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FEASIBILITY STUDY OF RECYCLED WATER INTERCONNECTIONS BETWEEN CITY OF POMONA, MONTE VISTA WATER DISTRICT AND INLAND EMPIRE UTILITIES AGENCY

FINAL
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RECYCLED WATER INTERCONNECTIONS

BETWEEN CITY OF POMONA, MONTE VISTA WATER DISTRICT AND
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1.0 INTRODUCTION

In collaboration with the City of Pomona (City or Pomona) and Monte Vista Water District (MVWD), Inland Empire Utilities Agency (IEUA) has requested Carollo Engineers to analyze future opportunities to increase the water supply within the region, which are discussed in this Recycled Water Feasibility Study (Study). To initiate the analysis, alternatives were evaluated that assessed the viability of potential supply sources and the interconnection between facilities owned and operated by the City, MVWD, and IEUA to convey treated water to direct use recycled water customers, groundwater recharge basins, and aquifer storage and recovery (ASR) well locations. Each of these is discussed in further detail in the proceeding sections. The top three ranked project alternatives were then selected and analyzed in more detail to determine the most cost effective and beneficial interagency project alternative.

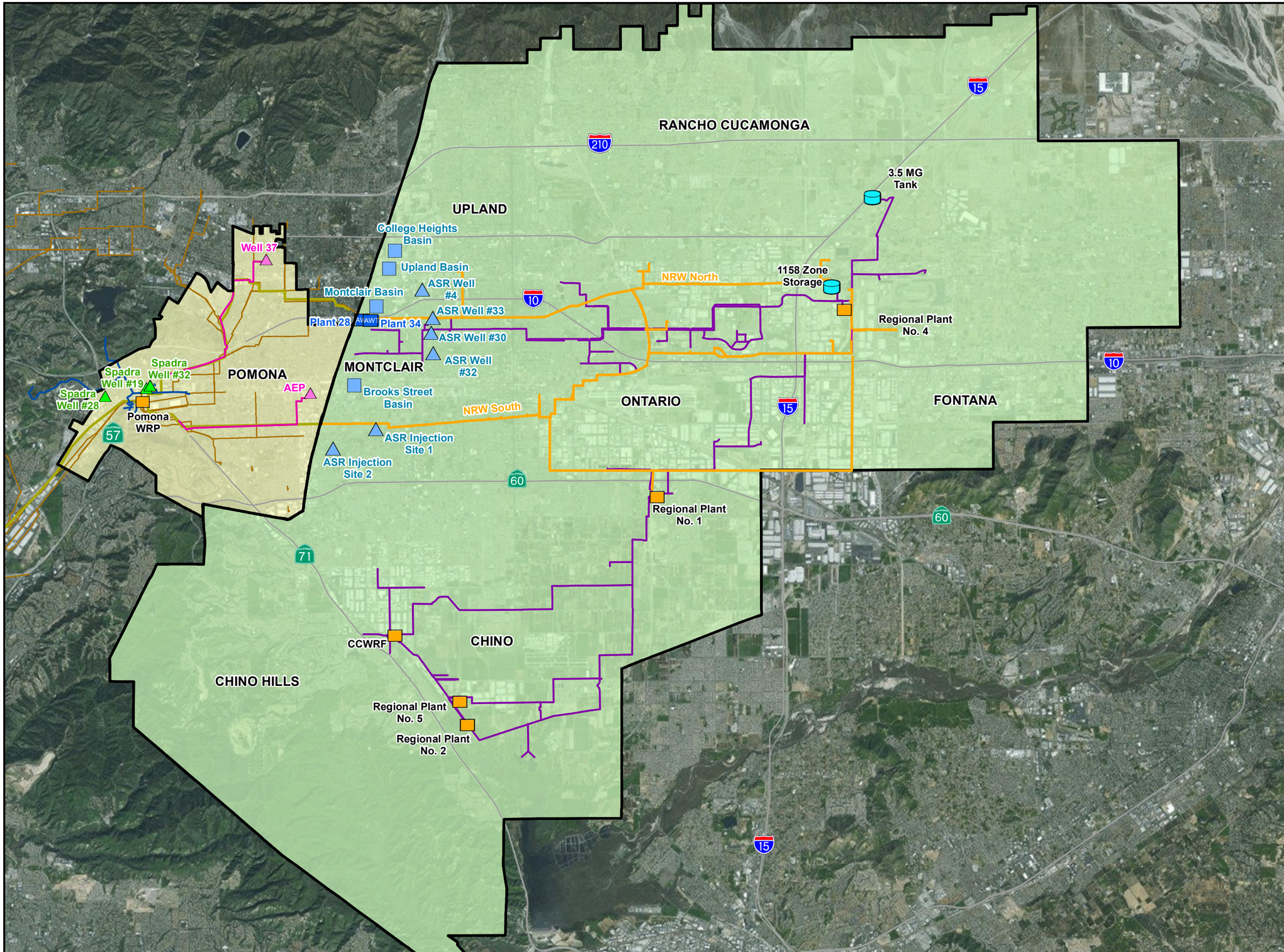
2.0 SUPPLY SOURCES AND EXISTING INFRASTRUCTURE

As part of this analysis, six potential supply sources were identified to supplement the water supply within the region along with existing infrastructure to convey treated water to direct use recycled water customers, groundwater recharge basins, and ASR well locations. The potential supply sources and the existing infrastructure are described by agency in the proceeding subsections. The location of the potential supply sources and the existing infrastructure are shown on Figure 1.

2.1 IEUA Supply Sources and Existing Infrastructure

The potential supply sources analyzed within IEUA's service area included brine from the Northern and Southern Non-Reclaimable Wastewater (NRW) system. The location of the NRW system is depicted on Figure 1 and the historical flow from the NRW system is listed in Table 1. As shown in Table 1, the average annual flow from the Southern NRW pipeline is approximately 3.5 mgd and the average annual flow from the northern NRW pipeline is less than 0.1 mgd. The flow into the northern NRW pipeline also fluctuates with inflow occurring mostly during summer months and limited to no flow in winter months.

To convey recycled water to direct use customers and groundwater recharge basins within IEUA's service area, IEUA's regional recycled water distribution infrastructure could be utilized. In addition, the basins included as part of this Study are currently operated by IEUA. The basins include Brooks, College Heights, Upland, and Montclair, which are located within Management Zone 1 of the Chino Groundwater Basin, which is described in further detail in Section 3.0.



Legend

- Storage Tanks
- Treatment Plant
- Potential Treatment Sites
- Potential ASR Sites
- Recharge Basin

City of Pomona Sources

- Well 37 and AEP
- Spadra Well

Recycled Water Pipelines

- Pomona RW Pipelines
- IEUA RW Pipelines

Brine Lines

- AEP and Well 37 Brine Liines
- IEUA Brine Lines
- Inland Empire Brine Line
- LACSD Regional Brine Pipeline
- LACSD Domestic Sewer Pipeline

Others

- IEUA Service Area
- Pomona Service Area

N

0 4 Miles

Figure 1
Supply Sources and Existing Infrastructure
Recycled Water Feasibility Study
Inland Empire Utilities Agency

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Table 1	Potential Supply by Source Recycled Water Feasibility Study IEUA		
	PWRP Recycled Water (mgd)(1,2)	**Southern NRW Flow (mgd)(1)**	**Northern NRW Flow (mgd)(1)**
2011	4.2	3.2	<0.1
2012	3.9	3.4	<0.1
2013	3.9	3.4	<0.1
2014	3.8	3.8	<0.1
Average (mgd)	**3.9**	**3.5**	**<0.1**

Notes:

(1) Based on data provided by the City and IEUA. Since complete historical data was not available for Spadra Well 19, the AEP brine flow, and Well 37, the average flow provided in available data was utilized in this analysis

(2) The average effluent flow from PWRP is approximately 8.1 mgd. The City is allocated two thirds of this flow for recycled water usage, which equates to approximately 5.4 mgd. The average recycled water usage of 1.5 mgd was deducted from the City's allocated effluent flow to estimate current available flow (which averages 3.9 mgd). In future, an additional 1.5 mgd of potential recycled water usage is estimated, which would reduce the average available flow from 3.9 mgd to 2.4 mgd.

2.2 Pomona Supply Sources and Existing Infrastructure

The potential supply sources analyzed within the City's service area included recycled water from the Sanitation Districts of Los Angeles County's Pomona Water Reclamation Plant (PWRP), groundwater from Spadra Basin (Wells 19, 28, and 31), and brine from the City's Anion Exchange Plant (AEP) and the ion exchange facility at Well 37. As shown in Table 1, the available average annual flow from PWRP is approximately 3.9 mgd. This total is based on the allocation of two-thirds of the effluent flow from PWRP, which is approximately 5.4 mgd, and excludes approximately 1.5 mgd of existing recycled water demand. Since the available PWRP flow and the recycled water usage fluctuate and approximately 1.5 mgd of future demand is anticipated to connect to the City's recycled water system, it is assumed that the variation in flow from the City would be offset with the use of IEUA's recycled water to maintain a constant supply. IEUA has identified projects, opportunities, and plans for long-term recharge augmentation. Providing recycled water to supplement Pomona's supply when necessary to augment groundwater recharge is consistent with IEUA's long-term groundwater recharge plans. In addition, Spadra Basin Wells 19, 28, and 31 were considered potential supply source options that could be utilized to blend with the City's recycled water supply. However, based on input from City staff, Spadra Well 28 is occasionally utilized to supplement the City's potable water system and Spadra Well 31 is no longer operational. Therefore, Spadra Well 19 was considered the best supply source option. In addition, Well 19 is located within 20 feet from an existing recycled water pipeline and has a capacity of approximately 0.5 mgd. Brine from the City's

AEP plant and Well 37 were also considered potential supply sources. The average annual brine flow from the AEP plant is approximately 3.2 mgd and the average annual flow from Well 37 is approximately 1.0 mgd, which was based on data presented in the City's Integrated Water Supply Plan (RMC, 2011).

To convey the treated flow into IEUA's service area, the City would need to utilize existing recycled water infrastructure that would be expanded to connect into IEUA's service area.

2.3 MVWD Supply Sources and Existing Infrastructure

Supply sources from MVWD were not considered in this analysis. However, MVWD has property and infrastructure available to convey treated water in the northwestern portion of the Chino Groundwater Basin as well as sites that could be utilized for advanced treatment and injection facilities, such as Plant 28 and Plant 34 and ASR Wells 4, 30, 32, and 33, which are depicted on Figure 1.

3.0 WATER QUALITY CONSIDERATIONS

Six potential water sources identified in the previous section were considered for this project. A summary of water quality data for each source is listed in Table 2. As listed, water sources 1 and 2 have total dissolved solids (TDS) concentrations well below 1,000 mg/L and non-detect levels of BOD. Water source 4 has moderate levels of TDS and BOD, and water sources 3, 5 and 6 have very high TDS concentrations, ranging from almost 20,000 mg/L on the low end, to over 90,000 mg/L (almost three times saltier than seawater) on the high end. Due to the very high salinity and the very high associated costs to treat water sources 5 and 6, they were eliminated from consideration.

Accordingly, source waters 1, 2, 3, and 4 were carried forward as standalone sources for consideration in the alternatives that were developed. Because sources 1 and 2 arose in the same area of the City and have similar water quality, these sources were combined into a single source for developing project alternatives. Source water 3, despite its high TDS, was also initially considered in one alternative due to its proximity to the recharge areas. However, this source was later eliminated from consideration due to the minimal volume available for treatment, its high variability of flow, and its high TDS.

Table 2	Supply Source Water Quality Recycled Water Feasibility Study IEUA							
Potential Water Source and Name		Water Quality for Selected Range of Parameters						
		TDS	BOD	TSS	Calcium	Sodium	Sulfate	Chloride
1	Spadra Well 19 - Pomona	670	NA(1)	NA(1)	130	30	140	47
2	Recycled Water - Pomona	570	<3	<2	68	103	75	140
3	Northern NRW Line - IEUA	19,600	100	100	30	7,000	NA	8,800
4	Southern NRW Line - IEUA	2,735	400	384	225	480	NA	753
5	AEP IX Brine - Pomona	36,100	700(2)	NA	91	NA	2,600	16,900
6	Well 36 IX Brine - Pomona	91,000	2,200(2)	85	163	NA	6,200	42,000

Notes:
(1) Not Available
(2) Estimated from COD value

Upon the initial screening of the potential water supply sources, the viable source alternatives were analyzed with various treatment options. Without advanced treatment, the City's recycled water and Spadra Well 19 (sources 1 and 2) water would improve the water quality within the Chino Basin by surface spreading. By implementing the use of advanced treatment for water sources 1, 2, and 4, salinity levels would be further improved and provide a higher quality supply source for surface spreading or injection at ASR well locations. Due to the higher levels of BOD in water supply source 4, the advanced treatment process would require biological treatment such as a Membrane Bioreactor (MBR) process while water sources 1 and 2 could be fed directly to an advanced treatment (microfiltration (MF) and reverse osmosis (RO)) train. Conventional and advanced treatment alternatives are further discussed in Section 5.1.

The water quality analysis identified two viable water sources that were carried forward in the feasibility analysis: A combination of water sources 1 and 2 and water source 4. Various combinations of these sources were used to develop potential alternatives.

4.0 EXISTING GROUNDWATER CONDITIONS

In order to develop and analyze potential groundwater recharge alternatives, existing groundwater basins were selected for analysis in the northwestern portion of IEUA's service area. The basins included Brooks, College Heights, Upland, and Montclair, which are located within Management Zone 1 of the Chino Groundwater Basin. At this time, Brook Basin is the only basin on the western side of Management Zone 1 that is regulated to recharge recycled water. College Heights, Upland, and Montclair have the capacity to recharge recycled water, but would require new infrastructure, regulatory approvals, and monitoring facilities prior to the implementation of a recharge project. To calculate the recharge potential at each site, the infiltration rates provided by IEUA were utilized, which are presented in Table 3. As listed in Table 3, the total estimated recharge volume for the listed basins is approximately 19,700 acre-feet per year (AFY), or 17.7 million gallons per day (mgd). Conditions such as weather, regulatory/environmental constraints, and proximity to existing drinking water wells have an impact on whether a site is considered feasible for recycled water spreading.

Table 3 Estimated Infiltration Rates
Recycled Water Feasibility Study
IEUA

	Recycled Water Recharge Potential			
Basins	**Estimated Infiltration Rate (ft/day)(1)**	**Effective Recharge Area (acres)(2)**	**Recharge Volume (AFY)(3)**	**Recharge Volume (mgd)(3)**
College Heights E.	3.0	3.3	3,600	3.2
College Heights W.	3.0	4.1	4,500	4.0
Montclair 1	1.0	5.7	2,100	1.9
Montclair 2	1.0	8.6	3,100	2.8
Montclair 3	1.0	3.9	1,400	1.3
Montclair 4(4)	1.0	3.4	1,200	1.1
Upland	1.0	10.5	3,800	3.4
Total	**N/A**	**N/A**	**19,700**	**17.7**

Notes:
(1) Infiltration rates based on data provided by IEUA.
(2) Effective recharge areas were based on basin storage data provided by IEUA.
(3) The estimated recharge volume assumes the maximum spreading potential that can occur in year. Therefore, a 12 month duration was utilized. Weather conditions and regulatory changes may impact the estimated recharge volume.
(4) Standing water occurs within Montclair Basin 4 during storm events.

To assist with the analysis of site selection and assessing the groundwater impacts associated with recharging at the selected sites, Tom Harder & Company conducted a groundwater impact analysis. A full report on the groundwater impact analysis is included in Appendix A of this Study. In this assessment, areas within the Chino Groundwater Basin with land subsidence issues and plumes were identified along with the location of existing drinking water wells, which are shown on Figure 2. To analyze the impact of recycled water recharge in the northwestern area of Management Zone 1, a two-dimensional analytical flow model was run to assess travel times and groundwater levels.

Based on the initial review conducted by Tom Harder & Company, together with input from IEUA and City staff, it was determined that recycled water recharge at Brooks Basin is currently maximized and the ability to mitigate land subsidence is not possible since the basin is located south of the area of concern. Therefore, Brooks Basin was not considered as an ideal site for future recharge, and was not considered further. The College Heights Basin and Upland Basin were also evaluated. Although both sites appear to be ideal recharge locations and would assist in mitigating land subsidence, both basins are located furthest north from potential advanced treatment plant sites that are owned by MVWD and would require additional infrastructure to implement groundwater recharge. Therefore, Montclair Basin was selected as the most feasible location for the groundwater modeling analysis due to its proximity to the area of land subsidence, capacity to recharge, and proximity to existing infrastructure. For conservative planning purposes, a flow rate of 4.4 mgd was utilized, which was based on the total average flow of Spadra Well 19 (0.5 mgd) and City's available recycled water flow (3.9 mgd). In the future, the flow from the City may be reduced with the connection of new recycled water customers to the system. It is anticipated that the offset of flow from the City would be supplemented with IEUA's recycled water to maintain a constant supply. By utilizing a higher estimated flow rate, the largest groundwater impacts are demonstrated.

The results of the groundwater modeling analysis in Appendix A demonstrate that Montclair Basin cells 1 and 3, which have a total recharge capacity of 3.1 mgd as listed Table 3, are the most optimal cells to recharge recycled water. Montclair Basin cell 2 is within close proximity to a drinking water well (MVWD 26) and cell 4 has standing water at various times throughout the year. Additional analysis would be required to further evaluate the travel times. However, this analysis demonstrated that the travel time range in cells 1 and 3 would average approximately 6 months at a flow rate of 4.4 mgd, which is shown on Figure 3. Since the ability to recharge in cells 1 and 3 is limited to 3.1 mgd, the travel time would be extended. In addition, the modeling analysis showed that by recharging at Montclair Basin, groundwater levels increase by approximately 50 feet, which would improve land subsidence in the area. There are also no impacts to nearby plumes. Weather constraints that may affect the ability to recharge at Montclair Basin could be mitigated by the implementation of ASR wells, which would provide operational flexibility during storm events. This is discussed further in Section 5.3.

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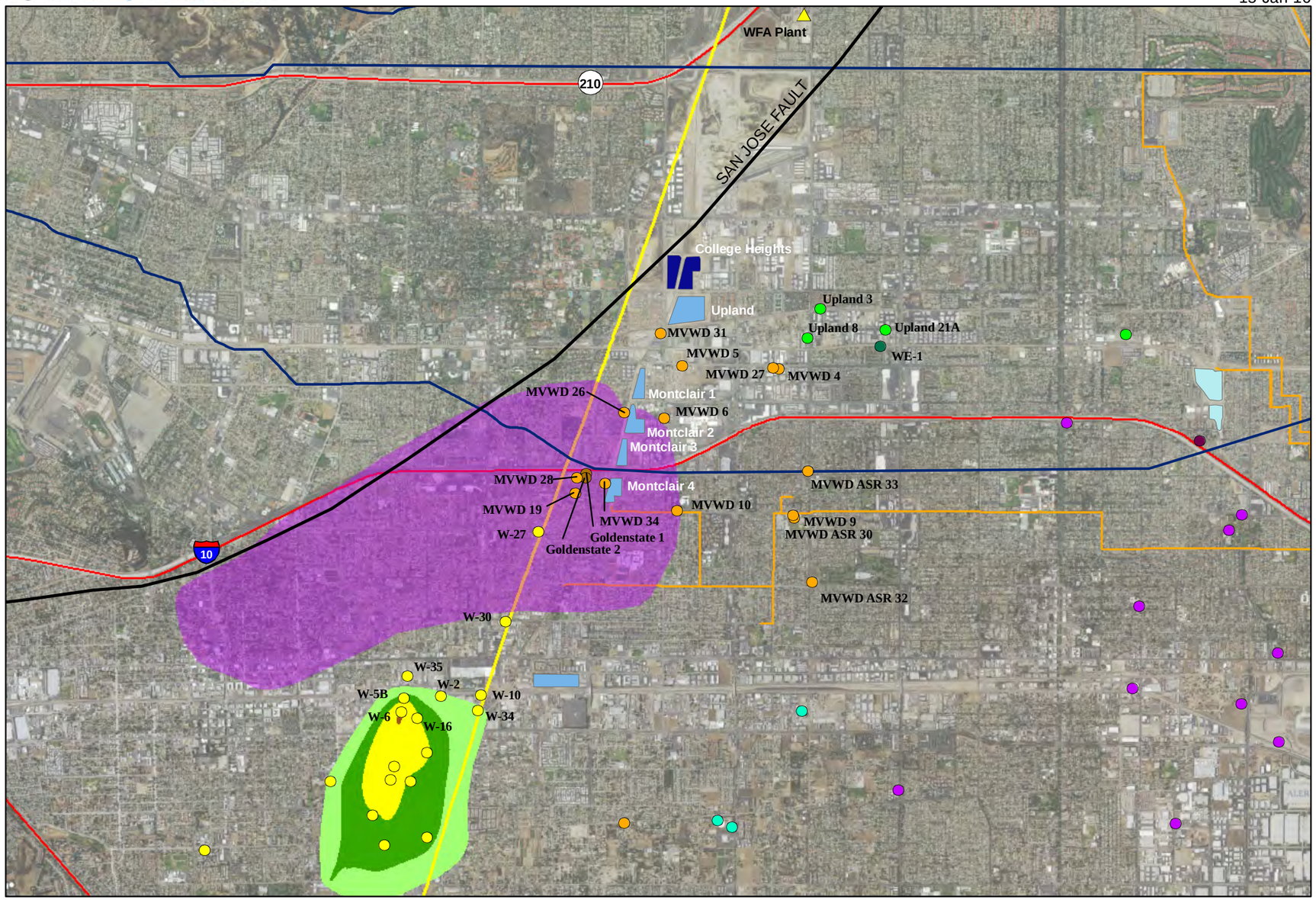
IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

0 0.5 1 2 Miles

NAD 83 UTM Zone 11
Central Meridian: -118

Map Features

- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Treatment Plant
- Area of Subsidence from Mar 2011 to Dec 2014 (-0.06 ft to -0.18 ft of relative change)

2014 TCE Plume Concentration (µg/L)

- 0 to 5
- 5 to 10
- 10 to 20
- 20 to 50

Recharge Basin Infiltration Rate (ft/day)

- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- > 3.0

- San Jose Fault
- Imported Water Pipeline
- IEUA Pipeline
- IEUA Service Area
- Freeway

Thomas Harder & Co.
Groundwater Consulting

Groundwater Impact Analysis

Project Area

Figure 2

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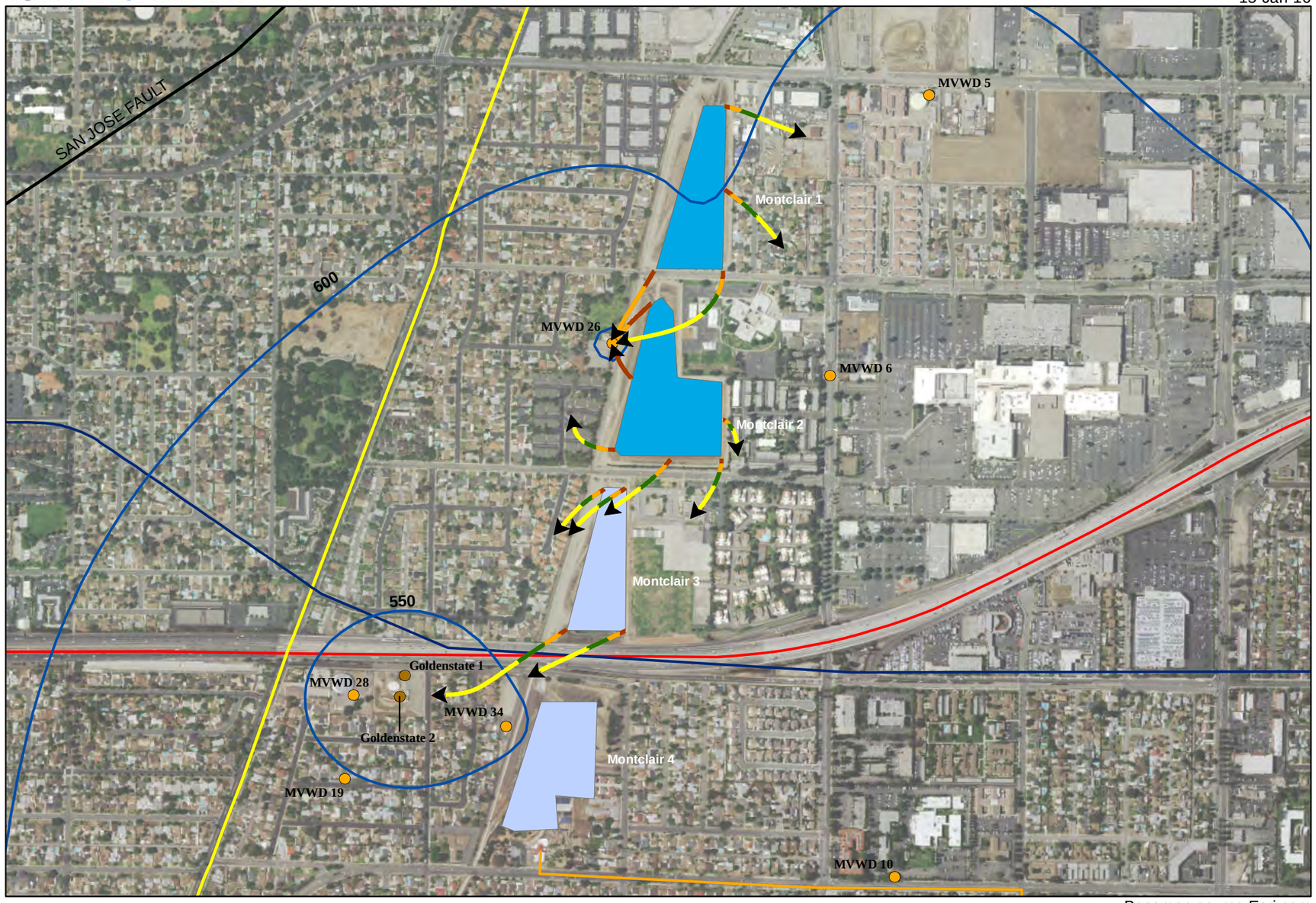
IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

NAD 83 Stateplane Zone 5
Central Meridian: -118

Map Features

- 0 to 2 Month Travel Time
- 2 to 6 Month Travel Time
- 6 Month to 1 Year Travel Time
- 1 Year to 2 Year Travel Time
- Model-Generated Groundwater Contours (ft amsl)
- Recharge Basin Used in Analysis
- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Other Recharge Basin
- Imported Water Pipeline
- IEUA Pipeline
- San Jose Fault
- IEUA Service Area
- Freeway

Thomas Harder & Co.
Groundwater Consulting

Montclair Basins Particle Travel Times

Figure 3

5.0 DEVELOPMENT OF ALTERNATIVES

Upon the initial review of the available water supply sources, varying water qualities, different pipeline routes, various recharge basins, and differing levels of treatment, six project alternatives (one with a sub-alternative) were identified, which are listed in Table 4. The list of alternatives were utilized to evaluate the feasibility of interconnecting the City, MVWD, and IEUA's recycled water systems for direct use to recycled water customers, spreading at groundwater recharge basins, and injection at ASR well locations.

Since the water quality and point of origin of Spadra Well 19 (source 1) and the City's recycled water (source 2) are similar, the sources were combined to provide a source of tertiary quality water. The Southern NRW pipeline (source 4) remained an independent supply source due to the high BOD and TSS, which necessitates a greater level of treatment. The available supply and treated capacity from each of the sources is listed by project alternative in Table 4.

Based on the water quality of the selected supply sources, three treatment processes were considered that would produce water suitable for ground water recharge. The treatment processes include conventional treatment, membrane microfiltration (MF) followed by reverse osmosis (RO) and advanced oxidation, and biological treatment followed by reverse osmosis and advanced oxidation (UV/AOP). These treatment alternatives were selected based on the latest groundwater recharge regulations and are described in further detail in Section 5.2.

To convey the two water supply sources from the City to potential advanced treatment facilities for groundwater recharge or ASR well injection, several pipeline routes were considered. Working with City and IEUA staff, a route along Orange Grove Avenue and Orchard Street was selected to convey recycled water from the City to the spreading basins and ASR wells. A route running north along Monte Vista Avenue was selected to convey either raw or treated water from the Southern NRW pipeline to the recharge locations. Based on the groundwater impact analysis discussed in Section 4.0, Montclair Basin and MNWD's ASR Wells 30 and 32 were selected as the targeted sites for recharge. The alternative alignments are listed in Table 4 and discussed in further detail in Section 5.0.

5.1 Treatment Alternatives

Two treated water qualities were considered for the project alternatives evaluated. The first was chlorinated tertiary effluent water and the second was Advanced Treated recycled water. These two recycled water qualities would be subject to different regulatory requirements and would impact whether spreading versus direct injection could be implemented, the groundwater travel time requirements prior to reaching a drinking water well, and differing levels of treatment. The treatment alternatives evaluated include conventional tertiary treatment and advanced treatment using membrane processes such as MBR, MF, and RO.

Table 4 **Development of Alternatives Matrix**

Recycled Water Feasibility Study

IEUA

Development of Alternatives Matrix															
		Supply Capacity					Available Flow			Beneficial Use Type			Facilities Required		
No.	Alternative Description	Pomona RW (mgd)	Spadra (mgd)	NRW South (mgd)	NRW North (mgd)	Total Flow (mgd)	Brine Discharge (mgd)	Treated Flow (mgd)	Treated Flow (AFY)	GWR	Injection Wells	Direct Use	Advanced Treatment Facilities	Ability to Utilize Existing Infrastructure	Infrastructure Needed
1	Pomona RW & Spadra Well 19 Treated to Title 22 for Spreading and/or Direct Use Customers (Treated Flow Based on Maximum Beneficial Use Potential at Montclair Basin)	2.6	0.5			3.1	0.0	3.1	3,500	X		X	N/A	-IEUA's RW System	-Approx. 6 miles of pipeline (16" dia.) -400 hp PS -100 hp PS
2a	Pomona RW & Spadra Well 19 with AWT for spreading	3.2	0.5			3.7	0.6	3.1	3,500	X		X	MF/RO/AOP	-IEUA's RW System -Plant 28 Site	-Approx. 6 miles of pipeline (16" dia.) -400 hp PS -3.1 mgd AWT Plant
2b	Pomona RW & Spadra Well 19 with AWT for injection and spreading	3.9	0.5			4.4	0.7	3.7	4,200	X	X	X	MF/RO/AOP	-IEUA's RW System -Plant 28 Site -ASR Wells	-Approx. 7 miles of pipeline (16" dia.) -400 hp PS -100 hp PS -3.7 mgd AWT Plant
3	Alternative 2 combined with NRW North with AWT for injection (or spreading)	3.9	0.5		0.006	4.4	0.7	3.7	4,200	X	X	X	MF/RO/AOP	-IEUA's RW System -Plant 28 Site -ASR Wells	-Approx. 8 miles of pipeline (6" to 16" dia.) -400 hp PS -100 hp PS -3.7 mgd AWT Plant
4	Alternative 2a & 2b combined with AWT from the NRW South for injection or spreading	3.9	0.5	3.8		8.2	1.3	6.9	7,700	X	X	X	MF/RO/AOP MBR/RO/AOP	-IEUA's RW System -Plant 28 Site -ASR Wells	-Approx. 10 miles of pipeline (6" to 16" dia.) -100 hp, 200 hp and 400 hp PS -3.7 mgd AWT Plant -3.2 mgd AWT Plant
5	Pomona RW & Spadra Well 19 plus pumped brine from NRW South with AWT for injection or spreading	3.9	0.5	3.8		8.2	1.3	6.9	7,700	X	X	X	MF/RO/AOP MBR/RO/AOP	-IEUA's RW System -Plant 28 Site -ASR Wells	-Approx. 10 miles of pipeline (6" to 16" dia.) -100 hp, 200 hp and 400 hp PS -3.7 mgd AWT Plant -3.2 mgd AWT Plant
6	Pomona RW & Spadra Well 19 with AWT for injection (or spreading) and NRW South AWT for injection or spreading	3.9	0.5	3.8		8.2	1.3	6.9	7,700	X	X	X	MF/RO/AOP MBR/RO/AOP	-IEUA's RW System -Plant 28 Site -ASR Wells	-Approx. 10 miles of pipeline (6" to 16" dia.) -100 hp, 200 hp and 400 hp PS -3.7 mgd AWT Plant -3.2 mgd AWT Plant

5.1.1 Conventional Treatment

To recharge the chlorinated tertiary effluent, source waters 1 and 2 would be combined and pumped to the Montclair Basin for surface spreading. This alternative would require minimal additional treatment to meet Title 22 requirements for surface spreading and the infrastructure would consist of mostly pipelines and pump stations to transport the excess recycled water.

5.1.2 Advanced Treatment

For the advanced treated recycled water, two alternative advanced water treatment processes were evaluated. One includes membrane bioreactor (MBR) treatment followed by reverse osmosis and advanced oxidation (MBR/RO/UV-AOP). This process train would be applied to water source 4 (from the Southern NRW pipeline) requiring removal of high concentrations of organic materials (BOD). The other process train includes microfiltration treatment followed by reverse osmosis and advanced oxidation (MF/RO/UV-AOP). This configuration could be used to further treat the excess recycled water from the City of Pomona (sources 1 and 2) to produce water suitable for groundwater recharge through spreading and direct injection. Process schematics for the MBR/RO/UV-AOP and MF/RO/UV-AOP processes are shown on Figure 4 and Figure 5, respectively.

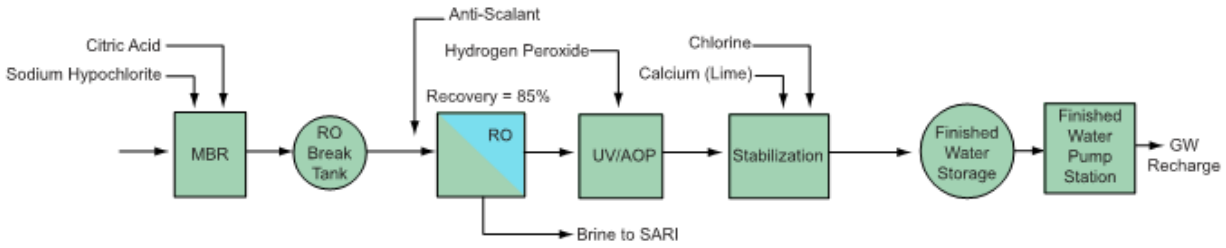


Figure 4 MBR/RO/UV-AOP Process Schematic

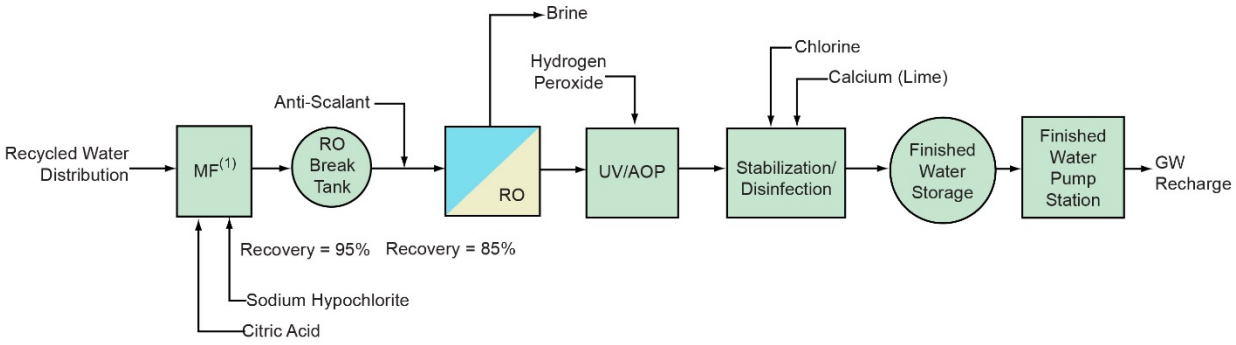


Figure 5 MF/RO/UV-AOP Process Schematic

5.1.2.1 Advanced Treatment Process Descriptions

Several advanced treatment processes were identified to produce recycled water suitable for groundwater recharge. These processes include MBR, MF, RO, and UV-AOP. Each process is described in the following sections.

5.1.2.1.1 Membrane Bioreactor

The MBR process combines conventional biological treatment with the use of membranes for separation of solid and liquid phases. The MBR treatment train is similar to the conventional activated sludge (CAS) process except that membranes replace secondary clarifiers and tertiary filters.

In the MBR process, mixed liquor suspended solids (MLSS) can be increased beyond what is possible in CAS systems. Typically, MBR systems operate at MLSS concentrations in the range of 8,000 to 10,000 mg/L, compared with a value of around 2,500 to 3,000 mg/L in CAS systems. Higher MLSS provides the benefit of greater treatment capacity per unit volume of aeration basin.

Because the MBR process incorporates a membrane barrier, it consistently produces a low-turbidity effluent that is less affected by changes in feed water quality. Another benefit is that the effluent TSS concentration is low enough that tertiary filtration is not required. Therefore, the MBR process produces a high-quality effluent and can be used as pretreatment for RO.

5.1.2.1.2 Microfiltration/Ultrafiltration

MF (and ultrafiltration (UF)) membranes are an efficient technology for particle removal and pathogen control either in a pressurized or submerged configuration. For the former, water is pumped through the membranes in modules or cartridges. In the latter form, membranes are submerged in tanks and water is pulled through the membranes by vacuum. Overall, membrane filtration provides a near absolute barrier to suspended solids and microorganisms with average pore sizes ranging from less than 0.1 (for UF systems) to 0.5 microns. MF and UF are typically applied in a tertiary filtration application to replace conventional media and/or cloth filters.

5.1.2.1.3 Reverse Osmosis

High-pressure membrane processes, such as RO, are typically used for the removal of dissolved constituents including both inorganic and organic compounds. The feed water is pressurized, forcing water through the semi-permeable membranes concentrating the dissolved solids that cannot pass through the membrane. Consequently, these processes can remove salts, hardness, synthetic organic compounds, disinfection by-product precursors, etc. However, dissolved gases such as hydrogen sulfide (H_2S) and carbon dioxide, and neutral low molecular weight molecules, pass through RO membranes. The

rejection by the RO membranes (removal efficiency) is not the same for all dissolved constituents, and is influenced by molecular weight, charge, and other factors.

RO is considered a high-pressure process because it operates from 75 to 1,200 psig, depending upon the TDS concentration of the feed water. Typical operating pressure in a wastewater application is in the range of 150 to 250 psi. Recoveries for RO plants operating on domestic wastewater are around 85 percent depending on the type and concentrations of sparingly soluble salts (calcium sulfate, calcium carbonate, calcium phosphate, silica, etc.) in the feed water.

5.1.2.1.4 Ultraviolet Advanced Oxidation Process with Peroxide

When hydrogen peroxide (H_2O_2) is exposed to ultraviolet (UV) light it reacts to form hydroxyl radicals that are high-energy, highly reactive molecules that attack chemical bonds of organic molecules and oxidize them. Combining UV with H_2O_2 is called an Advanced Oxidation Process (AOP). Other AOP approaches that result in hydroxyl radical formation include the use of ozone with UV, and ozone with H_2O_2, as well as, UV with sodium hypochlorite (NaOCl). It has been found that hydroxyl radicals are able to oxidize certain constituents or chemicals of emerging concern (CECs) such as certain endocrine disrupting compounds pharmaceuticals and personal care products (PPCPs), and other microconstituents such as 1,4-dioxane and NDMA that can be found in wastewater effluents, some of which already have regulatory limits.

In the UV/AOP process (UV plus H_2O_2) the UV dose required to break down the H_2O_2 is significantly greater than that required for typical disinfection (50 to 100 mJ/cm^2 for disinfection compared around 800 mJ/cm^2 for radical formation). Thus, a UV/AOP process provides both a disinfection barrier as well as a microconstituent barrier.

5.1.2.2 Advanced Treatment Alternatives

To determine the feasibility of the advanced treatment alternatives, ultimate capacities for each facility were estimated based on the availability of the source water and the capacity of the groundwater recharge facilities. Based on the ultimate capacities, preliminary process flow diagrams and site layouts were developed for each alternative. The estimated footprint for each facility was used to determine if land was available near the source water or the groundwater recharge facilities.

5.1.2.2.1 MBR/RO/UV-AOP

The MBR/RO/UV-AOP process train would be applied to sources requiring removal of high concentrations of organic materials (BOD) such as the Southern NRW system (Source 4) to produce recycled water suitable for groundwater recharge through spreading and direct injection. While a specific location has not been identified for this facility, it is anticipated that it would be located near the Southern NRW pipeline within IEUA's service area or close to IEUA's service area in the City of Pomona. A search for open property lots was

conducted. Two potential properties were identified for the MBR/RO/UV-AOP facility, which are both privately owned. The proposed facility would require approximately 200,000 square feet of space (4.6 acres). The layout of the proposed MBR/RO/UV-AOP is shown on Figure 6.

The anticipated advanced treatment facilities that would be located at the MBR/RO/UV-AOP site include:

- MBR treatment facility - The MBR treatment facility could include a feed pump station, fine screens, aeration basin, blower building, membrane tank, RAS/WAS pump station, permeate pump station, and ancillary equipment.
- RO break tank and pump station.
- RO treatment facility - The RO treatment facility includes three RO trains consisting of a feed pump and reverse osmosis membranes. The RO treatment facility also includes an RO flush tank and an RO clean-in-place system. These ancillary facilities are used intermittently during operation.
- UV-AOP treatment facility - The UV-AOP treatment facility consists of a UV reactor and hydrogen peroxide feed system.
- Control room
- Electrical room
- Chemical storage including threshold inhibitor, sodium hypochlorite, aqueous ammonia, sodium hydroxide, and hydrated lime.
- Chemical Truck off-loading pad.
- 3.0 MG storage reservoir.

5.1.2.2.2 MF/RO/UV-AOP

The MF/RO/UV-AOP configuration is proposed to treat the excess recycled water (Sources 1 and 2) to produce water suitable for groundwater recharge through spreading and direct injection. The anticipated location of the proposed MF/RO/UV-AOP facilities is MVWD's Plant 28 site. The total parcel area is approximately 189,000 square feet (4.3 acres) and is shown on Figure 7. The proposed area that would be utilized for the MF/RO/UV-AOP facilities is approximately 127,000 square feet, which is estimated to be able to accommodate facilities that can treat up to 5 mgd. The layout of the proposed advanced treatment facilities is shown on Figure 8. The remaining area in the center of the parcel is currently being utilized as a well site and is not included as part of this project.

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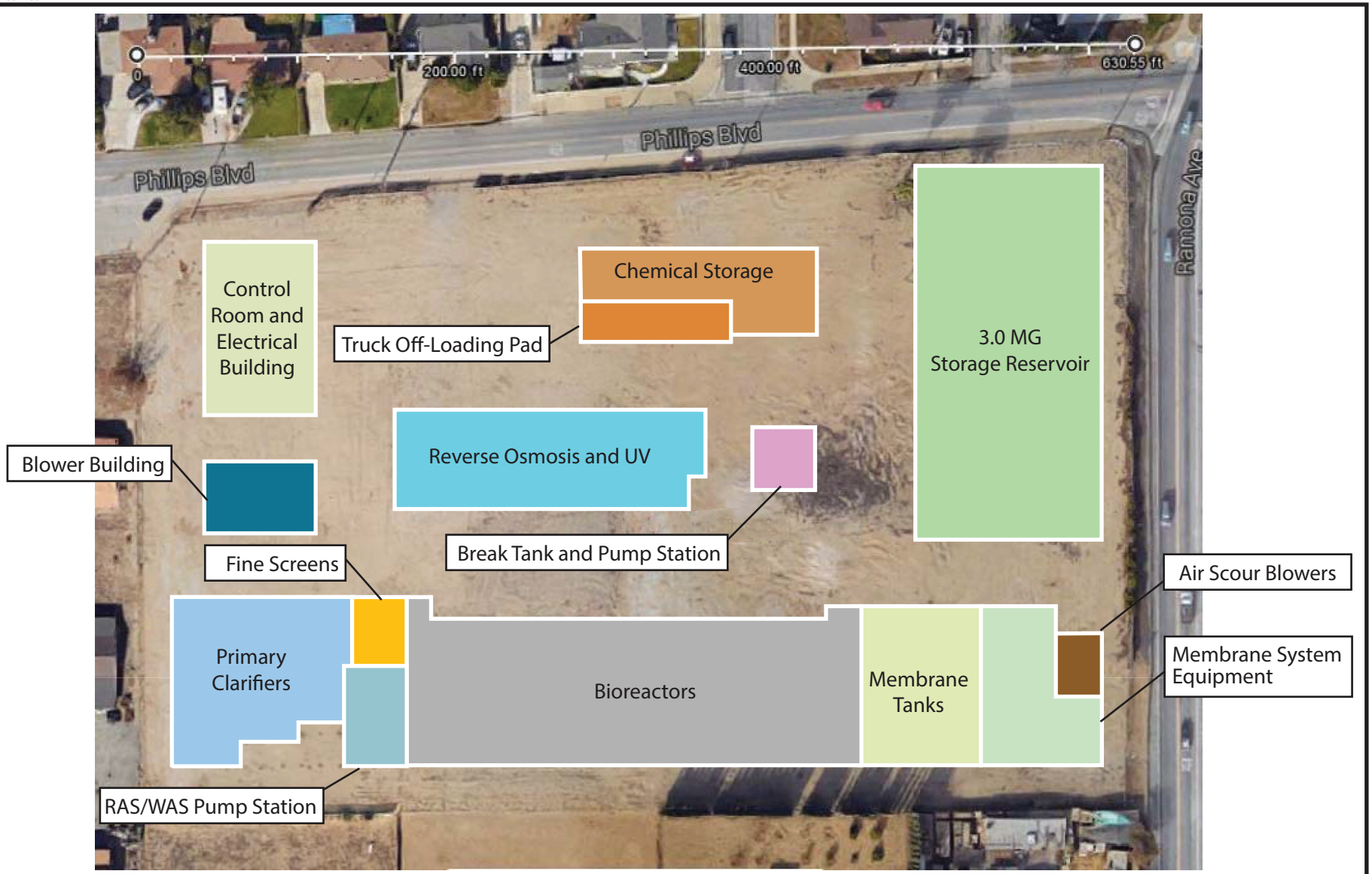

MBR/RO/UV-AOP
PRELIMINARY SITE LAYOUT

FIGURE 6

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A MUNICIPAL WATER DISTRICT

20-IEUA12-15F7-10002A00.AI

Note: Dashed boundary represents proposed area that would be utilized for future advanced treatment facilities.

EXISTING PLANT 28 LAYOUT

FIGURE 7

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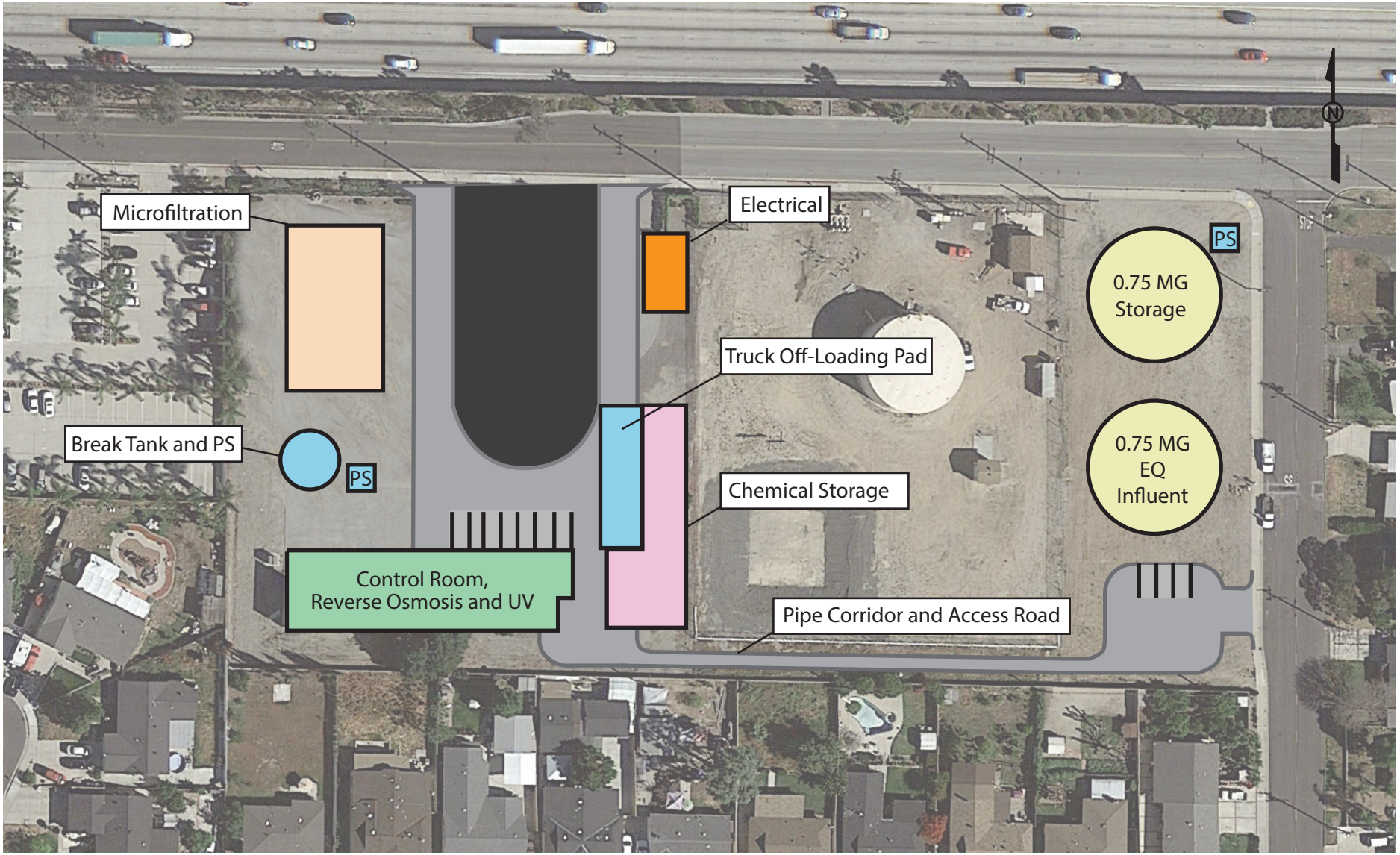

MF/RO/UV - AOP
PRELIMINARY SITE LAYOUT

FIGURE 8

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Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

The anticipated advanced treatment facilities that would be located at the Plant 28 site include:

- MF treatment facility - The MF treatment facility includes a feed pump station, microfiltration membranes, and ancillary equipment.
- RO break tank and pump station.
- RO treatment facility - The RO treatment facility includes three RO trains consisting of a feed pump and reverse osmosis membranes. The RO treatment facility also includes an RO flush tank and an RO clean-in-place system. These ancillary facilities are used intermittently during operation.
- UV-AOP treatment facility - The UV-AOP treatment facility consists of a UV reactor and hydrogen peroxide feed system.
- Control room
- Electrical room
- Chemical storage including threshold inhibitor, sodium hypochlorite, aqueous ammonia, sodium hydroxide, and hydrated lime.
- Chemical Truck off-loading pad.
- Pipeline corridor connecting the treatment facilities on the western side of the parcel to the 0.75 MG storage tank and 0.75 MG influent equalization tank on the eastern side of the parcel. This area would also be utilized as an access road.

5.2 PIPELINE ROUTE ALTERNATIVES

The pipeline routes presented in each alternative are preliminary and will need to be refined upon further analysis of field conditions at the time of project implementation. The preliminary recycled water pipeline alignment from Pomona into IEUA's service area was selected based on input from City staff along with previous planning documents. The proposed pipeline utilized in this Study connects into IEUA's regional recycled water system at Orchard Street within the City of Montclair. In all alternatives evaluated, a pipeline would either extend from IEUA's regional pipeline along Orchard Street to MVWD's Plant 28 site (located South of the 10 freeway) for advanced treatment or directly to Montclair Basin, if no further treatment is needed. The advanced treated water could be utilized for surface spreading at Montclair Basin or direct injection at existing ASR well sites owned by MVWD.

The concept of utilizing IEUA's non-reclaimable waste (NRW) from the northern and southern pipelines was also evaluated. The northern NRW pipeline is located adjacent to the Plant 28 site. Therefore, a small pipeline would be needed to connect to the Plant 28 site for either influent flow into the advanced water treatment plant or for brine disposal.

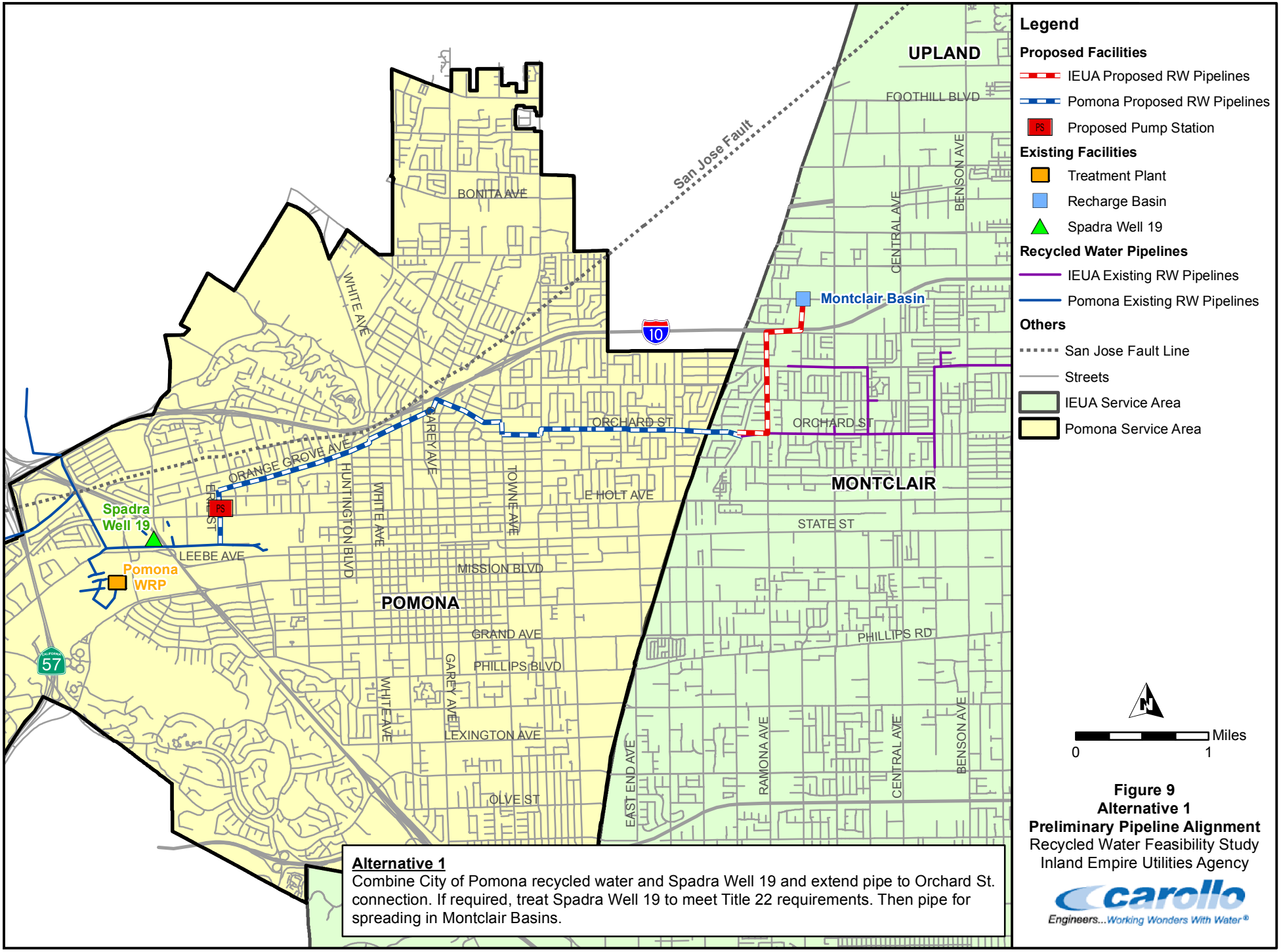
Utilizing the Southern NRW pipeline water as a potential supply source would require additional infrastructure to pump treated flow to Montclair Basin or potential ASR well sites owned by MVWD. The Southern NRW pipeline is located within IEUA's southern service area. A new treatment plant would be required to treat brine flow due to water quality. However, a site has not been selected at this time. Therefore, alignment alternatives presented are preliminary and will change based on future site selection. For planning purposes, an open lot located adjacent to the Southern NRW pipeline in the City of Chino was selected for the conceptual layout shown earlier in Figure 6. Based on assessor data, the lot is privately owned.

5.3 PROJECT ALTERNATIVES

There were six alternatives (one with a sub-alternative) analyzed to determine the most feasible near-term cost effective approach that would provide operational flexibility, maximize the local water supply source within the region, and improve land subsidence within the region. These alternatives vary with water source, treatment process, product water quality, and recharge location. The six alternatives are summarized in Table 4, presented earlier. Each is discussed in more detail below.

5.3.1 Alternative 1

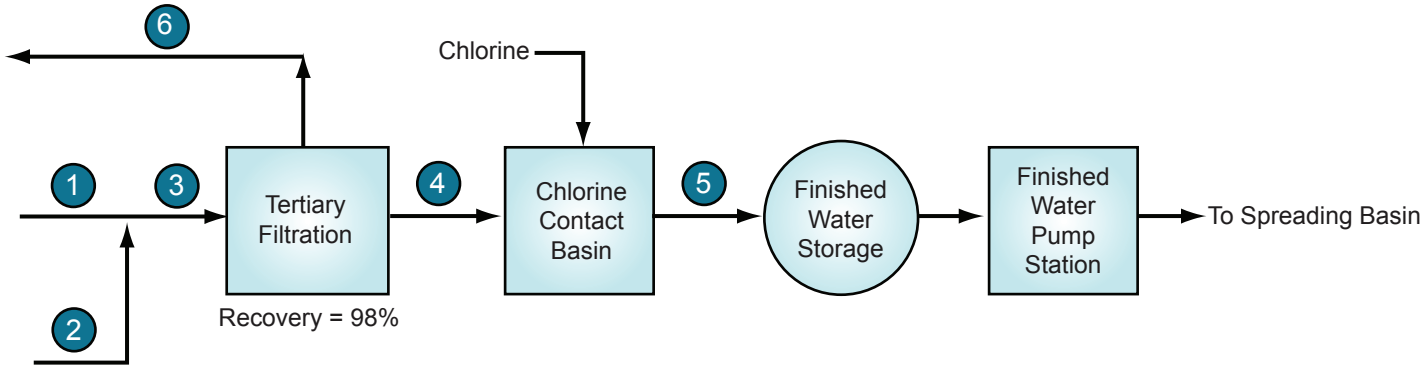
In Alternative 1, a pipeline would extend from the City of Pomona's existing recycled water system and connect into IEUA's recycled water system on Orchard Street within the City of Montclair. The City's recycled water and Spadra Well 19 water would be combined and treated to Title 22 standards, if needed, for spreading at Montclair Basin. An overview of Alternative 1 is shown on Figure 9. Additionally, a preliminary process flow diagram and mass balance for Alternative 1 is shown on Figure 10. As shown, the City's recycled water would be combined with the Spadra Well 19 water prior to conventional filtration and disinfection. This is considered the worst case treatment scenario because filtration of the water to meet Title 22 requirements may not be needed. Disinfection at the Well 19 head would be needed.



Alternative 1
Combine City of Pomona recycled water and Spadra Well 19 and extend pipe to Orchard St. connection. If required, treat Spadra Well 19 to meet Title 22 requirements. Then pipe for spreading in Montclair Basins.

Figure 9
Alternative 1
Preliminary Pipeline Alignment
Recycled Water Feasibility Study
Inland Empire Utilities Agency

		1	2	3	4	5	6
		PRW	Well 19	Combined	Filtered Effluent	Finished Water	Filter Backwash
Flow	mgd	2.7	0.5	3.2	3.1	3.1	0.1
TDS	mg/L	571	670	583.4	583.4	583.4	583.4
BOD	mg/L	<3	0	<3	<3	<3	-
TSS	mg/L	<2.5	0	<2.5	<2.5	<2.5	-
pH		7.3	7.3	7.3	7.3	7.3	7.3
Calcium	mg/L	68	130	75.8	75.8	75.8	75.8
Sodium	mg/L	103	29	93.8	93.8	93.8	93.8
Chloride	mg/L	136	47	124.9	124.9	124.9	124.9



ALTERNATIVE 1
PRELIMINARY PROCESS FLOW DIAGRAM AND MASS BALANCE

FIGURE 10

5.3.2 Alternatives 2A and 2B

Alternative 2a is the same as Alternative 1 with the addition of advanced treatment using MF/RO/UV-AOP and supplemental flow from IEUA's recycled water system. The advanced treated water would be sent to Montclair Basin for spreading. Alternative 2b is presented as a phased approach to Alternative 2a. In Alternative 2b, advanced treated water could be sent to Montclair Basin for spreading or ASR wells for injection. An overview of Alternatives 2a and 2b are shown on Figure 11 and Figure 12, respectively. Additionally, a preliminary process flow diagram and mass balance for Alternative 2 is shown on Figure 13. For the mass balance flows, process availability to allow time for maintenance and other activities was not considered. As shown, the City's recycled water would be combined with the Spadra Well 19 water prior to advanced treatment using MF/RO/UV-AOP. The proposed treatment train would provide a low TDS, high quality product for groundwater recharge and would require discharge of a concentrated brine into the Northern NRW pipeline.

5.3.3 Alternative 3

Alternative 3 is essentially the same as Alternative 2b except with the inclusion of flow from Northern NRW pipeline. An overview of Alternative 3 is presented on Figure 14. Additionally, a preliminary process flow diagram and mass balance for Alternative 3 is shown on Figure 15. As shown, the Northern NRW line has a high TDS and minimal average flow. The addition of this flow has very little impact on the average performance of the advanced water treatment facility. However, this flow is known to have significant variability, for which typical RO systems are not designed.

5.3.4 Alternative 4

Alternative 4 includes Alternative 2b and the additional flow from the Southern NRW pipeline. Water from the Southern NRW pipeline would be extracted and treated using a MBR/RO/UV-AOP treatment process where the advanced treated water would be pumped north using a new pump station and blended with the MF/RO/UV-AOP product water in the north. The combined streams would then be used for injection in the existing ASR wells and sent to Montclair for spreading. An overview of Alternative 4 is presented on Figure 16. Additionally, a preliminary process flow diagram and mass balance for the MBR/RO/UV-AOP process for Alternative 4 is shown on Figure 17. As shown, the Southern NRW pipeline flow would be treated using a membrane biological reactor to remove high levels of BOD and TSS prior to treatment using reverse osmosis and advanced oxidation and would produce a product water similar to the MF/RO/UV-AOP process. It is assumed that all solids produced in the MBR could be discharged to IEUA's collection system for treatment at one of the regional water reclamation plants and that the concentrated brine produced in the RO process could be discharged back into the Southern NRW pipeline downstream of the extraction point.

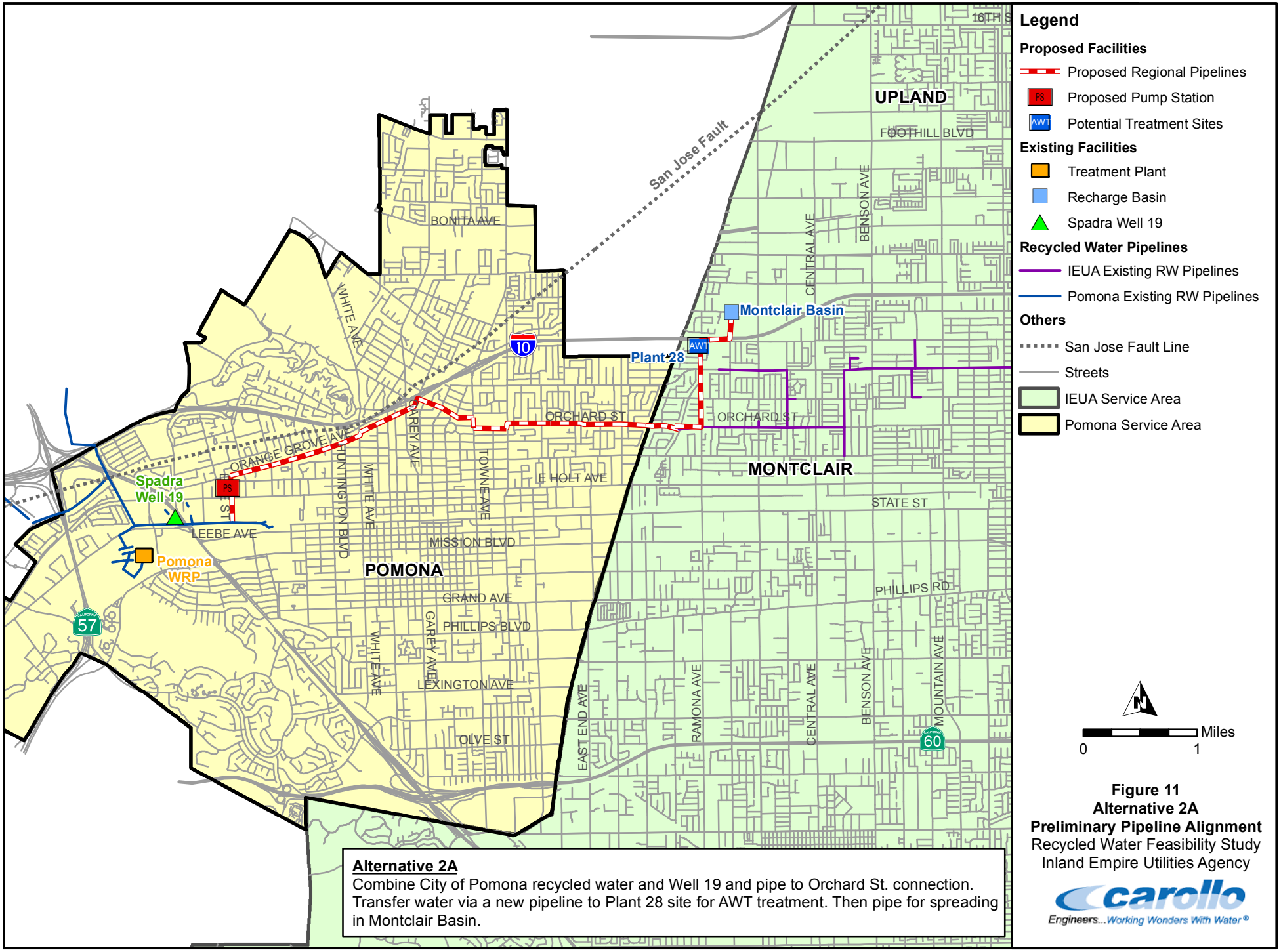


Figure 11
Alternative 2A
Preliminary Pipeline Alignment
Recycled Water Feasibility Study
Inland Empire Utilities Agency

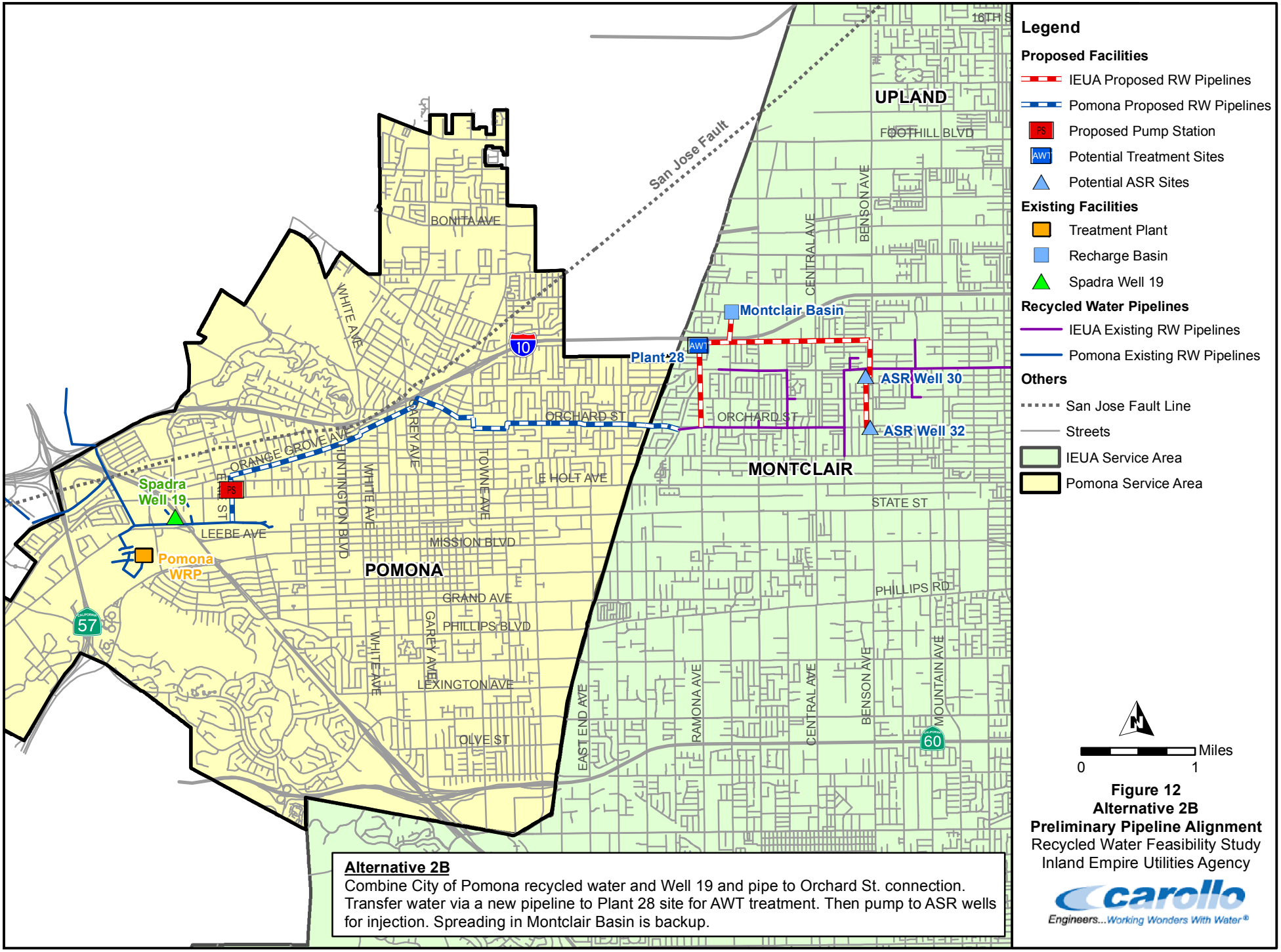
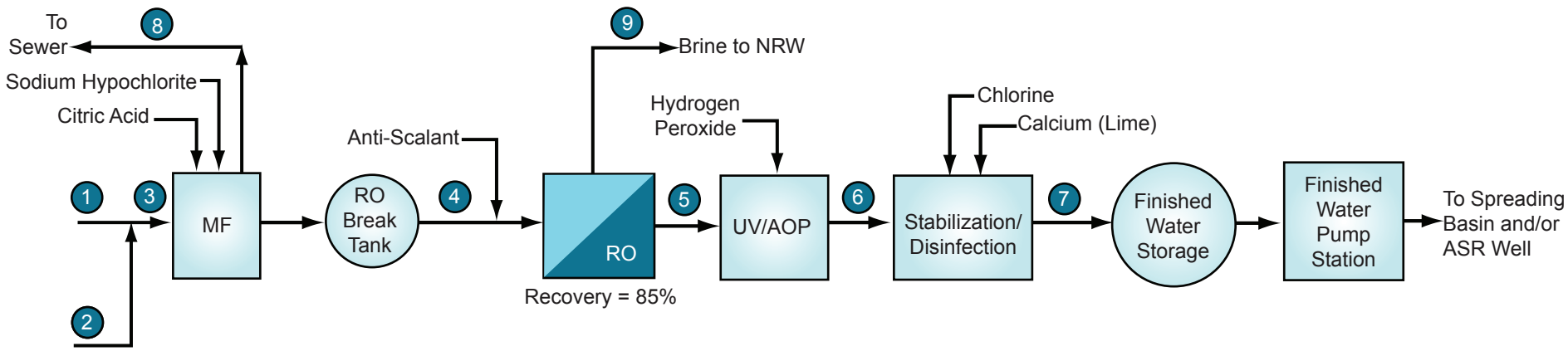


Figure 12
Alternative 2B
Preliminary Pipeline Alignment
Recycled Water Feasibility Study
Inland Empire Utilities Agency

		1	2	3	4	5	6	7	8	9
		PRW	Well 19	Combined	MF Effluent	RO Permeate	UV Effluent	Finished Water	MF Backwash	RO Brine
Flow	mgd	3.2	0.5	3.7	3.7	3.1	3.1	3.1	0.1	0.6
TDS	mg/L	571	670	583.4	583.4	16.0	16.0	50.0	583.4	4,420
BOD	mg/L	<3	0	<3	<3	<3	<3	<3	<3	<3
TSS	mg/L	<2.5	0	<2.5	<1	<1	<1	<1	-	<1
pH		7.3	7.3	7.3	7.3	5.6	5.6	7.5	7.3	7.9
Calcium	mg/L	68	130	75.8	75.8	0.6	0.6	34.0	75.8	505
Sodium	mg/L	103	29	93.8	93.8	3.3	3.3	3.3	93.8	610
Chloride	mg/L	136	47	124.9	124.9	1.8	1.8	1.8	124.9	826



ALTERNATIVE 2 PRELIMINARY PROCESS FLOW DIAGRAM AND MASS BALANCE

FIGURE 13

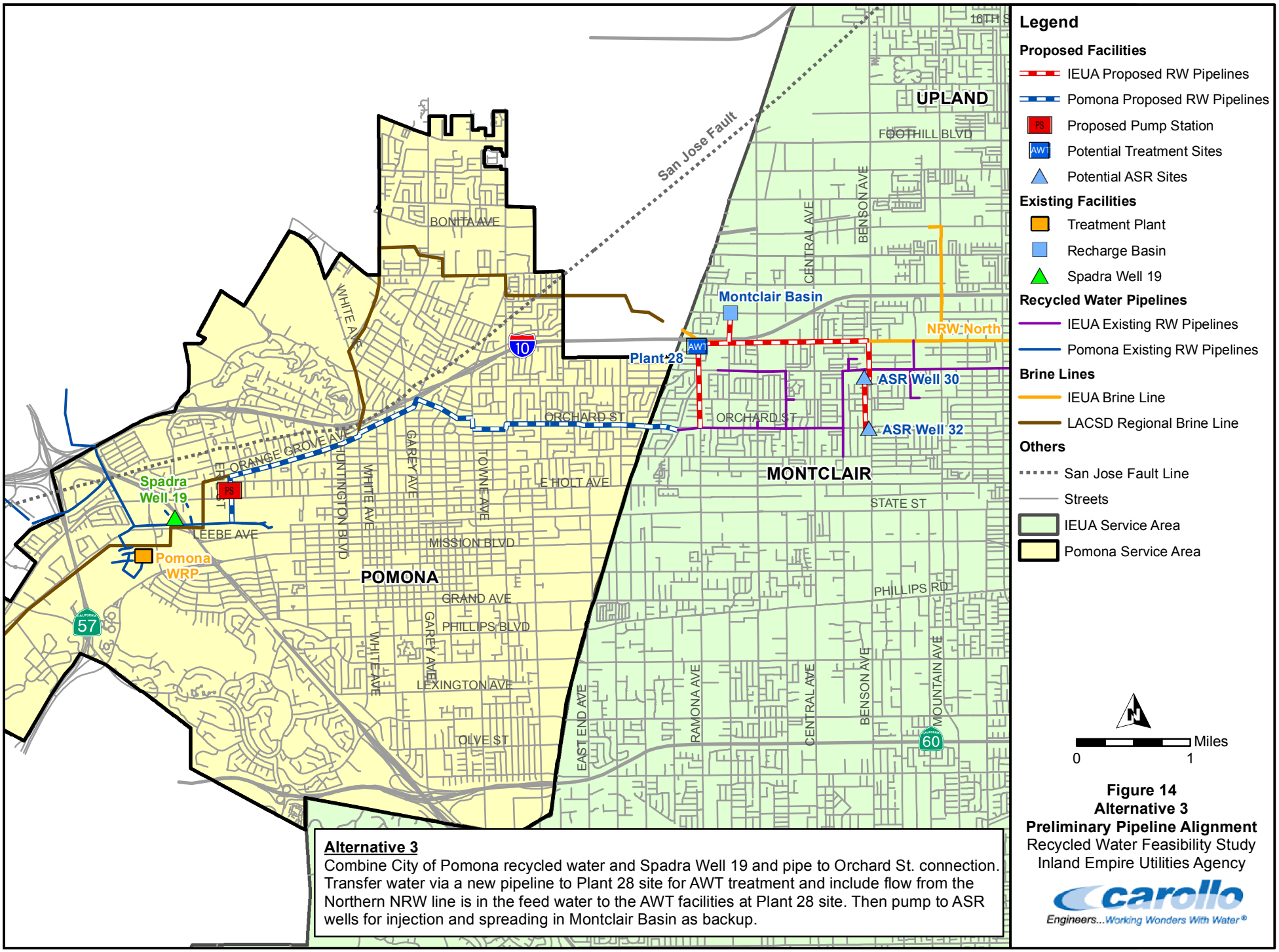
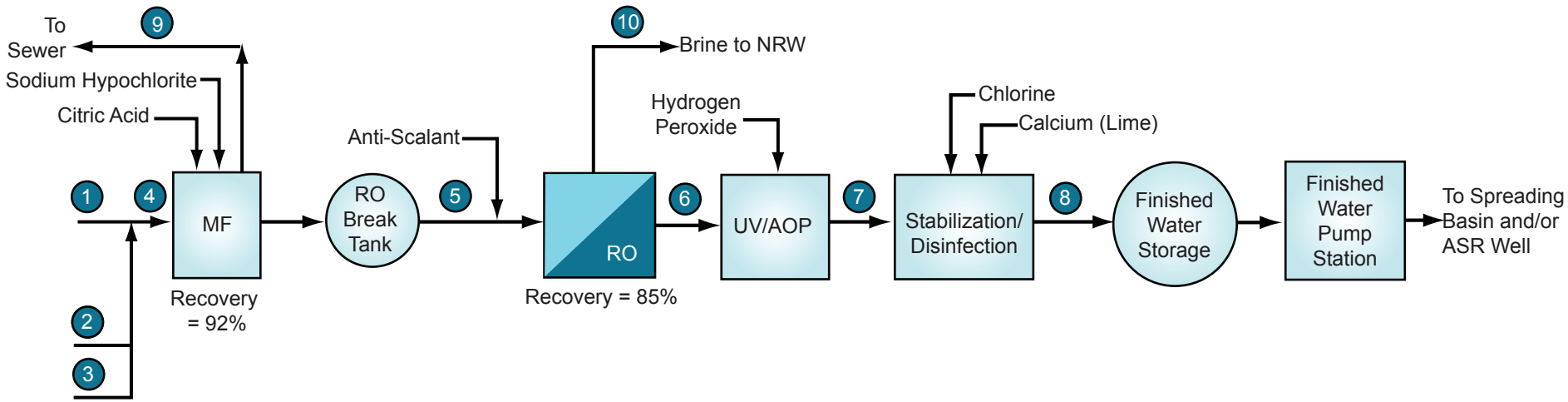


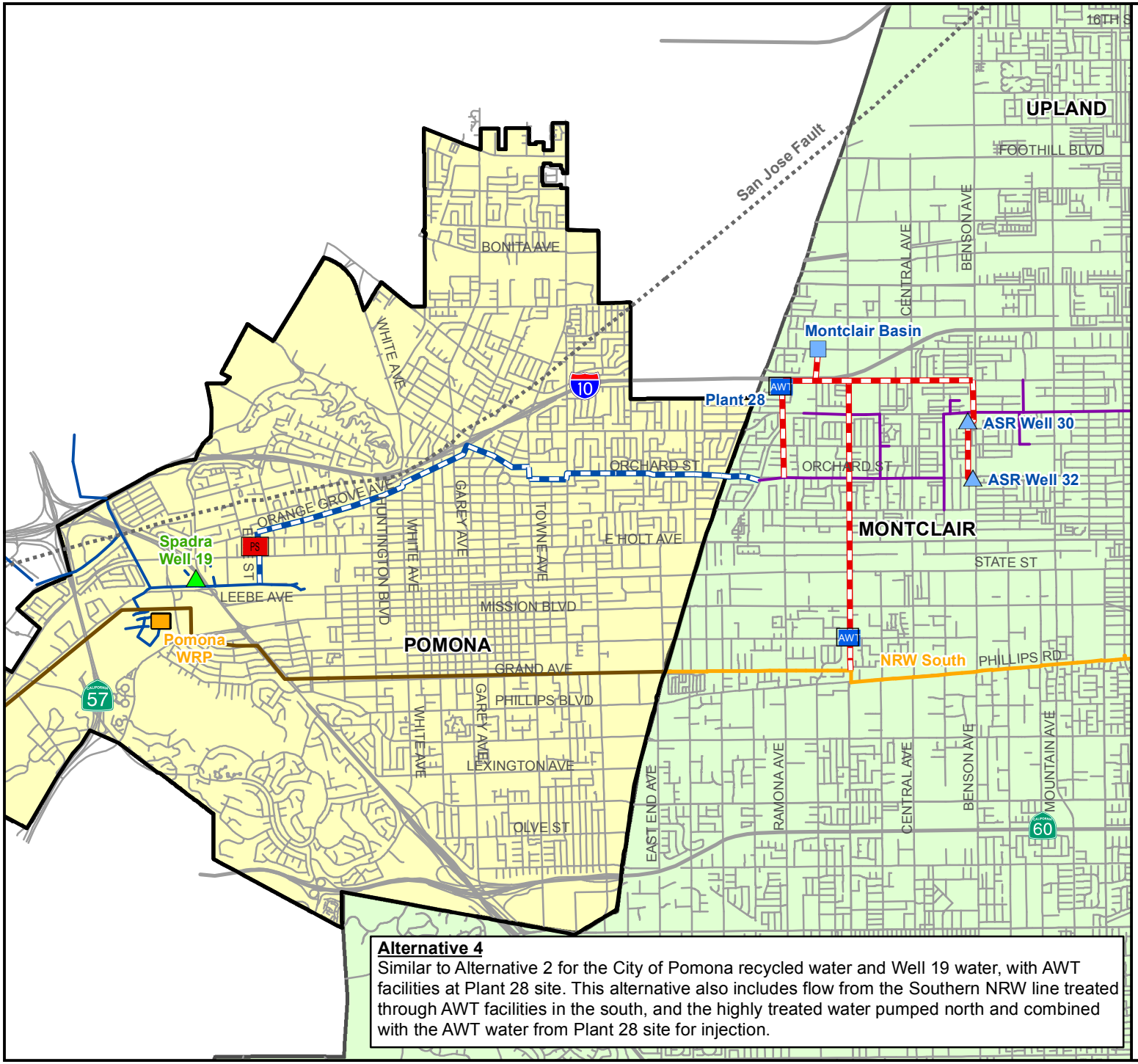
Figure 14
Alternative 3
Preliminary Pipeline Alignment
Recycled Water Feasibility Study
Inland Empire Utilities Agency

		1	2	3	4	5	6	7	8	9	10
		PRW	Well 19	NWR-N	Combined	MF Effluent	RO Permeate	UV Effluent	Finished Water	MF Backwash	RO Brine
Flow	mgd	3.9	0.5	0.006	4.4	4.4	3.7	3.7	3.7	0.1	0.7
TDS	mg/L	571	670	19,604	611.9	611.9	16.0	16.0	50.0	611.9	4,420
BOD	mg/L	<3	0	100	<3	<3	<3	<3	<3	<3	<3
TSS	mg/L	<2.5	0	103	<2.5	<1	<1	<1	<1	-	<1
pH		7.3	7.3	8.6	7.3	7.3	5.6	5.6	7.5	7.3	7.9
Calcium	mg/L	68	130	27	75.7	75.7	0.6	0.6	34.0	75.7	505
Sodium	mg/L	103	29	7,038	104.2	104.2	3.3	3.3	3.3	104.2	610
Chloride	mg/L	136	47	8,741	137.8	137.8	1.8	1.8	1.8	137.8	826



ALTERNATIVE 3 PRELIMINARY PROCESS FLOW DIAGRAM AND MASS BALANCE

FIGURE 15



Alternative 4
Similar to Alternative 2 for the City of Pomona recycled water and Well 19 water, with AWT facilities at Plant 28 site. This alternative also includes flow from the Southern NRW line treated through AWT facilities in the south, and the highly treated water pumped north and combined with the AWT water from Plant 28 site for injection.

Legend

Proposed Facilities
- IEUA Proposed RW Pipelines
- Pomona Proposed RW Pipelines
- Proposed Pump Station
- Potential Treatment Sites
- Potential ASR Sites

Existing Facilities
- Treatment Plant
- Recharge Basin
- Spadra Well 19

Recycled Water Pipelines
- IEUA Existing RW Pipelines
- Pomona Existing RW Pipelines

Brine Lines
- IEUA Brine Line
- LACSD Regional Brine Line

Others
- San Jose Fault Line
- Streets
- IEUA Service Area
- Pomona Service Area

N

0 1 Miles

Figure 16
Alternative 4
Preliminary Pipeline Alignment
Recycled Water Feasibility Study
Inland Empire Utilities Agency

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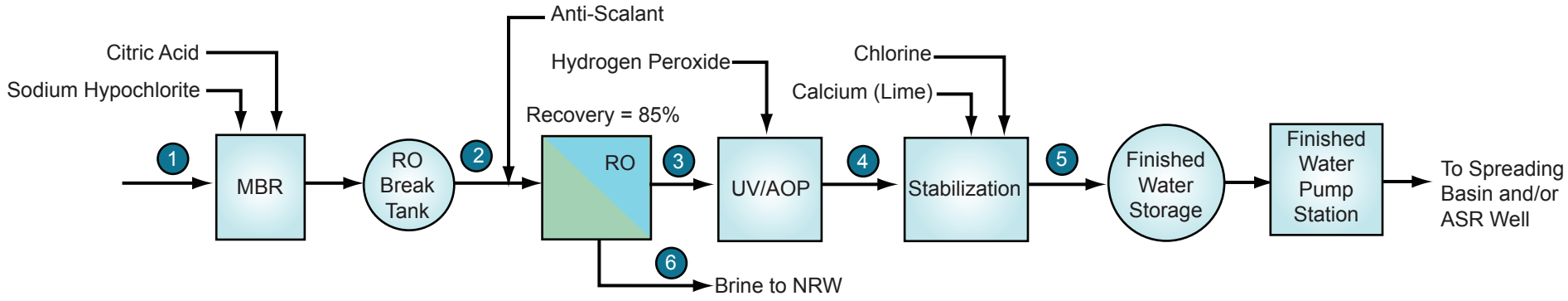
		1	2	3	4	5	6
		East End	MBR Effluent	RO Permeate	UV Effluent	Finished Water	RO Brine
Flow	mgd	3.8	3.8	3.2	3.2	3.2	0.6
TDS	mg/L	2735.0	2735.0	101.0	101.0	136.0	16,835
BOD	mg/L	400	<5	<1	<1	<1	<5
TSS	mg/L	384	<1	<1	<1	<1	<1
pH		7.1	7.1	5.1	5.1	7.5	6.9
Calcium	mg/L	225.0	225.0	2.3	2.3	37.3	1,500
Sodium	mg/L	481.0	481.0	23.0	23.0	23.0	3,100
Chloride	mg/L	753.0	753.0	27.0	27.0	27.0	4,895



ALTERNATIVE 4
PRELIMINARY PROCESS FLOW DIAGRAM AND MASS BALANCE

* Discharge and Facility Locations Vary for Alternatives 5 and 6.

FIGURE 17

5.3.5 Alternative 5

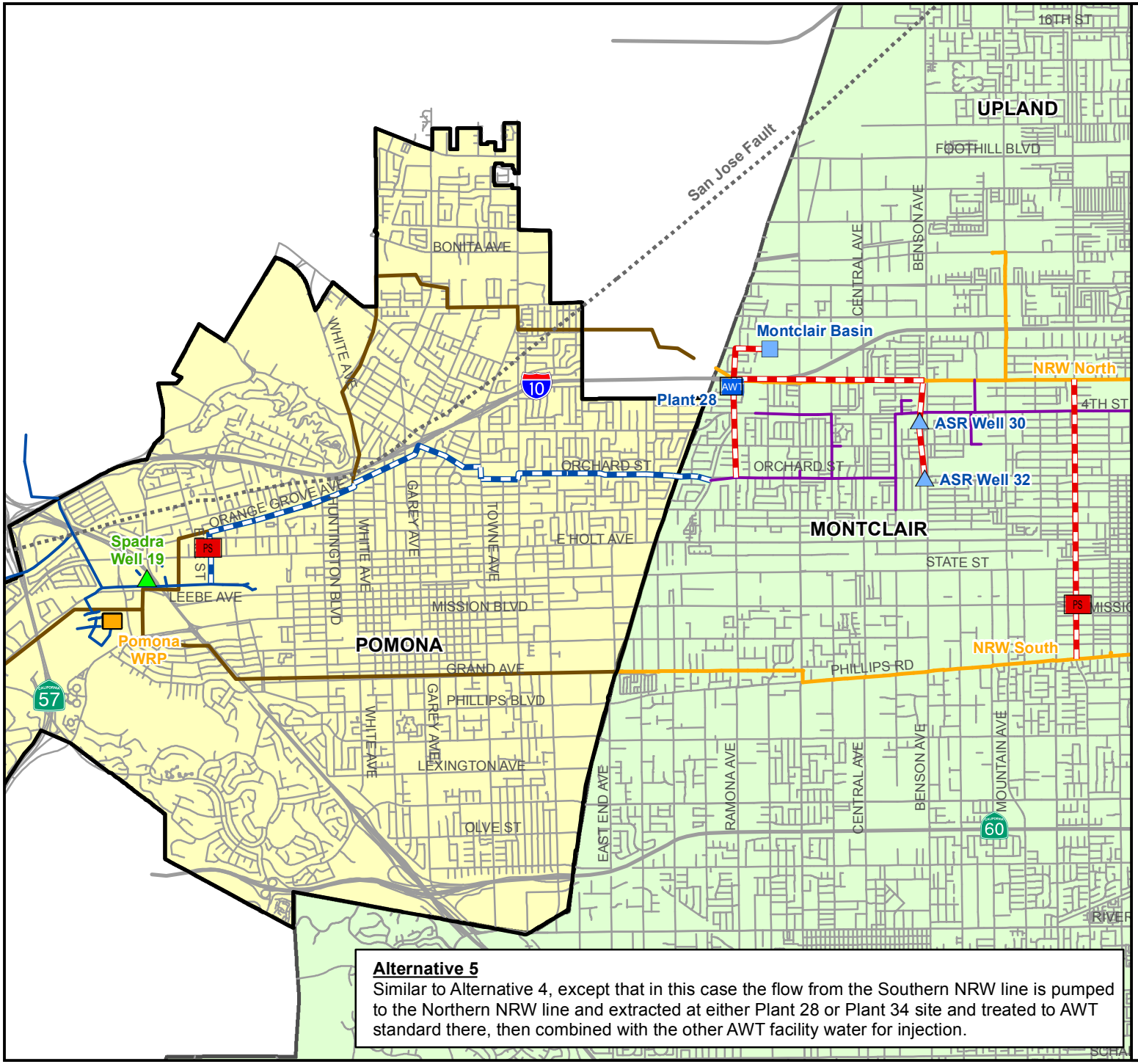
Alternative 5 is similar to Alternative 4. Alternative 5 includes Alternative 2b and treats water from the Southern NRW pipeline using a MBR/RO/UV-AOP treatment process. However, the untreated water from the Southern NRW pipeline is pumped to the Northern NRW pipeline. This flow would then be diverted to the Plant 28 site where the MF/RO/UV-AOP and the MBR/RO/UV-AOP plants would be co-located. A larger treatment facility at Plant 28 would be required to treat two separate processes due to difference in water quality. The combined streams would then be used for injection in the existing ASR wells and sent to Montclair for spreading. An overview of Alternative 5 is presented on Figure 18. The process flow diagram and mass balance is the same as Alternatives 2 and 4. It is assumed that all solids produced in the MBR could be discharged to IEUA's collection system for treatment at one of the regional water reclamation plants and that the concentrated brine produced in the RO processes would be discharged back into the Northern NRW pipeline.

5.3.6 Alternative 6

Alternative 6 includes Alternative 2b and a separate MBR/RO/UV-AOP treatment plant in the southern area, with flow taken from the Southern NRW pipeline (as in Alternative 4). The low TDS, high quality product water would injected in two or more new ASR wells in the south with back-up spreading in the Brooks Basin. An overview of Alternative 5 is presented on Figure 19. The process flow diagram and mass balance is the same as Alternatives 2 and 4. It is assumed that all solids produced in the MBR could be discharged to IEUA's collection system for treatment at one of the regional water reclamation plants and that the concentrated brine produced in the RO process could be discharged back into the Southern NRW pipeline.

5.4 Cost Estimates for Project Alternatives

The preliminary Class 5 planning level cost estimates prepared for each project alternative are listed in Table 5. Capital costs were rounded to the nearest $1000 for clarity, and $/AF costs were rounded to the nearest $10. A detailed breakdown of the planning level cost estimates along with the cost assumptions utilized to develop the estimates are located in Appendix B.



Alternative 5
Similar to Alternative 4, except that in this case the flow from the Southern NRW line is pumped to the Northern NRW line and extracted at either Plant 28 or Plant 34 site and treated to AWT standard there, then combined with the other AWT facility water for injection.

Figure 18
Alternative 5
Preliminary Pipeline Alignment
Recycled Water Feasibility Study
Inland Empire Utilities Agency

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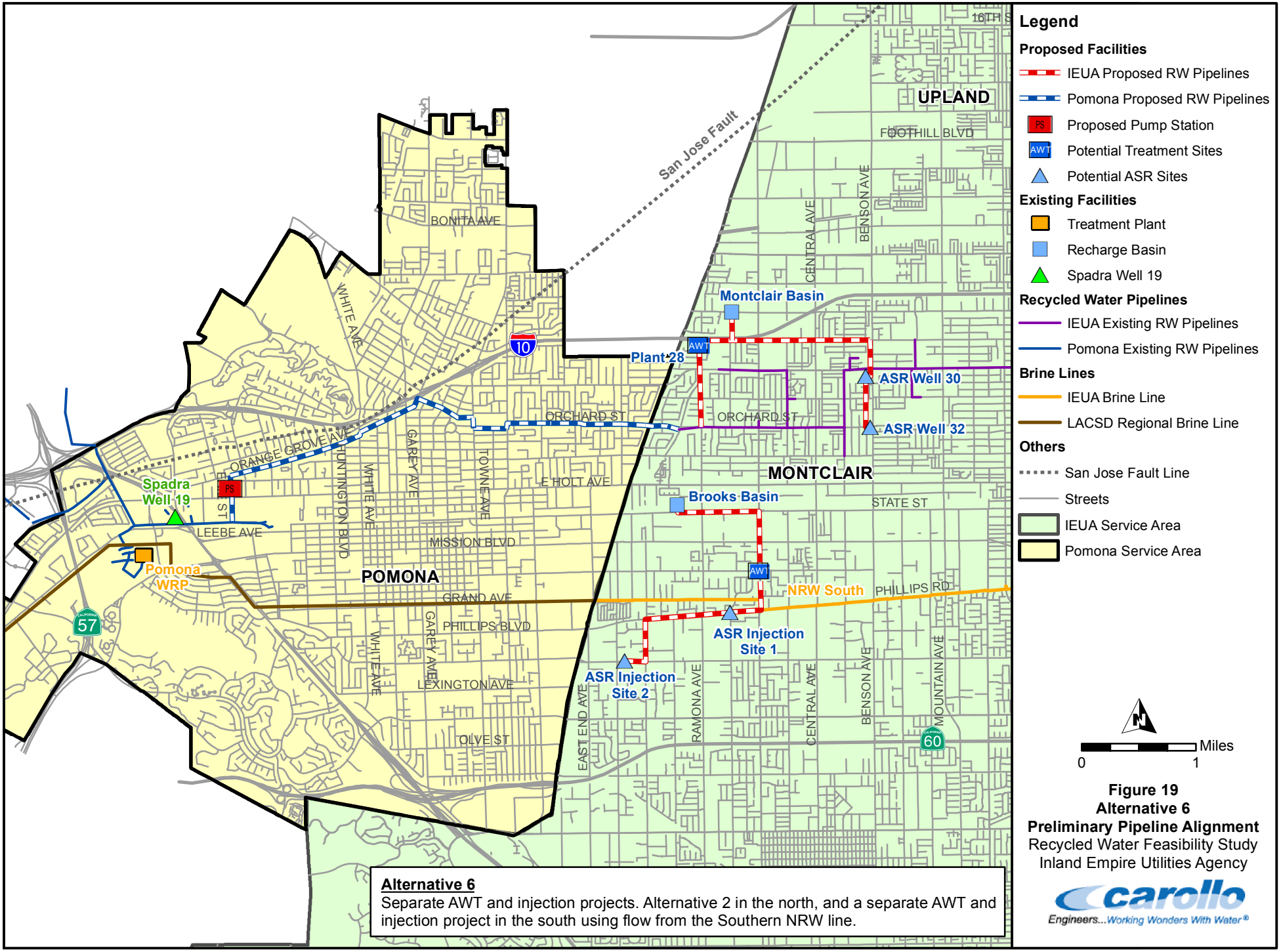
Legend
Proposed Facilities
IEUA Proposed RW Pipelines
Pomona Proposed RW Pipelines
Proposed Pump Station
Potential Treatment Sites
Potential ASR Sites
Existing Facilities
Treatment Plant
Recharge Basin
Spadra Well 19
Recycled Water Pipelines
IEUA Existing RW Pipelines
Pomona Existing RW Pipelines
Brine Lines
IEUA Brine Line
LACSD Regional Brine Line
Others
San Jose Fault Line
Streets
IEUA Service Area
Pomona Service Area
UPLAND
MONTCLAIR
POMONA
San Jose Fault
Montclair Basin
Plant 28
ASR Well 30
ASR Well 32
Brooks Basin
NRW South
ASR Injection Site 1
ASR Injection Site 2
Spadra Well 19
Pomona WRP
BONITA AVE
WHITE AVE
ORANGE GROVE AVE
HUNTINGTON BLVD
GAREY AVE
TOWNE AVE
ORCHARD ST
E HOLT AVE
LEEBE AVE
MISSION BLVD
GRAND AVE
PHILLIPS BLVD
LEXINGTON AVE
OLIVE ST
FOOTHILL BLVD
CENTRAL AVE
BENSON AVE
STATE ST
PHILLIPS RD
EAST END AVE
RAMONA AVE
MOUNTAIN AVE
16TH ST
10
57
60
AWT
PS
Miles
0
1
Figure 19
Alternative 6
Preliminary Pipeline Alignment
Recycled Water Feasibility Study
Inland Empire Utilities Agency
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Alternative 6
Separate AWT and injection projects. Alternative 2 in the north, and a separate AWT and injection project in the south using flow from the Southern NRW line.

Table 5	Preliminary Cost Estimates Recycled Water Feasibility Study IEUA			
Alternative	Beneficial Use Potential (AFY)(1)	Capital Cost(2,3)	Annual Operating Cost ($/year)(4,5,6)	Annual Cost(7) ($/AFY)
1	3,500	$25,351,000	$652,250	$510
2a	3,500	$64,498,000	$2,245,250	$1,460
2b	4,200	$71,349,000	$2,606,000	$1,380
3	4,200	$71,448,000	$2,567,250	$1,370
4	7,700	$166,730,000	$1,301,950	$1,140
5	7,700	$166,730,000	$1,303,950	$1,140
6	7,700	$168,743,000	$1,239,000	$1,140

Notes:
(1) Based on preliminary groundwater analysis, the maximum recharge potential at Montclair Basin is 3.1 mgd due to potable water wells within the vicinity. It is assumed that spreading may occur in Cells 1 and 3 to meet the 6 month travel time for recycled water spreading and a minimum of a 2 month travel time for advanced treated water. Adjacent basins and injection wells may be utilized to maximize recharge.
(2) Includes costs for pipelines as well as pressure-regulating stations and booster stations, as required.
(3) Capital Cost includes a construction cost contingency of 30 percent and additional markups for engineering, construction management, and administrative costs of 27.5 percent. Costs are escalated at 3% per year to mid-point of construction of April 2018.
(4) Assumes spreading basin O&M costs of $60/AF.
(5) Annual O&M costs include cost savings of reduced flows in the NRW pipeline for Alternatives 4 through 6.
(6) Estimated O&M for pipelines is 1 percent of the capital cost and 2 percent for pump stations (operating 8 hours a day with a cost of $0.15 per kW/hr).
(7) Annual cost assumes a useful life of 30 years, a loan period of 30 years and 1.5 percent annual interest rate. This does not include grant funding. $/AF values are rounded to nearest $10.
(8) Relocating 3 MVWD wells ($10M) to improve detention time has not been included in costs.

6.0 ANALYSIS OF ALTERNATIVES

The six project alternatives were analyzed to determine the most feasible near-term cost effective approach that would provide operational flexibility, maximize the local water supply source within the region, and improve land subsidence within the region. The analysis of the project alternatives is presented in Table 6 and the comments and recommendations are described in further detail below. The analysis was utilized to select the top ranked project alternative, which is described in Section 7.0 below.

6.1 Alternative 1 Analysis

Alternative 1 would be limited to surface spreading only with a six month travel time. The ability to spread at Montclair Basin would be weather dependent and would require diluent water for blending. Prior to implementing recycled water recharge at Montclair Basin, monitoring wells and lysimeters would be required.

Table 6

Project Alternative Analysis
Recycled Water Feasibility Study
IEUA

Alternatives Analysis Matrix

No.	Alternative Description	Recovery Rate	Implementation Schedule: Near-Term (2018)	Implementation Schedule: Mid-Term (2020)	Implementation Schedule: Long-Term (2025)	Regulatory Impacts	Meets Minimum Travel Time Requirements	Improves Land Subsidence	Total Points (♦)	Annual Cost ($/AFY)	Annual Cost w/Grant ($/AFY)
1	Pomona RW & Spadra Well 19 Treated to Title 22 for Spreading and/or Direct Use Customers	♦ ♦ ♦	♦ ♦ ♦			♦		♦ ♦	9	$510	$380
2a	Pomona RW & Spadra Well 19 with AWT for spreading	♦ ♦ ♦	♦ ♦ ♦			♦ ♦	♦	♦ ♦	11	$1,460	$1,240
2b	Pomona RW & Spadra Well 19 with AWT for injection and spreading	♦ ♦ ♦		♦ ♦		♦	♦ ♦	♦ ♦	10	$1,380	$1,190
3	Alternative 2 combined with NRW North with AWT for injection (or spreading)	♦ ♦ ♦		♦ ♦		♦	♦ ♦	♦ ♦	10	$1,370	$1,180
4	Alternative 2a & 2b combined with AWT from the NRW South for injection or spreading	♦ ♦			♦	♦	♦ ♦	♦ ♦ ♦	9	$1,140	$990
5	Pomona RW & Spadra Well 19 plus pumped brine from NRW South with AWT for injection or spreading	♦ ♦			♦	♦	♦ ♦	♦ ♦ ♦	9	$1,140	$990
6	Pomona RW & Spadra Well 19 with AWT for injection (or spreading) and NRW South AWT for injection or spreading	♦ ♦			♦	♦ ♦	♦ ♦ ♦		8	$1,140	$1,000

Notes:
(1) '♦' = good, '♦♦" = better, '♦♦♦' = best.

Preferred Alternative

Although this was a top ranked alternative based on the cost per acre-foot, it was decided to eliminate this alternative since surface spreading would be limited by weather conditions, the travel time requirement of six months, the need for diluent water blending, and operational flexibility would be limited. The issue with travel time to the existing MVWD drinking water wells could be mitigated by relocating those wells. About $10M would be needed for such a task. This cost was not included in the estimates shown in Table 5, but could be looked at further should Alternative 1 become the selected alternative for implementation.

6.2 Alternative 2a Analysis

Alternative 2a includes the use of advanced treated water for surface spreading at Montclair Basin. Based on current draft regulations, the travel time requirement would be reduced to two months and the ability to expand the system to include injection at ASR well locations would be possible (Alternative 2b).

Alternative 2a was the selected alternative since it provides operational flexibility, higher quality water for recharge, a decreased travel time requirement to two months, and the increased potential to expand the system in the future to include ASR or spreading at Upland or College Heights Basin.

6.3 Alternative 2b Analysis

Alternative 2b includes the use of advanced treated water for surface spreading at Montclair Basin or injection at MVWD's existing ASR well locations (Well 30 and Well 32). Based on current draft regulations, the travel time requirement would be reduced to two months and the ability to operate the system under various weather conditions would be possible.

Alternative 2b is a top ranked alternative since it provides operational flexibility, higher quality water for recharge, a decreased travel time requirement to two months, and includes existing ASR wells, which would increase the ability to recharge. This alternative was eliminated as the recommended project at this time because it would require additional infrastructure to convey water to the ASR well locations. Additional inter-agency agreements and regulatory review would also be required to utilize the injection well sites.

6.4 Alternative 3 Analysis

Alternative 3 includes the use of advanced treated water for surface spreading at Montclair Basin or injection at MVWD's existing ASR well locations. Based on current draft regulations, the travel time requirement would be reduced to two months and the ability to operate the system under various weather conditions would be possible. However, the flow variation of the Northern NRW line is not desirable for operation of the treatment plant and therefore adds unnecessary operational complexity.

It was decided to eliminate this alternative due to the fact that it does not add any significant flow and may complicate the treatment process due to the quality of water in the Northern NRW line.

6.5 Alternative 4 Analysis

Alternative 4 was considered a top ranked alternative and includes the use of advanced treated water for surface spreading at Montclair Basin or injection at MVWD's existing ASR well locations. The travel time requirement would be reduced to two months and the ability to operate the system under various weather conditions would be possible. IEUA's operational costs would also be offset drastically since discharging to the regional brine pipeline would be minimized.

It was decided to eliminate this alternative for this phase of the project due to the need to obtain right-of-way for the 3.8 mgd treatment plant, which may create project delays. This alternative will be considered at a later date.

6.6 Alternative 5 Analysis

Alternative 5 was considered a top ranked alternative and includes the use of advanced treated water for surface spreading at Montclair Basin or injection at MVWD's existing ASR well locations. Based on current draft regulations, the travel time requirement would be reduced to two months and the ability to operate the system under various weather conditions would be possible. IEUA's operational costs would also be offset drastically since discharging to the regional brine pipeline would be minimized.

It was decided to eliminate this alternative for this phase of the project since the Plant 28 site may not be able to accommodate two treatment facilities. The initial assessment concluded that up to a 5 mgd of treatment capacity could be constructed at the Plant 28 site. In addition, pumping brine to the northern NRW pipeline would have increased operational costs compared with Alternative 4 which would only pump the treated water.

6.7 Alternative 6 Analysis

Alternative 6 includes the use of advanced treated water for surface spreading at Montclair Basin or injection at MVWD's existing ASR well locations. Based on current draft regulations, the travel time requirement would be reduced to two months and the ability to operate the system under various weather conditions would be possible. IEUA's operational costs would also be offset drastically since discharging to the regional brine pipeline would be minimized. However, a site would be needed for the southern advanced treatment plant. In addition, Brooks Basin does not assist in improving the land subsidence issues and is currently over allocated.

It was decided to eliminate this alternative for this phase of the project due to the need to obtain right-of-way for the 3.8 mgd treatment plant and the proposed southern ASR wells,

which may create project delays. In addition, Brooks Basin is over allocated and recharging would not improve land subsidence within the area.

6.8 No Project Alternative

If one of the project alternatives was not selected for implementation, the City, MVWD, and IEUA would maintain the status quo. Under these conditions, there are three concerns for IEUA and the partner agencies that would remain:

- The City would continue to discharge excess recycled water to the local storm channel. In recent years, recycled water usage in the City has decreased due to one of its large recycled water users, SMURFIT a paper manufacturer, going out of business. This has reduced the recycled water demand to the point where excess recycled water is being discharged to the local stormwater channel and is lost from the region.

- Land along the western boundary of IEUA's service area would continue to subside due to over pumping of groundwater in the area. This is a major concern for the City and MVWD and is one of the major driving factors for finding an economically viable project that will allow groundwater levels to be restored and prevent further ground subsidence.

- The City of Pomona's Well 19 would remain out of service. The City of Pomona owns Well 19 located in the Spadra Basin within the City. This well has good quality, TDS (670 mg/L) water, and a yield of around 1-mgd, but there is nowhere for the water to be used within the City, given the decrease in recycled water demand mentioned above. If this well continues to remain off, it may be necessary to look to other potentially more costly local water sources, such as the higher TDS water in the Southern NRW system, and or bringing in more expensive imported water to recharge the region's existing spreading basins.

6.9 Economic Analysis

The current Tier 2 cost for treated imported water from MWD is approximately $1,055/AF. It is anticipated that the rate will continue to increase to $1,133 by the year 2018 and to $1,199 by the year 2020, based on figures from MWD's Biennial budget report posted in 2015. There are also other sources of water available that are less costly and can be utilized for applications such as diluent water blending. For example, untreated Tier 1 and 2 water from MWD, is approximately $582/AF and $714/AF, respectively. However, due to the current drought and the uncertainty of imported water supplies, the availability of such water is questionable. Therefore, maximizing the use of local water supplies to reduce the dependence on imported water is critical to sustain the local water resources.

The availability of grant funding would have a positive impact on the economics. By obtaining grant funding for the selected alternative, the annual costs presented in Table 5

would be reduced by about $200/AF depending on the alternative, making several of the projects potentially more cost effective than purchasing treated imported water from MWD. It should also be noted that the annual costs presented in Table 5 are based on the assumption that a long term (30-year) low interest rate (1.5%) loan can be secured. The project costs would be negatively impacted if such a loan was not available.

6.10 Regulatory Review

The State Water Resources Control Board (SWRCB), Division of Drinking Water (DDW), and the Regional Water Quality Control Board (RWQCB) have regulatory authority over projects using recycled water. There are three types of recycled water projects under consideration in this Study, which include recycled water spreading at recharge basins, advanced treated water for spreading at basins, and direct injection at ASR well sites for groundwater replenishment.

At this time, IEUA is operating their groundwater recharge program under Order No. R8-2009-0057, issued on October 30, 2009. This Order authorizes use of recycled water generated from IEUA's Regional Recycling Plants No. 1 and No. 4, for groundwater recharge via spreading in seven Phase I and six Phase II recharge basins. The recharge basins discussed in this report (Brooks, Montclair, Upland and College Heights) are all part of the Phase II project. The existing Order allows for spreading with the required addition of diluent water of non-wastewater origin to meet the 120-month Recycled Water Contribution (RWC) requirements.

The regulations related to recycled water were updated by the DDW and became effective on June 18, 2014. For surface spreading, among other things, the new requirements include the need to achieve at least 12-log enteric virus reduction, 10-log *Giardia* cyst reductions, and 10-log *Cryptosporidium oocyst* reduction. For injection, the new requirements also include RO treatment, advanced oxidation and the 12-10-10 requirements for pathogen control listed above. Based on the alternatives developed in this study, it is anticipated that the following permit needs/modifications would be required in order to implement the top-ranked projects:

1. New Title 22 Engineering Report - the alternatives include bringing in water that is not sourced from RP-1 or RP-4. This is not covered by the existing Order and therefore it is likely that DDW will require a new Title 22 Engineering Report to be prepared. In addition, the new requirements of the June 2014 regulations would likely also need to be addressed in such a report for the selected project.

2. Groundwater modeling - depending on the availability of existing model outputs, additional groundwater modeling may be needed to confirm the groundwater retention time, for both Title 22 disinfected tertiary treated effluent (Alternative 1) and AWT treated effluent (Alternatives 2, 3, 4, 5, and 6). In addition, for those alternatives that incorporate groundwater injection, additional modeling is likely to be required to

determine the minimum retention time to the closest drinking water well, and specifically if ASR wells are to be used as both recharge and recovery wells, it is anticipated that the 2-month minimum retention, to meet the stipulated minimum response time, would need to be demonstrated. To our knowledge, DDW has not yet permitted an ASR-type well for groundwater injection so it is not clear how DDW would respond to such a request. However, if the minimum 2-month detention time can be demonstrated, presumably through modeling and tracer studies, and the water quality meets all the required criteria, it seems reasonable that permitting an ASR well to retain its injection/extraction function could be possible.

If use of ASR wells for injection/extraction are not approved by DDW, then separate injection wells would need to be provided at an estimated cost of $2.5M each. This would allow for more strategic location of such wells to address land subsidence issues.

3. Monitoring wells - it is possible that additional monitoring wells would need to be constructed and used to confirm the findings of the groundwater modeling work by conducting tracer studies.

4. Impact of NRW Water Sources - the existing Order recognizes the NRW line as a disposal point for industrial wastewater and brines. Using this water as a source for preparing groundwater recharge water is likely to require discussion and approval by DDW, and inclusion in the Engineering Report.

5. Monitoring Program - it is possible that DDW may require the current monitoring program that is in place for the recharge basins to be updated or modified to suit the selected project requirements.

7.0 RECOMMENDED PROJECTS AND PHASING

Although, Alternative 2a has a higher annual cost per acre-foot than other alternatives listed, it was selected for Phase 1 of the project for the following reasons.

1. Based on the timeline to implement the project within the near-term planning period,

2. The ability to create operational flexibility by eliminating the need for diluent water blending and reducing travel time requirements,

3. The utilization of existing land for the advanced water treatment plant, and

4. It creates future opportunities to expand the system to extend to MVWD's existing ASR wells and the Upland and College Heights Basins.

As shown in Table 6, the top ranked alternatives that could be considered for future phases include Alternative 2b and Alternative 4. With the anticipated future phases of the project, the annual cost per-acre foot would decrease from $1,400 to $1,100, which does not

include potential grant funding opportunities. Grant funding could reduce the overall cost by $200/AF or more for Alternative 2a.

Since all infrastructure required for Alternative 2a would be needed for Alternative 2b, the recommended project is a natural first phase prior to the implementation of ASR injection wells in a second phase, which would then reduce the overall $/AF cost of the recharge water. In the future, the implementation of Alternative 4 would increase the future supply to the region by approximately 3.2 mgd. This would assist in offsetting the supply changes since the City estimates to connect approximately 1.5 mgd of recycled water customers in the future, which would reduce the available flow into IEUA's service area.

A preliminary schedule for Alternative 2a is presented in Figure 20. The schedule shows a preliminary Implementation Plan for the project. It assumes that Notice of Award would be received around approximately January, 2016 and shows that the project can be complete and operational by the end of 2018.

Coordination with IEUA, MVWD, and the City would take place first, prior to initiating design work and would include agreements between the three agencies for supply, transfer, treatment, and use of the recycled water. The water rights impacts between the partnering agencies (City of Pomona and MVWD) would also be addressed at this time.

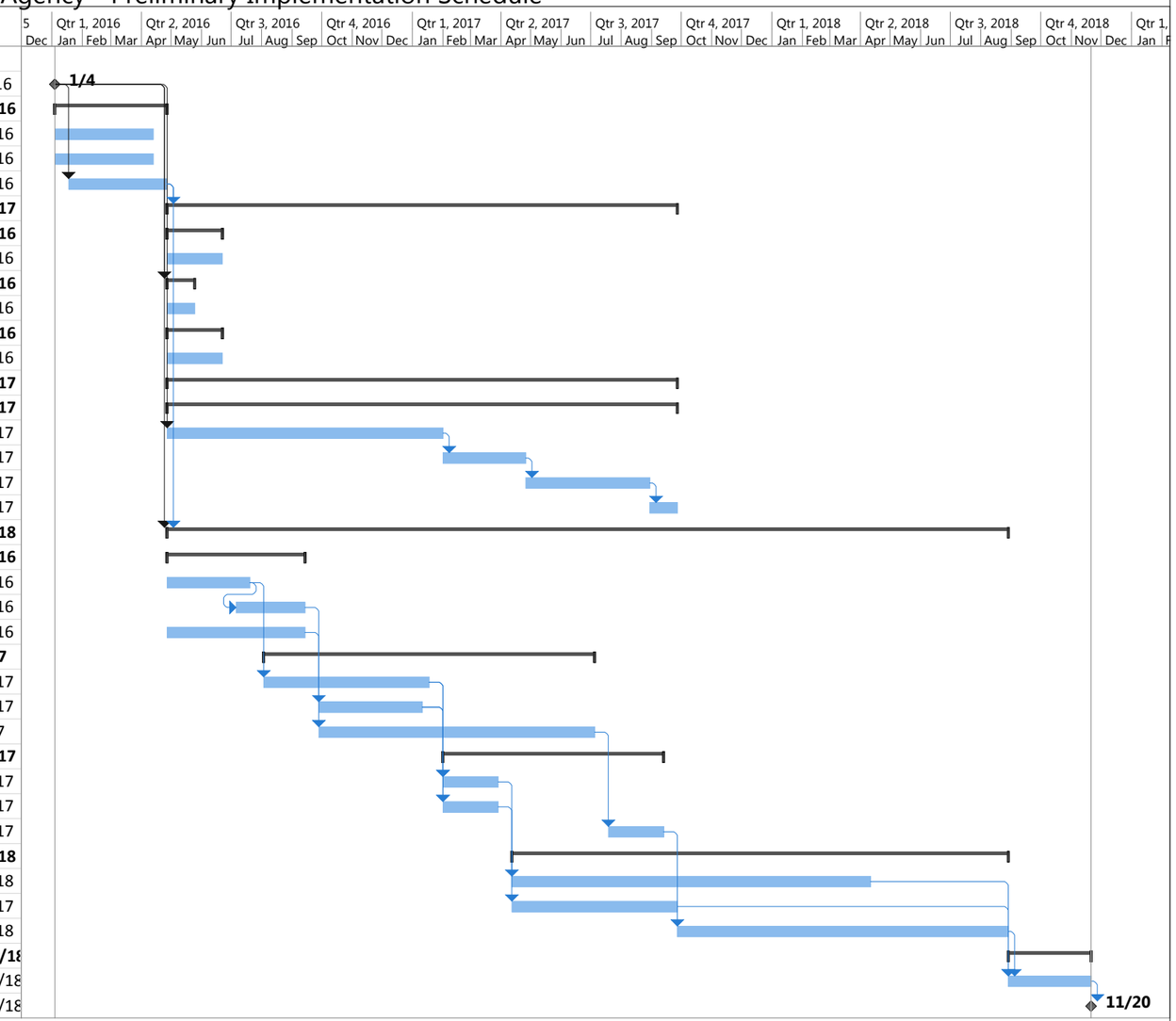
The implementation schedule shows about 15-months for obtaining a new permit from the RWQCB for operation of the spreading basins with advanced treated water. Based on IEUA's previous experience with obtaining permits for the existing spreading basin operations, this should be adequate time. Commitments from potential users are not applicable in this case because all of the recycled water will be spread into existing basins owned and operated by IEUA.

The most significant permit required will be that obtained from the RWQCB (incorporating the requirements of DDW) for the actual spreading operation. Right-of-way permits will be provided by the City of Pomona for the pipeline infrastructure to be located within the City. The AWT treatment plant will be constructed on a piece of property owned by the MVWD. IEUA will work in collaboration with MVWD to obtain the necessary permits for construction of the plant at their site. IEUA will obtain the right-of-way permits for the new pipelines and pump stations that will be constructed within their jurisdiction. Time has been allowed in the preliminary schedule for these activities.

Inland Empire Utilities Agency - Preliminary Implementation Schedule

Preliminary Schedule - 11/05/15

ID	Task Mode	Task Name	Duration	Start	Finish
1					
2		Notice to Proceed	0 days	Mon 1/4/16	Mon 1/4/16
3		**Coordination**	**82 days**	**Mon 1/4/16**	**Tue 4/26/16**
4		Coordinate with City of Pomona	72 days	Mon 1/4/16	Tue 4/12/16
5		Coordinate with Monte Vista Water District	72 days	Mon 1/4/16	Tue 4/12/16
6		Develop Agreements with Partners	72 days	Mon 1/18/16	Tue 4/26/16
7		**Permitting**	**370 days**	**Wed 4/27/16**	**Tue 9/26/17**
8		**City of Pomona**	**40 days**	**Wed 4/27/16**	**Tue 6/21/16**
9		Right of Ways for Pipeline	40 days	Wed 4/27/16	Tue 6/21/16
10		**Monte Vista Water District**	**20 days**	**Wed 4/27/16**	**Tue 5/24/16**
11		Land for AWT Plant Construction	20 days	Wed 4/27/16	Tue 5/24/16
12		**IEUA**	**40 days**	**Wed 4/27/16**	**Tue 6/21/16**
13		Rights of Way for Pipelines	40 days	Wed 4/27/16	Tue 6/21/16
14		**Regional Water Quality Contorl Board**	**370 days**	**Wed 4/27/16**	**Tue 9/26/17**
15		**Permit for Spreading AWT Water**	**370 days**	**Wed 4/27/16**	**Tue 9/26/17**
16		Develop Engineers Report	200 days	Wed 4/27/16	Tue 1/31/17
17		Review by RWQCB	60 days	Wed 2/1/17	Tue 4/25/17
18		Finalalize Engineers Report	90 days	Wed 4/26/17	Tue 8/29/17
19		Approval by RWQCB	20 days	Wed 8/30/17	Tue 9/26/17
20		**Design and Construction**	**610 days**	**Wed 4/27/16**	**Tue 8/28/18**
21		**Preliminary Design**	**100 days**	**Wed 4/27/16**	**Tue 9/13/16**
22		Pipelines	60 days	Wed 4/27/16	Tue 7/19/16
23		Pump Stations	50 days	Wed 7/6/16	Tue 9/13/16
24		Treatment Facility	100 days	Wed 4/27/16	Tue 9/13/16
25		**Final Design**	**240 days**	**Wed 8/3/16**	**Tue 7/4/17**
26		Pipelines	120 days	Wed 8/3/16	Tue 1/17/17
27		Pump Stations	75 days	Wed 9/28/16	Tue 1/10/17
28		Treatment Facility	200 days	Wed 9/28/16	Tue 7/4/17
29		**Bidding and Award**	**160 days**	**Wed 2/1/17**	**Tue 9/12/17**
30		Pipelines	40 days	Wed 2/1/17	Tue 3/28/17
31		Pump Stations	40 days	Wed 2/1/17	Tue 3/28/17
32		Treatment Facility	40 days	Wed 7/19/17	Tue 9/12/17
33		**Construction**	**360 days**	**Wed 4/12/17**	**Tue 8/28/18**
34		Pipelines	260 days	Wed 4/12/17	Tue 4/10/18
35		Pump Stations	120 days	Wed 4/12/17	Tue 9/26/17
36		Treatment Facility	240 days	Wed 9/27/17	Tue 8/28/18
37		**Start-up and Operation**	**60 days**	**Wed 8/29/18**	**Tue 11/20/18**
38		Initial Start-up and Shake Down Period	60 days	Wed 8/29/18	Tue 11/20/18
39		Begin Long Term Operation and Recharge	0 days	Tue 11/20/18	Tue 11/20/18



Project: IEUA-Grant Application

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

PRELIMINARY IMPLEMENTATION SCHEDULE

FIGURE 20

RECYCLED WATER FEASIBILITY STUDY
INLAND EMPIRE UTILITIES AGENCY

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An overview of the proposed design and construction activities are shown in the preliminary implementation plan. It is proposed that three design packages will be prepared, one for pipelines, one for pump stations, and one for the advanced treatment plant facility. The design work for these facilities will be carried out in parallel to save time. It is expected that the pipeline and pump station design packages will be completed first and will be bid first. This will allow more time for construction of the pipelines to and from the treatment plant site.

Construction on the pipelines is expected to commence in the spring of 2017, and construction of the plant would begin in the fall of the same year. All facilities should be constructed and ready for operation towards the end of summer 2018. This will provide time for extended commissioning of the system to address any operational issues that might arise. The entire system should be ready for long-term operation and the additional recharge activity during the fourth quarter of 2018.

8.0 DEVELOPMENT OF PRELIMINARY TERM SHEET

Based on the selected Alternative 2a, a very high level preliminary assessment was made for the involvement, contributions, and benefits for each participating agency. After subsequent consideration, it was concluded that additional analysis should be undertaken to further evaluate the financial impacts for each participating member if the project alternative was implemented.

APPENDIX A - GROUNDWATER IMPACT ANALYSIS

Technical Memorandum

To: Ms. Amy Martin
Carollo Engineers

From: Thomas Harder, P.G., C.HG.
Thomas Harder & Co.

Date: 15-Jan-16

Re: IEUA Recycled Water Feasibility Study

This Technical Memorandum (TM) presents an analysis of groundwater recharge using recycled water as part of the Inland Empire Utilities Agency's (IEUA's) Feasibility Study of Recycled Water Interconnections. The analysis is based on Carollo Engineers' (Carollo's) Recycled Water and Brine System Alternative No. 1, which involves conveying 4.4 million gallons per day (mgd) of recycled water from the City of Pomona to the Montclair Basins in Montclair, California for spreading and recharge (see Figure 1). The alternative has multiple potential benefits, including raising groundwater levels and mitigation of land surface subsidence.

Purpose and Scope

The purpose of this analysis was to evaluate potential changes in groundwater levels and flow associated with recharging recycled water in the Montclair Basins in accordance with Carollo's Recycled Water and Brine System Alternative No. 1. Specifically, the analysis addressed:

1. Potential changes in groundwater flow direction and gradient in the vicinity of the Montclair Basins,
2. Potential changes in groundwater flow direction and gradient in the vicinity of existing groundwater contaminant plumes downgradient of the Montclair Basins,
3. Potential changes in groundwater levels in the vicinity of the area of known land surface subsidence to the southwest of the Montclair Basins,
4. Potential recycled water travel time between the Montclair Basins and the nearest municipal supply wells.

The scope of work to address the objectives included:

- Compiling and reviewing hydrogeological data for the area.
- Coordinating with Carollo regarding the recharge alternative.
- Conducting a groundwater level impact and travel time analysis using analytical methods.
- Preparation of this TM.

Analysis Methodology

Potential groundwater mounding and travel time estimates associated with recharge of recycled water in the Montclair Basins were evaluated using a two-dimensional analytical flow model (see Figure 2 for model area). The analysis was conducted for steady state conditions using the model code WinFlow[1]. All travel time analyses were conducted using the particle tracking feature which allows for the estimation of groundwater travel time between two points from advective groundwater flow. The analysis incorporated the following assumptions:

- Recycled water was applied to Montclair Basins 1 and 2 at a rate of 4.4 mgd.
- The initial groundwater levels were conditioned to Spring 2014 groundwater levels published by Wildermuth Environmental (WEI)[2] (see Figure 3).
- The hydraulic conductivity of the aquifer beneath the basins is 15 ft/day.
- The porosity of the aquifer sediments is 0.33.
- The sediments in the vadose zone and aquifer are homogeneous.

In order to match the Spring 2014 groundwater level contour map, groundwater production from area wells was incorporated into the model, each pumping at rates published by WEI[2].

Sources of Data

The types of data used to develop the model included groundwater contour maps, aquifer properties, well locations, land subsidence contours, contaminant plumes, and groundwater recharge and pumping. Data for the model analysis were obtained from the following:

- WEI; Chino Basin Optimum Basin Management Program - 2014 State of the Basin Report. Prepared for Chino Basin Watermaster, June 2015;
- WEI; 2014 Annual Report of the Ground-Level Monitoring Committee (Draft Final). Prepared for Chino Basin Watermaster, June 2015;

[1] WinFlow Version 3, Environmental Simulations Inc., 2003.
[2] WEI, 2015. Chino Basin Optimum Basin Management Program - 2014 State of the Basin Report. Prepared for Chino Basin Watermaster, June 2015.

- Chino Basin Watermaster; Geographic Information System (GIS) shapefiles of groundwater contours, contaminant plumes, and well locations;
- Carollo; information for Recycled Water and Brine System Alternative No. 1.

Findings

Analysis of the recharge of 4.4 mgd of recycled water in Montclair Basins 1 and 2 showed minor changes in groundwater flow direction in the vicinity of the basins. Pre-recharge groundwater levels based on the WEI Spring 2014 groundwater contour map show a depression in the Montclair Basin area with groundwater flowing towards the basins from the west, north, and east (see Figure 3). Although groundwater levels were simulated to rise as much as 50 ft beneath the basins as a result of Project recharge, the depression in the area that governs pre-recharge groundwater flow directions is predicted to remain (see Figure 4). Groundwater flow in the vicinity of the volatile organic compound (VOC) plume south of the Montclair Basins is not predicted to change (see Figures 3 and 4).

Predicted groundwater level change resulting from the project is shown on Figure 5. As shown, maximum groundwater level rise is predicted to be greater than 50 ft directly beneath Montclair Basin No. 2. This groundwater level change will help mitigate land surface subsidence beneath and to the southwest of the Montclair Basins (see Figure 4).

The particle tracking analysis shows that recycled water may reach the nearby production well MVWD 26 within 2 months of reaching the groundwater surface (see Figure 6). Travel times to all other production wells exceed two years.

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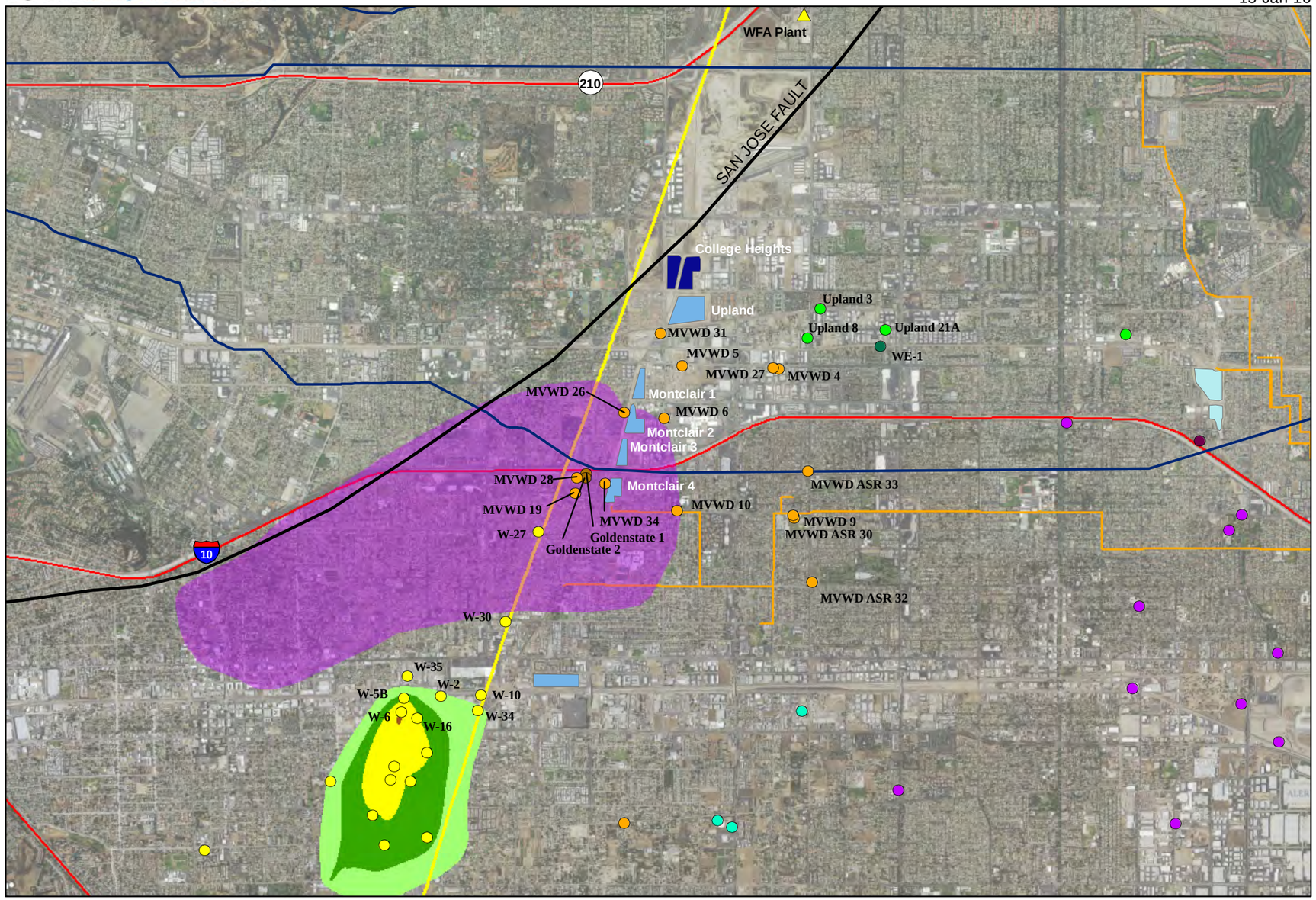
15-Jan-16

IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

0 0.5 1 2 Miles

NAD 83 UTM Zone 11
Central Meridian: -118

Map Features

- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Treatment Plant
- Area of Subsidence from Mar 2011 to Dec 2014 (-0.06 ft to -0.18 ft of relative change)

2014 TCE Plume Concentration (µg/L)

- 0 to 5
- 5 to 10
- 10 to 20
- 20 to 50

Recharge Basin Infiltration Rate (ft/day)

- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- > 3.0

- San Jose Fault
- Imported Water Pipeline
- IEUA Pipeline
- IEUA Service Area
- Freeway

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Groundwater Consulting

Project Area

Figure 1

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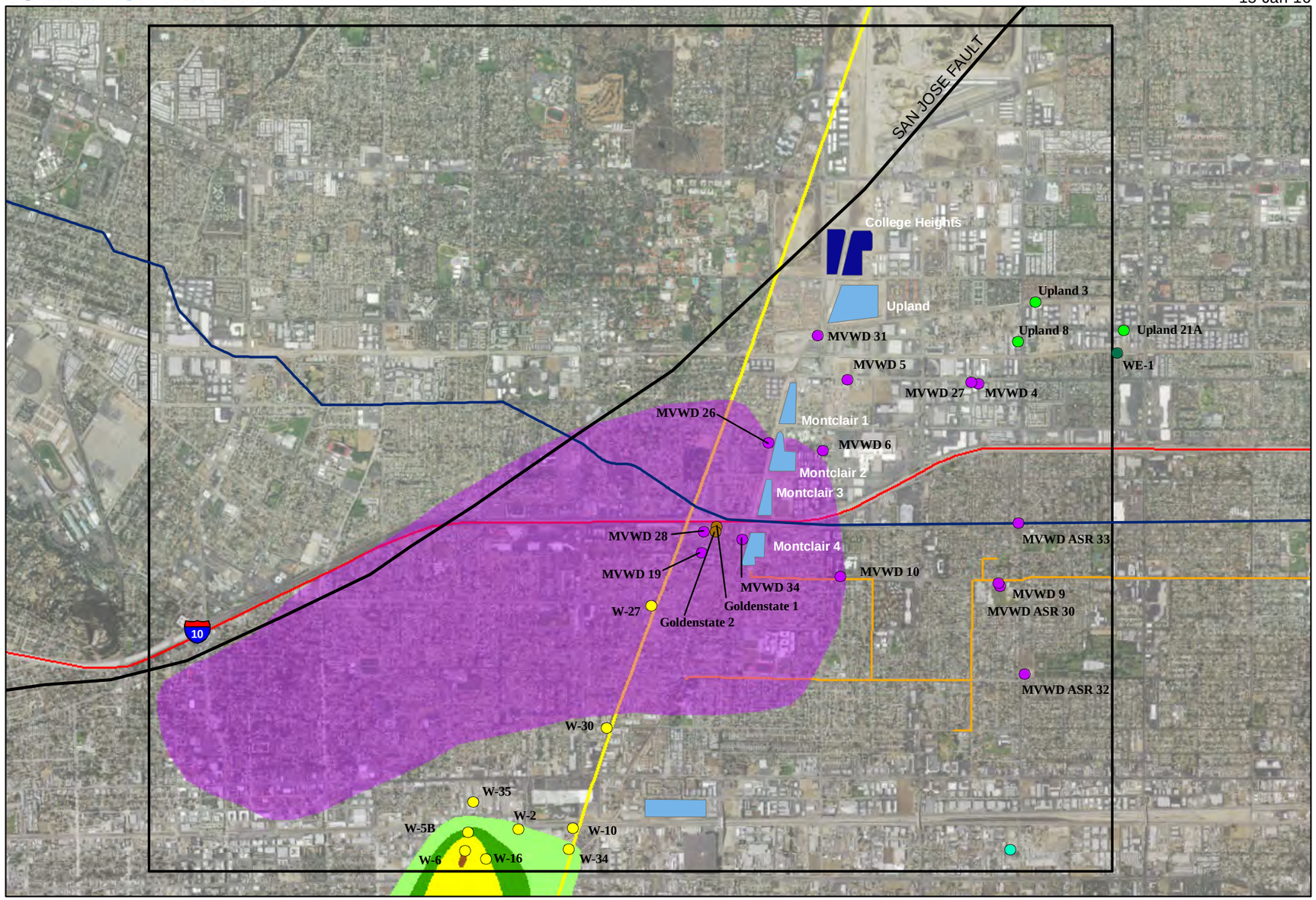
IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

0 0.25 0.5 1 Miles

NAD 83 UTM Zone 11
Central Meridian: -118

Map Features

- Model Domain
- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Treatment Plant
- Area of Subsidence from Mar 2011 to Dec 2014 (-0.06 ft to -0.18 ft of relative change)

2014 TCE Plume Concentration (µg/L)

- 0 to 5
- 5 to 10
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- 20 to 50

Recharge Basin Infiltration Rate (ft/day)

- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- > 3.0

- San Jose Fault
- Imported Water Pipeline
- IEUA Pipeline
- IEUA Service Area
- Freeway

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Project Area

Figure 2

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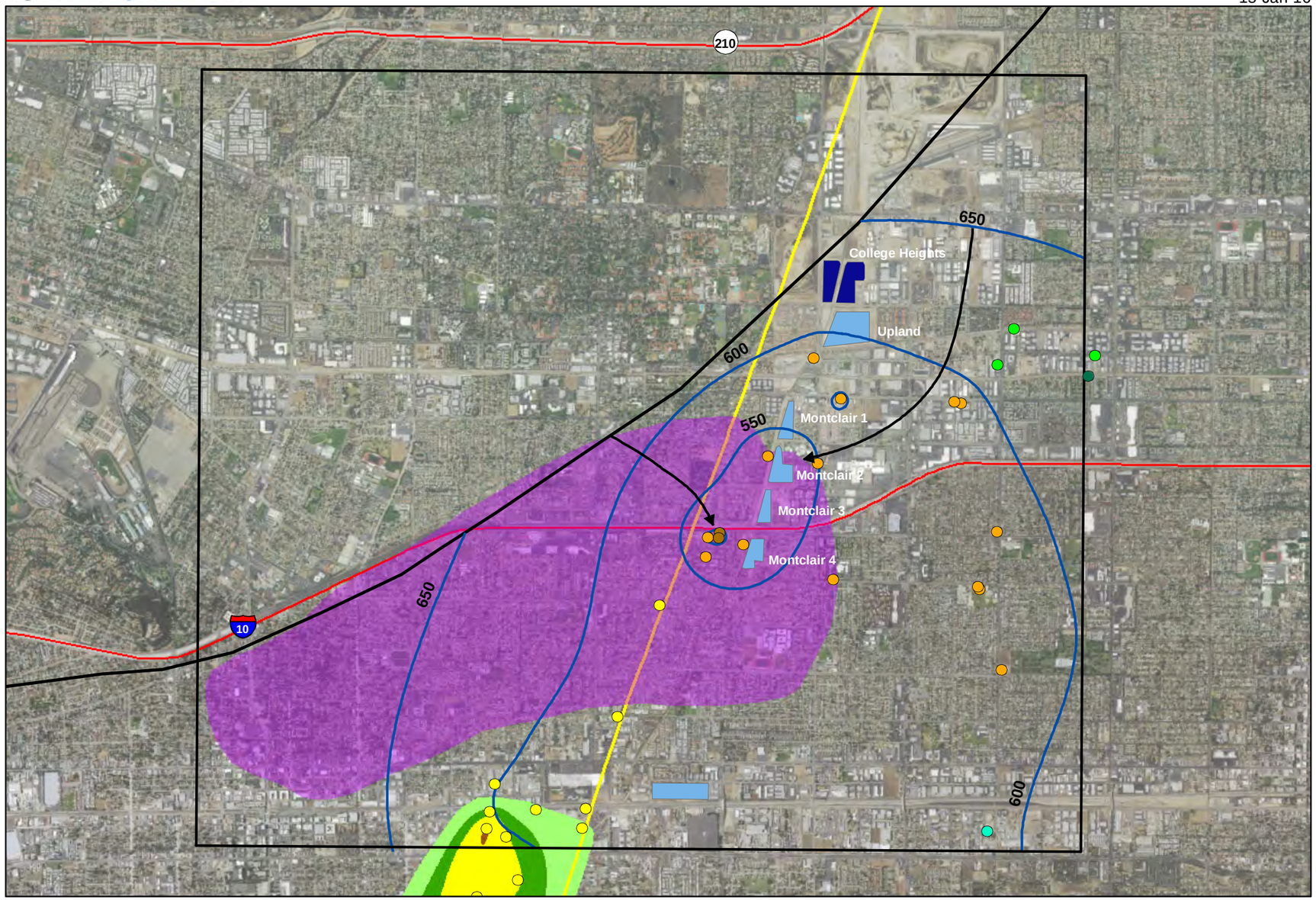
IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

0 0.25 0.5 1 Miles

NAD 83 Stateplane Zone 5
Central Meridian: -118

Map Features

- Model-Generated Groundwater Contours (ft amsl)
- Groundwater Flow Direction
- Proposed Model Domain
- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Area of Subsidence

2014 TCE Plume Concentration (µg/L)

- 0 to 5
- 5 to 10
- 10 to 20
- 20 to 50

Recharge Basin Infiltration Rate (ft/day)

- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- > 3.0

- San Jose Fault
- IEUA Service Area
- Freeway

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Model-Generated Groundwater Contour Map - Calibration

Figure 3

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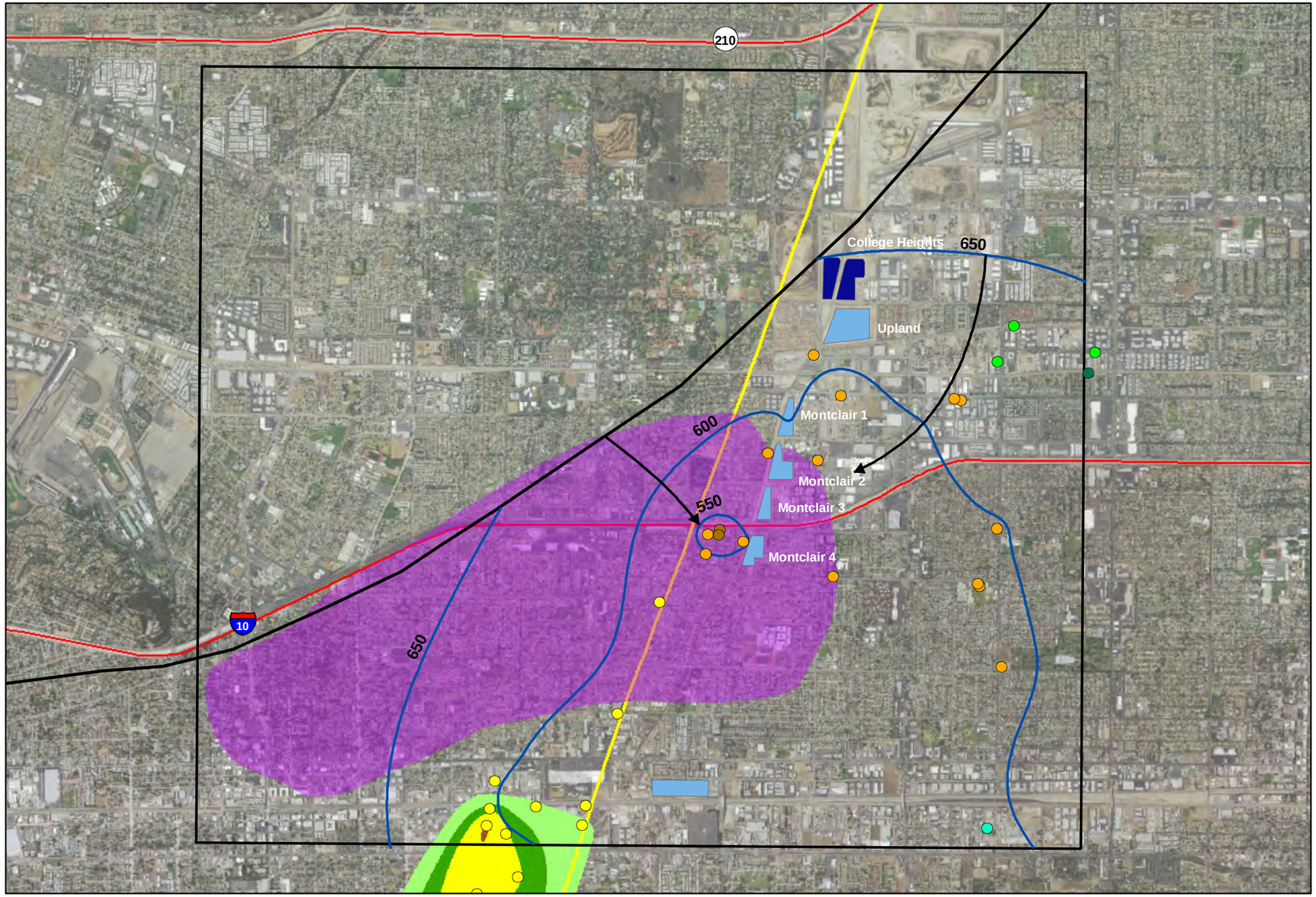
IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

0 0.25 0.5 1 Miles

NAD 83 Stateplane Zone 5
Central Meridian: -118

Thomas Harder & Co.
Groundwater Consulting

Map Features

- Model-Generated Groundwater Contours (ft amsl)
- Groundwater Flow Direction
- Proposed Model Domain
- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Area of Subsidence

2014 TCE Plume Concentration (µg/L)

- 0 to 5
- 5 to 10
- 10 to 20
- 20 to 50

Recharge Basin Infiltration Rate (ft/day)

- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- > 3.0

- San Jose Fault
- IEUA Service Area
- Freeway

Model-Generated Groundwater Contours - Montclair 1 & 2 4 mgd Scenario

Figure 4

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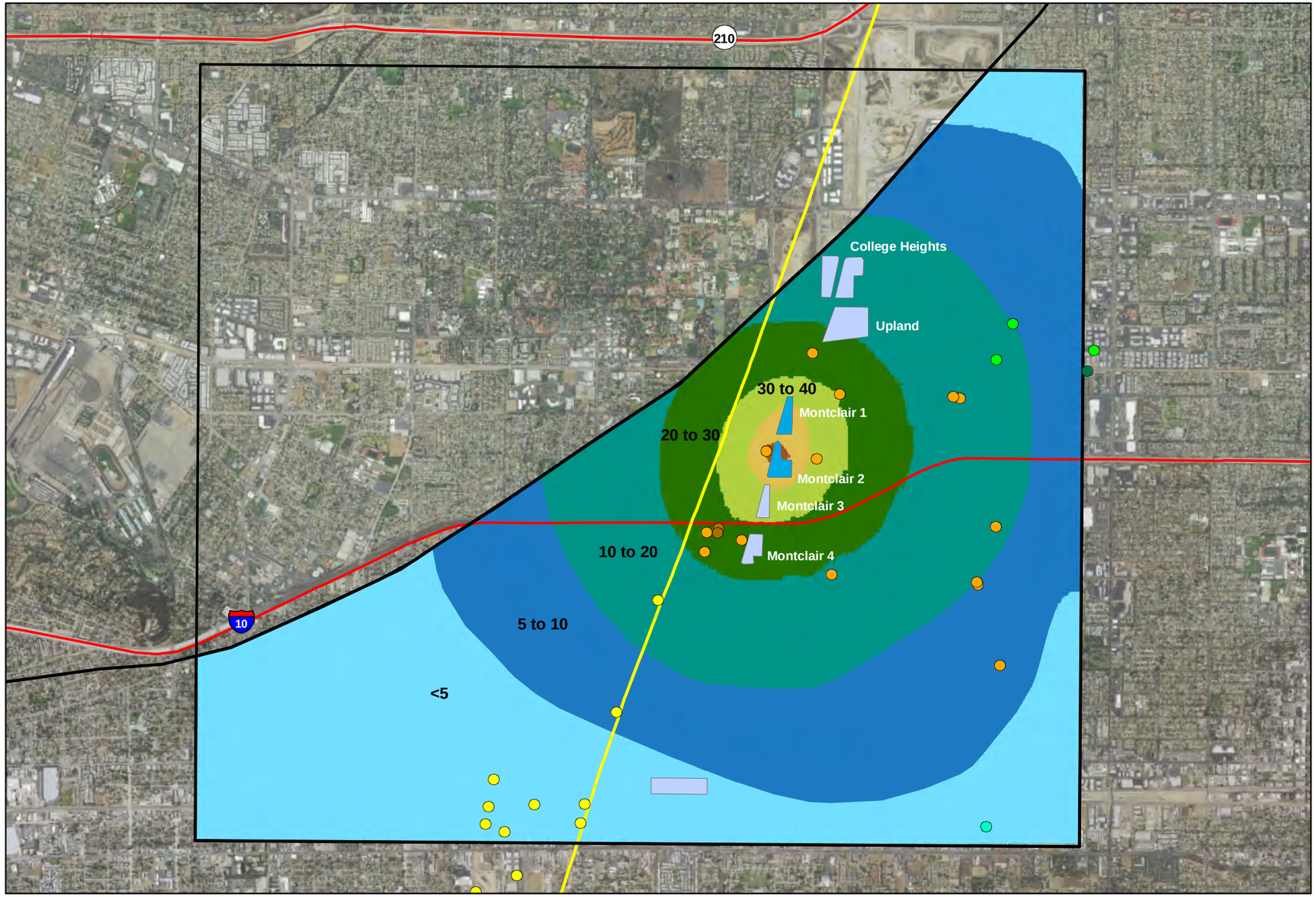
IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

0 0.25 0.5 1 Miles

NAD 83 Stateplane Zone 5
Central Meridian: -118

Map Features

Groundwater Level Difference (ft)

- > 50
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 5 to 10
- < 5

- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Recharge Basin Used in Analysis
- Other Recharge Basin
- Proposed Model Domain
- San Jose Fault
- IEUA Service Area
- Freeway

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Head Difference Map

Figure 5

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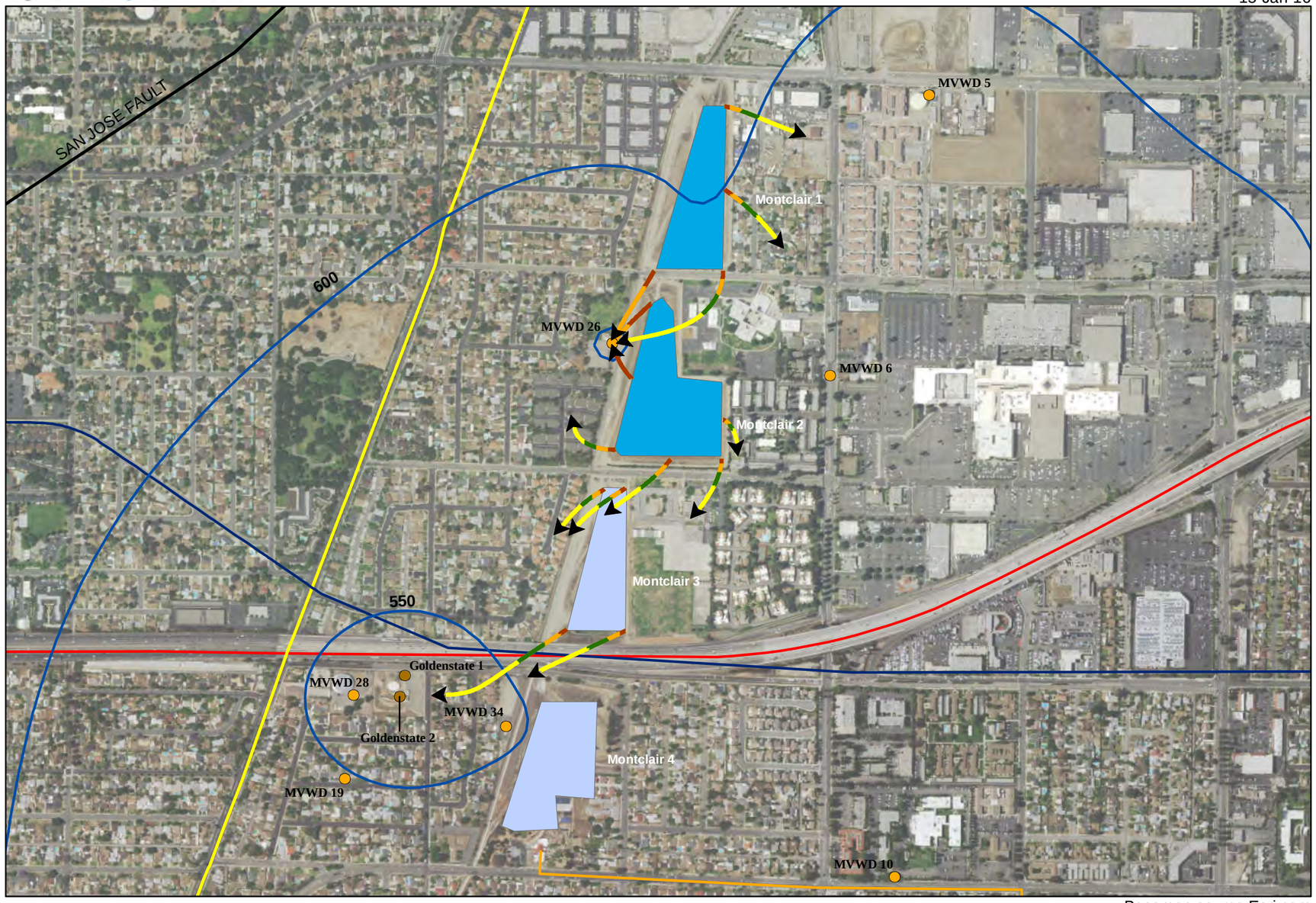
IEUA/Pomona Recycled Water Feasibility Study



Basemap source Esri.com

NAD 83 Stateplane Zone 5
Central Meridian: -118

Map Features

- 0 to 2 Month Travel Time
- 2 to 6 Month Travel Time
- 6 Month to 1 Year Travel Time
- 1 Year to 2 Year Travel Time
- Model-Generated Groundwater Contours (ft amsl)
- Recharge Basin Used in Analysis
- City of Chino Well
- Golden State Water Company Well
- Monte Vista Water District Well
- City of Ontario Well
- City of Pomona Well
- San Antonio Water Company Well
- City of Upland Well
- West End Consolidated Water Co Well
- Other Recharge Basin
- Imported Water Pipeline
- IEUA Pipeline
- San Jose Fault
- IEUA Service Area
- Freeway

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Montclair Basins Particle Travel Times

Figure 6

APPENDIX B - COST ESTIMATES

- B.1 – Cost Estimating Assumptions
- B.2 – Detailed Cost Estimate

B.1 – COST ESTIMATING ASSUMPTIONS

COST ESTIMATING ASSUMPTIONS

The cost estimates presented are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and experience on other similar projects. The costs are based on an Engineering News Record Construction Cost Index (ENR CCI) 10981 - Greater LA Index, July 2015).

The construction costs are representative of system facilities under normal construction conditions and schedules. Costs have been estimated for public works construction and are based on Class 5 planning level assumptions as defined by Association of the Advancement of Cost Engineering (AACE).

Cost Estimating Accuracy

The cost estimates presented have been prepared for general planning purposes and for guidance in project evaluation and implementation. Final costs of a project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors such as preliminary alignment generation, investigation of alternative routings, and detailed utility and topography surveys.

The AACE defines an Order-of-Magnitude Estimate (Class 5), deemed appropriate for planning level studies, as an approximate estimate made without detailed engineering data. It is normally expected that an estimate of this type would be accurate within plus 50 percent to minus 30 percent. This section presents the assumptions used in developing the Class 5 cost estimates for the recommended facilities.

Capital Cost Development

Capital costs developed are estimated by multiplying the estimated construction cost with various markups. The various cost components used in the development of capital cost estimates are described below.

Baseline Construction Cost

This is the total estimated construction cost, in dollars, of the proposed improvement projects. Baseline construction costs were calculated by multiplying the estimated number of units by the unit cost, such as length of pipeline times the average cost per lineal foot of pipeline. The majority of unit construction costs used will be presented in proceeding tables.

Estimated Construction Cost

Contingency costs are reviewed on a case-by-case basis because they vary considerably with each project. Such factors as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are a few of the items that can increase project costs for which a contingency amount would be requested.

Since knowledge about site-specific conditions of each proposed project is limited at the planning stage, a 30-percent contingency was applied to the Baseline Construction Cost to account for unforeseen events and unknown conditions. This contingency accounts for unknown site

conditions such as poor soil, unforeseen conditions, environmental mitigations, and other unknowns and is typical for planning projects. The Estimated Construction Cost for the proposed wastewater, potable water, and recycled water system improvements consists of the Baseline Construction Cost plus the 30-percent construction contingency.

Capital Improvement Cost

Other project construction contingency costs include costs associated with engineering, construction-phase professional services, and project administration. Engineering services associated with new facilities include preliminary investigations and reports, right-of-way (ROW) acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. Construction-phase professional services cover such items as construction management, engineering services, materials testing, and inspection during construction. Finally, there are project administration costs, which cover such items as legal fees, environmental/California Environmental Quality Act (CEQA) compliance requirements, financing expenses, administrative costs, and interest during construction.

The cost of these items can vary, but, for the purpose of this analysis, it is assumed that the other project contingency costs will equal approximately 27.5 percent of the Estimated Construction Cost.

As shown in the following sample calculation of the capital improvement cost, the total cost of all project construction contingencies (construction, engineering services, construction management, and project administration) is 65.8 percent of the baseline construction cost. Calculation of the 65.8 percent is the overall markup on the baseline construction cost to arrive at the capital improvement cost. It is not an additional contingency.

Example:

Baseline Construction Cost	**$1,000,000**
Construction Contingency (30%)	$300,000
Estimated Construction Cost	**$1,300,000**
Engineering Cost (10%)	130,000
Construction Management (10%)	130,000
Project Administration (7.5%)	$97,500
Capital Improvement Cost	**$1,657,500**

To obtain the cost estimates based on the time of construction, the capital improvement cost was escalated at a rate of 3 percent per year. In addition, an anticipated loan period of 30 years with an annual interest rate of 1.5 percent was utilized to calculate the annual cost per acre-foot.

Unit Construction Cost

Unit construction costs utilized for this analysis are presented in the tables that follow for the following facilities:

- Pipeline Cost
- Pump Station Cost
- Pressure-Reducing Stations

Consistent with typical planning cost estimating, pipeline materials are not specified at this time. Pump stations costs were based on total horsepower. Treatment plant costs were based on the cost of construction for similar projects within the region.

Unit Construction Costs - Pipelines	
Pipe Size (inches)	**Unit Construction Cost[(1)] ($/LF)**
Recycled Water Mains	**New Construction**
4"	$150
6"	$170
8"	$205
10"	$225
12"	$260
16"	$330
20"	$385
24"	$465

Note:
(1) ENR Greater LA 10981 (July 2015).

Unit Construction Costs – Pump Stations	
Station Size (HP)	**Unit Construction Cost ($/HP)**
100 hp	$8,000
200 hp	$6,000
250 hp	$6,000
300 hp	$6,000
350 hp	$6,000
400 hp	$6,000
500 hp	$6,000
650 hp	$6,000
700 hp	$4,000
750 hp and larger	$2,000

Unit Construction Costs – Pressure-Reducing Stations	
Type	**Unit Construction Cost ($/PRS)**
Small (1-2 valves <8")	$100,000
Medium (2-3 valves 8" and up)	$200,000
Large (3-4 valves 12" and up)	$300,000
Rehab and Repair	$75,000

Unit Construction Costs – Miscellaneous Items	
Type	**Unit Construction Cost ($/unit))**
ASR Well	$1 million
Land Acquisition in Chino/Pomona (Estimated) per acre	$1 million

B.2 – DETAILED COST ESTIMATE

Alternative 1 Cost Estimate

Recycled Water Segment 3

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	8,500	16"	$ 330	$ 2,805,000
New PRV				$ 100,000
Total Demand			**Pipeline**	**$ 2,905,000**
			Construction Cost	**$ 2,905,000**
			30% Contingency	$ 872,000
			Subtotal	***$ 3,777,000***
			Construction Management	$ 378,000
			Engineering	$ 378,000
			Environmental and Legal	$ 284,000
			Capital Cost	**$ 4,817,000**

Recycled Water Segment 5

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	10,500	16"	$ 330	$ 3,465,000
New PRV				$ 100,000
New PRV				$ 100,000
Total Demand			**Pipeline Cost**	**$ 3,665,000**
			30% Contingency	$ 1,100,000
			Subtotal	***$ 4,765,000***
			Construction Management	$ 477,000
			Engineering	$ 477,000
			Environmental and Legal	$ 358,000
			Capital Cost	**$ 6,077,000**

Other Distribution & Treatment Facilities

Proposed Facility	HP	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line (Seg 3 to 5)		6,000	16"	$ 330	$ 1,980,000
New Transmission Line (to Montclair Basin)		7,700	16"	$ 330	$ 2,541,000
Rehab at Spadra Well 19					$ 100,000
400 HP Interconnection PS	400 hp			$ 6,000	$ 2,400,000
100 HP Interconnection PS	100 hp			$ 6,000	$ 600,000
Land Acquisition for PS Site (1 acre)					$ 1,000,000
New PRV					$ 100,000
				Facilities Cost	**$ 8,721,000**
				30% Contingency	$ 2,617,000
				Subtotal	***$ 11,338,000***
				Construction Management	$ 1,134,000
				Engineering	$ 1,134,000
				Environmental and Legal	$ 851,000
				Capital Cost	**$ 14,457,000**

Total Capital Cost for Alternative 1 (Montclair Basin Only): $ 25,351,000

Alternative 2a Cost Estimate

Recycled Water Segment 3

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	8,500	16"	$ 330	$ 2,805,000
New PRV				$ 100,000
Total Demand			**Pipeline**	**$ 2,905,000**
			Construction Cost	**$ 2,905,000**
			30% Contingency	$ 872,000
			Subtotal	***$ 3,777,000***
			Construction Management	$ 378,000
			Engineering	$ 378,000
			Environmental and Legal	$ 284,000
			Capital Cost	**$ 4,817,000**

Recycled Water Segment 5

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	10,500	16"	$ 330	$ 3,465,000
New PRV				$ 100,000
New PRV				$ 100,000
Total Demand			**Pipeline Cost**	**$ 3,665,000**
			30% Contingency	$ 1,100,000
			Subtotal	***$ 4,765,000***
			Construction Management	$ 477,000
			Engineering	$ 477,000
			Environmental and Legal	$ 358,000
			Capital Cost	**$ 6,077,000**

Other Distribution & Treatment Facilities

Proposed Facility	HP	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line (Seg 3 to 5)		6,000	16"	$ 330	$ 1,980,000
New Transmission Line (to Plant 28)		5,000	16"	$ 330	$ 1,650,000
New Transmission Line (to Montclair Basin)		1,360	16"	$ 330	$ 448,800
New Transmission Line (from NRW N to Plant 28)		350	6"	$ 170	$ 59,500
Advanced Water Treatment Plant Facilities Cost (3.1 mgd)					**$ 24,000,000**
Rehab at Spadra Well 19					$ 100,000.00
400 HP Interconnection PS	400 hp			$ 6,000	$ 2,400,000
100 HP Interconnection PS	100 hp			$ 6,000	$ 600,000
Land Acquisition for PS Site (1 acre)					$ 1,000,000
New PRV					$ 100,000
				Facilities Cost	**$ 32,338,300**
				30% Contingency	$ 9,702,000
				Subtotal	***$ 42,040,300***
				Construction Management	$ 4,205,000
				Engineering	$ 4,205,000
				Environmental and Legal	$ 3,154,000
				Capital Cost	**$ 53,604,300**

Total Capital Cost for Alternative 2a (Monclair Spreading Only): $ 64,498,000

Alternative 2b Cost Estimate

Recycled Water Segment 3

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	8,500	16"	$ 330	$ 2,805,000
New PRV				$ 100,000
Total Demand			**Pipeline**	**$ 2,905,000**
			Construction Cost	**$ 2,905,000**
			30% Contingency	$ 872,000
			Subtotal	***$ 3,777,000***
			Construction Management	$ 378,000
			Engineering	$ 378,000
			Environmental and Legal	$ 284,000
			Capital Cost	**$ 4,817,000**

Recycled Water Segment 5

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	10,500	16"	$ 330	$ 3,465,000
New PRV				$ 100,000
New PRV				$ 100,000
Total Demand			**Pipeline Cost**	**$ 3,665,000**
			30% Contingency	$ 1,100,000
			Subtotal	***$ 4,765,000***
			Construction Management	$ 477,000
			Engineering	$ 477,000
			Environmental and Legal	$ 358,000
			Capital Cost	**$ 6,077,000**

Other Distribution & Treatment Facilities

Proposed Facility	HP	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line (Seg 3 to 5)		6,000	16"	$ 330	$ 1,980,000
New Transmission Line (to Plant 28)		5,000	16"	$ 330	$ 1,650,000
New Transmission Line (to ASR Well 30)		1,800	16"	$ 330	$ 594,000
New Transmission Line (to ASR Well 32)		2,400	10"	$ 225	$ 540,000
New Transmission Line (to Montclair Basin)		1,360	16"	$ 330	$ 448,800
New Transmission Line (from Plant 28 to NRW N)		350	6"	$ 170	$ 59,500
Advanced Water Treatment Plant Facilities Cost (3.7 mgd)					**$ 27,000,000**
Rehab at Spadra Well 19					$ 100,000
400 HP Interconnection PS	400 hp			$ 6,000	$ 2,400,000
100 HP Interconnection PS	100 hp			$ 6,000	$ 600,000
Land Acquisition for PS Site (1 acre)					$ 1,000,000
New PRV					$ 100,000
				Facilities Cost	**$ 36,472,300**
				30% Contingency	$ 10,942,000
				Subtotal	***$ 47,414,300***
				Construction Management	$ 4,742,000
				Engineering	$ 4,742,000
				Environmental and Legal	$ 3,557,000
				Capital Cost	**$ 60,455,300**

Total Capital Cost for Alternative 2b (with ASR):	**$**	**71,349,000**

Alternative 3 Cost Estimate

Recycled Water Segment 3

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost		Total Cost
New Transmission Line	8,500	16"	$ 330	$	2,805,000
New PRV				$	100,000
Total Demand			**Pipeline**	**$**	**2,905,000**
			Construction Cost	**$**	**2,905,000**
			30% Contingency	$	872,000
			Subtotal	***$***	***3,777,000***
			Construction Management	$	378,000
			Engineering	$	378,000
			Environmental and Legal	$	284,000
			Capital Cost	**$**	**4,817,000**

Recycled Water Segment 5

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost		Total Cost
New Transmission Line	10,500	16"	$ 330	$	3,465,000
New PRV				$	100,000
New PRV				$	100,000
Total Demand			**Pipeline Cost**	**$**	**3,665,000**
			30% Contingency	$	1,100,000
			Subtotal	***$***	***4,765,000***
			Construction Management	$	477,000
			Engineering	$	477,000
			Environmental and Legal	$	358,000
			Capital Cost	**$**	**6,077,000**

Other Distribution & Treatment Facilities

Proposed Facility	HP	New Pipe (ft)	Pipe Dia. (in)	Unit Cost		Total Cost
New Transmission Line (Seg 3 to 5)		6,000	16"	$ 330	$	1,980,000
New Transmission Line (to Plant 28)		5,000	16"	$ 330	$	1,650,000
New Transmission Line (to ASR Well 30)		1,800	16"	$ 330	$	594,000
New Transmission Line (to ASR Well 32)		2,400	10"	$ 225	$	540,000
New Transmission Line (to Montclair Basin)		1,360	16"	$ 330	$	448,800
New Transmission Line (from NRW N to Plant 28)		350	6"	$ 170	$	59,500
New Transmission Line (from Plant 28 to NRW N)		350	6"	$ 170	$	59,500
Advanced Water Treatment Plant Facilities Cost (3.7 mgd)					**$**	**27,000,000**
Rehab at Spadra Well 19					$	100,000
400 HP Interconnection PS	400 hp			$ 6,000	$	2,400,000
100 HP Interconnection PS	100 hp			$ 6,000	$	600,000
Land Acquisition for PS Site (1 acre)					$	1,000,000
New PRV					$	100,000
				Facilities Cost	**$**	**36,531,800**
				30% Contingency	$	10,960,000
				Subtotal	***$***	***47,491,800***
				Construction Management	$	4,750,000
				Engineering	$	4,750,000
				Environmental and Legal	$	3,562,000
				Capital Cost	**$**	**60,553,800**

Total Capital Cost for Alternative 3 (with ASR):	**$**	**71,448,000**

Alternative 4 Cost Estimate

Recycled Water Segment 3

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	8,500	16"	$ 330	$ 2,805,000
New PRV				$ 100,000
Total Demand			**Pipeline**	**$ 2,905,000**
			Construction Cost	**$ 2,905,000**
			30% Contingency	$ 872,000
			Subtotal	***$ 3,777,000***
			Construction Management	$ 378,000
			Engineering	$ 378,000
			Environmental and Legal	$ 284,000
			Capital Cost	**$ 4,817,000**

Recycled Water Segment 5

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	10,500	16"	$ 330	$ 3,465,000
New PRV				$ 100,000
New PRV				$ 100,000
Total Demand			**Pipeline Cost**	**$ 3,665,000**
			30% Contingency	$ 1,100,000
			Subtotal	***$ 4,765,000***
			Construction Management	$ 477,000
			Engineering	$ 477,000
			Environmental and Legal	$ 358,000
			Capital Cost	**$ 6,077,000**

Other Distribution & Treatment Facilities

Proposed Facility	HP	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line (Seg 3 to 5)		6,000	16"	$ 330	$ 1,980,000
New Transmission Line (to Plant 28)		5,000	16"	$ 330	$ 1,650,000
New Transmission Line (to ASR Well 30)		1,800	16"	$ 330	$ 594,000
New Transmission Line (to ASR Well 32)		2,400	10"	$ 225	$ 540,000
New Transmission Line (to Montclair Basin)		1,360	16"	$ 330	$ 448,800
New Transmission Line (to N AWT Pipeline)		11,900	16"	$ 330	$ 3,927,000
New Transmission Line (from NRW S to Southern AWT)		1,300	16"	$ 330	$ 429,000
New Transmission Line (from Southern AWT to NRW S)		1,300	16"	$ 330	$ 429,000
New Transmission Line (from NRW N to Plant 28)		350	6"	$ 170	$ 59,500
New Transmission Line (from Plant 28 to NRW N)		350	6"	$ 170	$ 59,500
Advanced Water Treatment Plant (3.7 mgd)					**$ 27,000,000**
Advanced Water Treatment Plant NRW (3.2 mgd)					**$ 46,900,000**
Rehab at Spadra Well 19					$ 100,000
Land Acquisition for Treatment Plant (4.6 acres)					$ 4,600,000
200 HP Pump Station from NRW to Brooks Ba	200 hp			$ 6,000	$ 1,200,000
400 HP Interconnection PS	400 hp			$ 6,000	$ 2,400,000
100 HP Interconnection PS	100 hp			$ 6,000	$ 600,000
Land Acquisition for PS Site (1 acre)					$ 1,000,000
New PRV					$ 100,000
				Facilities Cost	**$ 94,016,800**
				30% Contingency	$ 28,206,000
				Subtotal	***$ 122,222,800***
				Construction Management	$ 12,223,000
				Engineering	$ 12,223,000
				Environmental and Legal	$ 9,167,000
				Capital Cost	**$ 155,835,800**

Total Capital Cost for Alternative 4:	**$ 166,730,000**

Alternative 5 Cost Estimate

Recycled Water Segment 3

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	8,500	16"	$ 330	$ 2,805,000
New PRV				$ 100,000
Total Demand			**Pipeline**	**$ 2,905,000**
			Construction Cost	**$ 2,905,000**
			30% Contingency	$ 872,000
			Subtotal	***$ 3,777,000***
			Construction Management	$ 378,000
			Engineering	$ 378,000
			Environmental and Legal	$ 284,000
			Capital Cost	**$ 4,817,000**

Recycled Water Segment 5

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	10,500	16"	$ 330	$ 3,465,000
New PRV				$ 100,000
New PRV				$ 100,000
Total Demand			**Pipeline Cost**	**$ 3,665,000**
			30% Contingency	$ 1,100,000
			Subtotal	***$ 4,765,000***
			Construction Management	$ 477,000
			Engineering	$ 477,000
			Environmental and Legal	$ 358,000
			Capital Cost	**$ 6,077,000**

Other Distribution & Treatment Facilities

Proposed Facility	HP	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line (Seg 3 to 5)		6000	16"	$ 330	$ 1,980,000
New Transmission Line (to Plant 28)		5,000	16"	$ 330	$ 1,650,000
New Transmission Line (to ASR Well 30)		1,800	16"	$ 330	$ 594,000
New Transmission Line (to ASR Well 32)		2,400	10"	$ 225	$ 540,000
New Transmission Line (to Montclair Basin)		1,360	16"	$ 330	$ 448,800
New Transmission Line (to N AWT Pipeline)		11,900	16"	$ 330	$ 3,927,000
New Transmission Line (from NRW S to Southern AWT)		1,300	16"	$ 330	$ 429,000
New Transmission Line (from Southern AWT to NRW S)		1,300	16"	$ 330	$ 429,000
New Transmission Line (from NRW N to Plant 28)		350	6"	$ 170	$ 59,500
New Transmission Line (from Plant 28 to NRW N)		350	6"	$ 170	$ 59,500
Advanced Water Treatment Plant (3.7 mgd)					**$ 27,000,000**
Advanced Water Treatment Plant NRW (3.2 mgd)					**$ 46,900,000**
Rehab at Spadra Well 19					$ 100,000
Land Acquisition for Treatment Plant (4.6 acres)					$ 4,600,000
200 HP Pump Station from NRW to Brooks Ba	200 hp			$ 6,000	$ 1,200,000
400 HP Interconnection PS	400 hp			$ 6,000	$ 2,400,000
100 HP Interconnection PS	100 hp			$ 6,000	$ 600,000
Land Acquisition for PS Site (1 acre)					$ 1,000,000
New PRV					$ 100,000
				Facilities Cost	**$ 94,016,800**
				30% Contingency	$ 28,206,000
				Subtotal	***$ 122,222,800***
				Construction Management	$ 12,223,000
				Engineering	$ 12,223,000
				Environmental and Legal	$ 9,167,000
				Capital Cost	**$ 155,835,800**

Total Capital Cost for Alternative 5:	**$ 166,730,000**

Alternative 6 Cost Estimate

Recycled Water Segment 3

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	8,500	16"	$ 330	$ 2,805,000
New PRV				$ 100,000
Total Demand			**Pipeline**	**$ 2,905,000**
			Construction Cost	**$ 2,905,000**
			30% Contingency	$ 872,000
			Subtotal	***$ 3,777,000***
			Construction Management	$ 378,000
			Engineering	$ 378,000
			Environmental and Legal	$ 284,000
			Capital Cost	**$ 4,817,000**

Recycled Water Segment 5

Proposed Facility	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line	10,500	16"	$ 330	$ 3,465,000
New PRV				$ 100,000
New PRV				$ 100,000
Total Demand			**Pipeline Cost**	**$ 3,665,000**
			30% Contingency	$ 1,100,000
			Subtotal	***$ 4,765,000***
			Construction Management	$ 477,000
			Engineering	$ 477,000
			Environmental and Legal	$ 358,000
			Capital Cost	**$ 6,077,000**

Other Distribution & Treatment Facilities

Proposed Facility	HP	New Pipe (ft)	Pipe Dia. (in)	Unit Cost	Total Cost
New Transmission Line (Seg 3 to 5)		6,000	16"	$ 330	$ 1,980,000
New Transmission Line (to Plant 28)		5,000	16"	$ 330	$ 1,650,000
New Transmission Line (to ASR Well 30)		1,800	16"	$ 330	$ 594,000
New Transmission Line (to ASR Well 32)		2,400	10"	$ 225	$ 540,000
New Transmission Line (to Montclair Basin)		1,360	16"	$ 330	$ 448,800
New Transmission Line (to Brooks Basin)		6,700	16"	$ 330	$ 2,211,000
New Transmission Line (to ASR Well Site 1)		3,900	10"	$ 225	$ 877,500
New Transmission Line (to ASR Well Site 2)		2,900	10"	$ 225	$ 652,500
New Transmission Line (from NRW S to Southern AWT)		1,300	16"	$ 330	$ 429,000
New Transmission Line (from Southern AWT to NRW S)		1,300	16"	$ 330	$ 429,000
New Transmission Line (from NRW N to Plant 28)		350	6"	$ 170	$ 59,500
New Transmission Line (from Plant 28 to NRW N)		350	6"	$ 170	$ 59,500
Advanced Water Treatment Plant (3.7 mgd)					**$ 27,000,000**
Advanced Water Treatment Plant NRW (3.2 mgd)					**$ 46,900,000**
Rehab at Spadra Well 19					$ 100,000
ASR Well Site 1					$ 1,000,000
ASR Well Site 2					$ 1,000,000
Land Acquisition for Treatment Plant (4.6 acres)					$ 4,600,000
75 HP Pump Station from NRW to Brooks Basin	75 hp			$ 8,000	$ 600,000
400 HP Interconnection PS	400 hp			$ 6,000	$ 2,400,000
100 HP Interconnection PS	100 hp			$ 6,000	$ 600,000
Land Acquisition for PS Site (1 acre)					$ 1,000,000
New PRV					$ 100,000
				Facilities Cost	**$ 95,230,800**
				30% Contingency	$ 28,570,000
				Subtotal	***$ 123,800,800***
				Construction Management	$ 12,381,000
				Engineering	$ 12,381,000
				Environmental and Legal	$ 9,286,000
				Capital Cost	**$ 157,848,800**

Total Capital Cost for Alternative 6:	**$ 168,743,000**

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Preliminary Cost Estimates for Alternatives

Alt No.	Supply Capacity Range					Maximum Available Flow			Maximum Capacity		Alternative Cost Estimates								
	Pomona RW (mgd)	Spadra Well 19 (mgd)	NRW South (mgd)	NRW North (mgd)	Total Flow (mgd)	Brine Discharge (mgd)	Treated Flow (mgd)	Treated Flow (AFY)	Maximum Beneficial Use Potential (mgd)	Maximum Beneficial Use Potential (AFY)	Infrastructure Cost ($)	Treatment Plant Cost ($)	Total Capital Cost ($)	Total Capital Cost Mid-Point of Construction ($)(7)	35% Principal Forgiveness (up to $15 M)	Total Capital Cost w/ Grant Funding ($)(1,2)	Annual O&M Cost ($)(3)(6)	Annual Cost (Max Flow) ($/AF)(4,7)	Annual Cost w/ Grant (Max Flow) ($/AF)(5)
1	3.9	0.5			4.4		**4.4**	**4,900**	**3.1**	**3,500**	$ 25,351,000	$ -	$ 25,351,000	$ 27,000,000	$ 9,450,000	$ 17,550,000	$ 652,250	$ 510	$ 380
2a	3.2	0.5			3.7	0.6	**3.1**	**3,500**	**3.1**	**3,500**	$ 24,498,000	$ 40,000,000	$ 64,498,000	$ 69,000,000	$ 15,000,000	$ 54,000,000	$ 2,245,250	$ 1,460	$ 1,240
2b	3.9	0.5			4.4	0.7	**3.7**	**4,200**	**3.7**	**4,200**	$ 26,349,000	$ 45,000,000	$ 71,349,000	$ 77,000,000	$ 15,000,000	$ 62,000,000	$ 2,606,250	$ 1,380	$ 1,190
3	3.9	0.5		0.006	4.4	0.7	**3.7**	**4,200**	**3.7**	**4,200**	$ 26,448,000	$ 45,000,000	$ 71,448,000	$ 77,000,000	$ 15,000,000	$ 62,000,000	$ 2,567,250	$ 1,370	$ 1,180
4	3.9	0.5	3.8		8.2	1.3	**6.9**	**7,700**	**6.9**	**7,700**	$ 43,730,000	$ 123,000,000	$ 166,730,000	$ 179,000,000	$ 15,000,000	$ 164,000,000	$ 1,301,950	$ 1,140	$ 990
5	3.9	0.5	3.8		8.2	1.3	**6.9**	**7,700**	**6.9**	**7,700**	$ 43,730,000	$ 123,000,000	$ 166,730,000	$ 179,000,000	$ 15,000,000	$ 164,000,000	$ 1,303,950	$ 1,140	$ 990
6	3.9	0.5	3.8		8.2	1.3	**6.9**	**7,700**	**6.9**	**7,700**	$ 45,743,000	$ 123,000,000	$ 168,743,000	$ 181,000,000	$ 15,000,000	$ 166,000,000	$ 1,239,000	$ 1,140	$ 1,000

Notes:
(1) Capital Cost includes a construction cost contingency of 30 percent and additional markups for engineering, legal, and construction management of 27.5 percent.
(2) Grant funding includes 35 percent principal forgiveness (up to $15 million).
(3) Assumes spreading basin O&M costs of $60/AF.
(4) Annual cost assumes a useful life of 30 years at 1.5 percent interest without Grant funding.
(5) Annual cost assumes a useful life of 30 years at 1.0 percent interest with Grant funding.
(6) Annual O&M costs include cost savings of reduced flows in the NRW line for Alternatives 4 through 6.
(7) Capital Costs are escalated at 3 percent per year to midpoint of construction April 2018.

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Preliminary Cost Estimates for Alternatives

Alt No.	Supply Capacity Range					Maximum Available Flow			Maximum Capacity		Alternative Cost Estimates								
	Pomona RW (mgd)	Spadra Well 19 (mgd)	NRW South (mgd)	NRW North (mgd)	Total Flow (mgd)	Brine Discharge (mgd)	Treated Flow (mgd)	Treated Flow (AFY)	Maximum Beneficial Use Potential (mgd)	Maximum Beneficial Use Potential (AFY)	Infrastructure Cost ($)	Treatment Plant Cost ($)	Total Capital Cost ($)	Total Capital Cost Mid-Point of Construction ($)(7)	35% Principal Forgiveness (up to $15 M)	Total Capital Cost w/ Grant Funding ($)(1,2)	Annual O&M Cost ($)(3)(6)	Annual Cost (Max Flow) ($/AF)(4,7)	Annual Cost w/ Grant (Max Flow) ($/AF)(5)
1	1.0	0.5			1.5		**1.5**	**1,700**	**1.5**	**1,700**	$ 25,351,000	$ -	$ 25,351,000	$ 27,000,000	$ 9,450,000	$ 17,550,000	$ 544,250	$ 980	$ 720
2a	1.0	0.5			1.5	0.3	**1.2**	**1,300**	**1.2**	**1,300**	$ 24,498,000	$ 17,490,000	$ 41,988,000	$ 45,000,000	$ 15,000,000	$ 30,000,000	$ 1,173,250	$ 2,340	$ 1,800
2b	1.0	0.5			1.5	0.3	**1.2**	**1,300**	**1.2**	**1,300**	$ 26,349,000	$ 17,490,000	$ 43,839,000	$ 47,000,000	$ 15,000,000	$ 32,000,000	$ 1,192,250	$ 2,420	$ 1,870
3	1.0	0.5		0.006	1.5	0.3	**1.2**	**1,400**	**1.2**	**1,400**	$ 26,448,000	$ 17,490,000	$ 43,938,000	$ 47,000,000	$ 15,000,000	$ 32,000,000	$ 1,159,250	$ 2,230	$ 1,710
4	1.0	0.5	3.8		5.3	0.8	**4.5**	**5,000**	**4.5**	**5,000**	$ 43,730,000	$ 95,490,000	$ 139,220,000	$ 150,000,000	$ 15,000,000	$ 135,000,000	$ (100,050)	$ 1,230	$ 1,030
5	1.0	0.5	3.8		5.3	0.8	**4.5**	**5,000**	**4.5**	**5,000**	$ 43,730,000	$ 95,490,000	$ 139,220,000	$ 150,000,000	$ 15,000,000	$ 135,000,000	$ (98,050)	$ 1,230	$ 1,030
6	1.0	0.5	3.8		5.3	0.8	**4.5**	**5,000**	**4.5**	**5,000**	$ 45,743,000	$ 95,490,000	$ 141,233,000	$ 152,000,000	$ 15,000,000	$ 137,000,000	$ (163,113)	$ 1,230	$ 1,030

Notes:
(1) Capital Cost includes a construction cost contingency of 30 percent and additional markups for engineering, legal, and construction management of 27.5 percent.
(2) Grant funding includes 35 percent principal forgiveness (up to $15 million).
(3) Assumes spreading basin O&M costs of $60/AF.
(4) Annual cost assumes a useful life of 30 years at 1.5 percent interest without Grant funding.
(5) Annual cost assumes a useful life of 30 years at 1.0 percent interest with Grant funding.
(6) Annual O&M costs include cost savings of reduced flows in the NRW line for Alternatives 4 through 6.
(7) Capital Costs are escalated at 3 percent per year to midpoint of construction April 2018.

Preliminary Cost Estimates for Alternatives

Alt No.	Supply Capacity Range					Maximum Available Flow			Maximum Capacity		Alternative Cost Estimates								
	Pomona RW (mgd)	Spadra Well 19 (mgd)	NRW South (mgd)	NRW North (mgd)	Total Flow (mgd)	Brine Discharge (mgd)	Treated Flow (mgd)	Treated Flow (AFY)	Maximum Beneficial Use Potential (mgd)	Maximum Beneficial Use Potential (AFY)	Infrastructure Cost ($)	Treatment Plant Cost ($)	Total Capital Cost ($)	Total Capital Cost Mid-Point of Construction ($)(7)	35% Principal Forgiveness (up to $15 M)	Total Capital Cost w/ Grant Funding ($)(1,2)	Annual O&M Cost ($)(3)(6)	Annual Cost (Max Flow) ($/AF)(4,7)	Annual Cost w/ Grant (Max Flow) ($/AF)(5)
1	2.5	0.5			3.0		**3.0**	**3,400**	**3.1**	**3,500**	$ 25,351,000	$ -	$ 25,351,000	$ 27,000,000	$ 9,450,000	$ 17,550,000	$ 652,250	$ 510	$ 380
2a	2.5	0.5			3.0	0.5	**2.5**	**2,800**	**2.5**	**2,800**	$ 24,498,000	$ 32,010,000	$ 56,508,000	$ 61,000,000	$ 15,000,000	$ 46,000,000	$ 1,913,250	$ 1,590	$ 1,320
2b	2.5	0.5			3.0	0.5	**2.5**	**2,800**	**2.5**	**2,800**	$ 26,349,000	$ 32,010,000	$ 58,359,000	$ 63,000,000	$ 15,000,000	$ 48,000,000	$ 1,932,250	$ 1,630	$ 1,350
3	2.5	0.5		0.006	3.0	0.5	**2.5**	**2,800**	**2.5**	**2,800**	$ 26,448,000	$ 32,010,000	$ 58,458,000	$ 63,000,000	$ 15,000,000	$ 48,000,000	$ 1,893,250	$ 1,610	$ 1,340
4	2.5	0.5	3.8		6.8	1.1	**5.7**	**6,300**	**5.7**	**6,300**	$ 43,730,000	$ 110,010,000	$ 153,740,000	$ 165,000,000	$ 15,000,000	$ 150,000,000	$ 627,950	$ 1,190	$ 1,020
5	2.5	0.5	3.8		6.8	1.1	**5.7**	**6,300**	**5.7**	**6,300**	$ 43,730,000	$ 110,010,000	$ 153,740,000	$ 165,000,000	$ 15,000,000	$ 150,000,000	$ 629,950	$ 1,190	$ 1,020
6	2.5	0.5	3.8		6.8	1.1	**5.7**	**6,300**	**5.7**	**6,300**	$ 45,743,000	$ 110,010,000	$ 155,753,000	$ 167,000,000	$ 15,000,000	$ 152,000,000	$ 564,888	$ 1,190	$ 1,020

Notes:
(1) Capital Cost includes a construction cost contingency of 30 percent and additional markups for engineering, legal, and construction management of 27.5 percent.
(2) Grant funding includes 35 percent principal forgiveness (up to $15 million).
(3) Assumes spreading basin O&M costs of $60/AF.
(4) Annual cost assumes a useful life of 30 years at 1.5 percent interest without Grant funding.
(5) Annual cost assumes a useful life of 30 years at 1.0 percent interest with Grant funding.
(6) Annual O&M costs include cost savings of reduced flows in the NRW line for Alternatives 4 through 6.
(7) Capital Costs are escalated at 3 percent per year to midpoint of construction April 2018.