phase 2 Option A: Up to 30,000 AFY of GWR achieved via surface spreading at HSG and PSG
- Phase 2 Option B: 30,000 AFY of GWR achieved via surface spreading at HSG and PSG, plus direct injection using injection wells and/or Strathern Pit to increase reliability of GWR operations.

To assess the feasibility of replenishing 15,000 or 30,000 AFY of recycled water, both physical and regulatory constraints have been evaluated, as shown in **Table 3-1**.

Table 3-1: Major Physical and Regulatory Considerations

Physical	Regulatory
• Capacity of soils in the spreading grounds to percolate water	• Retention time from the point of spreading recycled water to the nearest receptor(s)
• Availability and capacity of spreading basins to accept the AWT water and maintain operational use and capture of stormwater runoff	• Percentage of total water recharged that is of recycled water origin

3.1.1 Phase 1

The goal of the Phase 1 project is to recharge an annual average volume of 15,000 AFY of AWPF product water at the HSG (**Figure 3-1**). As discussed in the GWR Master Planning Report, the AWPF maximum production capacity for Phase 1 is 23.4 mgd to provide peaking capacity for a number of reasons including peak month deliveries for non-potable reuse demands, periods in the rainy season when the spreading grounds may be unavailable due to their use for stormwater runoff spreading, and plant operating efficiencies, which equates to approximately 27,000 AFY if operated year-round. However year-round operation at full AWPF capacity is not realistic due to spreading ground outage and AWPF not having 100% reliability. These flow rates are shown in **Table 3-2**.

Figure 3-1: Schematic of Conveyance Facilities to Deliver 15,000 AFY from AWPF to HSG

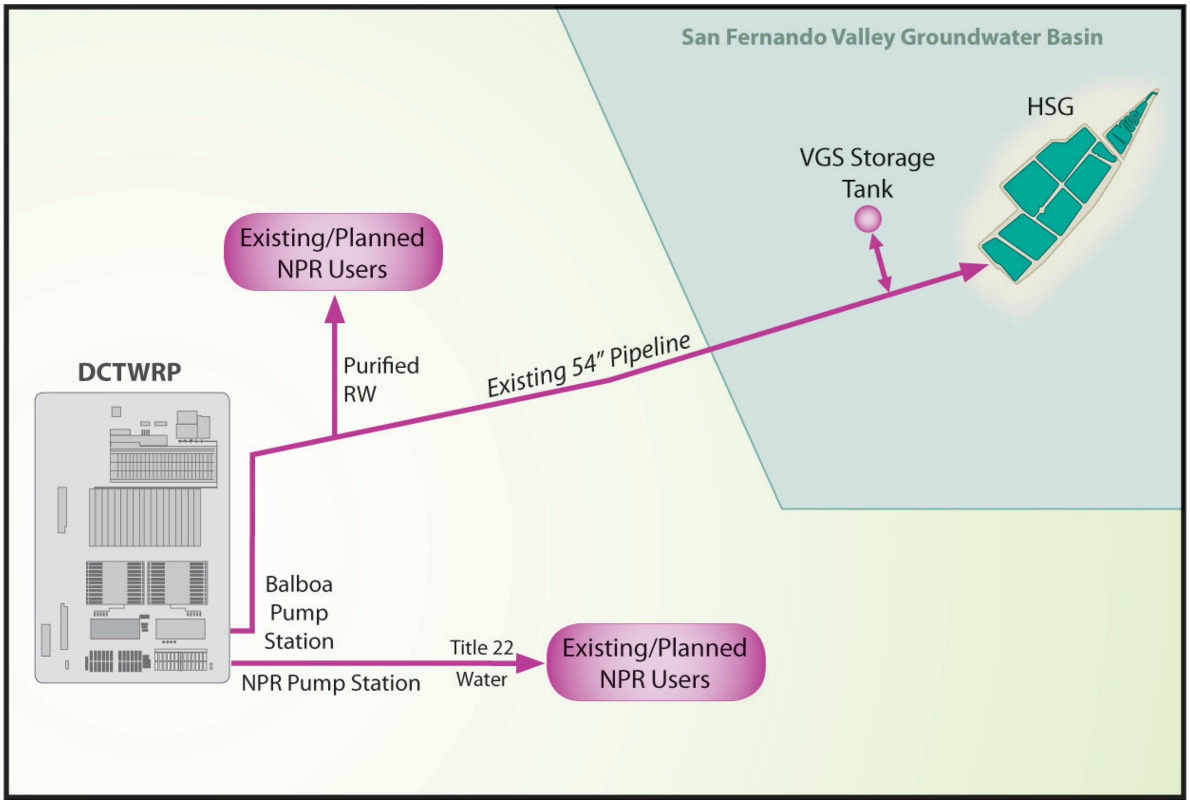


Table 3-2: Target GWR Volume and AWPF Capacity for Phase 1

	Target Rate
Annual Average Volume and Average Flow Rate of GWR	15,000 AFY (13.4 mgd)
AWPF Production Capacity (Maximum Flow Rate)	23.4 mgd

While the numbers shown in Table 3-2 would imply that there is substantially more treatment capacity than needed to meet the GWR target, the ability to deliver and recharge water year-round is significantly constrained by several factors including:

- AWPF Online Factor: The AWPF is assumed to have a 92 percent online factor. This assumes that the actual AWPF production would average 92 percent of the nominal plant capacity due to scheduled and unscheduled down times for maintenance and repair, and other unforeseen events.
- Non-Potable Reuse (NPR) Demands: The AWPF product water will also serve existing (except in Sepulveda Basin) and NPR demands off the 54-inch pipeline. These demands are seasonal and peak during the summer months.

- Unavailability of HSG: There will be periods (up to 70 days per year) when the HSG will not be available for AWPF product water spreading based on LACDPW's operations. These periods will primarily be during the winter months in wetter years when the entire HSG is dedicated to receiving and recharging stormwater runoff.

Future Recharge Conditions

The goal of the Phase 1 of the project is to recharge an annual average volume of 15,000 AFY (average of 1,250 acre-feet per month (AFM)) of purified recycled water at the HSG. Based on available information, the percolation capacity of the HSG would be more than sufficient to allow for continued recharge with stormwater as well as the additional volume of purified recycled water, if the HSG could receive water continuously throughout the year. The annual average volume of 15,000 AFY equates to a long term average of approximate 41 acre-feet per day (AFD). This rate is well below the percolation capacity of the entire HSG. While each of the six basins within the HSG are not evenly sized, the use of one basin at a time should be approximately sufficient to recharge the average instantaneous rate of purified recycled water without significantly ponding.

Figure 3-2 shows the additional purified recycled water recharge volume along with historic average stormwater recharge volume at the HSG for WY 1969 through WY 2008. **Figure 3-3** shows similar information for the two wettest years, WY 1983 and WY 2005.

Figure 3-2: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the HSG, WY 1969-2008

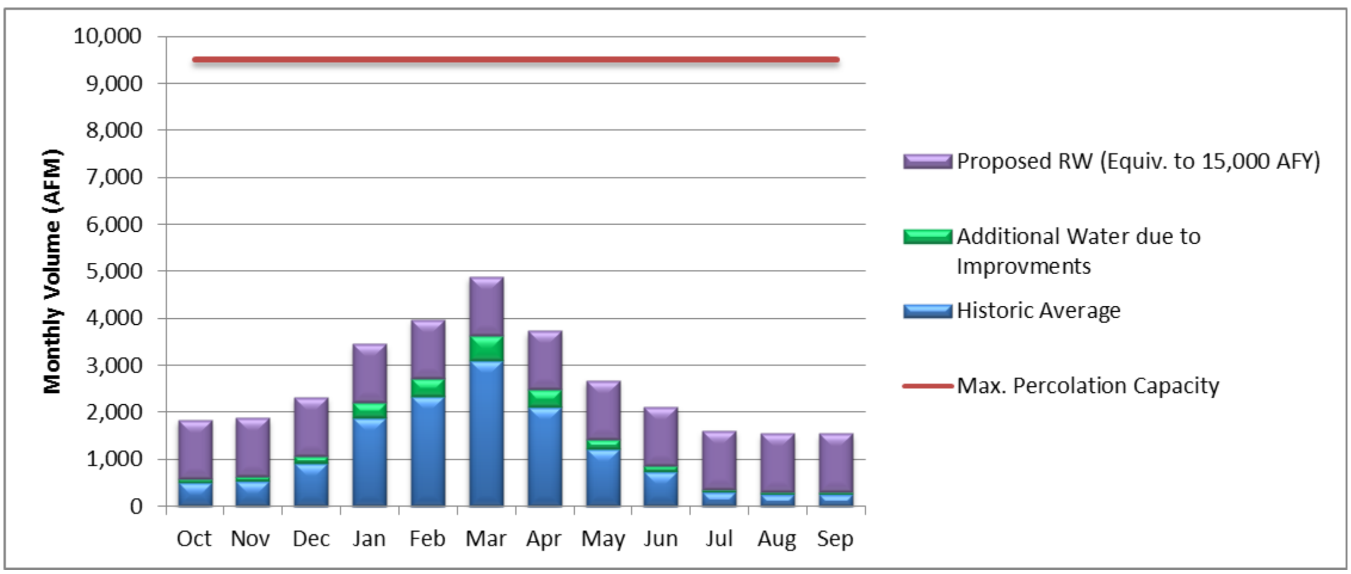
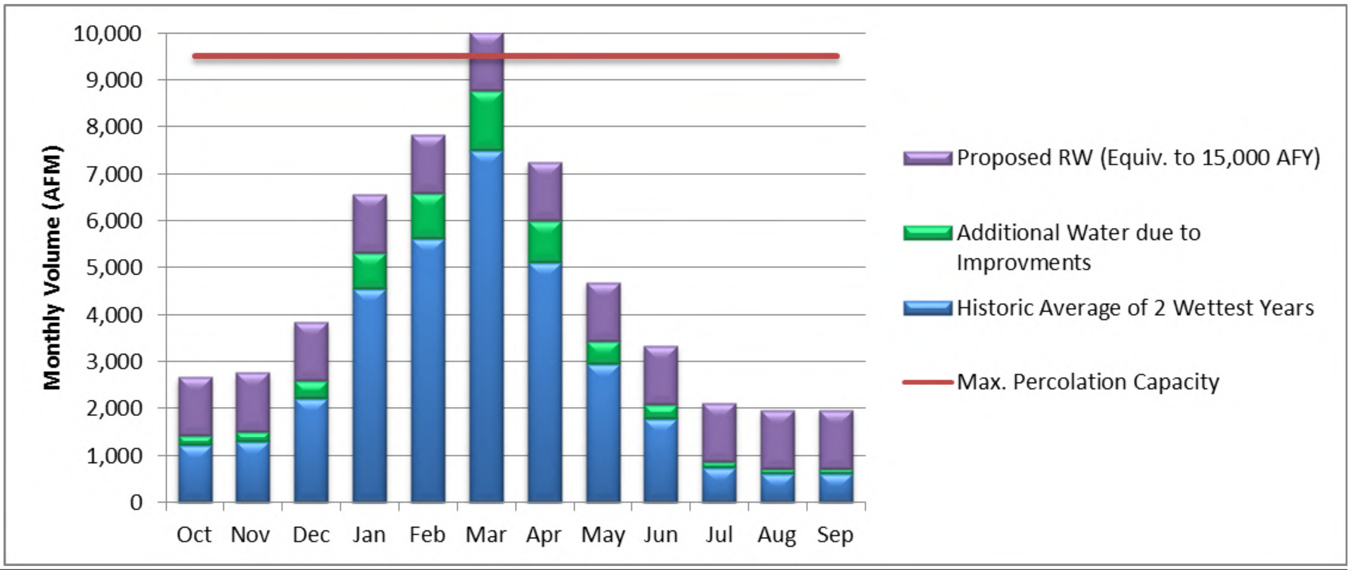


Figure 3-3: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the HSG, Two Wettest Years (WY 1983 and WY 2005)



Conveyance Facilities

During the initial stages of LADWP's East Valley Project, a 54-inch diameter pipe was installed on the southeastern boundary of the HSG, along the Tujunga Wash. A turnout and dispersion structure was constructed at the end of the pipeline, but the existing pipe is currently capped at the upstream end (near the northeastern corner of the HSG) as shown on **Figure 3-1**. This existing line will be able to be used to deliver AWPF product water to the HSG area. However, several additional ancillary facilities are recommended to allow for system flexibility (see **Figure 3-4**). These improvements will allow for the delivery of AWPF product water to each spreading basin individually to be able to provide maximum flexibility in coordinating activities with LACDPW as discussed below. With these additional facilities, water could be delivered to any of the basins individually or in combination.

- Turn-out at North End of Pipe. To re-activate the discharge at the northeast end of the 54-inch line, the segment of line that was removed and capped will need to be replaced and a new valve installed at the end of the pipe to allow AWPF product water to be discharged into Basin "S" in the HSG (**Figure 3-4**); or to isolate this discharge point when water is to be directed to other lower basins. Water in Basin S can then be directed, by LACDPW, to either Basins 1 or 2.
- Additional Lateral A. An additional lateral would be installed from the transmission pipe to allow for discharge of AWPF product water directly into Basins 1, 2, 3, or 4 (**Figure 3-4**). A discharge structure to allow water to exit the lateral into one or more of the basins would also be necessary. The lateral pipe would need to be sized for full AWPF product water flow from the AWPF to allow the full flow to be distributed to a single basin. A 36-inch diameter pipeline is recommended.

Figure 3-4: Proposed Facility Improvements at the Hansen Spreading Grounds

- Additional Lateral B. An additional 36-inch diameter lateral and discharge structure would be installed from the transmission pipe to a location between Basins 5 and 6 (**Figure 3-4**). The lateral pipe would need to be sized for full AWPF product water flow from the AWPF to allow the full flow to be distributed to either Basin 5 or 6 or a combination of both basins.

Operational Strategy

The operation of the GWR at the HSG is governed by both the availability of AWPF product water and the capacity of the spreading grounds to percolate the AWPF product water. The capacity of HSG to accept and recharge AWPF product water is dependent on LACDPW's operations to capture and recharge native stormwater. A discussion of existing and future recharge conditions at HSG is provided in Section 2.

Spreading Basin Availability

While the previous section suggested that while there is more than adequate metering into the basin capacity at the HSG to achieve the 15,000 AFY target, there are two major reasons that the basin(s) at the HSG may be unavailable for recharge of the AWPF product water: (1) due to extreme wet weather conditions; and (2) maintenance. These conditions require a careful plan of operations and close cooperation with LACDPW to be developed and followed to consistently meet the GWR goals.

As discussed previously, the primary objective of LACDPW's operation of the HSG is to capture and recharge the maximum quantity of stormwater possible. This objective may result in LACDPW not allowing AWPF product water to be distributed to and recharged at the HSG for 70 days. During these periods, the AWPF product water would need to be conveyed to another location or used for another purpose or the AWPF would need to stop delivering treated water. The duration and frequency of these periods is dependent on the frequency, duration, and intensity of the wet weather conditions that occur during each particular year. LACDPW also attempts to maximize storage in the upstream reservoirs behind Hansen Dam and Tujunga Dam, and release water at lower rates over an extended period of time, which can extend the period over which stormwater is available for spreading, particularly in wetter years.

LACDPW has stated that LADPW should plan for up to 70 days per year during which time the HSG will be unavailable to recharge AWPF product water. Therefore, if the HSG is available for recharge of AWPF product water for only 295 days per year, the average daily flow rate of AWPF product water to the HSG would need to be increased accordingly. As shown in Table 3-1, the AWPF production capacity is 23.4 mgd, and the planned AWPF product water delivery rate is also 23.4 mgd on days the spreading grounds are available. Therefore, the output capacity of the AWPF will be large enough to compensate for the downtime of the HSG and still meet the GWR goal of 15,000 AFY for the Initial Phase of the project.

LACDPW also takes spreading basin(s) out of service for routine maintenance and occasionally for extended periods if there is major repair work required. The basins require maintenance to remove accumulated fine materials and restore the surface infiltration capability to sustain long term percolation rates. The maintenance typically involves removal of accumulated fine grained material from the basin bottoms to restore percolation capacity. This activity normally occurs during dry periods of the year when stormwater is not being recharged and is typically performed sequentially from one basin to the next. During the maintenance period, which may be as short as one day per basin and also require a drying period in the basin, the basin having maintenance done cannot be used for recharge.

LACDPW's current practice allows for maintenance to occur during the normally dry (i.e., summer) portion of the year. However, with the introduction of year-round recharge of the AWPF product water, LADWP and LACDPW will need to work together to allow for continued recharge of the AWPF product water as well as the necessary maintenance. Typically only one basin will be taken out of service at a time, and because only one basin would normally be needed to recharge daily AWPF product water flows, there appears to be significant flexibility to direct AWPF product water to different basins as needed to minimize interference with maintenance operations. This concept has been discussed with LACDPW and basin maintenance should not be a major interference with AWPF product water recharge.

Figure 3-5 shows a Phase 1 scenario that incorporates downtime at the HSG. It shows the average monthly mass balance if the 70 days of HSG unavailability is assumed to occur during the winter months of December through April. LACDPW has indicated that HSG could be unavailable for 70 days during a typical year. During a wet year this number could increase, potentially up to 150 days per year.

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Figure 3-5

AWPF Capacity and GWR Capability Monthly Flow Chart
Phase 1 - Spreading at HSG, SG Downtimes in Winter Months Only

AWPF Capacity (min)[1]:	23.4	mgd
Total GWR:	15,000	AFY

AWPF		
Phase 1 Capacity (min)[1]	23.4	mgd
Phase 2 Capacity	35.0	mgd
Stage	Phase 1	
AWPF Recovery	79%	
Plant Capacity	23.4	mgd
Downtime	30	days/year
Online Factor	92%	
Offline Factor	8%	
Downtime	**Y/N**	**day/mo**
Jan	Y	2.5
Feb	Y	2.5
Mar	Y	2.5
Apr	Y	2.5
May	Y	2.5
Jun	Y	2.5
Jul	Y	2.5
Aug	Y	2.5
Sep	Y	2.5
Oct	Y	2.5
Nov	Y	2.5
Dec	Y	2.5
		30

NPR		
Existing/Tier 1	5,010	AFY
Existing/Tier 1	4.5	mgd
Max Tier 2	0	AFY
Max Tier 2	0.0	mgd
Total	5,010	AFY
Total	4.5	mgd
Peaking Factor		
Jan	0.5	
Feb	0.5	
Mar	0.6	
Apr	0.9	
May	1.2	
Jun	1.5	
Jul	1.8	
Aug	1.6	
Sep	1.3	
Oct	0.9	
Nov	0.7	
Dec	0.5	

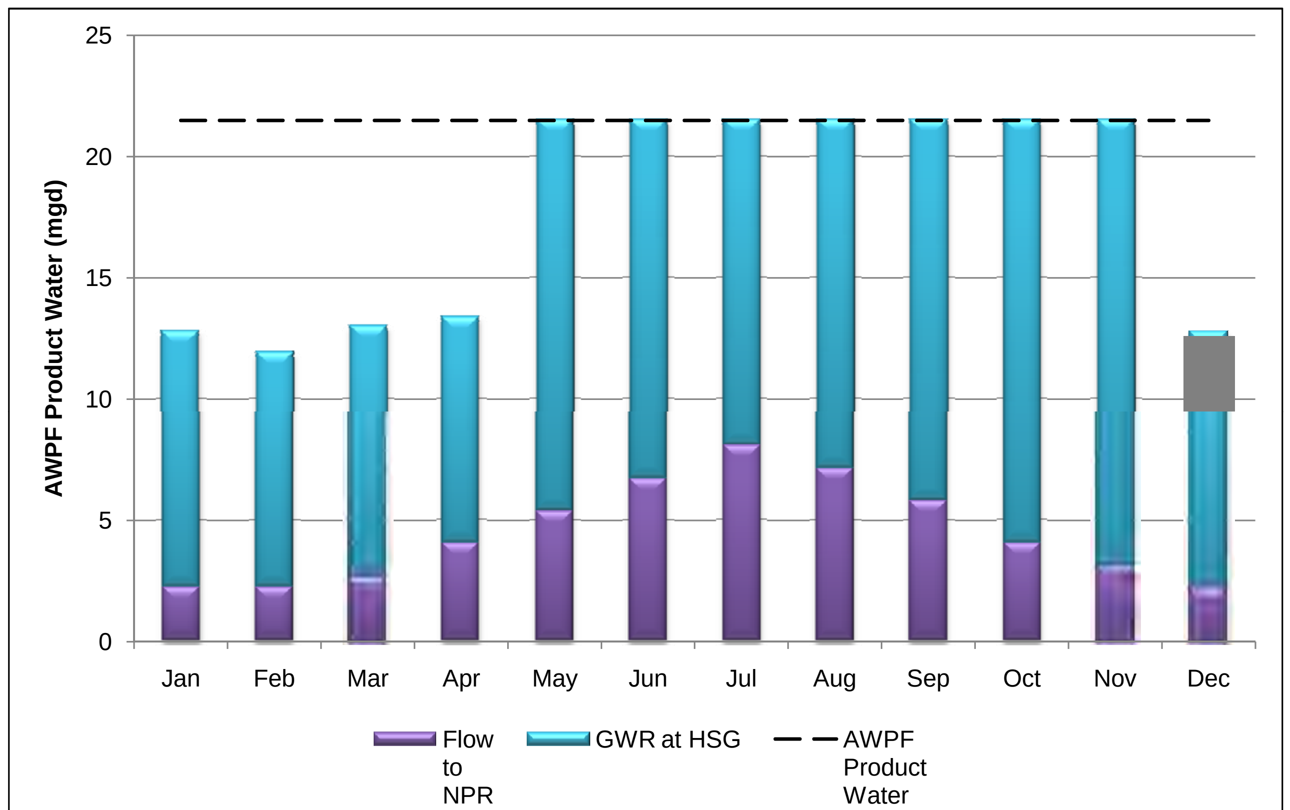
Month	No. of Days in Month	AWPF Product Water	Flow to NPR	Max Flow Available for GWR			Average Flows to Spreading Grounds			GWR Operations				
										Operation Period		Spreading Grounds		
	days	mgd (Note 2)	mgd	HSG mgd (Note 3)	PSG mgd (Note 3)	Total mgd (Note 3)	HSG mgd (Note 4)	PSG mgd (Note 4)	Total mgd (Note 4)	HSG days	PSG days	HSG (Note 5)	PSG (Note 5)	Total
Jan	31	21.5	2.2	19.2	0.0	19.2	10.6	0.0	10.6	17	25	327 MG/mo	0 MG/mo	1,004 AF/mo
Feb	28	21.5	2.2	19.2	0.0	19.2	9.6	0.0	9.6	14	22	269 MG/mo	0 MG/mo	827 AF/mo
Mar	31	21.5	2.7	18.8	0.0	18.8	10.3	0.0	10.3	17	25	320 MG/mo	0 MG/mo	981 AF/mo
Apr	30	21.5	4.0	17.5	0.0	17.5	9.3	0.0	9.3	16	24	279 MG/mo	0 MG/mo	857 AF/mo
May	31	21.5	5.4	16.1	0.0	16.1	16.1	0.0	16.1	31	31	500 MG/mo	0 MG/mo	1,533 AF/mo
Jun	30	21.5	6.7	14.8	0.0	14.8	14.8	0.0	14.8	30	30	443 MG/mo	0 MG/mo	1,360 AF/mo
Jul	31	21.5	8.1	13.4	0.0	13.4	13.4	0.0	13.4	31	31	416 MG/mo	0 MG/mo	1,278 AF/mo
Aug	31	21.5	7.2	14.3	0.0	14.3	14.3	0.0	14.3	31	31	444 MG/mo	0 MG/mo	1,363 AF/mo
Sep	30	21.5	5.8	15.7	0.0	15.7	15.7	0.0	15.7	30	30	470 MG/mo	0 MG/mo	1,442 AF/mo
Oct	31	21.5	4.0	17.5	0.0	17.5	17.5	0.0	17.5	31	31	541 MG/mo	0 MG/mo	1,661 AF/mo
Nov	30	21.5	3.1	18.4	0.0	18.4	18.4	0.0	18.4	30	30	551 MG/mo	0 MG/mo	1,690 AF/mo
Dec	31	21.5	2.2	19.2	0.0	19.2	10.6	0.0	10.6	17	25	327 MG/mo	0 MG/mo	1,004 AF/mo
Average		**21.5**	**4.5**	**17.0**	**0.0**	**17.0**	**13.4**	**0.0**	**13.4**					
Total	**365**									**295**	**335**	**4,888** MG/yr	**0** MG/yr	**15,000 AFY**

Notes:
2) Applied AWPF offline factor.
3) Before applying spreading grounds downtimes.
4) After applying spreading grounds downtimes.
5) Monthly spreading amounts (maximum flows available for GWR * no. of days of operation).

HSG		
% of GWR	100%	
Downtime	70	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	14.0
Feb	Y	14.0
Mar	Y	14.0
Apr	Y	14.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	14.0
		70

PSG		
% of GWR	0%	
Downtime	30	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	6.0
Feb	Y	6.0
Mar	Y	6.0
Apr	Y	6.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	6.0
		30

Notes:
1) While the minimum Phase 1 AWPF capacity is 23.4 mgd, the recommended AWPF design capacity for Phase 1 is 25 mgd. See Section 5 for more information.



3.1.2 Phase 2 Option A

The goal of the Phase 2 is to recharge an annual average volume of up to 30,000 AFY of AWPF product water. In Option A, the recharge would occur at both HSG and PSG (**Figure 3-6**). The maximum AWPF production capacity for the Phase 2 is 35.0 mgd, which equates to approximately 39,200 AFY if operated year-round. However year-round operation at full AWPF capacity is not realistic due to spreading ground outage and AWPF not having 100% reliability. These flow rates are shown in **Table 3-3**.

Figure 3-6: Schematic of Conveyance Facilities to Deliver 30,000 AFY from AWPF to HSG and PSG, Phase 2 Option A

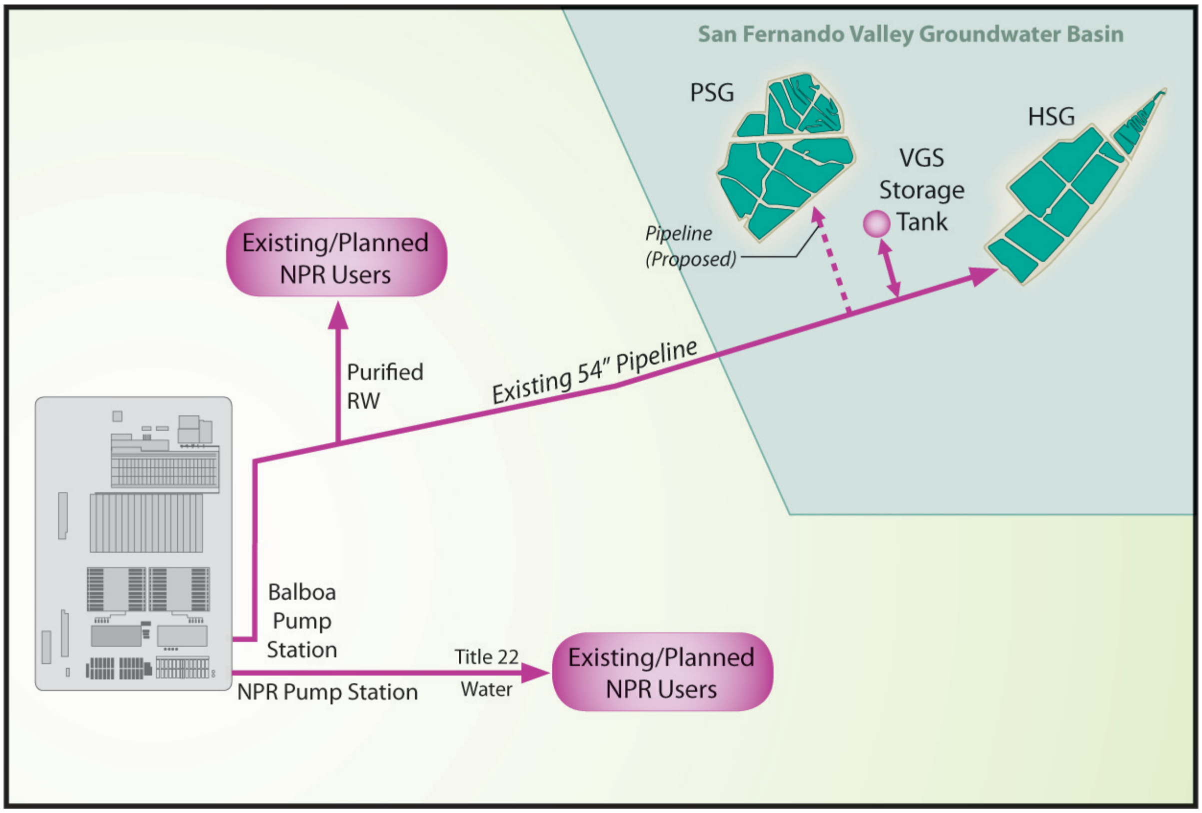


Table 3-3: Target GWR Volume and AWPF Capacity for Phase 2

	Target Rate
Annual Average Volume and Average Flow Rate of GWR	30,000 AFY (26.8 mgd)
AWPF Production Capacity (Maximum Flow Rate)	35.0 mgd

Use of HSG alone is not sufficient to allow GWR of 30,000 AFY for Phase 2. The depth of the aquifer near the HSG and the presence of a fault downgradient of HSG (approximately at San Fernando Road) do not allow this volume of GWR to be transmitted through the aquifer. These hydrogeologic conditions may cause excessive groundwater mounding in the HSG area if GWR flow is increased much above the Phase 1 condition of 15,000 AFY. The groundwater mounding has the potential to adversely impact operations at the nearby Bradley Landfill. Therefore, the use of both the HSG and the PSG is necessary to increase GWR in Phase 2.

As with Phase 1, while the Phase 2 values shown in Table 3-2 would imply that there is more treatment capacity than needed to meet the GWR target, the ability to deliver water year-round is constrained by the same factors as in Phase 1 including:

- AWPF Online Factor: The AWPF is assumed to have a 92 percent online factor. This assumes that the actual AWPF production would be average annual 92 percent of the plant capacity due to scheduled and unscheduled down times for maintenance and repair, and other unforeseen events.
- NPR Demands: The AWPF product water will also serve existing (except in Sepulveda Basin) and planned NPR demands off of 54-inch pipeline. These demands are seasonal and peak during the summer months.
- Unavailability of Spreading Grounds: There will be periods (up to 70 days per year at HSG and 30 days per year at PSG) when the spreading grounds will not be available for AWPF product water spreading based on LACDPW's operations. These periods will primarily be during the winter months in wetter years when the entire HSG is dedicated to receiving and recharging stormwater runoff.

Future Recharge Conditions

The goal of the Phase 2 of the project is to recharge an annual average volume of up to 15,000 AFY (average of 1,250 AFM) of purified recycled water at the HSG and up to 15,000 AFY at the PSG. Future conditions at the HSG where discussed in Section 7.1.2.

Based on available information, the percolation capacity of the PSG would be sufficient to allow for continued recharge with stormwater as well as the additional volume of purified recycled water. The annual average volume of 15,000 AFY equates to a long term average of approximate 41 AFD. This rate is significantly below the percolation capacity of the entire PSG of approximately 128 AFD.

Figure 3-7 shows the additional purified recycled water recharge volume along with historic average stormwater recharge volume at the PSG for WY 1969 through WY 2008. **Figure 3-8** shows similar information for the two wettest years, WY 1983 and WY 2005. Because the percolation capacity of the PSG is lower than the HSG, there may be additional instances of the PSG being filled to capacity, especially during wet years.

Figure 3-7: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the PSG, WY 1969-2008

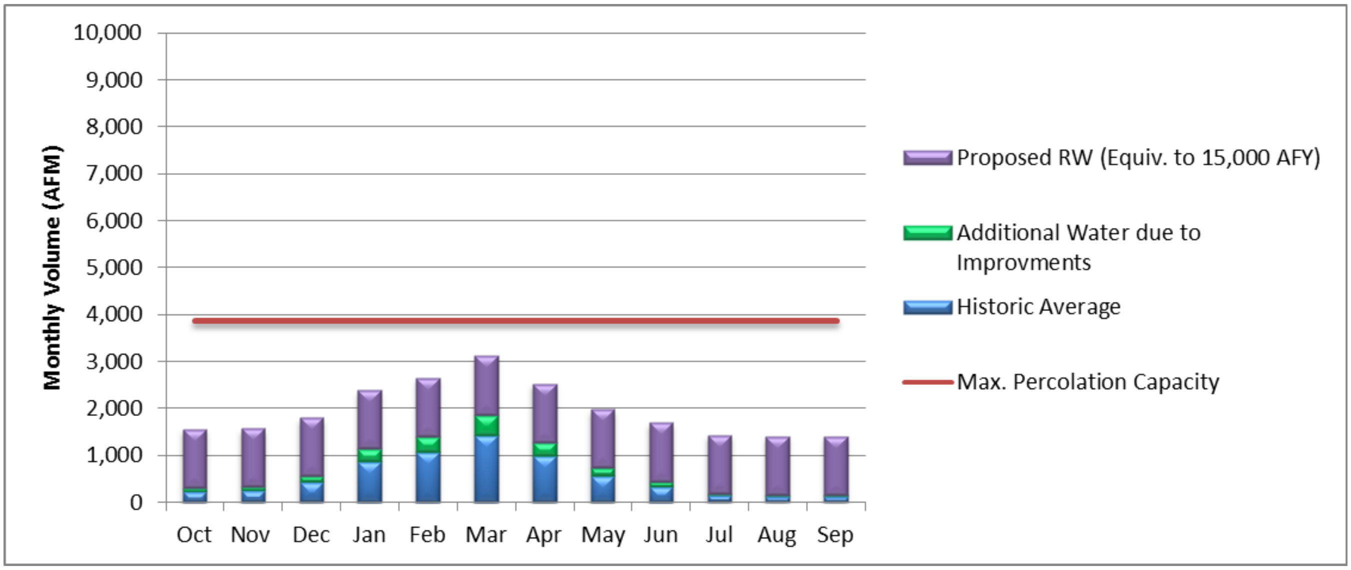
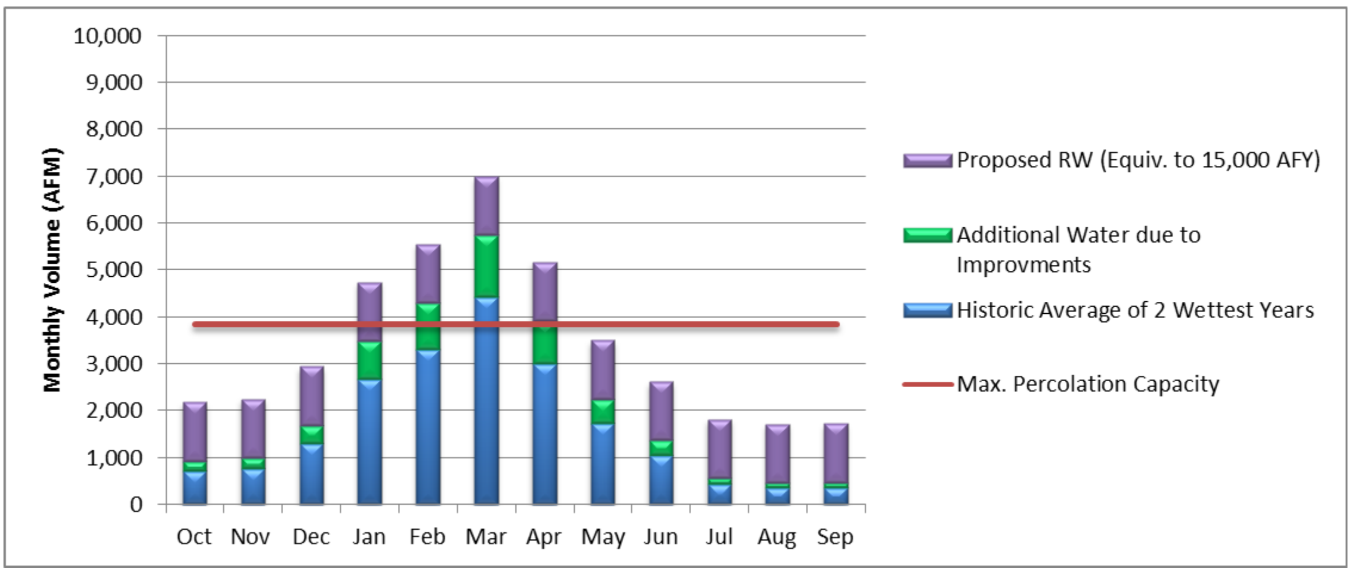


Figure 3-8: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the PSG, Two Wettest Years (WY 1983 and WY 2005)



Conveyance Facilities

As shown on **Figure 3-6**, conveyance from the AWPF at DCTWRP to the HSG would primarily be accomplished through the existing 54-inch pipeline. The facility improvements to HSG mentioned in Section 3.1.1 will also be required in for Phase 2 Option A.

To provide recycled water to PSG additional facility improvements will also be necessary (see **Figure 3-9**.

- Pipeline to PSG. A new transmission pipeline will be required to connect from the existing 54-inch line to PSG.
- Additional Laterals. Similar to the improvements at HSG, to provide maximum flexibility in providing recycled water to the PSG, laterals from the main PSG transmission line to each of the individual basins within PSG would need to be constructed. These laterals are shown conceptually in Figure 3-9 in one potential layout. The laterals would need to be sized according to the total percolation capacity of each of the individual basin(s) served by the lateral.

Operational Strategy

As in Phase 1, the operation of the GWR at the HSG and PSG is governed by both the availability of AWPF product water and the capacity of the spreading grounds to percolate the AWPF product water. The capacity of HSG and PSG to accept and recharge AWPF product water is dependent on LACDPW's operations to capture and recharge native stormwater. A discussion of existing and future recharge conditions at HSG and PSG is provided in Section 2.

Spreading Basin Availability

As with Phase 1, there will periods when the spreading grounds are unavailable for the recharge of recycled water. LACDPW has indicated that HSG could be unavailable for 70 days per year and PSG for 30 days per year.

Similar to **Figure 3-5** for Phase 1, **Figure 3-10** Phase 2 shows the average monthly mass balance if the 70 days of HSG and 30 days of PSG unavailability is assumed to occur during the winter months of December through April. LACDPW has indicated that HSG could be unavailable for 70 days during a typical year and PSG may be unavailable for 30 days. During a wet year these numbers could increase.

Figure 3-9: Proposed Facility Improvements at the Pacoima Spreading Grounds

W:\Office\Sacramento\Heywood_Brian\San Fernando_Aug11\Fig 2_Proposed Facility Improvements at the Pacoima Spreading Grounds.ai 08/05/11 JJT

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Figure 3-10

AWPF Capacity and GWR Capability Monthly Flow Chart

Phase 2 Option A - Spreading at HSG and PSG - SG Downtimes in Winter Months Only

AWPF Capacity:	35.0	mgd
Total GWR:	26,400	AFY

AWPF		
Phase 1 Capacity (min)[1]	23.4	mgd
Phase 2 Capacity	35.0	mgd
Stage	Phase 2	
AWPF Recovery	79%	
Plant Capacity	35.0	mgd
Downtime	30	days/year
Online Factor	92%	
Offline Factor	8%	
Downtime	**Y/N**	**day/mo**
Jan	Y	2.5
Feb	Y	2.5
Mar	Y	2.5
Apr	Y	2.5
May	Y	2.5
Jun	Y	2.5
Jul	Y	2.5
Aug	Y	2.5
Sep	Y	2.5
Oct	Y	2.5
Nov	Y	2.5
Dec	Y	2.5
		30

NPR		
Existing/Tier 1	5,010	AFY
Existing/Tier 1	4.5	mgd
Max Tier 2	0	AFY
Max Tier 2	0.0	mgd
Total	5,010	AFY
Total	4.5	mgd
Peaking Factor		
Jan	0.5	
Feb	0.5	
Mar	0.6	
Apr	0.9	
May	1.2	
Jun	1.5	
Jul	1.8	
Aug	1.6	
Sep	1.3	
Oct	0.9	
Nov	0.7	
Dec	0.5	

HSG		
% of GWR	50%	
Downtime	70	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	14.0
Feb	Y	14.0
Mar	Y	14.0
Apr	Y	14.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	14.0
		70

PSG		
% of GWR	50%	
Downtime	30	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	6.0
Feb	Y	6.0
Mar	Y	6.0
Apr	Y	6.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	6.0
		30

Notes:

1) While the minimum Phase 1 AWPF capacity is 23.4 mgd, the recommended AWPF design capacity for Phase 1 is 25 mgd. See Section 5 for more information.

Month	**No. of Days in Month** days	**AWPF Product Water** mgd (Note 2)	**Flow to NPR** mgd	**Max Flow Available for GWR** **HSG** mgd (Note 3)	**PSG** mgd (Note 3)	**Total** mgd (Note 3)	**Average Flows to Spreading Grounds** **HSG** mgd (Note 4)	**PSG** mgd (Note 4)	**Total** mgd (Note 4)	**GWR Operations – Operation** **HSG** days	**PSG** days	**Spreading Grounds** **HSG** (Note 5)	**PSG** (Note 5)	**Total**
Jan	31	32.1	2.2	14.9	14.9	29.9	8.2	12.1	20.2	17	25	254 MG/mo	374 MG/mo	1,926 AF/mo
Feb	28	32.1	2.2	14.9	14.9	29.9	7.5	11.7	19.2	14	22	209 MG/mo	329 MG/mo	1,651 AF/mo
Mar	31	32.1	2.7	14.7	14.7	29.4	8.1	11.9	19.9	17	25	250 MG/mo	368 MG/mo	1,897 AF/mo
Apr	30	32.1	4.0	14.0	14.0	28.1	7.5	11.2	18.7	16	24	225 MG/mo	337 MG/mo	1,725 AF/mo
May	31	32.1	5.4	13.4	13.4	26.8	13.4	13.4	26.8	31	31	415 MG/mo	415 MG/mo	2,545 AF/mo
Jun	30	32.1	6.7	12.7	12.7	25.4	12.7	12.7	25.4	30	30	381 MG/mo	381 MG/mo	2,340 AF/mo
Jul	31	32.1	8.1	12.0	12.0	24.1	12.0	12.0	24.1	31	31	373 MG/mo	373 MG/mo	2,290 AF/mo
Aug	31	32.1	7.2	12.5	12.5	25.0	12.5	12.5	25.0	31	31	387 MG/mo	387 MG/mo	2,375 AF/mo
Sep	30	32.1	5.8	13.2	13.2	26.3	13.2	13.2	26.3	30	30	395 MG/mo	395 MG/mo	2,422 AF/mo
Oct	31	32.1	4.0	14.0	14.0	28.1	14.0	14.0	28.1	31	31	436 MG/mo	436 MG/mo	2,673 AF/mo
Nov	30	32.1	3.1	14.5	14.5	29.0	14.5	14.5	29.0	30	30	435 MG/mo	435 MG/mo	2,669 AF/mo
Dec	31	32.1	2.2	14.9	14.9	29.9	8.2	12.1	20.2	17	25	254 MG/mo	374 MG/mo	1,926 AF/mo
Average		**32.1**	**4.5**	**13.8**	**13.8**	**27.7**	**11.0**	**12.6**	**23.6**					
Total	**365**									**295**	**335**	**4,013** MG/yr	**4,602** MG/yr	**26,441 AFY**

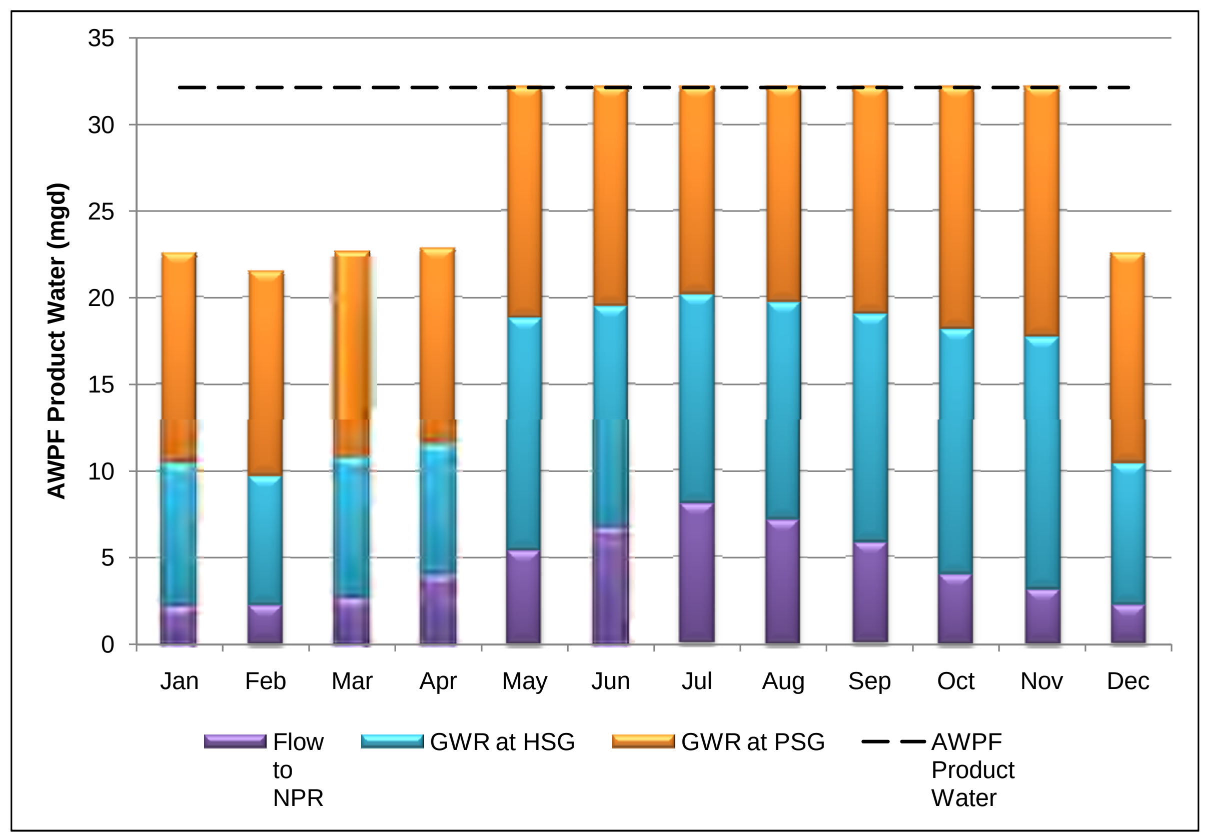
Notes:

2) Applied AWPF offline factor.

3) Before applying spreading grounds downtimes.

4) After applying spreading grounds downtimes.

5) Monthly spreading amounts (maximum flows available for GWR * no. of days of operation).



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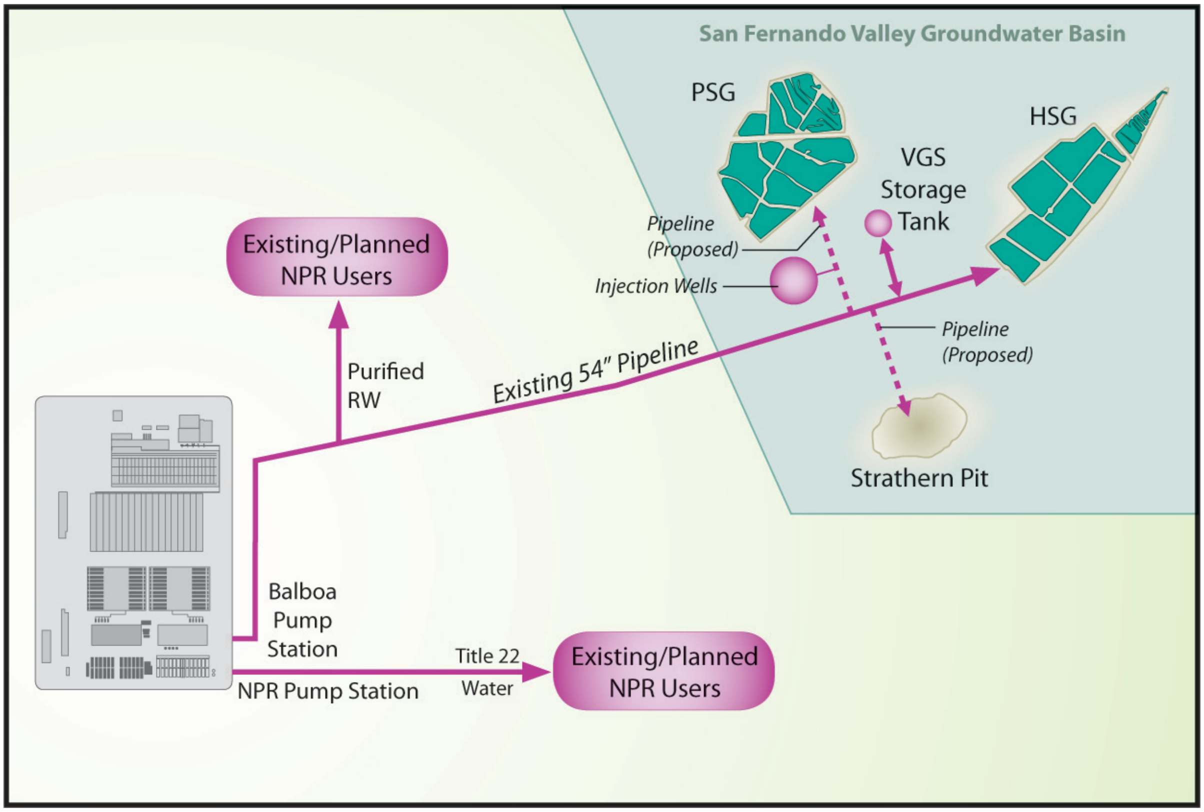
3.1.3 Phase 2 Option B

As with Phase 2 Option A, the goal is to recharge an annual average volume of 30,000 AFY of AWPF product water. In addition to the use of HSG and PSG, Option B adds the use of injection wells and/or Strathern Pit to recharge the product water (**Figure 3-11**).

Figure 3-11: Schematic of Conveyance Facilities to Deliver 30,000 AFY from AWPF to HSG, PSG, and Injection Wells and/or Strathern Pit (Phase 2 Option B)



3.1.3.1 System Flows and Operating Conditions

The injection wells will be used only during the rainy season and the wettest years when HSG and PSG are being used exclusively for stormwater spreading and are, therefore, not available for recycled water spreading. It is anticipated that under such conditions, LACDPW could require LADWP to stop sending any AWPF product water to the either or both spreading grounds for periods of time ranging from a few days to several weeks or longer depending upon rainfall and runoff conditions in the upstream watersheds including water stored behind the upstream dams. Therefore, the injection wells will be designed for the full capacity of the AWPF at 35.0 mgd so that for any day or extended periods that the basins are not available the full output capacity of the AWPF could be delivered to the wells to maximize groundwater replenishment and an annual average of 30,000 AF can be achieved. The system flows and operation conditions for the injection wells are summarized in **Table 3-4**.

The capacity for individual wells was estimated at 4.2 cfs or approximately 50% of the capacity of the larger production wells at the Tujunga well field. For this analysis, no redundant or standby wells were included because it is not essential that the system be 100% reliable at all times. This assumption can be further evaluated at a later time.

Table 3-4: System Flows and Operating Conditions

Text	Text
Total Injection Capacity	35.0 mgd
Operational Capacity per Well	2.7 mgd; 4.2 cfs
No. of Wells	12
Operating Conditions	Standby under normal conditions. To be used when HSG/PSG are not available for recycled water spreading.
Expected Use During a Wet Year [1]	Approximately 4,000 AFY

Note:

1. Assumes HSG will not be available 70 days and PSG will not be available 30 days during a wet year.

An important consideration with respect to introducing injection wells is question of meeting blend requirements under the draft CDPH regulations. Projects using AWPF treated recycled water can start at maximum RWC of 50%. Under these requirements, it would be possible to inject 100% recycled water into the wells whenever the spreading basins are not available, and inject an equivalent amount of treated potable water into the wells to achieve a 50/50 blend on a seasonal or annual basis during spring and fall months or during extended dry periods in the winter time when recycled water can be delivered to the basins. Therefore no additional infrastructure has been included to accommodate blend water. Further discussion is provided in Section 3.4.

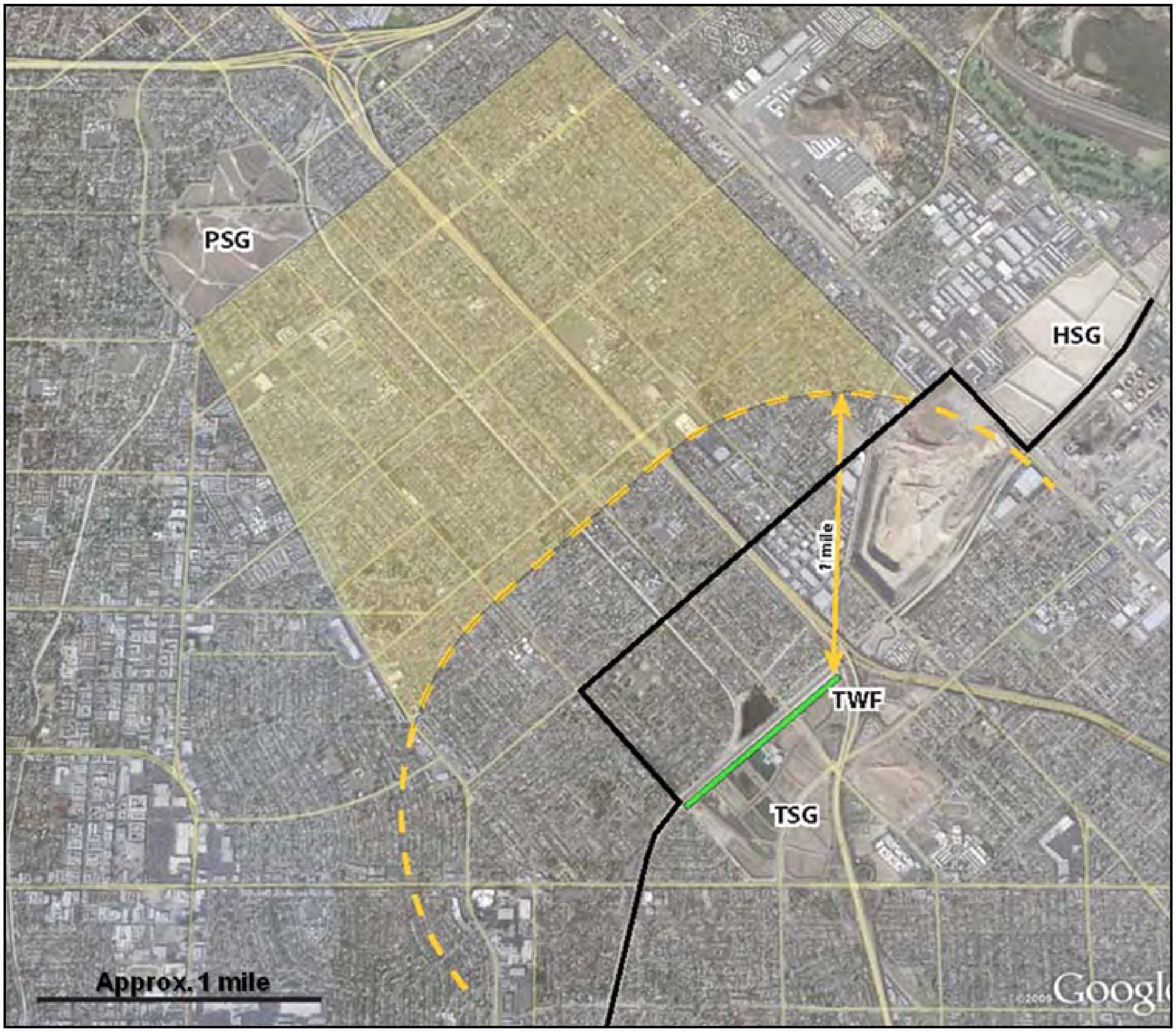
3.1.3.2 Injection Well Site Locations

The potential sites for injection wells considered the following:

- Closest well approximately 1 mile away from TSG Tujunga Well Fields to provide adequate retention time with some safety factor,
- Close proximity to one of the proposed alignments of the recycled water pipeline to PSG,
- Availability of City-owned land or right-of-way where possible, and
- Maintain adequate clearance due to electrical requirements.

Based on these criteria, the potential zone for injection wells is shown in **Figure 3-12**.

Figure 3-12: Potential Zone for Injection Wells

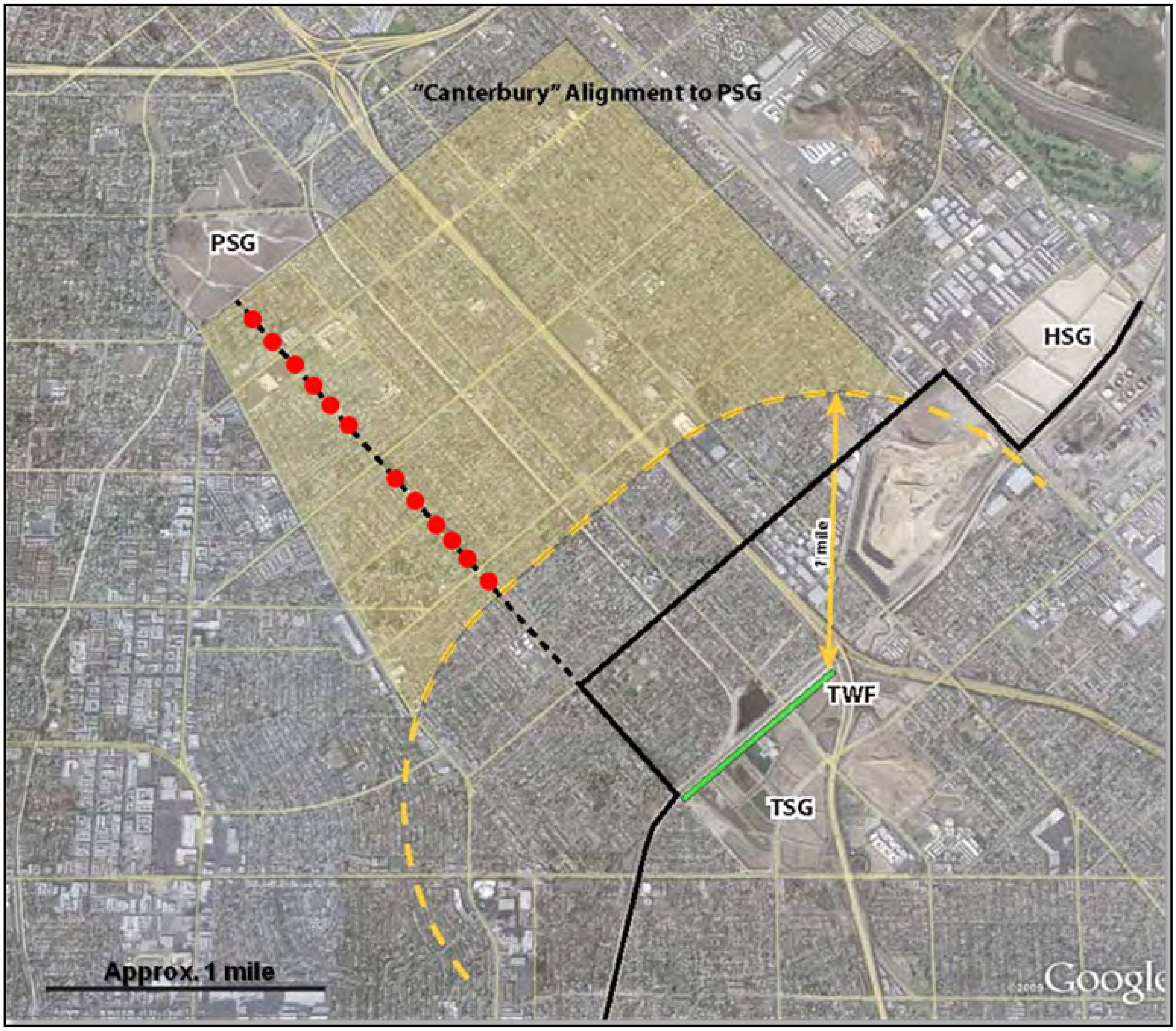


The following alignments were considered for the connecting pipeline to the PSG:

- LACFCD Channel Alternative
- Canterbury Avenue Alternative
- Woodman Avenue Alternative
- Van Nuys Boulevard Alternative

Based on the evaluation of traffic congestion, constructability, and cost, the alignment along Canterbury Avenue was found to be most feasible. **Figure 3-13** shows potential sites for injection wells along Canterbury Avenue alignment to PSG.

Figure 3-13: Potential Sites for Injection Wells along Canterbury Avenue Alignment to PSG



City-Owned Right-of-Way under Electrical Transmission Lines

One of the benefits of Canterbury Avenue alignment is that there is substantial City-owned right-of-way (ROW) adjacent to the Canterbury Avenue alignment to accommodate DWP-owned electrical transmission lines. For this evaluation it is assumed that using City-owned ROW will make the siting of injection wells easier. However, the following must be considered when siting injection wells below electrical transmission lines:

- Vertical and horizontal clearances must be maintained to keep construction outside of the drip line. Voltage and line conductor survey will determine required clearance distances.
- Clearances must be maintained from legs of transmission towers.
- Underground transmission lines and utilities must be considered.

- Wellhead facilities inside below-ground vaults are preferred to above-ground wellhead facilities.
- Lease/license agreements must be obtained. Existing leases for community gardens must be considered.

3.1.3.3 Conceptual Design

The diameter of the injection well is dependent upon the following:

- The anticipated injection rate; and
- The method of maintenance anticipated to be used in the future, such as the installation of a permanent or temporary pump for periodic redevelopment.

A 20-inch casing diameter well is recommended because the 20-inch diameter adds future flexibility to add pumps, liners, and other appurtenances. The borehole is recommended to be 4 to 5 inches greater in outside diameter than the casing diameter. A variation to the design would be to install 20-inch diameter casing in the upper portion of the well (where a future pump may be installed) and reduce the diameter to the casing/screen to 16-inches to the bottom of the well.

Type 304 stainless steel or fiberglass reinforced plastic (FRP) are recommended to be installed in the upper portion of the well above the screened section. Type 316L casing/screen is recommended to be installed in the well in the screened area (both screen and blank sections) for cathodic protection to minimize corrosion potential and extend the life of the well. The wall thickness of the casing will be determined during the design phase of the project.

A 3-inch diameter tube will be installed in the annulus between the borehole wall and the casing so that additional gravel may be added to the annulus in the future, if needed. A 3-inch diameter sounding/camera port will be installed into the well casing at a depth above the well screen. This tube will be used to install transducers for water level measurement and control and to obtain manual water levels, inject compressed air into the well to perform periodic well purging (redevelopment), and provide access to a camera or other tools so that the down hole valve or future pumps would not have to be removed. The tubing will be compatible with the well casing.

The preliminary design criteria for the injection wells are summarized in **Table 3-5**. Permitting considerations for injection wells are discussed the Regulatory Assessment TM.

Table 3-5: Conceptual Design Criteria

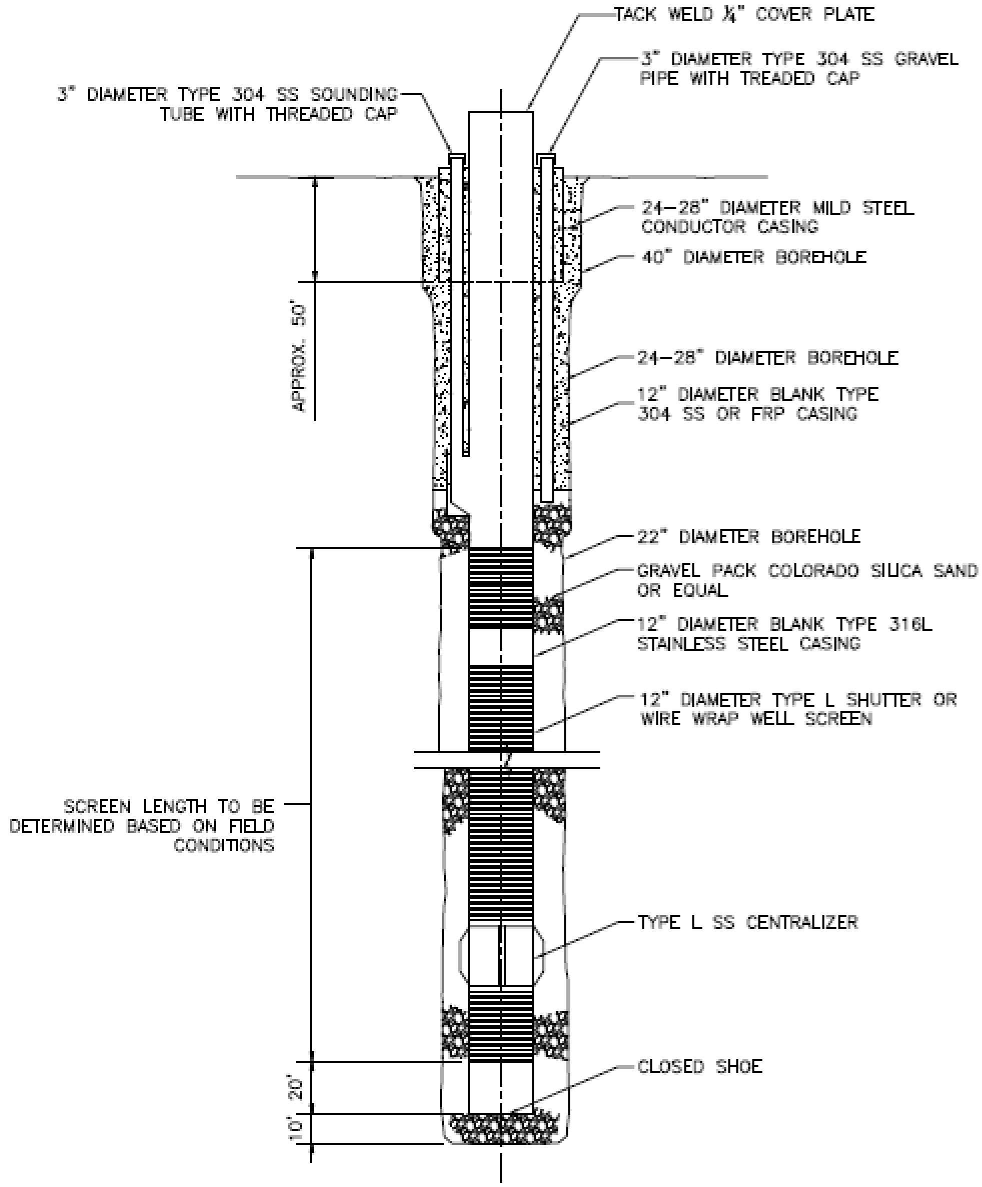
Total No. of Wells	12
Operational Capacities per Well	2.7 mgd; 4.2 cfs
Diameter	16 - 20 inch
Ground Elevation	865 to 915 ft mean sea level
Screen Intervals	To be determined
Well Depth	500 to 600 ft below ground surface
Well Type	Cluster Injection Well
Drilling Method	TBD
Well Construction Materials	
Casing Materials	Stainless steel or FRP
Well Screens	316L continuous slot or 316L shutter screen
Sealing Materials	TBD
Gravel Pack Materials	TBD

A typical injection well design is shown in **Figure 3-14**.

The wellhead facilities will serve cluster type wells. The cluster type wellhead facilities will include both above- and below-ground configurations. The cluster wells consist of individual wells situated close together, but not in the same borehole. Each well within a cluster will inject water into different aquifers. A typical above ground configuration will be located in a fenced area, while the below ground configuration will be a vault.

Typical injection well site layouts are shown in **Figures 3-15 and 3-16**. In general, a single above ground wellhead site would occupy an area of about 15 ft by 30 ft, and a below-ground vault would require about 10 ft by 15 ft. Where two or three wells are clustered together, the wells should be spaced a minimum of 15 to 20 ft apart to minimize drilling interferences and allow enough room for well head facilities.

Figure 3-14: Schematic of Typical Injection Wells



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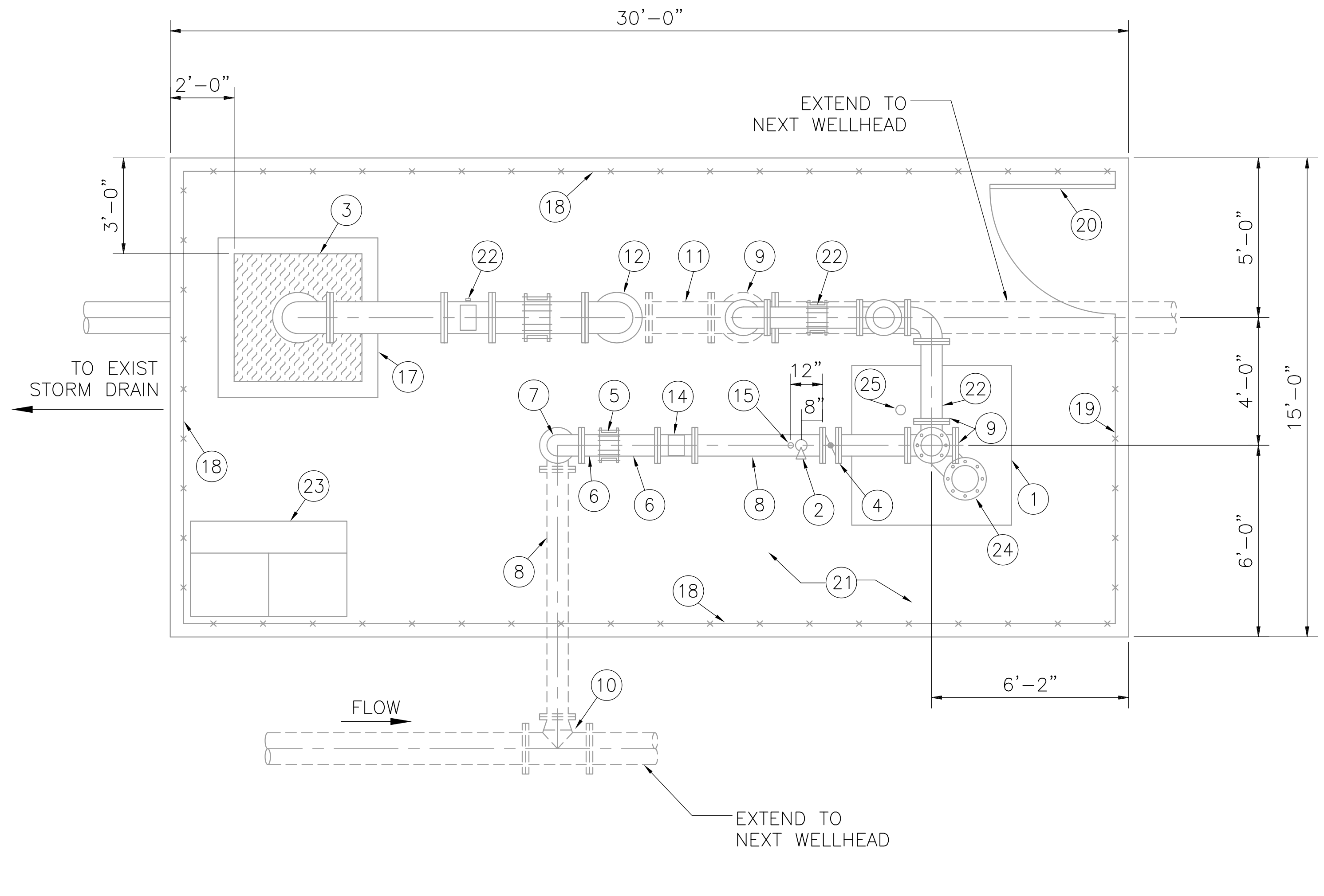
CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION



PLAN
3/8"=1'–0"

ITEM	TABLE 5–3 EQUIPMENT LIST
1	WELL HEAD PAD
2	1/2" HOSE BIBB
3	ALUMINUM DIAMOND PLATE COVER
4	8" BUTTERFLY VALVE
5	8" GROOVED COUPLING W/ JOINT HARNESS
6	8" PIPE: FLANGED x GROOVED
7	8" FLANGED 90° BEND
8	8" PIPE: FLANGED X FLANGED
9	8" BLIND FLANGE
10	12" x 8" FLANGED REDUCING TEE
11	12" PIPE: CML&C FLANGED x FLANGED
12	NOT USED
13	ADJUSTABLE PIPE SUPPORT
14	8" V–CONE FLOW METER AND TRANSMITTER
15	PRESSURE GAUGE AND TRANSMITTER
16	2" AIR RELEASE AND VACUUM RELIEF VALVE
17	4'–0" x 4'–0" PRE–CAST CONCRETE DRAIN BOX, DEPTH AS REQUIRED
18	6' HIGH REMOVEABLE FENCE PLANELS
19	6' HIGH FIXED FENCE
20	4'–0" WIDE PEDESTRIAN GATE
21	REINFORCED CONC. SLAB
22	RUTURE IMPROVEMENTS (IF PUMP IS INSTALLED IN WELL)
23	ELECTRICAL AND TELEMETRY PANEL
24	10" BLOW–OFF PIPE
25	3" AIR / CAMERA PORT

NOTES:

1. DISCHARGE AND PIPING ARRANGEMENTS, SLAB SIZE AND DRAINAGE, WILL VARY DEPENDING ON SITE CONDITIONS.
2. SLOPE SLAB TO DRAIN TO CATCH BASIN.

3/8" = 1'– 0"
2 0 2 4

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0" 1"
VERIFY SCALES
BAR IS ONE INCH LONG ON FULL SIZE DRAWING. IF NOT ONE INCH LONG ON THIS DRAWING, ADJUST SCALES ACCORDINGLY

LA DWP | CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS | RMC in association with CDM Smith

REV	DATE	BY	APVD	DESCRIPTION

DESIGNED XX
DRAWN XX
CHECKED XX

SUBMITTED: RMC PROJ ENGR C____
APPROVED: RMC ENGR C____

CITY OF LOS ANGELES - GWR MASTER PLANNING DOCUMENT

WELLHEAD FACILITIES

FIG NO 3-15
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PROJ NO 86538-71984
DATE MARCH 2012

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CONCEPTUAL DESIGN
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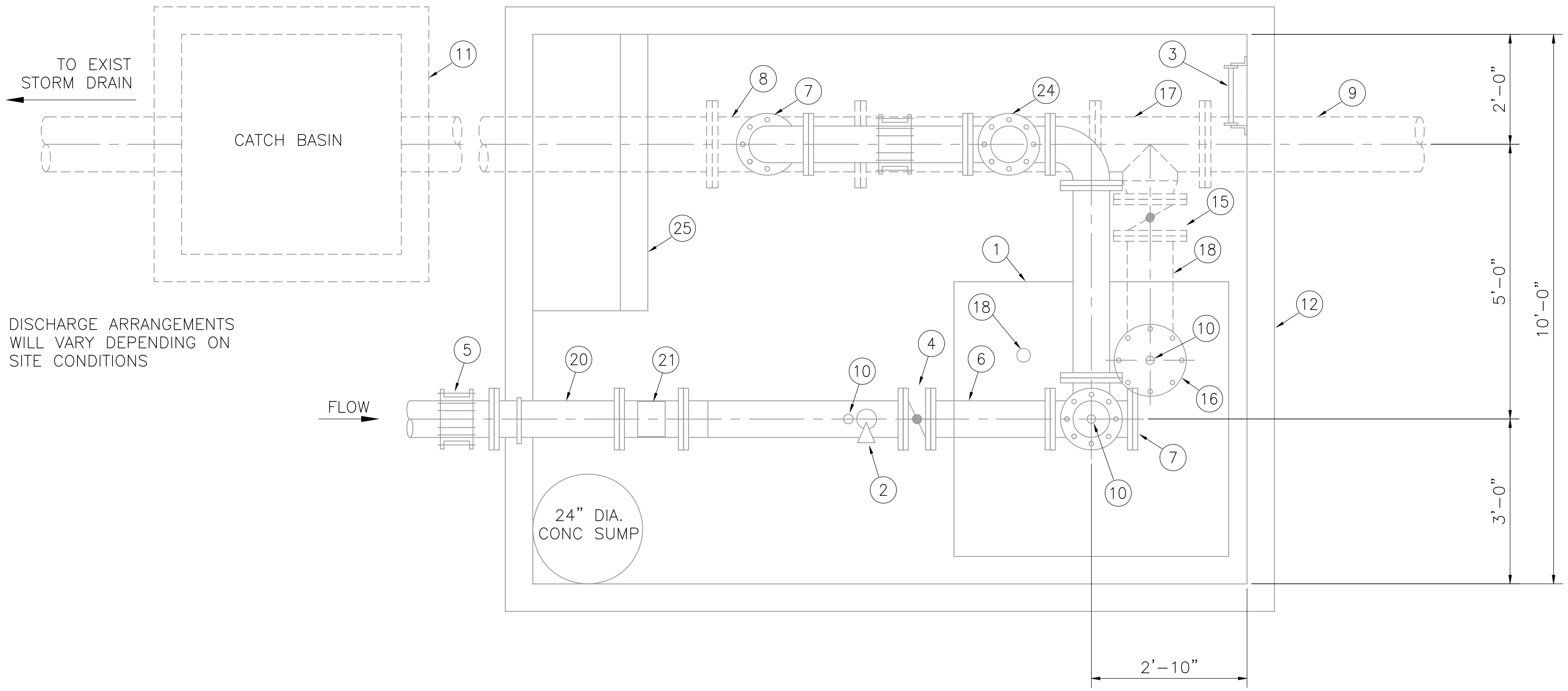

PLAN
3/4"=1'-0"

ITEM	TABLE 5-3 EQUIPMENT LIST
1	WELL HEAD PAD
2	1/2" HOSE BIBB
3	ALUMINUM LADDER
4	8" BUTTERFLY VALVE
5	DRESSER COUPLING
6	8" PIPE: FLANGED X FLANGED
7	8" BLIND FLANGE
8	12" x 8" FLANGED REDUCING TEE
9	12" PIPE: CML&C FLANGED x FLANGED
10	2" AIR RELEASE AND VACUUM RELIEF VALVE
11	4'-0" x 4'-0" PRE-CAST CONCRETE DRAIN BOX, DEPTH AS REQUIRED
12	REINFORCED CONC. VAULT
13	FUTURE IMPROVEMENT
14	ELECTRICAL AND TELEMETRY PANEL
15	10" BUTTERFLY VALVE
16	10" BLOW-OFF PIPE
17	12"x10" REDUCING TEE
18	10" PIPE: CML&C FLANGED x PE
19	3" AIR / CAMERA PORT
20	8" WATER STOP WALL PIPE
21	8" V-CONE FLOW METER AND TRANSMITTER

3/4" = 1'- 0"
1 0 1 2

VERIFY SCALES
BAR IS ONE INCH LONG ON FULL SIZE DRAWING. IF NOT ONE INCH LONG ON THIS DRAWING, ADJUST SCALES ACCORDINGLY

LA DWP | CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS | RMC in association with CDM Smith

REV	DATE	BY	APVD	DESCRIPTION

DESIGNED XX
DRAWN XX
CHECKED XX

SUBMITTED: RMC PROJ ENGR C____
APPROVED: RMC ENGR C____

CITY OF LOS ANGELES - GWR MASTER PLANNING DOCUMENT

WELLHEAD FACILITIES
IN VAULT

FIG NO 3-16
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PROJ NO 86538-71984
DATE MARCH 2012

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Conveyance Facilities

In addition to the injection well information provided above, the facility improvements to HSG and PSG mentioned in Section 3.1.2 will also be required in for Phase 2 Option B.

Operational Strategy

As in Phase 1, the operation of the GWR at the HSG and PSG is governed by both the availability of AWPF product water and the capacity of the spreading grounds to percolate the AWPF product water. The capacity of HSG and PSG to accept and recharge AWPF product water is dependent on LACDPW's operations to capture and recharge native stormwater. A discussion of existing and future recharge conditions at HSG and PSG is provided in Section 2.

Spreading Basin Availability

As with Phase 2 Option A, there will be periods when the spreading grounds are unavailable for the recharge of recycled water. LACDPW has indicated that HSG could be unavailable for 70 days per year and PSG for 30 days per year. It is assumed that the injection wells will be available for use whenever needed.

Figure 3-17 is the same as Figure 3-5 in Section 3.1.2 with the exception of the additional recycled water that is able to be recharged in the injection wells and/or Strathern Pit. The figure shows the average monthly mass balance if the 70 days of HSG and 30 days of PSG unavailability are assumed to occur during the winter months of December through April.

3.1.3.5 Strathern Pit

Strathern Pit is a former gravel mining pit and inert materials landfill that may potentially be used for AWPF product water recharge if necessary to achieve the GWR goal of 30,000 AFY. The proposed Strathern Pit Multi-Use Project will consist of stormwater capture and treatment facilities within the bounds of the 46-acre Strathern Pit site, formerly used as a gravel pit and construction debris landfill. This is a BOS and LACDPW Flood Control District joint project, identified in the Sun Valley Watershed Management Plan (LACDPW, 2004). The project site, located south of the Golden State Freeway (Interstate 5) in the community of Sun Valley, is bounded by Strathern Street on the south, Tujunga Avenue on the west, Roscoe Boulevard on the north and Fair Avenue on the east.

The Strathern Pit Multi-use Project will construct detention ponds and wetlands to store and treat stormwater runoff. The treated flows will then be pumped to the adjacent Sun Valley Park for infiltration in two underground basins with a total of 7 AF of storage. The project will also provide habitat restoration and recreational opportunities. It is estimated that the proposed Strathern Pit Multi-use Project will capture and treat approximately 895 AFY of dry and wet urban weather runoff, primarily during 5 months of the year (LACFCD and LABOS, 2006). The captured runoff would also support the wetlands when runoff is low or nonexistent.

Purified recycled water from the AWPF may potentially be supplied to the Strathern Pit along with injection wells if these facilities are necessary to achieve the GWR goal of 30,000 AFY. If necessary, AWPF product water would be conveyed to Strathern Pit in a lateral from the existing 54-inch-diameter pipeline from DCTWRP toward HSG. The sizing and alignments have not yet been identified, but the water would be conveyed in buried pipelines constructed under existing paved streets.

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Figure 3-17

AWPF Capacity and GWR Capability Monthly Flow Chart

Phase 2 Option B - Spreading at HSG and PSG, Supplemented by Injection Wells - SG Downtimes in Winter Months Only

AWPF Capacity: 35.0 mgd

Total GWR: 31,000 AFY

AWPF		
Phase 1 Capacity (min)[1]	23.4	mgd
Phase 2 Capacity	35.0	mgd
Stage	Phase 2	
AWPF Recovery	79%	
Plant Capacity	35	mgd
Downtime	30	days/year
Online Factor	92%	
Offline Factor	8%	
Downtime	**Y/N**	**day/mo**
Jan	Y	2.5
Feb	Y	2.5
Mar	Y	2.5
Apr	Y	2.5
May	Y	2.5
Jun	Y	2.5
Jul	Y	2.5
Aug	Y	2.5
Sep	Y	2.5
Oct	Y	2.5
Nov	Y	2.5
Dec	Y	2.5
		30

NPR		
Existing/Tier 1	5,010	AFY
Existing/Tier 1	4.5	mgd
Max Tier 2	0	AFY
Max Tier 2	0.0	mgd
Total	5,010	AFY
Total	4.5	mgd
Peaking Factor		
Jan	0.5	
Feb	0.5	
Mar	0.6	
Apr	0.9	
May	1.2	
Jun	1.5	
Jul	1.8	
Aug	1.6	
Sep	1.3	
Oct	0.9	
Nov	0.7	
Dec	0.5	

HSG		
% of GWR	50%	
Downtime	10	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	2.0
Feb	Y	2.0
Mar	Y	2.0
Apr	Y	2.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	2.0
		10

PSG		
% of GWR	50%	
Downtime	5	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	1.0
Feb	Y	1.0
Mar	Y	1.0
Apr	Y	1.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	1.0
		5

Notes:

1) While the minimum Phase 1 AWPF capacity is 23.4 mgd, the recommended AWPF design capacity for Phase 1 is 25 mgd. See Section 5 for more information.

Month	No. of Days in Month	AWPF Product Water	Flow to NPR	Max Flow Available for GWR			Average Flows to Spreading Grounds			Remaining Flow for Injection
				HSG	PSG	Total	HSG	PSG	Total	
	days	mgd (Note 2)	mgd	mgd (Note 3)	mgd (Note 3)	mgd (Note 3)	mgd (Note 4)	mgd (Note 4)	mgd (Note 4)	mgd
Jan	31	32.1	2.2	14.9	14.9	29.9	14.0	14.5	28.4	1.4
Feb	28	32.1	2.2	14.9	14.9	29.9	13.9	14.4	28.3	1.6
Mar	31	32.1	2.7	14.7	14.7	29.4	13.8	14.2	28.0	1.4
Apr	30	32.1	4.0	14.0	14.0	28.1	13.1	13.6	26.7	1.4
May	31	32.1	5.4	13.4	13.4	26.8	13.4	13.4	26.8	0.0
Jun	30	32.1	6.7	12.7	12.7	25.4	12.7	12.7	25.4	0.0
Jul	31	32.1	8.1	12.0	12.0	24.1	12.0	12.0	24.1	0.0
Aug	31	32.1	7.2	12.5	12.5	25.0	12.5	12.5	25.0	0.0
Sep	30	32.1	5.8	13.2	13.2	26.3	13.2	13.2	26.3	0.0
Oct	31	32.1	4.0	14.0	14.0	28.1	14.0	14.0	28.1	0.0
Nov	30	32.1	3.1	14.5	14.5	29.0	14.5	14.5	29.0	0.0
Dec	31	32.1	2.2	14.9	14.9	29.9	14.0	14.5	28.4	1.4
Average		**32.1**	**4.5**	**13.8**	**13.8**	**27.7**	**13.4**	**13.6**	**27.0**	**0.6**
Total	**365**									

GWR Operations								
Operation Period			Spreading Grounds			Injection Wells		Total
HSG days	PSG days	Wells days	HSG (Note 6)	PSG (Note 6)	Total (Note 6)	Wells	Total	AF/mo
29	30	2	433 MG/mo	448 MG/mo	2,706 AF/mo	45 MG/mo	138 AF/mo	2,843 AF/mo
26	27	2	389 MG/mo	403 MG/mo	2,431 AF/mo	45 MG/mo	138 AF/mo	2,568 AF/mo
29	30	2	427 MG/mo	442 MG/mo	2,665 AF/mo	44 MG/mo	136 AF/mo	2,801 AF/mo
28	29	2	393 MG/mo	407 MG/mo	2,458 AF/mo	42 MG/mo	129 AF/mo	2,587 AF/mo
31	31	0	415 MG/mo	415 MG/mo	2,545 AF/mo	0 MG/mo	0 AF/mo	2,545 AF/mo
30	30	0	381 MG/mo	381 MG/mo	2,340 AF/mo	0 MG/mo	0 AF/mo	2,340 AF/mo
31	31	0	373 MG/mo	373 MG/mo	2,290 AF/mo	0 MG/mo	0 AF/mo	2,290 AF/mo
31	31	0	387 MG/mo	387 MG/mo	2,375 AF/mo	0 MG/mo	0 AF/mo	2,375 AF/mo
30	30	0	395 MG/mo	395 MG/mo	2,422 AF/mo	0 MG/mo	0 AF/mo	2,422 AF/mo
31	31	0	436 MG/mo	436 MG/mo	2,673 AF/mo	0 MG/mo	0 AF/mo	2,673 AF/mo
30	30	0	435 MG/mo	435 MG/mo	2,669 AF/mo	0 MG/mo	0 AF/mo	2,669 AF/mo
29	30	2	433 MG/mo	448 MG/mo	2,706 AF/mo	45 MG/mo	138 AF/mo	2,843 AF/mo
355	**360**	**10**	**4,896 MG/yr**	**4,970 MG/yr**	**30,280 AFY**		**678 AFY**	**30,958 AFY**

Notes:

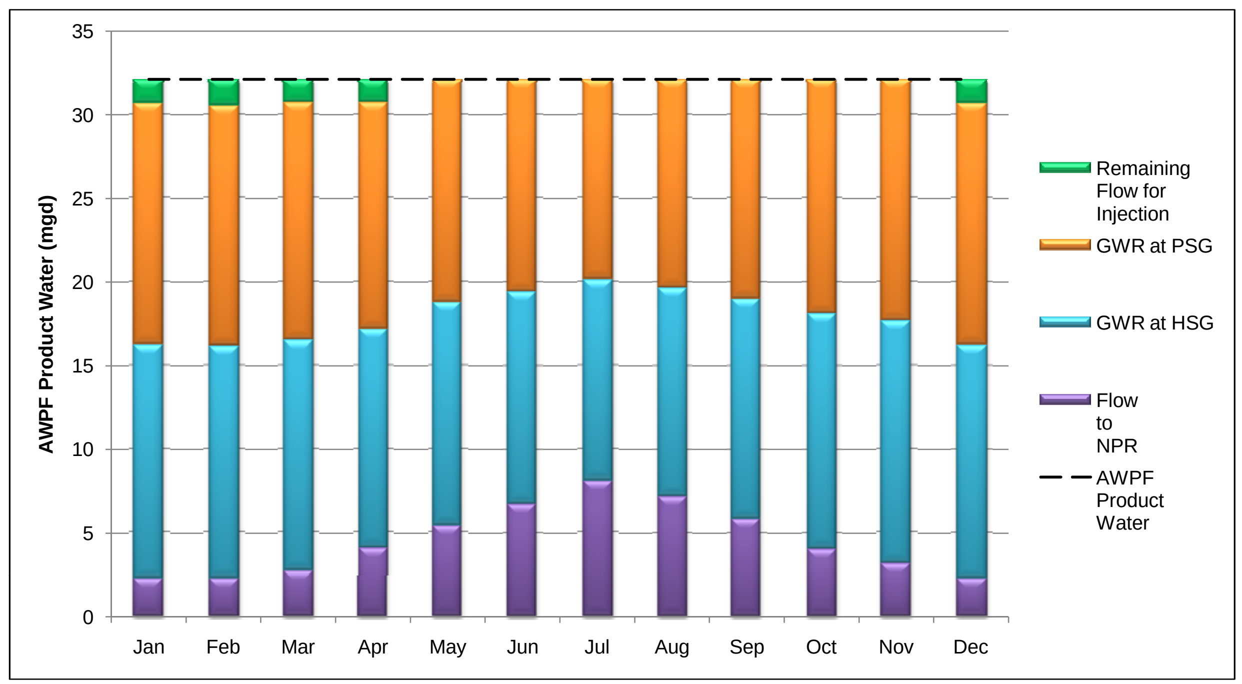
2) Applied AWPF offline factor.

3) Before applying spreading grounds downtimes.

4) After applying spreading grounds downtimes.

5) Actual number of days of operation will vary depending on ability to send flows to PSG.

6) Monthly spreading amounts (maximum flows available for GWR * no. of days of operation).



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3.2 Numerical Simulation

Several simulations were developed using the current version of the SFBGM (recently used for ULARA Watermaster work) to assess the potential impacts of the proposed Phase 1 and Phase 2 projects. The existing structure (e.g., grid, layers, hydraulic properties, etc.) of the SFBGM was not modified. The model simulations were run for a 20-year transient simulation period beginning in WY 2009-10 (except as noted below). The main differences between the simulations for Phase 1 and Phase 2 involves the pumping and recharge assignments as discussed below.

3.2.1 Phase 1

Recharge

Table 3-6 shows the groundwater recharge assignments for the SFBGM. Recharge includes both recycled water and stormwater runoff that is predominantly runoff from two major watersheds in the nearby San Gabriel Mountains, plus limited amounts of recharge from urbanized areas in the northeast portion of the San Fernando Valley above the spreading grounds. A constant annual volume of 15,000 AF of recycled water is assumed to be recharged at the HSG. The long term average volume of native water that is projected to be recharged at the HSG, PSG, and the TSG is based on historical records and increased over historical values to account for on-going and recently completed capital improvements to the spreading grounds and diversion facilities. These capital improvements will allow greater volumes of stormwater runoff to be retained and recharged in the future.

Pumping

Groundwater pumping assignments applied in the SFBGM are shown in **Table 3-7**. A description of the rationale for these assignments can be found in the ULARA Watermaster's "Groundwater Pumping and Spreading Plan, 2010-2015 Water Years" (2011b). The assignments include planned operations, including the City's reduction in pumping while the Centralized Purification Project is constructed and comes online. The 107,000 AFY of LADWP pumping includes an increase of 15,000 AFY to account for the additional recycled water recharge that is planned under Phase 1. The direct increase in water supply pumping due to the additional recycled water is based on LADWP's modeling assumptions as those assumptions described in the Pumping and Spreading Plan.

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Table 3-6: Groundwater Recharge Assignments in SFBGM Simulation, Phase I

Water Year	Rainfall		Basin Recharge																Total
			Percolation			Hill & Mountain	Spreading Grounds								Sub-Surface Inflow				
								Hansen											
	Valley	Hill & Mountain	Valley Fill	Return Water	Sub-total		Branford	Native	Recycled	Total	Lopez	Pacoima	Tujunga	Sub-total	Pacoima (Notch)	Sylmar (Notch)	Verdugo	Sub-total	
2009-10	16.46	19.56	11,435	53,516	64,951	3,341	394	15,408	0	15,408	172	4,957	8,774	29,705	350	400	70	820	98,817
2010-11	18.07	22.47	12,553	54,347	66,900	3,838	540	11,000	0	11,000	540	6,864	7,534	26,478	350	400	70	820	98,036
2011-12	18.07	22.47	12,553	54,347	66,900	3,838	540	18,534	0	18,534	540	6,864	0	26,478	350	400	70	820	98,036
2012-13	18.07	22.47	12,553	54,347	66,900	3,838	540	18,534	0	18,534	540	6,864	0	26,478	350	400	70	820	98,036
2013-14	18.07	22.47	12,553	54,347	66,900	3,838	540	11,000	0	11,000	540	6,864	7,534	26,478	350	400	70	820	98,036
2014-15	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	10,635	35,933	350	400	70	820	107,491
2015-16	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	10,635	35,933	350	400	70	820	107,491
2016-17	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	10,635	35,933	350	400	70	820	107,491
2017-18	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	10,635	35,933	350	400	70	820	107,491
2018-19	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	10,635	35,933	350	400	70	820	107,491
2019-20	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2020-21	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2021-22	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2022-23	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2023-24	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2024-25	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2025-26	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2026-27	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2027-28	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
2028-29	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	10,635	50,933	350	400	70	820	122,491
Total	**360**	**446**	**249,942**	**1,086,109**	**1,336,051**	**76,263**	**10,654**	**321,526**	**150,000**	**471,526**	**10,432**	**148,633**	**183,367**	**824,612**	**7,000**	**8,000**	**1,400**	**16,400**	**2,253,326**

Table 3-7: Groundwater Pumping Assignments in SFBGM Simulation, Phase I

Water Year	LADWP										Burbank			Glendale			Others		Total Extraction
	AE	EW	NH (West)	NH (East)	PO	RT	TJ	VD	WH	Total LADWP	Burbank PSD	Lockheed	Non-Burbank (VMP)	City of Glendale	Glendale OU - North	Glendale OU - South	Total (Non-LADWP)	Total (Non-Glendale [F. Lawn])	
2009-10	-1,357	-1,194	-10,612	0	-2,634	-16,935	-13,697	-1,728	-4,700	-52,857	0	-9,955	-300	-5	-4,745	-2,555	-1,818	-400	-72,635
2010-11	-1,380	-1,196	-6,172	0	-1,994	-7,099	-23,963	-2,549	-4,652	-49,005	0	-11,026	-300	-20	-4,745	-2,555	-1,818	-400	-69,869
2011-12	-1,937	0	-4,367	0	-2,178	-6,550	-15,674	-2,687	-8,607	-42,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-62,564
2012-13	-1,937	0	-2,967	0	-2,178	-4,451	-15,674	-2,687	-5,106	-35,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-55,564
2013-14	-1,937	0	-1,567	0	-2,178	-2,350	-15,674	-2,553	-1,741	-28,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-48,564
2014-15	-1937	0	-1211	0	-2,178	0	-15674	0	0	-21,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-41,005
2015-16	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2016-17	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2017-18	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2018-19	-4,923	0	-10,155	-5,620	-2,178	-15234	-25389	0	0	-63,499	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-83,504
2019-20	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2020-21	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2021-22	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2022-23	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2023-24	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2024-25	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2025-26	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2026-27	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2027-28	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
2028-29	-4,923	0	-30,890	-5,620	-2,178	-32,492	-30,897	0	0	-107,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-127,005
Total	**-64,638**	**-2,390**	**-345,951**	**-61,820**	**-43,832**	**-377,539**	**-481,737**	**-12,204**	**-24,806**	**-1,414,917**	**0**	**-206,489**	**-5,100**	**-460**	**-94,900**	**-51,100**	**-36,360**	**-8,000**	**-1,817,326**

3.2.2 Phase 2 Option A

Recharge

Table 3-8 shows the groundwater recharge assignments. A constant volume annual of 30,000 AF of recycled water is assumed to be split evenly and recharged at the HSG and PSG. Recharge targets shoul include at 120 month moving average. The long term average volume of native water recharge is the same as in the Phase 1 simulation.

Pumping

Groundwater pumping assignments applied in the SFBGM are shown in **Table 3-9**. The 107,000 AFY of LADWP pumping simulated in Phase 1 was increased by 15,000 AFY (to 122,000 AFY) to account for the increase in recycled water recharge in Phase 2.

3.2.3 Phase 2 Option B

Recharge

Table 3-10 shows the groundwater recharge assignments. A constant volume annual of 26,000 AF of recycled water is assumed to be split evenly and recharged at the HSG and PSG. An additional 4,000 AFY is assumed to be recharged at the injection wells. Therefore, the total volume of recycled water that is recharged would be 30,000 AFY, the same as Option A. The long term average volume of native water recharge is the same as in the Phase 1 simulation.

Pumping

Groundwater pumping assignments applied in the SFBGM are shown in **Table 3-11**. These values are the same as for Option A.

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Table 3-8: Groundwater Recharge Assignments in SFBGM Simulation, Phase II Option A

Water Year	Rainfall		Basin Recharge																		Total
			Percolation			Hill & Mountain	Spreading Grounds										Sub-Surface Inflow				
								Hansen			Lopez	Pacoima			Tujunga	Sub-total	Pacoima (Notch)	Sylmar (Notch)	Verdugo	Sub-total	
	Valley	Hill & Mountain	Valley Fill	Return Water	Sub-total		Branford	Native	Recycled	Total		Native	Recycled	Total							
2009-10	16.46	19.56	11,435	53,516	64,951	3,341	394	15,408	0	15,408	172	4,957	0	4,957	8,774	29,705	350	400	70	820	98,817
2010-11	18.07	22.47	12,553	54,347	66,900	3,838	540	11,000	0	11,000	540	6,864	0	6,864	7,534	26,478	350	400	70	820	98,036
2011-12	18.07	22.47	12,553	54,347	66,900	3,838	540	18,534	0	18,534	540	6,864	0	6,864	0	26,478	350	400	70	820	98,036
2012-13	18.07	22.47	12,553	54,347	66,900	3,838	540	18,534	0	18,534	540	6,864	0	6,864	0	26,478	350	400	70	820	98,036
2013-14	18.07	22.47	12,553	54,347	66,900	3,838	540	11,000	0	11,000	540	6,864	0	6,864	7,534	26,478	350	400	70	820	98,036
2014-15	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	35,933	350	400	70	820	107,491
2015-16	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	35,933	350	400	70	820	107,491
2016-17	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	35,933	350	400	70	820	107,491
2017-18	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	35,933	350	400	70	820	107,491
2018-19	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	35,933	350	400	70	820	107,491
2019-20	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2020-21	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2021-22	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2022-23	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2023-24	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2024-25	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2025-26	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2026-27	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2027-28	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
2028-29	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	15,000	31,470	540	7,748	15,000	22,748	10,635	65,933	350	400	70	820	137,491
Total	**360**	**446**	**249,942**	**1,086,109**	**1,336,051**	**76,263**	**10,654**	**321,526**	**150,000**	**471,526**	**10,432**	**148,633**	**150,000**	**298,633**	**183,367**	**974,612**	**7,000**	**8,000**	**1,400**	**16,400**	**2,403,326**

Table 3-9: Groundwater Pumping Assignments in SFBGM Simulation, Phase II Option A

Water Year	LADWP										Burbank			Glendale			Others		Total Extraction
	AE	EW	NH (West)	NH (East)	PO	RT	TJ	VD	WH	Total LADWP	Burbank PSD	Lockheed	Non-Burbank (VMP)	City of Glendale	Glendale OU - North	Glendale OU - South	Total (Non-LADWP)	Total (Non-Glendale [F. Lawn])	
2009-10	-1,357	-1,194	-10,612	0	-2,634	-16,935	-13,697	-1,728	-4,700	-52,857	0	-9,955	-300	-5	-4,745	-2,555	-1,818	-400	-72,635
2010-11	-1,380	-1,196	-6,172	0	-1,994	-7,099	-23,963	-2,549	-4,652	-49,005	0	-11,026	-300	-20	-4,745	-2,555	-1,818	-400	-69,869
2011-12	-1,937	0	-4,367	0	-2,178	-6,550	-15,674	-2,687	-8,607	-42,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-62,564
2012-13	-1,937	0	-2,967	0	-2,178	-4,451	-15,674	-2,687	-5,106	-35,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-55,564
2013-14	-1,937	0	-1,567	0	-2,178	-2,350	-15,674	-2,553	-1,741	-28,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-48,564
2014-15	-1937	0	-1211	0	-2,178	0	-15674	0	0	-21,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-41,005
2015-16	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2016-17	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2017-18	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2018-19	-4,923	0	-10,155	-5,620	-2,178	-15234	-25389	0	0	-63,499	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-83,504
2019-20	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2020-21	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2021-22	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2022-23	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2023-24	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2024-25	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2025-26	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2026-27	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2027-28	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2028-29	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
Total	**-64,638**	**-2,390**	**-345,951**	**-61,820**	**-43,832**	**-452,539**	**-556,737**	**-12,204**	**-24,806**	**-1,564,917**	**0**	**-206,489**	**-5,100**	**-460**	**-94,900**	**-51,100**	**-36,360**	**-8,000**	**-1,967,326**

Table 3-10: Groundwater Recharge Assignments in SFBGM Simulation, Phase II Option B

Water Year	Rainfall		Basin Recharge																			
			Percolation			Hill & Mountain	Spreading Grounds											Sub-Surface Inflow				Total
								Hansen				Pacoima										
	Valley	Hill & Mountain	Valley Fill	Return Water	Sub-total		Branford	Native	Recycled	Total	Lopez	Native	Recycled	Total	Tujunga	Injection Wells	Sub-total	Pacoima (Notch)	Sylmar (Notch)	Verdugo	Sub-total	
2009-10	16.46	19.56	11,435	53,516	64,951	3,341	394	15,408	0	15,408	172	4,957	0	4,957	8,774	0	29,705	350	400	70	820	98,817
2010-11	18.07	22.47	12,553	54,347	66,900	3,838	540	11,000	0	11,000	540	6,864	0	6,864	7,534	0	26,478	350	400	70	820	98,036
2011-12	18.07	22.47	12,553	54,347	66,900	3,838	540	18,534	0	18,534	540	6,864	0	6,864	0	0	26,478	350	400	70	820	98,036
2012-13	18.07	22.47	12,553	54,347	66,900	3,838	540	18,534	0	18,534	540	6,864	0	6,864	0	0	26,478	350	400	70	820	98,036
2013-14	18.07	22.47	12,553	54,347	66,900	3,838	540	11,000	0	11,000	540	6,864	0	6,864	7,534	0	26,478	350	400	70	820	98,036
2014-15	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	0	35,933	350	400	70	820	107,491
2015-16	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	0	35,933	350	400	70	820	107,491
2016-17	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	0	35,933	350	400	70	820	107,491
2017-18	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	0	35,933	350	400	70	820	107,491
2018-19	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	0	16,470	540	7,748	0	7,748	10,635	0	35,933	350	400	70	820	107,491
2019-20	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2020-21	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2021-22	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2022-23	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2023-24	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2024-25	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2025-26	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2026-27	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2027-28	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2028-29	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2029-30	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2030-31	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2031-32	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2032-33	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2033-34	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2034-35	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2035-36	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2036-37	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2037-38	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
2038-39	18.07	22.47	12,553	54,347	66,900	3,838	540	16,470	13,000	29,470	540	7,748	13,000	20,748	10,635	4,000	65,933	350	400	70	820	137,491
Total	**540**	**671**	**375,472**	**1,629,579**	**2,005,051**	**114,643**	**16,054**	**486,226**	**260,000**	**746,226**	**15,832**	**226,113**	**260,000**	**486,113**	**289,717**	**80,000**	**1,633,942**	**10,500**	**12,000**	**2,100**	**24,601**	**3,778,237**

Table 3-11: Groundwater Pumping Assignments in SFBGM Simulation, Phase II Option B

Water Year	LADWP										Burbank			Glendale			Others		Total Extraction
	AE	EW	NH (West)	NH (East)	PO	RT	TJ	VD	WH	Total LADWP	Burbank PSD	Lockheed	Non-Burbank (VMP)	City of Glendale	Glendale OU - North	Glendale OU - South	Total (Non-LADWP)	Total (Non-Glendale [F. Lawn])	
2009-10	-1,357	-1,194	-10,612	0	-2,634	-16,935	-13,697	-1,728	-4,700	-52,857	0	-9,955	-300	-5	-4,745	-2,555	-1,818	-400	-72,635
2010-11	-1,380	-1,196	-6,172	0	-1,994	-7,099	-23,963	-2,549	-4,652	-49,005	0	-11,026	-300	-20	-4,745	-2,555	-1,818	-400	-69,869
2011-12	-1,937	0	-4,367	0	-2,178	-6,550	-15,674	-2,687	-8,607	-42,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-62,564
2012-13	-1,937	0	-2,967	0	-2,178	-4,451	-15,674	-2,687	-5,106	-35,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-55,564
2013-14	-1,937	0	-1,567	0	-2,178	-2,350	-15,674	-2,553	-1,741	-28,000	0	-11,026	0	-20	-4,745	-2,555	-1,818	-400	-48,564
2014-15	-1937	0	-1211	0	-2,178	0	-15674	0	0	-21,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-41,005
2015-16	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2016-17	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2017-18	0	0	0	0	-2,178	0	-15674	0	0	-17,852	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-37,857
2018-19	-4,923	0	-10,155	-5,620	-2,178	-15234	-25389	0	0	-63,499	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-83,504
2019-20	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2020-21	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2021-22	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2022-23	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2023-24	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2024-25	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2025-26	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2026-27	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2027-28	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2028-29	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2029-30	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2030-31	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2031-32	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2032-33	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2033-34	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2034-35	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2035-36	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2036-37	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2037-38	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
2038-39	-4,923	0	-30,890	-5,620	-2,178	-39,992	-38,397	0	0	-122,000	0	-10,162	-300	-25	-4,745	-2,555	-1,818	-400	-142,005
Total	**-113,868**	**-2,390**	**-654,851**	**-118,020**	**-65,612**	**-852,459**	**-940,707**	**-12,204**	**-24,806**	**-2,784,917**	**0**	**-308,109**	**-8,100**	**-710**	**-142,350**	**-76,650**	**-54,540**	**-12,000**	**-3,387,376**

3.3 Retention Time

The 2008 draft CDPH regulations require a minimum underground retention time of six months from introduction of the recycled water to interception at the nearest drinking water supply well. CDPH requires that this retention time be verified with a tracer test aimed to calculate groundwater retention time based on 2% of an added tracer arriving at its endpoint from the spreading basin (T2). However, the draft regulations allow initial estimates of retention time to be developed through three different methods as shown in **Table 3-12.** This document discusses the results of numerical modeling analyses and, therefore, a minimum retention time of 12 months must be demonstrated utilizing this method.

Table 3-12: Options for Estimating Retention Time (2008 Draft CDPH Regulations)

Method Used to Estimate Retention Time to Nearest Downgradient Water Well	Minimum Estimated Retention Time
Tracer study utilizing an intrinsic tracer based on T10 (i.e., the time for 10% of tracer concentration to reach the endpoint) conducted under hydraulic conditions representative of normal project operations	9 months
Numerical modeling (i.e., calibrated finite element or finite difference models using verified computer codes such as MODFLOW, FEFLOW, SUTRA, FEMWATER, etc.)	12 months
Analytical modeling (i.e., using existing equations such as Darcy's Law to estimate groundwater flow conditions based on simplifying aquifer assumptions)	24 months

3.3.1 Particle Tracking Results

The SFBGM simulation was used to assess groundwater flow paths between the point of application of the recycled water (HSG, PSG, injection wells) and downgradient drinking water supply wells. Flow paths were generated by using the "back tracking" routine in MODPATH beginning at the two major downgradient wellfields, the TWF and the RTWF. **Figure 3-18** shows the simulated retention time from the HSG to the TWF and RTWF for the Phase 1 simulation. Based on the modeled results, the simulated retention time from the HSG to the TWF is estimated to be three years. A retention time of six years is estimated from the HSG to the RTWF. **Figures 3-19 and 3-20** shows the simulated retention time for the Phase 2 simulations of 4.5 years to the TWF and 11.5 years to the RTWF. **Table 3-13** summarizes the retention time results. It should be noted that simulated retention time is dependent on the hydraulic conductivity and effective porosity assumed in the model. Given the existing calibration of the model, the simulated retention times are well above the criteria set in Table 3-12. Therefore, reasonable variations in hydraulic conductivity and effective porosity should result in retention times at or above the criteria in the table.

Figure 3-18: Retention Time from the HSG, Phase 1 Simulation (15,000 AFY)

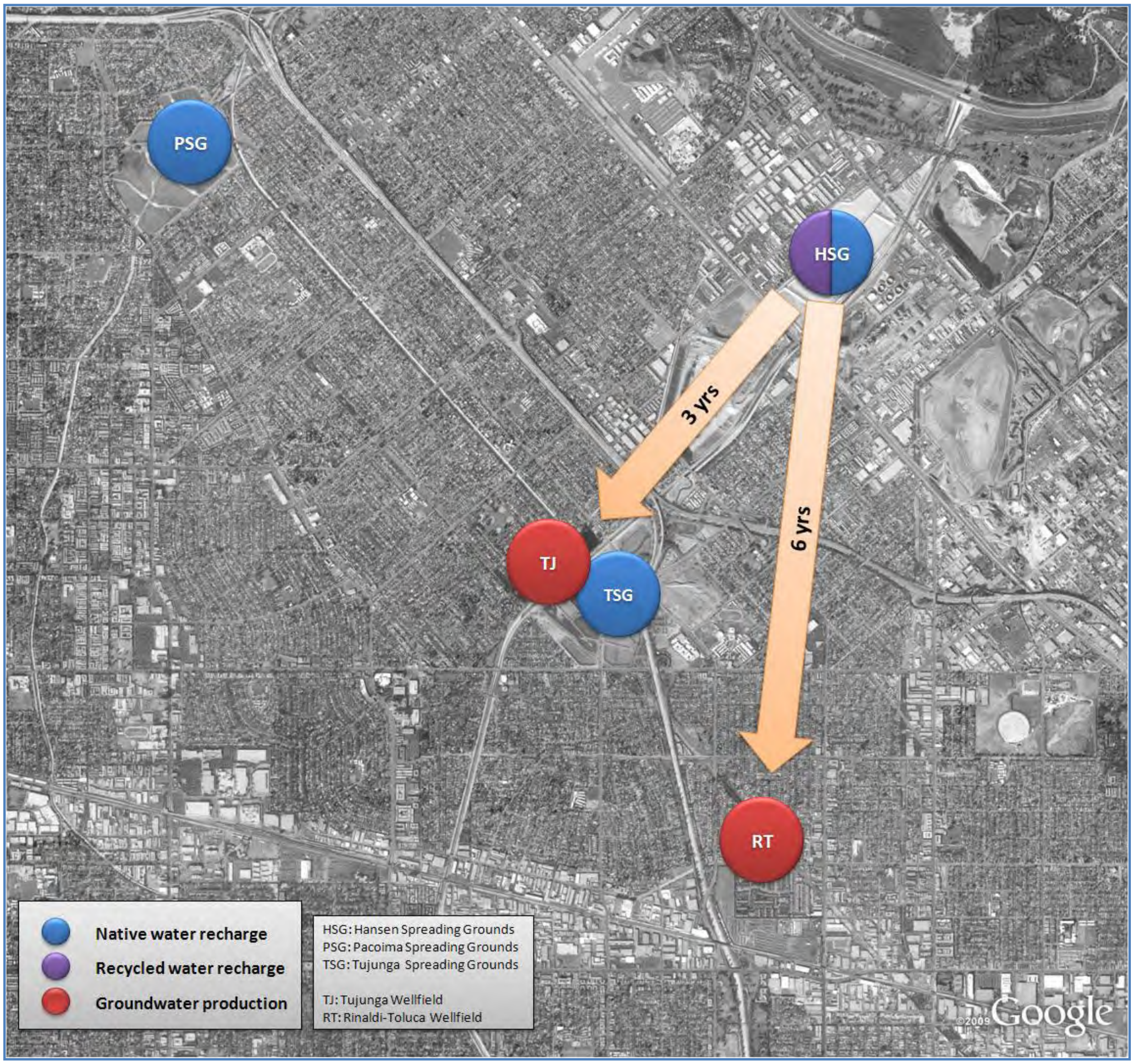


Figure 3-19: Retention Time from the HSG, Phase 2 Option A Simulation (30,000 AFY)

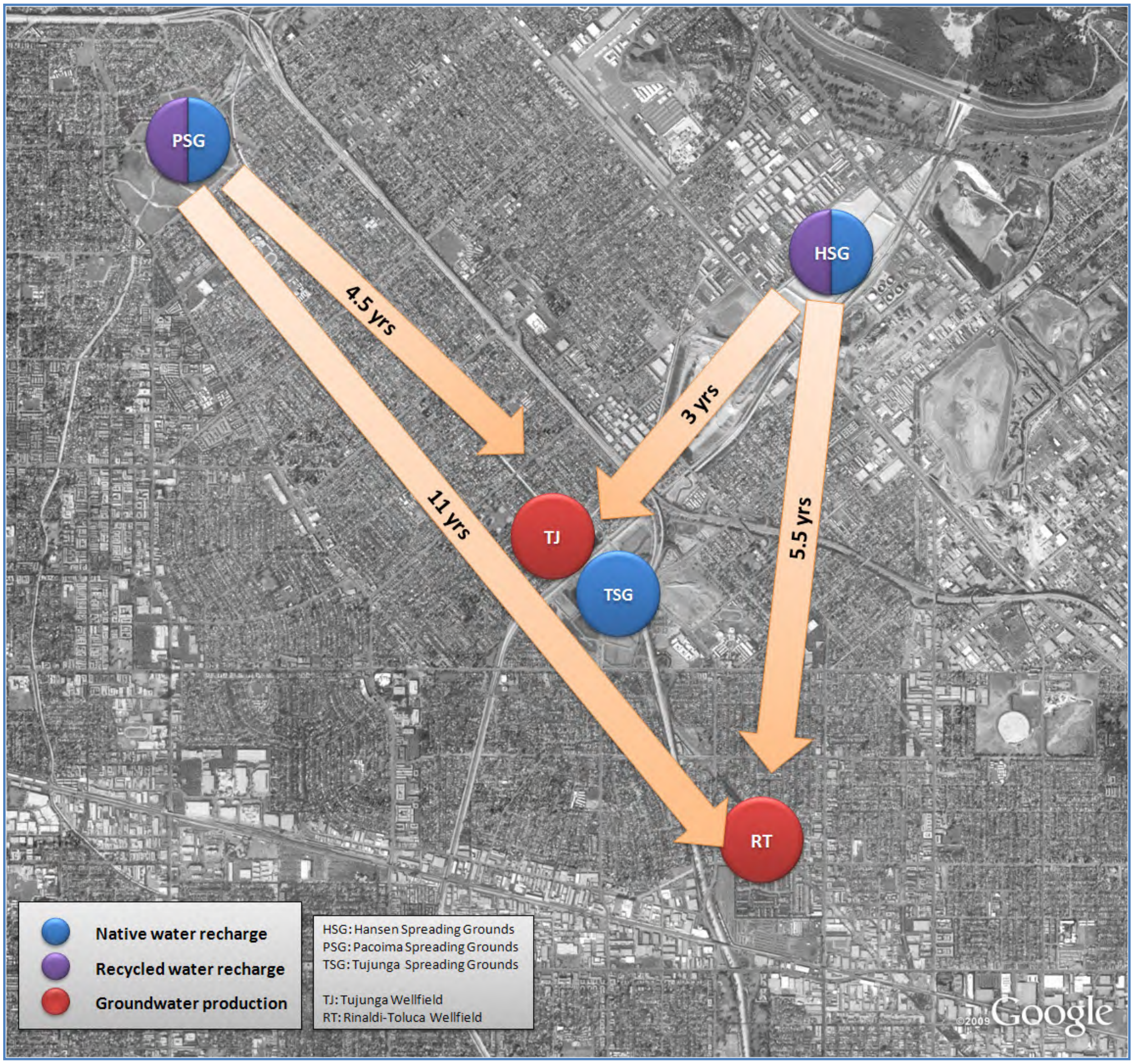


Figure 3-20: Retention Time from the HSG, Phase 2 Option B Simulation (30,000 AFY)

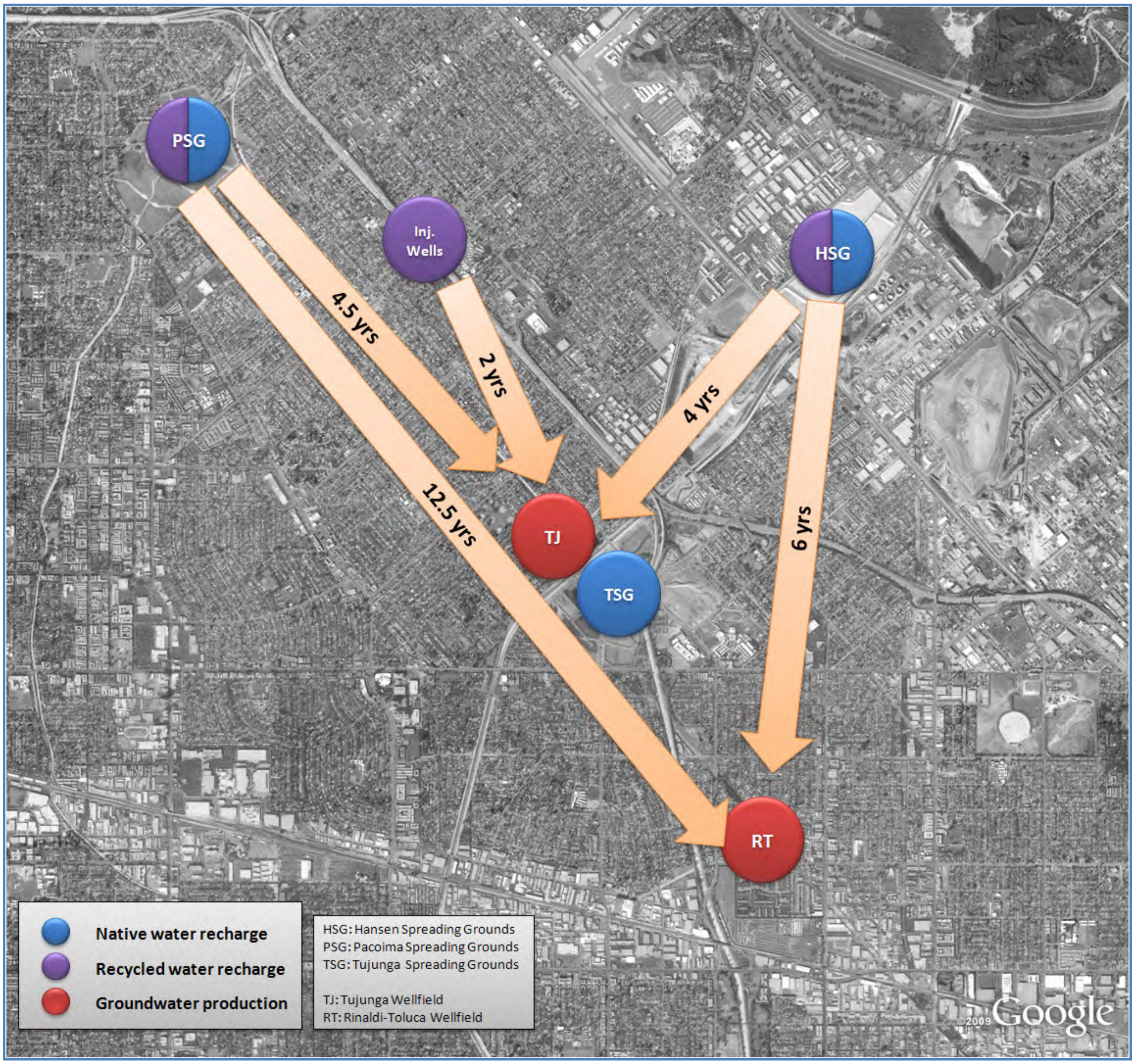


Table 3-13: Simulated Retention Time for Phases 1 and 2

Source of Recycled Water	Simulated Retention Time (years)	
	Tujunga Wellfield	Rinaldi-Toluca Wellfield
Phase 1		
HSG	3	6
Phase 2 Option A		
HSG	3	5.5
PSG	4.5	11
Phase 2 Option B		
HSG	4	6
PSG	4.5	12.5
Injection Wells	2	--- [1]

[1] Water from the injection wells does not flow to the Rinaldi-Toluca Wellfield as shown conceptually in Figure 3-20.

Based on the simulations conducted using the SFBGM, the CDPH estimated retention time requirement of 12 months (when assessed using a numerical model) is projected to be satisfied for recycled water recharged at the HSG, PSG, or the injection wells that flows to either the TWF or the RTWF under all three Phase 1 and Phase 2 conditions.

3.4 Recycled Water Contribution

The Recycled Water Contribution (RWC) is a calculation of the amount of recycled water recharged as a percentage of the total amount of recycled applied divided by the sum of the recycled water and dilution water of non-wastewater origin (diluent water). The source of and method for calculating diluent water must be approved by CDPH. **Table 3-14** shows the percent RWC as specified in the 2008 draft CDPH regulations. For this assessment an initial maximum RWC is assumed to be 50% as LADWP plans to treat recycled water for GWR with RO and AOP processes.

Table 3-14: Percent Recycled Water (RWC) Requirements

RWC	Type of Recharge	
	Surface Applications	Subsurface Applications
RWC_{max} Initial	Up to 20% disinfected tertiary Up to 50% with RO & AOP[1]	Up to 50% w/ RO & AOP
Increased RWC_{max}	Subject to additional requirements	

[1] RO (reverse osmosis) and AOP (advanced oxidation process)

The RWC could potentially be increased after the first year of operation if it meets CDPH requirements and has been reviewed by an independent advisory panel (IAP).

During groundwater replenishment activities, LADWP will need to calculate a running average RWC on a monthly basis. According to the 2008 draft CDPH regulations the RWC:

- Should be calculated for the preceding 60 months,
- Must not exceed 50%, and
- Is calculated as the amount of recycled water replenished to the groundwater divided by the total amount of groundwater replenished (recycled water plus diluent water).

For new projects, calculation of the running monthly average starts after 30 months of operation, based on the total volume of recycled water and diluent water for the preceding months.

3.4.1 Diluent Water

In accordance with the "default" criteria in the 2008 draft regulations (e.g., the RWC is based on water applied at the spreading grounds), the anticipated RWC was initially calculated using only the projected stormwater runoff that would be captured at the location where recycled water is applied. Initially for the Phase 1 project, these analytical calculations were conducted using only water anticipated to be recharged at the surface of the HSG where the recycled water would also be recharged. Therefore, the diluent water used in the RWC calculation was considered to include only the stormwater runoff projected to be available and recharged at the HSG.

However, in earlier discussions with CDPH, CDPH staff had indicated that water spread at the other spreading grounds in the area could potentially be considered as diluent water subject to demonstration of how the calculation would be representative of all water recharged to the aquifer that would reach the extraction wellfields. This approach is based on the premise that the majority of water recharged at the HSG, PSG, and TSG will flow to either the Tujunga or Rinaldi-Toluca wellfields and collectively dilute the highly purified recycled water prior to extraction. The numerical model was then used to validate this assumption and to evaluate the effect of recharge from all three of these locations on these wellfields.

The following sections summarize the various analyses conducted using these two different assumptions regarding the source of diluent water:

- Diluent from the spreading ground where recycled water is recharged, and
- Diluent water distributed from the HSG, PSG, and TSG.

Diluent from Spreading Ground Where Recycled Water is Recharged

As noted above, an initial RWC calculation was prepared considering only stormwater runoff recharged at the spreading ground where recycled water is to be recharged (e.g., only diluent from HSG in Phase 1) was considered as diluent water. The projected volume of stormwater was assumed to be equivalent to historic volumes augmented by the recent capital improvement projects as described previously.

These calculations assume that future stormwater runoff recharge will mimic the historical variations (both seasonally and over the long term) that have been evidenced in past hydrology.

Distributed Diluent Water

To evaluate the blending affects in the aquifer per CDPH recommendations, the SFBGM was used to evaluate the extent to which all water recharged at the HSG, PSG, and TSG blends in the aquifer upgradient of, and subsequently extracted at, the Tujunga and Rinaldi-Toluca wellfields. A combination of particle tracking and mass balance calculation results from the numerical model simulation were analyzed to determine the distribution that flows to each of these wellfields from each of the spreading grounds. **Figure 3-21** shows the simulated flow split from the HSG to the TWF and RTWF for the Phase 1 simulation. **Figures 3-22 and 3-23** shows the simulated flow split for the Phase 2 simulations. **Table 3-15** summarizes the simulated flow split results. The calculation of RWC in this “distributed” approach allows for a portion of the native stormwater recharged at each spreading ground to be counted as diluents.

Figure 3-21: Simulated Flow Split from HSG, PSG, and TSG to Tujunga and Rinaldi-Toluca Wellfields, Phase 1 Simulation

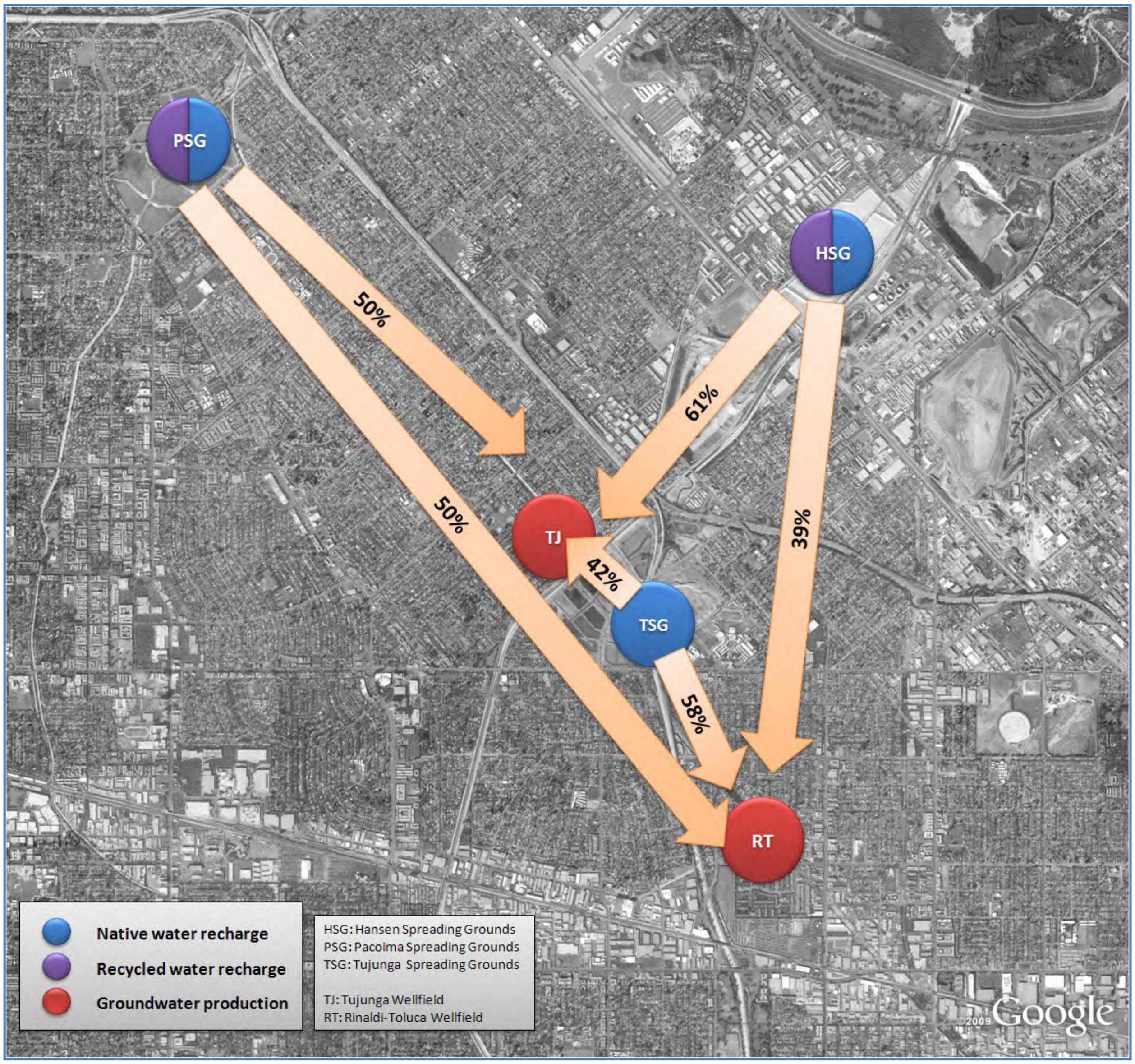


Figure 3-22: Simulated Flow Split from HSG, PSG, and TSG to Tujunga and Rinaldi-Toluca Wellfields, Phase 2 Option A Simulation

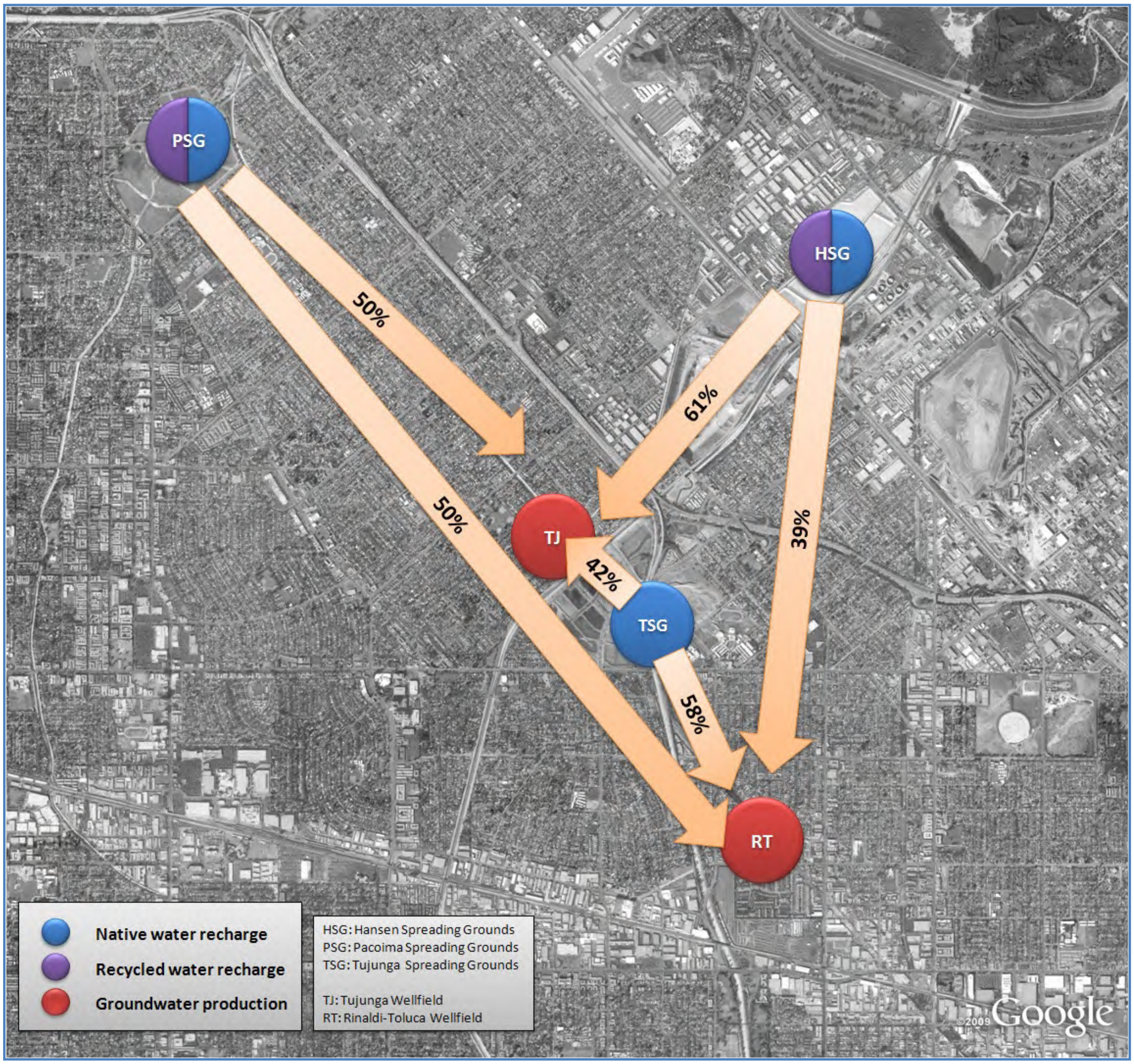


Figure 3-23: Simulated Flow Split from HSG, PSG, and TSG to Tujunga and Rinaldi-Toluca Wellfields, Phase 2 Option B Simulation

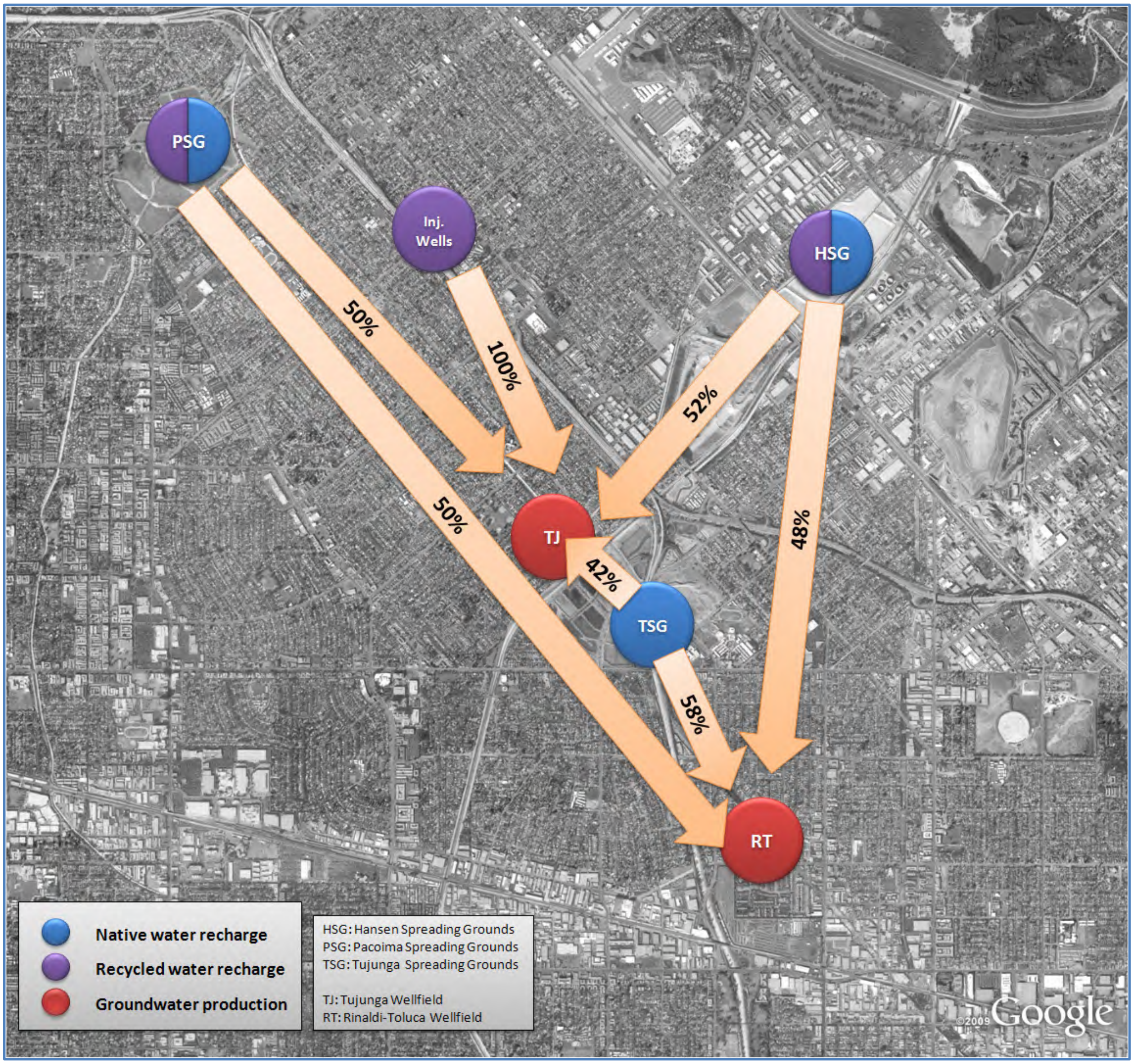


Table 3-15: Distribution of Water from the Spreading Grounds

Source of Recycled Water	Percent Flow to	
	Tujunga Wellfield	Rinaldi-Toluca Wellfield
Phase 1		
HSG	61%	39%
PSG	50%	50%
TSG	42%	58%
Phase 2 Option A		
HSG	61%	39%
PSG	50%	50%
TSG	42%	58%
Phase 2 Option B		
HSG	52%	48%
PSG	50%	50%
TSG	42%	58%
Injection Wells	100%	0%

It should be noted that because the production wells are very close together, the model distributes pumping from several cells within the model grid rather than at individual wells. Multiple model cells are used to represent each wellfield (five cells for the TWF, nine cells for the RTWF), but individual wells cannot be isolated in the model results (e.g., to an individual cell). Therefore, the calculations are effectively representative of the combined extraction of each of the wellfields and not individual wells. While it is expected that the wells closest to the spreading grounds (e.g., the most northeasterly well in the TWF) might extract a slightly higher percentage of recycled water compared to other wells, as noted earlier, all wells pump to a common header and blend in a tank/reservoir before delivery to the distribution system. Therefore, the RWC calculated from the model results using the blend from all cells is considered representative of the blended water delivered to the distribution system.

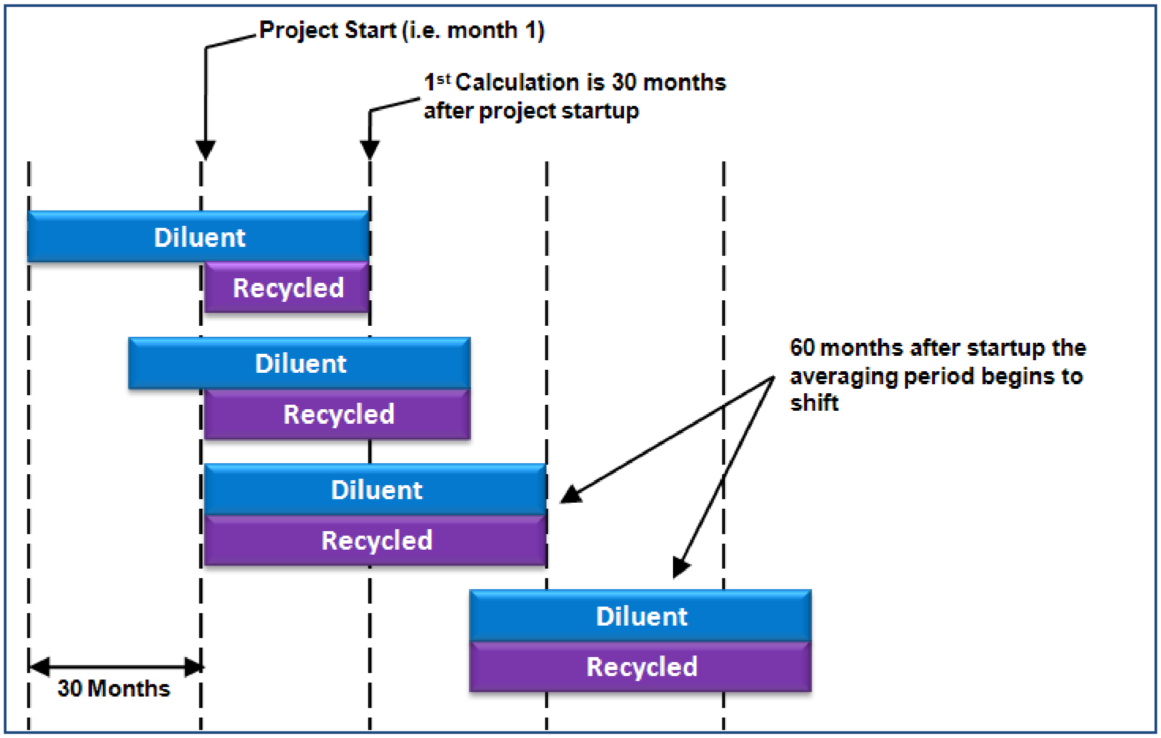
3.4.2 Calculation of RWC

The calculation of RWC was done based on the two different methods described above to estimate diluent water discussed in Section 3.4.1. Note that the first method (blending at the spreading basin) was applied only to the Phase 1 project.

Basic Assumptions

As discussed in Section 3.4, the 2008 draft CDPH regulations indicate that the RWC is to be calculated based on total volume of both recycled water and blend water for the preceding 60 months. Therefore, the period that the average is calculated over is always 60 months long but it "moves" in time as the project proceeds. **Figure 3-24** shows a schematic of the RWC calculation.

Figure 3-24 Schematic Diagram of RWC Calculation Period



The RWC calculations in this section are calculated as the sum of the recycled water recharged divided by the sum of the recycled and diluent water recharged. These volumes are totaled over the preceding 60 month period. The calculation is updated each month creating a 60-month running average.

- Recycled Water: The recycled water is assumed to be an annual volume of 15,000 AF recharged at the HSG distributed evenly throughout the year.
- Diluent Water: As discussed previously, a 40-year monthly record historic recharge at the HSG, PSG, and TSG was developed from recorded data. This historic record of recharge was used as the diluent water in the RWC calculations. The use of one or more spreading grounds as diluent water is discussed in the following two sub-sections.

The RWC calculations assume that recycled water recharge begins in month 30 (see Figure 3-6) of the 480-month record. The RWC is first calculated in month 60. At that point there have been 60 months of diluent water and 30 months of recycled water. As the project proceeds through the 480-month period, the averaging period moves such that the maximum length of the period over which either diluent or recycled volume is totaled remains 60 months.

Phase 1 - Diluent from HSG Only

Using long-term historic spreading volumes over a period of 40 years, the long term projected stormwater runoff at HSG would be approximately 16,815 AFY. Therefore, if a consistent quantity of 15,000 AFY recycled water was applied, the long-term average percentage of recycled water recharged compared to total water recharged would be approximately 47%. However, because of the highly variable hydrology in southern California, when an actual simulation of expected native water capture at the HSG is generated using historical rainfall/runoff data (as discussed above), the calculated 60-month RWC would be much more variable as shown in **Figure 3-25**. This figure also provides the monthly volume spread as a reference for wet and dry periods in the record. **Table 3-16** quantifies the amount of time when the calculated RWC would exceed the 50% limit. The monthly RWC calculations are provided in **Appendix A**.

Figure 3-25: RWC Calculated Using Stormwater Runoff at the HSG at Diluent, Phase 1

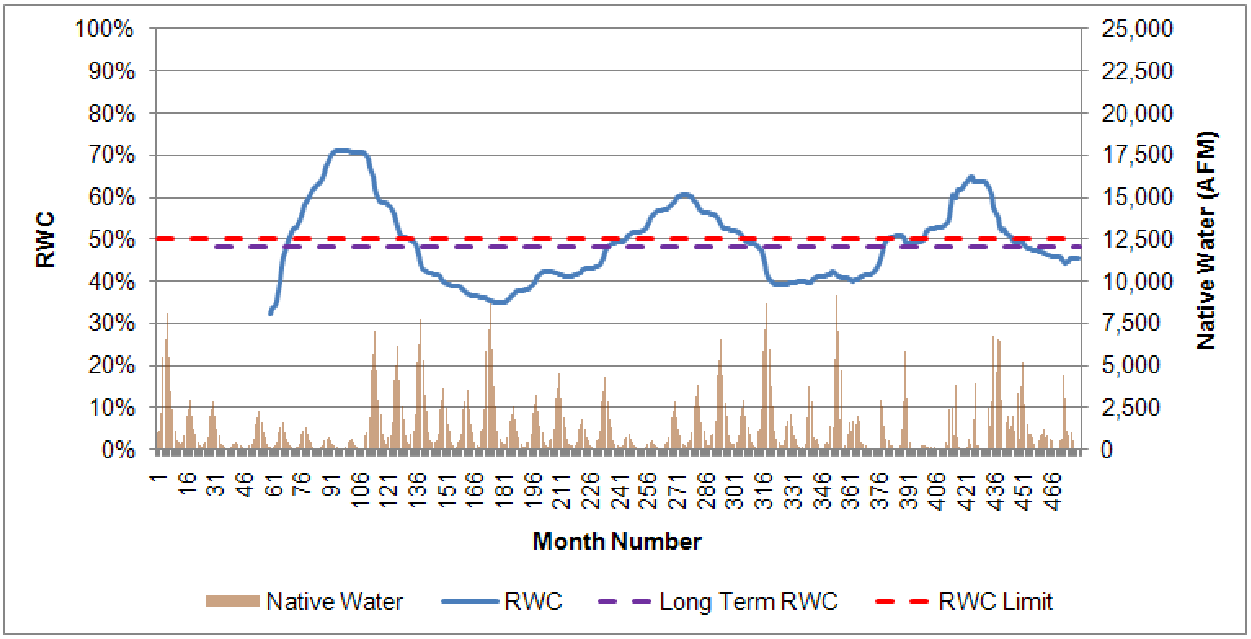


Table 3-16: RWC Calculated Using Stormwater Runoff at the HSG at Diluent

Description	Value
Number of Months when RWC Calculated	421
Number of Months when RWC Exceeds 50%	181
Percentage of Months when RWC Exceeds 50%	43%
Maximum Calculated RWC	71%
Minimum Calculated RWC	32%
Long Term RWC	47%

Therefore, even though the long-term hydrology suggests that a blend of 50% could be maintained considering only the water recharged at HSG, there could potentially be periods of a year or longer when the running average would exceed 50%, presenting significant limitations to a sustained recycled water spreading operation that relied solely on this approach to demonstrate the RWC. Therefore, additional analyses were undertaken as described below.

Phase 1 - Distributed Diluent Water

The HSG, where treated water is introduced in this initial proposed project, is located upgradient of two major LADWP wellfields, the Tujunga wellfield and the Rinaldi-Toluca wellfield. Two other major spreading grounds are also located upgradient of these wellfields. These spreading grounds, the TSG and PSG, also contribute water to the wellfields. Therefore, prior to recycled water reaching either wellfield, being pumped from the aquifer, and entering the distribution system, it is blended with water recharged from HSG, PSG, and TSG.

Based on this concept, RWC calculations were also completed to reflect the flow distribution shown in Table 3-5 and Figure 3-5. Accordingly, the RWC was calculated with the assumption that the recycled water recharged at HSG would blend in the aquifer with stormwater runoff recharged at all three spreading grounds and flow toward the TWF and RTWF. Based on the percentages shown in Table 3-5 and Figure 3-5, the RWC at each wellfield was calculated by dividing the amount of recycled water spread at HSG projected to be captured at that wellfield by the total of the recycled water plus the stormwater runoff recharged at all three spreading basins projected to be captured at that wellfield. The long-term RWC (from months 30 through 480 months of the long-term record) would be approximately 35% at the TWF and 28% at the RTWF.

Similar to Figure 3-25, the 40 years of historic hydrology was used to calculate the RWC at both the TWF and RTWF. The historic volumes, combined with the 15,000 AFY of recycled water, were used to calculate the 60-month average RWC. These results for the TWF are shown in **Figure 3-26**. Corresponding results for the RTWF are shown in **Figure 3-27**. **Table 3-17** quantifies the amount of time when the calculated RWC would exceed the 50% limit. The monthly RWC calculations are provided in **Appendix A** for the TWF and RWTF.

Figure 3-26: RWC Calculated with Combined Diluent Water Flowing to the Tujunga Wellfield, Phase 1

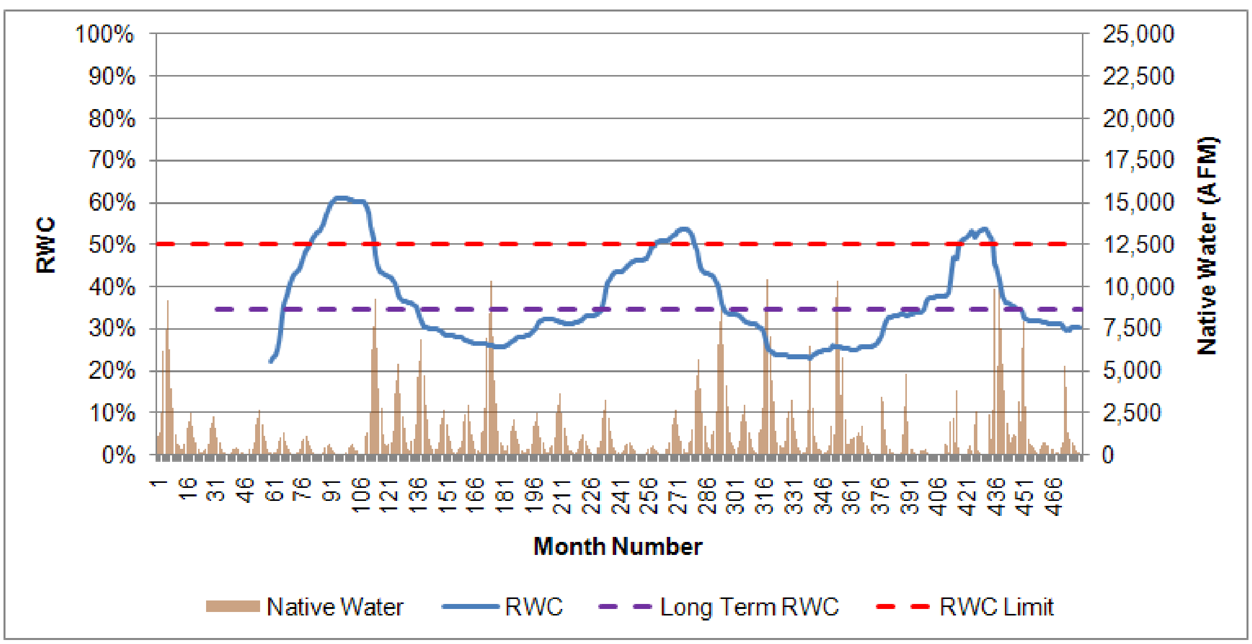


Figure 3-27: RWC Calculated with Combined Diluent Water Flowing to the Rinaldi-Toluca Wellfield, Phase 1

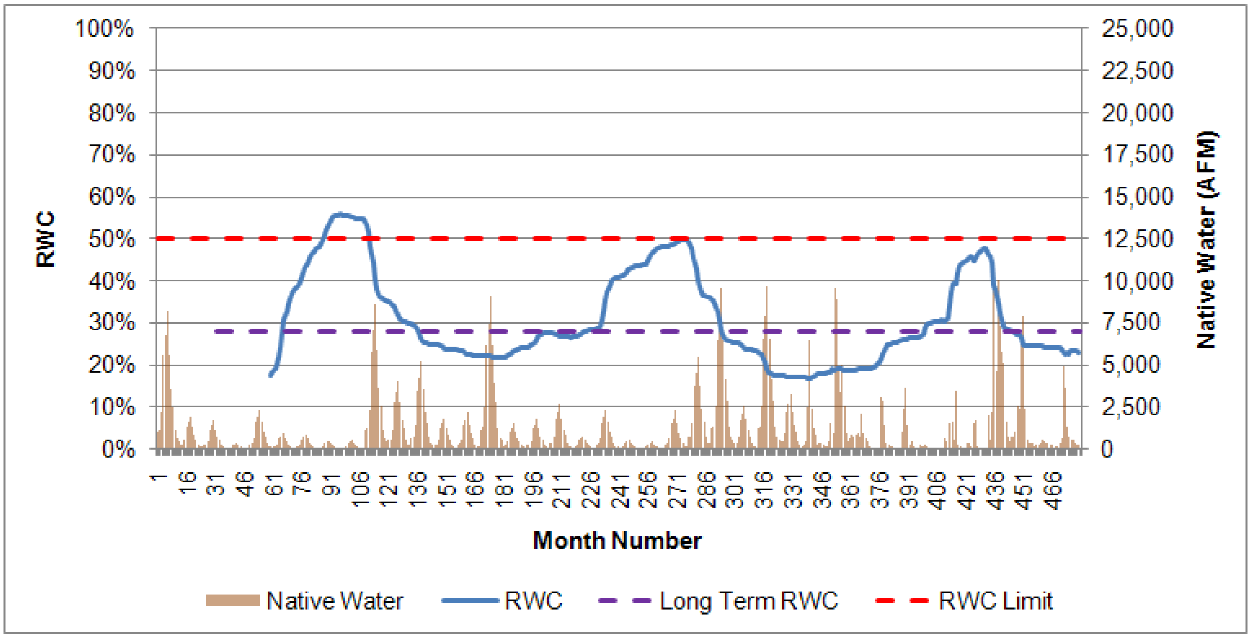


Table 3-17: RWC Calculated with Combined Diluent Flowing to the Rinaldi-Toluca Wellfield, Phase 1

Description	RWC Calculated at TWF	RWC Calculated at RTWF
Number of Months when RWC Calculated	421	421
Number of Months when RWC Exceeds 50%	73	24
Percentage of Months when RWC Exceeds 50%	17%	6%
Maximum Calculated RWC	61%	56%
Minimum Calculated RWC	22%	17%
Long Term RWC	35%	28%

As shown in the above figures and tables, this methodology used to calculated RWC based on diluent water recharged at all three spreading grounds as well as accounting for the flow distribution to the TWF and RTWF shows that the number of months and duration over which the 60-month RWC could potentially exceed 50%, as well as the maximum calculated RWC, would be reduced. Only if there were to be a recurrence of conditions similar to the extreme dry period that occurred the early 1970s (a very low probability of recurrence) would there be a prolonged period (e.g., greater than one year) when the RWC would exceed the 50% limit.

It should be noted that this approach does not take into account additional non-recycled water "underflow" that enters the aquifer upgradient of the spreading grounds and wellfields (e.g., from overlying return flows and mountain front recharge) that effectively provides further dilution in the aquifer, and therefore conservatively underestimates the amount of diluent water reaching the wellfields. Rather the analysis relies on recharge quantities that can be easily measured at the spreading basins.

Phase 2 Option A - Diluent from HSG or PSG Only

Under this option a total of 15,000 AFY of recycled water would be recharged at HSG similar to Phase 1. A total of 15,000 AFY would also be recharged at PSG. **Figure 3-28** shows the RWC calculation results at HSG allowing for only the native water recharged at HSG to be counted as diluent for the recycled water applied there. **Figure 3-29** shows a similar figure for PSG. **Table 3-18** quantifies the amount of time when the calculated RWC would exceed the 75% limit. To move to a 30,000 AFY project (Phase 2), LADWP would have had to demonstrate through operations and monitoring of Phase 1 that the permit conditions that allow for an increased RWC are met (from 50% to 75%), the information supporting the increase has been reviewed by an IAP (per the 2008 draft regulations), and the increase is approved by CDPH. The monthly RWC calculations at HSG and PSG are provided in **Appendix A**.

Figure 3-28: RWC at HSG Calculated Using Stormwater Runoff at the HSG as Diluent, Phase 2 Option A

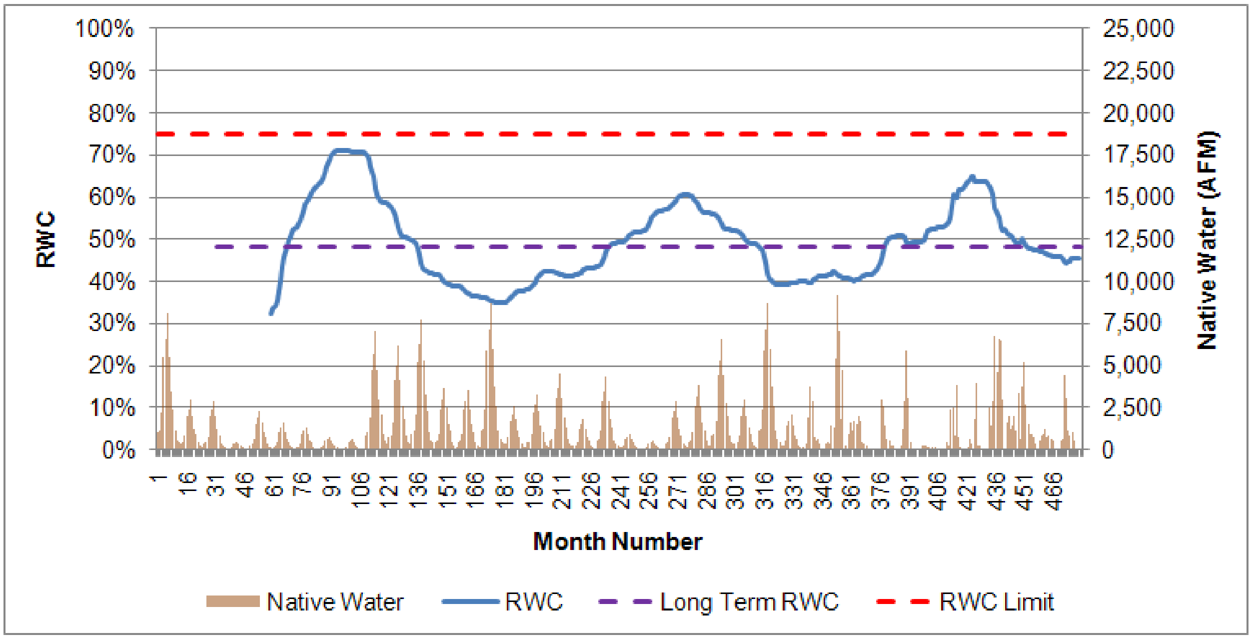


Figure 3-29: RWC at PSG Calculated Using Stormwater Runoff at the PSG as Diluent, Phase 2 Option A

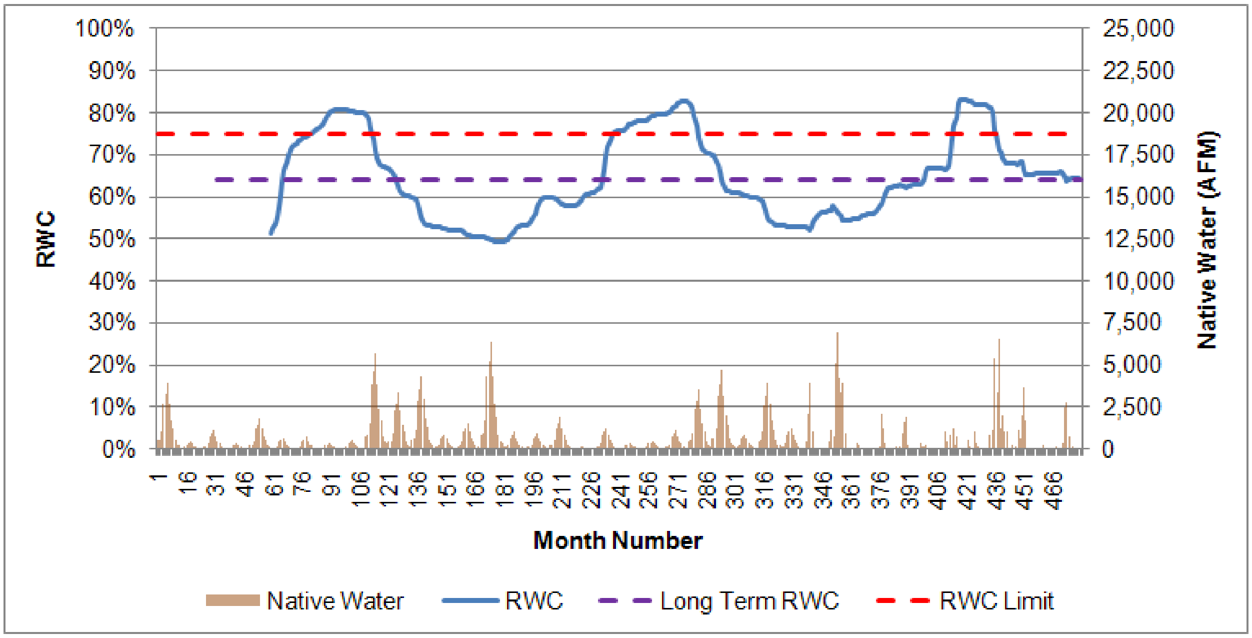


Table 3-18: RWC Calculated Using Stormwater Runoff at the HSG or PSG as Diluent, Phase 2 Option A

Description	RWC Calculated at HSG	RWC Calculated at PSG
Number of Months when RWC Calculated	421	421
Number of Months when RWC Exceeds 75%	0	98
Percentage of Months when RWC Exceeds 75%	0%	23%
Maximum Calculated RWC	71%	86%
Minimum Calculated RWC	32%	49%
Long Term RWC	48%	64%

Phase 2 Option A - Distributed Diluent Water

When RWC is calculated using the distributed diluent water recharged in the three spreading grounds and being intercepted at the Tujunga and Rinaldi-Toluca wellfields using the methodology previously discussed, the RWC is calculated to remain below the limit of 75% under all hydrologic conditions.

Similar to earlier calculations, the 40 years of historic hydrology was used to calculate the RWC. The historic volumes, combined with the 15,000 AFY of recycled water at each HSG and PSG, were used to calculate the 60-month average RWC. These results for the RWC calculation at the TWF are shown in **Figure 3-30**. Corresponding results for the RTWF are shown in **Figure 3-31**. **Table 3-19** quantifies the amount of time when the calculated RWC would exceed the 75% limit. The monthly RWC calculations are provided in **Appendix A** for the TWF and RWTF.

Figure 3-30: RWC Calculated with Combined Diluent Water Flowing to the Tujunga Wellfield, Phase 2 Option A

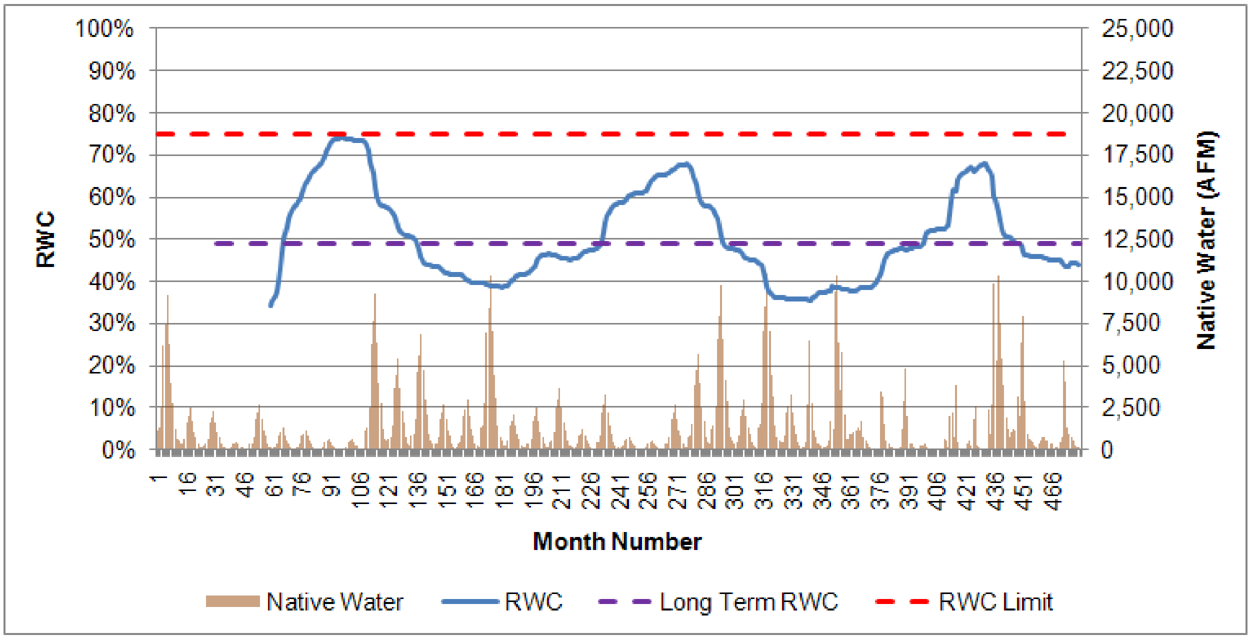


Figure 3-31: RWC Calculated with Combined Diluent Water Flowing to the Rinaldi-Toluca Wellfield, Phase 2 Option A

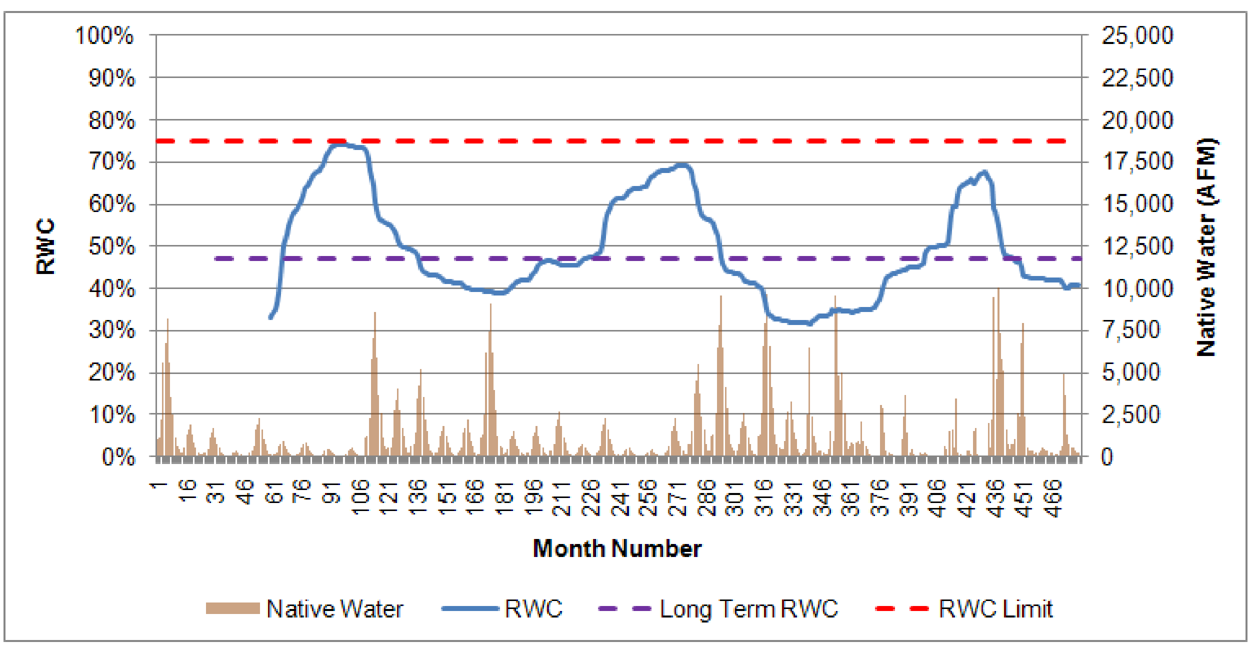


Table 3-19: RWC Calculated with Combined Diluent Flowing to the Rinaldi-Toluca Wellfield, Phase 2 Option A

Description	RWC Calculated at TWF	RWC Calculated at RTWF
Number of Months when RWC Calculated	421	421
Number of Months when RWC Exceeds 75%	0	0
Percentage of Months when RWC Exceeds 75%	0%	0%
Maximum Calculated RWC	74%	74%
Minimum Calculated RWC	34%	31%
Long Term RWC	49%	47%

As shown in the above figures and tables, this methodology used to calculated RWC based on diluent water recharged at all three spreading grounds as well as accounting for the flow distribution to the TWF and RTWF shows that the number of months and duration over which the 60-month RWC could potentially exceed 75%, as well as the maximum calculated RWC, would be greatly reduced or almost eliminated.

Phase 2 Option B - Diluent from HSG or PSG Only

Under this option a total of 13,000 AFY of recycled water would be recharged at HSG similar to Phase 1. A total of 13,000 AFY would also be recharged at PSG. A total of up to 4,000 AFY of recycled water would be recharged at the injection wells assuming that LADWP could eventually get permit approval for 100% recycled water in the injection wells, thus representing a maximum future recycled water scenario. **Figure 3-32** shows the RWC calculation results at HSG allowing for only the native water recharged at HSG to be counted as diluent for the recycled water applied there. **Figure 3-33** shows a similar figure for PSG. **Table 3-20** quantifies the amount of time when the calculated RWC would exceed the 75% limit. The monthly RWC calculations at HSG and PSG are provided in **Appendix A**. In the initial years, if LADWP was required to start at a maximum of 50% blend in the injection wells, a decision would have to be made as to how much recycled water would be injected relative to how much treated water could be provided for diluent water. However, for the modeling and analysis of the RWC, the maximum potential future condition of 4,000 AFY recycled water with no blend (100%) was assumed. Any blending would result in a lower calculated RWC, and therefore the analysis represents the maximum case assumption.

Figure 3-32: RWC at HSG Calculated Using Stormwater Runoff at the HSG as Diluent, Phase 2 Option B

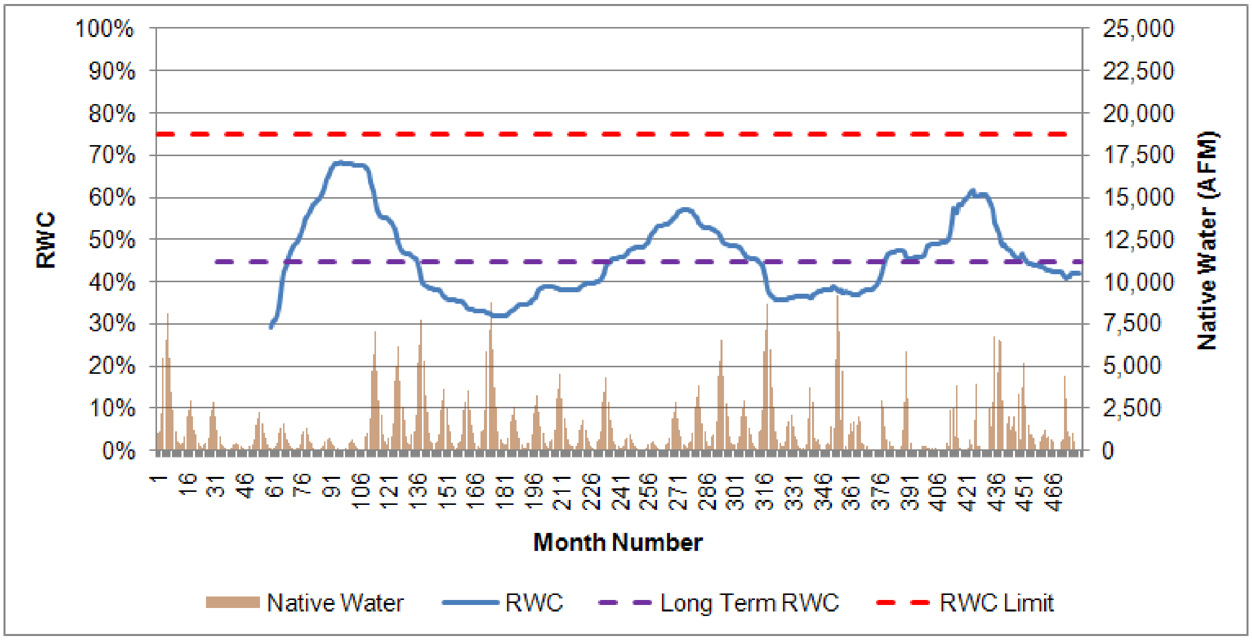


Figure 3-33: RWC at PSG Calculated Using Stormwater Runoff at the PSG as Diluent, Phase 2 Option B

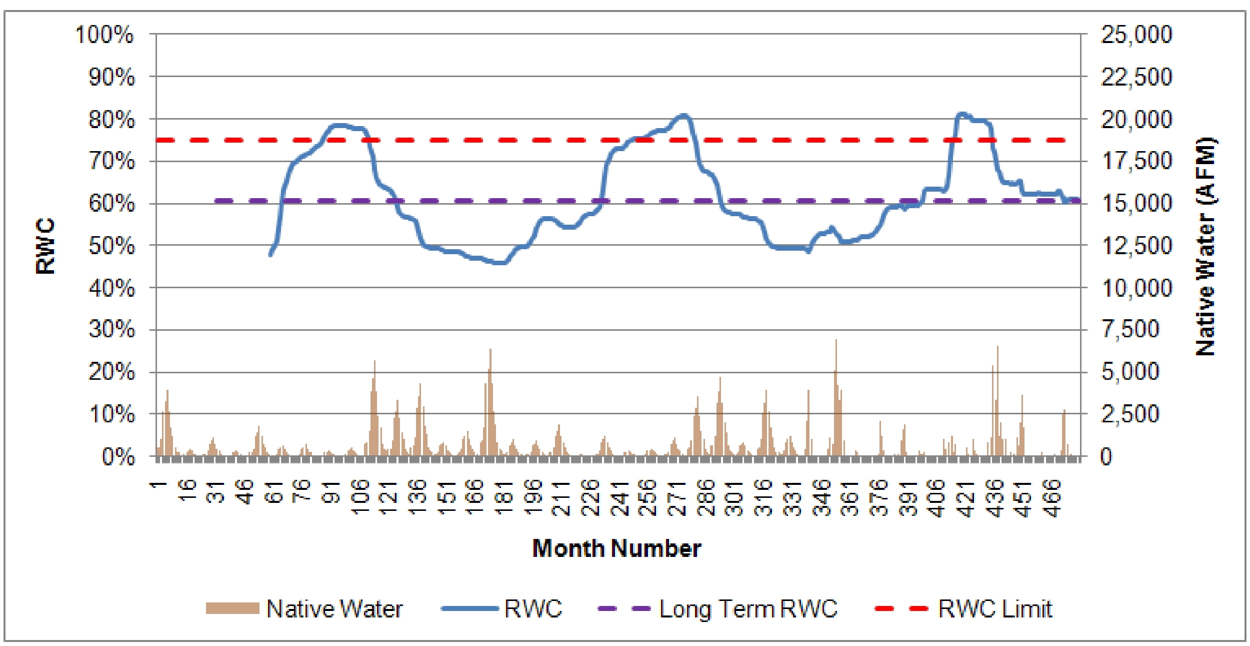


Table 3-20: RWC Calculated Using Stormwater Runoff at the HSG or PSG as Diluent, Phase 2 Option B

Description	RWC Calculated at HSG	RWC Calculated at PSG
Number of Months when RWC Calculated	421	421
Number of Months when RWC Exceeds 75%	0	77
Percentage of Months when RWC Exceeds 75%	0%	18%
Maximum Calculated RWC	68%	81%
Minimum Calculated RWC	29%	46%
Long Term RWC	45%	61%

Phase 2 Option B - Distributed Diluent Water

When RWC is calculated at the Tujunga and Rinaldi-Toluca wellfields using the distributed diluent water methodology discussed above, the RWC is calculated to remain below the limit of 75%.

Similar to earlier calculations, the 40 years of historic hydrology was used to calculate the RWC based on flow to both the TWF and RTWF. The historic volumes, combined with the 15,000 AFY of recycled water at each HSG and PSG, were used to calculate the 60-month average RWC. These results for the TWF are shown in **Figure 3-34**. Corresponding results for the RTWF are shown in **Figure 3-35**. **Table 3-21** quantifies the amount of time when the calculated RWC would exceed the 75% limit. The monthly RWC calculations are provided in **Appendix A** for the TWF and RWTF.

Figure 3-34: RWC Calculated with Combined Diluent Water Flowing to the Tujunga Wellfield, Phase 2 Option B

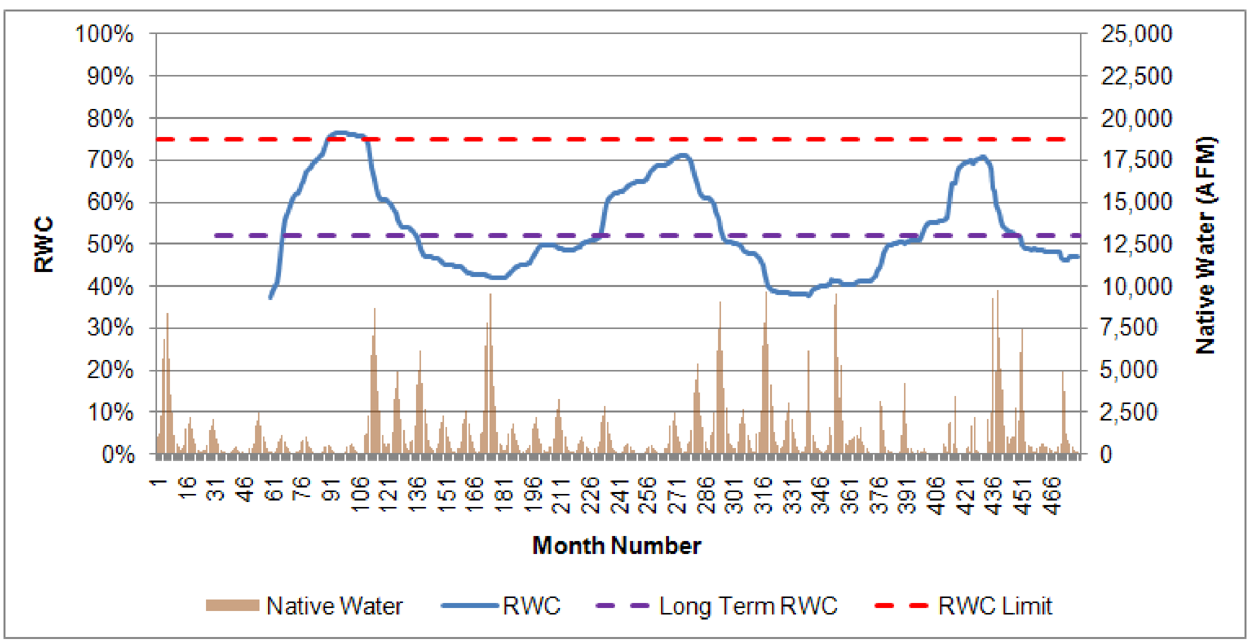


Figure 3-35: RWC Calculated with Combined Diluent Water Flowing to the Rinaldi-Toluca Wellfield, Phase 2 Option B

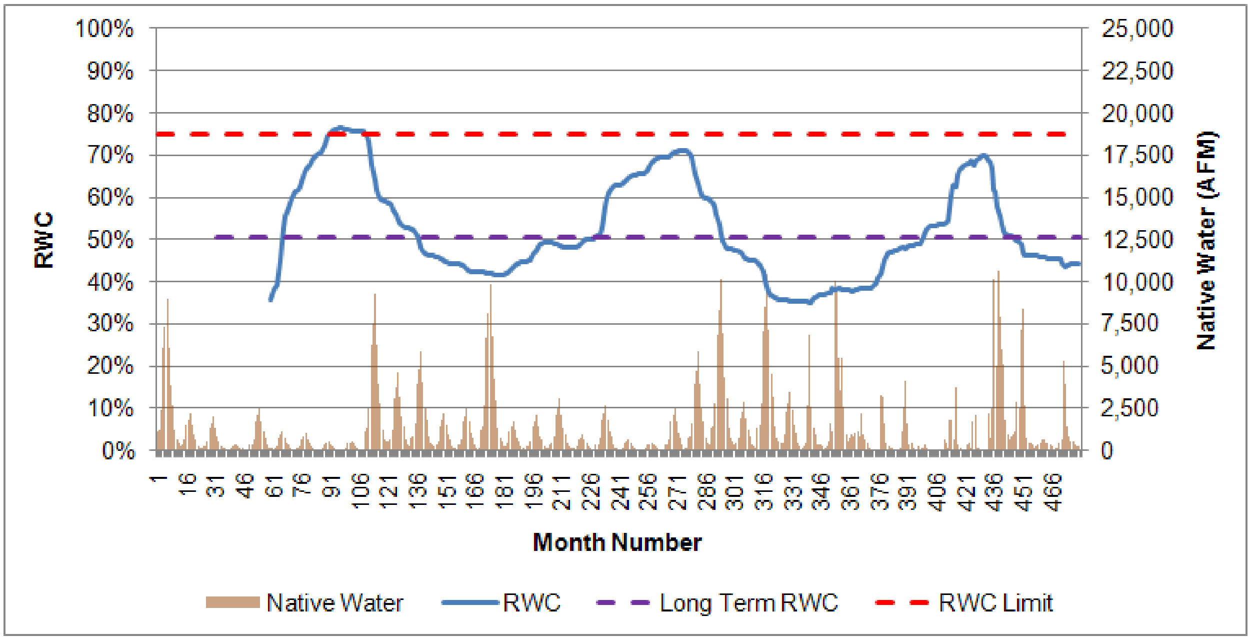


Table 3-21: RWC Calculated with Combined Diluent Flowing to the Rinaldi-Toluca Wellfield, Phase 2 Option B

Description	RWC Calculated at TWF	RWC Calculated at RTWF
Number of Months when RWC Calculated	421	421
Number of Months when RWC Exceeds 75%	19	19
Percentage of Months when RWC Exceeds 75%	5%	5%
Maximum Calculated RWC	77%	76%
Minimum Calculated RWC	37%	35%
Long Term RWC	52%	50%

As shown in the above figures and tables, this methodology used to calculated RWC based on diluent water recharged at all three spreading grounds as well as accounting for the flow distribution to the TWF and RTWF shows that the number of months and duration over which the 60-month RWC could potentially exceed 75%, as well as the maximum calculated RWC, would be greatly reduced or almost eliminated. The RWC calculated at the injection wells is based on the assumption that the project could eventually be permitted to inject 100% recycled water as previously discussed.

Other Diluent Water

This calculation approach encompasses tributary spreading basin (i.e., HSG, PSG, and TSG) stormwater recharge to the aquifer upgradient of the TWF and RTWF. However, this recharge does not comprise the entire volume of water pumped from the wellfields. Additional groundwater underflow from upgradient areas of the basin, including channel bottom recharge from upstream unlined portions of Tujunga Wash, also contribute flow to the wellfields. Additional groundwater flow in the aquifer is also contributed from distributed surface recharge from sources such as precipitation and urban return flow. However, this additional underflow was not included in this calculation. Therefore, the approach to calculating RWC by including only stormwater recharge from the HSG, PSG, and TSG represents a conservative approach. This approach also allows for a robust accounting of diluent water because the flow at the spreading grounds is regularly monitored and measured. Many of the other types of recharge cannot be as precisely quantified and are not proposed to be incorporated in the permitting approach. .

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4. Other Considerations

There are two additional considerations that warrant discussion with respect to the potential recharge of recycled water at the HSG, PSG, and/or injection wells.

- Groundwater levels
- Potential for mobilization of arsenic

4.1 Groundwater Levels

The additional recharge of either 15,000 AFY (Phase 1) or 30,000 AFY (Phase 2) of recycled water will increase groundwater levels in the vicinity of the spreading grounds. Increased groundwater levels could potentially interfere with the operations at the landfills adjacent to the spreading grounds (e.g., water levels rising to the elevation of the bottom of the landfill and/or its vapor control system). The increased pumping that accompanies the additional recharge of purified recycled water has the potential to lower water levels and adversely affect the production of existing wellfields. Simulated groundwater levels from the SFBGM runs were reviewed to address these potential issues. It should be noted that the simulations for both Phase 1 and Phase 2 begin recycled water recharge in WY 2019-20. Phase 2 would presumably follow a number of years of operation of Phase 1. However, for direct comparison of water level changes, the simulations assumed the same start date for both Phase 1 and Phase 2.

On the subsequent figures in Section 4.1, a blue-dashed line is provided on the figures to indicate the start of GWR operations (e.g. WY 2019-20) at HSG and/or PSG. Many of the figures show a decline in water level prior to the start of either Phase 1 or Phase 2. This decline is due to the increase in groundwater production from the LADWP well fields following the assumed start-up of the Centralized Purification Project in WY 2018-19. Therefore, the GWR operations (either Phase 1 or Phase 2) are layered on the assumed basin wide increase in pumping following the years prior to the centralized system coming online.

4.1.1 Spreading Grounds

Figure 4-1 shows the simulated groundwater levels at the HSG. Following the starting of recycled water recharge in WY 2019-20, groundwater levels rise noticeably. However, despite the groundwater mound that results from the recharge, groundwater levels remain well below the ground surface. **Figure 4-2** shows that groundwater levels remain well below ground surface in the area of PSG under Phase 2 conditions. **Figure 4-3** shows that groundwater levels remain well below ground surface in the area of TSG under Phase 1 and Phase 2 conditions. The groundwater level decline beginning in Water Year 2017-18 is due, primarily, to the overall increase in groundwater production within the San Fernando Valley Groundwater Basin.

Figure 4-1: Simulated Groundwater Levels at the HSG

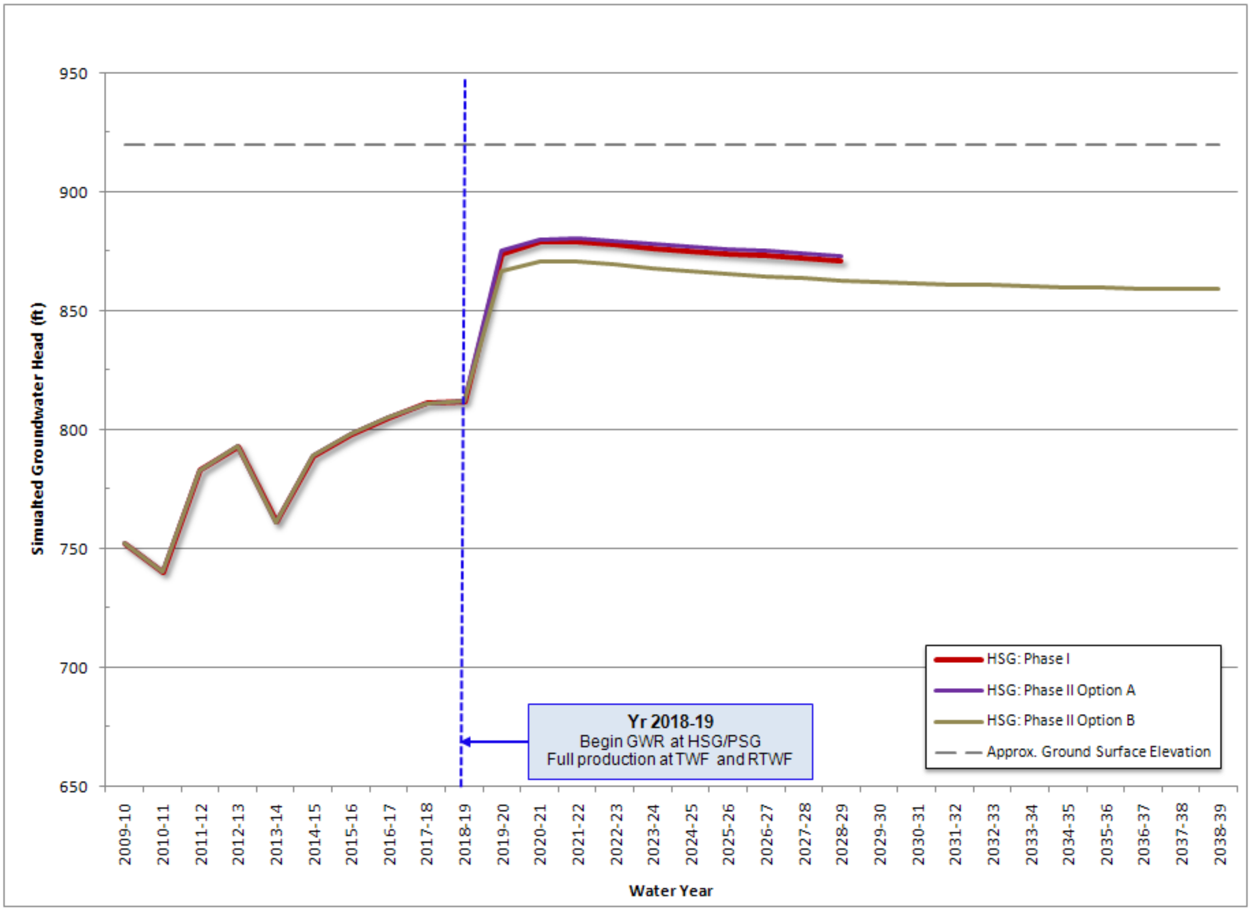


Figure 4-2: Simulated Groundwater Levels at the PSG

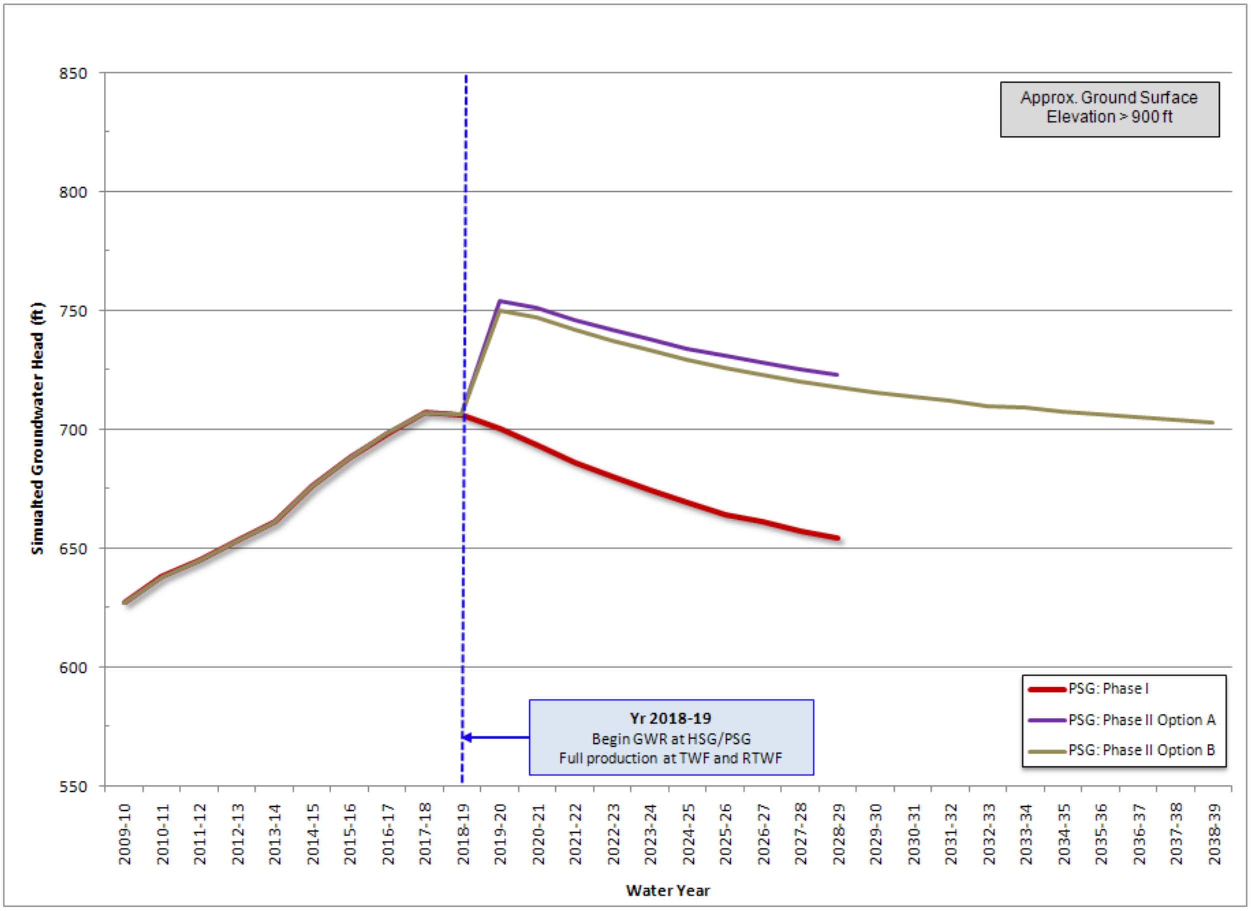
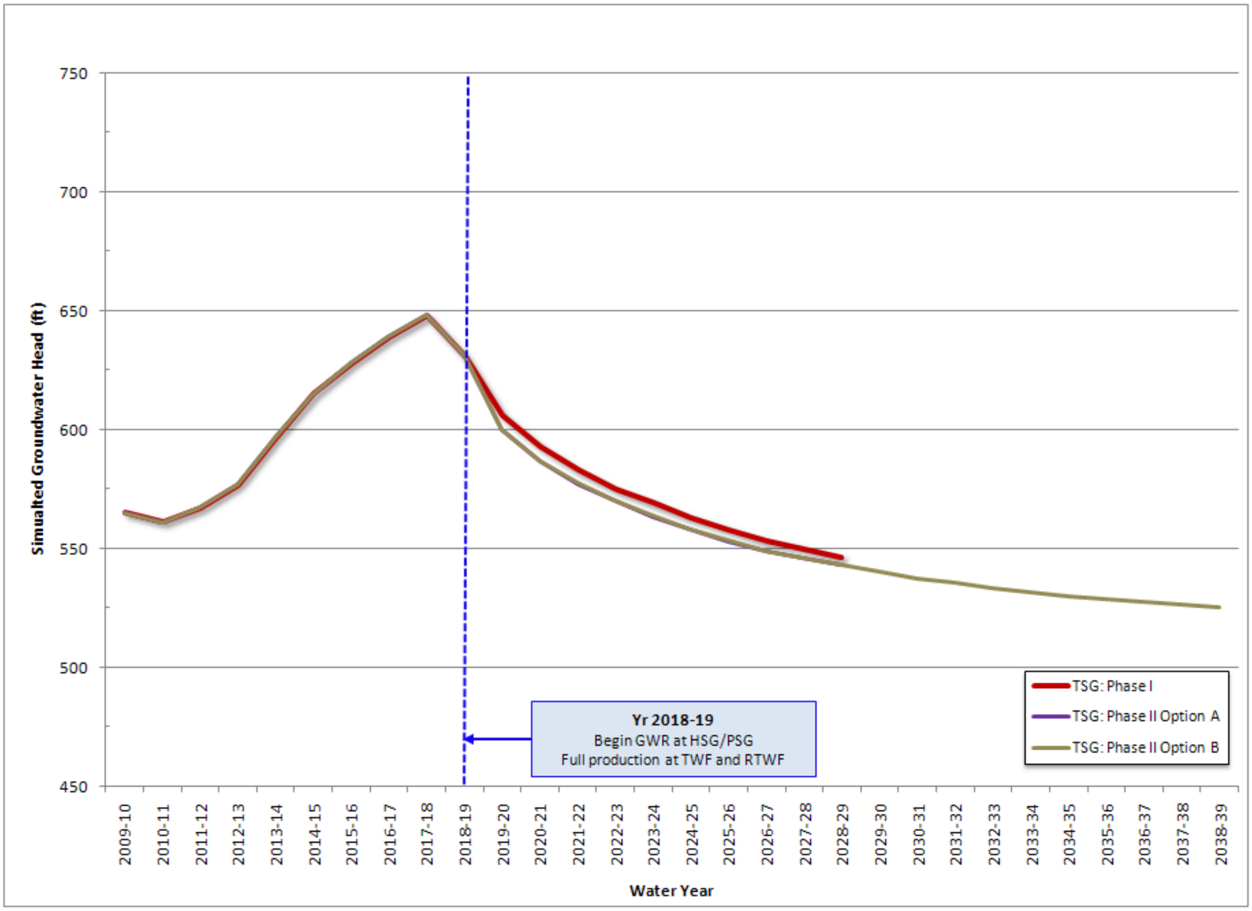


Figure 4-3: Simulated Groundwater Levels at the TSG



4.1.2 Wellfields

Figures 4-4 and 4-5 show that groundwater levels drop starting in Water Year 2017-18. This decline is due, primarily, to the overall increase in groundwater production within the San Fernando Valley Groundwater Basin. This simulation results show that the wells in the TWF and RTWF should remain viable under Phase 1 and Phase 2 conditions as the groundwater levels should remain above the screened intervals of the wells. It should be noted that the wells in the TWF and RTWF have relatively long screened intervals, 400 ft and 380 ft, respectively. These long screens also provide a factor of safety for declining water levels.

Figure 4-4: Simulated Groundwater Levels at the Tujunga Wellfield

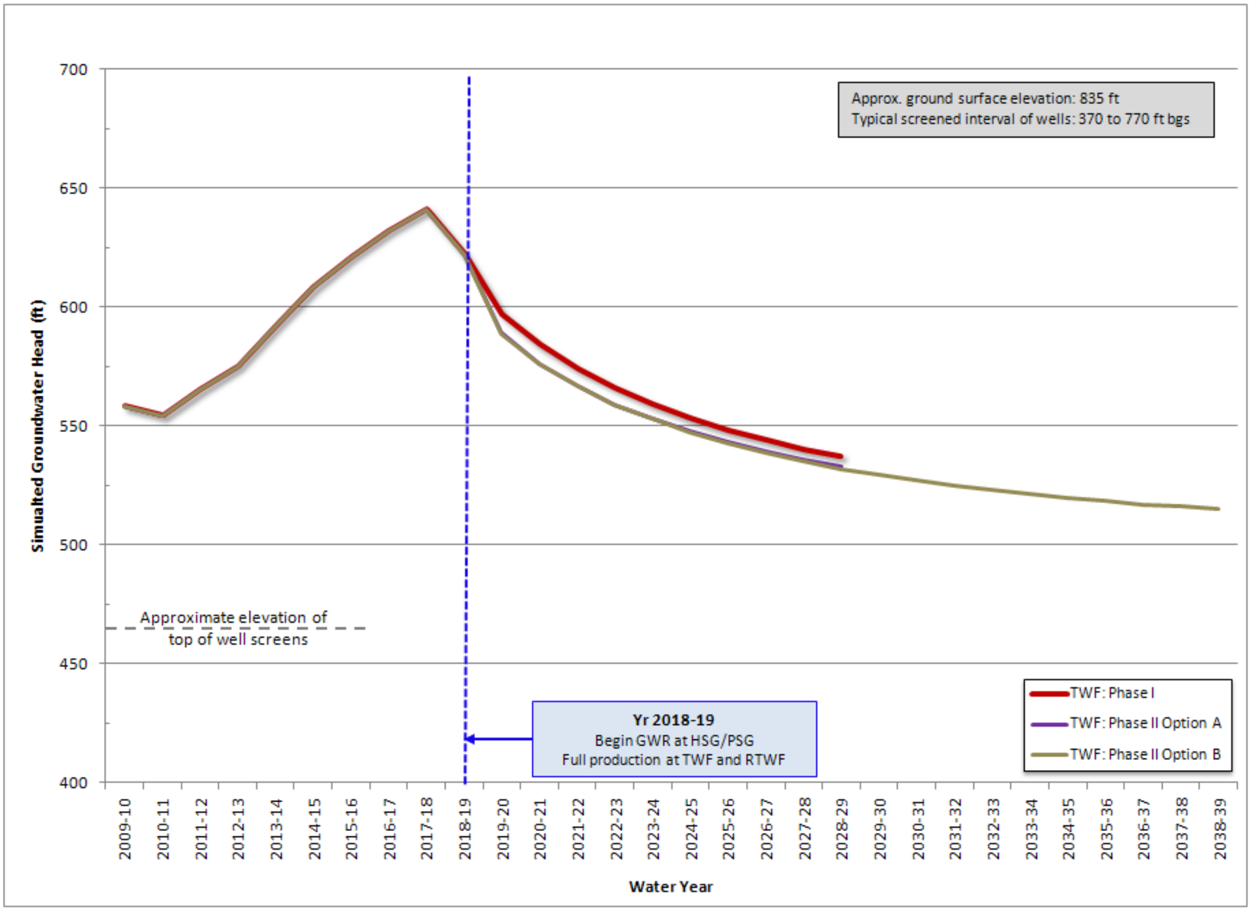
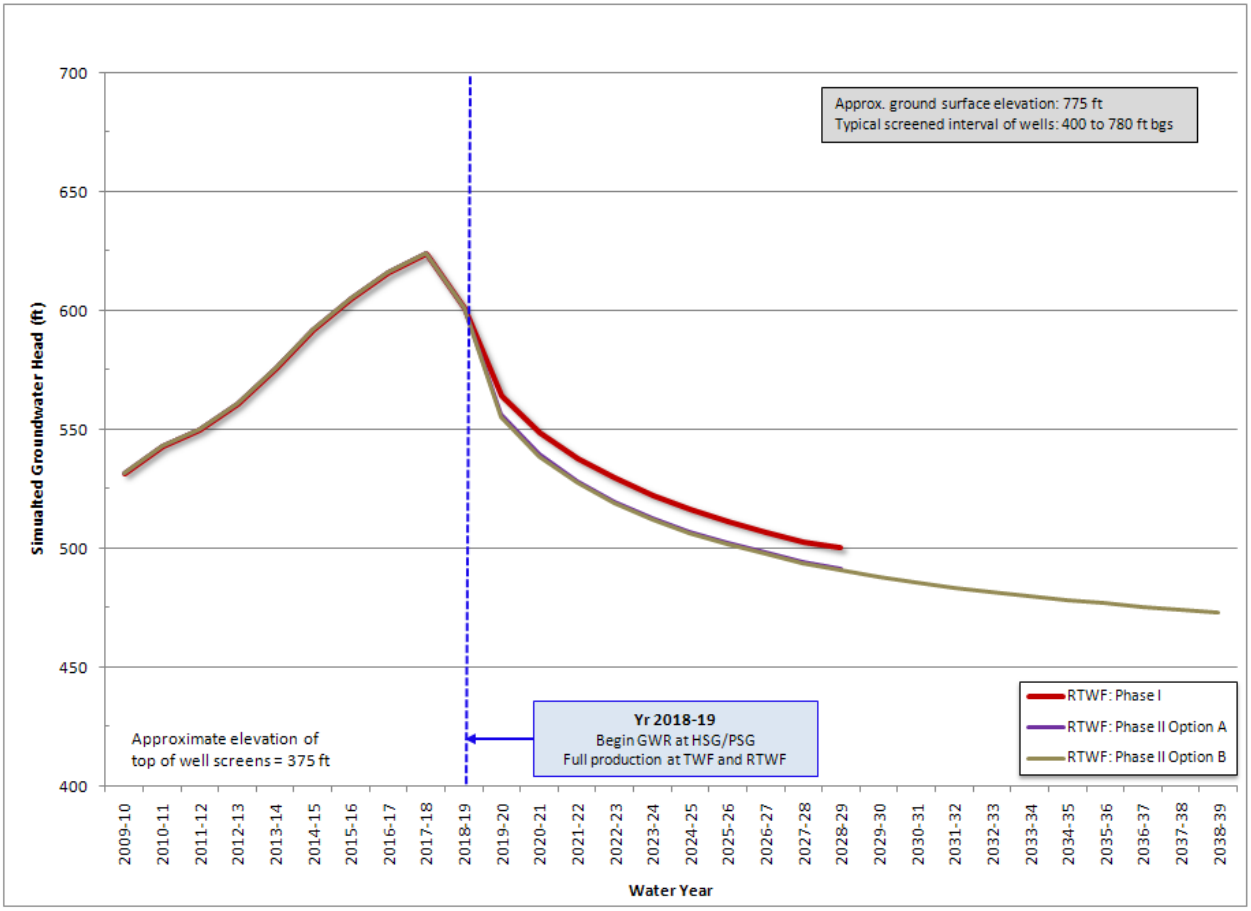


Figure 4-5: Simulated Groundwater Levels at the Rinaldi-Toluca Wellfield



4.1.3 Landfills

Figures 4-6 and 4-7 show that groundwater levels are simulated to remain below the buffer elevations at both the Bradley and Sheldon-Arleta landfills, respectively. The buffer elevations have been set to keep water levels from rising to adversely affect the landfill (e.g., below the bottom of the landfill, below the vapor extraction system).

Figure 4-6: Simulated Groundwater Levels at the Bradley Landfill

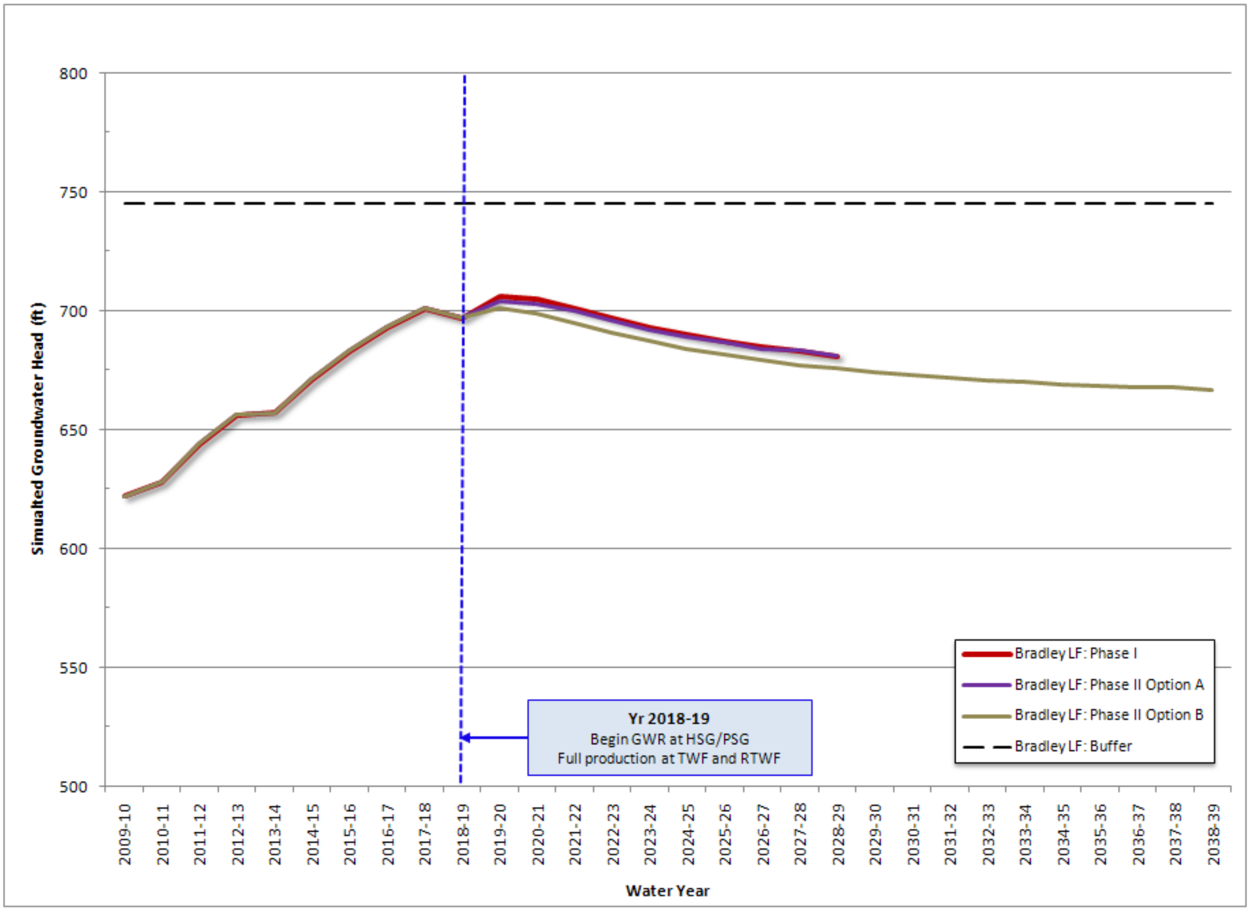
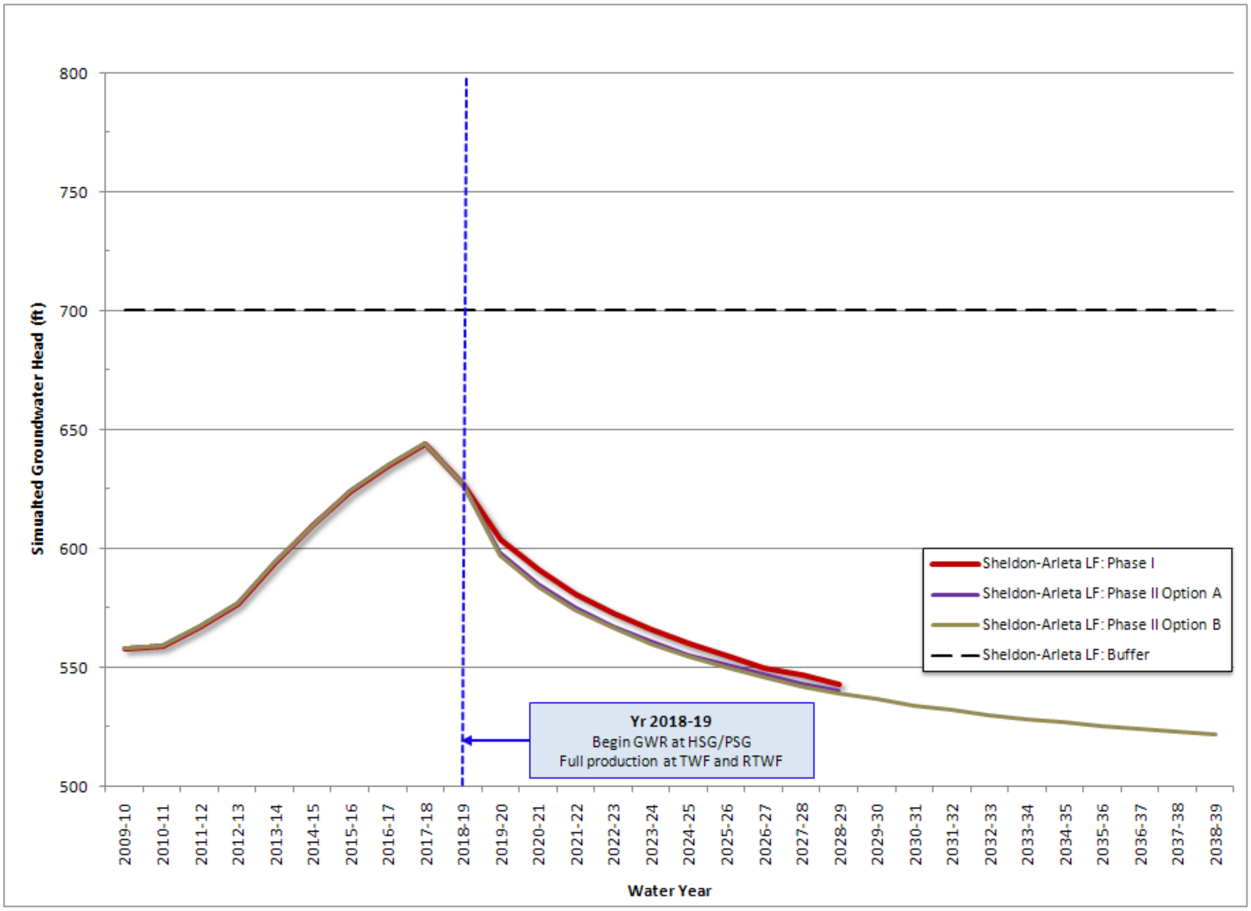


Figure 4-7: Simulated Groundwater Levels at the Sheldon-Arleta Landfill



4.2 Impact on Existing Groundwater Contamination

As noted in Section 2.3.3, there are a number of areas of existing contamination throughout portions of the eastern and southeastern portions of the SFB near the location of the proposed GWR project. Some of the contamination is already being remediated through Superfund or other wellhead treatment projects. In addition, LADWP is evaluating remediation and wellhead treatment projects to address additional contamination, including treatment, at the TWF and RTWF.

The following observations can be made with respect to the potential impact of the proposed GWR project on existing contamination and remediation projects:

1. The contamination plumes mapped by the ULARA Watermaster (refer to Section 2.3.3) are down gradient of the primary areas (i.e., HSG, PSG, and injection wells) of the aquifer in which advanced treated recycled water used for GWR will be introduced and intercepted by the wellfields. The zone of influence of changes in contours and flow fields resulting from the increased recharge and extraction of recycled water are generally limited to the areas between the spreading grounds and wellfields. The proposed GWR project would not

result in any significant changes further downgradient that would adversely impact existing remediation projects.

2. Under a separate ongoing Groundwater Systems Improvement Study (GSIS), LADWP intends to take into consideration a significant anticipated increase in production at the existing wellfields resulting from increased recharge if the proposed GWR project is implemented. The GSIS is taking this into account in the planning for groundwater treatment at the TWF and RTWF.

As detailed planning and eventual design of both the GWR program and the GSIS program to identify the facilities for the Groundwater Purification Project including centralized and/or wellhead treatment proceed, coordination between these two planning efforts will be important to confirm that the two efforts are compatible with each other. For example, the maximum treatment capacity being evaluated under the GSIS is a function of the GWR recharge capacity.

4.3 Potential for Arsenic Mobilization

The RWQCB can impose requirements on GWR projects in cases where the project could change the geochemistry of an aquifer causing the dissolution of constituents, such as arsenic, from the geologic formation into groundwater. Research conducted at other locations has shown that the potential exists for metal and semimetal mobilization (especially arsenic) from the surface soils and subsurface aquifer materials in response to the chemistry of the AWPF treated water and the existing soil properties at spreading grounds (WRF 2009). Arsenic is of particular interest because of its stringent drinking water standard. A preliminary evaluation of the potential to release arsenic from the soils and subsurface aquifer materials at the HSG as a result of AWPF water spreading is discussed in this section.

4.3.1 Overview of Arsenic Geochemistry

Arsenic is found in pure minerals mainly as sulfide minerals (As_2S_3, AsS, FeAsS) associated with ore deposits and mineralized areas. Soils and aquifer sediments typically contain natural arsenic; however, at relatively low concentrations (typically <1 to 100 milligrams per kilogram (mg/kg) (Shacklette 1984)). The arsenic in soils and subsurface aquifer sediments (solid phases) typically exists in one of the following three forms:

- **Form 1**: In this form, arsenic is associated with naturally occurring iron oxide/oxy-hydroxide phases either as coatings on natural geologic materials or as discrete phases in natural geologic materials. The arsenic is typically present at small/trace quantities (mg/kg levels) either adsorbed on the iron oxyhydroxides, in the matrix of the iron oxyhydroxides ("co-precipitated"), or as a solid solution phase with the iron oxyhydroxides.
- **Form 2**: In Form 2, arsenic is associated with natural occurring, trace, reduced mineral phases; typically iron sulfides (pyrite). The arsenic is typically present at low concentrations (mg/kg to percentage levels) in the matrix of the iron sulfides.
- **Form 3**: In the third form, arsenic is associated with naturally occurring materials such as organic matter, clays or iron containing minerals. The arsenic is typically present at trace levels (low mg/kg) and is adsorbed on the surface of the materials.

Appendix B discusses the various forms of aqueous arsenic can exist at various combinations of Eh and pH. The oxidation reduction potential (ORP) of the AWPF treated water is oxidizing. Therefore, arsenic released into the aqueous Phase 1s expected to be present as the As (+5) anions.

As AWPF water infiltrates and reacts with the solid surface soil and subsurface aquifer sediment phases, the arsenic may be released or mobilized as a result of the following three mechanisms:

- **Mechanism 1: Release from Solid Phase Form 1**: Under reducing conditions (i.e., infiltrating waters are reducing), iron oxides/hydroxides in the solid phases that are present in the ferric (i.e., +3 oxidation state) dissolve. This process causes the release of ferrous ion (e.g., +2 oxidation state) into the aqueous phases. Any arsenic that is associated in the iron oxides/hydroxides phases would also be released into the aqueous phase (into the discharge water or groundwater) during this process.
- **Mechanism 2: Release from Solid Phase Form 2**: Under oxidizing conditions (i.e., infiltrating waters are oxidizing), iron sulfides in the solid phases undergo a series of chemical and biological reactions during which the iron sulfides dissolve. This process results in the production of acid (hydronium ions) and sulfate and releases any arsenic associated with the iron sulfides into the aqueous phase.
- **Mechanism 3: Release from Solid Phase Form 3**: Under a variety of conditions where the infiltrating waters contain chemicals similar in structure to the adsorbed arsenic (i.e., tetrahedral anions), the chemicals will preferentially adsorb to the solid matrix. This adsorption releases the previously adsorbed arsenic into the aqueous phase. Low to medium concentrations of phosphate, silicate, carbonate/bicarbonate, vanadate, molybdenite, selenite, uranium, sulfate, etc. can replace (desorb) the arsenic (see Appendix B for a more complete list of chemicals and their potential to desorb arsenic).

Examples of the above types of arsenic release mechanisms have been well documented in literature. Release Mechanism 1 is the most common documented in literature. The reducing waters that mobilize the arsenic are a result of landfill leachate (United States Geological Survey (USGS) 2004, Delemos el al. 2006), petroleum spills (Bhosh et al. 2009), and introduction of reducing groundwaters (e.g., via pumping) into oxidized sediments (van Geen et al. 2004).

The release Mechanism 2 is typically associated with acid mine/rock drainage and mining related waste rock or tailings. However, the release of arsenic as a result of Aquifer Storage and Recovery (ASR) projects in Florida is well documented (Arthur 2002). In these ASR projects, the recharged waters are typically oxidizing. The aquifers being recharged also typically contain trace amounts of pyrite containing arsenic. As long as oxidizing conditions exist and pyrite is present, arsenic is released.

The release of adsorbed arsenic by competing anions (Mechanism 3) is also well documented in literature (Stachowicz et al. 2008). This mechanism has also been well studied in the treatment of arsenic at water treatment plants using hydrous ferric oxides (HFO) commercial adsorbents (e.g., Bayoxide E33). The competing anions limit the adsorption capacity of HFOs (essentially the HFO are the same as iron oxides/oxyhydroxides).

Appendix B provides a detailed discussion of arsenic geochemistry specifically related to its leachability and mobility (i.e., fate and transport) in soil/water systems.

4.3.2 Recent WateReuse Foundation Study

The WateReuse Foundation (WRF) and the U.S. Bureau of Reclamation (Reclamation) recently provided funding for researchers from Rice University to evaluate the leaching of metals from aquifer soils during infiltration of low-ionic strength reclaimed water (WRF 2009). In the studies, RO-treated wastewater and vadose soils and aquifer materials from two existing recharge sites were used to evaluate the effects of the treated water pH, total dissolved solids (TDS), ionic composition, and ORP on desorption equilibrium and kinetics of major metal species in the soils and subsurface aquifer materials. Major findings of the WRF study are summarized below:

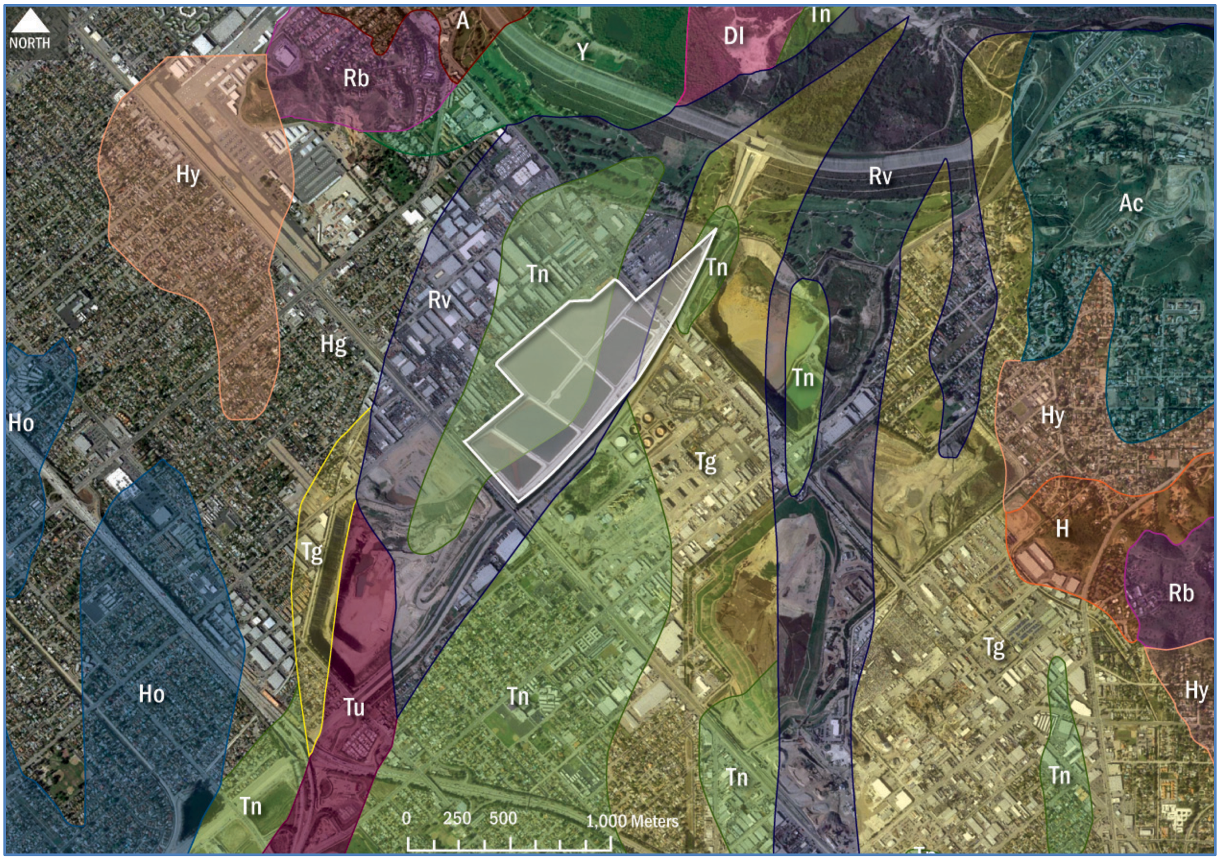
- Arsenic was identified as the major contaminant of concern at the Water Campus Project (WCP) site (the subject of the WRF study).
- The arsenic concentrations in the WCP soils were very low (1.3 to 3.5 mg/kg).The form of the arsenic was characterized using sequential leaching tests. Typically over half of the arsenic was in the "residual" fraction (in the matrix) and would not be leachable. The remaining arsenic was distributed in the carbonate, easily reducible and reducible oxides (typically iron oxyhydroxides) and organic matter phases. Little arsenic was associated with the "soluble and exchangeable metal" fraction.
- Arsenic desorption increased slightly with increasing pH, and TDS/ionic strength did not significantly change the arsenic desorption.
- Composition of the recharge water had a significant impact on the metal desorption. The addition of calcium decreased the dissolution of the carbonate phases (calcium carbonate) and the release of arsenic in this phase.
- Overall, approximately 10 to 20 percent of the total arsenic in the soils and subsurface materials was released during column tests. The concentration of arsenic in the soils was 3.5 mg/kg before leaching. The release of this arsenic resulted in a predicted significant impact to the groundwater under anticipated project conditions (see next bullet).
- The impact of the arsenic leaching on groundwater was modeled groundwater flow and transport models. The impact was dependent upon many factors including aquifer properties (e.g., hydraulic conductivity), recharge rates and amounts, water table depth, water composition and arsenic leaching characteristics. The highest concentration of arsenic predicted in the groundwater as a result of RO-treated water was 35 micrograms per liter (µg/L) and the 10 µg/L (EPA, MCL) concentration contour traveled a distance of 2.8 miles in 50 years. The maximum concentrations of arsenic and the migration distances decreased by the addition of high ionic strength water (with calcium) to the RO water in the models.

4.3.3 Site Specific Data at the HSG

<u>Soils</u>

Available soil information was requested from the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) office in Carson, California pertaining to soil types in the HSG area. No published information/data are available from the NRCS in the immediate area surrounding the HSG because it is located in an urban developed area (i.e., the area has not been mapped). NRCS provided unpublished 1915 data, that describe soils in the area to be from the Tujunga sandy loam (Tn), Riverwash (Rv), and Tujunga gravelly sand (Tg) units. The aerial extent of these soil units are shown on **Figure 4-8.**

Figure 4-8: Aerial Extent of Soil Units



The Tn unit is alluvial soils that have a sandy loam surface with sand textures in the subsurface. These soils (based on the unpublished data) tend to have stratified sand textures, irregular decreases in organic matter with depth, and a coarse fragment (>2millimeter (mm) in size) content between 0 and 35 percent. This unit is comprised of finer texture and less coarse fragments than other mapped units. The Rv unit separates (horizontally) the Tn and Tg units. This unit is "unstabilized, sandy, silty, clayey, or gravelly sediment that was flooded, washed, and reworked frequently by rivers" (National Soil Survey Handbook Section; Miscellaneous Areas: Exhibit 627-1).

The Tg unit is expected to contain a high coarse fragment content throughout the vertical profile. The gravels are described below a depth of 6 feet in the narrative map unit description. Unfortunately descriptions of the representative pedon were not published, so it is difficult to estimate a rock fragment percentage. Based on historical descriptions, a sandy profile with unsorted rock fragments of varying sizes can be expected.

Table 4-1 shows the percentage of the HSG that overlies Tn, Rv, and Tg soil types.

Table 4-1: Percentage of HSG that overlies Tn, Rv, and Tg Soil Types

Unit	Portion of HSG Overlying the Unit
Tujunga sandy loam (Tn)	50%
Riverwash (Rv)	40%
Tujunga gravelly sand (Tg)	10%

The HSG is mapped in an old drainage way with typical bar deposition and channel scouring. Overall, the drainage class is expected to be somewhat excessively drained. As shown on Figure 4-9, it appears there are sand and/or gravel barrow pits to the southwest. Given the close proximity of the HSG to the San Gabriel Mountains and being situated in a large drainage way, overall the soil units are expected to be sandy in nature with variable (or appreciable) percentages of gravel (2-75mm), cobbles (76-250mm), or even stone (251-600mm) size fragments.

Naturally Occurring Levels of Arsenic in Soils and Stream Sediments

Arsenic concentrations in soil/sediment for Los Angeles County and southern California were evaluated using published reports by the California Department of Toxic Substances Control (DTSC) and the USGS. The natural presence of arsenic is well documented. Available information indicates that arsenic is highly variable and may be due to naturally occurring, regional anthropogenic contributions, or a site-specific release.

Soil

The DTSC conducted a regional background study for arsenic in shallow soils at proposed school sites. Among Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties, Los Angeles County had the largest number of sites (19) and arsenic data points (1,097). Statistical analysis resulted in an upper-bound arsenic concentration of approximately 12 mg/kg (Chernoff, Bosan and Oudiz, unknown date) with a range of 0.15 mg/kg to 19.63 mg/kg within the county. Site specific arsenic concentrations near HSG and PSG could not be determined based on this study.

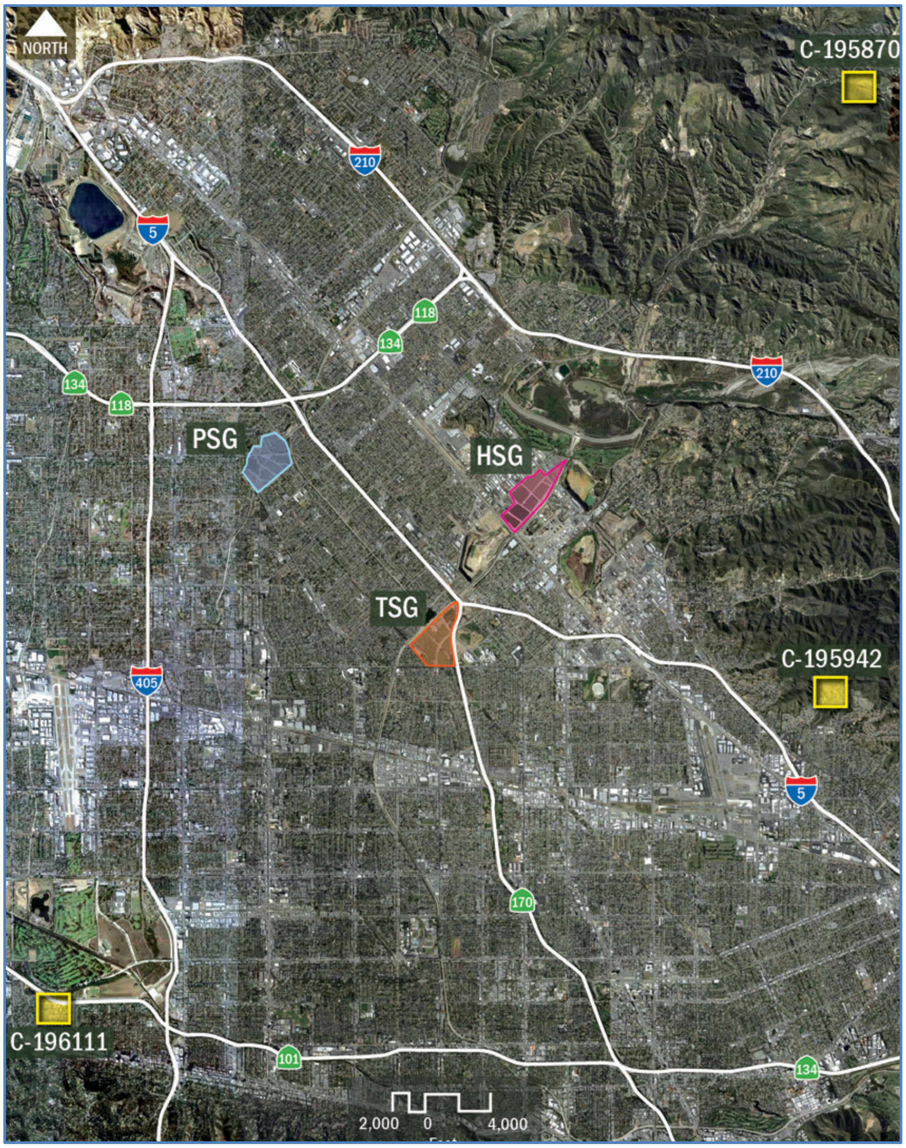
Stream Sediment

Arsenic data for sediment within Los Angeles County surface water tributaries were reviewed from the USGS National Geochemical Survey database (approximately 182 samples). Arsenic concentrations ranged from 0.31 to 90.8 mg/kg and averaged 6.75 mg/kg (USGS 2010). **Table 4-2** and **Figure 4-9** show the samples in the vicinity of HSG and PSG.

Table 4-2: Stream Sediment Data

Sediment Sample Number	Date Collected	Arsenic Concentration (mg/kg)	Latitude	Longitude	Stream Bed Material Description
C-195870	4-25-81	2.0	34°32’00.8”	-118°33’01.3”	Fines, Boulders
C-195942	1-29-82	2.4	34°21’68.4”	-118°33’47.5”	Sand, Cobbles
C-196111	8-4-79	28.4	34°16’44.0”	-118°49’05.5”	Fines, Sand, Gravel

Figure 4-9: Samples In the Vicinity of HSG and PSG



Samples C-195870 and C-195942 appear to have been collected in an upland area with greater topographic relief than the C-196111 sample. The stream bed material description also indicates the presence of heavier mountain parent material in the upland samples. Sample C-196111 appears to be a more representative sample of HSG and PSG area due to similar geomorphic and topographic features.

Up-Stream Surface Water Quality

LADWP surface water quality reports were reviewed to determine if water quality data from runoff from the San Gabriel Mountains were available. No sampling stations were identified upstream from the HSG and PSG and limited data were available for the typical quality of water originating from the San Gabriel Mountain foothills.

The "Los Angeles County 1994-2000 Integrated Receiving Water Impacts Report" (LAC 2000) indicated a sampling site (S11 Sawpit Creek) that lies downstream of a watershed that is almost entirely in the San Gabriel Mountains. The site is approximately 10 miles east of the Tujunga Wash Watershed and is assumed to have relatively similar watershed conditions. The S11 Sawpit Creek sampling station (located in the City of Monrovia) was characterized as "Vacant/Open Space Recreation". The report lists a total of 34 samples collected and analyzed for dissolved and total arsenic. The number of samples obtained for the S11 Sawpit Creek sampling site is not known. The data indicate no concentrations of dissolved arsenic above the detection limit of 5 ug/L. Two samples had reportable concentrations (values not reported) of total arsenic resulting in 6 percent detections. Based on the dissolved and total data from this location, significant arsenic levels in surface water originating from the San Gabriel Mountain foothills are not expected.

4.3.4 Other Relevant Area Studies

In Orange County, the Groundwater Replenishment System (GWRS) utilizes highly treated wastewater that would have previously been discharged into the Pacific Ocean and purifies it using a three-step advanced treatment process consisting of microfiltration, RO, and ultraviolet light with hydrogen peroxide, essentially the same processes as proposed for LADWP. Since operation in January 2008, the advanced treatment facility can produce up to 70 mgd of high-quality water that meets all state and federal drinking water standards. With current operation, approximately 35 mgd of GWRS water is pumped into injection wells to serve as a saltwater intrusion barrier. The remaining 35 mgd is pumped to surface recharge basins in Anaheim to replenish groundwater. The first GWRS purified recycled water deliveries to the basins occurred in January 2008. These same basins also have received other sources of recharge water including Santa Ana River water base flow, captured stormwater from the Santa Ana River, State Water Project (SWP) water, and Colorado River water for many years prior to the start of GWRS.

OCWD studies indicated the potential for surface spreading of purified wastewater to mobilize metals from alluvial aquifer sediments. The significance of arsenic in recharge water was evaluated as part of a quantitative relative risk assessment was conducted for GWRS (EOA 2000). For this study, existing chemical and microbiological data were used to compare the relative risk of using recycled water that had undergone treatment by reverse osmosis for replenishment, to other sources of replenishment water: 1) the Santa Ana River[2]; and 2) imported water from the Colorado River and State Water Project (SWP). For non-carcinogenic risk, the hazard index for each water matrix was below one, which is considered the threshold for potential health effects, with the advanced treated reclaimed water lower than the Santa Ana River water and the imported waters. For carcinogenic risks, the risk levels were lower for the advanced treated reclaimed water and imported waters in comparison to the Santa Ana River water. Although the levels of arsenic were below the then "existing" drinking water maximum contaminant level of 50 ug/L and the then "proposed" maximum contaminant level of 10 ug/L, arsenic represented the majority of risk. Arsenic concentrations in the advanced treated reclaimed water were 60 times lower than the Santa Ana River water and 35 times lower than the imported water levels.

[2] At times of the year, the Santa Ana River is comprised almost entirely of wastewater from upstream discharges.

A quarterly groundwater monitoring program (including arsenic) was implemented in 2006 at select wells downgradient of the recharge basins. **Figures 4-10, 4-11, and 4-12** (Burris 2011) show water quality measurements from three aquifers in the GWRS area.

- Figure 4-10 (Shallow Aquifer): Concentrations of arsenic have not been reported above the Primary MCL of 10 ug/L since inception of sampling. Higher concentrations are reported at AM-7 as compared to AM-8. Decreasing concentrations have been reported at AM-7 since the first quarter 2010 and are presently at levels less than the 2008 recycled water delivery background.

- Figure 4-11 (Principal Aquifer): Five individual depths are monitored from well AMD-10. Arsenic concentrations in the upper-most screened interval (AMD-10/1) from this well indicated sporadic MCL exceedances during 2008 through 2010. In the first quarter of 2010, arsenic was reported at 13.2 ug/L and decreased during the remainder of the year to levels less than the 2008 recycled water delivery background level (approximately 5.5 ug/L). The data from the four remaining deeper zones have never exceeded the MCL (10 ug/L), but concentrations from AMD-10/2 appear to have an overall increasing trend.

- Figure 4-12 (Principal Aquifer): Five individual depths are monitored from well AMD-12. Concentrations of arsenic have not been reported above the MCL since inception of sampling. Arsenic concentrations in the upper-most screened interval (AMD-12/1) increased to a maximum of 8.6 ug/L in the first quarter of 2010, compared to 6.8 ug/L in the 4th quarter of 2009, and decreased during the remainder of 2010. The 4th quarter 2010 result of 5 ug/L is slightly higher than the 2008 recycled water delivery background level (approximately 1.2 ug/L). The data from the four remaining deeper zones have never exceeded the MCL, with no apparent increasing trends.

Overall, decreases in arsenic were observed in all of the monitoring wells in 2010. This decrease is believed to coincide with an increase in chloride concentration in the recharge water. The chloride increase was interpreted to be caused by a considerably higher proportion of Santa Ana River and imported water recharge in the vicinity of the Anaheim basins during 2010 compared to 2009. In general, groundwater arsenic concentrations in the monitoring wells appear to increase when greater volumes of GWRS purified recycled water are delivered to the basins or mixing of Santa Ana River/imported water volumes are lower. Similarly, arsenic concentrations tend to fall when more Santa Ana/imported water is recharged. No groundwater production wells in the GWRS area have been impacted by the Anaheim basins.

Figure 4-10: Arsenic Concentrations in OCWD Shallow Aquifer Wells AM-7 and AM-8, 2006-2010

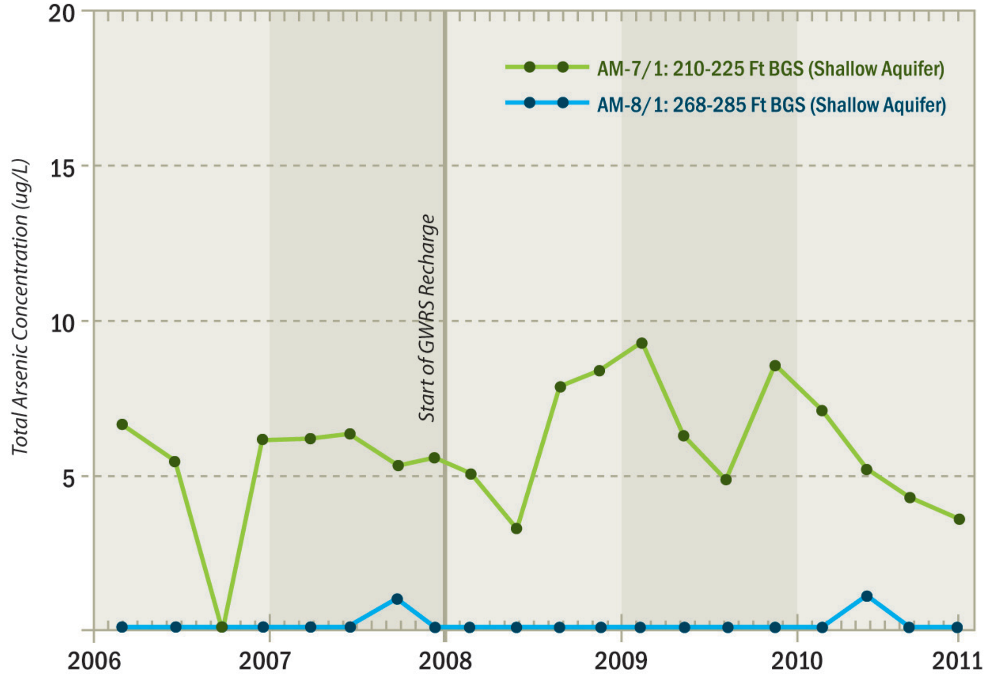


Figure 4-11: Arsenic Concentrations in OCWD Principal Aquifer Well AMD-10, 2006-2010

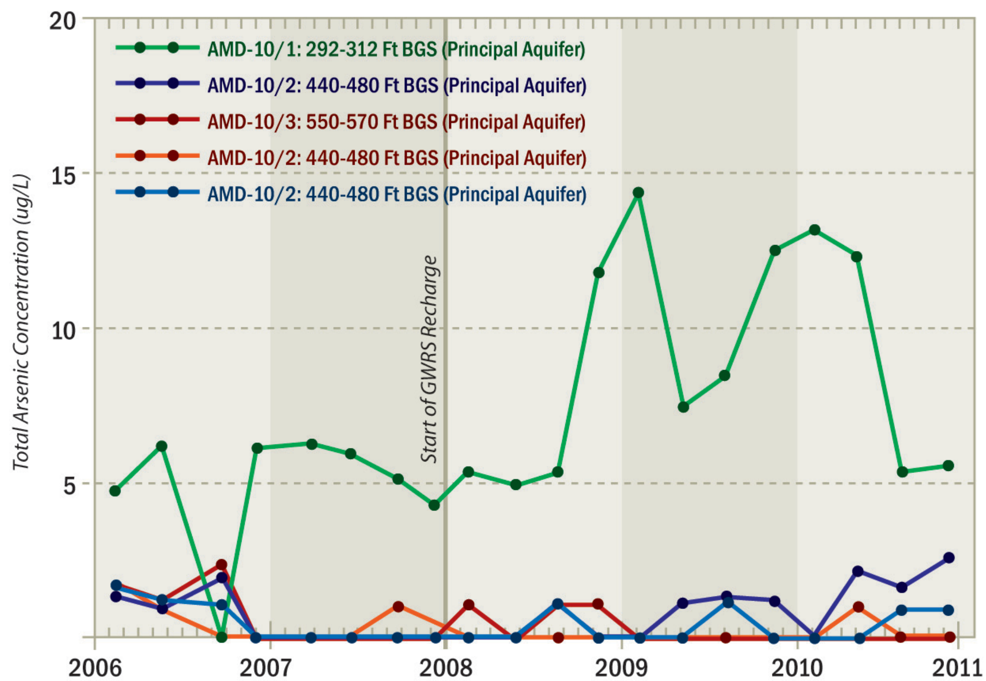
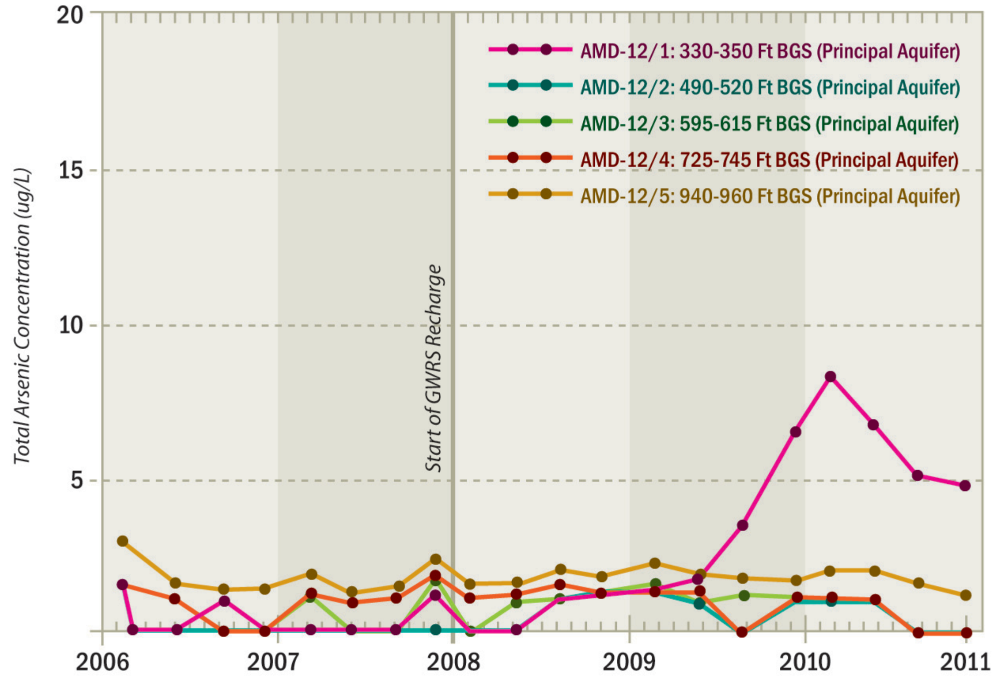


Figure 4-12: Arsenic Concentrations in OCWD Principal Aquifer Well AMD-12, 2006-2010



4.3.5 AWPF Water Quality

Effluent water quality samples from the AWPF pilot system to determine the geochemical conditions that may result from the recharge of the AWPF treated water. **Table 4-3** provides the analytical results for the parameters of interest in this evaluation.

Table 4-3: AWPF Pilot Effluent Water Quality Analytical Results

Parameter	Units	Detection Limit	RO Product Water
Aluminum	mg/L	0.05	ND
Antimony	mg/L	0.006	ND
Arsenic	mg/L	0.002	ND
Asbestos	MFL	0.2	ND
Barium	mg/L	0.1	ND
Beryllium	mg/L	0.001	ND
Cadmium	mg/L	0.001	ND
Total Chromium	mg/L	0.01	ND
Cyanide	mg/L	0.1	ND
Fluoride	mg/L	0.1	ND
Mercury	mg/L	0.001	ND
Nickel	mg/L	0.01	ND

Table 4-3: AWPF Pilot Effluent Water Quality Analytical Results (cont.)

Parameter	Units	Detection Limit	RO Product Water
Nitrate (as NO3)	mg/L	2	4.8
Nitrite (as N)	mg/L	0.4	ND
Nitrate + Nitrite (as N)	mg/L	-	1.1
Perchlorate	mg/L	0.004	ND
Selenium	mg/L	0.005	ND
Thallium	mg/L	0.001	ND
Molybdenum	µg/L	0.10	0.11
Vanadium	µg/L	5.0	ND
Uranium	µg/L	0.20	ND
Color	Pt-Co	3	ND
Copper	mg/L	0.0005	ND
Foaming Agents (MBAs)	mg/L	0.05	ND
Iron	mg/L	0.01	ND
Manganese	mg/L	0.0002	ND
Silver	mg/L	0.002	ND
Turbidity	NTU	0.1	0.11
Total Dissolved Solids (TDS)	mg/L	10	22
Specific Conductance	micromhos	-	37
Chloride	mg/L	0.5	3.6
Sulfate	mg/L	0.5	0.96
Boron	µg/L	10	400
Bromide	µg/L	10	ND
Calcium	mg/L	0.1	0.41
Magnesium	mg/L	0.1	ND
Strontium	µg/L	0.2	2.7
Total Nitrogen	mg/L	-	1.9
Ammonia as N	mg/L	0.1	0.37
Orthophosphate, as P	µg/L	2	ND
Total phosphorous, as P	µg/L	10	ND
Potassium	mg/L	0.1	0.63
Silica	mg/L	0.04	0.52
Sodium	mg/L	0.5	6.6
TOC	mg/L	0.3	0.1
TKN	mg/L	0.1	0.38
Total Organic Halogens (TOX)	µg/L	20	20
Temperature	C°	0.1	26.3
pH	su	0.1	6.4
Alkalinity as CaCO3	mg/L	2	7.1

Table 4-4 lists results for "field" parameters that were analyzed from a sample collected just prior to the shutdown of the pilot plant.

Table 4-4: AWPF Pilot Effluent Water Quality Field Parameter Results

Parameter (units)	Result
pH (SU)	6.87
Temperature (C°)	16.9
Oxidation-Reduction Potential (mv)	114
Specific Conductance (umhos/cm)	69
Ferrous Iron (mg/L)	< 0.03
Dissolved Oxygen (mg/L)	4.1

4.3.6 Conclusions and Recommendations

Conclusions

The AWPF treated water that would be recharged at the HSG and PSG is expected to be slightly oxidizing (ORP of 114 mv, DO of 4.1 mg/L, have no detectable ferrous iron, and have nitrites at 1.1 mg/L). Therefore, release Mechanism 1 described in Section 4.3.1 (i.e., reduction of iron oxyhydroxides) will not occur. The oxidizing nature of the discharge water could be changed during the infiltration process by reaction with the soils at, or downgradient of, the recharge site (e.g., if the soils contained organic matter to create reducing conditions). However, based on the available soil information (Section 4.3.3), this reaction is not anticipated to occur.

Because the discharge waters are oxidizing, release Mechanism 2 (i.e., oxidation of reduced minerals) is possible. However, based on the available soil information (Section 4.3.3), arsenic associated with reduced mineral phases (e.g., iron sulfides/pyrites) is not present. No information was found concerning the aquifer materials below or downgradient of the recharge site; however, we would anticipate that no reduced minerals are present. Therefore, release Mechanism 2 is not expected to occur.

Release Mechanism 3 (i.e., desorption due to presence of competing anions) could occur depending upon the chemistry of the discharge water and the forms of arsenic present. As shown in Table 4-4, some of the enabling anions are not present (e.g., orthophosphate, selenium) while other enabling anions are present (e.g., carbonate/bicarbonate, silica, sulfate). However, the concentrations are relatively low. In addition, some enabling anions (e.g., vanadium, and uranium) were not detected in the discharge water. Another anion, molybdenum was measured at extremely low concentrations.

Overall, the available data indicate that the potential for release of arsenic appears low as a result of recharging AWPF treated water at the HSG. However, it is suggested that limited additional site-specific evaluations be performed to further support these conclusions. These recommendations are discussed below.

During design, arsenic dissolution is a factor that will need to be considered in the final product water conditioning step, and certain design considerations can further reduce the potential for release under this mechanism.

Recommendations for Additional Evaluations

Measurement of arsenic concentrations in surface and subsurface soils

Concentrations of arsenic in soils at the HSG and PSG are not known, but may range up to 20 mg/kg. These potential concentrations are much higher than the 1 to 3.5 mg/kg levels observed at the WRF study site where release and impact on groundwater is predicted. As discussed, no specific data exist concerning arsenic concentrations in the site specific soils at the HSG and PSG or in the aquifer below the HSG and PSG. Surface soils at the HSG and PSG and aquifer materials from below the HSG should be collected and analyzed for a variety of chemical characteristics including arsenic. The aquifer materials should be collected during the upcoming installation of monitoring wells in the area as part of the GSIS. These measurements would provide definitive documentation of the arsenic concentrations at and below the recharge area.

Forms of arsenic in the surface and subsurface soils

The leachability of the arsenic from the soils and aquifer materials depends upon the form of the arsenic in the soils and aquifer materials. Based on the forms present and the discharge water quality, more accurate evaluations of the leachability and impact of the arsenic can be made. The forms and species of arsenic should be determined in the soils and aquifer materials collected as part of above recommendation. The forms and species of arsenic typically found in solid materials are determined by electron-microprobe analyses. However, the concentrations may be too low for this type of analysis. Therefore, a more indirect determination of the forms and species of arsenic in the solid Phase 1s recommended including sequential leaching tests that operationally define the forms of arsenic present. The proposed sequential leaching tests and the associated forms of the arsenic follow:

- Extraction 1 (Soluble arsenic): 1M $MgCl_2$ at pH = 8
- Extraction 2 (Exchangeable/strongly adsorbed arsenic): 1 M NaH_2PO_4 at pH = 5
- Extraction 3 (Manganese oxide/carbonate bound arsenic): 1N HCl
- Extraction 4 (Iron oxide bound arsenic): 0.05 M $TiCl_3$, 0.05 M citrate, 0.05 M Na_4EDTA,Bicarbonate, pH = 7
- Extraction 5 (Silica phase arsenic): 10 M HF

These extractions are based on the procedures found in Dhoum and Evans (1998), Keon et al. (2001) and Wilkin and Ford (2002). The extractions and analyses are similar to those performed by Rice University for WRF 2009. Based on the chemical nature of the recharge waters and forms of arsenic in the surface and subsurface soils, more definitive evaluations can be performed concerning the leachability of the arsenic. For example, the silica phase bound arsenic is typically not leachable except at pH values above 9 to 10.

Measurement of competing anions

Several potential anions that may release arsenic from soils were not analyzed in the AWPF water. These include vanadium, molybdenum and uranium. Although these anions are not expected to be present, these parameters will be analyzed on the sample of AWPF pilot plant effluent water currently stored at 4 degrees Celsius to confirm this assumption.

Future potential evaluations

Analyses of the data collected from the above recommendations may indicate that leaching of arsenic could be a concern. If so, additional tests may be warranted only if the above testing suggests this may be a concern. Specifically, batch and column leaching tests should be conducted using the site specific soils and aquifer materials collected at the site (see above recommendation) combined with the AWPF water. A specific work plan would be prepared for this work. Some of the tests would be similar to those performed by Rice University for the WateReuse Foundation (WRF 2009). The results of the leaching tests would provide the most definitive information concerning the leachability of arsenic from surface and subsurface soils at the recharge area. This information could be used to more definitively predict potential impacts on groundwater below the recharge area.

5. Alternative Regulatory Provisions

The Inland Empire Utilities Agency (IEUA) operates the Chino Basin Groundwater Recharge Project under a permit originally issued by the Santa Ana RWQCB in 2005 based at the time on the 2004 draft CDPH groundwater recharge regulations with one exception. Compliance for the disinfection byproduct MCLs was based on samples collected from a lysimeter in each of the recharge basins used for the project. LADWP and the consultant team met with Andy Campbell of IEUA to discuss the similarities and differences between LADWP's proposed project and IEAU's implemented project. The following similarities and differences were noted:

- Spreading Basins: IEUA operates several separate basins distributed across the entire Chino basin. Each basin has its own allowed RWC based on project start-up. In the SFB, the HSG, TSG, and PSG each consist of a number of basins in the same general area. Each of these spreading grounds is located within three miles of each other.
- Recycled Water: IEUA recharges tertiary-treated effluent in their recharge basins. LADWP's project would recharge recycled water processed through advanced treatment.
- Groundwater Production: Similar to the distribution of the spreading grounds, groundwater production is distributed throughout the Chino basin. Groundwater production in the SFB is concentrated in the southeastern portion of the basin. Groundwater pumping downgradient of the HSG, TSG, and PSG is focused in two large LADWP wellfields, the TWF and RTWF. These concentrated pumping centers aid in "focusing" groundwater flow as it converges at the basin discharge location in Glendale area.
- RWC: In 2009, IEUA's permit was amended to allow the use of groundwater "underflow" to be used in the calculation of RWC. The underflow represents groundwater that enters the aquifer upgradient of a spreading basin and flows under a basin. The approach was allowed by CDPH and incorporated into the permit after being reviewed by an IAP. The rationale for using underflow in the calculation suggests that the recycled water that is recharged on the ground surface will blend with the underflow prior to reaching a groundwater well or wellfield. Information from the Chino basin groundwater model and field data is used to estimate the quantity of underflow utilizing the simple Darcy groundwater flow equation. For LADWP's project, a similar use of water that has recharged the aquifer upgradient of groundwater pumping locations has been analyzed. However, for LADWP's case, only the stormwater runoff that has been captured, quantified, and recharged at the major spreading grounds (i.e., HSG, PSG, and TSG) is counted as upgradient water.

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6. References

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Appendix A
Monthly RWC Calculations

Table A.1	RWC calculation using only HSG as diluent source (Phase 1)
Table A.2	RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase 1)
Table A.3	RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase 1)
Table A.4	RWC calculation at HSG using only HSG as diluent source (Phase 2 Option A)
Table A.5	RWC calculation at PSG using only PSG as diluent source (Phase 2 Option A)
Table A.6	RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase 2 Option A)
Table A.7	RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase 1 Option A)
Table A.8	RWC calculation at HSG using only HSG as diluent source (Phase 2 Option B)
Table A.9	RWC calculation at PSG using only PSG as diluent source (Phase 2 Option B)
Table A.10	RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase 2 Option B)
Table A.11	RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase 1 Option B)

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Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	1,013	0	0	1,013			
2	11/1968	1,135	0	0	1,135			
3	12/1968	2,169	0	0	2,169			
4	01/1969	5,442	0	0	5,442			
5	02/1969	6,580	0	0	6,580			
6	03/1969	8,074	0	0	8,074			
7	04/1969	5,487	0	0	5,487			
8	05/1969	3,446	0	0	3,446			
9	06/1969	2,416	0	0	2,416			
10	07/1969	1,076	0	0	1,076			
11	08/1969	578	0	0	578			
12	09/1969	438	0	0	438			
13	10/1969	372	0	0	372			
14	11/1969	417	0	0	417			
15	12/1969	797	0	0	797			
16	01/1970	1,999	0	0	1,999			
17	02/1970	2,417	0	0	2,417			
18	03/1970	2,966	0	0	2,966			
19	04/1970	2,016	0	0	2,016			
20	05/1970	1,266	0	0	1,266			
21	06/1970	888	0	0	888			
22	07/1970	395	0	0	395			
23	08/1970	212	0	0	212			
24	09/1970	161	0	0	161			
25	10/1970	364	0	0	364			
26	11/1970	407	0	0	407			
27	12/1970	779	0	0	779			
28	01/1971	1,954	0	0	1,954			
29	02/1971	2,363	0	0	2,363			
30	03/1971	2,899	0	0	2,899			
31	04/1971	1,970	0	0	1,970	1,250		
32	05/1971	1,237	0	0	1,237	1,250		
33	06/1971	867	0	0	867	1,250		
34	07/1971	386	0	0	386	1,250		
35	08/1971	208	0	0	208	1,250		
36	09/1971	157	0	0	157	1,250		
37	10/1971	60	0	0	60	1,250		
38	11/1971	68	0	0	68	1,250		
39	12/1971	129	0	0	129	1,250		
40	01/1972	324	0	0	324	1,250		
41	02/1972	392	0	0	392	1,250		
42	03/1972	481	0	0	481	1,250		
43	04/1972	327	0	0	327	1,250		
44	05/1972	205	0	0	205	1,250		
45	06/1972	144	0	0	144	1,250		
46	07/1972	64	0	0	64	1,250		
47	08/1972	34	0	0	34	1,250		
48	09/1972	26	0	0	26	1,250		
49	10/1972	289	0	0	289	1,250		
50	11/1972	324	0	0	324	1,250		
51	12/1972	619	0	0	619	1,250		
52	01/1973	1,554	0	0	1,554	1,250		
53	02/1973	1,879	0	0	1,879	1,250		
54	03/1973	2,306	0	0	2,306	1,250		

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	1,567	0	0	1,567	1,250		
56	05/1973	984	0	0	984	1,250		
57	06/1973	690	0	0	690	1,250		
58	07/1973	307	0	0	307	1,250		
59	08/1973	165	0	0	165	1,250		
60	09/1973	125	0	0	125	1,250	50%	32%
61	10/1973	196	0	0	196	1,250	50%	33%
62	11/1973	220	0	0	220	1,250	50%	34%
63	12/1973	420	0	0	420	1,250	50%	36%
64	01/1974	1,054	0	0	1,054	1,250	50%	38%
65	02/1974	1,274	0	0	1,274	1,250	50%	40%
66	03/1974	1,564	0	0	1,564	1,250	50%	43%
67	04/1974	1,063	0	0	1,063	1,250	50%	46%
68	05/1974	667	0	0	667	1,250	50%	48%
69	06/1974	468	0	0	468	1,250	50%	50%
70	07/1974	208	0	0	208	1,250	50%	51%
71	08/1974	112	0	0	112	1,250	50%	52%
72	09/1974	85	0	0	85	1,250	50%	52%
73	10/1974	169	0	0	169	1,250	50%	53%
74	11/1974	190	0	0	190	1,250	50%	54%
75	12/1974	362	0	0	362	1,250	50%	54%
76	01/1975	909	0	0	909	1,250	50%	56%
77	02/1975	1,099	0	0	1,099	1,250	50%	57%
78	03/1975	1,349	0	0	1,349	1,250	50%	58%
79	04/1975	917	0	0	917	1,250	50%	59%
80	05/1975	576	0	0	576	1,250	50%	60%
81	06/1975	404	0	0	404	1,250	50%	61%
82	07/1975	180	0	0	180	1,250	50%	62%
83	08/1975	97	0	0	97	1,250	50%	62%
84	09/1975	73	0	0	73	1,250	50%	63%
85	10/1975	98	0	0	98	1,250	50%	63%
86	11/1975	109	0	0	109	1,250	50%	64%
87	12/1975	209	0	0	209	1,250	50%	65%
88	01/1976	524	0	0	524	1,250	50%	66%
89	02/1976	634	0	0	634	1,250	50%	67%
90	03/1976	778	0	0	778	1,250	50%	69%
91	04/1976	529	0	0	529	1,250	50%	70%
92	05/1976	332	0	0	332	1,250	50%	70%
93	06/1976	233	0	0	233	1,250	50%	71%
94	07/1976	104	0	0	104	1,250	50%	71%
95	08/1976	56	0	0	56	1,250	50%	71%
96	09/1976	42	0	0	42	1,250	50%	71%
97	10/1976	83	0	0	83	1,250	50%	71%
98	11/1976	93	0	0	93	1,250	50%	71%
99	12/1976	177	0	0	177	1,250	50%	71%
100	01/1977	445	0	0	445	1,250	50%	71%
101	02/1977	538	0	0	538	1,250	50%	71%
102	03/1977	661	0	0	661	1,250	50%	71%
103	04/1977	449	0	0	449	1,250	50%	71%
104	05/1977	282	0	0	282	1,250	50%	71%
105	06/1977	198	0	0	198	1,250	50%	71%
106	07/1977	88	0	0	88	1,250	50%	71%
107	08/1977	47	0	0	47	1,250	50%	71%
108	09/1977	36	0	0	36	1,250	50%	71%

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	877	0	0	877	1,250	50%	70%
110	11/1977	983	0	0	983	1,250	50%	70%
111	12/1977	1,879	0	0	1,879	1,250	50%	69%
112	01/1978	4,714	0	0	4,714	1,250	50%	67%
113	02/1978	5,700	0	0	5,700	1,250	50%	65%
114	03/1978	6,994	0	0	6,994	1,250	50%	62%
115	04/1978	4,754	0	0	4,754	1,250	50%	61%
116	05/1978	2,985	0	0	2,985	1,250	50%	60%
117	06/1978	2,093	0	0	2,093	1,250	50%	59%
118	07/1978	932	0	0	932	1,250	50%	59%
119	08/1978	501	0	0	501	1,250	50%	59%
120	09/1978	379	0	0	379	1,250	50%	59%
121	10/1978	770	0	0	770	1,250	50%	58%
122	11/1978	863	0	0	863	1,250	50%	58%
123	12/1978	1,650	0	0	1,650	1,250	50%	57%
124	01/1979	4,140	0	0	4,140	1,250	50%	56%
125	02/1979	5,005	0	0	5,005	1,250	50%	55%
126	03/1979	6,142	0	0	6,142	1,250	50%	53%
127	04/1979	4,175	0	0	4,175	1,250	50%	52%
128	05/1979	2,622	0	0	2,622	1,250	50%	51%
129	06/1979	1,838	0	0	1,838	1,250	50%	51%
130	07/1979	819	0	0	819	1,250	50%	50%
131	08/1979	440	0	0	440	1,250	50%	50%
132	09/1979	333	0	0	333	1,250	50%	50%
133	10/1979	970	0	0	970	1,250	50%	50%
134	11/1979	1,087	0	0	1,087	1,250	50%	50%
135	12/1979	2,077	0	0	2,077	1,250	50%	49%
136	01/1980	5,211	0	0	5,211	1,250	50%	48%
137	02/1980	6,300	0	0	6,300	1,250	50%	46%
138	03/1980	7,732	0	0	7,732	1,250	50%	44%
139	04/1980	5,255	0	0	5,255	1,250	50%	43%
140	05/1980	3,300	0	0	3,300	1,250	50%	43%
141	06/1980	2,313	0	0	2,313	1,250	50%	42%
142	07/1980	1,030	0	0	1,030	1,250	50%	42%
143	08/1980	554	0	0	554	1,250	50%	42%
144	09/1980	419	0	0	419	1,250	50%	42%
145	10/1980	451	0	0	451	1,250	50%	42%
146	11/1980	506	0	0	506	1,250	50%	42%
147	12/1980	967	0	0	967	1,250	50%	41%
148	01/1981	2,426	0	0	2,426	1,250	50%	41%
149	02/1981	2,933	0	0	2,933	1,250	50%	40%
150	03/1981	3,599	0	0	3,599	1,250	50%	40%
151	04/1981	2,446	0	0	2,446	1,250	50%	39%
152	05/1981	1,536	0	0	1,536	1,250	50%	39%
153	06/1981	1,077	0	0	1,077	1,250	50%	39%
154	07/1981	480	0	0	480	1,250	50%	39%
155	08/1981	258	0	0	258	1,250	50%	39%
156	09/1981	195	0	0	195	1,250	50%	39%
157	10/1981	447	0	0	447	1,250	50%	39%
158	11/1981	500	0	0	500	1,250	50%	39%
159	12/1981	956	0	0	956	1,250	50%	39%
160	01/1982	2,400	0	0	2,400	1,250	50%	38%
161	02/1982	2,902	0	0	2,902	1,250	50%	38%
162	03/1982	3,561	0	0	3,561	1,250	50%	37%

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	2,420	0	0	2,420	1,250	50%	37%
164	05/1982	1,520	0	0	1,520	1,250	50%	37%
165	06/1982	1,065	0	0	1,065	1,250	50%	36%
166	07/1982	475	0	0	475	1,250	50%	36%
167	08/1982	255	0	0	255	1,250	50%	36%
168	09/1982	193	0	0	193	1,250	50%	36%
169	10/1982	1,098	0	0	1,098	1,250	50%	36%
170	11/1982	1,230	0	0	1,230	1,250	50%	36%
171	12/1982	2,351	0	0	2,351	1,250	50%	36%
172	01/1983	5,899	0	0	5,899	1,250	50%	36%
173	02/1983	7,132	0	0	7,132	1,250	50%	36%
174	03/1983	8,752	0	0	8,752	1,250	50%	35%
175	04/1983	5,949	0	0	5,949	1,250	50%	35%
176	05/1983	3,736	0	0	3,736	1,250	50%	35%
177	06/1983	2,619	0	0	2,619	1,250	50%	35%
178	07/1983	1,167	0	0	1,167	1,250	50%	35%
179	08/1983	627	0	0	627	1,250	50%	35%
180	09/1983	475	0	0	475	1,250	50%	35%
181	10/1983	325	0	0	325	1,250	50%	35%
182	11/1983	364	0	0	364	1,250	50%	35%
183	12/1983	695	0	0	695	1,250	50%	35%
184	01/1984	1,745	0	0	1,745	1,250	50%	36%
185	02/1984	2,110	0	0	2,110	1,250	50%	36%
186	03/1984	2,589	0	0	2,589	1,250	50%	37%
187	04/1984	1,760	0	0	1,760	1,250	50%	37%
188	05/1984	1,105	0	0	1,105	1,250	50%	38%
189	06/1984	775	0	0	775	1,250	50%	38%
190	07/1984	345	0	0	345	1,250	50%	38%
191	08/1984	185	0	0	185	1,250	50%	38%
192	09/1984	140	0	0	140	1,250	50%	38%
193	10/1984	414	0	0	414	1,250	50%	38%
194	11/1984	464	0	0	464	1,250	50%	38%
195	12/1984	887	0	0	887	1,250	50%	38%
196	01/1985	2,225	0	0	2,225	1,250	50%	39%
197	02/1985	2,690	0	0	2,690	1,250	50%	40%
198	03/1985	3,301	0	0	3,301	1,250	50%	41%
199	04/1985	2,244	0	0	2,244	1,250	50%	41%
200	05/1985	1,409	0	0	1,409	1,250	50%	42%
201	06/1985	988	0	0	988	1,250	50%	42%
202	07/1985	440	0	0	440	1,250	50%	42%
203	08/1985	236	0	0	236	1,250	50%	42%
204	09/1985	179	0	0	179	1,250	50%	42%
205	10/1985	567	0	0	567	1,250	50%	42%
206	11/1985	636	0	0	636	1,250	50%	42%
207	12/1985	1,215	0	0	1,215	1,250	50%	42%
208	01/1986	3,049	0	0	3,049	1,250	50%	42%
209	02/1986	3,686	0	0	3,686	1,250	50%	42%
210	03/1986	4,523	0	0	4,523	1,250	50%	42%
211	04/1986	3,074	0	0	3,074	1,250	50%	42%
212	05/1986	1,931	0	0	1,931	1,250	50%	41%
213	06/1986	1,353	0	0	1,353	1,250	50%	41%
214	07/1986	603	0	0	603	1,250	50%	41%
215	08/1986	324	0	0	324	1,250	50%	41%
216	09/1986	245	0	0	245	1,250	50%	41%

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	228	0	0	228	1,250	50%	41%
218	11/1986	256	0	0	256	1,250	50%	41%
219	12/1986	488	0	0	488	1,250	50%	42%
220	01/1987	1,226	0	0	1,226	1,250	50%	42%
221	02/1987	1,482	0	0	1,482	1,250	50%	42%
222	03/1987	1,818	0	0	1,818	1,250	50%	43%
223	04/1987	1,236	0	0	1,236	1,250	50%	43%
224	05/1987	776	0	0	776	1,250	50%	43%
225	06/1987	544	0	0	544	1,250	50%	43%
226	07/1987	242	0	0	242	1,250	50%	43%
227	08/1987	130	0	0	130	1,250	50%	43%
228	09/1987	99	0	0	99	1,250	50%	43%
229	10/1987	538	0	0	538	1,250	50%	43%
230	11/1987	603	0	0	603	1,250	50%	44%
231	12/1987	1,152	0	0	1,152	1,250	50%	44%
232	01/1988	2,892	0	0	2,892	1,250	50%	45%
233	02/1988	3,496	0	0	3,496	1,250	50%	46%
234	03/1988	4,291	0	0	4,291	1,250	50%	47%
235	04/1988	2,916	0	0	2,916	1,250	50%	48%
236	05/1988	1,831	0	0	1,831	1,250	50%	48%
237	06/1988	1,284	0	0	1,284	1,250	50%	49%
238	07/1988	572	0	0	572	1,250	50%	49%
239	08/1988	307	0	0	307	1,250	50%	49%
240	09/1988	233	0	0	233	1,250	50%	49%
241	10/1988	120	0	0	120	1,250	50%	49%
242	11/1988	134	0	0	134	1,250	50%	49%
243	12/1988	257	0	0	257	1,250	50%	49%
244	01/1989	644	0	0	644	1,250	50%	50%
245	02/1989	779	0	0	779	1,250	50%	50%
246	03/1989	956	0	0	956	1,250	50%	51%
247	04/1989	650	0	0	650	1,250	50%	51%
248	05/1989	408	0	0	408	1,250	50%	51%
249	06/1989	286	0	0	286	1,250	50%	52%
250	07/1989	127	0	0	127	1,250	50%	52%
251	08/1989	68	0	0	68	1,250	50%	52%
252	09/1989	52	0	0	52	1,250	50%	52%
253	10/1989	63	0	0	63	1,250	50%	52%
254	11/1989	71	0	0	71	1,250	50%	52%
255	12/1989	136	0	0	136	1,250	50%	52%
256	01/1990	340	0	0	340	1,250	50%	53%
257	02/1990	411	0	0	411	1,250	50%	54%
258	03/1990	505	0	0	505	1,250	50%	55%
259	04/1990	343	0	0	343	1,250	50%	56%
260	05/1990	215	0	0	215	1,250	50%	56%
261	06/1990	151	0	0	151	1,250	50%	57%
262	07/1990	67	0	0	67	1,250	50%	57%
263	08/1990	36	0	0	36	1,250	50%	57%
264	09/1990	27	0	0	27	1,250	50%	57%
265	10/1990	358	0	0	358	1,250	50%	57%
266	11/1990	402	0	0	402	1,250	50%	57%
267	12/1990	768	0	0	768	1,250	50%	57%
268	01/1991	1,926	0	0	1,926	1,250	50%	58%
269	02/1991	2,328	0	0	2,328	1,250	50%	58%
270	03/1991	2,857	0	0	2,857	1,250	50%	59%

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	1,942	0	0	1,942	1,250	50%	**60%**
272	05/1991	1,220	0	0	1,220	1,250	50%	**60%**
273	06/1991	855	0	0	855	1,250	50%	**60%**
274	07/1991	381	0	0	381	1,250	50%	**60%**
275	08/1991	205	0	0	205	1,250	50%	**60%**
276	09/1991	155	0	0	155	1,250	50%	**61%**
277	10/1991	482	0	0	482	1,250	50%	**60%**
278	11/1991	540	0	0	540	1,250	50%	**60%**
279	12/1991	1,033	0	0	1,033	1,250	50%	**60%**
280	01/1992	2,592	0	0	2,592	1,250	50%	**59%**
281	02/1992	3,134	0	0	3,134	1,250	50%	**59%**
282	03/1992	3,845	0	0	3,845	1,250	50%	**58%**
283	04/1992	2,613	0	0	2,613	1,250	50%	**57%**
284	05/1992	1,641	0	0	1,641	1,250	50%	**57%**
285	06/1992	1,150	0	0	1,150	1,250	50%	**56%**
286	07/1992	513	0	0	513	1,250	50%	**56%**
287	08/1992	275	0	0	275	1,250	50%	**56%**
288	09/1992	209	0	0	209	1,250	50%	**56%**
289	10/1992	817	0	0	817	1,250	50%	**56%**
290	11/1992	915	0	0	915	1,250	50%	**56%**
291	12/1992	1,749	0	0	1,749	1,250	50%	**56%**
292	01/1993	4,389	0	0	4,389	1,250	50%	**55%**
293	02/1993	5,307	0	0	5,307	1,250	50%	**54%**
294	03/1993	6,513	0	0	6,513	1,250	50%	**54%**
295	04/1993	4,426	0	0	4,426	1,250	50%	**53%**
296	05/1993	2,780	0	0	2,780	1,250	50%	**53%**
297	06/1993	1,949	0	0	1,949	1,250	50%	**52%**
298	07/1993	868	0	0	868	1,250	50%	**52%**
299	08/1993	466	0	0	466	1,250	50%	**52%**
300	09/1993	353	0	0	353	1,250	50%	**52%**
301	10/1993	376	0	0	376	1,250	50%	**52%**
302	11/1993	421	0	0	421	1,250	50%	**52%**
303	12/1993	805	0	0	805	1,250	50%	**52%**
304	01/1994	2,020	0	0	2,020	1,250	50%	**51%**
305	02/1994	2,443	0	0	2,443	1,250	50%	**51%**
306	03/1994	2,997	0	0	2,997	1,250	50%	**50%**
307	04/1994	2,037	0	0	2,037	1,250	50%	50%
308	05/1994	1,279	0	0	1,279	1,250	50%	49%
309	06/1994	897	0	0	897	1,250	50%	49%
310	07/1994	400	0	0	400	1,250	50%	49%
311	08/1994	215	0	0	215	1,250	50%	49%
312	09/1994	163	0	0	163	1,250	50%	49%
313	10/1994	1,096	0	0	1,096	1,250	50%	49%
314	11/1994	1,228	0	0	1,228	1,250	50%	48%
315	12/1994	2,347	0	0	2,347	1,250	50%	48%
316	01/1995	5,890	0	0	5,890	1,250	50%	46%
317	02/1995	7,121	0	0	7,121	1,250	50%	44%
318	03/1995	8,739	0	0	8,739	1,250	50%	42%
319	04/1995	5,939	0	0	5,939	1,250	50%	41%
320	05/1995	3,730	0	0	3,730	1,250	50%	40%
321	06/1995	2,615	0	0	2,615	1,250	50%	40%
322	07/1995	1,165	0	0	1,165	1,250	50%	39%
323	08/1995	626	0	0	626	1,250	50%	39%
324	09/1995	474	0	0	474	1,250	50%	39%

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	257	0	0	257	1,250	50%	39%
326	11/1995	288	0	0	288	1,250	50%	39%
327	12/1995	550	0	0	550	1,250	50%	39%
328	01/1996	1,380	0	0	1,380	1,250	50%	39%
329	02/1996	1,668	0	0	1,668	1,250	50%	39%
330	03/1996	2,047	0	0	2,047	1,250	50%	40%
331	04/1996	1,391	0	0	1,391	1,250	50%	40%
332	05/1996	874	0	0	874	1,250	50%	40%
333	06/1996	613	0	0	613	1,250	50%	40%
334	07/1996	273	0	0	273	1,250	50%	40%
335	08/1996	147	0	0	147	1,250	50%	40%
336	09/1996	111	0	0	111	1,250	50%	40%
337	10/1996	0	0	0	0	1,250	50%	40%
338	11/1996	339	0	0	339	1,250	50%	40%
339	12/1996	1,924	0	0	1,924	1,250	50%	40%
340	01/1997	3,708	0	0	3,708	1,250	50%	40%
341	02/1997	2,833	0	0	2,833	1,250	50%	40%
342	03/1997	733	0	0	733	1,250	50%	40%
343	04/1997	491	0	0	491	1,250	50%	41%
344	05/1997	624	0	0	624	1,250	50%	41%
345	06/1997	345	0	0	345	1,250	50%	41%
346	07/1997	94	0	0	94	1,250	50%	41%
347	08/1997	20	0	0	20	1,250	50%	41%
348	09/1997	324	0	0	324	1,250	50%	41%
349	10/1997	428	0	0	428	1,250	50%	41%
350	11/1997	392	0	0	392	1,250	50%	42%
351	12/1997	1,364	0	0	1,364	1,250	50%	42%
352	01/1998	1,318	0	0	1,318	1,250	50%	42%
353	02/1998	5,422	0	0	5,422	1,250	50%	42%
354	03/1998	9,153	0	0	9,153	1,250	50%	42%
355	04/1998	7,008	0	0	7,008	1,250	50%	41%
356	05/1998	1,831	0	0	1,831	1,250	50%	41%
357	06/1998	4,746	0	0	4,746	1,250	50%	41%
358	07/1998	212	0	0	212	1,250	50%	41%
359	08/1998	0	0	0	0	1,250	50%	41%
360	09/1998	926	0	0	926	1,250	50%	41%
361	10/1998	1,597	0	0	1,597	1,250	50%	41%
362	11/1998	1,114	0	0	1,114	1,250	50%	40%
363	12/1998	1,667	0	0	1,667	1,250	50%	40%
364	01/1999	1,469	0	0	1,469	1,250	50%	40%
365	02/1999	1,947	0	0	1,947	1,250	50%	40%
366	03/1999	1,679	0	0	1,679	1,250	50%	41%
367	04/1999	396	0	0	396	1,250	50%	41%
368	05/1999	297	0	0	297	1,250	50%	41%
369	06/1999	239	0	0	239	1,250	50%	41%
370	07/1999	28	0	0	28	1,250	50%	42%
371	08/1999	0	0	0	0	1,250	50%	42%
372	09/1999	0	0	0	0	1,250	50%	42%
373	10/1999	21	0	0	21	1,250	50%	42%
374	11/1999	10	0	0	10	1,250	50%	42%
375	12/1999	16	0	0	16	1,250	50%	43%
376	01/2000	21	0	0	21	1,250	50%	44%
377	02/2000	2,927	0	0	2,927	1,250	50%	45%
378	03/2000	2,624	0	0	2,624	1,250	50%	47%

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	1,376	0	0	1,376	1,250	50%	48%
380	05/2000	668	0	0	668	1,250	50%	49%
381	06/2000	520	0	0	520	1,250	50%	50%
382	07/2000	285	0	0	285	1,250	50%	50%
383	08/2000	262	0	0	262	1,250	50%	51%
384	09/2000	0	0	0	0	1,250	50%	51%
385	10/2000	0	0	0	0	1,250	50%	51%
386	11/2000	0	0	0	0	1,250	50%	51%
387	12/2000	233	0	0	233	1,250	50%	51%
388	01/2001	1,214	0	0	1,214	1,250	50%	51%
389	02/2001	2,836	0	0	2,836	1,250	50%	51%
390	03/2001	5,886	0	0	5,886	1,250	50%	49%
391	04/2001	3,064	0	0	3,064	1,250	50%	49%
392	05/2001	402	0	0	402	1,250	50%	49%
393	06/2001	0	0	0	0	1,250	50%	49%
394	07/2001	0	0	0	0	1,250	50%	49%
395	08/2001	0	0	0	0	1,250	50%	49%
396	09/2001	0	0	0	0	1,250	50%	49%
397	10/2001	101	0	0	101	1,250	50%	49%
398	11/2001	267	0	0	267	1,250	50%	49%
399	12/2001	223	0	0	223	1,250	50%	50%
400	01/2002	259	0	0	259	1,250	50%	51%
401	02/2002	162	0	0	162	1,250	50%	52%
402	03/2002	159	0	0	159	1,250	50%	52%
403	04/2002	156	0	0	156	1,250	50%	52%
404	05/2002	84	0	0	84	1,250	50%	53%
405	06/2002	154	0	0	154	1,250	50%	53%
406	07/2002	0	0	0	0	1,250	50%	53%
407	08/2002	0	0	0	0	1,250	50%	53%
408	09/2002	0	0	0	0	1,250	50%	53%
409	10/2002	0	0	0	0	1,250	50%	53%
410	11/2002	31	0	0	31	1,250	50%	53%
411	12/2002	402	0	0	402	1,250	50%	53%
412	01/2003	232	0	0	232	1,250	50%	54%
413	02/2003	2,355	0	0	2,355	1,250	50%	55%
414	03/2003	2,472	0	0	2,472	1,250	50%	58%
415	04/2003	858	0	0	858	1,250	50%	61%
416	05/2003	3,813	0	0	3,813	1,250	50%	60%
417	06/2003	688	0	0	688	1,250	50%	62%
418	07/2003	140	0	0	140	1,250	50%	62%
419	08/2003	0	0	0	0	1,250	50%	62%
420	09/2003	0	0	0	0	1,250	50%	62%
421	10/2003	28	0	0	28	1,250	50%	63%
422	11/2003	168	0	0	168	1,250	50%	64%
423	12/2003	637	0	0	637	1,250	50%	64%
424	01/2004	331	0	0	331	1,250	50%	65%
425	02/2004	1,796	0	0	1,796	1,250	50%	65%
426	03/2004	3,941	0	0	3,941	1,250	50%	64%
427	04/2004	285	0	0	285	1,250	50%	64%
428	05/2004	227	0	0	227	1,250	50%	64%
429	06/2004	73	0	0	73	1,250	50%	64%
430	07/2004	5	0	0	5	1,250	50%	64%
431	08/2004	0	0	0	0	1,250	50%	64%
432	09/2004	0	0	0	0	1,250	50%	64%

Table A.1
RWC calculation using only HSG as diluent source (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	2,437	0	0	2,437	1,250	50%	63%
434	11/2004	1,446	0	0	1,446	1,250	50%	62%
435	12/2004	2,833	0	0	2,833	1,250	50%	60%
436	01/2005	6,705	0	0	6,705	1,250	50%	57%
437	02/2005	4,617	0	0	4,617	1,250	50%	57%
438	03/2005	6,553	0	0	6,553	1,250	50%	55%
439	04/2005	6,495	0	0	6,495	1,250	50%	53%
440	05/2005	2,938	0	0	2,938	1,250	50%	52%
441	06/2005	13	0	0	13	1,250	50%	52%
442	07/2005	1,597	0	0	1,597	1,250	50%	52%
443	08/2005	1,959	0	0	1,959	1,250	50%	51%
444	09/2005	1,236	0	0	1,236	1,250	50%	51%
445	10/2005	1,446	0	0	1,446	1,250	50%	50%
446	11/2005	1,959	0	0	1,959	1,250	50%	50%
447	12/2005	1,144	0	0	1,144	1,250	50%	49%
448	01/2006	3,370	0	0	3,370	1,250	50%	49%
449	02/2006	634	0	0	634	1,250	50%	49%
450	03/2006	3,755	0	0	3,755	1,250	50%	50%
451	04/2006	5,154	0	0	5,154	1,250	50%	49%
452	05/2006	2,705	0	0	2,705	1,250	50%	49%
453	06/2006	1,474	0	0	1,474	1,250	50%	48%
454	07/2006	969	0	0	969	1,250	50%	48%
455	08/2006	914	0	0	914	1,250	50%	48%
456	09/2006	777	0	0	777	1,250	50%	47%
457	10/2006	300	0	0	300	1,250	50%	47%
458	11/2006	0	0	0	0	1,250	50%	47%
459	12/2006	553	0	0	553	1,250	50%	47%
460	01/2007	871	0	0	871	1,250	50%	47%
461	02/2007	885	0	0	885	1,250	50%	47%
462	03/2007	1,248	0	0	1,248	1,250	50%	47%
463	04/2007	758	0	0	758	1,250	50%	46%
464	05/2007	830	0	0	830	1,250	50%	46%
465	06/2007	621	0	0	621	1,250	50%	46%
466	07/2007	566	0	0	566	1,250	50%	46%
467	08/2007	87	0	0	87	1,250	50%	46%
468	09/2007	0	0	0	0	1,250	50%	46%
469	10/2007	40	0	0	40	1,250	50%	46%
470	11/2007	521	0	0	521	1,250	50%	46%
471	12/2007	617	0	0	617	1,250	50%	46%
472	01/2008	4,407	0	0	4,407	1,250	50%	45%
473	02/2008	3,102	0	0	3,102	1,250	50%	44%
474	03/2008	1,165	0	0	1,165	1,250	50%	45%
475	04/2008	854	0	0	854	1,250	50%	45%
476	05/2008	1,038	0	0	1,038	1,250	50%	45%
477	06/2008	521	0	0	521	1,250	50%	46%
478	07/2008	0	0	0	0	1,250	50%	46%
479	08/2008	0	0	0	0	1,250	50%	46%
480	09/2008	0	0	0	0	1,250	50%	46%

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	618	248	282	1,148			
2	11/1968	692	277	316	1,286			
3	12/1968	1,323	530	604	2,457			
4	01/1969	3,320	1,330	1,516	6,166			
5	02/1969	4,014	1,608	1,833	7,455			
6	03/1969	4,925	1,974	2,250	9,149			
7	04/1969	3,347	1,342	1,529	6,218			
8	05/1969	2,102	842	960	3,905			
9	06/1969	1,474	591	673	2,737			
10	07/1969	656	263	300	1,219			
11	08/1969	353	141	161	655			
12	09/1969	267	107	122	496			
13	10/1969	227	27	51	306			
14	11/1969	254	31	58	343			
15	12/1969	486	59	110	655			
16	01/1970	1,220	147	276	1,643			
17	02/1970	1,475	178	334	1,987			
18	03/1970	1,809	218	410	2,438			
19	04/1970	1,230	148	279	1,657			
20	05/1970	772	93	175	1,041			
21	06/1970	541	65	123	729			
22	07/1970	241	29	55	325			
23	08/1970	130	16	29	175			
24	09/1970	98	12	22	132			
25	10/1970	222	70	0	292			
26	11/1970	249	79	0	327			
27	12/1970	475	151	0	626			
28	01/1971	1,192	378	0	1,570			
29	02/1971	1,441	457	0	1,898			
30	03/1971	1,768	560	0	2,329			
31	04/1971	1,202	381	0	1,583	763		
32	05/1971	755	239	0	994	763		
33	06/1971	529	168	0	697	763		
34	07/1971	236	75	0	310	763		
35	08/1971	127	40	0	167	763		
36	09/1971	96	30	0	126	763		
37	10/1971	37	19	0	56	763		
38	11/1971	41	22	0	63	763		
39	12/1971	79	41	0	120	763		
40	01/1972	198	104	0	301	763		
41	02/1972	239	126	0	364	763		
42	03/1972	293	154	0	447	763		
43	04/1972	199	105	0	304	763		
44	05/1972	125	66	0	191	763		
45	06/1972	88	46	0	134	763		
46	07/1972	39	21	0	60	763		
47	08/1972	21	11	0	32	763		
48	09/1972	16	8	0	24	763		
49	10/1972	176	110	49	336	763		
50	11/1972	198	123	55	376	763		
51	12/1972	378	236	105	719	763		
52	01/1973	948	592	264	1,804	763		
53	02/1973	1,146	715	319	2,181	763		
54	03/1973	1,407	878	392	2,676	763		

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	956	597	266	1,819	763		
56	05/1973	600	375	167	1,142	763		
57	06/1973	421	263	117	801	763		
58	07/1973	187	117	52	357	763		
59	08/1973	101	63	28	192	763		
60	09/1973	76	48	21	145	763	50%	22%
61	10/1973	120	41	0	161	763	50%	23%
62	11/1973	134	46	0	180	763	50%	24%
63	12/1973	256	88	0	345	763	50%	25%
64	01/1974	643	222	0	865	763	50%	27%
65	02/1974	777	268	0	1,045	763	50%	29%
66	03/1974	954	329	0	1,283	763	50%	33%
67	04/1974	648	224	0	872	763	50%	36%
68	05/1974	407	140	0	548	763	50%	38%
69	06/1974	285	98	0	384	763	50%	40%
70	07/1974	127	44	0	171	763	50%	41%
71	08/1974	68	24	0	92	763	50%	42%
72	09/1974	52	18	0	70	763	50%	43%
73	10/1974	103	43	0	146	763	50%	43%
74	11/1974	116	48	0	164	763	50%	44%
75	12/1974	221	92	0	313	763	50%	45%
76	01/1975	555	231	0	785	763	50%	46%
77	02/1975	670	279	0	950	763	50%	47%
78	03/1975	823	343	0	1,165	763	50%	48%
79	04/1975	559	233	0	792	763	50%	49%
80	05/1975	351	146	0	497	763	50%	**50%**
81	06/1975	246	103	0	349	763	50%	**51%**
82	07/1975	110	46	0	155	763	50%	**52%**
83	08/1975	59	25	0	83	763	50%	**52%**
84	09/1975	45	19	0	63	763	50%	**53%**
85	10/1975	60	23	0	82	763	50%	**53%**
86	11/1975	67	25	0	92	763	50%	**54%**
87	12/1975	127	49	0	176	763	50%	**55%**
88	01/1976	320	122	0	442	763	50%	**56%**
89	02/1976	387	148	0	534	763	50%	**57%**
90	03/1976	475	181	0	656	763	50%	**59%**
91	04/1976	323	123	0	446	763	50%	**60%**
92	05/1976	203	77	0	280	763	50%	**60%**
93	06/1976	142	54	0	196	763	50%	**61%**
94	07/1976	63	24	0	87	763	50%	**61%**
95	08/1976	34	13	0	47	763	50%	**61%**
96	09/1976	26	10	0	36	763	50%	**61%**
97	10/1976	51	34	0	84	763	50%	**61%**
98	11/1976	57	38	0	94	763	50%	**61%**
99	12/1976	108	72	0	180	763	50%	**61%**
100	01/1977	272	181	0	453	763	50%	**61%**
101	02/1977	328	219	0	547	763	50%	**61%**
102	03/1977	403	269	0	672	763	50%	**60%**
103	04/1977	274	183	0	457	763	50%	**60%**
104	05/1977	172	115	0	287	763	50%	**60%**
105	06/1977	121	80	0	201	763	50%	**60%**
106	07/1977	54	36	0	90	763	50%	**60%**
107	08/1977	29	19	0	48	763	50%	**60%**
108	09/1977	22	15	0	36	763	50%	**60%**

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	535	355	277	1,168	763	50%	60%
110	11/1977	600	398	311	1,308	763	50%	59%
111	12/1977	1,146	761	594	2,501	763	50%	58%
112	01/1978	2,876	1,910	1,489	6,275	763	50%	54%
113	02/1978	3,477	2,309	1,801	7,586	763	50%	51%
114	03/1978	4,267	2,833	2,210	9,310	763	50%	48%
115	04/1978	2,900	1,926	1,502	6,327	763	50%	45%
116	05/1978	1,821	1,209	943	3,974	763	50%	44%
117	06/1978	1,277	848	661	2,785	763	50%	43%
118	07/1978	569	378	295	1,241	763	50%	43%
119	08/1978	305	203	158	667	763	50%	43%
120	09/1978	231	154	120	505	763	50%	43%
121	10/1978	470	209	0	679	763	50%	43%
122	11/1978	527	234	0	761	763	50%	42%
123	12/1978	1,006	447	0	1,454	763	50%	42%
124	01/1979	2,525	1,123	0	3,648	763	50%	41%
125	02/1979	3,053	1,357	0	4,411	763	50%	40%
126	03/1979	3,747	1,666	0	5,413	763	50%	38%
127	04/1979	2,547	1,132	0	3,679	763	50%	37%
128	05/1979	1,599	711	0	2,310	763	50%	37%
129	06/1979	1,121	498	0	1,619	763	50%	36%
130	07/1979	499	222	0	721	763	50%	36%
131	08/1979	268	119	0	388	763	50%	36%
132	09/1979	203	90	0	294	763	50%	36%
133	10/1979	592	271	0	862	763	50%	36%
134	11/1979	663	303	0	966	763	50%	36%
135	12/1979	1,267	579	0	1,846	763	50%	35%
136	01/1980	3,179	1,454	0	4,632	763	50%	34%
137	02/1980	3,843	1,757	0	5,601	763	50%	33%
138	03/1980	4,716	2,157	0	6,873	763	50%	32%
139	04/1980	3,205	1,466	0	4,671	763	50%	31%
140	05/1980	2,013	921	0	2,934	763	50%	30%
141	06/1980	1,411	645	0	2,056	763	50%	30%
142	07/1980	629	287	0	916	763	50%	30%
143	08/1980	338	154	0	492	763	50%	30%
144	09/1980	256	117	0	373	763	50%	30%
145	10/1980	275	55	0	330	763	50%	30%
146	11/1980	309	62	0	370	763	50%	30%
147	12/1980	590	118	0	707	763	50%	30%
148	01/1981	1,480	296	0	1,775	763	50%	29%
149	02/1981	1,789	357	0	2,146	763	50%	29%
150	03/1981	2,195	439	0	2,634	763	50%	29%
151	04/1981	1,492	298	0	1,790	763	50%	28%
152	05/1981	937	187	0	1,124	763	50%	28%
153	06/1981	657	131	0	788	763	50%	28%
154	07/1981	293	58	0	351	763	50%	28%
155	08/1981	157	31	0	189	763	50%	28%
156	09/1981	119	24	0	143	763	50%	28%
157	10/1981	272	95	0	368	763	50%	28%
158	11/1981	305	107	0	412	763	50%	28%
159	12/1981	583	204	0	788	763	50%	28%
160	01/1982	1,464	513	0	1,977	763	50%	28%
161	02/1982	1,770	620	0	2,390	763	50%	27%
162	03/1982	2,172	761	0	2,933	763	50%	27%

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	1,476	517	0	1,993	763	50%	27%
164	05/1982	927	325	0	1,252	763	50%	27%
165	06/1982	650	228	0	877	763	50%	27%
166	07/1982	289	101	0	391	763	50%	26%
167	08/1982	156	54	0	210	763	50%	26%
168	09/1982	118	41	0	159	763	50%	26%
169	10/1982	670	399	229	1,297	763	50%	26%
170	11/1982	750	447	256	1,453	763	50%	26%
171	12/1982	1,434	854	490	2,778	763	50%	26%
172	01/1983	3,598	2,143	1,229	6,970	763	50%	26%
173	02/1983	4,351	2,591	1,486	8,428	763	50%	26%
174	03/1983	5,339	3,179	1,824	10,342	763	50%	26%
175	04/1983	3,629	2,161	1,239	7,029	763	50%	26%
176	05/1983	2,279	1,357	778	4,414	763	50%	26%
177	06/1983	1,597	951	546	3,094	763	50%	26%
178	07/1983	712	424	243	1,378	763	50%	26%
179	08/1983	382	228	131	740	763	50%	26%
180	09/1983	290	172	99	561	763	50%	26%
181	10/1983	198	62	0	260	763	50%	26%
182	11/1983	222	69	0	291	763	50%	26%
183	12/1983	424	132	0	556	763	50%	26%
184	01/1984	1,064	331	0	1,395	763	50%	26%
185	02/1984	1,287	400	0	1,687	763	50%	27%
186	03/1984	1,579	491	0	2,070	763	50%	27%
187	04/1984	1,073	333	0	1,407	763	50%	28%
188	05/1984	674	209	0	883	763	50%	28%
189	06/1984	473	147	0	619	763	50%	28%
190	07/1984	210	65	0	276	763	50%	28%
191	08/1984	113	35	0	148	763	50%	28%
192	09/1984	86	27	0	112	763	50%	28%
193	10/1984	253	59	0	311	763	50%	28%
194	11/1984	283	66	0	349	763	50%	28%
195	12/1984	541	125	0	666	763	50%	29%
196	01/1985	1,357	315	0	1,672	763	50%	29%
197	02/1985	1,641	381	0	2,022	763	50%	30%
198	03/1985	2,014	467	0	2,481	763	50%	31%
199	04/1985	1,369	317	0	1,686	763	50%	31%
200	05/1985	860	199	0	1,059	763	50%	32%
201	06/1985	603	140	0	742	763	50%	32%
202	07/1985	268	62	0	331	763	50%	32%
203	08/1985	144	33	0	178	763	50%	32%
204	09/1985	109	25	0	135	763	50%	32%
205	10/1985	346	116	0	463	763	50%	32%
206	11/1985	388	130	0	518	763	50%	32%
207	12/1985	741	249	0	990	763	50%	32%
208	01/1986	1,860	625	0	2,485	763	50%	32%
209	02/1986	2,249	756	0	3,005	763	50%	32%
210	03/1986	2,759	928	0	3,687	763	50%	32%
211	04/1986	1,875	631	0	2,506	763	50%	31%
212	05/1986	1,178	396	0	1,574	763	50%	31%
213	06/1986	826	278	0	1,103	763	50%	31%
214	07/1986	368	124	0	491	763	50%	31%
215	08/1986	198	66	0	264	763	50%	31%
216	09/1986	150	50	0	200	763	50%	31%

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	139	8	0	147	763	50%	31%
218	11/1986	156	9	0	165	763	50%	31%
219	12/1986	298	17	0	315	763	50%	31%
220	01/1987	748	44	0	791	763	50%	32%
221	02/1987	904	53	0	957	763	50%	32%
222	03/1987	1,109	65	0	1,174	763	50%	32%
223	04/1987	754	44	0	798	763	50%	33%
224	05/1987	473	28	0	501	763	50%	33%
225	06/1987	332	19	0	351	763	50%	33%
226	07/1987	148	9	0	156	763	50%	33%
227	08/1987	79	5	0	84	763	50%	33%
228	09/1987	60	4	0	64	763	50%	33%
229	10/1987	328	78	0	407	763	50%	33%
230	11/1987	368	88	0	456	763	50%	34%
231	12/1987	703	168	0	871	763	50%	34%
232	01/1988	1,764	422	0	2,186	763	50%	35%
233	02/1988	2,133	510	0	2,643	763	50%	37%
234	03/1988	2,617	626	0	3,243	763	50%	39%
235	04/1988	1,779	425	0	2,204	763	50%	41%
236	05/1988	1,117	267	0	1,384	763	50%	42%
237	06/1988	783	187	0	970	763	50%	43%
238	07/1988	349	83	0	432	763	50%	43%
239	08/1988	187	45	0	232	763	50%	43%
240	09/1988	142	34	0	176	763	50%	44%
241	10/1988	73	23	0	96	763	50%	44%
242	11/1988	82	25	0	107	763	50%	44%
243	12/1988	157	49	0	205	763	50%	44%
244	01/1989	393	122	0	515	763	50%	44%
245	02/1989	475	147	0	623	763	50%	45%
246	03/1989	583	181	0	764	763	50%	45%
247	04/1989	396	123	0	519	763	50%	46%
248	05/1989	249	77	0	326	763	50%	46%
249	06/1989	174	54	0	229	763	50%	46%
250	07/1989	78	24	0	102	763	50%	46%
251	08/1989	42	13	0	55	763	50%	46%
252	09/1989	32	10	0	41	763	50%	46%
253	10/1989	39	30	0	68	763	50%	46%
254	11/1989	43	33	0	76	763	50%	46%
255	12/1989	83	63	0	146	763	50%	47%
256	01/1990	207	159	0	367	763	50%	47%
257	02/1990	251	193	0	443	763	50%	48%
258	03/1990	308	236	0	544	763	50%	49%
259	04/1990	209	161	0	370	763	50%	50%
260	05/1990	131	101	0	232	763	50%	**50%**
261	06/1990	92	71	0	163	763	50%	**51%**
262	07/1990	41	32	0	73	763	50%	**51%**
263	08/1990	22	17	0	39	763	50%	**51%**
264	09/1990	17	13	0	30	763	50%	**51%**
265	10/1990	219	68	54	341	763	50%	**51%**
266	11/1990	245	77	60	382	763	50%	**51%**
267	12/1990	468	146	115	730	763	50%	**51%**
268	01/1991	1,175	368	289	1,831	763	50%	**52%**
269	02/1991	1,420	444	349	2,214	763	50%	**52%**
270	03/1991	1,743	545	429	2,717	763	50%	**53%**

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	1,185	371	291	1,847	763	50%	53%
272	05/1991	744	233	183	1,160	763	50%	53%
273	06/1991	521	163	128	813	763	50%	53%
274	07/1991	232	73	57	362	763	50%	54%
275	08/1991	125	39	31	195	763	50%	54%
276	09/1991	95	30	23	147	763	50%	54%
277	10/1991	294	224	200	719	763	50%	53%
278	11/1991	330	251	225	805	763	50%	53%
279	12/1991	630	480	429	1,539	763	50%	52%
280	01/1992	1,581	1,205	1,077	3,863	763	50%	50%
281	02/1992	1,911	1,456	1,302	4,670	763	50%	48%
282	03/1992	2,346	1,787	1,598	5,731	763	50%	46%
283	04/1992	1,594	1,215	1,086	3,895	763	50%	45%
284	05/1992	1,001	763	682	2,446	763	50%	44%
285	06/1992	702	535	478	1,715	763	50%	43%
286	07/1992	313	238	213	764	763	50%	43%
287	08/1992	168	128	114	410	763	50%	43%
288	09/1992	127	97	87	311	763	50%	43%
289	10/1992	498	295	425	1,218	763	50%	43%
290	11/1992	558	331	476	1,365	763	50%	42%
291	12/1992	1,067	632	910	2,609	763	50%	42%
292	01/1993	2,678	1,586	2,283	6,547	763	50%	40%
293	02/1993	3,237	1,917	2,761	7,916	763	50%	38%
294	03/1993	3,973	2,353	3,388	9,713	763	50%	36%
295	04/1993	2,700	1,599	2,302	6,602	763	50%	35%
296	05/1993	1,696	1,004	1,446	4,146	763	50%	34%
297	06/1993	1,189	704	1,014	2,906	763	50%	34%
298	07/1993	529	314	452	1,295	763	50%	34%
299	08/1993	284	168	243	695	763	50%	33%
300	09/1993	215	128	184	527	763	50%	33%
301	10/1993	229	55	89	373	763	50%	33%
302	11/1993	257	61	100	418	763	50%	33%
303	12/1993	491	117	191	800	763	50%	33%
304	01/1994	1,232	294	480	2,006	763	50%	33%
305	02/1994	1,490	356	580	2,426	763	50%	32%
306	03/1994	1,828	437	712	2,977	763	50%	32%
307	04/1994	1,243	297	484	2,023	763	50%	32%
308	05/1994	780	186	304	1,271	763	50%	31%
309	06/1994	547	131	213	891	763	50%	31%
310	07/1994	244	58	95	397	763	50%	31%
311	08/1994	131	31	51	213	763	50%	31%
312	09/1994	99	24	39	161	763	50%	31%
313	10/1994	669	244	394	1,307	763	50%	31%
314	11/1994	749	274	442	1,464	763	50%	30%
315	12/1994	1,432	523	844	2,799	763	50%	30%
316	01/1995	3,593	1,312	2,118	7,023	763	50%	29%
317	02/1995	4,344	1,586	2,561	8,491	763	50%	27%
318	03/1995	5,331	1,946	3,143	10,420	763	50%	26%
319	04/1995	3,623	1,323	2,136	7,082	763	50%	25%
320	05/1995	2,275	831	1,342	4,448	763	50%	24%
321	06/1995	1,595	582	940	3,118	763	50%	24%
322	07/1995	710	259	419	1,389	763	50%	24%
323	08/1995	382	139	225	746	763	50%	24%
324	09/1995	289	106	170	565	763	50%	24%

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	157	79	168	403	763	50%	24%
326	11/1995	176	88	188	452	763	50%	24%
327	12/1995	335	168	360	864	763	50%	24%
328	01/1996	842	423	902	2,167	763	50%	24%
329	02/1996	1,018	511	1,091	2,620	763	50%	23%
330	03/1996	1,249	627	1,339	3,215	763	50%	23%
331	04/1996	849	426	910	2,185	763	50%	23%
332	05/1996	533	268	571	1,372	763	50%	23%
333	06/1996	374	188	401	962	763	50%	23%
334	07/1996	166	84	178	428	763	50%	23%
335	08/1996	89	45	96	230	763	50%	23%
336	09/1996	68	34	73	174	763	50%	23%
337	10/1996	0	0	192	192	763	50%	23%
338	11/1996	207	217	57	481	763	50%	23%
339	12/1996	1,174	1,038	494	2,705	763	50%	23%
340	01/1997	2,262	1,979	2,222	6,463	763	50%	23%
341	02/1997	1,728	507	538	2,774	763	50%	23%
342	03/1997	447	0	697	1,145	763	50%	24%
343	04/1997	299	0	469	768	763	50%	24%
344	05/1997	381	0	0	381	763	50%	24%
345	06/1997	211	0	125	336	763	50%	25%
346	07/1997	58	0	238	296	763	50%	25%
347	08/1997	12	0	144	156	763	50%	25%
348	09/1997	198	1	0	198	763	50%	25%
349	10/1997	261	0	0	261	763	50%	25%
350	11/1997	239	233	73	545	763	50%	25%
351	12/1997	832	563	291	1,686	763	50%	25%
352	01/1998	804	374	54	1,232	763	50%	26%
353	02/1998	3,307	2,563	3,539	9,410	763	50%	26%
354	03/1998	5,583	3,465	1,317	10,365	763	50%	26%
355	04/1998	4,275	2,089	0	6,364	763	50%	26%
356	05/1998	1,117	1,661	739	3,516	763	50%	26%
357	06/1998	2,895	1,992	873	5,759	763	50%	25%
358	07/1998	129	465	1,463	2,057	763	50%	25%
359	08/1998	0	34	638	673	763	50%	25%
360	09/1998	565	0	48	612	763	50%	25%
361	10/1998	974	0	0	974	763	50%	25%
362	11/1998	679	29	250	958	763	50%	25%
363	12/1998	1,017	36	0	1,053	763	50%	25%
364	01/1999	896	179	87	1,163	763	50%	25%
365	02/1999	1,188	134	10	1,331	763	50%	25%
366	03/1999	1,024	0	53	1,077	763	50%	25%
367	04/1999	242	0	1,422	1,664	763	50%	26%
368	05/1999	181	36	551	769	763	50%	26%
369	06/1999	146	38	339	523	763	50%	26%
370	07/1999	17	0	320	337	763	50%	26%
371	08/1999	0	0	144	144	763	50%	26%
372	09/1999	0	0	2	2	763	50%	26%
373	10/1999	13	0	0	13	763	50%	26%
374	11/1999	6	0	0	6	763	50%	26%
375	12/1999	10	0	0	10	763	50%	27%
376	01/2000	13	51	11	75	763	50%	28%
377	02/2000	1,785	1,038	617	3,440	763	50%	29%
378	03/2000	1,600	606	921	3,128	763	50%	30%

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	839	192	521	1,553	763	50%	31%
380	05/2000	408	0	83	491	763	50%	32%
381	06/2000	317	0	0	317	763	50%	32%
382	07/2000	174	0	0	174	763	50%	33%
383	08/2000	160	0	0	160	763	50%	33%
384	09/2000	0	0	0	0	763	50%	33%
385	10/2000	0	57	0	57	763	50%	33%
386	11/2000	0	81	0	81	763	50%	33%
387	12/2000	142	0	0	142	763	50%	33%
388	01/2001	740	459	66	1,266	763	50%	34%
389	02/2001	1,730	799	335	2,864	763	50%	34%
390	03/2001	3,590	938	267	4,795	763	50%	33%
391	04/2001	1,869	148	26	2,043	763	50%	33%
392	05/2001	245	0	99	345	763	50%	33%
393	06/2001	0	0	337	337	763	50%	34%
394	07/2001	0	0	108	108	763	50%	34%
395	08/2001	0	0	73	73	763	50%	34%
396	09/2001	0	0	50	50	763	50%	34%
397	10/2001	62	175	41	278	763	50%	34%
398	11/2001	163	53	0	215	763	50%	34%
399	12/2001	136	60	7	203	763	50%	34%
400	01/2002	158	143	32	333	763	50%	36%
401	02/2002	99	46	1	146	763	50%	37%
402	03/2002	97	0	0	97	763	50%	37%
403	04/2002	95	0	0	95	763	50%	37%
404	05/2002	51	18	0	69	763	50%	37%
405	06/2002	94	0	0	94	763	50%	38%
406	07/2002	0	0	0	0	763	50%	38%
407	08/2002	0	0	0	0	763	50%	38%
408	09/2002	0	0	0	0	763	50%	38%
409	10/2002	0	4	0	4	763	50%	38%
410	11/2002	19	520	53	592	763	50%	38%
411	12/2002	245	208	38	491	763	50%	38%
412	01/2003	142	0	0	142	763	50%	39%
413	02/2003	1,437	435	140	2,012	763	50%	41%
414	03/2003	1,508	606	36	2,149	763	50%	44%
415	04/2003	523	143	37	703	763	50%	47%
416	05/2003	2,326	381	1,123	3,830	763	50%	47%
417	06/2003	420	0	0	420	763	50%	49%
418	07/2003	85	0	0	85	763	50%	51%
419	08/2003	0	0	78	78	763	50%	51%
420	09/2003	0	0	41	41	763	50%	51%
421	10/2003	17	0	0	17	763	50%	52%
422	11/2003	102	261	0	363	763	50%	52%
423	12/2003	388	98	8	494	763	50%	52%
424	01/2004	202	13	0	215	763	50%	53%
425	02/2004	1,095	520	205	1,821	763	50%	53%
426	03/2004	2,404	164	0	2,568	763	50%	52%
427	04/2004	174	61	0	235	763	50%	53%
428	05/2004	139	0	0	139	763	50%	53%
429	06/2004	45	0	0	45	763	50%	53%
430	07/2004	3	6	0	9	763	50%	54%
431	08/2004	0	1	0	1	763	50%	54%
432	09/2004	0	0	0	0	763	50%	54%

Table A.2
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	1,487	415	438	2,340	763	50%	52%
434	11/2004	882	10	0	892	763	50%	52%
435	12/2004	1,728	574	403	2,705	763	50%	50%
436	01/2005	4,090	2,706	3,038	9,834	763	50%	45%
437	02/2005	2,817	1,700	777	5,293	763	50%	45%
438	03/2005	3,997	3,257	3,087	10,341	763	50%	42%
439	04/2005	3,962	607	3,006	7,574	763	50%	39%
440	05/2005	1,792	973	2,618	5,384	763	50%	38%
441	06/2005	8	533	3,329	3,870	763	50%	37%
442	07/2005	974	511	366	1,852	763	50%	36%
443	08/2005	1,195	0	0	1,195	763	50%	36%
444	09/2005	754	0	0	754	763	50%	36%
445	10/2005	882	146	24	1,052	763	50%	35%
446	11/2005	1,195	0	3	1,198	763	50%	35%
447	12/2005	698	86	380	1,164	763	50%	35%
448	01/2006	2,056	550	516	3,122	763	50%	34%
449	02/2006	387	305	1,341	2,033	763	50%	35%
450	03/2006	2,290	1,006	3,103	6,399	763	50%	34%
451	04/2006	3,144	1,810	2,974	7,928	763	50%	33%
452	05/2006	1,650	863	352	2,865	763	50%	32%
453	06/2006	899	0	0	899	763	50%	32%
454	07/2006	591	0	0	591	763	50%	32%
455	08/2006	558	0	0	558	763	50%	32%
456	09/2006	474	0	0	474	763	50%	32%
457	10/2006	183	0	39	222	763	50%	32%
458	11/2006	0	0	163	163	763	50%	32%
459	12/2006	337	5	37	379	763	50%	32%
460	01/2007	531	25	1	557	763	50%	32%
461	02/2007	540	126	29	695	763	50%	32%
462	03/2007	761	0	0	761	763	50%	31%
463	04/2007	462	43	0	506	763	50%	31%
464	05/2007	506	0	0	506	763	50%	31%
465	06/2007	379	0	0	379	763	50%	31%
466	07/2007	345	0	0	345	763	50%	31%
467	08/2007	53	0	8	61	763	50%	31%
468	09/2007	0	83	23	106	763	50%	31%
469	10/2007	24	0	95	120	763	50%	31%
470	11/2007	318	34	96	448	763	50%	31%
471	12/2007	376	182	141	699	763	50%	31%
472	01/2008	2,689	1,233	1,414	5,335	763	50%	30%
473	02/2008	1,892	1,363	778	4,033	763	50%	30%
474	03/2008	711	1	604	1,316	763	50%	30%
475	04/2008	521	360	11	892	763	50%	30%
476	05/2008	633	89	0	722	763	50%	30%
477	06/2008	318	0	215	533	763	50%	30%
478	07/2008	0	0	229	229	763	50%	30%
479	08/2008	0	0	195	195	763	50%	30%
480	09/2008	0	0	175	175	763	50%	30%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	395	248	390	1,032			
2	11/1968	443	277	437	1,157			
3	12/1968	846	530	834	2,210			
4	01/1969	2,122	1,330	2,094	5,546			
5	02/1969	2,566	1,608	2,532	6,706			
6	03/1969	3,149	1,974	3,107	8,229			
7	04/1969	2,140	1,342	2,111	5,593			
8	05/1969	1,344	842	1,326	3,512			
9	06/1969	942	591	929	2,462			
10	07/1969	420	263	414	1,097			
11	08/1969	225	141	222	589			
12	09/1969	171	107	168	446			
13	10/1969	145	27	71	244			
14	11/1969	163	31	80	273			
15	12/1969	311	59	152	522			
16	01/1970	780	147	382	1,309			
17	02/1970	943	178	462	1,582			
18	03/1970	1,157	218	566	1,942			
19	04/1970	786	148	385	1,320			
20	05/1970	494	93	242	829			
21	06/1970	346	65	169	581			
22	07/1970	154	29	75	259			
23	08/1970	83	16	41	139			
24	09/1970	63	12	31	105			
25	10/1970	142	70	0	212			
26	11/1970	159	79	0	238			
27	12/1970	304	151	0	454			
28	01/1971	762	378	0	1,140			
29	02/1971	921	457	0	1,378			
30	03/1971	1,131	560	0	1,691			
31	04/1971	768	381	0	1,149	488		
32	05/1971	483	239	0	722	488		
33	06/1971	338	168	0	506	488		
34	07/1971	151	75	0	225	488		
35	08/1971	81	40	0	121	488		
36	09/1971	61	30	0	92	488		
37	10/1971	24	19	0	43	488		
38	11/1971	26	22	0	48	488		
39	12/1971	50	41	0	92	488		
40	01/1972	126	104	0	230	488		
41	02/1972	153	126	0	278	488		
42	03/1972	187	154	0	341	488		
43	04/1972	127	105	0	232	488		
44	05/1972	80	66	0	146	488		
45	06/1972	56	46	0	102	488		
46	07/1972	25	21	0	46	488		
47	08/1972	13	11	0	24	488		
48	09/1972	10	8	0	19	488		
49	10/1972	113	110	68	291	488		
50	11/1972	126	123	76	326	488		
51	12/1972	242	236	145	623	488		
52	01/1973	606	592	365	1,563	488		
53	02/1973	733	715	441	1,889	488		
54	03/1973	899	878	541	2,318	488		

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	611	597	368	1,576	488		
56	05/1973	384	375	231	990	488		
57	06/1973	269	263	162	694	488		
58	07/1973	120	117	72	309	488		
59	08/1973	64	63	39	166	488		
60	09/1973	49	48	29	126	488	50%	18%
61	10/1973	76	41	0	118	488	50%	18%
62	11/1973	86	46	0	132	488	50%	19%
63	12/1973	164	88	0	252	488	50%	20%
64	01/1974	411	222	0	633	488	50%	22%
65	02/1974	497	268	0	765	488	50%	24%
66	03/1974	610	329	0	939	488	50%	28%
67	04/1974	414	224	0	638	488	50%	31%
68	05/1974	260	140	0	401	488	50%	33%
69	06/1974	182	98	0	281	488	50%	35%
70	07/1974	81	44	0	125	488	50%	36%
71	08/1974	44	24	0	67	488	50%	37%
72	09/1974	33	18	0	51	488	50%	38%
73	10/1974	66	43	0	109	488	50%	38%
74	11/1974	74	48	0	122	488	50%	39%
75	12/1974	141	92	0	233	488	50%	40%
76	01/1975	355	231	0	585	488	50%	41%
77	02/1975	429	279	0	708	488	50%	42%
78	03/1975	526	343	0	869	488	50%	43%
79	04/1975	357	233	0	590	488	50%	44%
80	05/1975	225	146	0	371	488	50%	45%
81	06/1975	157	103	0	260	488	50%	46%
82	07/1975	70	46	0	116	488	50%	47%
83	08/1975	38	25	0	62	488	50%	47%
84	09/1975	29	19	0	47	488	50%	48%
85	10/1975	38	23	0	61	488	50%	48%
86	11/1975	43	25	0	68	488	50%	49%
87	12/1975	81	49	0	130	488	50%	50%
88	01/1976	204	122	0	327	488	50%	51%
89	02/1976	247	148	0	395	488	50%	52%
90	03/1976	303	181	0	484	488	50%	54%
91	04/1976	206	123	0	329	488	50%	55%
92	05/1976	129	77	0	207	488	50%	55%
93	06/1976	91	54	0	145	488	50%	55%
94	07/1976	40	24	0	65	488	50%	56%
95	08/1976	22	13	0	35	488	50%	56%
96	09/1976	16	10	0	26	488	50%	56%
97	10/1976	32	34	0	66	488	50%	56%
98	11/1976	36	38	0	74	488	50%	56%
99	12/1976	69	72	0	141	488	50%	56%
100	01/1977	174	181	0	355	488	50%	56%
101	02/1977	210	219	0	429	488	50%	55%
102	03/1977	258	269	0	527	488	50%	55%
103	04/1977	175	183	0	358	488	50%	55%
104	05/1977	110	115	0	225	488	50%	55%
105	06/1977	77	80	0	158	488	50%	55%
106	07/1977	34	36	0	70	488	50%	55%
107	08/1977	18	19	0	38	488	50%	55%
108	09/1977	14	15	0	29	488	50%	55%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	342	355	383	1,080	488	50%	54%
110	11/1977	383	398	429	1,210	488	50%	53%
111	12/1977	733	761	820	2,313	488	50%	52%
112	01/1978	1,839	1,910	2,057	5,805	488	50%	48%
113	02/1978	2,223	2,309	2,487	7,018	488	50%	44%
114	03/1978	2,728	2,833	3,052	8,613	488	50%	40%
115	04/1978	1,854	1,926	2,074	5,854	488	50%	38%
116	05/1978	1,164	1,209	1,302	3,676	488	50%	37%
117	06/1978	816	848	913	2,577	488	50%	36%
118	07/1978	364	378	407	1,148	488	50%	36%
119	08/1978	195	203	218	617	488	50%	35%
120	09/1978	148	154	165	467	488	50%	35%
121	10/1978	300	209	0	509	488	50%	35%
122	11/1978	337	234	0	571	488	50%	35%
123	12/1978	643	447	0	1,091	488	50%	35%
124	01/1979	1,615	1,123	0	2,737	488	50%	34%
125	02/1979	1,952	1,357	0	3,310	488	50%	33%
126	03/1979	2,396	1,666	0	4,061	488	50%	32%
127	04/1979	1,628	1,132	0	2,760	488	50%	31%
128	05/1979	1,022	711	0	1,733	488	50%	31%
129	06/1979	717	498	0	1,215	488	50%	30%
130	07/1979	319	222	0	541	488	50%	30%
131	08/1979	172	119	0	291	488	50%	30%
132	09/1979	130	90	0	220	488	50%	30%
133	10/1979	378	271	0	649	488	50%	30%
134	11/1979	424	303	0	727	488	50%	30%
135	12/1979	810	579	0	1,389	488	50%	29%
136	01/1980	2,032	1,454	0	3,486	488	50%	28%
137	02/1980	2,457	1,757	0	4,215	488	50%	28%
138	03/1980	3,015	2,157	0	5,172	488	50%	26%
139	04/1980	2,049	1,466	0	3,515	488	50%	26%
140	05/1980	1,287	921	0	2,208	488	50%	25%
141	06/1980	902	645	0	1,547	488	50%	25%
142	07/1980	402	287	0	689	488	50%	25%
143	08/1980	216	154	0	370	488	50%	25%
144	09/1980	164	117	0	280	488	50%	25%
145	10/1980	176	55	0	231	488	50%	25%
146	11/1980	197	62	0	259	488	50%	25%
147	12/1980	377	118	0	495	488	50%	25%
148	01/1981	946	296	0	1,242	488	50%	25%
149	02/1981	1,144	357	0	1,501	488	50%	24%
150	03/1981	1,404	439	0	1,842	488	50%	24%
151	04/1981	954	298	0	1,252	488	50%	24%
152	05/1981	599	187	0	786	488	50%	24%
153	06/1981	420	131	0	551	488	50%	24%
154	07/1981	187	58	0	246	488	50%	24%
155	08/1981	100	31	0	132	488	50%	24%
156	09/1981	76	24	0	100	488	50%	24%
157	10/1981	174	95	0	270	488	50%	24%
158	11/1981	195	107	0	302	488	50%	24%
159	12/1981	373	204	0	577	488	50%	23%
160	01/1982	936	513	0	1,449	488	50%	23%
161	02/1982	1,132	620	0	1,751	488	50%	23%
162	03/1982	1,389	761	0	2,149	488	50%	23%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	944	517	0	1,461	488	50%	22%
164	05/1982	593	325	0	917	488	50%	22%
165	06/1982	415	228	0	643	488	50%	22%
166	07/1982	185	101	0	286	488	50%	22%
167	08/1982	99	54	0	154	488	50%	22%
168	09/1982	75	41	0	117	488	50%	22%
169	10/1982	428	399	316	1,143	488	50%	22%
170	11/1982	480	447	354	1,280	488	50%	22%
171	12/1982	917	854	676	2,447	488	50%	22%
172	01/1983	2,301	2,143	1,697	6,141	488	50%	22%
173	02/1983	2,782	2,591	2,052	7,425	488	50%	22%
174	03/1983	3,413	3,179	2,518	9,111	488	50%	22%
175	04/1983	2,320	2,161	1,711	6,192	488	50%	22%
176	05/1983	1,457	1,357	1,075	3,889	488	50%	22%
177	06/1983	1,021	951	753	2,726	488	50%	22%
178	07/1983	455	424	336	1,214	488	50%	22%
179	08/1983	244	228	180	652	488	50%	22%
180	09/1983	185	172	137	494	488	50%	22%
181	10/1983	127	62	0	188	488	50%	22%
182	11/1983	142	69	0	211	488	50%	22%
183	12/1983	271	132	0	403	488	50%	22%
184	01/1984	681	331	0	1,011	488	50%	22%
185	02/1984	823	400	0	1,223	488	50%	23%
186	03/1984	1,010	491	0	1,500	488	50%	23%
187	04/1984	686	333	0	1,020	488	50%	23%
188	05/1984	431	209	0	640	488	50%	24%
189	06/1984	302	147	0	449	488	50%	24%
190	07/1984	135	65	0	200	488	50%	24%
191	08/1984	72	35	0	107	488	50%	24%
192	09/1984	55	27	0	81	488	50%	24%
193	10/1984	162	59	0	220	488	50%	24%
194	11/1984	181	66	0	247	488	50%	24%
195	12/1984	346	125	0	471	488	50%	24%
196	01/1985	868	315	0	1,183	488	50%	25%
197	02/1985	1,049	381	0	1,430	488	50%	25%
198	03/1985	1,288	467	0	1,755	488	50%	26%
199	04/1985	875	317	0	1,193	488	50%	27%
200	05/1985	550	199	0	749	488	50%	27%
201	06/1985	385	140	0	525	488	50%	27%
202	07/1985	172	62	0	234	488	50%	27%
203	08/1985	92	33	0	126	488	50%	28%
204	09/1985	70	25	0	95	488	50%	28%
205	10/1985	221	116	0	338	488	50%	28%
206	11/1985	248	130	0	378	488	50%	28%
207	12/1985	474	249	0	723	488	50%	27%
208	01/1986	1,189	625	0	1,814	488	50%	27%
209	02/1986	1,438	756	0	2,194	488	50%	27%
210	03/1986	1,764	928	0	2,692	488	50%	27%
211	04/1986	1,199	631	0	1,830	488	50%	27%
212	05/1986	753	396	0	1,149	488	50%	27%
213	06/1986	528	278	0	805	488	50%	27%
214	07/1986	235	124	0	359	488	50%	27%
215	08/1986	126	66	0	193	488	50%	27%
216	09/1986	96	50	0	146	488	50%	27%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	89	8	0	97	488	50%	27%
218	11/1986	100	9	0	109	488	50%	27%
219	12/1986	190	17	0	208	488	50%	27%
220	01/1987	478	44	0	522	488	50%	27%
221	02/1987	578	53	0	631	488	50%	27%
222	03/1987	709	65	0	774	488	50%	28%
223	04/1987	482	44	0	526	488	50%	28%
224	05/1987	303	28	0	330	488	50%	28%
225	06/1987	212	19	0	232	488	50%	28%
226	07/1987	95	9	0	103	488	50%	28%
227	08/1987	51	5	0	55	488	50%	28%
228	09/1987	38	4	0	42	488	50%	28%
229	10/1987	210	78	0	288	488	50%	29%
230	11/1987	235	88	0	323	488	50%	29%
231	12/1987	449	168	0	618	488	50%	29%
232	01/1988	1,128	422	0	1,549	488	50%	31%
233	02/1988	1,364	510	0	1,873	488	50%	33%
234	03/1988	1,673	626	0	2,299	488	50%	35%
235	04/1988	1,137	425	0	1,562	488	50%	37%
236	05/1988	714	267	0	981	488	50%	39%
237	06/1988	501	187	0	688	488	50%	40%
238	07/1988	223	83	0	306	488	50%	40%
239	08/1988	120	45	0	165	488	50%	41%
240	09/1988	91	34	0	125	488	50%	41%
241	10/1988	47	23	0	69	488	50%	41%
242	11/1988	52	25	0	78	488	50%	41%
243	12/1988	100	49	0	149	488	50%	41%
244	01/1989	251	122	0	373	488	50%	42%
245	02/1989	304	147	0	451	488	50%	42%
246	03/1989	373	181	0	554	488	50%	43%
247	04/1989	253	123	0	376	488	50%	43%
248	05/1989	159	77	0	236	488	50%	43%
249	06/1989	112	54	0	166	488	50%	43%
250	07/1989	50	24	0	74	488	50%	44%
251	08/1989	27	13	0	40	488	50%	44%
252	09/1989	20	10	0	30	488	50%	44%
253	10/1989	25	30	0	54	488	50%	44%
254	11/1989	28	33	0	61	488	50%	44%
255	12/1989	53	63	0	116	488	50%	44%
256	01/1990	133	159	0	292	488	50%	45%
257	02/1990	160	193	0	353	488	50%	45%
258	03/1990	197	236	0	433	488	50%	46%
259	04/1990	134	161	0	294	488	50%	47%
260	05/1990	84	101	0	185	488	50%	47%
261	06/1990	59	71	0	130	488	50%	48%
262	07/1990	26	32	0	58	488	50%	48%
263	08/1990	14	17	0	31	488	50%	48%
264	09/1990	11	13	0	23	488	50%	48%
265	10/1990	140	68	74	282	488	50%	48%
266	11/1990	157	77	83	316	488	50%	48%
267	12/1990	299	146	159	605	488	50%	48%
268	01/1991	751	368	399	1,518	488	50%	48%
269	02/1991	908	444	482	1,835	488	50%	49%
270	03/1991	1,114	545	592	2,252	488	50%	49%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	757	371	402	1,530	488	50%	49%
272	05/1991	476	233	253	961	488	50%	50%
273	06/1991	333	163	177	674	488	50%	50%
274	07/1991	149	73	79	300	488	50%	50%
275	08/1991	80	39	42	161	488	50%	50%
276	09/1991	60	30	32	122	488	50%	50%
277	10/1991	188	224	277	689	488	50%	49%
278	11/1991	211	251	310	772	488	50%	49%
279	12/1991	403	480	593	1,476	488	50%	48%
280	01/1992	1,011	1,205	1,487	3,703	488	50%	45%
281	02/1992	1,222	1,456	1,798	4,477	488	50%	43%
282	03/1992	1,500	1,787	2,207	5,494	488	50%	40%
283	04/1992	1,019	1,215	1,500	3,734	488	50%	38%
284	05/1992	640	763	942	2,345	488	50%	37%
285	06/1992	449	535	660	1,644	488	50%	37%
286	07/1992	200	238	294	732	488	50%	36%
287	08/1992	107	128	158	393	488	50%	36%
288	09/1992	81	97	120	298	488	50%	36%
289	10/1992	319	295	587	1,201	488	50%	36%
290	11/1992	357	331	657	1,345	488	50%	35%
291	12/1992	682	632	1,257	2,571	488	50%	34%
292	01/1993	1,712	1,586	3,153	6,451	488	50%	33%
293	02/1993	2,070	1,917	3,812	7,800	488	50%	31%
294	03/1993	2,540	2,353	4,678	9,571	488	50%	28%
295	04/1993	1,726	1,599	3,180	6,505	488	50%	27%
296	05/1993	1,084	1,004	1,997	4,085	488	50%	26%
297	06/1993	760	704	1,400	2,864	488	50%	26%
298	07/1993	339	314	624	1,276	488	50%	26%
299	08/1993	182	168	335	685	488	50%	26%
300	09/1993	138	128	254	519	488	50%	25%
301	10/1993	147	55	123	325	488	50%	25%
302	11/1993	164	61	138	364	488	50%	25%
303	12/1993	314	117	264	695	488	50%	25%
304	01/1994	788	294	662	1,745	488	50%	25%
305	02/1994	953	356	801	2,109	488	50%	25%
306	03/1994	1,169	437	983	2,589	488	50%	24%
307	04/1994	794	297	668	1,759	488	50%	24%
308	05/1994	499	186	419	1,105	488	50%	24%
309	06/1994	350	131	294	774	488	50%	24%
310	07/1994	156	58	131	345	488	50%	24%
311	08/1994	84	31	70	185	488	50%	23%
312	09/1994	63	24	53	140	488	50%	23%
313	10/1994	428	244	544	1,216	488	50%	23%
314	11/1994	479	274	610	1,363	488	50%	23%
315	12/1994	915	523	1,166	2,604	488	50%	23%
316	01/1995	2,297	1,312	2,925	6,534	488	50%	22%
317	02/1995	2,777	1,586	3,537	7,900	488	50%	20%
318	03/1995	3,408	1,946	4,340	9,695	488	50%	19%
319	04/1995	2,316	1,323	2,950	6,589	488	50%	18%
320	05/1995	1,455	831	1,853	4,138	488	50%	18%
321	06/1995	1,020	582	1,299	2,901	488	50%	18%
322	07/1995	454	259	578	1,292	488	50%	18%
323	08/1995	244	139	311	694	488	50%	17%
324	09/1995	185	106	235	526	488	50%	17%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	100	79	232	411	488	50%	17%
326	11/1995	112	88	260	460	488	50%	17%
327	12/1995	214	168	497	880	488	50%	17%
328	01/1996	538	423	1,246	2,207	488	50%	17%
329	02/1996	651	511	1,506	2,668	488	50%	17%
330	03/1996	798	627	1,849	3,274	488	50%	17%
331	04/1996	543	426	1,256	2,225	488	50%	17%
332	05/1996	341	268	789	1,398	488	50%	17%
333	06/1996	239	188	553	980	488	50%	17%
334	07/1996	106	84	246	436	488	50%	17%
335	08/1996	57	45	132	234	488	50%	17%
336	09/1996	43	34	100	178	488	50%	17%
337	10/1996	0	0	266	266	488	50%	17%
338	11/1996	132	217	78	428	488	50%	17%
339	12/1996	750	1,038	682	2,470	488	50%	17%
340	01/1997	1,446	1,979	3,069	6,494	488	50%	17%
341	02/1997	1,105	507	743	2,356	488	50%	17%
342	03/1997	286	0	963	1,249	488	50%	17%
343	04/1997	191	0	647	839	488	50%	18%
344	05/1997	243	0	0	243	488	50%	18%
345	06/1997	135	0	173	308	488	50%	18%
346	07/1997	37	0	329	366	488	50%	18%
347	08/1997	8	0	199	206	488	50%	18%
348	09/1997	126	1	0	127	488	50%	18%
349	10/1997	167	0	0	167	488	50%	18%
350	11/1997	153	233	100	486	488	50%	18%
351	12/1997	532	563	402	1,497	488	50%	18%
352	01/1998	514	374	75	963	488	50%	19%
353	02/1998	2,115	2,563	4,887	9,565	488	50%	19%
354	03/1998	3,570	3,465	1,819	8,853	488	50%	19%
355	04/1998	2,733	2,089	0	4,822	488	50%	19%
356	05/1998	714	1,661	1,020	3,395	488	50%	19%
357	06/1998	1,851	1,992	1,205	5,048	488	50%	19%
358	07/1998	83	465	2,020	2,568	488	50%	19%
359	08/1998	0	34	882	916	488	50%	19%
360	09/1998	361	0	66	427	488	50%	19%
361	10/1998	623	0	0	623	488	50%	19%
362	11/1998	434	29	346	809	488	50%	19%
363	12/1998	650	36	0	686	488	50%	19%
364	01/1999	573	179	121	873	488	50%	19%
365	02/1999	759	134	13	906	488	50%	19%
366	03/1999	655	0	73	727	488	50%	19%
367	04/1999	155	0	1,964	2,119	488	50%	19%
368	05/1999	116	36	761	913	488	50%	19%
369	06/1999	93	38	469	600	488	50%	19%
370	07/1999	11	0	442	453	488	50%	19%
371	08/1999	0	0	199	199	488	50%	19%
372	09/1999	0	0	3	3	488	50%	19%
373	10/1999	8	0	0	8	488	50%	19%
374	11/1999	4	0	0	4	488	50%	19%
375	12/1999	6	0	0	6	488	50%	20%
376	01/2000	8	51	15	74	488	50%	21%
377	02/2000	1,141	1,038	851	3,031	488	50%	21%
378	03/2000	1,023	606	1,272	2,901	488	50%	23%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	537	192	720	1,448	488	50%	23%
380	05/2000	261	0	115	375	488	50%	24%
381	06/2000	203	0	0	203	488	50%	25%
382	07/2000	111	0	0	111	488	50%	25%
383	08/2000	102	0	0	102	488	50%	25%
384	09/2000	0	0	0	0	488	50%	25%
385	10/2000	0	57	0	57	488	50%	25%
386	11/2000	0	81	0	81	488	50%	25%
387	12/2000	91	0	0	91	488	50%	26%
388	01/2001	473	459	92	1,024	488	50%	26%
389	02/2001	1,106	799	463	2,368	488	50%	26%
390	03/2001	2,296	938	368	3,602	488	50%	26%
391	04/2001	1,195	148	36	1,379	488	50%	26%
392	05/2001	157	0	137	294	488	50%	26%
393	06/2001	0	0	465	465	488	50%	26%
394	07/2001	0	0	150	150	488	50%	26%
395	08/2001	0	0	100	100	488	50%	27%
396	09/2001	0	0	69	69	488	50%	27%
397	10/2001	40	175	57	271	488	50%	27%
398	11/2001	104	53	0	157	488	50%	27%
399	12/2001	87	60	10	157	488	50%	27%
400	01/2002	101	143	45	288	488	50%	29%
401	02/2002	63	46	1	110	488	50%	30%
402	03/2002	62	0	0	62	488	50%	30%
403	04/2002	61	0	0	61	488	50%	30%
404	05/2002	33	18	0	51	488	50%	30%
405	06/2002	60	0	0	60	488	50%	30%
406	07/2002	0	0	0	0	488	50%	30%
407	08/2002	0	0	0	0	488	50%	30%
408	09/2002	0	0	0	0	488	50%	30%
409	10/2002	0	4	0	4	488	50%	31%
410	11/2002	12	520	74	606	488	50%	30%
411	12/2002	157	208	52	417	488	50%	31%
412	01/2003	90	0	0	90	488	50%	31%
413	02/2003	919	435	193	1,547	488	50%	34%
414	03/2003	964	606	49	1,619	488	50%	37%
415	04/2003	335	143	51	529	488	50%	39%
416	05/2003	1,487	381	1,551	3,419	488	50%	39%
417	06/2003	268	0	0	268	488	50%	42%
418	07/2003	55	0	0	55	488	50%	44%
419	08/2003	0	0	108	108	488	50%	44%
420	09/2003	0	0	57	57	488	50%	44%
421	10/2003	11	0	0	11	488	50%	45%
422	11/2003	65	261	0	326	488	50%	45%
423	12/2003	248	98	11	357	488	50%	45%
424	01/2004	129	13	0	142	488	50%	46%
425	02/2004	700	520	283	1,504	488	50%	45%
426	03/2004	1,537	164	0	1,701	488	50%	45%
427	04/2004	111	61	0	172	488	50%	46%
428	05/2004	89	0	0	89	488	50%	47%
429	06/2004	29	0	0	29	488	50%	47%
430	07/2004	2	6	0	8	488	50%	47%
431	08/2004	0	1	0	1	488	50%	48%
432	09/2004	0	0	0	0	488	50%	48%

Table A.3
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase I)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	950	415	605	1,970	488	50%	46%
434	11/2004	564	10	0	574	488	50%	46%
435	12/2004	1,105	574	557	2,235	488	50%	44%
436	01/2005	2,615	2,706	4,196	9,516	488	50%	39%
437	02/2005	1,801	1,700	1,072	4,573	488	50%	38%
438	03/2005	2,556	3,257	4,263	10,075	488	50%	35%
439	04/2005	2,533	607	4,151	7,291	488	50%	32%
440	05/2005	1,146	973	3,615	5,735	488	50%	31%
441	06/2005	5	533	4,597	5,136	488	50%	29%
442	07/2005	623	511	505	1,640	488	50%	29%
443	08/2005	764	0	0	764	488	50%	28%
444	09/2005	482	0	0	482	488	50%	28%
445	10/2005	564	146	33	743	488	50%	28%
446	11/2005	764	0	4	768	488	50%	28%
447	12/2005	446	86	524	1,057	488	50%	28%
448	01/2006	1,314	550	713	2,577	488	50%	27%
449	02/2006	247	305	1,852	2,405	488	50%	27%
450	03/2006	1,464	1,006	4,285	6,755	488	50%	27%
451	04/2006	2,010	1,810	4,106	7,927	488	50%	25%
452	05/2006	1,055	863	487	2,404	488	50%	25%
453	06/2006	575	0	0	575	488	50%	25%
454	07/2006	378	0	0	378	488	50%	25%
455	08/2006	357	0	0	357	488	50%	24%
456	09/2006	303	0	0	303	488	50%	24%
457	10/2006	117	0	54	170	488	50%	24%
458	11/2006	0	0	225	225	488	50%	24%
459	12/2006	216	5	51	272	488	50%	24%
460	01/2007	340	25	1	366	488	50%	24%
461	02/2007	345	126	40	511	488	50%	24%
462	03/2007	487	0	0	487	488	50%	24%
463	04/2007	296	43	0	339	488	50%	24%
464	05/2007	324	0	0	324	488	50%	24%
465	06/2007	242	0	0	242	488	50%	24%
466	07/2007	221	0	0	221	488	50%	24%
467	08/2007	34	0	11	45	488	50%	24%
468	09/2007	0	83	32	115	488	50%	24%
469	10/2007	15	0	132	147	488	50%	24%
470	11/2007	203	34	133	370	488	50%	24%
471	12/2007	241	182	194	617	488	50%	24%
472	01/2008	1,719	1,233	1,953	4,904	488	50%	23%
473	02/2008	1,210	1,363	1,075	3,647	488	50%	23%
474	03/2008	454	1	835	1,290	488	50%	23%
475	04/2008	333	360	16	709	488	50%	23%
476	05/2008	405	89	0	494	488	50%	23%
477	06/2008	203	0	297	500	488	50%	23%
478	07/2008	0	0	316	316	488	50%	23%
479	08/2008	0	0	269	269	488	50%	23%
480	09/2008	0	0	241	241	488	50%	23%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	1,013	0	0	1,013			
2	11/1968	1,135	0	0	1,135			
3	12/1968	2,169	0	0	2,169			
4	01/1969	5,442	0	0	5,442			
5	02/1969	6,580	0	0	6,580			
6	03/1969	8,074	0	0	8,074			
7	04/1969	5,487	0	0	5,487			
8	05/1969	3,446	0	0	3,446			
9	06/1969	2,416	0	0	2,416			
10	07/1969	1,076	0	0	1,076			
11	08/1969	578	0	0	578			
12	09/1969	438	0	0	438			
13	10/1969	372	0	0	372			
14	11/1969	417	0	0	417			
15	12/1969	797	0	0	797			
16	01/1970	1,999	0	0	1,999			
17	02/1970	2,417	0	0	2,417			
18	03/1970	2,966	0	0	2,966			
19	04/1970	2,016	0	0	2,016			
20	05/1970	1,266	0	0	1,266			
21	06/1970	888	0	0	888			
22	07/1970	395	0	0	395			
23	08/1970	212	0	0	212			
24	09/1970	161	0	0	161			
25	10/1970	364	0	0	364			
26	11/1970	407	0	0	407			
27	12/1970	779	0	0	779			
28	01/1971	1,954	0	0	1,954			
29	02/1971	2,363	0	0	2,363			
30	03/1971	2,899	0	0	2,899			
31	04/1971	1,970	0	0	1,970	1,250		
32	05/1971	1,237	0	0	1,237	1,250		
33	06/1971	867	0	0	867	1,250		
34	07/1971	386	0	0	386	1,250		
35	08/1971	208	0	0	208	1,250		
36	09/1971	157	0	0	157	1,250		
37	10/1971	60	0	0	60	1,250		
38	11/1971	68	0	0	68	1,250		
39	12/1971	129	0	0	129	1,250		
40	01/1972	324	0	0	324	1,250		
41	02/1972	392	0	0	392	1,250		
42	03/1972	481	0	0	481	1,250		
43	04/1972	327	0	0	327	1,250		
44	05/1972	205	0	0	205	1,250		
45	06/1972	144	0	0	144	1,250		
46	07/1972	64	0	0	64	1,250		
47	08/1972	34	0	0	34	1,250		
48	09/1972	26	0	0	26	1,250		
49	10/1972	289	0	0	289	1,250		
50	11/1972	324	0	0	324	1,250		
51	12/1972	619	0	0	619	1,250		
52	01/1973	1,554	0	0	1,554	1,250		
53	02/1973	1,879	0	0	1,879	1,250		
54	03/1973	2,306	0	0	2,306	1,250		

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	1,567	0	0	1,567	1,250		
56	05/1973	984	0	0	984	1,250		
57	06/1973	690	0	0	690	1,250		
58	07/1973	307	0	0	307	1,250		
59	08/1973	165	0	0	165	1,250		
60	09/1973	125	0	0	125	1,250	75%	32%
61	10/1973	196	0	0	196	1,250	75%	33%
62	11/1973	220	0	0	220	1,250	75%	34%
63	12/1973	420	0	0	420	1,250	75%	36%
64	01/1974	1,054	0	0	1,054	1,250	75%	38%
65	02/1974	1,274	0	0	1,274	1,250	75%	40%
66	03/1974	1,564	0	0	1,564	1,250	75%	43%
67	04/1974	1,063	0	0	1,063	1,250	75%	46%
68	05/1974	667	0	0	667	1,250	75%	48%
69	06/1974	468	0	0	468	1,250	75%	50%
70	07/1974	208	0	0	208	1,250	75%	51%
71	08/1974	112	0	0	112	1,250	75%	52%
72	09/1974	85	0	0	85	1,250	75%	52%
73	10/1974	169	0	0	169	1,250	75%	53%
74	11/1974	190	0	0	190	1,250	75%	54%
75	12/1974	362	0	0	362	1,250	75%	54%
76	01/1975	909	0	0	909	1,250	75%	56%
77	02/1975	1,099	0	0	1,099	1,250	75%	57%
78	03/1975	1,349	0	0	1,349	1,250	75%	58%
79	04/1975	917	0	0	917	1,250	75%	59%
80	05/1975	576	0	0	576	1,250	75%	60%
81	06/1975	404	0	0	404	1,250	75%	61%
82	07/1975	180	0	0	180	1,250	75%	62%
83	08/1975	97	0	0	97	1,250	75%	62%
84	09/1975	73	0	0	73	1,250	75%	63%
85	10/1975	98	0	0	98	1,250	75%	63%
86	11/1975	109	0	0	109	1,250	75%	64%
87	12/1975	209	0	0	209	1,250	75%	65%
88	01/1976	524	0	0	524	1,250	75%	66%
89	02/1976	634	0	0	634	1,250	75%	67%
90	03/1976	778	0	0	778	1,250	75%	69%
91	04/1976	529	0	0	529	1,250	75%	70%
92	05/1976	332	0	0	332	1,250	75%	70%
93	06/1976	233	0	0	233	1,250	75%	71%
94	07/1976	104	0	0	104	1,250	75%	71%
95	08/1976	56	0	0	56	1,250	75%	71%
96	09/1976	42	0	0	42	1,250	75%	71%
97	10/1976	83	0	0	83	1,250	75%	71%
98	11/1976	93	0	0	93	1,250	75%	71%
99	12/1976	177	0	0	177	1,250	75%	71%
100	01/1977	445	0	0	445	1,250	75%	71%
101	02/1977	538	0	0	538	1,250	75%	71%
102	03/1977	661	0	0	661	1,250	75%	71%
103	04/1977	449	0	0	449	1,250	75%	71%
104	05/1977	282	0	0	282	1,250	75%	71%
105	06/1977	198	0	0	198	1,250	75%	71%
106	07/1977	88	0	0	88	1,250	75%	71%
107	08/1977	47	0	0	47	1,250	75%	71%
108	09/1977	36	0	0	36	1,250	75%	71%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	877	0	0	877	1,250	75%	70%
110	11/1977	983	0	0	983	1,250	75%	70%
111	12/1977	1,879	0	0	1,879	1,250	75%	69%
112	01/1978	4,714	0	0	4,714	1,250	75%	67%
113	02/1978	5,700	0	0	5,700	1,250	75%	65%
114	03/1978	6,994	0	0	6,994	1,250	75%	62%
115	04/1978	4,754	0	0	4,754	1,250	75%	61%
116	05/1978	2,985	0	0	2,985	1,250	75%	60%
117	06/1978	2,093	0	0	2,093	1,250	75%	59%
118	07/1978	932	0	0	932	1,250	75%	59%
119	08/1978	501	0	0	501	1,250	75%	59%
120	09/1978	379	0	0	379	1,250	75%	59%
121	10/1978	770	0	0	770	1,250	75%	58%
122	11/1978	863	0	0	863	1,250	75%	58%
123	12/1978	1,650	0	0	1,650	1,250	75%	57%
124	01/1979	4,140	0	0	4,140	1,250	75%	56%
125	02/1979	5,005	0	0	5,005	1,250	75%	55%
126	03/1979	6,142	0	0	6,142	1,250	75%	53%
127	04/1979	4,175	0	0	4,175	1,250	75%	52%
128	05/1979	2,622	0	0	2,622	1,250	75%	51%
129	06/1979	1,838	0	0	1,838	1,250	75%	51%
130	07/1979	819	0	0	819	1,250	75%	50%
131	08/1979	440	0	0	440	1,250	75%	50%
132	09/1979	333	0	0	333	1,250	75%	50%
133	10/1979	970	0	0	970	1,250	75%	50%
134	11/1979	1,087	0	0	1,087	1,250	75%	50%
135	12/1979	2,077	0	0	2,077	1,250	75%	49%
136	01/1980	5,211	0	0	5,211	1,250	75%	48%
137	02/1980	6,300	0	0	6,300	1,250	75%	46%
138	03/1980	7,732	0	0	7,732	1,250	75%	44%
139	04/1980	5,255	0	0	5,255	1,250	75%	43%
140	05/1980	3,300	0	0	3,300	1,250	75%	43%
141	06/1980	2,313	0	0	2,313	1,250	75%	42%
142	07/1980	1,030	0	0	1,030	1,250	75%	42%
143	08/1980	554	0	0	554	1,250	75%	42%
144	09/1980	419	0	0	419	1,250	75%	42%
145	10/1980	451	0	0	451	1,250	75%	42%
146	11/1980	506	0	0	506	1,250	75%	42%
147	12/1980	967	0	0	967	1,250	75%	41%
148	01/1981	2,426	0	0	2,426	1,250	75%	41%
149	02/1981	2,933	0	0	2,933	1,250	75%	40%
150	03/1981	3,599	0	0	3,599	1,250	75%	40%
151	04/1981	2,446	0	0	2,446	1,250	75%	39%
152	05/1981	1,536	0	0	1,536	1,250	75%	39%
153	06/1981	1,077	0	0	1,077	1,250	75%	39%
154	07/1981	480	0	0	480	1,250	75%	39%
155	08/1981	258	0	0	258	1,250	75%	39%
156	09/1981	195	0	0	195	1,250	75%	39%
157	10/1981	447	0	0	447	1,250	75%	39%
158	11/1981	500	0	0	500	1,250	75%	39%
159	12/1981	956	0	0	956	1,250	75%	39%
160	01/1982	2,400	0	0	2,400	1,250	75%	38%
161	02/1982	2,902	0	0	2,902	1,250	75%	38%
162	03/1982	3,561	0	0	3,561	1,250	75%	37%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	2,420	0	0	2,420	1,250	75%	37%
164	05/1982	1,520	0	0	1,520	1,250	75%	37%
165	06/1982	1,065	0	0	1,065	1,250	75%	36%
166	07/1982	475	0	0	475	1,250	75%	36%
167	08/1982	255	0	0	255	1,250	75%	36%
168	09/1982	193	0	0	193	1,250	75%	36%
169	10/1982	1,098	0	0	1,098	1,250	75%	36%
170	11/1982	1,230	0	0	1,230	1,250	75%	36%
171	12/1982	2,351	0	0	2,351	1,250	75%	36%
172	01/1983	5,899	0	0	5,899	1,250	75%	36%
173	02/1983	7,132	0	0	7,132	1,250	75%	36%
174	03/1983	8,752	0	0	8,752	1,250	75%	35%
175	04/1983	5,949	0	0	5,949	1,250	75%	35%
176	05/1983	3,736	0	0	3,736	1,250	75%	35%
177	06/1983	2,619	0	0	2,619	1,250	75%	35%
178	07/1983	1,167	0	0	1,167	1,250	75%	35%
179	08/1983	627	0	0	627	1,250	75%	35%
180	09/1983	475	0	0	475	1,250	75%	35%
181	10/1983	325	0	0	325	1,250	75%	35%
182	11/1983	364	0	0	364	1,250	75%	35%
183	12/1983	695	0	0	695	1,250	75%	35%
184	01/1984	1,745	0	0	1,745	1,250	75%	36%
185	02/1984	2,110	0	0	2,110	1,250	75%	36%
186	03/1984	2,589	0	0	2,589	1,250	75%	37%
187	04/1984	1,760	0	0	1,760	1,250	75%	37%
188	05/1984	1,105	0	0	1,105	1,250	75%	38%
189	06/1984	775	0	0	775	1,250	75%	38%
190	07/1984	345	0	0	345	1,250	75%	38%
191	08/1984	185	0	0	185	1,250	75%	38%
192	09/1984	140	0	0	140	1,250	75%	38%
193	10/1984	414	0	0	414	1,250	75%	38%
194	11/1984	464	0	0	464	1,250	75%	38%
195	12/1984	887	0	0	887	1,250	75%	38%
196	01/1985	2,225	0	0	2,225	1,250	75%	39%
197	02/1985	2,690	0	0	2,690	1,250	75%	40%
198	03/1985	3,301	0	0	3,301	1,250	75%	41%
199	04/1985	2,244	0	0	2,244	1,250	75%	41%
200	05/1985	1,409	0	0	1,409	1,250	75%	42%
201	06/1985	988	0	0	988	1,250	75%	42%
202	07/1985	440	0	0	440	1,250	75%	42%
203	08/1985	236	0	0	236	1,250	75%	42%
204	09/1985	179	0	0	179	1,250	75%	42%
205	10/1985	567	0	0	567	1,250	75%	42%
206	11/1985	636	0	0	636	1,250	75%	42%
207	12/1985	1,215	0	0	1,215	1,250	75%	42%
208	01/1986	3,049	0	0	3,049	1,250	75%	42%
209	02/1986	3,686	0	0	3,686	1,250	75%	42%
210	03/1986	4,523	0	0	4,523	1,250	75%	42%
211	04/1986	3,074	0	0	3,074	1,250	75%	42%
212	05/1986	1,931	0	0	1,931	1,250	75%	41%
213	06/1986	1,353	0	0	1,353	1,250	75%	41%
214	07/1986	603	0	0	603	1,250	75%	41%
215	08/1986	324	0	0	324	1,250	75%	41%
216	09/1986	245	0	0	245	1,250	75%	41%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	228	0	0	228	1,250	75%	41%
218	11/1986	256	0	0	256	1,250	75%	41%
219	12/1986	488	0	0	488	1,250	75%	42%
220	01/1987	1,226	0	0	1,226	1,250	75%	42%
221	02/1987	1,482	0	0	1,482	1,250	75%	42%
222	03/1987	1,818	0	0	1,818	1,250	75%	43%
223	04/1987	1,236	0	0	1,236	1,250	75%	43%
224	05/1987	776	0	0	776	1,250	75%	43%
225	06/1987	544	0	0	544	1,250	75%	43%
226	07/1987	242	0	0	242	1,250	75%	43%
227	08/1987	130	0	0	130	1,250	75%	43%
228	09/1987	99	0	0	99	1,250	75%	43%
229	10/1987	538	0	0	538	1,250	75%	43%
230	11/1987	603	0	0	603	1,250	75%	44%
231	12/1987	1,152	0	0	1,152	1,250	75%	44%
232	01/1988	2,892	0	0	2,892	1,250	75%	45%
233	02/1988	3,496	0	0	3,496	1,250	75%	46%
234	03/1988	4,291	0	0	4,291	1,250	75%	47%
235	04/1988	2,916	0	0	2,916	1,250	75%	48%
236	05/1988	1,831	0	0	1,831	1,250	75%	48%
237	06/1988	1,284	0	0	1,284	1,250	75%	49%
238	07/1988	572	0	0	572	1,250	75%	49%
239	08/1988	307	0	0	307	1,250	75%	49%
240	09/1988	233	0	0	233	1,250	75%	49%
241	10/1988	120	0	0	120	1,250	75%	49%
242	11/1988	134	0	0	134	1,250	75%	49%
243	12/1988	257	0	0	257	1,250	75%	49%
244	01/1989	644	0	0	644	1,250	75%	50%
245	02/1989	779	0	0	779	1,250	75%	50%
246	03/1989	956	0	0	956	1,250	75%	51%
247	04/1989	650	0	0	650	1,250	75%	51%
248	05/1989	408	0	0	408	1,250	75%	51%
249	06/1989	286	0	0	286	1,250	75%	52%
250	07/1989	127	0	0	127	1,250	75%	52%
251	08/1989	68	0	0	68	1,250	75%	52%
252	09/1989	52	0	0	52	1,250	75%	52%
253	10/1989	63	0	0	63	1,250	75%	52%
254	11/1989	71	0	0	71	1,250	75%	52%
255	12/1989	136	0	0	136	1,250	75%	52%
256	01/1990	340	0	0	340	1,250	75%	53%
257	02/1990	411	0	0	411	1,250	75%	54%
258	03/1990	505	0	0	505	1,250	75%	55%
259	04/1990	343	0	0	343	1,250	75%	56%
260	05/1990	215	0	0	215	1,250	75%	56%
261	06/1990	151	0	0	151	1,250	75%	57%
262	07/1990	67	0	0	67	1,250	75%	57%
263	08/1990	36	0	0	36	1,250	75%	57%
264	09/1990	27	0	0	27	1,250	75%	57%
265	10/1990	358	0	0	358	1,250	75%	57%
266	11/1990	402	0	0	402	1,250	75%	57%
267	12/1990	768	0	0	768	1,250	75%	57%
268	01/1991	1,926	0	0	1,926	1,250	75%	58%
269	02/1991	2,328	0	0	2,328	1,250	75%	58%
270	03/1991	2,857	0	0	2,857	1,250	75%	59%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	1,942	0	0	1,942	1,250	75%	60%
272	05/1991	1,220	0	0	1,220	1,250	75%	60%
273	06/1991	855	0	0	855	1,250	75%	60%
274	07/1991	381	0	0	381	1,250	75%	60%
275	08/1991	205	0	0	205	1,250	75%	60%
276	09/1991	155	0	0	155	1,250	75%	61%
277	10/1991	482	0	0	482	1,250	75%	60%
278	11/1991	540	0	0	540	1,250	75%	60%
279	12/1991	1,033	0	0	1,033	1,250	75%	60%
280	01/1992	2,592	0	0	2,592	1,250	75%	59%
281	02/1992	3,134	0	0	3,134	1,250	75%	59%
282	03/1992	3,845	0	0	3,845	1,250	75%	58%
283	04/1992	2,613	0	0	2,613	1,250	75%	57%
284	05/1992	1,641	0	0	1,641	1,250	75%	57%
285	06/1992	1,150	0	0	1,150	1,250	75%	56%
286	07/1992	513	0	0	513	1,250	75%	56%
287	08/1992	275	0	0	275	1,250	75%	56%
288	09/1992	209	0	0	209	1,250	75%	56%
289	10/1992	817	0	0	817	1,250	75%	56%
290	11/1992	915	0	0	915	1,250	75%	56%
291	12/1992	1,749	0	0	1,749	1,250	75%	56%
292	01/1993	4,389	0	0	4,389	1,250	75%	55%
293	02/1993	5,307	0	0	5,307	1,250	75%	54%
294	03/1993	6,513	0	0	6,513	1,250	75%	54%
295	04/1993	4,426	0	0	4,426	1,250	75%	53%
296	05/1993	2,780	0	0	2,780	1,250	75%	53%
297	06/1993	1,949	0	0	1,949	1,250	75%	52%
298	07/1993	868	0	0	868	1,250	75%	52%
299	08/1993	466	0	0	466	1,250	75%	52%
300	09/1993	353	0	0	353	1,250	75%	52%
301	10/1993	376	0	0	376	1,250	75%	52%
302	11/1993	421	0	0	421	1,250	75%	52%
303	12/1993	805	0	0	805	1,250	75%	52%
304	01/1994	2,020	0	0	2,020	1,250	75%	51%
305	02/1994	2,443	0	0	2,443	1,250	75%	51%
306	03/1994	2,997	0	0	2,997	1,250	75%	50%
307	04/1994	2,037	0	0	2,037	1,250	75%	50%
308	05/1994	1,279	0	0	1,279	1,250	75%	49%
309	06/1994	897	0	0	897	1,250	75%	49%
310	07/1994	400	0	0	400	1,250	75%	49%
311	08/1994	215	0	0	215	1,250	75%	49%
312	09/1994	163	0	0	163	1,250	75%	49%
313	10/1994	1,096	0	0	1,096	1,250	75%	49%
314	11/1994	1,228	0	0	1,228	1,250	75%	48%
315	12/1994	2,347	0	0	2,347	1,250	75%	48%
316	01/1995	5,890	0	0	5,890	1,250	75%	46%
317	02/1995	7,121	0	0	7,121	1,250	75%	44%
318	03/1995	8,739	0	0	8,739	1,250	75%	42%
319	04/1995	5,939	0	0	5,939	1,250	75%	41%
320	05/1995	3,730	0	0	3,730	1,250	75%	40%
321	06/1995	2,615	0	0	2,615	1,250	75%	40%
322	07/1995	1,165	0	0	1,165	1,250	75%	39%
323	08/1995	626	0	0	626	1,250	75%	39%
324	09/1995	474	0	0	474	1,250	75%	39%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	257	0	0	257	1,250	75%	39%
326	11/1995	288	0	0	288	1,250	75%	39%
327	12/1995	550	0	0	550	1,250	75%	39%
328	01/1996	1,380	0	0	1,380	1,250	75%	39%
329	02/1996	1,668	0	0	1,668	1,250	75%	39%
330	03/1996	2,047	0	0	2,047	1,250	75%	40%
331	04/1996	1,391	0	0	1,391	1,250	75%	40%
332	05/1996	874	0	0	874	1,250	75%	40%
333	06/1996	613	0	0	613	1,250	75%	40%
334	07/1996	273	0	0	273	1,250	75%	40%
335	08/1996	147	0	0	147	1,250	75%	40%
336	09/1996	111	0	0	111	1,250	75%	40%
337	10/1996	0	0	0	0	1,250	75%	40%
338	11/1996	339	0	0	339	1,250	75%	40%
339	12/1996	1,924	0	0	1,924	1,250	75%	40%
340	01/1997	3,708	0	0	3,708	1,250	75%	40%
341	02/1997	2,833	0	0	2,833	1,250	75%	40%
342	03/1997	733	0	0	733	1,250	75%	40%
343	04/1997	491	0	0	491	1,250	75%	41%
344	05/1997	624	0	0	624	1,250	75%	41%
345	06/1997	345	0	0	345	1,250	75%	41%
346	07/1997	94	0	0	94	1,250	75%	41%
347	08/1997	20	0	0	20	1,250	75%	41%
348	09/1997	324	0	0	324	1,250	75%	41%
349	10/1997	428	0	0	428	1,250	75%	41%
350	11/1997	392	0	0	392	1,250	75%	42%
351	12/1997	1,364	0	0	1,364	1,250	75%	42%
352	01/1998	1,318	0	0	1,318	1,250	75%	42%
353	02/1998	5,422	0	0	5,422	1,250	75%	42%
354	03/1998	9,153	0	0	9,153	1,250	75%	42%
355	04/1998	7,008	0	0	7,008	1,250	75%	41%
356	05/1998	1,831	0	0	1,831	1,250	75%	41%
357	06/1998	4,746	0	0	4,746	1,250	75%	41%
358	07/1998	212	0	0	212	1,250	75%	41%
359	08/1998	0	0	0	0	1,250	75%	41%
360	09/1998	926	0	0	926	1,250	75%	41%
361	10/1998	1,597	0	0	1,597	1,250	75%	41%
362	11/1998	1,114	0	0	1,114	1,250	75%	40%
363	12/1998	1,667	0	0	1,667	1,250	75%	40%
364	01/1999	1,469	0	0	1,469	1,250	75%	40%
365	02/1999	1,947	0	0	1,947	1,250	75%	40%
366	03/1999	1,679	0	0	1,679	1,250	75%	41%
367	04/1999	396	0	0	396	1,250	75%	41%
368	05/1999	297	0	0	297	1,250	75%	41%
369	06/1999	239	0	0	239	1,250	75%	41%
370	07/1999	28	0	0	28	1,250	75%	42%
371	08/1999	0	0	0	0	1,250	75%	42%
372	09/1999	0	0	0	0	1,250	75%	42%
373	10/1999	21	0	0	21	1,250	75%	42%
374	11/1999	10	0	0	10	1,250	75%	42%
375	12/1999	16	0	0	16	1,250	75%	43%
376	01/2000	21	0	0	21	1,250	75%	44%
377	02/2000	2,927	0	0	2,927	1,250	75%	45%
378	03/2000	2,624	0	0	2,624	1,250	75%	47%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	1,376	0	0	1,376	1,250	75%	48%
380	05/2000	668	0	0	668	1,250	75%	49%
381	06/2000	520	0	0	520	1,250	75%	50%
382	07/2000	285	0	0	285	1,250	75%	50%
383	08/2000	262	0	0	262	1,250	75%	51%
384	09/2000	0	0	0	0	1,250	75%	51%
385	10/2000	0	0	0	0	1,250	75%	51%
386	11/2000	0	0	0	0	1,250	75%	51%
387	12/2000	233	0	0	233	1,250	75%	51%
388	01/2001	1,214	0	0	1,214	1,250	75%	51%
389	02/2001	2,836	0	0	2,836	1,250	75%	51%
390	03/2001	5,886	0	0	5,886	1,250	75%	49%
391	04/2001	3,064	0	0	3,064	1,250	75%	49%
392	05/2001	402	0	0	402	1,250	75%	49%
393	06/2001	0	0	0	0	1,250	75%	49%
394	07/2001	0	0	0	0	1,250	75%	49%
395	08/2001	0	0	0	0	1,250	75%	49%
396	09/2001	0	0	0	0	1,250	75%	49%
397	10/2001	101	0	0	101	1,250	75%	49%
398	11/2001	267	0	0	267	1,250	75%	49%
399	12/2001	223	0	0	223	1,250	75%	50%
400	01/2002	259	0	0	259	1,250	75%	51%
401	02/2002	162	0	0	162	1,250	75%	52%
402	03/2002	159	0	0	159	1,250	75%	52%
403	04/2002	156	0	0	156	1,250	75%	52%
404	05/2002	84	0	0	84	1,250	75%	53%
405	06/2002	154	0	0	154	1,250	75%	53%
406	07/2002	0	0	0	0	1,250	75%	53%
407	08/2002	0	0	0	0	1,250	75%	53%
408	09/2002	0	0	0	0	1,250	75%	53%
409	10/2002	0	0	0	0	1,250	75%	53%
410	11/2002	31	0	0	31	1,250	75%	53%
411	12/2002	402	0	0	402	1,250	75%	53%
412	01/2003	232	0	0	232	1,250	75%	54%
413	02/2003	2,355	0	0	2,355	1,250	75%	55%
414	03/2003	2,472	0	0	2,472	1,250	75%	58%
415	04/2003	858	0	0	858	1,250	75%	61%
416	05/2003	3,813	0	0	3,813	1,250	75%	60%
417	06/2003	688	0	0	688	1,250	75%	62%
418	07/2003	140	0	0	140	1,250	75%	62%
419	08/2003	0	0	0	0	1,250	75%	62%
420	09/2003	0	0	0	0	1,250	75%	62%
421	10/2003	28	0	0	28	1,250	75%	63%
422	11/2003	168	0	0	168	1,250	75%	64%
423	12/2003	637	0	0	637	1,250	75%	64%
424	01/2004	331	0	0	331	1,250	75%	65%
425	02/2004	1,796	0	0	1,796	1,250	75%	65%
426	03/2004	3,941	0	0	3,941	1,250	75%	64%
427	04/2004	285	0	0	285	1,250	75%	64%
428	05/2004	227	0	0	227	1,250	75%	64%
429	06/2004	73	0	0	73	1,250	75%	64%
430	07/2004	5	0	0	5	1,250	75%	64%
431	08/2004	0	0	0	0	1,250	75%	64%
432	09/2004	0	0	0	0	1,250	75%	64%

Table A.4
RWC calculation at HSG using only HSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	2,437	0	0	2,437	1,250	75%	63%
434	11/2004	1,446	0	0	1,446	1,250	75%	62%
435	12/2004	2,833	0	0	2,833	1,250	75%	60%
436	01/2005	6,705	0	0	6,705	1,250	75%	57%
437	02/2005	4,617	0	0	4,617	1,250	75%	57%
438	03/2005	6,553	0	0	6,553	1,250	75%	55%
439	04/2005	6,495	0	0	6,495	1,250	75%	53%
440	05/2005	2,938	0	0	2,938	1,250	75%	52%
441	06/2005	13	0	0	13	1,250	75%	52%
442	07/2005	1,597	0	0	1,597	1,250	75%	52%
443	08/2005	1,959	0	0	1,959	1,250	75%	51%
444	09/2005	1,236	0	0	1,236	1,250	75%	51%
445	10/2005	1,446	0	0	1,446	1,250	75%	50%
446	11/2005	1,959	0	0	1,959	1,250	75%	50%
447	12/2005	1,144	0	0	1,144	1,250	75%	49%
448	01/2006	3,370	0	0	3,370	1,250	75%	49%
449	02/2006	634	0	0	634	1,250	75%	49%
450	03/2006	3,755	0	0	3,755	1,250	75%	50%
451	04/2006	5,154	0	0	5,154	1,250	75%	49%
452	05/2006	2,705	0	0	2,705	1,250	75%	49%
453	06/2006	1,474	0	0	1,474	1,250	75%	48%
454	07/2006	969	0	0	969	1,250	75%	48%
455	08/2006	914	0	0	914	1,250	75%	48%
456	09/2006	777	0	0	777	1,250	75%	47%
457	10/2006	300	0	0	300	1,250	75%	47%
458	11/2006	0	0	0	0	1,250	75%	47%
459	12/2006	553	0	0	553	1,250	75%	47%
460	01/2007	871	0	0	871	1,250	75%	47%
461	02/2007	885	0	0	885	1,250	75%	47%
462	03/2007	1,248	0	0	1,248	1,250	75%	47%
463	04/2007	758	0	0	758	1,250	75%	46%
464	05/2007	830	0	0	830	1,250	75%	46%
465	06/2007	621	0	0	621	1,250	75%	46%
466	07/2007	566	0	0	566	1,250	75%	46%
467	08/2007	87	0	0	87	1,250	75%	46%
468	09/2007	0	0	0	0	1,250	75%	46%
469	10/2007	40	0	0	40	1,250	75%	46%
470	11/2007	521	0	0	521	1,250	75%	46%
471	12/2007	617	0	0	617	1,250	75%	46%
472	01/2008	4,407	0	0	4,407	1,250	75%	45%
473	02/2008	3,102	0	0	3,102	1,250	75%	44%
474	03/2008	1,165	0	0	1,165	1,250	75%	45%
475	04/2008	854	0	0	854	1,250	75%	45%
476	05/2008	1,038	0	0	1,038	1,250	75%	45%
477	06/2008	521	0	0	521	1,250	75%	46%
478	07/2008	0	0	0	0	1,250	75%	46%
479	08/2008	0	0	0	0	1,250	75%	46%
480	09/2008	0	0	0	0	1,250	75%	46%

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	0	495	0	495			
2	11/1968	0	555	0	555			
3	12/1968	0	1,060	0	1,060			
4	01/1969	0	2,661	0	2,661			
5	02/1969	0	3,217	0	3,217			
6	03/1969	0	3,948	0	3,948			
7	04/1969	0	2,683	0	2,683			
8	05/1969	0	1,685	0	1,685			
9	06/1969	0	1,181	0	1,181			
10	07/1969	0	526	0	526			
11	08/1969	0	283	0	283			
12	09/1969	0	214	0	214			
13	10/1969	0	55	0	55			
14	11/1969	0	61	0	61			
15	12/1969	0	117	0	117			
16	01/1970	0	294	0	294			
17	02/1970	0	356	0	356			
18	03/1970	0	437	0	437			
19	04/1970	0	297	0	297			
20	05/1970	0	186	0	186			
21	06/1970	0	131	0	131			
22	07/1970	0	58	0	58			
23	08/1970	0	31	0	31			
24	09/1970	0	24	0	24			
25	10/1970	0	141	0	141			
26	11/1970	0	158	0	158			
27	12/1970	0	301	0	301			
28	01/1971	0	755	0	755			
29	02/1971	0	913	0	913			
30	03/1971	0	1,121	0	1,121			
31	04/1971	0	762	0	762	1,250		
32	05/1971	0	478	0	478	1,250		
33	06/1971	0	335	0	335	1,250		
34	07/1971	0	149	0	149	1,250		
35	08/1971	0	80	0	80	1,250		
36	09/1971	0	61	0	61	1,250		
37	10/1971	0	39	0	39	1,250		
38	11/1971	0	43	0	43	1,250		
39	12/1971	0	83	0	83	1,250		
40	01/1972	0	208	0	208	1,250		
41	02/1972	0	251	0	251	1,250		
42	03/1972	0	308	0	308	1,250		
43	04/1972	0	209	0	209	1,250		
44	05/1972	0	131	0	131	1,250		
45	06/1972	0	92	0	92	1,250		
46	07/1972	0	41	0	41	1,250		
47	08/1972	0	22	0	22	1,250		
48	09/1972	0	17	0	17	1,250		
49	10/1972	0	220	0	220	1,250		
50	11/1972	0	247	0	247	1,250		
51	12/1972	0	472	0	472	1,250		
52	01/1973	0	1,183	0	1,183	1,250		
53	02/1973	0	1,431	0	1,431	1,250		
54	03/1973	0	1,756	0	1,756	1,250		

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	0	1,193	0	1,193	1,250		
56	05/1973	0	749	0	749	1,250		
57	06/1973	0	525	0	525	1,250		
58	07/1973	0	234	0	234	1,250		
59	08/1973	0	126	0	126	1,250		
60	09/1973	0	95	0	95	1,250	75%	51%
61	10/1973	0	83	0	83	1,250	75%	52%
62	11/1973	0	93	0	93	1,250	75%	54%
63	12/1973	0	177	0	177	1,250	75%	55%
64	01/1974	0	444	0	444	1,250	75%	57%
65	02/1974	0	536	0	536	1,250	75%	60%
66	03/1974	0	658	0	658	1,250	75%	64%
67	04/1974	0	447	0	447	1,250	75%	66%
68	05/1974	0	281	0	281	1,250	75%	68%
69	06/1974	0	197	0	197	1,250	75%	70%
70	07/1974	0	88	0	88	1,250	75%	71%
71	08/1974	0	47	0	47	1,250	75%	72%
72	09/1974	0	36	0	36	1,250	75%	72%
73	10/1974	0	86	0	86	1,250	75%	73%
74	11/1974	0	96	0	96	1,250	75%	73%
75	12/1974	0	184	0	184	1,250	75%	74%
76	01/1975	0	462	0	462	1,250	75%	74%
77	02/1975	0	558	0	558	1,250	75%	74%
78	03/1975	0	685	0	685	1,250	75%	74%
79	04/1975	0	466	0	466	1,250	75%	74%
80	05/1975	0	293	0	293	1,250	75%	75%
81	06/1975	0	205	0	205	1,250	75%	**75%**
82	07/1975	0	91	0	91	1,250	75%	**75%**
83	08/1975	0	49	0	49	1,250	75%	**76%**
84	09/1975	0	37	0	37	1,250	75%	**76%**
85	10/1975	0	45	0	45	1,250	75%	**76%**
86	11/1975	0	51	0	51	1,250	75%	**77%**
87	12/1975	0	97	0	97	1,250	75%	**77%**
88	01/1976	0	244	0	244	1,250	75%	**78%**
89	02/1976	0	295	0	295	1,250	75%	**79%**
90	03/1976	0	362	0	362	1,250	75%	**80%**
91	04/1976	0	246	0	246	1,250	75%	**80%**
92	05/1976	0	155	0	155	1,250	75%	**81%**
93	06/1976	0	108	0	108	1,250	75%	**81%**
94	07/1976	0	48	0	48	1,250	75%	**81%**
95	08/1976	0	26	0	26	1,250	75%	**81%**
96	09/1976	0	20	0	20	1,250	75%	**81%**
97	10/1976	0	67	0	67	1,250	75%	**81%**
98	11/1976	0	76	0	76	1,250	75%	**81%**
99	12/1976	0	144	0	144	1,250	75%	**81%**
100	01/1977	0	362	0	362	1,250	75%	**81%**
101	02/1977	0	438	0	438	1,250	75%	**81%**
102	03/1977	0	538	0	538	1,250	75%	**80%**
103	04/1977	0	366	0	366	1,250	75%	**80%**
104	05/1977	0	230	0	230	1,250	75%	**80%**
105	06/1977	0	161	0	161	1,250	75%	**80%**
106	07/1977	0	72	0	72	1,250	75%	**80%**
107	08/1977	0	39	0	39	1,250	75%	**80%**
108	09/1977	0	29	0	29	1,250	75%	**80%**

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	0	711	0	711	1,250	75%	80%
110	11/1977	0	796	0	796	1,250	75%	79%
111	12/1977	0	1,522	0	1,522	1,250	75%	78%
112	01/1978	0	3,819	0	3,819	1,250	75%	76%
113	02/1978	0	4,618	0	4,618	1,250	75%	74%
114	03/1978	0	5,667	0	5,667	1,250	75%	71%
115	04/1978	0	3,851	0	3,851	1,250	75%	69%
116	05/1978	0	2,419	0	2,419	1,250	75%	68%
117	06/1978	0	1,695	0	1,695	1,250	75%	68%
118	07/1978	0	755	0	755	1,250	75%	67%
119	08/1978	0	406	0	406	1,250	75%	67%
120	09/1978	0	307	0	307	1,250	75%	67%
121	10/1978	0	418	0	418	1,250	75%	67%
122	11/1978	0	468	0	468	1,250	75%	66%
123	12/1978	0	895	0	895	1,250	75%	66%
124	01/1979	0	2,245	0	2,245	1,250	75%	65%
125	02/1979	0	2,715	0	2,715	1,250	75%	64%
126	03/1979	0	3,332	0	3,332	1,250	75%	62%
127	04/1979	0	2,264	0	2,264	1,250	75%	61%
128	05/1979	0	1,422	0	1,422	1,250	75%	61%
129	06/1979	0	997	0	997	1,250	75%	61%
130	07/1979	0	444	0	444	1,250	75%	60%
131	08/1979	0	239	0	239	1,250	75%	60%
132	09/1979	0	181	0	181	1,250	75%	60%
133	10/1979	0	541	0	541	1,250	75%	60%
134	11/1979	0	606	0	606	1,250	75%	60%
135	12/1979	0	1,159	0	1,159	1,250	75%	59%
136	01/1980	0	2,907	0	2,907	1,250	75%	58%
137	02/1980	0	3,515	0	3,515	1,250	75%	57%
138	03/1980	0	4,313	0	4,313	1,250	75%	55%
139	04/1980	0	2,932	0	2,932	1,250	75%	54%
140	05/1980	0	1,841	0	1,841	1,250	75%	54%
141	06/1980	0	1,291	0	1,291	1,250	75%	53%
142	07/1980	0	575	0	575	1,250	75%	53%
143	08/1980	0	309	0	309	1,250	75%	53%
144	09/1980	0	234	0	234	1,250	75%	53%
145	10/1980	0	110	0	110	1,250	75%	53%
146	11/1980	0	123	0	123	1,250	75%	53%
147	12/1980	0	236	0	236	1,250	75%	53%
148	01/1981	0	591	0	591	1,250	75%	53%
149	02/1981	0	715	0	715	1,250	75%	53%
150	03/1981	0	877	0	877	1,250	75%	52%
151	04/1981	0	596	0	596	1,250	75%	52%
152	05/1981	0	374	0	374	1,250	75%	52%
153	06/1981	0	262	0	262	1,250	75%	52%
154	07/1981	0	117	0	117	1,250	75%	52%
155	08/1981	0	63	0	63	1,250	75%	52%
156	09/1981	0	48	0	48	1,250	75%	52%
157	10/1981	0	191	0	191	1,250	75%	52%
158	11/1981	0	214	0	214	1,250	75%	52%
159	12/1981	0	409	0	409	1,250	75%	52%
160	01/1982	0	1,025	0	1,025	1,250	75%	52%
161	02/1982	0	1,239	0	1,239	1,250	75%	51%
162	03/1982	0	1,521	0	1,521	1,250	75%	51%

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	0	1,034	0	1,034	1,250	75%	51%
164	05/1982	0	649	0	649	1,250	75%	51%
165	06/1982	0	455	0	455	1,250	75%	51%
166	07/1982	0	203	0	203	1,250	75%	50%
167	08/1982	0	109	0	109	1,250	75%	50%
168	09/1982	0	82	0	82	1,250	75%	50%
169	10/1982	0	798	0	798	1,250	75%	50%
170	11/1982	0	894	0	894	1,250	75%	50%
171	12/1982	0	1,708	0	1,708	1,250	75%	50%
172	01/1983	0	4,286	0	4,286	1,250	75%	50%
173	02/1983	0	5,182	0	5,182	1,250	75%	50%
174	03/1983	0	6,359	0	6,359	1,250	75%	50%
175	04/1983	0	4,322	0	4,322	1,250	75%	50%
176	05/1983	0	2,714	0	2,714	1,250	75%	50%
177	06/1983	0	1,902	0	1,902	1,250	75%	49%
178	07/1983	0	847	0	847	1,250	75%	49%
179	08/1983	0	455	0	455	1,250	75%	49%
180	09/1983	0	345	0	345	1,250	75%	49%
181	10/1983	0	123	0	123	1,250	75%	49%
182	11/1983	0	138	0	138	1,250	75%	50%
183	12/1983	0	264	0	264	1,250	75%	50%
184	01/1984	0	661	0	661	1,250	75%	50%
185	02/1984	0	800	0	800	1,250	75%	51%
186	03/1984	0	981	0	981	1,250	75%	52%
187	04/1984	0	667	0	667	1,250	75%	52%
188	05/1984	0	419	0	419	1,250	75%	53%
189	06/1984	0	294	0	294	1,250	75%	53%
190	07/1984	0	131	0	131	1,250	75%	53%
191	08/1984	0	70	0	70	1,250	75%	53%
192	09/1984	0	53	0	53	1,250	75%	53%
193	10/1984	0	117	0	117	1,250	75%	53%
194	11/1984	0	131	0	131	1,250	75%	54%
195	12/1984	0	251	0	251	1,250	75%	54%
196	01/1985	0	630	0	630	1,250	75%	55%
197	02/1985	0	761	0	761	1,250	75%	56%
198	03/1985	0	934	0	934	1,250	75%	57%
199	04/1985	0	635	0	635	1,250	75%	58%
200	05/1985	0	399	0	399	1,250	75%	59%
201	06/1985	0	280	0	280	1,250	75%	60%
202	07/1985	0	125	0	125	1,250	75%	60%
203	08/1985	0	67	0	67	1,250	75%	60%
204	09/1985	0	51	0	51	1,250	75%	60%
205	10/1985	0	233	0	233	1,250	75%	60%
206	11/1985	0	261	0	261	1,250	75%	60%
207	12/1985	0	498	0	498	1,250	75%	60%
208	01/1986	0	1,251	0	1,251	1,250	75%	59%
209	02/1986	0	1,512	0	1,512	1,250	75%	59%
210	03/1986	0	1,856	0	1,856	1,250	75%	59%
211	04/1986	0	1,261	0	1,261	1,250	75%	58%
212	05/1986	0	792	0	792	1,250	75%	58%
213	06/1986	0	555	0	555	1,250	75%	58%
214	07/1986	0	247	0	247	1,250	75%	58%
215	08/1986	0	133	0	133	1,250	75%	58%
216	09/1986	0	101	0	101	1,250	75%	58%

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	0	16	0	16	1,250	75%	58%
218	11/1986	0	18	0	18	1,250	75%	58%
219	12/1986	0	35	0	35	1,250	75%	58%
220	01/1987	0	87	0	87	1,250	75%	59%
221	02/1987	0	105	0	105	1,250	75%	59%
222	03/1987	0	129	0	129	1,250	75%	60%
223	04/1987	0	88	0	88	1,250	75%	60%
224	05/1987	0	55	0	55	1,250	75%	61%
225	06/1987	0	39	0	39	1,250	75%	61%
226	07/1987	0	17	0	17	1,250	75%	61%
227	08/1987	0	9	0	9	1,250	75%	61%
228	09/1987	0	7	0	7	1,250	75%	61%
229	10/1987	0	157	0	157	1,250	75%	61%
230	11/1987	0	176	0	176	1,250	75%	62%
231	12/1987	0	336	0	336	1,250	75%	62%
232	01/1988	0	843	0	843	1,250	75%	64%
233	02/1988	0	1,020	0	1,020	1,250	75%	67%
234	03/1988	0	1,251	0	1,251	1,250	75%	70%
235	04/1988	0	850	0	850	1,250	75%	72%
236	05/1988	0	534	0	534	1,250	75%	74%
237	06/1988	0	374	0	374	1,250	75%	75%
238	07/1988	0	167	0	167	1,250	75%	**75%**
239	08/1988	0	90	0	90	1,250	75%	**75%**
240	09/1988	0	68	0	68	1,250	75%	**76%**
241	10/1988	0	45	0	45	1,250	75%	**76%**
242	11/1988	0	51	0	51	1,250	75%	**76%**
243	12/1988	0	97	0	97	1,250	75%	**76%**
244	01/1989	0	244	0	244	1,250	75%	**76%**
245	02/1989	0	295	0	295	1,250	75%	**77%**
246	03/1989	0	361	0	361	1,250	75%	**77%**
247	04/1989	0	246	0	246	1,250	75%	**77%**
248	05/1989	0	154	0	154	1,250	75%	**78%**
249	06/1989	0	108	0	108	1,250	75%	**78%**
250	07/1989	0	48	0	48	1,250	75%	**78%**
251	08/1989	0	26	0	26	1,250	75%	**78%**
252	09/1989	0	20	0	20	1,250	75%	**78%**
253	10/1989	0	59	0	59	1,250	75%	**78%**
254	11/1989	0	66	0	66	1,250	75%	**78%**
255	12/1989	0	127	0	127	1,250	75%	**78%**
256	01/1990	0	319	0	319	1,250	75%	**78%**
257	02/1990	0	385	0	385	1,250	75%	**79%**
258	03/1990	0	473	0	473	1,250	75%	**79%**
259	04/1990	0	321	0	321	1,250	75%	**79%**
260	05/1990	0	202	0	202	1,250	75%	**79%**
261	06/1990	0	141	0	141	1,250	75%	**80%**
262	07/1990	0	63	0	63	1,250	75%	**80%**
263	08/1990	0	34	0	34	1,250	75%	**80%**
264	09/1990	0	26	0	26	1,250	75%	**80%**
265	10/1990	0	137	0	137	1,250	75%	**80%**
266	11/1990	0	153	0	153	1,250	75%	**80%**
267	12/1990	0	293	0	293	1,250	75%	**80%**
268	01/1991	0	735	0	735	1,250	75%	**81%**
269	02/1991	0	889	0	889	1,250	75%	**81%**
270	03/1991	0	1,091	0	1,091	1,250	75%	**82%**

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	0	741	0	741	1,250	75%	82%
272	05/1991	0	465	0	465	1,250	75%	82%
273	06/1991	0	326	0	326	1,250	75%	83%
274	07/1991	0	145	0	145	1,250	75%	83%
275	08/1991	0	78	0	78	1,250	75%	83%
276	09/1991	0	59	0	59	1,250	75%	83%
277	10/1991	0	448	0	448	1,250	75%	82%
278	11/1991	0	502	0	502	1,250	75%	82%
279	12/1991	0	960	0	960	1,250	75%	81%
280	01/1992	0	2,409	0	2,409	1,250	75%	79%
281	02/1992	0	2,913	0	2,913	1,250	75%	77%
282	03/1992	0	3,575	0	3,575	1,250	75%	74%
283	04/1992	0	2,429	0	2,429	1,250	75%	73%
284	05/1992	0	1,526	0	1,526	1,250	75%	72%
285	06/1992	0	1,069	0	1,069	1,250	75%	71%
286	07/1992	0	476	0	476	1,250	75%	71%
287	08/1992	0	256	0	256	1,250	75%	70%
288	09/1992	0	194	0	194	1,250	75%	70%
289	10/1992	0	590	0	590	1,250	75%	70%
290	11/1992	0	661	0	661	1,250	75%	70%
291	12/1992	0	1,264	0	1,264	1,250	75%	69%
292	01/1993	0	3,172	0	3,172	1,250	75%	68%
293	02/1993	0	3,835	0	3,835	1,250	75%	66%
294	03/1993	0	4,706	0	4,706	1,250	75%	64%
295	04/1993	0	3,198	0	3,198	1,250	75%	63%
296	05/1993	0	2,009	0	2,009	1,250	75%	62%
297	06/1993	0	1,408	0	1,408	1,250	75%	62%
298	07/1993	0	627	0	627	1,250	75%	61%
299	08/1993	0	337	0	337	1,250	75%	61%
300	09/1993	0	255	0	255	1,250	75%	61%
301	10/1993	0	110	0	110	1,250	75%	61%
302	11/1993	0	123	0	123	1,250	75%	61%
303	12/1993	0	235	0	235	1,250	75%	61%
304	01/1994	0	589	0	589	1,250	75%	61%
305	02/1994	0	712	0	712	1,250	75%	61%
306	03/1994	0	874	0	874	1,250	75%	60%
307	04/1994	0	594	0	594	1,250	75%	60%
308	05/1994	0	373	0	373	1,250	75%	60%
309	06/1994	0	261	0	261	1,250	75%	60%
310	07/1994	0	116	0	116	1,250	75%	60%
311	08/1994	0	63	0	63	1,250	75%	60%
312	09/1994	0	47	0	47	1,250	75%	60%
313	10/1994	0	488	0	488	1,250	75%	60%
314	11/1994	0	547	0	547	1,250	75%	59%
315	12/1994	0	1,046	0	1,046	1,250	75%	59%
316	01/1995	0	2,624	0	2,624	1,250	75%	58%
317	02/1995	0	3,172	0	3,172	1,250	75%	57%
318	03/1995	0	3,893	0	3,893	1,250	75%	55%
319	04/1995	0	2,646	0	2,646	1,250	75%	54%
320	05/1995	0	1,662	0	1,662	1,250	75%	54%
321	06/1995	0	1,165	0	1,165	1,250	75%	53%
322	07/1995	0	519	0	519	1,250	75%	53%
323	08/1995	0	279	0	279	1,250	75%	53%
324	09/1995	0	211	0	211	1,250	75%	53%

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	0	157	0	157	1,250	75%	53%
326	11/1995	0	176	0	176	1,250	75%	53%
327	12/1995	0	337	0	337	1,250	75%	53%
328	01/1996	0	845	0	845	1,250	75%	53%
329	02/1996	0	1,022	0	1,022	1,250	75%	53%
330	03/1996	0	1,254	0	1,254	1,250	75%	53%
331	04/1996	0	853	0	853	1,250	75%	53%
332	05/1996	0	535	0	535	1,250	75%	53%
333	06/1996	0	375	0	375	1,250	75%	53%
334	07/1996	0	167	0	167	1,250	75%	53%
335	08/1996	0	90	0	90	1,250	75%	53%
336	09/1996	0	68	0	68	1,250	75%	53%
337	10/1996	0	0	0	0	1,250	75%	53%
338	11/1996	0	435	0	435	1,250	75%	53%
339	12/1996	0	2,076	0	2,076	1,250	75%	53%
340	01/1997	0	3,958	0	3,958	1,250	75%	52%
341	02/1997	0	1,015	0	1,015	1,250	75%	53%
342	03/1997	0	0	0	0	1,250	75%	54%
343	04/1997	0	0	0	0	1,250	75%	55%
344	05/1997	0	0	0	0	1,250	75%	56%
345	06/1997	0	0	0	0	1,250	75%	56%
346	07/1997	0	0	0	0	1,250	75%	56%
347	08/1997	0	0	0	0	1,250	75%	56%
348	09/1997	0	1	0	1	1,250	75%	56%
349	10/1997	0	0	0	0	1,250	75%	57%
350	11/1997	0	466	0	466	1,250	75%	57%
351	12/1997	0	1,126	0	1,126	1,250	75%	57%
352	01/1998	0	749	0	749	1,250	75%	58%
353	02/1998	0	5,126	0	5,126	1,250	75%	57%
354	03/1998	0	6,930	0	6,930	1,250	75%	56%
355	04/1998	0	4,179	0	4,179	1,250	75%	56%
356	05/1998	0	3,322	0	3,322	1,250	75%	55%
357	06/1998	0	3,984	0	3,984	1,250	75%	54%
358	07/1998	0	930	0	930	1,250	75%	54%
359	08/1998	0	69	0	69	1,250	75%	54%
360	09/1998	0	0	0	0	1,250	75%	55%
361	10/1998	0	0	0	0	1,250	75%	55%
362	11/1998	0	57	0	57	1,250	75%	55%
363	12/1998	0	71	0	71	1,250	75%	55%
364	01/1999	0	358	0	358	1,250	75%	55%
365	02/1999	0	267	0	267	1,250	75%	55%
366	03/1999	0	0	0	0	1,250	75%	55%
367	04/1999	0	0	0	0	1,250	75%	56%
368	05/1999	0	73	0	73	1,250	75%	56%
369	06/1999	0	77	0	77	1,250	75%	56%
370	07/1999	0	0	0	0	1,250	75%	56%
371	08/1999	0	0	0	0	1,250	75%	56%
372	09/1999	0	0	0	0	1,250	75%	56%
373	10/1999	0	0	0	0	1,250	75%	56%
374	11/1999	0	0	0	0	1,250	75%	56%
375	12/1999	0	0	0	0	1,250	75%	57%
376	01/2000	0	103	0	103	1,250	75%	58%
377	02/2000	0	2,076	0	2,076	1,250	75%	58%
378	03/2000	0	1,212	0	1,212	1,250	75%	60%

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	0	384	0	384	1,250	75%	61%
380	05/2000	0	0	0	0	1,250	75%	61%
381	06/2000	0	0	0	0	1,250	75%	62%
382	07/2000	0	0	0	0	1,250	75%	62%
383	08/2000	0	0	0	0	1,250	75%	62%
384	09/2000	0	0	0	0	1,250	75%	63%
385	10/2000	0	114	0	114	1,250	75%	63%
386	11/2000	0	162	0	162	1,250	75%	63%
387	12/2000	0	0	0	0	1,250	75%	63%
388	01/2001	0	919	0	919	1,250	75%	63%
389	02/2001	0	1,597	0	1,597	1,250	75%	62%
390	03/2001	0	1,876	0	1,876	1,250	75%	62%
391	04/2001	0	296	0	296	1,250	75%	62%
392	05/2001	0	0	0	0	1,250	75%	63%
393	06/2001	0	0	0	0	1,250	75%	63%
394	07/2001	0	0	0	0	1,250	75%	63%
395	08/2001	0	0	0	0	1,250	75%	63%
396	09/2001	0	0	0	0	1,250	75%	63%
397	10/2001	0	349	0	349	1,250	75%	63%
398	11/2001	0	105	0	105	1,250	75%	63%
399	12/2001	0	119	0	119	1,250	75%	64%
400	01/2002	0	285	0	285	1,250	75%	66%
401	02/2002	0	92	0	92	1,250	75%	67%
402	03/2002	0	0	0	0	1,250	75%	67%
403	04/2002	0	0	0	0	1,250	75%	67%
404	05/2002	0	36	0	36	1,250	75%	67%
405	06/2002	0	0	0	0	1,250	75%	67%
406	07/2002	0	0	0	0	1,250	75%	67%
407	08/2002	0	0	0	0	1,250	75%	67%
408	09/2002	0	0	0	0	1,250	75%	67%
409	10/2002	0	8	0	8	1,250	75%	67%
410	11/2002	0	1,039	0	1,039	1,250	75%	66%
411	12/2002	0	415	0	415	1,250	75%	67%
412	01/2003	0	0	0	0	1,250	75%	67%
413	02/2003	0	871	0	871	1,250	75%	70%
414	03/2003	0	1,212	0	1,212	1,250	75%	74%
415	04/2003	0	285	0	285	1,250	75%	77%
416	05/2003	0	762	0	762	1,250	75%	79%
417	06/2003	0	0	0	0	1,250	75%	82%
418	07/2003	0	0	0	0	1,250	75%	83%
419	08/2003	0	0	0	0	1,250	75%	83%
420	09/2003	0	0	0	0	1,250	75%	83%
421	10/2003	0	0	0	0	1,250	75%	83%
422	11/2003	0	522	0	522	1,250	75%	83%
423	12/2003	0	196	0	196	1,250	75%	83%
424	01/2004	0	26	0	26	1,250	75%	83%
425	02/2004	0	1,041	0	1,041	1,250	75%	82%
426	03/2004	0	327	0	327	1,250	75%	82%
427	04/2004	0	122	0	122	1,250	75%	82%
428	05/2004	0	0	0	0	1,250	75%	82%
429	06/2004	0	0	0	0	1,250	75%	82%
430	07/2004	0	12	0	12	1,250	75%	82%
431	08/2004	0	1	0	1	1,250	75%	82%
432	09/2004	0	0	0	0	1,250	75%	82%

Table A.5
RWC calculation at PSG using only PSG as diluent source (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	0	831	0	831	1,250	75%	81%
434	11/2004	0	19	0	19	1,250	75%	81%
435	12/2004	0	1,147	0	1,147	1,250	75%	80%
436	01/2005	0	5,411	0	5,411	1,250	75%	76%
437	02/2005	0	3,400	0	3,400	1,250	75%	75%
438	03/2005	0	6,514	0	6,514	1,250	75%	71%
439	04/2005	0	1,213	0	1,213	1,250	75%	71%
440	05/2005	0	1,947	0	1,947	1,250	75%	69%
441	06/2005	0	1,067	0	1,067	1,250	75%	69%
442	07/2005	0	1,023	0	1,023	1,250	75%	68%
443	08/2005	0	0	0	0	1,250	75%	68%
444	09/2005	0	0	0	0	1,250	75%	68%
445	10/2005	0	292	0	292	1,250	75%	68%
446	11/2005	0	0	0	0	1,250	75%	68%
447	12/2005	0	173	0	173	1,250	75%	68%
448	01/2006	0	1,100	0	1,100	1,250	75%	68%
449	02/2006	0	610	0	610	1,250	75%	68%
450	03/2006	0	2,011	0	2,011	1,250	75%	68%
451	04/2006	0	3,621	0	3,621	1,250	75%	66%
452	05/2006	0	1,726	0	1,726	1,250	75%	65%
453	06/2006	0	0	0	0	1,250	75%	65%
454	07/2006	0	0	0	0	1,250	75%	65%
455	08/2006	0	0	0	0	1,250	75%	65%
456	09/2006	0	0	0	0	1,250	75%	65%
457	10/2006	0	0	0	0	1,250	75%	65%
458	11/2006	0	0	0	0	1,250	75%	66%
459	12/2006	0	10	0	10	1,250	75%	66%
460	01/2007	0	51	0	51	1,250	75%	66%
461	02/2007	0	252	0	252	1,250	75%	66%
462	03/2007	0	0	0	0	1,250	75%	66%
463	04/2007	0	87	0	87	1,250	75%	66%
464	05/2007	0	0	0	0	1,250	75%	66%
465	06/2007	0	0	0	0	1,250	75%	66%
466	07/2007	0	0	0	0	1,250	75%	66%
467	08/2007	0	0	0	0	1,250	75%	66%
468	09/2007	0	166	0	166	1,250	75%	65%
469	10/2007	0	0	0	0	1,250	75%	66%
470	11/2007	0	67	0	67	1,250	75%	66%
471	12/2007	0	365	0	365	1,250	75%	66%
472	01/2008	0	2,466	0	2,466	1,250	75%	65%
473	02/2008	0	2,725	0	2,725	1,250	75%	64%
474	03/2008	0	1	0	1	1,250	75%	64%
475	04/2008	0	720	0	720	1,250	75%	64%
476	05/2008	0	178	0	178	1,250	75%	64%
477	06/2008	0	0	0	0	1,250	75%	64%
478	07/2008	0	0	0	0	1,250	75%	64%
479	08/2008	0	0	0	0	1,250	75%	64%
480	09/2008	0	0	0	0	1,250	75%	64%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	618	248	282	1,148			
2	11/1968	692	277	316	1,286			
3	12/1968	1,323	530	604	2,457			
4	01/1969	3,320	1,330	1,516	6,166			
5	02/1969	4,014	1,608	1,833	7,455			
6	03/1969	4,925	1,974	2,250	9,149			
7	04/1969	3,347	1,342	1,529	6,218			
8	05/1969	2,102	842	960	3,905			
9	06/1969	1,474	591	673	2,737			
10	07/1969	656	263	300	1,219			
11	08/1969	353	141	161	655			
12	09/1969	267	107	122	496			
13	10/1969	227	27	51	306			
14	11/1969	254	31	58	343			
15	12/1969	486	59	110	655			
16	01/1970	1,220	147	276	1,643			
17	02/1970	1,475	178	334	1,987			
18	03/1970	1,809	218	410	2,438			
19	04/1970	1,230	148	279	1,657			
20	05/1970	772	93	175	1,041			
21	06/1970	541	65	123	729			
22	07/1970	241	29	55	325			
23	08/1970	130	16	29	175			
24	09/1970	98	12	22	132			
25	10/1970	222	70	0	292			
26	11/1970	249	79	0	327			
27	12/1970	475	151	0	626			
28	01/1971	1,192	378	0	1,570			
29	02/1971	1,441	457	0	1,898			
30	03/1971	1,768	560	0	2,329			
31	04/1971	1,202	381	0	1,583	1,388		
32	05/1971	755	239	0	994	1,388		
33	06/1971	529	168	0	697	1,388		
34	07/1971	236	75	0	310	1,388		
35	08/1971	127	40	0	167	1,388		
36	09/1971	96	30	0	126	1,388		
37	10/1971	37	19	0	56	1,388		
38	11/1971	41	22	0	63	1,388		
39	12/1971	79	41	0	120	1,388		
40	01/1972	198	104	0	301	1,388		
41	02/1972	239	126	0	364	1,388		
42	03/1972	293	154	0	447	1,388		
43	04/1972	199	105	0	304	1,388		
44	05/1972	125	66	0	191	1,388		
45	06/1972	88	46	0	134	1,388		
46	07/1972	39	21	0	60	1,388		
47	08/1972	21	11	0	32	1,388		
48	09/1972	16	8	0	24	1,388		
49	10/1972	176	110	49	336	1,388		
50	11/1972	198	123	55	376	1,388		
51	12/1972	378	236	105	719	1,388		
52	01/1973	948	592	264	1,804	1,388		
53	02/1973	1,146	715	319	2,181	1,388		
54	03/1973	1,407	878	392	2,676	1,388		

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	956	597	266	1,819	1,388		
56	05/1973	600	375	167	1,142	1,388		
57	06/1973	421	263	117	801	1,388		
58	07/1973	187	117	52	357	1,388		
59	08/1973	101	63	28	192	1,388		
60	09/1973	76	48	21	145	1,388	75%	34%
61	10/1973	120	41	0	161	1,388	75%	35%
62	11/1973	134	46	0	180	1,388	75%	36%
63	12/1973	256	88	0	345	1,388	75%	38%
64	01/1974	643	222	0	865	1,388	75%	40%
65	02/1974	777	268	0	1,045	1,388	75%	43%
66	03/1974	954	329	0	1,283	1,388	75%	47%
67	04/1974	648	224	0	872	1,388	75%	50%
68	05/1974	407	140	0	548	1,388	75%	53%
69	06/1974	285	98	0	384	1,388	75%	55%
70	07/1974	127	44	0	171	1,388	75%	56%
71	08/1974	68	24	0	92	1,388	75%	57%
72	09/1974	52	18	0	70	1,388	75%	58%
73	10/1974	103	43	0	146	1,388	75%	58%
74	11/1974	116	48	0	164	1,388	75%	59%
75	12/1974	221	92	0	313	1,388	75%	60%
76	01/1975	555	231	0	785	1,388	75%	61%
77	02/1975	670	279	0	950	1,388	75%	62%
78	03/1975	823	343	0	1,165	1,388	75%	63%
79	04/1975	559	233	0	792	1,388	75%	64%
80	05/1975	351	146	0	497	1,388	75%	65%
81	06/1975	246	103	0	349	1,388	75%	65%
82	07/1975	110	46	0	155	1,388	75%	66%
83	08/1975	59	25	0	83	1,388	75%	66%
84	09/1975	45	19	0	63	1,388	75%	67%
85	10/1975	60	23	0	82	1,388	75%	67%
86	11/1975	67	25	0	92	1,388	75%	68%
87	12/1975	127	49	0	176	1,388	75%	69%
88	01/1976	320	122	0	442	1,388	75%	70%
89	02/1976	387	148	0	534	1,388	75%	71%
90	03/1976	475	181	0	656	1,388	75%	72%
91	04/1976	323	123	0	446	1,388	75%	73%
92	05/1976	203	77	0	280	1,388	75%	73%
93	06/1976	142	54	0	196	1,388	75%	74%
94	07/1976	63	24	0	87	1,388	75%	74%
95	08/1976	34	13	0	47	1,388	75%	74%
96	09/1976	26	10	0	36	1,388	75%	74%
97	10/1976	51	34	0	84	1,388	75%	74%
98	11/1976	57	38	0	94	1,388	75%	74%
99	12/1976	108	72	0	180	1,388	75%	74%
100	01/1977	272	181	0	453	1,388	75%	74%
101	02/1977	328	219	0	547	1,388	75%	74%
102	03/1977	403	269	0	672	1,388	75%	74%
103	04/1977	274	183	0	457	1,388	75%	73%
104	05/1977	172	115	0	287	1,388	75%	73%
105	06/1977	121	80	0	201	1,388	75%	73%
106	07/1977	54	36	0	90	1,388	75%	73%
107	08/1977	29	19	0	48	1,388	75%	73%
108	09/1977	22	15	0	36	1,388	75%	73%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	535	355	277	1,168	1,388	75%	73%
110	11/1977	600	398	311	1,308	1,388	75%	72%
111	12/1977	1,146	761	594	2,501	1,388	75%	71%
112	01/1978	2,876	1,910	1,489	6,275	1,388	75%	69%
113	02/1978	3,477	2,309	1,801	7,586	1,388	75%	66%
114	03/1978	4,267	2,833	2,210	9,310	1,388	75%	62%
115	04/1978	2,900	1,926	1,502	6,327	1,388	75%	60%
116	05/1978	1,821	1,209	943	3,974	1,388	75%	59%
117	06/1978	1,277	848	661	2,785	1,388	75%	58%
118	07/1978	569	378	295	1,241	1,388	75%	58%
119	08/1978	305	203	158	667	1,388	75%	58%
120	09/1978	231	154	120	505	1,388	75%	58%
121	10/1978	470	209	0	679	1,388	75%	57%
122	11/1978	527	234	0	761	1,388	75%	57%
123	12/1978	1,006	447	0	1,454	1,388	75%	57%
124	01/1979	2,525	1,123	0	3,648	1,388	75%	56%
125	02/1979	3,053	1,357	0	4,411	1,388	75%	54%
126	03/1979	3,747	1,666	0	5,413	1,388	75%	53%
127	04/1979	2,547	1,132	0	3,679	1,388	75%	52%
128	05/1979	1,599	711	0	2,310	1,388	75%	51%
129	06/1979	1,121	498	0	1,619	1,388	75%	51%
130	07/1979	499	222	0	721	1,388	75%	51%
131	08/1979	268	119	0	388	1,388	75%	51%
132	09/1979	203	90	0	294	1,388	75%	51%
133	10/1979	592	271	0	862	1,388	75%	51%
134	11/1979	663	303	0	966	1,388	75%	50%
135	12/1979	1,267	579	0	1,846	1,388	75%	50%
136	01/1980	3,179	1,454	0	4,632	1,388	75%	49%
137	02/1980	3,843	1,757	0	5,601	1,388	75%	47%
138	03/1980	4,716	2,157	0	6,873	1,388	75%	46%
139	04/1980	3,205	1,466	0	4,671	1,388	75%	45%
140	05/1980	2,013	921	0	2,934	1,388	75%	44%
141	06/1980	1,411	645	0	2,056	1,388	75%	44%
142	07/1980	629	287	0	916	1,388	75%	44%
143	08/1980	338	154	0	492	1,388	75%	44%
144	09/1980	256	117	0	373	1,388	75%	44%
145	10/1980	275	55	0	330	1,388	75%	44%
146	11/1980	309	62	0	370	1,388	75%	44%
147	12/1980	590	118	0	707	1,388	75%	43%
148	01/1981	1,480	296	0	1,775	1,388	75%	43%
149	02/1981	1,789	357	0	2,146	1,388	75%	43%
150	03/1981	2,195	439	0	2,634	1,388	75%	42%
151	04/1981	1,492	298	0	1,790	1,388	75%	42%
152	05/1981	937	187	0	1,124	1,388	75%	42%
153	06/1981	657	131	0	788	1,388	75%	42%
154	07/1981	293	58	0	351	1,388	75%	42%
155	08/1981	157	31	0	189	1,388	75%	42%
156	09/1981	119	24	0	143	1,388	75%	42%
157	10/1981	272	95	0	368	1,388	75%	42%
158	11/1981	305	107	0	412	1,388	75%	42%
159	12/1981	583	204	0	788	1,388	75%	41%
160	01/1982	1,464	513	0	1,977	1,388	75%	41%
161	02/1982	1,770	620	0	2,390	1,388	75%	41%
162	03/1982	2,172	761	0	2,933	1,388	75%	40%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	1,476	517	0	1,993	1,388	75%	40%
164	05/1982	927	325	0	1,252	1,388	75%	40%
165	06/1982	650	228	0	877	1,388	75%	40%
166	07/1982	289	101	0	391	1,388	75%	40%
167	08/1982	156	54	0	210	1,388	75%	40%
168	09/1982	118	41	0	159	1,388	75%	40%
169	10/1982	670	399	229	1,297	1,388	75%	40%
170	11/1982	750	447	256	1,453	1,388	75%	39%
171	12/1982	1,434	854	490	2,778	1,388	75%	39%
172	01/1983	3,598	2,143	1,229	6,970	1,388	75%	39%
173	02/1983	4,351	2,591	1,486	8,428	1,388	75%	39%
174	03/1983	5,339	3,179	1,824	10,342	1,388	75%	39%
175	04/1983	3,629	2,161	1,239	7,029	1,388	75%	39%
176	05/1983	2,279	1,357	778	4,414	1,388	75%	39%
177	06/1983	1,597	951	546	3,094	1,388	75%	39%
178	07/1983	712	424	243	1,378	1,388	75%	39%
179	08/1983	382	228	131	740	1,388	75%	39%
180	09/1983	290	172	99	561	1,388	75%	39%
181	10/1983	198	62	0	260	1,388	75%	39%
182	11/1983	222	69	0	291	1,388	75%	39%
183	12/1983	424	132	0	556	1,388	75%	39%
184	01/1984	1,064	331	0	1,395	1,388	75%	39%
185	02/1984	1,287	400	0	1,687	1,388	75%	40%
186	03/1984	1,579	491	0	2,070	1,388	75%	41%
187	04/1984	1,073	333	0	1,407	1,388	75%	41%
188	05/1984	674	209	0	883	1,388	75%	41%
189	06/1984	473	147	0	619	1,388	75%	41%
190	07/1984	210	65	0	276	1,388	75%	42%
191	08/1984	113	35	0	148	1,388	75%	42%
192	09/1984	86	27	0	112	1,388	75%	42%
193	10/1984	253	59	0	311	1,388	75%	42%
194	11/1984	283	66	0	349	1,388	75%	42%
195	12/1984	541	125	0	666	1,388	75%	42%
196	01/1985	1,357	315	0	1,672	1,388	75%	43%
197	02/1985	1,641	381	0	2,022	1,388	75%	44%
198	03/1985	2,014	467	0	2,481	1,388	75%	45%
199	04/1985	1,369	317	0	1,686	1,388	75%	45%
200	05/1985	860	199	0	1,059	1,388	75%	46%
201	06/1985	603	140	0	742	1,388	75%	46%
202	07/1985	268	62	0	331	1,388	75%	46%
203	08/1985	144	33	0	178	1,388	75%	46%
204	09/1985	109	25	0	135	1,388	75%	46%
205	10/1985	346	116	0	463	1,388	75%	46%
206	11/1985	388	130	0	518	1,388	75%	46%
207	12/1985	741	249	0	990	1,388	75%	46%
208	01/1986	1,860	625	0	2,485	1,388	75%	46%
209	02/1986	2,249	756	0	3,005	1,388	75%	46%
210	03/1986	2,759	928	0	3,687	1,388	75%	46%
211	04/1986	1,875	631	0	2,506	1,388	75%	45%
212	05/1986	1,178	396	0	1,574	1,388	75%	45%
213	06/1986	826	278	0	1,103	1,388	75%	45%
214	07/1986	368	124	0	491	1,388	75%	45%
215	08/1986	198	66	0	264	1,388	75%	45%
216	09/1986	150	50	0	200	1,388	75%	45%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	139	8	0	147	1,388	75%	45%
218	11/1986	156	9	0	165	1,388	75%	45%
219	12/1986	298	17	0	315	1,388	75%	45%
220	01/1987	748	44	0	791	1,388	75%	46%
221	02/1987	904	53	0	957	1,388	75%	46%
222	03/1987	1,109	65	0	1,174	1,388	75%	47%
223	04/1987	754	44	0	798	1,388	75%	47%
224	05/1987	473	28	0	501	1,388	75%	47%
225	06/1987	332	19	0	351	1,388	75%	47%
226	07/1987	148	9	0	156	1,388	75%	47%
227	08/1987	79	5	0	84	1,388	75%	47%
228	09/1987	60	4	0	64	1,388	75%	47%
229	10/1987	328	78	0	407	1,388	75%	48%
230	11/1987	368	88	0	456	1,388	75%	48%
231	12/1987	703	168	0	871	1,388	75%	48%
232	01/1988	1,764	422	0	2,186	1,388	75%	50%
233	02/1988	2,133	510	0	2,643	1,388	75%	52%
234	03/1988	2,617	626	0	3,243	1,388	75%	54%
235	04/1988	1,779	425	0	2,204	1,388	75%	56%
236	05/1988	1,117	267	0	1,384	1,388	75%	57%
237	06/1988	783	187	0	970	1,388	75%	58%
238	07/1988	349	83	0	432	1,388	75%	58%
239	08/1988	187	45	0	232	1,388	75%	58%
240	09/1988	142	34	0	176	1,388	75%	58%
241	10/1988	73	23	0	96	1,388	75%	58%
242	11/1988	82	25	0	107	1,388	75%	59%
243	12/1988	157	49	0	205	1,388	75%	59%
244	01/1989	393	122	0	515	1,388	75%	59%
245	02/1989	475	147	0	623	1,388	75%	59%
246	03/1989	583	181	0	764	1,388	75%	60%
247	04/1989	396	123	0	519	1,388	75%	60%
248	05/1989	249	77	0	326	1,388	75%	61%
249	06/1989	174	54	0	229	1,388	75%	61%
250	07/1989	78	24	0	102	1,388	75%	61%
251	08/1989	42	13	0	55	1,388	75%	61%
252	09/1989	32	10	0	41	1,388	75%	61%
253	10/1989	39	30	0	68	1,388	75%	61%
254	11/1989	43	33	0	76	1,388	75%	61%
255	12/1989	83	63	0	146	1,388	75%	61%
256	01/1990	207	159	0	367	1,388	75%	62%
257	02/1990	251	193	0	443	1,388	75%	63%
258	03/1990	308	236	0	544	1,388	75%	64%
259	04/1990	209	161	0	370	1,388	75%	64%
260	05/1990	131	101	0	232	1,388	75%	65%
261	06/1990	92	71	0	163	1,388	75%	65%
262	07/1990	41	32	0	73	1,388	75%	65%
263	08/1990	22	17	0	39	1,388	75%	65%
264	09/1990	17	13	0	30	1,388	75%	65%
265	10/1990	219	68	54	341	1,388	75%	65%
266	11/1990	245	77	60	382	1,388	75%	65%
267	12/1990	468	146	115	730	1,388	75%	66%
268	01/1991	1,175	368	289	1,831	1,388	75%	66%
269	02/1991	1,420	444	349	2,214	1,388	75%	66%
270	03/1991	1,743	545	429	2,717	1,388	75%	67%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	1,185	371	291	1,847	1,388	75%	67%
272	05/1991	744	233	183	1,160	1,388	75%	67%
273	06/1991	521	163	128	813	1,388	75%	68%
274	07/1991	232	73	57	362	1,388	75%	68%
275	08/1991	125	39	31	195	1,388	75%	68%
276	09/1991	95	30	23	147	1,388	75%	68%
277	10/1991	294	224	200	719	1,388	75%	67%
278	11/1991	330	251	225	805	1,388	75%	67%
279	12/1991	630	480	429	1,539	1,388	75%	66%
280	01/1992	1,581	1,205	1,077	3,863	1,388	75%	65%
281	02/1992	1,911	1,456	1,302	4,670	1,388	75%	63%
282	03/1992	2,346	1,787	1,598	5,731	1,388	75%	61%
283	04/1992	1,594	1,215	1,086	3,895	1,388	75%	60%
284	05/1992	1,001	763	682	2,446	1,388	75%	59%
285	06/1992	702	535	478	1,715	1,388	75%	58%
286	07/1992	313	238	213	764	1,388	75%	58%
287	08/1992	168	128	114	410	1,388	75%	58%
288	09/1992	127	97	87	311	1,388	75%	58%
289	10/1992	498	295	425	1,218	1,388	75%	57%
290	11/1992	558	331	476	1,365	1,388	75%	57%
291	12/1992	1,067	632	910	2,609	1,388	75%	56%
292	01/1993	2,678	1,586	2,283	6,547	1,388	75%	55%
293	02/1993	3,237	1,917	2,761	7,916	1,388	75%	53%
294	03/1993	3,973	2,353	3,388	9,713	1,388	75%	51%
295	04/1993	2,700	1,599	2,302	6,602	1,388	75%	50%
296	05/1993	1,696	1,004	1,446	4,146	1,388	75%	49%
297	06/1993	1,189	704	1,014	2,906	1,388	75%	48%
298	07/1993	529	314	452	1,295	1,388	75%	48%
299	08/1993	284	168	243	695	1,388	75%	48%
300	09/1993	215	128	184	527	1,388	75%	48%
301	10/1993	229	55	89	373	1,388	75%	48%
302	11/1993	257	61	100	418	1,388	75%	48%
303	12/1993	491	117	191	800	1,388	75%	47%
304	01/1994	1,232	294	480	2,006	1,388	75%	47%
305	02/1994	1,490	356	580	2,426	1,388	75%	47%
306	03/1994	1,828	437	712	2,977	1,388	75%	46%
307	04/1994	1,243	297	484	2,023	1,388	75%	46%
308	05/1994	780	186	304	1,271	1,388	75%	45%
309	06/1994	547	131	213	891	1,388	75%	45%
310	07/1994	244	58	95	397	1,388	75%	45%
311	08/1994	131	31	51	213	1,388	75%	45%
312	09/1994	99	24	39	161	1,388	75%	45%
313	10/1994	669	244	394	1,307	1,388	75%	45%
314	11/1994	749	274	442	1,464	1,388	75%	44%
315	12/1994	1,432	523	844	2,799	1,388	75%	44%
316	01/1995	3,593	1,312	2,118	7,023	1,388	75%	42%
317	02/1995	4,344	1,586	2,561	8,491	1,388	75%	41%
318	03/1995	5,331	1,946	3,143	10,420	1,388	75%	39%
319	04/1995	3,623	1,323	2,136	7,082	1,388	75%	38%
320	05/1995	2,275	831	1,342	4,448	1,388	75%	37%
321	06/1995	1,595	582	940	3,118	1,388	75%	36%
322	07/1995	710	259	419	1,389	1,388	75%	36%
323	08/1995	382	139	225	746	1,388	75%	36%
324	09/1995	289	106	170	565	1,388	75%	36%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	157	79	168	403	1,388	75%	36%
326	11/1995	176	88	188	452	1,388	75%	36%
327	12/1995	335	168	360	864	1,388	75%	36%
328	01/1996	842	423	902	2,167	1,388	75%	36%
329	02/1996	1,018	511	1,091	2,620	1,388	75%	36%
330	03/1996	1,249	627	1,339	3,215	1,388	75%	36%
331	04/1996	849	426	910	2,185	1,388	75%	36%
332	05/1996	533	268	571	1,372	1,388	75%	36%
333	06/1996	374	188	401	962	1,388	75%	36%
334	07/1996	166	84	178	428	1,388	75%	36%
335	08/1996	89	45	96	230	1,388	75%	36%
336	09/1996	68	34	73	174	1,388	75%	36%
337	10/1996	0	0	192	192	1,388	75%	36%
338	11/1996	207	217	57	481	1,388	75%	36%
339	12/1996	1,174	1,038	494	2,705	1,388	75%	36%
340	01/1997	2,262	1,979	2,222	6,463	1,388	75%	35%
341	02/1997	1,728	507	538	2,774	1,388	75%	35%
342	03/1997	447	0	697	1,145	1,388	75%	36%
343	04/1997	299	0	469	768	1,388	75%	37%
344	05/1997	381	0	0	381	1,388	75%	37%
345	06/1997	211	0	125	336	1,388	75%	37%
346	07/1997	58	0	238	296	1,388	75%	37%
347	08/1997	12	0	144	156	1,388	75%	37%
348	09/1997	198	1	0	198	1,388	75%	37%
349	10/1997	261	0	0	261	1,388	75%	38%
350	11/1997	239	233	73	545	1,388	75%	38%
351	12/1997	832	563	291	1,686	1,388	75%	38%
352	01/1998	804	374	54	1,232	1,388	75%	39%
353	02/1998	3,307	2,563	3,539	9,410	1,388	75%	39%
354	03/1998	5,583	3,465	1,317	10,365	1,388	75%	38%
355	04/1998	4,275	2,089	0	6,364	1,388	75%	38%
356	05/1998	1,117	1,661	739	3,516	1,388	75%	39%
357	06/1998	2,895	1,992	873	5,759	1,388	75%	38%
358	07/1998	129	465	1,463	2,057	1,388	75%	38%
359	08/1998	0	34	638	673	1,388	75%	38%
360	09/1998	565	0	48	612	1,388	75%	38%
361	10/1998	974	0	0	974	1,388	75%	38%
362	11/1998	679	29	250	958	1,388	75%	38%
363	12/1998	1,017	36	0	1,053	1,388	75%	38%
364	01/1999	896	179	87	1,163	1,388	75%	38%
365	02/1999	1,188	134	10	1,331	1,388	75%	38%
366	03/1999	1,024	0	53	1,077	1,388	75%	38%
367	04/1999	242	0	1,422	1,664	1,388	75%	38%
368	05/1999	181	36	551	769	1,388	75%	39%
369	06/1999	146	38	339	523	1,388	75%	39%
370	07/1999	17	0	320	337	1,388	75%	39%
371	08/1999	0	0	144	144	1,388	75%	39%
372	09/1999	0	0	2	2	1,388	75%	39%
373	10/1999	13	0	0	13	1,388	75%	39%
374	11/1999	6	0	0	6	1,388	75%	39%
375	12/1999	10	0	0	10	1,388	75%	40%
376	01/2000	13	51	11	75	1,388	75%	41%
377	02/2000	1,785	1,038	617	3,440	1,388	75%	42%
378	03/2000	1,600	606	921	3,128	1,388	75%	44%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	839	192	521	1,553	1,388	75%	45%
380	05/2000	408	0	83	491	1,388	75%	46%
381	06/2000	317	0	0	317	1,388	75%	47%
382	07/2000	174	0	0	174	1,388	75%	47%
383	08/2000	160	0	0	160	1,388	75%	47%
384	09/2000	0	0	0	0	1,388	75%	47%
385	10/2000	0	57	0	57	1,388	75%	47%
386	11/2000	0	81	0	81	1,388	75%	47%
387	12/2000	142	0	0	142	1,388	75%	48%
388	01/2001	740	459	66	1,266	1,388	75%	48%
389	02/2001	1,730	799	335	2,864	1,388	75%	48%
390	03/2001	3,590	938	267	4,795	1,388	75%	47%
391	04/2001	1,869	148	26	2,043	1,388	75%	47%
392	05/2001	245	0	99	345	1,388	75%	48%
393	06/2001	0	0	337	337	1,388	75%	48%
394	07/2001	0	0	108	108	1,388	75%	48%
395	08/2001	0	0	73	73	1,388	75%	48%
396	09/2001	0	0	50	50	1,388	75%	48%
397	10/2001	62	175	41	278	1,388	75%	48%
398	11/2001	163	53	0	215	1,388	75%	48%
399	12/2001	136	60	7	203	1,388	75%	49%
400	01/2002	158	143	32	333	1,388	75%	51%
401	02/2002	99	46	1	146	1,388	75%	51%
402	03/2002	97	0	0	97	1,388	75%	52%
403	04/2002	95	0	0	95	1,388	75%	52%
404	05/2002	51	18	0	69	1,388	75%	52%
405	06/2002	94	0	0	94	1,388	75%	52%
406	07/2002	0	0	0	0	1,388	75%	52%
407	08/2002	0	0	0	0	1,388	75%	52%
408	09/2002	0	0	0	0	1,388	75%	52%
409	10/2002	0	4	0	4	1,388	75%	53%
410	11/2002	19	520	53	592	1,388	75%	52%
411	12/2002	245	208	38	491	1,388	75%	53%
412	01/2003	142	0	0	142	1,388	75%	53%
413	02/2003	1,437	435	140	2,012	1,388	75%	56%
414	03/2003	1,508	606	36	2,149	1,388	75%	59%
415	04/2003	523	143	37	703	1,388	75%	62%
416	05/2003	2,326	381	1,123	3,830	1,388	75%	62%
417	06/2003	420	0	0	420	1,388	75%	64%
418	07/2003	85	0	0	85	1,388	75%	65%
419	08/2003	0	0	78	78	1,388	75%	65%
420	09/2003	0	0	41	41	1,388	75%	66%
421	10/2003	17	0	0	17	1,388	75%	66%
422	11/2003	102	261	0	363	1,388	75%	66%
423	12/2003	388	98	8	494	1,388	75%	67%
424	01/2004	202	13	0	215	1,388	75%	67%
425	02/2004	1,095	520	205	1,821	1,388	75%	67%
426	03/2004	2,404	164	0	2,568	1,388	75%	66%
427	04/2004	174	61	0	235	1,388	75%	67%
428	05/2004	139	0	0	139	1,388	75%	67%
429	06/2004	45	0	0	45	1,388	75%	68%
430	07/2004	3	6	0	9	1,388	75%	68%
431	08/2004	0	1	0	1	1,388	75%	68%
432	09/2004	0	0	0	0	1,388	75%	68%

Table A.6
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	1,487	415	438	2,340	1,388	75%	67%
434	11/2004	882	10	0	892	1,388	75%	66%
435	12/2004	1,728	574	403	2,705	1,388	75%	65%
436	01/2005	4,090	2,706	3,038	9,834	1,388	75%	60%
437	02/2005	2,817	1,700	777	5,293	1,388	75%	59%
438	03/2005	3,997	3,257	3,087	10,341	1,388	75%	56%
439	04/2005	3,962	607	3,006	7,574	1,388	75%	54%
440	05/2005	1,792	973	2,618	5,384	1,388	75%	53%
441	06/2005	8	533	3,329	3,870	1,388	75%	51%
442	07/2005	974	511	366	1,852	1,388	75%	51%
443	08/2005	1,195	0	0	1,195	1,388	75%	51%
444	09/2005	754	0	0	754	1,388	75%	50%
445	10/2005	882	146	24	1,052	1,388	75%	50%
446	11/2005	1,195	0	3	1,198	1,388	75%	50%
447	12/2005	698	86	380	1,164	1,388	75%	49%
448	01/2006	2,056	550	516	3,122	1,388	75%	49%
449	02/2006	387	305	1,341	2,033	1,388	75%	49%
450	03/2006	2,290	1,006	3,103	6,399	1,388	75%	49%
451	04/2006	3,144	1,810	2,974	7,928	1,388	75%	47%
452	05/2006	1,650	863	352	2,865	1,388	75%	46%
453	06/2006	899	0	0	899	1,388	75%	46%
454	07/2006	591	0	0	591	1,388	75%	46%
455	08/2006	558	0	0	558	1,388	75%	46%
456	09/2006	474	0	0	474	1,388	75%	46%
457	10/2006	183	0	39	222	1,388	75%	46%
458	11/2006	0	0	163	163	1,388	75%	46%
459	12/2006	337	5	37	379	1,388	75%	46%
460	01/2007	531	25	1	557	1,388	75%	46%
461	02/2007	540	126	29	695	1,388	75%	46%
462	03/2007	761	0	0	761	1,388	75%	45%
463	04/2007	462	43	0	506	1,388	75%	45%
464	05/2007	506	0	0	506	1,388	75%	45%
465	06/2007	379	0	0	379	1,388	75%	45%
466	07/2007	345	0	0	345	1,388	75%	45%
467	08/2007	53	0	8	61	1,388	75%	45%
468	09/2007	0	83	23	106	1,388	75%	45%
469	10/2007	24	0	95	120	1,388	75%	45%
470	11/2007	318	34	96	448	1,388	75%	45%
471	12/2007	376	182	141	699	1,388	75%	45%
472	01/2008	2,689	1,233	1,414	5,335	1,388	75%	44%
473	02/2008	1,892	1,363	778	4,033	1,388	75%	43%
474	03/2008	711	1	604	1,316	1,388	75%	44%
475	04/2008	521	360	11	892	1,388	75%	43%
476	05/2008	633	89	0	722	1,388	75%	44%
477	06/2008	318	0	215	533	1,388	75%	44%
478	07/2008	0	0	229	229	1,388	75%	44%
479	08/2008	0	0	195	195	1,388	75%	44%
480	09/2008	0	0	175	175	1,388	75%	44%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	395	248	390	1,032			
2	11/1968	443	277	437	1,157			
3	12/1968	846	530	834	2,210			
4	01/1969	2,122	1,330	2,094	5,546			
5	02/1969	2,566	1,608	2,532	6,706			
6	03/1969	3,149	1,974	3,107	8,229			
7	04/1969	2,140	1,342	2,111	5,593			
8	05/1969	1,344	842	1,326	3,512			
9	06/1969	942	591	929	2,462			
10	07/1969	420	263	414	1,097			
11	08/1969	225	141	222	589			
12	09/1969	171	107	168	446			
13	10/1969	145	27	71	244			
14	11/1969	163	31	80	273			
15	12/1969	311	59	152	522			
16	01/1970	780	147	382	1,309			
17	02/1970	943	178	462	1,582			
18	03/1970	1,157	218	566	1,942			
19	04/1970	786	148	385	1,320			
20	05/1970	494	93	242	829			
21	06/1970	346	65	169	581			
22	07/1970	154	29	75	259			
23	08/1970	83	16	41	139			
24	09/1970	63	12	31	105			
25	10/1970	142	70	0	212			
26	11/1970	159	79	0	238			
27	12/1970	304	151	0	454			
28	01/1971	762	378	0	1,140			
29	02/1971	921	457	0	1,378			
30	03/1971	1,131	560	0	1,691			
31	04/1971	768	381	0	1,149	1,113		
32	05/1971	483	239	0	722	1,113		
33	06/1971	338	168	0	506	1,113		
34	07/1971	151	75	0	225	1,113		
35	08/1971	81	40	0	121	1,113		
36	09/1971	61	30	0	92	1,113		
37	10/1971	24	19	0	43	1,113		
38	11/1971	26	22	0	48	1,113		
39	12/1971	50	41	0	92	1,113		
40	01/1972	126	104	0	230	1,113		
41	02/1972	153	126	0	278	1,113		
42	03/1972	187	154	0	341	1,113		
43	04/1972	127	105	0	232	1,113		
44	05/1972	80	66	0	146	1,113		
45	06/1972	56	46	0	102	1,113		
46	07/1972	25	21	0	46	1,113		
47	08/1972	13	11	0	24	1,113		
48	09/1972	10	8	0	19	1,113		
49	10/1972	113	110	68	291	1,113		
50	11/1972	126	123	76	326	1,113		
51	12/1972	242	236	145	623	1,113		
52	01/1973	606	592	365	1,563	1,113		
53	02/1973	733	715	441	1,889	1,113		
54	03/1973	899	878	541	2,318	1,113		

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	611	597	368	1,576	1,113		
56	05/1973	384	375	231	990	1,113		
57	06/1973	269	263	162	694	1,113		
58	07/1973	120	117	72	309	1,113		
59	08/1973	64	63	39	166	1,113		
60	09/1973	49	48	29	126	1,113	75%	33%
61	10/1973	76	41	0	118	1,113	75%	34%
62	11/1973	86	46	0	132	1,113	75%	35%
63	12/1973	164	88	0	252	1,113	75%	36%
64	01/1974	411	222	0	633	1,113	75%	39%
65	02/1974	497	268	0	765	1,113	75%	42%
66	03/1974	610	329	0	939	1,113	75%	47%
67	04/1974	414	224	0	638	1,113	75%	50%
68	05/1974	260	140	0	401	1,113	75%	53%
69	06/1974	182	98	0	281	1,113	75%	55%
70	07/1974	81	44	0	125	1,113	75%	56%
71	08/1974	44	24	0	67	1,113	75%	57%
72	09/1974	33	18	0	51	1,113	75%	58%
73	10/1974	66	43	0	109	1,113	75%	59%
74	11/1974	74	48	0	122	1,113	75%	59%
75	12/1974	141	92	0	233	1,113	75%	60%
76	01/1975	355	231	0	585	1,113	75%	61%
77	02/1975	429	279	0	708	1,113	75%	62%
78	03/1975	526	343	0	869	1,113	75%	64%
79	04/1975	357	233	0	590	1,113	75%	65%
80	05/1975	225	146	0	371	1,113	75%	65%
81	06/1975	157	103	0	260	1,113	75%	66%
82	07/1975	70	46	0	116	1,113	75%	67%
83	08/1975	38	25	0	62	1,113	75%	67%
84	09/1975	29	19	0	47	1,113	75%	68%
85	10/1975	38	23	0	61	1,113	75%	68%
86	11/1975	43	25	0	68	1,113	75%	69%
87	12/1975	81	49	0	130	1,113	75%	69%
88	01/1976	204	122	0	327	1,113	75%	70%
89	02/1976	247	148	0	395	1,113	75%	71%
90	03/1976	303	181	0	484	1,113	75%	73%
91	04/1976	206	123	0	329	1,113	75%	73%
92	05/1976	129	77	0	207	1,113	75%	74%
93	06/1976	91	54	0	145	1,113	75%	74%
94	07/1976	40	24	0	65	1,113	75%	74%
95	08/1976	22	13	0	35	1,113	75%	74%
96	09/1976	16	10	0	26	1,113	75%	74%
97	10/1976	32	34	0	66	1,113	75%	74%
98	11/1976	36	38	0	74	1,113	75%	74%
99	12/1976	69	72	0	141	1,113	75%	74%
100	01/1977	174	181	0	355	1,113	75%	74%
101	02/1977	210	219	0	429	1,113	75%	74%
102	03/1977	258	269	0	527	1,113	75%	74%
103	04/1977	175	183	0	358	1,113	75%	74%
104	05/1977	110	115	0	225	1,113	75%	74%
105	06/1977	77	80	0	158	1,113	75%	74%
106	07/1977	34	36	0	70	1,113	75%	74%
107	08/1977	18	19	0	38	1,113	75%	73%
108	09/1977	14	15	0	29	1,113	75%	73%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	342	355	383	1,080	1,113	75%	73%
110	11/1977	383	398	429	1,210	1,113	75%	72%
111	12/1977	733	761	820	2,313	1,113	75%	71%
112	01/1978	1,839	1,910	2,057	5,805	1,113	75%	68%
113	02/1978	2,223	2,309	2,487	7,018	1,113	75%	64%
114	03/1978	2,728	2,833	3,052	8,613	1,113	75%	61%
115	04/1978	1,854	1,926	2,074	5,854	1,113	75%	58%
116	05/1978	1,164	1,209	1,302	3,676	1,113	75%	57%
117	06/1978	816	848	913	2,577	1,113	75%	56%
118	07/1978	364	378	407	1,148	1,113	75%	56%
119	08/1978	195	203	218	617	1,113	75%	56%
120	09/1978	148	154	165	467	1,113	75%	55%
121	10/1978	300	209	0	509	1,113	75%	55%
122	11/1978	337	234	0	571	1,113	75%	55%
123	12/1978	643	447	0	1,091	1,113	75%	55%
124	01/1979	1,615	1,123	0	2,737	1,113	75%	54%
125	02/1979	1,952	1,357	0	3,310	1,113	75%	53%
126	03/1979	2,396	1,666	0	4,061	1,113	75%	51%
127	04/1979	1,628	1,132	0	2,760	1,113	75%	51%
128	05/1979	1,022	711	0	1,733	1,113	75%	50%
129	06/1979	717	498	0	1,215	1,113	75%	50%
130	07/1979	319	222	0	541	1,113	75%	50%
131	08/1979	172	119	0	291	1,113	75%	50%
132	09/1979	130	90	0	220	1,113	75%	49%
133	10/1979	378	271	0	649	1,113	75%	49%
134	11/1979	424	303	0	727	1,113	75%	49%
135	12/1979	810	579	0	1,389	1,113	75%	49%
136	01/1980	2,032	1,454	0	3,486	1,113	75%	48%
137	02/1980	2,457	1,757	0	4,215	1,113	75%	46%
138	03/1980	3,015	2,157	0	5,172	1,113	75%	45%
139	04/1980	2,049	1,466	0	3,515	1,113	75%	44%
140	05/1980	1,287	921	0	2,208	1,113	75%	44%
141	06/1980	902	645	0	1,547	1,113	75%	43%
142	07/1980	402	287	0	689	1,113	75%	43%
143	08/1980	216	154	0	370	1,113	75%	43%
144	09/1980	164	117	0	280	1,113	75%	43%
145	10/1980	176	55	0	231	1,113	75%	43%
146	11/1980	197	62	0	259	1,113	75%	43%
147	12/1980	377	118	0	495	1,113	75%	43%
148	01/1981	946	296	0	1,242	1,113	75%	43%
149	02/1981	1,144	357	0	1,501	1,113	75%	42%
150	03/1981	1,404	439	0	1,842	1,113	75%	42%
151	04/1981	954	298	0	1,252	1,113	75%	42%
152	05/1981	599	187	0	786	1,113	75%	42%
153	06/1981	420	131	0	551	1,113	75%	41%
154	07/1981	187	58	0	246	1,113	75%	41%
155	08/1981	100	31	0	132	1,113	75%	41%
156	09/1981	76	24	0	100	1,113	75%	41%
157	10/1981	174	95	0	270	1,113	75%	41%
158	11/1981	195	107	0	302	1,113	75%	41%
159	12/1981	373	204	0	577	1,113	75%	41%
160	01/1982	936	513	0	1,449	1,113	75%	41%
161	02/1982	1,132	620	0	1,751	1,113	75%	41%
162	03/1982	1,389	761	0	2,149	1,113	75%	40%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	944	517	0	1,461	1,113	75%	40%
164	05/1982	593	325	0	917	1,113	75%	40%
165	06/1982	415	228	0	643	1,113	75%	40%
166	07/1982	185	101	0	286	1,113	75%	40%
167	08/1982	99	54	0	154	1,113	75%	39%
168	09/1982	75	41	0	117	1,113	75%	39%
169	10/1982	428	399	316	1,143	1,113	75%	39%
170	11/1982	480	447	354	1,280	1,113	75%	39%
171	12/1982	917	854	676	2,447	1,113	75%	39%
172	01/1983	2,301	2,143	1,697	6,141	1,113	75%	39%
173	02/1983	2,782	2,591	2,052	7,425	1,113	75%	39%
174	03/1983	3,413	3,179	2,518	9,111	1,113	75%	39%
175	04/1983	2,320	2,161	1,711	6,192	1,113	75%	39%
176	05/1983	1,457	1,357	1,075	3,889	1,113	75%	39%
177	06/1983	1,021	951	753	2,726	1,113	75%	39%
178	07/1983	455	424	336	1,214	1,113	75%	39%
179	08/1983	244	228	180	652	1,113	75%	39%
180	09/1983	185	172	137	494	1,113	75%	39%
181	10/1983	127	62	0	188	1,113	75%	39%
182	11/1983	142	69	0	211	1,113	75%	39%
183	12/1983	271	132	0	403	1,113	75%	39%
184	01/1984	681	331	0	1,011	1,113	75%	40%
185	02/1984	823	400	0	1,223	1,113	75%	40%
186	03/1984	1,010	491	0	1,500	1,113	75%	41%
187	04/1984	686	333	0	1,020	1,113	75%	41%
188	05/1984	431	209	0	640	1,113	75%	41%
189	06/1984	302	147	0	449	1,113	75%	42%
190	07/1984	135	65	0	200	1,113	75%	42%
191	08/1984	72	35	0	107	1,113	75%	42%
192	09/1984	55	27	0	81	1,113	75%	42%
193	10/1984	162	59	0	220	1,113	75%	42%
194	11/1984	181	66	0	247	1,113	75%	42%
195	12/1984	346	125	0	471	1,113	75%	42%
196	01/1985	868	315	0	1,183	1,113	75%	43%
197	02/1985	1,049	381	0	1,430	1,113	75%	44%
198	03/1985	1,288	467	0	1,755	1,113	75%	45%
199	04/1985	875	317	0	1,193	1,113	75%	45%
200	05/1985	550	199	0	749	1,113	75%	46%
201	06/1985	385	140	0	525	1,113	75%	46%
202	07/1985	172	62	0	234	1,113	75%	46%
203	08/1985	92	33	0	126	1,113	75%	46%
204	09/1985	70	25	0	95	1,113	75%	47%
205	10/1985	221	116	0	338	1,113	75%	47%
206	11/1985	248	130	0	378	1,113	75%	46%
207	12/1985	474	249	0	723	1,113	75%	46%
208	01/1986	1,189	625	0	1,814	1,113	75%	46%
209	02/1986	1,438	756	0	2,194	1,113	75%	46%
210	03/1986	1,764	928	0	2,692	1,113	75%	46%
211	04/1986	1,199	631	0	1,830	1,113	75%	46%
212	05/1986	753	396	0	1,149	1,113	75%	45%
213	06/1986	528	278	0	805	1,113	75%	45%
214	07/1986	235	124	0	359	1,113	75%	45%
215	08/1986	126	66	0	193	1,113	75%	45%
216	09/1986	96	50	0	146	1,113	75%	45%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	89	8	0	97	1,113	75%	45%
218	11/1986	100	9	0	109	1,113	75%	45%
219	12/1986	190	17	0	208	1,113	75%	46%
220	01/1987	478	44	0	522	1,113	75%	46%
221	02/1987	578	53	0	631	1,113	75%	46%
222	03/1987	709	65	0	774	1,113	75%	47%
223	04/1987	482	44	0	526	1,113	75%	47%
224	05/1987	303	28	0	330	1,113	75%	47%
225	06/1987	212	19	0	232	1,113	75%	47%
226	07/1987	95	9	0	103	1,113	75%	47%
227	08/1987	51	5	0	55	1,113	75%	47%
228	09/1987	38	4	0	42	1,113	75%	47%
229	10/1987	210	78	0	288	1,113	75%	48%
230	11/1987	235	88	0	323	1,113	75%	48%
231	12/1987	449	168	0	618	1,113	75%	49%
232	01/1988	1,128	422	0	1,549	1,113	75%	50%
233	02/1988	1,364	510	0	1,873	1,113	75%	52%
234	03/1988	1,673	626	0	2,299	1,113	75%	55%
235	04/1988	1,137	425	0	1,562	1,113	75%	58%
236	05/1988	714	267	0	981	1,113	75%	59%
237	06/1988	501	187	0	688	1,113	75%	60%
238	07/1988	223	83	0	306	1,113	75%	61%
239	08/1988	120	45	0	165	1,113	75%	61%
240	09/1988	91	34	0	125	1,113	75%	61%
241	10/1988	47	23	0	69	1,113	75%	61%
242	11/1988	52	25	0	78	1,113	75%	61%
243	12/1988	100	49	0	149	1,113	75%	62%
244	01/1989	251	122	0	373	1,113	75%	62%
245	02/1989	304	147	0	451	1,113	75%	62%
246	03/1989	373	181	0	554	1,113	75%	63%
247	04/1989	253	123	0	376	1,113	75%	63%
248	05/1989	159	77	0	236	1,113	75%	63%
249	06/1989	112	54	0	166	1,113	75%	64%
250	07/1989	50	24	0	74	1,113	75%	64%
251	08/1989	27	13	0	40	1,113	75%	64%
252	09/1989	20	10	0	30	1,113	75%	64%
253	10/1989	25	30	0	54	1,113	75%	64%
254	11/1989	28	33	0	61	1,113	75%	64%
255	12/1989	53	63	0	116	1,113	75%	64%
256	01/1990	133	159	0	292	1,113	75%	65%
257	02/1990	160	193	0	353	1,113	75%	65%
258	03/1990	197	236	0	433	1,113	75%	66%
259	04/1990	134	161	0	294	1,113	75%	67%
260	05/1990	84	101	0	185	1,113	75%	67%
261	06/1990	59	71	0	130	1,113	75%	68%
262	07/1990	26	32	0	58	1,113	75%	68%
263	08/1990	14	17	0	31	1,113	75%	68%
264	09/1990	11	13	0	23	1,113	75%	68%
265	10/1990	140	68	74	282	1,113	75%	68%
266	11/1990	157	77	83	316	1,113	75%	68%
267	12/1990	299	146	159	605	1,113	75%	68%
268	01/1991	751	368	399	1,518	1,113	75%	68%
269	02/1991	908	444	482	1,835	1,113	75%	68%
270	03/1991	1,114	545	592	2,252	1,113	75%	69%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	757	371	402	1,530	1,113	75%	69%
272	05/1991	476	233	253	961	1,113	75%	69%
273	06/1991	333	163	177	674	1,113	75%	69%
274	07/1991	149	73	79	300	1,113	75%	69%
275	08/1991	80	39	42	161	1,113	75%	69%
276	09/1991	60	30	32	122	1,113	75%	69%
277	10/1991	188	224	277	689	1,113	75%	69%
278	11/1991	211	251	310	772	1,113	75%	68%
279	12/1991	403	480	593	1,476	1,113	75%	68%
280	01/1992	1,011	1,205	1,487	3,703	1,113	75%	65%
281	02/1992	1,222	1,456	1,798	4,477	1,113	75%	63%
282	03/1992	1,500	1,787	2,207	5,494	1,113	75%	60%
283	04/1992	1,019	1,215	1,500	3,734	1,113	75%	59%
284	05/1992	640	763	942	2,345	1,113	75%	58%
285	06/1992	449	535	660	1,644	1,113	75%	57%
286	07/1992	200	238	294	732	1,113	75%	57%
287	08/1992	107	128	158	393	1,113	75%	56%
288	09/1992	81	97	120	298	1,113	75%	56%
289	10/1992	319	295	587	1,201	1,113	75%	56%
290	11/1992	357	331	657	1,345	1,113	75%	55%
291	12/1992	682	632	1,257	2,571	1,113	75%	55%
292	01/1993	1,712	1,586	3,153	6,451	1,113	75%	52%
293	02/1993	2,070	1,917	3,812	7,800	1,113	75%	50%
294	03/1993	2,540	2,353	4,678	9,571	1,113	75%	48%
295	04/1993	1,726	1,599	3,180	6,505	1,113	75%	46%
296	05/1993	1,084	1,004	1,997	4,085	1,113	75%	45%
297	06/1993	760	704	1,400	2,864	1,113	75%	44%
298	07/1993	339	314	624	1,276	1,113	75%	44%
299	08/1993	182	168	335	685	1,113	75%	44%
300	09/1993	138	128	254	519	1,113	75%	44%
301	10/1993	147	55	123	325	1,113	75%	44%
302	11/1993	164	61	138	364	1,113	75%	44%
303	12/1993	314	117	264	695	1,113	75%	43%
304	01/1994	788	294	662	1,745	1,113	75%	43%
305	02/1994	953	356	801	2,109	1,113	75%	43%
306	03/1994	1,169	437	983	2,589	1,113	75%	42%
307	04/1994	794	297	668	1,759	1,113	75%	42%
308	05/1994	499	186	419	1,105	1,113	75%	41%
309	06/1994	350	131	294	774	1,113	75%	41%
310	07/1994	156	58	131	345	1,113	75%	41%
311	08/1994	84	31	70	185	1,113	75%	41%
312	09/1994	63	24	53	140	1,113	75%	41%
313	10/1994	428	244	544	1,216	1,113	75%	41%
314	11/1994	479	274	610	1,363	1,113	75%	41%
315	12/1994	915	523	1,166	2,604	1,113	75%	40%
316	01/1995	2,297	1,312	2,925	6,534	1,113	75%	39%
317	02/1995	2,777	1,586	3,537	7,900	1,113	75%	37%
318	03/1995	3,408	1,946	4,340	9,695	1,113	75%	35%
319	04/1995	2,316	1,323	2,950	6,589	1,113	75%	34%
320	05/1995	1,455	831	1,853	4,138	1,113	75%	33%
321	06/1995	1,020	582	1,299	2,901	1,113	75%	33%
322	07/1995	454	259	578	1,292	1,113	75%	33%
323	08/1995	244	139	311	694	1,113	75%	33%
324	09/1995	185	106	235	526	1,113	75%	32%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	100	79	232	411	1,113	75%	32%
326	11/1995	112	88	260	460	1,113	75%	32%
327	12/1995	214	168	497	880	1,113	75%	32%
328	01/1996	538	423	1,246	2,207	1,113	75%	32%
329	02/1996	651	511	1,506	2,668	1,113	75%	32%
330	03/1996	798	627	1,849	3,274	1,113	75%	32%
331	04/1996	543	426	1,256	2,225	1,113	75%	32%
332	05/1996	341	268	789	1,398	1,113	75%	32%
333	06/1996	239	188	553	980	1,113	75%	32%
334	07/1996	106	84	246	436	1,113	75%	32%
335	08/1996	57	45	132	234	1,113	75%	32%
336	09/1996	43	34	100	178	1,113	75%	32%
337	10/1996	0	0	266	266	1,113	75%	32%
338	11/1996	132	217	78	428	1,113	75%	32%
339	12/1996	750	1,038	682	2,470	1,113	75%	32%
340	01/1997	1,446	1,979	3,069	6,494	1,113	75%	31%
341	02/1997	1,105	507	743	2,356	1,113	75%	32%
342	03/1997	286	0	963	1,249	1,113	75%	32%
343	04/1997	191	0	647	839	1,113	75%	33%
344	05/1997	243	0	0	243	1,113	75%	33%
345	06/1997	135	0	173	308	1,113	75%	33%
346	07/1997	37	0	329	366	1,113	75%	33%
347	08/1997	8	0	199	206	1,113	75%	33%
348	09/1997	126	1	0	127	1,113	75%	33%
349	10/1997	167	0	0	167	1,113	75%	34%
350	11/1997	153	233	100	486	1,113	75%	34%
351	12/1997	532	563	402	1,497	1,113	75%	34%
352	01/1998	514	374	75	963	1,113	75%	35%
353	02/1998	2,115	2,563	4,887	9,565	1,113	75%	35%
354	03/1998	3,570	3,465	1,819	8,853	1,113	75%	35%
355	04/1998	2,733	2,089	0	4,822	1,113	75%	35%
356	05/1998	714	1,661	1,020	3,395	1,113	75%	35%
357	06/1998	1,851	1,992	1,205	5,048	1,113	75%	35%
358	07/1998	83	465	2,020	2,568	1,113	75%	34%
359	08/1998	0	34	882	916	1,113	75%	34%
360	09/1998	361	0	66	427	1,113	75%	34%
361	10/1998	623	0	0	623	1,113	75%	34%
362	11/1998	434	29	346	809	1,113	75%	34%
363	12/1998	650	36	0	686	1,113	75%	34%
364	01/1999	573	179	121	873	1,113	75%	34%
365	02/1999	759	134	13	906	1,113	75%	35%
366	03/1999	655	0	73	727	1,113	75%	35%
367	04/1999	155	0	1,964	2,119	1,113	75%	35%
368	05/1999	116	36	761	913	1,113	75%	35%
369	06/1999	93	38	469	600	1,113	75%	35%
370	07/1999	11	0	442	453	1,113	75%	35%
371	08/1999	0	0	199	199	1,113	75%	35%
372	09/1999	0	0	3	3	1,113	75%	35%
373	10/1999	8	0	0	8	1,113	75%	35%
374	11/1999	4	0	0	4	1,113	75%	36%
375	12/1999	6	0	0	6	1,113	75%	36%
376	01/2000	8	51	15	74	1,113	75%	37%
377	02/2000	1,141	1,038	851	3,031	1,113	75%	38%
378	03/2000	1,023	606	1,272	2,901	1,113	75%	40%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	537	192	720	1,448	1,113	75%	41%
380	05/2000	261	0	115	375	1,113	75%	42%
381	06/2000	203	0	0	203	1,113	75%	43%
382	07/2000	111	0	0	111	1,113	75%	43%
383	08/2000	102	0	0	102	1,113	75%	43%
384	09/2000	0	0	0	0	1,113	75%	44%
385	10/2000	0	57	0	57	1,113	75%	44%
386	11/2000	0	81	0	81	1,113	75%	44%
387	12/2000	91	0	0	91	1,113	75%	44%
388	01/2001	473	459	92	1,024	1,113	75%	44%
389	02/2001	1,106	799	463	2,368	1,113	75%	44%
390	03/2001	2,296	938	368	3,602	1,113	75%	44%
391	04/2001	1,195	148	36	1,379	1,113	75%	45%
392	05/2001	157	0	137	294	1,113	75%	45%
393	06/2001	0	0	465	465	1,113	75%	45%
394	07/2001	0	0	150	150	1,113	75%	45%
395	08/2001	0	0	100	100	1,113	75%	45%
396	09/2001	0	0	69	69	1,113	75%	45%
397	10/2001	40	175	57	271	1,113	75%	45%
398	11/2001	104	53	0	157	1,113	75%	45%
399	12/2001	87	60	10	157	1,113	75%	46%
400	01/2002	101	143	45	288	1,113	75%	48%
401	02/2002	63	46	1	110	1,113	75%	49%
402	03/2002	62	0	0	62	1,113	75%	49%
403	04/2002	61	0	0	61	1,113	75%	50%
404	05/2002	33	18	0	51	1,113	75%	50%
405	06/2002	60	0	0	60	1,113	75%	50%
406	07/2002	0	0	0	0	1,113	75%	50%
407	08/2002	0	0	0	0	1,113	75%	50%
408	09/2002	0	0	0	0	1,113	75%	50%
409	10/2002	0	4	0	4	1,113	75%	50%
410	11/2002	12	520	74	606	1,113	75%	50%
411	12/2002	157	208	52	417	1,113	75%	50%
412	01/2003	90	0	0	90	1,113	75%	51%
413	02/2003	919	435	193	1,547	1,113	75%	54%
414	03/2003	964	606	49	1,619	1,113	75%	57%
415	04/2003	335	143	51	529	1,113	75%	60%
416	05/2003	1,487	381	1,551	3,419	1,113	75%	60%
417	06/2003	268	0	0	268	1,113	75%	62%
418	07/2003	55	0	0	55	1,113	75%	64%
419	08/2003	0	0	108	108	1,113	75%	64%
420	09/2003	0	0	57	57	1,113	75%	64%
421	10/2003	11	0	0	11	1,113	75%	65%
422	11/2003	65	261	0	326	1,113	75%	65%
423	12/2003	248	98	11	357	1,113	75%	65%
424	01/2004	129	13	0	142	1,113	75%	66%
425	02/2004	700	520	283	1,504	1,113	75%	65%
426	03/2004	1,537	164	0	1,701	1,113	75%	65%
427	04/2004	111	61	0	172	1,113	75%	66%
428	05/2004	89	0	0	89	1,113	75%	67%
429	06/2004	29	0	0	29	1,113	75%	67%
430	07/2004	2	6	0	8	1,113	75%	67%
431	08/2004	0	1	0	1	1,113	75%	67%
432	09/2004	0	0	0	0	1,113	75%	67%

Table A.7
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option A)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	950	415	605	1,970	1,113	75%	66%
434	11/2004	564	10	0	574	1,113	75%	66%
435	12/2004	1,105	574	557	2,235	1,113	75%	64%
436	01/2005	2,615	2,706	4,196	9,516	1,113	75%	59%
437	02/2005	1,801	1,700	1,072	4,573	1,113	75%	58%
438	03/2005	2,556	3,257	4,263	10,075	1,113	75%	55%
439	04/2005	2,533	607	4,151	7,291	1,113	75%	52%
440	05/2005	1,146	973	3,615	5,735	1,113	75%	50%
441	06/2005	5	533	4,597	5,136	1,113	75%	48%
442	07/2005	623	511	505	1,640	1,113	75%	48%
443	08/2005	764	0	0	764	1,113	75%	48%
444	09/2005	482	0	0	482	1,113	75%	47%
445	10/2005	564	146	33	743	1,113	75%	47%
446	11/2005	764	0	4	768	1,113	75%	47%
447	12/2005	446	86	524	1,057	1,113	75%	47%
448	01/2006	1,314	550	713	2,577	1,113	75%	46%
449	02/2006	247	305	1,852	2,405	1,113	75%	46%
450	03/2006	1,464	1,006	4,285	6,755	1,113	75%	45%
451	04/2006	2,010	1,810	4,106	7,927	1,113	75%	43%
452	05/2006	1,055	863	487	2,404	1,113	75%	43%
453	06/2006	575	0	0	575	1,113	75%	43%
454	07/2006	378	0	0	378	1,113	75%	43%
455	08/2006	357	0	0	357	1,113	75%	43%
456	09/2006	303	0	0	303	1,113	75%	42%
457	10/2006	117	0	54	170	1,113	75%	42%
458	11/2006	0	0	225	225	1,113	75%	42%
459	12/2006	216	5	51	272	1,113	75%	42%
460	01/2007	340	25	1	366	1,113	75%	42%
461	02/2007	345	126	40	511	1,113	75%	42%
462	03/2007	487	0	0	487	1,113	75%	42%
463	04/2007	296	43	0	339	1,113	75%	42%
464	05/2007	324	0	0	324	1,113	75%	42%
465	06/2007	242	0	0	242	1,113	75%	42%
466	07/2007	221	0	0	221	1,113	75%	42%
467	08/2007	34	0	11	45	1,113	75%	42%
468	09/2007	0	83	32	115	1,113	75%	42%
469	10/2007	15	0	132	147	1,113	75%	42%
470	11/2007	203	34	133	370	1,113	75%	42%
471	12/2007	241	182	194	617	1,113	75%	42%
472	01/2008	1,719	1,233	1,953	4,904	1,113	75%	41%
473	02/2008	1,210	1,363	1,075	3,647	1,113	75%	40%
474	03/2008	454	1	835	1,290	1,113	75%	40%
475	04/2008	333	360	16	709	1,113	75%	40%
476	05/2008	405	89	0	494	1,113	75%	41%
477	06/2008	203	0	297	500	1,113	75%	41%
478	07/2008	0	0	316	316	1,113	75%	41%
479	08/2008	0	0	269	269	1,113	75%	41%
480	09/2008	0	0	241	241	1,113	75%	41%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	1,013	0	0	1,013			
2	11/1968	1,135	0	0	1,135			
3	12/1968	2,169	0	0	2,169			
4	01/1969	5,442	0	0	5,442			
5	02/1969	6,580	0	0	6,580			
6	03/1969	8,074	0	0	8,074			
7	04/1969	5,487	0	0	5,487			
8	05/1969	3,446	0	0	3,446			
9	06/1969	2,416	0	0	2,416			
10	07/1969	1,076	0	0	1,076			
11	08/1969	578	0	0	578			
12	09/1969	438	0	0	438			
13	10/1969	372	0	0	372			
14	11/1969	417	0	0	417			
15	12/1969	797	0	0	797			
16	01/1970	1,999	0	0	1,999			
17	02/1970	2,417	0	0	2,417			
18	03/1970	2,966	0	0	2,966			
19	04/1970	2,016	0	0	2,016			
20	05/1970	1,266	0	0	1,266			
21	06/1970	888	0	0	888			
22	07/1970	395	0	0	395			
23	08/1970	212	0	0	212			
24	09/1970	161	0	0	161			
25	10/1970	364	0	0	364			
26	11/1970	407	0	0	407			
27	12/1970	779	0	0	779			
28	01/1971	1,954	0	0	1,954			
29	02/1971	2,363	0	0	2,363			
30	03/1971	2,899	0	0	2,899			
31	04/1971	1,970	0	0	1,970	1,083		
32	05/1971	1,237	0	0	1,237	1,083		
33	06/1971	867	0	0	867	1,083		
34	07/1971	386	0	0	386	1,083		
35	08/1971	208	0	0	208	1,083		
36	09/1971	157	0	0	157	1,083		
37	10/1971	60	0	0	60	1,083		
38	11/1971	68	0	0	68	1,083		
39	12/1971	129	0	0	129	1,083		
40	01/1972	324	0	0	324	1,083		
41	02/1972	392	0	0	392	1,083		
42	03/1972	481	0	0	481	1,083		
43	04/1972	327	0	0	327	1,083		
44	05/1972	205	0	0	205	1,083		
45	06/1972	144	0	0	144	1,083		
46	07/1972	64	0	0	64	1,083		
47	08/1972	34	0	0	34	1,083		
48	09/1972	26	0	0	26	1,083		
49	10/1972	289	0	0	289	1,083		
50	11/1972	324	0	0	324	1,083		
51	12/1972	619	0	0	619	1,083		
52	01/1973	1,554	0	0	1,554	1,083		
53	02/1973	1,879	0	0	1,879	1,083		
54	03/1973	2,306	0	0	2,306	1,083		

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	1,567	0	0	1,567	1,083		
56	05/1973	984	0	0	984	1,083		
57	06/1973	690	0	0	690	1,083		
58	07/1973	307	0	0	307	1,083		
59	08/1973	165	0	0	165	1,083		
60	09/1973	125	0	0	125	1,083	75%	29%
61	10/1973	196	0	0	196	1,083	75%	30%
62	11/1973	220	0	0	220	1,083	75%	31%
63	12/1973	420	0	0	420	1,083	75%	32%
64	01/1974	1,054	0	0	1,054	1,083	75%	34%
65	02/1974	1,274	0	0	1,274	1,083	75%	37%
66	03/1974	1,564	0	0	1,564	1,083	75%	40%
67	04/1974	1,063	0	0	1,063	1,083	75%	42%
68	05/1974	667	0	0	667	1,083	75%	44%
69	06/1974	468	0	0	468	1,083	75%	46%
70	07/1974	208	0	0	208	1,083	75%	47%
71	08/1974	112	0	0	112	1,083	75%	48%
72	09/1974	85	0	0	85	1,083	75%	49%
73	10/1974	169	0	0	169	1,083	75%	49%
74	11/1974	190	0	0	190	1,083	75%	50%
75	12/1974	362	0	0	362	1,083	75%	51%
76	01/1975	909	0	0	909	1,083	75%	52%
77	02/1975	1,099	0	0	1,099	1,083	75%	53%
78	03/1975	1,349	0	0	1,349	1,083	75%	55%
79	04/1975	917	0	0	917	1,083	75%	56%
80	05/1975	576	0	0	576	1,083	75%	57%
81	06/1975	404	0	0	404	1,083	75%	58%
82	07/1975	180	0	0	180	1,083	75%	58%
83	08/1975	97	0	0	97	1,083	75%	59%
84	09/1975	73	0	0	73	1,083	75%	59%
85	10/1975	98	0	0	98	1,083	75%	60%
86	11/1975	109	0	0	109	1,083	75%	60%
87	12/1975	209	0	0	209	1,083	75%	61%
88	01/1976	524	0	0	524	1,083	75%	62%
89	02/1976	634	0	0	634	1,083	75%	64%
90	03/1976	778	0	0	778	1,083	75%	66%
91	04/1976	529	0	0	529	1,083	75%	67%
92	05/1976	332	0	0	332	1,083	75%	67%
93	06/1976	233	0	0	233	1,083	75%	68%
94	07/1976	104	0	0	104	1,083	75%	68%
95	08/1976	56	0	0	56	1,083	75%	68%
96	09/1976	42	0	0	42	1,083	75%	68%
97	10/1976	83	0	0	83	1,083	75%	68%
98	11/1976	93	0	0	93	1,083	75%	68%
99	12/1976	177	0	0	177	1,083	75%	68%
100	01/1977	445	0	0	445	1,083	75%	68%
101	02/1977	538	0	0	538	1,083	75%	68%
102	03/1977	661	0	0	661	1,083	75%	68%
103	04/1977	449	0	0	449	1,083	75%	68%
104	05/1977	282	0	0	282	1,083	75%	68%
105	06/1977	198	0	0	198	1,083	75%	68%
106	07/1977	88	0	0	88	1,083	75%	68%
107	08/1977	47	0	0	47	1,083	75%	68%
108	09/1977	36	0	0	36	1,083	75%	68%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	877	0	0	877	1,083	75%	67%
110	11/1977	983	0	0	983	1,083	75%	67%
111	12/1977	1,879	0	0	1,879	1,083	75%	66%
112	01/1978	4,714	0	0	4,714	1,083	75%	64%
113	02/1978	5,700	0	0	5,700	1,083	75%	61%
114	03/1978	6,994	0	0	6,994	1,083	75%	59%
115	04/1978	4,754	0	0	4,754	1,083	75%	57%
116	05/1978	2,985	0	0	2,985	1,083	75%	56%
117	06/1978	2,093	0	0	2,093	1,083	75%	56%
118	07/1978	932	0	0	932	1,083	75%	55%
119	08/1978	501	0	0	501	1,083	75%	55%
120	09/1978	379	0	0	379	1,083	75%	55%
121	10/1978	770	0	0	770	1,083	75%	55%
122	11/1978	863	0	0	863	1,083	75%	54%
123	12/1978	1,650	0	0	1,650	1,083	75%	54%
124	01/1979	4,140	0	0	4,140	1,083	75%	53%
125	02/1979	5,005	0	0	5,005	1,083	75%	51%
126	03/1979	6,142	0	0	6,142	1,083	75%	49%
127	04/1979	4,175	0	0	4,175	1,083	75%	48%
128	05/1979	2,622	0	0	2,622	1,083	75%	47%
129	06/1979	1,838	0	0	1,838	1,083	75%	47%
130	07/1979	819	0	0	819	1,083	75%	47%
131	08/1979	440	0	0	440	1,083	75%	47%
132	09/1979	333	0	0	333	1,083	75%	47%
133	10/1979	970	0	0	970	1,083	75%	46%
134	11/1979	1,087	0	0	1,087	1,083	75%	46%
135	12/1979	2,077	0	0	2,077	1,083	75%	45%
136	01/1980	5,211	0	0	5,211	1,083	75%	44%
137	02/1980	6,300	0	0	6,300	1,083	75%	43%
138	03/1980	7,732	0	0	7,732	1,083	75%	41%
139	04/1980	5,255	0	0	5,255	1,083	75%	40%
140	05/1980	3,300	0	0	3,300	1,083	75%	39%
141	06/1980	2,313	0	0	2,313	1,083	75%	39%
142	07/1980	1,030	0	0	1,030	1,083	75%	39%
143	08/1980	554	0	0	554	1,083	75%	38%
144	09/1980	419	0	0	419	1,083	75%	38%
145	10/1980	451	0	0	451	1,083	75%	38%
146	11/1980	506	0	0	506	1,083	75%	38%
147	12/1980	967	0	0	967	1,083	75%	38%
148	01/1981	2,426	0	0	2,426	1,083	75%	38%
149	02/1981	2,933	0	0	2,933	1,083	75%	37%
150	03/1981	3,599	0	0	3,599	1,083	75%	36%
151	04/1981	2,446	0	0	2,446	1,083	75%	36%
152	05/1981	1,536	0	0	1,536	1,083	75%	36%
153	06/1981	1,077	0	0	1,077	1,083	75%	36%
154	07/1981	480	0	0	480	1,083	75%	36%
155	08/1981	258	0	0	258	1,083	75%	36%
156	09/1981	195	0	0	195	1,083	75%	36%
157	10/1981	447	0	0	447	1,083	75%	35%
158	11/1981	500	0	0	500	1,083	75%	35%
159	12/1981	956	0	0	956	1,083	75%	35%
160	01/1982	2,400	0	0	2,400	1,083	75%	35%
161	02/1982	2,902	0	0	2,902	1,083	75%	34%
162	03/1982	3,561	0	0	3,561	1,083	75%	34%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	2,420	0	0	2,420	1,083	75%	34%
164	05/1982	1,520	0	0	1,520	1,083	75%	33%
165	06/1982	1,065	0	0	1,065	1,083	75%	33%
166	07/1982	475	0	0	475	1,083	75%	33%
167	08/1982	255	0	0	255	1,083	75%	33%
168	09/1982	193	0	0	193	1,083	75%	33%
169	10/1982	1,098	0	0	1,098	1,083	75%	33%
170	11/1982	1,230	0	0	1,230	1,083	75%	33%
171	12/1982	2,351	0	0	2,351	1,083	75%	33%
172	01/1983	5,899	0	0	5,899	1,083	75%	33%
173	02/1983	7,132	0	0	7,132	1,083	75%	33%
174	03/1983	8,752	0	0	8,752	1,083	75%	32%
175	04/1983	5,949	0	0	5,949	1,083	75%	32%
176	05/1983	3,736	0	0	3,736	1,083	75%	32%
177	06/1983	2,619	0	0	2,619	1,083	75%	32%
178	07/1983	1,167	0	0	1,167	1,083	75%	32%
179	08/1983	627	0	0	627	1,083	75%	32%
180	09/1983	475	0	0	475	1,083	75%	32%
181	10/1983	325	0	0	325	1,083	75%	32%
182	11/1983	364	0	0	364	1,083	75%	32%
183	12/1983	695	0	0	695	1,083	75%	32%
184	01/1984	1,745	0	0	1,745	1,083	75%	32%
185	02/1984	2,110	0	0	2,110	1,083	75%	33%
186	03/1984	2,589	0	0	2,589	1,083	75%	34%
187	04/1984	1,760	0	0	1,760	1,083	75%	34%
188	05/1984	1,105	0	0	1,105	1,083	75%	34%
189	06/1984	775	0	0	775	1,083	75%	34%
190	07/1984	345	0	0	345	1,083	75%	34%
191	08/1984	185	0	0	185	1,083	75%	35%
192	09/1984	140	0	0	140	1,083	75%	35%
193	10/1984	414	0	0	414	1,083	75%	35%
194	11/1984	464	0	0	464	1,083	75%	35%
195	12/1984	887	0	0	887	1,083	75%	35%
196	01/1985	2,225	0	0	2,225	1,083	75%	36%
197	02/1985	2,690	0	0	2,690	1,083	75%	36%
198	03/1985	3,301	0	0	3,301	1,083	75%	37%
199	04/1985	2,244	0	0	2,244	1,083	75%	38%
200	05/1985	1,409	0	0	1,409	1,083	75%	38%
201	06/1985	988	0	0	988	1,083	75%	39%
202	07/1985	440	0	0	440	1,083	75%	39%
203	08/1985	236	0	0	236	1,083	75%	39%
204	09/1985	179	0	0	179	1,083	75%	39%
205	10/1985	567	0	0	567	1,083	75%	39%
206	11/1985	636	0	0	636	1,083	75%	39%
207	12/1985	1,215	0	0	1,215	1,083	75%	39%
208	01/1986	3,049	0	0	3,049	1,083	75%	39%
209	02/1986	3,686	0	0	3,686	1,083	75%	38%
210	03/1986	4,523	0	0	4,523	1,083	75%	38%
211	04/1986	3,074	0	0	3,074	1,083	75%	38%
212	05/1986	1,931	0	0	1,931	1,083	75%	38%
213	06/1986	1,353	0	0	1,353	1,083	75%	38%
214	07/1986	603	0	0	603	1,083	75%	38%
215	08/1986	324	0	0	324	1,083	75%	38%
216	09/1986	245	0	0	245	1,083	75%	38%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	228	0	0	228	1,083	75%	38%
218	11/1986	256	0	0	256	1,083	75%	38%
219	12/1986	488	0	0	488	1,083	75%	38%
220	01/1987	1,226	0	0	1,226	1,083	75%	38%
221	02/1987	1,482	0	0	1,482	1,083	75%	39%
222	03/1987	1,818	0	0	1,818	1,083	75%	39%
223	04/1987	1,236	0	0	1,236	1,083	75%	39%
224	05/1987	776	0	0	776	1,083	75%	40%
225	06/1987	544	0	0	544	1,083	75%	40%
226	07/1987	242	0	0	242	1,083	75%	40%
227	08/1987	130	0	0	130	1,083	75%	40%
228	09/1987	99	0	0	99	1,083	75%	40%
229	10/1987	538	0	0	538	1,083	75%	40%
230	11/1987	603	0	0	603	1,083	75%	40%
231	12/1987	1,152	0	0	1,152	1,083	75%	40%
232	01/1988	2,892	0	0	2,892	1,083	75%	41%
233	02/1988	3,496	0	0	3,496	1,083	75%	42%
234	03/1988	4,291	0	0	4,291	1,083	75%	43%
235	04/1988	2,916	0	0	2,916	1,083	75%	44%
236	05/1988	1,831	0	0	1,831	1,083	75%	45%
237	06/1988	1,284	0	0	1,284	1,083	75%	45%
238	07/1988	572	0	0	572	1,083	75%	45%
239	08/1988	307	0	0	307	1,083	75%	46%
240	09/1988	233	0	0	233	1,083	75%	46%
241	10/1988	120	0	0	120	1,083	75%	46%
242	11/1988	134	0	0	134	1,083	75%	46%
243	12/1988	257	0	0	257	1,083	75%	46%
244	01/1989	644	0	0	644	1,083	75%	46%
245	02/1989	779	0	0	779	1,083	75%	47%
246	03/1989	956	0	0	956	1,083	75%	47%
247	04/1989	650	0	0	650	1,083	75%	48%
248	05/1989	408	0	0	408	1,083	75%	48%
249	06/1989	286	0	0	286	1,083	75%	48%
250	07/1989	127	0	0	127	1,083	75%	48%
251	08/1989	68	0	0	68	1,083	75%	48%
252	09/1989	52	0	0	52	1,083	75%	48%
253	10/1989	63	0	0	63	1,083	75%	48%
254	11/1989	71	0	0	71	1,083	75%	48%
255	12/1989	136	0	0	136	1,083	75%	49%
256	01/1990	340	0	0	340	1,083	75%	49%
257	02/1990	411	0	0	411	1,083	75%	50%
258	03/1990	505	0	0	505	1,083	75%	51%
259	04/1990	343	0	0	343	1,083	75%	52%
260	05/1990	215	0	0	215	1,083	75%	53%
261	06/1990	151	0	0	151	1,083	75%	53%
262	07/1990	67	0	0	67	1,083	75%	53%
263	08/1990	36	0	0	36	1,083	75%	53%
264	09/1990	27	0	0	27	1,083	75%	53%
265	10/1990	358	0	0	358	1,083	75%	54%
266	11/1990	402	0	0	402	1,083	75%	54%
267	12/1990	768	0	0	768	1,083	75%	54%
268	01/1991	1,926	0	0	1,926	1,083	75%	54%
269	02/1991	2,328	0	0	2,328	1,083	75%	55%
270	03/1991	2,857	0	0	2,857	1,083	75%	56%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	1,942	0	0	1,942	1,083	75%	56%
272	05/1991	1,220	0	0	1,220	1,083	75%	57%
273	06/1991	855	0	0	855	1,083	75%	57%
274	07/1991	381	0	0	381	1,083	75%	57%
275	08/1991	205	0	0	205	1,083	75%	57%
276	09/1991	155	0	0	155	1,083	75%	57%
277	10/1991	482	0	0	482	1,083	75%	57%
278	11/1991	540	0	0	540	1,083	75%	57%
279	12/1991	1,033	0	0	1,033	1,083	75%	57%
280	01/1992	2,592	0	0	2,592	1,083	75%	56%
281	02/1992	3,134	0	0	3,134	1,083	75%	55%
282	03/1992	3,845	0	0	3,845	1,083	75%	54%
283	04/1992	2,613	0	0	2,613	1,083	75%	54%
284	05/1992	1,641	0	0	1,641	1,083	75%	53%
285	06/1992	1,150	0	0	1,150	1,083	75%	53%
286	07/1992	513	0	0	513	1,083	75%	53%
287	08/1992	275	0	0	275	1,083	75%	53%
288	09/1992	209	0	0	209	1,083	75%	53%
289	10/1992	817	0	0	817	1,083	75%	53%
290	11/1992	915	0	0	915	1,083	75%	52%
291	12/1992	1,749	0	0	1,749	1,083	75%	52%
292	01/1993	4,389	0	0	4,389	1,083	75%	52%
293	02/1993	5,307	0	0	5,307	1,083	75%	51%
294	03/1993	6,513	0	0	6,513	1,083	75%	50%
295	04/1993	4,426	0	0	4,426	1,083	75%	49%
296	05/1993	2,780	0	0	2,780	1,083	75%	49%
297	06/1993	1,949	0	0	1,949	1,083	75%	49%
298	07/1993	868	0	0	868	1,083	75%	49%
299	08/1993	466	0	0	466	1,083	75%	49%
300	09/1993	353	0	0	353	1,083	75%	49%
301	10/1993	376	0	0	376	1,083	75%	48%
302	11/1993	421	0	0	421	1,083	75%	48%
303	12/1993	805	0	0	805	1,083	75%	48%
304	01/1994	2,020	0	0	2,020	1,083	75%	48%
305	02/1994	2,443	0	0	2,443	1,083	75%	47%
306	03/1994	2,997	0	0	2,997	1,083	75%	46%
307	04/1994	2,037	0	0	2,037	1,083	75%	46%
308	05/1994	1,279	0	0	1,279	1,083	75%	46%
309	06/1994	897	0	0	897	1,083	75%	46%
310	07/1994	400	0	0	400	1,083	75%	45%
311	08/1994	215	0	0	215	1,083	75%	45%
312	09/1994	163	0	0	163	1,083	75%	45%
313	10/1994	1,096	0	0	1,096	1,083	75%	45%
314	11/1994	1,228	0	0	1,228	1,083	75%	45%
315	12/1994	2,347	0	0	2,347	1,083	75%	44%
316	01/1995	5,890	0	0	5,890	1,083	75%	42%
317	02/1995	7,121	0	0	7,121	1,083	75%	41%
318	03/1995	8,739	0	0	8,739	1,083	75%	39%
319	04/1995	5,939	0	0	5,939	1,083	75%	37%
320	05/1995	3,730	0	0	3,730	1,083	75%	37%
321	06/1995	2,615	0	0	2,615	1,083	75%	36%
322	07/1995	1,165	0	0	1,165	1,083	75%	36%
323	08/1995	626	0	0	626	1,083	75%	36%
324	09/1995	474	0	0	474	1,083	75%	36%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	257	0	0	257	1,083	75%	36%
326	11/1995	288	0	0	288	1,083	75%	36%
327	12/1995	550	0	0	550	1,083	75%	36%
328	01/1996	1,380	0	0	1,380	1,083	75%	36%
329	02/1996	1,668	0	0	1,668	1,083	75%	36%
330	03/1996	2,047	0	0	2,047	1,083	75%	36%
331	04/1996	1,391	0	0	1,391	1,083	75%	36%
332	05/1996	874	0	0	874	1,083	75%	36%
333	06/1996	613	0	0	613	1,083	75%	36%
334	07/1996	273	0	0	273	1,083	75%	36%
335	08/1996	147	0	0	147	1,083	75%	36%
336	09/1996	111	0	0	111	1,083	75%	36%
337	10/1996	0	0	0	0	1,083	75%	37%
338	11/1996	339	0	0	339	1,083	75%	37%
339	12/1996	1,924	0	0	1,924	1,083	75%	36%
340	01/1997	3,708	0	0	3,708	1,083	75%	36%
341	02/1997	2,833	0	0	2,833	1,083	75%	36%
342	03/1997	733	0	0	733	1,083	75%	37%
343	04/1997	491	0	0	491	1,083	75%	37%
344	05/1997	624	0	0	624	1,083	75%	38%
345	06/1997	345	0	0	345	1,083	75%	38%
346	07/1997	94	0	0	94	1,083	75%	38%
347	08/1997	20	0	0	20	1,083	75%	38%
348	09/1997	324	0	0	324	1,083	75%	38%
349	10/1997	428	0	0	428	1,083	75%	38%
350	11/1997	392	0	0	392	1,083	75%	38%
351	12/1997	1,364	0	0	1,364	1,083	75%	38%
352	01/1998	1,318	0	0	1,318	1,083	75%	39%
353	02/1998	5,422	0	0	5,422	1,083	75%	39%
354	03/1998	9,153	0	0	9,153	1,083	75%	38%
355	04/1998	7,008	0	0	7,008	1,083	75%	38%
356	05/1998	1,831	0	0	1,831	1,083	75%	38%
357	06/1998	4,746	0	0	4,746	1,083	75%	37%
358	07/1998	212	0	0	212	1,083	75%	37%
359	08/1998	0	0	0	0	1,083	75%	38%
360	09/1998	926	0	0	926	1,083	75%	37%
361	10/1998	1,597	0	0	1,597	1,083	75%	37%
362	11/1998	1,114	0	0	1,114	1,083	75%	37%
363	12/1998	1,667	0	0	1,667	1,083	75%	37%
364	01/1999	1,469	0	0	1,469	1,083	75%	37%
365	02/1999	1,947	0	0	1,947	1,083	75%	37%
366	03/1999	1,679	0	0	1,679	1,083	75%	37%
367	04/1999	396	0	0	396	1,083	75%	38%
368	05/1999	297	0	0	297	1,083	75%	38%
369	06/1999	239	0	0	239	1,083	75%	38%
370	07/1999	28	0	0	28	1,083	75%	38%
371	08/1999	0	0	0	0	1,083	75%	38%
372	09/1999	0	0	0	0	1,083	75%	38%
373	10/1999	21	0	0	21	1,083	75%	38%
374	11/1999	10	0	0	10	1,083	75%	39%
375	12/1999	16	0	0	16	1,083	75%	39%
376	01/2000	21	0	0	21	1,083	75%	41%
377	02/2000	2,927	0	0	2,927	1,083	75%	42%
378	03/2000	2,624	0	0	2,624	1,083	75%	43%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	1,376	0	0	1,376	1,083	75%	45%
380	05/2000	668	0	0	668	1,083	75%	46%
381	06/2000	520	0	0	520	1,083	75%	47%
382	07/2000	285	0	0	285	1,083	75%	47%
383	08/2000	262	0	0	262	1,083	75%	47%
384	09/2000	0	0	0	0	1,083	75%	47%
385	10/2000	0	0	0	0	1,083	75%	47%
386	11/2000	0	0	0	0	1,083	75%	47%
387	12/2000	233	0	0	233	1,083	75%	47%
388	01/2001	1,214	0	0	1,214	1,083	75%	47%
389	02/2001	2,836	0	0	2,836	1,083	75%	47%
390	03/2001	5,886	0	0	5,886	1,083	75%	46%
391	04/2001	3,064	0	0	3,064	1,083	75%	45%
392	05/2001	402	0	0	402	1,083	75%	45%
393	06/2001	0	0	0	0	1,083	75%	46%
394	07/2001	0	0	0	0	1,083	75%	46%
395	08/2001	0	0	0	0	1,083	75%	46%
396	09/2001	0	0	0	0	1,083	75%	46%
397	10/2001	101	0	0	101	1,083	75%	46%
398	11/2001	267	0	0	267	1,083	75%	46%
399	12/2001	223	0	0	223	1,083	75%	46%
400	01/2002	259	0	0	259	1,083	75%	47%
401	02/2002	162	0	0	162	1,083	75%	48%
402	03/2002	159	0	0	159	1,083	75%	49%
403	04/2002	156	0	0	156	1,083	75%	49%
404	05/2002	84	0	0	84	1,083	75%	49%
405	06/2002	154	0	0	154	1,083	75%	49%
406	07/2002	0	0	0	0	1,083	75%	49%
407	08/2002	0	0	0	0	1,083	75%	49%
408	09/2002	0	0	0	0	1,083	75%	49%
409	10/2002	0	0	0	0	1,083	75%	49%
410	11/2002	31	0	0	31	1,083	75%	49%
411	12/2002	402	0	0	402	1,083	75%	50%
412	01/2003	232	0	0	232	1,083	75%	50%
413	02/2003	2,355	0	0	2,355	1,083	75%	51%
414	03/2003	2,472	0	0	2,472	1,083	75%	54%
415	04/2003	858	0	0	858	1,083	75%	57%
416	05/2003	3,813	0	0	3,813	1,083	75%	56%
417	06/2003	688	0	0	688	1,083	75%	58%
418	07/2003	140	0	0	140	1,083	75%	58%
419	08/2003	0	0	0	0	1,083	75%	58%
420	09/2003	0	0	0	0	1,083	75%	59%
421	10/2003	28	0	0	28	1,083	75%	60%
422	11/2003	168	0	0	168	1,083	75%	60%
423	12/2003	637	0	0	637	1,083	75%	61%
424	01/2004	331	0	0	331	1,083	75%	62%
425	02/2004	1,796	0	0	1,796	1,083	75%	62%
426	03/2004	3,941	0	0	3,941	1,083	75%	60%
427	04/2004	285	0	0	285	1,083	75%	60%
428	05/2004	227	0	0	227	1,083	75%	60%
429	06/2004	73	0	0	73	1,083	75%	61%
430	07/2004	5	0	0	5	1,083	75%	61%
431	08/2004	0	0	0	0	1,083	75%	61%
432	09/2004	0	0	0	0	1,083	75%	61%

Table A.8
RWC calculation at HSG using only HSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	2,437	0	0	2,437	1,083	75%	59%
434	11/2004	1,446	0	0	1,446	1,083	75%	58%
435	12/2004	2,833	0	0	2,833	1,083	75%	57%
436	01/2005	6,705	0	0	6,705	1,083	75%	54%
437	02/2005	4,617	0	0	4,617	1,083	75%	53%
438	03/2005	6,553	0	0	6,553	1,083	75%	51%
439	04/2005	6,495	0	0	6,495	1,083	75%	49%
440	05/2005	2,938	0	0	2,938	1,083	75%	49%
441	06/2005	13	0	0	13	1,083	75%	49%
442	07/2005	1,597	0	0	1,597	1,083	75%	48%
443	08/2005	1,959	0	0	1,959	1,083	75%	48%
444	09/2005	1,236	0	0	1,236	1,083	75%	47%
445	10/2005	1,446	0	0	1,446	1,083	75%	47%
446	11/2005	1,959	0	0	1,959	1,083	75%	46%
447	12/2005	1,144	0	0	1,144	1,083	75%	46%
448	01/2006	3,370	0	0	3,370	1,083	75%	45%
449	02/2006	634	0	0	634	1,083	75%	46%
450	03/2006	3,755	0	0	3,755	1,083	75%	47%
451	04/2006	5,154	0	0	5,154	1,083	75%	46%
452	05/2006	2,705	0	0	2,705	1,083	75%	45%
453	06/2006	1,474	0	0	1,474	1,083	75%	45%
454	07/2006	969	0	0	969	1,083	75%	44%
455	08/2006	914	0	0	914	1,083	75%	44%
456	09/2006	777	0	0	777	1,083	75%	44%
457	10/2006	300	0	0	300	1,083	75%	44%
458	11/2006	0	0	0	0	1,083	75%	44%
459	12/2006	553	0	0	553	1,083	75%	44%
460	01/2007	871	0	0	871	1,083	75%	44%
461	02/2007	885	0	0	885	1,083	75%	43%
462	03/2007	1,248	0	0	1,248	1,083	75%	43%
463	04/2007	758	0	0	758	1,083	75%	43%
464	05/2007	830	0	0	830	1,083	75%	43%
465	06/2007	621	0	0	621	1,083	75%	43%
466	07/2007	566	0	0	566	1,083	75%	42%
467	08/2007	87	0	0	87	1,083	75%	42%
468	09/2007	0	0	0	0	1,083	75%	42%
469	10/2007	40	0	0	40	1,083	75%	42%
470	11/2007	521	0	0	521	1,083	75%	42%
471	12/2007	617	0	0	617	1,083	75%	42%
472	01/2008	4,407	0	0	4,407	1,083	75%	41%
473	02/2008	3,102	0	0	3,102	1,083	75%	41%
474	03/2008	1,165	0	0	1,165	1,083	75%	41%
475	04/2008	854	0	0	854	1,083	75%	41%
476	05/2008	1,038	0	0	1,038	1,083	75%	42%
477	06/2008	521	0	0	521	1,083	75%	42%
478	07/2008	0	0	0	0	1,083	75%	42%
479	08/2008	0	0	0	0	1,083	75%	42%
480	09/2008	0	0	0	0	1,083	75%	42%

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	0	495	0	495			
2	11/1968	0	555	0	555			
3	12/1968	0	1,060	0	1,060			
4	01/1969	0	2,661	0	2,661			
5	02/1969	0	3,217	0	3,217			
6	03/1969	0	3,948	0	3,948			
7	04/1969	0	2,683	0	2,683			
8	05/1969	0	1,685	0	1,685			
9	06/1969	0	1,181	0	1,181			
10	07/1969	0	526	0	526			
11	08/1969	0	283	0	283			
12	09/1969	0	214	0	214			
13	10/1969	0	55	0	55			
14	11/1969	0	61	0	61			
15	12/1969	0	117	0	117			
16	01/1970	0	294	0	294			
17	02/1970	0	356	0	356			
18	03/1970	0	437	0	437			
19	04/1970	0	297	0	297			
20	05/1970	0	186	0	186			
21	06/1970	0	131	0	131			
22	07/1970	0	58	0	58			
23	08/1970	0	31	0	31			
24	09/1970	0	24	0	24			
25	10/1970	0	141	0	141			
26	11/1970	0	158	0	158			
27	12/1970	0	301	0	301			
28	01/1971	0	755	0	755			
29	02/1971	0	913	0	913			
30	03/1971	0	1,121	0	1,121			
31	04/1971	0	762	0	762	1,083		
32	05/1971	0	478	0	478	1,083		
33	06/1971	0	335	0	335	1,083		
34	07/1971	0	149	0	149	1,083		
35	08/1971	0	80	0	80	1,083		
36	09/1971	0	61	0	61	1,083		
37	10/1971	0	39	0	39	1,083		
38	11/1971	0	43	0	43	1,083		
39	12/1971	0	83	0	83	1,083		
40	01/1972	0	208	0	208	1,083		
41	02/1972	0	251	0	251	1,083		
42	03/1972	0	308	0	308	1,083		
43	04/1972	0	209	0	209	1,083		
44	05/1972	0	131	0	131	1,083		
45	06/1972	0	92	0	92	1,083		
46	07/1972	0	41	0	41	1,083		
47	08/1972	0	22	0	22	1,083		
48	09/1972	0	17	0	17	1,083		
49	10/1972	0	220	0	220	1,083		
50	11/1972	0	247	0	247	1,083		
51	12/1972	0	472	0	472	1,083		
52	01/1973	0	1,183	0	1,183	1,083		
53	02/1973	0	1,431	0	1,431	1,083		
54	03/1973	0	1,756	0	1,756	1,083		

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	0	1,193	0	1,193	1,083		
56	05/1973	0	749	0	749	1,083		
57	06/1973	0	525	0	525	1,083		
58	07/1973	0	234	0	234	1,083		
59	08/1973	0	126	0	126	1,083		
60	09/1973	0	95	0	95	1,083	75%	48%
61	10/1973	0	83	0	83	1,083	75%	49%
62	11/1973	0	93	0	93	1,083	75%	50%
63	12/1973	0	177	0	177	1,083	75%	51%
64	01/1974	0	444	0	444	1,083	75%	54%
65	02/1974	0	536	0	536	1,083	75%	57%
66	03/1974	0	658	0	658	1,083	75%	60%
67	04/1974	0	447	0	447	1,083	75%	63%
68	05/1974	0	281	0	281	1,083	75%	65%
69	06/1974	0	197	0	197	1,083	75%	67%
70	07/1974	0	88	0	88	1,083	75%	68%
71	08/1974	0	47	0	47	1,083	75%	69%
72	09/1974	0	36	0	36	1,083	75%	69%
73	10/1974	0	86	0	86	1,083	75%	70%
74	11/1974	0	96	0	96	1,083	75%	70%
75	12/1974	0	184	0	184	1,083	75%	71%
76	01/1975	0	462	0	462	1,083	75%	71%
77	02/1975	0	558	0	558	1,083	75%	71%
78	03/1975	0	685	0	685	1,083	75%	71%
79	04/1975	0	466	0	466	1,083	75%	72%
80	05/1975	0	293	0	293	1,083	75%	72%
81	06/1975	0	205	0	205	1,083	75%	72%
82	07/1975	0	91	0	91	1,083	75%	73%
83	08/1975	0	49	0	49	1,083	75%	73%
84	09/1975	0	37	0	37	1,083	75%	73%
85	10/1975	0	45	0	45	1,083	75%	74%
86	11/1975	0	51	0	51	1,083	75%	74%
87	12/1975	0	97	0	97	1,083	75%	75%
88	01/1976	0	244	0	244	1,083	75%	76%
89	02/1976	0	295	0	295	1,083	75%	76%
90	03/1976	0	362	0	362	1,083	75%	77%
91	04/1976	0	246	0	246	1,083	75%	78%
92	05/1976	0	155	0	155	1,083	75%	78%
93	06/1976	0	108	0	108	1,083	75%	78%
94	07/1976	0	48	0	48	1,083	75%	79%
95	08/1976	0	26	0	26	1,083	75%	79%
96	09/1976	0	20	0	20	1,083	75%	79%
97	10/1976	0	67	0	67	1,083	75%	79%
98	11/1976	0	76	0	76	1,083	75%	79%
99	12/1976	0	144	0	144	1,083	75%	79%
100	01/1977	0	362	0	362	1,083	75%	78%
101	02/1977	0	438	0	438	1,083	75%	78%
102	03/1977	0	538	0	538	1,083	75%	78%
103	04/1977	0	366	0	366	1,083	75%	78%
104	05/1977	0	230	0	230	1,083	75%	78%
105	06/1977	0	161	0	161	1,083	75%	78%
106	07/1977	0	72	0	72	1,083	75%	78%
107	08/1977	0	39	0	39	1,083	75%	78%
108	09/1977	0	29	0	29	1,083	75%	78%

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	0	711	0	711	1,083	75%	77%
110	11/1977	0	796	0	796	1,083	75%	77%
111	12/1977	0	1,522	0	1,522	1,083	75%	76%
112	01/1978	0	3,819	0	3,819	1,083	75%	73%
113	02/1978	0	4,618	0	4,618	1,083	75%	71%
114	03/1978	0	5,667	0	5,667	1,083	75%	68%
115	04/1978	0	3,851	0	3,851	1,083	75%	66%
116	05/1978	0	2,419	0	2,419	1,083	75%	65%
117	06/1978	0	1,695	0	1,695	1,083	75%	64%
118	07/1978	0	755	0	755	1,083	75%	64%
119	08/1978	0	406	0	406	1,083	75%	64%
120	09/1978	0	307	0	307	1,083	75%	64%
121	10/1978	0	418	0	418	1,083	75%	63%
122	11/1978	0	468	0	468	1,083	75%	63%
123	12/1978	0	895	0	895	1,083	75%	63%
124	01/1979	0	2,245	0	2,245	1,083	75%	62%
125	02/1979	0	2,715	0	2,715	1,083	75%	60%
126	03/1979	0	3,332	0	3,332	1,083	75%	59%
127	04/1979	0	2,264	0	2,264	1,083	75%	58%
128	05/1979	0	1,422	0	1,422	1,083	75%	57%
129	06/1979	0	997	0	997	1,083	75%	57%
130	07/1979	0	444	0	444	1,083	75%	57%
131	08/1979	0	239	0	239	1,083	75%	57%
132	09/1979	0	181	0	181	1,083	75%	57%
133	10/1979	0	541	0	541	1,083	75%	56%
134	11/1979	0	606	0	606	1,083	75%	56%
135	12/1979	0	1,159	0	1,159	1,083	75%	56%
136	01/1980	0	2,907	0	2,907	1,083	75%	55%
137	02/1980	0	3,515	0	3,515	1,083	75%	53%
138	03/1980	0	4,313	0	4,313	1,083	75%	52%
139	04/1980	0	2,932	0	2,932	1,083	75%	51%
140	05/1980	0	1,841	0	1,841	1,083	75%	50%
141	06/1980	0	1,291	0	1,291	1,083	75%	50%
142	07/1980	0	575	0	575	1,083	75%	50%
143	08/1980	0	309	0	309	1,083	75%	49%
144	09/1980	0	234	0	234	1,083	75%	49%
145	10/1980	0	110	0	110	1,083	75%	49%
146	11/1980	0	123	0	123	1,083	75%	49%
147	12/1980	0	236	0	236	1,083	75%	49%
148	01/1981	0	591	0	591	1,083	75%	49%
149	02/1981	0	715	0	715	1,083	75%	49%
150	03/1981	0	877	0	877	1,083	75%	49%
151	04/1981	0	596	0	596	1,083	75%	49%
152	05/1981	0	374	0	374	1,083	75%	49%
153	06/1981	0	262	0	262	1,083	75%	49%
154	07/1981	0	117	0	117	1,083	75%	49%
155	08/1981	0	63	0	63	1,083	75%	49%
156	09/1981	0	48	0	48	1,083	75%	48%
157	10/1981	0	191	0	191	1,083	75%	48%
158	11/1981	0	214	0	214	1,083	75%	48%
159	12/1981	0	409	0	409	1,083	75%	48%
160	01/1982	0	1,025	0	1,025	1,083	75%	48%
161	02/1982	0	1,239	0	1,239	1,083	75%	48%
162	03/1982	0	1,521	0	1,521	1,083	75%	47%

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	0	1,034	0	1,034	1,083	75%	47%
164	05/1982	0	649	0	649	1,083	75%	47%
165	06/1982	0	455	0	455	1,083	75%	47%
166	07/1982	0	203	0	203	1,083	75%	47%
167	08/1982	0	109	0	109	1,083	75%	47%
168	09/1982	0	82	0	82	1,083	75%	47%
169	10/1982	0	798	0	798	1,083	75%	47%
170	11/1982	0	894	0	894	1,083	75%	47%
171	12/1982	0	1,708	0	1,708	1,083	75%	47%
172	01/1983	0	4,286	0	4,286	1,083	75%	47%
173	02/1983	0	5,182	0	5,182	1,083	75%	46%
174	03/1983	0	6,359	0	6,359	1,083	75%	46%
175	04/1983	0	4,322	0	4,322	1,083	75%	46%
176	05/1983	0	2,714	0	2,714	1,083	75%	46%
177	06/1983	0	1,902	0	1,902	1,083	75%	46%
178	07/1983	0	847	0	847	1,083	75%	46%
179	08/1983	0	455	0	455	1,083	75%	46%
180	09/1983	0	345	0	345	1,083	75%	46%
181	10/1983	0	123	0	123	1,083	75%	46%
182	11/1983	0	138	0	138	1,083	75%	46%
183	12/1983	0	264	0	264	1,083	75%	46%
184	01/1984	0	661	0	661	1,083	75%	47%
185	02/1984	0	800	0	800	1,083	75%	47%
186	03/1984	0	981	0	981	1,083	75%	48%
187	04/1984	0	667	0	667	1,083	75%	49%
188	05/1984	0	419	0	419	1,083	75%	49%
189	06/1984	0	294	0	294	1,083	75%	49%
190	07/1984	0	131	0	131	1,083	75%	50%
191	08/1984	0	70	0	70	1,083	75%	50%
192	09/1984	0	53	0	53	1,083	75%	50%
193	10/1984	0	117	0	117	1,083	75%	50%
194	11/1984	0	131	0	131	1,083	75%	50%
195	12/1984	0	251	0	251	1,083	75%	50%
196	01/1985	0	630	0	630	1,083	75%	51%
197	02/1985	0	761	0	761	1,083	75%	52%
198	03/1985	0	934	0	934	1,083	75%	54%
199	04/1985	0	635	0	635	1,083	75%	55%
200	05/1985	0	399	0	399	1,083	75%	56%
201	06/1985	0	280	0	280	1,083	75%	56%
202	07/1985	0	125	0	125	1,083	75%	56%
203	08/1985	0	67	0	67	1,083	75%	56%
204	09/1985	0	51	0	51	1,083	75%	57%
205	10/1985	0	233	0	233	1,083	75%	56%
206	11/1985	0	261	0	261	1,083	75%	56%
207	12/1985	0	498	0	498	1,083	75%	56%
208	01/1986	0	1,251	0	1,251	1,083	75%	56%
209	02/1986	0	1,512	0	1,512	1,083	75%	56%
210	03/1986	0	1,856	0	1,856	1,083	75%	55%
211	04/1986	0	1,261	0	1,261	1,083	75%	55%
212	05/1986	0	792	0	792	1,083	75%	55%
213	06/1986	0	555	0	555	1,083	75%	54%
214	07/1986	0	247	0	247	1,083	75%	54%
215	08/1986	0	133	0	133	1,083	75%	54%
216	09/1986	0	101	0	101	1,083	75%	54%

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	0	16	0	16	1,083	75%	54%
218	11/1986	0	18	0	18	1,083	75%	55%
219	12/1986	0	35	0	35	1,083	75%	55%
220	01/1987	0	87	0	87	1,083	75%	55%
221	02/1987	0	105	0	105	1,083	75%	56%
222	03/1987	0	129	0	129	1,083	75%	56%
223	04/1987	0	88	0	88	1,083	75%	57%
224	05/1987	0	55	0	55	1,083	75%	57%
225	06/1987	0	39	0	39	1,083	75%	57%
226	07/1987	0	17	0	17	1,083	75%	57%
227	08/1987	0	9	0	9	1,083	75%	57%
228	09/1987	0	7	0	7	1,083	75%	57%
229	10/1987	0	157	0	157	1,083	75%	58%
230	11/1987	0	176	0	176	1,083	75%	58%
231	12/1987	0	336	0	336	1,083	75%	59%
232	01/1988	0	843	0	843	1,083	75%	61%
233	02/1988	0	1,020	0	1,020	1,083	75%	63%
234	03/1988	0	1,251	0	1,251	1,083	75%	67%
235	04/1988	0	850	0	850	1,083	75%	69%
236	05/1988	0	534	0	534	1,083	75%	71%
237	06/1988	0	374	0	374	1,083	75%	72%
238	07/1988	0	167	0	167	1,083	75%	72%
239	08/1988	0	90	0	90	1,083	75%	73%
240	09/1988	0	68	0	68	1,083	75%	73%
241	10/1988	0	45	0	45	1,083	75%	73%
242	11/1988	0	51	0	51	1,083	75%	73%
243	12/1988	0	97	0	97	1,083	75%	73%
244	01/1989	0	244	0	244	1,083	75%	74%
245	02/1989	0	295	0	295	1,083	75%	74%
246	03/1989	0	361	0	361	1,083	75%	74%
247	04/1989	0	246	0	246	1,083	75%	75%
248	05/1989	0	154	0	154	1,083	75%	75%
249	06/1989	0	108	0	108	1,083	75%	75%
250	07/1989	0	48	0	48	1,083	75%	75%
251	08/1989	0	26	0	26	1,083	75%	75%
252	09/1989	0	20	0	20	1,083	75%	75%
253	10/1989	0	59	0	59	1,083	75%	75%
254	11/1989	0	66	0	66	1,083	75%	75%
255	12/1989	0	127	0	127	1,083	75%	76%
256	01/1990	0	319	0	319	1,083	75%	76%
257	02/1990	0	385	0	385	1,083	75%	76%
258	03/1990	0	473	0	473	1,083	75%	77%
259	04/1990	0	321	0	321	1,083	75%	77%
260	05/1990	0	202	0	202	1,083	75%	77%
261	06/1990	0	141	0	141	1,083	75%	77%
262	07/1990	0	63	0	63	1,083	75%	77%
263	08/1990	0	34	0	34	1,083	75%	77%
264	09/1990	0	26	0	26	1,083	75%	77%
265	10/1990	0	137	0	137	1,083	75%	77%
266	11/1990	0	153	0	153	1,083	75%	77%
267	12/1990	0	293	0	293	1,083	75%	78%
268	01/1991	0	735	0	735	1,083	75%	78%
269	02/1991	0	889	0	889	1,083	75%	79%
270	03/1991	0	1,091	0	1,091	1,083	75%	79%

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	0	741	0	741	1,083	75%	80%
272	05/1991	0	465	0	465	1,083	75%	80%
273	06/1991	0	326	0	326	1,083	75%	81%
274	07/1991	0	145	0	145	1,083	75%	81%
275	08/1991	0	78	0	78	1,083	75%	81%
276	09/1991	0	59	0	59	1,083	75%	81%
277	10/1991	0	448	0	448	1,083	75%	80%
278	11/1991	0	502	0	502	1,083	75%	80%
279	12/1991	0	960	0	960	1,083	75%	79%
280	01/1992	0	2,409	0	2,409	1,083	75%	77%
281	02/1992	0	2,913	0	2,913	1,083	75%	74%
282	03/1992	0	3,575	0	3,575	1,083	75%	71%
283	04/1992	0	2,429	0	2,429	1,083	75%	70%
284	05/1992	0	1,526	0	1,526	1,083	75%	69%
285	06/1992	0	1,069	0	1,069	1,083	75%	68%
286	07/1992	0	476	0	476	1,083	75%	68%
287	08/1992	0	256	0	256	1,083	75%	67%
288	09/1992	0	194	0	194	1,083	75%	67%
289	10/1992	0	590	0	590	1,083	75%	67%
290	11/1992	0	661	0	661	1,083	75%	67%
291	12/1992	0	1,264	0	1,264	1,083	75%	66%
292	01/1993	0	3,172	0	3,172	1,083	75%	64%
293	02/1993	0	3,835	0	3,835	1,083	75%	63%
294	03/1993	0	4,706	0	4,706	1,083	75%	61%
295	04/1993	0	3,198	0	3,198	1,083	75%	59%
296	05/1993	0	2,009	0	2,009	1,083	75%	59%
297	06/1993	0	1,408	0	1,408	1,083	75%	58%
298	07/1993	0	627	0	627	1,083	75%	58%
299	08/1993	0	337	0	337	1,083	75%	58%
300	09/1993	0	255	0	255	1,083	75%	58%
301	10/1993	0	110	0	110	1,083	75%	58%
302	11/1993	0	123	0	123	1,083	75%	58%
303	12/1993	0	235	0	235	1,083	75%	57%
304	01/1994	0	589	0	589	1,083	75%	57%
305	02/1994	0	712	0	712	1,083	75%	57%
306	03/1994	0	874	0	874	1,083	75%	57%
307	04/1994	0	594	0	594	1,083	75%	57%
308	05/1994	0	373	0	373	1,083	75%	57%
309	06/1994	0	261	0	261	1,083	75%	56%
310	07/1994	0	116	0	116	1,083	75%	56%
311	08/1994	0	63	0	63	1,083	75%	56%
312	09/1994	0	47	0	47	1,083	75%	56%
313	10/1994	0	488	0	488	1,083	75%	56%
314	11/1994	0	547	0	547	1,083	75%	56%
315	12/1994	0	1,046	0	1,046	1,083	75%	56%
316	01/1995	0	2,624	0	2,624	1,083	75%	54%
317	02/1995	0	3,172	0	3,172	1,083	75%	53%
318	03/1995	0	3,893	0	3,893	1,083	75%	52%
319	04/1995	0	2,646	0	2,646	1,083	75%	51%
320	05/1995	0	1,662	0	1,662	1,083	75%	50%
321	06/1995	0	1,165	0	1,165	1,083	75%	50%
322	07/1995	0	519	0	519	1,083	75%	50%
323	08/1995	0	279	0	279	1,083	75%	50%
324	09/1995	0	211	0	211	1,083	75%	50%

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	0	157	0	157	1,083	75%	50%
326	11/1995	0	176	0	176	1,083	75%	49%
327	12/1995	0	337	0	337	1,083	75%	49%
328	01/1996	0	845	0	845	1,083	75%	49%
329	02/1996	0	1,022	0	1,022	1,083	75%	49%
330	03/1996	0	1,254	0	1,254	1,083	75%	49%
331	04/1996	0	853	0	853	1,083	75%	49%
332	05/1996	0	535	0	535	1,083	75%	49%
333	06/1996	0	375	0	375	1,083	75%	49%
334	07/1996	0	167	0	167	1,083	75%	49%
335	08/1996	0	90	0	90	1,083	75%	49%
336	09/1996	0	68	0	68	1,083	75%	49%
337	10/1996	0	0	0	0	1,083	75%	49%
338	11/1996	0	435	0	435	1,083	75%	49%
339	12/1996	0	2,076	0	2,076	1,083	75%	49%
340	01/1997	0	3,958	0	3,958	1,083	75%	48%
341	02/1997	0	1,015	0	1,015	1,083	75%	49%
342	03/1997	0	0	0	0	1,083	75%	50%
343	04/1997	0	0	0	0	1,083	75%	51%
344	05/1997	0	0	0	0	1,083	75%	52%
345	06/1997	0	0	0	0	1,083	75%	53%
346	07/1997	0	0	0	0	1,083	75%	53%
347	08/1997	0	0	0	0	1,083	75%	53%
348	09/1997	0	1	0	1	1,083	75%	53%
349	10/1997	0	0	0	0	1,083	75%	53%
350	11/1997	0	466	0	466	1,083	75%	53%
351	12/1997	0	1,126	0	1,126	1,083	75%	53%
352	01/1998	0	749	0	749	1,083	75%	54%
353	02/1998	0	5,126	0	5,126	1,083	75%	54%
354	03/1998	0	6,930	0	6,930	1,083	75%	53%
355	04/1998	0	4,179	0	4,179	1,083	75%	52%
356	05/1998	0	3,322	0	3,322	1,083	75%	52%
357	06/1998	0	3,984	0	3,984	1,083	75%	51%
358	07/1998	0	930	0	930	1,083	75%	51%
359	08/1998	0	69	0	69	1,083	75%	51%
360	09/1998	0	0	0	0	1,083	75%	51%
361	10/1998	0	0	0	0	1,083	75%	51%
362	11/1998	0	57	0	57	1,083	75%	51%
363	12/1998	0	71	0	71	1,083	75%	51%
364	01/1999	0	358	0	358	1,083	75%	51%
365	02/1999	0	267	0	267	1,083	75%	51%
366	03/1999	0	0	0	0	1,083	75%	52%
367	04/1999	0	0	0	0	1,083	75%	52%
368	05/1999	0	73	0	73	1,083	75%	52%
369	06/1999	0	77	0	77	1,083	75%	52%
370	07/1999	0	0	0	0	1,083	75%	52%
371	08/1999	0	0	0	0	1,083	75%	52%
372	09/1999	0	0	0	0	1,083	75%	52%
373	10/1999	0	0	0	0	1,083	75%	52%
374	11/1999	0	0	0	0	1,083	75%	53%
375	12/1999	0	0	0	0	1,083	75%	53%
376	01/2000	0	103	0	103	1,083	75%	54%
377	02/2000	0	2,076	0	2,076	1,083	75%	55%
378	03/2000	0	1,212	0	1,212	1,083	75%	56%

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	0	384	0	384	1,083	75%	57%
380	05/2000	0	0	0	0	1,083	75%	58%
381	06/2000	0	0	0	0	1,083	75%	59%
382	07/2000	0	0	0	0	1,083	75%	59%
383	08/2000	0	0	0	0	1,083	75%	59%
384	09/2000	0	0	0	0	1,083	75%	59%
385	10/2000	0	114	0	114	1,083	75%	59%
386	11/2000	0	162	0	162	1,083	75%	59%
387	12/2000	0	0	0	0	1,083	75%	59%
388	01/2001	0	919	0	919	1,083	75%	59%
389	02/2001	0	1,597	0	1,597	1,083	75%	59%
390	03/2001	0	1,876	0	1,876	1,083	75%	59%
391	04/2001	0	296	0	296	1,083	75%	59%
392	05/2001	0	0	0	0	1,083	75%	59%
393	06/2001	0	0	0	0	1,083	75%	59%
394	07/2001	0	0	0	0	1,083	75%	60%
395	08/2001	0	0	0	0	1,083	75%	60%
396	09/2001	0	0	0	0	1,083	75%	60%
397	10/2001	0	349	0	349	1,083	75%	59%
398	11/2001	0	105	0	105	1,083	75%	60%
399	12/2001	0	119	0	119	1,083	75%	61%
400	01/2002	0	285	0	285	1,083	75%	63%
401	02/2002	0	92	0	92	1,083	75%	63%
402	03/2002	0	0	0	0	1,083	75%	63%
403	04/2002	0	0	0	0	1,083	75%	63%
404	05/2002	0	36	0	36	1,083	75%	63%
405	06/2002	0	0	0	0	1,083	75%	63%
406	07/2002	0	0	0	0	1,083	75%	63%
407	08/2002	0	0	0	0	1,083	75%	63%
408	09/2002	0	0	0	0	1,083	75%	63%
409	10/2002	0	8	0	8	1,083	75%	63%
410	11/2002	0	1,039	0	1,039	1,083	75%	63%
411	12/2002	0	415	0	415	1,083	75%	63%
412	01/2003	0	0	0	0	1,083	75%	64%
413	02/2003	0	871	0	871	1,083	75%	67%
414	03/2003	0	1,212	0	1,212	1,083	75%	71%
415	04/2003	0	285	0	285	1,083	75%	74%
416	05/2003	0	762	0	762	1,083	75%	**76%**
417	06/2003	0	0	0	0	1,083	75%	**80%**
418	07/2003	0	0	0	0	1,083	75%	**81%**
419	08/2003	0	0	0	0	1,083	75%	**81%**
420	09/2003	0	0	0	0	1,083	75%	**81%**
421	10/2003	0	0	0	0	1,083	75%	**81%**
422	11/2003	0	522	0	522	1,083	75%	**81%**
423	12/2003	0	196	0	196	1,083	75%	**80%**
424	01/2004	0	26	0	26	1,083	75%	**81%**
425	02/2004	0	1,041	0	1,041	1,083	75%	**80%**
426	03/2004	0	327	0	327	1,083	75%	**80%**
427	04/2004	0	122	0	122	1,083	75%	**80%**
428	05/2004	0	0	0	0	1,083	75%	**80%**
429	06/2004	0	0	0	0	1,083	75%	**80%**
430	07/2004	0	12	0	12	1,083	75%	**80%**
431	08/2004	0	1	0	1	1,083	75%	**80%**
432	09/2004	0	0	0	0	1,083	75%	**80%**

Table A.9
RWC calculation at PSG using only PSG as diluent source (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	0	831	0	831	1,083	75%	79%
434	11/2004	0	19	0	19	1,083	75%	79%
435	12/2004	0	1,147	0	1,147	1,083	75%	78%
436	01/2005	0	5,411	0	5,411	1,083	75%	73%
437	02/2005	0	3,400	0	3,400	1,083	75%	72%
438	03/2005	0	6,514	0	6,514	1,083	75%	68%
439	04/2005	0	1,213	0	1,213	1,083	75%	67%
440	05/2005	0	1,947	0	1,947	1,083	75%	66%
441	06/2005	0	1,067	0	1,067	1,083	75%	65%
442	07/2005	0	1,023	0	1,023	1,083	75%	65%
443	08/2005	0	0	0	0	1,083	75%	65%
444	09/2005	0	0	0	0	1,083	75%	65%
445	10/2005	0	292	0	292	1,083	75%	65%
446	11/2005	0	0	0	0	1,083	75%	65%
447	12/2005	0	173	0	173	1,083	75%	65%
448	01/2006	0	1,100	0	1,100	1,083	75%	65%
449	02/2006	0	610	0	610	1,083	75%	65%
450	03/2006	0	2,011	0	2,011	1,083	75%	65%
451	04/2006	0	3,621	0	3,621	1,083	75%	63%
452	05/2006	0	1,726	0	1,726	1,083	75%	62%
453	06/2006	0	0	0	0	1,083	75%	62%
454	07/2006	0	0	0	0	1,083	75%	62%
455	08/2006	0	0	0	0	1,083	75%	62%
456	09/2006	0	0	0	0	1,083	75%	62%
457	10/2006	0	0	0	0	1,083	75%	62%
458	11/2006	0	0	0	0	1,083	75%	62%
459	12/2006	0	10	0	10	1,083	75%	62%
460	01/2007	0	51	0	51	1,083	75%	62%
461	02/2007	0	252	0	252	1,083	75%	62%
462	03/2007	0	0	0	0	1,083	75%	62%
463	04/2007	0	87	0	87	1,083	75%	62%
464	05/2007	0	0	0	0	1,083	75%	62%
465	06/2007	0	0	0	0	1,083	75%	62%
466	07/2007	0	0	0	0	1,083	75%	62%
467	08/2007	0	0	0	0	1,083	75%	62%
468	09/2007	0	166	0	166	1,083	75%	62%
469	10/2007	0	0	0	0	1,083	75%	62%
470	11/2007	0	67	0	67	1,083	75%	63%
471	12/2007	0	365	0	365	1,083	75%	63%
472	01/2008	0	2,466	0	2,466	1,083	75%	61%
473	02/2008	0	2,725	0	2,725	1,083	75%	60%
474	03/2008	0	1	0	1	1,083	75%	61%
475	04/2008	0	720	0	720	1,083	75%	61%
476	05/2008	0	178	0	178	1,083	75%	61%
477	06/2008	0	0	0	0	1,083	75%	61%
478	07/2008	0	0	0	0	1,083	75%	61%
479	08/2008	0	0	0	0	1,083	75%	61%
480	09/2008	0	0	0	0	1,083	75%	61%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	527	248	282	1,056			
2	11/1968	590	277	316	1,184			
3	12/1968	1,128	530	604	2,262			
4	01/1969	2,830	1,330	1,516	5,676			
5	02/1969	3,421	1,608	1,833	6,863			
6	03/1969	4,198	1,974	2,250	8,422			
7	04/1969	2,853	1,342	1,529	5,724			
8	05/1969	1,792	842	960	3,595			
9	06/1969	1,256	591	673	2,520			
10	07/1969	560	263	300	1,122			
11	08/1969	301	141	161	603			
12	09/1969	228	107	122	457			
13	10/1969	193	27	51	272			
14	11/1969	217	31	58	305			
15	12/1969	414	59	110	583			
16	01/1970	1,040	147	276	1,463			
17	02/1970	1,257	178	334	1,769			
18	03/1970	1,542	218	410	2,171			
19	04/1970	1,048	148	279	1,475			
20	05/1970	658	93	175	927			
21	06/1970	462	65	123	650			
22	07/1970	206	29	55	289			
23	08/1970	110	16	29	155			
24	09/1970	84	12	22	118			
25	10/1970	189	70	0	259			
26	11/1970	212	79	0	291			
27	12/1970	405	151	0	555			
28	01/1971	1,016	378	0	1,394			
29	02/1971	1,229	457	0	1,685			
30	03/1971	1,508	560	0	2,068			
31	04/1971	1,025	381	0	1,405	1,438		
32	05/1971	643	239	0	883	1,438		
33	06/1971	451	168	0	619	1,438		
34	07/1971	201	75	0	276	1,438		
35	08/1971	108	40	0	148	1,438		
36	09/1971	82	30	0	112	1,438		
37	10/1971	31	19	0	51	1,438		
38	11/1971	35	22	0	57	1,438		
39	12/1971	67	41	0	108	1,438		
40	01/1972	168	104	0	272	1,438		
41	02/1972	204	126	0	329	1,438		
42	03/1972	250	154	0	404	1,438		
43	04/1972	170	105	0	275	1,438		
44	05/1972	107	66	0	172	1,438		
45	06/1972	75	46	0	121	1,438		
46	07/1972	33	21	0	54	1,438		
47	08/1972	18	11	0	29	1,438		
48	09/1972	14	8	0	22	1,438		
49	10/1972	150	110	49	310	1,438		
50	11/1972	169	123	55	347	1,438		
51	12/1972	322	236	105	663	1,438		
52	01/1973	808	592	264	1,664	1,438		
53	02/1973	977	715	319	2,012	1,438		
54	03/1973	1,199	878	392	2,469	1,438		

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	815	597	266	1,678	1,438		
56	05/1973	512	375	167	1,054	1,438		
57	06/1973	359	263	117	739	1,438		
58	07/1973	160	117	52	329	1,438		
59	08/1973	86	63	28	177	1,438		
60	09/1973	65	48	21	134	1,438	75%	37%
61	10/1973	102	41	0	143	1,438	75%	38%
62	11/1973	114	46	0	161	1,438	75%	39%
63	12/1973	218	88	0	307	1,438	75%	41%
64	01/1974	548	222	0	770	1,438	75%	43%
65	02/1974	663	268	0	931	1,438	75%	46%
66	03/1974	813	329	0	1,142	1,438	75%	50%
67	04/1974	553	224	0	776	1,438	75%	54%
68	05/1974	347	140	0	488	1,438	75%	56%
69	06/1974	243	98	0	342	1,438	75%	58%
70	07/1974	108	44	0	152	1,438	75%	59%
71	08/1974	58	24	0	82	1,438	75%	60%
72	09/1974	44	18	0	62	1,438	75%	61%
73	10/1974	88	43	0	131	1,438	75%	62%
74	11/1974	99	48	0	147	1,438	75%	62%
75	12/1974	188	92	0	280	1,438	75%	63%
76	01/1975	473	231	0	704	1,438	75%	64%
77	02/1975	572	279	0	851	1,438	75%	65%
78	03/1975	701	343	0	1,044	1,438	75%	66%
79	04/1975	477	233	0	710	1,438	75%	67%
80	05/1975	299	146	0	446	1,438	75%	68%
81	06/1975	210	103	0	312	1,438	75%	69%
82	07/1975	93	46	0	139	1,438	75%	69%
83	08/1975	50	25	0	75	1,438	75%	69%
84	09/1975	38	19	0	57	1,438	75%	70%
85	10/1975	51	23	0	73	1,438	75%	70%
86	11/1975	57	25	0	82	1,438	75%	71%
87	12/1975	109	49	0	157	1,438	75%	72%
88	01/1976	273	122	0	395	1,438	75%	73%
89	02/1976	330	148	0	477	1,438	75%	74%
90	03/1976	405	181	0	586	1,438	75%	75%
91	04/1976	275	123	0	398	1,438	75%	76%
92	05/1976	173	77	0	250	1,438	75%	76%
93	06/1976	121	54	0	175	1,438	75%	76%
94	07/1976	54	24	0	78	1,438	75%	76%
95	08/1976	29	13	0	42	1,438	75%	76%
96	09/1976	22	10	0	32	1,438	75%	77%
97	10/1976	43	34	0	77	1,438	75%	77%
98	11/1976	48	38	0	86	1,438	75%	76%
99	12/1976	92	72	0	164	1,438	75%	76%
100	01/1977	232	181	0	413	1,438	75%	76%
101	02/1977	280	219	0	499	1,438	75%	76%
102	03/1977	343	269	0	612	1,438	75%	76%
103	04/1977	233	183	0	416	1,438	75%	76%
104	05/1977	147	115	0	261	1,438	75%	76%
105	06/1977	103	80	0	183	1,438	75%	76%
106	07/1977	46	36	0	82	1,438	75%	76%
107	08/1977	25	19	0	44	1,438	75%	76%
108	09/1977	19	15	0	33	1,438	75%	76%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	456	355	277	1,089	1,438	75%	75%
110	11/1977	511	398	311	1,220	1,438	75%	75%
111	12/1977	977	761	594	2,332	1,438	75%	74%
112	01/1978	2,451	1,910	1,489	5,850	1,438	75%	71%
113	02/1978	2,964	2,309	1,801	7,073	1,438	75%	68%
114	03/1978	3,637	2,833	2,210	8,680	1,438	75%	65%
115	04/1978	2,472	1,926	1,502	5,899	1,438	75%	63%
116	05/1978	1,552	1,209	943	3,705	1,438	75%	62%
117	06/1978	1,088	848	661	2,597	1,438	75%	61%
118	07/1978	485	378	295	1,157	1,438	75%	61%
119	08/1978	260	203	158	621	1,438	75%	61%
120	09/1978	197	154	120	471	1,438	75%	60%
121	10/1978	401	209	0	610	1,438	75%	60%
122	11/1978	449	234	0	683	1,438	75%	60%
123	12/1978	858	447	0	1,305	1,438	75%	60%
124	01/1979	2,153	1,123	0	3,275	1,438	75%	59%
125	02/1979	2,603	1,357	0	3,960	1,438	75%	57%
126	03/1979	3,194	1,666	0	4,860	1,438	75%	56%
127	04/1979	2,171	1,132	0	3,303	1,438	75%	55%
128	05/1979	1,363	711	0	2,074	1,438	75%	55%
129	06/1979	956	498	0	1,454	1,438	75%	54%
130	07/1979	426	222	0	648	1,438	75%	54%
131	08/1979	229	119	0	348	1,438	75%	54%
132	09/1979	173	90	0	264	1,438	75%	54%
133	10/1979	504	271	0	775	1,438	75%	54%
134	11/1979	565	303	0	868	1,438	75%	53%
135	12/1979	1,080	579	0	1,659	1,438	75%	53%
136	01/1980	2,710	1,454	0	4,163	1,438	75%	52%
137	02/1980	3,276	1,757	0	5,034	1,438	75%	51%
138	03/1980	4,020	2,157	0	6,177	1,438	75%	49%
139	04/1980	2,732	1,466	0	4,198	1,438	75%	48%
140	05/1980	1,716	921	0	2,637	1,438	75%	48%
141	06/1980	1,203	645	0	1,848	1,438	75%	47%
142	07/1980	536	287	0	823	1,438	75%	47%
143	08/1980	288	154	0	442	1,438	75%	47%
144	09/1980	218	117	0	335	1,438	75%	47%
145	10/1980	235	55	0	290	1,438	75%	47%
146	11/1980	263	62	0	325	1,438	75%	47%
147	12/1980	503	118	0	620	1,438	75%	47%
148	01/1981	1,261	296	0	1,557	1,438	75%	46%
149	02/1981	1,525	357	0	1,882	1,438	75%	46%
150	03/1981	1,871	439	0	2,310	1,438	75%	46%
151	04/1981	1,272	298	0	1,570	1,438	75%	45%
152	05/1981	799	187	0	986	1,438	75%	45%
153	06/1981	560	131	0	691	1,438	75%	45%
154	07/1981	249	58	0	308	1,438	75%	45%
155	08/1981	134	31	0	165	1,438	75%	45%
156	09/1981	101	24	0	125	1,438	75%	45%
157	10/1981	232	95	0	328	1,438	75%	45%
158	11/1981	260	107	0	367	1,438	75%	45%
159	12/1981	497	204	0	702	1,438	75%	45%
160	01/1982	1,248	513	0	1,761	1,438	75%	44%
161	02/1982	1,509	620	0	2,129	1,438	75%	44%
162	03/1982	1,852	761	0	2,612	1,438	75%	43%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	1,258	517	0	1,775	1,438	75%	43%
164	05/1982	790	325	0	1,115	1,438	75%	43%
165	06/1982	554	228	0	782	1,438	75%	43%
166	07/1982	247	101	0	348	1,438	75%	43%
167	08/1982	133	54	0	187	1,438	75%	43%
168	09/1982	100	41	0	142	1,438	75%	43%
169	10/1982	571	399	229	1,198	1,438	75%	43%
170	11/1982	640	447	256	1,343	1,438	75%	43%
171	12/1982	1,222	854	490	2,566	1,438	75%	43%
172	01/1983	3,068	2,143	1,229	6,439	1,438	75%	43%
173	02/1983	3,709	2,591	1,486	7,786	1,438	75%	42%
174	03/1983	4,551	3,179	1,824	9,554	1,438	75%	42%
175	04/1983	3,093	2,161	1,239	6,493	1,438	75%	42%
176	05/1983	1,943	1,357	778	4,078	1,438	75%	42%
177	06/1983	1,362	951	546	2,859	1,438	75%	42%
178	07/1983	607	424	243	1,273	1,438	75%	42%
179	08/1983	326	228	131	684	1,438	75%	42%
180	09/1983	247	172	99	518	1,438	75%	42%
181	10/1983	169	62	0	230	1,438	75%	42%
182	11/1983	189	69	0	258	1,438	75%	42%
183	12/1983	362	132	0	493	1,438	75%	42%
184	01/1984	907	331	0	1,238	1,438	75%	43%
185	02/1984	1,097	400	0	1,497	1,438	75%	43%
186	03/1984	1,346	491	0	1,837	1,438	75%	44%
187	04/1984	915	333	0	1,248	1,438	75%	44%
188	05/1984	575	209	0	784	1,438	75%	45%
189	06/1984	403	147	0	550	1,438	75%	45%
190	07/1984	179	65	0	245	1,438	75%	45%
191	08/1984	96	35	0	132	1,438	75%	45%
192	09/1984	73	27	0	100	1,438	75%	45%
193	10/1984	215	59	0	274	1,438	75%	45%
194	11/1984	241	66	0	307	1,438	75%	45%
195	12/1984	461	125	0	587	1,438	75%	46%
196	01/1985	1,157	315	0	1,472	1,438	75%	46%
197	02/1985	1,399	381	0	1,780	1,438	75%	47%
198	03/1985	1,717	467	0	2,184	1,438	75%	48%
199	04/1985	1,167	317	0	1,484	1,438	75%	49%
200	05/1985	733	199	0	932	1,438	75%	49%
201	06/1985	514	140	0	653	1,438	75%	50%
202	07/1985	229	62	0	291	1,438	75%	50%
203	08/1985	123	33	0	156	1,438	75%	50%
204	09/1985	93	25	0	118	1,438	75%	50%
205	10/1985	295	116	0	411	1,438	75%	50%
206	11/1985	331	130	0	461	1,438	75%	50%
207	12/1985	632	249	0	881	1,438	75%	50%
208	01/1986	1,585	625	0	2,211	1,438	75%	50%
209	02/1986	1,917	756	0	2,673	1,438	75%	49%
210	03/1986	2,352	928	0	3,280	1,438	75%	49%
211	04/1986	1,599	631	0	2,229	1,438	75%	49%
212	05/1986	1,004	396	0	1,400	1,438	75%	49%
213	06/1986	704	278	0	981	1,438	75%	49%
214	07/1986	314	124	0	437	1,438	75%	49%
215	08/1986	168	66	0	235	1,438	75%	49%
216	09/1986	128	50	0	178	1,438	75%	49%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	119	8	0	127	1,438	75%	49%
218	11/1986	133	9	0	142	1,438	75%	49%
219	12/1986	254	17	0	271	1,438	75%	49%
220	01/1987	637	44	0	681	1,438	75%	49%
221	02/1987	771	53	0	823	1,438	75%	50%
222	03/1987	946	65	0	1,010	1,438	75%	50%
223	04/1987	643	44	0	687	1,438	75%	50%
224	05/1987	404	28	0	431	1,438	75%	50%
225	06/1987	283	19	0	302	1,438	75%	51%
226	07/1987	126	9	0	135	1,438	75%	51%
227	08/1987	68	5	0	72	1,438	75%	51%
228	09/1987	51	4	0	55	1,438	75%	51%
229	10/1987	280	78	0	358	1,438	75%	51%
230	11/1987	314	88	0	401	1,438	75%	51%
231	12/1987	599	168	0	767	1,438	75%	52%
232	01/1988	1,504	422	0	1,925	1,438	75%	53%
233	02/1988	1,818	510	0	2,328	1,438	75%	55%
234	03/1988	2,231	626	0	2,857	1,438	75%	58%
235	04/1988	1,516	425	0	1,942	1,438	75%	59%
236	05/1988	952	267	0	1,219	1,438	75%	61%
237	06/1988	668	187	0	855	1,438	75%	61%
238	07/1988	297	83	0	381	1,438	75%	62%
239	08/1988	160	45	0	205	1,438	75%	62%
240	09/1988	121	34	0	155	1,438	75%	62%
241	10/1988	62	23	0	85	1,438	75%	62%
242	11/1988	70	25	0	95	1,438	75%	62%
243	12/1988	134	49	0	182	1,438	75%	63%
244	01/1989	335	122	0	457	1,438	75%	63%
245	02/1989	405	147	0	552	1,438	75%	63%
246	03/1989	497	181	0	678	1,438	75%	64%
247	04/1989	338	123	0	461	1,438	75%	64%
248	05/1989	212	77	0	289	1,438	75%	64%
249	06/1989	149	54	0	203	1,438	75%	65%
250	07/1989	66	24	0	90	1,438	75%	65%
251	08/1989	36	13	0	49	1,438	75%	65%
252	09/1989	27	10	0	37	1,438	75%	65%
253	10/1989	33	30	0	63	1,438	75%	65%
254	11/1989	37	33	0	70	1,438	75%	65%
255	12/1989	70	63	0	134	1,438	75%	65%
256	01/1990	177	159	0	336	1,438	75%	66%
257	02/1990	214	193	0	406	1,438	75%	66%
258	03/1990	262	236	0	499	1,438	75%	67%
259	04/1990	178	161	0	339	1,438	75%	68%
260	05/1990	112	101	0	213	1,438	75%	68%
261	06/1990	79	71	0	149	1,438	75%	69%
262	07/1990	35	32	0	66	1,438	75%	69%
263	08/1990	19	17	0	36	1,438	75%	69%
264	09/1990	14	13	0	27	1,438	75%	69%
265	10/1990	186	68	54	309	1,438	75%	69%
266	11/1990	209	77	60	346	1,438	75%	69%
267	12/1990	399	146	115	661	1,438	75%	69%
268	01/1991	1,001	368	289	1,658	1,438	75%	69%
269	02/1991	1,211	444	349	2,004	1,438	75%	70%
270	03/1991	1,486	545	429	2,460	1,438	75%	70%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	1,010	371	291	1,672	1,438	75%	71%
272	05/1991	634	233	183	1,050	1,438	75%	71%
273	06/1991	445	163	128	736	1,438	75%	71%
274	07/1991	198	73	57	328	1,438	75%	71%
275	08/1991	106	39	31	176	1,438	75%	71%
276	09/1991	81	30	23	133	1,438	75%	71%
277	10/1991	251	224	200	675	1,438	75%	71%
278	11/1991	281	251	225	757	1,438	75%	70%
279	12/1991	537	480	429	1,446	1,438	75%	70%
280	01/1992	1,348	1,205	1,077	3,629	1,438	75%	68%
281	02/1992	1,629	1,456	1,302	4,388	1,438	75%	66%
282	03/1992	2,000	1,787	1,598	5,385	1,438	75%	64%
283	04/1992	1,359	1,215	1,086	3,660	1,438	75%	63%
284	05/1992	853	763	682	2,298	1,438	75%	62%
285	06/1992	598	535	478	1,611	1,438	75%	61%
286	07/1992	267	238	213	718	1,438	75%	61%
287	08/1992	143	128	114	386	1,438	75%	61%
288	09/1992	108	97	87	292	1,438	75%	61%
289	10/1992	425	295	425	1,145	1,438	75%	60%
290	11/1992	476	331	476	1,283	1,438	75%	60%
291	12/1992	910	632	910	2,452	1,438	75%	59%
292	01/1993	2,283	1,586	2,283	6,152	1,438	75%	58%
293	02/1993	2,760	1,917	2,761	7,438	1,438	75%	56%
294	03/1993	3,387	2,353	3,388	9,127	1,438	75%	54%
295	04/1993	2,302	1,599	2,302	6,203	1,438	75%	52%
296	05/1993	1,445	1,004	1,446	3,896	1,438	75%	51%
297	06/1993	1,013	704	1,014	2,731	1,438	75%	51%
298	07/1993	451	314	452	1,216	1,438	75%	51%
299	08/1993	242	168	243	654	1,438	75%	50%
300	09/1993	184	128	184	495	1,438	75%	50%
301	10/1993	196	55	89	340	1,438	75%	50%
302	11/1993	219	61	100	380	1,438	75%	50%
303	12/1993	419	117	191	727	1,438	75%	50%
304	01/1994	1,051	294	480	1,825	1,438	75%	50%
305	02/1994	1,270	356	580	2,206	1,438	75%	49%
306	03/1994	1,559	437	712	2,707	1,438	75%	49%
307	04/1994	1,059	297	484	1,840	1,438	75%	48%
308	05/1994	665	186	304	1,155	1,438	75%	48%
309	06/1994	466	131	213	810	1,438	75%	48%
310	07/1994	208	58	95	361	1,438	75%	48%
311	08/1994	112	31	51	194	1,438	75%	48%
312	09/1994	85	24	39	147	1,438	75%	48%
313	10/1994	570	244	394	1,208	1,438	75%	47%
314	11/1994	639	274	442	1,354	1,438	75%	47%
315	12/1994	1,221	523	844	2,588	1,438	75%	46%
316	01/1995	3,063	1,312	2,118	6,493	1,438	75%	45%
317	02/1995	3,703	1,586	2,561	7,851	1,438	75%	43%
318	03/1995	4,544	1,946	3,143	9,634	1,438	75%	41%
319	04/1995	3,088	1,323	2,136	6,547	1,438	75%	40%
320	05/1995	1,940	831	1,342	4,112	1,438	75%	39%
321	06/1995	1,360	582	940	2,882	1,438	75%	39%
322	07/1995	606	259	419	1,284	1,438	75%	39%
323	08/1995	325	139	225	690	1,438	75%	39%
324	09/1995	246	106	170	522	1,438	75%	39%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	134	79	168	380	1,438	75%	39%
326	11/1995	150	88	188	426	1,438	75%	39%
327	12/1995	286	168	360	814	1,438	75%	39%
328	01/1996	718	423	902	2,043	1,438	75%	38%
329	02/1996	868	511	1,091	2,470	1,438	75%	38%
330	03/1996	1,065	627	1,339	3,031	1,438	75%	38%
331	04/1996	724	426	910	2,060	1,438	75%	38%
332	05/1996	454	268	571	1,293	1,438	75%	38%
333	06/1996	319	188	401	907	1,438	75%	38%
334	07/1996	142	84	178	404	1,438	75%	38%
335	08/1996	76	45	96	217	1,438	75%	38%
336	09/1996	58	34	73	164	1,438	75%	38%
337	10/1996	0	0	192	192	1,438	75%	38%
338	11/1996	176	217	57	450	1,438	75%	38%
339	12/1996	1,000	1,038	494	2,532	1,438	75%	38%
340	01/1997	1,928	1,979	2,222	6,129	1,438	75%	38%
341	02/1997	1,473	507	538	2,519	1,438	75%	38%
342	03/1997	381	0	697	1,079	1,438	75%	39%
343	04/1997	255	0	469	724	1,438	75%	39%
344	05/1997	324	0	0	324	1,438	75%	40%
345	06/1997	179	0	125	305	1,438	75%	40%
346	07/1997	49	0	238	287	1,438	75%	40%
347	08/1997	10	0	144	154	1,438	75%	40%
348	09/1997	169	1	0	169	1,438	75%	40%
349	10/1997	223	0	0	223	1,438	75%	40%
350	11/1997	204	233	73	509	1,438	75%	40%
351	12/1997	709	563	291	1,563	1,438	75%	40%
352	01/1998	685	374	54	1,114	1,438	75%	41%
353	02/1998	2,819	2,563	3,539	8,922	1,438	75%	41%
354	03/1998	4,760	3,465	1,317	9,542	1,438	75%	41%
355	04/1998	3,644	2,089	0	5,733	1,438	75%	41%
356	05/1998	952	1,661	739	3,352	1,438	75%	41%
357	06/1998	2,468	1,992	873	5,332	1,438	75%	41%
358	07/1998	110	465	1,463	2,038	1,438	75%	41%
359	08/1998	0	34	638	673	1,438	75%	41%
360	09/1998	481	0	48	529	1,438	75%	41%
361	10/1998	831	0	0	831	1,438	75%	40%
362	11/1998	579	29	250	858	1,438	75%	40%
363	12/1998	867	36	0	903	1,438	75%	40%
364	01/1999	764	179	87	1,030	1,438	75%	40%
365	02/1999	1,013	134	10	1,156	1,438	75%	41%
366	03/1999	873	0	53	926	1,438	75%	41%
367	04/1999	206	0	1,422	1,628	1,438	75%	41%
368	05/1999	155	36	551	742	1,438	75%	41%
369	06/1999	124	38	339	502	1,438	75%	41%
370	07/1999	15	0	320	335	1,438	75%	41%
371	08/1999	0	0	144	144	1,438	75%	41%
372	09/1999	0	0	2	2	1,438	75%	41%
373	10/1999	11	0	0	11	1,438	75%	42%
374	11/1999	5	0	0	5	1,438	75%	42%
375	12/1999	8	0	0	8	1,438	75%	42%
376	01/2000	11	51	11	73	1,438	75%	44%
377	02/2000	1,522	1,038	617	3,177	1,438	75%	45%
378	03/2000	1,364	606	921	2,891	1,438	75%	46%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	715	192	521	1,429	1,438	75%	48%
380	05/2000	347	0	83	431	1,438	75%	49%
381	06/2000	270	0	0	270	1,438	75%	49%
382	07/2000	148	0	0	148	1,438	75%	50%
383	08/2000	136	0	0	136	1,438	75%	50%
384	09/2000	0	0	0	0	1,438	75%	50%
385	10/2000	0	57	0	57	1,438	75%	50%
386	11/2000	0	81	0	81	1,438	75%	50%
387	12/2000	121	0	0	121	1,438	75%	50%
388	01/2001	631	459	66	1,157	1,438	75%	51%
389	02/2001	1,475	799	335	2,609	1,438	75%	51%
390	03/2001	3,061	938	267	4,266	1,438	75%	50%
391	04/2001	1,593	148	26	1,767	1,438	75%	50%
392	05/2001	209	0	99	309	1,438	75%	51%
393	06/2001	0	0	337	337	1,438	75%	51%
394	07/2001	0	0	108	108	1,438	75%	51%
395	08/2001	0	0	73	73	1,438	75%	51%
396	09/2001	0	0	50	50	1,438	75%	51%
397	10/2001	53	175	41	269	1,438	75%	51%
398	11/2001	139	53	0	191	1,438	75%	51%
399	12/2001	116	60	7	183	1,438	75%	52%
400	01/2002	135	143	32	310	1,438	75%	54%
401	02/2002	84	46	1	131	1,438	75%	54%
402	03/2002	82	0	0	82	1,438	75%	55%
403	04/2002	81	0	0	81	1,438	75%	55%
404	05/2002	44	18	0	62	1,438	75%	55%
405	06/2002	80	0	0	80	1,438	75%	55%
406	07/2002	0	0	0	0	1,438	75%	55%
407	08/2002	0	0	0	0	1,438	75%	55%
408	09/2002	0	0	0	0	1,438	75%	55%
409	10/2002	0	4	0	4	1,438	75%	55%
410	11/2002	16	520	53	589	1,438	75%	55%
411	12/2002	209	208	38	455	1,438	75%	56%
412	01/2003	121	0	0	121	1,438	75%	56%
413	02/2003	1,225	435	140	1,800	1,438	75%	59%
414	03/2003	1,285	606	36	1,927	1,438	75%	62%
415	04/2003	446	143	37	626	1,438	75%	65%
416	05/2003	1,983	381	1,123	3,487	1,438	75%	64%
417	06/2003	358	0	0	358	1,438	75%	67%
418	07/2003	73	0	0	73	1,438	75%	68%
419	08/2003	0	0	78	78	1,438	75%	68%
420	09/2003	0	0	41	41	1,438	75%	69%
421	10/2003	15	0	0	15	1,438	75%	69%
422	11/2003	87	261	0	348	1,438	75%	69%
423	12/2003	331	98	8	437	1,438	75%	70%
424	01/2004	172	13	0	185	1,438	75%	70%
425	02/2004	934	520	205	1,659	1,438	75%	70%
426	03/2004	2,049	164	0	2,213	1,438	75%	69%
427	04/2004	148	61	0	209	1,438	75%	70%
428	05/2004	118	0	0	118	1,438	75%	70%
429	06/2004	38	0	0	38	1,438	75%	70%
430	07/2004	2	6	0	8	1,438	75%	71%
431	08/2004	0	1	0	1	1,438	75%	71%
432	09/2004	0	0	0	0	1,438	75%	71%

Table A.10
RWC calculation at TWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	1,267	415	438	2,120	1,438	75%	70%
434	11/2004	752	10	0	762	1,438	75%	69%
435	12/2004	1,473	574	403	2,450	1,438	75%	68%
436	01/2005	3,486	2,706	3,038	9,230	1,438	75%	63%
437	02/2005	2,401	1,700	777	4,878	1,438	75%	62%
438	03/2005	3,408	3,257	3,087	9,751	1,438	75%	60%
439	04/2005	3,377	607	3,006	6,990	1,438	75%	57%
440	05/2005	1,528	973	2,618	5,119	1,438	75%	56%
441	06/2005	7	533	3,329	3,869	1,438	75%	54%
442	07/2005	831	511	366	1,708	1,438	75%	54%
443	08/2005	1,019	0	0	1,019	1,438	75%	53%
444	09/2005	643	0	0	643	1,438	75%	53%
445	10/2005	752	146	24	922	1,438	75%	53%
446	11/2005	1,019	0	3	1,022	1,438	75%	53%
447	12/2005	595	86	380	1,061	1,438	75%	52%
448	01/2006	1,752	550	516	2,819	1,438	75%	52%
449	02/2006	330	305	1,341	1,976	1,438	75%	52%
450	03/2006	1,952	1,006	3,103	6,061	1,438	75%	52%
451	04/2006	2,680	1,810	2,974	7,464	1,438	75%	50%
452	05/2006	1,407	863	352	2,622	1,438	75%	49%
453	06/2006	766	0	0	766	1,438	75%	49%
454	07/2006	504	0	0	504	1,438	75%	49%
455	08/2006	475	0	0	475	1,438	75%	49%
456	09/2006	404	0	0	404	1,438	75%	49%
457	10/2006	156	0	39	195	1,438	75%	49%
458	11/2006	0	0	163	163	1,438	75%	49%
459	12/2006	287	5	37	330	1,438	75%	49%
460	01/2007	453	25	1	479	1,438	75%	49%
461	02/2007	460	126	29	615	1,438	75%	49%
462	03/2007	649	0	0	649	1,438	75%	48%
463	04/2007	394	43	0	438	1,438	75%	48%
464	05/2007	432	0	0	432	1,438	75%	48%
465	06/2007	323	0	0	323	1,438	75%	48%
466	07/2007	294	0	0	294	1,438	75%	48%
467	08/2007	45	0	8	54	1,438	75%	48%
468	09/2007	0	83	23	106	1,438	75%	48%
469	10/2007	21	0	95	116	1,438	75%	48%
470	11/2007	271	34	96	401	1,438	75%	48%
471	12/2007	321	182	141	644	1,438	75%	48%
472	01/2008	2,292	1,233	1,414	4,939	1,438	75%	47%
473	02/2008	1,613	1,363	778	3,754	1,438	75%	46%
474	03/2008	606	1	604	1,211	1,438	75%	46%
475	04/2008	444	360	11	815	1,438	75%	46%
476	05/2008	540	89	0	629	1,438	75%	47%
477	06/2008	271	0	215	486	1,438	75%	47%
478	07/2008	0	0	229	229	1,438	75%	47%
479	08/2008	0	0	195	195	1,438	75%	47%
480	09/2008	0	0	175	175	1,438	75%	47%

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
1	10/1968	486	248	390	1,123			
2	11/1968	545	277	437	1,259			
3	12/1968	1,041	530	834	2,406			
4	01/1969	2,612	1,330	2,094	6,036			
5	02/1969	3,158	1,608	2,532	7,298			
6	03/1969	3,876	1,974	3,107	8,956			
7	04/1969	2,634	1,342	2,111	6,087			
8	05/1969	1,654	842	1,326	3,823			
9	06/1969	1,160	591	929	2,680			
10	07/1969	517	263	414	1,194			
11	08/1969	277	141	222	641			
12	09/1969	210	107	168	486			
13	10/1969	179	27	71	277			
14	11/1969	200	31	80	310			
15	12/1969	382	59	152	593			
16	01/1970	960	147	382	1,489			
17	02/1970	1,160	178	462	1,800			
18	03/1970	1,424	218	566	2,209			
19	04/1970	968	148	385	1,501			
20	05/1970	608	93	242	943			
21	06/1970	426	65	169	661			
22	07/1970	190	29	75	294			
23	08/1970	102	16	41	158			
24	09/1970	77	12	31	120			
25	10/1970	175	70	0	245			
26	11/1970	196	79	0	274			
27	12/1970	374	151	0	524			
28	01/1971	938	378	0	1,316			
29	02/1971	1,134	457	0	1,591			
30	03/1971	1,392	560	0	1,952			
31	04/1971	946	381	0	1,327	1,395		
32	05/1971	594	239	0	833	1,395		
33	06/1971	416	168	0	584	1,395		
34	07/1971	185	75	0	260	1,395		
35	08/1971	100	40	0	140	1,395		
36	09/1971	75	30	0	106	1,395		
37	10/1971	29	19	0	48	1,395		
38	11/1971	32	22	0	54	1,395		
39	12/1971	62	41	0	103	1,395		
40	01/1972	155	104	0	259	1,395		
41	02/1972	188	126	0	313	1,395		
42	03/1972	231	154	0	385	1,395		
43	04/1972	157	105	0	261	1,395		
44	05/1972	98	66	0	164	1,395		
45	06/1972	69	46	0	115	1,395		
46	07/1972	31	21	0	51	1,395		
47	08/1972	17	11	0	28	1,395		
48	09/1972	13	8	0	21	1,395		
49	10/1972	139	110	68	317	1,395		
50	11/1972	156	123	76	355	1,395		
51	12/1972	297	236	145	678	1,395		
52	01/1973	746	592	365	1,702	1,395		
53	02/1973	902	715	441	2,058	1,395		
54	03/1973	1,107	878	541	2,526	1,395		

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
55	04/1973	752	597	368	1,717	1,395		
56	05/1973	472	375	231	1,078	1,395		
57	06/1973	331	263	162	756	1,395		
58	07/1973	148	117	72	337	1,395		
59	08/1973	79	63	39	181	1,395		
60	09/1973	60	48	29	137	1,395	75%	36%
61	10/1973	94	41	0	135	1,395	75%	37%
62	11/1973	105	46	0	152	1,395	75%	38%
63	12/1973	202	88	0	290	1,395	75%	39%
64	01/1974	506	222	0	728	1,395	75%	42%
65	02/1974	612	268	0	880	1,395	75%	45%
66	03/1974	751	329	0	1,080	1,395	75%	49%
67	04/1974	510	224	0	734	1,395	75%	53%
68	05/1974	320	140	0	461	1,395	75%	55%
69	06/1974	225	98	0	323	1,395	75%	57%
70	07/1974	100	44	0	144	1,395	75%	59%
71	08/1974	54	24	0	77	1,395	75%	60%
72	09/1974	41	18	0	59	1,395	75%	61%
73	10/1974	81	43	0	124	1,395	75%	61%
74	11/1974	91	48	0	139	1,395	75%	62%
75	12/1974	174	92	0	266	1,395	75%	63%
76	01/1975	436	231	0	667	1,395	75%	64%
77	02/1975	528	279	0	807	1,395	75%	65%
78	03/1975	647	343	0	990	1,395	75%	66%
79	04/1975	440	233	0	673	1,395	75%	67%
80	05/1975	276	146	0	423	1,395	75%	68%
81	06/1975	194	103	0	296	1,395	75%	68%
82	07/1975	86	46	0	132	1,395	75%	69%
83	08/1975	46	25	0	71	1,395	75%	69%
84	09/1975	35	19	0	54	1,395	75%	70%
85	10/1975	47	23	0	70	1,395	75%	70%
86	11/1975	52	25	0	78	1,395	75%	71%
87	12/1975	100	49	0	149	1,395	75%	71%
88	01/1976	252	122	0	374	1,395	75%	72%
89	02/1976	304	148	0	452	1,395	75%	74%
90	03/1976	373	181	0	554	1,395	75%	75%
91	04/1976	254	123	0	377	1,395	75%	**75%**
92	05/1976	159	77	0	237	1,395	75%	**76%**
93	06/1976	112	54	0	166	1,395	75%	**76%**
94	07/1976	50	24	0	74	1,395	75%	**76%**
95	08/1976	27	13	0	40	1,395	75%	**76%**
96	09/1976	20	10	0	30	1,395	75%	**76%**
97	10/1976	40	34	0	74	1,395	75%	**76%**
98	11/1976	45	38	0	82	1,395	75%	**76%**
99	12/1976	85	72	0	157	1,395	75%	**76%**
100	01/1977	214	181	0	395	1,395	75%	**76%**
101	02/1977	258	219	0	478	1,395	75%	**76%**
102	03/1977	317	269	0	586	1,395	75%	**76%**
103	04/1977	215	183	0	398	1,395	75%	**76%**
104	05/1977	135	115	0	250	1,395	75%	**76%**
105	06/1977	95	80	0	175	1,395	75%	**76%**
106	07/1977	42	36	0	78	1,395	75%	**76%**
107	08/1977	23	19	0	42	1,395	75%	**76%**
108	09/1977	17	15	0	32	1,395	75%	**76%**

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
109	10/1977	421	355	383	1,159	1,395	75%	75%
110	11/1977	472	398	429	1,299	1,395	75%	74%
111	12/1977	902	761	820	2,482	1,395	75%	73%
112	01/1978	2,263	1,910	2,057	6,229	1,395	75%	71%
113	02/1978	2,736	2,309	2,487	7,531	1,395	75%	67%
114	03/1978	3,357	2,833	3,052	9,242	1,395	75%	64%
115	04/1978	2,282	1,926	2,074	6,281	1,395	75%	62%
116	05/1978	1,433	1,209	1,302	3,945	1,395	75%	61%
117	06/1978	1,004	848	913	2,765	1,395	75%	60%
118	07/1978	447	378	407	1,232	1,395	75%	59%
119	08/1978	240	203	218	662	1,395	75%	59%
120	09/1978	182	154	165	501	1,395	75%	59%
121	10/1978	370	209	0	579	1,395	75%	59%
122	11/1978	414	234	0	648	1,395	75%	59%
123	12/1978	792	447	0	1,239	1,395	75%	58%
124	01/1979	1,987	1,123	0	3,110	1,395	75%	57%
125	02/1979	2,403	1,357	0	3,760	1,395	75%	56%
126	03/1979	2,948	1,666	0	4,614	1,395	75%	55%
127	04/1979	2,004	1,132	0	3,136	1,395	75%	54%
128	05/1979	1,258	711	0	1,969	1,395	75%	53%
129	06/1979	882	498	0	1,381	1,395	75%	53%
130	07/1979	393	222	0	615	1,395	75%	53%
131	08/1979	211	119	0	330	1,395	75%	53%
132	09/1979	160	90	0	250	1,395	75%	53%
133	10/1979	466	271	0	736	1,395	75%	53%
134	11/1979	522	303	0	825	1,395	75%	52%
135	12/1979	997	579	0	1,576	1,395	75%	52%
136	01/1980	2,501	1,454	0	3,955	1,395	75%	51%
137	02/1980	3,024	1,757	0	4,782	1,395	75%	50%
138	03/1980	3,711	2,157	0	5,868	1,395	75%	48%
139	04/1980	2,522	1,466	0	3,988	1,395	75%	47%
140	05/1980	1,584	921	0	2,505	1,395	75%	47%
141	06/1980	1,110	645	0	1,756	1,395	75%	46%
142	07/1980	495	287	0	782	1,395	75%	46%
143	08/1980	266	154	0	420	1,395	75%	46%
144	09/1980	201	117	0	318	1,395	75%	46%
145	10/1980	217	55	0	272	1,395	75%	46%
146	11/1980	243	62	0	304	1,395	75%	46%
147	12/1980	464	118	0	582	1,395	75%	46%
148	01/1981	1,164	296	0	1,460	1,395	75%	46%
149	02/1981	1,408	357	0	1,765	1,395	75%	45%
150	03/1981	1,727	439	0	2,166	1,395	75%	45%
151	04/1981	1,174	298	0	1,472	1,395	75%	45%
152	05/1981	737	187	0	924	1,395	75%	44%
153	06/1981	517	131	0	648	1,395	75%	44%
154	07/1981	230	58	0	289	1,395	75%	44%
155	08/1981	124	31	0	155	1,395	75%	44%
156	09/1981	94	24	0	117	1,395	75%	44%
157	10/1981	214	95	0	310	1,395	75%	44%
158	11/1981	240	107	0	347	1,395	75%	44%
159	12/1981	459	204	0	663	1,395	75%	44%
160	01/1982	1,152	513	0	1,665	1,395	75%	44%
161	02/1982	1,393	620	0	2,013	1,395	75%	43%
162	03/1982	1,709	761	0	2,470	1,395	75%	43%

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
163	04/1982	1,162	517	0	1,678	1,395	75%	43%
164	05/1982	730	325	0	1,054	1,395	75%	43%
165	06/1982	511	228	0	739	1,395	75%	42%
166	07/1982	228	101	0	329	1,395	75%	42%
167	08/1982	122	54	0	177	1,395	75%	42%
168	09/1982	93	41	0	134	1,395	75%	42%
169	10/1982	527	399	316	1,242	1,395	75%	42%
170	11/1982	590	447	354	1,391	1,395	75%	42%
171	12/1982	1,128	854	676	2,659	1,395	75%	42%
172	01/1983	2,832	2,143	1,697	6,672	1,395	75%	42%
173	02/1983	3,424	2,591	2,052	8,066	1,395	75%	42%
174	03/1983	4,201	3,179	2,518	9,899	1,395	75%	42%
175	04/1983	2,855	2,161	1,711	6,728	1,395	75%	42%
176	05/1983	1,793	1,357	1,075	4,225	1,395	75%	42%
177	06/1983	1,257	951	753	2,962	1,395	75%	42%
178	07/1983	560	424	336	1,319	1,395	75%	42%
179	08/1983	301	228	180	709	1,395	75%	42%
180	09/1983	228	172	137	537	1,395	75%	42%
181	10/1983	156	62	0	217	1,395	75%	42%
182	11/1983	175	69	0	244	1,395	75%	42%
183	12/1983	334	132	0	466	1,395	75%	42%
184	01/1984	838	331	0	1,168	1,395	75%	42%
185	02/1984	1,013	400	0	1,413	1,395	75%	43%
186	03/1984	1,243	491	0	1,733	1,395	75%	44%
187	04/1984	845	333	0	1,178	1,395	75%	44%
188	05/1984	530	209	0	740	1,395	75%	44%
189	06/1984	372	147	0	519	1,395	75%	44%
190	07/1984	166	65	0	231	1,395	75%	45%
191	08/1984	89	35	0	124	1,395	75%	45%
192	09/1984	67	27	0	94	1,395	75%	45%
193	10/1984	199	59	0	257	1,395	75%	45%
194	11/1984	223	66	0	288	1,395	75%	45%
195	12/1984	426	125	0	551	1,395	75%	45%
196	01/1985	1,068	315	0	1,383	1,395	75%	46%
197	02/1985	1,291	381	0	1,672	1,395	75%	47%
198	03/1985	1,585	467	0	2,052	1,395	75%	48%
199	04/1985	1,077	317	0	1,394	1,395	75%	48%
200	05/1985	676	199	0	876	1,395	75%	49%
201	06/1985	474	140	0	614	1,395	75%	49%
202	07/1985	211	62	0	273	1,395	75%	49%
203	08/1985	113	33	0	147	1,395	75%	49%
204	09/1985	86	25	0	111	1,395	75%	49%
205	10/1985	272	116	0	389	1,395	75%	49%
206	11/1985	305	130	0	436	1,395	75%	49%
207	12/1985	583	249	0	832	1,395	75%	49%
208	01/1986	1,463	625	0	2,089	1,395	75%	49%
209	02/1986	1,769	756	0	2,525	1,395	75%	49%
210	03/1986	2,171	928	0	3,099	1,395	75%	49%
211	04/1986	1,476	631	0	2,106	1,395	75%	48%
212	05/1986	927	396	0	1,323	1,395	75%	48%
213	06/1986	650	278	0	927	1,395	75%	48%
214	07/1986	289	124	0	413	1,395	75%	48%
215	08/1986	155	66	0	222	1,395	75%	48%
216	09/1986	118	50	0	168	1,395	75%	48%

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
217	10/1986	109	8	0	118	1,395	75%	48%
218	11/1986	123	9	0	132	1,395	75%	48%
219	12/1986	234	17	0	252	1,395	75%	48%
220	01/1987	588	44	0	632	1,395	75%	49%
221	02/1987	711	53	0	764	1,395	75%	49%
222	03/1987	873	65	0	937	1,395	75%	49%
223	04/1987	593	44	0	637	1,395	75%	50%
224	05/1987	373	28	0	400	1,395	75%	50%
225	06/1987	261	19	0	280	1,395	75%	50%
226	07/1987	116	9	0	125	1,395	75%	50%
227	08/1987	62	5	0	67	1,395	75%	50%
228	09/1987	47	4	0	51	1,395	75%	50%
229	10/1987	258	78	0	337	1,395	75%	50%
230	11/1987	289	88	0	377	1,395	75%	51%
231	12/1987	553	168	0	721	1,395	75%	51%
232	01/1988	1,388	422	0	1,810	1,395	75%	53%
233	02/1988	1,678	510	0	2,188	1,395	75%	55%
234	03/1988	2,060	626	0	2,685	1,395	75%	58%
235	04/1988	1,400	425	0	1,825	1,395	75%	60%
236	05/1988	879	267	0	1,146	1,395	75%	61%
237	06/1988	616	187	0	803	1,395	75%	62%
238	07/1988	274	83	0	358	1,395	75%	63%
239	08/1988	147	45	0	192	1,395	75%	63%
240	09/1988	112	34	0	146	1,395	75%	63%
241	10/1988	58	23	0	80	1,395	75%	63%
242	11/1988	64	25	0	90	1,395	75%	63%
243	12/1988	123	49	0	172	1,395	75%	63%
244	01/1989	309	122	0	431	1,395	75%	64%
245	02/1989	374	147	0	521	1,395	75%	64%
246	03/1989	459	181	0	640	1,395	75%	65%
247	04/1989	312	123	0	435	1,395	75%	65%
248	05/1989	196	77	0	273	1,395	75%	65%
249	06/1989	137	54	0	191	1,395	75%	65%
250	07/1989	61	24	0	85	1,395	75%	65%
251	08/1989	33	13	0	46	1,395	75%	65%
252	09/1989	25	10	0	35	1,395	75%	65%
253	10/1989	30	30	0	60	1,395	75%	66%
254	11/1989	34	33	0	67	1,395	75%	66%
255	12/1989	65	63	0	129	1,395	75%	66%
256	01/1990	163	159	0	323	1,395	75%	66%
257	02/1990	197	193	0	390	1,395	75%	67%
258	03/1990	242	236	0	479	1,395	75%	68%
259	04/1990	165	161	0	325	1,395	75%	69%
260	05/1990	103	101	0	204	1,395	75%	69%
261	06/1990	72	71	0	143	1,395	75%	69%
262	07/1990	32	32	0	64	1,395	75%	69%
263	08/1990	17	17	0	34	1,395	75%	69%
264	09/1990	13	13	0	26	1,395	75%	69%
265	10/1990	172	68	74	315	1,395	75%	70%
266	11/1990	193	77	83	353	1,395	75%	70%
267	12/1990	368	146	159	674	1,395	75%	70%
268	01/1991	924	368	399	1,691	1,395	75%	70%
269	02/1991	1,118	444	482	2,044	1,395	75%	70%
270	03/1991	1,372	545	592	2,509	1,395	75%	71%

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
271	04/1991	932	371	402	1,705	1,395	75%	71%
272	05/1991	585	233	253	1,071	1,395	75%	71%
273	06/1991	410	163	177	751	1,395	75%	71%
274	07/1991	183	73	79	334	1,395	75%	71%
275	08/1991	98	39	42	180	1,395	75%	71%
276	09/1991	74	30	32	136	1,395	75%	71%
277	10/1991	232	224	277	733	1,395	75%	71%
278	11/1991	259	251	310	821	1,395	75%	70%
279	12/1991	496	480	593	1,569	1,395	75%	70%
280	01/1992	1,244	1,205	1,487	3,936	1,395	75%	68%
281	02/1992	1,504	1,456	1,798	4,759	1,395	75%	66%
282	03/1992	1,846	1,787	2,207	5,840	1,395	75%	63%
283	04/1992	1,254	1,215	1,500	3,969	1,395	75%	62%
284	05/1992	788	763	942	2,493	1,395	75%	61%
285	06/1992	552	535	660	1,747	1,395	75%	60%
286	07/1992	246	238	294	778	1,395	75%	60%
287	08/1992	132	128	158	418	1,395	75%	60%
288	09/1992	100	97	120	317	1,395	75%	60%
289	10/1992	392	295	587	1,274	1,395	75%	59%
290	11/1992	439	331	657	1,428	1,395	75%	59%
291	12/1992	840	632	1,257	2,728	1,395	75%	58%
292	01/1993	2,107	1,586	3,153	6,846	1,395	75%	56%
293	02/1993	2,547	1,917	3,812	8,277	1,395	75%	54%
294	03/1993	3,126	2,353	4,678	10,157	1,395	75%	51%
295	04/1993	2,125	1,599	3,180	6,903	1,395	75%	50%
296	05/1993	1,334	1,004	1,997	4,335	1,395	75%	49%
297	06/1993	935	704	1,400	3,039	1,395	75%	48%
298	07/1993	417	314	624	1,354	1,395	75%	48%
299	08/1993	224	168	335	727	1,395	75%	48%
300	09/1993	170	128	254	551	1,395	75%	48%
301	10/1993	180	55	123	359	1,395	75%	48%
302	11/1993	202	61	138	402	1,395	75%	47%
303	12/1993	386	117	264	768	1,395	75%	47%
304	01/1994	970	294	662	1,926	1,395	75%	47%
305	02/1994	1,172	356	801	2,329	1,395	75%	46%
306	03/1994	1,439	437	983	2,858	1,395	75%	46%
307	04/1994	978	297	668	1,943	1,395	75%	46%
308	05/1994	614	186	419	1,220	1,395	75%	45%
309	06/1994	430	131	294	855	1,395	75%	45%
310	07/1994	192	58	131	381	1,395	75%	45%
311	08/1994	103	31	70	205	1,395	75%	45%
312	09/1994	78	24	53	155	1,395	75%	45%
313	10/1994	526	244	544	1,315	1,395	75%	45%
314	11/1994	590	274	610	1,473	1,395	75%	44%
315	12/1994	1,127	523	1,166	2,815	1,395	75%	44%
316	01/1995	2,827	1,312	2,925	7,064	1,395	75%	42%
317	02/1995	3,418	1,586	3,537	8,541	1,395	75%	41%
318	03/1995	4,195	1,946	4,340	10,481	1,395	75%	39%
319	04/1995	2,851	1,323	2,950	7,124	1,395	75%	38%
320	05/1995	1,790	831	1,853	4,474	1,395	75%	37%
321	06/1995	1,255	582	1,299	3,136	1,395	75%	36%
322	07/1995	559	259	578	1,397	1,395	75%	36%
323	08/1995	300	139	311	750	1,395	75%	36%
324	09/1995	227	106	235	568	1,395	75%	36%

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
325	10/1995	123	79	232	434	1,395	75%	36%
326	11/1995	138	88	260	486	1,395	75%	36%
327	12/1995	264	168	497	929	1,395	75%	36%
328	01/1996	662	423	1,246	2,331	1,395	75%	36%
329	02/1996	801	511	1,506	2,818	1,395	75%	36%
330	03/1996	983	627	1,849	3,459	1,395	75%	35%
331	04/1996	668	426	1,256	2,351	1,395	75%	35%
332	05/1996	419	268	789	1,476	1,395	75%	35%
333	06/1996	294	188	553	1,035	1,395	75%	35%
334	07/1996	131	84	246	461	1,395	75%	35%
335	08/1996	70	45	132	248	1,395	75%	35%
336	09/1996	53	34	100	188	1,395	75%	35%
337	10/1996	0	0	266	266	1,395	75%	35%
338	11/1996	163	217	78	458	1,395	75%	35%
339	12/1996	923	1,038	682	2,643	1,395	75%	35%
340	01/1997	1,780	1,979	3,069	6,827	1,395	75%	35%
341	02/1997	1,360	507	743	2,611	1,395	75%	35%
342	03/1997	352	0	963	1,315	1,395	75%	36%
343	04/1997	236	0	647	883	1,395	75%	36%
344	05/1997	299	0	0	299	1,395	75%	37%
345	06/1997	166	0	173	339	1,395	75%	37%
346	07/1997	45	0	329	375	1,395	75%	37%
347	08/1997	10	0	199	208	1,395	75%	37%
348	09/1997	156	1	0	156	1,395	75%	37%
349	10/1997	205	0	0	205	1,395	75%	37%
350	11/1997	188	233	100	521	1,395	75%	37%
351	12/1997	655	563	402	1,620	1,395	75%	37%
352	01/1998	632	374	75	1,082	1,395	75%	38%
353	02/1998	2,603	2,563	4,887	10,053	1,395	75%	38%
354	03/1998	4,393	3,465	1,819	9,677	1,395	75%	38%
355	04/1998	3,364	2,089	0	5,453	1,395	75%	38%
356	05/1998	879	1,661	1,020	3,560	1,395	75%	39%
357	06/1998	2,278	1,992	1,205	5,475	1,395	75%	38%
358	07/1998	102	465	2,020	2,587	1,395	75%	38%
359	08/1998	0	34	882	916	1,395	75%	38%
360	09/1998	444	0	66	510	1,395	75%	38%
361	10/1998	767	0	0	767	1,395	75%	38%
362	11/1998	534	29	346	909	1,395	75%	38%
363	12/1998	800	36	0	836	1,395	75%	38%
364	01/1999	705	179	121	1,005	1,395	75%	38%
365	02/1999	935	134	13	1,082	1,395	75%	38%
366	03/1999	806	0	73	878	1,395	75%	39%
367	04/1999	190	0	1,964	2,154	1,395	75%	38%
368	05/1999	143	36	761	940	1,395	75%	39%
369	06/1999	115	38	469	622	1,395	75%	39%
370	07/1999	13	0	442	455	1,395	75%	39%
371	08/1999	0	0	199	199	1,395	75%	39%
372	09/1999	0	0	3	3	1,395	75%	39%
373	10/1999	10	0	0	10	1,395	75%	39%
374	11/1999	5	0	0	5	1,395	75%	39%
375	12/1999	8	0	0	8	1,395	75%	40%
376	01/2000	10	51	15	76	1,395	75%	41%
377	02/2000	1,405	1,038	851	3,294	1,395	75%	42%
378	03/2000	1,259	606	1,272	3,137	1,395	75%	44%

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
379	04/2000	660	192	720	1,572	1,395	75%	45%
380	05/2000	321	0	115	436	1,395	75%	46%
381	06/2000	250	0	0	250	1,395	75%	47%
382	07/2000	137	0	0	137	1,395	75%	47%
383	08/2000	126	0	0	126	1,395	75%	47%
384	09/2000	0	0	0	0	1,395	75%	47%
385	10/2000	0	57	0	57	1,395	75%	47%
386	11/2000	0	81	0	81	1,395	75%	48%
387	12/2000	112	0	0	112	1,395	75%	48%
388	01/2001	583	459	92	1,134	1,395	75%	48%
389	02/2001	1,361	799	463	2,623	1,395	75%	48%
390	03/2001	2,825	938	368	4,132	1,395	75%	48%
391	04/2001	1,471	148	36	1,654	1,395	75%	48%
392	05/2001	193	0	137	330	1,395	75%	48%
393	06/2001	0	0	465	465	1,395	75%	49%
394	07/2001	0	0	150	150	1,395	75%	49%
395	08/2001	0	0	100	100	1,395	75%	49%
396	09/2001	0	0	69	69	1,395	75%	49%
397	10/2001	49	175	57	280	1,395	75%	49%
398	11/2001	128	53	0	181	1,395	75%	49%
399	12/2001	107	60	10	177	1,395	75%	50%
400	01/2002	124	143	45	312	1,395	75%	52%
401	02/2002	78	46	1	125	1,395	75%	52%
402	03/2002	76	0	0	76	1,395	75%	53%
403	04/2002	75	0	0	75	1,395	75%	53%
404	05/2002	40	18	0	58	1,395	75%	53%
405	06/2002	74	0	0	74	1,395	75%	53%
406	07/2002	0	0	0	0	1,395	75%	53%
407	08/2002	0	0	0	0	1,395	75%	53%
408	09/2002	0	0	0	0	1,395	75%	53%
409	10/2002	0	4	0	4	1,395	75%	54%
410	11/2002	15	520	74	608	1,395	75%	54%
411	12/2002	193	208	52	453	1,395	75%	54%
412	01/2003	111	0	0	111	1,395	75%	54%
413	02/2003	1,131	435	193	1,759	1,395	75%	57%
414	03/2003	1,187	606	49	1,842	1,395	75%	61%
415	04/2003	412	143	51	606	1,395	75%	63%
416	05/2003	1,830	381	1,551	3,762	1,395	75%	63%
417	06/2003	330	0	0	330	1,395	75%	65%
418	07/2003	67	0	0	67	1,395	75%	67%
419	08/2003	0	0	108	108	1,395	75%	67%
420	09/2003	0	0	57	57	1,395	75%	67%
421	10/2003	13	0	0	13	1,395	75%	68%
422	11/2003	81	261	0	341	1,395	75%	68%
423	12/2003	306	98	11	415	1,395	75%	68%
424	01/2004	159	13	0	172	1,395	75%	69%
425	02/2004	862	520	283	1,666	1,395	75%	68%
426	03/2004	1,892	164	0	2,055	1,395	75%	68%
427	04/2004	137	61	0	198	1,395	75%	69%
428	05/2004	109	0	0	109	1,395	75%	69%
429	06/2004	35	0	0	35	1,395	75%	70%
430	07/2004	2	6	0	8	1,395	75%	70%
431	08/2004	0	1	0	1	1,395	75%	70%
432	09/2004	0	0	0	0	1,395	75%	70%

Table A.11
RWC calculation at RTWF using HSG, PSG, and TSG as diluent sources (Phase II Option B)

Month #	Month / Year	Diluent Water (AF)				Recycled Water (AF)	RWC Limit	RWC
		HSG	PSG	TSG	Total			
433	10/2004	1,170	415	605	2,190	1,395	75%	69%
434	11/2004	694	10	0	704	1,395	75%	68%
435	12/2004	1,360	574	557	2,490	1,395	75%	67%
436	01/2005	3,218	2,706	4,196	10,120	1,395	75%	62%
437	02/2005	2,216	1,700	1,072	4,989	1,395	75%	61%
438	03/2005	3,145	3,257	4,263	10,665	1,395	75%	58%
439	04/2005	3,117	607	4,151	7,875	1,395	75%	56%
440	05/2005	1,410	973	3,615	5,999	1,395	75%	54%
441	06/2005	6	533	4,597	5,137	1,395	75%	52%
442	07/2005	767	511	505	1,784	1,395	75%	51%
443	08/2005	940	0	0	940	1,395	75%	51%
444	09/2005	593	0	0	593	1,395	75%	51%
445	10/2005	694	146	33	873	1,395	75%	51%
446	11/2005	940	0	4	945	1,395	75%	50%
447	12/2005	549	86	524	1,160	1,395	75%	50%
448	01/2006	1,617	550	713	2,881	1,395	75%	50%
449	02/2006	304	305	1,852	2,462	1,395	75%	50%
450	03/2006	1,802	1,006	4,285	7,093	1,395	75%	49%
451	04/2006	2,474	1,810	4,106	8,390	1,395	75%	47%
452	05/2006	1,298	863	487	2,648	1,395	75%	46%
453	06/2006	707	0	0	707	1,395	75%	46%
454	07/2006	465	0	0	465	1,395	75%	46%
455	08/2006	439	0	0	439	1,395	75%	46%
456	09/2006	373	0	0	373	1,395	75%	46%
457	10/2006	144	0	54	197	1,395	75%	46%
458	11/2006	0	0	225	225	1,395	75%	46%
459	12/2006	265	5	51	322	1,395	75%	46%
460	01/2007	418	25	1	445	1,395	75%	46%
461	02/2007	425	126	40	591	1,395	75%	46%
462	03/2007	599	0	0	599	1,395	75%	46%
463	04/2007	364	43	0	407	1,395	75%	46%
464	05/2007	398	0	0	398	1,395	75%	46%
465	06/2007	298	0	0	298	1,395	75%	46%
466	07/2007	271	0	0	271	1,395	75%	45%
467	08/2007	42	0	11	53	1,395	75%	45%
468	09/2007	0	83	32	115	1,395	75%	45%
469	10/2007	19	0	132	151	1,395	75%	45%
470	11/2007	250	34	133	417	1,395	75%	45%
471	12/2007	296	182	194	673	1,395	75%	45%
472	01/2008	2,116	1,233	1,953	5,301	1,395	75%	44%
473	02/2008	1,489	1,363	1,075	3,926	1,395	75%	44%
474	03/2008	559	1	835	1,394	1,395	75%	44%
475	04/2008	410	360	16	785	1,395	75%	44%
476	05/2008	498	89	0	587	1,395	75%	44%
477	06/2008	250	0	297	547	1,395	75%	44%
478	07/2008	0	0	316	316	1,395	75%	44%
479	08/2008	0	0	269	269	1,395	75%	44%
480	09/2008	0	0	241	241	1,395	75%	44%

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Appendix B
Arsenic Geochemistry

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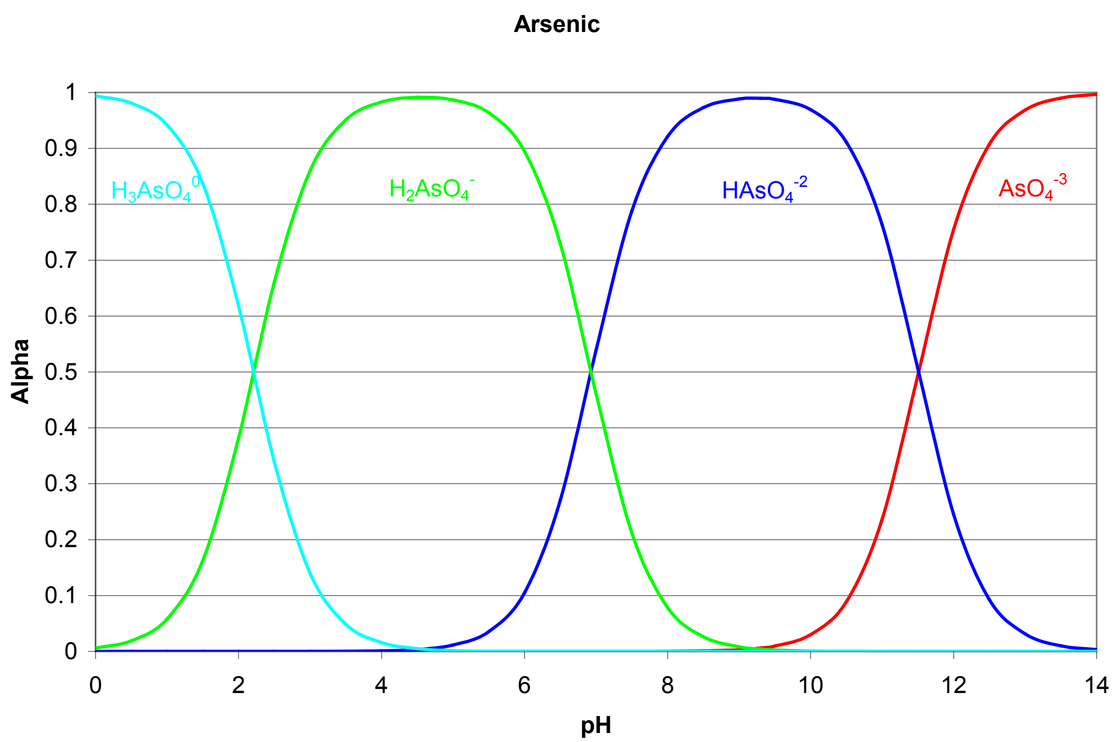
Appendix B - Arsenic Geochemistry

B.1 Arsenic Aqueous Speciation

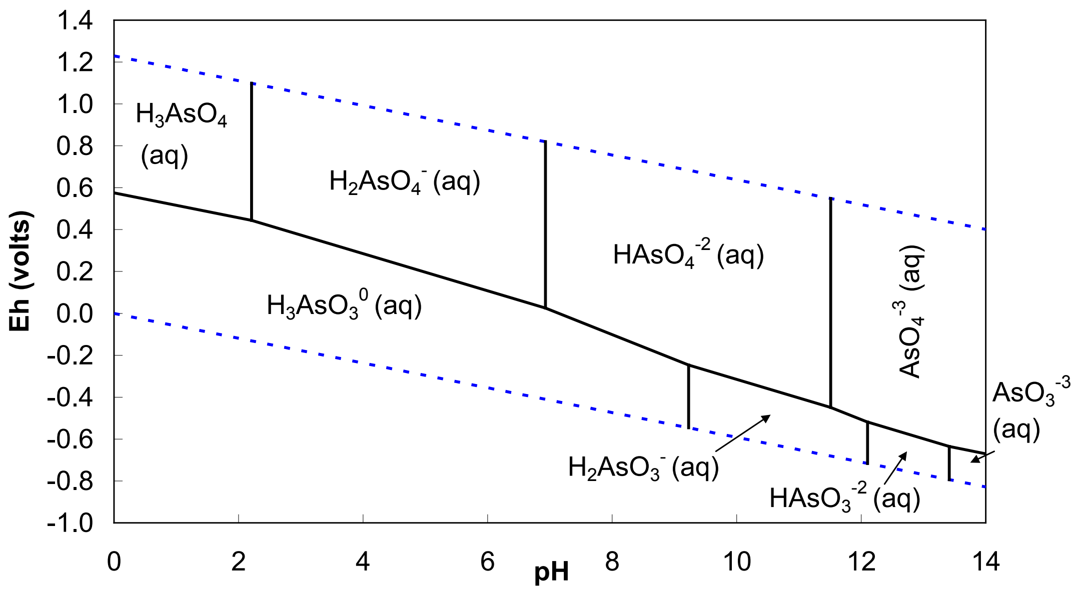
Arsenic occurs in two oxidation states in natural waters, +3 (arsenite) and +5 (arsenate). As(+5) exists predominantly as a negatively charged ion (anion) above a pH of about 2. As(+5) is predominantly monovalent (charge of -1) over the pH range of 2 to 7 (H_2AsO_4), divalent from pH 7 to 11.5 ($HAsO_4^{2-}$) and trivalent at pH values above 11.5 (AsO_4^{3-}), as shown in **Figure B-1**.

Figure B-1: – Arsenate Speciation as a Function of pH (alpha is the fraction of the total dissolved arsenate consisting of the given species).



The aqueous arsenate and arsenite species distribution with Eh and pH are shown in **Figure B-2** **(**Parkhurst 1999).

Figure B-2: Eh-pH Diagram for the System As-O-H at 25º C and 1 atm.



As (+3) is predominantly a neutral species ($H_3AsO_3^0$) below a pH of about 9. $H_2AsO_3^-$ and $HAsO_3^{-2}$ do not become important until the pH exceeds 9 su, which is higher than observed in the vast majority of natural waters.

B.2 Arsenic Pure Solid Phase Minerals

Pure phase arsenic minerals such as orpiment (As_2S_3), realgar (AsS), and arsenopyrite (FeAsS) occur mainly in ore deposits formed from hydrothermal fluids within the Earth's crust. A few pure phase arsenic minerals occur under low temperature and low pressure conditions at the Earth's surface, such as scorodite ($FeAsO_4 \cdot 2H_2O$ at low pH), and arsenic sulfides (under reducing conditions). However, the vast majority of pure phase arsenic minerals are too soluble to be present in soils that are in contact with water.

B.3 Arsenic Solid-Solution Phases

Arsenic forms solid-solution phases with ferric hydroxide and iron hydroxysulfates such as jarosite ($HFe_3(OH)_6(SO_4)_2$) and schwertmannite ($Fe_8O_8(OH)_6SO_4$) and with amorphous silica. Arsenate, like silicate, has a tetrahedral form (a central atom coordinated with four oxygen atoms) which may facilitate the incorporation of arsenate into amorphous silica.

Amorphous phases such as ferric hydroxide or schwertmanite tend to substitute hydroxide or sulfate for arsenate. A reaction to form an iron-arsenic solid-solution is as follows:

$$Fe^{+3} + xAsO_4^{-3} + (3-3x)\ OH^- \rightarrow [FeAsO_4\ 2H_2O]_x[Fe(OH)_3]_{1-x}$$

The amount of substitution of arsenic into ferric hydroxide is determined by the pH of the solution (more arsenic substitution occurs at lower pH values) and the concentration of arsenic in solution (higher arsenic concentrations result in more substitution).

B.4 Arsenic Adsorption

Arsenic adsorbs to solid surfaces due partly to interactions between the negatively charged ions and a positively charged surface. Therefore, arsenic adsorption tends to be favored for solid materials which are positively charged. The surface charge of the material depends on the type of solid, the pH of the water, and the concentration of other anions in solution.

At low pH values, the water and mineral surfaces have higher concentrations of hydronium ion (H_3O^+) which imparts a positive charge to the surface. As the pH increases, the hydronium ion concentration decreases relative to the hydroxide ion (OH^-) concentration in both the water and the solid materials within the water. At a specific threshold pH value called the pH of the zero-point-of-charge (pH_{ZPC}), the surface charge transitions from positive to neutral to negative. Once the surface charge becomes negative, adsorption of the negatively charged arsenate ions become less prevalent. The pH_{ZPC} is different for different materials, as shown in **Table B-1.**

Table B-1: pH of the Zero-Point-of-Charge (pH_{ZPC}) for Various Minerals[1]

Material	Formula	pH_{ZPC}
Magnetite	Fe_3O_4	6.5
Goethite	FeOOH	7.8
Hematite	Fe_2O_3	6.7
Amorphous Ferric hydroxide	$Fe(OH)_3$	8.5
Aluminum Hydroxide	γ-AlOOH	8.2
Aluminum Hydroxide	Ά-$Al(OH)_3$	5.0
Amorphous Silica	SiO_2	2.0
Manganese Dioxide	δ-MnO_2	2.8
Montmorillonite Clay	$Na_{0.2}Ca_{0.1}Al_2Si_4O_{10}(OH)_2 \bullet 10\ H_2O$	2.5
Kaolinite Clay	$Al_2Si_2O_5(OH)_4$	4.6

1. Data from Stumm and Morgan (1981)

The materials with a higher pH_{ZPC} are able to maintain a positive charge at a higher pH than for materials with a lower pH_{ZPC}. Of the materials listed in Table 1, amorphous ferric hydroxide is the best anion adsorbent at higher pH values (below 8.5).

Under typical Eh/pH conditions, As(+3) is a neutral ion and does not adsorb well to negatively or positively charged surfaces. Therefore, As(+3) is roughly 4-10 times more mobile than As(+5) (Duel and Swoboda, 1972). In addition, As(+3) is about 60 times more toxic to humans than arsenate (Hounslow, 1980).

Arsenic has a strong affinity for iron phases and minerals. Strong correlations between arsenic and iron have been found in soils (Woolson et al., 1971; Duel and Swoboda 1972); in ores (Shnyukov, 1963); within ferrihydrite impurities in phosphate pebbles (Stow, 1969); and in sediments impacted by arsenic-containing groundwaters (Whiting, 1992).

The solid material properties not only control the degree to which arsenic is adsorbed at a given pH, but also the amount of arsenic that can be adsorbed before the surface of the solid becomes saturated. The process is described mathematically by the Langmuir Isotherm, which is as follows:

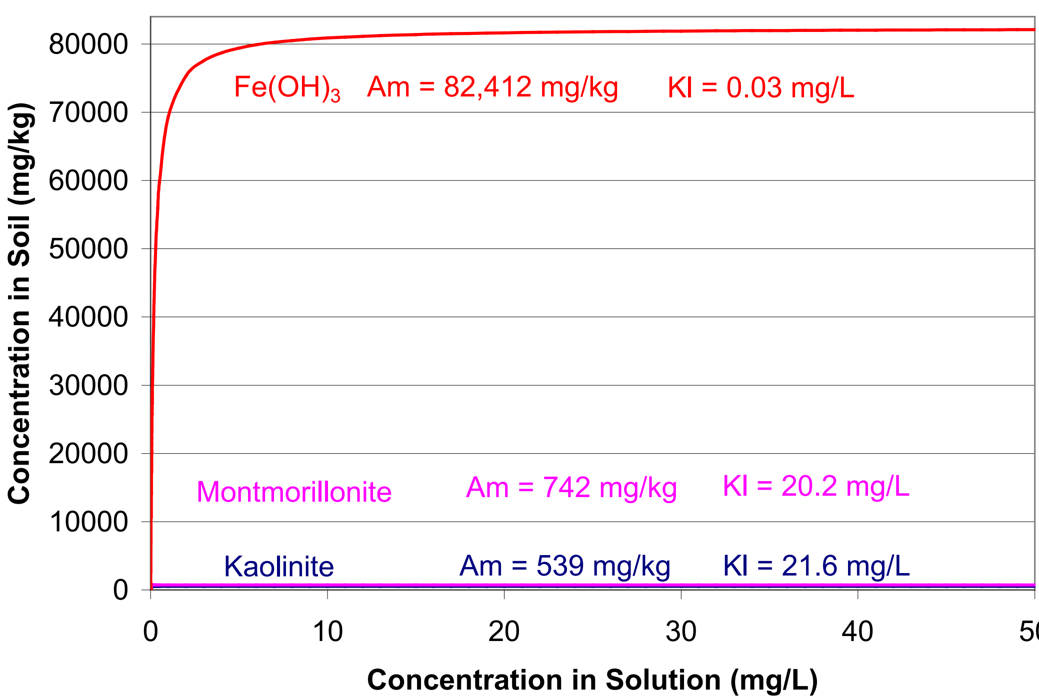
$$C(solid) = K_l*A_m*C(soln)/(1+K_l*C(soln))$$

Where,

C(solid)=		concentration of arsenic adsorbed to the solid phase (mg/kg)
C(soln)	=	concentration of arsenic dissolved in the solution phase (mg/L)
A_m	=	maximum adsorption capacity of the solid (mg/kg)
K_l	=	Langmuir adsorption constant

Examples of Langmuir Adsorption Isotherms for three different solid materials are illustrated in **Figure B-3**.

Figure B-3: Langmuir Isotherms Illustrating Arsenate Adsorption Capacities of $Fe(OH)_3(s)$, Kaolinite, And Montmorillonite at a pH of 5 SU



Note: *Langmuir Adsorption Constants (Kl and Am) are from Pierce and Moore (1982) for $Fe(OH)_3(s)$ and Frost and Griffin (1977) for Kaolinite and Montmorillonite.*

The adsorption of arsenate as illustrated in Figure 3 can be understood by imagining a "clean" soil or sediment which is subjected to waters with increasing arsenate concentrations (such as a with the expansion of an arsenate-bearing groundwater plume). As concentrations in the arsenate solution increase, increasingly greater amounts of arsenate can be "forced" onto the solid surface. This process is seen in Figure 3 as the steep part of the curve. As the arsenate concentrations on the soil continue to increase, a point is eventually reached where the solid surfaces are completely saturated with arsenate and there is no more capacity for additional arsenate adsorption. No matter how high the dissolved arsenate concentrations become, the solid arsenate concentration remains constant. The flat part of the curve describes the saturation point of the solid. The Langmuir Am constant is the adsorption capacity and determines the level of the flat portion of the curve, while the Kl constant determines the rate at which Am is reached (the steepness of the initial segment of the curve).

Figure B-3 shows that at pH 5, iron hydroxide has a much higher arsenate adsorption capacity than montmorillonite or kaolinite clays. Theoretically, a sample of ferric hydroxide could be analyzed, and the concentration of arsenic could be compared to Am. If the analytical result of the solid is significantly higher than Am, then arsenate is likely controlled by coprecipitation rather than adsorption. However, in practice, soils and sediments are rarely composed of a single phase, but are instead heterogeneous mixtures of different minerals with varying amounts of iron hydroxide present. However, the affinity of arsenate for iron minerals such as iron hydroxide can be used to evaluate the fate and transport of arsenate when exposed to soils of varying iron contents.

pH also has a significant effect on the adsorption capacity of arsenic, as shown in **Table B-2.**

Table B-2: Adsorption Capacity of Arsenate and Arsenite vs. pH

	Arsenate Adsorption Capacity (mg/kg)		Arsenite Adsorption Capacity (mg/kg)
PH	$Fe(OH)_3$ (s)[1]	$Al(OH)_3$ (s)[2]	$Fe(OH)_3$ (s)[1]
5	82,412	119,872	34,688
6	63,682	110,732	37,685
7	34,014	88,331	38,434
8	16,932	62,783	36,561
9	10,189	37,535	31,242

1. Pierce and Moore (1982)
2. Anderson et al. (1976)

The pH dependence is due to the speciation of arsenic and the surface charge of the solid at different pH values. Arsenate is a negatively charged ion (anion) at pH values greater than about 2 (Figure 1), while the aluminum and iron hydroxides tend to be positively charged. However, as the pH increases, the surfaces of the solids become less positive and the arsenate species become increasingly negative resulting in fewer adsorption sites. Arsenite, being a neutral species below pH 9 (Figure B-2), is relatively insensitive to changes in pH.

B.5 Adsorption Kinetics

The kinetics of arsenic adsorption onto iron oxyhydroxides has been found to be generally very rapid. Luengo et al., (2007) found that arsenic adsorption onto granular ferric hydroxide (GFH) occurs in two stages, the first of which occurs in less than 5 minutes and the second over the course of several hours or more. The second, slower stage was thought to be controlled by diffusion of the water into the small pore spaces of the media.

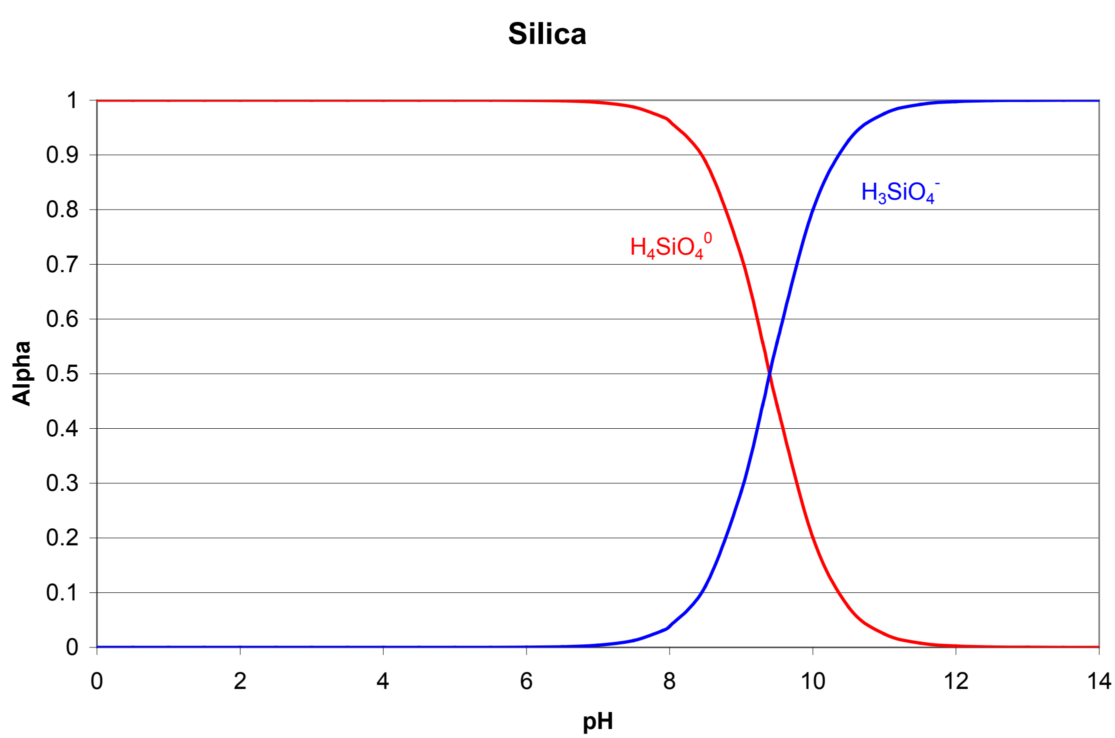
B.6 Competing Elements

The following paragraphs discuss various constituents that will compete with arsenic for the adsorption sites on a solid media.

Silica

Silica competes with arsenic for adsorption sites, and can affect both the effectiveness and the adsorption capacity of adsorption media such as E33. As the pH of the solution increases (above about 8.5 su), not only does the surface charge of the media become negative, which tends to repel negatively charged arsenic oxyanions, but the dissolved silica species go from neutral species to predominantly charged anions, which compete with arsenic for specific adsorption sites (see **Figure B-4**).

Figure B-4: Silica Speciation As A Function of pH
(alpha is the fraction of the total dissolved silica consisting of the given species).



Gustafssona and Bhattacharyaa (2007) found that silica concentrations of 0.14 mg/L had only a minor effect on the adsorption of arsenic, while concentrations of 14 mg/L silica had a very significant effect. Based on their calibrated modeling results, adsorption of arsenate onto ferrihydrite in the presence of 0.14 mg/L silica (as Si) was predicted to have a partition coefficient (Kd) of 20,000 (mol/L adsorbed As / mol/L dissolved As). However, in the presence of only 14 mg/L silica, the Kd decreased by three orders of magnitude to just 20.

Highfield (2002) found that the arsenic adsorption capacity was significantly decreased by the presence of silica as well. A capacity of 1 mg As/g GFH (1000 mg/kg) was obtained for a pH 7 water spiked with 28 mg/L Si, compared to a baseline capacity of 15 mg As/g GFH (15,000 mg/kg). Möller and Sylvestera (2007) found that the presence of dissolved silica results in increased competition and a decease in the adsorption capacity of the media as the pH is increased (as predicted by Figure 4). In the presence of 31 mg/L silica, the capacity of the iron oxide-based media tested was decreased 71.8% when the pH was increased from 7 to 9 su.

Phosphate

Phosphate competes with arsenate for adsorption sites resulting in less arsenate adsorption and greater mobility. Gustafsson and Bhattacharya (2007) reviewed spectroscopic data (EXAFS/XANES) conducted by a number of investigators which showed that arsenate and arsenite both form strong inner sphere complexes with the surface of a metal oxide. An inner sphere complex is one in which the oxygen atoms of the arsenate or arsenite ion are shared with the oxygen atoms associated with the metal oxide surface (forming a covalent bond). Phosphate ion was found to be adsorbed in a similar fashion, which helps to explain why competition between arsenic and phosphorous is prevalent over the entire pH range. Modeling results showed that at pH = 8 su, and a phosphate concentration of 0.03 mg/L the As Kd was 15,800 (dimensionless), but when the phosphate was increased by two orders of magnitude (3 mg/L), the Kd decreased to 630. Stachowicz et al., (2007) found that competition between arsenate and phosphate was significant and of much greater magnitude than for other anions such as carbonate/bicarbonate.

Dissolved Organic Matter

Bauer and Blodau (2006) found that up to 53.3% of the arsenic adsorbed onto iron oxide could be desorbed by a 25-50 mg/L solution of dissolved organic matter (DOM) derived from peat. The authors determined that the leaching effect was due mainly to competition between DOM and arsenic, as iron and arsenic reduction was minor under the conditions of the experiment. Gustafsson and Bhattacharya (2007) found that DOM is a particularly important competing ion when the surface of the iron oxide is coated with humic substances. The anionic nature of DOM and the affinity of the carboxylic and phenolic function group of the DOM for the oxide surface help to explain the adsorption of DOM onto iron oxyhydroxides.

Carbonate/Bicarbonate

In the absence of phosphate and at high CO_2 partial pressures, carbonate/bicarbonate competition with arsenic can be significant. Gustafsson and Bhattacharya (2007) found that at near-neutral pH, and CO_2 partial pressures ranging up to 1.8×10^{-2} atm (50 times the atmospheric value), competition between carbonate species and arsenic is very similar to the effect of 14 mg/L Si (a decrease in the Kd of three orders of magnitude).

Other Ions

Other ions such as chloride, sulfate, and nitrate have little or no effect on arsenic adsorption, while the effect of selenium, molybdenum, and vanadium is minor (Youngran et al., 2007).

Summary of Ions that Compete With Arsenic

A summary of the importance of each species as a competitor with arsenic for adsorption sites on iron oxyhydroxide media is presented in **Table B-4**.

Table B- 4: Summary of Ions Which Compete with Arsenic for Adsorption Sites on Oxide Surfaces

Competing Species	Importance
Phosphate (HPO_4^{-2}, $H_2PO_4^{-1}$), Silicate ($H_4SiO_4^0$, $H_3SiO_4^{-1}$), Carbonate (CO_3^{-2}, HCO_3^{-1})	Significant
Dissolved Organic Matter (DOM), Vanadate (VO_4^{-3}, HVO_4^{-2}, $H_2VO_4^{-1}$), Molybdenate (MoO_4^{-2}, $HMoO_4^{-1}$) and selenite (SeO_3^{-2}, and $HSeO_3^{-1}$)	Moderate
Sulfate (SO_4^{-2}), Chloride (Cl^{-1}), and Nitrate (NO_3^{-2}) Selenate (SeO_4^{-3}, $HSeO_4^{-2}$, $H_2SeO_4^{-1}$)	Minor

The qualification of each species as "significant", "moderate", or "minor" is obviously subjective and is influenced by the amount of the species present. For example, competition between arsenic and vanadium is moderate at best unless the water under consideration happens to have high concentrations of vanadium, in which case the importance could become significant.

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Appendix K

Conveyance System Alternative Alignments to Pacoima Spreading Grounds Evaluation TM

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Technical Memorandum

Title: Conveyance System Alternative Alignments to Pacoima Spreading Grounds Evaluation TM

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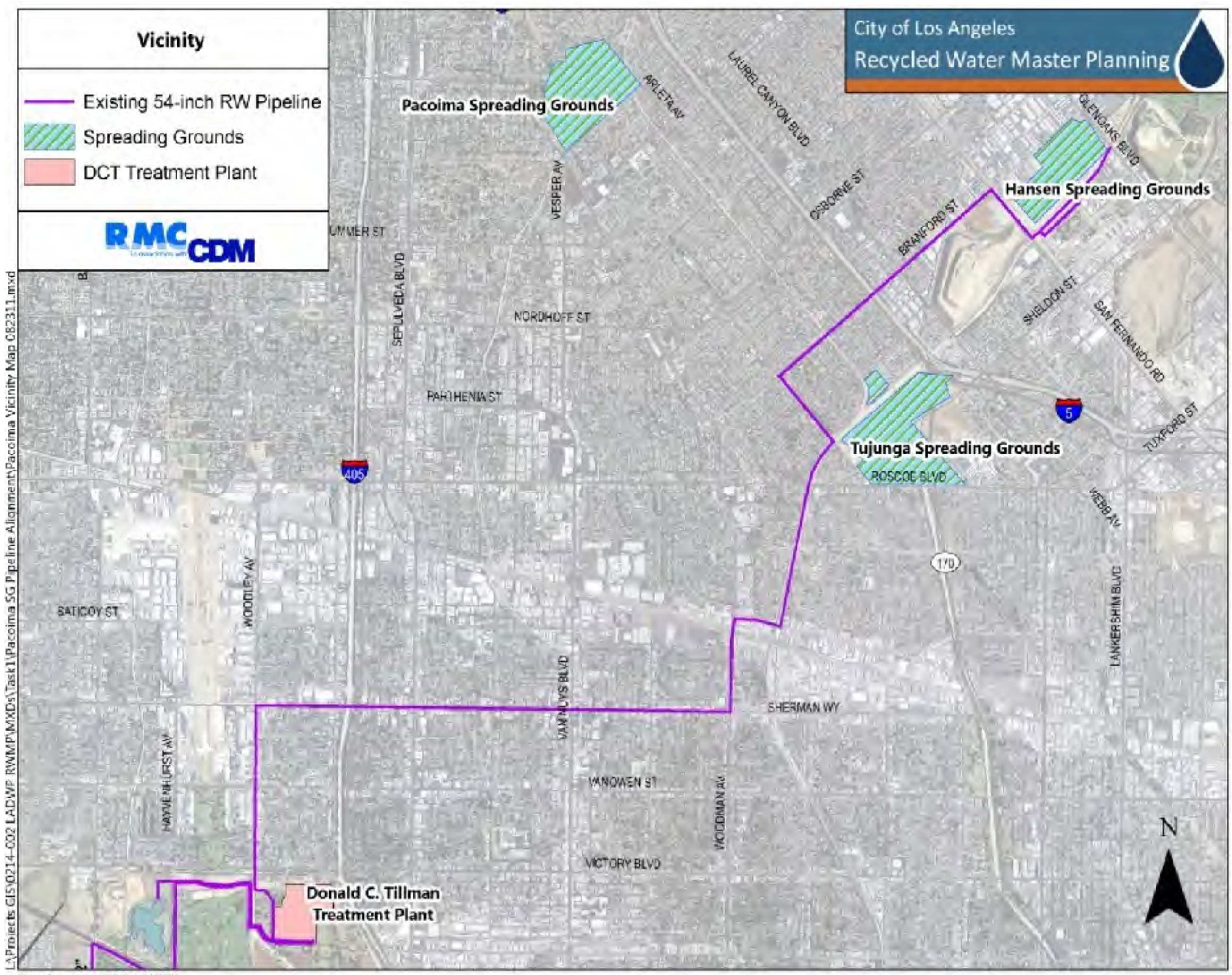
1. Introduction

Currently, product water from an advanced water treatment facility (AWTF) at Donald C. Tillman Water Reclamation Plant (DCTWRP) is planned to be spread at Hansen Spreading Grounds (HSG) via an existing 54-inch diameter recycled water pipeline. Due to recharge limitations at HSG, the concept to spread AWTF product water at the Pacoima Spreading Grounds (PSG) has emerged[1]. The purpose of this Technical Memorandum (TM) is to develop and evaluate pipeline alignment alternatives to deliver AWTF product water from the existing 54-inch pipeline to the Pacoima Spreading Grounds and potentially to injection wells located in the vicinity of the pipeline route (**Figure 1**).

Figure 1 : Vicinity Map



[1] See GWR Master Planning Report for further description of recharge limitations at HSG.

2. Alignments Evaluation Approach and Assumptions

This section discusses the evaluation methodology, cost estimate assumptions, and hydraulic evaluation.

2.1 Evaluation Methodology

Alignment alternatives were developed and evaluated based on the criteria presented below. For each criterion, potential alignments are compared against one another and an alignment is identified that has a noticeable advantage over the other alternative(s). If there is no noticeable advantage for one alignment over the alternatives, then this is stated. A discussion of each criterion and its basis for comparing alternatives is presented below.

- **Cost** – Estimated construction cost of the pipeline is provided for each alternative alignment for comparison purposes. Lower costs are an advantage.
- **Constructability** – Constructability challenges identified in the field include narrow construction corridors, utility congestion, and major infrastructure crossings. Utility congestion and major utility crossings were identified using NavigateLA and through above ground evidence of utilities observed during site visits. Fewer constructability challenges are an advantage.
- **Right-of-Way Considerations** – The need for easement or right-of-way acquisition is identified for each alignment. Purchase costs for right-of-way are included in cost estimates based on information provided by LADWP. In addition to the cost of easements, there is a risk in being able to secure the necessary easements, as well as potential schedule impacts. An alignment that does not require easements will have an advantage over an alignment that requires easements.
- **Permitting Requirements** – General permitting requirements on this project will include the need for encroachment permits for installation within the right-of-way. Additional potential permits such as flood control and environmental permits could delay the project or add risk. The need for environmental permits is a disadvantage.
- **Traffic Impacts** – Traffic impacts primarily involve the need for lane or street closures. Construction in streets with significant traffic volume and businesses will have more impact to the public versus construction in more lightly traveled residential streets. Less traffic impacts is considered an advantage.
- **Injection Wells** – Each alignment alternative is evaluated for its proximity to potential injection well locations, which is within the potential zone of capture of the Tujunga Well Field and primarily include undeveloped City-owned properties. The potential zone for injection wells starts approximately 1 mile from the Tujunga Well Field to provide adequate underground retention time with some safety factor, as shown in **Figure 2**. Location within the zone of capture and proximity to vacant City property is considered an advantage.
- **Non-Potable Demand** – Potential non-potable demands within a half mile of each pipeline alignment were identified. These demands could potentially be served from the pipeline. However, additional demand is not considered to be a significant advantage because there may be operational concerns with serving a small amount of demand with a large diameter

pipeline when recharge is not occurring so this information was documented for informational purposes

Figure 2: Potential Zone for Injection Wells

2.2 Cost Estimate Assumptions

The alignment alternative cost estimates are included in **Appendix A**. This section describes assumptions applied to develop the cost estimates, including:

- Pipeline Construction Cost
- Pipeline Connection Cost
- LACFCD Channel Right-of-Way Cost
- Cost Contingencies and Implementation Factor
- Costs Not Included

Pipeline Construction Cost

The unit prices used to estimate construction costs for the proposed recycled water pipelines were developed in accordance with the Cost Estimating Basis for Recycled Water Master Planning TM (RMC/CDM, Revised Draft, May 2011). The unit prices represent both open-cut and trenchless construction mostly in normal soils with depth typically less than 10 feet and include typical surface restoration and typical surface and subsurface congestion in an urban environment. Unit prices assume pipelines operating pressures up to 200 pounds per square inch (psi). The cost estimates for pipelines provided in this TM include materials, equipment and labor, pipeline appurtenances (valves and fittings), and surface restoration over the trench.

Based on representative LADWP projects, the following unit prices were developed for pipeline installation using open-cut construction:

- $24/inch-diameter/LF for 6" and 8" diameter pipe
- $20/inch-diameter/LF for 10" and 12" diameter pipe
- $18/inch-diameter/LF for 16" and 20" diameter pipe
- $16/inch-diameter/LF for 24", 30", 36", 42", 54", and 60" diameter pipe

Pipeline Connection Cost

The connection of the new pipeline to the existing 54-inch pipeline is beyond those costs included in typical pipeline construction. The cost of materials to connect the new recycled water pipeline to the existing 54-inch pipeline was obtained from US Pipe & Foundry Company and included in **Appendix B**. The basis for a raw construction cost estimate for the pipeline connection of $110,000 is shown in **Appendix A**.

LACFCD Channel Right-of-Way Cost

The right-of way cost for the Los Angeles County Flood Control District (LACFCD) channel is based on the Tujunga Wash - Parcels 593, 595, 725, and 726 Property Information (LACDPW, June 2010) provided by LADWP. In this document comparable property sales were evaluated and a weighted average was developed. The weighted average indicated a property market value of approximately $35 per square foot. The right of way is only for subsurface interest so a factor of 25% was applied to that value. By applying this factor, LADWP appraised the permanent pipeline easement value to be $8.75 per square foot. See Table 1 for a summary of previous property sales that were included in development of this estimate.

Table 1 - LACFCD Channel Right of Way Cost Development

Comparable Property	Date of Sale	Notes	Cost ($/sq ft.)
Sale Property 3 - Montangue St, Pacoima	October 2008	Proximity to subject	$30.52
Sale Property 4 - 2450 E. Vernon Ave, Vernon	January 2009	Site in Vernon representative of subject	$36.38
Sale Property 5 - 408 E. Alondra Blvd, Compton	August 2009	Site in Compton, most recent sale.	$35.00
		Weighted Average of Property Market Value	$35.00
		Subsurface Interest Factor	25%
		Fair Market Permanent Fee Value	**$8.75**

Cost Contingencies and Implementation Factor

Construction cost contingencies and an implementation factor are applied in accordance with the Cost Estimating Basis for Recycled Water Master Planning TM (RMC/CDM, May 2011). At this level of planning, a 30% contingency was applied to construction cost to account for currently unforeseen conditions. Also an implementation factor of 30% of the construction cost was applied to account for these additional services:

- Planning, Environmental Documentation, and Permits
- Engineering Services (Pre-Construction)
- Engineering Services during Construction
- Construction Management and Inspection
- Legal and Administrative Services
- Field Detail Allowance
- Market Adjustment Factor

Costs Not Included

The following costs were not included in the estimates in this TM:

- Balboa Pump Station expansion since the required flow could be delivered with existing pumping capacity (see section 2.3)
- Connection of non-potable customers to the conveyance pipeline
- Groundwater injection wells and associated laterals
- Significant restoration requirements, including street resurfacing due to City pavement moratorium requirements
- Pacoima Spreading Grounds facilities necessary to deliver water to the basins or monitoring wells and other facilities for monitoring and regulatory compliance

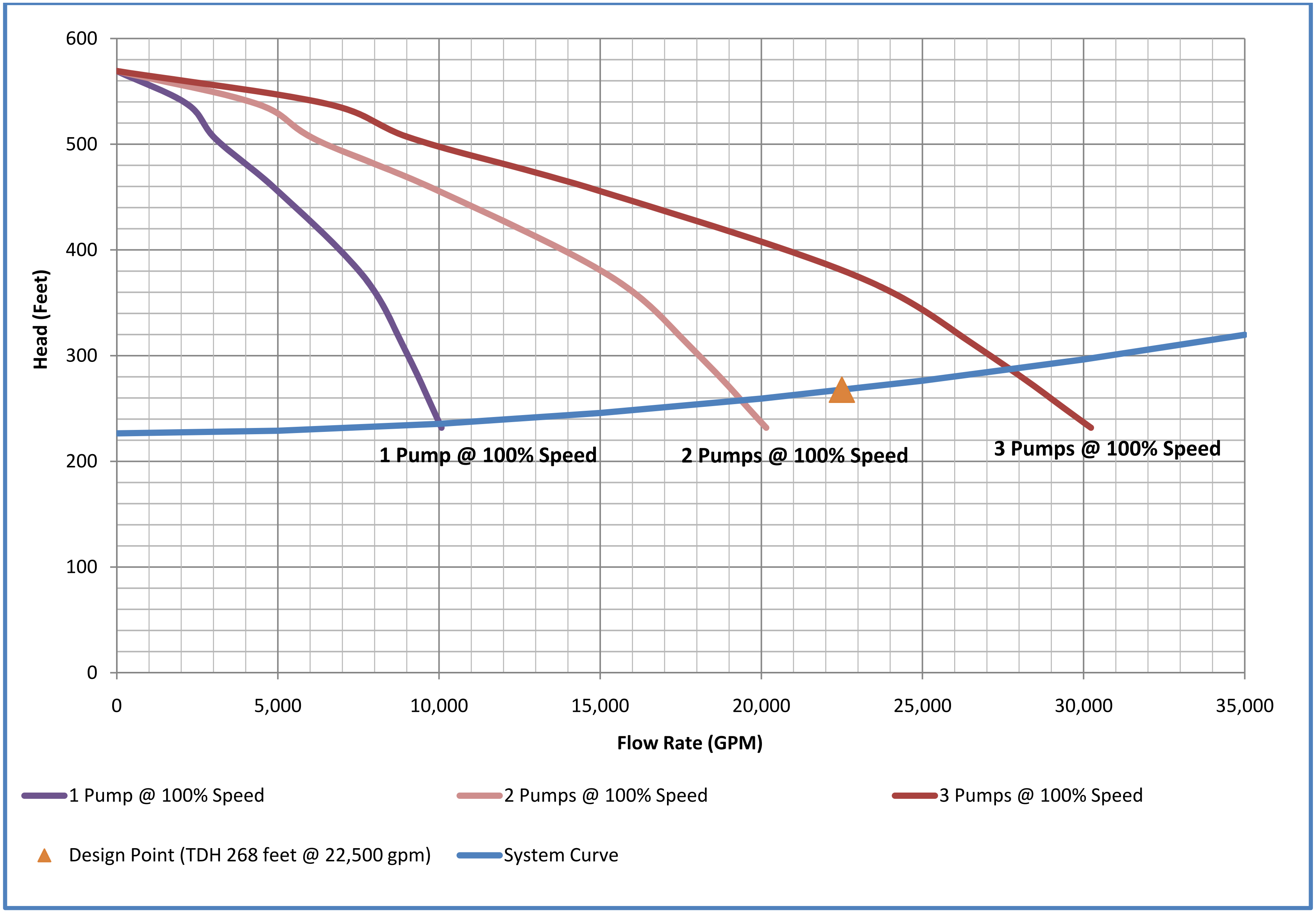
2.3 Hydraulic Evaluation

A preliminary hydraulic evaluation was performed to determine the pipeline diameter and pump station capacity requirements to deliver recycled water to the PSG. The hydraulic evaluation was based on conveying a peak flow of up to 32.4 MGD (22,500 gallons per minute (gpm)) to the spreading grounds, which is the maximum production from the AWTF. The hydraulic evaluation is based on spreadsheet model head loss calculations using the Hazen-Williams equation.

Currently, Balboa Pump Station pumps DCTWRP effluent to non-potable customers and works with the Hansen Tank (located at the Valley Generation Station) to provide floating head to the system. The Balboa Pump Station, which consists of three 3-stage vertical turbine pumps with two on duty and one on standby, will pump AWTF product water to the Pacoima Spreading Grounds. A fourth pump will be added as part of the Valley GWR project.

Preliminary calculations indicate a 42-inch diameter pipeline would be required to deliver the peak flow to PSG with a maximum velocity of 5 feet per second and that no modifications would be required at Balboa Pump Station. The static head from the pump station to the connection point at Pacoima Spreading Grounds is approximately 227 feet. The Total Dynamic Head (TDH) is calculated to be 268 feet at the peak flow of 22,500 gpm assuming a pipeline C-factor of 100. The pump curves were developed from Ingersoll-Dresser Pump Company Pump Test Data from July 27, 1998 provided by LADWP and included in **Appendix C**. The Balboa Pump Station pump curves are shown in **Figure 3**. The figure shows that the operating point lies between the capacity of 2 and 3 of the existing Balboa Pump station pumps, therefore three pumps operating at reduced speed could meet the design condition. The fourth pump to be added as part of the Valley GWR project will serve as the standby pump.

Figure 3: Existing Balboa Pump Station System Curve



The pipeline evaluation and costs are based on a 54-inch diameter pipeline even though a 42-inch pipeline would be sufficient to match the diameter of the existing pipeline designed to deliver recycled water to HSG. The larger diameter pipeline will reduce head loss and allow more flow to the spreading grounds, injection wells or customers, if needed in the future. The installation of the 54-inch pipeline would increase the total capital cost (including construction contingency and implementation factor) by up to $3.3 million compared to the 42-inch pipeline. This cost is based on the most direct route to the Pacoima Spreading Grounds, which is 10,200 feet, and applying the unit costs, contingencies and factors defined in **Section 2.2**.

3. Conveyance Pipeline Alignments

Four conveyance alignment alternatives were identified and are presented in **Figure 4**:

- Van Nuys Blvd
- Woodman Ave
- Canterbury Ave
- LACFCD Channel

The following evaluation criteria, which were defined in **Section 2.1**, are discussed for each alternative:

- Cost
- Constructability
- Right-of-Way Considerations
- Permitting Requirements
- Traffic Impacts
- Injection Wells
- Non-Potable Demand

3.1 Van Nuys Blvd Alternative

The Van Nuys Blvd alternative was developed to maximize the number of potential non-potable demands that could be connected along the conveyance pipeline route. As a result, this is the longest alternative with approximately 17,400 feet of pipeline. This alternative begins at the connection to the existing 54-inch recycled water pipeline at the intersection of Canterbury Ave and Branford St. From the connection point, the alignment will head northwest along Canterbury Ave approximately 500 feet, west along Chase St. for 6,000 feet, cross a major intersection at Woodman Ave., and then head north along Van Nuys Blvd for 10,900 feet to the Pacoima Spreading Grounds at Filmore St.

3.1.1 Cost

Based on a preliminary estimate, the capital cost of this alternative is $31.7 million. This alternative is the least cost-effective of the alternatives. The primary factor in the cost is the pipeline length, which is longer than all the other alignment alternatives because the alignment was developed to maximize non-potable demand along the pipeline route. Detailed cost estimates can be found in **Appendix A**.

Figure 4: Pacoima Spreading Grounds Potential Alignment Alternatives

Data Sources: USGS, LADWP

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3.1.2 Constructability

This alternative has moderate utility congestion based on a review of major utilities using NavigateLA and above ground evidence of utilities observed during a site visit. The following major utilities along the alignment were identified:

- 72-inch diameter water pipeline along Canterbury St
- 60-inch diameter storm drain along Van Nuys Blvd

The following major utility crossings were identified:

- 72-inch diameter storm drain pipeline at Dorrington Ave along Chase St.
- 16-inch and 18-inch diameter sewer pipeline at Filmore Ave along Woodman Ave
- 16-inch diameter water pipeline at Filmore Ave along Woodman Ave

Lists of all utilities along this alignment are included in **Appendix D**. Overall, utility congestion on this alternative is moderate with sewer mains and a large storm drain along Van Nuys Blvd that would make construction more challenging.

3.1.3 Right-of-way Considerations

East of Woodman Ave, Chase St is a residential street with two travel lanes and parking on each side of the street (**Figure 5**). Chase St becomes wider west of Woodman Ave with five travel lanes and a parking lane on each side (**Figure 6**). Chase St has a right-of-way ranging from 60 to 80 feet. A portion of the alignment on Chase St east of Woodman Ave appears to have been recently repaved and may fall under a City pavement moratorium (**Figure 5**). The Chase St right-of-way width is adequate for a major pipeline installation.

Van Nuys Blvd has five travel lanes road with a parking lane on each side. The five lanes consist of two travel lanes in each direction and a center turn lane (**Figure 7**). Van Nuys Blvd mainly consists of commercial development and multi-family residential complexes with a right-of-way ranging from 80 feet to 100 feet. The Van Nuys Blvd right-of-way width is adequate for a major pipeline installation.

Figure 5: Chase St East of Woodman Ave

Figure 6: Chase St West of Woodman Ave

Figure 7: Van Nuys Blvd South of Plummer St

3.1.4 Permitting Requirements

Permitting is not anticipated to be a concern for this alignment although Van Nuys Blvd is a major road and construction is prohibited from 6:00 am to 9:00 am and 3:30 pm to 7:00 pm in accordance with Mayor's Executive Directive No. 2. A City encroachment permit would be required for construction.

3.1.5 Traffic Impacts

Overall, this alternative experiences heavy traffic. Chase St normally experiences medium traffic west of Woodman Ave and light traffic east of Woodman Ave. The majority of the alignment is along Van Nuys Blvd, a major five-lane street with parking lanes on each side. Van Nuys Blvd normally experiences moderate to heavy traffic. Several businesses are located along the alignment that would be disrupted during construction.

3.1.6 Injection Wells

Along this alignment there are no vacant city properties within close proximity to place the injection well. Also, delivery of AWTF product water to injection wells would require additional pipeline(s) depending on the well locations due to being outside the potential zone for injection wells (**Figure 2**).

3.1.7 Non-Potable Demand

This alternative has the most potential non-potable demand with 20 customers totaling 195 acre feet per year (AFY). The potential non-potable customers along this alignment are tabulated in **Table 2**.

Table 2: Potential Non-Potable Customers for the Van Nuys Blvd Alternative

Customer Name	Type of Use	Jurisdiction	Customer Type	Annual Average Demand (AFY)
Sepulveda Recreation Center	Irrigation-Only	City	Parks	26
Iceoplex	Industrial – Only	Private	Ice Rink	23
Panorama Recreation Center	Irrigation-Only	City	Parks	16
Devonwood Park	Irrigation-Only	City	Parks	15
Panorama Gardens	Irrigation-Only	Private	Parks	14
Woodman Car Wash	Industrial-Only	Private	Car Wash	12
Saint Genevieve High School	Irrigation-Only	non-LAUSD	School	9
Tobias Partners	Mixed-Use	Private	Commercial	8
Villas II Apartments	Irrigation-Only	Private	Residential	8
Village Green West HOA	Irrigation-Only	Private	Residential	8
ZIAD G AWAD	Mixed-Use	Private	Other Private	7
JFU Enterprises	Mixed-Use	Private	Other Private	7
Canterbury Ave Elementary	Irrigation-Only	LAUSD	School	6
Kabadayan Dev. INC	Mixed-Use	Private	Commercial	6
Terra Bella Gardens	Irrigation-Only	Private	Residential	6
Peerless Building Corp	Mixed-Use	Private	Commercial	6
Woodman Gardens II HOA	Irrigation-Only	Private	Residential	5
Chase St Elementary School	Irrigation-Only	LAUSD	School	5
Tobias Ave Park	Irrigation-Only	City	Parks	4
C Nurseries	Irrigation-Only	Private	Nursery	4
TOTAL				**195**

3.2 Woodman Ave Alternative

The Woodman Ave alignment was developed as an alternative that has the shortest pipeline route within a major road. The alternative consists of approximately 12,800 feet of 54-inch diameter pipeline from the existing 54-inch pipeline connection point at the intersection of Canterbury Ave and Branford St to the Pacoima Spreading Grounds. From the connection point the alignment will head northwest along Canterbury Ave 500 feet then west along Chase St. 2,500 feet then north along Woodman Ave 9,800 feet to Pacoima Spreading Grounds at Filmore St.

3.2.1 Cost

Based on a preliminary cost estimate, the capital cost of this alternative is $25.0 million. The primary factor in the cost is the pipeline length, which is longer than some other alignment alternatives because it stays within a major roadway. Detailed cost estimates can be found in **Appendix A**.

3.2.2 Constructability

This alternative has significant utility congestion based on a review of major utilities using NavigateLA and above ground evidence of utilities observed during a site visit. The following major utilities along the alignment were identified:

- 72 inch diameter water pipeline along Canterbury St.
- 57 inch diameter storm drain along Woodman Ave
- 24 inch and 36 inch diameter sewer pipeline along Woodman Ave.

The following major utility crossings were identified:

- 72 inch diameter storm drain pipeline at Dorrington Ave along Chase St.
- 18 inch diameter sewer at Osborne St along Woodman Ave.

Lists of all utilities along this alignment are included in **Appendix D**. In general, utility congestion on this alternative is significant with sewer mains and large storm drain along Woodman Ave that would make construction difficult. Congestion will be an issue for the entire length of Woodman Ave (from Chase St to Filmore St).

3.2.3 Right-of-way Considerations

Chase St is mainly a residential street with two travel lanes with parking on each side of the street (**Figure 5**). Chase St has a right-of-way ranging from 60 to 80 feet. Along the Chase St portion of the alignment it appears to have been recently repaved and may fall under a City pavement moratorium. Woodman Ave is a five-lane road with parking on each side (**Figure 8** and **Figure 9**). The five lanes consist of two travel lanes on each side and a center turn lane. Woodman Ave mainly consists of commercial development and residential complexes with a right-of-way ranging from 80 feet to 100 feet. Both the Chase St and Woodman Ave right-of-way width is adequate for a major pipeline installation.

Figure 8: Woodman Ave North of Nordhoff St

Figure 9: Woodman Ave North of Osborne St

3.2.4 Permitting Requirements

Permitting is not anticipated to be a concern on this project. City of LA encroachment permit would be required for construction.

3.2.5 Traffic Impacts

This alignment has the most traffic congestion of all alternatives. Chase St normally experiences medium traffic. The majority of the alignment is along Woodman Ave which is a major five-lane roadway with parking on each side that normally experiences heavy traffic. Woodman Ave has several businesses that would be disrupted during construction.

3.2.6 Injection Wells

Similar to the Van Nuys Alternative, there is no vacant city property along this alignment to place injection wells, as depicted in **Figure 4**. The closest vacant city property is along Canterbury Ave. Also, the alignment is located along the western edge of the (Figure 1) so significant amount of additional pipelines is necessary.

3.2.7 Non-Potable Demand

This alternative has a potential non-potable demand of 124 AFY with 15 potential customers. Some of these potential non-potable customers would also be served by the Van Nuys Blvd alternative. Potential non-potable customers are tabulated in **Table 3**.

Table 3: Potential Non-Potable Customers for the Woodman Ave Alternative

Customer Name	Type of Use	Jurisdiction	Customer Type	Annual Average Demand (AFY)
Panorama Rec. Center	Irrigation-Only	City	Parks	16
Devonwood Park	Irrigation-Only	City	Parks	15
Panorama Gardens	Irrigation-Only	Private	Parks	14
Woodman Car Wash	Industrial-Only	Private	Car Wash	12
ZIAD G AWAD	Mixed-Use	Private	Other Private	9
Village Green West HOA	Irrigation-Only	Private	Residential	8
JFU Enterprises	Mixed-Use	Private	Other Private	7
Vepo Design Services	Mixed-Use	Private	Other Private	7
Canterbury Ave Elementary	Irrigation-Only	LAUSD	School	6
Terra Bella Gardens	Irrigation-Only	Private	Residential	6
Peerless Building Corp	Mixed-Use	Private	Commercial	6
JK Properties	Mixed-Use	Private	Commercial	5
Woodman Gardens II HOA	Irrigation-Only	Private	Residential	5
Chase St ES	Irrigation-Only	LAUSD	School	5
C Nurseries	Irrigation-Only	Private	Nursery	4
TOTAL				**124**

3.3 Canterbury Ave Alternative

The Canterbury Ave alternative is the most direct route to the Pacoima Spreading Grounds within existing rights-of-way. This alternative would consist of 10,200 linear feet of 54-inch diameter pipeline from the existing 54-inch pipeline connection at the intersection of Branford St and Canterbury Ave to the Pacoima Spreading Grounds. The 54-inch diameter pipeline will head northwest on Canterbury Ave passing the following major intersections: Osborne St, Terra Bella St and Van Nuys Blvd. The 54-inch diameter pipeline will connect to the Pacoima Spreading Grounds at Filmore St. The pipeline alignment will be placed adjacent to the former Whitnall Highway, a city-owned corridor.

3.3.1 Cost

Based on a preliminary estimate, the capital cost for this alternative is $21.2 million. This alternative is the most economical primarily due to being located within existing City right-of-way and having the shortest length. Detailed cost estimates can be found in **Appendix A**.

3.3.2 Constructability

This alternative has minimal utility congestion based on a review of major utilities using NavigateLA and above ground evidence of utilities observed during site visit. The only major utility along the alignment is 72-inch diameter water pipeline. In general utility congestion in this alternative is minimal, which will facilitate construction. More detailed information on utilities identified along every major street and cross-sections of areas with major congestion has been developed and reference in **Appendix D**.

3.3.3 Right-of-Way Considerations

Canterbury Ave is mainly a residential street with two travel lanes with parking on each side of the street. Canterbury has a right-of-way width of 60 feet. In addition to the right-of-way of the street there is an additional 120 feet of city owned right-of-way which is mainly categorized as open space in GIS. Based on the site visit, it appears that most of the development within the city owned right-of-way is nurseries which have minimal existing structures or buildings (**Figure 10**).

Figure 10: Canterbury Ave South of Filmore Ave

3.3.4 Permitting Requirements

Permitting is not anticipated to be a concern for this alignment. A City encroachment permit would be required for construction.

3.3.5 Traffic Impacts

Overall this alternative experiences light traffic since Canterbury Ave is located in a residential area. Interruption to local residential traffic is expected during construction.

3.3.6 Injection Wells

As shown in **Figure 4**, the alignment is located near several undeveloped City parcels, which makes this alternative the best-suited for recharge using injection wells. This is mainly attributed to the alignment being adjacent to the Whitnall Highway right-of-way, which was originally acquired by the City for construction of a highway, but is now a major utility corridor. As shown in **Figure 10**, electrical overhead utilities may be an issue for injection well installation due to required overhead clearances for construction equipment such as cranes.

3.3.7 Non-Potable Demand

This alternative has a potential non-potable demand of 66 AFY with 9 potential customers. Potential non-potable customers are tabulated in **Table 4**.

Table 4: Potential Non-Potable Customers for the Canterbury Ave Alternative

Customer Name	Type of Use	Jurisdiction	Customer Type	Annual Average Demand (AFY)
Devonwood Park	Irrigation-Only	City	Parks	15
40018 REV-E V NEW HS #2	Irrigation-Only	LAUSD	School	11
JFU Enterprises	Mixed-Use	Private	Other Private	7
Vepo Design Services	Mixed-Use	Private	Other Private	7
Canterbury Ave Elementary	Irrigation-Only	LAUSD	School	6
Terra Bella Gardens	Irrigation-Only	Private	Residential	6
JK Properties	Mixed-Use	Private	Commercial	5
Woodman Gardens II HOA	Irrigation-Only	Private	Residential	5
C Nurseries	Irrigation-Only	Private	Nursery	4
TOTAL				**66**

3.4 LACFCD Channel Alternative

Portions of the existing 54-inch recycled water line are installed along the Tujunga Wash channel. This alternative would use LACFCD right-of-way along the channel to provide a direct route to the Pacoima Spreading Grounds, minimize traffic impacts and avoid utility congestion associated with construction within roadways. The LACFCD Channel Alternative would consist of 10,200 linear feet of 54-inch diameter pipeline from the 54-inch pipeline connection at the intersection of Branford St and the LACFCD Channel to the Pacoima Spreading Grounds. The 54-inch diameter pipeline would head northwest parallel to the LACFCD Channel passing the following major intersections: Osborne St, Terra Bella St and Van Nuys Blvd. The 54-inch diameter pipeline will connect to the Pacoima Spreading Grounds at Filmore St.

3.4.1 Cost

Based on a preliminary estimate, the capital cost of the LACFCD Channel alternative is $23.9 million. The capital cost is mainly attributed to the cost of the right-of-way along the LACFCD Channel which is it expected to cost $1.8 million, contributing to 15% of the project cost. The $1.8 million right of way cost includes an easement that is 20 feet wide and 10,200 feet long using a unit cost of $8.75 per square feet as describe in **section 2.2**. In addition to the high easement cost, certain sections of the alignment will need to be constructed using trenchless technology due to access restrictions, particularly at Osborne St where there is no space on the side of the channel for open-cut construction equipment (**Figure 11**). Detailed cost estimates can be found in **Appendix A**.

3.4.2 Constructability

Investigation of major utilities was conducted by researching as-builts drawings using NavigateLA and above ground evidence of utilities observed during a site visit. According to the utility research the LACFCD Channel alternative had no utilities along the alignment. Storm drain connections to the channel were identified in the field and would have to be crossed at several locations. Utilities along major streets would have to be crossed.

The narrow corridor of 20 feet would make construction difficult. Trenchless construction would be required in the section of the channel where there is no right-of-way. In addition, the alignment would have to cross the channel to reach the Pacoima Spreading Grounds.

A list of all utilities along this alignment are included in **Appendix D.**

3.4.3 Right-of-Way Considerations

The LACFCD Channel has 140 feet of right-of-way width. The proposed 54-inch pipeline could potentially be installed within a 20 feet wide access road on the east side of the LACFCD Channel throughout most of the alignment. Certain areas are problematic such as south of Osborne St, where there is no access road for about 100 feet (**Figure 11**). At this location, trenchless construction would have to be employed due to access limitations. The pipeline would be installed under the channel embankment.

Figure 11: LACFCD Channel Section without Right-of-way South of Osborne St

3.4.4 Permitting Requirements

Installing a pipeline along the LACFCD Channel would require a LACFCD encroachment permit and LACFCD easement in addition to the city encroachment permit. In addition, crossing the channel may require the following environmental permits:

- US Army Corps of Engineers – CWA Section 404, if channel is determined to be waters of the US
- Regional Water Quality Control Board – CWA Section 401, if 404 is triggered
- Regional Water Quality Control Board – NPDES General Construction Permit
- US Fish and Wildlife Service – ESA consultation, if there are threatened or endangered species present in the channel
- California Department of Fish and Game – CFGC Section 1600, if channel is determined to be waters of the State
- California Department of Fish and Game – CESA consultation, if there are threatened or endangered species present in the channel
- State Historic Preservation Office – NHPA Section 106, if the flood channel facilities are older than 50 years

3.4.5 Traffic Impacts

There is no traffic along the channel but the three major streets (Osborne St, Terra Bella St, and Van Nuys Blvd) will have to be crossed during construction. These major streets usually experience medium to heavy traffic.

3.4.6 Injection Wells

As shown in **Figure 2** and **Figure 4,** the LACFCD Channel alternative is within the potential injection well zone but has limited city-owned open space for well citing.

3.4.7 Non-Potable Demand

This alternative has the least potential non-potable demand at 62 AFY with 4 potential customers. Only potential non-potable customers east of the channel are considered because the cost to cross the channel was assumed to make non-potable service uneconomical. Potential non-potable customers are tabulated in **Table 5**.

Table 5: Potential Non-Potable Customers for the LACFCD Channel Alternative

Customer Name	Type of Use	Jurisdiction	Customer Type	Annual Average Demand (AFY)
Pacoima Middle School	Irrigation-Only	LAUSD	School	30
Devonwood Park	Irrigation-Only	City	Parks	15
Caltrans @ Sharp Ave	Irrigation-Only	State	Caltrans	9
Caltrans @ Terra Bella St	Irrigation-Only	State	Caltrans	7
TOTAL				**62**

3.5 Evaluation/Recommendations

3.5.1 Evaluation

Table 6 is a comparison of the evaluation criteria for the Pacoima Spreading Grounds conveyance alternatives.

3.5.2 Recommendation

Based on the established criteria the Canterbury Ave alternative is the preferred alternative. This alternative has the lowest capital cost, minimal traffic and utility congestion, and is within a close proximity to potential sites for an injection wells. The Canterbury Ave alternative conveyance pipeline has an estimated capital cost of $21.2 million.

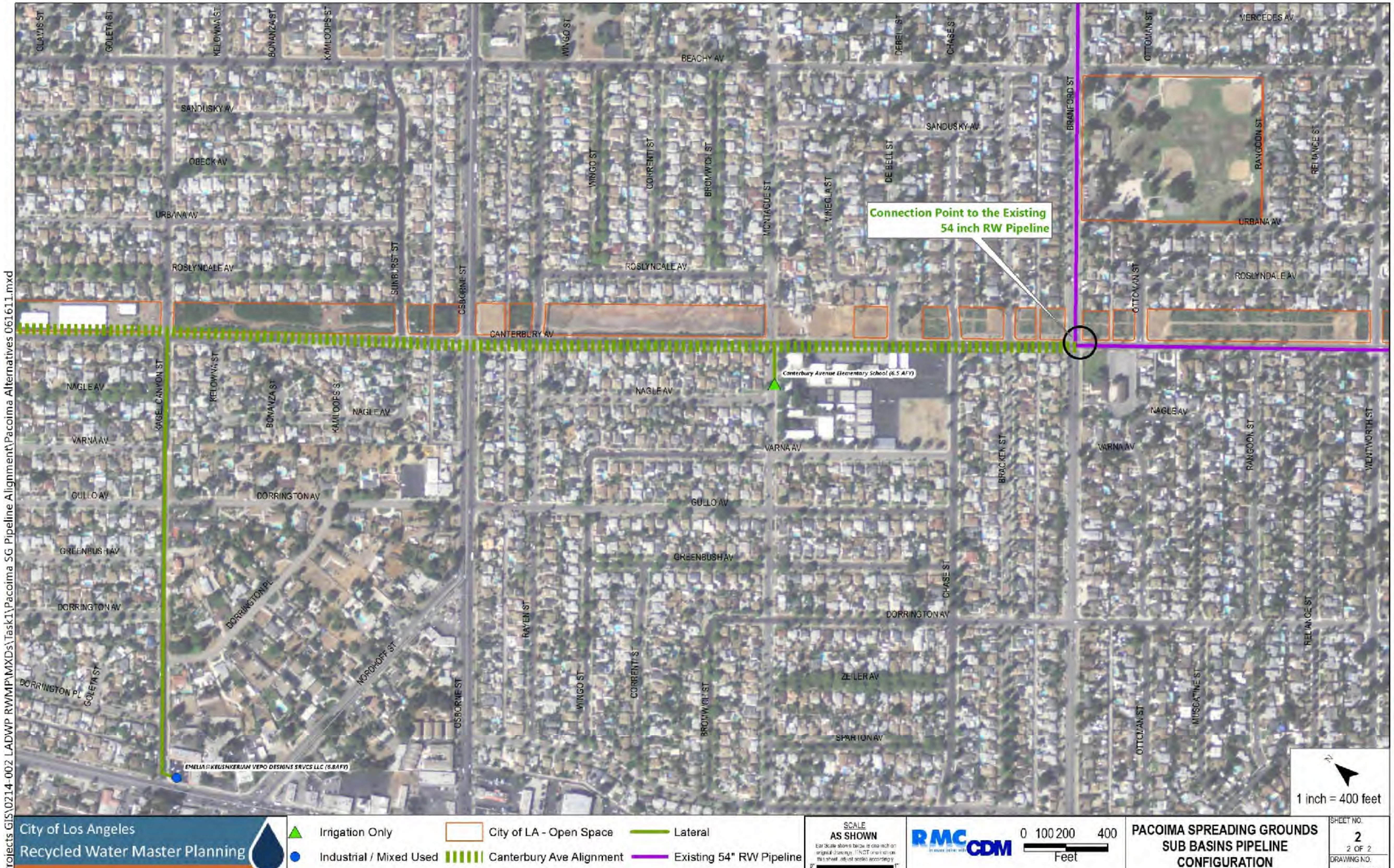
To connect to potential non-potable customers an additional 9,000 linear feet of 6-inch diameter would have to be installed. The additional capital cost of the pipeline to server potential non-potable customers would be $2.2 million. The Canterbury Ave alignment is shown in **Figure 12** and **Figure 13** along with the laterals to the potential non-potable customers.

Table 6 – Evaluation Table

Evaluation Criteria	Alignment Alternatives: Van Nuys Blvd	Woodman Ave	Canterbury Ave	LACFCD Channel	Alignment w/ Advantage
Cost					
Capital Cost	**$31.7 M**	**$25.0 M**	**$21.2 M**	**$23.9 M**	**Canterbury Ave**
Constructability / Implementation Considerations					
Constructability Considerations	Moderate utility congestion - 72" Water - 60" Storm Drain	Significant utility congestion - 72" Water - 24", 36" Sewer - 57" Storm Drain	Minimal existing utilities - 72" Water	Narrow corridor No known existing utilities	**Canterbury Ave/ LACFCD Channel**
	5 lane road Major Intersections - Woodman Ave - Van Nuys Blvd - Nordhoff - Plummer	5 lane road Major Intersections - Woodman Ave - Nordhoff - Terra Bella St - Plummer	Residential Major Intersections - Osborne St - Terra Bella St - Van Nuys Blvd	Major Intersections - Osborne St - Terra Bella St - Van Nuys Blvd	**Canterbury Ave/ LACFCD Channel**
Right-of-Way Considerations	Wide corridor	Wide corridor	Wide corridor (Whitnall Corridor)	Trenchless channel crossing	**Canterbury Ave**
Permitting Requirements	City encroachment permit	City encroachment permit	City encroachment permit	City encroachment permit LACFCD encroachment permit LACFCD Easement	**Van Nuys Blvd/ Woodman Ave/ Canterbury Ave**
Traffic/Community Impacts	Medium-Heavy traffic	Heavy traffic	Low-medium traffic	No traffic along channel Medium traffic at crossings	**Canterbury Ave/ LACFCD Channel**
Injection Wells					
Proximity to Injection Well Zone	Poor	Poor	Good	Fair	**Canterbury Ave/ LACFCD Channel**
Non-Potable Reuse					
Non-Potable Demand	195 AFY	124 AFY	66 AFY	62 AFY	**Woodman Ave**
Conveyance Pipe Capital Cost	$3.9 M	$2.2 M	$2.2 M	$1.3 M	

Figure 12: Canterbury Ave Alignment (North Portion)

Figure 13: Canterbury Ave Alignment (South Portion)



4. Spreading Grounds Facilities

The Pacoima Spreading Grounds has a total of 9 basins with a total spread surface area of approximately 92 acres. The spreading ground has an average percolation rate of 65 cubic feet per second according to the Tujunga Wash Watershed Groundwater Master Plan Phase II. Based on the recommended Canterbury Ave alternative, a pipeline configuration within the spreading basins to feed into the spreading grounds' sub basins has been developed. The sub basin pipeline configuration is presented in **Figure 14**.

The pipelines to the subbasins were sized to convey the percolation rate of 65 cubic feet per second. The pipe diameter to each subbasin is based on a design velocity of 5 feet per second. The percolation rate of 65 cubic feet per second was evenly distributed to each sub basin based on area. The percolation rate to each sub basin was calculated and the pipeline to each sub basin was sized accordingly. The sub basin pipelines would consist of sizes ranging from 12-inch to 54-inch diameter at 6,520 linear feet. The estimated construction cost of the spreading grounds pipelines is $3.6 million. Cost and calculations of the basin's pipelines is documented in **Appendix E**.

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Figure 14 – Pacoima Spreading Grounds Facilities

Data Sources: USGS, LADWP

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Appendix A - Alternative Cost Estimates

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City of Los Angeles

Recycled Water Master Planning

DESCRIPTION: Present Value Estimate Date: 11/9/2011

Pacoima Spreading Grounds Conveyance: Van Nuys Blvd Alternative

SUPPLY: DCT

Item	Qty	Units	Unit Cost		Cost
Capital Costs					
Pacoima Spreading Grounds Piping (Canterbury Ave Alignment)					
12 inch to 54 inch	6,520				$3,631,000
GWR Conveyance Pipeline					
54 inch	17,400	in-diam*LF	$16	$	15,034,000
Connection to the Existing 54 inch RW Pipeline					
Materials[1]					
Field Weld kit	1	Quantity	$100	$	100
54 inch RJ field-weld rings	2	Quantity	$171	$	300
54 inch RJ Tee	1	Quantity	$43,500	$	44,000
54 inch Spool Pipe #1	1	Quantity	$5,700	$	6,000
54 inch RJ Telescoping sleeve	1	Quantity	$22,300	$	22,300
54 inch Spool Pipe #2	1	Quantity	$4,000	$	4,000
Materials Total				$	76,700
Labor - Crew	5	Days	$6,000	$	30,000
			Construction Subtotal	**$**	**18,772,000**
		Contingency Costs	30%	$	5,632,000
			Construction Total	**$**	**24,404,000**
		Implementation Costs	30%	$	7,321,000
			Total Capital Cost	**$**	**31,725,000**

Non-Potable Reuse Cost and Yield	Length (ft)				
Conveyance Pipeline to Serve NPR					
6 inch	16,200	in-diam*LF	$24	$	2,333,000
			Construction Subtotal	**$**	**2,333,000**
		Contingency Costs	30%	$	700,000
			Construction Total	**$**	**3,033,000**
		Implementation Costs	30%	$	910,000
			Total Capital Cost	**$**	**3,943,000**
			Number of Customers		20
			Non-Potable Demand (AFY)		195

1. Unit Costs obtain from US Pipe & Foundry Company Quote

City of Los Angeles

Recycled Water Master Planning

DESCRIPTION: Present Value Estimate Date: 11/9/2011

Pacoima Spreading Grounds Conveyance: Woodman Ave Alternative

SUPPLY: DCT

Item	Qty	Units	Unit Cost		Cost
Capital Costs					
Pacoima Spreading Grounds Piping (Canterbury Ave Alignment)					
12 inch to 54 inch	6,520				$3,631,000
GWR Conveyance Pipeline					
54 inch	12,800	in-diam*LF	$16	$	11,059,000
Connection to the Existing 54 inch RW Pipeline					
Materials[1]					
Field Weld kit	1	Quantity	$100	$	100
54 inch RJ field-weld rings	2	Quantity	$171	$	300
54 inch RJ Tee	1	Quantity	$43,500	$	44,000
54 inch Spool Pipe #1	1	Quantity	$5,700	$	6,000
54 inch RJ Telescoping sleeve	1	Quantity	$22,300	$	22,300
54 inch Spool Pipe #2	1	Quantity	$4,000	$	4,000
Materials Total				$	76,700
Labor - Crew	5	Days	$6,000	$	30,000
			Construction Subtotal	**$**	**14,797,000**
		Contingency Costs	30%	$	4,439,000
			Construction Total	**$**	**19,236,000**
		Implementation Costs	30%	$	5,771,000
			Total Capital Cost	**$**	**25,007,000**

Non-Potable Reuse Cost and Yield					
	Length (ft)				
Conveyance Pipeline to Serve NPR					
6 inch	8,900	in-diam*LF	$24	$	1,282,000
			Construction Subtotal	**$**	**1,282,000**
		Contingency Costs	30%	$	385,000
			Construction Total	**$**	**1,667,000**
		Implementation Costs	30%	$	500,000
			Total Capital Cost	**$**	**2,167,000**
			Number of Customers		15
			Non-Potable Demand (AFY)		124

1. Unit Costs obtain from US Pipe & Foundry Company Quote

City of Los Angeles

Recycled Water Master Planning

DESCRIPTION: Present Value Estimate Date: 11/9/2011

Pacoima Spreading Grounds Conveyance: Canterbury Ave Alternative

SUPPLY: DCT

Item	Qty	Units	Unit Cost		Cost
Capital Costs					
Pacoima Spreading Grounds Piping (Canterbury Ave Alignment)					
12 inch to 54 inch	6,520				$3,631,000
GWR Conveyance Pipeline					
54 inch	10,200	in-diam*LF	$16	$	8,813,000
Connection to the Existing 54 inch RW Pipeline					
Materials[1]					
Field Weld kit	1	Quantity	$100	$	100
54 inch RJ field-weld rings	2	Quantity	$171	$	300
54 inch RJ Tee	1	Quantity	$43,500	$	44,000
54 inch Spool Pipe #1	1	Quantity	$5,700	$	6,000
54 inch RJ Telescoping sleeve	1	Quantity	$22,300	$	22,300
54 inch Spool Pipe #2	1	Quantity	$4,000	$	4,000
Materials Total				$	76,700
Labor - Crew	5	Days	$6,000	$	30,000
			Construction Subtotal	**$**	**12,551,000**
		Contingency Costs	30%	$	3,765,000
			Construction Total	**$**	**16,316,000**
		Implementation Costs	30%	$	4,895,000
			Total Capital Cost	**$**	**21,211,000**
Non-Potable Reuse Cost and Yield					
	Length (ft)				
Conveyance Pipeline to Serve NPR					
6 inch	9,000	in-diam*LF	$24	$	1,296,000
			Construction Subtotal	**$**	**1,296,000**
		Contingency Costs	30%	$	389,000
			Construction Total	**$**	**1,685,000**
		Implementation Costs	30%	$	506,000
			Total Capital Cost	**$**	**2,191,000**
			Number of Customers		9
			Non-Potable Demand (AFY)		66

1. Unit Costs obtain from US Pipe & Foundry Company Quote

City of Los Angeles
Recycled Water Master Planning

DESCRIPTION: Present Value Estimate Date: 11/9/2011

Pacoima Spreading Grounds Conveyance: LACFCD Channel Alternative

SUPPLY: DCT

Item	Qty	Units	Unit Cost		Cost
Capital Costs					
Pacoima Spreading Grounds Piping (Canterbury Ave Alignment)					
12 inch to 54 inch	6,520				$3,631,000
Conveyance Pipeline					
54 inch	10,000	in-diam*LF	$16	$	8,640,000
Connection to the Existing 54 inch RW Pipeline					
Materials[1]					
Field Weld kit	1	Quantity	$100	$	100
54 inch RJ field-weld rings	2	Quantity	$171	$	300
54 inch RJ Tee	1	Quantity	$43,500	$	44,000
54 inch Spool Pipe #1	1	Quantity	$5,700	$	6,000
54 inch RJ Telescoping sleeve	1	Quantity	$22,300	$	22,000
54 inch Spool Pipe #2	1	Quantity	$4,000	$	4,000
Materials Total				$	76,400
Labor - Crew	5	Days	$6,000	$	30,000
Miscellaneous					
LACFCD ROW[2] (20 feet)	204,000	SF	$8.75	$	1,785,000
			Construction Subtotal	**$**	**14,162,000**
		Contingency Costs	30%	$	4,249,000
			Construction Total	**$**	**18,411,000**
		Implementation Costs	30%	$	5,523,000
			Total Capital Cost	**$**	**23,934,000**
Non-Potable Reuse Cost and Yield					
	Length (ft)				
Conveyance Pipeline to Serve NPR					
6 inch	5,500	in-diam*LF	$24	$	792,000
			Construction Subtotal	**$**	**792,000**
		Contingency Costs	30%	$	238,000
			Construction Total	**$**	**1,030,000**
		Implementation Costs	30%	$	309,000
			Total Capital Cost	**$**	**1,339,000**
			Number of Customers		4
			Non-Potable Demand (AFY)		62

1. Unit Costs obtain from US Pipe & Foundry Company Quote
2. Unit Cost obtain from Tujunga Wash - Parcels 593, 595, 725, and 726 Property Information, LACDPW, June 22, 2010

Appendix B - Materials Quote for Connection to Existing 54-inch Pipeline

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PLANT WORK PIPING SYSTEMS

U.S. Pipe & Foundry Company, LLC

3032 SHADOW HILL CIRCLE THOUSAND OAKS CA. 91360

PHONE: 805-241-5040 FAX: 866-734-1879 EMAIL: wmckinney@uspipe.com

Date:	7/26/2011	ATTN--->		
Project:				
	54" TEE CUT IN			
	Quote #	Revision #	Bid Date:	Addendums:
Engineer:	RMC Water and Environment			

Sales Terms: Sales Terms posted at www.uspipe.com under Terms and Conditions of Sale / Purchase.

Payment: Net 30 Days - 1.5% surcharge per month after.

Taxes: Prices do not include any local, state, or federal taxes. Applicable taxes will be added to your invoice unless a valid Tax Exemption Certificate is furnished in a form satisfactory to taxing authorities.

Freight Terms:

Pipe - Full Length:	Freight allowed to JOBSITE defined as		for FULL TRUCKLOAD quantities only. (40,000#)
Fabricated Pipe:	Freight allowed for releases with a minimum of	$ 5,000.00	of fabricated items
Fittings:	Freight allowed for releases with a minimum of	$ 5,000.00	of fittings.
Glass Lined Products:	Freight allowed for releases with a minimum of	$ 40,000.00	of glass lined products.

Fabricated Pipe, Fittings, and Glass Lined Products may ship in a closed van. If closed vans are not allowed, U.S. Pipe will re-price these items and/or modify the freight terms to allow for flatbed equipment. This requirement must be established prior to bid acceptance.

ALL OTHER FREIGHT COSTS WILL BE PREPAID AND ADDED TO CUSTOMER INVOICE.

Delivery: Shipment available Stock to 16 weeks ARO. Please call prior to release for most current lead times by item.

Acceptance: This quote is subject to acceptance by purchase order within 30 days from Bid Date listed above. If a purchase order is not received within 30 days from the Bid Date, this proposal may be withdrawn.

Pricing Escalation Terms: Due to continuing volatility in the price of raw materials, energy, and transportation, the pricing for TYTON®, TR FLEX®, and HP LOK® pipe represented on this quotation cannot be held firm for a period of more than 60 days. Orders, releases, and or shipments placed or made after the 60 day period will be subject to a 4% price increase. Open orders remaining after 90 days will either be cancelled or re-quoted using the prices in effect at the time of release. Fittings and Flanged/Fabricated ductile iron pipe prices cannot be held for a period of more than 180 days from the date of quotation.

We are pleased to offer you our proposal for furnishing the ductile iron pipe and fittings listed herein:
All pipe and fittings are quoted with our standard cement mortar lining and seal coated on the inside and outside with our standard asphaltic coating unless otherwise noted. This is our understanding of the requirements as indicated in the project plans & specifications. We believe the material included does reasonably cover the requirements. However, you should carefully check this list. as it is not in any way guaranteed. This quotation contains special material not subject to return or cancellation. It is the responsibility of the ordering party to verify quantities, sizes, and descriptions prior to order placement. The responsibility lies with the ordering party to determine the suitability of the material being quoted for the intended use. We appreciate the opportunity of submitting this proposal and hope that we may have the pleasure of furnishing your ductile iron pressure pipe and fitting requirements on this project. If we can be of further assistance, please do not hesitate to call.

Sincerely,

WES MCKINNEY

NOTES: SPECIFICATION AND SCOPE

1. NOTE: Some components and other materials including but not limited to flanges, gaskets, and fittings, may be globally sourced and NOT of domestic manufacture. We supply third-party manufactured items to augment our product line and production capacity to meet customer's needs.
2. NOTE: All Fabricated Products are subject to U.S. Pipe Engineering Review and approval prior to production.
3. NOTE: All WELDED OUTLET and BOSSES must have adequate support designed and/or approved by the project engineer. The support must be provided to prevent loads and moments being applied during installation and/or operation. Refer to our brochure for more information.
4. NOTE: All prices included on this quotation are based on ALL items to be purchased from U.S. PIPE. If any items are to be furnished by others, ALL prices for ALL items are subject to change.
5. NOTE: FBE (Fusion Bonded Epoxy) Coated Fittings may be quoted and/or furnished on this project. These fittings meet all the requirements of AWWA C153 specification.
6. NOTE: All Lead Times are based on the manufacturing schedule at the time of this quotation. Manufacturing Lead Times at the time of order may change.
7. NOTE: All cost for materials and labor required to electrically bond ductile iron pipe and fittings joints is NOT included in our quotation and will NOT be furnished by U.S. Pipe.
8. NOTE: All FLANGED joint prices do NOT include FLG accessories (bolts, nuts, gaskets) unless noted separately. We can furnish pricing upon request.
9. NOTE: All MJ fittings and MJ valves are quoted W/O Accessories. We can furnish itemized pricing for MJ accessories upon request.

10. NOTE: Gaskets for TYTON® and TR FLEX® joint pipe and fittings are quoted as standard SBR material unless specifically shown on our quote. We can furnish pricing for special push on gaskets upon request.

11. NOTE: All POLYWRAP is to be furnished <u>by others</u> if required unless specifically itemized on this quotation. We can furnished pricing upon request.

12. NOTE: Unless otherwise stated, we have <u>NOT</u> quoted restraint connections for materials quoted by others or not manufactured by U.S. Pipe. Please check the quotation carefully to insure you have the restraint you require. We may quote additional restraint upon request.

13. NOTE: Unless materials are specifically listed in our quotation, they are <u>NOT</u> included as part of our proposal. If you have any questions concerning the items which are included or NOT included, please discuss with your U.S. Pipe Sales Rep listed on this quotation prior to project bid time.

14. CAUTION: U.S. Pipe recommends the use of FULL FACE FLANGE-TYTE® Gaskets or RING FLANGE-TYTE® Gaskets with ductile iron flanged joint products supplied by U.S. Pipe. These gaskets were designed specifically for the unique surface of ductile iron. Flat rubber gaskets are NOT considered equal in performance and may not provide the sealing capability the project requires. In addition, their use could result in unintended damage to the flanges and threads of the fabricated pipe by applying excess torque to the bolts/flanges in order to seal the joint.

15. LAYOUT DRAWINGS: We can furnish products from your bill of material or we can furnish a dimensioned bill of material complete with LAYOUT DRAWINGS of our products from the Engineer's plans and specifications for your approval. LAYOUT DRAWINGS are $800/sheet. This charge includes up to (2) revisions per drawing. Additional revisions cost $50/revision or $800 for a complete re-draw. These costs include 4 copies for distribution. Additional copies cost $10 per drawing. Drawing charges are additional and not included in the totals below unless specifically shown.

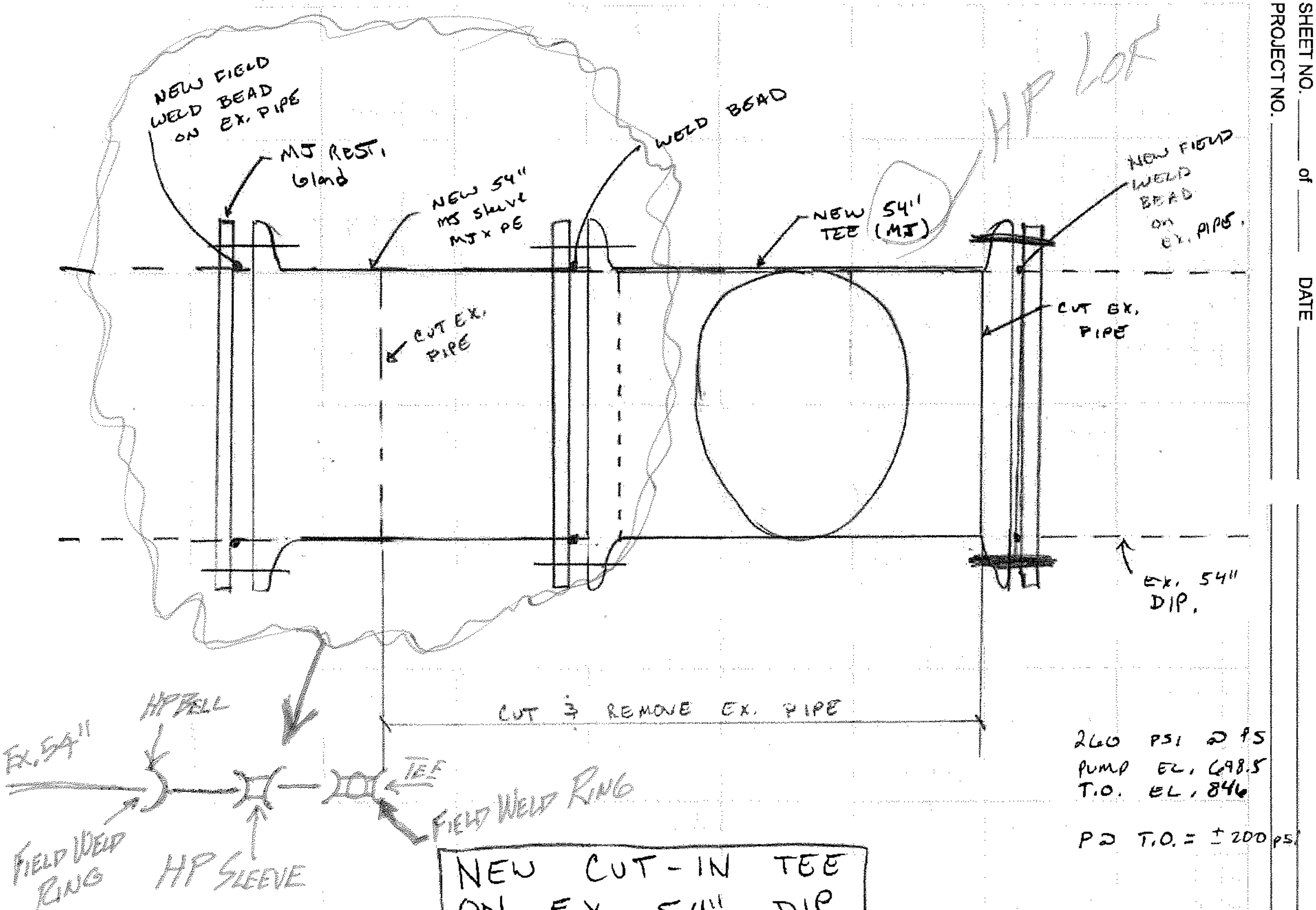
Date: 7/26/2011 ATTN-->

Project:

54" TEE CUT IN

Quote # Revision # Bid Date: Addendums:

SEQ#	QUAN.	DESCRIPTION	LENGTH	WEIGHT #	PRICE	TOTAL
10						
20	1 EA	54" HP LOK® TEE ACL/AC		9,615	$43,535.20 EA	$43,535.20
30						
40	1 EA	54" HP LOK® TELESCOPING SLEEVE AL/AC		3,710	$22,260.00 EA	$22,260.00
50						
60	2 EA	54" HP LOK® FIELD-WELD RING			$171.00 EA	$342.00
70						
80	1 EA	HP LOK® FIELD-WELD KIT (NO ROD)			$106.00 EA	$106.00
90						
100	1 EA	54" PE x PE DIP CL53 ACL/AC (1)-54pehp (1)-54petshp	2'0" LG	949	$5,665.32 EA	$5,665.32
110						
120	1 EA	54" PE x PE DIP CL53 ACL/AC (1)-54hpb (1)-54petshp	2'0" LG	1,274	$3,980.89 EA	$3,980.89
130						
140						
150						$75,889.41
160						



NEW CUT-IN TEE ON EX. 54" DIP

RMC

BY ____

SHEET NO. ____ of ____

PROJECT NO. ____

DATE ____

CHK ____

SUBJECT ____

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Appendix C - Balboa Pump Station Test Data

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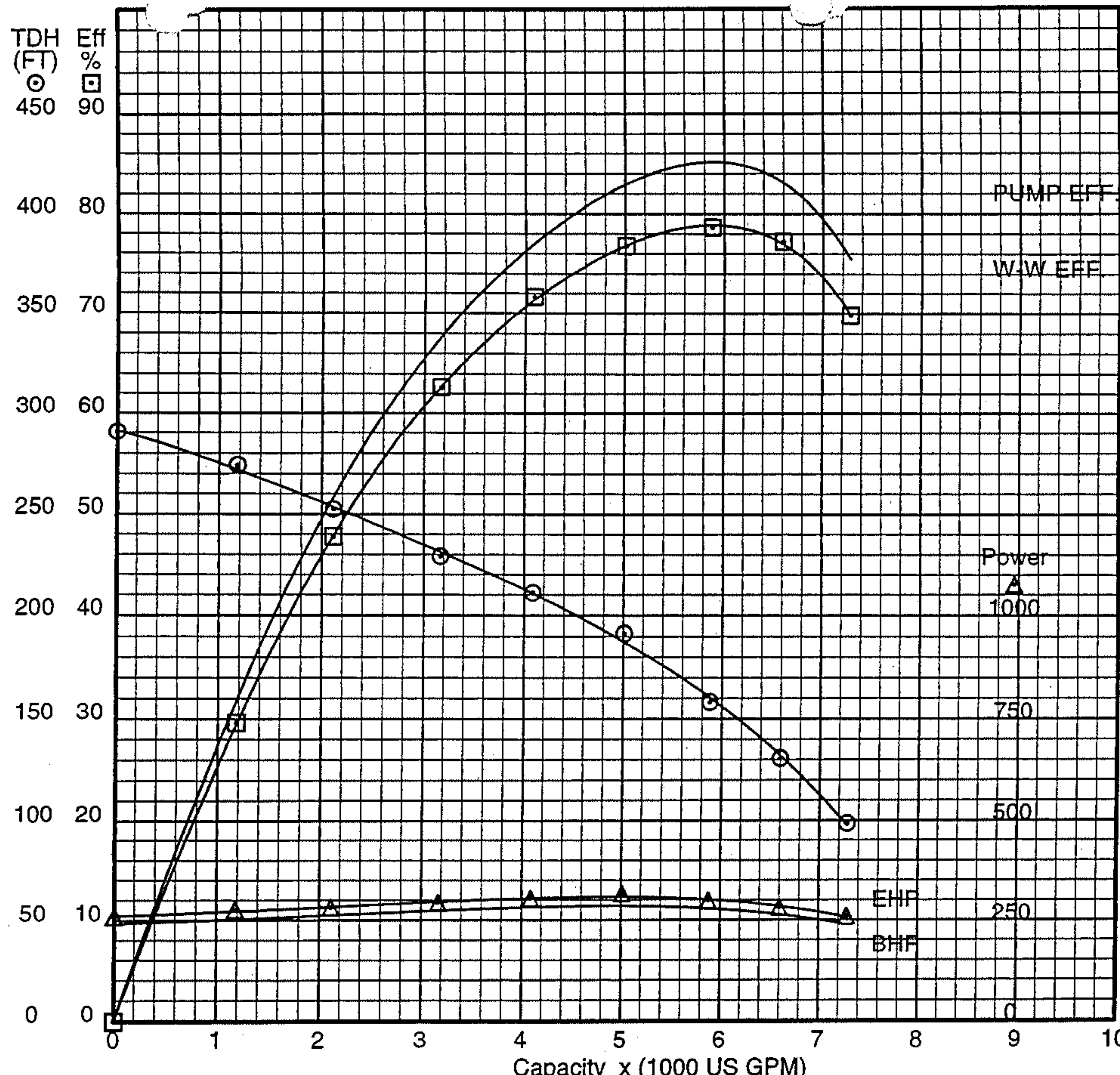


INGERSOLL-DRESSER PUMP COMPANY

PUMP TEST DATA

RPM	GPM	TDH	BHP	Eff
853	0.0	290.3	259.2	0.0
852	1181.2	274.1	276.1	29.6
852	2113.1	252.2	281.7	47.8
851	3169.6	229.2	293.0	62.6
851	4091.9	210.8	304.2	71.6
852	5011.6	191.4	315.5	76.8
852	5882.5	158.1	298.6	78.6
853	6598.1	130.5	281.7	77.2
853	7281.7	98.4	259.2	69.8

I CERTIFY THAT WITHIN THE ACCURACY OF THE TEST INSTRUMENTATION, THIS TEST REPRESENTS THE PERFORMANCE OF 26LSL-3 PUMP 9806MS000526-1

G. Hagstrom

SP.GR.: 1.000

CASING DATA

CI	LINED	
MATERIAL	FINISH	TONGUE

IMPELLER DATA

BRONZE	1A	.31 X 3.00
MATERIAL	FINISH	DISC. TIPS
		18.38
PATT. NO.	COMB. NO.	DIA

26LSL-3	3	S000526	9806MS000526-1	27JUL98	WTAC		1000H/1200R	16x10.5,#29	Job	T-S000526-1WA
PUMP	STAGES	ORDER NO.	SERIAL NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	VENTURI	PLOTTED RPM	CURVE NO

TEST DATA CARD

Conditions of Service

GPM		Venturi	16 x 10.5 #29	Wattmeter	2
TDH				Condition	2.5
EFF		Driver	1000 HP	Leads	4160
BHP			1200 RPM	Ct	300/5

Order Number	Serial Number	Size and Type	Test ID	Test Date	Time
	S 526-~~2~~1	26 LSL-3	WTAC	7-27-98	

Number of Points	RPM	Barom	Specific Gravity	Vent	Meter Fact	Driver	DBG	Suction Diameter	Discharge Diameter	Z
	850	30.10								

Point Number	RPM	Suction Pressure	Discharge Pressure	Capacity HG"	Power	H_2O Temp 84°
1	853	/	/ 123.5	0 / 0	46	
2	852	/	/ 116.5	.1 / .15	49	
3	852	/	/ 107	.35 / .45	50	
4	851	/	/ 97	.85 / .95	52	
5	851	/	/ 89	1.45 / 1.55	54	
6	852	/	/ 80.5	2.2 / 2.3	56	
7	852	/	/ 66	3.05 / 3.15	53	
8	853	/	/ 54	3.85 / 3.95	50	
9	853	/	/ 40	4.7 / 4.8	46	
10		/	/	/		
11		/	/	/		
12		/	/	/		
13		/	/	/		
14		/	/	/		
15		/	/	/		

Distance from CL of discharge gauge to water level 50 inches

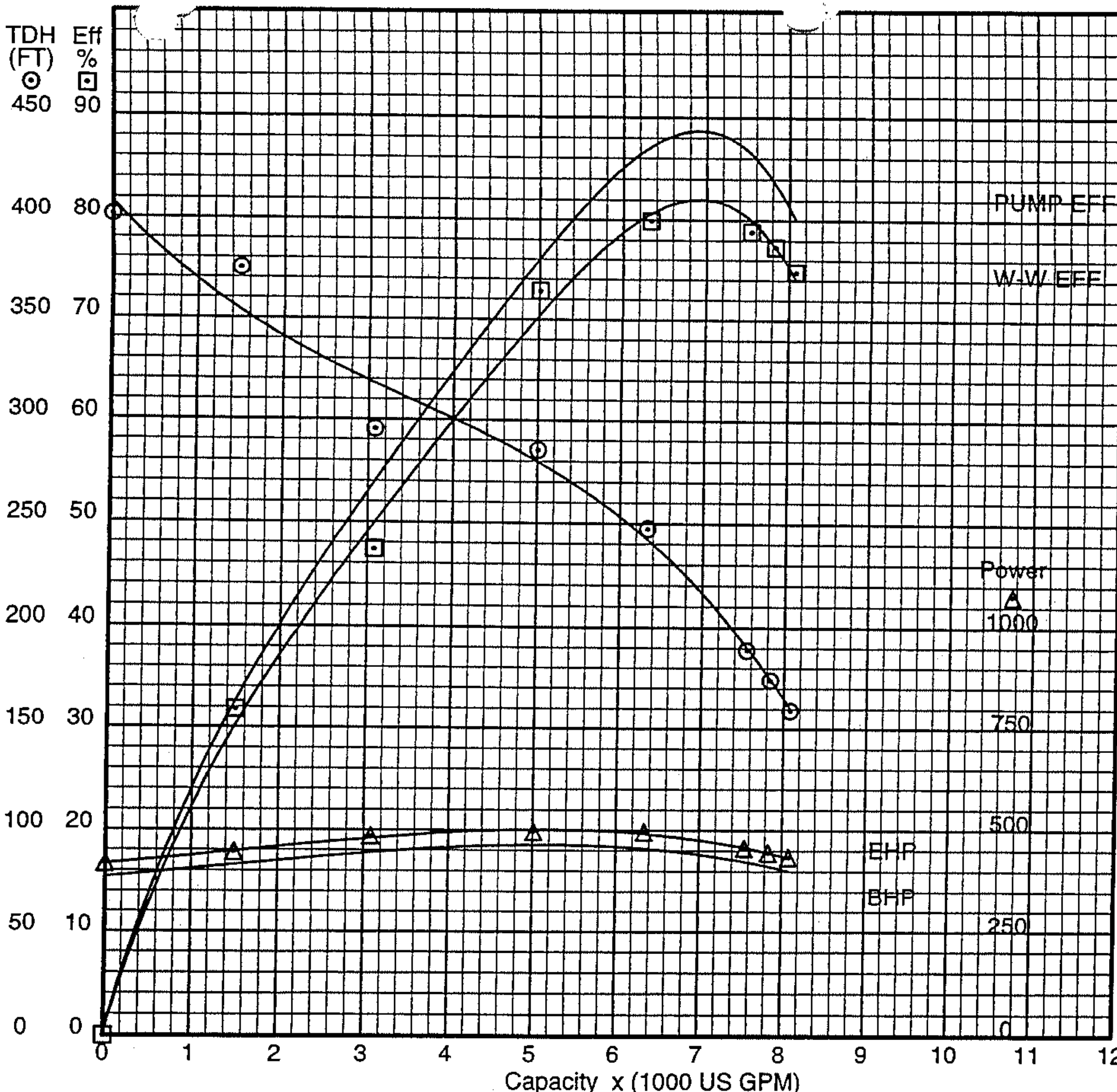
Distance from CL of suction piezometer ring to water level ____ inches

Distance from CL of discharge pipe to water level 73 inches

TESTED BY: NAME (PRINT): James Ryder

SIGNATURE: J. Ryder DATE: 7-27-98

Form QAF.022



INGERSOLL-DRESSER PUMP COMPANY

PUMP TEST DATA

RPM	GPM	TDH	BHP	Eff
1000	0.0	401.5	416.9	0.0
1000	1494.2	374.9	445.1	31.8
999	3080.3	295.2	484.5	47.4
999	5011.6	285.2	495.8	72.8
999	6339.2	247.4	495.8	79.9
1000	7545.2	188.9	456.4	78.9
1000	7835.5	173.9	445.1	77.3
1000	8080.9	159.0	433.8	74.8

I CERTIFY THAT WITHIN THE ACCURACY OF THE TEST INSTRUMENTATION, THIS TEST REPRESENTS THE PERFORMANCE OF 26LSL-3 PUMP 9806MS000526-1

G. Hagstrom

SP.GR.: 1.000

CASING DATA		
CI	LINED	
MATERIAL	FINISH	TONGUE

IMPELLER DATA		
BRONZE	1A	.31 X 3.00
MATERIAL	FINISH	DISC. TIPS
		18.38
PATT. NO.	COMB. NO.	DIA

26LSL-3	3	S000526	9806MS000526-1	27JUL98	WTAB		1000H/1200R	16x10.5,#29	Job	T-S000526-1WA
PUMP	STAGES	ORDER NO.	SERIAL NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	VENTURI	PLOTTED RPM	CURVE NO

TEST DATA CARD

Conditions of Service

GPM ______
TDH ______
EFF ______
BHP ______

Venturi 16 x 10.5 #29

Driver 1000 HP
1200 RPM

Wattmeter 2
Condition 2.5
Leads 4160
Ct 300/5

Order Number	Serial Number	Size and Type	Test ID	Test Date	Time
	S 526-21	26 LSL-3	WTAB	7-27-98	

Number of Points	RPM	Barom	Specific Gravity	Vent	Meter Fact	Driver	DBG	Suction Diameter	Discharge Diameter	Z
	1000	30.10								

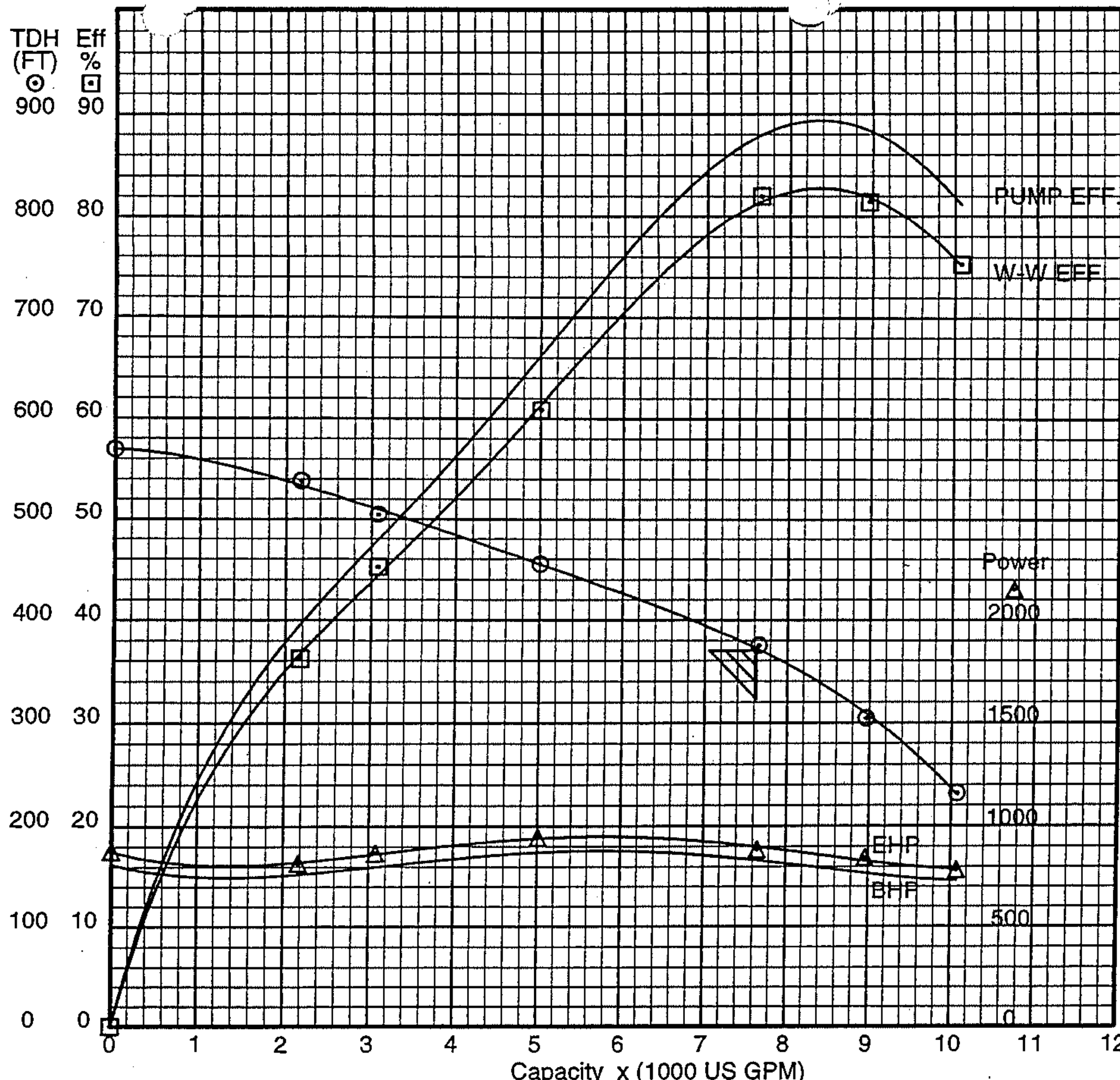
Point Number	RPM	Suction Pressure		Discharge Pressure		Capacity HG"		Power		H2O Temp 84°
1	1000	/		/	171.5	0 / 0		74		
2	1000	/		/	160	.151 / .25		79		
3	999	/		/	125.5	.8 / .9		86		
4	999	/		/	121	2.2 / 2.3		88		
5	999	/		/	104.5	3.55 / 3.65		88		
6	1000	/		/	79	5.05 / 5.15		81		
7	1000	/		/	72.5	5.45 / 5.55		79		
8	1000	/		/	66	5.8 / 5.9		77		
9		/		/		/				
10		/		/		/				
11		/		/		/				
12		/		/		/				
13		/		/		/				
14		/		/		/				
15		/		/		/				

Distance from CL of discharge gauge to water level 50 inches
Distance from CL of suction piezometer ring to water level ______ inches
Distance from CL of discharge pipe to water level 73 inches

TESTED BY: NAME (PRINT): James Ryder

SIGNATURE: [signature] DATE: 7-27-98

Form QAF.022



INGERSOLL-DRESSER PUMP COMPANY

PUMP TEST DATA

RPM	GPM	TDH	BHP	Eff
1199	0.0	569.2	878.9	0.0
1200	2177.5	538.1	816.9	36.2
1199	3079.5	504.6	867.6	45.2
1199	5010.3	455.3	946.5	60.9
1200	7653.4	375.2	884.5	82.0
1200	8962.7	304.1	845.1	81.4
1200	10076.1	231.8	783.1	75.3

I CERTIFY THAT WITHIN THE ACCURACY OF THE TEST INSTRUMENTATION, THIS TEST REPRESENTS THE PERFORMANCE OF 26LSL-3 PUMP 9806MS000526-1

G. Hagstrom

SP.GR.: 1.000

CASING DATA		
CI	LINED	
MATERIAL	FINISH	TONGUE

IMPELLER DATA		
BRONZE	1A	.31 X 3.00
MATERIAL	FINISH	DISC. TIPS
		18.38
PATT. NO.	COMB. NO.	DIA

PUMP	STAGES	ORDER NO.	SERIAL NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	VENTURI	PLOTTED RPM	CURVE NO
26LSL-3	3	S000526	9806MS000526-1	27JUL98	WTAA		1000H/1200R	16x10.5,#29	Job	T-S000526-1WA

TEST DATA CARD

Conditions of Service

GPM		Venturi	16 x 10.5 #24	Wattmeter	2
TDH				Condition	2.5
EFF		Driver	1000 HP	Leads	4160
BHP			1200 RPM	Ct	300/5

Order Number	Serial Number	Size and Type	Test ID	Test Date	Time
	S 526-21	26 LSL-3	WTA-A	7-27-98	1215

Number of Points	RPM	Barom	Specific Gravity	Vent	Meter Fact	Driver	DBG	Suction Diameter	Discharge Diameter	Z
	1200	30.10								

Point Number	RPM	Suction Pressure		Discharge Pressure			Capacity HG"		Power		H_2O Temp 81°
1	1199	/		/	244		.0 1 .0		156		
2	1200	/		/	230.5		.41.45		145		
3	1199	/		/	216		.81.9		154		
4	1199	/		/	194.5		2.212.3		168		
5	1200	/		/	159.5		5.255.25		157		
6	1200	/		/	128.5		7.1517.25		150		
7	1200	/		/	97		9.0519.15		139		
8		/		/			/				
9		/		/			/				
10		/		/			/				
11		/		/			/				
12		/		/			/				
13		/		/			/				
14		/		/			/				
15		/		/			/				

Distance from CL of discharge gauge to water level 50 inches

Distance from CL of suction piezometer ring to water level ______ inches

Distance from CL of discharge pipe to water level 73 inches

TESTED BY: NAME (PRINT): James Ryder Bert King

SIGNATURE: J. Ryder DATE: 7-27-98

Form QAF.022

Appendix D - Utility Research and Cross Sections

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Van Nuys Blvd Alternative - Utility Review

Source		Sub. Map	Nav. LA	Nav. LA	Sub. Map	Sub Map	Sub. Map	Sub. Map			
Pipeline Street	**Cross Street**	**ROW (ft)**	**Sewer**	**Storm**	**Water (DWP)**	**Power**	**Gas**	**Communication**	**Other 1**	**Status**	**Major Utilities at Crossing**
Corridor (Canterbury Ave)	Branford St	60	8"		72" (6' W of CL) 8" (15' W of CL)						18" Sewer
	Chase St	60	8"		72" (6' W of CL) 8" (15' W of CL)						
Chase St	Corridor	54	8"	-	6" (9' S of CL)	Y	2" (12' N of CL)				
	Dorrington Ave	60	8"	30"	6" (9' S of CL)	Y	2" (12' N of CL)				72" Storm Drain (LA County)
	Woodman Ave	80	-	-	6" (9' S of CL)	Y					
	Hazeltine	80	8"	60"	8" (15' S of CL)	Y	4" (22' N of CL)				
	Lennox	80	8"		8" (15' S of CL)		4" (22' N of CL)				
Van Nuys Blvd	Chase St		-		8" (36' W of CL) 12" (26' E of CL)	Y	4" (8' W of CL)				
	Pathernia St		15"	10" (City)	8" (20' W of CL) 12" (26' E of CL) 6" ABN (18' W of CL)	Y	8" (17' E of CL) 2" (9' of CL)	Y			Storm Drain
	Nordhoff		8"	-	8" (20' W of CL) 6" ABN (18' W of CL)	Y	8" (17' E of CL) 2" (9' of CL)	Y			
	Plummer		8"(2)		8" (31' E of CL) 6" ABN (12' W of CL)	Y	3" (19' E of CL)	Y	TV		
Vesper Ave	Filmore		8"								12"-16" Water 18" Sewer 21" Sewer 16" Water

Woodman Ave Alternative - Utility Review

Source		Sub. Map	Nav. LA	Nav. LA	Sub. Map	Sub Map	Sub. Map	Sub. Map			
Pipeline Street	**Cross Street**	**ROW (ft)**	**Sewer**	**Storm**	**Water (DWP)**	**Power**	**Gas**	**Communication**	**Other 1**	**Status**	**Major Utilities at Crossing**
Corridor (Canterbury Ave)	Branford St	60	8"		72" (6' W of CL) 8" (15' W of CL)						18" Sewer
	Chase St	60	8"		72" (6' W of CL) 8" (15' W of CL)						
Chase St	Corridor	54	8"	-	6" (9' S of CL)		2" (12' N of CL)				
	Dorrington Ave	60	8"	30"	6" (9' S of CL)		2" (12' N of CL)				72" Storm Drain (LA County)
	Woodman Ave	80	-	-	6" (9' S of CL)						
Woodman Ave	Chase St	100	24" 36"	57"	8" (15' W of CL)		4" (14' E of CL)				
	Montague St	100	24" 36"	57"	8" (15' W of CL)		4" (14' E of CL)	4" (45' E of CL)			
	Osborne St	100	24" 36"	57"	6" (42' W of CL) ABN 8" (26' W of CL)	Y (2)	4" (16' E of CL)	4" (44' E of CL)			18" Sewer
	Nordhoff	100	24" 36"	57"	6" (42' W of CL) ABN 8" (26' W of CL)		4" (16' E of CL)	4" (44' E of CL)			Storm Drain
	Terra Bella St	100	21" 36"	57"	6" ABN (42' W of CL) 8" (26' W of CL)	Y (1)	4" (1' W of CL) 3" (6' W of CL)	4" (50' W of CL)	TV		
	Van Nuys Blvd	100	8"-18" 36"	57"	6" ABN (12' W of CL) 8" (17' W of CL)		3" (20' E of CL)				
	Filmore	100	8" 36"	-	6" ABN (12' W of CL) 6" 12" (14' W of CL)		3" (20' E of CL)				

Canterbury Ave Alternative - Utility Review

Source		Sub. Map	Nav. LA	Nav. LA	Sub. Map	Sub Map	Sub. Map	Sub. Map				
Pipeline Street	**Cross Street**	**ROW (ft)**	**Sewer**	**Storm**	**Water (DWP)**	**Other**	**Power**	**Gas**	**Communication**	**Other 1**	**Status**	**Major Utilities at Crossing**
Canterbury Ave	Branford St	-	8"	-	72" (6' W of CL) 8" (15" W of CL)			-				
	Osborne St	-	8"	60"	72" (6' W of CL) 8" ABN (16.5" W of CL)			-				18" Sewer 12" Water
	Pierce	-	8"	Y	72" (6' W of CL) 8" (15" W of CL)			3" ABN (24' E of CL) 2" (24" SW of CL)	4" (24 NE of CL)			21" Sewer
	Van Nuys Blvd	-	-	-	72" (6' W of CL) 6" (12" W of CL)		6" (15' S of CL)	3" (12' E of CL) 2"				12" Water Storm Drain
	Filmore St	-	-	-	72" (6' W of CL) 6" (12" W of CL)							12" Water

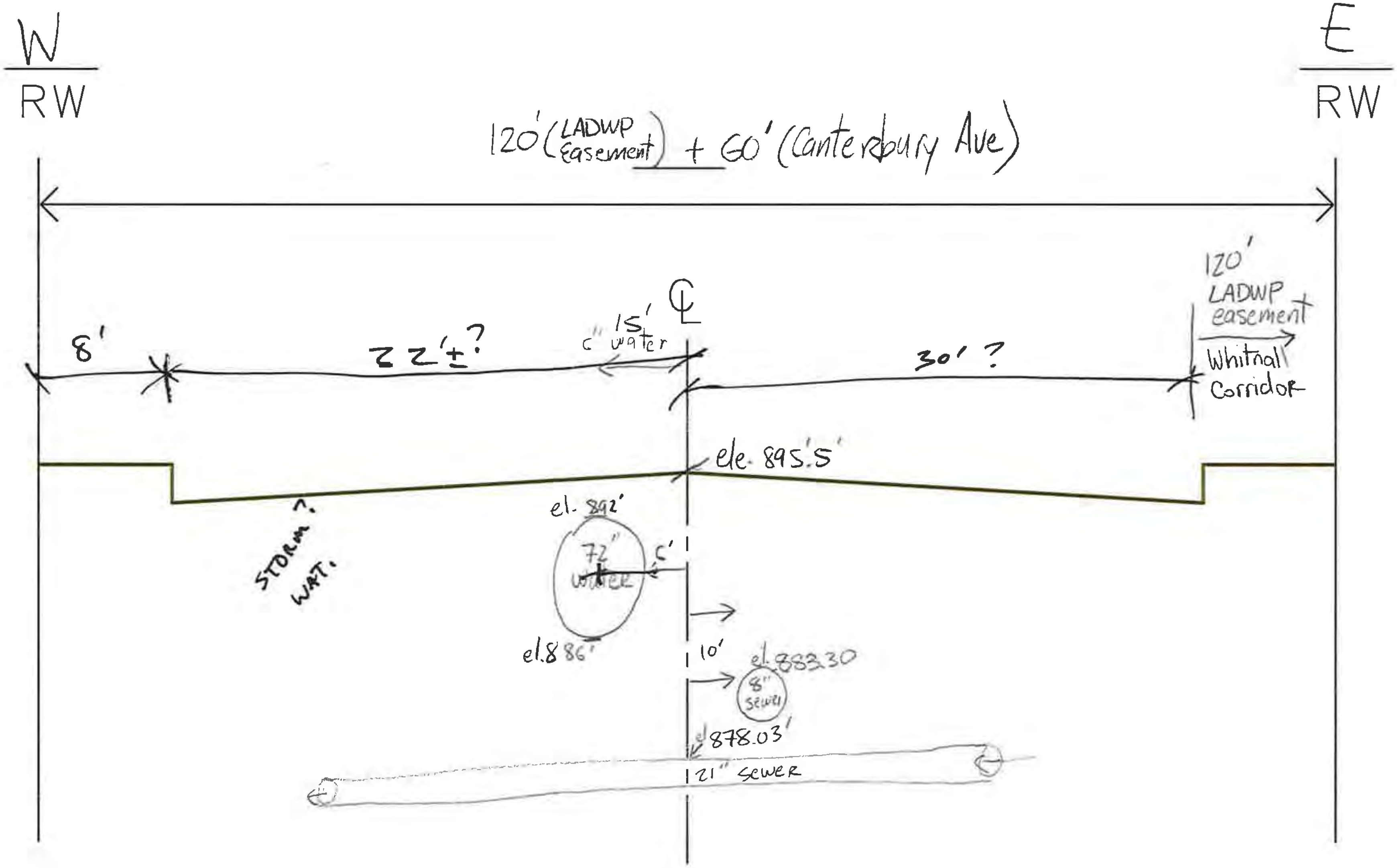
LACFCD Channel Alternative - Utility Review

Source		Sub. Map	Nav. LA	Nav. LA	Sub. Map	Sub Map	Sub. Map	Sub. Map			
Pipeline Street	**Cross Street**	**Sewer**	**Storm**	**Water (DWP)**	**Other**	**Power**	**Gas**	**Communication**	**Other 1**	**Major Utilities at Crossing**	**Status**
Channel	Branford St	-	Y	-	-	-	-	-		-	OK
	Osborne St	-	Y	-	-	-	-	-		15" Sewer	OK
	Terra Bella St	-	Y	-	-	-	-	-		12" Water	OK
	Pierce St	-	Y	-	-	-	-	-		18" Sewer	OK
	Van Nuys Blvd	-	Y	-	-	-	-	-		Storm 12" Water	OK
	Filmore St	-	Y	-	-	-	-	-		-	OK

LADWP Sheet
SOURCE: D-103.6 Sheet 3/4

SOME UTIL. MIGHT NOT BE SHOWN.

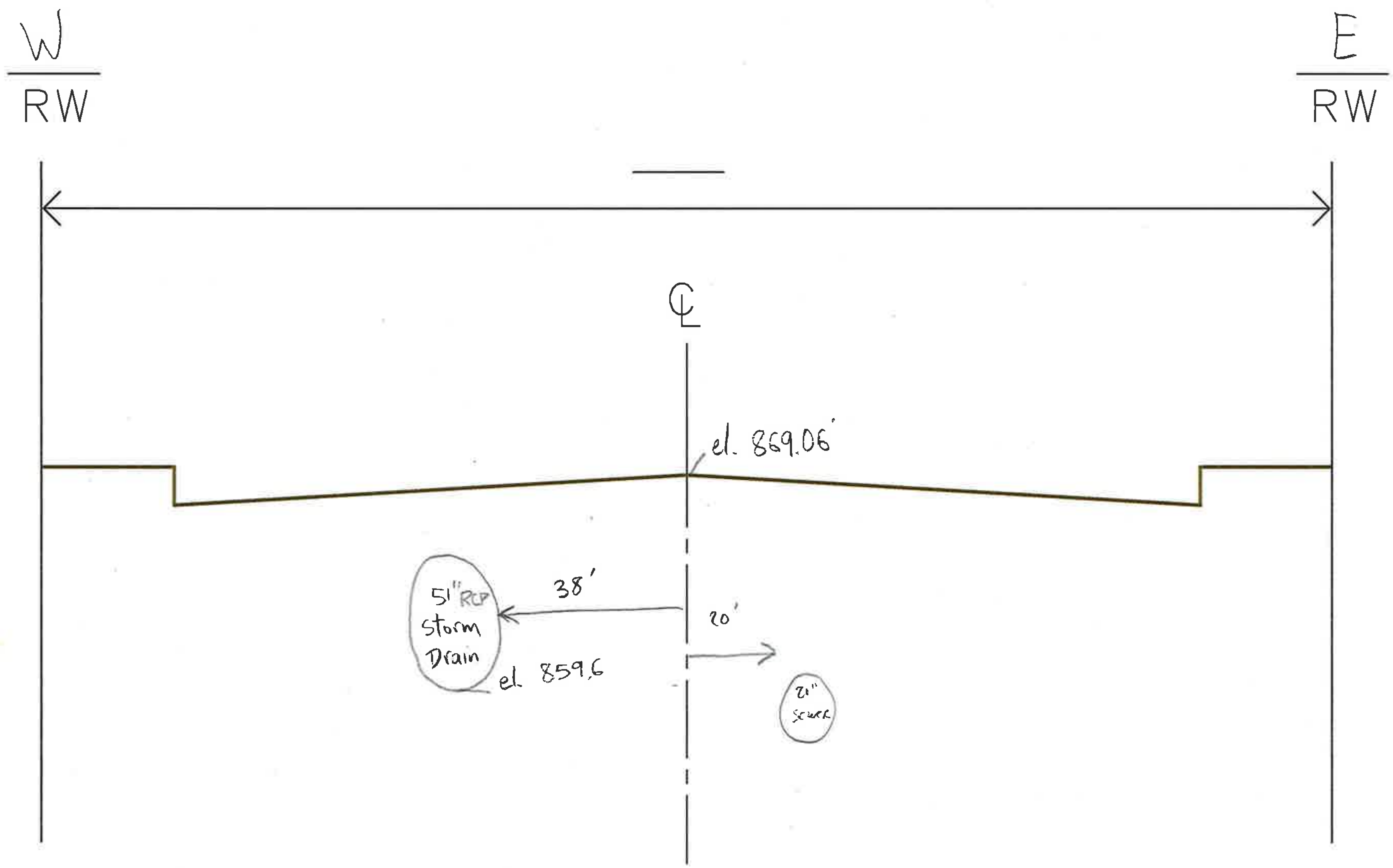
Canterbury Alt



Canterbury Ave @ Pierce St.

* BASED ON .....
LADWP Sheet
D-10376 Sheet 3/4
NOTE SOME UTILITIES MAY NOT BE SHOWN.

Woodman Av. Alt



Woodman Ave @ Terra Bella St

Appendix E – Pacoima Spreading Grounds Pipe Size Calculations

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Pacoima Spreading Grounds - Pipeline Size Calculations

Assumptions:

Percolation Rate	65	cfs
Design Velocity	5	fps

Basin	Sub basin Area (Square Feet)	Sub basin Area /Total Area	Sub Basin Percolation Rate (cfs)	Pipeline Size (in.) Calculated	Pipeline Size (in.) Design
1	0	0.00	0.0	0.0	8
2	470,867	0.12	7.6	16.7	20
3	752,249	0.19	12.2	21.1	24
4	553,732	0.14	9.0	18.1	20
5	175,182	0.04	2.8	10.2	12
6	723,389	0.18	11.7	20.7	24
7	564,981	0.14	9.1	18.3	20
8	251,996	0.06	4.1	12.2	16
9	253,227	0.06	4.1	12.3	16
10	267,995	0.07	4.3	12.6	16
11	0	0.00	0.0	0.0	8
12	0	0.00	0.0	0.0	8
Total	**4,013,618**	**1**	**65**	**48.8**	**54**

Pipe Segment	Sub Basin Percolation Rate (cfs)	Pipeline Size (in.) Calculated	Pipeline Size (in.) Design	Pipe Flow	Length (ft)	Notes
P01	0.0	0.0	8		0	
P02	7.6	16.7	20	Basin 2	130	
P03	12.2	21.1	24	Basin 3	370	
P04	9.0	18.1	20	Basin 4	190	
P05	2.8	10.2	12	Basin 5	160	
P06	11.7	20.7	24	Basin 6	190	
P07	9.1	18.3	20	Basin 7	140	
P08	4.1	12.2	16	Basin 8	160	
P09	4.1	12.3	16	Basin 9	150	
P10	4.3	12.6	16	Basin 10	550	
A	65	48.8	54	Total	180	
B	57.4	45.9	48	Total - Basin 2	520	
C	48.4	42.1	48	Total - Basin 2,4	980	
D	36.7	36.7	42	Total - Basin 2,4,6	1100	
E	27.5	31.8	36	Basins 3,5,8,9,10	1060	
F	23.2	29.2	30	Basins 3,5,8,9	60	
G	19.1	26.5	30	Basins 3,5,8,9	580	
					6,520	

Pipe Size (in.)	Unit Cost $/LF-dia	Total Length (ft)	Cost
8	$24	0	$0
12	$20	160	$38,400
16	$18	860	$247,680
20	$18	460	$165,600
24	$16	560	$215,040
30	$16	640	$307,200
36	$16	1,060	$610,560
42	$16	1,100	$739,200
48	$16	1,500	$1,152,000
54	$16	180	$155,520
Total		**6,520**	**$3,631,000**

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Appendix L

Engineering Report Outline

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City of Los Angeles
Proposed Groundwater Recharge (GWR) Project
Draft Engineering Report Outline 2/28/12
(Text in Blue Denotes Additions per the November 2011 Draft GWR Regulations)

Engineering Report Sections
Executive Summary
1. Project Overview 1.1. Background 1.2. GWR master planning program 1.3. Public outreach and coordination effort 1.4. Independent Advisory Panel scope of work and members (and any completed work at the time the report is submitted) 1.5. Environmental compliance (status of CEQA/NEPA) 1.6. Project goals (specific for this project, how it fits in with the GWR Master Planning Report, phases) 1.7. Purpose of this report
2. Project Participants and Regulations 2.1. Project participants 2.2. Regulatory Requirements 2.2.1. California Department of Public Health (CDPH) requirements 2.2.2. Regional Water Quality Control Board (RWQCB) requirements 2.3. State Water Resources Control Board (SWRCB) requirements
3. Project Facilities 3.1. Donald C. Tillman Water Reclamation Plant (DCTWRP) - description and location of facilities, design criteria, plans, reliability features, standby units, standby power 3.2. Full Advanced Treatment (FAT) Plant option located at DCTWRP - description and location of facilities, design criteria, plans, reliability features, standby units, standby power 3.2.1. Reverse osmosis membrane criteria and performance monitoring 3.2.2. Advanced oxidation process design option and performance monitoring 3.3. Preventive maintenance program for treatment facilities 3.4. Recycled water transmission facilities 3.5. Recharge facilities (including cross-connection prevention measures) 3.6. Facility phasing (if any)
4. Source Wastewater 4.1. Industrial pretreatment and source control program 4.1.1. Description of program 4.1.2. Compliance with CDPH draft groundwater recharge regulations 4.2. Source raw wastewater characteristics – flows and quality (5 years of data)
5. Pathogenic Microorganism Control 5.1. Identification of treatment barriers and performance monitoring to achieve 12-log enteric virus reduction, 10-log Giardia cyst reduction, and 10-log Cryptosporidium reduction
6. Response Retention Time 6.1. Information on the amount of time recycled water will be retained underground to respond to treatment failures and implement appropriate response actions
7. Recycled Water Quality 7.1. DCTWRP's water quality (5 years of data) 7.2. AWTP water quality – results of pilot tests, basis for AWTP water quality 7.2.1. Total nitrogen (TN) - requirement and anticipated AWTP TN 7.2.2. Total organic carbon (TOC) – requirement and anticipated AWTP TOC

Engineering Report Sections
7.2.3. Title 22 constituents – requirements and anticipated AWTP water quality 7.2.4. Other Basin Plan objectives – requirements and anticipated AWTP water quality 7.2.5. Other relevant constituents – anticipated AWTP water quality
8. Diluent Water 8.1. Sources (native water and watershed descriptions, delivery method) 8.2. Water quality (drinking water standards and Basin Plan objectives – 5 years of data) 8.3. Source water evaluations
9. Recharge Basin Operations and Maintenance 9.1. Delivery/conveyance of recharge sources 9.2. Recharge basin area land uses 9.3. Recharge rates, capacities, storage volumes, plans for maintenance/offline/cleaning periods 9.4. Any seasonal restrictions
10. Groundwater Basin 10.1. Description of the existing groundwater basin (location, physical features, surface water, groundwater supplies/extractions, land uses, climate) 10.2. Existing hydrogeology (aquifers, existing recharge supplies, extractions, water supply uses) 10.3. Existing water budget including usable storage capacity of the groundwater basin 10.4. Water rights 10.5. Existing water quality (5 years of data) 10.5.1. General basin water quality conditions 10.5.2. Specific areas of contamination 10.6. Information on future pumping, centralized and/or well head treatment
11. Domestic Water Supply Production Wells 11.1. Location, distances from the recharge sites, depths, screened intervals/aquifers, capacities within 10 years of the GWR project based on groundwater flow directions and velocities (both public permitted wells and private wells used for drinking, irrigation or industrial use) 11.2. Closest domestic well to each recharge site (both public permitted wells and private wells used for drinking, irrigation or industrial use) 11.3. Water quality (5 years of data) 11.4. Ownership 11.5. Existing remediation projects 11.6. San Fernando Basin Groundwater Treatment Complex
12. Groundwater Recharge Impacts 12.1. Regional geologic and hydrogeologic framework 12.1.1. Description of other existing or proposed GWR projects that could impact the basin (no other projects) 12.1.2. An estimate of the cumulative impact on water quantity and quality with and without the proposed GWR project 12.2. Impact evaluation methodology (modeling) 12.3. Description of the Response Retention Time "control zone", including how it will be managed/maintained including localized pumping, and how the City will prevent/confirm with CDPH and County Health that new wells will not be drilled in this area 12.4. Predicted recycled water retention time (planning method or tracer testing) 12.5. Recycled Water Contribution 12.5.1. Diluent water credit method 12.5.2. Predicted initial RWC at the Hansen Spreading Grounds and how it will be met 12.5.3. Plans for increasing RWC , how requirements will be met, and method for determination 12.6. Anti-degradation assessment 12.6.1. Predicted groundwater quality post recharge

Engineering Report Sections
12.6.2. Utilization of available assimilative capacity of basin 12.7. Impact of the GWR project on contaminant plumes 12.8. Potential for the GWR project to change the geochemistry of an aquifer causing the dissolution of contaminants
13. Proposed Monitoring Program 13.1. Recycled water, both DCTWRP and the AWTP (TOC, advanced oxidation performance surrogates, pathogen performance parameters, Title 22 constituents, priority pollutants, CDPH designated chemicals with notification levels (NLs), CDPH designated chemicals for source control performance, chemicals of emerging concern (CECs) including those specified by the SWRCB per the Recycled Water Policy and by CDPH, other Basin Plan objectives) 13.2. Monitoring wells 13.2.1. Siting and design – locations, distances from the recharge sites, depths, screened intervals/aquifer 13.2.2. Background water quality 13.2.3. Existing wells for nitrogen, TOC, regulated contaminants, Priority Pollutants, NLs specified by CDPH, anything from the source control assessment, and indicator compounds specified by CDPH and RWQCB (see CDPH website under FAQ), Basin Plan objectives. 13.2.4. Monitoring wells – at least two samples per well for nitrogen, TOC, regulated contaminants, Priority Pollutants, NLs specified by CDPH, anything from the source control assessment, and indicator compounds specified by CDPH and RWQCB (see CDPH website under FAQ), Basin Plan objectives. 13.3. Monitoring well sampling program (nitrogen, TOC, regulated contaminants, Priority Pollutants, NLs specified by CDPH, anything from the source control assessment, and indicator compounds specified by CDPH and RWQCB (see CDPH website under FAQ), Basin Plan objectives). 13.4. Diluent water sampling program (nitrogen, TOC, regulated contaminants, Priority Pollutants, NLs specified by CDPH, anything from the source control assessment, and indicator compounds specified by CDPH and RWQCB (see CDPH website under FAQ), Basin Plan objectives).
14. General Operations Plan 14.1. AWTP 14.2. Diluent water distribution and actions if not available 14.3. Training program (AWTP and recharge facilities) 14.4. Contingency Plans 14.4.1. Recycled water that does not meet water quality requirements, pathogen performance, FAT criteria 14.4.2. Upset at DCTWRP 14.4.3. Upset at AWTP 14.4.4. Source control 14.4.5. Power failure 14.4.6. Basin operation, emergency pipeline drains 14.4.7. Work plan for alternative water source/treatment mechanism if project negatively impacts groundwater so it cannot be used for drinking 14.4.8. Reporting plan for emergencies
Appendix – Summary of Background Studies (for the GWR project that have been conducted prior the submittal of the Engineering Report)

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Appendix M

Integrated Alternatives Development and Analysis TM

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Integrated Alternatives Development and Analysis TM

Prepared by:

RMC in association with CDM Smith

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Technical Memorandum

Title:	**Integrated Alternatives Development and Analysis TM**
Prepared For:	John Hinds, Project Manager, LADWP Doug Walters, Project Manager, BOS
Prepared by:	Jennifer Thompson, Task 1 Lead, CDM Smith Rob Morrow, Task 2 Co-Lead, RMC Heather Boyle VanMeter, Deputy Project Manager, CDM Smith Evelyn You, Task 1 Project Engineer, CDM Smith Arthur Goh, CDM Smith Joe Webb, CDM Smith
Reviewed by:	Tom Richardson, Project Manager, RMC Marilyn Bailey, RMC
Date:	March 2012
Reference:	Task 2b: Non Potable Reuse Master Plan and Project Management Task 2.9: Integrated Alternatives Development and Analysis

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Executive Summary

The Los Angeles Department of Water and Power (LADWP), in partnership with the Los Angeles Department of Public Works, Bureau of Sanitation (BOS), and Bureau of Engineering (BOE), developed the Recycled Water Master Planning Documents (RWMP). The RWMP documents include the development and evaluation of several integrated alternatives – strategies that take into account forward-looking groundwater replenishment (GWR) options as well as the more familiar form of recycling water for non-potable reuse (NPR) purposes such as irrigation and industry.

The Final Integrated Alternatives Development and Analysis (IAA) Technical Memorandum documents a thorough examination of alternatives that integrate multiple recycled water management strategies, satisfy master planning objectives, and would meet the City's goals for increasing the use of recycled water.

LADWP's 2010 Urban Water Master Plan (UWMP) includes a near-term goal to develop 59,000 AFY of recycled water by 2035 as a sustainable source of local water. Of this amount, approximately 8,000 AFY is currently used for non-potable reuse and barrier supplement in the Dominguez Barrier Gap. An additional 11,350 AFY of proposed NPR projects are in development. The focus for the near-term, therefore, is to develop the remaining 39,650 AFY of recycled water in Los Angeles.

The original recycled water goal for the RWMP was 50,000 AFY, which was established before the completion of the 2010 UWMP. The recycled water goal was increased to 59,000 AFY with the issuance of the 2010 UWMP. The integrated alternatives analysis was initially focused on determining the balance of GWR and NPR to achieve 30,650 AFY, so that when combined with the 19,350 AFY of existing and planned NPR demands would achieve an overall recycled water goal of 50,000 AFY. While the themes and integrated alternatives of this Technical Memorandum were developed to meet the 50,000 AFY goals, it should be noted that the resulting findings and conclusions would not change if the alternatives were based on 59,000 AFY.

This Integrated Alternatives Analysis TM includes preliminary capital and operations and maintenance (O&M) cost estimates to help determine the split of GWR and NPR to meet the City's recycled water goals. To provide consistency between the initial RWMP documents, the following documents were updated to include the same cost estimates:

- Site Assessment TM
- Integrated Alternatives Development and Analysis TM (this document)
- Integrated Alternatives Analysis – Preliminary Cost Summary

Note that the GWR and NPR project costs were developed in more detail as part of the GWR and NPR Master Planning Reports, respectively. The most current GWR and NPR project costs developed as part of the RWMP are included in the GWR and NPR Master Planning Reports, respectively, and would not change the outcome of this analysis.

ES.1 Overview Statement

For this technical study, independent recycled water management strategies – such as groundwater replenishment (GWR), non-potable reuse (NPR), maximum reuse, and satellite reuse -- were combined to develop integrated alternatives with the goal of replacing potable water supplies with recycled water.

The integrated alternatives analysis compared different alternatives formed by several overarching themes. Each of the themes includes varying amounts of GWR in the San Fernando Basin (from 15,000 AFY to 30,000 AFY).

Comparing alternatives with varying GWR capacities gave insight as to what combination of GWR and NPR projects may best meet the City's recycled water goals. Ultimately, the analysis results formed the basis for planning recommendations for the Groundwater Replenishment and Non-Potable Reuse Master Planning Reports.

The organization of the draft Integrated Alternatives Development and Analysis Technical Memorandum is as follows:

Section 1 - Introduction

Section 2 - Integrated Alternatives Analysis Approach

Section 3 - Description of Alternatives

Section 4 - Evaluation Criteria and Performance Measures

Section 5 - Evaluation Results

Section 6 - Key Findings and Conclusions

Section 7 - References

Appendices

The results from the Integrated Alternatives Development and Analysis TM were the ranking of alternatives from highest to lowest, based upon meeting the objectives, performance criteria, and sensitivity tests. Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April 2011. Updated costs are shown in the GWR and NPR Master Planning Reports. Two other studies of similar technical detail and investigative scope were conducted concurrently with the integrated alternatives development and analysis: the assessment of potential sites for GWR projects and a GWR treatment pilot study. These three studies provided the technical foundation for the Groundwater Replenishment Master Planning Document.

ES.2 Integrated Alternatives Analysis Approach

Planning Objectives

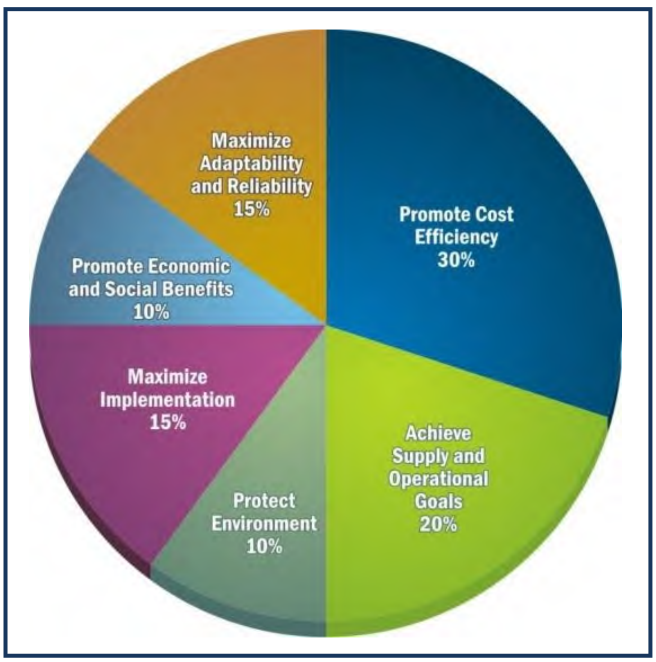
The studies for each of the planning documents mentioned in Section ES.1, including the Integrated Alternatives Development and Analysis, were based upon a common set of planning objectives, as follows.

Incorporating guidance from the Recycled Water Advisory Group (RWAG), two threshold objectives were established, which had to be met regardless of the alternative:

- **Threshold Objective 1** – Meet all water quality regulations and health and safety requirements, and use proven technologies.
- **Threshold Objective 2** – Provide effective communication and education about the recycled water program.

In addition to the threshold objectives, six additional recycled water planning objectives were established. These are shown in Figure ES-1 along with their relative weights.

Figure ES-1: Objectives Weighting for the Integrated Alternatives Analysis



Alternative Evaluation Approach

The integrated alternatives are composed of different project options, which are single-focused concepts such as new supplies (e.g., expansion of existing water reclamation plants, additional level of treatment, and/or new satellite plants) and new conveyance/distribution facilities to meet new demands (e.g., NPR and GWR). Individual project options cannot fully achieve all the RWMP goals; instead, project options form the building blocks for each of the integrated alternatives.

Figure ES-2 illustrates the approach used to develop and evaluate the integrated alternatives.

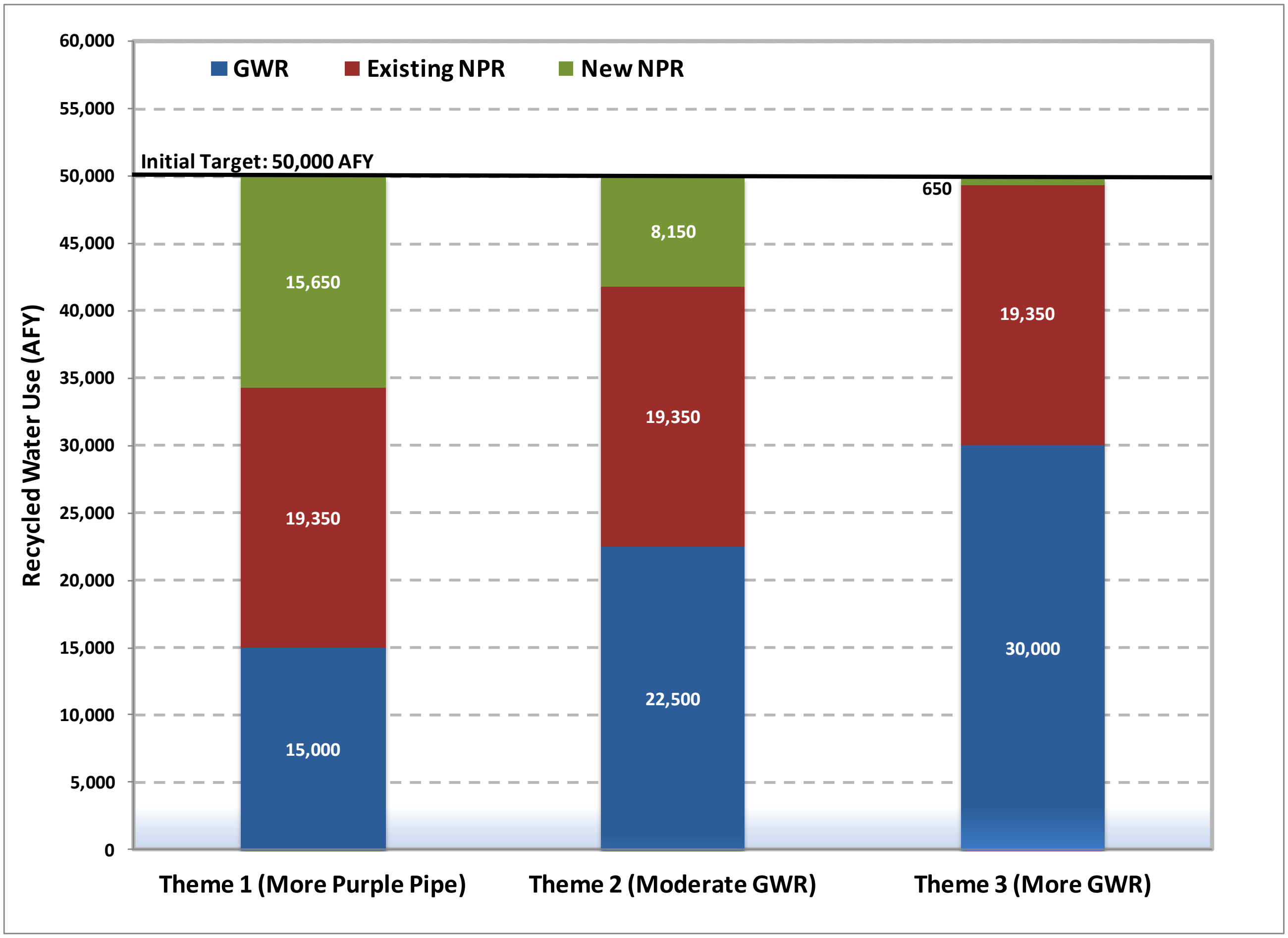
Figure ES-2: Integrated Alternatives Development and Analysis Approach

Themes

As shown in Figure ES-3, three themes were established to guide the development of integrated alternatives. Themes included the following:

- **Theme 1**: More Purple Pipe (NPR): GWR = 15,000 AFY
- **Theme 2**: Moderate GWR: GWR = 22,500 AFY
- **Theme 3**: More GWR: GWR = 30,000 AFY

Figure ES-3: Themes for the Integrated Alternatives Analysis

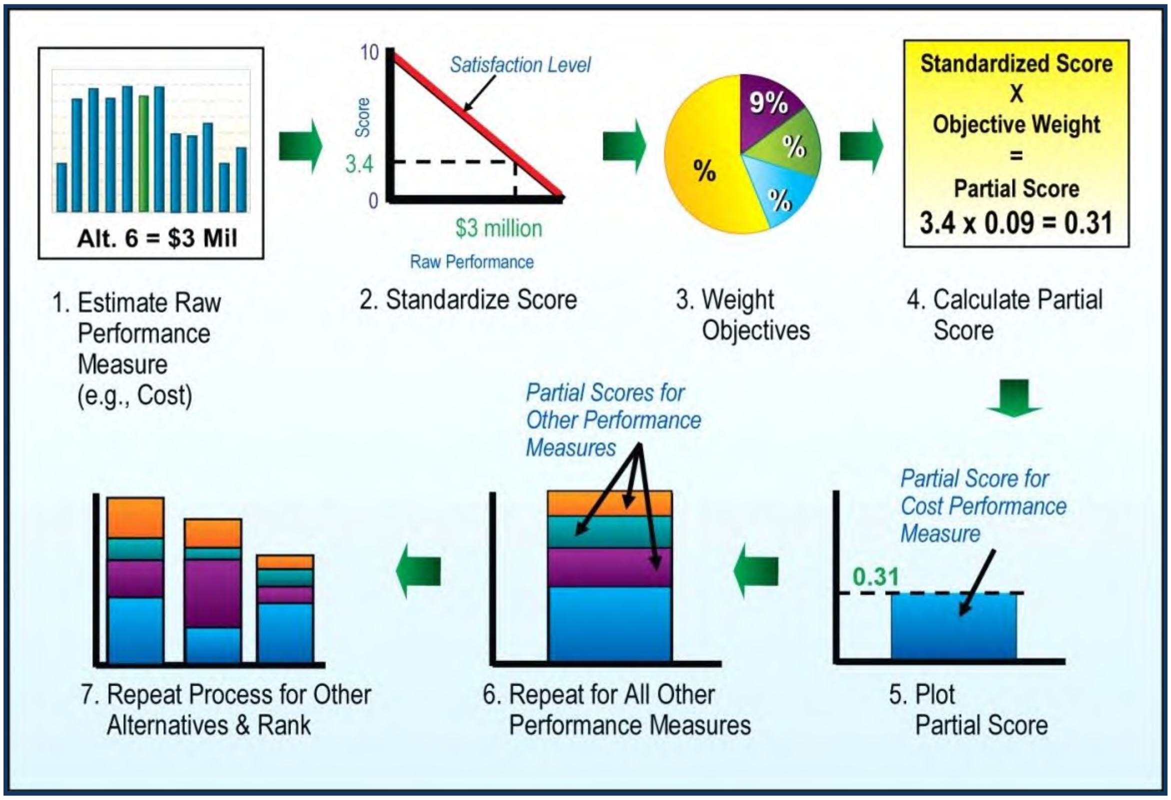


Note: The original recycled water goal for the RWMP was 50,000 AFY, which was established before the completion of the 2010 UWMP. The recycled water goal was increased to 59,000 AFY with the issuance of the 2010 UWMP. The integrated alternatives analysis was initially focused on determining the balance of GWR and NPR to achieve 30,650 AFY, so that when combined with the 19,350 AFY of existing and planned NPR demands would achieve an overall recycled water goal of 50,000 AFY. While the themes and integrated alternatives of this Technical Memorandum were developed to meet the 50,000 AFY goals, it should be noted that the resulting findings and conclusions would not change if the alternatives were based on 59,000 AFY.

Decision Model Process

Figure ES-4 below illustrates the seven-step evaluation process that was performed for each alternative.

Figure ES-4: Multi-Attribute Rating Technique for Evaluating Alternatives



The process of evaluating multiple alternatives for multiple criteria is extremely complex. Planners use computer software to do the evaluation accurately and to help support the selection of a preferred alternative. For this evaluation, the planners used a multi-attribute decision model (computer software) called Criterium® DecisionPlus® (CDP).

Briefly, the seven steps can be described as follows:

1. **Estimate the raw performance measure.** The RWMP team determined how to measure performance, for example, tons of CO_2 emissions was used as a quantitative measure of the objective Protect Environment; while other objectives were evaluated using qualitative scores 1 to 5. In the first step, the CDP was used with this input to estimate a raw score for each alternative for further refinement.

2. **Standardize the score.** Because the performance measures vary significantly – dollars, tons, numeric score of 1 – 5, etc. – the next step was to standardize the raw performance measures into comparable numeric scores. This enables the scores to be additive (the higher the score, the better the performance).

3. **Weight the objectives.** Early in the planning process, LADWP and BOS, RWAG members, and others participated in a weighting exercise. This resulted in the weighted percentages for each planning objective shown in Figure ES-1. The CDP weights evaluation criteria in terms of their importance to the overall RWMP objectives.

4. **Calculate a partial score.** A standardized score (step 2) was multiplied by its relative weight of importance (step 3) to arrive at a partial score for a particular alternative.

5. **Plot the partial score.** The partial score (step 4) was plotted on a graph to represent the results of the individual performance measure for the alternative.

6. **Repeat for all other performance measures.** Steps 1 – 5 were repeated for all of the performance measures until a total score for the alternative was calculated.

7. **Repeat the process for other alternatives and rank them.** Steps 1 – 6 were repeated for each of the alternatives. This produced graphs showing the total score for each alternative. Then the total score for each alternative was compared and ranked to other alternatives.

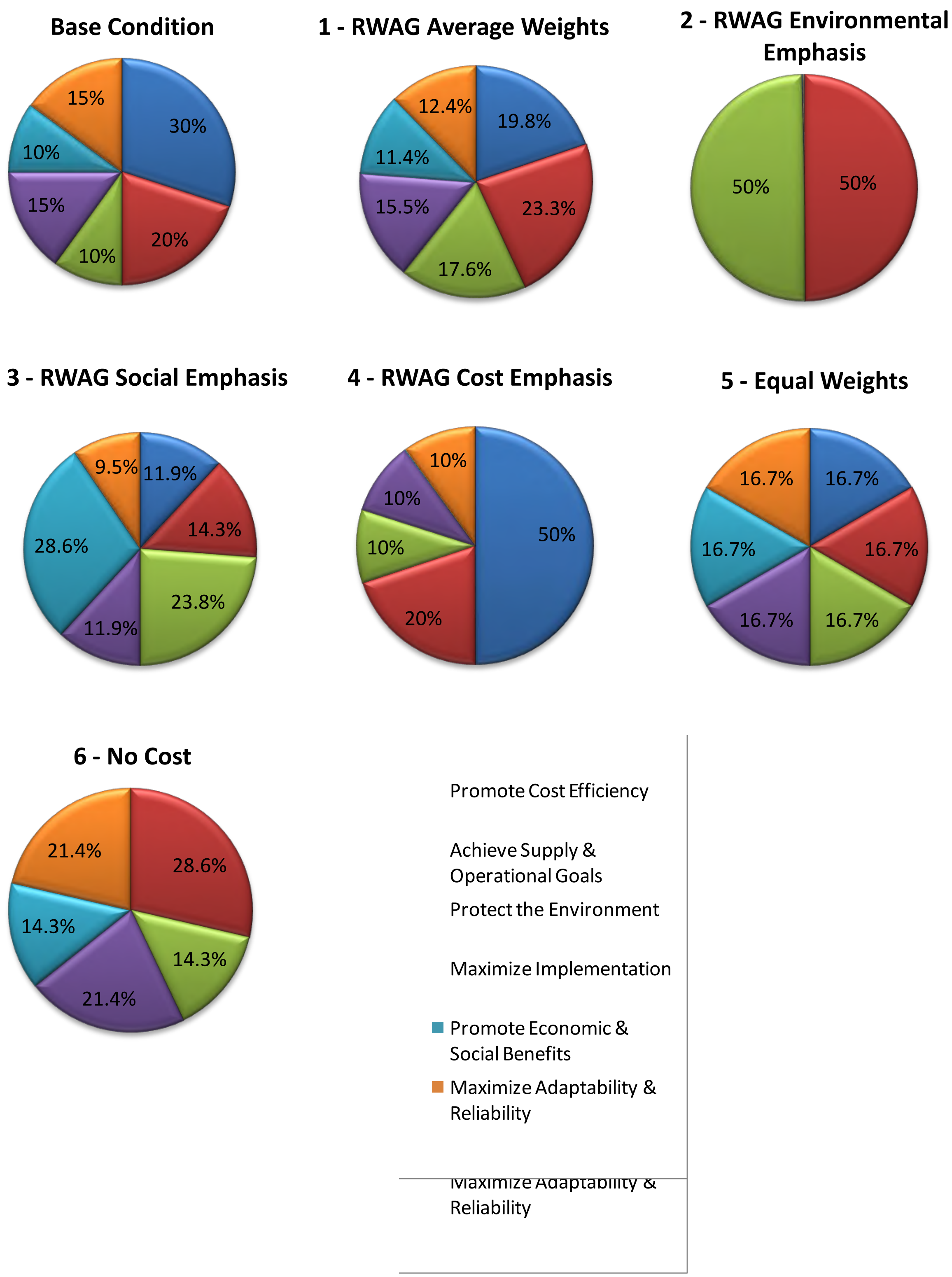
Sensitivity Analysis

Sensitivity analyses helped verify the robustness of the initial alternatives rankings. Using input from RWAG members, six sensitivity runs were developed by the RWMP team:

1. Average weights
2. Environmental emphasis
3. Social emphasis
4. Cost emphasis
5. Equal weights for all objectives
6. Cost = 0% weight (cost not considered in the comparison of alternatives)

The modified objectives weightings for the sensitivity runs are displayed graphically in Figure ES-5.

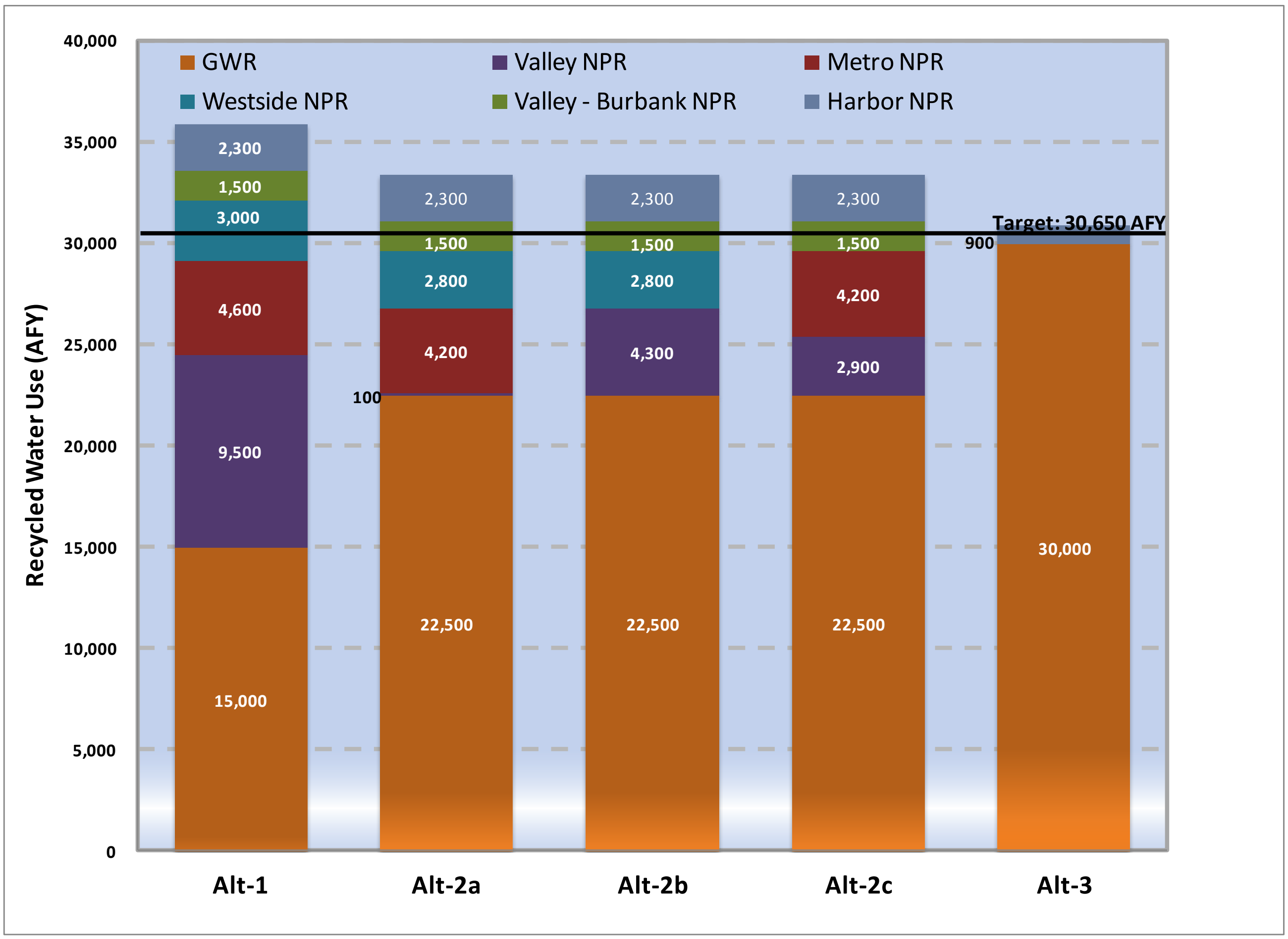
Figure ES-5: Modified Objectives Weightings for Sensitivity Analysis



ES.3 Alternatives Development and Evaluation

Candidate alternatives were developed based upon the three Themes discussed earlier. The alternatives combined GWR and NPR projects to meet the different targets established by the themes. Figure ES-6 compares each of the alternatives for the volume of GWR and NPR that would be distributed to the seven service areas and sub-areas analyzed.

Figure ES-6: Comparison of Alternatives -- GWR and NPR by Service Area



Note: Amounts shown above do not include existing and planned non-potable reuse and barrier supplement projects that total an average annual reuse of 19,350 AFY.

The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

GWR Assumptions in Alternatives

All alternatives include GWR in varying capacities. For this Technical Memorandum, it was assumed that GWR included the following facilities:

- New Advanced Water Purification Facility (AWPF), treating DCTWRP tertiary product via microfiltration and reverse osmosis (MF/RO) and providing advanced oxidation via ultra violet (UV) light and hydrogen peroxide.
- Existing/New Conveyance pipelines from AWPF to Hansen and Pacoima Spreading Grounds for replenishment into the San Fernando Groundwater Basin
- Existing Extraction wells to pump groundwater from San Fernando Groundwater Basin to drinking water distribution system.[1]

Another key assumption for this TM is that the potential location for the AWPF is either the City's DCTWRP or Valley Generating Station (VGS).

A total of 10 near-term integrated alternatives were evaluated, which are described in Table ES-1, Alternatives, Summary of Recycled Water Volume by Component.

[1] As a separate project to improve the groundwater quality in the San Fernando Basin, the City is planning the San Fernando Basin Groundwater Treatment Complex. Since this project is being pursued in parallel to the GWR Project, the costs for this program are not included in this integrated alternatives analysis.

Table ES-1: Alternatives – Summary of Recycled Water Volume by Component

		DCT Alternatives					VGS Alternatives				
		Alternative 1	Alternative 2			Alternative 3[b]	Alternative 1	Alternative 2			Alternative 3[b]
		Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
		(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)
GWR	Valley	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000
NPR	Valley	9,500	100	4,300	2,900	0	9,500	100	4,300	2,900	0
	Metro	4,600	4,200	0	4,200	0	4,600	4,200	0	4,200	0
	Westside	3,000	2,800	2,800	0	0	3,000	2,800	2,800	0	0
	Valley-Burbank	1,500	1,500	1,500	1,500	0	1,500	1,500	1,500	1,500	0
	Harbor	2,300	2,300	2,300	2,300	900	2,300	2,300	2,300	2,300	900
	NPR Total	20,900	10,900	10,900	10,900	900	20,900	10,900	10,900	10,900	900
	NPR Total – With Contingency	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700
Total Without Contingency		35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900
Total With Contingency[a]		30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700

Footnote:

a. *The total is rounded from 30,650 AFY to 30,700 AFY for simplicity.*

b. *The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.*

ES.4 Evaluation Criteria and Performance Measures

The RWMP team developed criteria and performance measures to evaluate the alternatives identified in the previous section. Table ES-2 lists the evaluation criteria and performance measures that were used in the CDP decision-model to analyze and rank the integrated alternatives.

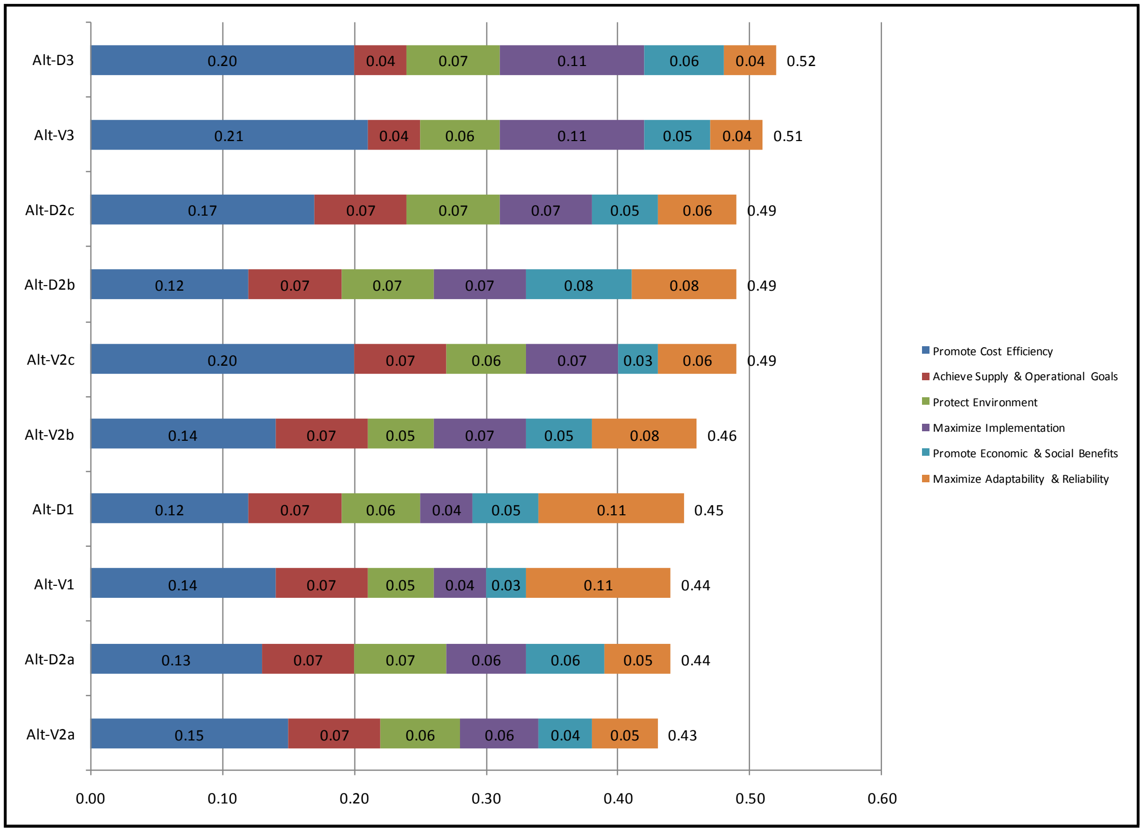
Table ES-2: Planning Objectives and Evaluation Criteria and Performance Measures

Objectives	Evaluation Criteria and Performance Measures
Objective 1: Promote Cost Efficiency	▪ Unit capital cost ▪ Unit annual operations & maintenance (O&M) cost
Objective 2: Achieve Supply and Operational Goals	▪ Reduction in imported water ▪ Water system flexibility ▪ Overall wastewater system benefits 1. Hyperion Treatment Plant (HTP) service area collection system (sewer system) benefits 2. HTP treatment impacts 3. Terminal Island Water Reclamation Plant benefits
Objective 3: Protect Environment	▪ Groundwater quality ▪ Greenhouse gas emissions
Objective 4: Maximize Implementation	▪ Public acceptance ▪ Institutional complexity ▪ Permitting ▪ Implementation complexity ▪ Construction impacts
Objective 5: Promote Economic and Social Benefits	▪ Temporary job creation ▪ Permanent job creation ▪ Environmental justice
Objective 6: Maximize Adaptability and Reliability	▪ Recycled water demand reliability ▪ Water supply reliability

ES.5 Evaluation Results

The chart below shows the results of the CDP decision-model evaluation to analyze and rank the integrated alternatives. Figure ES-7 shows the scores and ranking of the alternatives.

Figure ES-7: Alternatives Scoring (In Order of Ranking)



Sensitivity Analysis

Sensitivity analyses were conducted on all alternatives using the CDP decision model. The sensitivity runs involved deliberately altering the objectives weightings to determine sensitivity to the specific objectives. Table ES-3 summarizes the Integrated Alternatives scoring for base and sensitivity runs. The left column of the table lists the objective weighting that was altered to examine sensitivity to that objective. Ideally, sensitivity runs would have no effect on the highest ranked alternatives, meaning that the alternative was not sensitive to different interests and scenarios.

Table ES-3: Summary of Alternatives Scoring for the Base Run and Sensitivity Runs

	CDP Rankings									
	Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
0 Base	7	8	3	3	1	8	10	6	3	2
1 RWAG Average Weights	7	8	2	4	1	10	9	5	5	3
2 RWAG Environmental Emphasis	4	1	3	1	5	9	5	8	7	10
3 RWAG Social Emphasis	8	5	3	3	1	10	9	6	7	2
4 RWAG Cost Emphasis	9	10	8	4	3	5	5	5	1	2
5 Equal Weights	5	7	1	3	2	9	9	6	7	3
6 No Cost	2	6	1	4	4	7	10	3	9	7
Average Ranking	6.0	6.4	3.0	3.1	2.4	8.3	8.1	5.6	5.6	4.1
Total Number of Times Ranked No.1	0	1	2	1	3	0	0	0	1	0

Color Coding of Rankings:	1	2	3	4	5	6	7	8	9	10

Highest Ranked ← → Lowest Ranked

ES.6 Key Findings and Results

The key findings from the CDP evaluation of Integrated Alternatives are summarized below:

Alternatives That Ranked Higher Than Others

Alternatives D3, D2b, D2c and V3 consistently ranked highest among all alternatives evaluated. Alternatives D3 and V3 (More GWR):

- Rank strongly due to their having the lowest capital costs, nearly the lowest O&M costs, and the highest operational flexibility.
- Do not require any agreements with outside agencies, have the least amount of individual NPR projects, and the lowest potential construction impacts (e.g., miles of pipe through streets).
- Have the lowest temporary job creation (estimated as a function of capital costs)
- Have the highest estimated permanent jobs created.
- Impact the least number of low-income and/or minority census tracts with permanent above-grade facilities.
- Are considered to be less drought-proof than other alternatives since D3 and V3 have the lowest NPR irrigation quantity. Title 22 recycled water is considered a drought-proof water supply because is not subject to water use restrictions.
- Do not have the highest scores for protecting the environment, primarily because of Greenhouse Gas emissions related to pumping.

Alternatives That Ranked Lower Than Others

Alternatives V1, V2a, D2a, and D1 ranked lowest among all alternatives evaluated. These alternatives would achieve 15,000 AFY (V1 and D1, More Purple Pipe) and 22,500 AFY (V2a and D2a, Moderate GWR) respectively. They consistently ranked low due to their emphasis on NPR project options in the dense and built-up Metro and Westside service areas, which increase the amount of recycled water pipelines required.

Conclusion: More GWR (Alternative D3) is Best

Based on this integrated analysis, it was concluded that More GWR (Alternative D3) is best, since it has the lowest cost (capital and operation and maintenance (O&M) costs) and the fewest hurdles for implementation.

Therefore, it is recommended that the GWR Master Planning Report be developed with facilities planning for the more aggressive GWR alternative (30,000 AFY). But, to recognize the supply reliability benefits and potential ability to implement smaller individual projects as funding becomes available, it is also recommended that the NPR Master Planning be developed identifying potential NPR projects to be developed in parallel.

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1. Introduction

The purpose of this TM is to combine independent project options (e.g., groundwater replenishment (GWR), non-potable reuse (NPR), maximum reuse, and satellite reuse) into integrated alternatives with the goal of replacing imported water with recycled water. These integrated alternatives will be evaluated to understand their benefits and tradeoffs, and ultimately establish planning recommendations for the GWR and NPR Master Planning Reports.

The initial basis for GWR and NPR Master Planning was to provide a framework to achieve 50,000 AFY, tentatively by 2030. Therefore, the analysis in this TM was based upon achieving this goal. However, the City's 2010 UWMP calls for 59,000 AFY of imported water to be replaced by recycled water by 2035, which serves as the updated recycled water goal for the RWMP. While the alternatives in this TM were developed to meet the 50,000 AFY goals, it should be noted that the resulting findings and conclusions would not change if the alternatives were based on 59,000 AFY. Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April 2011. Updated costs are shown in the GWR and NPR Master Planning Reports.

The City has existing[2] non-potable reuse and barrier supplement projects with an average annual reuse of 8,000 AFY and has planned non-potable reuse projects that are under construction or in planning/design with an average annual reuse of 11,350 AFY. The total imported water offset capacity of these recycled water projects is 19,350 AFY. Therefore, the goal of alternatives developed as part of this TM is to offset the remaining 39,650 AFY of imported water.

The integrated alternatives analysis seeks to compare different alternatives that are formed by several overarching themes, where the different focus of each theme provides opportunities for understanding tradeoffs. In particular, each theme includes varying amounts of GWR in the San Fernando Valley to provide insight as to what combination of GWR and NPR may provide the best solution to meet the City's recycled water goals. The alternatives will be compared and ranked according to the RWMP objectives for the City's consideration to achieve the recycled water goals.

This Integrated Alternatives Analysis TM includes preliminary capital and operations and maintenance (O&M) cost estimates to help determine the split of GWR and NPR to meet the City's recycled water goals. To provide consistency between the initial RWMP documents, the following documents were updated to include the same cost estimates:

- Site Assessment TM
- Integrated Alternatives Development and Analysis TM (this document)
- Integrated Alternatives Analysis – Preliminary Cost Summary

Note that the GWR and NPR project costs were developed in more detail as part of the GWR and NPR Master Planning Reports, respectively. The most current GWR and NPR project costs developed as part of the RWMP are included in the GWR and NPR Master Planning Reports, respectively, and would not change the outcome of this analysis.

[2] For the purposes of accounting in this TM, "existing" customers are those that were served as of December 1, 2011.

This Integrated Alternatives Development and Analysis TM is organized into the following sections:

Section 1 – Introduction

Section 2 – Integrated Alternatives Analysis Approach

Section 3 – Description of Alternatives

Section 4 - Evaluation Criteria and Performance Measures

Section 5 – Evaluation Results

Section 6 – Key Findings and Conclusions

Section 7 - References

Appendices

2. Integrated Alternatives Analysis Approach

Due to the complexity of decision-making associated with the integrated alternatives analysis, a detailed evaluation process was developed to enable the comparison of various alternatives using multiple criteria. This section outlines the overall approach for the analysis starting with a review of the RWMP objectives that guide the formation of integrated alternatives followed by the an evaluation process to compare and rank alternatives in how they meet those objectives. This section also describes the framework used for the detailed evaluation, including the decision model process.

2.1 Recycled Water Master Planning Objectives

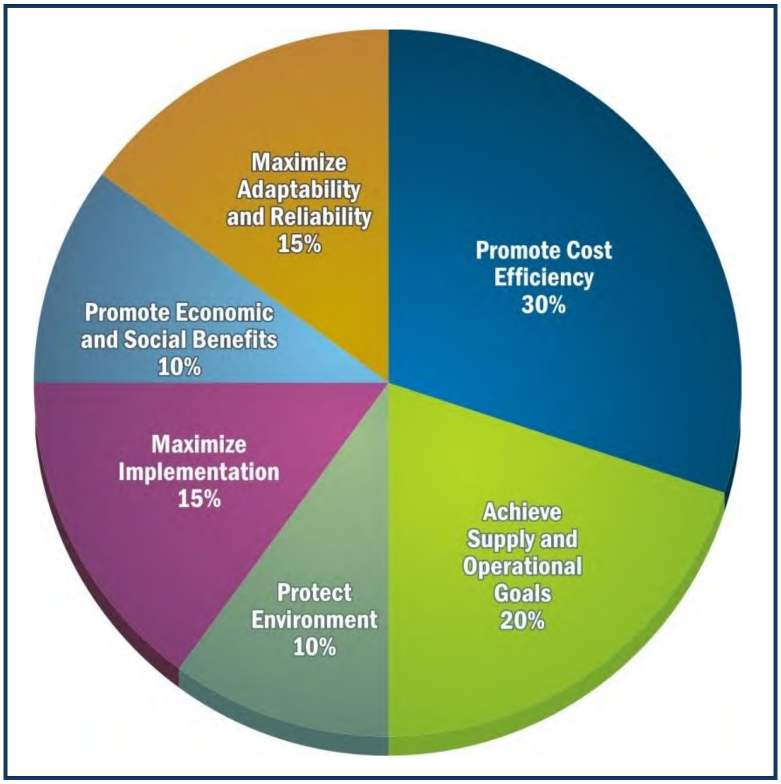
Establishing planning objectives was an early step in the planning process. Objectives support the goals of the RWMP and establish criteria by which alternatives can be compared against each other. Several guidelines were used when establishing objectives. The objectives must be: easy to understand; non-redundant; measureable with evaluation criteria; and, concise in numbers, generally no more than five to eight objectives. It is also important to note that objectives are not solutions. Objectives define what the City is trying to achieve through the RWMP, and solutions (i.e., alternatives) represent how these objectives will be achieved.

The objectives were developed based on guidance from the community Recycled Water Advisory Group (RWAG), which is a group of Los Angeles residents who represent specific community groups and their interests. The RWAG provided feedback about the RWMP throughout the planning Process. The following objectives were developed and used for the RWMP evaluations:

- **Threshold Objective 1** – Meet all water quality regulations and health & safety requirements, and use proven technologies.
- **Threshold Objective 2** – Provide effective communication and education on recycled water program.
- **Objective 1 - Promote Cost Efficiency:** Meet the goals of the recycled water program in a cost-effective manner, considering both City and recycled water customer costs.
- **Objective 2 – Achieve Supply and Operational Goals:** Meet or exceed water supply targets and operational goals established by the City.
- **Objective 3 – Protect Environment:** Develop projects that not only protect the environment, but also provide opportunities to enhance it.
- **Objective 4 - Maximize Implementation:** Maximize implementation by minimizing typical hurdles including institutional complexity, permitting challenges, and maximizing customer acceptance.
- **Objective 5 - Promote Economic and Social Benefits:** Provide economic and social benefits in the implementation and operation of recycled water projects.
- **Objective 6 – Maximize Adaptability and Reliability:** Maximize adaptability and reliability to be able to adapt to uncertainties and to maximize reliability of operations once projects are implemented.

To determine the relative weights of the objectives, the RWMP team established preliminary weightings for the RWMP tasks. The objectives weightings for the integrated alternatives analysis are presented graphically in **Figure 2-1**. The two threshold criteria are not included in this chart because all alternatives need to meet the threshold criteria in order to be considered.

Figure 2-1: Objectives Weighting for the Integrated Alternatives Analysis



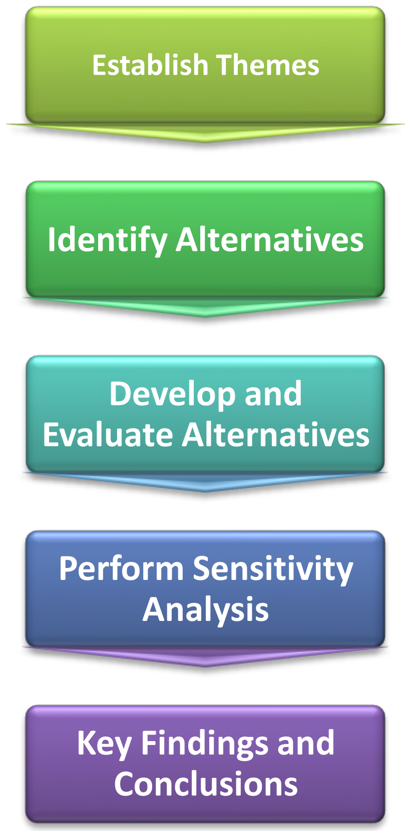
In addition, the City also conducted a weighting exercise with the members of the RWAG at their first meeting in December 2009. The RWAG objectives weightings were used in the sensitivity analysis, which is described in Section 2.3.1.

2.2 Alternatives Evaluation Approach

The integrated alternatives are composed of different project options, which are single-focused concepts such as new supplies (e.g., expansion of existing water reclamation plants, additional level of treatment, and/or new satellite plants) and new conveyance/distribution facilities to meet new demands (e.g., NPR and GWR). These project options were evaluated and documented in the Groundwater Replenishment Master Planning Report (GWR MPR) and the Non-Potable Reuse Master Planning Report (NPR MPR). Individual project options cannot fully achieve all the RWMP goals; instead, project options form the building blocks for each of the integrated alternatives. The following describes the approach used to develop and evaluate the integrated alternatives.

The alternatives evaluation approach is presented in **Figure 2-2** and described in detail in the following steps.

Figure 2-2: Alternatives Development and Evaluation Approach



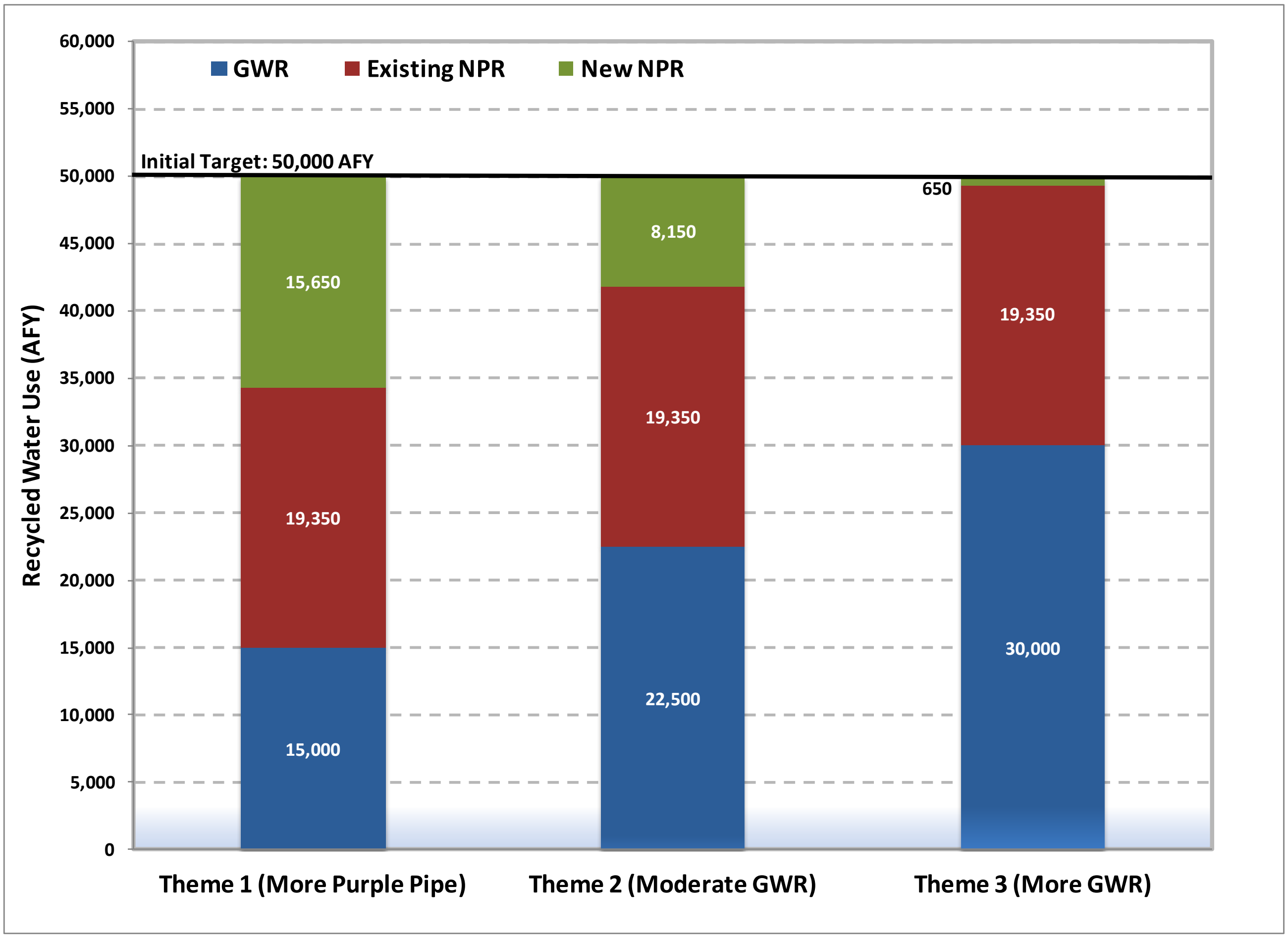
Step 1: Establish Themes

Overarching themes were established to guide the development of alternatives that have different focuses in order to provide opportunities for trade-off comparisons. To evaluate the relative complexity of attaining GWR permitting, three themes with varying GWR capacities were identified to meet the original goal of 30,650 AFY, supplemented by NPR or additional GWR projects:

Theme 1 – "More Purple Pipe (NPR)": GWR = 15,000 AFY
Theme 2 – "Moderate GWR": GWR = 22,500 AFY
Theme 3 – "More GWR": GWR = 30,000 AFY

Figure 2-3 summarizes the themes and Section 3.1 provides additional details.

Figure 2-3: Themes for the Integrated Alternatives Analysis



Step 2: Identify Alternatives

The alternatives are integrated combinations of available project options that represent a means of accomplishing the RWMP goals. Each alternative identified is based on the themes from Step 1. After the main alternatives were identified, different option variations were applied to create more focused scenarios pertaining to different NPR project portfolios and GWR site. See Section 3.2 for more details.

Step 3: Develop and Evaluate Alternatives

After the alternatives were identified in Step 2, further technical assumptions and assessment (e.g., facility sizing, energy costs, etc.) were developed based on the different project options that compose a particular alternative. These performance measures were used as the basis of comparison between the different alternatives with respect to the RWMP objectives described in Section 2.1. For each objective, evaluation criteria (or sub-objectives) were established to further define the meaning of the objectives. A performance measure was defined for each evaluation criterion as a quantitative value to determine how well an alternative meets a given evaluation criteria and objective. See Section 4 for more details on how evaluation criteria and performance measures were assigned to each alternative.

After performance measures were assigned to the alternatives, each alternative was ranked with respect to the objective weighting identified in Section 2.1. See Section 2.3 for more details on the decision model process; see Section 5 for the decision model results.

Step 4: Perform Sensitivity Analysis

After the initial decision model run using the base condition objectives weightings, a series of sensitivity runs were also conducted using the decision model. The sensitivity runs involved altering the objectives' weightings based on the RWAG weightings to verify the robustness of the initial alternatives rankings. If the alternatives rankings change with the sensitivity runs, then this means that the alternative selection was sensitive to that particular element that was emphasized in the sensitivity run. See Section 2.3.1 for more details on the sensitivity analysis approach; see Section 5.3 for the sensitivity analysis results.

Step 5: Key Findings and Preferred Alternatives

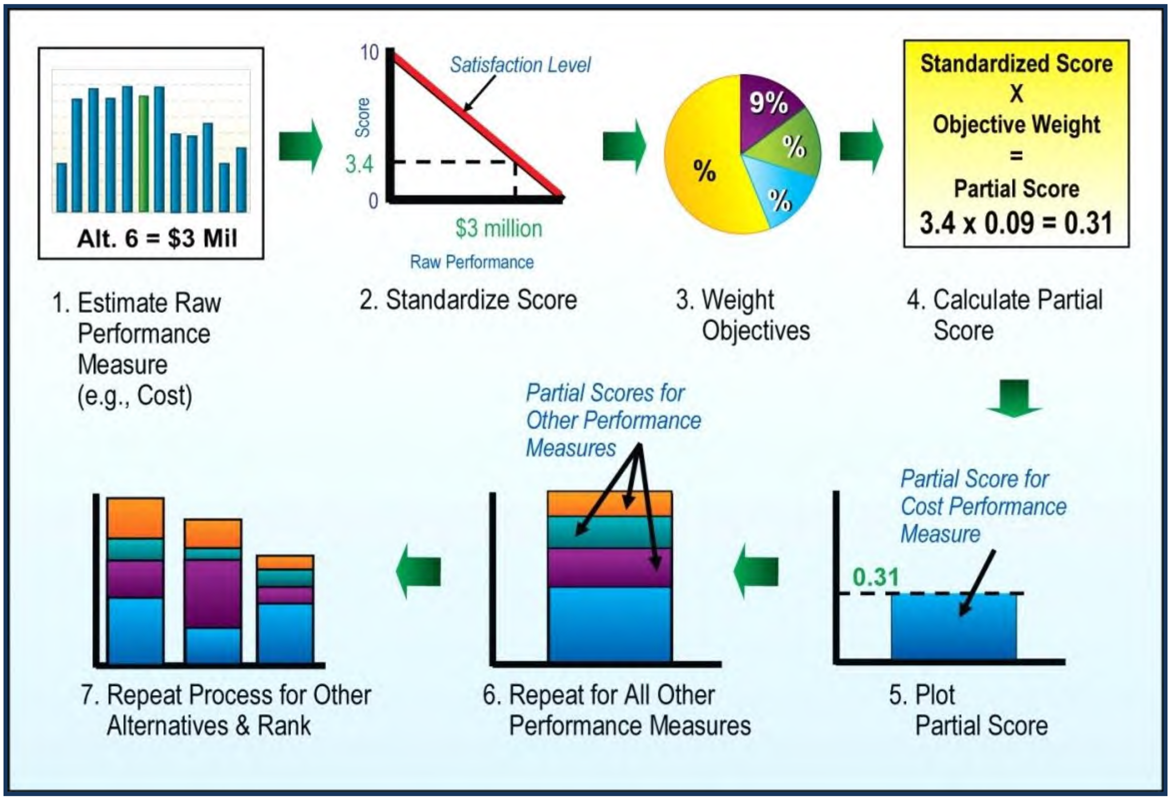
Once the alternatives are ranked using the results of the decision model results and sensitivity analysis, the City can use the key findings discussed in Section 6 and their financial analysis to identify preferred options for moving forward to meet the original 30,650 AFY goal. The timing for the individual projects within the preferred alternative would be refined with the financial analysis.

2.3 Decision Model Process

As stated in Step 3, a decision model based on a multi-attribute rating methodology was developed to support the selection of a preferred alternative. The objectives, evaluation criteria, and performance measures for each alternative were inputs to the decision model. Developing such a decision model is helpful when there are multiple alternatives that can be measured differently against multiple criteria, and when no single alternative clearly performs the best in all areas. In these cases, systematizing the decision process by explicitly defining and weighting criteria and then giving scores to the alternatives for those criteria can make the ultimate decision easier and more objective.

The decision model based on the multi-attribute rating methodology was developed using the commercial software Criterium® DecisionPlus® (CDP). This software was developed by Infoharvest Inc., and was selected to rank the alternatives because of its sophistication, ease of understanding and use, and its ability to conduct sensitivity analyses. There are seven procedures in the multi-attribute rating technique, which are shown in **Figure 2-4**.

Figure 2-4: Multi-Attribute Rating Technique for Evaluating Alternatives



Descriptions of the seven procedures in Figure 2-4 are as follows:

1. Estimate Raw Performance Measure

The engineering analysis provides information about the raw performance of each alternative with respect to each of the criteria. The performance score can either be quantitative or qualitative in nature. For example, the objective to Protect Environment uses both Groundwater Quality evaluation criterion (with a qualitative performance measure based on a numeric scale from 1 to 5 as determined by expert opinion), and Greenhouse Gas Emissions evaluation criterion (with a quantitative performance measure of the metric tons of CO_2 equivalents emissions per year). For quantitative performances measures, a range of possible scores must be set. In the CDP model, the range of possible scores was set from 90% of the lowest score to 110% of the highest score.

2. Standardize Score

Because different criteria are measured in different units (e.g., lifecycle cost estimate is measured in dollars; public acceptance is ranked on a 1 to 5 scale, etc.), it is necessary to standardize the raw performance measures into comparable numeric scores. This ensures that all scores are additive (the higher the score, the better the performance of the alternative). In this example, the lifecycle cost estimate is an inverse function—meaning that the higher the cost, the lower the performance and vice versa. Based on a min-max technique using the capital cost of all alternatives in question, a linear satisfaction curve is generated to measure how the alternative satisfies the objective. As part of the internal process of CDP, the raw performance of a certain cost for an alternative is translated into a standardized score (where the score of 1 indicates the worst performance and the score of 5 indicates the best performance).

3. Weight Objectives

The criteria are weighted in terms of their importance to the overall RWMP objectives as described in Section 2.1.

4. Calculate Partial Score

A standardized score is multiplied by its relative weight of importance in order to get a partial score for a particular alternative.

5. Plot Partial Score

The partial score is then plotted on a graph for an alternative.

6. Repeat for All Other Performance Measures

This procedure is repeated for all of the other criteria for an alternative until a total score for the alternative is calculated.

7. Repeat Process for Other Alternatives & Rank

Finally, the total score for an alternative is compared to the total scores of the other alternatives in order to get a ranking or prioritization for implementation.

2.3.1 Sensitivity Analysis

As described in Step 4, sensitivity analyses were performed to verify the robustness of the initial alternatives rankings. A total of six sensitivity runs were conducted. The variations in objectives weightings for the sensitivity runs were developed based on input from the RWAG and the City. The six sensitivity runs are summarized below.

Sensitivity Runs 1 through 6: Modified Objectives Weighting

Sensitivity Runs 1 through 4 were developed based on input from the RWAG. At the first RWAG workshop in December 2009, the members completed a survey about the weightings for the RWMP objectives to reflect their interests. Based on the input from the RWAG, the following sensitivity runs were developed by the RWMP team:

- *Average Weights:* an average of the inputs on weightings from all RWAG members.
- *Environmental Emphasis:* weightings based on the inputs of RWAG members who felt the environment was their primary concern.
- *Social Emphasis:* weightings based on the inputs of RWAG members who felt that social issues were their chief concern.
- *Cost Emphasis:* weighting based on the inputs of RWAG members who felt that cost issues were their chief concern.

Sensitivity Runs 5 and 6 were developed by the RWMP team to test the alternatives rankings:

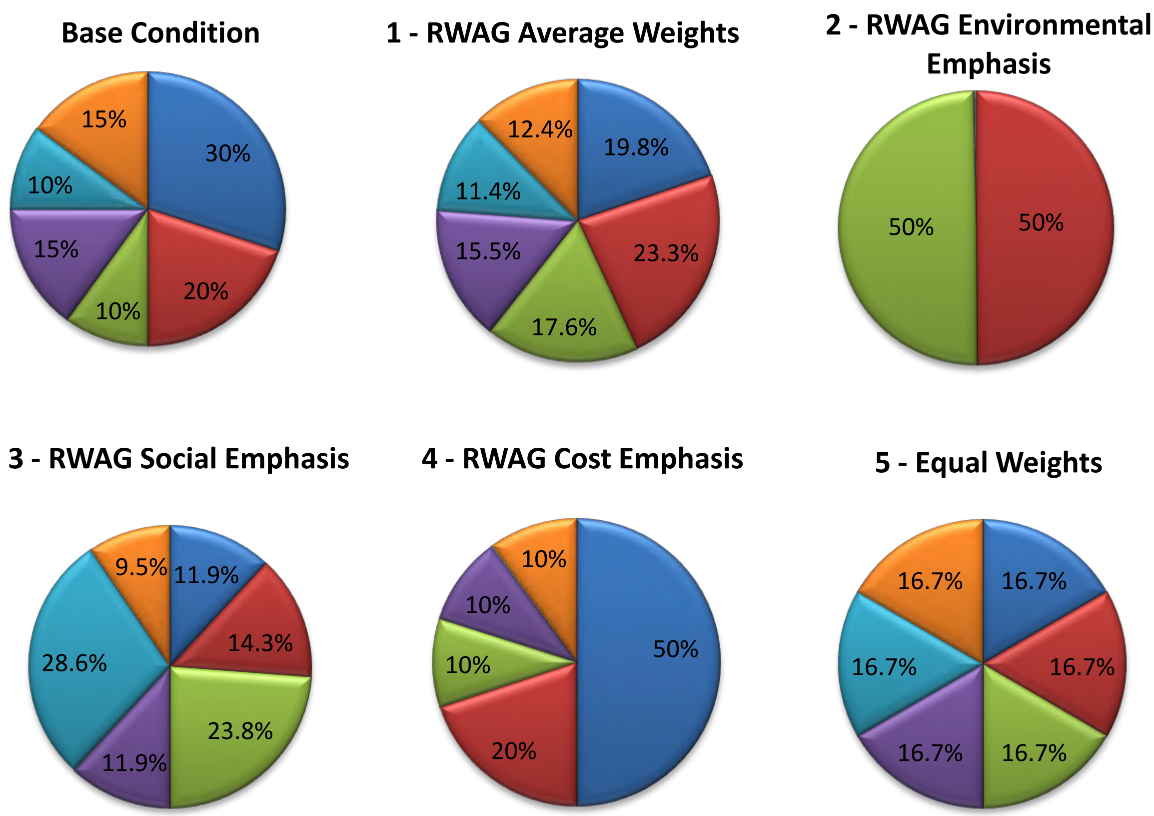
- *Equal Weights:* equal weighting for all objectives to see if the results change if none of the objectives are weighted higher than the others.
- *No Cost:* cost receives 0% weighting to see if the results change if cost is not an issue.

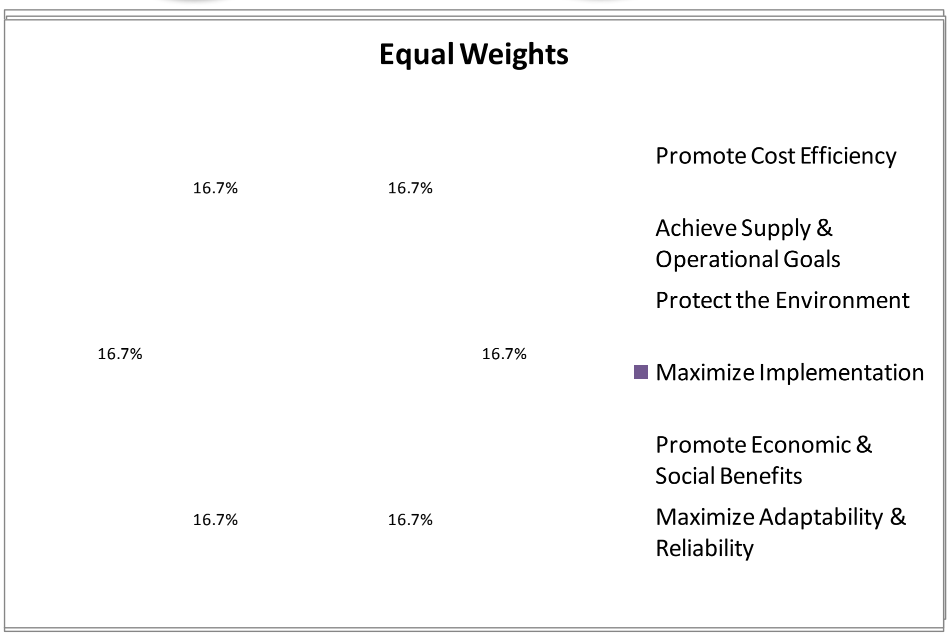
The modified objectives weightings for Sensitivity Runs 1 through 6 are summarized in Table 2-1 and displayed graphically in **Figure 2-5**.

Table 2-1: Modified Objectives Weightings for Sensitivity Analysis

Sensitivity Run Number	Base Condition	1 RWAG Average Weights	2 RWAG Environmental Emphasis	3 RWAG Social Emphasis	4 RWAG Cost Emphasis	5 Equal Weights	6 No Cost
Promote Cost Efficiency	30%	19.8%	0%	11.9%	50%	16.7%	0.0%
Achieve Supply & Operational Goals	20%	23.3%	50%	14.3%	20%	16.7%	28.6%
Protect the Environment	10%	17.6%	50%	23.8%	10%	16.7%	14.3%
Maximize Implementation	15%	15.5%	0%	11.9%	10%	16.7%	21.4%
Promote Economic & Social Benefits	10%	11.4%	0%	28.6%	0%	16.7%	14.3%
Maximize Adaptability & Reduce Risk	15%	12.4%	0%	9.5%	10%	16.7%	21.4%
Total	100%	100%	100%	100%	100%	100%	100%

Figure 2-5: Modified Objectives Weightings for Sensitivity Analysis





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3. Description of Alternatives

Expanding on the outline of steps in Section 2, this section describes the alternatives, including facility assumptions. Section 4 describes their associated evaluation criteria and performance measures. Then, the results of the decision model are presented in Section 5 and key findings are discussed in Section 6.

3.1 Themes

As described in Section 2.2, three overarching themes were formed based on different GWR production capacities that reflect different levels of permitting complexities. After the amount of GWR was set for each theme, NPR project options were used to supplement the remaining amount of recycled water use to achieve the original overall goal of 30,650 AFY. All themes have some NPR and GWR. The three themes are as follows:

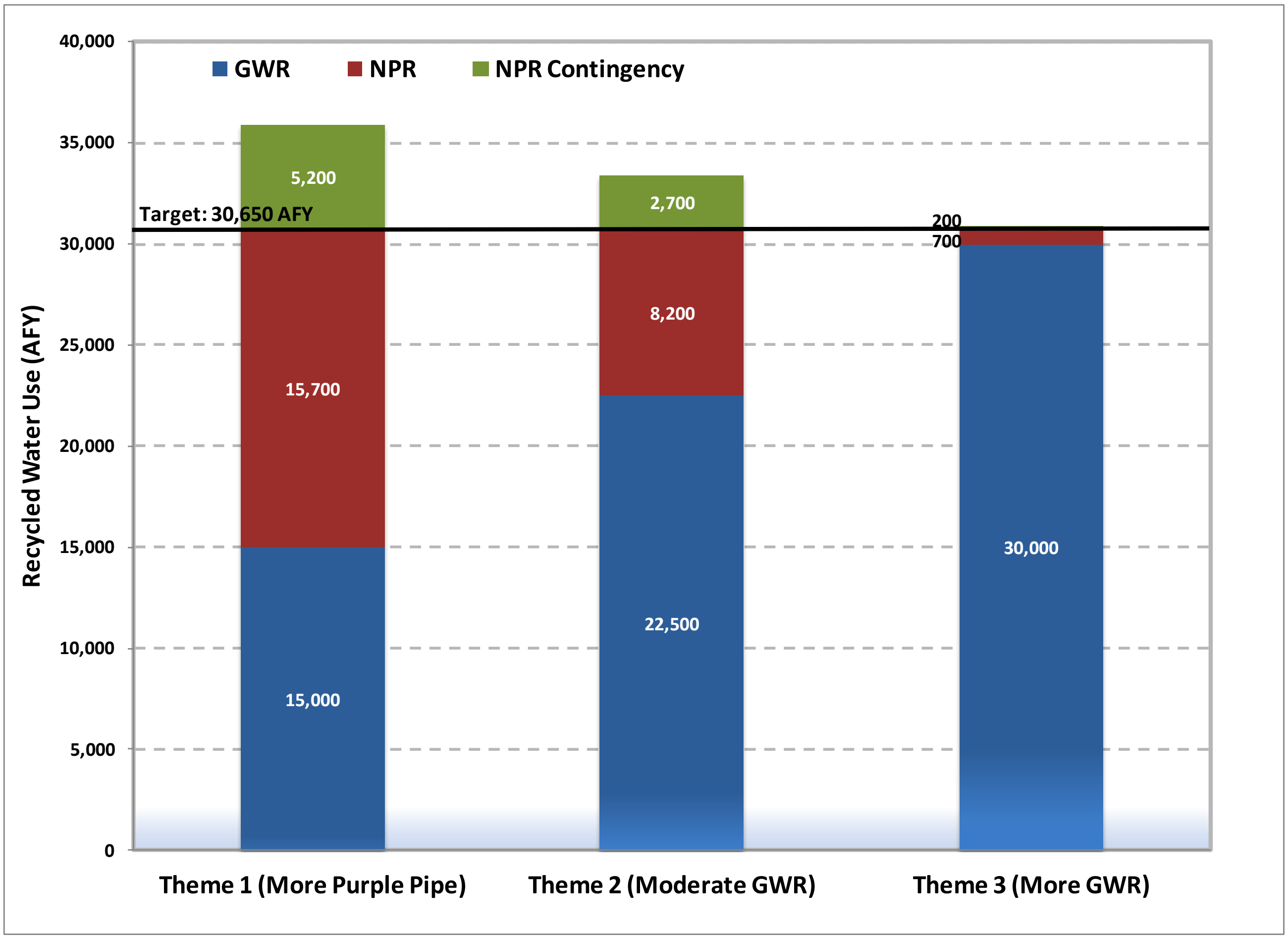
- **Theme 1 – More Purple Pipe (NPR) (GWR = 15,000 AFY, NPR = 15,650 AFY)**
  GWR of 15,000 AFY was chosen as the lower limit, because it is assumed to be achievable with 50/50 blend of purified recycled water and stormwater. The California Department of Public Health (CDPH) draft regulations (August 2008) in place at the time of this analysis in 2010 stipulated initial recycled water contribution (RWC) to be 50% for projects using purified recycled water, which could be achieved with 15,000 AFY.

- **Theme 2 – Moderate GWR (GWR = 22,500 AFY, NPR= 8,150 AFY)**
  GWR of 22,500 AFY was set between the lower (Theme 1) and upper (Theme 3) GWR limits. This size of GWR project would likely need to be implemented in phases to start at 15,000 AFY and be expanded to 22,500 AFY.

- **Theme 3 – More GWR (GWR = 30,000 AFY, NPR = 650 AFY)**
  GWR of 30,000 AFY was chosen as the upper limit because it is the maximum amount of purified recycled water that could be produced from Donald C. Tillman Water Reclamation Plant (DCTWRP) effluent available for GWR. This size of GWR project would likely need to be implemented in phases to start at 15,000 AFY and be expanded up to 30,000 AFY.

NPR demands can be uncertain because they rely on individual customers to convert to using recycled water. To ensure that the necessary amount of NPR can be achieved, additional projects and customers were identified as a contingency, which constitutes an additional 25% of the NPR demands. **Figure 3-1** shows the amounts of GWR and NPR as well as the NPR contingency for each theme.

Figure 3-1: Themes – GWR and NPR Targets



Note: Does not include existing and planned non-potable reuse and barrier supplement projects with an average annual reuse of 19,350 AFY.

3.2 Alternatives Identification and Variations

All alternatives are developed to meet the themes described in Section 3.1. Once the total amount of GWR was set and the required amount of supplemental NPR, including NPR contingency, was determined for each alternative, NPR project options were selected for each alternative. The following sections describe the five alternatives that were evaluated for this TM.

3.2.1 Theme 1 More Purple Pipe (NPR) - Alternative 1

Based on Theme 1, this alternative includes the minimum GWR amount of 15,000 AFY and maximum NPR projects (15,650 AFY) to meet the original recycled water use goal of 30,650 AFY. Therefore, Alternative 1 requires the most NPR projects among all alternatives. The assumed NPR customers and distribution system are shown in **Figure 3-2.** The NPR project portfolio for Alternative 1 includes:

- Valley Service Area, DCTWRP: 9,500 AFY

- Metro Service Area: 4,600 AFY
- Westside Service Area: 3,000 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY

3.2.2 Theme 2 Moderate GWR - Alternative 2a

Based on Theme 2 (Moderate GWR), this alternative includes moderate or mid-range GWR amount of 22,500 AFY and moderate NPR projects (8,150 AFY plus 2,750 AFY of contingency) as a supplement to meet the original recycled water use goal of 30,650 AFY. Alternative 2a includes a reduction of Valley NPR projects in order to preserve DCTWRP recycled water supply for future GWR expansion. The assumed NPR customers and distribution system are shown in **Figure 3-3**. The NPR project portfolio for Alternative 2a includes:

- Metro Service Area: 4,200 AFY
- Westside Service Area: 2,800 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY
- Valley Service Area, DCTWRP: 100 AFY

3.2.3 Theme 2 Moderate GWR - Alternative 2b

Similar to Alternative 2a, this alternative includes moderate GWR amount of 22,500 AFY and moderate NPR recommended projects (8,150 AFY plus 2,750 AFY of contingency) as a supplement to meet the original recycled water use goal of 30,650 AFY. However, Alternative 2b includes the elimination of Metro NPR projects since Metro NPR projects could be among the most difficult to implement due to its dependence on conversion of industrial customers. The assumed NPR customers and distribution system are shown in **Figure 3-5**. The NPR project portfolio for Alternative 2b includes:

- Valley Service Area, DCTWRP: 4,300 AFY
- Westside Service Area: 2,800 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY

3.2.4 Theme 2 Moderate GWR - Alternative 2c

Similar to Alternative 2a and 2b, this alternative includes moderate GWR amount of 22,500 AFY and moderate NPR recommended projects (8,150 AFY plus 2,750 AFY of contingency) as a supplement to meet the original recycled water use goal of 30,650 AFY. However, Alternative 2c includes the elimination of Westside NPR projects since Westside NPR projects could be more difficult to implement due to the distance of demands from available supplies. The assumed NPR customers and distribution system are shown in **Figure 3-6**. The NPR project portfolio of Alternative 2c includes:

- Valley Service Area, DCTWRP: 2,900 AFY
- Metro Service Area: 4,200 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY

3.2.5 Theme 3 More GWR - Alternative 3

Based on Theme 3 (More GWR), this alternative includes the maximum GWR amount of 30,000 AFY and nominal NPR (650 AFY plus 250 AFY of contingency) as a supplement to meet the recycled water use goal of 30,650 AFY. Therefore, Alternative 3 requires minimal amount of NPR projects compared to other alternatives. The NPR projects will be located entirely in the Harbor service area and are shown in Figure 3-7. The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.The NPR projects (900 AFY with contingency) could be served by TIWRP or with other NPR projects in the City.

3.2.6 Alternatives Summary

Table 3-1 shows the service areas which would include NPR and GWR projects, according to each alternative. **Figure 3-2** shows the amounts of GWR and NPR (with and without contingency) by service area for each alternative. **Figure 3-3** through **Figure 3-6** depict the approximate geographic locations of NPR projects for Alternatives 1, 2a, 2b, 2c and 3. Note that the pipelines and facilities are diagrammatic and not intended to reflect proposed specific locations or alignments.

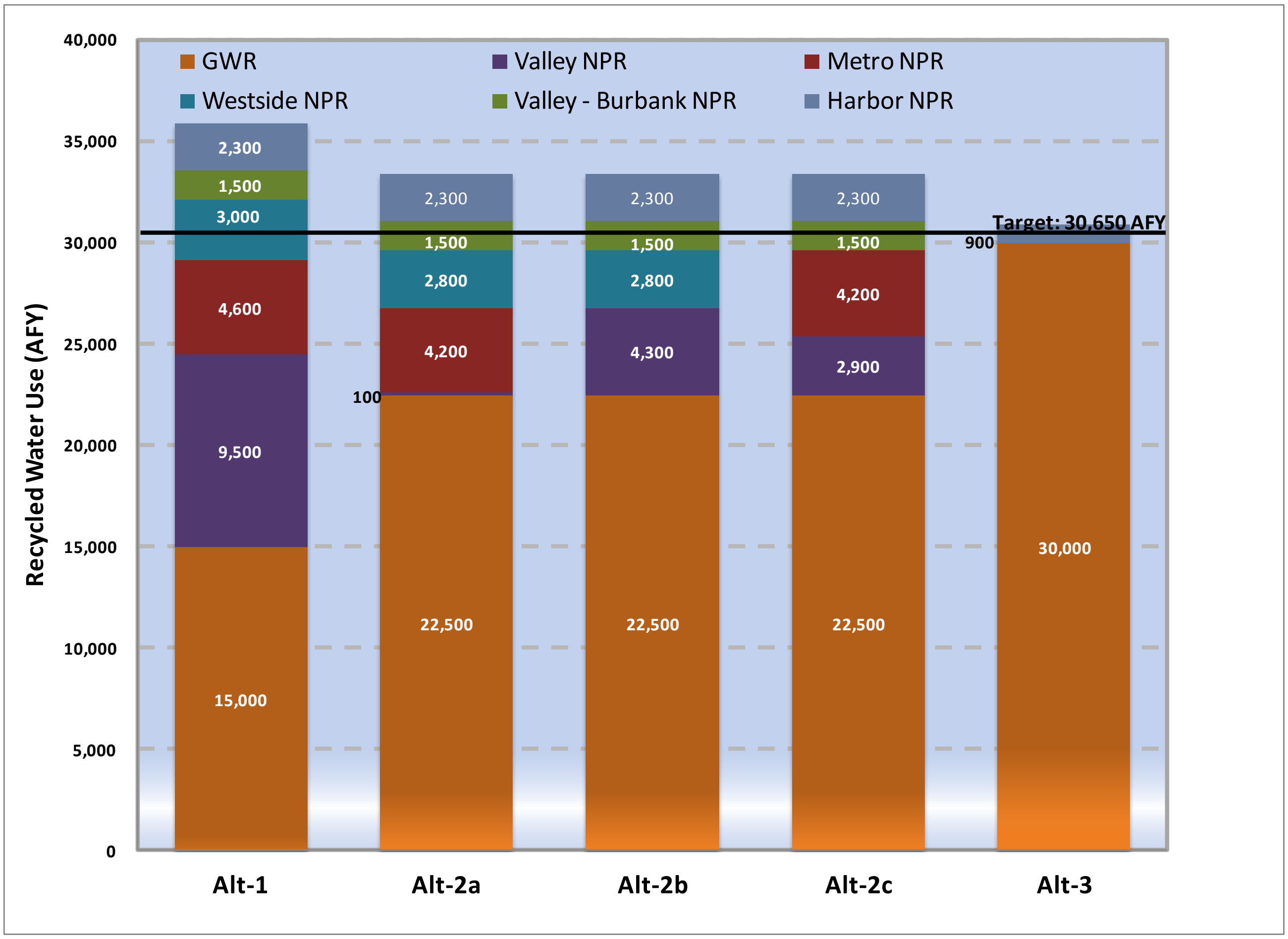
Table 3-1: Alternatives and Services Areas

Alternative	NPR					GWR
	Valley, DCTWRP	Valley, Burbank	Metro	Westside	Harbor	Valley
1	X	X	X	X	X	X
2a		X	X	X	X	X
2b	X	X		X	X	X
2c	X	X	X		X	X
3					X[a]	X

Footnote

a. The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

Figure 3-2: Alternatives – GWR and NPR by Service Area



Notes:
Does not include existing and planned non-potable reuse and barrier supplement projects with an average annual reuse of 19,350 AFY.
The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

Figure 3-3: Alternative 1 Proposed NPR Projects

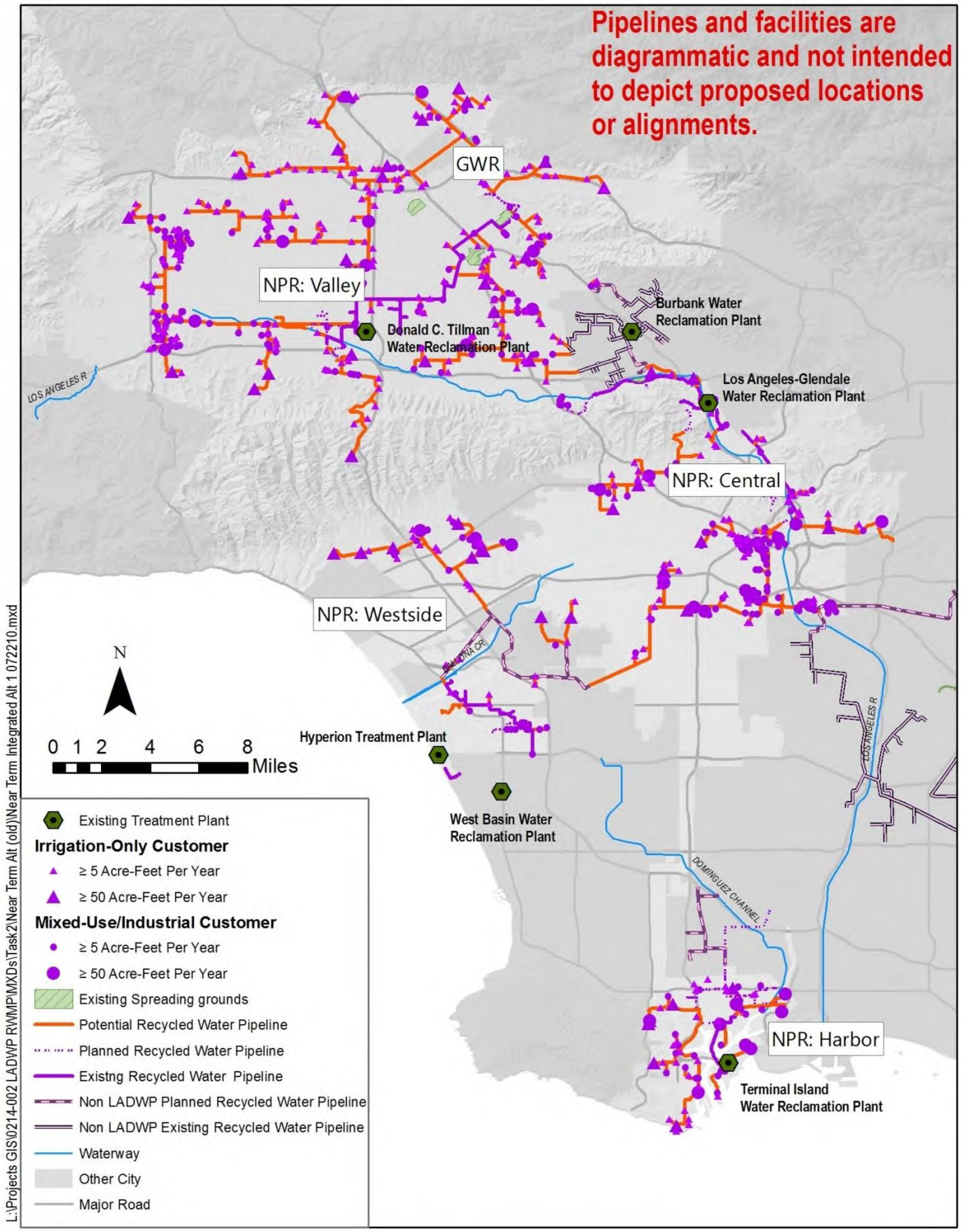


Figure 3-4: Alternative 2a Proposed NPR Projects

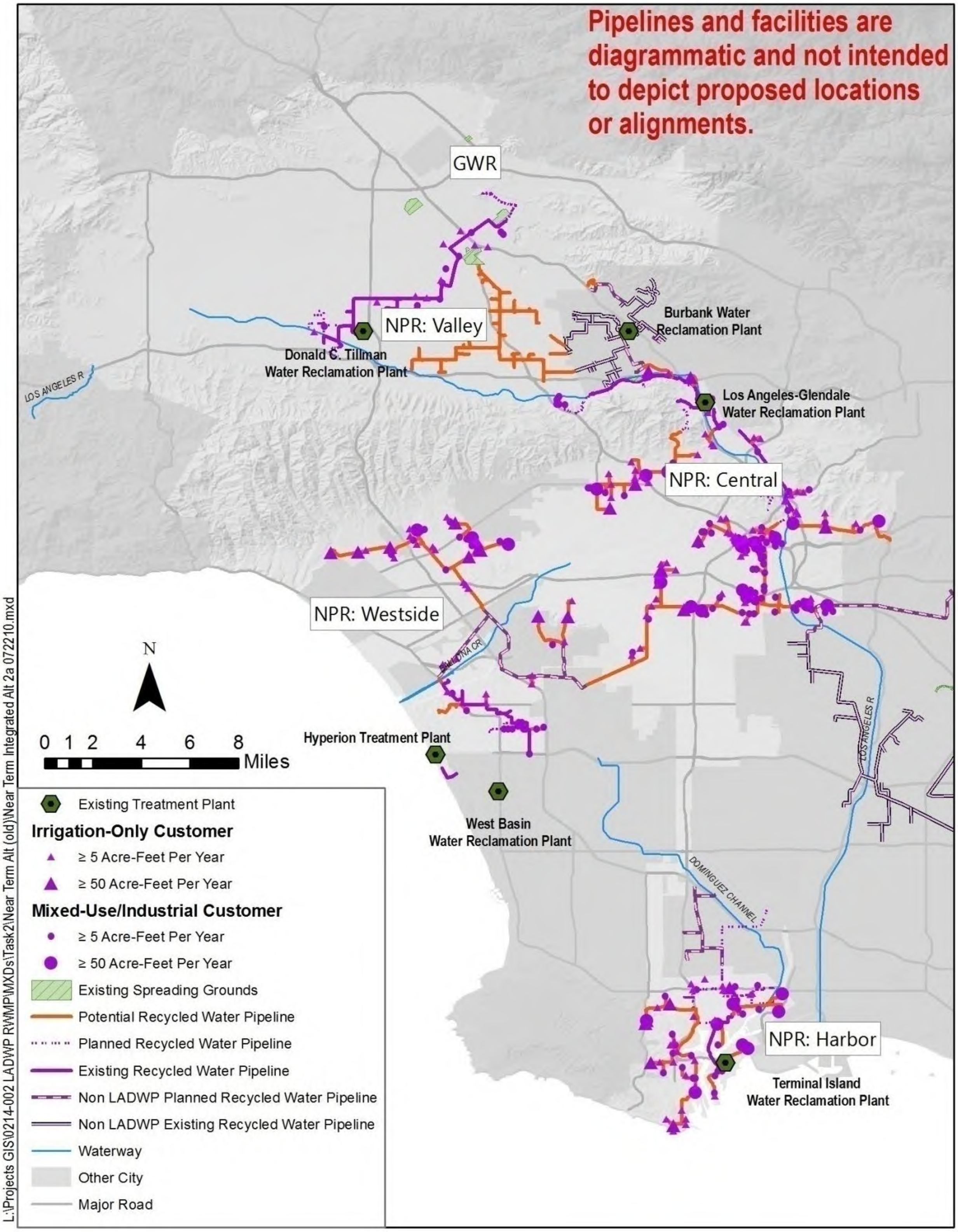


Figure 3-5: Alternative 2b Proposed NPR Projects

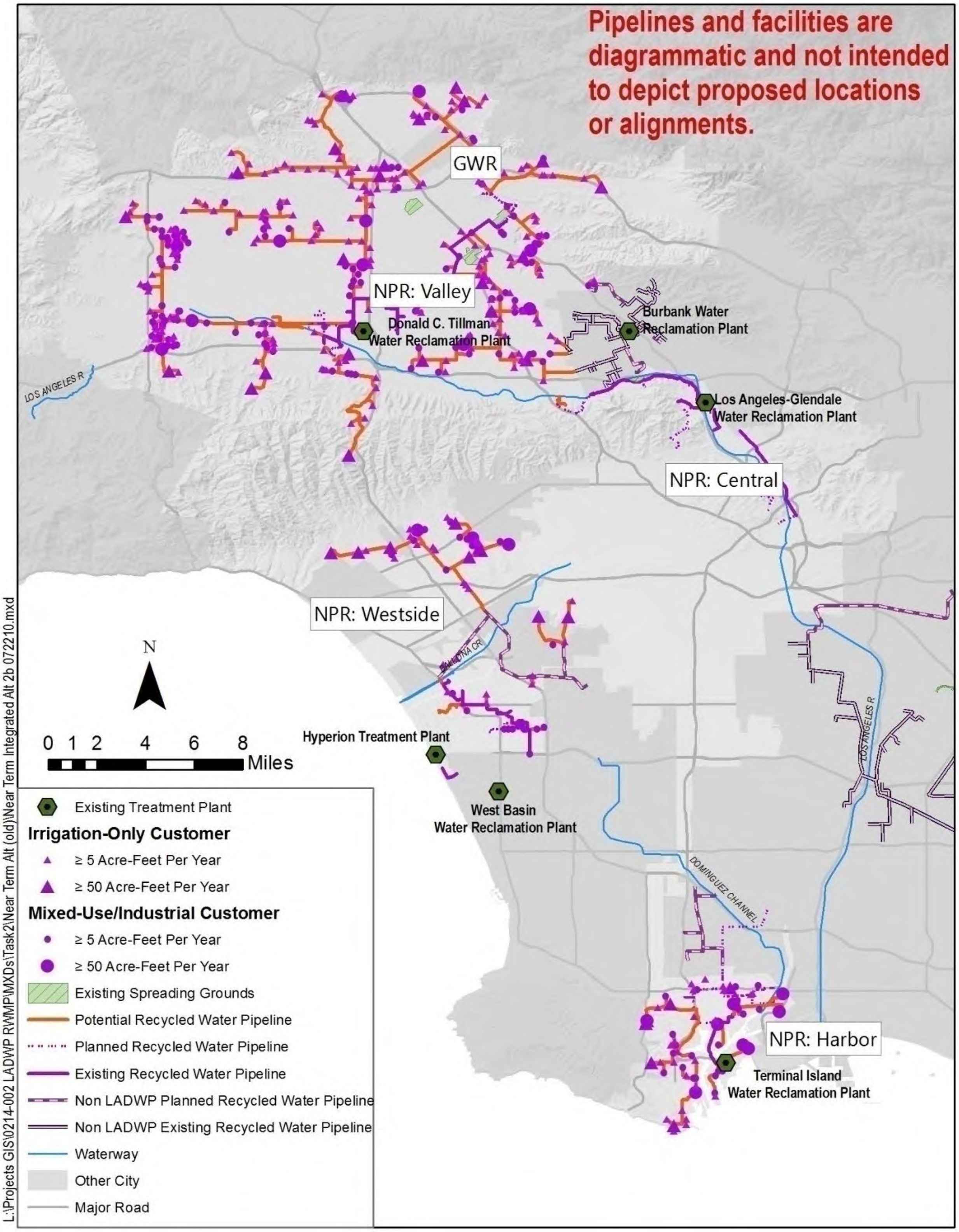


Figure 3-6: Alternative 2c Proposed NPR Projects

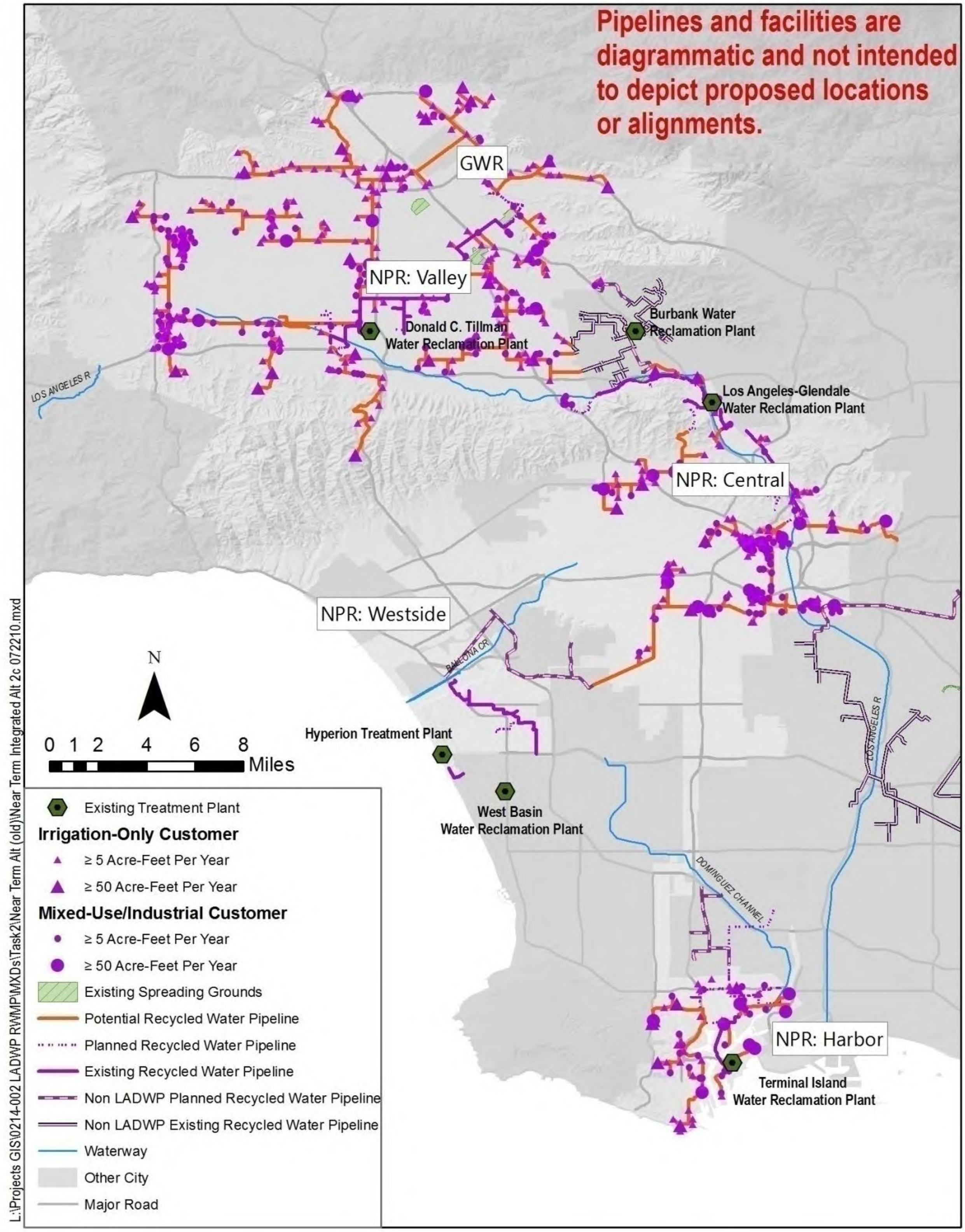
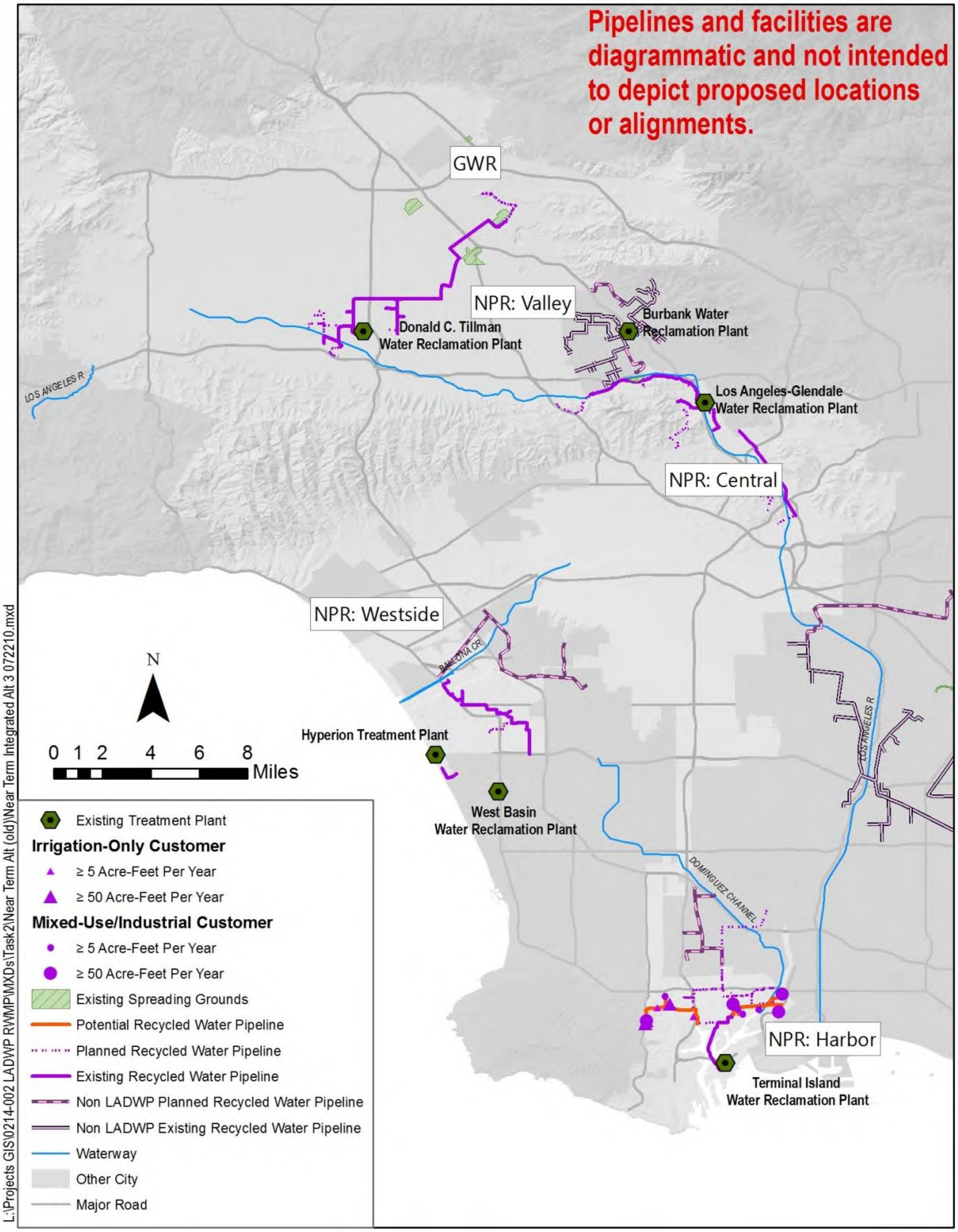


Figure 3-7: Alternative 3 Proposed NPR Projects



Note: The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

3.2.7 GWR Assumptions in Alternatives

As described earlier in this section, all alternatives include GWR in varying capacities. As shown on **Figure 3-8** and **Figure 3-9**, using state-of-the-art technology, the GWR system would include treating recycled water from the DCTWRP to produce purified recycled water using advanced water purification (AWP) processes. This purified recycled water would be conveyed to spreading grounds, where it would percolate into natural underground groundwater, and potentially injection wells to inject the water into the groundwater. This water replenishes the aquifers that feed the City's water supply production wells. After the minimum required blend time within the aquifer, the water would be extracted (or pumped) from the existing groundwater basins for treatment and distribution to LADWP drinking water customers. This GWR Master Planning Report covers treatment, conveyance, and replenishment of the purified recycled water. The extraction facilities (City's water supply production wells), treatment of extracted groundwater, and distribution to drinking water customers are not included in the alternatives since they are existing.

Figure 3-8: GWR Concept

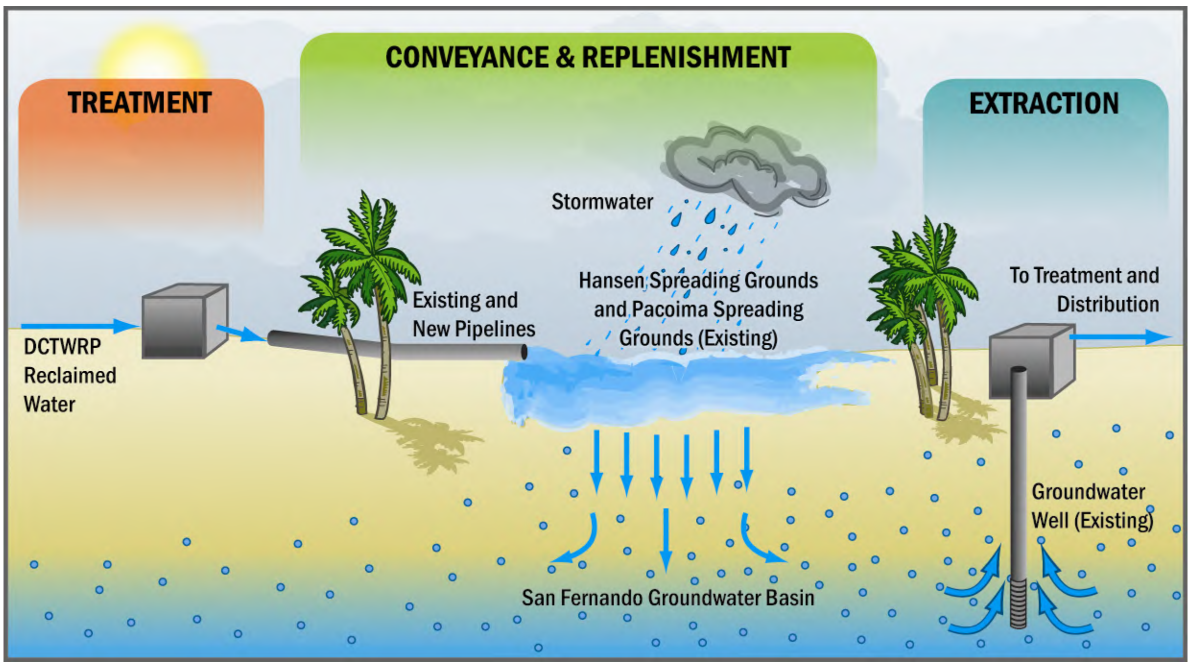
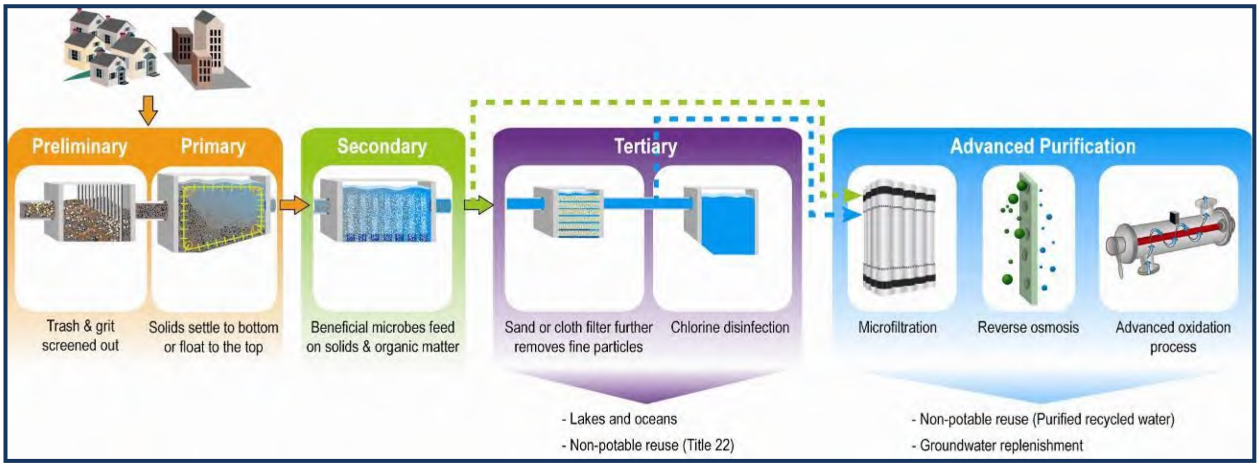


Figure 3-9: Major Treatment Processes at DCTWRP and Proposed for the AWPF



For this TM, it is assumed that GWR includes the following facilities:

- New Advanced Water Purification Facility (AWPF), treating DCTWRP tertiary product via microfiltration and reverse osmosis (MF/RO) and providing advanced oxidation via ultra violet (UV) light and hydrogen peroxide.
- Existing/New Conveyance pipelines from AWPF to Hansen and Pacoima Spreading Grounds for replenishment into the San Fernando Groundwater Basin
- Existing Extraction wells to pump groundwater from San Fernando Groundwater Basin to drinking water distribution system.[3]

Another key assumption for this TM is the potential location for the AWPF. The RWMP planning team prepared a separate study (Site Assessment TM, RMC/CDM Smith 2012) to identify and evaluate several potential sites. From that process, five viable candidate sites were identified. These sites are located at the City's DCTWRP and Valley Generating Station (VGS).

For the alternative analyses in this TM, the set of five alternatives described earlier were evaluated using two potential AWPF sites to assess whether or not the AWPF location affects the overall decision model results for the alternatives evaluation. The two potential AWPF locations considered included DCTWRP and the Valley Generating Station (VGS). While the Site Assessment TM included four potential sites at DCTWRP, for the evaluation of integrated alternatives, DCT Southwest (SW) was used as a proxy since it was assumed that all DCTWRP sites would generally perform equally against the objectives used for the integrated analysis. Therefore, a total of 10 alternatives were identified and evaluated, as described in Table 3-2.

[3] As a separate project to improve the groundwater quality in the San Fernando Basin, the City is planning the Groundwater Treatment Complex. Since this project is independent of GWR, the costs for this program are not included in this integrated alternatives analysis.

Table 3-2: Alternatives – Summary of Recycled Water Volume by Component

		DCT Alternatives					VGS Alternatives				
		Alternative 1	Alternative 2			Alternative 3[b]	Alternative 1	Alternative 2			Alternative 3[b]
		Alt-D1 (AFY)	Alt-D2a (AFY)	Alt-D2b (AFY)	Alt-D2c (AFY)	Alt-D3 (AFY)	Alt-V1 (AFY)	Alt-V2a (AFY)	Alt-V2b (AFY)	Alt-V2c (AFY)	Alt-V3 (AFY)
GWR	Valley	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000
NPR	Valley	9,500	100	4,300	2,900	0	9,500	100	4,300	2,900	0
	Metro	4,600	4,200	0	4,200	0	4,600	4,200	0	4,200	0
	Westside	3,000	2,800	2,800	0	0	3,000	2,800	2,800	0	0
	Valley-Burbank	1,500	1,500	1,500	1,500	0	1,500	1,500	1,500	1,500	0
	Harbor	2,300	2,300	2,300	2,300	900	2,300	2,300	2,300	2,300	900
	NPR Total	20,900	10,900	10,900	10,900	900	20,900	10,900	10,900	10,900	900
	NPR Total – Without Contingency	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700
Total With Contingency		35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900
Total Without Contingency[a]		30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700

Footnote:

a. The total is rounded from 30,650 AFY to 30,700 AFY for simplicity.

b. The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

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4. Evaluation Criteria and Performance Measures

Evaluation criteria and performance measures were specifically defined to rank the integrated alternatives. This section describes the evaluation criteria and the associated performance measures used to evaluate the alternatives defined in Section 4. The threshold criteria do not have any evaluation criteria or performance measures because they must be met by all alternatives in order to proceed.

Table 4-1: Objectives, Evaluation Criteria, Performance Measures, and Scores for Alternatives summarizes the evaluation criteria, performance measures, and scores for the alternatives analysis. As shown in this table, the performance measures are measured both qualitatively (i.e., relative score of 1 to 5) and quantitatively (i.e., unit capital cost, temporary job creation, etc.). When a qualitative score is used, a score of 5 is better and a score of 1 is worse.

The following sections provide detailed descriptions of the evaluation criteria and performance measures and how each of the alternatives scored.

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Table 4-1: Objectives, Evaluation Criteria, Performance Measures, and Scores for Alternatives

Objectives		Evaluation Criteria							DCT Alternatives					VGS Alternatives					Notes
									Alt 1	Alt 2			Alt 3	Alt 1	Alt 2			lternative	
Objective	Weight	Sub-objective	Sub-Weight	Overall Weight	Performance Measure	Unit	Sub-Weight		Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3	
								GWR	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000	
								NPR	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700	
								NPR Contingency	5,200	2,700	2,700	2,700	200	5,200	2,700	2,700	2,700	200	
								Harbor Projects	0	0	0	0	0	0	0	0	0	0	
								Total (w/o Contingency)	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	
								Total (w/ Contingency)	35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900	
Meet All Water Quality Regulations and Health & Safety Requirements, and Use Proven Technologies									**All alternatives meet these critical, threshold objectives.**										
Promote Cost Efficiency	30%	Unit Capital Cost	50%	15.0%	Unit Capital Cost (lower number is better)	$/AF			$19,600	$17,300	$18,400	$16,500	$14,000	$18,900	$16,700	$17,800	$15,800	$14,100	Includes capital cost for Existing and Planned NPR.
		Unit Annual O&M Cost	50%	15.0%	Unit Annual O&M Cost (lower is better)	$/AF			$677	$717	$701	$677	$691	$661	$693	$683	$657	$677	Includes O&M cost for Existing and Planned NPR.
Achieve Supply & Operational Goals	20%	Reduction in Imported Water	50%	10.0%	Reduction in volume of imported water purchases (higher number is better)	AFY			30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	Does not include purple pipe NPR contingency numbers. Does not include GW exchange with the refineries.
		Water System Operational Flexibility	20%	4.0%	% of total recycled water stored in the ground (No restrictions on how this water is used) (Higher number is better)	%			49%	73%	73%	73%	98%	49%	73%	73%	73%	98%	Percent of total recycled water that will be stored in the ground for future use. Saving the water in the ground allows flexibility in how this water will be used in the future. Projects with more GWR in the project scores better.
		Overall Wastewater System Benefits	30%	6.0%	HTP service area collection system benefits	Score	12.5%		3	4	4	4	5	3	4	4	4	5	Reducing ww flow in HTP service area collection system. The AWPF is the only firm offset of the HTP service area collection system, since NPR has seasonal variability in demand. Alts 1 - Scores as 3 because has a year-round offset of 15,000 AFY Alts 2 - Scores as 4 because has a year-round offset of 22,500 AFY (more than Alt 1, but less than Alt 3) Alts 3 - Scores as 5 because has a year-round offset of 30,000 AFY
					HTP treatment system impacts	Score	12.5%		3	2	2	2	1	3	2	2	2	1	Brine discharge to HTP influent will impact treatment system at HTP. Larger AWPFs will have a larger brine flow to HTP.
					TIWRP discharge benefits	Score	75%		3	3	3	3	1	3	3	3	3	1	Assesses reduction in TIWRP ocean outfall discharge flow. Options with more Harbor NPR projects score higher: Alts 1 and 2a, 2b & 2c - score 3 because all include the same amount of NPR water in the Harbor. Alts 2d&2e - Will score 4 because TIWRP discharges to the Harbor will be partially reduced. With additional 2,300 AFY of Harbor NPR, these alternatives will score a 5. Alts 3 - scores lower because uses less NPR water in the Harbor.
Protect Environment	10%	Groundwater Quality	50%	5.0%	Improves groundwater quality	Score			3	4	4	4	5	3	4	4	4	5	Recharging with AWT water will improve GW quality by dilution. Existing GW quality is commonly contaminated and have higher TDS than AWTP product water. Alternatives with more GWR score better.
		Greenhouse Gas Emissions	50%	5.0%	Greenhouse gas emissions (lower number is better)	metric tons of CO_2 eq. /AF			-1.130	-1.059	-1.033	-1.065	-0.948	-0.958	-0.964	-0.876	-0.915	-0.808	Same as above. Does not include GHG emissions from GW extraction and purification treatment.

Costs developed in this document are based on the original IAA Preliminary Cost TM (Appendix A) from April 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.
Unless noted otherwise, for performance measures scored on a scale of 1 to 5, 5 = better and 1 = worse. Los Angeles Department of Water and Power | Recycled Water Master Plan | Table 4-1 2012-03-05.xls

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Table 4-1 Objectives, Evaluation Criteria, Performance Measures, and Scores for Alternatives (Cont.)

Objectives		Evaluation Criteria							DCT Alternatives					VGS Alternatives					Notes
									Alt 1	Alt 2			Alt 3	Alt 1	Alt 2			lternative	
Objective	Weight	Sub-objective	Sub-Weight	Overall Weight	Performance Measure	Unit	Sub-Weight		Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3	
								GWR	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000	
								NPR	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700	
								NPR Contingency	5,200	2,700	2,700	2,700	200	5,200	2,700	2,700	2,700	200	
								Harbor Projects	0	0	0	0	0	0	0	0	0	0	
								Total (w/o Contingency)	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	
								Total (w/ Contingency)	35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900	
Maximize Implementation	15%	Public Acceptance	20%	3.0%	Public perception of GWR	Score			3	3	3	3	3	3	3	3	3	3	Keep scores neutral, use as a sensitivity
		Institutional Complexity	20%	3.0%	Complexity of operating relationship measured in number of contracts/agreements needed with outside agencies	Score			1	1	3	3	5	1	1	3	3	5	Any projects outside of the San Fernando Valley require more contracts/agreements with outside agencies. Alternatives with more Metro and Westside NPR will have a higher number of contracts/agreements with outside agencies: Alts 1 & 2a - score the lowest because have the most NPR in Metro and Westside. Alts 2b & 2c - score better than Alts 1 and 2a because either Metro or Westside eliminated. Alt 3 - scores highest because does not have any agreements with outside agencies.
		Permitting	20%	3.0%	Difficulty of GWR permitting process	Score			4	3	3	3	2	4	3	3	3	2	Larger GWR is more difficult to permit.
		Implementation Complexity	20%	3.0%	Number of projects/contracts to implement	Score			1	3	3	3	5	1	3	3	3	5	NPR projects are implemented in smaller pojrects and require many more projects than GWR projects. Projects with more NPR projects score lower. Alt 1 - Scores worst because has most number of NPR projects. Alts 2a, 2b, & 2c - Score better than alt 1 because has less number of NPR projects. Alt 3 - Scores highest because has least amount of NPR projects.
		Construction Impacts	20%	3.0%	Temporary traffic/noise/odor/dust impacts due to construction of pipelines	Miles			247.1	127.0	186.5	175.0	7.2	254.5	134.4	193.9	182.4	14.6	Purple pipe NPR projects have more construction impacts due to traffic/noise/odor/dust, etc. VGS options include 7.4 miles of brine pipeline. The less pipeline distances, the better.
Promote Economic & Social Benefits	10%	Temporary job creation	33%	3.3%	Temporary job creation (higher number is better)	Number of jobs			7,200	6,400	6,800	6,100	5,100	7,000	6,100	6,500	5,800	5,200	Based on the total capital cost. Assumed 7.2 temporary jobs per $1M of capital cost.
		Permanent job creation	33%	3.3%	Permanent job creation (higher number is better)	Number of jobs			60	63	64	64	62	50	53	53	53	59	Includes staffing for NPR and GWR. For GWR, assumed 1.9 personnel/mgd of GWR. For NPR, assumed 23 personnel for Alt 1, 12 personnel for Alts 2a, 2b and 2c, and 1 personnel for Alt3.
		Environmental Justice	33%	3.3%	Total number of low-income and/or minority tract with permanent above-grade facilities (lower number is better)	Number of census tracts			7	5	1	5	0	8	6	2	6	1	Permanent facilities: AWPF and NPR pump station and storage tanks in low-income and minority communities. Look at number of low income and/or minority community parcels/tracts impacted. New permanent above-grade facilities are assumed to negative for low income or minority census tracts. Does not include below-grade piping projects. VGS alternatives score one higher than the DCT alternatives because VGS is located in area designated as environmental justice improvement area. Alts 2d & 2e: Permanent above-grade facilities for the TI expansion will be within the existing facility property. Wells will be permanent above-grade facilities, located low-income minority areas, but these tracts are not counted since they are not residential areas.
Maximize Adaptability & Reliability	15%	Recycled Water Demand Reliability	25%	3.8%	Number of large (> 50 AFY) industrial customers (lower number is better)	No. of customers			34	27	14	26	2	34	27	14	26	2	Counted number of large industrial NPR customers with >50 AFY demand.
		Water Supply Reliability	75%	11.3%	RW is drought-proof water supply for irrigation NPR (higher number is better)	NPR irrigation quantity (AFY)			12,740	5,240	7,310	6,050	100	12,740	5,240	7,310	6,050	100	NPR is not subject to water supply restrictions (drought-proof water supply) and is beneficial for irrigation users who currently have restrictions for potable water use for irrigation during drought periods. Projects with more NPR use for irrigation use will score better.

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4.1 Objective 1 – Promote Cost Efficiency

The intent of Objective 1(Promote Cost Efficiency) is to meet the goals of the recycled water program in a cost-effective manner, considering both City and recycled water customer costs. Two evaluation criteria are used for Objective 1 – Promote Cost Efficiency:

- Unit Capital Cost; and,
- Unit Annual O&M Cost.

The following sections discuss the assumptions for the unit capital costs and annual O&M costs for the alternatives. The cost estimating procedures for the RWMP are documented separately in the Cost Estimating Basis for Recycled Water Master Planning TM (RMC/CDM Smith, 2011) and the TM, "Integrated Alternatives Analysis – Preliminary Cost Summary" (RMC/CDM Smith, April 2011) in Appendix A, which provides an overview of the preliminary costs shared with the RWAG. Updated costs are shown in the GWR and NPR Master Planning Reports.

4.1.1 Unit Capital Cost

Capital costs are the one-time setup expenses for a project and include both construction costs of facilities and implementation costs, such as design and permitting. Typically, payment for capital costs may be spread out over many years. For GWR, capital costs include treatment equipment, buildings, design and environmental permitting. For NPR projects, capital costs include pipelines, pump stations, storage facilities, design and environmental permitting.

Depending on the stage of the project and the level of detail understood, different estimating accuracies can be assumed. Since the RWMP is at a master planning stage, the accuracy range for the estimate is at a "Order of Magnitude Level", which reflects an accuracy range of -30% to +50%. All costs presented are reflected in January 2011 dollars using an Engineering News Record Construction Cost Index for Los Angeles of 10000.30 (January 2011). In addition, the capital costs include a 30% contingency to account for unknown or unforeseen construction costs. Capital costs also include a 30% implementation factor to account for the costs for planning and environmental documentation, permits, engineering, design and construction services, construction management and inspections, and typical overhead items such and legal and administration services.

Table 4-2 shows an example of how the cost contingencies and other factors are applied to capital cost estimates.

Table 4-2: Example Application of Cost Factors for Alternatives

Items	Calculation	Planning Estimate
Capital Cost Factors		
A. Estimated Construction Cost Subtotal		$1,000,000
B. Construction Contingency Cost Factor (30%)	0.3 * (A)	$300,000
C. Total Construction Cost Subtotal	(A) + (B)	$1,300,000
D. Implementation Cost Factor (30%)	0.3 * (C)	$390,000
E. Total Capital Cost	**(C) + (D)**	**$1,690,000**

A detailed discussion of these cost estimating criteria, as well as the assumed construction and O&M unit costs can be found in the document titled, "Cost Estimating Basis for Recycled Water Master Planning TM" (RMC/CDM Smith, 2011).

For this analysis, unit capital costs were developed. The unit capital cost for each alternative considered in this evaluation is the total capital cost estimate divided by the total potable water use offset by recycled water use (including GWR and NPR), represented in $/AFY. **Table 4-3** presents a summary of the unit capital costs developed for this analysis. Refer to Appendix A (Table 3-2) and Appendix B for additional details on the capital cost estimates.

Table 4-3: Alternatives Development - Summary of Estimated Capital Costs

Alternative	Planned NPR Capital Cost ($million)	Potential NPR Capital Cost ($million)	New GWR Capital Cost ($million)	Total Capital Cost ($million)	Total Potable Water Use Offset (AFY)	Unit Capital Cost ($/AFY)
D1	$310	$467	$223	$1,000	51,100	19,600
D2a	$310	$251	$322	$883	51,100	17,300
D2b	$310	$305	$326	$941	51,100	18,400
D2c	$310	$205	$326	$841	51,100	16,500
D3	$310	$32	$373	$715	51,100	14,000
V1	$310	$467	$189	$966	51,100	18,900
V2a	$310	$251	$292	$853	51,100	16,700
V2b	$310	$305	$292	$907	51,100	17,800
V2c	$310	$205	$292	$807	51,100	15,800
V3	$310	$32	$377	$719	51,000	14,100

Notes:
January 2011 dollars
Includes 30% contingency and 30% implementation costs
Refer to Appendix A Table 3-2 and Appendix B for additional details and assumptions.
Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April, 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.

4.1.2 Unit Annual O&M Cost

O&M costs are the recurring annual expenses to operate and maintain the facilities after construction is completed. For the GWR AWTP, O&M costs include chemicals for treatment processes, power, labor, and cleaning, servicing, repairs and replacement. For NPR projects, O&M costs include purchase of recycled water, power, labor, and cleaning, servicing, repairs and replacement.

For this analysis, unit annual O&M costs were developed. The unit annual O&M cost for each alternative is the total annual O&M cost estimate (estimated in January 2011 dollars) divided by the total potable water use offset by recycled water use (including GWR and NPR), represented in $/AF. A contingency was not applied to O&M costs. The recycled water purchase cost was applied for NPR for certain service areas, as applicable. **Table 4-4** presents a summary of the unit O&M costs developed for this analysis. Refer to Appendix A (Table 3-2) and Appendix C for additional details on the O&M cost estimates.

Table 4-4: Alternatives Development - Summary of Estimated O&M Costs

Alternative	Existing and Planned NPR O&M costs ($million/yr)	Potential NPR O&M Cost ($million/yr)	New GWR O&M Cost ($million/yr)	Total O&M Cost ($million/yr)	Total Potable Water Use Offset (AFY)	Unit O&M Cost ($/AFY)
D1	$16	$7.6	$11.2	$35	51,100	$677
D2a	$16	$5.7	$15.1	$36	51,100	$717
D2b	$16	$4.6	$15.4	$35	51,100	$701
D2c	$16	$3.4	$15.4	$35	51,100	$677
D3	$16	$0.3	$19.2	$35	51,100	$691
V1	$16	$7.6	$10	$34	51,100	$661
V2a	$16	$5.7	$14	$35	51,100	$693
V2b	$16	$4.6	$14.5	$34	51,100	$683
V2c	$16	$3.4	$14.4	$34	51,100	$657
V3	$16	$0.3	$18.5	$35	51,100	$677

Notes:
January 2011 dollars
Includes 0%
Refer to Appendix A Table 3-2 and Appendix C for additional details and assumptions
Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April, 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.

4.2 Objective 2 – Achieve Supply & Operational Goals

The intent of Objective 2 (Achieve Supply and Operational Goals) is to meet or exceed water supply targets and operational goals established by the City. For this objective, three evaluation criteria are used:

- Reduction in imported water;
- Water system operational flexibility; and,
- Overall wastewater system benefits.

4.2.1 Reduction in Imported Water

Since reducing dependence on potable water (or imported water) supplies is the City's goal, alternatives are ranked by the total amount of potable water use offset by recycled water use (GWR and NPR), measured in AFY, that they achieve.

The amount of recycled water use is equal to the amount of potable water offset or reduction in imported water dependence. All alternatives achieve 30,700 AFY of reduction in imported water.

4.2.2 Water System Operational Flexibility

Storing water in groundwater basins provides flexibility in how this water could be used in the future because the water is available when needed to meet peak demand periods. Therefore, for the water system operational flexibility criterion, each alternative is evaluated on the percent of total recycled water that will be stored in groundwater basins.

The percent of the total recycled water, excluding planned NPR, that will be stored in groundwater basins for future use is equal to the percent of GWR in each alternative as shown in **Table 4-5.**

Table 4-5: Alternatives Development - Summary of Water System Operational Flexibility

Alternative	GWR (AFY)	Total Recycled Water (AFY)	Percent of Recycled Water Stored in Ground
D1	15,000	30,650	49%
D2a	22,500	30,650	73%
D2b	22,500	30,650	73%
D2c	22,500	30,650	73%
D3	30,000	30,650	98%
V1	15,000	30,650	49%
V2a	22,500	30,650	73%
V2b	22,500	30,650	73%
V2c	22,500	30,650	73%
V3	30,000	30,650	98%

4.2.3 Overall Wastewater System Benefits

For overall wastewater system benefits, the alternatives are be scored based on three performance measures:

- HTP service area collection system benefits;
- HTP treatment benefits (impacts); and,
- TIWRP discharge benefits.

HTP Service Area Collection System Benefits

This performance measure ranks alternatives based on how well they reduce wastewater flows in the HTP service area, thereby reducing stress on the collection system. To measure HTP service area collection system benefits, the RWMP planning team established a scale ranging from 1 (no benefits) to 5 (high benefits), with 3 representing moderate (average) benefits. All the alternatives provide some benefit to the downstream collection system, therefore none scored below a 3. The GWR in the Valley service area (i.e., AWPF production capacity) is the only firm offset of the HTP service area collection system, since it can run year round, while NPR has seasonal variability in demand. Table 4-6 shows the scores used in the evaluation of each alternative relative to HTP Service Area System Benefits

Table 4-6: HTP Service Area Collection Benefits

Alternative (both VGS and DCT)	Year-Round Reduction in Flow to HTP Collection System (AFY)	Score
1	15,000	3
2a	22,500	4
2b	22,500	4
2c	22,500	4
3	30,000	5

HTP Treatment System Benefits/Impacts

This performance measure ranks alternatives based on the impacts they have on the HTP treatment system. To measure HTP treatment system benefits, the RWMP planning team established a scale ranging from 1 (no potential benefits/high potential impacts) to 5 (high potential benefits/no potential impacts), with 3 representing moderate (average) potential benefits/impacts. All the alternatives provide some potential impact to the downstream HTP treatment facilities, therefore none scored above a 3. This performance measure is affected by the amount of GWR in the alternative and the associated AWPF brine that could be discharged in to the wastewater treatment system. The AWPF brine (i.e., MF backwash waste and RO concentrate with high total dissolved solids (TDS)), will be discharged to the outfall sewer in the HTP service area and could ultimately increase the TDS in the HTP influent. Increased levels of TDS in the HTP influent could also result in higher-than-desired levels of TDS in the HTP effluent and could potentially affect treatment at the WBMWD ELWRF, which takes the HTP effluent as its influent. Alternatives with more GWR in the Valley service area will discharge larger brine flows to HTP and potentially may have a greater impact on ELWRF.

Alternatives D1 and V1 feature the smallest AWPFs, and have the least potential impacts to the treatment facilities so these alternatives receive a score of 3. Alternatives D2a through D2c and V2a through V2c have the next smallest AWPFs and receive a score of 2. Alternatives D3 and V3 have the largest AWPFs and receive a score of 1, representing the least benefit/most potential impacts.

TIWRP Discharge Benefits

This performance measure ranks alternatives based on how well they reduce TIWRP ocean outfall discharge in the Harbor service area. TIWRP seeks to reduce their ocean outfall discharge flow in order to comply with discharge permit requirements. Alternatives with more barrier and NPR projects in the Harbor area utilizing AWPF product water from TIWRP score higher since those alternatives achieve more reduction in ocean outfall discharge flow. To measure TIWRP discharge benefits, the RWMP planning team established a scale ranging from 1 (no benefits) to 5 (high benefits), with 3 representing moderate (average) benefits.

Alternatives D1, V1, D2a, D2c, V2a and V2c receive a score of 3 since these alternatives have 2,300 AFY of RW projects in the Harbor service area. Alternatives D3 and V3 receive a score of 1 since they have only 900 AFY of NPR projects in the Harbor service area.

4.3 Objective 3 – Protect Environment

The intent of Objective 3 (Protect Environment) is to develop projects that not only protect the environment, but also provide opportunities to enhance it. Two evaluation criteria are used for Objective 3 – Protect Environment:

- Groundwater quality; and,
- Greenhouse gas emissions.

4.3.1 Groundwater Quality

This evaluation criterion ranks alternatives based on how well they improve the existing groundwater quality. Existing groundwater basins located within the City of Los Angeles often have higher TDS than the AWPF product water used for GWR. By recharging the groundwater basins with AWPF product water, the groundwater quality will be improved (i.e., TDS and other contaminants will be lowered in concentration by dilution). Therefore, alternatives with higher amounts of GWR are assumed to better improve groundwater quality. To measure groundwater quality benefits, the RWMP planning team established a scale ranging from 1 (no benefits) to 5 (high benefits), with 3 representing moderate (average) benefits. All the alternatives provide some benefit to groundwater quality, therefore none scored below a 3.

Alternatives D1 and V1 have 15,000 AFY of GWR and score a 3. Alternatives D2a through D2c and V2a through V2c have 22,500 AFY of GWR and score a 4. Alternatives D3 and V3 have 30,000 AFY of GWR and score a 5.

4.3.2 Greenhouse Gas Emissions

This evaluation criterion ranks alternatives based on the amount of GHG emitted by the GWR and NPR facilities in each alternative. The GHG emissions that result from the operation of GWR and NPR facilities are calculated from the electricity usage of these systems. The GWR and NPR components with electricity usage are summarized in Table 4-7.

The emissions calculated are carbon dioxide, methane, and nitrous oxide, which each converted to metric tons of carbon dioxide equivalents. This evaluation criterion is scored based on the metric tons metric tons CO_2 equivalents divided by the total potable water use offset by recycled water use (including GWR and NPR).

Table 4-7: GWR and NPR Components with Electricity Usage

Components with Electricity Usage	GWR Site Location	
	DCT	VGS
GWR	Valley AWPF	Valley AWPF
	UV Systems	UV Systems
	Balboa Pump Station	Balboa Pump Station
	--	Treated Water Pump Station
	--	Administration Building
	--	--
NPR	Treatment Plant Processes	Treatment Plant Processes
	Pumping to NPR Customers	Pumping to NPR Customers
Reduction in Imported Water	Less Pumping	Less Pumping
	Less Treatment	Less Treatment

This evaluation criterion also takes into consideration the reduction in GHG emissions that will be realized by potable water offset (i.e., pumping and treating less imported water). This explains why most of the GHG emissions values for this evaluation criterion are negative since the reduction in GHG emissions from imported water outweighs the GHG emissions from GWR and NPR facilities.

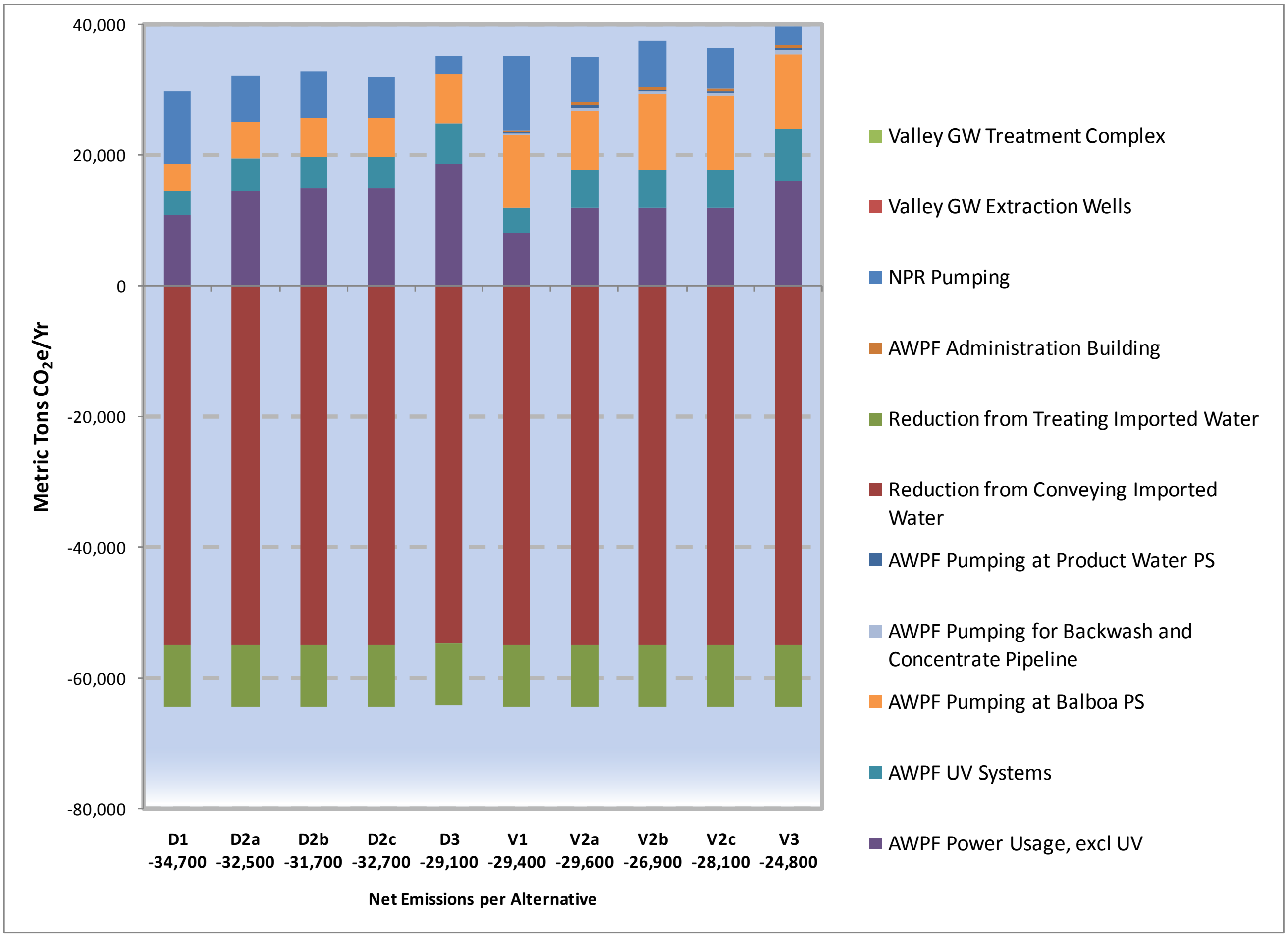
Table 4-8 summarizes the net GHG emissions for DCT and VGS alternatives. Figure 4-1 presents the breakdown of GHG emission productions and reductions for DCT and VGS alternatives without the Groundwater Treatment Complex. Refer to Appendix D for details of the GHG calculations.

Table 4-8: Performance Measure Scores for GHG Emissions

Greenhouse Gas Emissions	Alternatives				
	1	2a	2b	2c	3
DCT	-1.130	-1.059	-1.033	-1.065	-0.948
VGS	-0.958	-0.964	-0.876	-0.915	-0.808

Footnote:
a. GHG emissions measured in metric tons CO_2 equivalents/AF.

Figure 4-1: Summary of GHG Emission Productions and Reductions



4.4 Objective 4 – Maximize Implementation

The intent of Objective 4 (Maximize Implementation) is to maximize implementation by minimizing typical hurdles including institutional complexity, permitting challenges, and maximizing customer acceptance. Five specific evaluation criteria are used for Objective 4 – Maximize Implementation:

- Public acceptance;
- Institutional complexity;
- Permitting;
- Implementation complexity; and,
- Construction impacts.

4.4.1 Public Acceptance

This evaluation criterion assesses public acceptance of the GWR process. Since all alternatives include GWR, the alternatives all receive a neutral score of 3. This evaluation criterion could be used for a sensitivity analysis to determine how the alternatives rankings might change if the scores were altered to reflect a positive or negative public view of GWR.

4.4.2 Institutional Complexity

This evaluation criterion ranks alternatives based on the complexity of operating relationships with outside agencies. The higher the number of agreements required with agencies outside the City departments, then the more institutionally complex the alternative is, which could impact the ability to maximize implementation. Therefore, to measure institutional complexity, the RWMP planning team established a scale ranging from 1 (numerous agreements with outside agencies) to 5 (no agreements with outside agencies), with 3 representing moderate number of agreements. Projects outside of the San Fernando Valley would require more contracts/agreements with outside agencies, due to the distance from existing, City-owned supplies. Similarly, alternatives with more Metro and Westside NPR will have a higher number of contracts/agreements with outside agencies and will score lower.

Alternatives D1, V1, D2a and V2a receive the lowest score of 1, because they have the most NPR in Metro and Westside area. Alternatives D2b, V2b, D2c and V2c receive a moderate score of 3 because Metro or Westside NPR projects are eliminated, respectively. Alternatives D3 and V3 receive the highest score of 5 because these alternatives do not have NPR projects outside of the San Fernando Valley and therefore do not have any agreements with outside agencies.

4.4.3 Permitting

The permitting process can affect the implementation of an alternative. The key component of each alternative that differentiates the difficulty of the permitting process between alternatives is the amount GWR. This evaluation criterion ranks alternatives based on the difficulty of GWR permitting. Alternatives that result in more GWR will face more difficulties in permitting. Therefore, to measure permitting complexity, the RWMP planning team established a scale ranging from 1 (potentially challenging to permit) to 5 (potentially easy to permit), with 3 representing moderate permitting complexity.

Alternatives D1 and V1 have 15,000 AFY of GWR; therefore these alternatives receive a score of 4. Alternatives D2a through D2c and V2a through V2c have 22,500 AFY of GWR and receive a neutral score of 3. Alternatives D3 and V3 have 30,000 AFY of GWR and receive a score of 2.

4.4.4 Implementation Complexity

This evaluation criterion ranks alternatives based on the number of projects/contracts to implement. Each alternative involves GWR and NPR components. While GWR is a single project for the construction of an AWPF, improvements to Hansen Spreading Grounds, and groundwater wells, NPR is composed of numerous smaller projects. Therefore, alternatives that involve more NPR will face greater implementation complexity. To measure implementation complexity, the

RWMP planning team established a scale ranging from 1 (complex with number of NPR projects) to 5 (not complex with limited number of NPR project), with 3 representing moderate complexity.

Alternatives D1 and V1 receive the lowest score of 1 because these alternatives have the greatest number of NPR projects. Alternatives D2a through D2c and V2a through V2c receive a score of 3 because these alternatives have a moderate amount of NPR projects. Alternatives D3 and V3 receive a score of 5 because these alternatives have the least amount of NPR projects.

4.4.5 Construction Impacts

This evaluation criterion ranks alternatives based on the approximate length of new pipelines since all of the pipeline construction expected to occur in public streets would cause temporary traffic impacts, noise, odor, and dust during construction. NPR projects involve the construction of recycled water pipelines (a.k.a., purple pipes) throughout the city to reach their intended customers. In general, alternatives at DCT site have shorter pipeline distances than the alternatives at the VGS sites since the alternatives at the VGS site include the construction of approximately seven miles of brine pipeline from the AWPF to the connection to outfall sewer. **Table 4-9** provides a summary of the estimated length of new pipelines for each alternative. Refer to Appendix A (Table 3-2) for details on the pipeline estimates.

Table 4-9: Alternatives Development – Construction Impacts Performance Measures

Alternative	GWR Brine Pipeline (miles)	GWR Spreading Grounds Pipeline (miles)[a]	NPR Pipelines (miles)	Total Pipelines
D1	0	4.9	247.1	252
D2a	0	4.9	127.0	131.9
D2b	0	4.9	186.5	191.4
D2c	0	4.9	175.0	179.9
D3	0	4.9	7.2	12.1
V1	7.4	4.9	247.1	259.4
V2a	7.4	4.9	127	139.3
V2b	7.4	4.9	186.5	198.8
V2c	7.4	4.9	175	187.3
V3	7.4	4.9	7.2	19.5

[a] Spreading grounds pipeline miles were determined before Pacoima Spreading Grounds option was considered for Alternatives 2 and 3.The pipeline to the Pacoima Spreading Grounds is discussed in the GWR Master Planning Report.

4.5 Objective 5 – Promote Economic & Social Benefits

The intent of Objective 5 (Promote Economic & Social Benefits) is to provide economic and social benefits in the implementation and operation of recycled water projects. Three evaluation criteria are used for Objective 5 – Promote Economic & Social Benefits:

- Temporary job creation;
- Permanent job creation; and

- Environmental justice

4.5.1 Temporary Job Creation

This evaluation criterion ranks alternatives based on the number of temporary jobs that will be created for the design and construction of the GWR and NPR projects. Temporary job creation was estimated based on the total capital cost of the project. It is assumed that 7.2 direct and indirect jobs are created for every million dollars in construction spending, where a job is defined as one year of full-time work. This factor comes from the *Estimated San Francisco Jobs Created by Capital Spending* document written by the Office of the City Administrator in San Francisco on February 25, 2009. It references the REMI Policy Insight Model. This factor is supported by the American Recovery and Reinvestment Act as part of the Senate Stimulus Bill, which allocates $1.4 billion of capital investment for "water reclamation and reuse projects." The bill estimates that this money will generate 11,500 direct new private sector jobs or 8.2 direct jobs per million dollars of capital investment. In this TM, a factor of 7.2 direct jobs per million dollars of capital investment is used, since it is a more conservative estimate than 8.2.

Table 4-10 provides a summary of the estimated temporary jobs for each alternative.

Table 4-10: Alternatives Development – Estimated Temporary Jobs

Alternative	Total Capital Cost (million)	Estimated Temporary Jobs[1]
D1	$1,000	7,200
D2a	$813	6,400
D2b	$851	6,800
D2c	$841	6,100
D3	$715	5,100
V1	$966	7,000
V2a	$783	6,100
V2b	$817	6,500
V2c	$807	5,800
V3	$719	5,200

[1]Estimated using a factor of 7.2 direct jobs per million dollars of capital investment. (Estimated San Francisco Jobs Created by Capital Spending, February 25, 2009)
Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April, 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.

4.5.2 Permanent Job Creation

This evaluation criterion ranks alternatives based on the number of permanent jobs that will be created for the operation and maintenance of the NPR and GWR facilities.

For GWR, it was assumed that 1.9 full-time employment positions would be required per million gallons per day (mgd) of GWR. This factor is estimated by analyzing the personnel required to operate similar AWPFs. The three AWPFs listed in **Table 4-11** are similar to the proposed AWPF in that they receive secondary or tertiary effluent from a neighboring wastewater treatment plant. As a result, some of the personnel used to staff the AWPFs are shared with the wastewater treatment plant. Also, the capacities of these facilities are comparable to the capacity of the proposed AWPF. The average number of personnel required per mgd of the AWPF production capacity used in this analysis is 1.9. It should be noted that the multiplication factor used for the estimation of permanent jobs was refined as part of the development of the GWR Master Planning Report. Although the total number of jobs estimated does change as a result of this value change, the relative score of each alternative analyzed would not change since each of the alternatives would change by the same factor.

Table 4-11: Personnel Requirements at Similar AWPF Facilities

Facility	Source Water	Flow (mgd)	Number of Personnel	Number of Personnel/mgd
Terminal Island Water Reclamation Plant (TIWRP)	Tertiary Effluent from Terminal Island Water Reclamation Facility	5	9.18	1.8
WBMWD Edward C. Little Water Reclamation Facility (ELWRF)	Secondary Effluent from Hyperion Treatment Plant	22	40	1.8
Miami-Dade Water and Sewer Department (WASD)	Tertiary Effluent from the South District Wastewater Treatment Plant	21	40.8	1.9

For NPR, it is assumed that 23 personnel would be added for Alternatives D1 and V1, 12 personnel for Alternatives D2a through D2c and V2a through V2c, and one personnel for Alternatives D3 and V3. These estimates were provided by LADWP based on estimates of the number of NPR pump stations, tanks, and pipelines for each alternative.

Table 4-12 provides a summary of the estimated permanent jobs for each alternative.

Table 4-12: Alternatives Development – Estimated Permanent Jobs

Alternative	NPR Permanent Jobs	GWR Production Capacity (mgd)	GWR Permanent Jobs (Capacity x 1.9)	Estimated Permanent Jobs
D1	23	19.9	37	60
D2a	12	26.9	51	63
D2b	12	27.4	52	64
D2c	12	27.4	52	64
D3	1	32.4	61	62
V1	23	14.6	27	50
V2a	12	21.8	41	53
V2b	12	21.8	41	53
V2c	12	21.8	41	53
V3	1	30.6	58	59

4.5.3 Environmental Justice

This evaluation criterion ranks alternatives based on the environmental justice effects of the new permanent above-grade facilities, such as pump stations and storage tanks, included in each GWR and NPR facilities. Below-grade piping projects are not considered because their temporary effects are covered by the Construction Impacts evaluation criterion. The environmental justice effects are determined by counting the number of census tracts, designated as low-income and/or minority community parcels/tracts, where new permanent above-grade facilities for GWR and NPR facilities would be located.

For the DCT alternatives, Alternative D1 impacts seven tracts, Alternatives D2a and D2c each impact five, Alternative D2b impacts one, and Alternative D3 impacts no low-income and/or minority census tracts. The VGS counterparts of these alternatives each score one census tract higher than the DCT alternatives to account for VGS location being in an environmental justice improvement area.

Appendix E includes maps showing potential aboveground NPR facilities with respect to low to moderate income and minority tracts for each service area.

4.6 Objective 6 – Maximize Adaptability & Reliability

The intent of Objective 6 (Maximize Adaptability & Reliability) is to be able to adapt to uncertainties and maximize reliability of operations once projects are implemented. Two evaluation criteria are used for Objective 6 – Maximize Adaptability & Reliability:

- Recycled water demand reliability; and,
- Recycled water supply reliability.

4.6.1 Recycled Water Demand Reliability

This evaluation criterion ranks alternatives based on the reliability of recycled water demand. The recycled water demand is defined by the end-use of the recycled water: groundwater replenishment or specific NPR customers. Among the different end-users of recycled water, GWR is considered the most reliable demand, because it does not depend on individual customers. Among NPR customers, large industrial customers are considered the least reliable and most risky, because the demand may no longer be there by the time the purple pipe is constructed; the demands of a particular customer could have changed or the customer could have moved or be no longer in business. Therefore, alternatives with more large industrial customers with greater than 50 AFY of recycled water demand would rank lower. To measure recycled water demand reliability, the RWMP selected a performance measure of number of large industrial customers. The fewer numbers of potential industrial customers, the better the alternative scored for this criterion.

Alternatives D1 and V1 scored the worst with 34 large industrial customers. Alternatives D3 and V3 rank the best with two large industrial customers.

4.6.2 Recycled Water Supply Reliability

This evaluation criterion ranks alternatives based on the reliability of water supply. Recycled water is considered a drought-proof water supply and is not subject to water use restrictions. Therefore, for irrigation users who currently have restrictions for potable water use for irrigation during drought periods, using recycled water improves their irrigation water supply reliability. Since water use restrictions typically only affect irrigation customers rather than industrial customers, projects with more NPR for irrigation use score better.

Alternatives D1 and V1 rank the highest with 12,740 AFY of NPR irrigation demand. Alternatives D3and V3 rank the lowest with 100 AFY of NPR irrigation demands.

5. Evaluation Results

This section summarizes the results of the decision modeling for the alternatives evaluation. As discussed in Section 4, each alternative was characterized in terms of the evaluation criteria and performance measures established for the alternatives evaluation. Table 5-1 summarizes the performance measures and their scores. As discussed in Section 2.3, the decision model was built using the commercial software CDP to rank the alternatives.

5.1 Score Interpretation

In the figures presented in this section, the overall length of the horizontal bars represents the total decision score for the alternative. The overall score indicates how well each alternative performed in meeting the overall *set* of criteria. The colored segments within each bar represent the contribution of each of the *individual* criteria to the total decision score. Two factors determine the size of each color segment for a given bar, or alternative: 1) the raw performance or score of the alternative for that objective; and 2) the weight of the objective. In general, the results should be interpreted as follows:

- If the color segment is larger, then that alternative scores better for that performance measure when considered along with the weight of importance.
- If the color segment is smaller, then that alternative does not score as well for that performance measure, or the objective has a lower weight of importance, or both.

The scores for the individual objectives and the overall score for each alternative are shown on each graph.

5.2 Alternatives Analysis Results

Figure 5-1 and **Figure 5-2 s**how graphical results for the CDP model analysis.

Figure 5-1: Alternatives Scoring (In Order of Ranking)

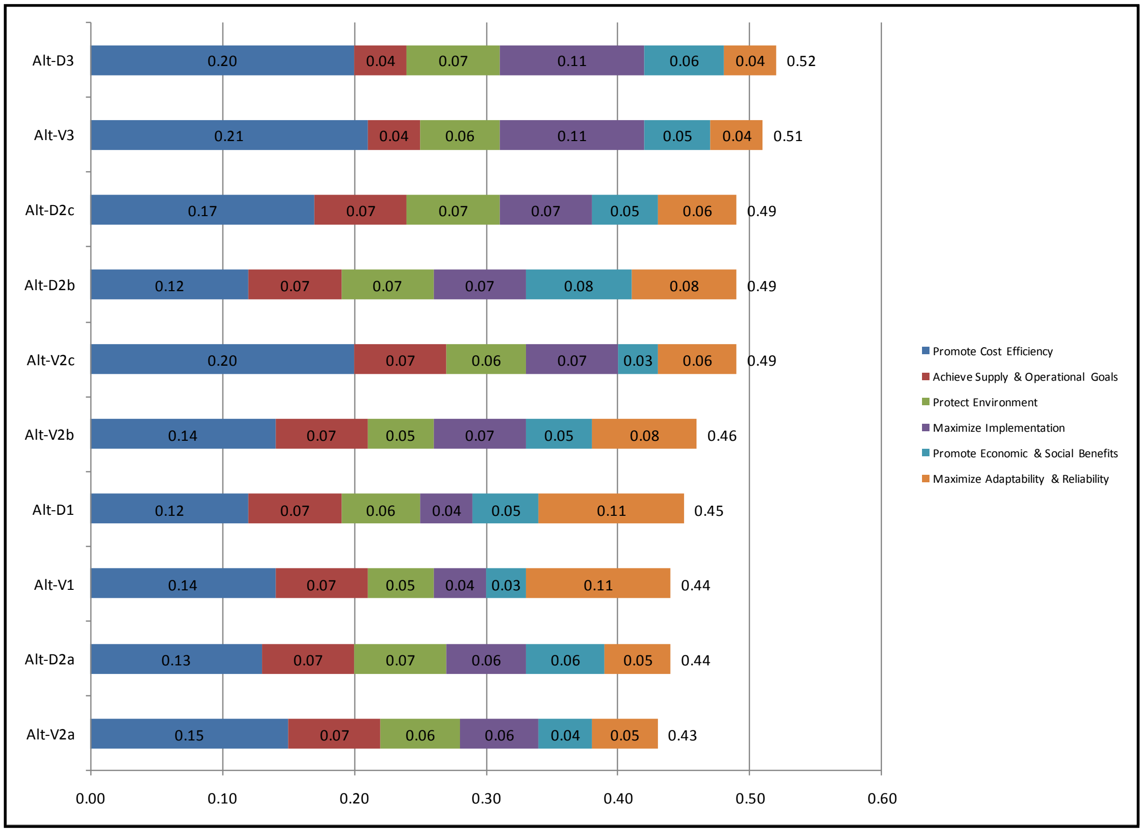
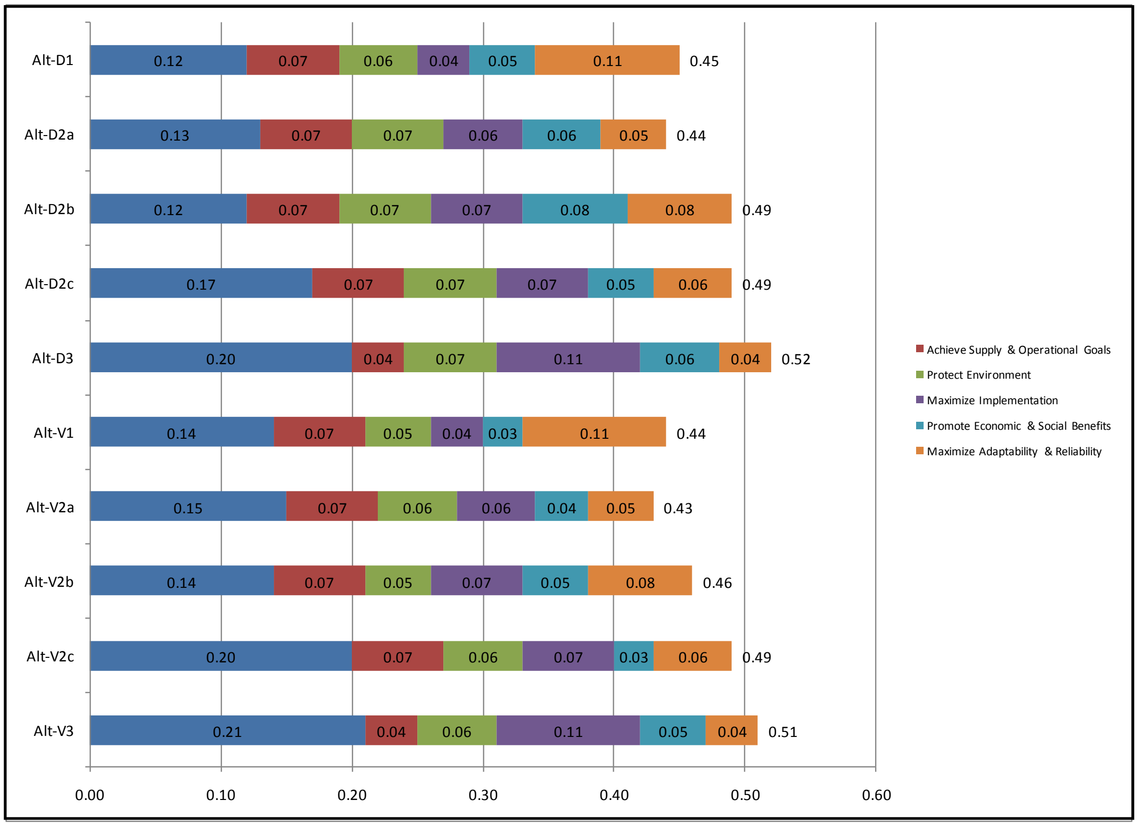


Figure 5-2: Alternatives Scoring (In Order of Name)



5.3 Sensitivity Analysis

As described in Section 2.3.1, a series of sensitivity runs were conducted using the decision model. These sensitivity runs involved altering the objectives weightings in accordance with Table 2-1. If the alternatives rankings change with the sensitivity runs, then this means that the alternative was sensitive to that particular element that was emphasized in the sensitivity run.

Table 5-1 summarizes the results of the CDP runs (Alternative Scoring for the Base Run as well as Sensitivity Runs). The graphical results of the sensitivity runs are included in Appendix F.

Table 5-1: Summary of Alternatives Scoring for the Base Run and Sensitivity Runs

	CDP Rankings									
	Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
0 Base	7	8	3	3	1	8	10	6	3	2
1 RWAG Average Weights	7	8	2	4	1	10	9	5	5	3
2 RWAG Environmental Emphasis	4	1	3	1	5	9	5	8	7	10
3 RWAG Social Emphasis	8	5	3	3	1	10	9	6	7	2
4 RWAG Cost Emphasis	9	10	8	4	3	5	5	5	1	2
5 Equal Weights	5	7	1	3	2	9	9	6	7	3
6 No Cost	2	6	1	4	4	7	10	3	9	7
Average Ranking	6.0	6.4	3.0	3.1	2.4	8.3	8.1	5.6	5.6	4.1
Total Number of Times Ranked No.1	0	1	2	1	3	0	0	0	1	0

Color Coding of Rankings:

1	2	3	4	5	6	7	8	9	10

Highest Ranked ⟵ ⟶ Lowest Ranked

6. Key Findings and Conclusions

6.1 Key Findings

Table 5-1 summarizes the number of times that each alternative was determined to be the highest ranked alternative. It is important to note that when two or more alternatives had the same overall score, there are ties in the rankings. The ideal situation would be that the sensitivity runs have no effect on the highest ranked alternative, signifying that the choice of the alternative was not sensitive to different RWAG member interests and scenarios represented in each weighting variation. Key findings of the CDP analysis are summarized below.

- ***Alternatives D3, D2b, D2c and V3 consistently ranked highest*** among all alternatives evaluated. Of the seven decision model runs, Alternative D3 ranks the highest on three of these runs, and Alternative D2b ranks highest on two of the decision model runs. The only other alternatives which have the highest score on any run are Alternative D2a, D2c, and V2c, which rank the highest on one run each. Although Alternative V3 does not rank the highest on any one run, it has the fourth highest average ranking, usually ranking second in the runs where Alternative D3 has the best ranking.
    - **Alternative D3** and **V3** (More GWR) rank strongly due to their having the lowest capital costs, nearly the lowest O&M costs, the highest operational flexibility measured by the percent of recycled water stored in the ground and the highest year-round offset of the HTP service area collection system. These alternatives also receive high scores in Maximizing Implementation because they do not require any agreements with outside agencies, require a less difficult permitting process, and have the least amount of individual NPR projects, in addition to the lowest potential construction impacts (e.g., miles of pipe through streets). Although these alternatives have the lowest temporary job creation (estimated as a function of capital costs), D3 and V3 have the highest estimated permanent jobs created. These alternatives score well in the Environmental Justice metric since they have the lowest number of low-income and/or minority census tracts with permanent above-grade facilities. Finally, because these alternatives have the lowest number of large industrial NPR customers, they score poorly in Maximizing Adaptability and Reliability because they are not as reliant on NPR irrigation (by an order of magnitude in AFY), which is considered to be drought-proof in this analysis. But, these alternatives do not receive high marks when ranking the alternatives according to the Sensitivity Analyses with Environmental Emphasis, and when Costs are not taken into account. Alternatives D3 and V3 do not have the highest scores for protecting the environment despite their high amount of groundwater recharge, which will improve groundwater quality by dilution, because they have high Greenhouse Gas emission scores, particularly Alternative V3. The GHG emissions are a result of power usage for treatment processes at the AWPF and conveyance pumping for GWR and NPR projects. The GHG emissions are particularly high for Alternative V3 because it includes pumping of a larger amount of Title 22 water over a longer distance, larger UV system to account for potentially higher NDMA in the AWPF influent water, pumping of the backwash and concentrate to offsite outfall sewer, pumping product water, and usage from a new Administration Building (DCT options assume using

existing Administration Building). Therefore, when the sensitivity analysis runs emphasizes environmental impacts and de-emphasize costs, Alternative V3 ranks very poorly, while Alternative D3 falls near the middle of the rankings.

- ***Alternatives V1, V2a, D2a, and D1 ranked lowest*** among all alternatives evaluated.
- Alternatives D1, D2a, V1, and V2a consistently ranked low due to their emphasis on NPR project options in the dense and built-up Metro and Westside service areas, which increase the amount of recycled water pipelines required. These NPR projects consequently resulted in higher capital and annual O&M costs, high GHG emissions, high construction impacts, lower economic and social benefits, and low recycled water demand reliability. But, while they ranked low in these areas, they did rank higher Conclusions

Based on this integrated analysis, it was concluded that more GWR (Alternative D3) is the best alternative, since it has the lowest cost (capital and O&M costs) and the fewest hurdles for implementation. Therefore, it is recommended that the GWR Master Planning Report be developed with facilities planning for the more aggressive GWR alternative (30,000 AFY). But, to recognize the supply reliability benefits and potential ability to implement smaller individual projects as funding becomes available, it is also recommended that the NPR Master Planning be developed identifying potential NPR projects to be developed in parallel.

7. References

1. City of Los Angeles Department of Water and Power (LADWP), (2011). *2010 Urban Water Management Plan*.
2. Office of the City Administrator in San Francisco, (February 25, 2009*). Estimated San Francisco Jobs Created by Capital Spending.*
3. RMC/CDM Smith, (2011). *Cost Estimating Basis for Recycled Water Master Planning TM.*
4. RMC/CDM Smith (2011). *Groundwater Replenishment (GWR) Master Planning Document.*
5. RMC/CDM Smith (2011). *Non-Potable Reuse Master Planning Document.*

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Appendix A

Integrated Alternatives Analysis – Preliminary Cost Summary TM (April 26, 2011)

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Summary of Modifications to "Integrated Alternatives Analysis – Preliminary Cost Summary" since Initial Publication on April 26 2011

The Recycled Water Master Planning (RWMP) effort has spanned three years (April 2009 – March 2012). As is the nature of a planning project, assumptions are typically modified and refined as a project is further developed. The most recent assumptions related the master planning effort are presented in the GWR Master Planning Report and the NPR Master Planning Report. Assumptions and conclusions presented in these reports supersede assumptions included in this technical memorandum (TM). The following table summarizes the modifications applicable to all RWMP TMs and those specifically applicable to this TM are described in the following sections.

Assumption	Modified	Original
Applicable to all RWMP TMs		
Recycled Water Goal	59,000 AFY by 2035 This goal reflects the 2010 LADWP Urban Water Management Plan that was adopted in early 2011, after the original RWMP goals were drafted	50,000 AFY by 2019
Name for Project and Master Planning Reports	Recycled Water Master Planning Documents GWR Master Planning Report NPR Master Planning Report	Recycled Water Master Plan GWR Master Plan NPR Master Plan
Introduction Section	This is superseded by the Introduction Sections in the NPR Master Planning Report.	This section was included in all initial TMs but the terms described have been replaced by the Introduction Section for the NPR Master Planning Report.
NPR Projects Terminology	To avoid confusion related to LADWP's water rate structure, the terms "Tier 1" and "Tier 2" are superseded with the terms "planned" and "potential," respectively. Both planned and potential projects would be considered for implementation by 2035.	"Tier 1" for NPR projects that were originally planned for design and construction by the year 2015. "Tier 2" for NPR projects that were originally being evaluated in the NPR Master Planning Report for potential future implementation after the year 2015.
Name for MF/RO/AOP treatment plant	Advanced water purification facility (AWPF)	Advanced water treatment facility (AWTF)
Name for water produced by AWPF	Purified recycled water	Advanced treated recycled water, highly purified recycled water, etc.
Treatment Plant Acronyms	DCTWRP LAGWRP	DCT LAG
GWR Project Phases	Phase 1 = 15,000 AFY annual recharge goal and 25 mgd AWPF product water capacity Phase 2 = 30,000 AFY annual recharge goal and 35 mgd AWPF product water capacity	Phase 1 = 20 mgd AWPF product water capacity Phase 2 = 40 mgd AWPF product water capacity

The following modifications are specific to this TM.

2.1 Preliminary Alternatives

The original recycled water goal for the RWMP was 50,000 AFY, which was established before completion of the 2010 UWMP. The recycled water goal was increased to 59,000 AFY with the issuance of the 2010 UWMP. The integrated alternatives analysis was focused on determining the balance of GWR and NPR to achieve 30,650 AFY so that when combined with the 19,350 AFY of existing and planned NPR demands will achieve an overall recycled water goal of 50,000 AFY. Although this TM was initially structured to achieve the 50,000 AFY goal, combinations of GWR and NPR alternatives are included in the subsequent Groundwater Replenishment Master Planning Report and Non-Potable Reuse Master Planning Report to support the UWMP 59,000 AFY goal by 2035. **Figure 2-1** summarizes the three integrated alternatives developed to offset the initial goal of 50,000 AFY of potable water as well as modifications to achieve the UWMP goal of 59,000 AFY.

Revised Figure 2-1: Integrated Alternatives to Reach 50,000 AFY and 59,000 AFY

	50,000 AFY[1]	59,000 AFY
	Alternative 1. More Purple Pipe (NPR)	**Alternative 1. More Purple Pipe (NPR)**
	Existing NPR: 8,000 AFY	Existing NPR: 8,000 AFY
	Planned NPR: 11,350 AFY	Planned NPR: 11,350 AFY
	Potential NPR: 15, 650 AFY	Potential NPR: 24, 650 AFY
	GWR: 15,000 AFY	GWR: 15,000 AFY
	Alternative 2. Moderate GWR/NPR	**Alternative 2. Moderate GWR/NPR**
	Existing NPR: 8,000 AFY	Existing NPR: 8,000 AFY
	Planned NPR: 11,350 AFY	Planned NPR: 11,350 AFY
	Potential NPR: 8,150 AFY	Potential NPR: 17,150 AFY
	GWR: 22,500 AFY	GWR: 22,500 AFY
	Alternative 3. More GWR	**Alternative 3. More GWR**
	Existing NPR: 8,000 AFY	Existing NPR: 8,000 AFY
	Planned NPR: 11,350 AFY	Planned NPR: 11,350 AFY
	Potential NPR: 650 AFY	Potential NPR: 9, 650 AFY
	GWR: 30,000 AFY	GWR: 30,000 AFY

Note:

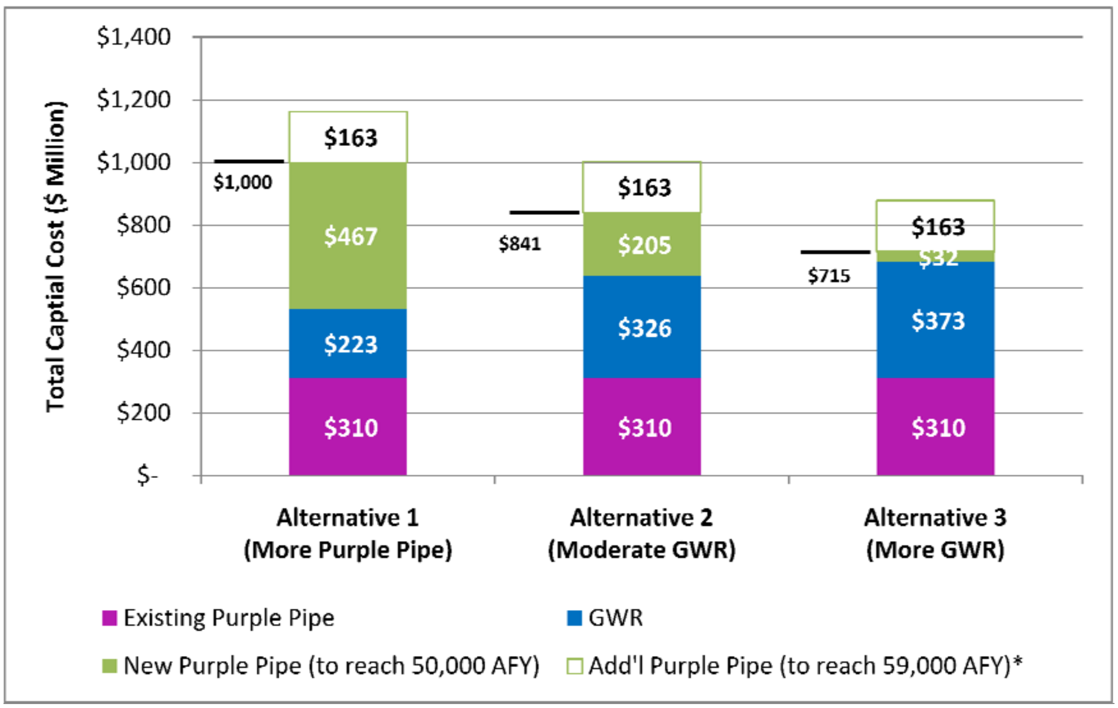
1. The original recycled water goal for the RWMP was 50,000 AFY by 2019, which was established before the completion of the 2010 UWMP. The recycled water goal was revised to 59,000 AFY by 2035 with the issuance of the 2010 UWMP. The UWMP reflects realities of funding limitations that were not addressed in the 2008 Water Supply Action Plan. Water rate increases are required to achieve even the revised projections in the UWMP. The integrated alternatives analysis was originally focused on determining the balance of GWR and NPR to achieve 30,650 AFY so that when combined with the 19,350 AFY of existing and planned NPR demands will achieve an overall recycled water goal of 50,000 AFY.

4.1 Capital Costs

In this TM, Section 4.1 presented a summary of the estimated capital costs for the three alternatives to deliver 50,000 AFY. To meet the updated 59,000 AFY, an addition 9,000 AFY of NPR would be required. The revised Figure 4-1 shows the additional minimum capital costs that would be required to deliver these additional projects. Note that the costs were based on adding additional NPR projects to Alternative 3. The additional costs to Alternatives 1 and 2 could be higher than what is shown, since most of the lower cost NPR projects were already accounted for in the alternatives. Note that costs developed in this document were developed in April 2011.

The most current GWR and NPR project costs developed as part of the RWMP are included in the GWR and NPR Master Planning Reports, respectively, and would not change the outcome of this analysis.

Revised Figure 4-1: Capital Costs for Alternatives to Achieve 50,000 AFY and 59,000 AFY



*Note that the additional NPR costs were based on adding additional NPR projects to Alternative 3. The additional costs to Alternatives 1 and 2 could be higher, since most of the lower cost NPR projects were already accounted for in the alternatives.

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Integrated Alternatives Analysis – Preliminary Cost Summary

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Reviewed by:	Tom Richardson, Project Manager, RMC
Date:	April 26, 2011

1. Introduction

With imported water supplies becoming ever more unpredictable, the Los Angeles Department of Water and Power (LADWP) adopted the City of Los Angeles' (City) Water Supply Action Plan in May 2008, calling for 50,000 acre-feet per year (AFY) of potable supplies to be replaced by recycled water. To meet this near-term challenge and plan for expanding reuse in the future, LADWP has partnered with the Department of Public Works to develop the Recycled Water Master Plan (RWMP). The RWMP includes seven major tasks: 1) Groundwater Replenishment (GWR) Master Plan; 2) Non-Potable Reuse Master Plan; 3) GWR Treatment Pilot Study; 4) Max Reuse Concept Report; 5) Satellite Feasibility Concept Report; 6) Existing System Reliability Concept Report; and 7) Training.

As part of the master planning process, several alternatives were developed and evaluated. The process for developing and evaluating these alternatives were documented in detail in a document titled, "Draft Near-Term Integrated Alternatives Development and Analysis Technical Memorandum" (TM) (RMC/CDM, November 13, 2010).

The purpose of this document is to provide an overview of the alternatives and associated costs, to supplement the information presented to the Recycled Water Advisory Group on March 24, 2011.

2. Background & Approach

2.1 Preliminary Alternatives

The recycled water planning team established alternatives that vary the amount of GWR and non-potable reuse projects (aka "purple pipe" projects). All alternatives include the existing purple pipe projects that are currently constructed or underway (19,350 AFY). Preliminary alternatives were developed with different focuses to provide opportunities for understanding trade-offs. **Figures 2-1** and **2-2** illustrate the themes of the three alternatives.

Figure 2-1: Themes of Preliminary Alternatives to Reach 50,000 AFY

Alternative 1. More Purple Pipe

- **GWR: 15,000 AFY**
- **New Purple Pipe: 15,650 AFY**
- **Existing Purple Pipe: 19,350 AFY**

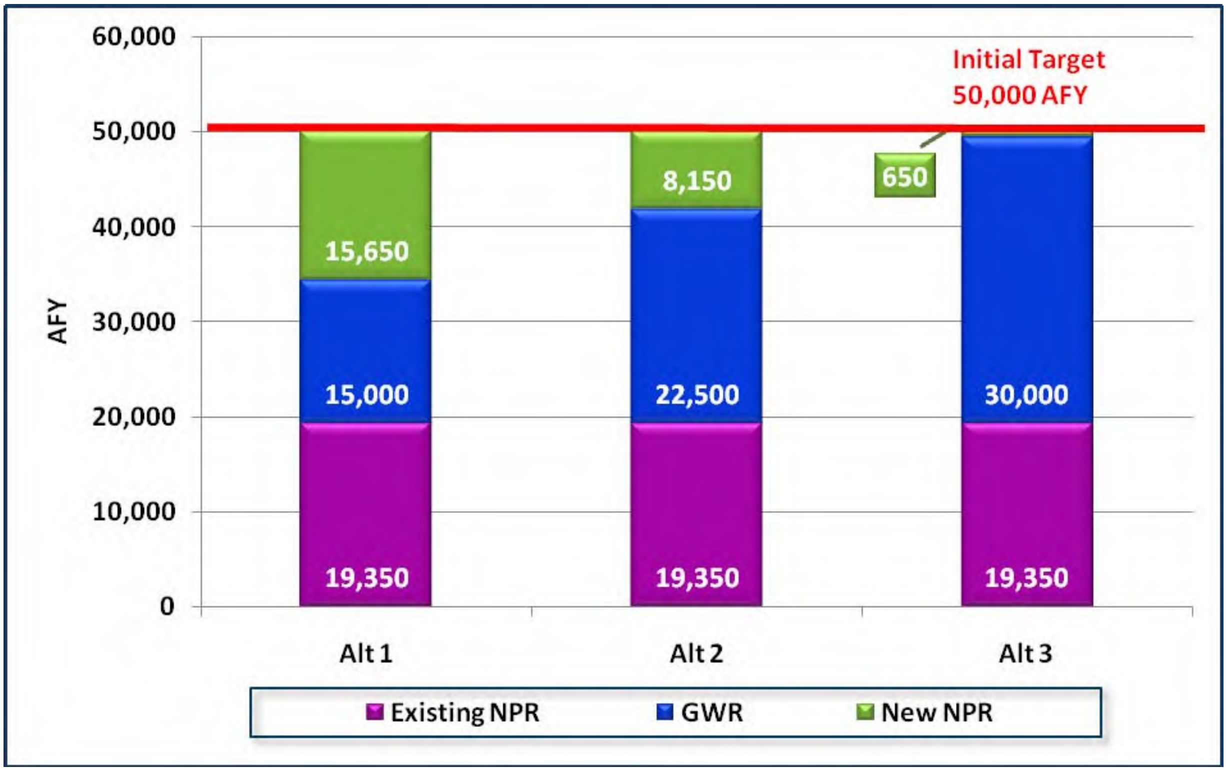
Alternative 2. Moderate GWR

- **GWR: 22,500 AFY**
- **New Purple Pipe: 8,150 AFY**
- **Existing Purple Pipe: 19,350 AFY**

Alternative 3. More GWR

- **GWR: 30,000 AFY**
- **New Purple Pipe: 650 AFY**
- **Existing Purple Pipe: 19,350 AFY**

Figure 2-2: Preliminary Alternatives to Reach 50,000 AFY



2.2 Recycled Water Master Planning Objectives

The recycled water planning team established objectives established for the RWMP at the beginning of the planning process. These objectives define the goals of the RWMP and establish criteria by which alternatives can be compared against each other.

Several guidelines were used when establishing objectives. The objectives had to be: easy to understand; non-redundant; measureable with evaluation criteria; and, concise in numbers, generally no more than five to eight objectives. It is also important to note that objectives are not solutions. Objectives define ***what*** the City is trying to achieve through the RWMP, and solutions (i.e., alternatives) represent ***how*** these objectives will be achieved.

Two threshold objectives were established, which had to be met regardless of the alternative:

- **Threshold Objective 1** – Meet all water quality regulations and health & safety requirements, and use proven technologies.
- **Threshold Objective 2** – Provide effective communication and education on recycled water program.

In addition to the threshold objectives, six additional objectives summarized in **Table 2-1** were also established.

Table 2-1: Recycled Water Planning Objectives

Recycled Water Planning Objectives
1 - Promote Cost Efficiency: Meet the goals of the recycled water program in a cost-effective manner, considering both City and recycled water customer costs.
2 – Achieve Supply and Operational Goals: Meet or exceed water supply targets and operational goals established by the City.
3 – Protect Environment: Develop projects that not only protect the environment, but also provide opportunities to enhance it.
4 - Maximize Implementation: Maximize implementation by minimizing typical hurdles including institutional complexity, permitting challenges, and maximizing customer acceptance.
5 - Promote Economic and Social Benefits: Provide economic and social benefits in the implementation and operation of recycled water projects
6 – Maximize Adaptability and Reliability: Maximize adaptability and reliability to be able to adapt to uncertainties and to maximize reliability of operations once projects are implemented.

This document focuses on the how costs were developed for each alternative, to be able to measure Objective 1 – Promote Cost Efficiency. Methods of measuring the other objectives were also developed, as presented in the "Draft Near-Term Integrated Alternatives Development and Analysis TM" (RMC/CDM, November 13, 2010).

2.3 Approach to Cost Estimating

2.3.1 Capital and Annual Costs

To understand the potential costs of the alternatives, the recycled water planning team established cost estimating criteria for following types of costs:

- **Capital Costs:** One-time setup expenses for a project, payment for which may be spread out over many years. Capital costs include treatment equipment, buildings, conveyance pipelines, pump stations, and storage (as needed). Capital costs also include factors to account for design and environmental permitting costs.
- **Operation & Maintenance Costs (O&M):** recurring expenses that continue after construction. O&M costs include chemicals for treatment processes, power, labor, cleaning, servicing, repairs and routine replacements. For our alternatives, O&M costs also included the purchase of recycled water from partner agencies, such as West Basin Municipal Water District (as needed).

Depending on the stage of the project and the level of detail understood, different estimating accuracies can be assumed. Since we are at a master planning stage, the accuracy range for our estimate is at a "Budget Level", which reflects an accuracy range of -15% to +30%. All costs presented are reflected in today's dollars, which is based upon the Engineering News Record Construction Cost Index for Los Angeles of 10000.30 (January 2011). In addition, the capital costs include a 30% contingency to account for unknown or unforeseen construction costs. Capital costs also include a 30% implementation factor to account for the costs for planning and environmental documentation, permits, engineering, design and construction services, construction management and inspections, and typical overhead items such and legal and administration services.

Table 2-2 shows an example of how we applied the cost contingencies and other factors to capital cost estimates.

Table 2-2: Example Application of Cost Factors for Alternatives

Items	Calculation	Planning Estimate
Capital Cost Factors		
A. Estimated Construction Cost Subtotal		$1,000,000
B. Construction Contingency Cost Factor (30%)	0.3 * (A)	$300,000
C. Total Construction Cost Subtotal	(A) + (B)	$1,300,000
D. Implementation Cost Factor (30%)	0.3 * (C)	$390,000
E. Total Capital Cost	**(C) + (D)**	**$1,690,000**

A detailed discussion of these cost estimating criteria, as well as the assumed construction and O&M unit costs can be found in the document titled, "Final Draft Cost Estimating Basis for Recycled Water Master Planning TM" (RMC/CDM, April 2011).

2.3.2 Present Value

Present Value (PV) is a common financial method for comparing costs. PV reflects the "time value" of money, meaning that a dollar is worth more today than tomorrow. So, PV accounts for inflation. PV looks at total costs including capital and O&M over a defined lifecycle. It converts future costs projected over time to today's dollars. The following are the key assumptions used to calculate PV for our alternatives:

- 50-year lifecycle
- Estimates of future capital costs
- Estimates of future O&M costs
- All costs brought back to today's dollars with PV discount factor

The PV assumptions applied for comparison of the preliminary alternatives include:

- 50 year useful life for permanent structures; 20 year useful life for equipment
- 50-year lifecycle period is from year 2015 to year 2064
- 0% for borrowing rate
- 3% for capital and O&M inflation
- 3% for discount rate

See the "Final Draft Cost Estimating Basis for Recycled Water Master Planning TM" for additional detailed discussion of accounting assumptions.

3. Recycled Water Options in the Alternatives

Each of the alternatives includes various purple pipe and GWR options, which when combined become a complete integrated alternative. This section describes the existing purple pipe, new purple pipe, and GWR options included in the alternatives.

3.1 Existing Purple Pipe

All alternatives include existing purple pipe projects to deliver approximately 19,350 AFY by Fiscal Year (FY) 2014/15. These projects are either already in operation (approximately 8,000 AFY) or are in construction or planning/design with planned construction by FY 2014/15 (approximately 11,350 AFY). **Table 3-1** is a summary of the existing purple pipe projects included in all alternatives.

Table 3-1: Summary of Existing Purple Pipe Projects (through FY 14/15)

Service Area	Average Annual Yield	Estimated Capital Cost	Estimated O&M Cost
Harbor	12,500	$203 M	$13.6 M / yr
Metro	3,063	$61 M	$0.8 M / yr
Valley	2,960	$39 M	$1.2 M / yr
Westside	827	$7 M	$0.20 M / yr
Total	**19,350 AFY**	**$310 M**	**$15.8 M / yr**

The “existing purple pipe” includes infrastructure that has already been installed dating back to 1979 that is currently delivering approximately 8,000 AFY of recycled water. Approximately $180 million has been spent through FY 2008/09. The estimated capital cost shown in Table 3-1 of $310 million is for expanding the recycled water infrastructure the additional 11,350 AFY from FY 2009/10 through FY 2014/15, which represents projects that are currently in planning, design or construction.

3.2 New Purple Pipe

In addition to the existing purple pipe projects, alternatives include varying amounts of new purple pipe projects. For example, we would need to deliver recycled water to all major areas of the City (valley, central, westside and harbor) for Alternative 1 to deliver over 15,650 AFY of recycled water to new customers. To meet the Alternative 2 goal of 8,150 AFY, we could focus purple pipe development in a few areas of the City while Alternative 3 only needs a few new purple pipe projects to supply 650 AFY.

The recycled water master planning team identified potential irrigation and industrial customers with demands over 5 AFY. This represents the most amount of non-potable reuse that we could efficiently achieve. **Table 3-2** summarizes the purple pipe projects considered for the alternatives and define the estimated facility costs (capital and O&M), the facilities, and the annual yield for each option. **Figure 3-2** show the potential locations purple pipe projects considered for the alternatives. Note that the pipelines and facilities shown are diagrammatic and not intended to depict actual locations or alignments.

Table 3-2: Summary of New Purple Pipe Projects for IAA Cost Summary TM

	Annual Yield (AFY)		Facilities				Facility Capital Cost Estimates				Total Capital	O&M Cost Estimates			EXAMPLE (See Notes 2 & 3) NPR Components of Alternatives		
NPR Projects	Total	With 75% Factor	Storage Tank	Pump Station	PRV	Conveyance	Storage Tank	Pump Station	PRV	Conveyance	(w/ 30% cont. + 30% design, env., etc.)	O&M Cost ($/yr)	RW Purchase ($/yr)	Total O&M ($/yr)	Alt 1	Alt 2	Alt 3
Harbor	**2,130**	**1,598**					**$ 4,100,000**	**$ 2,940,000**	**$ -**	**$ 23,910,000**	**$ 33,300,000**	**$ 367,000**	**$ 400,000**	**$ 605,000**			
WBMWD																	
Ex/T1 Laterals	711	533	--	--	--	1.4 mi	$ -	$ -	$ -	$ 1,080,000	**$ 1,800,000**	$ 4,000	$ 400,000	**$ 404,000**	✓	✓	
TIWRP			2 x 0.5 MG	3,600 gpm													
Ex/T1 Laterals	551	413	--	--	--	1.4 mi	$ -	$ -	$ -	$ 1,110,000	**$ 1,900,000**	$ 5,000	$ -	**$ 5,000**	✓		
SA Recycling	105	79	--	6%	--	1.3 mi	$ -	$ 180,000	$ -	$ 1,010,000	**$ 2,000,000**	$ 39,000	$ -	**$ 39,000**	✓	✓	
Peck Park	189	142	33%	10%	--	2.1 mi	$ 680,000	$ 290,000	$ -	$ 2,450,000	**$ 5,800,000**	$ 55,000	$ -	**$ 55,000**	✓		
Port of LA	265	199	33%	15%	--	3.8 mi	$ 680,000	$ 440,000	$ -	$ 6,220,000	**$ 12,400,000**	$ 47,000	$ -	**$ 47,000**	✓	✓	
Angels Gate	206	155	34%	12%	--	2.8 mi	$ 700,000	$ 350,000	$ -	$ 3,170,000	**$ 7,100,000**	$ 36,000	$ -	**$ 36,000**	✓		
Coast Guard	103	77	--	6%	--	1.5 mi	$ -	$ 180,000	$ -	$ 1,190,000	**$ 2,300,000**	$ 19,000	$ -	**$ 19,000**	✓	✓	
Metro	**5,877**	**4,408**					**$ 9,410,000**	**$ 1,280,000**	**$ 720,000**	**$ 52,000,000**	**$ 107,200,000**	**$ 310,000**	**$ 2,320,000**	**$ 2,630,000**			
LAG																	
Ex/T1 Laterals	937	703	--	--	--	7.0 mi	$ -	$ -	$ -	$ 6,540,000	**$ 11,100,000**	$ 23,000	$ -	**$ 23,000**	✓	✓	
Hollywood	1,244	933	2.0 MG	1,300 gpm	16"	11.8 mi	$ 6,140,000	$ -	$ 360,000	$ 14,810,000	**$ 36,000,000**	$ 64,000	$ 930,000	**$ 994,000**	✓		
CBMWD																	
USC	2,422	1,816	--	--	--	10.2 mi	$ -	$ -	$ -	$ 18,270,000	**$ 30,900,000**	$ 33,000	$ 910,000	**$ 943,000**	✓	✓	
Downtown	1,274	956	0.8 MG	1,500 gpm	20"	6.8 mi	$ 3,270,000	$ 1,280,000	$ 360,000	$ 12,380,000	**$ 29,200,000**	$ 190,000	$ 480,000	**$ 670,000**	✓	✓	
Valley	**8,601**	**6,451**					**$ 29,420,000**	**$ 11,120,000**	**$ 1,030,000**	**$ 88,400,000**	**$ 219,600,000**	**$ 1,676,000**	**$ -**	**$ 1,676,000**			
Ex/T1 Laterals	1,647	1,235	--			5.7 mi	$ -	$ -	$ -	$ 6,510,000	**$ 11,000,000**	$ 18,000	$ -	**$ 18,000**	✓	✓	
North Valley																	
VA	1,367	1,025	1.0 MG	4,000 gpm	--	10.2 mi	$ -	$ 1,620,000	$ -	$ 18,110,000	**$ 33,300,000**	$ 200,000	$ -	**$ 200,000**	✓	✓	
Knollwood	993	745	1.3 MG	3,800 gpm	16"	10.0 mi	$ 7,930,000	$ 3,670,000	$ 360,000	$ 11,880,000	**$ 40,300,000**	$ 300,000	$ -	**$ 300,000**	✓		
Porter Valley	797	598	1.0 MG	700 gpm	--	6.1 mi	$ 4,090,000	$ 720,000	$ -	$ 7,270,000	**$ 20,400,000**	$ 110,000	$ -	**$ 110,000**	✓		
West Valley				4,300 gpm	--												
Braemar	1,074	806	2.5 MG	47%	--	6.4 mi	$ 5,120,000	$ 1,340,000	$ -	$ 10,900,000	**$ 29,300,000**	$ 230,000	$ -	**$ 230,000**	✓	✓	
Pierce	357	268	--	16%	--	3.5 mi	$ -	$ 460,000	$ -	$ 4,750,000	**$ 8,800,000**	$ 52,000	$ -	**$ 52,000**	✓		
Woodland	848	636	2.0 MG	37%	--	7.8 mi	$ 6,140,000	$ 1,050,000	$ -	$ 7,780,000	**$ 25,300,000**	$ 200,000	$ -	**$ 200,000**	✓		
East Valley (Burbank)																	
N. Hollywood Park	143	107	--	--	--	3.0 mi	$ -	$ -	$ -	$ 4,000,000	**$ 6,800,000**	$ 36,000	$ -	**$ 36,000**	✓	✓	✓
Van Nuys	629	472	1.0 MG	1,800 gpm	16"	8.9 mi	$ 2,050,000	$ 880,000	$ 360,000	$ 11,090,000	**$ 24,300,000**	$ 230,000	$ -	**$ 230,000**	✓	✓	✓
Hwy 170	672	504	0.5 MG	800 gpm	12"	6.7 mi	$ 4,090,000	$ 1,380,000	$ 310,000	$ 5,580,000	**$ 19,200,000**	$ 270,000	$ -	**$ 270,000**	✓		
Valhalla	74	56	--	--	--	1.1 mi	$ -	$ -	$ -	$ 530,000	**$ 900,000**	$ 30,000	$ -	**$ 30,000**	✓	✓	✓
Westside	**4,258**	**3,193**					**$ 12,890,000**	**$ 3,690,000**	**$ 360,000**	**$ 46,300,000**	**$ 106,900,000**	**$ 553,000**	**$ 2,140,000**	**$ 2,693,000**			
Ex/T1 Laterals	833	625	--			4.0 mi	$ -	$ -	$ -	$ 5,720,000	**$ 9,700,000**	$ 13,000	$ 500,000	**$ 513,000**	✓	✓	
Westside																	
Kenneth Hahn	668	501	1.0 MG	1,300 gpm	--	5.5 mi	$ 3,070,000	$ 1,150,000	$ -	$ 5,450,000	**$ 16,300,000**	$ 160,000	$ 190,000	**$ 350,000**	✓		
UCLA	2,757	2,068	0.4, 4.0 MG	3,700 gpm	24"	23.3 mi	$ 9,820,000	$ 2,540,000	$ 360,000	$ 35,130,000	**$ 80,900,000**	$ 380,000	$ 1,450,000	**$ 1,830,000**	✓		
Total	**20,866**	**15,650**					**$ 55,820,000**	**$ 19,030,000**	**$ 2,110,000**	**$ 210,610,000**	**$ 467,000,000**	**$ 2,906,000**	**$ 4,860,000**	**$ 7,604,000**	EXAMPLE (See Notes 2 & 3)		

Notes:

1. Cost estimates based on facilites from intial hydraulic modeling completed in August 2010. All costs are in January 2011 dollars.

2. NPR components of Alternatives 1, 2, and 3 were selected for demonstration purposes only. LADWP will select NPR projects to implement that are most viable and cost effective while considering environmental, constructability, and available sources of recycled water.

3. For each alternative, see Table 3-3 for total capital costs by service area and Table 3-4 for total annual O&M costs by service area.

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Figure 3-2: Potential New Purple Pipe Projects

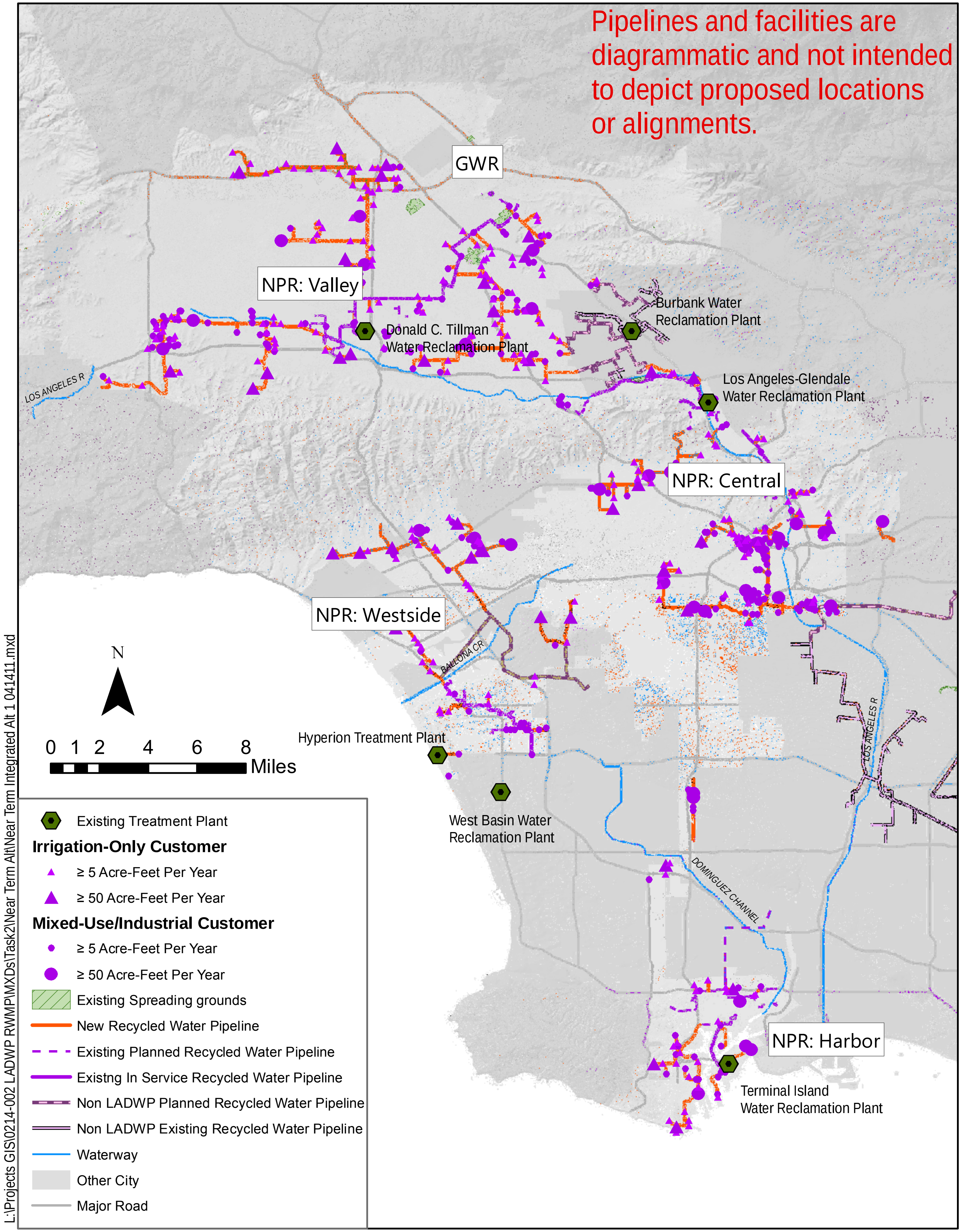


Table 3-3 and **Table 3-4** summarize the total capital and O&M costs of new purple pipe projects for each preliminary alternative by service area. Note that the components of Alternatives 1, 2, and 3 were selected for demonstration purposes only. LADWP will select NPR projects to implement that are most viable and cost effective while considering environmental, constructability, and available sources of recycled water.

Table 3-3: Summary of New Purple Pipe Projects for each Alternative - Capital Costs

Service Area	Alt 1	Alt 2	Alt 3
Harbor	$33,000,000	$19,000,000	--
Metro	$107,000,000	$71,000,000	--
Valley	$220,000,000	$106,000,000	$32,000,000
Westside	$107,000,000	$9,000,000	--
New Purple Pipe Total	**$467,000,000**	**$205,000,000**	**$32,000,000**

Note: Costs are in January 2011 dollars and include 30% construction contingency costs and 30% implementation costs.

Table 3-4: Summary of New Purple Pipe Projects for each Alternative - O&M Costs

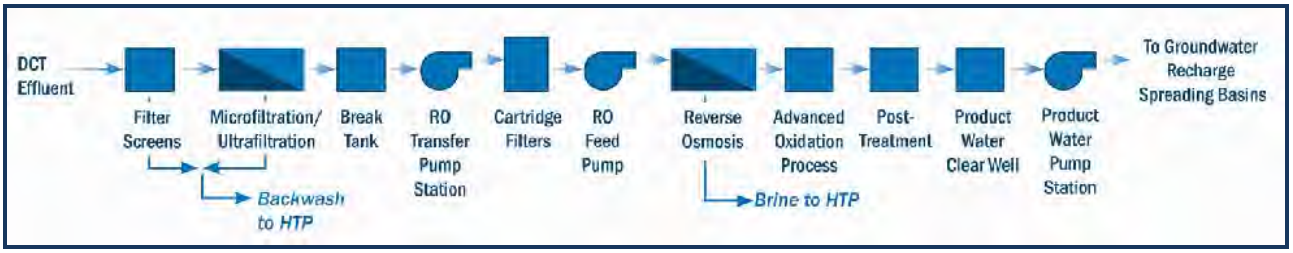
Service Area	Alt 1	Alt 2	Alt 3
Harbor	$ 600,000	$500,000	--
Metro	$2,650,000	$1,700,000	--
Valley	$1,700,000	$700,000	$300,000
Westside	$2,650,000	$500,000	--
New Purple Pipe Total	**$7,600,000**	**$3,400,000**	**$300,000**

Note: Costs are in January 2011 dollars.

3.3 GWR

In addition to existing purple pipe and new purple pipe projects, the alternatives include GWR options, ranging from 15,000 AFY to 30,000 AFY. Facilities included for GWR include advanced water treatment facility (AWTF) components including structures, equipment, parking, pumps, conveyance pipeline, backwash and concentrate pipelines. **Figure 3-3** presents the proposed treatment train.

Figure 3-3: Proposed Advanced Water Treatment Train



DCT – Donald C. Tillman Water Reclamation Plant; HTP – Hyperion Treatment Plant

3.3.1 Candidate Sites for AWTF

The recycled water planning team is considering five candidate sites for the AWTF. Four candidate sites are at or near the Donald C. Tillman Water Reclamation Plant (DCT), as shown in **Figure 3-4,** and one candidate site at the Valley Generating Station (VGS), as shown in **Figure 3-5**.

Figure 3-4: AWTF Candidate Sites at or Near DCT

Figure 3-5: AWTF Candidate Site at VGS

The five candidate sites for the AWTF were initially and preliminarily evaluated based on the objectives described in Section 2.2. **Table 3-5** and **Table 3-6** summarize the capital costs and O&M costs for the five candidate sites for the 30,000 AFY GWR project option.

Table 3-5: Capital Cost Estimate Comparison for AWTF at 5 Candidate Sites

Parameter	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
AWTF - Structures	$62,300,000	$62,300,000	$58,800,000	$62,300,000	$62,300,000
AWTF - Equipment	$110,400,000	$110,400,000	$104,300,000	$110,400,000	$110,400,000
Two-Story MF/RO Building	$510,000	$510,000	--	--	--
New parking and fencing	--	$60,000	$280,000	$200,000	$200,000
New site security	--	--	$47,000	$47,000	$47,000
New Administration Building	--	--	$5,400,000	--	--
Use eastern half of Phase II CCB for MF/RO Break Tank and UV Building (Incremental Cost)	$770,000	--	--	--	--
Additional UV Capacity	--	--	$1,400,000	--	--

Table 3-5: Capital Cost Estimate Comparison for AWTF at 5 Candidate Sites (Continued)

Parameter	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
Demolition and replacement of Maintenance and Warehouse Buildings	--	$14,200,000	--	--	--
Demolition and relocation of Existing Training Towers at VGS	--	--	TBD	--	--
Purchase new land to relocate Cricket Fields	--	--	--	$27,200,000	$0
Raise site grade or build berm around site for 100-yr flood	--	--	--	$3,100,000	$180,000
Compensate for flood water storage volume off-site	--	--	--	$800,000	$320,000
Add one new pump at Balboa PS for AWTF product water pumping	$750,000	$750,000	--	$750,000	$750,000
Add two new pumps at Balboa PS for AWTF influent/NPR water pumping	--	--	$1,500,000	--	--
Add New AWTF Product Water PS for AWTF product water to spreading grounds	--	--	$630,000	--	--
New pipeline to convey DCT effluent to AWTF influent	--	$400,000	--	--	$1,600,000
New pipeline to convey AWTF product water to Balboa PS	--	$1,000,000	--	--	$1,000,000
New pipeline for AWTF product water to spreading grounds	--	--	$800,000	--	--
New AWTF backwash and concentrate pipeline (gravity)	$500,000	$500,000	--	$500,000	$500,000
New AWTF backwash and concentrate pipeline (forcemain) and pump station [a]	--	--	$19,400,000[a]	--	--
New Phase 4 Equalization Basins (to equalize primary influent)	$9,500,000	$9,500,000	$9,500,000	$9,500,000	$9,500,000
AWTF Construction Subtotal	**$184.7 M**	**$199.6 M**	**$202.1 M**	**$214.8 M**	**$186.8 M**
Contingency Costs (30%)	$55.4 M	$59.9 M	$60.6 M	$64.4 M	$56.0 M
Construction Total	**$240.1 M**	**$259.5 M**	**$262.7 M**	**$279.2 M**	**$242.8 M**
Implementation Costs (30%)	$72.0 M	$77.9 M	$78.8 M	$83.8 M	$72.8 M
Total Capital Cost	**$312 M**	**$337 M**	**$342 M**	**$363 M**	**$316 M**

Note: Costs are in January 2011 dollars.

a. Cost could increase considerably if pipe jacking becomes necessary in certain portions to alleviate concerns of open trenching.

Table 3-6: Annual O&M Cost Estimate Comparison for AWTF at 5 Candidate Sites

Parameter	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
Total Labor, Chemical, Equipment Replacement	$12,300,000	$12,300,000	$10,600,000	$12,300,000	$12,300,000
Power Usage - AWTF excl. UV	$4,000,000	$4,000,000	$3,400,000	$4,000,000	$4,000,000
Power Usage - UV	$1,300,000	$1,300,000	$1,700,000	$1,300,000	$1,300,000
Power Usage - Balboa PS	$1,600,000	$1,600,000	$2,500,000	$1,600,000	$1,600,000
Power Usage - Product Water PS	--	--	$100,000	--	--
Power Usage - Brineline PS	--	--	$100,000	--	--
Power Usage - New Admin Bldg	--	--	$100,000	--	--
Total O&M Cost ($/year):	**$19.2 M/yr**	**$19.2 M/yr**	**$18.5 M/yr**	**$19.2 M/yr**	**$19.2 M/yr**

Note: Costs are in January 2011 dollars.

Cost is one of many logistical and operational parameters considered in selecting a site for recycled water master planning. In addition to the non-cost factors described in objectives 2-6 (Section 2.2), three specific, critical criteria were identified by LADWP and BOS management for consideration and summarized in Table 3-7. Only DCT SW meets each of these three criteria. On the basis of this, DCT SW was used as the basis for this cost analyses.

Table 3-7: Critical Criteria for Evaluation of 5 Candidate Sites

Critical Criteria	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
Bureau of Sanitation already has related facilities and staffing at the site to support the operation of the advanced treatment facility for GWR. Although new facilities will be built for GWR, there are benefits and economies of operation having new facilities alongside existing operational facilities and staff.	✓	✓		✓	✓
Site is within the boundaries of the existing berm or outside of the Sepulveda Flood Control Basin.	✓	✓	✓		
Site is not in an area of potential future expansion to the existing treatment processes for producing tertiary treated effluent at DCT.		✓	✓		

3.3.2 GWR Components for IAA Evaluation

To compare the costs for each of the three alternatives (Table 3-8) for expanding the recycled water program, the RWMP team used the AWTF estimated capital and O&M costs for Site 2 (DCT SW). This site was used because it met all of the critical criteria as identified in Table 3-7. All AWTF sites will be evaluated equally for environmental impacts through the CEQA/NEPA process. **Table 3-8** summarizes the estimated capital cost of GWR components and **Table 3-9** summarizes the estimated annual O&M cost for GWR.

Table 3-8: Capital Cost of GWR Components for each Alternative

GWR Components	Alt 1	Alt 2	Alt 3
GWR	**15,000 AFY**	**22,500 AFY**	**30,000 AFY**
Treatment Structures	$64,600,000	$88,900,000	$105,200,000
Treatment Equipment	$114,700,000	$157,800,000	$186,700,000
MF/RO Building	$800,000	$800,000	$900,000
Parking/Fencing	$100,000	$100,000	$100,000
Demolition/Relocation of Maintenance & Warehouse buildings	$24,100,000	$24,100,000	$24,100,000
New Product Water Pumps at Balboa Pump Station	--	--	$1,300,000
New Pipeline from Secondary/Tertiary Effluent to AWTF	$400,000	$700,000	$700,000
New Product Water Pipeline from AWTF to Balboa Pump Station	$1,400,000	$1,800,000	$1,800,000
Backwash and Concentrate Pipeline	$700,000	$800,000	$800,000
Equalization Basins	$16,100,000	$16,100,000	$16,100,000
Conveyance Pipeline from Hansen SG to Pacoima SG	$0	$35,300,000	$35,300,000
Total	**$223,000,000**	**$326,000,000**	**$373,000,000**

Note: Costs are in January 2011 dollars and include 30% construction contingency costs and 30% implementation costs. In order to achieve the annual goals of 15,000, 22,500, and 30,000 AFY, the size of the AWTF will be designed for an ultimate treatment capacity of approximately 20, 27, and 32 million gallons per day (mgd), respectively. These capacities account for offline factors for AWTF and spreading grounds, and seasonal variations for NPR demand.

Table 3-9: Annual O&M Costs for GWR Components for each Alternative

GWR Components	Alt 1	Alt 2	Alt 3
GWR	**15,000 AFY**	**22,500 AFY**	**30,000 AFY**
Total Labor, Chemical, Equipment Replacement	$7,200,000	$9,900,000	$12,300,000
AWTF Power Usage, excluding UV	$2,400,000	$3,200,000	$4,000,000
UV Power Usage	$800,000	$1,100,000	$1,300,000
Pumping at Balboa PS	$900,000	$1,300,000	$1,600,000
Total ($/year)	**$11,000,000**	**$15,000,000**	**$19,000,000**

Note: Costs are in January 2011 dollars.
To establish the AWTF annual O&M costs for the 15,000, 22,500 and 30,000 AFY alternatives, an average treatment rate of approximately 18, 25, and 31 mgd, respectively is used

4. Costs for Alternatives

4.1 Capital Cost

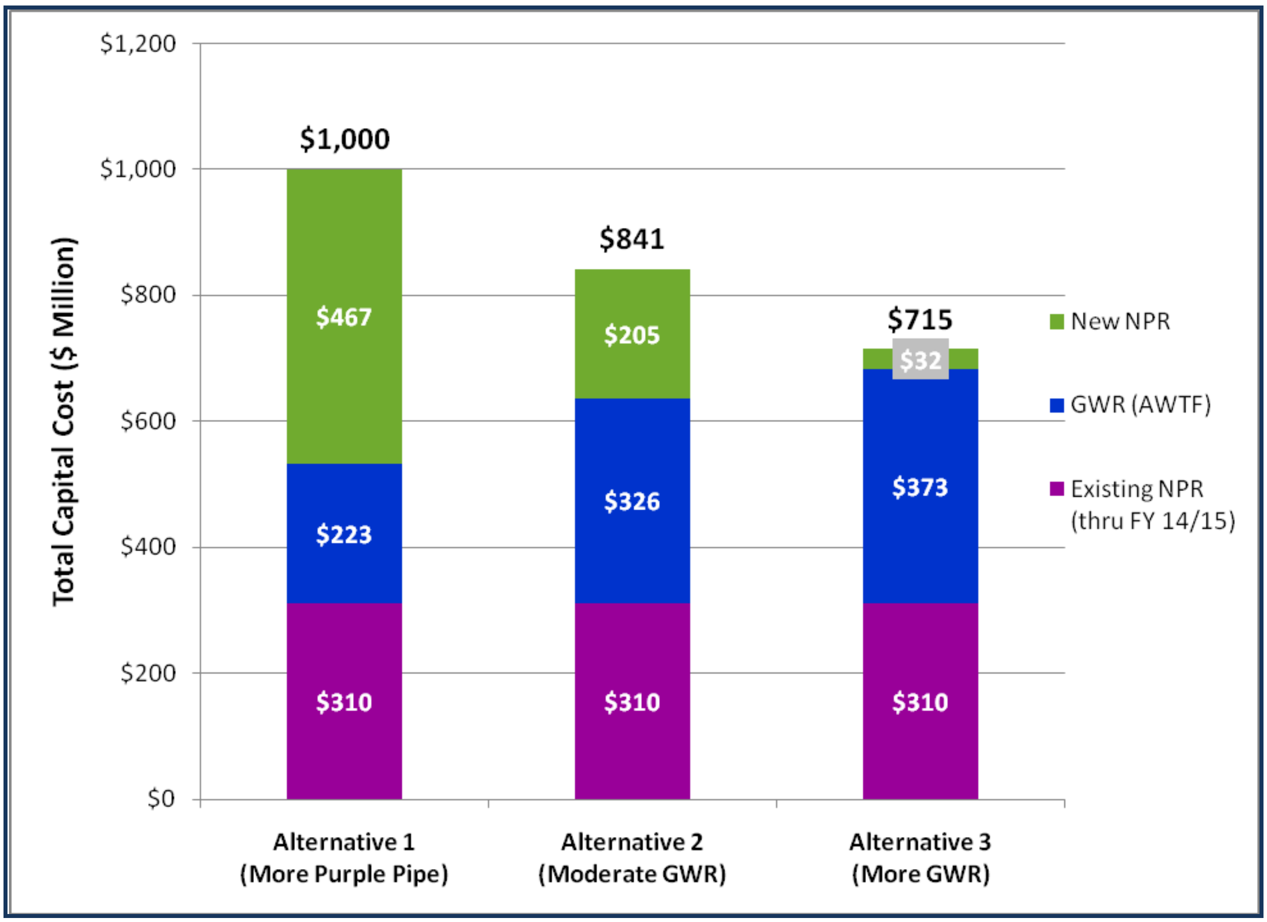
Using the components described in Section 3, **Table 4-1** presents a summary of the capital costs for each alternative. **Figure 4-1** presents a chart summarizing the capital costs.

Table 4-1: Capital Costs for Preliminary Alternatives

Component	Alt 1	Alt 2	Alt 3
Existing Purple Pipe	$310,000,000	$310,000,000	$310,000,000
New Purple Pipe	$467,000,000	$205,000,000	$32,000,000
GWR	$223,000,000	$326,000,000	$373,000,000
Total	**$1,000,000,000**	**$841,000,000**	**$715,000,000**

Note: Costs are in January 2011 dollars and include 30% construction contingency costs and 30% implementation costs.

Figure 4-1: Capital Costs for Alternatives to Achieve 50,000 AFY



Note: Total capital cost for each alternative is rounded to the nearest million dollars.

4.2 O&M Costs

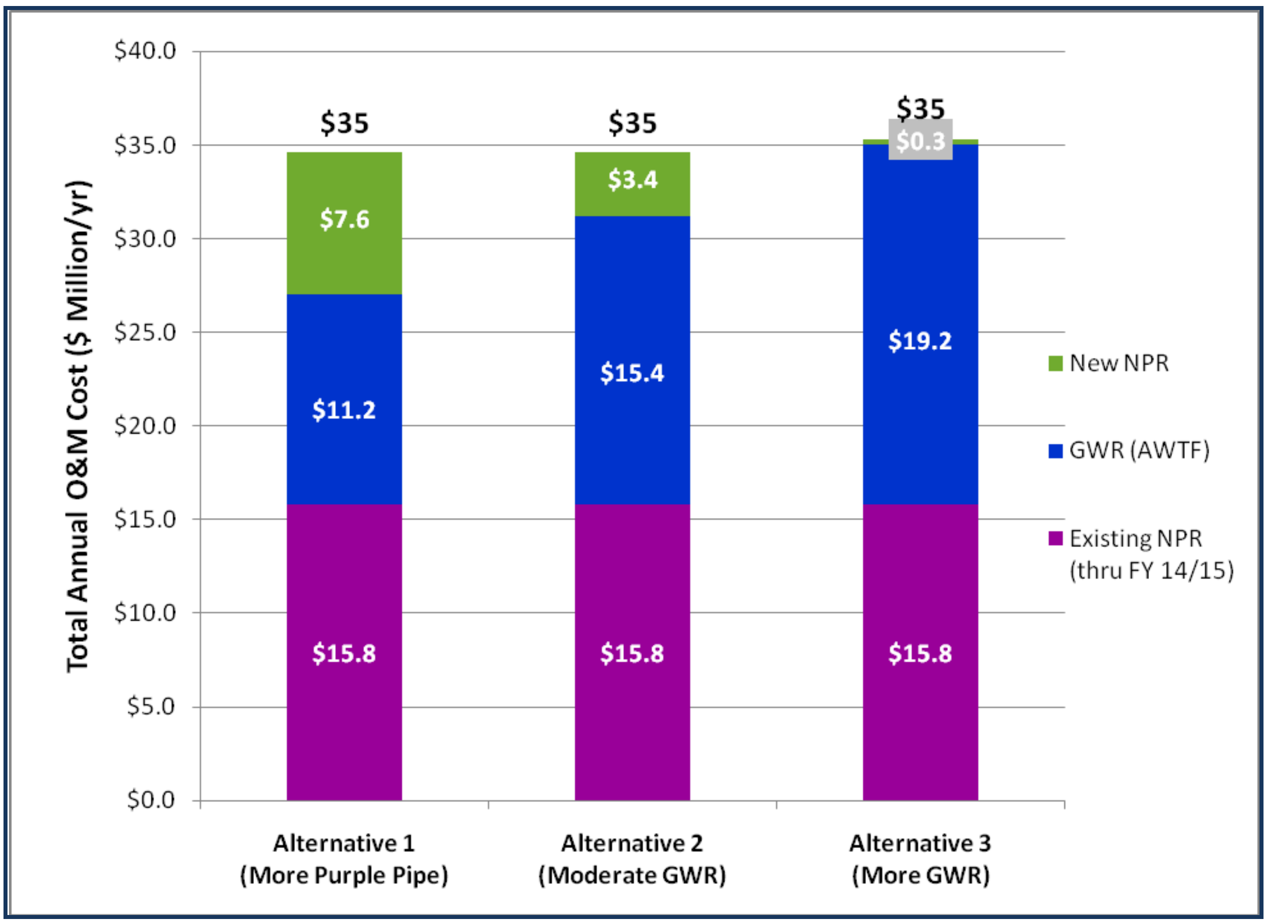
Using the components described in Section 3, **Table 4-2** presents a summary of the O&M costs for each alternative. **Figure 4-2** presents a chart summarizing the O&M costs.

Table 4-2: Annual O&M Costs for Alternatives to Achieve 50,000 AFY

Component	Alt 1	Alt 2	Alt 3
Existing Purple Pipe	$15,800,000	$15,800,000	$15,800,000
New Purple Pipe	$7,600,000	$3,400,000	$300,000
GWR	$11,300,000	$15,500,000	$19,200,000
Total	**$34,700,000**	**$34,700,000**	**$35,300,000**

Note: Costs are in January 2011 dollars.

Figure 4-2: Annual O&M Costs for Alternatives to Achieve 50,000 AFY



Note: Total annual O&M cost for each alternative is rounded to the nearest million dollars.

4.3 Present Value

Using the components described in Section 3 and capital and O&M costs described in earlier Section 4.1 and 4.2, **Table 4-3** presents a summary of the present value cost, yield, and unit cost for each alternative. **Figure 4-3** presents a chart summarizing the present value for each alternative.

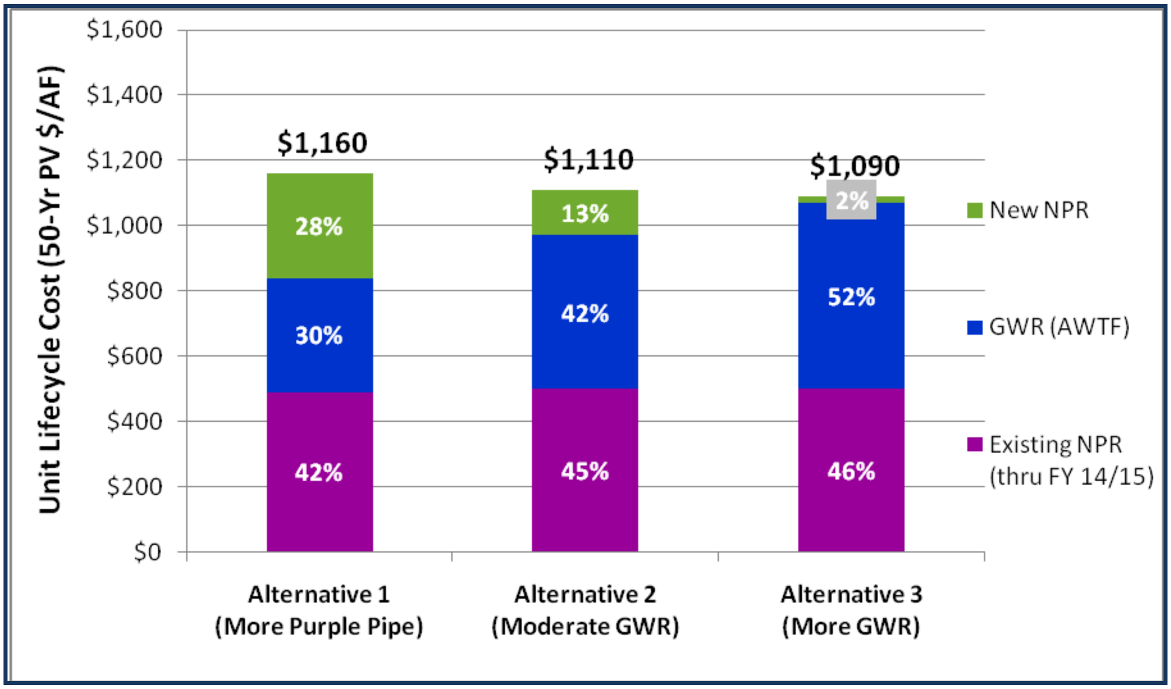
Table 4-3: Present Value Cost for Alternatives to Achieve 50,000 AFY

Component	Alt 1 [a]	Alt 2 [a,b]	Alt 3 [a,c]
Present Value (Capital and O&M over 50-Year Lifecycle) [d]			
Existing Purple Pipe	$1,164,000,000	$1,164,000,000	$1,164,000,000
New Purple Pipe	$747,000,000	$329,000,000	$37,000,000
GWR	$834,000,000	$1,098,000,000	$1,325,000,000
Total Present Value	**$2,745,000,000**	**$2,591,000,000**	**$2,526,000,000**
Total RW Produced (over 50 years)	2,357,350 AF [a]	2,323,600 AF [a,b]	2,327,350 AF [a,c]
Unit PV Cost ($/AF)	**$1,160/AF**	**$1,110/AF**	**$1,090/AF**

Notes:

a. For all alternatives, new purple pipe construction starts in 2020 and finishes in 2029. New purple pipe yield starts in 2021 and increases through 2030.
b. For Alt 2, GWR Phase 1 construction starts in 2015, finishes in 2019, and production starts in 2020. GWR Phase 2 construction starts in 2025, finishes in 2029, and production starts in 2030.
c. For Alt 3, GWR Phase 1 construction starts in 2015, finishes in 2019, and production starts in 2020. GWR Phase 2 construction starts in 2020, finishes in 2024, and production starts in 2025. GWR Phase 3 construction starts in 2025, finishes in 2029, and production starts in 2030.
d. Costs are in January 2011 dollars. See Section 2.3.2 for Present Value assumptions.

Figure 4-3: Unit Lifecycle Cost for Alternatives to Achieve 50,000 AFY

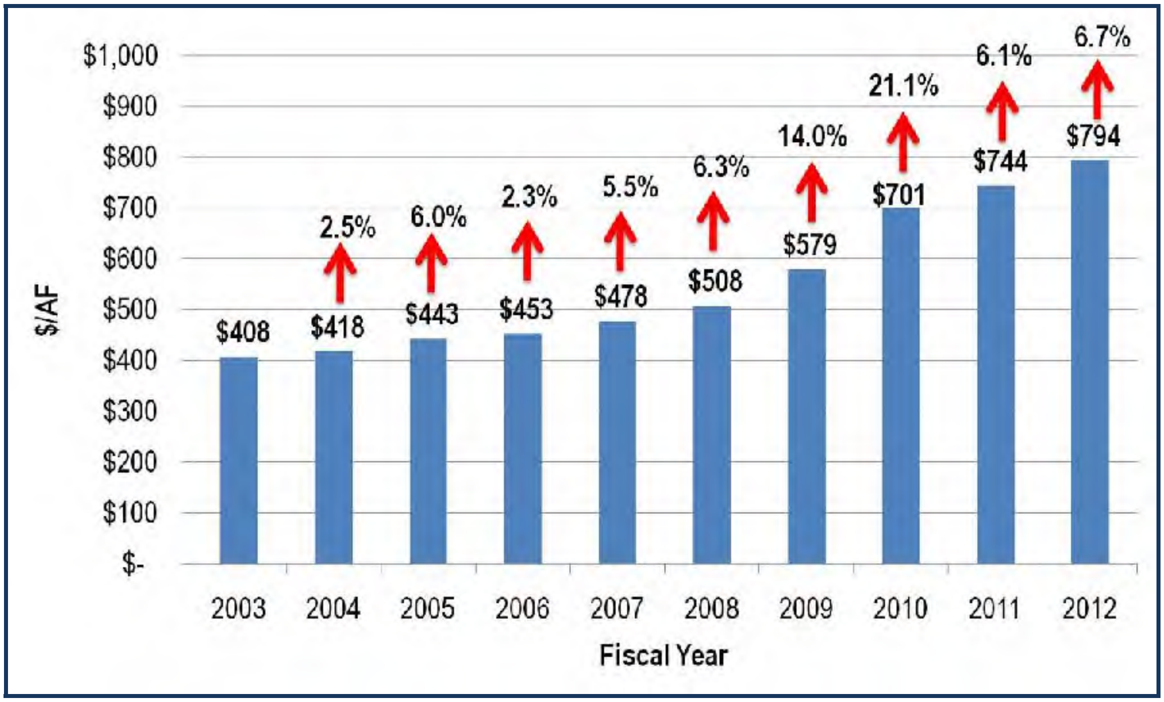


4.4 Comparison with Forecasted Imported Water Rates

LADWP purchases imported water from MWD under both Tier 1 and Tier 2 treated water rates. MWD sells a limited amount of Tier 1 imported water to each of its contractors (such as LADWP) and, once this allotment is met, the contractor must purchase more expensive Tier 2 supplies. Based on LADWP's Draft Urban Water Management Plan (UWMP) (January 2011), LADWP plans to stay within their Tier 1 allotment throughout the projected period (through 2035). As a result, the three alternatives for expanding recycled water to 50,000 AFY are being compared to the cost of MWD Tier 1 imported water. For the purpose of this comparison, LADWP developed water purchase costs for MWD Tier 1 imported water.

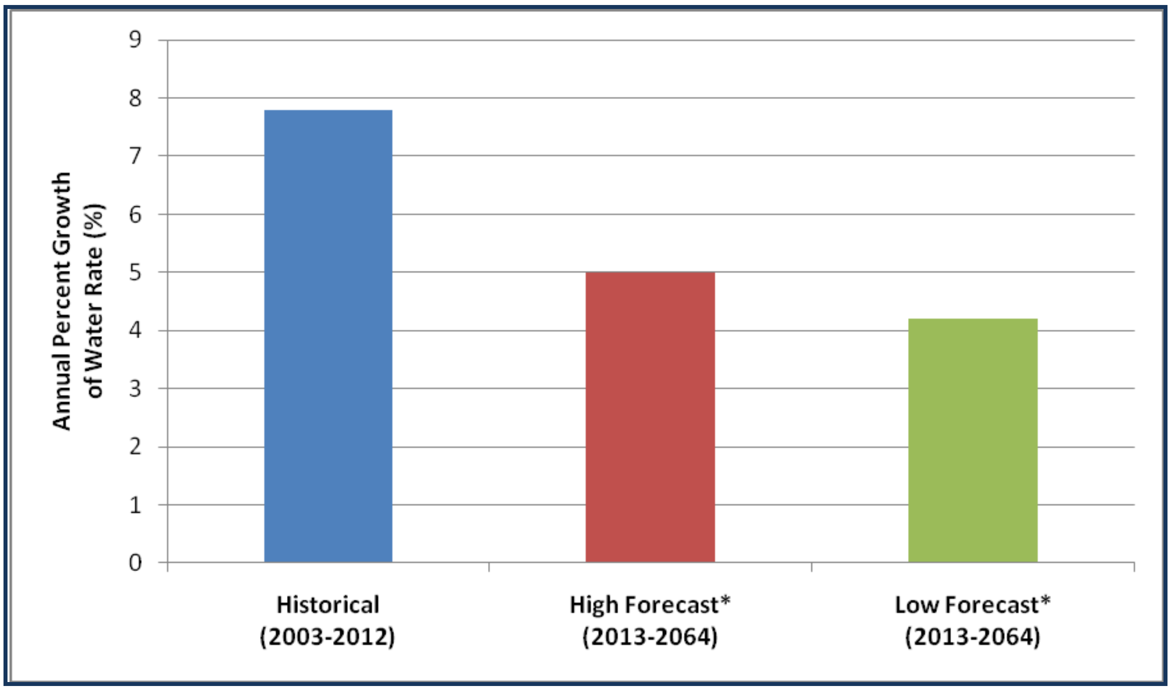
As shown in **Figure 4-4**, MWD rates have increased significantly over the last 10 years. The figure shows those increases from FY 2003 through FY 2012 (which is already approved). The increases may seem smooth, but looking at it on an annual basis you can see they are highly volatile, ranging from a low of 2.3% to a high of over 21%. This makes estimating rates into the future very difficult. Additionally, MWD only provides rate forecasts to 2020 and we need to plan well beyond that, to 2064 in this case.

Figure 4-4: Historical and Approved MWD Tier 1 Imported Water Rates



Based on current MWD rate projections (through 2020) and historical rate increases (through 2012), LADWP developed two forecasts of future MWD Tier 1 rates through the planning period – a "high forecast" and a "low forecast." The "low forecast" is based on 5% annual growth until 2040 and then a 3% annual growth to 2064. The "high forecast" is based on a 5% annual growth from 2013 to 2064. In comparison with historical increases from MWD, as shown in **Figure 4-5**, this is conservative.

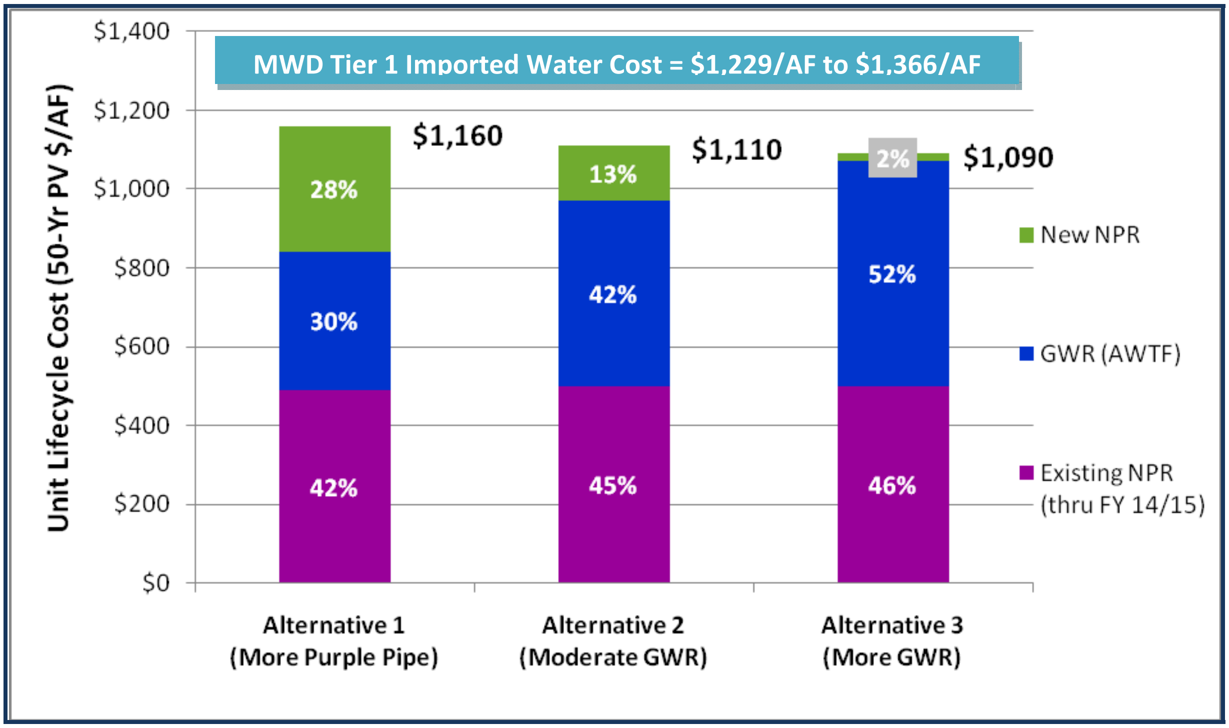
Figure 4-5: Historical and LADWP Projected Annual Growth of MWD Tier 1 Rates



*LADWP Projections

By using the high and low forecasts, we developed a range of what future MWD Tier 1 imported water rates would be and then calculated the present value using the same assumptions applied to calculate the present value for the recycled water alternatives in Section 4.3. **Figure 4-6** shows the present value unit costs for the range of imported water rate projections along with the present value unit costs for the recycled water alternatives from Section 4.3. As shown in the figure, all three alternatives cost less than we would spend purchasing that water from MWD.

Figure 4-6: Unit Lifecycle Cost for Preliminary Alternatives Compared with LADWP Projected MWD Tier 1 Imported Water Costs



Notes:

a. The high end forecast is based on an assumed 5% per year growth from 2013-2064.

b. The low end forecast is based on an assumed 5% per year growth from 2013-2040, ramping down to 3% growth by 2050 and beyond.

In conclusion, all alternatives cost less than forecasted MWD Tier 1 imported water costs. In addition, all alternatives are:

- More reliable
- Locally-controlled
- More environmentally-responsible

Therefore, all options are better than doing nothing.

Appendix B

AWPF Capital Cost Estimates for Integrated Alternatives Analysis

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Note: **Costs in this spreadsheet add contingency and implementation costs separately at the end of the table.**
This sheet references 'CAP' sheet. Do not change numbers directly in this sheet.

DCT Alternatives	Alt-D1						Alt-D2a						Alt-D2b					
	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**19.9**				**AWTF Capacity (mgd)**		**26.9**				**AWTF Capacity (mgd)**		**27.4**			
	Capacity Cost of Structures	a1	$38,200,000	$38,200,000	$0	$0	Capacity Cost of Structures	a2	$51,700,000	$51,700,000	$0	$0	Capacity Cost of Structures	a3	$52,600,000	$52,600,000	$0	$0
	Capacity Cost of Equipment	a1	$67,800,000	$67,800,000	$0	$0	Capacity Cost of Equipment	a2	$91,700,000	$67,800,000	$23,900,000	$0	Capacity Cost of Equipment	a3	$93,400,000	$67,800,000	$25,600,000	$0
	Two-story MF/RO Building	b	$432,000	$432,000	$0	$0	Two-story MF/RO Building	b	$488,000	$488,000	$0	$0	Two-story MF/RO Building	b	$488,000	$488,000	$0	$0
	New parking and fence	c	$65,000	$65,000	$0	$0	New parking and fence	c	$65,000	$65,000	$0	$0	New parking and fence	c	$65,000	$65,000	$0	$0
	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0
	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0
	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0
	New 32" STL (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g1	$265,000	$265,000	$0	$0	New 42" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g2	$348,000	$348,000	$0	$0	New 42" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g2	$348,000	$348,000	$0	$0
	New 34" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h1	$844,000	$844,000	$0	$0	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0
	New 24" PVC (450 ft) AWTP backwash and concentrate pipeline	i1	$408,000	$408,000	$0	$0	New 24" PVC (450 ft) AWTP backwash and concentrate pipeline	i1	$408,000	$408,000	$0	$0	New 27" PVC (450 ft) AWTP backwash and concentrate pipeline	i2	$459,000	$459,000	$0	$0
	New Phase 4 Equalization Basin	j	$9,540,000	$9,540,000	$0	$0	New Phase 4 Equalization Basin	j	$9,540,000	$0	$9,540,000	$0	New Phase 4 Equalization Basin	j	$9,540,000	$0	$9,540,000	$0
	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$0	$0	$0	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0
	Subtotal		**$131,800,000**	**$131,800,000**	**$0**	**$0**	**Subtotal**		**$190,400,000**	**$136,100,000**	**$54,300,000**	**$0**	**Subtotal**		**$193,100,000**	**$137,000,000**	**$56,000,000**	**$0**
	Contingency (30%)		***$39,500,000***	***$39,500,000***	***$0***	***$0***	***Contingency (30%)***		***$57,100,000***	***$40,800,000***	***$16,300,000***	***$0***	***Contingency (30%)***		***$57,900,000***	***$41,100,000***	***$16,800,000***	***$0***
	Construction Total		**$171,300,000**	**$171,300,000**	**$0**	**$0**	**Construction Total**		**$247,500,000**	**$176,900,000**	**$70,600,000**	**$0**	**Construction Total**		**$251,000,000**	**$178,100,000**	**$72,800,000**	**$0**
	Implementation Costs (30%)		**$51,400,000**	**$51,400,000**	**$0**	**$0**	**Implementation Costs (30%)**		**$74,300,000**	**$53,100,000**	**$21,200,000**	**$0**	**Implementation Costs (30%)**		**$75,300,000**	**$53,400,000**	**$21,800,000**	**$0**
	TOTAL CAPITAL COST		**$223,000,000**	**$223,000,000**	**$0**	**$0**	**TOTAL CAPITAL COST**		**$322,000,000**	**$230,000,000**	**$92,000,000**	**$0**	**TOTAL CAPITAL COST**		**$326,000,000**	**$232,000,000**	**$95,000,000**	**$0**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 10000.30
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.

Footnotes:

- a1. See General Note 2. Scaled to 19.9 mgd.
- a2. See General Note 2. Scaled to 26.9 mgd.
- a3. See General Note 2. Scaled to 27.4 mgd.
- a4. See General Note 2. Scaled to 26.8 mgd.
- a5. See General Note 2. Scaled to 32.4 mgd.
- b. Cost to construct one two-story MF/RO building.
- c. Relocate parking within property line and add new fence.
- d. Demolish existing maintenance building and warehouse west of Phase I CCB. Assumed existing maintenance building and warehouse has combined footprint of 23,200 sf.
- e. Construct new maintenance building and warehouse adjacent to existing blower building at DCT. Assumed maintenance building and warehouse has combined footprint of 23,200 sf.
- f. Expand existing Balboa Pump Station by adding one 800 hp capacity pump.
- g1. 500 ft of 32-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
- g2. 500 ft of 42-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
- g3. 500 ft of 48-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
- h1. 1500 ft of 34-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
- h2. 1500 ft of 42-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
- i1. 450 ft of 24-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
- i2. 450 ft of 27-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
- j. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation Technical Memorandum, dated January 21, 2010, and prepared by RMC:CDM, and escalated to January 2011 costs.
- k. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

Note:

DCT Alternatives	Alt-D2c						Alt-D3					
	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**27.4**				**AWTF Capacity (mgd)**		**32.4**			
	Capacity Cost of Structures	a3	$52,600,000	$52,600,000	$0	$0	Capacity Cost of Structures	a5	$62,300,000	$62,300,000	$0	$0
	Capacity Cost of Equipment	a3	$93,400,000	$67,800,000	$25,600,000	$0	Capacity Cost of Equipment	a5	$110,400,000	$67,800,000	$23,900,000	$18,700,000
	Two-story MF/RO Building	b	$499,000	$499,000	$0	$0	Two-story MF/RO Building	b	$515,000	$515,000	$0	$0
	New parking and fence	c	$65,000	$65,000	$0	$0	New parking and fence	c	$65,000	$65,000	$0	$0
	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0
	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0
	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0	Add new pumps at existing Balboa PS for AWTP product water pumping	f	$762,000	$0	$0	$762,000
	New 42" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g2	$348,000	$348,000	$0	$0	New 48" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g3	$397,000	$397,000	$0	$0
	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0
	New 27" PVC (450 ft) AWTP backwash and concentrate pipeline	i2	$459,000	$459,000	$0	$0	New 27" PVC (450 ft) AWTP backwash and concentrate pipeline	i2	$459,000	$459,000	$0	$0
	New Phase 4 Equalization Basin	j	$9,540,000	$0	$9,540,000	$0	New Phase 4 Equalization Basin	j	$9,540,000	$0	$0	$9,540,000
	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0
	Subtotal		**$193,100,000**	**$137,000,000**	**$56,000,000**	**$0**	**Subtotal**		**$220,600,000**	**$146,800,000**	**$44,800,000**	**$29,000,000**
	Contingency (30%)		***$57,900,000***	***$41,100,000***	***$16,800,000***	***$0***	***Contingency (30%)***		***$66,200,000***	***$44,000,000***	***$13,400,000***	***$8,700,000***
	Construction Total		**$251,000,000**	**$178,100,000**	**$72,800,000**	**$0**	**Construction Total**		**$286,800,000**	**$190,800,000**	**$58,200,000**	**$37,700,000**
	Implementation Costs (30%)		**$75,300,000**	**$53,400,000**	**$21,800,000**	**$0**	**Implementation Costs (30%)**		**$86,000,000**	**$57,200,000**	**$17,500,000**	**$11,300,000**
	TOTAL CAPITAL COST		**$326,000,000**	**$232,000,000**	**$95,000,000**	**$0**	**TOTAL CAPITAL COST**		**$373,000,000**	**$248,000,000**	**$76,000,000**	**$49,000,000**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 10000.30
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced

Footnotes:

a1. See General Note 2. Scaled to 19.9 mgd.
a2. See General Note 2. Scaled to 26.9 mgd.
a3. See General Note 2. Scaled to 27.4 mgd.
a4. See General Note 2. Scaled to 26.8 mgd.
a5. See General Note 2. Scaled to 32.4 mgd.
b. Cost to construct one two-story MF/RO building.
c. Relocate parking within property line and add new fence.
d. Demolish existing maintenance building and warehouse west of Phase I CCB. Assumed existing maintenance building and warehouse has combined footprint of 23,200 sf.
e. Construct new maintenance building and warehouse adjacent to existing blower building at DCT. Assumed maintenance building and warehouse has combined footprint of 23,200 sf.
f. Expand existing Balboa Pump Station by adding one 800 hp capacity pump.
g1. 500 ft of 32-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
g2. 500 ft of 42-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
g3. 500 ft of 48-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
h1. 1500 ft of 34-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
h2. 1500 ft of 42-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
i1. 450 ft of 24-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
i2. 450 ft of 27-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
j. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation
k. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

VGS Alternatives	Alt-V1					
	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**14.6**			
	Capacity Cost of Structures	a1	$28,100,000	$28,100,000	$0	$0
	Capacity Cost of Equipment	a1	$49,800,000	$49,800,000	$0	$0
	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0
	Additional UV Capacity (Incremental cost)	c	$664,000	$664,000	$0	$0
	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d1	$1,130,000	$1,130,000	$0	$0
	Add new AWTP Product Water Pump Station at VGS	e1	$445,000	$445,000	$0	$0
	New 30" (500 ft) AWTP Product Water pipeline	f1	$513,000	$513,000	$0	$0
	New 14" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g1	$15,000,000	$15,000,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Two 40-hp Pumps, 1 duty standby	h1	$281,000	$281,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0
	New Phase 4 Equalization Basin	i	$9,540,000	$9,540,000	$0	$0
	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$0	$0	$0	$0
	Subtotal		**$111,500,000**	**$111,500,000**	**$0**	**$0**
	Contingency (30%)		***$33,500,000***	***$33,500,000***	***$0***	***$0***
	Construction Total		**$145,000,000**	**$145,000,000**	**$0**	**$0**
	Implementation Costs (30%)		**$43,500,000**	**$43,500,000**	**$0**	**$0**
	TOTAL CAPITAL COST		**$189,000,000**	**$189,000,000**	**$0**	**$0**

Alt-V2a					
Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
AWTF Capacity (mgd)		**21.8**			
Capacity Cost of Structures	a2	$41,900,000	$41,900,000	$0	$0
Capacity Cost of Equipment	a2	$74,300,000	$49,800,000	$24,500,000	$0
New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0
Additional UV Capacity (Incremental cost)	c	$991,000	$664,000	$327,000	$0
Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d2	$843,000	$843,000	$0	$0
Add new AWTP Product Water Pump Station at VGS	e2	$495,000	$445,000	$49,000	$0
New 36" (500 ft) AWTP Product Water pipeline	f2	$513,000	$513,000	$0	$0
New 16" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g2	$16,800,000	$16,800,000	$0	$0
AWTP Backwash/Concentrate Pump Station: Two 100-hp Pumps, 1 duty standby	h2	$378,000	$378,000	$0	$0
AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0
New Phase 4 Equalization Basin	i	$9,540,000	$0	$9,540,000	$0
Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0
Subtotal		**$172,700,000**	**$117,400,000**	**$55,300,000**	**$0**
Contingency (30%)		***$51,800,000***	***$35,200,000***	***$16,600,000***	***$0***
Construction Total		**$224,500,000**	**$152,600,000**	**$71,900,000**	**$0**
Implementation Costs (30%)		**$67,400,000**	**$45,800,000**	**$21,600,000**	**$0**
TOTAL CAPITAL COST		**$292,000,000**	**$198,000,000**	**$94,000,000**	**$0**

Alt-V2b					
Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
AWTF Capacity (mgd)		**27.4**			
Capacity Cost of Structures	a2	$41,900,000	$41,900,000	$0	$0
Capacity Cost of Equipment	a2	$74,300,000	$49,800,000	$24,500,000	$0
New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0
Additional UV Capacity (Incremental cost)	c	$991,000	$664,000	$327,000	$0
Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d1	$1,130,000	$1,130,000	$0	$0
Add new AWTP Product Water Pump Station at VGS	e2	$495,000	$445,000	$49,000	$0
New 36" (500 ft) AWTP Product Water pipeline	f2	$513,000	$513,000	$0	$0
New 16" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g2	$16,800,000	$16,800,000	$0	$0
AWTP Backwash/Concentrate Pump Station: Two 100-hp Pumps, 1 duty standby	h2	$378,000	$378,000	$0	$0
AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0
New Phase 4 Equalization Basin	i	$9,540,000	$0	$9,540,000	$0
Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0
Subtotal		**$173,000,000**	**$117,700,000**	**$55,300,000**	**$0**
Contingency (30%)		***$51,900,000***	***$35,300,000***	***$16,600,000***	***$0***
Construction Total		**$224,900,000**	**$153,000,000**	**$71,900,000**	**$0**
Implementation Costs (30%)		**$67,500,000**	**$45,900,000**	**$21,600,000**	**$0**
TOTAL CAPITAL COST		**$292,000,000**	**$199,000,000**	**$94,000,000**	**$0**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 9771.69.
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.

Footnotes:

- a1. See General Note 3. Scaled to 14.6 mgd.
- a2. See General Note 3. Scaled to 21.8 mgd.
- a3. See General Note 3. Scaled to 30.6 mgd.
- b. Cost to install new parking, fence, site security and administration building.
- c. Cost to install a UV system sized for 1.7 log reduction of NDMA. The cost of UV system is based on the information provided by Calgon Carbon.
- d1. Expand existing Balboa Pump Station by adding one 1250 hp capacity pump.
- d2. Expand existing Balboa Pump Station by adding one 900 hp capacity pump.
- d3. Expand existing Balboa Pump Station by adding two 800 hp capacity pump.
- e1. New AWTF Product Water Pump Station with three 50 hp capacity pumps.
- e2. New AWTF Product Water Pump Station with three 70 hp capacity pumps.
- e3. New AWTF Product Water Pump Station with four 60 hp capacity pumps.
- f1. 500 ft of 30-inch pressure pipe to convey product water to spreading grounds.
- f2. 500 ft of 36-inch pressure pipe to convey product water to spreading grounds.
- f3. 500 ft of 42-inch pressure pipe to convey product water to spreading grounds.
- g1. 7.4 miles of 14-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
- g2. 7.4 miles of 16-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
- g3. 7.4 miles of 18-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
- h1. New AWTF backwash/concentrate pump station with two 40 hp capacity pumps.
- h2. New AWTF backwash/concentrate pump station with two 100 hp capacity pumps.
- h3. New AWTF backwash/concentrate pump station with two 200 hp capacity pumps.
- i. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation Technical Memorandum, dated January 21, 2010, and prepared by RMC:CDM, and escalated to January 2011 costs.
- j. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

VGS Alternatives	Alt-V2c						Alt-V3					
	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**21.8**				**AWTF Capacity (mgd)**		**30.6**			
	Capacity Cost of Structures	a2	$41,900,000	$41,900,000	$0	$0	Capacity Cost of Structures	a3	$58,800,000	$58,800,000	$0	$0
	Capacity Cost of Equipment	a2	$74,300,000	$49,800,000	$24,500,000	$0	Capacity Cost of Equipment	a3	$104,300,000	$49,800,000	$24,500,000	$30,000,000
	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0
	Additional UV Capacity (Incremental cost)	c	$991,000	$664,000	$327,000	$0	Additional UV Capacity (Incremental cost)	c	$1,390,000	$660,000	$327,000	$400,000
	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d1	$1,130,000	$1,130,000	$0	$0	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d3	$1,520,000	$1,520,000	$0	$0
	Add new AWTP Product Water Pump Station at VGS	e2	$495,000	$445,000	$49,000	$0	Add new AWTP Product Water Pump Station at VGS	e3	$627,000	$445,000	$50,000	$130,000
	New 36" (500 ft) AWTP Product Water pipeline	f2	$513,000	$513,000	$0	$0	New 42" (500 ft) AWTP Product Water pipeline	f3	$792,000	$792,000	$0	$0
	New 16" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g2	$16,800,000	$16,800,000	$0	$0	New 18" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g3	$18,600,000	$18,600,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Two 100-hp Pumps, 1 duty standby	h2	$378,000	$378,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Two 200-hp Pumps, 1 duty standby	h3	$542,000	$542,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0
	New Phase 4 Equalization Basin	i	$9,540,000	$0	$9,540,000	$0	New Phase 4 Equalization Basin	i	$9,540,000	$0	$0	$9,540,000
	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0
	Subtotal		**$173,000,000**	**$117,700,000**	**$55,300,000**	**$0**	**Subtotal**		**$223,000,000**	**$137,200,000**	**$45,800,000**	**$40,100,000**
	Contingency (30%)		***$51,900,000***	***$35,300,000***	***$16,600,000***	***$0***	***Contingency (30%)***		***$66,900,000***	***$41,200,000***	***$13,700,000***	***$12,000,000***
	Construction Total		**$224,900,000**	**$153,000,000**	**$71,900,000**	**$0**	**Construction Total**		**$289,900,000**	**$178,400,000**	**$59,500,000**	**$52,100,000**
	Implementation Costs (30%)		**$67,500,000**	**$45,900,000**	**$21,600,000**	**$0**	**Implementation Costs (30%)**		**$87,000,000**	**$53,500,000**	**$17,900,000**	**$15,600,000**
	TOTAL CAPITAL COST		**$292,000,000**	**$199,000,000**	**$94,000,000**	**$0**	**TOTAL CAPITAL COST**		**$377,000,000**	**$232,000,000**	**$77,000,000**	**$68,000,000**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 9771.69.
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced

Footnotes:

a1. See General Note 3. Scaled to 14.6 mgd.
a2. See General Note 3. Scaled to 21.8 mgd.
a3. See General Note 3. Scaled to 30.6 mgd.
b. Cost to install new parking, fence, site security and administration building.
c. Cost to install a UV system sized for 1.7 log reduction of NDMA. The cost of UV system is based on the information provided by Calgon Carbon.
d1. Expand existing Balboa Pump Station by adding one 1250 hp capacity pump.
d2. Expand existing Balboa Pump Station by adding one 900 hp capacity pump.
d3. Expand existing Balboa Pump Station by adding two 800 hp capacity pump.
e1. New AWTF Product Water Pump Station with three 50 hp capacity pumps.
e2. New AWTF Product Water Pump Station with three 70 hp capacity pumps.
e3. New AWTF Product Water Pump Station with four 60 hp capacity pumps.
f1. 500 ft of 30-inch pressure pipe to convey product water to spreading grounds.
f2. 500 ft of 36-inch pressure pipe to convey product water to spreading grounds.
f3. 500 ft of 42-inch pressure pipe to convey product water to spreading grounds.
g1. 7.4 miles of 14-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
g2. 7.4 miles of 16-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
g3. 7.4 miles of 18-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
h1. New AWTF backwash/concentrate pump station with two 40 hp capacity pumps.
h2. New AWTF backwash/concentrate pump station with two 100 hp capacity pumps.
h3. New AWTF backwash/concentrate pump station with two 200 hp capacity pumps.
i. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation
j. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

Appendix C

AWPF Operations and Maintenance Cost Estimate for Integrated Alternatives Analysis

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DCT Alternative	Alt-D1 Item	Notes	Cost	Alt-D2a Item	Notes	Cost	Alt-D2b Item	Notes	Cost	Alt-D2c Item	Notes	Cost	Alt-D2d Item	Notes	Cost	Alt-D2e Item	Notes	Cost	Alt-D3 Item	Notes	Cost
	Total Labor, Chemical, Equipment Replacement (mgd)	a	$7,225,000	Total Labor, Chemical, Equipment Replacement (mgd)	e	$9,659,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,855,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,855,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,659,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,659,000	Total Labor, Chemical, Equipment Replacement (mgd)	m	$12,290,000
	AWTP Power Usage, excl. UV (kW-hr/yr)	b	$2,356,000	AWTP Power Usage, excl. UV (kW-hr/yr)	f	$3,150,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,214,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,214,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,150,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,150,000	AWTP Power Usage, excl. UV (kW-hr/yr)	n	$4,008,000
	UV (kW-hr/yr)	c	$774,000	UV (kW-hr/yr)	g	$1,034,000	UV (kW-hr/yr)	k	$1,055,000	UV (kW-hr/yr)	k	$1,055,000	UV (kW-hr/yr)	k	$1,034,000	UV (kW-hr/yr)	k	$1,034,000	UV (kW-hr/yr)	o	$1,316,000
	Pumping at Balboa PS (kW-hr/yr)	d	$874,000	Pumping at Balboa PS (kW-hr/yr)	h	$1,236,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,260,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,260,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,236,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,236,000	Pumping at Balboa PS (kW-hr/yr)	p	$1,632,000
	Annual O&M Cost:		**$11,200,000**	**Annual O&M Cost:**		**$15,100,000**	**Annual O&M Cost:**		**$15,400,000**	**Annual O&M Cost:**		**$15,400,000**	**Annual O&M Cost:**		**$15,100,000**	**Annual O&M Cost:**		**$15,100,000**	**Annual O&M Cost:**		**$19,200,000**
	Contingency :		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**
	Total Annual O&M Cost:		**$11,200,000**	**Total Annual O&M Cost:**		**$15,100,000**	**Total Annual O&M Cost:**		**$15,400,000**	**Total Annual O&M Cost:**		**$15,400,000**	**Total Annual O&M Cost:**		**$15,100,000**	**Total Annual O&M Cost:**		**$15,100,000**	**Total Annual O&M Cost:**		**$19,200,000**

General Notes:

1. All costs are in January 2011 dollars. CPI Index for January 2011 for Los Angeles, CA is 225.916
2. Total labor and chemical costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
3. AWTP power usage cost (excluding UV system and conveyance pumping) is escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
4. The power usage for UV system is based on the information provided by Calgon Carbon. A 40 mgd UV system for 1.2 log removal of NDMA, Calgon Carbon recommended a 1,600 kW UV system.
5. A unit cost of $0.12/kW-hr is used for power cost.

Footnotes:

a. See General Note 2. Scaled to 18.4 mgd.
b. See General Note 3. Scaled to 18.4 mgd.
c. See General Note 4. Assumed 660 kW UV system for a 18.4 mgd UV system for 1.2 log removal.
d. To pump 18.4 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 2 pumps at 660 hp brake-horsepower each.
e. See General Note 2. Scaled to 24.6 mgd.
f. See General Note 3. Scaled to 24.6 mgd.
g. See General Note 4. Assumed 904 kW UV system for a 24.6 mgd UV system for 1.2 log removal.
h. To pump 24.6 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 2 pumps at 940 hp brake-horsepower each.
i. See General Note 2. Scaled to 25.1 mgd.
j. See General Note 3. Scaled to 25.1 mgd.
k. See General Note 4. Assumed 928 kW UV system for a 25.1 mgd UV system for 1.2 log removal.
l. To pump 25.1 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 2 pumps at 960 hp brake-horsepower each.
m. See General Note 2. Scaled to 31.3 mgd.
n. See General Note 3. Scaled to 31.3 mgd.
o. See General Note 4. Assumed 1,172 kW UV system for a 31.3 mgd UV system for 1.2 log removal.
p. To pump 31.3 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 3 pumps at 700 hp brake-horsepower each.

VGS Alternative	Alt-V1			Alt-V2a			Alt-V2b			Alt-V2c			Alt-V2d			Alt-V2e			Alt-V3		
	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost
	Total Labor, Chemical, Equipment Replacement (mgd)	a	$5,261,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,892,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,892,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,881,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,881,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,881,000	Total Labor, Chemical, Equipment Replacement (mgd)	l	$10,562,000
	AWTP Power Usage, excl. UV (kW-hr/yr)	b	$1,716,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,574,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,574,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,570,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,570,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,570,000	AWTP Power Usage, excl. UV (kW-hr/yr)	m	$3,445,000
	UV (kW-hr/yr)	c	$845,000	UV (kW-hr/yr)	i	$1,268,000	UV (kW-hr/yr)	i	$1,268,000	UV (kW-hr/yr)	i	$1,266,000	UV (kW-hr/yr)	i	$1,266,000	UV (kW-hr/yr)	i	$1,266,000	UV (kW-hr/yr)	n	$1,697,000
	Pumping at Balboa PS (kW-hr/yr)	d	$2,400,000	Pumping at Balboa PS (kW-hr/yr)	j	$1,956,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,472,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,448,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,052,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,052,000	Pumping at Balboa PS (kW-hr/yr)	o	$2,484,000
	Pumping at Product Water PS (kW-hr/yr)	e	$61,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	p	$124,000
	Pumping for Brineline		$22,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$108,000
	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000
	Annual O&M Cost:		**$10,400,000**	**Annual O&M Cost:**		**$13,900,000**	**Annual O&M Cost:**		**$14,500,000**	**Annual O&M Cost:**		**$14,400,000**	**Annual O&M Cost:**		**$14,000,000**	**Annual O&M Cost:**		**$14,000,000**	**Annual O&M Cost:**		**$18,500,000**
	Contingency :		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**
	Total Annual O&M Cost:		**$10,400,000**	**Total Annual O&M Cost:**		**$13,900,000**	**Total Annual O&M Cost:**		**$14,500,000**	**Total Annual O&M Cost:**		**$14,400,000**	**Total Annual O&M Cost:**		**$14,000,000**	**Total Annual O&M Cost:**		**$14,000,000**	**Total Annual O&M Cost:**		**$18,500,000**

General Notes:

1. All costs are in January 2011 dollars. CPI Index for January 2011 for Los Angeles, CA is 225.916.
2. Total labor and chemical costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
3. AWTP power usage cost (excluding UV system and conveyance pumping) is escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
4. The power usage for UV system is based on the information provided by Calgon Carbon. A 40 mgd UV system for 1.7 log removal of NDMA, Calgon Carbon recommended a 2,400 kW UV system.
5. A unit cost of $0.12/kW-hr is used for power cost.

Footnotes:

a. See General Note 2. Scaled to 13.4 mgd.
b. See General Note 3. Scaled to 13.4 mgd.
c. See General Note 4. Assumed 804 kW UV system for a 13.4 mgd UV system for 1.7 log removal.
d. To pump 13.4 mgd of secondary/tertiary effluent from DCT to the AWTP, operate 4 pumps at 790 hp brake-horsepower each.
e. To pump 13.4 mgd of AWTP product water from the AWTP to Hansen Spreading Grounds, operate 3 pumps at 30 hp brake-horsepower each.
f. The power usage for a administrative building at the AWTP assumes the power consumption of 9.5 watts/sf for typical office/administrative buildings. Assumed 9,000 sf area for administrative building.
g. See General Note 2. Scaled to 20.1 mgd.
h. See General Note 3. Scaled to 20.1 mgd.
i. See General Note 4. Assumed 1,206 kW UV system for a 20.1 mgd UV system for 1.7 log removal.
j. To pump 20.1 mgd of secondary/tertiary effluent from DCT to the AWTP, operate 4 pumps at 790 hp brake-horsepower each.
k. To pump 20.1 mgd of AWTP product water from the AWTP to Hansen Spreading Grounds, operate 3 pumps at 50 hp brake-horsepower each.
l. See General Note 2. Scaled to 26.9 mgd.
m. See General Note 3. Scaled to 26.9 mgd.
n. See General Note 4. Assumed 1,608 kW UV system for a 26.9 mgd UV system for 1.7 log removal.
o. To pump 26.9 mgd of secondary/tertiary effluent from DCT to the AWTP, operate 4 pumps at 790 hp brake-horsepower each.
p. To pump 26.9 mgd of AWTP product water from the AWTP to Hansen Spreading Grounds, operate 3 pumps at 60 hp brake-horsepower each.

Appendix D

Greenhouse Gas Emissions Calculations

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Figure D-1: Performance Measure Scores for GHG Emissions

Greenhouse Gas Emissions	Alternatives				
	1.000	2a	2b	2c	3
DCT	-1.130	-1.059	-1.033	-1.065	-0.948
VGS	-0.958	-0.964	-0.876	-0.915	-0.808

Figure D-2: Summary of GHG Emission Productions and Reductions

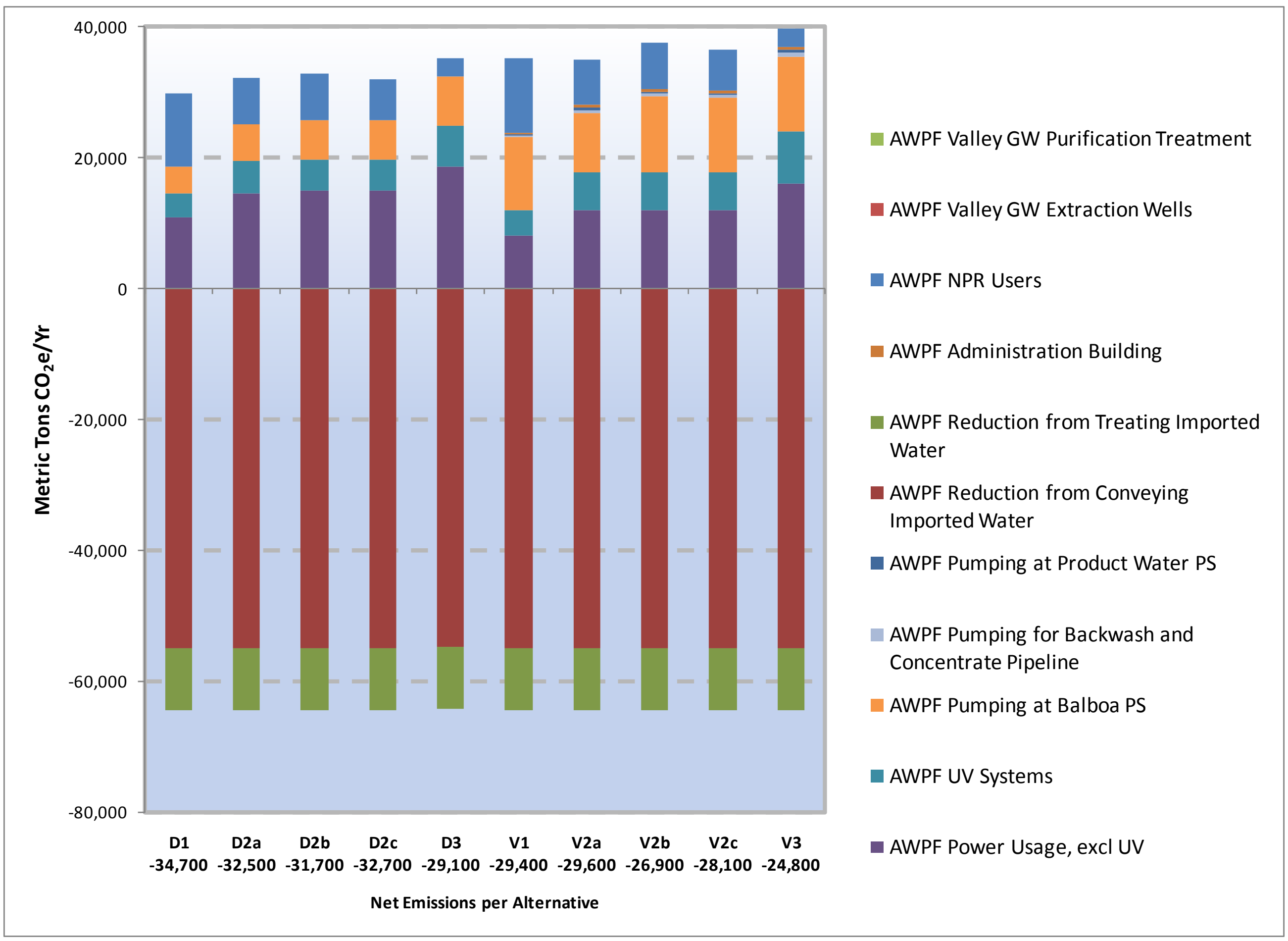

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Figure D-3: General Greenhouse Gas Emissions Calculations

Table 3. Global Warming Potential (GWP) Factors	
CO_2	1
CH_4	21
N_2O	310

Source:
California Climate Action Registry (CCAR). 2008. *Local Government Operations Protocol* . Version 1.0. September 25.
http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf

Items	Annual Electricity Use (kWh/yr)	GHG Emissions (metric tons/yr)			CO_2e Emissions (metric ton/yr)				Valley GWR (AFY)	NPR (AFY)	Harbor Projects (AFY)	Annual Yield (AFY)	CO_2e Emissions (metric ton/AF)
		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total					
DCT 1													
AWTP Power Usage, excl UV (See Notes 1 & 4)	19,600,000	10,920	0	0	10,920	5	30	10,960					
UV Systems (See Note 1)	6,450,000	3,590	0	0	3,590	2	10	3,600					
Pumping at Balboa PS (See Note 1)	7,280,000	4,050	0	0	4,050	2	11	4,060					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	20,200,000	11,300	0	0	11,300	6	31	11,300					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-34,700	15,000	15,700	0	30,700	-1.13
DCT 2a													
AWTP Power Usage, excl UV (See Notes 1 & 4)	26,300,000	14,600	0	0	14,600	7	41	14,600					
UV Systems (See Note 1)	8,620,000	4,800	0	0	4,800	2	13	4,820					
Pumping at Balboa PS (See Note 1)	10,300,000	5,740	0	0	5,740	3	16	5,760					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	12,300,000	6,900	0	0	6,900	3	19	6,920					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-32,500	22,500	8,200	0	30,700	-1.06
DCT 2b													
AWTP Power Usage, excl UV (See Notes 1 & 4)	26,800,000	14,900	0	0	14,900	7	41	14,900					
UV Systems (See Note 1)	8,800,000	4,900	0	0	4,900	2	14	4,920					
Pumping at Balboa PS (See Note 1)	10,500,000	5,850	0	0	5,850	3	16	5,870					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	12,900,000	7,180	0	0	7,180	4	20	7,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-31,700	22,500	8,200	0	30,700	-1.03
DCT 2c													
AWTP Power Usage, excl UV (See Notes 1 & 4)	26,800,000	14,900	0	0	14,900	7	41	14,900					
UV Systems (See Note 1)	8,800,000	4,900	0	0	4,900	2	14	4,920					
Pumping at Balboa PS (See Note 1)	10,500,000	5,850	0	0	5,850	3	16	5,870					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	11,100,000	6,180	0	0	6,180	3	17	6,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-32,700	22,500	8,200	0	30,700	-1.07
DCT 3													
AWTP Power Usage, excl UV (See Notes 1 & 4)	33,400,000	18,600	0	0	18,600	9	52	18,700					
UV Systems (See Note 1)	11,000,000	6,130	0	0	6,130	3	17	6,150					
Pumping at Balboa PS (See Note 1)	13,600,000	7,570	0	0	7,570	4	21	7,590					
Reduction from Conveying Imported Water (See Note 2)	-98,000,000	-54,600	-1	0	-54,600	-27	-152	-54,800					
Reduction from Treating Imported Water (See Note 3)	-17,000,000	-9,500	0	0	-9,500	-5	-26	-9,500					
NPR Users (See Table 4)	4,970,000	2,770	0	0	2,770	1	8	2,780					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-29,100	30,000	700	0	30,700	-0.95

Figure D-3: General Greenhouse Gas Emissions Calculations (cont.)

Items	Annual Electricity Use (kWh/yr)	GHG Emissions (metric tons/yr) CO_2	CH_4	N_2O	CO_2e Emissions (metric ton/yr) CO_2	CH_4	N_2O	Total	Valley GWR (AFY)	NPR (AFY)	Harbor Projects (AFY)	Annual Yield (AFY)	CO_2e Emissions (metric ton/AF)
VGS 1													
AWTP Power Usage, excl UV (See Notes 1 & 4)	14,300,000	7,960	0	0	7,960	4	22	7,990					
UV Systems (See Note 1)	7,040,000	3,920	0	0	3,920	2	11	3,930					
Pumping at Balboa PS (See Note 1)	20,000,000	11,140	0	0	11,140	6	31	11,180					
Pumping at Product Water PS (See Note 1)	512,000	290	0	0	290	0	1	290					
Pumping for Brineline	180,000	100	0	0	100	0	0	100					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	20,200,000	11,300	0	0	11,300	6	31	11,300					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-29,400	15,000	15,700	0	30,700	-0.96
VGS 2a													
AWTP Power Usage, excl UV (See Notes 1 & 4)	21,400,000	11,900	0	0	11,900	6	33	11,900					
UV Systems (See Note 1)	10,600,000	5,900	0	0	5,900	3	16	5,920					
Pumping at Balboa PS (See Note 1)	16,300,000	9,080	0	0	9,080	5	25	9,110					
Pumping at Product Water PS (See Note 1)	768,000	430	0	0	430	0	1	430					
Pumping for Brineline	530,000	300	0	0	300	0	1	300					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	12,300,000	6,850	0	0	6,850	3	19	6,870					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-29,600	22,500	8,200	0	30,700	-0.964
VGS 2b													
AWTP Power Usage, excl UV (See Notes 1 & 4)	21,400,000	11,900	0	0	11,900	6	33	11,900					
UV Systems (See Note 1)	10,600,000	5,900	0	0	5,900	3	16	5,920					
Pumping at Balboa PS (See Note 1)	20,600,000	11,470	0	0	11,470	6	32	11,510					
Pumping at Product Water PS (See Note 1)	768,000	430	0	0	430	0	1	430					
Pumping for Brineline	530,000	300	0	0	300	0	1	300					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	12,900,000	7,180	0	0	7,180	4	20	7,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-26,900	22,500	8,200	0	30,700	-0.876
VGS 2c													
AWTP Power Usage, excl UV (See Notes 1 & 4)	21,400,000	11,900	0	0	11,900	6	33	11,900					
UV Systems (See Note 1)	10,500,000	5,850	0	0	5,850	3	16	5,870					
Pumping at Balboa PS (See Note 1)	20,400,000	11,360	0	0	11,360	6	32	11,400					
Pumping at Product Water PS (See Note 1)	767,000	430	0	0	430	0	1	430					
Pumping for Brineline	530,000	300	0	0	300	0	1	300					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	11,100,000	6,180	0	0	6,180	3	17	6,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-28,100	22,500	8,200	0	30,700	-0.915
VGS 3													
AWTP Power Usage, excl UV (See Notes 1 & 4)	28,700,000	16,000	0	0	16,000	8	44	16,100					
UV Systems (See Note 1)	14,100,000	7,850	0	0	7,850	4	22	7,880					
Pumping at Balboa PS (See Note 1)	20,700,000	11,500	0	0	11,500	6	32	11,500					
Pumping at Product Water PS (See Note 1)	1,030,000	570	0	0	570	0	2	570					
Pumping for Brineline	900,000	500	0	0	500	0	1	500					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	4,970,000	2,770	0	0	2,770	1	8	2,780					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-24,800	30,000	700	0	30,700	-0.808

Notes:
1) Only operating AWTP for 83% of the time (except for Alt 3--where AWTP is in operation for 0.95% of the time)
2) Conveyance of Imported Water requires 3.2 MWh/AF
3) Treatment of Imported Water requires 0.565 MWh/AF
4) Plant Power Usage excluding UV is calculated by subtracting 115,971 kWh/mo for UV operation from 1,503,243 kWh/mo for the AWTP based on IRP tech memo
5) Based on NT Greenhouse Gas Calculations average power use per mgd

Figure D-4: NPR Supplies GHG Worksheet 1

Table 1. LADWP 2007 Total Electricity Deliveries

1,227.89 lbs CO_2/MWh

Table 2. California Grid Average Electricity Emission Factors

Year	CH_4 (lbs/MWh)	N_2O (lbs/MWh)
2004	0.029	0.011

Table 3. Global Warming Potential (GWP) Factors

CO_2	CH_4	N_2O
1	21	310

Source:
CCAR, 2008. *Local Government Operations Protocol*. Version 1.0. September 25.
http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf

Example Equation
CO_2 Emissions = Electricity Usage (kWh/yr) x (0.001 MWh/kWh) x Emission Factor (lb/MWh) x (453.6 g/lb) / (1,000,000 metric ton/g)
H1 = 3,983,200 kWh/yr x 0.001 MWh/kWh x 1,227.89 lb/MWh x 453.6 g/lb / 1,000,000 metric ton/g = 2,219 metric ton/year

CH_4 and N_2O Emissions = Emissions (metric ton/year) x GWP

Table 4. Emissions from Purchased Electricity

	NPR Supply Option	Average TDH (feet)	Annual Flow (AFY)	Electricity Use (kWh/yr)	GHG Emissions (metric tons/yr) CO_2	CH_4	N_2O	CO_2e Emissions (metric ton/yr) CO_2	CH_4	N_2O	Total	Total per AFY
H1	TIWRP	20	2,000	3,983,200	2,219	0.05	0.02	2,219	1	6	2,226	1.1
H2	West Basin Nitrified	90	2,000	245,600	137	0.00	0.00	137	0	0	137	0.1
W1	West Basin to Rancho Park	300	3,000	1,227,800	684	0.02	0.01	684	0	2	686	0.2
W2	Rancho Park Satellite	0	3,000	0	0	0.00	0.00	0	0	0	0	0.0
M1	West Basin to Downtown	560	4,600	3,511,700	1,956	0.05	0.02	1,956	1	5	1,962	0.4
M2	Central Basin to Downtown	280	4,600	1,755,900	978	0.02	0.01	978	0	3	981	0.2
M3a	LAG expansion	170	4,600	1,066,100	594	0.01	0.01	594	0	2	596	0.1
M4	Central City Satellite	230	4,600	1,442,300	803	0.02	0.01	803	0	2	806	0.2
M5	Hollywood Satellite	360	1,400	689,100	384	0.01	0.00	384	0	1	385	0.3
V1	DCT	0	9,500	0	0	0.00	0.00	0	0	0	0	0.0
V2	Burbank	270	1,700	623,800	347	0.01	0.00	347	0	1	349	0.2
V3	LAG expansion	420	9,500	5,443,200	3,032	0.07	0.03	3,032	2	8	3,042	0.3
V4	Southeast Satellite	220	1,700	508,300	283	0.01	0.00	283	0	1	284	0.2
V5	Las Virgenes MWD	730	1,700	1,686,500	939	0.02	0.01	939	0	3	942	0.6
M3b	LAG expansion	110	1,000	150,100	84	0.00	0.00	84	0	0	84	0.1
M3c	LAG expansion	460	1,000	627,500	349	0.01	0.00	349	0	1	351	0.4

Pump Efficiency 75%

H1 TIWRP - Advanced Trmt 1.8 mgd 3,928,600 kWh / yr MF/RO/AOP (kWh / yr / mgd): 2,200,000

Head loss per 1,000 ft (ft) 2

		start elev	end elev	lift		distance	head loss		TDH
		ft	ft	ft		mi	ft		ft
H1	TIWRP	30	20	-10		2.5	27		17
H2	HTP / West Basin nitrified	10	20	10		7.1	76		86
W1	HTP / West Basin to Rancho Park	40	200	160		13	139		299
W2	Rancho Park Satellite	0	0	0		0	0		0
M1	HTP / West Basin to USC	40	400	360		19	204		564
M2	Central Basin to USC	280	400	120		15	161		281
M3	LAG expansion	440	400	-40		20	214		174
M4	Central City Satellite	210	400	190		4	43		233
M5	Hollywood Satellite	200	500	300		6	64		364
V1	DCT	0	0	0		0	0		0
V2	Burbank	550	710	160		10	107		267
V3	LAG expansion	440	710	270		14	150		420
V4	Southeast Satellite	580	710	130		8	86		216
V5	Las Virgenes MWD	480	1100	620		10	107		727
M3b	LAG expansion	440	400	-40		14	150		110
M3c	LAG expansion	440	876	436		2	21		457

Figure D-5: NPR Supplies GHG Worksheet 2

Table 1. LADWP 2007 Total Electricity Deliveries

1,227.89 lbs CO_2/MWh

Table 2. California Grid Average Electricity Emission Factors

Year	CH_4 (lbs/MWh)	N_2O (lbs/MWh)
2004	0.029	0.011

Table 3. Global Warming Potential (GWP) Factors

CO_2	CH_4	N_2O
1	21	310

Source:
CCAR, 2008. *Local Government Operations Protocol* . Version 1.0. September 25.
http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf

Example Equation

CO_2 Emissions = Electricity Usage (kWh/yr) x (0.001 MWh/kWh) x Emission Factor (lb/MWh) x (453.6 g/lb) / (1,000,000 metric ton/g)
H1 = 5,713,600 kWh/yr x 0.001 MWh/kWh x 1,227.89 lb/MWh x 453.6 g/lb / 1,000,000 metric ton/g = 3,182 metric ton/year

CH_4 and N_2O Emissions = Emissions (metric ton/year) x GWP

Table 4. Emissions from Purchased Electricity

		Average TDH (feet)	Average Annual Flow	Annual Electricity Use	GHG Emissions (metric tons/yr) CO_2	CH_4	N_2O	CO_2e Emissions (metric ton/yr) CO_2	CH_4	N_2O	Total	Total per AFY
	Alt 1a		**20,900**	**20,240,000**	**11,270**	**0.27**	**0.10**	**11,270**	**6**	**31**	**11,310**	**0.5**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
W1	West Basin to Rancho Park	830	3,000	3,396,900	1,892	0.04	0.02	1,892	1	5	1,898	0.6
M2	Central Basin to Downtown	380	4,600	2,383,000	1,327	0.03	0.01	1,327	1	4	1,332	0.3
V1	DCT-low	390	4,500	2,394,200	1,333	0.03	0.01	1,333	1	4	1,338	0.3
V1	DCT-high	760	5,000	5,184,000	2,887	0.07	0.03	2,887	1	8	2,897	0.6
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 2a		**10,900**	**12,280,000**	**6,840**	**0.16**	**0.06**	**6,840**	**3**	**19**	**6,860**	**0.6**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
W1	West Basin to Rancho Park	830	2,800	3,177,700	1,770	0.04	0.02	1,770	1	5	1,776	0.6
M2	Central Basin to Downtown	380	4,200	2,173,900	1,211	0.03	0.01	1,211	1	3	1,215	0.3
V1	DCT-low	390	100	51,500	29	0.00	0.00	29	0	0	29	0.3
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 2b		**10,900**	**12,850,000**	**7,160**	**0.17**	**0.06**	**7,160**	**4**	**20**	**7,180**	**0.7**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
W1	West Basin to Rancho Park	830	2,800	3,177,700	1,770	0.04	0.02	1,770	1	5	1,776	0.6
V1	DCT-low	390	3,300	1,759,200	980	0.02	0.01	980	0	3	983	0.3
V1	DCT-high	760	1,000	1,036,800	577	0.01	0.01	577	0	2	579	0.6
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 2c		**10,900**	**11,100,000**	**6,180**	**0.15**	**0.06**	**6,180**	**3**	**17**	**6,200**	**0.6**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
M2	Central Basin to Downtown	380	4,200	2,173,900	1,211	0.03	0.01	1,211	1	3	1,215	0.3
V1	DCT-low	390	1,900	1,012,600	564	0.01	0.01	564	0	2	566	0.3
V1	DCT-high	760	1,000	1,036,800	577	0.01	0.01	577	0	2	579	0.6
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 3a		**900**	**4,970,000**	**2,770**	**0.07**	**0.02**	**2,770**	**1**	**8**	**2,780**	**3.1**
H1	TIWRP	380	870	4,969,400	2,768	0.07	0.02	2,768	1	8	2,777	3.2
			Pump Efficiency	75%								
H1	TIWRP - Advanced Trmt	2.1	mgd	4,517,900	kWh / yr				MF/RO/AOP (kWh / yr / mgd):			2,200,000

Appendix E

Environmental Justice Maps

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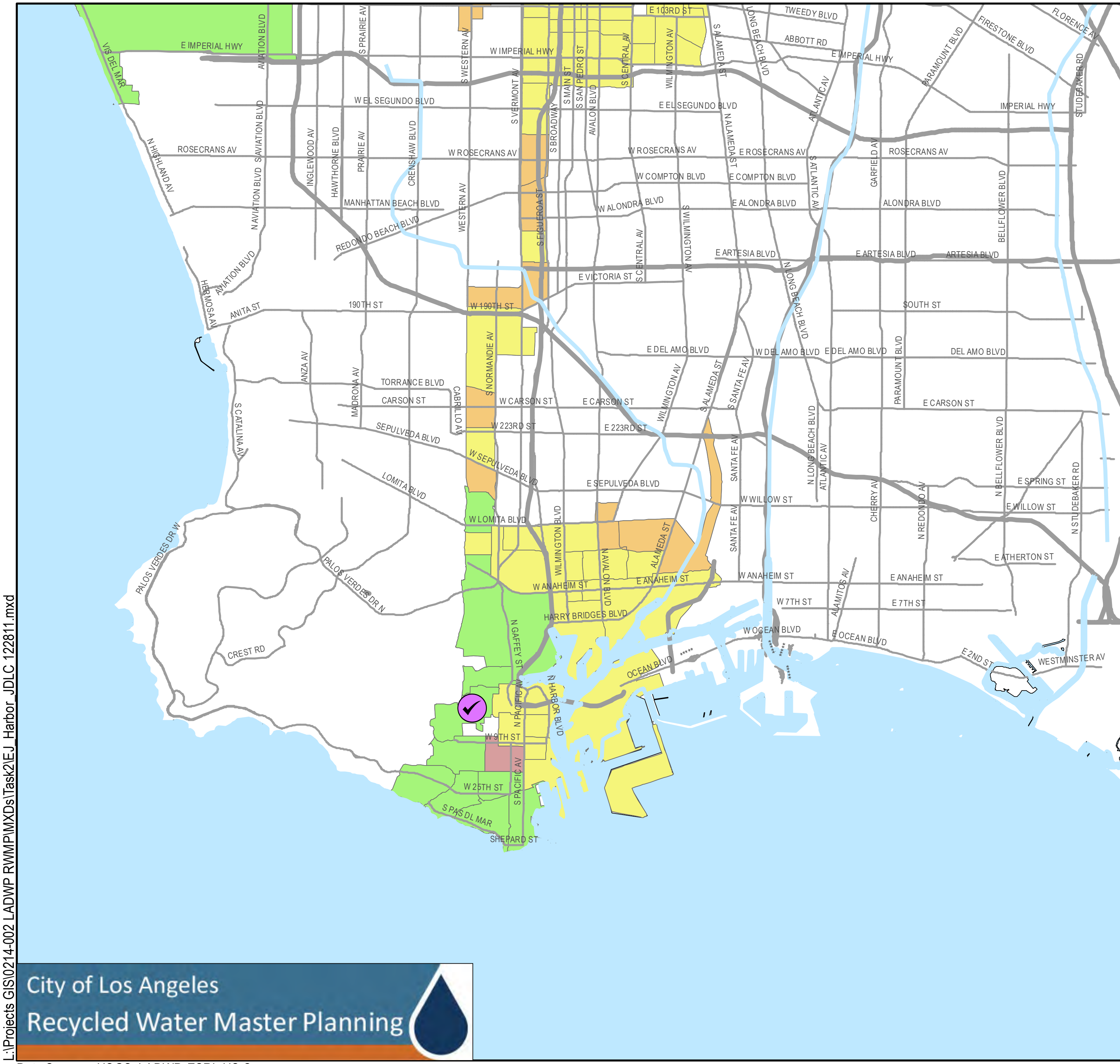
Harbor Service Area Low to Moderate Income and Minority Tracts



Potential Aboveground NPR Facility Outside of Low to Moderate Income and/or Minority Tract

Census Tracts

- Low/Moderate Income
- Low/Moderate Income & Minority
- Minority
- Non Low/Moderate Income or Minority
- Major Road
- Waterway

N

0 1 2 4

Miles

LA DWP

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS

RMC in association with CDM

City of Los Angeles
Recycled Water Master Planning

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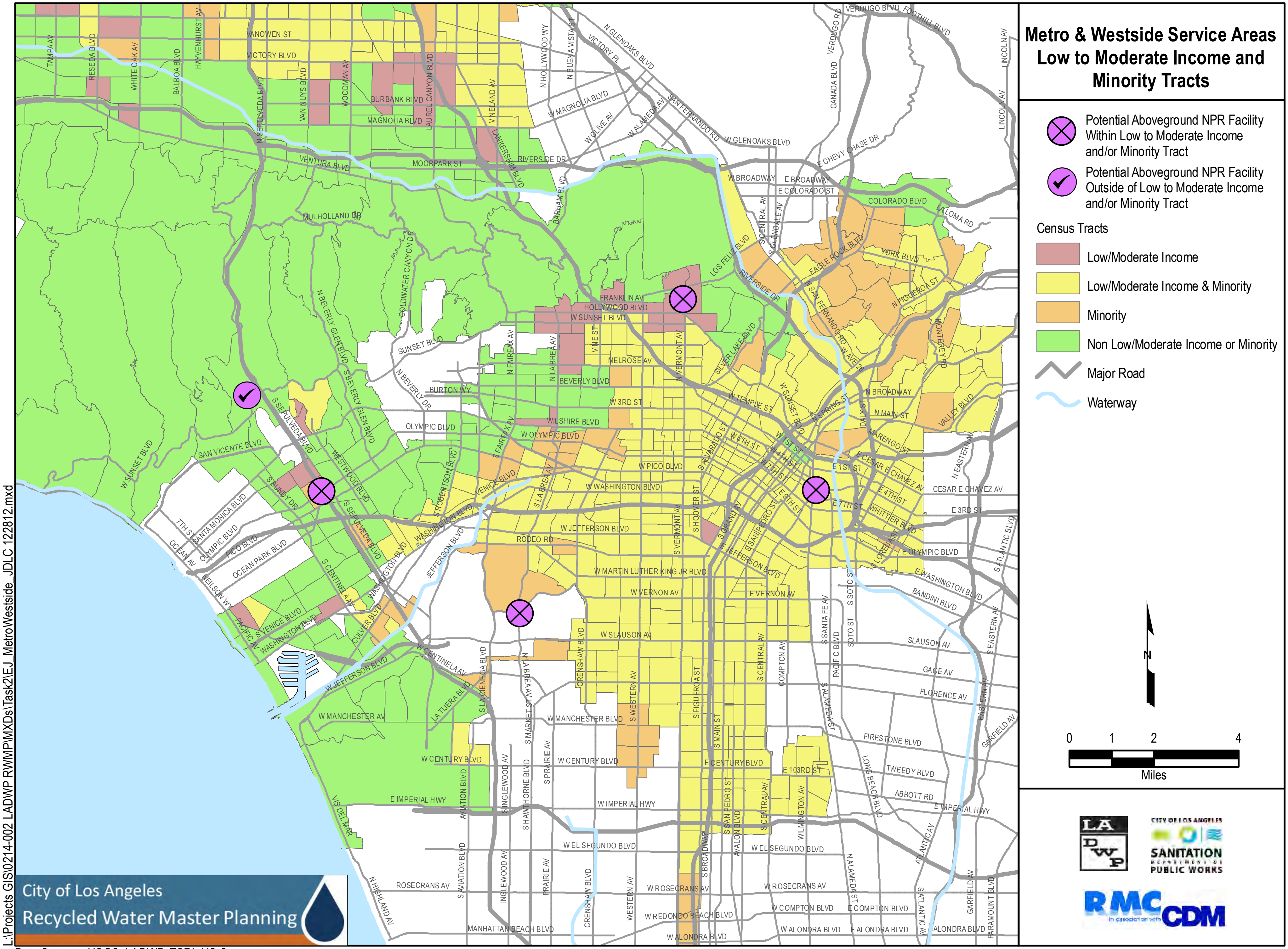
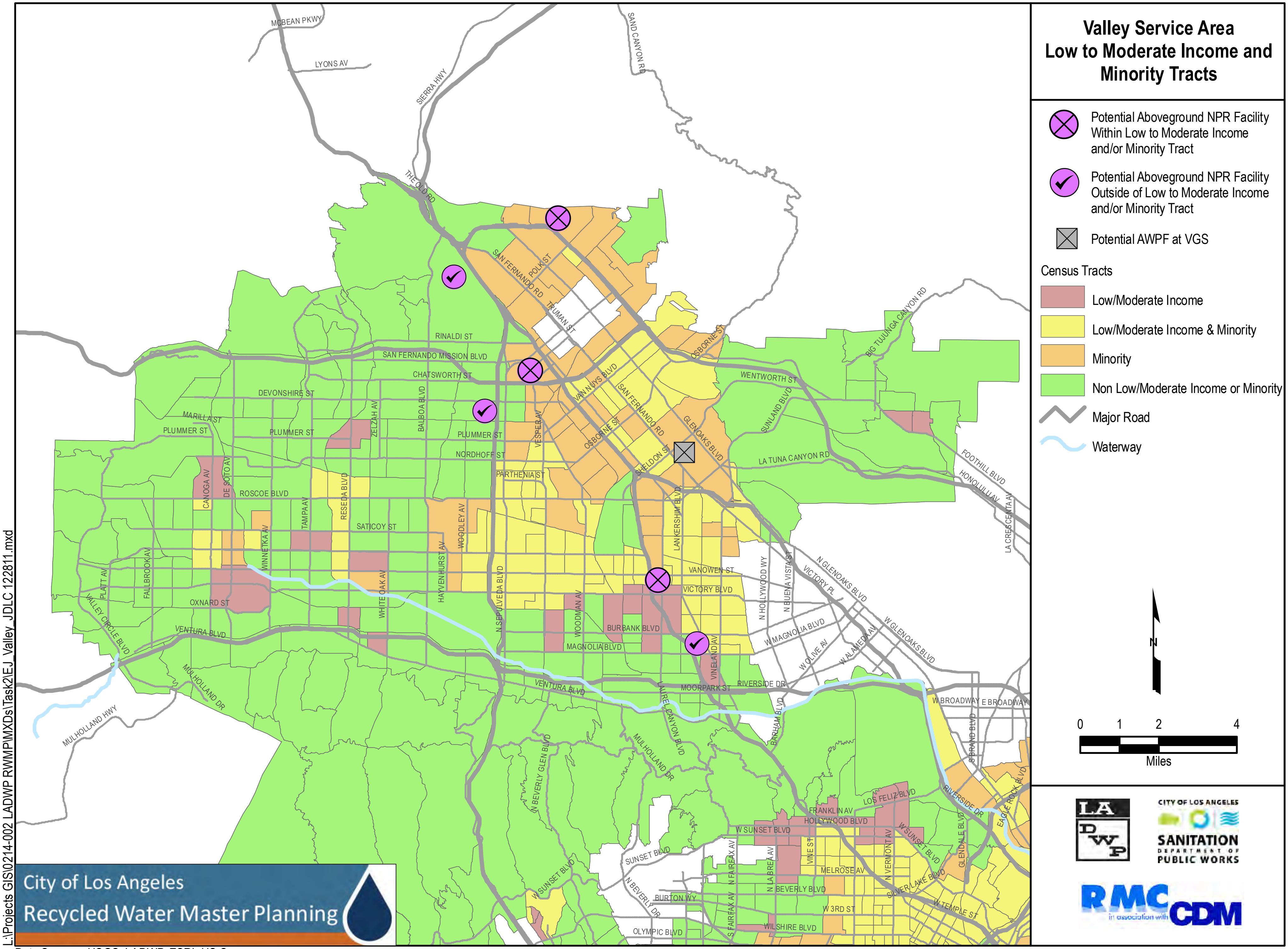
Data Sources: USGS, LADWP, ESRI, US Census


Metro & Westside Service Areas Low to Moderate Income and Minority Tracts
Potential Aboveground NPR Facility Within Low to Moderate Income and/or Minority Tract
Potential Aboveground NPR Facility Outside of Low to Moderate Income and/or Minority Tract
Census Tracts
Low/Moderate Income
Low/Moderate Income & Minority
Minority
Non Low/Moderate Income or Minority
Major Road
Waterway
N
0
1
2
4
Miles
City of Los Angeles
Recycled Water Master Planning
CITY OF LOS ANGELES
SANITATION
DEPARTMENT OF PUBLIC WORKS
RMC
in association with
CDM
VANOWEN ST
VICTORY BLVD
BURBANK BLVD
MAGNOLIA BLVD
VENTURA BLVD
MOORPARK ST
RIVERSIDE DR
MULHOLLAND DR
FRANKLIN AV
HOLLYWOOD BLVD
W SUNSET BLVD
MELROSE AV
BEVERLY BLVD
W 3RD ST
WILSHIRE BLVD
W OLYMPIC BLVD
W PICO BLVD
W WASHINGTON BLVD
W JEFFERSON BLVD
RODEO RD
W MARTIN LUTHER KING JR BLVD
W VERNON AV
W SLAUSON AV
W MANCHESTER BLVD
W CENTURY BLVD
W IMPERIAL HWY
W EL SEGUNDO BLVD
W ROSECRANS AV
W REDONDO BEACH BLVD
W ALONDRA BLVD
MANHATTAN BEACH BLVD
SAN VICENTE BLVD
OCEAN PARK BLVD
COLORADO BLVD
E OLYMPIC BLVD
E WASHINGTON BLVD
SLAUSON AV
GAGE AV
FLORENCE AV
FIRESTONE BLVD
E IMPERIAL HWY
E COMPTON BLVD



Data Sources: USGS, LADWP, ESRI, US Census

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Appendix F

Graphical Results for CDP Sensitivity Runs

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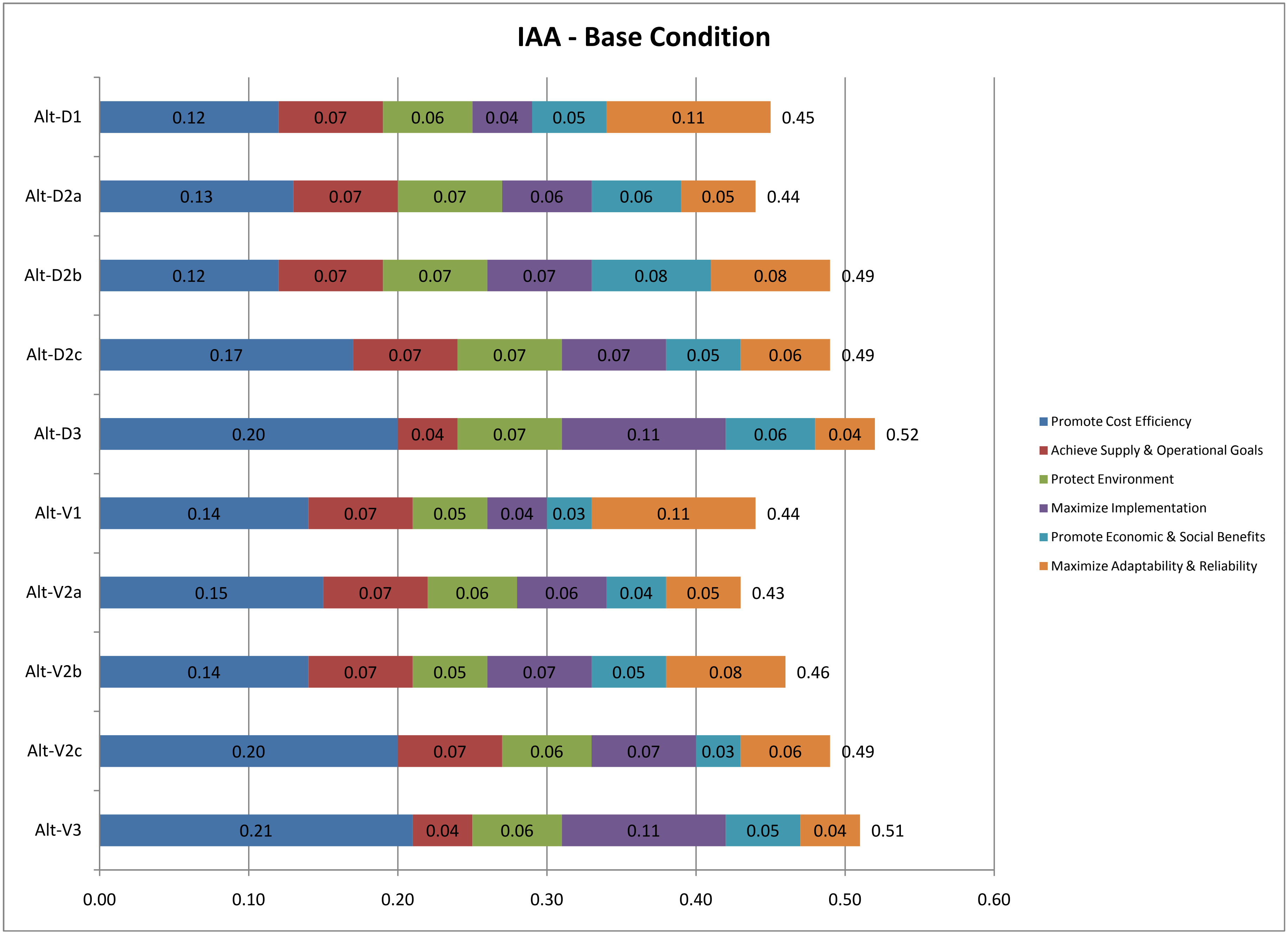
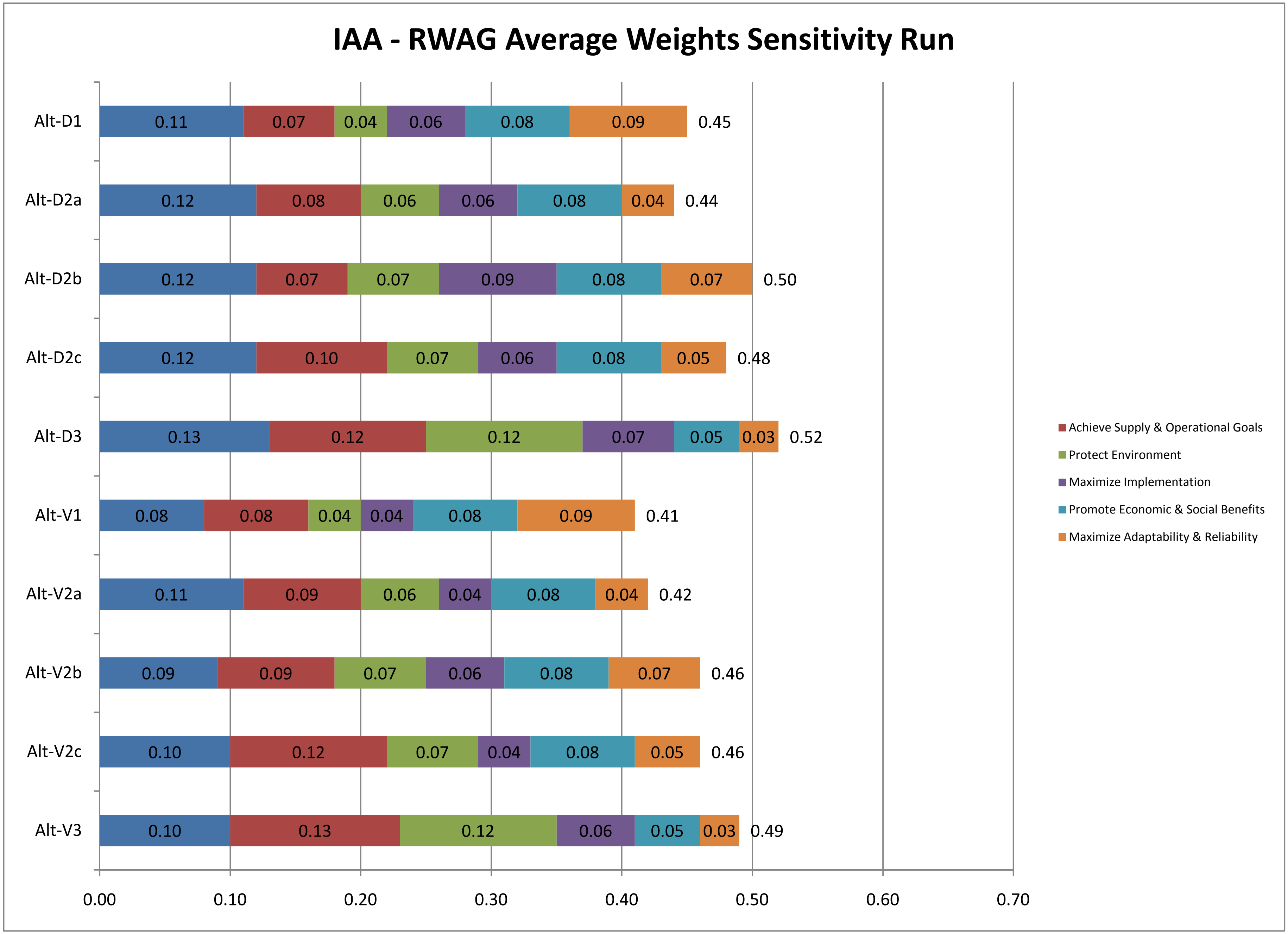
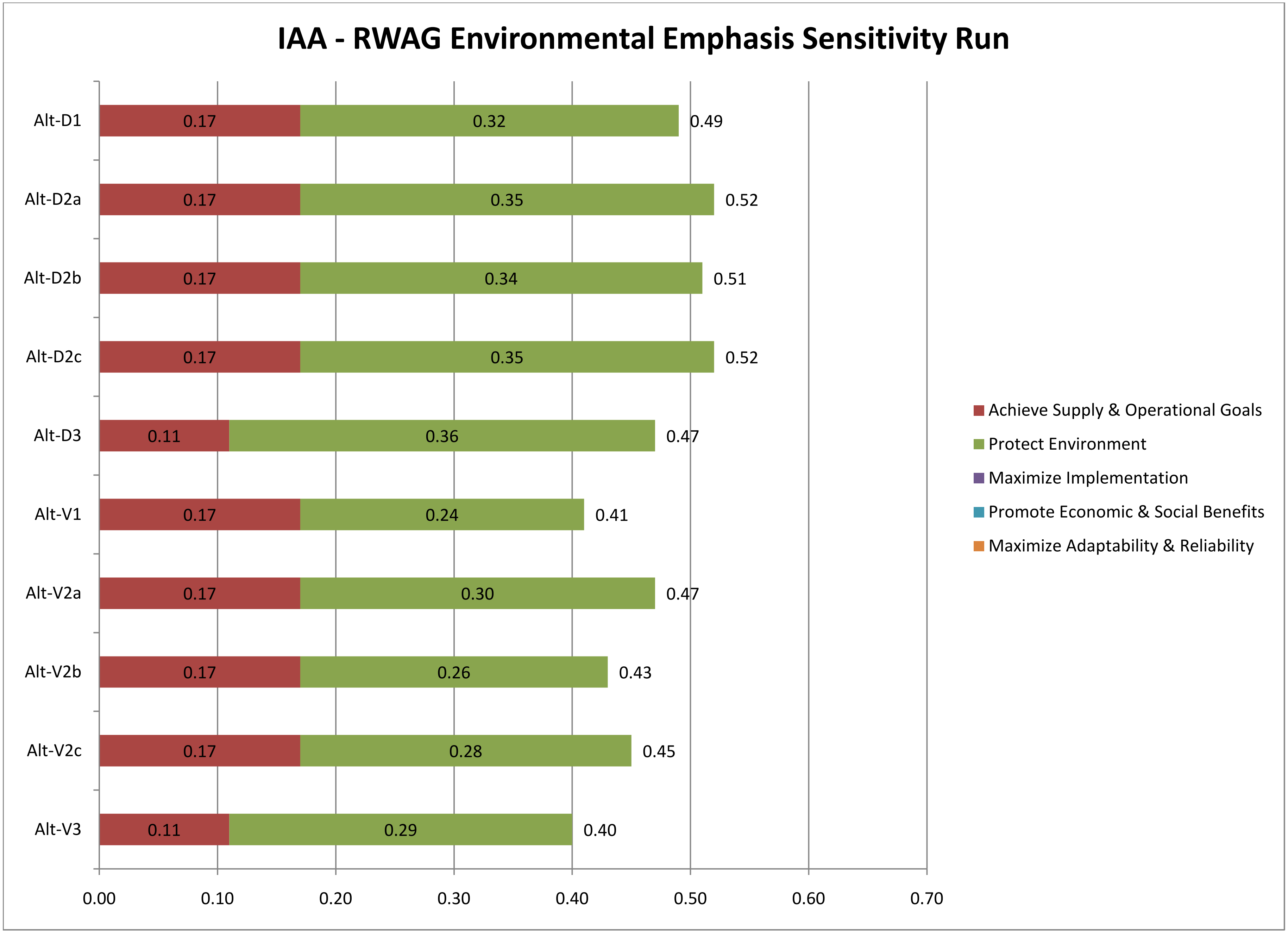
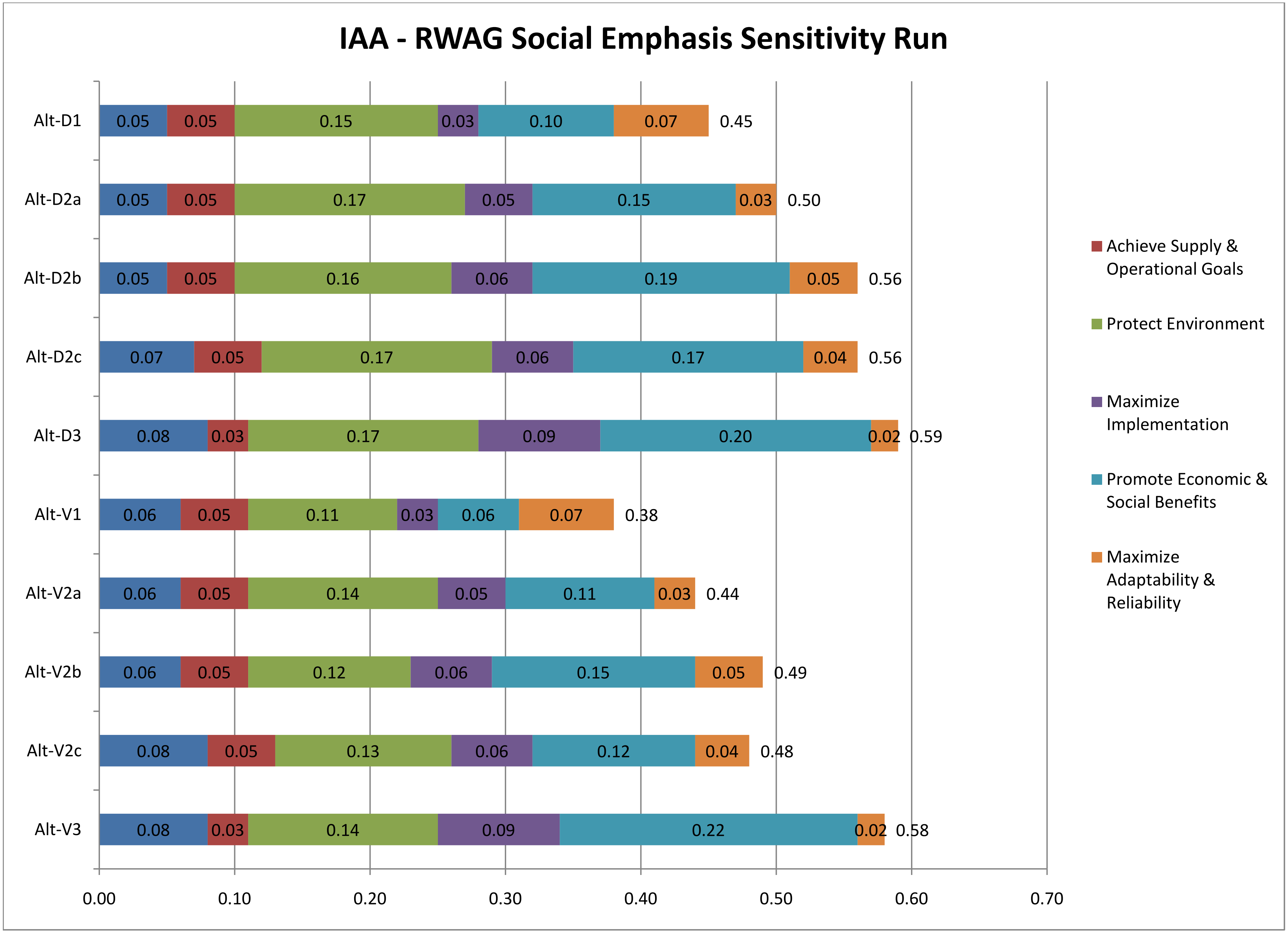
CDP Rankings										
	Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
0 Base	7	8	3	3	1	8	10	6	3	2
1 RWAG Average Weights	7	8	2	4	1	10	9	5	5	3
2 RWAG Environmental Emphasis	4	1	3	1	5	9	5	8	7	10
3 RWAG Social Emphasis	8	5	3	3	1	10	9	6	7	2
4 RWAG Cost Emphasis	9	10	8	4	3	5	5	5	1	2
5 Equal Weights	5	7	1	3	2	9	9	6	7	3
6 No Cost	2	6	1	4	4	7	10	3	9	7
Average Ranking	6.0	6.4	3.0	3.1	2.4	8.3	8.1	5.6	5.6	4.1
Total Number of Times Ranked No.1	0	1	2	1	3	0	0	0	1	0

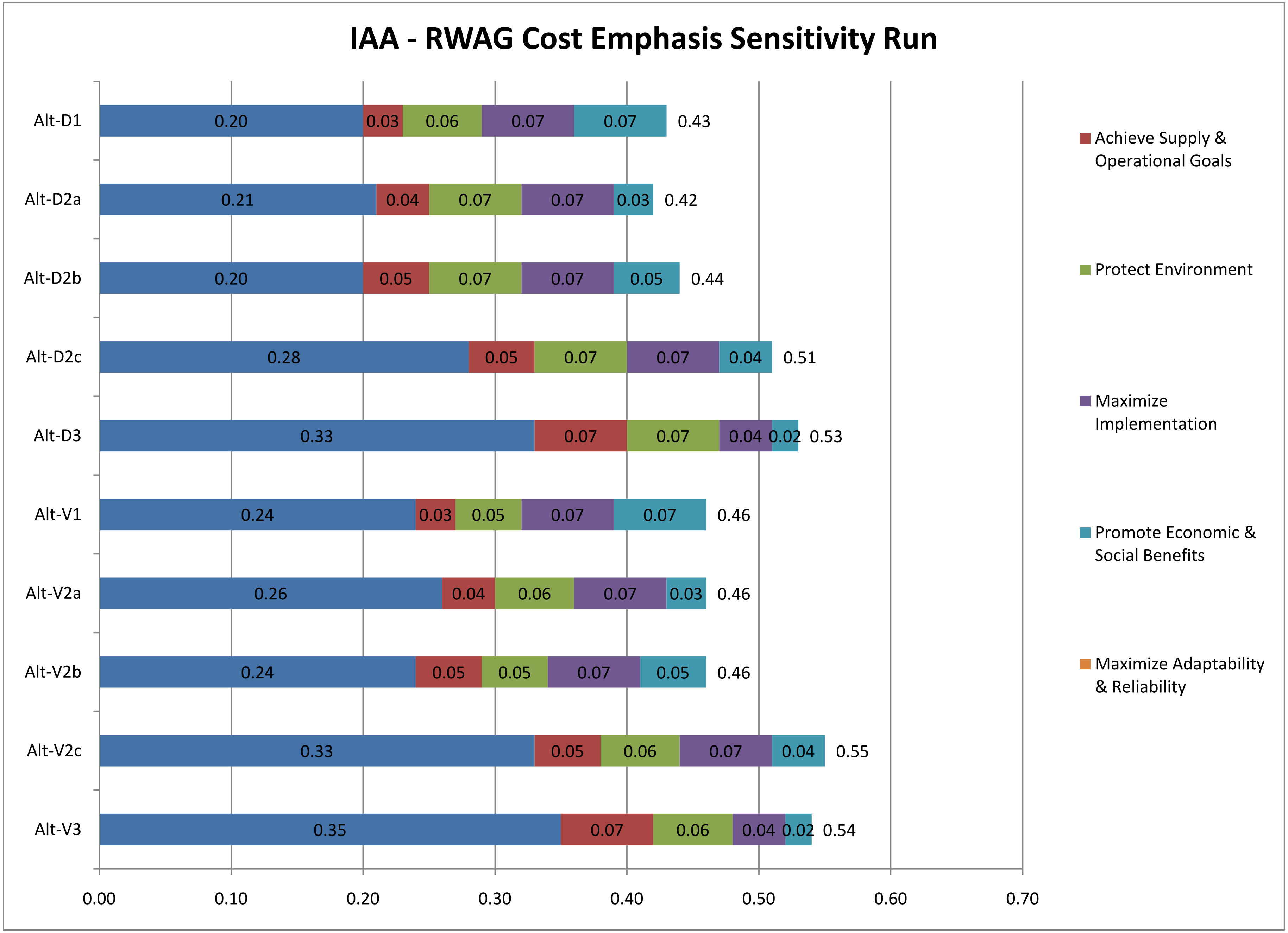


IAA - Base Condition
Alt-D1
0.12
0.07
0.06
0.04
0.05
0.11
0.45
Alt-D2a
0.13
0.07
0.07
0.06
0.06
0.05
0.44
Alt-D2b
0.12
0.07
0.07
0.07
0.08
0.08
0.49
Alt-D2c
0.17
0.07
0.07
0.07
0.05
0.06
0.49
Alt-D3
0.20
0.04
0.07
0.11
0.06
0.04
0.52
Alt-V1
0.14
0.07
0.05
0.04
0.03
0.11
0.44
Alt-V2a
0.15
0.07
0.06
0.06
0.04
0.05
0.43
Alt-V2b
0.14
0.07
0.05
0.07
0.05
0.08
0.46
Alt-V2c
0.20
0.07
0.06
0.07
0.03
0.06
0.49
Alt-V3
0.21
0.04
0.06
0.11
0.05
0.04
0.51
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Promote Cost Efficiency
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability

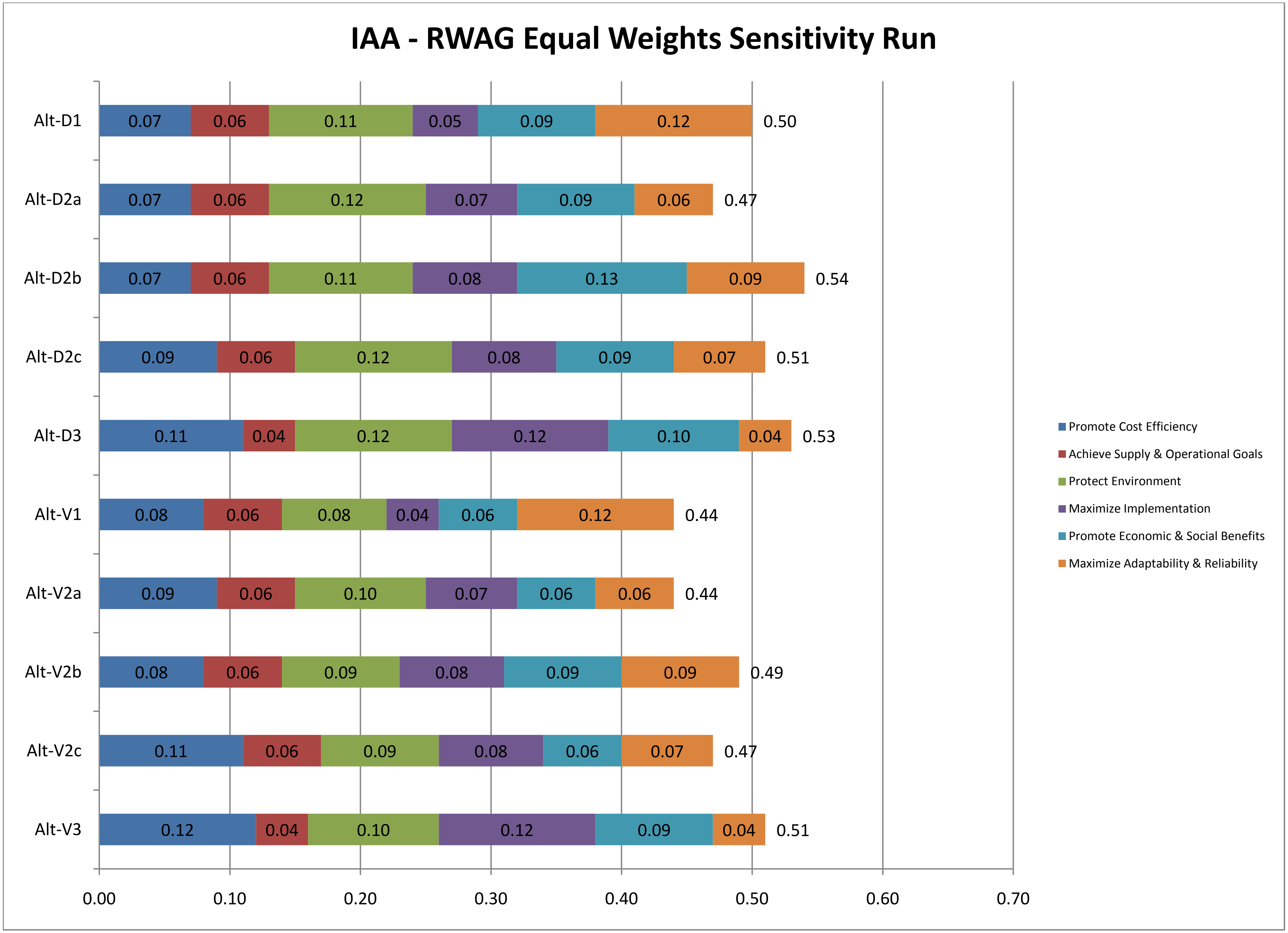

IAA - RWAG Average Weights Sensitivity Run
Alt-D1
0.11
0.07
0.04
0.06
0.08
0.09
0.45
Alt-D2a
0.12
0.08
0.06
0.06
0.08
0.04
0.44
Alt-D2b
0.12
0.07
0.07
0.09
0.08
0.07
0.50
Alt-D2c
0.12
0.10
0.07
0.06
0.08
0.05
0.48
Alt-D3
0.13
0.12
0.12
0.07
0.05
0.03
0.52
Alt-V1
0.08
0.08
0.04
0.04
0.08
0.09
0.41
Alt-V2a
0.11
0.09
0.06
0.04
0.08
0.04
0.42
Alt-V2b
0.09
0.09
0.07
0.06
0.08
0.07
0.46
Alt-V2c
0.10
0.12
0.07
0.04
0.08
0.05
0.46
Alt-V3
0.10
0.13
0.12
0.06
0.05
0.03
0.49
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability

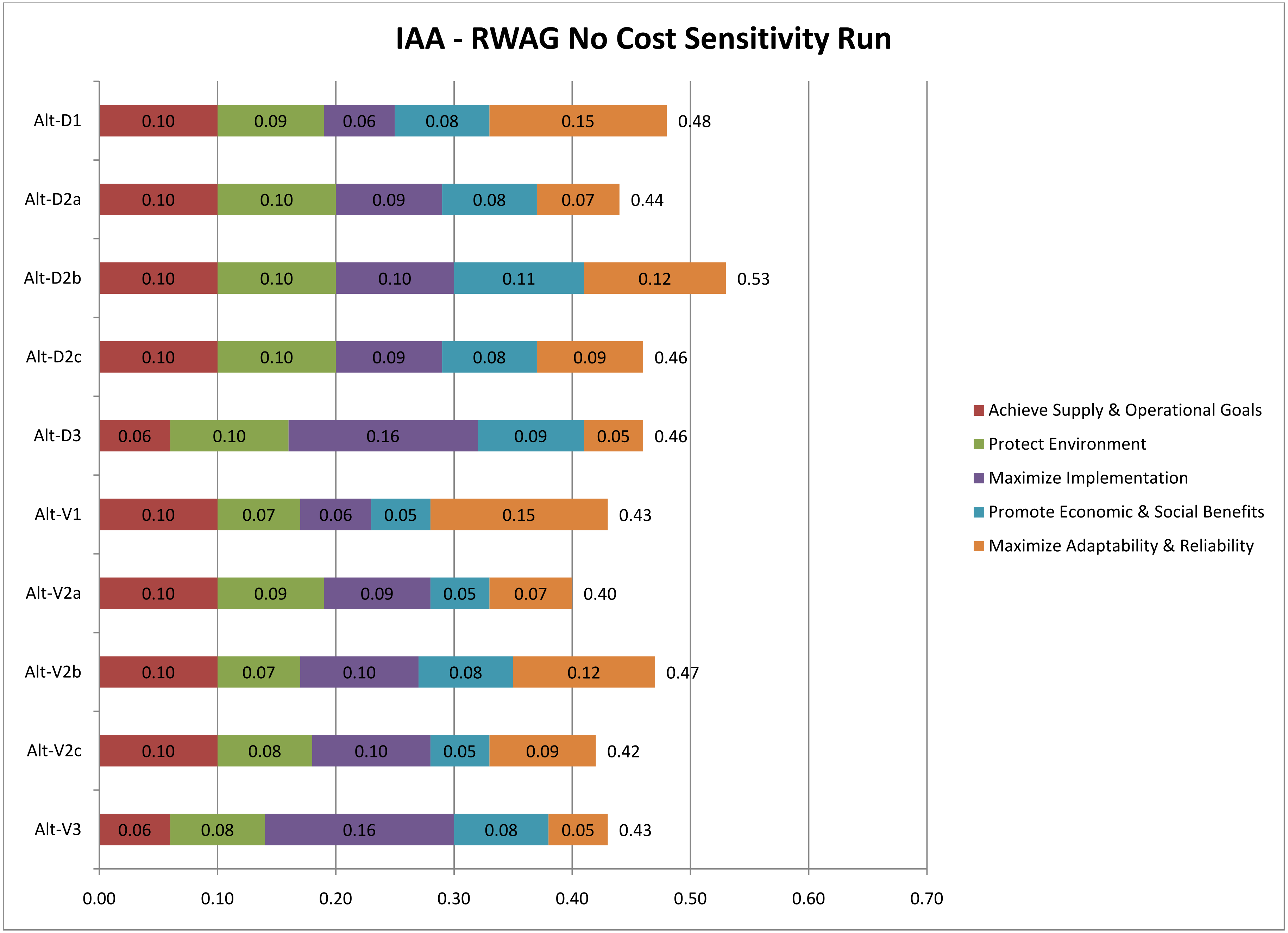

IAA - RWAG Environmental Emphasis Sensitivity Run
Alt-D1
0.17
0.32
0.49
Alt-D2a
0.17
0.35
0.52
Alt-D2b
0.17
0.34
0.51
Alt-D2c
0.17
0.35
0.52
Alt-D3
0.11
0.36
0.47
Alt-V1
0.17
0.24
0.41
Alt-V2a
0.17
0.30
0.47
Alt-V2b
0.17
0.26
0.43
Alt-V2c
0.17
0.28
0.45
Alt-V3
0.11
0.29
0.40
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability


IAA - RWAG Social Emphasis Sensitivity Run
Alt-D1
0.05 0.05 0.15 0.03 0.10 0.07 0.45
Alt-D2a
0.05 0.05 0.17 0.05 0.15 0.03 0.50
Alt-D2b
0.05 0.05 0.16 0.06 0.19 0.05 0.56
Alt-D2c
0.07 0.05 0.17 0.06 0.17 0.04 0.56
Alt-D3
0.08 0.03 0.17 0.09 0.20 0.02 0.59
Alt-V1
0.06 0.05 0.11 0.03 0.06 0.07 0.38
Alt-V2a
0.06 0.05 0.14 0.05 0.11 0.03 0.44
Alt-V2b
0.06 0.05 0.12 0.06 0.15 0.05 0.49
Alt-V2c
0.08 0.05 0.13 0.06 0.12 0.04 0.48
Alt-V3
0.08 0.03 0.14 0.09 0.22 0.02 0.58
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability



IAA - RWAG Cost Emphasis Sensitivity Run
Alt-D1
0.20
0.03
0.06
0.07
0.07
0.43
Alt-D2a
0.21
0.04
0.07
0.07
0.03
0.42
Alt-D2b
0.20
0.05
0.07
0.07
0.05
0.44
Alt-D2c
0.28
0.05
0.07
0.07
0.04
0.51
Alt-D3
0.33
0.07
0.07
0.04
0.02
0.53
Alt-V1
0.24
0.03
0.05
0.07
0.07
0.46
Alt-V2a
0.26
0.04
0.06
0.07
0.03
0.46
Alt-V2b
0.24
0.05
0.05
0.07
0.05
0.46
Alt-V2c
0.33
0.05
0.06
0.07
0.04
0.55
Alt-V3
0.35
0.07
0.06
0.04
0.02
0.54
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability


IAA - RWAG Equal Weights Sensitivity Run
Alt-D1
0.07
0.06
0.11
0.05
0.09
0.12
0.50
Alt-D2a
0.07
0.06
0.12
0.07
0.09
0.06
0.47
Alt-D2b
0.07
0.06
0.11
0.08
0.13
0.09
0.54
Alt-D2c
0.09
0.06
0.12
0.08
0.09
0.07
0.51
Alt-D3
0.11
0.04
0.12
0.12
0.10
0.04
0.53
Alt-V1
0.08
0.06
0.08
0.04
0.06
0.12
0.44
Alt-V2a
0.09
0.06
0.10
0.07
0.06
0.06
0.44
Alt-V2b
0.08
0.06
0.09
0.08
0.09
0.09
0.49
Alt-V2c
0.11
0.06
0.09
0.08
0.06
0.07
0.47
Alt-V3
0.12
0.04
0.10
0.12
0.09
0.04
0.51
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Promote Cost Efficiency
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability


IAA - RWAG No Cost Sensitivity Run
Alt-D1
0.10
0.09
0.06
0.08
0.15
0.48
Alt-D2a
0.10
0.10
0.09
0.08
0.07
0.44
Alt-D2b
0.10
0.10
0.10
0.11
0.12
0.53
Alt-D2c
0.10
0.10
0.09
0.08
0.09
0.46
Alt-D3
0.06
0.10
0.16
0.09
0.05
0.46
Alt-V1
0.10
0.07
0.06
0.05
0.15
0.43
Alt-V2a
0.10
0.09
0.09
0.05
0.07
0.40
Alt-V2b
0.10
0.07
0.10
0.08
0.12
0.47
Alt-V2c
0.10
0.08
0.10
0.05
0.09
0.42
Alt-V3
0.06
0.08
0.16
0.08
0.05
0.43
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability

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Los Angeles Department of Water & Power

City of Los Angeles Sanitation, Department of Public Works

Bureau of Engineering

City of Los Angeles, Founded 1781