City of Palo Alto (ID # 10913)

City Council Staff Report

Report Type: Consent Calendar **Meeting Date: 3/2/2020**

Summary Title: Northwest County Recycled Water Strategic Plan Report

Title: Acceptance of the Northwest County Recycled Water Strategic Plan Report

From: City Manager

Lead Department: Utilities

Recommendation

Staff and the Utilities Advisory Commission (UAC) recommend that Council accept the Northwest County Recycled Water Strategic Plan Report (Report).

Executive Summary

The Regional Water Quality Control Plant (RWQCP) is a local source of drought-proof, sustainable water, only a small fraction of which is currently being used for irrigation and toilet flushing. The Council-adopted Sustainability Implementation Plan (Council Report #8487) included direction to investigate expanded uses of this resource. To that end, in December 2016, Council approved a contract with RMC Water and Environment (now Woodard & Curran) for the development of the Northwest County Recycled Water Strategic Plan Report in collaboration with Valley Water (Council Report #7024). City staff from the Public Works and Utilities Departments worked closely with the consulting team and Valley Water to evaluate the most effective water reuse options within Palo Alto as well as within the RWQCP service area.

The attached Northwest County Recycled Water Strategic Plan Report (Report) and Appendices contains a summary and ranking of the water reuse alternatives or "Concept Options" based on cost and non-cost criteria. No specific projects are recommended at this time. A Council-approved agreement with Valley Water and the City of Mountain View (Partnership Agreement) (Council Report #10627) gives Valley Water an option to acquire about half of the treated wastewater produced by the RWQCP, which would render some local water reuse options infeasible. Water reuse alternatives identified in the Report and compatible with the Partnership Agreement will be considered as part of an overall water resource portfolio in a 2020 Water Integrated Resource Plan.

Background

Council Policy

In November 2016 Council adopted the Sustainability and Climate Action Plan (S/CAP) Framework (Council Report #7304) including four water-specific goals, all of which have implications for water reuse:

1. Utilize the right water supply for the right use;
2. Ensure sufficient water quantity and quality;
3. Protect the Bay, other surface waters, and groundwater; and
4. Lead in sustainable water management.

Two relevant strategies identified in the S/CAP are:

1. Verify ability to meet Palo Alto's long-term water needs; and
2. Investigate all potential uses of recycled water.

Palo Alto's Current Potable Water Supply

Palo Alto receives 100% of its potable water (about 11,000 AF per year or approximately 10 million gallons per day (MGD)) from the City and County of San Francisco's Regional Water System (RWS), operated by the San Francisco Public Utilities Commission (SFPUC). About 85% of the supply on the RWS is from the Tuolumne River with the other 15% sourced from local reservoirs. The City of Palo Alto is subject to water supply reductions during droughts. Shortages are expected to become more frequent and more severe in the future as a result of climate change and other changes to the California water system.

Description of the RWQCP Water Resource and Palo Alto's Current non-potable Water Supply

The RWQCP treats and discharges wastewater collected from the communities of Palo Alto, Mountain View, Stanford University, Los Altos, Los Altos Hills, and the East Palo Alto Sanitary District. In 2018, about 96% of the treated wastewater was discharged to the Lower South San Francisco Bay and about 4% was treated further to produce recycled water for non-potable reuse in Palo Alto and Mountain View. Most of the recycled water used in Palo Alto is for irrigation at the municipal golf course and Greer Park. An increase in the amount of recycled water used, particularly in Mountain View, is expected once a small salt removal facility is constructed at the RWQCP. The Concept Options identified in the Report assume the salt removal project is implemented.

Treatment Options

One of Palo Alto's water-specific goals as outlined in the S/CAP is to utilize the right water supply for the right use. Recycled water can be used for various demands based on its level of treatment. Non-potable reuse, such as that for irrigation or toilet flushing, requires more treatment than wastewater that is treated for discharge to the Bay; similarly, potable reuse requires significantly more treatment than non-potable reuse to ensure public safety when ingesting the water.

Partnership Agreement to Advance Resilient Water Reuse Programs in Santa Clara County

On November 18, 2019, Council approved a Partnership Agreement that gives Valley Water an option to acquire about half of the treated wastewater produced by the RWQCP. Valley Water has approximately 20 years to take delivery of the treated effluent which would likely be used in the county south of Mountain View. If Valley Water exercises the option to take delivery of the treated effluent, some of the concept options within the report will not be viable; these options are described below in Table 3.

Previous UAC, Council and Community Feedback

Water Reuse has been discussed publicly at the following meetings:

- August 2018 UAC meeting: Discussed a business plan for expansion of Palo Alto's non-potable reuse irrigation network.
- October 2018 UAC meeting: Discussed wastewater reuse expansion opportunities
- November 2018 Council (Council Report #9731): Study session on high-level wastewater reuse expansion opportunities.
- April 2019 Community Engagement Event: Feedback solicited on water reuse opportunities
- September 2019 UAC meeting: Discussed water reuse options and the Partnership Agreement with Valley Water
- September 2019 Council meeting: Study session regarding water reuse opportunities and the Partnership Agreement with Valley Water
- October 2019 Community Engagement Event: Provided information and answered questions regarding the Partnership Agreement with Valley Water.
- November 2019 Council meeting: Council approved the Partnership Agreement with Valley Water

Discussion

Non-potable Reuse (NPR) Concept Options

Non-potable reuse Concept Options included extensions of the current recycled water transmission system to various locations for toilet flushing, irrigation, and industrial process water demands within the RWQCP service area, including south Palo Alto, Los Altos, Los Altos Hills, Mountain View, and East Palo Alto. Concept Options evaluated specifically for Palo Alto were:

- The Phase 3 Pipeline that would provide recycled water to south Palo Alto (Concept Option A1), and
- The Phase 3 Pipeline expanded to provide recycled water to south Palo Alto and additional users in the Palo Alto foothills (Concept Options A2 and A3). Expansions to users in the Palo Alto foothills included pipeline extensions to users in Los Altos Hills (Concept Option A2) and Los Altos (Concept Option A3).

Satellite Non-potable Reuse Concept Option

A satellite treatment Concept Option (Concept Option B1) was evaluated, consisting of a new wastewater treatment facility located in south Palo Alto that would collect and treat wastewater from the surrounding community to provide approximately 900 AFY of recycled water for non-potable reuse in adjacent facilities throughout south Palo Alto and Los Altos. The report suggests that satellite treatment is cost prohibitive.

Indirect Potable Reuse (IPR) Concept Options

Three indirect potable reuse Concept Options were evaluated; all consist of injecting purified wastewater into the aquifer below Palo Alto, extraction of that purified water mixed with groundwater, and blending with the Palo Alto potable water supply. IPR Concept Options would require a purification facility at the RWQCP, transmission pipeline, injection wells, and the routine use of groundwater. The IPR Concept Options differ in their pipeline alignments, amount of purified water injected, and whether or not the pipeline offers non-potable reuse connections. Because IPR requires very large capital investments in treatment, injection wells, and conveyance, IPR will not be viable if Valley Water exercises its option to take delivery of the treated effluent from the RWQCP.

- Concept Option C1 involves using groundwater augmented with purified water for potable needs only.
- Concept Options C2 and C3 combine indirect potable reuse with meeting non-potable reuse demands.

Direct Potable Reuse (DPR) Concept Option

Lastly, the Strategic Plan evaluated one Concept Option (D1) for direct potable reuse within Palo Alto. Concept Option D1 consists of a purification treatment plant, engineering storage, a short transmission pipeline, and injection of purified water directly into the Palo Alto potable water supply. DPR will not be viable if Valley Water exercises its option under the Partnership Agreement.

The Report indicates that multiple water reuse opportunities are feasible for Palo Alto to meet both near-term and long-term water demands. Near-term opportunities, those that could be implemented within five years, include non-potable reuse program expansion projects and satellite treatment for non-potable reuse projects. In contrast, long-term opportunities that could be implemented include indirect potable reuse within 10-20 years and direct potable reuse implementation within 20-40 years. It should be noted that the opportunities are not all explicitly distinct from each other; it is possible to pursue a combination of near term and long-term opportunities. For example, non-potable reuse pipeline expansion Concept Options can be constructed in the near term while subsequent phases of potable reuse Concept Options can be planned and designed for future implementation.

The Concept Options and cost estimates are summarized in Table 1; cost estimates represent the cost for individual Concept Options and do not account for any efficiency that may result from combining Concept Options. These preliminary cost estimates are offered to facilitate discussion of various project options. They are separate and distinct from a cost of service

study, which, if a project is selected for implementation, would determine the amount of project costs to be allocated system-wide and a constitutionally compliant recycled water rate.

Table 1: Northwest County Recycled Water Strategic Plan Concept Option Cost Estimates[a,b]

Concept Option Number	Brief Description	Project Yield (AFY)	Capital Cost ($M)	Operations & Maintenance Cost ($M/year)	Unit Cost ($/AF)
Non-potable Reuse (NPR) Concept Options					
A1	Phase 3 Pipeline serving south Palo Alto	800	$47.8	$0.3	$3,400
A2	Phase 3 Pipeline Extended to Foothills & Los Altos Hills	1,100	$63.0	$0.5	$3,400
A3	Phase 3 Pipeline Extended to Foothills & Los Altos	1,200	$85.1	$0.7	$4,000
A4	Mountain View Long Term Expansion Pipeline	200	$6.2	$0.1	$2,100
A5	Mountain View Long Term Expansion Pipeline Extended to Los Altos	900	$72.6	$0.4	$4,600
A6	East Palo Alto Pipeline	500	$20.7	$0.2	$2,400
Satellite Non-potable Reuse Concept Option					
B1	Serving south Palo Alto & Los Altos	900	$129.6	$1.4	$8,900
Indirect Potable Reuse (IPR) Concept Options[c]					
C1	IPR serving Palo Alto	5,900	$92.2	$14.8d	$3,300
C2	IPR & NPR serving Palo Alto	6,100	$152.1	$16.9d	$4,000
C3	IPR & NPR from Phase 3 Pipeline serving Palo Alto	5,900	$198.4	$15.8d	$4,400
-	Palo Alto Groundwater Usage without IPR	2,500	$37.7	$5.5d	$3,000
Direct Potable Reuse Concept Option					
D1	DPR serving Palo Alto	5,300	$104.6	$8.0	$2,500

[a]For comparison, SFPUC (imported water) is currently $1,948/AF and is projected to be $3,000/AF in 2030.
[b]Cost estimates are AACE Class 5 for a project definition of 0 – 2% and have an expected accuracy of -20 to 50%. Capital costs are amortized at 3% over 30 years.
[c]Project yield for IPR Concept Options represents half purified water, half groundwater.
[d]Operations and maintenance cost estimates include the Valley Water Groundwater Production Charge.

Cost was not the only criteria considered in the evaluation. The Concept Options were scored on a variety of qualitative characteristics such as water supply resiliency, public acceptance and regulatory complexity. The rankings after weighting both cost and non-cost criteria are shown in Table 2.

Table 1: Ranking Considering Cost and Non-cost Evaluation Criteria

Rank	Concept Option
1	A2: NPR Palo Alto Phase 3 Extended to Foothills
	C1: Palo Alto Dedicated IPR
2	A1: NPR Palo Alto Phase 3
	A4: NPR Mountain View
	A6: NPR East Palo Alto
3	D1: Palo Alto Dedicated DPR
4	C2: Palo Alto IPR with NPR
5	A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos
6	C3: Palo Alto IPR and NPR from Phase 3 Pipeline
7	A5: NPR Mountain View Extended to Los Altos
8	B1: NPR Satellite Treatment Plant

Concept Option Viability with Partnership Agreement

If Valley Water exercises its option to receive treated wastewater from the RWQCP, the capability for some Concept Options to be fully implemented is reduced while other Concept Options could be implemented in parallel with a transfer. Table 3 indicates which projects are and are not mutually exclusive with an effluent transfer to Valley Water. Generally, a transfer would not preclude non-potable reuse expansion projects. Indirect potable reuse requires expensive pipeline construction and, therefore, a significant amount of water for economies of scale, so those Concept Options would be excluded for the proposed 76-year term of the transfer. Direct potable reuse, on the other hand, could be developed on a pilot scale.

Table 3: Summary of Concept Option Viability with Effluent Transfer

Concept Option Number	Brief Description	Project Yield (AFY)	Unit Cost ($/AF)	Implement in Addition to Treated Effluent Transfer
A1	Phase 3 Pipeline serving south Palo Alto	800	$3,400	Yes
A2	Phase 3 Pipeline Extended to Foothills & Los Altos Hills	1,100	$3,400	Yes
A3	Phase 3 Pipeline Extended to Foothills & Los Altos	1,200	$4,000	Yes
A4	Mountain View Long Term Expansion Pipeline	200	$2,100	Yes
A5	Mountain View Long Term Expansion Pipeline Extended to Los Altos	900	$4,600	Yes
A6	East Palo Alto Pipeline	500	$2,400	Yes
B1	Serving south Palo Alto & Los Altos	900	$8,900	Yes
C1	IPR serving Palo Alto	5,900	$3,300	No
C2	IPR & NPR serving Palo Alto	6,100	$4,000	No
C3	IPR & NPR from Phase 3 Pipeline serving Palo Alto	5,900	$4,400	No
-	Palo Alto Groundwater Usage without IPR	2,500	$3,000	Yes
D1	DPR serving Palo Alto	5,300	$2,500	Small scale project possible but cost estimates may vary

Next Steps

The Concept Options will be evaluated within the context of a potable and non-potable water supply portfolio as part of a Water integrated Resources Plan. Staff intends to return to the UAC and Council with more information in 2020.

Policy Implications

While there is no recommendation to proceed with any specific project at this time, expanding the use of recycled water would be consistent with the Sustainability Climate Action Plan Framework (Council Report #7304) and the Sustainability Implementation Plan (Council Report #8487).

Community Engagement
Palo Alto hosted a community meeting on April 30, 2019 to solicit input on the preliminary Strategic Plan results. Approximately 30 members of the public attended, and many attendees asked questions and made comments. During the meeting Palo Alto staff requested feedback on whether attendees were interested in expanded non-potable reuse and potable reuse options. Community members expressed interest in reducing reliance on imported water and enhancing water conservation and efficiency to save water for the environment. Community members also expressed concern with the use of the Measure E site for a Valley Water regional purification facility. The Strategic Plan was also discussed at the public meetings listed above.

At the February 5 meeting, the Utilities Advisory Commission (UAC) voted 6-0; Scharff absent, to recommend Council accept the Northwest County Recycled Water Plan Report. UAC DRAFT excerpt minutes.

Environmental Review
Acceptance of the Northwest County Recycled Water Strategic Plan Report is not subject to review under the California Environmental Quality Act because it does not meet the definition of a project under Public Resources Code 21065.

Attachments:

- Attachment A: Recycled Water Strategic Plan Report
- Attachment B: RWSPR Appendices

Recycled Water Strategic Plan Report

Northwest County Recycled Water Strategic Plan

Interim Final Report*

Prepared by:

RMC water and environment

WOODARD & CURRAN

National Experience. Local Focus.

July 2019

**This report has yet to be accepted by Palo Alto City Council.*

Table of Contents

Appendices

Figures

Tables

Abbreviations

AACE	Association for the Advancement of Cost Engineering
AF	Acre feet
AFY	Acre feet per year
AOP	Advanced oxidation process
AWPF	Advanced water purification facility [for potable reuse]
AWTS	Advanced water treatment system [for enhanced recycled water]
CCI	Construction cost index
CIP	Cast iron pipe
CIPP	Cured in place pipe
DDW	Division of Drinking Water
DIP	Ductile iron pipe
DPR	Direct potable reuse
ENR	Engineering News Record
EPASD	East Palo Alto Sanitary District
ESDC	Engineering services during construction
FAT	Full advanced treatment
gpm	Gallons per minute
HDD	Horizonal directional drill
HGL	Hydraulic grade line
HP	Horsepower
ID	Internal diameter
IPR	Indirect potable reuse
LF	Linear feet
MF	Membrane filtration
MGD	Million gallons per day
MV	Mountain View
NPR	Non-potable reuse
OD	Outside diameter
O&M	Operations and maintenance
PHWD	Purissima Hills Water District
psi	Pressure per square inch
PTGAB	Pilot tube guided auger boring
RO	Reverse osmosis

RWQCP	Regional Water Quality Control Plant
RWMP	Recycled Water Master Plan
SFPUC	San Francisco Public Utilities Commission
SWRCB	State Water Resources Control Board
TDS	Total dissolved solids
UV	Ultraviolet
UWMP	Urban Water Management Plan
WBSD	West Bay Sanitary District

Executive Summary

The Northwest County Recycled Water Strategic Plan (Strategic Plan) was undertaken by the City of Palo Alto, in collaboration with Valley Water, to assess drought-proof recycled water expansion opportunities throughout the Palo Alto Regional Water Quality Control Plant (RWQCP) service area (i.e., Palo Alto, Mountain View, Los Altos, Los Altos Hills, Stanford University, and East Palo Alto Sanitary District) including additional portions of East Palo Alto and Menlo Park not serviced by the East Palo Alto Sanitary District.

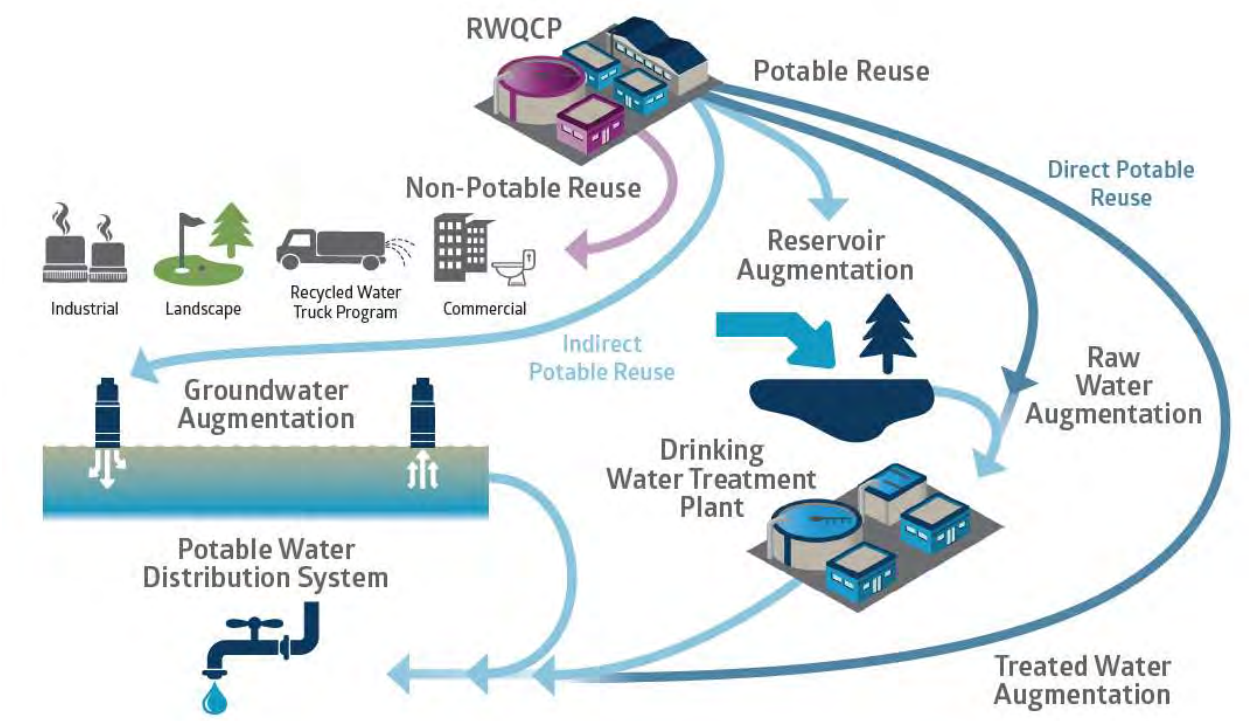
To aid in future decisions regarding RWQCP recycled water expansion and commitments, Palo Alto, as the owner and operator of the RWQCP, saw a need to assess other RWQCP Partner Agencies' interests in recycled water. The RWQCP is interested in expanding the recycled water program to help move itself towards becoming a resource recovery facility by providing a drought-proof, sustainable, local water supply, and for recycled water's potential to help meet future regulatory actions pertaining to discharge limitations. Palo Alto, similar to many of the other RWQCP Partner Agencies', is subject to water supply reductions during droughts. Shortages are expected to become more frequent and more severe in the future as a result of climate change and other changes to the California water system. Both imported water and groundwater are at risk during dry periods. In order to understand how to best expand the RWQCP recycled water program, a comprehensive and holistic evaluation was needed to reassess the service area needs and acceptance given changes in water supplies and governing regulations.

The purpose of the Strategic Plan is to evaluate potential additional uses of recycled water Study Area through the year 2030, to identify recycled water concepts that look beyond individual agency boundaries, and to evaluate previously recommended recycled water projects with new options developed through this Strategic Plan.

Types of Water Reuse Considered

The Strategic Plan builds off of the work from the 1992 Recycled Water Master Plan (RWMP) to incorporate options for new and different kinds of reuse. Recycled water can be used for various demands based on its level of treatment. Non-potable reuse, such as that for irrigation or toilet flushing, requires more treatment than wastewater that is treated for discharge to the Bay. Similarly, potable reuse requires significantly more treatment than non-potable reuse to ensure public safety when ingesting the water.

Figure ES-0-1: Potential recycled water uses for both potable and non-potable reuse applications



Note: City of Palo Alto does not have an existing Drinking Water Treatment Plant

The potential reuse demand for the various types of water reuse considered in the Strategic Plan is summarized in Table ES 0-1.

Table ES-0-1: Summary of Demand Potential by Type of Water Reuse

Type of Reuse	Annual Average Demand	Comments
Non-Potable Reuse	4,456 AFY	Throughout RWQCP service area, not one specific concept
Indirect Potable Reuse	2,800 / 5,900 AFY	For City of Palo Alto only
Direct Potable Reuse	5,300 AFY	For City of Palo Alto only

Note: IPR annual average demand reflects volume recharged to the groundwater basin and volume extracted from the groundwater basin

Results of Concept Options Development and Analysis

Through collaborative development with the RWQCP Partner Agencies, water retailers, and neighboring agencies, 11 concept options (i.e., recycled water expansion opportunities) were developed for detailed analysis in the Strategic Plan. In summary, the concept options could provide between 200 and 6,100 AFY of water supplies at an annual unit cost ranging from $2,100 per AF to $8,900 per AF (see Table ES 0-2). For comparison with other non-water reuse water supplies, potable water from SFPUC is projected

to cost $3,000 per AF in 2030, and groundwater, including wellhead treatment and the Valley Water groundwater pumping charge, is projected to cost $3,000 per AF. [1]

To provide a basis for comparison, cost estimates reflect the incremental cost of pursuing each concept option. For the NPR options, the cost estimates include distribution to the end-user. Consistent with the incremental cost methodology, this report does not estimate the total cost of providing the IPR or DPR water to end-users as Palo Alto's existing potable water distribution system costs are not included in the estimates.

The concept options were selected based on cost effectiveness and applicability to solving regional water supply issues. The concept options are divided into four categories:

- "A" series for centralized non-potable reuse (NPR) concept options
- "B" concept option for NPR from satellite treatment
- "C" series for indirect potable reuse (IPR) concept options
- "D" concept option for direct potable reuse (DPR)

The concept options were evaluated for capital and operational costs and scored on a variety of non-cost criteria including water supply resiliency, public acceptance, adaptability, regulatory complexity, and regional perspective. Concept option ranking by cost is included in Table ES 0-3. Concept option ranking by non-cost criteria is included in Table ES 0-4. The summary of weighted ranking of concept options including both cost and non-cost criteria is included in Table ES 0-5.

NPR concept options evaluated multiple pipeline extensions throughout the Study Area. **Concept Option A2, NPR Palo Alto Phase 3 Extended to Foothills** ranks highly because it delivers among the largest volumes of the NPR concept options and strikes a balance between offering regional benefits while requiring few agencies to implement and operate.

NPR is challenging for Los Altos and Los Altos Hills because their customers are located furthest from the RWQCP and existing recycled water infrastructure and coordination with the Partner Agencies upstream would be needed. Between the two options to serve Los Altos – **Concept Option A3, NPR Palo Alto Phase 3 Extended to Foothills and Los Altos** (which builds off of Concept Option A1) and **Concept Option A5, NPR Mountain View Extended to Los Altos** (which builds off of Concept Option A4) – Concept Option A3 is preferred due to preliminary costs. Between the two options to serve Los Altos Hills - **Concept Option A2, NPR Palo Alto Phase 3 Extended to Foothills** and **Concept Option A3, NPR Palo Alto Phase 3 Extended to Foothills and Los Altos –** Concept Option A2 is ranked higher.

Concept Option A4, NPR Mountain View, was previously recommended in the 2014 Mountain View Recycled Water Feasibility Study, due to its low cost and average non-cost score, was determined to be a reasonable investment compared to the other concept options explored in the Strategic Plan. Currently (July 2019), Mountain View is in the process of updating the 2014 Recycled Water Feasibility Study focusing on extending their existing system to Google and NASA, and across Highway 101; this update may alter the facility needs and costs for Concept Option A4.

Concept Option A6, NPR East Palo Alto, is low cost, and the average non-cost score make it a reasonable investment compared to other concept options.

The **IPR concept options** are attractive due to the large amount of water supplied combined with greater ability to repurpose the infrastructure and only one agency required to implement and operate.

[1] These are the estimated costs to the City of Palo Alto of purchasing SFPUC water or pumping groundwater and these cost estimates do not include distribution system costs.

Concept Option D1, Palo Alto Dedicated DPR delivers the greatest volume of recycled water out of all the concept options, requires only one agency to implement and operate, and does not require infrastructure changes by customers. The notable drawback of Concept Option D1 is the implementation process. Given the lack of established regulations, pursuing a DPR project at this time would require more effort by Palo Alto to establish a process that regulatory agencies will permit. Even when DPR regulations are established, the hurdles that agencies must clear to permit DPR projects will likely be more challenging compared to other recycled water projects. Another challenge will be hiring/training staff to operate the new treatment facilities.

The presumed benefit of **Concept Option B1, NPR Satellite Treatment Plant** was the ability to create a compact recycled water distribution system closer to the customer locations rather than requiring an extensive pipe network extending from the RWQCP. However, in this setting, the preferred location for diverting flows from the sewer system does not correspond to the areas of potential recycled water nor is there land available in the immediate vicinity of the diversion point to site a satellite treatment facility that is cost effective.

Table ES-0-2: Summary of Concept Options including Yield, Engineer's Opinion of Probable Capital and O&M Costs

Concept Option	Yield (AFY)	Capital Cost	O&M ($/Y)	Unit Cost ($/AF)
A1: NPR Palo Alto Phase 3	800	$47.8M	$0.29M	$3,400
A2: NPR Palo Alto Phase 3 Extended to Foothills	1,100	$63.0M	$0.52M	$3,400
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	1,200	$85.1M	$0.68M	$4,000
A4: NPR Mountain View	200	$6.2M	$0.1M	$2,100
A5: NPR Mountain View Extended to Los Altos	900	$72.6M	$0.4M	$4,600
A6: NPR East Palo Alto	500	$20.7M	$0.15M	$2,400
B1: NPR Satellite Treatment Plant	900	$129.6M	$1.37M	$8,900
C1: Palo Alto Dedicated IPR	5,900	$92.2M	$14.83M	$3,300
C2: Palo Alto IPR with NPR	6,100	$152.1M	$16.92M	$4,000
C3: Palo Alto IPR and NPR from Phase 3 Pipeline	5,900	$198.4M	$15.78M	$4,400
D1: Palo Alto Dedicated DPR	5,300	$104.6M	$8.01M	$2,500

Note: Costs based on an ENR CCI San Francisco index for June 2018 of 12,015. Costs are consistent with a Class 5 estimate (-20% to +50%) (AACE 2008). Capital costs are amortized at 3% over 30 years.

Table ES-0-3: Ranking of Concept Options by Cost

Rank	Score	Concept Option
1	5 (<$3,500/AF)	A1: NPR Palo Alto Phase 3
		A2: NPR Palo Alto Phase 3 Extended to Foothills
		A4: NPR Mountain View
		A6: NPR East Palo Alto
		C1: Palo Alto Dedicated IPR
		D1: Palo Alto Dedicated DPR
2	3 (≥$4,000/AF and <$4,500/AF)	A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos
		C2: Palo Alto IPR with NPR
		C3: Palo Alto IPR and NPR from Phase 3 Pipeline
3	2 (≥$4,500/AF and <$5,000/AF)	A5: NPR Mountain View Extended to Los Altos
4	1 (≥$5,000/AF)	B1: NPR Satellite Treatment Plant

Table ES-0-4: Ranking of Concept Options by Non-Cost Criteria

Rank	Score (Maximum = 500)	Concept Option
1	291	A2: NPR Palo Alto Phase 3 Extended to Foothills
2	290	C1: Palo Alto Dedicated IPR
3	289	C2: Palo Alto IPR with NPR
	289	C3: Palo Alto IPR and NPR from Phase 3 Pipeline
4	286	A5: NPR Mountain View Extended to Los Altos
5	285	A1: NPR Palo Alto Phase 3
	285	A4: NPR Mountain View
	285	A6: NPR East Palo Alto
6	282	A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos
7	271	B1: NPR Satellite Treatment Plant
8	269	D1: Palo Alto Dedicated DPR

Table ES-0-5: Ranking Considering Cost and Non-Cost Evaluation Criteria

Rank	Concept Option
1	A2: NPR Palo Alto Phase 3 Extended to Foothills
	C1: Palo Alto Dedicated IPR
2	A1: NPR Palo Alto Phase 3
	A4: NPR Mountain View
	A6: NPR East Palo Alto
3	D1: Palo Alto Dedicated DPR
4	C2: Palo Alto IPR with NPR
5	A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos
6	C3: Palo Alto IPR and NPR from Phase 3 Pipeline
7	A5: NPR Mountain View Extended to Los Altos
8	B1: NPR Satellite Treatment Plant

Next Steps

Results of the Strategic Plan indicate that there are multiple water reuse expansion opportunities within the Study Area that agencies could pursue, including NPR, IPR, and DPR. Next steps would include undertaking a variety of activities including:

- Facilities planning
- Funding and financing
- Inter-agency agreements
- Environmental documentation
- Reuse permitting
- Customer and public outreach

Note that one of the options being considered by Valley Water's Countywide Plan, currently under development, is export of water from the RWQCP for potable reuse further south in Santa Clara County, where Valley Water operates recharge ponds. Depending on the outcomes of the Countywide Plan, some of the Concept Options described in this Report may not implementable due to limited supply of recycled water; further evaluation for joint implementation may be required as a next step.

Chapter 1 Introduction

1.1 Background and Purpose of the Recycled Water Strategic Plan

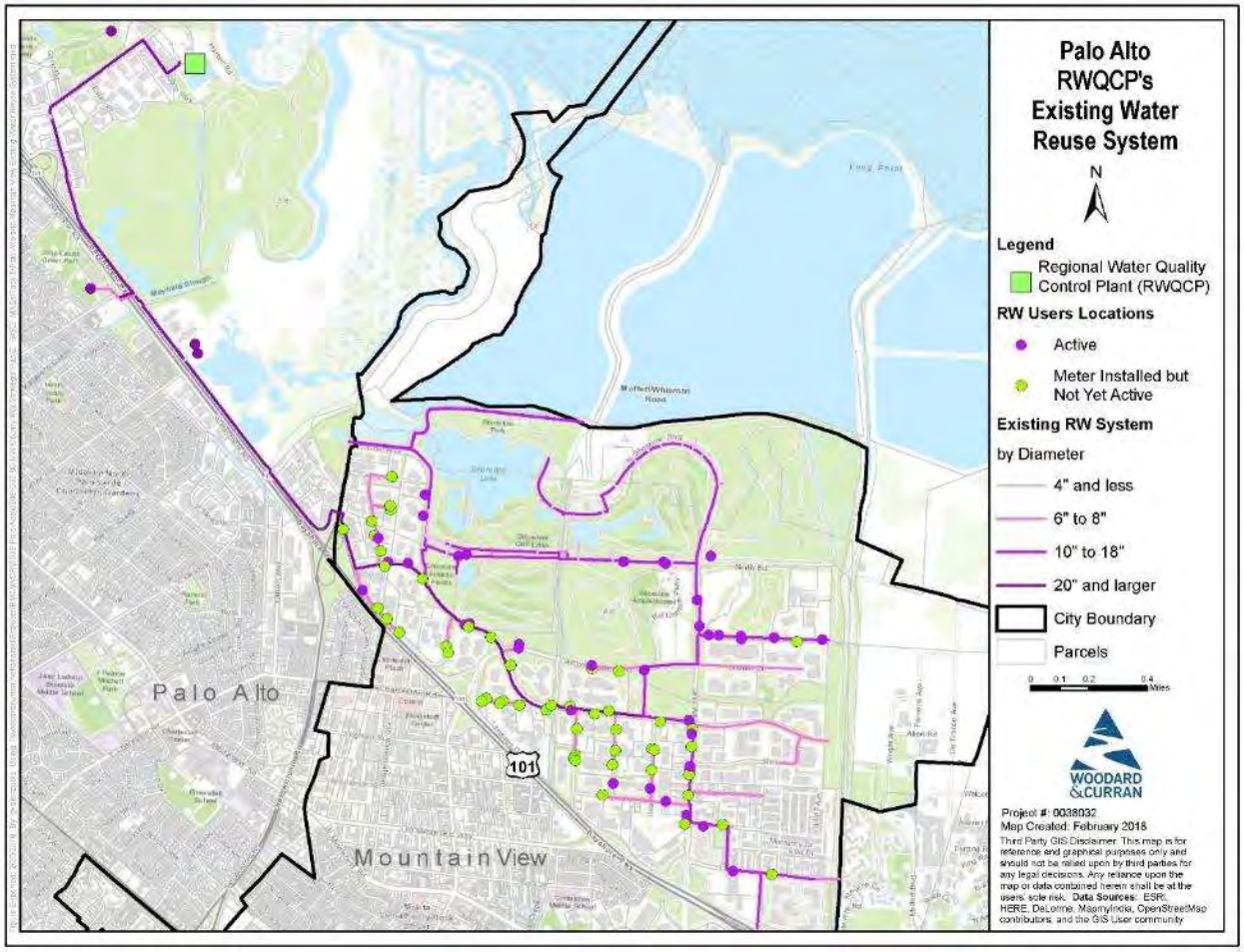
The Northwest County Recycled Water Strategic Plan (Strategic Plan) was undertaken by the City of Palo Alto (Palo Alto), in collaboration with Valley Water (formerly the Santa Clara Valley Water District), to assess recycled water expansion opportunities throughout the Palo Alto Regional Water Quality Control Plant (RWQCP) service area (i.e., Palo Alto, Mountain View, Los Altos, Los Altos Hills, Stanford University, and East Palo Alto Sanitary District) including additional portions of East Palo Alto and Menlo Park not serviced by the East Palo Alto Sanitary District. The cities of Palo Alto, Mountain View, Los Altos, the town of Los Altos Hills, East Palo Alto Sanitary District (EPASD), and Stanford University are known as the RWQCP Partner Agencies. Figure 1-1 shows the boundaries of the RWQCP service area as well as each of the RWQCP Partner Agencies.

Figure 1-1: Study Area

Source: City of Palo Alto, 2017

The last comprehensive recycled water planning study for the RWQCP service area was the 1992 Recycled Water Master Plan (RWMP). Since the completion of the RWMP, Palo Alto and Mountain View implemented Phase 2 of the RWQCP's Regional Recycled Water System, which replaced the deteriorated non-potable recycled water pipeline from Phase 1 and expanded non-potable recycled water service to the Shoreline area of Mountain View (see Figure 1-2). Both Palo Alto and Mountain View have completed individual planning studies looking at opportunities to expand recycled water in their respective service areas.

Figure 1-2: RWQCP Existing Water Reuse System



In 2008, Palo Alto completed a Recycled Water Facility Plan that recommended a Phase 3 project. The Phase 3 project would expand the non-potable recycled water system to South Palo Alto to serve landscape irrigation demands and potential dual-plumbed systems mainly within the Stanford Research Park area (see Figure 1-3). In the time that it took to certify the Program Environmental Impact Report for the Phase 3 project (2015), the recycled water setting changed. Notably, prolonged drought conditions and notable water shortages in southern California has moved forward public acceptance of potable reuse options and policy makers have begun to question the expansion of non-potable reuse (NPR) systems over long-term potable reuse options, including indirect potable reuse (IPR) and direct potable reuse (DPR). Spurred by the recent drought, the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) adopted a final version of the Groundwater Replenishments Regulations in 2014, providing a formal pathway for permitting IPR through groundwater augmentation. Regulations for permitting surface water augmentation, another type of IPR, were adopted in 2018. With the passage of Assembly Bill 574, the SWRCB is required to develop regulations for potable reuse through raw water

augmentation, a form of DPR, by 2023. While there is not yet a timeline established for development of potable reuse through treated drinking water augmentation, another form of DPR, several California agencies have begun to investigate this option. Accordingly, this Strategic Plan considers NPR, IPR, and DPR opportunities.

Figure 1-3: Proposed Phase 3 Recycled Water Project

Source: Woodard & Curran, 2018, Preliminary Design for Phase 3 Recycled Water Distribution System Final Report

In 2014, Mountain View completed a Recycled Water Feasibility Study that recommended near-term extension of recycled water into the NASA Ames Research Center and a longer-term extension south of US-101. These extensions would serve landscape irrigation demands and dual-plumbed systems. Currently (July 2019), Mountain View is in the process of updating the 2014 RWFS focusing on extending their existing system to Google and NASA, and across Highway 101.

To aid in future decisions regarding RWQCP recycled water expansion and commitments, Palo Alto, as the owner and operator of the RWQCP, saw a need to assess other RWQCP Partner Agencies' interests in recycled water. The RWQCP is interested in expanding the recycled water program to help move itself towards becoming a resource recovery facility by providing a drought-proof, sustainable, local water supply, and for recycled water's potential to help meet future regulatory actions pertaining to discharge limitations. In order to understand how to best expand the program, a comprehensive and holistic evaluation was needed to reassess the service area needs and acceptance given changes in water supplies and governing regulations.

Valley Water is also interested in understanding how flows from the RWQCP can support countywide water supply planning and its goal of using recycled and purified water to meet at least 10% (24,000 AFY) of the total county water demand by 2025. Valley Water recently completed a Pure Water Program planning study that looked at opportunities to implement potable reuse projects using water from the San Jose/Santa Clara Regional Wastewater Facility and the Sunnyvale Water Pollution Control Plant. Valley Water is now developing a Countywide Water Reuse Master Plan to understand recycled water opportunities, including NPR, IPR, and DPR, throughout Santa Clara County. The information from this Strategic Plan will support the Countywide Water Reuse Master Plan and help Valley Water identify wastewater flows that may be available for export from the RWQCP service area to other parts of the county.

The purpose of the Strategic Plan is to evaluate potential additional uses of recycled water within the RWQCP service area through the year 2030, to identify recycled water expansion concept options that look beyond individual agency boundaries, and to evaluate previously recommended recycled water projects with new expansion options developed through this Strategic Plan.

1.2 Organization of this Report

This report is organized as follows:

- **Chapter 1: Background and Purpose of the Strategic Plan –**Background on previous recycled water projects in the Study Area and a description of the wastewater and water agencies in the Study Area
- **Chapter 2: Recycled Water Demand Assessment –**Description of allowable recycled water uses and the Study Area market assessment
- **Chapter 3: Project Concept Options** –Description of the different recycled water concept options developed under this Strategic Plan
- **Chapter 4: Strategic Plan Concept Options Evaluation** –Summary of the evaluation of the concept options based on cost and non-cost criteria
- **Chapter 5: Conclusions and Next Steps** –Summary of the conclusions on the Strategic Plan concept options and next steps to be undertaken if the concept options are to move into implementation

1.3 Study Area

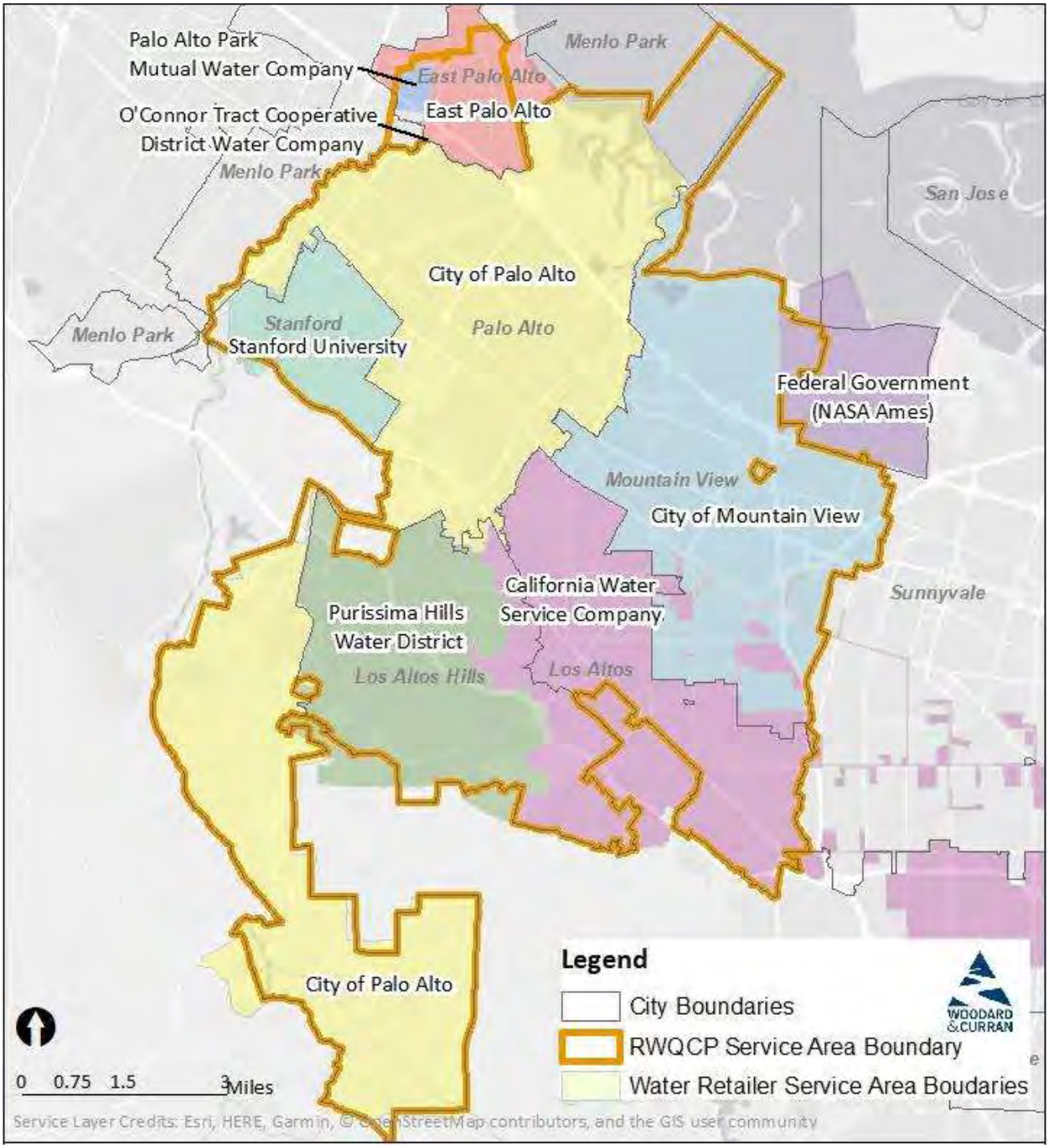
The Study Area for the Strategic Plan encompasses the RWQCP service area, shown in Figure 1-1, as well as additional areas in the Cities of East Palo Alto and Menlo Park not served by EPASD.

EPASD, which is one of the RWQCP Partner Agencies, covers the majority of East Palo Alto and a small section of Menlo Park. The portions of these cities not served by EPASD are served by West Bay Sanitary District (WBSD), which is a tributary agency to Silicon Valley Clean Water in Redwood City. Currently recycled water infrastructure does not exist in these areas, although both WBSD and Redwood City have looked at opportunities to provide recycled water to these areas. Given the proximity of the RWQCP to East Palo Alto and Menlo Park and water supply shortfalls that existed in these communities when this project was initiated, the Study Area for this project was extended beyond the RWQCP service boundary to include the entirety of East Palo Alto and the northern portion of the Menlo Park Municipal Water's service area.

1.3.1 Water Supply Agencies

The Study Area is served by two water wholesalers and a number of retailers (Figure 1-4 and Table 1-1). The wholesalers are Valley Water and San Francisco Public Utilities Commission (SFPUC), and the retailers are Palo Alto, Mountain View, California Water Service Company (Cal Water), Purissima Hills Water District (PHWD), East Palo Alto, Stanford University, Palo Alto Park Mutual Water Company, O'Connor Tract Co-operative Water Company, Federal Government (NASA Ames), and Menlo Park Municipal Water.

Figure 1-4: Water Retailers (names indicated in black text)



Valley Water distributes potable water to portions of Santa Clara County, which encompasses all but the EPASD portion of the RWQCP service area. Valley Water sells water to 13 retailers including 2 retailers in the Study Area – Mountain View and Cal Water. Valley Water is a special district that was formed to address groundwater overdraft in the county. The water delivered to retailers is a combination of local surface water, imported water from the State Water Project and Central Valley Project and water transfers. As the Groundwater Sustainability Agency for the Santa Clara and Llagas subbasins, Valley Water manages the groundwater in Santa Clara County. Valley Water diverts local surface water as well as imported water to recharge facilities to augment natural groundwater recharge.

SFPUC is the water retailer for San Francisco as well as wholesaler to 26 agencies in the San Francisco Bay Area including 6 retailers in the Study Area – Palo Alto, Mountain View, PHWD, East Palo Alto, Stanford University, and Menlo Park Municipal Water. SFPUC's primary source of water is the Hetch Hetchy watershed of the Tuolumne River. The Tuolumne River is the largest tributary to the San Joaquin River, which feeds into the Sacramento-San Joaquin Bay-Delta.

In addition to water purchased from Valley Water and SFPUC, the majority of the Study Area retailers either utilize groundwater or have plans to develop groundwater supplies to meet demand projections. Cal Water and Stanford University currently use groundwater to meet demands. Palo Alto Park Mutual Water Company and the O'Connor Tract Co-operative Water Company rely solely on groundwater. Palo Alto and Mountain View maintain groundwater wells for emergency supply. East Palo Alto has plans to rehabilitate an existing well and develop an additional well for emergency and potential future water supply. Menlo Park Municipal Water has plans to develop groundwater as an emergency supply as well.

Stanford University is unique among the water retailers in this area in that its water supplies include local surface water and captured stormwater, which it uses to meet non-potable demands. Groundwater is used to supplement this non-potable system.

A review of retailers' 2015 Urban Water Management Plans (UWMPs) identified the demand imbalances described herein. Although the planning horizon for the Strategic Plan is through 2030, the water supply shortfalls summarized here go through the UWMPs' planning horizon of 2040. In normal years, East Palo Alto projected a shortfall by 2040; however, since completion of its 2015 UWMP, East Palo Alto has secured additional SFPUC supplies. During a single dry year, Menlo Park Municipal Water projected shortfalls beginning in 2020, and Mountain View, Cal Water and East Palo Alto projected shortfalls by 2040; however, since completion of its 2015 UWMP and given some major changes in land use policies, Mountain View has updated their projected shortfalls in a single dry year to occurred starting in 2020. During multiple dry years, Mountain View and Menlo Park Municipal Water project shortfall in all years beginning in 2020, and East Palo Alto projected shortfalls in all years given 2040 demands and in the second and third years under 2035 demands. Palo Alto, similar to many of the other RWQCP Partner Agencies', is subject to water supply reductions during droughts. Shortages are expected to become more frequent and more severe in the future as a result of climate change and other changes to the California water system. Both imported water and groundwater are at risk during dry periods.

Table 1-1 summarizes the water supply sources for each city as well as the current uses, projected needs, and the local wastewater agency.

Table 1-1: Summary of Water Supply Sources and Needs

City	Wholesaler	Retailer(s)	Current/ Planned Groundwater User (Y/N)	Projected Water Supply Shortfall[1] (Y/N)	Current Recycled Water User (Y/N)	Wastewater Agency
East Palo Alto	SFPUC / Self	• East Palo Alto (SFPUC, groundwater) • Palo Alto Park Mutual Water Company (100% groundwater) • O'Connor Tract Co-operative Water Company (100% groundwater)	Yes	Yes (2040)	No	RWQCP
Los Altos	Valley Water	Cal Water	Yes	Yes (2040)	No	RWQCP
Los Altos Hills	SFPUC	PHWD	No	No	No	RWQCP
Menlo Park	SFPUC	Menlo Park Municipal Water	Yes	Yes (2020)	No	West Bay Sanitary District
Mountain View	SFPUC & Valley Water	Mountain View	Yes	Yes (2020)	Yes	RWQCP
Palo Alto	SFPUC	Palo Alto	No	No	Yes	RWQCP
Stanford University	SFPUC	Stanford University	Yes	No	No	RWQCP

[1]*Projections for single dry year taken from retailer 2015 Urban Water Management Plans except Mountain View which is based on more updated information.*

1.3.2 Wastewater Agencies & Current Recycled Water Programs

Palo Alto owns and operates the RWQCP, a 39.0 MGD-dry weather capacity wastewater treatment plant for the benefit of the RWQCP Partners. The RWQCP discharges treated effluent to an outfall in Lower South San Francisco Bay and to Renzel Marsh, which ultimately drains to the Lower South San Francisco Bay via Matadero Creek. The RWQCP treats an average of 20 MGD of wastewater. In addition, a portion of RWQCP effluent is further treated at tertiary recycled water facilities located at the RWQCP. The tertiary recycled water facilities have a capacity of 4.5 MGD, though currently production averages 0.6 MGD. The RWQCP has existing agreements with its Partner agencies that provide them with the right to acquire all wastewater by-products, such as recycled water, in the proportion to their percentage of influent flow. Recycled water from the RWQCP is available to Los Altos, Los Altos Hills, Stanford University and EPASD through truck-fill stations, while Palo Alto and Mountain View receive recycled water through a purple-pipe distribution system. Palo Alto and Mountain View are the only retailers in the Study Area that currently use recycled water via a purple-pipe distribution system. The RWQCP has committed a peak flow of up to 1.0 MGD to Palo Alto and 3.0 MGD to Mountain View under an agreement that extends until 2060.

Palo Alto, Valley Water, and Mountain View partnered in the development of an Advanced Water Purification Feasibility Study and Preliminary/Conceptual Design Report in 2017 to evaluate advanced treatment options for total dissolved solids (TDS) reduction in the RWQCP's recycled water for use in

irrigating salt-sensitive plants and industrial processes. The Feasibility Study recommended implementation of an Advanced Water Treatment System (AWTS) to provide 1.125 MGD of reverse osmosis treated water, with optional future expanded production reaching 2.25 MGD. The AWTS water will be blended at a 1:1 ratio with tertiary recycled water from the RWQCP to bring salinity levels between 400-500 mg/L TDS, below the Palo Alto goal of 600 mg/L TDS.

The Study Area includes a portion of WBSD's service area. WBSD provides wastewater collection services for Menlo Park, Atherton, and Portola Valley; the portion of East Palo Alto that is not served by EPASD; and areas of Woodside, unincorporated San Mateo County, and unincorporated Santa Clara County. WBSD is currently implementing a satellite recycled water facility in the southern portion of Menlo Park Municipal Water's service area and is investigating the potential to implement a satellite recycled water facility in the northern portion of Menlo Park.

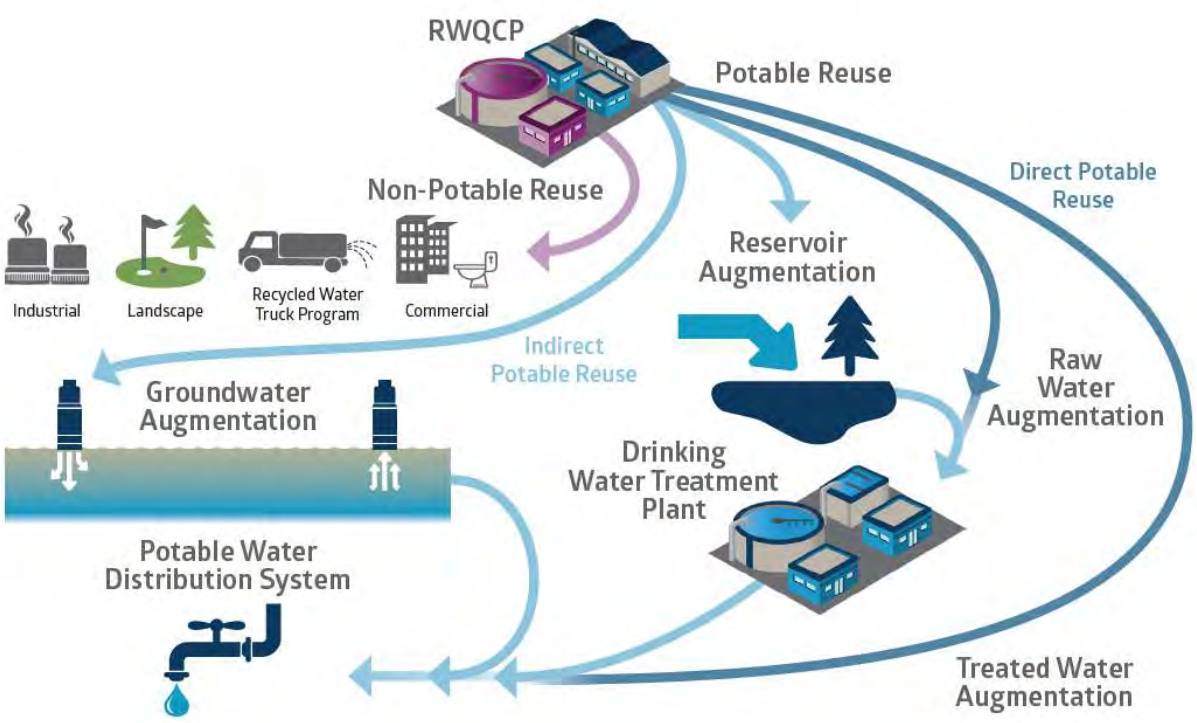
Chapter 2 Recycled Water Demand Assessment

2.1 Recycled Water Uses

2.1.1 Types of Recycled Water

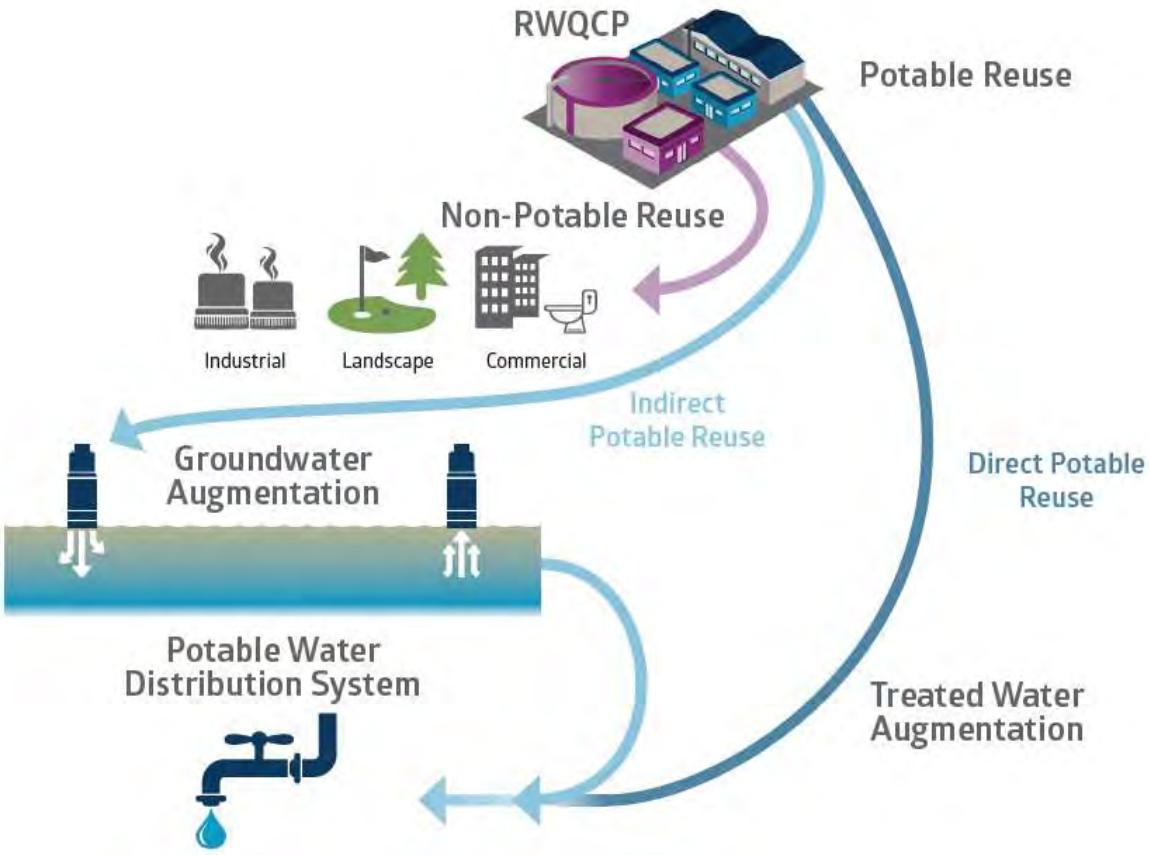
There are a variety of types of recycled water, as shown in Figure 2-1, covering both non-potable and potable reuse applications. These types of recycled water can lead to various options for how to implement conceptual projects in a specific setting. The applicability of these types of recycled water in the local setting is described in further detail later in this chapter.

Figure 2-1: Overview of Non-Potable and Potable Reuse Types



Because there is no suitable reservoir or a raw water treatment facility in the RWQCP service territory, reservoir augmentation and treated water augmentation were not evaluated. Figure 2-2 is an overview of the non-potable and potable options included in this report.

Figure 2-2: Overview of Non-Potable and Potable Reuse Types included in this Recycled Water Strategic Plan



Currently, the RWQCP produces recycled water that is treated to disinfected tertiary treatment standards and is compliant with Title 22 of the California Code of Regulations. This is defined as oxidized, filtered, and disinfected wastewater that meets a median concentration of total coliform requirements < 2.2 MPN/100mL and 5.0-log removal of viruses. This disinfected tertiary recycled water is suitable for all NPR uses considered in this study, which include landscape irrigation, dual plumbing, cooling towers, industrial process water and habitat enhancement. Further details about these non-potable uses, including associated water quality requirements requested by users and examples of potential users in the service area, are outlined in Section 2.2. The methodology used to assess NPR demands is summarized in Section 2.2.2.

IPR includes groundwater augmentation, either through percolation ponds or injection wells, where the purified recycled water mixes with the local groundwater and the mixture is extracted through existing or new wells for use in the potable (i.e., drinking) distribution system. IPR also includes reservoir augmentation, which is adding purified recycled water mixed in with local supplies in a reservoir that feeds to a surface water treatment plant, but is not considered in this Strategic Plan because no suitable reservoirs or surface water treatment plants exist proximate to the Study Area. The process to model available groundwater capacity to accept purified recycled water for recharge is included in Section 2.3.2.

DPR includes raw water augmentation, which would introduce purified recycled water upstream of a surface water treatment plant, and treated drinking water augmentation, which would introduce the purified recycled water directly to the drinking water distribution system. Raw water augmentation was not considered in this Strategic Plan because there are no surface water treatment plants within the service area of the one agency interested in DPR that also had sufficient information for this evaluation at the

time of this writing (i.e., Palo Alto). The methodology to estimate the amount of water available to direct towards DPR is included in Section 2.4.2.

2.1.2 Interests of the RWQCP Partner Agencies

The Strategic Plan team sent out surveys to the RWQCP Partner Agencies and other interested parties to gauge their interest in using recycled water to meet their current and projected demands. These stakeholders were asked about their interest in non-potable as well as potable uses, and the information received was used to inform the development of the concepts within this study. The results of the surveys are summarized in Table 2-1.

Table 2-1: Summary of Recycled Water Interests

Agency	Interested in use of Recycled Water from RWQCP	Types of Use of Interest						
		Landscape Irrigation (NPR)	Dual Plumbed Toilet Flushing (NPR)	Industrial Process Water (NPR)	Cooling Tower (NPR)	Habitat Enhancement (NPR)	Groundwater Augmentation (IPR)	Direct Potable (DPR)
City of Palo Alto	Yes	x	x	x	x	x	x	x
City of Mountain View	Yes	x	x		x			
City of Los Altos	Yes	x	x			x		
Town of Los Altos Hills	Yes	x						
East Palo Alto Sanitary District	Yes	x		x			x	x
Stanford University	No[1]		x					
Cal Water	Yes	x					x	x
City of East Palo Alto	Yes	x	x	x	x	x	x	x
City of Menlo Park	Yes	x	x	x	x			
West Bay Sanitary District	Yes	x	x	x	x		x	

Note:
1. Though Stanford University is not interested in receiving recycled water from the RWQCP, Stanford University is interested in using recycled water generated on-site for dual plumbed toilet flushing.

2.2 Non-Potable Uses

2.2.1 Potential Non-Potable Uses

Landscape Irrigation

Landscape irrigation sites identified for this study include parks, schools, commercial landscaping, multi-family residential landscaping, cemeteries, and golf courses. Irrigators in the Study Area have historically expressed concern with the salinity content in recycled water and its specific impacts to salt-sensitive species such as Redwood trees. To address these concerns and improve the quality of this water, Palo Alto, in collaboration with Valley Water and Mountain View, is planning to construct an AWTS facility

(see Section 1.3.2) to decrease RWQCP recycled water salinity and improve marketability for landscape irrigation purposes.

Dual Plumbing

Dual plumbing uses identified for this study include urinal and toilet flushing in existing dual-plumbed buildings and future developments identified in General Plans or Specific Plans where dual plumbing could be incorporated into the design of new commercial, industrial, and institutional buildings as well as multi-family residences. Existing buildings with dual-plumbing systems were included in the demand assessment; however, retrofitting existing buildings was not considered due to the cost and complexity of typical retrofits.

Because the majority of the Study Area is built out, there are few opportunities to implement dual-plumbing. East Palo Alto has the greatest potential for new development and redevelopment. This includes plans to redevelop the Ravenswood area to add various commercial and industrial buildings. In addition, various multi-residential developments were considered.

To promote dual-plumbing, Palo Alto has adopted an ordinance requiring buildings greater than 10,000 square feet within a designated Recycled Water Use Area to incorporate dual-plumbing (Palo Alto has yet to designate such an area), while Mountain View adopted the same guidelines for buildings greater than 25,000 square feet. Buildings in the planning phase that are anticipated to meet these thresholds were included as potential users. Many buildings currently under construction were approved prior to these ordinances and were not included in the demand assessment. As of this writing, no other dual plumbing or recycled water use ordinances exist within the RWQCP service area.

Cooling Tower

Cooling tower uses identified for this study include larger commercial and industrial buildings in the Study Area. Like landscape irrigation uses, cooling towers are sensitive to salinity levels in recycled water (as well as ammonia and certain metals). The AWTS (see Section 1.3.2) will make RWQCP recycled water more marketable for cooling tower purposes.

Industrial Process Water

Industrial process water use identified for this study was limited to one industrial customer in Palo Alto along the Phase 3 project pipeline alignment. The redevelopment in the East Palo Alto Ravenswood area has the potential to include industrial process water demands. However, given the uncertainty of future development plans, these potential industrial demands were not included.

Habitat Enhancement

Habitat enhancement is a potential non-potable use. While several stakeholders indicated an interest in habitat enhancement opportunities, only two specific concepts were identified:

- A horizontal levee near the RWQCP; however, because this project would be served with treated effluent without a chlorine residual and using a small dedicated pipeline, this opportunity is considered a potential habitat enhancement project beyond the scope of concept options developed for this study.
- Byxbee Park in Palo Alto was included in this study. Currently, through a pilot project, Byxbee Park receives recycled water to irrigate vegetated islands (Engelage, 2018).

Other Non-Potable Uses

Other non-potable uses in the Study Area that did not fall into the specific categories outlined above include street cleaning, car washes, and demands for Boronda Lake at Foothill Park.

2.2.2 Non-Potable Market Assessment

Site-specific water use estimates were obtained from the partner agencies, as available, including demand estimates for Palo Alto Phase 3 that were recently updated as part of the Palo Alto Phase 3 Business Plan and the Mountain View Recycled Water Feasibility Study.

Where site-specific information was not available from the agency, the methodologies described in Appendix A were used to estimate landscape irrigation, dual plumbing, and cooling tower demands. Estimates for other uses were developed as needed on a case by case basis. Peaking factors are summarized in Table 2-2.

For potential customers with the largest demand estimates, Palo Alto coordinated with the partner agencies to reach out to these potential customers to further refine the recycled water estimates.

2.2.3 Non-Potable Demand

The potential annual average recycled water demand for all non-potable users in the Study Area is 4,456 AFY or 3.98 MGD. These potential users are shown in Figure 2-3. Potential recycled water demand estimates for each non-potable customer, including a breakdown of estimated annual average, maximum day, and peak hour demands, are included in Appendix B. Appendix B includes each potential user's location, type of use (e.g. landscape irrigation, dual plumbing, industrial process water, cooling tower, etc.), site status (e.g. existing recycled water customer, existing water customer, future customer), Partner Agency, and water retailer. Appendix C contains a discussion of potential uses considered but not included in the Strategic Plan. These appendices are excluded from the public version of this report in compliance with the California Public Records Act, which protects certain utility usage data and customer information from disclosure.

The maximum day demand, defined as the average daily demand in July, for all non-potable uses in the service area is 6.84 MGD. The peaking factors used to develop the non-potable maximum day and peak hour demands are summarized in Table 2-2, and annual average and maximum day demands are summarized in Table 2-3. Peaking factors are a ratio of the maximum day or maximum hourly demand to the average day or average hourly demand.

The peak maximum day flows were used to size treatment facilities and peak hour demands were used to size pump stations and pipelines.

Table 2-2: Demand Peaking Factors

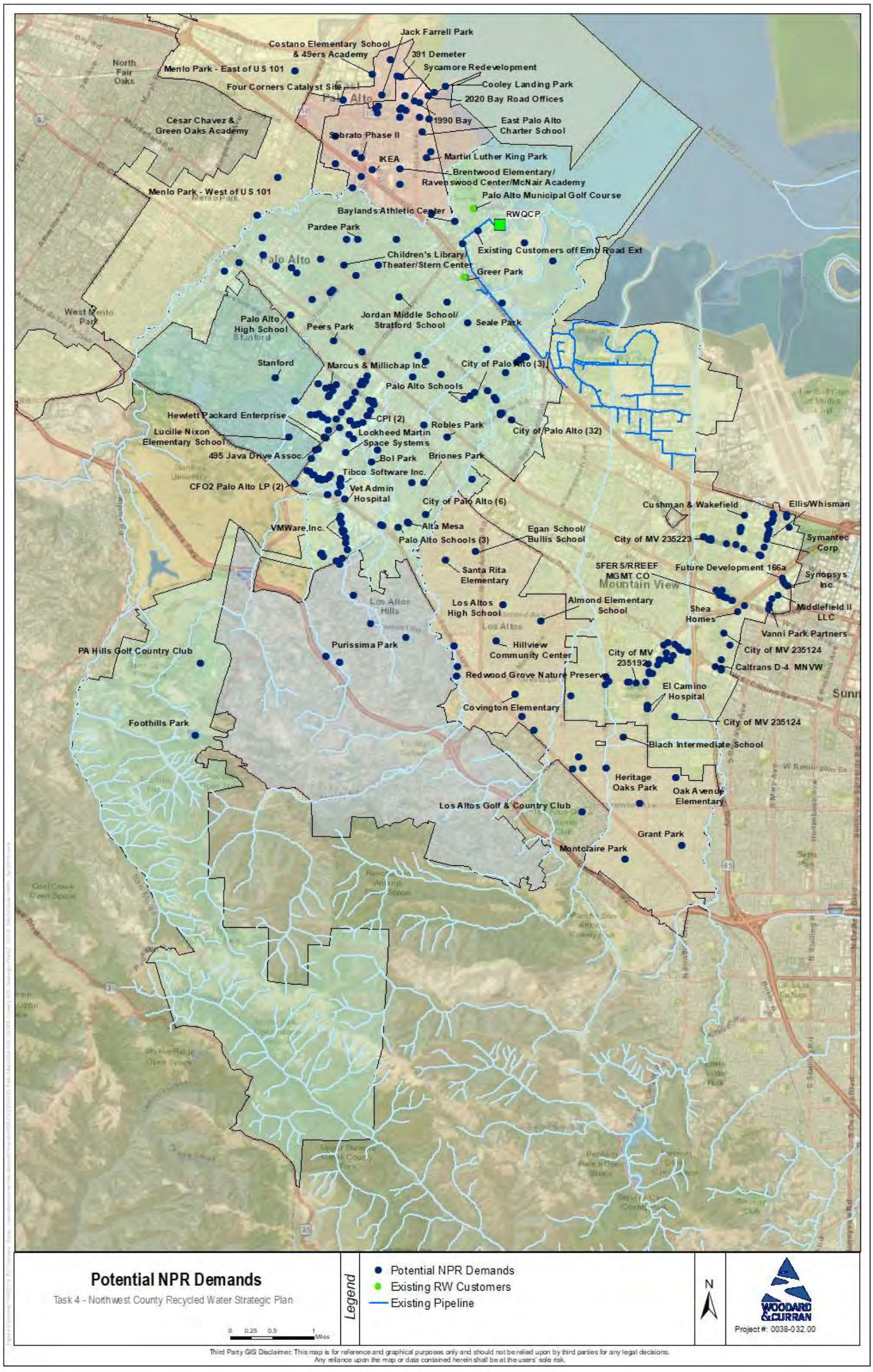
Demand Type	Peaking Factor
Maximum Day	
Irrigation	1.7
Cooling Tower	2.7
Hourly	
Irrigation[1]	3.0
Dual Plumbing	2.0
Cooling Tower	2.0

1. Irrigation hourly peaking factor applies to irrigation users who use water on demand. There are a small number of irrigation customers in the Study Area with on-site water storage where this peaking factor does not apply.

Table 2-3: Non-Potable Demand Summary

Demand Type	Value
Annual Average	4,456 AFY (3.98 MGD)
Maximum Day	6.84 MGD

Figure 2-3: Potential Non-Potable Users in Study Area



2.3 Indirect Potable Uses

2.3.1 Potential Indirect Potable Uses

Indirect potable uses identified for this study focused on groundwater augmentation via injection wells. Due to the densely developed nature of the Study Area and high cost of land, groundwater augmentation via surface spreading is not viable. IPR requires full advanced treatment of recycled water. The conventional full advanced treatment train consists of membrane filtration, reverse osmosis, and an ultraviolet light -advanced oxidation process. These advanced water purification processes are designed to remove or inactivate a spectrum of constituents, including viruses, parasites, N-Nitrosodimethylamine, and 1,4-dioxane.

Within East Palo Alto, the potential to use the city's existing or future wells for IPR extraction was considered. However, after additional discussion regarding injection well siting and uncertainty of the benefit of groundwater augmentation in this area, IPR use in East Palo Alto was not considered further.

Groundwater augmentation within the Cal Water service area in Los Altos was also discussed but eliminated from the project concept options analysis. Cal Water's service area is within the area of the groundwater basins that is actively managed by Valley Water, and groundwater use in this area was deemed to be better addressed through the Valley Water's countywide efforts rather than through this Strategic Plan.

Results from a recently completed Groundwater Assessment, and Indirect Potable Reuse Feasibility Evaluation and Implementation Strategy (IPR Feasibility Evaluation) indicated that IPR within Palo Alto was technically feasible given the current condition of the aquifers in northwestern Santa Clara County and the potential to supplement Palo Alto's water supply with groundwater. Modeling results from the IPR Feasibility Evaluation and the scenario that was selected to be included in this study's project concept options are discussed in the following section.

2.3.2 Indirect Potable Reuse Assessment

The IPR Feasibility Evaluation (Todd 2018) included a characterization of hydrogeologic conditions in Palo Alto and the surrounding areas. An initial evaluation of the feasibility of increased pumping by Palo Alto was based on historical and contemporary groundwater balances in the area. Subsequently, groundwater modeling was conducted to refine the estimate of groundwater yield available to Palo Alto with and without varying levels of IPR. From the groundwater modeling assessment, one scenario was selected for use in this Strategic Plan as it represented a technically feasible recharge and extraction scenario with no projected adverse impacts, and the volume was deemed conservative and achievable while still providing a substantial volume for use. The selected scenario, referenced as Scenario 4 in the IPR Feasibility Evaluation, includes recharge of 2,800 AFY of fully advanced treated recycled water with Palo Alto extracting 5,900 AFY of augmented groundwater (i.e., mixture of groundwater and injected recycled water) to supplement potable water supplies.

2.3.3 Indirect Potable Demand

Based on Scenario 4 of the IPR Feasibility Evaluation, the annual recycled water IPR demand is 2,800 AFY. This converts to a daily demand of 2.5 MGD and is the volume of treated water that can be used for injection purposes. Once injected, the volume of water that can be sustainably extracted from the groundwater basin (or the "Project Yield") under this scenario is 5,900 AFY (or 5.27 MGD). These demands and yields are summarized in Table 2-4.

Table 2-4: IPR Demand and Groundwater Project Yield Summary

Demand Type	Value
Annual Recycled Water Demand (Daily Recycled Water Demand)	2,800 AFY (2.50 MGD)
Annual Project Yield (Daily Project Yield)	5,900 AFY (5.27 MGD)

These demand and project yield values were adjusted for IPR concept options that included NPR uses. This is further detailed in Section 3.5.3.

2.4 Direct Potable Uses

2.4.1 Potential Direct Potable Uses

At the initial stages of this study, Palo Alto, the East Palo Alto Sanitary District, East Palo Alto, and Cal Water all expressed an interest in DPR. Although DPR regulations for both raw water and treated drinking water augmentation are not yet developed, the SWRCB's DDW released a framework for these regulations in April 2018. This framework considered recycled water used for DPR purposes to be treated by full advanced treatment standards, at a minimum.

This framework also included surface water treatment as a necessary component of raw water augmentation. Because there is no dedicated surface water treatment plant in the Study Area, treated drinking water augmentation is considered the only feasible DPR option available at this time. Per anticipated DDW regulations, treated drinking water augmentation (colloquially called a "pipe-to-pipe" approach) requires water to be treated to potable standards at the advanced water treatment plant (AWTP) that would include full advanced treatment plus other treatment processes. For DPR use in Palo Alto, an AWTP would be located at the RWQCP. Meanwhile for DPR use in the East Palo Alto Sanitary District, East Palo Alto, or the Cal Water service area, the AWTP could be located at the RWQCP or a satellite site. AWTP water would then be kept in engineered storage and delivered directly to the potable water distribution system.

DPR use in Palo Alto was considered as a project concept option (D1) in this study and is further discussed in Section 3.6.

2.4.2 Direct Potable Reuse Assessment

Each partner agency to the RWQCP (including Palo Alto) retains the right to reuse as much recycled water as wastewater that was sent from their agency to the RWQCP for treatment. As such, the amount of potential DPR yield was based on Palo Alto's share of the RWQCP effluent flow, which is 7.31 MGD or about 36% of the RWQCP's average annual flow (20.3 MGD, 2010-2018 average). With 1.0 MGD assumed to be dedicated to other recycled water customers in Palo Alto, the available flow estimated to feed a DPR facility is 6.31 MGD. Finally, after accounting for a 25% rejection rate during the treatment process, the amount of produced water for potable consumption was estimated to be 4.73 MGD (average and maximum day are the same in this case such that the DPR facility operates at a constant steady rate). Similarly, this converts to an average annual demand of 5,300 AFY of 4.73 MGD. The development of this DPR demand estimate is summarized in Table 2-5.

Table 2-5: DPR Demand Estimate Summary

RWQCP Average Annual Flow (2010-2018)	Palo Alto's Share of RWQCP Effluent Flow	Flow Available as DPR Input	Flow Produced as DPR Output
20.3 MGD	7.31 MGD	6.31 MGD	4.73 MGD (5,300 AFY)

2.5 Other Potential Uses Outside of Study Area

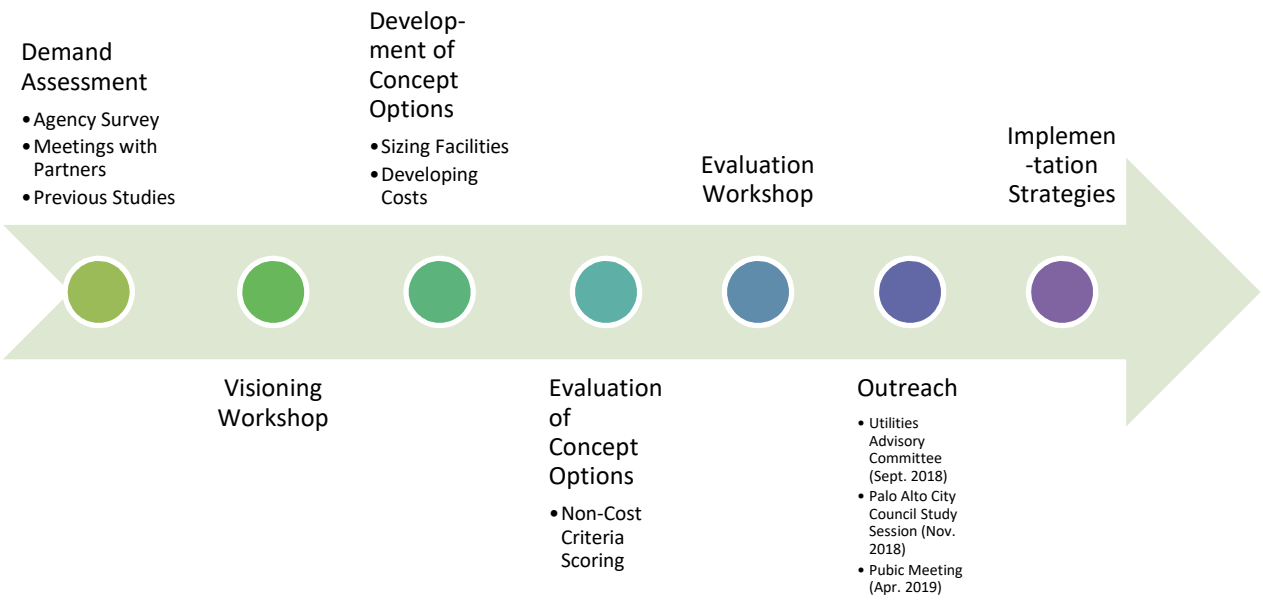
In addition to the Strategic Plan, Valley Water is collaborating with local stakeholders to develop a Countywide Water Reuse Master Plan (Countywide Plan). This effort aims to integrate and expand recycled and purified water as a local and drought-proof water supply throughout Santa Clara County. The plan is projected to be completed by June 2020. Valley Water's goal is to develop recycled water to provide for at least 10% of the total county demands by 2028 by developing up to 24,000 AFY of additional potable reuse. Valley Water is exploring sourcing water from a variety of wastewater treatment facilities in Santa Clara County. One of the options being considered by the Countywide Plan is export of water from the RWQCP for potable reuse further south in Santa Clara County, where Valley Water operates recharge ponds. Depending on the outcomes of the Countywide Plan, some of the Concept Options described in this Report may not implementable due to limited supply of recycled water; further evaluation for joint implementation may be required.

Chapter 3 Strategic Plan Concept Options

3.1 Summary of Approach

Figure 3-1 summarizes the process used to develop the Strategic Plan concept options, or expansion opportunities. The approach was to start by incorporating key findings from previous studies, and to then survey and meet with the various agencies to validate previous findings and to confirm future interests. Through a Visioning Workshop, the consultant team aided the agencies in identifying and prioritizing opportunities for recycled water within the study area and to select concept options for further analysis. The consultant team then provided technical development of the concept options and preliminary evaluations which were confirmed with the agencies at an Evaluation Workshop. After completion of the evaluation of the concept options, implementation strategies for each recycled water use type were then defined.

Figure 3-1: Summary of Overall Approach to Strategic Plan Concept Option Development and Assessment



3.2 Concept Option Development Process

This section summarizes the objectives, screening process, and engineering design criteria used to develop the Strategic Plan concepts considered in the study.

3.2.1 Objectives in Concept Option Development

The following objectives guided the development of Strategic Plan Concept Options for the Study Area:

1) **Develop Cost Effective Concept Options:** To meet this objective, concept options were developed around large potential users as well as dense areas of users. Users with estimated demands greater than 50 AFY were included in at least one of the preliminary concept options presented to stakeholders for screening. The intent was that these customers would serve as anchor customers along an alignment, providing sufficient demand to justify needed infrastructure costs. However, because many of the large users are on the edge of the Study Area, the cost effectiveness of including some of these customers became less certain. While aiming to

meet the most demand in each concept option, the distance between customers was also considered such that concept options focused on clusters of users that could be served from a common pipeline. Extensions off the main pipeline generally were not pursued for users with less than 5 AFY of demand.

2) **Pursue Regional Solutions:** One of the primary goals of the Strategic Plan is to assess whether a regional approach to recycled water projects in the RWQCP service area would result in concept options that are more economically-feasible to implement and multi-beneficial. With this in mind, concept options were developed that incorporated multiple jurisdictions and water retailers to analyze whether this created beneficial outcomes in the Study Area.

3.2.2 Preliminary Concept Options Screening

In March 2018, Palo Alto and Valley Water conducted a Visioning Workshop with interested RWQCP Partner Agencies, water retailers, and neighboring agencies. At the workshop, a number of preliminary concept options were presented to the stakeholder group and valuable input received. Through discussion with the stakeholders, some of the concept options were modified, while others were eliminated. Additionally, a concept option looking at satellite treatment for non-potable reuse – versus centralized treatment at the RWQCP – was added.

The remainder of this chapter, beginning in Section 3.3, includes a description of each of the concept options evaluated. The concept options are divided into four categories:

- "A" series for NPR concept options from RWQCP (Section 3.2)
- "B" concept option for NPR from satellite treatment (Section 3.3)
- "C" series for IPR concept options (Section 3.4)
- "D" concept option for DPR (Section 3.5)

3.2.3 Engineering Design Criteria

Hydraulic Criteria

The criteria used to size the distribution infrastructure for new concept options developed as part of this study are summarized in Table 3-1. In general, the minimum pressure criterion establishes the hydraulic grade line (HGL) required, which in turn helps define pumping requirements. The maximum flow velocity criterion generally governs pipe sizing.

Table 3-1: Hydraulic Criteria

Description	Value
Pipelines	
Minimum Pressure at Standard Pressurized Customer Connections	40 psi
Minimum Pressure at Injection Well Connections[1]	15 psi
Minimum Pressure at Pond Storage Customer Connections	10 psi
Maximum Customer Pressure[2]	120 psi
Minimum Pipe Size	6 in
Maximum Flow Velocity	5 ft/s
Pump Stations	
Assumed Pumping Efficiency	75%
Non-Overloading Horsepower Adjustment	10%
Maximum Standard Motor Size, Each Pump	100 hp

Notes:
1. Determined to be the minimum required pressure for injection wells, per communication with Sally McCraven, Todd Groundwater.
2. Certain customer demand nodes exceed the maximum pressure criterion at times, which is acceptable to maintain minimum service pressures elsewhere. Customers with high pressures will require a pressure regulating valve on the service line.

A spreadsheet was developed to model each concept option's pipe network and optimized backbone pipe sizes. Each alignment was divided into segments, and peak hour flows for each customer along or downstream of a given segment were aggregated to determine the minimum pipeline diameter needed to convey maximum flows. This model was utilized to check pressure at customer connections and determine each concept option's pump station sizes.

To develop conceptual costs at this planning level, hydraulic head required at the RWQCP to serve the concept options was treated as a separate pump station at the RWQCP location. The potential for integrating this hydraulic capacity to existing facilities at the RWQCP would need to be analyzed upon further development of any concept option. The results for each concept option's hydraulic analysis, including pipeline and pump station sizing, are summarized in Sections 3.3 to 3.6.

Treatment Criteria

Palo Alto has committed to delivering 3.0 MGD of enhanced recycled water to Mountain View and 1.0 MGD to Palo Alto for non-potable uses. As discussed in Section 1.3.2, Palo Alto is planning to implement an AWTS to provide 1.125 MGD of reverse osmosis treated water, which will be blended at with RWQCP tertiary recycled water to produce enhanced recycled water with a target TDS level below 600 mg/L. Plans for the AWTS include potential expansion to produce 2.25 MGD of reverse osmosis treated water.

In evaluating additional treatment needs for the centralized NPR concept options ("A" series) in this study, it is assumed that the 2.25 MGD AWTS facility will be constructed. If a combination of the AWTS facility and the existing 4.5 MGD granular media filters can be used to meet the total demand for a concept option including the current flow commitments for NPR in Mountain View and Palo Alto while still meeting a 600 mg/L TDS target, additional treatment is not included. As such, the 1:1 blend ratio used in the 2017 Advanced Water Purification Feasibility Study and Preliminary/Conceptual Design Report is not used for this study. Rather, 2.25 MGD AWTS produced water with TDS of 50 mg/L is assumed to be combined with the balance of RWQCP tertiary recycled water needed to meet the concept option demand with TDS of 900 mg/L. Consequently, the final TDS concentration varied depending on the concept option tertiary recycled water demand, however all concept options remained below the 600 mg/L TDS goal. This approach allows the NPR concept options to be consistent with the previously

completed Feasibility Study while maintaining sufficient operational flexibility to ensure cost effective solutions to meet enhanced recycled water demands.

For non-potable uses served from a satellite treatment facility, this study assumes the facility to provide disinfected tertiary treated recycled water and that saline inflow and infiltration is negligible.

For IPR, recycled water would be treated to full advanced treatment standards for injection (membrane filtration, reverse osmosis, and an ultraviolet light -advanced oxidation process). In addition, each extraction well is planned to have wellhead treatment per Option 4 of Palo Alto's 2017 Water Integrated Resources Plan. Option 4 includes treatment for iron, manganese, and TDS at each well site such that the extracted water will be comparable to SFPUC water supplies. Option 4 is the treatment option assumed for this study since this is most comparable to the existing Palo Alto supply and most likely to gain customer acceptance.

For DPR, treatment standards were designed to align with guidance provided by the SWRCB in its Proposed Framework for Regulating Direct Potable Reuse in California (April 2018). Also, the SWRCB's Feasibility Report on Developing Uniform Water Recycling Criteria for DPR indicated that DPR treatment trains should be sourced from tertiary recycled water (defined as any process employed after secondary treatment to further improve water quality). Therefore, the water quality of the influent wastewater for DPR was assumed to be final effluent from the RWQCP; the RWQCP is a tertiary treatment facility that treats all of its wastewater beyond secondary treatment standards. In addition to the steps required to treat recycled water to full advanced treatment standards, the DPR train would include ozone, biologically active filtration, and free chlorine process steps.

Reverse osmosis concentrate treatment is included in concept options as necessary to maintain compliance with the RWQCP's NPDES discharge permit. The 2017 Advanced Water Purification Feasibility Study identified maximum AWTS sizes to comply with the RWQCP's permit without concentrate treatment under the following scenarios:

- Scenario 1. All enhanced recycled water: This scenario assumes all of the advanced treated water from the AWTS is blended with tertiary-treated recycled water at a 1:1 ratio and distributed to customers.
- Scenario 2. All potable reuse: This scenario assumes all of the advanced treated water from the AWTS would be used for potable reuse and no blending with tertiary-treated recycled water would occur.
- Scenario 3. Enhanced recycled water with additional potable reuse: This scenario assumes implementation of a 2.25 MGD AWTS for enhanced recycled water production (4.5 MGD of total enhanced recycled water capacity) with the remaining advanced water purification facility (AWPF) capacity for potable reuse.

Table 3-2 summarizes the findings from the feasibility study which were based on a conservative approach in order to meet the various maximum daily permit limits. The scenarios relevant to this planning effort are Scenarios 1 and 3. The Strategic Plan assumes that the 2.25 MGD enhanced recycled water AWTS will be constructed to meet the RWQCP's existing commitments to Mountain View and Palo Alto. If any of the NPR concept options were to require additional AWTS treatment capacity, the threshold above which concentrate treatment would be needed is an additional 1.65 MGD of AWTS capacity (for total enhanced recycled water capacity of 7.8 MGD). For the IPR and DPR concept options (which both including reverse osmosis in their treatment trains), the threshold above which concentrate treatment would be needed is 2.5 MGD.

Table 3-2: Maximum AWTS Sizes Without Requiring Reverse Osmosis Concentrate Treatment

	Maximum AWTS Size (MGD)	AWTS for Enhanced Recycled Water Size (MGD)	Enhanced Recycled Water Produced (MGD)	AWPF for Potable Reuse Size (MGD)
Scenario 1: All Enhanced Recycled Water	3.9	--	7.8	--
Scenario 2: All Potable Reuse	5.8	--	--	5.8
Scenario 3: Enhanced Recycled Water AWTS of 2.25 MGD with Additional Potable Reuse	4.8	2.25	4.5	2.5

Note: The sizing is based on the RWQCP's minimum daily flow of 12 MGD. See MNS Advanced Water Purification System Preliminary/Conceptual Design Report, December 2017, for additional details.

3.3 Concept Options A: NPR from RWQCP

There are six concept options in the "A" series that contain different pipeline alignments to meet differing NPR demands throughout the Study Area:

- A1: The Phase 3 Pipeline to south Palo Alto recommended in the 2008 City of Palo Alto Recycled Water Facility Plan and reassessed through the 2018 Phase 3 Business Plan and 2018 Preliminary Design Report. This concept option was included in this study in order to evaluate its feasibility relative to other concept options.
- A2: Extends the Phase 3 Pipeline (Concept Option A1) to serve additional customers in the Palo Alto Foothills and Los Altos Hills.
- A3: Extends Concept Option A2 to serve additional customers in Los Altos.
- A4: Extends the Mountain View Systems in accordance with the Long-Term Expansion Project from the 2014 Mountain View Recycled Water Feasibility Study. This concept option was included in this study in order to evaluate its feasibility relative to other concept options.
- A5: Extends Concept Option A4 to service customers in Los Altos.
- A6: Serves existing and future customers in East Palo Alto and Palo Alto and includes sizing facilities for an extension to Menlo Park.

3.3.1 Concept Option A1: NPR Palo Alto Phase 3

Concept Option A1 is the Phase 3 Pipeline to south Palo Alto recommended in the 2008 Palo Alto Recycled Water Facility Plan and reassessed through the 2018 Phase 3 Business Plan and 2018 Preliminary Design Report. Facilities for the concept option are summarized in Table 3-3 and shown on Figure 3-2.

Notable items from Concept Option A1 are:

- Customers: Unlike other customers on Phase 3, the anchor customer for this Concept Option relies on groundwater for its water supply and does not currently receive water service from Palo Alto.
- Pipelines: Build off the existing 30-inch recycled water backbone along Embarcadero Road.
- Pump Stations: Two - 1) expansion of existing recycled water pump station at the RWQCP; and 2) a booster pump station along the Phase 3 alignment.

Table 3-3: Demand and Facility Summary for Concept Option A1, NPR Palo Alto Phase 3

Customer Location	Number of Users	Demand Total (AFY)
Palo Alto – Phase 3	109	634
Anchor Customer[1]	1	167
Total	**110**	**801**

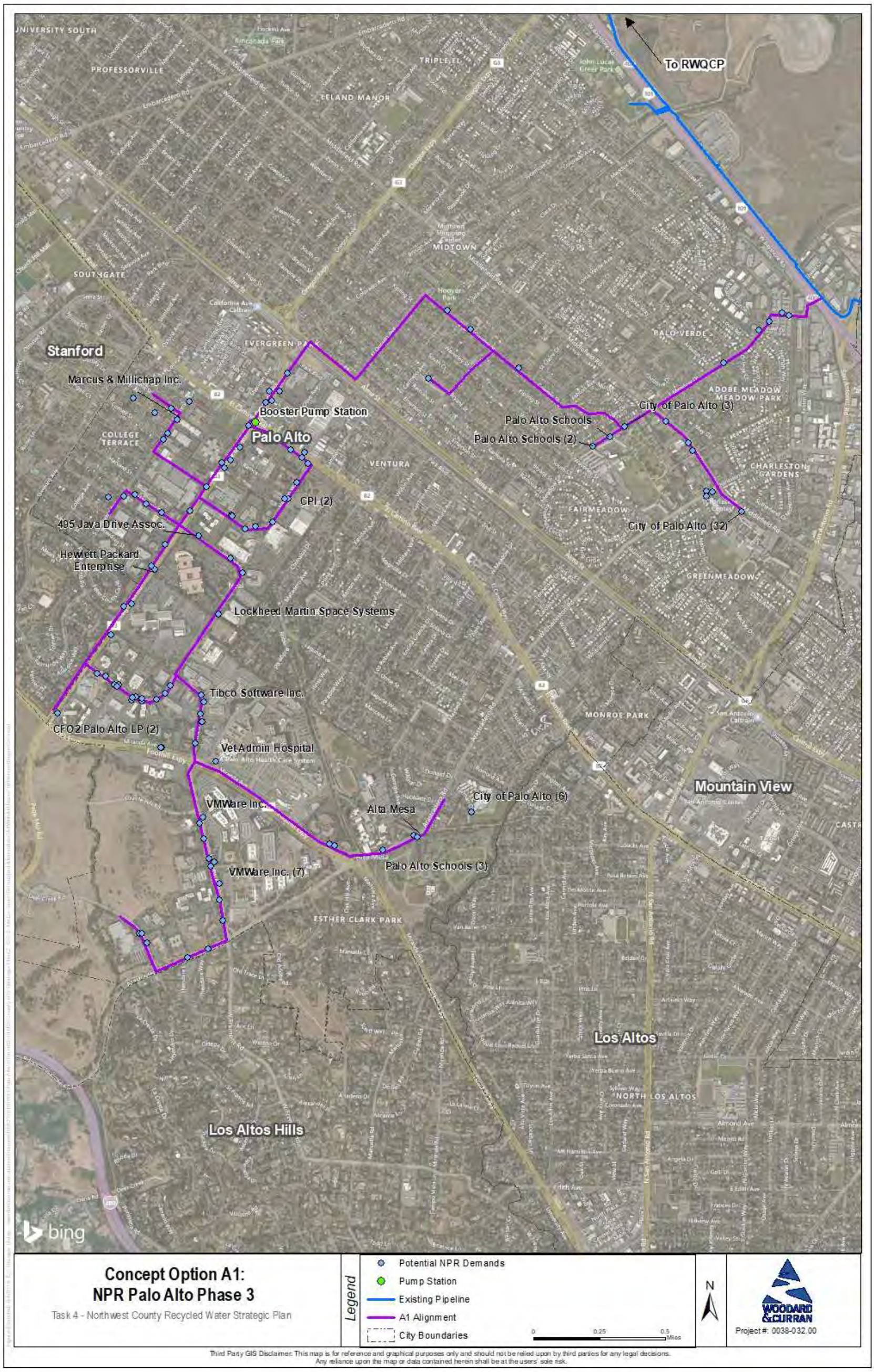
Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	18,500
8	9,000
10	7,200
12	23,200
Total Length (LF)	**57,900**
Total Length (mi)	**11.0**

Description	Performance Requirements	
	Recycled Water Pump Station	Phase 3 Booster Pump Station
Required Flow	1,637 gpm	1,408 gpm
Discharge Head	200 ft	198 ft
Pump Configuration (duty + standby)	2 (duty)	3+1
Pump Motor Rating (each)	100 hp	60 hp
Total Installed Motor Horsepower	200 hp	240 hp

Notes:

1. Anchor customer is distinguished from the rest of the Phase 3 customers because, unlike others, this customer relies on groundwater for its water supply and does not currently receive water service from Palo Alto.

Figure 3-2: Alignment for Concept Option A1, NPR Palo Alto Phase 3



3.3.2 Concept Option A2: NPR Palo Alto Phase 3 Extended to Foothills

Concept Option A2 extends the Phase 3 Pipeline in Concept Option A1 to serve additional customers in the Palo Alto Foothills and Los Altos Hills. The Concept Option A2 alignment is shown in Figure 3-3. A summary of the customers included in this concept option and their corresponding demand values and facilities are outlined in Table 3-4.

Some notable items for Concept Option A2 are:

- Customers: Concept Option A2 captures two additional high demand customers and benefits an additional RWQCP partner by including a branch to Los Altos Hills.
- Pipelines: Build off of the existing 30-inch recycled water backbone in Embarcadero Road.
- Pump Stations: Four - Expansion of the existing recycled water pump station at the RWQCP and three booster pump stations at optimized locations throughout the alignment.

Table 3-4: Demand and Facilities Summary for Concept Option A2, NPR Palo Alto Phase 3 Extended to Foothills

Customer Location	Number of Users	Demand Total (AFY)
Palo Alto – Phase 3	109	634
Anchor Customer No. 1[1]	1	167
Anchor Customer No. 2	1	169
Foothills Park	1	75
Los Altos Hills	3	24
Total	**115**	**1069**

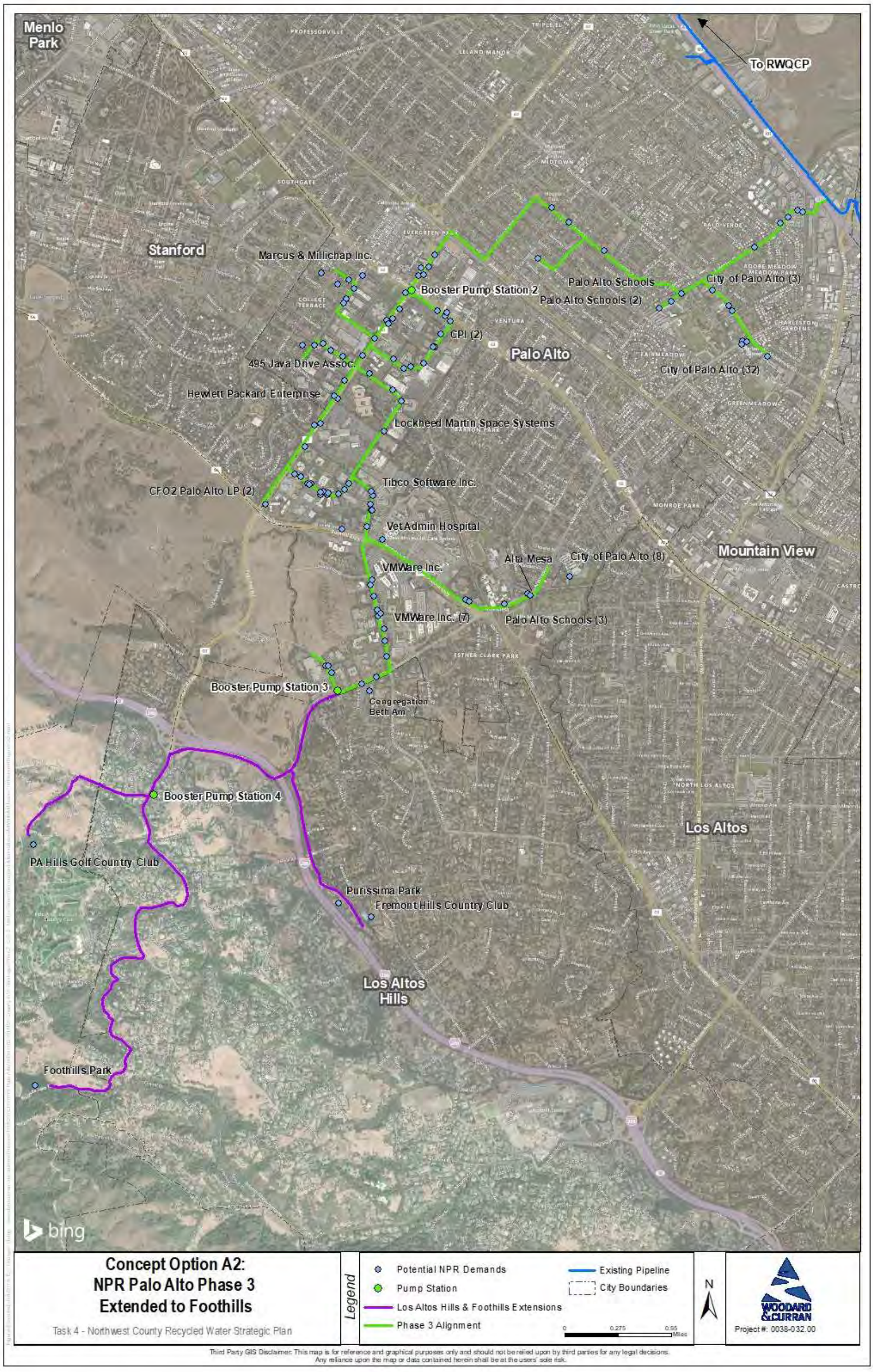
Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	55,100
8	8,600
10	5,900
12	1,000
16	8,000
Total Length (LF)	**78,600**
Total Length (mi)	**14.9**

Description	Performance Requirements			
	Recycled Water Pump Station (PS1)	Booster Pump Station #2 (PS2)	Booster Pump Station #3 (PS3)	Booster Pump Stations #4 (PS4)
Required Flow	2,270 gpm	1,887 gpm	268 gpm	161 gpm
Discharge Head	178 ft	285 ft	174 ft	588 ft[3]
Pump Configuration (duty + standby)	3+1	3+1	1+1	2+1
Pump Motor Rating (each)	50 hp	75 hp	20 hp[2]	20 hp
Total Installed Motor Horsepower	200 hp	300 hp	40 hp	60 hp

Notes:

1. Required discharge head at Booster Pump Station #4 is notably larger due to the 610-foot elevation increase from its location to the end user (Foothills Park).
2. After assessing the feasibility of other hydraulic configurations (including removing Booster Pump Station #3 and upsizing other booster pump stations), it was determined that including Booster Pump Station #3 at the specified pump motor rating was optimal to meet pressure criteria at nearby customers.
3. Anchor Customer No. 1 is distinguished from the rest of the Phase 3 customers because, unlike other customers on Phase 3, this customer relies on groundwater for its water supply and does not currently receive water service from Palo Alto.

Figure 3-3: Alignment for Concept Option A2, NPR Palo Alto Phase 3 Extended to Foothills



3.3.3 Concept Option A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos

Concept Option A3 extends the Phase 3 Pipeline to serve additional customers in the Palo Alto Foothills, Los Altos, and Los Altos Hills to capture some of the highest potential demands as well as create a more regional NPR concept option.

The original intent of this concept option was to capture customers within the northern portion of Los Altos by branching off of the proposed Phase 3 pipeline on Arastradero Road, crossing Adobe Creek and ending at Hillview Community Center. However, during development of the proposed alignment, it was determined that crossing to Los Altos from the Alta Mesa Memorial Park region required too much disruption and coordination with private entities. As such, the alignment to Los Altos extends eastward to Briones Park, down El Camino Real, and southwards towards Covington Elementary School, resulting in a longer length of pipeline than initially envisioned.

The Concept Option A3 alignment and customer demands are shown in Figure 3-4. A summary of the customers included in this concept option and their corresponding facilities are outlined in Table 3-5.

- Customers: Serves customers in Palo Alto, Los Altos, and Los Altos Hills including Briones Park and Elementary School in Palo Alto.
- Pipelines: Concept Option A3 would be built off of the 24-inch recycled water pipeline on East Bayshore. In order to meet the additional demands in the Palo Alto Foothills, Los Altos, and Los Altos Hills, some of the Phase 3 pipeline segments were upsized for additional capacity.
- Pump Stations: Five – expansion of the existing recycled water pump station at the RWQCP and four booster pump stations at optimized locations throughout the alignment.

Table 3-5: Demand and Facilities Summary for Concept Option A3, NPR Palo Alto Phase 3 Extended to Foothills and Los Altos

Customer Location	Number of Users	Demand Total (AFY)
Palo Alto – Phase 3	109	634
Anchor Customer No. 1[1]	1	167
Briones Park	1	14
Briones Elementary School	1	5
Anchor Customer No. 2	1	169
Foothills Park	1	75
Los Altos	8	143
Los Altos Hills	3	24
Total	**125**	**1231**

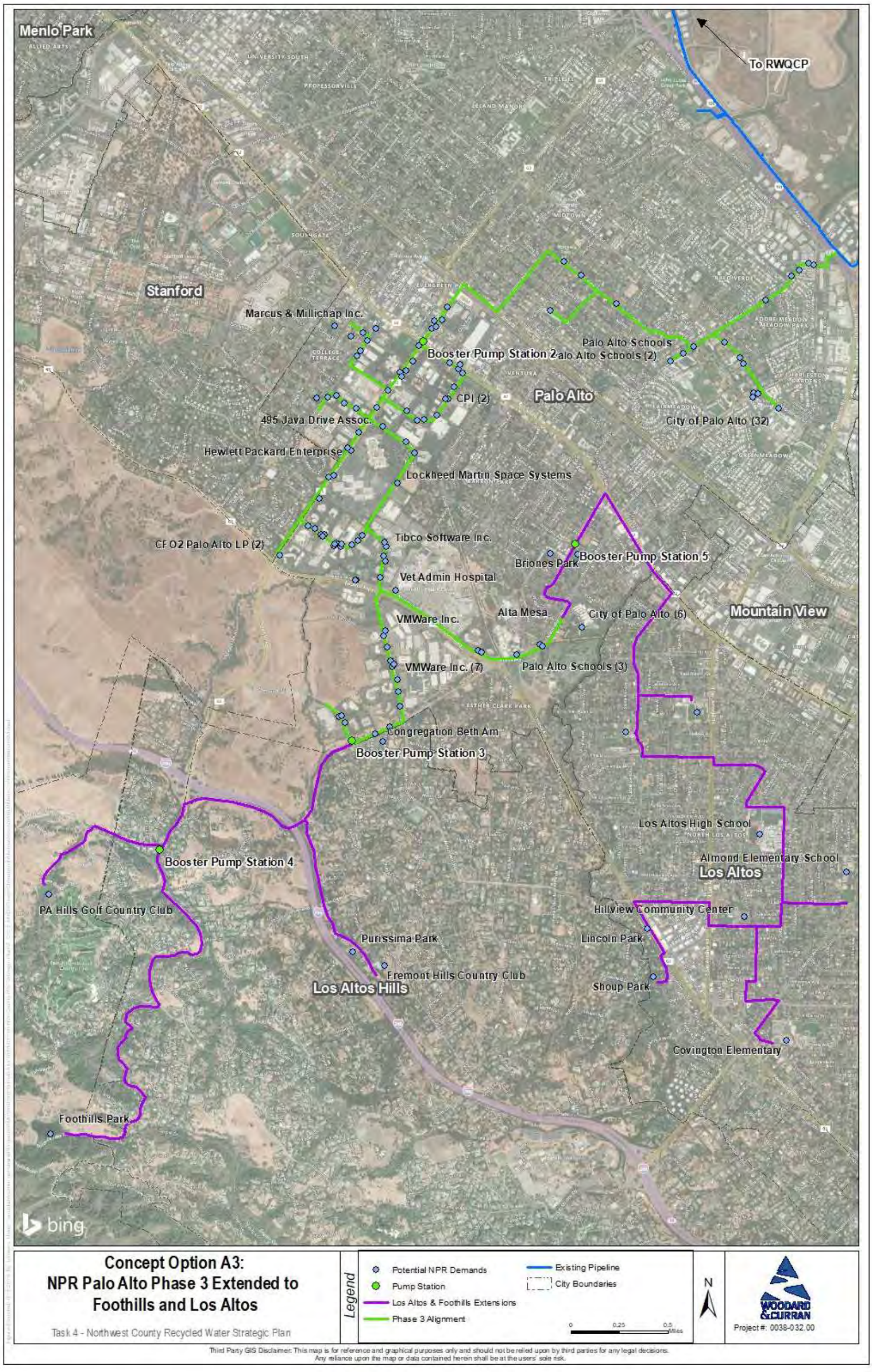
Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	65,000
8	32,700
12	3,600
16	9,000
Total Length (LF)	**116,200**
Total Length (mi)	**22.0**

Description	Performance Requirements				
	Recycled Water Pump Station (PS1)	Booster Pump Station #2 (PS2)	Booster Pump Station #3 (PS3)	Booster Pump Station #4 (PS4)	Booster Pump Station #5 (PS5)
Required Flow	2,783 gpm	2,399 gpm	268 gpm	161 gpm	454 gpm
Discharge Head	204 ft	271 ft	174 ft	588 ft	133 ft[2]
Pump Configuration (duty + standby)	3+1	4+1	1+1	2+1	2+1
Pump Motor Rating (each)	75 hp	60 hp	20 hp	20 hp[3]	23d hp
Total Installed Motor Horsepower	300 hp	300 hp	40 hp	60 hp	69 hp

Notes:

1. Anchor Customer No.1 is distinguished from the rest of the Phase 3 customers because this customer relies on groundwater for its water supply and does not currently receive water service from Palo Alto.
2. Required discharge head at Booster Pump Station #4 is notably larger due to the 610-foot elevation increase from its location to the end user (Foothills Park).
3. After assessing the feasibility of other hydraulic configurations (including removing Booster Pump Station #3 and upsizing other booster pump stations), it was determined that including Booster Pump Station #3 at the specified pump motor rating was optimal in order to avoid exceeding pressure criteria for customers near Booster Pump Station #5.

Figure 3-4: Alignment for Concept Option A3, NPR Palo Alto Phase 3 Extended to Foothills and Los Altos



3.3.4 Concept Option A4: NPR Mountain View

Concept Option A4 is the Mountain View Long-Term Expansion Project from the 2014 Mountain View Recycled Water Feasibility Study (RWFS). This concept option was included in this study to evaluate its feasibility relative to other concept options. Note that the distribution system hydraulic analysis criteria used in the Mountain View RWFS differ slightly from those presented in Table 3-1 but resulting facility sizing would be similar. Also of note, Mountain View is in the process of updating the 2014 RWFS focusing on extending their existing system to Google and NASA, and across Highway 101.

The Concept Option A4 alignment and customer demands are shown in Figure 3-5. A summary of the customers included in this concept option and their corresponding facilities are outlined in Table 3-6.

Notable items from Concept Option A4 are:

- Customers: Same as the customers identified in the Mountain View RWFS for the Long-Term Expansion Project continuing to build off of Mountain View's Phase 2 pipeline.
- Pump Station: Additional pumping capacity at the Charleston Pump Station and NASA Pump Station to meet peak hour demands for Concept Option A4.

Pump Stations

The Recommended Project presented in Mountain View RWFS Study consists of three phases: the Short-Term Expansion, the Mid-Term Expansion, and the Long-Term Expansion. The Short-Term and Mid-Term Expansions are constructed or planned to be constructed by 2020, while the construction of the Long-Term Expansion is unscheduled. The total system for all phases of the Mountain View Recommended Project requires two pump stations: one at Charleston Park and one at NASA's Ames Research Park (NASA Pump Station). The Charleston Park Pump Station was initially sized at 450 hp to meet demands included in the Short-Term and Mid-Term Expansions. To meet the peak hour demand for the Long-Term Expansion, two additional variable frequency drive units with a combined capacity of 100 hp would need to be added to the Charleston Park Pump Station for a total installed horsepower of 550. Additional capacity would need to be installed at the 275-hp NASA Pump Station to meet Long-Term Expansion demands. This includes an additional 25-hp variable frequency drive unit for a total capacity of 300 hp.

Storage Tank Sizing

As part of the Mid-Term Phase, a storage tank with 1.6 MG capacity was included to meet demands included in all phases of the Recommended Project. This storage facility is sited at NASA's Ames Research Park and is planned to be constructed. Therefore, the cost of the storage tank is included in the Mid-Term Phase construction and is not considered in the Concept Option A4 cost estimate. Pending the results of the current update to the 2014 RWFS, previous recommendations for sizing of storage and pump stations may be altered.

Table 3-6: Demand and Facilities Summary for Concept Option A4, Mountain View

Customer Location	Number of Users	Demand Total (AFY)
Mountain View – Long-Term Expansion	42	216
Total	**42**	**216**

Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	12,200
10	1,500
12	2,500
Total Length (LF)	**16,200**
Total Length (mi)	**3.1**

Description	Additional Capacity Requirements	
	Charleston Park Pump Station	NASA Pump Station
Required Flow	900 gpm[1]	600 gpm[2]
Pump Configuration (duty only)[3]	2[4]	1[4]
Pump Motor Rating (each)	50 hp[4]	25 hp[4]
Total Installed Motor Horsepower	100 hp (for 550 hp total system capacity)[4]	25 hp (for 300 hp total system capacity)[4]

Notes:

1. Calculated as the difference between the total design flow (6,100 gpm; Mountain View RWFS, p. 7-11) and the design flow for the Mid-Term Expansion (5,200 gpm; Mountain View RWFS, p. 7-9).
2. Calculated as the difference between the total design flow (4,300 gpm) and the design flow for the Mid-Term Expansion (3,700 gpm). Both values were found in the Mountain View RWFS, Table 7.4.
3. The Mountain View RWFS installed pump horsepower does not include spare pumping capacity, per the note in Table 7.4.
4. The pumps' configuration, motor rating, and total installed horsepower are on page 7-11 of the Mountain View RWFS.

Figure 3-5: Alignment for Concept Option A4, NPR Mountain View

3.3.5 Concept Option A5: NPR Mountain View Extended to Los Altos

Concept Option A5 would serve customers from Concept Option A4 and includes an extension that was considered in the 2014 Mountain View RWFS "Alternative 3". While initially considered as a long-term extension for the Mountain View system, "Alternative 3" was not included as part of Mountain View's final Recommended Project to due financial considerations. For the purposes of this study, Concept Option A5 uses that same alignment and customer base, then extends service to Los Altos customers south of Central Expressway to El Camino Hospital and Cooper Park, including the Los Altos Golf & Country Club. The Concept Option A5 alignment and customer demands are shown in Figure 3-6. A summary of the customers included in this concept option and their corresponding facilities are outlined in Table 3-7.

Notable items from Concept Option A5 are:

- Customers: Concept Option A4 with expansion to service additional Mountain View and Los Altos customers.
- Pump Stations: Two - 1) located at the NASA's Ames Research Park that serves all users on the Long-Term Expansion alignment and 2) another located at Central Expressway that serves all other users.
- Storage Tank: Operational volume of 1.2 MG to serve Concept Option A5 users beyond the Long-Term Expansion demands, located at NASA Ames Research Park.

Storage Tank Sizing

To provide enough supply during peak hours, Concept Option A5 requires a storage tank. The Mountain View RWFS included a "NASA Storage Tank" at the connection between the Mid-Term and Long-Term Expansion alignments, located at NASA's Ames Research Park. This tank is sized to meet demands through the Long-Term Expansion. Additional storage capacity is required to meet Mountain View and Los Altos demands beyond the Long-Term Expansion users. For planning purposes, this increased capacity requirement was sized and cost as a separate storage tank at the NASA Storage Tank location. The potential for adding this capacity to existing storage facilities at NASA's Ames Research Park location would need to be evaluated upon further development of this concept option. The storage tank operational volume needed to serve Concept Option A5 users beyond the Long-Term Expansion demands is 1.2 MG.

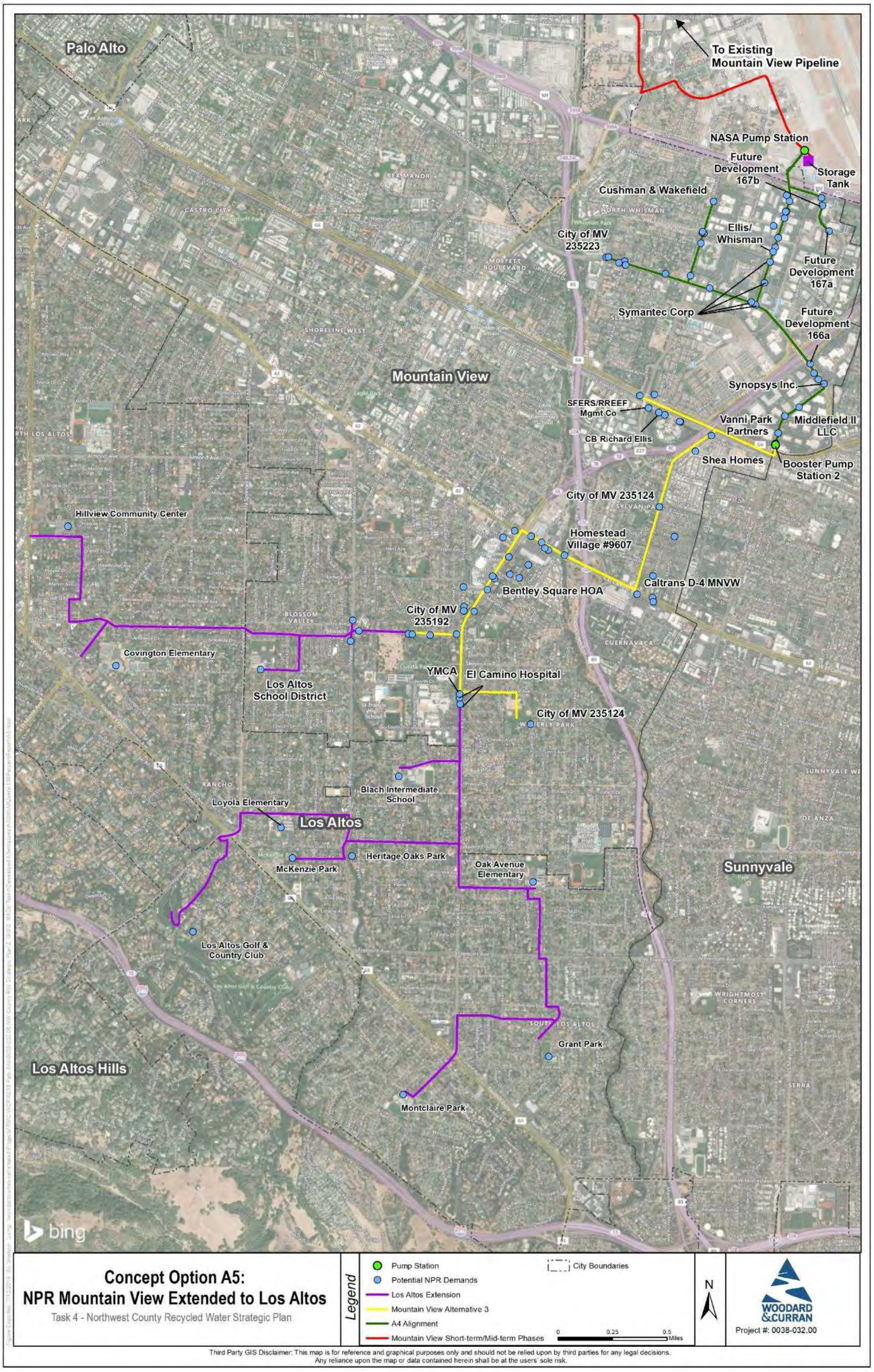
Table 3-7: Demand and Facilities Summary of Concept Option A5, NPR Mountain View Extended to Los Altos

Customer Location	Number of Users	Demand Total (AFY)
Mountain View – Long-Term Expansion	42	216
Mountain View – Alternative 3	53	274
Additional Mountain View Site	1	12
Los Altos	10	370
Total	**106**	**872**

Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	21,600
8	14,900
10	5,600
16	45,000
Total Length (LF)	**87,100**
Total Length (mi)	**16.5**

Storage Tank	1.2 MG	
Description	Performance Requirements	
	NASA Pump Station (PS1)	Booster Pump Station #2 (PS2)
Required Flow	3,031 gpm	1,799 gpm
Discharge Head	190 ft	187 ft
Pump Configuration (duty + standby)	3+1	2+1
Pump Motor Rating (each)	75 hp	75 hp
Total Installed Motor Horsepower	300 hp	225 hp

Figure 3-6: Alignment for Concept Option A5, NPR Mountain View Extended to Los Altos



3.3.6 Concept Option A6: NPR East Palo Alto and Menlo Park

Concept Option A6 would serve customers (including yet to be constructed customers) in East Palo Alto, with facilities sized to extend to areas of developments in Menlo Park that are east of U.S. Highway 101. Menlo Park does not currently use any recycled water and does not own or operate a wastewater treatment facility. Menlo Park has expresses interest in receiving recycled water supplies from other agencies, including Redwood City, West Bay Sanitary District, and Palo Alto's RWQCP (West Yost, 2017). The Concept Option A6 alignment and customer demands are shown in Figure 3-7. A summary of the customers included in this concept option and their corresponding facilities are outlined in Table 3-8.

Notable items from Concept Option A6 are:

- Customers: Potential demand for Menlo Park was obtained through discussions with Menlo Park and WBSD, both of which have conducted recycled water assessments for this area. Note that East Palo Alto is continuing to see increases in development such that these demand estimates may be lower than actuals.
- Pipelines: Builds off of the existing 30-inch recycled water backbone along Embarcadero Road.
- Pump Stations: One – expanded existing recycled water pump station at RWQCP

Table 3-8: Demand and Facilities Summary for Concept Option A6, NPR East Palo Alto and Menlo Park

Customer Location	Number of Users	Demand Total (AFY)
East Palo Alto	10	145
East Palo Alto – yet to be constructed	17	192
Palo Alto	6	114
Subtotal	***33***	***451***
Menlo Park	N/A[1]	250
Total		**701**

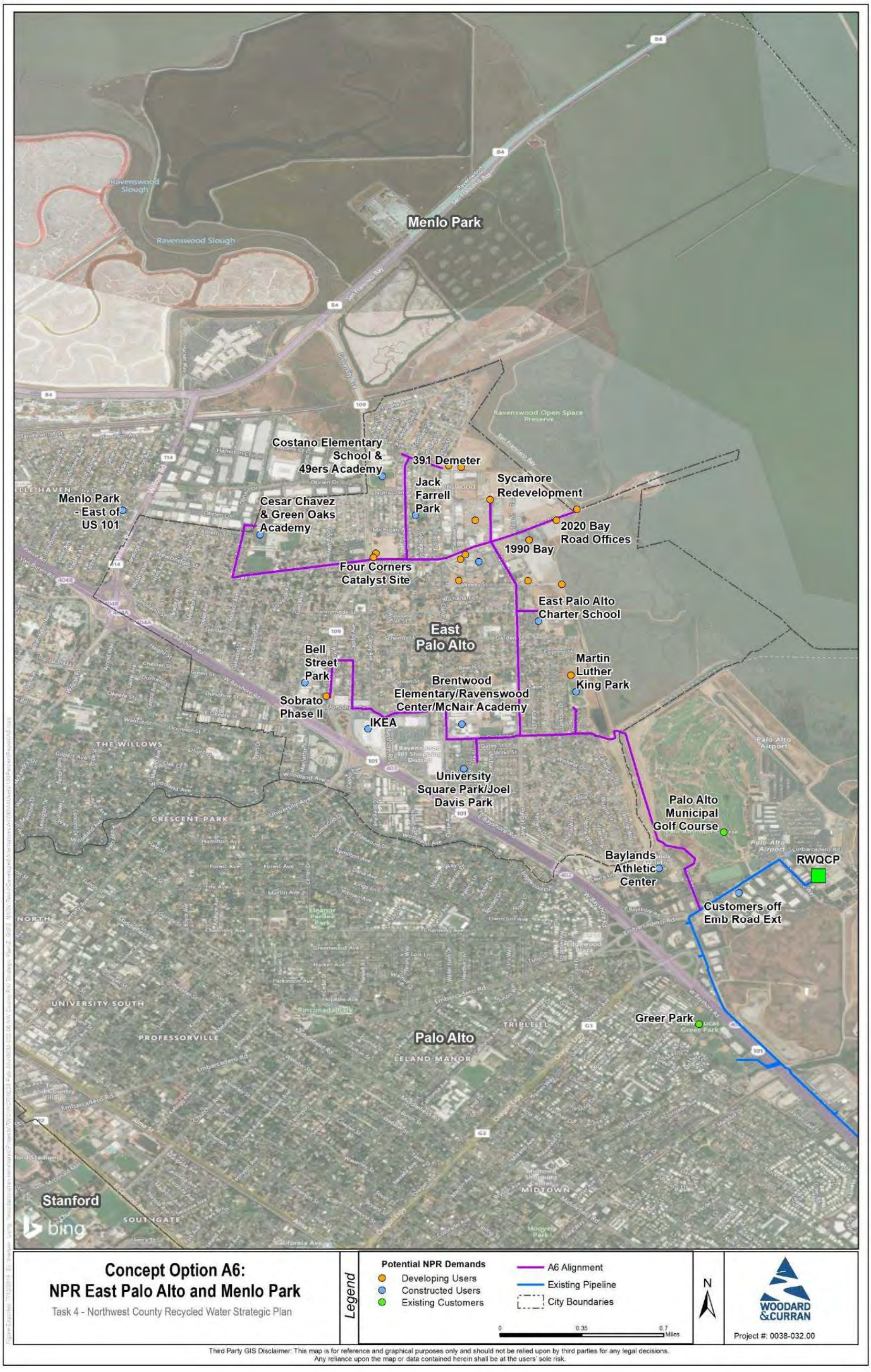
Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	14,100
8	10,200
10	10,000
Total Length (LF)	**34,300**
Total Length (mi)	**6.5**

Description	Performance Requirements
	Recycled Water Pump Station (PS1)
Required Flow	1,000 gpm
Discharge Head	250 ft
Pump Configuration (duty + standby)	2+1
Pump Motor Rating (each)	50 hp
Total Installed Motor Horsepower	150 hp

Note:

1. The number of users in Menlo Park was not identified as part of the Strategic Plan. The estimated demand is based on discussions with Menlo Park and WBSD.

Figure 3-7: Alignment for Concept Option A6, NPR East Palo Alto and Menlo Park



3.4 Concept Option B: NPR from Satellite Location

3.4.1 Concept Option B1: NPR Satellite Treatment Plant

Concept Option B1 is a satellite treatment plant that would treat wastewater flows from a more proximate location to recycled water customers compared to the RWQCP. Based on a planning-level assessment of wastewater flow volumes available in the Study Area, the satellite plant would treat wastewater from Los Altos to provide NPR water to customers in Palo Alto and Los Altos. The Concept Option B1 alignment and the locations of the satellite treatment plant and customer demands are shown in Figure 3-8. A summary of the customers included in this concept option and their corresponding facilities are outlined in Table 3-9.

Notable items from Concept Option B1 are:

- Location: The satellite plant could be located at Robles Park in Palo Alto and would treat wastewater from Los Altos.
- Customers: Customers would be located nearby in Los Altos and in Palo Alto
- Pump Stations: Four – 1 raw influent pump station to feed wastewater to the satellite plant and three to distribute and boost recycled water to customers
- Storage: Satellite plant would include 1.4 MG of treated water storage to meet peak hour demands

Treatment Facilities

A potential site for the satellite facility is Robles Park in Palo Alto. Due to the urban setting of the Study Area, there are limited opportunities to site new treatment facilities. There are no vacant properties in the immediate vicinity of the sewer diversion point. Robles Park was identified as a potential site because it is a public property and has sufficient open space to accommodate the satellite facilities. Although, public use of the treatment plant site would be lost. For purposes of this study, the facilities are assumed to be above ground at Robles Park. Use of Robles Park would also require City Council adoption of a Parks Improvement Ordinance approving any substantial construction or development per Palo Alto Municipal Code 22.08.005. However, if this concept option were to be pursued further, alternative treatment facility siting may be considered, for example purchasing private property closer to the diversion point or siting facilities below ground at Robles Park.

Pipelines

Concept Option B1's distribution system would consist of approximately 12.8 miles of pipeline, including 6,000 LF of pipeline to convey influent wastewater flows from the sewer diversion point to the satellite treatment facilities.

Pump Stations

To meet the pressure criteria, Concept Option B1 includes three pump stations: one at the satellite plant site and two booster pump stations at optimized locations on the Phase 3 alignment and in Los Altos.

In addition, a Satellite Influent Pump Station is required to transport raw wastewater flows from the diversion point at the end of the Los Altos sewer system to the satellite treatment facility in Palo Alto. This influent pump station is co-located at the Pump Station #3 site.

Storage Tank Sizing

In order to meet demands during peak hours, Concept Option B1 requires a storage tank. The storage tank is sized to store the maximum day demands for this concept option (1.4 MG) and is assumed to be sited next to the satellite treatment plant.

Table 3-9: Demand and Facilities Summary for Concept Option B1, NPR Satellite Treatment Plant

Customer Location	Number of Users	Demand Total (AFY)
Palo Alto – Phase 3[2]	83	595
Palo Alto – Non-Phase 3	2	28
Anchor Customer No. 1[1]	1	167
Los Altos	5	104
Total	**91**	**894**

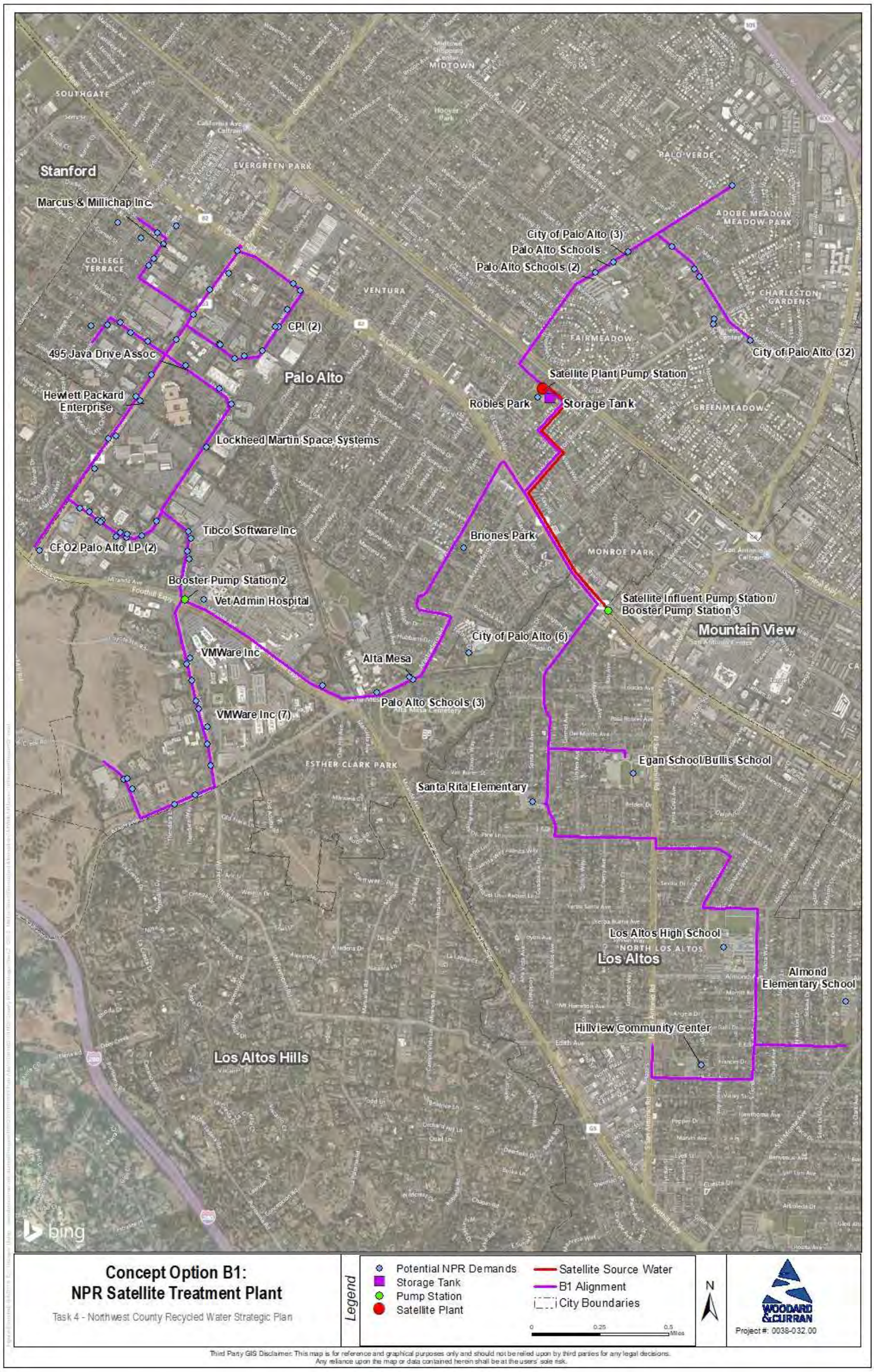
Treatment (MBR)	1.5 MGD
Modeled Pipe ID (in)	**Approximate Length of Pipe (LF)**
6	39,800
8	4,000
10	6,400
12	11,500
16 (influent to satellite plant)	6,000
Total Length (LF)	**67,700**
Total Length (mi)	**12.8**

Storage Tank	1.4 MG			
Description	**Performance Requirements**			
	Satellite Plant Pump Station (PS1)	**Booster Pump Station 2 (PS2)**	**Booster Pump Station 3 (PS3)**	**Satellite Influent Pump Station (PS4)**
Required Flow	1,676 gpm	416 gpm	329 gpm	1,979 gpm
Discharge Head	252 ft	204 ft	288 ft	75 ft [3]
Pump Configuration (duty + standby)	4+1	2+1	2+1	2+1
Pump Motor Rating (each)	40 hp	20 hp	20 hp	2 hp
Total Installed Motor Horsepower	200 hp	60 hp	60 hp	6 hp

Notes:

1. Anchor Customer No. 1 is distinguished from the rest of the Phase 3 customers because this customer relies on groundwater for its water supply and does not receive water from Palo Alto.
2. These customers represent a subset of Phase 3 alignment customers from Concept Option A1.
3. Required discharge head at the Satellite Influent Pump Station is notably smaller due to the 30-foot elevation decrease from its location to the satellite facility site.

Figure 3-8: Alignment for Concept Option B1, NPR Satellite Treatment Plant



3.5 Concept Option C: IPR Concept Options

3.5.1 Concept Option C1: Palo Alto Dedicated IPR

Concept Option C1 was developed as Scenario 4 under the IPR Feasibility Evaluation (Todd 2018). Concept Option C1 provides purified water for injection at five injection well sites in Palo Alto. The Concept Option C1 alignment and the locations of injection wells are shown in Figure 3-9. As discussed in Section 2.3.2, the volume of fully advanced treated recycled water that can be used for injection purposes is 2,800 AFY, while the volume of water that can be sustainably extracted from the groundwater basin (or the Project Yield) is 5,900 AFY (a mixture of recycled water and groundwater). These values are summarized in Table 3-10.

Notable items from Concept Option C1 are:

- Treatment: full advanced treatment facilities are assumed to be constructed near the RWQCP on the Measure E site. Use of this site would require Palo Alto voter approval to change the designated use to include treatment facilities. Fully advanced treated recycled water would be injected and mixed into the local groundwater system.
- Customers: Palo Alto potable water system customers.
- Pipeline: Dedicated pipeline to bring fully advanced treated recycled water from treatment facilities at the RWQCP to the injection wells.
- Pump Stations: One – dedicated pump station for purified recycled water at RWQCP

Table 3-10: Demand and Facilities Summary for Concept Option C1, Palo Alto Dedicated IPR

Customer Location	Demand Total (AFY)	Project Yield (AFY)
Palo Alto - IPR Injection Wells	2,800	5,900
Modeled Pipe ID (in)	**Approximate Length of Pipe (LF)**	
6	2,000	
8	1,500	
10	5,000	
12	21,000	
Total Length (LF)	**29,500**	
Total Length (mi)	**5.6**	
Description	**Performance Requirements**	
	Purified Recycled Water Pump Station (PS1)	
Required Flow	1,736 gpm	
Discharge Head	269 ft	
Pump Configuration (duty + standby)	2+1	
Pump Motor Rating (each)	100 hp	
Total Installed Motor Horsepower	300 hp	
Recycled Water Treatment	**Wellhead Treatment**	
Membrane Filtration, Reverse Osmosis, Advanced Oxidation Process with UV	Included to lower iron, manganese, and TDS concentrations	

Treatment Facilities

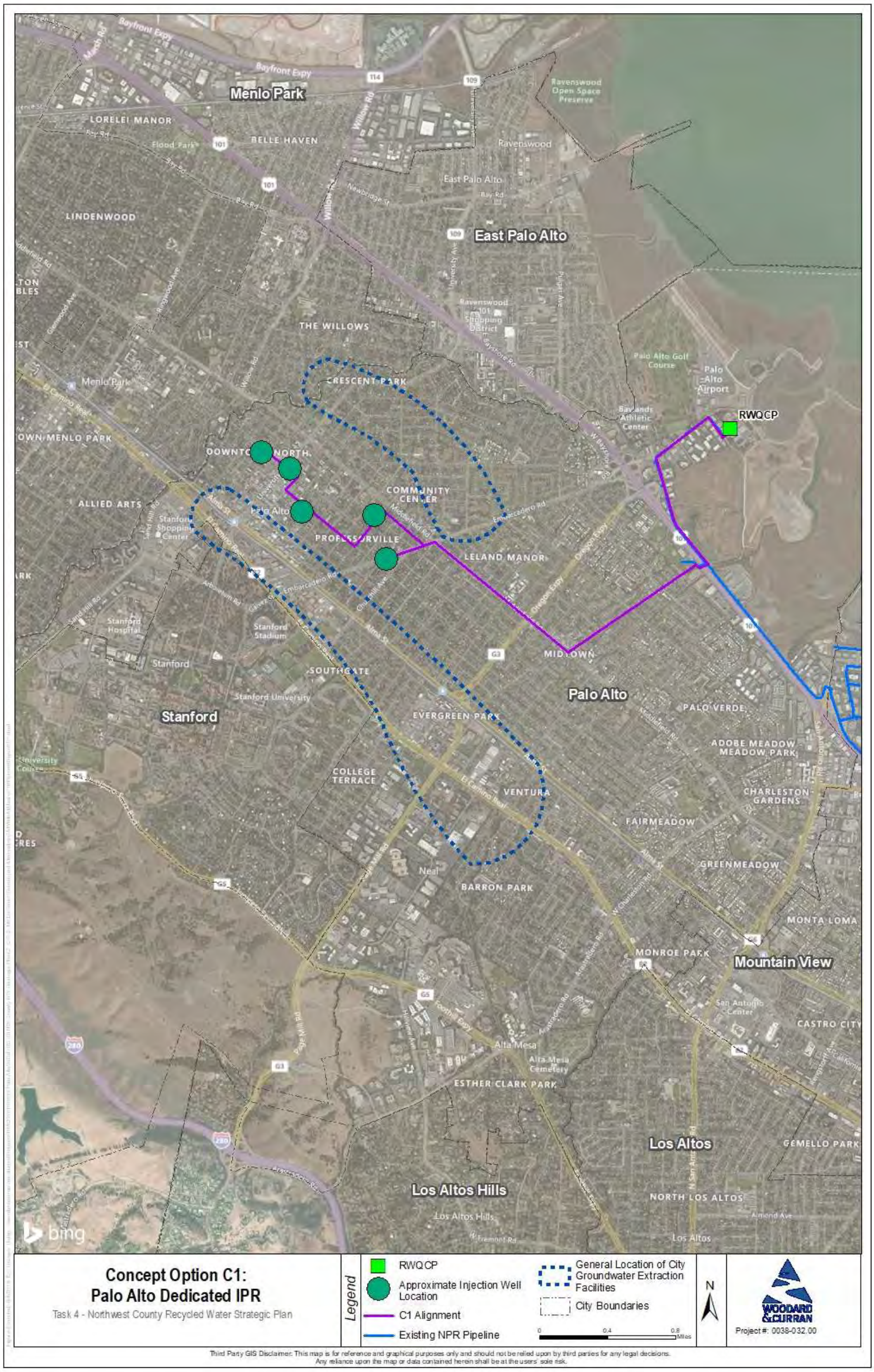
Recycled water from the RWQCP would be treated to full advanced treatment standards for injection. The treatment facilities would be sized to produce 2.5 MGD to meet the daily flow required to be injected into the groundwater basin to achieve 2,800 AFY. This assumes each of the five proposed injection wells is constantly operating and does not account for downtime. The treatment facilities for this concept option are assumed to be sited at Palo Alto's Measure E Site. The Measure E site is a 10-acre site adjacent to the RWQCP that includes a relatively flat portion that could be suitable for treatment facilities. Use of this site would require Palo Alto voter approval to change the designated use to include treatment facilities.

Wellhead treatment is included to lower iron, manganese, and TDS concentrations to make the groundwater quality comparable to Palo Alto's existing SFPUC supply.

Pipelines

Concept Option C1's distribution system would consist of approximately 5.6 miles of pipeline. A dedicated IPR transmission main would be needed to convey fully advanced treated recycled water from the RWQCP to the injection well field while the existing recycled water pipeline would continue to deliver disinfected tertiary recycled water to non-potable demands.

Figure 3-9: Alignment for Concept Option C1, Palo Alto Dedicated IPR



3.5.2 Concept Option C2: Palo Alto IPR with NPR

Concept Option C2 expands upon Concept Option C1 to include service of non-potable demands along or in close proximity to the alignment. Both uses (IPR and NPR) would share a transmission line and consequently, fully advanced treated recycled water would be served to all customers in this concept option despite the additional treatment being unnecessary for NPR.

The Concept Option C2 alignment is shown in Figure 3-10. A summary of the customers included in this concept option and their corresponding demands are outlined in Table 3-11. As discussed in Section 2.3.2, the volume of fully advanced treated recycled water that can be used for NPR and injection purposes is 2,800 AFY, while the volume of water that can be sustainably extracted from the groundwater basin (or the Project Yield) is 5,900 AFY (a mixture of recycled water and groundwater). These values are summarized in Table 3-11.

Notable items from Concept Option C2 are:

- Treatment: Full advanced treatment is assumed to be constructed near the RWQCP on the Measure E site. Use of this site would require Palo Alto voter approval to change the designated use to include treatment facilities. Fully advanced treated recycled water would be injected and mixed into the local groundwater system.
- Customers: Palo Alto potable water system customers and 18 non-potable customers along the pipeline route. Both potable and non-potable customers would receive fully advanced treated recycled water due to use of the same transmission pipeline despite the additional treatment being unnecessary for NPR customers.
- Pipeline: Dedicated pipeline to bring fully advanced treated recycled water from treatment facilities at the RWQCP to the injection wells will also serve non-potable demands in close proximity (with higher quality fully advanced treated recycled water).
- Pump Stations: One – dedicated pump station for purified recycled water at the RWQCP.

Treatment Facilities

RWQCP recycled water will be treated to full advanced treatment standards for injection. Because the potable and non-potable demands will be served from the same pipeline, the treatment facilities must be sized to treat the base flows to the injection wells plus the maximum day demand for the non-potable users. This translates to a total maximum day demand of 2.8 MGD. The treatment facilities for this concept option, which would include reverse osmosis concentrate treatment facilities (see Section 3.2.3), are assumed to be sited at Palo Alto's Measure E site. Use of this site would require Palo Alto voter approval to change the designated use to include these treatment facilities. Wellhead treatment is included to lower iron, manganese, and TDS concentrations to make the groundwater quality comparable to Palo Alto's existing SFPUC supply.

Table 3-11: Demand and Facilities Summary for Concept Option C2, Palo Alto IPR with NPR

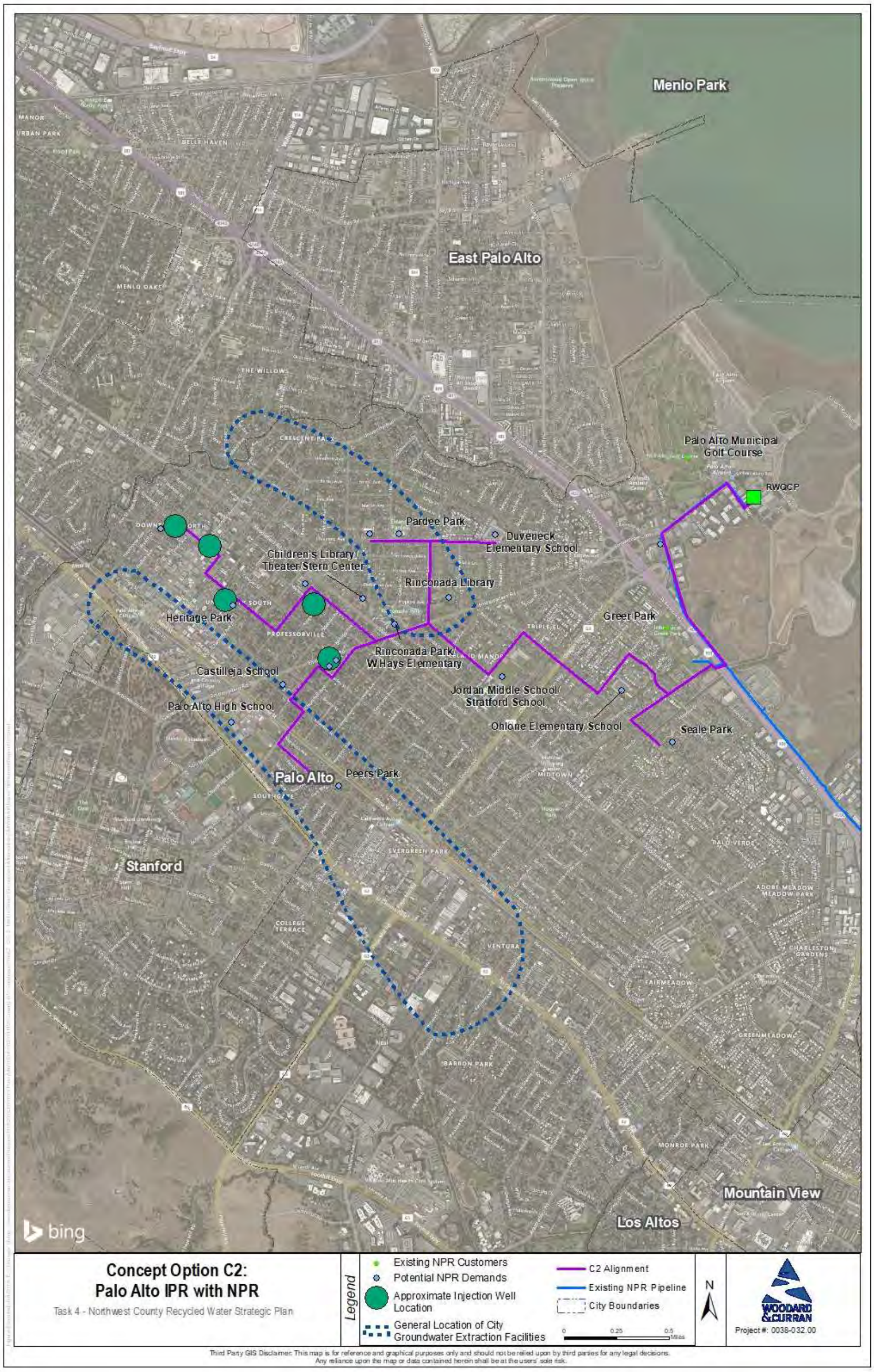
Customer Location	Number of Users	Demand Total (AFY)	Project Yield (AFY)
Palo Alto – Non-Phase 3	18	189	189
IPR Injection Wells	-	2800	5900
Total	**18**	**3,000**	**6,100**

Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	11,300
8	5,500
10	3,000
12	2,500
16	19,100
Total Length (LF)	**41,400**
Total Length (mi)	**7.8**

Description	Performance Requirements
	Purified Recycled Water Pump Station (PS1)
Required Flow	2,334 gpm
Discharge Head	265 ft
Pump Configuration (duty + standby)	4+1
Pump Motor Rating (each)	60 hp
Total Installed Motor Horsepower	300 hp

Recycled Water Treatment	RO Concentrate Treatment
Membrane Filtration, Reverse Osmosis, Advanced Oxidation Process with UV	Needed due to total reuse quantity; nanofiltration assumed (MNS, 2017)
Wellhead Treatment	
Included to lower iron, manganese, and TDS concentrations	

Figure 3-10: Alignment for Concept Option C2, Palo Alto IPR with NPR



3.5.3 Concept Option C3: Palo Alto IPR and NPR from Phase 3 Pipeline

Concept Option C3 is similar to Concept Option C2 but uses an extension from the Phase 3 Pipeline (Concept Option A1) to serve the injection well sites. Similar to Concept Option C2, fully advanced treated recycled water would be served to all customers (NPR and IPR) in this concept option. Concept Option C3 is unique in that it assumes that the Phase 3 Pipeline for NPR has already been constructed and flows to the injection well field are limited by the excess capacity in the Phase 3 Pipeline during off-peak hours and outside of the peak irrigation season. This concept option mitigates the risk of decreasing NPR demand along the Phase 3 Pipeline and would enable phased implementation with NPR in the near term and IPR in the longer term.

The Concept Option C3 alignment is shown in Figure 3-11. A summary of the customers included in this concept option and their corresponding demands are outlined in Table 3-12. The values shown assume the estimated demand for the Phase 3 Pipeline is maintained, which allows for approximately 2,280 AFY to be sent to IPR versus the 2,800 AFY in Concept Options C1 and C2. Correspondingly the project yield (total of recycled water and groundwater) was reduced to 5,000 AFY from 5,900 AFY.

Notable items from Concept Option C3:

- Phasing: Concept Option C3 represents a potential phased implementation with NPR in the near term and IPR in the longer term.
- Treatment: Full advanced treatment facilities are assumed to be constructed near the RWQCP on the Measure E site. Use of this site would require Palo Alto voter approval to change the designated use to include treatment facilities .AWTS Fully advanced treated recycled water would be injected and mixed into the local groundwater system.
- Customers: In a future phase, customers on the Phase 3 Pipeline would receive fully advanced treated recycled water through a new dedicated connection from the RWQCP. Both potable and non-potable customers would receive fully advanced treated recycled water due to use of same transmission pipeline despite the additional treatment being unnecessary for NPR customers.
- Pipeline: Includes the Phase 3 Pipeline (Concept Option A1) and, in a future phase, a new connection from the RWQCP full advanced treatment facilities to Phase 3 and an extension to IPR injection wells.

Treatment Facilities

Recycled water from the RWQCP would be treated to full advanced treatment standards for injection. Because the potable and non-potable demands would be served from the same pipeline, the treatment facilities must be sized to treat both the flows to the injection wells plus the flows to the non-potable users, or 3.3 MGD. The non-potable demands will be served by nearly potable water. This concept option includes reverse osmosis concentrate treatment (see 3.2.3) that is assumed to be sited at Palo Alto's Measure E site. Use of this site would require Palo Alto voter approval to change the designated use to include treatment facilities. Wellhead treatment is included to lower iron, manganese, and TDS concentrations to make the groundwater quality comparable to Palo Alto's existing SFPUC supply.

Pump Stations

To meet the pressure criteria, Concept Option C3 includes an additional pump station beyond the ones identified for the Phase 3 Pipeline (Concept Option A1). This additional pump station would be at the connection between the Phase 3 Pipeline and the IPR extension pipeline.

Table 3-12: Demand and Facilities Summary for Concept Option C3, Palo Alto IPR and NPR from Phase 3 Pipeline

Customer Location	Number of Users	Demand Total (AFY)	Project Yield (AFY)
Palo Alto – Phase 3	109	634	634
Anchor Customer No. 1[1]	1	167	167
Palo Alto – Non-Phase 3	10	119	119
Palo Alto – IPR Injection Wells	-	2,280	5,000
Total	**120**	**3,200**	**5,900**

Modeled Pipe ID (in)	Approximate Length of Pipe (LF)
6	20,000
8	12,500
10	9,900
12	48,300
16	900
Total Length (LF)	**91,600**
Total Length (mi)	**17.3**

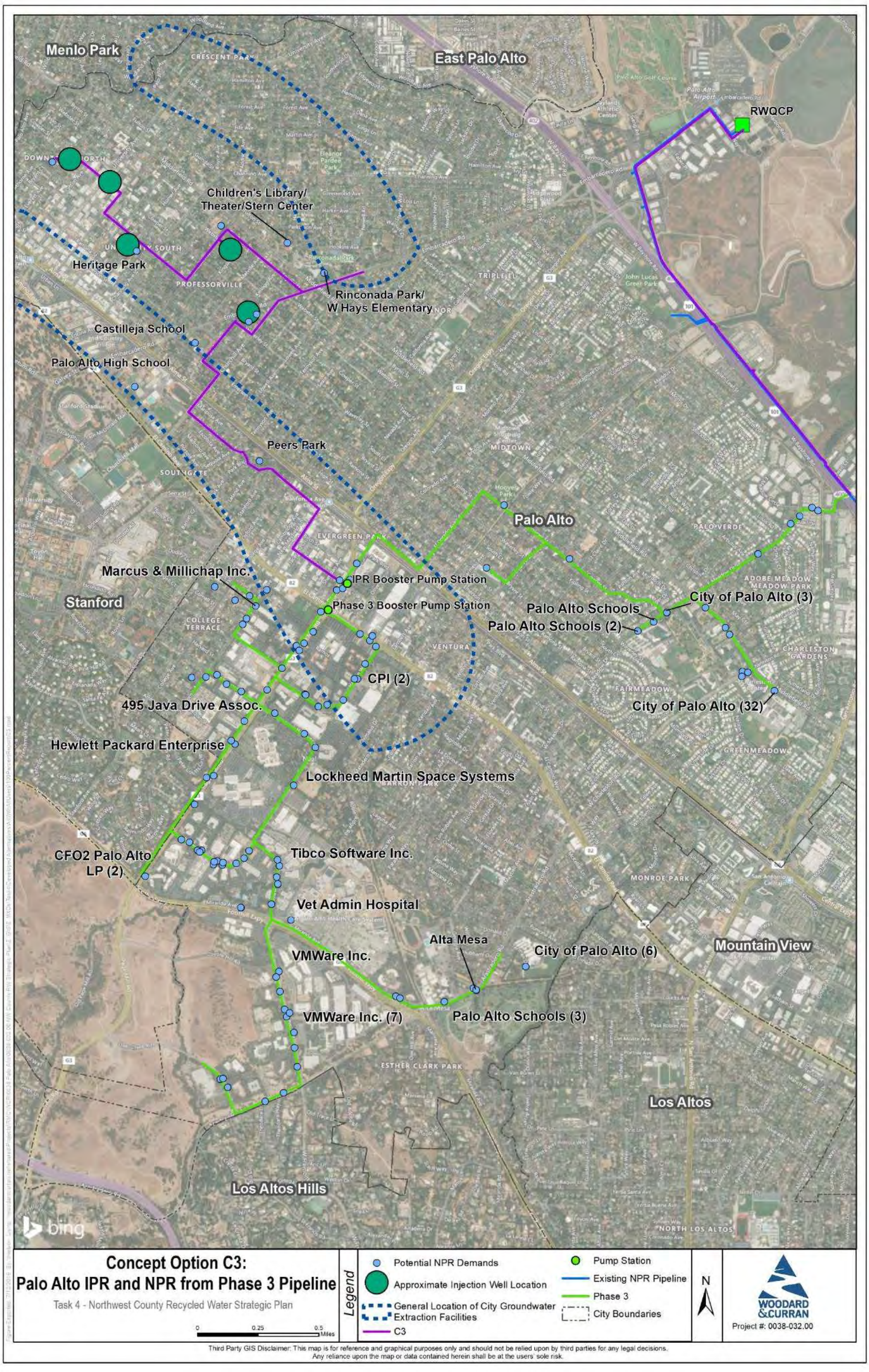
Description	Performance Requirements		
	IPR Booster Pump Station (PS1)	Recycled Water Pump Station	Phase 3 Booster Pump Station
Required Flow	2,108 gpm	1,637 gpm	1,408 gpm
Discharge Head	302 ft	200 ft	198 ft
Pump Configuration (duty + standby)	3+1	2	3+1
Pump Motor Rating (each)	100 hp	100 hp	60 hp
Total Installed Motor Horsepower	400 hp	200 hp	240 hp

Recycled Water Treatment	RO Concentrate Treatment
Membrane Filtration, Reverse Osmosis, Advanced Oxidation Process with UV	Needed due to total reuse quantity; nanofiltration assumed (MNS, 2017)
Wellhead Treatment	
Included to lower iron, manganese, and TDS concentrations	

Notes:

1. Anchor Customer No. 1 is distinguished from the rest of the Phase 3 customers because this customer relies on groundwater for its water supply and does not receive water from Palo Alto.

Figure 3-11: Alignment for Concept Option C3, Palo Alto IPR and NPR from Phase 3 Pipeline



3.6 Concept Option D: DPR Concept Options

3.6.1 Concept Option D1: Palo Alto Dedicated DPR

Concept Option D1 uses advanced treated recycled water to directly supplement the potable water supply for customers in Palo Alto. As discussed in Section 2.4, because there is no dedicated surface water treatment plant in the service area, treated drinking water augmentation is the only feasible DPR option available at this time.

Treated water would be stored in a purified water tank for 8 hours and delivered to the potable water distribution system. A map showing the approximate alignment and connection points to the potable water system for Concept Option D1 is shown in Figure 3-12. As explained in Section 2.4.2, the demand for DPR (Table 3-13) was based on Palo Alto's share of the RWQCP effluent flow.

Notable items from Concept Option D1:

- Treatment: Full advanced treatment plus other treatment process facilities are assumed to be constructed near the RWQCP on the Measure E site. Use of this site would require Palo Alto voter approval to change the designated use to include these facilities. Fully advanced treated recycled water would be injected directly into the potable distribution system. Additional monitoring and reporting of treatment performance is anticipated to demonstrate protection of public health.
- Customers: Palo Alto potable water system customers.
- Pump Stations: Two pump stations: one to convey fully advanced treated recycled water to storage (Storage Pump Station) and one from the storage to the distribution system (Distribution Pump Station).
- Pipeline: Connects from treatment facilities to storage and from storage to potable water system at three separate points to add in blending and to match existing potable water system hydraulics.
- Storage: Engineered storage of 4.75 MG is assumed to be located beneath the Palo Alto Municipal Golf Course driving range.

Treatment Facilities

Consistent with the SWRCB's Feasibility Report on Developing Uniform Water Recycling Criteria for DPR, the water quality of the influent wastewater for DPR was assumed to be final effluent from the RWQCP (filtered and disinfected secondary effluent). Without specific regulatory requirements, the assumed Advanced Water Purification Facility (AWPF) treatment train is the full advanced treatment train with the additions of ozone-biologically active filtration and free chlorine process steps. In order to comply with the RWQCP discharge limits, facilities to treat the reverse osmosis concentrate would also be part of the AWTP. The AWTP treatment facilities are assumed to be sited at Palo Alto's Measure E site. Use of this site would require Palo Alto voter approval to change the designated use to include these facilities. Additional monitoring and reporting of treatment performance is anticipated for DPR to demonstrate protection of public health. Concept Option D1 includes additional annual costs to reflect this additional, but undefined by regulations, monitoring.

Storage Tank Sizing

It is anticipated that an engineered storage buffer will be required between the AWPF and introduction of purified water to the potable distribution system. A potential location for this tank is beneath the Palo Alto Municipal Golf Course driving range. A preliminary estimate of the storage tank operational volume needed to serve Concept Option D1 users is 4.75 MG assuming 8 hours of cycling storage (filling, testing, and distributing from three different cells within the storage tank operational volume).

Table 3-13: Demand and Facilities Summary for Concept Option D1, Palo Alto Dedicated DPR

Customer Location	Demand Total (AFY)	
Palo Alto	**5,300**	
Modeled Pipe ID (in)	**Approximate Length of Pipe (LF)**	
10	5,000	
16	1,700	
18	1,400	
24	2,600	
Total Length (LF)	**10,700**	
Total Length (mi)	**2.0**	
Description	**Performance Requirements**	
	To Storage Pump Station (PS1)	**Distribution Pump Station (PS2)**
Required Flow	4,382 gpm	3,285 gpm
Discharge Head	31 ft	257 ft
Pump Configuration (duty + standby)	3+1	3+1
Pump Motor Rating (each)	15 hp	100 hp
Total Installed Motor Horsepower	60 hp	400 hp
Recycled Water Treatment	**RO Concentrate Treatment**	
Ozone, Biologically Active Filtration, Membrane Filtration, Reverse Osmosis, Advanced Oxidation Process with UV, Free Chlorine	Needed due to total reuse quantity; nanofiltration assumed (MNS, 2017)	
Storage		
4.75 million gallons		

Figure 3-12: Alignment for Concept Option D1, Palo Alto Dedicated DPR

Chapter 4 Strategic Plan Concept Options Evaluation

4.1 Approach for Concept Options Evaluation

The concept options described in Chapter 3 were evaluated for estimated costs (e.g., capital, annual, unit cost of water) and for non-cost criteria. Section 4.2 describes the basis of the preliminary cost estimates while Section 4.3 presents the cost information by concept option. Section 4.4 describes the non-cost criteria scoring. Section 4.5 provides the evaluation of concept options with weighted scores for cost and non-cost criteria.

Each concept option was evaluated for implementation costs (capital, operations, maintenance) based on technical information developed by the consulting team, described in Chapter 3, and using an approach for planning-level costs development discussed in this chapter. Following the implementation cost development, the concept options were evaluated for non-cost related criteria in a collaborative approach using input from agency stakeholders on priorities for the criteria and how to weigh criteria relative to one another.

4.2 Basis of Preliminary Cost Estimate

This section provides an overview of the approach and methodology used to develop a preliminary estimate of costs for each concept option developed in this study. The estimated costs represent the Engineer's opinion based on the current state of development for the project components. Specific information on the unit costs and source for each element is identified in the unit cost spreadsheets that are part of the detailed cost estimate provided in Appendix D.

4.2.1 Cost Estimate Classification

The Association for the Advancement of Cost Engineering International (AACE International) has developed a cost estimate classification system that provides guidelines for applying the general principles of estimate classification to project cost estimates. The five estimate classes are presented in AACE International Recommended Practice No. 56R-08 (Cost Estimate Classification System – As Applied for the Building and General Construction Industries). The guideline establishes a relationship between the project maturity (i.e. project definition as percent of complete definition) and the accuracy and methodology used to produce the cost estimate. Based on the level of project definition, the cost estimates developed for this report are Class 5 as defined by Publication 56R-08. The accuracy range for Class 5 estimates in the Strategic Plan is between 20% below and 50% above estimated bid cost.

4.2.2 Cost Estimating Approach

Cost estimates have been developed based on preliminary facility layouts and design criteria for pipeline alignments and pump stations. Construction costs were estimated using unit costs developed from past construction projects, industry cost estimate resources (primarily RSMeans Heavy Construction Cost Data) as well as engineering allowances based on engineering judgement and previous project experience. Operations and maintenance (O&M) costs are based on estimated labor hours, consumables, significant regular O&M activities (e.g. recoating of exposed metallic surfaces) and energy costs.

Raw Construction Cost

Raw construction costs are estimated by major work or component line item based on a unit cost multiplied by estimated quantity. Unit costs were developed using:

- RSMeans Heavy Construction Cost Data (RSMeans);
- Manufacturer's equipment proposals; and
- Experience with prior projects and activities of similar size or configuration.

Historic unit cost or out-of-area unit cost information was adjusted to June 2018 dollars for the project vicinity using Engineering News Record's (ENR) Construction Cost Index (CCI) and the RSMeans Location Factor.

Cost Estimate Benchmark Index

The concept options' preliminary cost estimates presented herein are benchmarked to ENR CCI for San Francisco. The estimate is in June 2018 dollars, with an ENR CCI SF index of 12,015.

Construction Cost Allowances and Contingencies

From the raw construction cost subtotal, several construction cost factors are applied to develop an estimated total construction cost. The construction cost factors used are listed below.

- **9% Sales Tax on Materials.** Sales tax on materials was estimated as 9.0% (local sales tax) applied to 50% of capital costs (not including General Requirement costs). The assumption is that materials and equipment represent 50% of the raw construction cost.
- **40% Construction Contingency.** The construction contingency is defined as unknown costs due to incomplete engineering during the preliminary design phase and uncertainty about full scope of the project. The contingency is applied to the construction cost subtotal that are estimated as a percentage of defined project costs (i.e. raw construction cost subtotal). As the level of project definition and understanding increases and the level of unknown decreases, the construction contingency typically decreases. For this report, a construction contingency of 40% was applied to the raw construction cost estimates.
- **10% Market Adjustment Factor.** To account for bidding market price increases, a Market Adjustment Factor of 10% has been applied.

Capital Cost Allowances

- **15% Engineering Services (Design) & Administration Services.** Engineering services include field investigations (e.g. surveys, geotechnical reports, hazardous materials investigations), final design, contract document development (i.e. plans and specifications), preparation of detailed cost estimates, and project scheduling. Administration costs include Palo Alto's project management and staff time during construction. An engineering and City administrative services allowance of 15% was applied to the total construction cost.
- **10% Construction Management.** Costs for construction management, including inspection, can vary greatly with project size and complexity and whether the Owner performs this work with in-house staff or through a consultant. A construction management factor of 10% was applied to the total construction cost.
- **3% Engineering Services During Construction.** Engineering services during construction (ESDC) includes submittal and request for information reviews, design clarifications, and startup support services. An ESDC factor of 3% was applied to the total construction cost.

Property Acquisition

For facilities such as pump stations and satellite treatment located outside of the public right of way or outside the RWQCP, land would need to be purchased or leased. The market rate for the project area was assumed to be $500 per square foot. These land costs were added to a concept option's total capital cost following the allowances and contingencies. Purchase or lease of land includes RWQCP partner-owned properties. However, in the case of Concept Option D1, Palo Alto Dedicated DPR, which assumes the engineered storage tank is beneath the Palo Alto Municipal Golf Course, acquisition of the land is not required since normal golf course operations can resume following construction. In order to account for

the potential loss of revenue due to construction of this storage facility, an allowance for loss of revenue was applied. This cost was added to total capital cost following all allowances and contingencies.

Property acquisition was not included for injection wells since the impact to properties is considered minimal.

Operations and Maintenance (O&M) Costs

O&M requirements and annual costs were derived from experience on similar projects, as well as input from Palo Alto. The three components used to develop annual O&M costs were:

- **Labor** – Labor costs associated with the water treatment and pump station O&M is calculated on an hourly basis. The required labor hours are estimated based on historical data. The average hourly cost of O&M personnel, which includes all wages and benefits to the operator, is assumed to be $100 per hour. Annual inspection and maintenance for storage tanks were estimated as 1 percent of the total capital costs for that element, while conveyance O&M was based on a cost metric per linear foot of pipeline.
- **Energy** – Energy costs for pump stations are a combination of an energy charge (per kWh) and the kWh required input for each pump station in a concept option. Energy costs for treatment are estimated as a combined cost with consumables on a per unit of water basis (cost per MGD).
- **Consumables** – Consumables are a major component of operational expenditures and include resources that are intended and expected to be used and replaced routinely. Consumable costs for treatment were estimated on a per unit of water basis (cost per MGD). Consumable costs for pump stations were estimated as a percentage of the raw construction cost. Consumable costs are not applied to the pipeline portion of each concept option.

4.2.3 Wastewater/Recycled Water Treatment Construction Costs

Wastewater and recycled water treatment construction costs have been developed for each concept option, where needed, on a per MGD basis. Per MGD cost estimates for membrane bioreactor (MBR) and for the advanced treatment facilities (membrane filtration, reverse osmosis, advanced oxidation process with UV, ozone, biologically active filtration, chlorination) are based on previous project experience.

4.2.4 Pipeline Construction

Pipeline construction costs have been developed for each concept option as described in the following sections. Pipeline capital costs include open-cut, special crossing elements, and pipe rehabilitation.

Pipeline Construction Cost – Open Cut

The pipe material for open cut installation is assumed to be high density polyethylene (HDPE). Based on the estimated pressures within the system and a surcharge allowance, a pressure rating of 200 psi was chosen as a suitable pressure rating for the pipe network. The corresponding dimension ratio resulted in DR 11.

A pipeline cost estimating tool was used to generate unit costs for underground pipeline construction for HDPE ranging in size from 8- to 30-inch (nominal diameter) assuming an average of 5-foot depth of cover, in urban settings. The estimating tool uses the following to develop installed unit costs:

- Historical engineering and bid price data for HDPE pipelines, appurtenances, traffic control, potholing, cathodic protection, excess soil disposal tipping fees, and urban setting production rates.
- RSMeans unit costs for trench shoring, excavation, backfill, backfill compaction, pavement, grinding and milling, aggregate base, and pavement restoration including valves, haul to disposal, labor/installation, and dewatering.

The tool contains various input parameters including depth of cover, type of trench backfill and source (i.e. import vs. native material), condition of soil (i.e. clean vs. contaminated), percentage of backfill to be imported, amount of traffic control needed (i.e. none, light, or heavy), percentage of alignment requiring dewatering, production rate, and valve and pothole frequency. Using these inputs, the tool estimates the construction quantities related to buried piping (i.e. excavation volume), and subsequently, the associated unit cost per length of pipe.

The unit costs are summarized in Table 4-1.

Table 4-1: Unit Cost of HDPE Pipe

Modeled Pipe Internal Diameter (ID) (in)	HDPE DR 11 ID (in)	HDPE DR 11 Nominal Outer Diameter (OD) (in)	Unit Cost ($/LF)
6	6.96	8	$200
8	8.68	10	$212
10	10.29	12	$254
12	12.92	16	$277
16	16.15	20	$334
18	19.37	24	$381
24	24.22	30	$462

Assumptions:

- Pipeline is in an urban setting
  - Asphalt concrete pavement replacement would be the width of the trench plus 6-inches on each side
  - Heavy traffic control required
  - One pothole per 100 LF of pipe required
- Average depth of cover of 5 feet
- 100% of soil excavated is hauled to a landfill or reused offsite and 100% of soil required for backfill is imported
- Isolation valves and other appurtenances amount to 20% or the pipeline material costs

Production rate is 150-linear feet of pipeline construction per day

Note: HDPE pipe sizes are IPS (outside diameter controlled) based on AWWA C906

Pipeline Construction Cost – Special Crossings

For special crossings (such as highway and creek crossings), a range of crossing methods was assessed for the preferred crossing method at each location. Following this assessment, Pilot Tube Guided Auger Boring (PTGAB) was considered the default method for all trenchless underground crossings. PTGAB is a costlier method compared to other trenchless techniques and may be required due to the concept option's smaller pipeline diameters and certain soil conditions in the Study Area. Therefore, it is a conservative basis for the purpose of developing a planning-level cost estimate. PTGAB is favorable in conditions with little to no groundwater; therefore, if further geotechnical investigations identify high groundwater along the pipeline route, another trenchless method should be considered.

Each special crossing was evaluated as a potential trenchless underground crossing, but where feasible, crossings were also evaluated for less costly construction methods. Therefore, non-trenchless installation methods were utilized where possible. This was applied when pipeline alignments crossed bridges and box culverts; it was assumed that under these specific conditions, a pipe bridge could be used rather than a trenchless method. Pipe bridges are generally lower cost and allow for reduced permitting efforts and traffic control during construction compared to trenchless methods.

Under the Phase 3 Pipeline design (Woodard & Curran 2018), feasible trenchless construction methods included microtunneling and horizontal directional drilling (HDD). Open cut methods were assumed when the alignment crossed over an existing culvert and there is adequate cover over the box culvert.

Table 4-2 summarizes the unit costs used for special crossings. These costs were developed based on a collection of past project experience and unit costs taken from RSMeans.

Table 4-2: Special Crossing Unit Costs

Element	Unit	Unit Cost
Trenchless		
Microtunnel Launch Pit	Lump sum	$300,000
Microtunnel Receiving Pit	Lump sum	$150,000
Microtunnel Casing and Pipe (36-inch)	Linear foot	$1,728
HDD (24-inch bore diameter)	Linear foot	$528
PTGAB (HDPE)		
6-inch	Linear foot	$375
8-inch	Linear foot	$500
10-inch	Linear foot	$625
12-inch	Linear foot	$750
16-inch	Linear foot	$1,000
20-inch	Linear foot	$1,250
PTGAB Launch Pit	Lump sum	$258,000
PTGAB Receiving Pit	Lump sum	$148,000
Pipe Bridge (DIP, Class 50, Mechanical Joint)		
6-inch	Linear foot	$66
8-inch	Linear foot	$86
10-inch	Linear foot	$108
16-inch	Linear foot	$175
Pipe Bridge Support	Lump sum	$5,000

Pipeline Construction Cost – Pipe Rehabilitation

Pipelines that serve Los Altos Hills under Concept Options A2 and A3 were assumed to convey recycled water via re-lined abandoned PHWD 6- and 8-inch cast iron pipe (CIP) water mains in Purissima Road. The 6- and 8-inch water mains were abandoned in 1995. The condition of the pipes is unknown but was assumed to be in relatively good condition. Under current recycled water demand projections, there is sufficient capacity in the existing pipes.

Cured-in-Place-Pipe (CIPP) lining was assumed to be the more practical method of rehabilitation compared to pipe bursting due to the minimal pipe cover depths, which were estimated by PHWD to be approximately three to four feet. The shallow cover could present problems of ground heave and soil displacement if pipe bursting were to take place.

CIPP lining costs, for both the 6- and 8-inch mains, were estimated from historical data. Unit costs include closed-circuit television inspection and minor cleaning prior to lining. Advanced cleaning

mechanisms to address instances of tuberculation and point repair to address structural deficiencies are not included in the cost.

4.2.5 Pump Station Construction Cost

Pump station costs for concept options were estimated using a pump cost curve based on each pump station's total installed motor horsepower. This cost curve is applicable to pump stations of average complexity. The pump cost curve was determined using the following equation:

$$Cost\left(\frac{\$}{Horsepower}\right) = 17437 * Total\ Horsepower^{-.36}$$

Pump station costs for Concept Option A1, Phase 3 Pipeline, including costs for the Phase 3 recycled water pump station and booster pump station were taken from the Phase 3 Preliminary Design Report (Woodard & Curran 2018).

Hydropneumatic and Surge Tanks Costs

Concept Options with multiple pump stations would benefit from the installation of recycled water tanks, but given the challenge of acquiring land in the Study Area to construct such tanks, hydropneumatic tanks were assumed instead. Hydropneumatic tanks would regulate system pressures to meet demand while acting as a cushion for pumps in series in a closed conduit system. Since the tanks contain both water and air under pressure, they can exert or absorb pressure throughout the system when needed.

Costs for surge tanks were also included for some concept options assuming the need to mitigate variations due to rapid changes in flow. A surge analysis would be required to determine the need for surge tanks. The tank costs were estimated from previous experience with projects of similar characteristics and configuration.

4.2.6 Extraction Well Treatment Construction Costs

For IPR concept options, wellhead treatment was assumed to be required at all extraction wells. The wellhead treatment capital and O&M costs were developed based on calculations completed for Palo Alto's 2017 Water Integrated Resources Plan. Wellhead treatment capital costs include reverse osmosis treatment for iron, manganese, and total dissolved solids (Option 4 from the 2000 Long Term Water Supply Study, updated for the 2017 Water Integrated Resources Plan). These wellhead treatment capital costs do not account for land acquisition. Therefore, separate land costs were developed for the Rinconada and Peers wells, which would require additional land to be purchased to locate wellhead treatment facilities. These land costs are also sourced from Palo Alto's 2017 Water Integrated Resources Plan.

In addition to wellhead treatment, O&M costs for extraction wells also included the Valley Water groundwater pumping charge. This cost was based on projected Valley Water rates for groundwater pumping in the Study Area.

4.3 Engineer's Opinion of Probable Cost Summary

Table 4-3 below provides a summary of probable capital and O&M costs, as well as unit costs, for each developed concept option. Detailed cost estimates are included in Appendix D.

Table 4-3: Summary of Engineer's Opinion of Probable Capital and O&M Costs

Concept Option ID & Name	Capital Cost	O&M ($/Year)	Yield (AFY)	Unit Cost ($/AF)
A1: NPR Palo Alto Phase 3	$47,800,000	$290,000	800	$3,400
A2: NPR Palo Alto Phase 3 Extended to Foothills	$63,000,000	$520,000	1,100	$3,400
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	$85,100,000	$680,000	1,200	$4,000
A4: NPR Mountain View	$6,200,000	$100,000	200	$2,100
A5: NPR Mountain View Extended to Los Altos	$72,600,000	$400,000	900	$4,600
A6: NPR East Palo Alto	$20,700,000	$150,000	500	$2,400
B1: NPR Satellite Treatment Plant	$129,600,000	$1,370,000	900	$8,900
C1: Palo Alto Dedicated IPR	$92,200,000	$14,830,000	5,900	$3,300
C2: Palo Alto IPR and NPR	$152,100,000	$16,920,000	6,100	$4,000
C3: Palo Alto IPR and NPR from Phase 3	$198,400,000	$15,780,000	5,900	$4,400
D1: Palo Alto Dedicated DPR	$104,600,000	$8,010,000	5,300	$2,500

Note: Costs based on an ENR CCI June 2018 SF index of 12,015. Costs are consistent with a Class 5 estimate (-20% to +50%) (AACE 2008). Capital costs are amortized at 3% over 30 years.

4.4 Concept Option Evaluation Non-Cost Criteria

In evaluating concept options, Palo Alto and Valley Water solicited input from stakeholders on factors to consider in addition to cost. The stakeholders aided in developing the list of non-cost criteria and Palo Alto and Valley Water staff participated in the development of scoring rubrics to apply each non-cost criteria to the various concept options. The selected non-cost criteria are:

- Water Supply Resiliency
- Public Acceptance
- Adaptability
- Level of Agency Coordination
- Level of Customer Retrofits/Coordination
- Regulatory Complexity
- Institutional Complexity
- Regional Perspective
- Social and Economic Benefit
- Environmental Benefit

For each criterion, concept options could score up to 5 points. A description of the criteria, the scoring rubric for that criteria, and how each concept option scored with respect to those criteria are described in the following sections.

4.4.1 Water Supply Resiliency

This criterion evaluates concept options based on their total potential recycled water demand or amount of water supplied. Concept Options were scored as follows:

- 5 points: potential demands totaling > 2,000 AFY
- 4 points: potential demands totaling between 1,501 and 2,000 AFY
- 3 points: potential demands totaling between 1,001 and 1,500 AFY
- 2 points: potential demands totaling between 501 and 1,000 AFY
- 1 point: potential demands totaling ≤ 500 AFY

Table 4-4: Concept Option Scores for Water Supply Resiliency

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	2	800 AFY
A2: NPR Palo Alto Phase 3 Extended to Foothills	3	1,100 AFY
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	3	1,250 AFY
A4: NPR Mountain View	1	200 AFY
A5: NPR Mountain View Extended to Los Altos	2	900 AFY
A6: NPR East Palo Alto	1	500 AFY
B1: NPR Sate Satellite Treatment Plant	2	900 AFY
C1: Palo Alto Dedicated IPR	5	2,800 AFY
C2: Palo Alto IPR and NPR	5	3,000 AFY
C3: Palo Alto IPR and NPR from Phase 3	5	3,200 AFY
D1: Palo Alto Dedicated DPR	5	5,300 AFY

Note. For IPR options, the rationale is based on purified recycled water yield.

4.4.2 Public Acceptance

Public acceptance criterion gauges the likelihood of potential customers accepting recycled water and continuing to use it for the foreseeable future. Customer acceptance of NPR is assumed to be greater than potable reuse. Public properties, which are mainly owned by agencies that have been engaged in the recycled water planning process, are assumed to be easier to convert to recycled water usage than privately owned properties. For potable reuse options, given initial feedback from members of the Palo Alto Utilities Advisory Commission and City Council at their respective study sessions held in 2018, DPR is assumed to have greater public acceptance than IPR.

Concept Options were scored as follows:

- 5 points: NPR concept options serving public properties only
- 4 points: NPR concept options including private properties but with customers (or an anchor customer) eager to accept recycled water or where a detailed market assessment has been performed
- 3 points: NPR including private properties
- 2 points: DPR concept options
- 1 point: IPR concept options

Table 4-5: Concept Option Scores for Public Acceptance

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	4	Demands recently refined during pre-design
A2: NPR Palo Alto Phase 3 Extended to Foothills	4	Phase 3 demands recently refined during pre-design. Additional area includes strong anchor
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	4	Phase 3 demands recently refined during pre-design. Additional area includes strong anchor
A4: NPR Mountain View	4	Demands from Mountain View RWFS
A5: NPR Mountain View Extended to Los Altos	3	Mountain View demands from RWFS. Demand in Los Altos includes a large private user.
A6: NPR East Palo Alto	3	Includes numerous private properties in East Palo Alto
B1: NPR Satellite Treatment Plant	4	Phase 3 demands recently refined during pre-design. Demand in Los Altos is non-potable for public properties only
C1: Palo Alto Dedicated IPR	1	IPR
C2: Palo Alto IPR and NPR	1	IPR
C3: Palo Alto IPR and NPR from Phase 3	1	IPR
D1: Palo Alto Dedicated DPR	2	DPR

4.4.3 Adaptability

Adaptability criterion assesses the potential to repurpose the proposed facilities in case of changes in the demand base. Concept options with the lowest risk of assets being stranded in the future scored highest. The concept options that included both NPR and IPR uses were considered most adaptable. Because the recycled water used for these concept options would be fully-advanced treated water suitable for groundwater injection, if NPR decreased, the water could be redirected to groundwater recharge. After the combined NPR and IPR concept options, the IPR-only concept option was considered the most adaptable given the ability to use the IPR treatment train within the DPR treatment train and repurpose the pipeline to the injection wells for conveyance of DPR water to the drinking water distribution system. IPR and DPR conveyance infrastructure could be repurposed to serve NPR customers if potable reuse for some reason became unacceptable to the community, but the injection wells and the advanced water purification facilities would be stranded assets. The NPR pipelines, which generally consist of smaller diameters than the IPR and DPR concept options, provide fewer repurposing opportunities than the IPR and DPR pipelines. Among the NPR concept options, those with larger diameter pipelines provide more opportunities for future uses.

Concept Options were scored as follows:

- 5 points: NPR/IPR
- 4 points: IPR only
- 3 points: DPR or NPR with backbone ≥ 16-inch and non-extensive branching
- 2 points: NPR with backbone < 16-inch and non-extensive branching
- 1 point: NPR with extensive branching

Table 4-6: Concept Option Scores for Adaptability

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	2	NPR, pipeline backbone 12-inch
A2: NPR Palo Alto Phase 3 Extended to Foothills	1	NPR, extensive pipeline branches
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	1	NPR, extensive pipeline branches
A4: NPR Mountain View	2	NPR, pipeline ranges from 12- to 6-inch
A5: NPR Mountain View Extended to Los Altos	3	NPR, pipeline backbone 6-inch with several long branches following the 16-inch segment
A6: NPR East Palo Alto	2	NPR, pipeline backbone ranges from 12- to 10-inch with a few relatively short branches
B1: NPR Satellite Treatment Plant	1	NPR, pipeline branching begins at satellite facility
C1: Palo Alto Dedicated IPR	4	IPR only
C2: Palo Alto IPR and NPR	5	NPR with IPR
C3: Palo Alto IPR and NPR from Phase 3	5	NPR with IPR
D1: Palo Alto Dedicated DPR	3	DPR

4.4.4 Level of Agency Coordination

This criterion reflects the effort required by the lead agency to implement the concept option including design, use permitting, and operating requirements. Centralized NPR concept options were considered preferable to satellite NPR, IPR and DPR, all of which require new treatment processes to operate. DPR, which requires a new classification of treatment operators, was considered the least favorable concept option in this regard.

Concept Options were scored as follows:

- 5 points: Project previously evaluated and supported by community
- 4 points: NPR serving only lead agency or RWQCP partner owned sites or Project has already gone through public reviews
- 3 points: NPR serving various sites
- 2 points: NPR with satellite treatment or IPR
- 1 point: DPR

Table 4-7: Concept Option Scores for Level of Agency Coordination

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	4	Completed facilities plan and EIR
A2: NPR Palo Alto Phase 3 Extended to Foothills	3	NPR including non-partner sites in Palo Alto and Los Altos Hills
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	3	NPR including non-partner sites in Palo Alto, Los Altos, and Los Altos Hills
A4: NPR Mountain View	5	Mountain View prepared to implement project pending current update (July 2019) of RWFS
A5: NPR Mountain View Extended to Los Altos	3	NPR including non-partner sites in Los Altos
A6: NPR East Palo Alto	3	NPR including non-partner sites in East Palo Alto
B1: NPR Satellite Treatment Plant	2	New satellite treatment facilities
C1: Palo Alto Dedicated IPR	2	New treatment facilities for IPR
C2: Palo Alto IPR and NPR	2	New treatment facilities for IPR
C3: Palo Alto IPR and NPR from Phase 3	2	New treatment facilities for IPR
D1: Palo Alto Dedicated DPR	1	New treatment facilities for DPR

4.4.5 Level of Customer Retrofits/Coordination

Level of customer retrofits/coordination criterion is the effort and improvements required by the customer to use the recycled water. Having no retrofit requirements would be preferred, followed by changing meters for customers who already have a separate irrigation meter. Conversion of existing buildings is the least preferred due to anticipated complications with local public health approvals to verify there are no cross-connections within the retrofitted building. Concept Options were scored as follows:

- 5 points: No customer retrofits
- 4 points: Irrigation use only with separate meters
- 3 points: Irrigation use only, or indoor use limited to future development
- 2 points: Irrigation and indoor uses within existing buildings
- 1 point: Indoor uses only within existing buildings

Table 4-8: Concept Option Scores for Level of Customer Retrofits/Coordination

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	2	Includes indoor use for existing Palo Alto customers
A2: NPR Palo Alto Phase 3 Extended to Foothills	2	Includes indoor use for existing Palo Alto customers
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	2	Includes indoor use for existing Palo Alto customers
A4: NPR Mountain View	2	Includes indoor use for existing Mountain View customer
A5: NPR Mountain View Extended to Los Altos	2	Includes indoor use for existing Mountain View customer
A6: NPR East Palo Alto	3	Includes indoor uses limited to future developments in East Palo Alto
B1: NPR Satellite Treatment Plant	2	Includes indoor use for existing Palo Alto customers
C1: Palo Alto Dedicated IPR	5	IPR does not require customer retrofits
C2: Palo Alto IPR and NPR	3	NPR limited to irrigation
C3: Palo Alto IPR and NPR from Phase 3	3	Includes indoor use for existing Palo Alto customers
D1: Palo Alto Dedicated DPR	5	DPR does not require customer retrofits

4.4.6 Regulatory Complexity

Regulatory complexity criterion is a measure of the precedence of proposed uses of recycled water and permitting required for implementation. As a well-established practice, permitting for NPR will be more streamlined than potable reuse. Permitting for IPR which has established regulations will be less complex than DPR which does not yet have established regulations.

Concept Options were scored as follows:

- 5 points: NPR for irrigation only
- 4 points: NPR including non-irrigation uses
- 3 points: IPR only
- 2 points: NPR with IPR
- 1 point: DPR only

Table 4-9: Concept Option Scores for Regulatory Complexity

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	4	NPR including non-irrigation uses
A2: NPR Palo Alto Phase 3 Extended to Foothills	4	NPR including non-irrigation uses
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	4	NPR including non-irrigation uses
A4: NPR Mountain View	4	NPR including non-irrigation uses
A5: NPR Mountain View Extended to Los Altos	4	NPR including non-irrigation uses
A6: NPR East Palo Alto	4	NPR including non-irrigation uses
B1: NPR Satellite Treatment Plant	4	NPR including non-irrigation uses
C1: Palo Alto Dedicated IPR	3	IPR
C2: Palo Alto IPR and NPR	2	NPR with IPR
C3: Palo Alto IPR and NPR from Phase 3	2	NPR with IPR
D1: Palo Alto Dedicated DPR	1	DPR

4.4.7 Institutional Complexity

Institutional complexity criterion reflects the number of local agencies that would be involved in implementation and operation of the concept option. The more favorable concept options were those with fewer agencies involved since institutional complexity increases with the number of agencies involved. Concept Options were scored as follows:

- 5 points: One local agency
- 4 points: Two local agencies
- 3 points: Three local agencies
- 2 points: Four local agencies
- 1 point: Five local agencies

Table 4-10: Concept Option Scores for Institutional Complexity

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	5	1 agency: Palo Alto
A2: NPR Palo Alto Phase 3 Extended to Foothills	3	3 agencies: Palo Alto, Los Altos Hills, Purissima Hills Water District
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	1	5 agencies: Palo Alto, Los Altos, Los Altos Hills, Cal Water, Purissima Hills Water District
A4: NPR Mountain View	5	1 agency: Mountain View
A5: NPR Mountain View Extended to Los Altos	3	3 agencies: Mountain View, Los Altos, Cal Water
A6: NPR East Palo Alto[1]	3	3 agencies: Palo Alto, East Palo Alto Sanitary District, East Palo Alto
B1: NPR Satellite Treatment Plant	3	3 agencies: Palo Alto, Los Altos, Cal Water
C1: Palo Alto Dedicated IPR	5	1 agency: Palo Alto
C2: Palo Alto IPR and NPR	5	1 agency: Palo Alto
C3: Palo Alto IPR and NPR from Phase 3	5	1 agency: Palo Alto
D1: Palo Alto Dedicated DPR	5	1 agency: Palo Alto

Note: 1. Although the infrastructure for Concept Option A6 is sized for anticipated Menlo Park demands, the short-term project does not require coordination with Menlo Park.

4.4.8 Regional Perspective

Regional perspective criterion reflects the number of local agencies benefitting from the implementation of the concept option. In contrast to the institutional complexity criterion, the more favorable concept options were those that included multiple agencies. Concept Options were scored as follows:

- 5 points: Majority of RWQCP partners, multiple water retailers and multiple wholesalers benefit
- 4 points: Multiple water retailers and multiple wholesalers benefit
- 3 points: Multiple water retailers but only one wholesaler benefit
- 2 points: One water retailer but multiple wholesalers benefit
- 1 point: One water retailer and one wholesaler benefit

Table 4-11: Concept Option Scores for Regional Perspective

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	1	Partner Agency: Palo Alto; Retailers: Palo Alto; Wholesaler: San Francisco Public Utilities Commission
A2: NPR Palo Alto Phase 3 Extended to Foothills	3	Partner Agency: Palo Alto, Los Altos Hills Retailers: Palo Alto, Purissima Hills Water District Wholesaler: San Francisco Public Utilities Commission
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	4	Partner Agency: Palo Alto, Los Altos, Los Altos Hills Retailers: Palo Alto, Cal Water, Purissima Hills Water District Wholesaler: San Francisco Public Utilities Commission, Valley Water
A4: NPR Mountain View	1	Partner Agency: Mountain View Retailers: Mountain View Wholesaler: San Francisco Public Utilities Commission
A5: NPR Mountain View Extended to Los Altos	4	Partner Agency: Mountain View, Los Altos Retailers: Mountain View, Cal Water Wholesaler: San Francisco Public Utilities Commission, Valley Water
A6: NPR East Palo Alto[1]	3	Partner Agency: East Palo Alto Sanitary District, Palo Alto Retailers: East Palo Alto, Palo Alto Wholesaler: San Francisco Public Utilities Commission
B1: NPR Satellite Treatment Plant	4	Partner Agency: Palo Alto, Los Altos Retailers: Palo Alto, Cal Water Wholesaler: San Francisco Public Utilities Commission, Valley Water
C1: Palo Alto Dedicated IPR	1	Partner Agency: Palo Alto Retailers: Palo Alto Wholesaler: San Francisco Public Utilities Commission
C2: Palo Alto IPR and NPR	1	Partner Agency: Palo Alto Retailers: Palo Alto Wholesaler: San Francisco Public Utilities Commission
C3: Palo Alto IPR and NPR from Phase 3	1	Partner Agency: Palo Alto Retailers: Palo Alto Wholesaler: San Francisco Public Utilities Commission
D1: Palo Alto Dedicated DPR	1	Partner Agency: Palo Alto Retailers: Palo Alto Wholesaler: San Francisco Public Utilities Commission

Note: 1. Although the infrastructure for Concept Option A6 is sized for anticipated Menlo Park demands, the short-term project does not directly benefit Menlo Park

.

4.4.9 Social and Economic Benefit

Social and economic benefit criterion reflects the benefits of improved water supply reliability. Concept Options were scored as follows:

- 5 points: Supports a disadvantaged community
- 4 points: Supports community with projected shortfalls by 2020 in normal years
- 3 points: Supports community with projected shortfalls by 2020 in dry years
- 2 points: Supports community with projected shortfalls by 2040
- 1 point: No projected shortfalls

Table 4-12: Concept Option Scores for Social and Economic Benefit

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	1	No projected shortfalls
A2: NPR Palo Alto Phase 3 Extended to Foothills	1	No projected shortfalls
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	1	No projected shortfalls
A4: NPR Mountain View	2	Mountain View has projected shortfall by 2040
A5: NPR Mountain View Extended to Los Altos	2	Mountain View has projected shortfall by 2040
A6: NPR East Palo Alto	5	East Palo Alto is a disadvantaged community; East Palo Alto and Menlo Park have projected shortfalls
B1: NPR Satellite Treatment Plant	1	No projected shortfalls
C1: Palo Alto Dedicated IPR	1	No projected shortfalls
C2: Palo Alto IPR and NPR	1	No projected shortfalls
C3: Palo Alto IPR and NPR from Phase 3	1	No projected shortfalls
D1: Palo Alto Dedicated DPR	1	No projected shortfalls

4.4.10 Environmental Benefit

Environmental benefit criterion considers the improvement to the RWQCP's discharge to the San Francisco Bay. NPR diverts more contaminants from Bay discharge, and it is assumed that IPR and DPR will involve discharge of reverse osmosis concentrate with trace organics, nutrients, and trace metals. Concept Options were scored as follows:

- 5 points: NPR > 999 AFY
- 4 points: NPR 0 to 999 AFY
- 3 points: NPR with IPR
- 2 points: IPR only
- 1 point: DPR only

Table 4-13: Concept Option Scores for Environmental Benefit

Concept Option ID	Score	Rationale
A1: NPR Palo Alto Phase 3	4	NPR 800 AFY
A2: NPR Palo Alto Phase 3 Extended to Foothills	5	NPR 1,100 AFY
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	5	NPR 1,200 AFY
A4: NPR Mountain View	4	NPR 200 AFY
A5: NPR Mountain View Extended to Los Altos	4	NPR 900 AFY
A6: NPR East Palo Alto	4	NPR 500 AFY
B1: NPR Satellite Treatment Plant	5	NPR 900 AFY
C1: Palo Alto Dedicated IPR	2	IPR only
C2: Palo Alto IPR and NPR	3	NPR with IPR
C3: Palo Alto IPR and NPR from Phase 3	3	NPR with IPR
D1: Palo Alto Dedicated DPR	1	DPR only

4.5 Concept Option Scoring

4.5.1 Non-Cost Scoring

Palo Alto, Valley Water, and Mountain View, as the Strategic Plan primary stakeholders, weighted the non-cost criteria. Table 4-14 shows the average of the provided weights.

Table 4-15 presents the ranking of concept options based on the non-cost criteria alone. Considering only the non-cost criteria, the top scoring concept options are A2, NPR Palo Alto Phase 3 Extended to Foothills and the IPR concept options (Concept Options C1- C3) while the lowest scoring concept options are D1, Palo Alto Dedicated DPR and B1, NPR Satellite Treatment Plant. The previously recommended Palo Alto Phase 3 (Concept Option A1) and Mountain View long term project (Concept Option A4) rank in the middle.

Table 4-14: Non-Cost Criteria Weighting

Criteria	Percent of Non-Cost Score	Weighted Maximum Score per Criteria (Maximum score per Criteria being 5)
Amount of water supplied	19%	95
Public acceptance	17%	85
Adaptability	10%	50
Level of agency coordination	9%	45
Level of customer retrofits/coordination	5%	25
Regulatory complexity	6%	30
Institutional complexity	9%	45
Regional perspective	8%	40
Social and economic benefit	10%	50
Environmental benefit	7%	35
Total	100%	500

Table 4-15: Non-Cost Ranking

Rank	Score (Maximum Score = 500)	Concept Option
1	291	A2: NPR Palo Alto Phase 3 Extended to Foothills
2	290	C1: Palo Alto Dedicated IPR
3	289	C2: Palo Alto IPR with NPR
	289	C3: Palo Alto IPR and NPR from Phase 3 Pipeline
4	286	A5: NPR Mountain View Extended to Los Altos
5	285	A1: NPR Palo Alto Phase 3
	285	A4: NPR Mountain View
	285	A6: NPR East Palo Alto
6	282	A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos
7	271	B1: NPR Satellite Treatment Plant
8	269	D1: Palo Alto Dedicated DPR

The **IPR concept options** are scored well with non-cost criteria due to the large amount of water supplied combined with greater ability to repurpose the infrastructure and only one agency required to implement and operate.

Concept Option A2, NPR Palo Alto Phase 3 Extended to Foothills ranks highly because it delivers among the largest volumes of the NPR concept options and strikes a balance between offering regional benefits while requiring few agencies to implement and operate.

Concept Option D1, Palo Alto Dedicated DPR delivers the greatest volume of recycled water out of all the concept options, requires only one agency to implement and operate, and does not require infrastructure changes by customers. The notable drawback of Concept Option D1 is the implementation process. Given the lack of established regulations, pursuing a DPR project at this time would require more effort by Palo Alto to establish a process that DDW will permit. Even when DPR regulations are established, the hurdles that agencies must clear to permit DPR projects will likely be more challenging compared to other recycled water projects. Another challenge will be hiring/training staff to operate the new treatment facilities.

The presumed benefit of **Concept Option B1, NPR Satellite Treatment Plant** was the ability to create a compact recycled water distribution system rather than requiring an extensive network extending from the RWQCP. However, in this setting, the preferred location for diverting flows from the sewer system does not correspond to the areas of potential recycled water nor is there land available in the immediate vicinity of the diversion point to site a satellite treatment facility. As shown in Figure 3-8, Concept Option B1 involves a significant, branched pipe network.

4.5.2 Cost and Non-Cost Scoring

Table 4-16 presents the ranking of concept options by cost using the scoring listed herein. Factoring cost in at 30% of the score, concept options were scored as follows:

- 5 points: < $3,500/AF
- 4 points: ≥ $3,500/AF and < $4,000/AF
- 3 points: ≥ $4,000/AF and < $4,500/AF
- 2 points: ≥ $4,500/AF and < $5,000/AF
- 1 point: ≥ $5,000/AF

Factoring in cost at 30% of the total score was selected after testing for sensitivity to prevent cost from overtaking or from not having an impact on the total non-cost criteria scores. From the sensitivity analysis, weighting cost at 50% yielded similar results to weighting at 30%. Table 4-17 presents the combined weighting of the cost and non-cost criteria together. Table 4-18 presents the ranking of concept options combining the non-cost criteria and estimated costs.

Table 4-16: Ranking of Concept Options by Cost

Rank	Score	Concept Option
1	5	A1: NPR Palo Alto Phase 3
		A2: NPR Palo Alto Phase 3 Extended to Foothills
		A4: NPR Mountain View
		A6: NPR East Palo Alto
		C1: Palo Alto Dedicated IPR
		D1: Palo Alto Dedicated DPR
2	3	A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos
		C2: Palo Alto IPR with NPR
		C3: Palo Alto IPR and NPR from Phase 3 Pipeline
3	2	A5: NPR Mountain View Extended to Los Altos
4	1	B1: NPR Satellite Treatment Plant

Table 4-17: Combined Weighting Including both Cost and Non-Cost Criteria

Criteria	Percent of Non-Cost Score (Rounded)	Weighted Maximum Score per Criteria (Maximum score per Criteria being 5)
Amount of water supplied	13%	67
Public acceptance	12%	61
Adaptability	7%	35
Level of agency coordination	6%	30
Level of customer retrofits/coordination	4%	19
Regulatory complexity	4%	21
Institutional complexity	6%	30
Regional perspective	6%	28
Social and economic benefit	7%	36
Environmental benefit	5%	23
Cost	30%	150
Total	100%	500

Table 4-18: Combined Ranking Considering Cost at 30% of the Score

Rank	Score (Maximum Score = 500)	Concept Option
1	354	A2: NPR Palo Alto Phase 3 Extended to Foothills
	353	C1: Palo Alto Dedicated IPR
2	350	A1: NPR Palo Alto Phase 3
	350	A4: NPR Mountain View
	350	A6: NPR East Palo Alto
3	339	D1: Palo Alto Dedicated DPR
4	323	C2: Palo Alto IPR with NPR
5	317	A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos
6	293	C3: Palo Alto IPR and NPR from Phase 3 Pipeline
7	260	A5: NPR Mountain View Extended to Los Altos
8	220	B1: NPR Satellite Treatment Plant

Factoring in costs at 30% of the score, the top scoring concept options are NPR Palo Alto Phase 3 Extended to Foothills (**Concept Option A2**), Palo Alto Dedicated IPR (**Concept Option C1**), the previously recommended NPR Palo Alto Phase 3 (**Concept Option A1**) and Mountain View long-term project (**Concept Option A4**) and the NPR East Palo Alto concept option (**Concept Option A6**).

Concept Option D1, Palo Alto Dedicated DPR ranks in the middle. With the greatest amount of water supplied and one of the lowest estimated unit costs, Concept Option D1 scores well for the two most highly weighted evaluation criteria. The attractive cost helps to offset the DPR implementation challenges noted above.

Concept Option B1, NPR Satellite Treatment Plant remains solidly at the bottom. As discussed previously, Concept Option B1 requires a significant investment of infrastructure to convey flows from the sewer diversion point to treatment facilities and then to customers. The cost of conveyance infrastructure plus the cost of new treatment facilities including land acquisition are significant and, when factored into the scoring, further reduces the ranking of this concept option relative to the others.

Chapter 5 Conclusions and Next Steps

5.1 Conclusions

5.1.1 Summary of Demands and Engineer's Opinion of Probable Costs

Table 5-1 provides a summary of potential demand by water reuse type considered in this Strategic Plan. The potential market for NPR demands includes the entire RWQCP service area, not one specific concept option. Table 5-2 summarizes the capital, O&M, and unit costs for the various concept options investigated in this Strategic Plan.

Table 5-1: Summary of Demand Potential by Type of Water Reuse

Type of Reuse	Annual Average Demand	Comments
NPR	4,456 AFY	Throughout RWQCP service area
IPR	2,800 / 5,900 AFY	For Palo Alto only
DPR	5,300 AFY	For Palo Alto only

Note: IPR annual average demand reflects volume recharged to the groundwater basin/ volume extracted from the groundwater basin

Table 5-2: Summary of Engineer's Opinion of Probable Capital and O&M Costs

Concept Option	Capital Cost	O&M ($/year)	Unit Cost ($/AF)
A1: NPR Palo Alto Phase 3	$47.8M	$0.29M	$3,400
A2: NPR Palo Alto Phase 3 Extended to Foothills	$63.0M	$0.52M	$3,400
A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos	$85.1M	$0.68M	$4,000
A4: NPR Mountain View	$6.2M	$0.1M	$2,100
A5: NPR Mountain View Extended to Los Altos	$72.6M	$0.4M	$4,600
A6: NPR East Palo Alto	$20.7M	$0.15M	$2,400
B1: NPR Satellite Treatment Plant	$129.6M	$1.37M	$8,900
C1: Palo Alto Dedicated IPR	$92.2M	$14.83M	$3,300
C2: Palo Alto IPR with NPR	$152.1M	$16.92M	$4,000
C3: Palo Alto IPR and NPR from Phase 3 Pipeline	$198.4M	$15.78M	$4,400
D1: Palo Alto Dedicated DPR	$104.6M	$8.01M	$2,500

Note: Costs based on an ENR CCI San Francisco index for June 2018 of 12,015. Costs are consistent with a Class 5 estimate (-20% to +50%) (AACE 2008). Capital costs are amortized at 3% over 30 years.

For comparison with other non-water reuse water supplies, potable water from SFPUC is projected to cost $3,000 per AF in 2030, and groundwater, including wellhead treatment and the Valley Water groundwater pumping charge, is projected to cost $3,000 per AF. [2]

To provide a basis for comparison, cost estimates reflect the incremental cost of pursuing each concept option. For the NPR options, the cost estimates include distribution to the end-user. Consistent with the incremental cost methodology, this report does not estimate the total cost of providing the IPR or DPR water to end-users as Palo Alto's existing potable water distribution system costs are not included in the estimates.

[2] These are the estimated costs to the City of Palo Alto of purchasing SFPUC water or pumping groundwater and these cost estimates do not include distribution system costs.

5.1.2 General Conclusions Regarding NPR Concept Options

The Strategic Plan determined that there is interest throughout most of the RWQCP service area and neighboring communities in receiving recycled water from the RWQCP for NPR uses. The one Partner Agency that is not interested is Stanford University. Stanford University maintains a diverse water supply portfolio consisting of water from SFPUC, groundwater, local surface water, and captured stormwater. Stanford University does have significant non-potable water demands, but the university does not foresee a need for recycled water from the RWQCP due to the existence of its separate non-potable irrigation water system that meets over 30% of the campus' water demands (over 80% of irrigation demands). As such the NPR concept options evaluated under this Strategic Plan did not include service to Stanford.

The Strategic Plan considered NPR concept options with both centralized treatment at the RWQCP ("A" concept options) and a satellite treatment option ("B" concept option).

Of the centralized treatment options, Concept Option A2, NPR Palo Alto Phase 3 Extended to Foothills scored highest both with and without the cost criteria. The unit cost for Concept Option A2 is estimated to be similar to the cost of the previously recommended Concept Option A1, NPR Palo Alto Phase 3. Therefore, should Palo Alto elect to move forward with an NPR project, Concept Option A2 or variants, as shown in Appendix D, should be given additional consideration. An analysis of the cost implications of removing various branches of the base concept option will inform discussions regarding cost sharing between the relevant stakeholders in Palo Alto and Los Altos Hills as well as support rate analyses for Palo Alto and PHWD (the two retailers that would be involved in the concept option).

Concept Option A4, NPR Mountain View, was previously recommended in the 2014 Mountain View RWFS, due to its low cost and average non-cost score, was determined to be a reasonable investment compared to the other concept options explored in the Strategic Plan, and during the stakeholder evaluation process, Mountain View staff indicated their commitment to implementing this extension.

Concept Option A6, NPR East Palo Alto scored similarly to the Concept Options A1, NPR Palo Alto Phase 3 and A4, NPR Mountain View. Concept Option A6 is low cost, and the average non-cost score make it a reasonable investment compared to other concept options. Implementation will require coordination with EPASD, who is the Partner Agency that owns the wastewater flows from East Palo Alto to the RWQCP. Though implementation of the concept option does not require coordination with Menlo Park, if East Palo Alto chooses to move forward with the concept option, Menlo Park's level of interest should be verified prior to sizing the infrastructure. Appendix E presents variants of Concept Option A6 and the cost implications of including or not including Menlo Park's demands as well as the benefits of including Palo Alto's demands. This information can inform cost sharing discussion among the relevant stakeholders in Palo Alto, East Palo Alto, and Menlo Park and support a cost of service analysis for the City of East Palo Alto, the likely recycled water retailer.

NPR is challenging for Los Altos and Los Altos Hills because their customers are located furthest from the RWQCP and existing recycled water infrastructure and coordination with the Partner Agencies upstream would be needed. Between the two options to serve Los Altos – Concept Option A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos (which builds off of Concept Option A1) and Concept Option A5: NPR Mountain View Extended to Los Altos (which builds off of Concept Option A4) – Concept Option A3 is preferred due to preliminary costs. Between the two options to serve Los Altos Hills - Concept Option A2, NPR Palo Alto Phase 3 Extended to Foothills Concept Option A3: NPR Palo Alto Phase 3 Extended to Foothills and Los Altos – Concept Option A2 is higher ranked. To assist Los Altos and its retailer Cal Water, and to assist Los Altos Hills and its retailer Purissima Hills Water District, in evaluating an extension from the Palo Phase 3 Pipeline, Appendix E presents variants of Concept Options A2 and A3 that can inform cost sharing discussions among the relevant stakeholders and cost of service analyses for Cal Water and Purissima Hills Water District.

Satellite NPR

Concept Option B1, NPR Satellite Treatment Plant was included to bridge the gap between the source of recycled water at the RWQCP and customers at the periphery of the RWQCP's service area. However, the satellite option was found to be impractical for this setting given the mismatch between the ideal sewer diversion point and where demands are concentrated plus the limited availability of land and the cost of acquiring land to construct a new treatment facility in this area.

Treatment

Both distribution infrastructure and treatment facilities were considered for each of the NPR concept options. Palo Alto has committed to providing enhanced recycled water quality for NPR, meaning water delivered to non-potable customers would be a blend of advanced treated recycled water and disinfected tertiary recycled water to reduce TDS concentration to below 600 mg/L. Assuming implementation of the 2.25 MGD AWTS (which was recommended to provide a 1:1 blend of advanced and tertiary recycled water for the RWQCP's flow commitments of 3.0 MGD for Mountain View and 1.0 MGD for Palo Alto), each of the centralized NPR concept options presented in this Strategic Plan can independently be implemented without additional treatment facilities. The enhanced recycled water provided for these NPR concept options would have a TDS concentration below the 600 mg/L target threshold based on the RWQCP's average TDS concentration of approximately 900 mg/L and an anticipated advanced treated recycled water concentration of 50 mg/L.

Note that the three highest ranked NPR options (without overlap to other options) are A2, A4 and A6; together these options could all be implemented without triggering the need for reverse osmosis concentrate treatment but would require additional advanced or tertiary treatment facilities to produce enough enhanced recycled water, particularly to meet a 1:1 blend ratio.

The City has considered setting a more aggressive goal for the enhanced recycled water of maintaining TDS between 400 to 500 mg/L. Only the Mountain View concept option (Concept Option A4) would meet this goal during peak month demands without additional treatment facilities.

5.1.3 General Conclusions Regarding IPR Concept Options

Several of the RWQCP Partner Agencies and Strategic Plan stakeholders expressed interest in IPR. However, Palo Alto is the only agency that is actively investigating this option and that had groundwater data to support development of IPR concept options.

The IPR concept options that were considered in the Strategic Plan include a concept option dedicated to providing water to Palo Alto groundwater injection wells (Concept Option C1: Palo Alto Dedicated IPR), a concept option that captures non-potable uses in the vicinity of the pipeline needed to reach the Palo Alto groundwater injection wells (Concept Option C2: Palo Alto IPR with NPR), and a concept option that builds off of the Palo Alto Phase 3 Pipeline to convey water to the Palo Alto groundwater injection wells (Concept Option C3: Palo Alto IPR and NPR from Phase 3 Pipeline). Without considering cost, all three IPR concept options are among the top ranked concept options given the large amount of water they supply and lack of institutional complexity. With cost factored into the scoring, only Concept Option C1, Palo Alto Dedicated IPR remains a top scoring IPR concept option.

Implementation of an IPR project would require Palo Alto to incorporate groundwater into its water supply, and Palo Alto is assessing its desire to pursue groundwater use. In some other communities, IPR has generally been seen as a first step towards DPR, gaining customer acceptance of the concept of potable reuse before moving to DPR. However, Palo Alto does not currently use groundwater, and during preliminary study sessions, members of the Utilities Advisory Commission and City Council expressed a preference for DPR over IPR.

Given concerns regarding customer acceptance of groundwater quality compared to the existing SFPUC supply, Palo Alto is assumed to provide wellhead treatment at the groundwater extraction wells to lower

iron, manganese and TDS concentrations. Costs of this treatment were included in each IPR concept option and overall unit costs ranged from $3,300 - $4,400/AF for IPR concept options. For comparison, groundwater use with wellhead treatment and the Valley Water groundwater pumping charge but without any injection of recycled water, is projected to cost $3,000 per AF (in 2018 dollars).

Treatment costs also include new full advanced treatment facilities, including reverse osmosis concentrate treatment, as needed, and associated land acquisition costs. Reverse osmosis concentrate treatment is estimated to be needed to ensure compliance with the RWQCP discharge permit for Concept Options C2 and C3 and thus included in the associated cost estimates.

5.1.4 General Conclusions Regarding DPR Concept Option

Because DPR regulations are not established, developing DPR concept options and drawing conclusions about the feasibility of DPR requires interpretation of the SWRCB's Proposed Framework for Regulating Direct Potable Reuse in California. The uncertainty in regulations is reflected in the low score that the Concept Option D1, Palo Alto Dedicated DPR received when considering only the non-cost criteria. However, when factoring in the estimated unit cost of Concept Option D1, which included extensive additional treatment facilities and engineered storage, the concept option rose to the middle of the rankings. Given the significant volume of existing potable supply that could be offset through Concept Option D1, its low estimated unit cost ($2,500/AF), and the presumably greater acceptance of DPR over IPR in this setting, this concept option deserves further evaluation by Palo Alto and refinement as regulations emerge. For comparison, potable water from SFPUC is projected to cost approximately $3,000 per AF in 2030.

5.2 Next Steps

Results of the Strategic Plan indicate that there are multiple water reuse expansion opportunities within the Study Area that agencies could pursue, including NPR, IPR, and DPR. The following are general next steps that should be considered for any of the concept options to move forward. Table 5-3summarizes the recommended next steps by each category of water reuse.

Note that depending on the outcomes of the Countywide Plan, some of the Concept Options described in this Report may not implementable due to limited supply of recycled water; further evaluation for joint implementation may be required as a next step.

Table 5-3: Recommended Next Steps for Type of Opportunity

	NPR – Next Steps	IPR- Next Steps	DPR – Next Steps
Facilities Planning	Prepare more detailed technical analysis to define facility requirements and to refine cost estimates to a Class 4 level of development (-10% to +30%).	Prepare more detailed technical analysis to define facility requirements and to refine cost estimates to a Class 4 level of development (-10% to +30%).	Prepare more detailed technical analysis to define facility requirements and to refine cost estimates to a Class 4 level of development (-10% to +30%). Prepare various treatment train options with cost estimates to reflect uncertainty to regulatory requirements for treatment.
Funding and Financing	Apply for funding and financing options; Appendix G contains a funding and financing matrix describing a variety of options for recycled water projects. At present, these programs apply to all types of water reuse. Develop recycled water rates to be applied to recycled water customers.	Apply for funding and financing options; Appendix G contains a funding and financing matrix describing a variety of options for recycled water projects. At present, these programs apply to all types of water reuse.	Apply for funding and financing options; Appendix G contains a funding and financing matrix describing a variety of options for recycled water projects. At present, these programs apply to all types of water reuse.
Inter-agency Agreements	If the NPR project involves more than one of the RWQCP Partners, an inter-agency agreement would be needed. New agreements could be modeled after the existing agreement between Palo Alto and Mountain View for the Phase 2 system.	With Valley Water's role as Groundwater Sustainability Agency, an agreement between Palo Alto and Valley Water is needed for an IPR project.	For a DPR project serving Palo Alto only (as described in Concept Option D1), no specific inter-agency agreements are identified at this time.
Environmental Documentation	NPR concept options could be covered under a new environmental document or possibly an amendment to the Phase 3 Environmental Impact Report, depending on the concept option. Either document should meet the requirements of CEQA, and pending selected funding and financing options, the requirements of CEQA-Plus or NEPA.	A new environmental document covering the IPR project would be needed. This document should meet the requirements of CEQA; and, pending selected funding and financing options, the requirements of CEQA-Plus or NEPA.	A new environmental document covering the DPR project would be needed. This document should meet the requirements of CEQA; and, pending selected funding and financing options, the requirements of CEQA-Plus or NEPA.
Reuse Permitting	Covered under Statewide General Order for Recycled Water Use (WQ-2014-009).	Covered under SWRCB regulations, adopted by the State in 2014.	There are no established regulations for DPR projects and no proposed timeline for the State to develop DPR regulations for treated drinking water augmentation.
Customer and Public Outreach	Outreach to specific customers to be served by the NPR project to confirm delivery location, confirm demand, discuss site retrofits, etc. For NPR projects delivering to areas that do not have a mandatory use ordinance in place, customer outreach to encourage customers to sign on to the NPR project.	Public outreach to inform Palo Alto customers of changes to source water (i.e. blending in groundwater to the existing SFPUC supplies) should be considered.	Public outreach to inform Palo Alto customers of changes to source water (i.e. blending in of DPR water to the existing SFPUC supplies) should be considered.

References

Anderson, Daren (Division Manager at the City of Palo Alto Open Space and Parks Department). Email to Emmalynne Roy providing details on habitat enhancement water use at Foothill Park's Boronda Lake. 2018.

Association of the Advancement of Cost Engineering International (AACE), 2008. International Recommended Practice No. 56R-08:Cost Estimate Classification System – As Applied for the Building and General Construction Industries.

Brown and Caldwell, 1992. Water Reclamation Master Plan for the Regional Water Quality Control Plant. April, 1992.

California Building Standards Commission, 2011. 2011 CalGreen Green Building Requirements. January, 2011.

Carollo, 2014. City of Mountain View Recycled Water Feasibility Study. March, 2014.

Engelage, Samantha (Senior Engineer at City of Palo Alto Recycled Water Program). Email to Emmalynne Roy providing details on habitat enhancement water use at Byxbee Park. 2018.

City of Mountain View, 2017. Ordinance No. 17.16. Available: https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=21813

City of Palo Alto. 2017. *Clean Bay 2017 Pollution Prevention Plan*. Available: https://www.cityofpaloalto.org/civicax/filebank/documents/56148

City of Palo Alto, 2008. Ordinance No. 5002. Available: https://www.cityofpaloalto.org/civicax/filebank/documents/19503

City of Palo Alto Utilities, 2017. 2017 Water Integrated Resources Plan. January, 2017.

City of Palo Alto Utilities, 2016. City of Palo Alto 2015 Urban Water Management Plan. June, 2016.

MNS, 2017. Advanced Water Purification System Preliminary/Conceptual Design Report. December, 2017.

State Water Resources Control Board (SWRCB), 2018. A Proposed Framework for Regulating Direct Potable Reuse in California. April, 2018.

SWRCB, 2016. Investigation on the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse. December, 2016.

Todd Groundwater, 2018. Groundwater Assessment, and Indirect Potable Reuse Feasibility Evaluation and Implementation Strategy Report. November, 2018.

Unites States Green Building Council, 2014. LEED Reference for Building Operations and Maintenance, Version 4. October, 2014.

Unites States Green Building Council, 2012. LEED 2009 Water Use Reduction Additional Guidance (Version 7). July, 2012.

West Yost Associates, 2017. City of Menlo Park Water Supply Master Plan, Draft. November, 2017.

Woodard & Curran, 2018. Preliminary Design for Phase 3 Recycled Water Distribution System Final Report. February, 2018.

Appendix A - Non-Potable Demand Assessment Methodology

Appendix A: Non-Potable Demand Assessment

Landscape Irrigation

Landscape irrigation demands were the primary recycled water use identified within the study area. In developing these demands, each customer's landscaped area was estimated using recent aerial imagery from Google Earth, as well as GIS-compatible aerial imagery. From the aerial review, the percentage of each customer's site that is landscaped was estimated and applied this percentage to the total parcel area. In addition, recent aerial imagery was used to check that each site's perceived irrigated space did not include artificial turf. Parcel areas that had artificial turf fields were removed from the total irrigated acreage.

In order to calculate demand, an annual average irrigation factor of 3.4 acre-feet per year (AFY) per acre of landscaped area was applied based on: annual evapotranspiration (ET_o) of 44.8 inches; total annual precipitation of 15.3 inches; and effective precipitation (Eppt) of 25% of total annual precipitation:

$$Annual\ Average\ Irrigation\ Demand\ \left[\frac{AFY}{acre}\right] = \frac{ET_o\ \left[\frac{in}{yr}\right] - Eppt\left[\frac{in}{yr}\right]}{12\ \left[\frac{in}{ft}\right]}$$

$$= \frac{44.8\frac{in}{yr} - 0.25\ \times\ 15.3\frac{in}{yr}}{12\frac{in}{ft}}$$

$$= 3.4\frac{AFY}{acre}$$

The ET_o and precipitation values are taken from the climate data presented in Palo Alto's 2015 Urban Water Management Plan (UWMP) and summarized below in Table 1.

Table 1: City of Palo Alto Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Standard Monthly Average ET_o [1]	1.4	1.9	3.4	4.4	5.5	6.0	6.2	5.5	4.4	3.1	1.7	1.3	**44.8**
Average Rainfall[2] (in)	3.2	2.9	2.3	1.0	0.4	0.1	0.0	0.1	0.2	0.7	1.7	2.7	**15.3**

Source: City of Palo Alto 2015 Urban Water Management Plan

Notes:

1. Average ET_o data for closest active station (Hayward) reported by CIMIS website http://www.cimis.water.ca.gov/
2. Average rainfall data for Palo Alto reported by NOAA website http://www.wrcc.dri.edu/

July is the maximum demand month for landscape irrigation, with a maximum day peaking factor of 1.7. This maximum day peaking factor was applied for all landscape irrigation demands throughout the study area. The peak hour landscape irrigation demands were calculated using an hourly peaking factor of 3.0 assuming an 8-hour irrigation window at night. These peaking factors are summarized in Table 5.

Dual Plumbing

The first step to determining dual-plumbing demands was to estimate the total building square footage. For future developments where site-specific details were not yet known, information was gathered on anticipated building density from developers and architects. If this information was not available, the likely building density was estimated using allowable floor area ratios (FARs) in the development's respective zoning code. The estimated total building square footage was found with the following calculation:

$$Total\ Building\ Area\ [Sq\ Ft] = Total\ Parcel\ Area\ [Sq\ Ft] * FAR * FAR\ Reduction\ Factor$$

It was assumed that not all buildings would be calculated to the maximum FAR over the entire parcel area, so a FAR reduction factor of 0.75 was applied to find the most likely building density. Any comments from developers on likely development density were incorporated into the estimate.

After determining total building square footage, the total potential daily water demand for urinal and toilet fixtures was determined using the following calculation:

$$\begin{aligned} Total\ Daily\ Water\ Demand\ \left[\frac{Gallons}{Day}\right] \\ = Flow\ Rate\ \left[\frac{Gallons}{Flush}\right] * Duration\ [Flush] * Average\ Daily\ Use * No.of\ FTEs \\ + Flow\ Rate\ \left[\frac{Gallons}{Flush}\right] * Duration\ [Flush] * Average\ Transient\ Daily\ Use * No.of\ Transient\ FTEs \end{aligned}$$

Full Time Equivalents (FTEs) are defined as the occupants who spend at least 40 hours per week (8 hours per day) in the building. Transient FTEs represent occupants that do not utilize the building services on a regular basis, such as visitors, customers, or delivery persons. The number of FTEs and Transient FTEs were estimated from the total building footprint square footage and the space type metrics outlined in Table 2. Space types for existing buildings were determined based on known information about the site. Future developments were categorized as "General Office," "Service," "R&D or Laboratory," "Hotel," or "Mixed Use High" based on developer input and zoning descriptions.

Table 2: Space Type Default Occupancy Numbers

Space Type	Gross Square Feet per Occupant – FTE	Gross Square Feet Per Occupant – Transient FTE
General Office	250	0
Retail, general	550	130
Service (e.g. financial, auto)	600	130
Restaurant	435	95
Grocery Store	550	115
Medical Office	225	330
R&D or Laboratory	400	0
Warehouse, distribution	2500	0
Warehouse, storage	20000	0
Hotel	1500	700
Education, daycare	630	105
Educational, K–12	1300	140
Education, postsecondary	2100	150
Mixed Use Corridor[1]	480	90
Mixed Use High[2]	460	80

Source: LEED Reference for Building Operations and Maintenance, Version 4**Error! Reference source not found.**. Appendix 2-Table 1. Default Occupancy Numbers.

Notes:

1. Developed based on zoning description, which averages General Office, Retail, Service, Restaurant, and Grocery Store occupancy numbers.
2. Developed based on zoning description, which averages General Office, Retail, Service, Restaurant, Grocery Store, and R&D/Laboratory occupancy numbers.

Water fixture metrics that were used for flow rate, duration and average daily use are summarized in Table 3.

Table 3: Water Fixture Metrics

Fixture Type	Flow Rate[1] (gallons/flush)	Duration (flush)	Avg Daily Use – FTE[1]	Avg Daily Use – Transient FTE[2]
Urinals	0.5	1	2	0.4
Toilet (Water Closet)	1.28	1	2	0.5

Notes:

1. Source: 2011 CalGreen Green Building Requirements. (Table 13C.5.303.2.2).
2. Source: LEED 2009 Water Use Reduction Additional Guidance (Version 7). Table 1. Non-residential Default Fixture Uses.

IKEA and the Mitchell Park Library and Community Center are the two customers in the service area known to have dual plumbing. Since IKEA's site-specific meter data was not available, its demands were estimated using the methodology outlined above. For the Mitchell Park facilities, the demand was taken

from the Phase 3 Business Plan in which it was assumed that 30% of the water measured by the site's W4 meter is used for toilet flushing that could be converted to recycled water.

In order to adjust each site's total daily water demand to an annual average demand, the daily demand was multiplied by the customer's assumed number of days of operation. The values used for days of operation for different customer types are summarized in Table 4.

Table 4: Days of Operation

Space Type	Days of Operation
Retail, general	365
Hotel	365
Mixed Use High	365
General Office	260
Service (e.g. financial, auto)	260
R&D or Laboratory	260

The peak hour dual-plumbing demands were calculated using an hourly peaking factor of 2.0, assuming the average occupancy of the buildings is 12 hours during the day. Peaking factors are summarized in Table 5.

Cooling Towers

Demands for cooling towers included customers previously identified as having cooling towers and customers assumed to have cooling towers through review of building characteristics. In addition, certain future developments were identified as potential cooling tower users through specific conversations with developers and architects.

The magnitude of cooling tower demand was determined using the following equation:

$$Cooling\ Tower\ Demand\ (AFY) = \frac{Total\ Building\ Area\ [Sq\ Ft]}{330\ \left[\frac{Sq\ Ft}{Ton\ of\ Load}\right] * 4.1} * 0.02\ \left[\frac{AFY}{Ton\ of\ Load}\right]$$

This demand calculation was based on historical cooling tower use data from southern California, adjusted for the climate in Palo Alto. The historical data from several office buildings in Burbank, California showed about 330 square feet per ton of cooling tower load and about .02 AF of water use per ton of cooling tower load. This resulted in an average cooling tower water demand of 0.073 AF per 1,000 square feet of building area. This demand metric was then adjusted to Palo Alto's climate using Cooling Degree Days – the number of degrees that a day's average temperature is above 65°F (which is assumed to be when air conditioning is needed), summed over an entire year. Since Burbank has approximately 4.1 times as many CDDs as Palo Alto, the Burbank cooling tower use factor was divided by 4.1 to yield a cooling tower use factor of 0.018 AF per 1,000 square feet for the Palo Alto area. This factor was applied to all developments assumed to have cooling towers in the service area.

Based on the total number of cooling degree days per month in Palo Alto, August is the maximum demand month for cooling tower demands, with a maximum day peaking factor of 2.7. The peak hour cooling tower

demands were calculated using an hourly peaking factor of 2.0, assuming the average occupancy of the buildings is 12 hours during the day.

These peaking factors are summarized in Table 5.

Table 5: Demand Peaking Factors

Demand Type	Peaking Factor
Maximum Day	
Irrigation	1.7
Cooling Tower	2.7
Hourly	
Irrigation	3.0
Dual Plumbing	2.0
Cooling Tower	2.0

Appendix B - Recycled Water Customers and Demand Estimates [Confidential – Not Included]

Appendix C - Potential Uses Considered but Not Included

Appendix C: Users Considered but Eliminated

Appendix A identifies potential non-potable recycled water customers throughout the Strategic Plan study area whereas this appendix identifies customers that were considered but not included in the study.

The 1992 Palo Alto Recycled Water Master Plan (RWMP) was used as the starting point for identifying potential recycled water demands. Additional uses were then identified through review of available recycled water feasibility studies, Urban Water Management Plans, General and Specific Plans and aerials of the study area. The City and District then reached out to the Regional Water Quality Control Plan (RWQCP) Partner Agencies and other stakeholders to verify if the customers identified in their areas could realistically be expected to accept recycled water and whether additional customers should be considered.

Customers from the 1992 RWMP that are not included in this Strategic Plan include:

- East Palo Alto Greenhouses – In the 1990s there were a number of functioning greenhouses in East Palo Alto, but now there are not many greenhouses known to be operating in the area. Those that are still operating are not anticipated to have significant demand.

- Medians and Streetscapes – The State Water Resources Control Board has proposed regulations prohibiting the irrigation of ornamental turf in publicly owned medians and streetscapes (i.e. the landscaped area between the street and sidewalk). The prohibition includes recycled water irrigation systems unless the system was installed prior to 2018. While irrigation of trees within medians and streetscapes are exempt from the proposed regulation, the default assumption for the Strategic Plan was not to include medians and streetscapes unless stakeholders provided information confirming the type of vegetation and associated water use for specific areas.

  Stakeholders suggested that medians along Foothill Expressway be considered. However, through field investigations, Palo Alto determined that the portion of Foothill Expressway in its service area is not irrigated and verification of irrigation of the portion within Los Altos could not be obtained. As such, Foothill Expressway was dropped from further consideration.

- Gate of Heaven Cemetery – This customer, though previously identified as a potential customer in Los Altos's service area, was found to be within Cupertino's service area.

Additional customers considered but not included:

- Cooley Landing Park – Recycled water is currently being trucked to this East Palo Alto park to support the establishment period for new native landscaping. Following the establishment period there will be no irrigation demand.
- East Bayshore Redevelopment - East Palo Alto staff noted that the area along East Bayshore has potential for significant multi-family residential redevelopment. However, there were no specific redevelopment plans, and the City indicated it would probably not pursue dual-plumbing for residential use.
- East Palo Alto Neighborhood Gardens and Sports Fields – Through review of aerials of East Palo Alto, a number of sizeable gardens and what looked like communal sports fields in between

residences were identified. East Palo Alto city staff indicated that these are temporary uses that sprung up on vacant lots. When the building moratorium in East Palo Alto is lifted, the City expects that these sites will be developed.

- Edith Park – This park in Los Altos Hills was recently redone to minimize irrigation needs.
- Gateway District Retail Center Redevelopment – This potential redevelopment area was in review in East Palo Alto's General Plan, but East Palo Alto city staff noted there are no specific plans for redevelopment of this area.
- Los Altos Redevelopment along El Camino – The majority of redevelopment will occur in the next few years. Because the City currently does not require installation of recycled water infrastructure for new developments, incorporating recycled water use within these buildings seems unlikely.
- Ravenswood Family Health Center – This facility in East Palo Alto is dual-plumbed. However, review of the facility's plans showed that the dual-plumbing was for on-site rain capture and not designed to have recycled water incorporated.
- San Antonio Redevelopment – This redevelopment area in Mountain View received conditions of approval prior to Mountain View's dual-plumbing ordinance and, as a result, is not dual-plumbed for recycled water.
- Single Family Residences – Los Altos Hills and Purissima Hills Water District (PHWD) indicated interest in working with large residential irrigators in Los Altos Hills to convert to recycled water use. Review of potential residences focused on parcels along Purissima Road and Fremont Road where PHWD identified the potential to repurpose abandoned or soon to be abandoned potable water pipelines for recycled water distribution. In these areas the residences averaged less than 1 acre-foot per year (AFY) of total water consumption. These volumes are not considered significant enough for residences to willingly undertake conversion of their irrigation systems plus the regulatory complexity involved with using recycled water at single family residences.
- Sobrato Phase I – Construction for this site in East Palo Alto, which is also known as Amazon I, was already underway at the time of the demand assessment and was determined not to include purple pipe for recycled water.
- Stanford Shopping Center – The General Manager of Stanford Shopping Center contacted the City at the start of the Strategic Planning process inquiring about the possibility of extending recycled water infrastructure to the shopping center. Through subsequent discussions, the shopping center indicated potential for both irrigation use as well as dual-plumbing use in future buildings. However, estimated demands were not provided.

Appendix D - Opinions of Probable Costs

A1				Palo Alto Recycled Water Feasibility Study	
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					

Item	Size	Qty	Unit	Unit Cost	Total Cost
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$2,265,933
Traffic Control			*Applied to all capital costs*	4%	$906,373
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	0.0		MGD	$ 1,317,000	$0
RO System	0.0		MGD	$ 1,586,000	$0
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	0.0		MGD	$ 470,000	$0
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		18,494	LF	$ 200	$3,699,008
10 Inch		9,029	LF	$ 212	$1,914,318
12 Inch		6,873	LF	$ 254	$1,747,873
16 Inch		22,301	LF	$ 277	$6,178,938
18 Inch		0	LF	$ 290	$0
20 Inch		0	LF	$ 334	$0
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$406,204
Microtunneling					
Tunnel and Casing (36")		800	LF	$ 1,728	$1,382,400
Jacking Shaft		3	EA	$ 300,000	$900,000
Receiving Shaft		3	EA	$ 150,000	$450,000
Horizontal Directional Drilling					
24 Inch Bore Diameter		350	LF	$ 528	$184,800
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		0	LF	$ 500	$0
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		0	EA	$ 258,000	$0
Receiving Shafts		0	EA	$ 148,000	$0
Pipe Bridge					
Pipe Bridge Support		8	LF	$ 5,000	$40,000
Pipe Bridge Pipe					
6 Inch		0	LF	$ 66	$0
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		65	LF	$ 139	$9,049
16 Inch		0	LF	$ 175	$0
Potholing		579	EA	$ 500	$289,560
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$506,178
Customer Services (no meter replacement)		62	EA	$ 10,000	$620,000
Customer Services (with meter replacement)		132	EA	$ 15,000	$1,980,000
Planter Box (Housing Pipe on Bridge Sidewalk)		6	CY	$ 2,000	$12,000
Planter Box (Installation Labor)		8	Day	$ 4,000	$32,000
Pump Stations					
Pump Station #1	0	Total installed HP, including standby		$ -	$0
Pump Station #2	0	Total installed HP, including standby		$ -	$0
Pump Station #3	0	Total installed HP, including standby		$ -	$0
Pump Station #4	0	Total installed HP, including standby		$ -	$0
Pump Station #5	0	Total installed HP, including standby		$ -	$0
Phase 3 RWQCP Pump Station Improvements		1	LS	$ 1,389,000	$1,389,000
Phase 3 Booster Pump Station		1	LS	$ 918,000	$918,000
Hydropneumatic Tank - Pump Station #1	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #2	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$25,832,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$1,020,000
Construction Cost Subtotal					**$26,852,000**
Market Adjustment Factor				10%	$2,685,000
Construction Contingency				40%	$10,741,000
Construction Cost Total					**$40,300,000**
Engineering and Admin Services (Design)				15%	$4,028,000
Construction Management				10%	$2,685,000
Engineering Services During Construction				3%	$806,000
Property Acquisition (Property Only)		0	SQ FT	$ 500	$0
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$47,800,000**

A1					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	0		MGD	$ 342,000	$0
RO System	0		MGD	$ 574,000	$0
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	0		MGD	$ 73,000	$0
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	0	1,040	hrs/MGD	$ 100	$0
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$44,942
Pump Stations					
Consumables					
Equipment				1%	$0
Mechanical				1%	$0
Electrical/Instrumentation				1%	$0
Electricity Requirement					
Energy Charge		444,385	kWh/year	$ 0.15	$66,658
Labor Costs					
Total No. Operators		0	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		0	Hours	$ 99.81	$0
Phase 3 RWQCP Pump Station Improvements		1	LS	$ 96,000	$96,000
Phase 3 Booster Pump Station		1	LS	$ 81,000	$81,000
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$290,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$2,439,000
Annual O&M Costs					$290,000
Total Annualized Cost					$2,729,000
Deliveries of Recycled Water	800 AFY				
Estimated Unit Cost ($/AF)					**$3,400**

A2					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$2,987,744
Traffic Control			*Applied to all capital costs*	4%	$1,195,097
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	0.0		MGD	$ 1,317,000	$0
RO System	0.0		MGD	$ 1,586,000	$0
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	0.0		MGD	$ 470,000	$0
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		50,383	LF	$ 200	$10,077,166
10 Inch		8,600	LF	$ 212	$1,823,362
12 Inch		5,500	LF	$ 254	$1,398,705
16 Inch		1,000	LF	$ 277	$277,070
18 Inch		0	LF	$ 290	$0
20 Inch		7,115	LF	$ 334	$2,375,058
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		2,200	LF	$ 55	$120,839
8 Inch		1,850	LF	$ 66	$121,540
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$478,541
Microtunneling					
Tunnel and Casing (36")		820	LF	$ 1,728	$1,416,960
Jacking Shaft		3	EA	$ 300,000	$900,000
Receiving Shaft		3	EA	$ 150,000	$450,000
Horizontal Directional Drilling					
24 Inch Bore Diameter		350	LF	$ 528	$184,800
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		236	LF	$ 500	$118,025
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		2	EA	$ 258,000	$516,000
Receiving Shafts		2	EA	$ 148,000	$296,000
Pipe Bridge					
Pipe Bridge Support		56	LF	$ 5,000	$280,000
Pipe Bridge Pipe					
6 Inch		431	LF	$ 66	$28,252
8 Inch		0	LF	$ 86	$0
10 Inch		50	LF	$ 108	$5,424
12 Inch		0	LF	$ 139	$0
16 Inch		65	LF	$ 175	$11,387
Potholing		746	EA	$ 500	$372,750
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$593,614
Customer Services (no meter replacement)		62	EA	$ 10,000	$620,000
Customer Services (with meter replacement)		137	EA	$ 15,000	$2,055,000
Planter Box (Housing Pipe on Bridge Sidewalk)		6	CY	$ 2,000	$12,000
Planter Box (Installation Labor)		8	Day	$ 4,000	$32,000
Pump Stations					
Pump Station #1	200		Total installed HP, including standby	$ 7,444	$1,488,839
Pump Station #2	300		Total installed HP, including standby	$ 6,433	$1,929,951
Pump Station #3	40		Total installed HP, including standby	$ 13,288	$531,505
Pump Station #4	60		Total installed HP, including standby	$ 11,483	$688,978
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	9,100		Gal	$ 29	$266,555
Hydropneumatic Tank - Pump Station #2	8,500		Gal	$ 30	$258,258
Hydropneumatic Tank - Pump Station #3	2,900		Gal	$ 41	$117,657
Hydropneumatic Tank - Pump Station #4	700		Gal	$ 45	$31,202
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$34,060,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$1,344,000
Construction Cost Subtotal					**$35,404,000**
Market Adjustment Factor				10%	$3,540,000
Construction Contingency				40%	$14,162,000
Construction Cost Total					**$53,200,000**
Engineering and Admin Services (Design)				15%	$5,311,000
Construction Management				10%	$3,540,000
Engineering Services During Construction				3%	$1,062,000
Property Acquisition (Property Only)		0	SQ FT	$ 500	$0
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$63,000,000**

A2					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	0		MGD	$ 342,000	$0
RO System	0		MGD	$ 574,000	$0
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	0		MGD	$ 73,000	$0
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	0	1,040	hrs/MGD	$ 100	$0
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$58,100
Pump Stations					
Consumables					
Equipment				1%	$46,393
Mechanical				1%	$46,393
Electrical/Instrumentation				1%	$46,393
Electricity Requirement					
Energy Charge		794,111	kWh/year	$ 0.15	$119,117
Labor Costs					
Total No. Operators		4	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		2,080	Hours	$ 99.81	$207,610
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$520,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$3,214,000
Annual O&M Costs					$520,000
Total Annualized Cost					$3,734,000
Deliveries of Recycled Water	1,100 AFY				
Estimated Unit Cost ($/AF)					**$3,400**

A3					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$4,033,005
Traffic Control			*Applied to all capital costs*	4%	$1,613,202
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	0.0		MGD	$ 1,317,000	$0
RO System	0.0		MGD	$ 1,586,000	$0
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	0.0		MGD	$ 470,000	$0
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		60,148	LF	$ 200	$12,030,275
10 Inch		32,577	LF	$ 212	$6,906,936
12 Inch		3,550	LF	$ 254	$902,801
16 Inch		5,500	LF	$ 277	$1,523,885
18 Inch		0	LF	$ 290	$0
20 Inch		8,115	LF	$ 334	$2,708,868
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		2,200	LF	$ 55	$120,839
8 Inch		1,850	LF	$ 66	$121,540
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$722,183
Microtunneling					
Tunnel and Casing (36")		820	LF	$ 1,728	$1,416,960
Jacking Shaft		3	EA	$ 300,000	$900,000
Receiving Shaft		3	EA	$ 150,000	$450,000
Horizontal Directional Drilling					
24 Inch Bore Diameter		350	LF	$ 528	$184,800
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		236	LF	$ 500	$118,025
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		2	EA	$ 258,000	$516,000
Receiving Shafts		2	EA	$ 148,000	$296,000
Pipe Bridge					
Pipe Bridge Support		87	LF	$ 5,000	$435,000
Pipe Bridge Pipe					
6 Inch		566	LF	$ 66	$37,101
8 Inch		123	LF	$ 86	$10,631
10 Inch		50	LF	$ 108	$5,424
12 Inch		50	LF	$ 139	$6,961
16 Inch		65	LF	$ 175	$11,387
Potholing		1,122	EA	$ 500	$560,750
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$845,358
Customer Services (no meter replacement)		62	EA	$ 10,000	$620,000
Customer Services (with meter replacement)		147	EA	$ 15,000	$2,205,000
Planter Box (Housing Pipe on Bridge Sidewalk)		6	CY	$ 2,000	$12,000
Planter Box (Installation Labor)		8	Day	$ 4,000	$32,000
Pump Stations					
Pump Station #1	300		Total installed HP, including standby	$ 6,433	$1,929,951
Pump Station #2	300		Total installed HP, including standby	$ 6,433	$1,929,951
Pump Station #3	40		Total installed HP, including standby	$ 13,288	$531,505
Pump Station #4	60		Total installed HP, including standby	$ 11,483	$688,978
Pump Station #5	69		Total installed HP, including standby	$ 10,920	$753,446
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	11,200		Gal	$ 25	$285,278
Hydropneumatic Tank - Pump Station #2	10,500		Gal	$ 27	$280,820
Hydropneumatic Tank - Pump Station #3	2,900		Gal	$ 41	$117,657
Hydropneumatic Tank - Pump Station #4	700		Gal	$ 45	$31,202
Hydropneumatic Tank - Pump Station #5	1,900		Gal	$ 42	$80,542
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$45,976,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$1,815,000
Construction Cost Subtotal					**$47,791,000**
Market Adjustment Factor				10%	$4,779,000
Construction Contingency				40%	$19,116,000
Construction Cost Total					**$71,700,000**
Engineering and Admin Services (Design)				15%	$7,169,000
Construction Management				10%	$4,779,000
Engineering Services During Construction				3%	$1,434,000
Property Acquisition (Property Only)		0	SQ FT	$ 500	$0
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$85,100,000**

A3					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	0		MGD	$ 342,000	$0
RO System	0		MGD	$ 574,000	$0
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	0		MGD	$ 73,000	$0
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	0	1,040	hrs/MGD	$ 100	$0
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$87,864
Pump Stations					
Consumables					
Equipment				1%	$58,338
Mechanical				1%	$58,338
Electrical/Instrumentation				1%	$58,338
Electricity Requirement					
Energy Charge		1,040,732	kWh/year	$ 0.15	$156,110
Labor Costs					
Total No. Operators		5	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		2,600	Hours	$ 99.81	$259,513
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$680,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$4,342,000
Annual O&M Costs					$680,000
Total Annualized Cost					$5,022,000
Deliveries of Recycled Water	1,250 AFY				
Estimated Unit Cost ($/AF)					**$4,000**

A4				Palo Alto Recycled Water Feasibility Study	
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$0
Traffic Control			*Applied to all capital costs*	4%	$0
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	0.0		MGD	$ 1,317,000	$0
RO System	0.0		MGD	$ 1,586,000	$0
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	0.0		MGD	$ 470,000	$0
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		0	LF	$ 200	$0
10 Inch		0	LF	$ 212	$0
12 Inch		0	LF	$ 254	$0
16 Inch		0	LF	$ 277	$0
18 Inch		0	LF	$ 290	$0
20 Inch		0	LF	$ 334	$0
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$0
Microtunneling					
Tunnel and Casing (36")		0	LF	$ 1,728	$0
Jacking Shaft		0	EA	$ 300,000	$0
Receiving Shaft		0	EA	$ 150,000	$0
Horizontal Directional Drilling					
24 Inch Bore Diameter		0	LF	$ 528	$0
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		0	LF	$ 500	$0
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		0	EA	$ 258,000	$0
Receiving Shafts		0	EA	$ 148,000	$0
Pipe Bridge					
Pipe Bridge Support		0	LF	$ 5,000	$0
Pipe Bridge Pipe					
6 Inch		0	LF	$ 66	$0
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		0	LF	$ 139	$0
16 Inch		0	LF	$ 175	$0
Potholing		0	EA	$ 500	$0
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$0
Customer Services (no meter replacement)		0	EA	$ 10,000	$0
Customer Services (with meter replacement)		0	EA	$ 15,000	$0
Planter Box (Housing Pipe on Bridge Sidewalk)		0	CY	$ 2,000	$0
Planter Box (Installation Labor)		0	Day	$ 4,000	$0
Pump Stations					
Pump Station #1	0		Total installed HP, including standby	$ -	$0
Pump Station #2	0		Total installed HP, including standby	$ -	$0
Pump Station #3	0		Total installed HP, including standby	$ -	$0
Pump Station #4	0		Total installed HP, including standby	$ -	$0
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #2	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		1	LS	$ 3,326,000	$3,326,000
Subtotal					**$3,326,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$150,000
Construction Cost Subtotal					**$3,476,000**
Market Adjustment Factor				10%	$348,000
Construction Contingency				40%	$1,390,000
Construction Cost Total					**$5,300,000**
Engineering and Admin Services (Design)				15%	$521,000
Construction Management				10%	$348,000
Engineering Services During Construction				3%	$104,000
Property Acquisition (Property Only)		0	SQ FT	$ 500	$0
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$6,200,000**

A4					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	0		MGD	$ 342,000	$0
RO System	0		MGD	$ 574,000	$0
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	0		MGD	$ 73,000	$0
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	0	1,040	hrs/MGD	$ 100	$0
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$0
Pump Stations					
Consumables					
Equipment				1%	$0
Mechanical				1%	$0
Electrical/Instrumentation				1%	$0
Electricity Requirement					
Energy Charge		-	kWh/year	$ 0.15	$0
Labor Costs					
Total No. Operators		0	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		0	Hours	$ 99.81	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		1	LS	$ 100,000	$100,000
Total O&M Costs ($/yr)					**$100,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$316,000
Annual O&M Costs					$100,000
Total Annualized Cost					$416,000
Deliveries of Recycled Water	200 AFY				
Estimated Unit Cost ($/AF)					**$2,100**

A5					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$3,443,427
Traffic Control			*Applied to all capital costs*	4%	$1,377,371
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	0.0		MGD	$ 1,317,000	$0
RO System	0.0		MGD	$ 1,586,000	$0
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	0.0		MGD	$ 470,000	$0
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		21,500	LF	$ 200	$4,300,241
10 Inch		14,500	LF	$ 212	$3,074,272
12 Inch		5,500	LF	$ 254	$1,398,705
16 Inch		0	LF	$ 277	$0
18 Inch		0	LF	$ 290	$0
20 Inch		44,714	LF	$ 334	$14,925,980
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$710,976
Microtunneling					
Tunnel and Casing (36")		0	LF	$ 1,728	$0
Jacking Shaft		0	EA	$ 300,000	$0
Receiving Shaft		0	EA	$ 150,000	$0
Horizontal Directional Drilling					
24 Inch Bore Diameter		0	LF	$ 528	$0
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		0	LF	$ 500	$0
10 Inch		122	LF	$ 625	$76,266
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		114	LF	$ 1,250	$142,530
Jacking Shafts		2	EA	$ 258,000	$516,000
Receiving Shafts		2	EA	$ 148,000	$296,000
Pipe Bridge					
Pipe Bridge Support		61	LF	$ 5,000	$305,000
Pipe Bridge Pipe					
6 Inch		92	LF	$ 66	$6,031
8 Inch		240	LF	$ 86	$20,744
10 Inch		91	LF	$ 108	$9,871
12 Inch		0	LF	$ 139	$0
16 Inch		172	LF	$ 175	$30,132
Potholing		870	EA	$ 500	$435,225
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$736,597
Customer Services (no meter replacement)		0	EA	$ 10,000	$0
Customer Services (with meter replacement)		106	EA	$ 15,000	$1,590,000
Planter Box (Housing Pipe on Bridge Sidewalk)		0	CY	$ 2,000	$0
Planter Box (Installation Labor)		0	Day	$ 4,000	$0
Pump Stations					
Pump Station #1	300		Total installed HP, including standby	$ 6,433	$1,929,951
Pump Station #2	225		Total installed HP, including standby	$ 7,135	$1,605,408
Pump Station #3	0		Total installed HP, including standby	$ -	$0
Pump Station #4	0		Total installed HP, including standby	$ -	$0
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	12,200		Gal	$ 24	$288,554
Hydropneumatic Tank - Pump Station #2	7,200		Gal	$ 33	$235,789
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	1.2		MG	$ 1,500,000	$1,800,000
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$39,255,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$1,550,000
Construction Cost Subtotal					**$40,805,000**
Market Adjustment Factor				10%	$4,081,000
Construction Contingency				40%	$16,322,000
Construction Cost Total					**$61,300,000**
Engineering and Admin Services (Design)				15%	$6,121,000
Construction Management				10%	$4,081,000
Engineering Services During Construction				3%	$1,224,000
Property Acquisition (Property Only)		0	SQ FT	$ 500	$0
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$72,600,000**

A5					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	0		MGD	$ 342,000	$0
RO System	0		MGD	$ 574,000	$0
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	0		MGD	$ 73,000	$0
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	0	1,040	hrs/MGD	$ 100	$0
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$68,908
Pump Stations					
Consumables					
Equipment				1%	$35,354
Mechanical				1%	$35,354
Electrical/Instrumentation				1%	$35,354
Electricity Requirement					
Energy Charge		668,276	kWh/year	$ 0.15	$100,241
Labor Costs					
Total No. Operators		2	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		1,040	Hours	$ 99.81	$103,805
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$18,000
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$400,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$3,704,000
Annual O&M Costs					$400,000
Total Annualized Cost					$4,104,000
Deliveries of Recycled Water	900 AFY				
Estimated Unit Cost ($/AF)					**$4,600**

A6					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$980,415
Traffic Control			*Applied to all capital costs*	4%	$392,166
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	0.0		MGD	$ 1,317,000	$0
RO System	0.0		MGD	$ 1,586,000	$0
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	0.0		MGD	$ 470,000	$0
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		14,100	LF	$ 200	$2,820,158
10 Inch		10,200	LF	$ 212	$2,162,592
12 Inch		10,000	LF	$ 254	$2,543,100
16 Inch		0	LF	$ 277	$0
18 Inch		0	LF	$ 290	$0
20 Inch		0	LF	$ 334	$0
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$225,775
Microtunneling					
Tunnel and Casing (36")		0	LF	$ 1,728	$0
Jacking Shaft		0	EA	$ 300,000	$0
Receiving Shaft		0	EA	$ 150,000	$0
Horizontal Directional Drilling					
24 Inch Bore Diameter		0	LF	$ 528	$0
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		0	LF	$ 500	$0
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		0	EA	$ 258,000	$0
Receiving Shafts		0	EA	$ 148,000	$0
Pipe Bridge					
Pipe Bridge Support		0	LF	$ 5,000	$0
Pipe Bridge Pipe					
6 Inch		0	LF	$ 66	$0
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		0	LF	$ 139	$0
16 Inch		0	LF	$ 175	$0
Potholing		343	EA	$ 500	$171,500
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$232,549
Customer Services (no meter replacement)		17	EA	$ 10,000	$170,000
Customer Services (with meter replacement)		16	EA	$ 15,000	$240,000
Planter Box (Housing Pipe on Bridge Sidewalk)		0	CY	$ 2,000	$0
Planter Box (Installation Labor)		0	Day	$ 4,000	$0
Pump Stations					
Pump Station #1	150		Total installed HP, including standby	$ 8,256	$1,238,474
Pump Station #2	0		Total installed HP, including standby	$ -	$0
Pump Station #3	0		Total installed HP, including standby	$ -	$0
Pump Station #4	0		Total installed HP, including standby	$ -	$0
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #2	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$11,177,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$441,000
Construction Cost Subtotal					**$11,618,000**
Market Adjustment Factor				10%	$1,162,000
Construction Contingency				40%	$4,647,000
Construction Cost Total					**$17,500,000**
Engineering and Admin Services (Design)				15%	$1,743,000
Construction Management				10%	$1,162,000
Engineering Services During Construction				3%	$349,000
Property Acquisition (Property Only)		0	SQ FT	$ 500	$0
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$20,700,000**

A6					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	0		MGD	$ 342,000	$0
RO System	0		MGD	$ 574,000	$0
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	0		MGD	$ 73,000	$0
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	0	1,040	hrs/MGD	$ 100	$0
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$27,152
Pump Stations					
Consumables					
Equipment				1%	$12,385
Mechanical				1%	$12,385
Electrical/Instrumentation				1%	$12,385
Electricity Requirement					
Energy Charge		201,615	kWh/year	$ 0.15	$30,242
Labor Costs					
Total No. Operators		1	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		520	Hours	$ 99.81	$51,903
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$150,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$1,056,000
Annual O&M Costs					$150,000
Total Annualized Cost					$1,206,000
Deliveries of Recycled Water	500 AFY				
Estimated Unit Cost ($/AF)					**$2,400**

B1					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$4,956,940
Traffic Control			*Applied to all capital costs*	4%	$1,982,776
Treatment					
MBR	1.5		MGD	$ 16,125,000	$24,000,000
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	0.0		MGD	$ 1,317,000	$0
RO System	0.0		MGD	$ 1,586,000	$0
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	0.0		MGD	$ 470,000	$0
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		39,500	LF	$ 200	$7,900,443
10 Inch		4,000	LF	$ 212	$848,075
12 Inch		6,000	LF	$ 254	$1,525,860
16 Inch		11,500	LF	$ 277	$3,186,305
18 Inch		0	LF	$ 290	$0
20 Inch		6,000	LF	$ 334	$2,002,860
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$463,906
Microtunneling					
Tunnel and Casing (36")		0	LF	$ 1,728	$0
Jacking Shaft		0	EA	$ 300,000	$0
Receiving Shaft		0	EA	$ 150,000	$0
Horizontal Directional Drilling					
24 Inch Bore Diameter		350	LF	$ 528	$184,800
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		179	LF	$ 500	$89,519
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		0	EA	$ 258,000	$0
Receiving Shafts		0	EA	$ 148,000	$0
Pipe Bridge					
Pipe Bridge Support		14	LF	$ 5,000	$70,000
Pipe Bridge Pipe					
6 Inch		123	LF	$ 66	$8,063
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		0	LF	$ 139	$0
16 Inch		0	LF	$ 175	$0
Potholing		677	EA	$ 500	$338,260
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$486,295
Customer Services (no meter replacement)		62	EA	$ 10,000	$620,000
Customer Services (with meter replacement)		139	EA	$ 15,000	$2,085,000
Planter Box (Housing Pipe on Bridge Sidewalk)		0	CY	$ 2,000	$0
Planter Box (Installation Labor)		0	Day	$ 4,000	$0
Pump Stations					
Pump Station #1	200		Total installed HP, including standby	$ 7,444	$1,488,839
Pump Station #2	60		Total installed HP, including standby	$ 11,483	$688,978
Pump Station #3	60		Total installed HP, including standby	$ 11,483	$688,978
Pump Station #4	6		Total installed HP, including standby	$ 26,306	$157,836
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	6,800		Gal	$ 33	$227,638
Hydropneumatic Tank - Pump Station #2	5,500		Gal	$ 36	$197,127
Hydropneumatic Tank - Pump Station #3	1,400		Gal	$ 43	$60,621
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	1.5		MG	$ 1,500,000	$2,250,000
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$56,509,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$2,231,000
Construction Cost Subtotal					**$58,740,000**
Market Adjustment Factor				10%	$5,874,000
Construction Contingency				40%	$23,496,000
Construction Cost Total					**$88,200,000**
Engineering and Admin Services (Design)				15%	$8,811,000
Construction Management				10%	$5,874,000
Engineering Services During Construction				3%	$1,762,000
Property Acquisition (Property Only)		50,000	SQ FT	$ 500	$25,000,000
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$129,600,000**

B1					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	2		MGD	$ 540,000	$810,000
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	0		MGD	$ 342,000	$0
RO System	0		MGD	$ 574,000	$0
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	0		MGD	$ 73,000	$0
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	0	1,040	hrs/MGD	$ 100	$0
Labor for MBR	2	1,040	hrs/year	$ 100	$104,000
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$53,279
Pump Stations					
Consumables					
Equipment				1%	$30,246
Mechanical				1%	$30,246
Electrical/Instrumentation				1%	$30,246
Electricity Requirement					
Energy Charge		550,080	kWh/year	$ 0.15	$82,512
Labor Costs					
Total No. Operators		4	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		2,080	Hours	$ 99.81	$207,610
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$22,500
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$1,370,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$6,612,000
Annual O&M Costs					$1,370,000
Total Annualized Cost					$7,982,000
Deliveries of Recycled Water	900 AFY				
Estimated Unit Cost ($/AF)					**$8,900**

C1					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$3,353,169
Traffic Control			*Applied to all capital costs*	4%	$1,341,268
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	2.5		MGD	$ 1,317,000	$3,300,000
RO System	2.5		MGD	$ 1,586,000	$4,000,000
RO Concentrate Treatment	0.0		MGD	$ 1,510,000	$0
Advanced Oxidation and Disinfection	2.5		MGD	$ 470,000	$1,200,000
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	2.5		MGD	$ 134,000	$340,000
Sitework/Piping/Structures	2.5		MGD	$ 3,427,000	$8,600,000
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		2,000	LF	$ 200	$400,023
10 Inch		1,500	LF	$ 212	$318,028
12 Inch		5,000	LF	$ 254	$1,271,550
16 Inch		20,500	LF	$ 277	$5,679,935
18 Inch		0	LF	$ 290	$0
20 Inch		0	LF	$ 334	$0
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$230,086
Microtunneling					
Tunnel and Casing (36")		0	LF	$ 1,728	$0
Jacking Shaft		0	EA	$ 300,000	$0
Receiving Shaft		0	EA	$ 150,000	$0
Horizontal Directional Drilling					
24 Inch Bore Diameter		0	LF	$ 528	$0
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		0	LF	$ 500	$0
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		458	LF	$ 1,000	$458,096
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		1	EA	$ 258,000	$258,000
Receiving Shafts		1	EA	$ 148,000	$148,000
Pipe Bridge					
Pipe Bridge Support		0	LF	$ 5,000	$0
Pipe Bridge Pipe					
6 Inch		0	LF	$ 66	$0
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		0	LF	$ 139	$0
16 Inch		0	LF	$ 175	$0
Potholing		295	EA	$ 500	$147,290
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$250,732
Customer Services (no meter replacement)		0	EA	$ 10,000	$0
Customer Services (with meter replacement)		0	EA	$ 15,000	$0
Planter Box (Housing Pipe on Bridge Sidewalk)		0	CY	$ 2,000	$0
Planter Box (Installation Labor)		0	Day	$ 4,000	$0
Pump Stations					
Pump Station #1	300		Total installed HP, including standby	$ 6,433	$1,929,951
Pump Station #2	0		Total installed HP, including standby	$ -	$0
Pump Station #3	0		Total installed HP, including standby	$ -	$0
Pump Station #4	0		Total installed HP, including standby	$ -	$0
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #2	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		5	EA	$ 1,000,000	$5,000,000
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$38,226,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$1,509,000
Construction Cost Subtotal					**$39,735,000**
Market Adjustment Factor				10%	$3,974,000
Construction Contingency				40%	$15,894,000
Construction Cost Total					**$59,700,000**
Engineering and Admin Services (Design)				15%	$5,960,000
Construction Management				10%	$3,974,000
Engineering Services During Construction				3%	$1,192,000
Property Acquisition (Property Only)		20,000	SQ FT	$ 500	$10,000,000
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		1	LS	$ 4,500,000	$4,500,000
Peers Land Cost		1	LS	$ 7,000,000	$7,000,000
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$92,200,000**

C1					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	3		MGD	$ 342,000	$860,000
RO System	3		MGD	$ 574,000	$1,400,000
RO Concentrate Treatment	0		MGD	$ 226,000	$0
Advanced Oxidation and Disinfection	3		MGD	$ 73,000	$180,000
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	3		MGD	$ 121,000	$300,000
Labor for Treatment (no MBR)	3	1,040	hrs/MGD	$ 100	$260,000
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$23,320
Pump Stations					
Consumables					
Equipment				1%	$19,300
Mechanical				1%	$19,300
Electrical/Instrumentation				1%	$19,300
Electricity Requirement					
Energy Charge		342,958	kWh/year	$ 0.15	$51,444
Labor Costs					
Total No. Operators		1	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		520	Hours	$ 99.81	$51,903
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		5	EA	$ 15,000	$75,000
Extraction Wells					
Groundwater Pumping Charge		5,900	AFY	$ 1,960	$11,564,000
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$14,820,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$4,704,000
Annual O&M Costs					$14,820,000
Total Annualized Cost					$19,524,000
Deliveries of Recycled Water	5,900 AFY				
Estimated Unit Cost ($/AF)					**$3,300**

C2					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$4,213,006
Traffic Control			*Applied to all capital costs*	4%	$1,685,202
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	2.8		MGD	$ 1,317,000	$3,700,000
RO System	2.8		MGD	$ 1,586,000	$4,400,000
RO Concentrate Treatment	0.9		MGD	$ 1,510,000	$1,400,000
Advanced Oxidation and Disinfection	2.8		MGD	$ 470,000	$1,300,000
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	2.8		MGD	$ 134,000	$370,000
Sitework/Piping/Structures	2.8		MGD	$ 3,427,000	$9,600,000
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		11,000	LF	$ 200	$2,200,124
10 Inch		5,500	LF	$ 212	$1,166,103
12 Inch		3,000	LF	$ 254	$762,930
16 Inch		2,500	LF	$ 277	$692,675
18 Inch		0	LF	$ 290	$0
20 Inch		18,500	LF	$ 334	$6,175,485
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$329,920
Microtunneling					
Tunnel and Casing (36")		0	LF	$ 1,728	$0
Jacking Shaft		0	EA	$ 300,000	$0
Receiving Shaft		0	EA	$ 150,000	$0
Horizontal Directional Drilling					
24 Inch Bore Diameter		0	LF	$ 528	$0
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		160	LF	$ 500	$80,017
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		619	LF	$ 1,250	$773,912
Jacking Shafts		3	EA	$ 258,000	$774,000
Receiving Shafts		3	EA	$ 148,000	$444,000
Pipe Bridge					
Pipe Bridge Support		19	LF	$ 5,000	$95,000
Pipe Bridge Pipe					
6 Inch		170	LF	$ 66	$11,143
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		0	LF	$ 139	$0
16 Inch		0	LF	$ 175	$0
Potholing		414	EA	$ 500	$207,245
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$342,552
Customer Services (no meter replacement)		0	EA	$ 10,000	$0
Customer Services (with meter replacement)		25	EA	$ 15,000	$375,000
Planter Box (Housing Pipe on Bridge Sidewalk)		0	CY	$ 2,000	$0
Planter Box (Installation Labor)		0	Day	$ 4,000	$0
Pump Stations					
Pump Station #1	300		Total installed HP, including standby	$ 6,433	$1,929,951
Pump Station #2	0		Total installed HP, including standby	$ -	$0
Pump Station #3	0		Total installed HP, including standby	$ -	$0
Pump Station #4	0		Total installed HP, including standby	$ -	$0
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #2	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		5	EA	$ 1,000,000	$5,000,000
Extraction Wellhead Treatment					
Hale		983	AFY	$ 2,937	$2,887,865
Rinconada		983	AFY	$ 2,937	$2,887,865
Peers		983	AFY	$ 3,353	$3,296,834
El Camino		983	AFY	$ 4,538	$4,462,774
Eleanor		983	AFY	$ 4,538	$4,462,774
Library		983	AFY	$ 4,538	$4,462,774
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$70,489,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$2,907,000
Construction Cost Subtotal					**$73,396,000**
Market Adjustment Factor				10%	$7,340,000
Construction Contingency				40%	$29,358,000
Construction Cost Total					**$110,100,000**
Engineering and Admin Services (Design)				15%	$11,009,000
Construction Management				10%	$7,340,000
Engineering Services During Construction				3%	$2,202,000
Property Acquisition (Property Only)		20,000	SQ FT	$ 500	$10,000,000
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		1	LS	$ 4,500,000	$4,500,000
Peers Land Cost		1	LS	$ 7,000,000	$7,000,000
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$152,100,000**

C2					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	3		MGD	$ 342,000	$950,000
RO System	3		MGD	$ 574,000	$1,600,000
RO Concentrate Treatment	1		MGD	$ 226,000	$210,000
Advanced Oxidation and Disinfection	3		MGD	$ 73,000	$200,000
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	3		MGD	$ 121,000	$340,000
Labor for Treatment (no MBR)	3	1,040	hrs/MGD	$ 100	$290,000
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$32,816
Pump Stations					
Consumables					
Equipment				1%	$19,300
Mechanical				1%	$19,300
Electrical/Instrumentation				1%	$19,300
Electricity Requirement					
Energy Charge		453,458	kWh/year	$ 0.15	$68,019
Labor Costs					
Total No. Operators		1	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		520	Hours	$ 99.81	$51,903
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		5	EA	$ 15,000	$75,000
Extraction Wells					
Groundwater Pumping Charge		5,900	AFY	$ 1,960	$11,564,000
Hale Extraction Well/Wellhead Treatment		983	AFY	$ 265	$260,797
Rinconada Extraction Well/Wellhead Treatment		983	AFY	$ 263	$258,689
Peers Extraction Well/Wellhead Treatment		983	AFY	$ 224	$220,625
El Camino Extraction Well/Wellhead Treatment		983	AFY	$ 256	$251,497
Eleanor Extraction Well/Wellhead Treatment		983	AFY	$ 256	$251,783
Library Extraction Well/Wellhead Treatment		983	AFY	$ 242	$238,429
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$16,920,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$7,760,000
Annual O&M Costs					$16,920,000
Total Annualized Cost					$24,680,000
Deliveries of Recycled Water	6,100 AFY				
Estimated Unit Cost ($/AF)					**$4,000**

C3					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$6,472,618
Traffic Control			*Applied to all capital costs*	4%	$2,589,047
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	0.0		MGD	$ 360,000	$0
BAC	0.0		MGD	$ 323,000	$0
MF/UF system	3.3		MGD	$ 1,317,000	$4,400,000
RO System	3.3		MGD	$ 1,586,000	$5,300,000
RO Concentrate Treatment	1.0		MGD	$ 1,510,000	$1,500,000
Advanced Oxidation and Disinfection	3.3		MGD	$ 470,000	$1,600,000
Free Chlorine	0.0		MGD	$ 271,000	$0
Chemicals (Storage and Use)	3.3		MGD	$ 134,000	$440,000
Sitework/Piping/Structures	3.3		MGD	$ 3,427,000	$11,000,000
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		19,994	LF	$ 200	$3,999,025
10 Inch		12,529	LF	$ 212	$2,656,383
12 Inch		9,873	LF	$ 254	$2,510,803
16 Inch		47,801	LF	$ 277	$13,244,223
18 Inch		0	LF	$ 290	$0
20 Inch		0	LF	$ 334	$0
24 Inch		0	LF	$ 381	$0
30 Inch		0	LF	$ 462	$0
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$672,313
Microtunneling					
Tunnel and Casing (36")		800	LF	$ 1,728	$1,382,400
Jacking Shaft		3	EA	$ 300,000	$900,000
Receiving Shaft		3	EA	$ 150,000	$450,000
Horizontal Directional Drilling					
24 Inch Bore Diameter		350	LF	$ 528	$184,800
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		0	LF	$ 500	$0
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		160	LF	$ 1,000	$160,033
20 Inch		0	LF	$ 1,250	$0
Jacking Shafts		1	EA	$ 258,000	$258,000
Receiving Shafts		1	EA	$ 148,000	$148,000
Pipe Bridge					
Pipe Bridge Support		8	LF	$ 5,000	$40,000
Pipe Bridge Pipe					
6 Inch		0	LF	$ 66	$0
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		0	LF	$ 139	$0
16 Inch		65	LF	$ 175	$11,387
Potholing		916	EA	$ 500	$457,860
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$785,141
Customer Services (no meter replacement)		62	EA	$ 10,000	$620,000
Customer Services (with meter replacement)		142	EA	$ 15,000	$2,130,000
Planter Box (Housing Pipe on Bridge Sidewalk)		6	CY	$ 2,000	$12,000
Planter Box (Installation Labor)		8	Day	$ 4,000	$32,000
Pump Stations					
Pump Station #1	400		Total installed HP, including standby	$ 5,800	$2,320,102
Pump Station #2	0		Total installed HP, including standby	$ -	$0
Pump Station #3	0		Total installed HP, including standby	$ -	$0
Pump Station #4	0		Total installed HP, including standby	$ -	$0
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		1	LS	$ 1,389,000	$1,389,000
Phase 3 Booster Pump Station		1	LS	$ 918,000	$918,000
Hydropneumatic Tank - Pump Station #1	5,800		Gal	$ 35	$204,714
Hydropneumatic Tank - Pump Station #2	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	0.0		MG	$ 1,500,000	$0
Underground Construction		0.0	LS	$ 1,000,000	
Injection Well					
		5	EA	$ 1,000,000	$5,000,000
Extraction Wellhead Treatment					
Hale		833	AFY	$ 2,937	$2,447,343
Rinconada		833	AFY	$ 2,937	$2,447,343
Peers		833	AFY	$ 3,353	$2,793,927
El Camino		833	AFY	$ 4,538	$3,782,012
Eleanor		833	AFY	$ 4,538	$3,782,012
Library		833	AFY	$ 4,538	$3,782,012
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$92,822,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$3,769,000
Construction Cost Subtotal					**$96,591,000**
Market Adjustment Factor				10%	$9,659,000
Construction Contingency				40%	$38,636,000
Construction Cost Total					**$144,900,000**
Engineering and Admin Services (Design)				15%	$14,489,000
Construction Management				10%	$9,659,000
Engineering Services During Construction				3%	$2,898,000
Property Acquisition (Property Only)		30,000	SQ FT	$ 500	$15,000,000
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		1	LS	$ 4,500,000	$4,500,000
Peers Land Cost		1	LS	$ 7,000,000	$7,000,000
On-Time Fee		0	LS	$ 75,000	
Total Capital Cost					**$198,400,000**

C3					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	0		MGD	$ 93,000	$0
BAC	0		MGD	$ 131,000	$0
MF/UF system	3		MGD	$ 342,000	$1,100,000
RO System	3		MGD	$ 574,000	$1,900,000
RO Concentrate Treatment	1		MGD	$ 226,000	$220,000
Advanced Oxidation and Disinfection	3		MGD	$ 73,000	$240,000
Free Chlorine	0		MGD	$ 32,000	$0
Chemicals	3		MGD	$ 121,000	$400,000
Labor for Treatment (no MBR)	3	1,040	hrs/MGD	$ 100	$350,000
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		0	$/year	$ 1,000,000	$0
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$71,588
Pump Stations					
Consumables					
Equipment				1%	$23,201
Mechanical				1%	$23,201
Electrical/Instrumentation				1%	$23,201
Electricity Requirement					
Energy Charge		466,792	kWh/year	$ 0.15	$70,019
Labor Costs					
Total No. Operators		1	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		520	Hours	$ 99.81	$51,903
Phase 3 RWQCP Pump Station Improvements		1	LS	$ 96,000	$96,000
Phase 3 Booster Pump Station		1	LS	$ 81,000	$81,000
Storage Tanks					
Annual O&M				1%	$0
Injection Wells					
Annual O&M		5	EA	$ 15,000	$75,000
Extraction Wells					
Groundwater Pumping Charge		5,000	AFY	$ 1,960	$9,800,000
Hale Extraction Well/Wellhead Treatment		833	AFY	$ 265	$221,014
Rinconada Extraction Well/Wellhead Treatment		833	AFY	$ 263	$219,228
Peers Extraction Well/Wellhead Treatment		833	AFY	$ 224	$186,970
El Camino Extraction Well/Wellhead Treatment		833	AFY	$ 256	$213,133
Eleanor Extraction Well/Wellhead Treatment		833	AFY	$ 256	$213,376
Library Extraction Well/Wellhead Treatment		833	AFY	$ 242	$202,059
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$15,780,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$10,122,000
Annual O&M Costs					$15,780,000
Total Annualized Cost					$25,902,000
Deliveries of Recycled Water	5,900 AFY				
Estimated Unit Cost ($/AF)					**$4,400**

D1				Palo Alto Recycled Water Feasibility Study	
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Capital Costs					
General Requirements					
Mobilization			*Applied to all capital costs*	10%	$3,772,451
Traffic Control			*Applied to all capital costs*	4%	$1,508,980
Treatment					
MBR	0.0		MGD	$ 17,200,000	$0
Ozone	4.7		MGD	$ 360,000	$1,700,000
BAC	4.7		MGD	$ 323,000	$1,500,000
MF/UF system	4.7		MGD	$ 1,317,000	$6,200,000
RO System	4.7		MGD	$ 1,586,000	$7,500,000
RO Concentrate Treatment	1.2		MGD	$ 1,510,000	$1,900,000
Advanced Oxidation and Disinfection	4.7		MGD	$ 470,000	$2,200,000
Free Chlorine	4.7		MGD	$ 271,000	$1,300,000
Chemicals (Storage and Use)	0.0		MGD	$ 134,000	$0
Sitework/Piping/Structures	0.0		MGD	$ 3,427,000	$0
Conveyance					
High-Density Urban Pipeline, HDPE					
6 Inch		0	LF	$ 186	$0
8 Inch		0	LF	$ 200	$0
10 Inch		0	LF	$ 212	$0
12 Inch		5,000	LF	$ 254	$1,271,550
16 Inch		0	LF	$ 277	$0
18 Inch		0	LF	$ 290	$0
20 Inch		500	LF	$ 334	$166,905
24 Inch		1,400	LF	$ 381	$533,568
30 Inch		2,600	LF	$ 462	$1,202,422
Repurposing Pipe					
6 Inch		0	LF	$ 55	$0
8 Inch		0	LF	$ 66	$0
Sheeting and Shoring (Open Cut)	*3% of Open Cut Pipeline Cost*			3%	$59,161
Microtunneling					
Tunnel and Casing (36")		0	LF	$ 1,728	$0
Jacking Shaft		0	EA	$ 300,000	$0
Receiving Shaft		0	EA	$ 150,000	$0
Horizontal Directional Drilling					
24 Inch Bore Diameter		0	LF	$ 528	$0
PTGAB					
6 Inch		0	LF	$ 375	$0
8 Inch		0	LF	$ 500	$0
10 Inch		0	LF	$ 625	$0
12 Inch		0	LF	$ 750	$0
16 Inch		0	LF	$ 1,000	$0
20 Inch		1,200	LF	$ 1,250	$1,500,313
Jacking Shafts		1	EA	$ 258,000	$258,000
Receiving Shafts		1	EA	$ 148,000	$148,000
Pipe Bridge					
Pipe Bridge Support		0	LF	$ 5,000	$0
Pipe Bridge Pipe					
6 Inch		0	LF	$ 66	$0
8 Inch		0	LF	$ 86	$0
10 Inch		0	LF	$ 108	$0
12 Inch		0	LF	$ 139	$0
16 Inch		0	LF	$ 175	$0
Potholing		107	EA	$ 500	$53,500
Cathodic Protection	*3% of Pipeline Installation Cost*			3%	$97,008
Customer Services (no meter replacement)		0	EA	$ 10,000	$0
Customer Services (with meter replacement)		0	EA	$ 15,000	$0
Planter Box (Housing Pipe on Bridge Sidewalk)		0	CY	$ 2,000	$0
Planter Box (Installation Labor)		0	Day	$ 4,000	$0
Pump Stations					
Pump Station #1	60		Total installed HP, including standby	$ 11,483	$688,978
Pump Station #2	400		Total installed HP, including standby	$ 5,800	$2,320,102
Pump Station #3	0		Total installed HP, including standby	$ -	$0
Pump Station #4	0		Total installed HP, including standby	$ -	$0
Pump Station #5	0		Total installed HP, including standby	$ -	$0
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 1,389,000	$0
Phase 3 Booster Pump Station		0	LS	$ 918,000	$0
Hydropneumatic Tank - Pump Station #1	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #2	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #3	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #4	0		Gal	$ -	$0
Hydropneumatic Tank - Pump Station #5	0		Gal	$ -	$0
Storage Tank					
Storage Tank	4.8		MG	$ 1,500,000	$7,125,000
Underground Construction		1.0	LS	$ 1,000,000	
Injection Well					
		0	EA	$ 1,000,000	$0
Extraction Wellhead Treatment					
Hale		0	AFY	$ 2,937	$0
Rinconada		0	AFY	$ 2,937	$0
Peers		0	AFY	$ 3,353	$0
El Camino		0	AFY	$ 4,538	$0
Eleanor		0	AFY	$ 4,538	$0
Library		0	AFY	$ 4,538	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 3,326,000	$0
Subtotal					**$43,006,000**
Sales Tax	*Applied to half of capital costs (not including General)*			9%	$1,698,000
Construction Cost Subtotal					**$44,704,000**
Market Adjustment Factor				10%	$4,470,000
Construction Contingency				40%	$17,882,000
Construction Cost Total					**$67,100,000**
Engineering and Admin Services (Design)				15%	$6,706,000
Construction Management				10%	$4,470,000
Engineering Services During Construction				3%	$1,341,000
Property Acquisition (Property Only)		50,000	SQ FT	$ 500	$25,000,000
Property Acquisition (House on Property)		0	SQ FT	$ 1,000	$0
Rinconada Land Cost		0	LS	$ 4,500,000	$0
Peers Land Cost		0	LS	$ 7,000,000	$0
On-Time Fee		1	LS	$ 75,000	
Total Capital Cost					**$104,600,000**

D1					Palo Alto Recycled Water Feasibility Study
Last Updated:	4-Feb-19		**Discount Rate**		**Project Life**
Updated by:	K. Howes		3%		30 Years
CCI (SF, June 2018): 12014.72					
Item	**Size**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
O&M Costs (Annual)					
Advanced Water Treatment					
MBR	0		MGD	$ 560,000	$0
Ozone	5		MGD	$ 93,000	$440,000
BAC	5		MGD	$ 131,000	$620,000
MF/UF system	5		MGD	$ 342,000	$1,600,000
RO System	5		MGD	$ 574,000	$2,700,000
RO Concentrate Treatment	1		MGD	$ 226,000	$280,000
Advanced Oxidation and Disinfection	5		MGD	$ 73,000	$350,000
Free Chlorine	5		MGD	$ 32,000	$150,000
Chemicals	0		MGD	$ 121,000	$0
Labor for Treatment (no MBR)	5	1,040	hrs/MGD	$ 100	$490,000
Labor for MBR	0	1,040	hrs/year	$ 100	$0
Monitoring		1	$/year	$ 1,000,000	$1,000,000
Conveyance					
Annual Inspection and Maintenance of Pipeline - Average Annual Operator Hours per			LF	$0.78	$6,434
Pump Stations					
Consumables					
Equipment				1%	$30,091
Mechanical				1%	$30,091
Electrical/Instrumentation				1%	$30,091
Electricity Requirement					
Energy Charge		718,547	kWh/year	$ 0.15	$107,782
Labor Costs					
Total No. Operators		2	No.		
Average Annual Operator Hours per Year		520	Hours		
Total Operator Hours per Year		1,040	Hours	$ 99.81	$103,805
Phase 3 RWQCP Pump Station Improvements		0	LS	$ 96,000	$0
Phase 3 Booster Pump Station		0	LS	$ 81,000	$0
Storage Tanks					
Annual O&M				1%	$71,250
Injection Wells					
Annual O&M		0	EA	$ 15,000	$0
Extraction Wells					
Groundwater Pumping Charge		0	AFY	$ 1,960	$0
Hale Extraction Well/Wellhead Treatment		0	AFY	$ 265	$0
Rinconada Extraction Well/Wellhead Treatment		0	AFY	$ 263	$0
Peers Extraction Well/Wellhead Treatment		0	AFY	$ 224	$0
El Camino Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Eleanor Extraction Well/Wellhead Treatment		0	AFY	$ 256	$0
Library Extraction Well/Wellhead Treatment		0	AFY	$ 242	$0
Mountain View Feasibility Study Long-Term Recommended Phase					
		0	LS	$ 100,000	$0
Total O&M Costs ($/yr)					**$8,010,000**
Annualized Costs ($ / Year)					
Annualized Capital Costs ($/Year)	*One payment per year, spread over Project Life*				$5,337,000
Annual O&M Costs					$8,010,000
Total Annualized Cost					$13,347,000
Deliveries of Recycled Water	5,300 AFY				
Estimated Unit Cost ($/AF)					**$2,500**

Appendix E - Concept Option Variations [Confidential – Not Included]

Appendix F - Cost Per Unit of Water Analyses for Palo Alto, Cal Water, Purissima Hills Water District and East Palo Alto [Confidential – Not Included]

Appendix G - Funding Matrix

Summary of Potential Recycled Water Funding Opportunities – Updated March 13, 2019

Program	Administering Agency	Funding Type	CEQA/ NEPA Required?	Program Purpose	Eligible Uses	Eligibility Requirements	Due Date & Future Rounds	Funding Amounts & Terms	Cost Share	Priority Determination / Critical Factors
Title XVI Water Reuse & Reclamation Grant Program - Construction	U.S. Bureau of Reclamation (Reclamation)	Grant	CEQA and NEPA	Construction of water recycling treatment and conveyance facilities.	Planning, design, construction (can include prior costs)	A Title XVI Feasibility Study must be submitted to Reclamation for review and approval prior to submitting a construction application. Project must receive congressional authorization in order to receive construction grant funding.	Most recent round was due in Summer 2018. Next round anticipated spring 2019	The total amount of available funds varies each year. The 2018 FOA included $34M for Title XVI. Historically, there has been a max of ~$4M per applicant, though the new administration has favored funding fewer projects with larger awards per project. Maximum grant award of 25% of the total project costs or $20 million, whichever is less. Grant funding is provided over multiple applications submitted on an annual basis until the project is complete or the total federal cost share has been provided. Typically limited to 3 years of costs per application.	75% cost share	1 Project must receive congressional approval.
Website	https://www.usbr.gov/watersmart/title/index.html									
Water Infrastructure Improvements for the Nation (WIIN) Subset of Title XVI	U.S. Bureau of Reclamation (Reclamation)	Grant	CEQA and NEPA	Construction of water recycling treatment and conveyance facilities for projects that have a Title XVI Feasibility Study completed, *but are not congressionally authorized.*	Similar to Title XVI: planning, design, construction (including prior costs)	A Title XVI Feasibility Study must have already been submitted to Reclamation for review and approval and the project must have a Determination of Feasibility from Reclamation	Reclamation appears to intend three rounds of funding – the first was in 2017, the second was in 2018, and a third to be released shortly after announcement of Round 2 awards – anticipated in spring 2019.	$50M total has been allocated under WIIN. $10M released in first FOA, $20M released in second FOA, $20M anticipated for third FOA. Maximum grant award of 25% of the total project costs. Typically limited to 3 years of costs per application.	75% cost share	1 Competitive program, but will only get more competitive as additional agencies submit their Feasibility Studies. Better to get money early and keep going back.
Website	A specific funding website has not been developed. For reference, visit: https://www.usbr.gov/watersmart/title/index.html									

Program	Administering Agency	Funding Type	CEQA/ NEPA Required?	Program Purpose	Eligible Uses	Eligibility Requirements	Due Date & Future Rounds	Funding Amounts & Terms	Cost Share	Priority Determination / Critical Factors
Drought Response Program – Drought Resiliency Projects	Reclamation	Grant	CEQA and NEPA	Increase the reliability of water supply; improve water management; implement systems to facilitate the voluntary sale, transfer or exchange of water; and provide benefits for fish, wildlife, and the environment to mitigate impacts caused by drought.	Construction, tool development to improve water management, installation of data collecting devices, improving habitat. Proposed resiliency project should improve ability of water managers to deliver water during a drought.	Based on most recent FOA, project cannot be part of a congressionally authorized Title XVI Project. Must demonstrate that project is supported by an existing drought contingency plan; quantify benefits during droughts; address urgent needs and severe drought impacts.	Anticipate FOA in December 2018, with applications due February 2019	$8.3M was awarded in 2018 FY2019 budget TBD Funding Group I: up to $300,000 for projects that can be completed within 2 years Funding Group II: up to $750,000 for larger projects that can be completed within 3 years	50% cost share	4 Competitiveness would be evaluated if and when another FOA is released based on project status and scoring criteria. Status of next round is unknown.
Website	https://www.usbr.gov/drought/									
Integrated Regional Water Management (IRWM) Implementation Grant Program	California Department of Water Resources (DWR)	Grant	CEQA Only	Identify and implement projects and programs that increase regional self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives.	Planning, design, land acquisition, legal fees, environmental documentation, environmental mitigation, construction/ implementation, construction administration	Project must be included on the project list of an IRWM Region's IRWMP. Palo Alto is within the San Francisco Bay IRWM Region and thus, the project must be in its IRWMP.	Prop 1 – Round 1 is underway; local call for projects closed Nov. 16, 2018 FY20/21: Round 2 Implementation Grant Solicitation anticipated City submitted a project in Fall 2018 for Round 1; currently awaiting selection for inclusion in regional application.	$58.5M for the 2 rounds of implementation funding in the SF Funding Area, which includes the entire SF Bay Area IRWM Region and a portion of the East Contra Costa IRWM Region. ($65M is allocated to SF Funding Area, $6.5M to be allocated to DAC Involvement.) $22.75M anticipated available in each round for non-DAC implementation projects	50% cost share	3 Limited funding available for competitive area. Participate in SF Bay Area IRWM process. Ultimately, up to SF Bay Area project prioritization and selection process as to which projects are included in an application
Website	https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs or Bay Area IRWM Program: http://bayareairwmp.org/									

Program	Administering Agency	Funding Type	CEQA/ NEPA Required?	Program Purpose	Eligible Uses	Eligibility Requirements	Due Date & Future Rounds	Funding Amounts & Terms	Cost Share	Priority Determination / Critical Factors
Clean Water State Revolving Fund (CWSRF) loan program	State Water Resources Control Board (SWRCB)	Loan	CEQA+ (includes CEQA and select federal crosscutters, i.e., not full NEPA)	Construction of publicly-owned facilities including wastewater treatment, local sewers, sewer interceptors, water reclamation and distribution, stormwater treatment, and combined sewers.	Planning, design, construction, construction management, mitigation measures (can include prior planning/design costs). Construction costs incurred prior to executing funding agreement NOT eligible for reimbursement.	Must either provide proof of submitted UWMP, proof of CUWCC MOU, or copy of Water Conservation Program for State Board approval. Letter of 2015 UWMP approval from DWR required prior to executing financing agreement.	Applications are continuously accepted, though the State Board now implements a deadline of December 31 and a scoring system to be added to the Fundable List. Projects must first get on Fundable Project List before applications will be reviewed. May be as long as 2 years from application submittal to contract	Typically, there is $200M-$300M available; Water recycling projects are given priority. Interest rate is ½ of the General Obligation Rate at the time of award (SRF i=1.9% for this year). Financing term up to 30 years. There is no maximum financing amount for a project / agency.	0%	2 Program is very popular. Application review can be up to 12 months, so financial forecast could change by the time an application is prepared, submitted, and reviewed. Highest scoring projects will be “corrective”, or address drinking water or Delta water quality; help implement a climate change action plan or address multiple water quality issues; and those with both a complete application and at least 90% design/specs
Website	https://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/									
Water Recycling Funding Program (WRFP) Construction Grants	SWRCB	Loans & Grant	CEQA+ (includes CEQA and select federal crosscutters, i.e., not full NEPA)	Promote beneficial use of recycled water to augment fresh water supplies in CA by supporting water recycling projects and research.	Planning, design and construction, including reasonable costs to provide emergency backup water supply for a recycled water system; pilot projects for new potable reuse (can include prior planning/design costs). Construction costs incurred prior to executing funding agreement NOT eligible for reimbursement.	Apply through CWSRF program.	Applications are continuously accepted, though the State Board now implements a deadline of December 31 and a scoring system to be added to the Fundable List. Projects must first get on Fundable Project List before applications will be reviewed. May be as long as 2 years from application submittal to contract	Prop 1 provided $625M for planning and construction of water recycling projects; however, this funding has been exhausted. Future allocations to the WRFP are possible, though currently TBD. Project could receive $15M or 35% of project costs for construction, whichever is less. Offers 1% financing for recycled water projects through CWSF	N/A	2 By applying for CWSRF, the City will automatically be applying for any available grant funding under the umbrella CWSRF program.
Website	https://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/									

Program	Administering Agency	Funding Type	CEQA/ NEPA Required?	Program Purpose	Eligible Uses	Eligibility Requirements	Due Date & Future Rounds	Funding Amounts & Terms	Cost Share	Priority Determination / Critical Factors
Infrastructure SRF (ISRF) Loan Program	California Infrastructure and Economic Development Bank (I-Bank)	Loan	Application does not consist of environmental portion; however, CEQA would be required prior to construction	Construction and/or repair of publicly-owned wastewater collection and treatment systems.	Architectural, engineering, financial and legal services, plans, specifications, admin expenses, land acquisition, construction, machinery/equipment	Project complete construction within 2 years of financing approval. Must have applied for all required permits.	Applications are continuously accepted. Loans typically awarded three months after application submittal	ISRF Program funding is available in amounts ranging from $50,000 to $25M, with loan terms of up to 30 years. Pre-payment of loan not allowed until Year 13 of loan	N/A	5 Projects must demonstrate job creation, though this is only a small piece of the application. Loan terms not as good as other programs, and there are penalties to early repayment
Website	http://www.ibank.ca.gov/infrastructure-state-revolving-fund-isrf-program/									
Water Infrastructure Finance and Innovation Act (WIFIA)	USEPA	Loan	CEQA and NEPA	Construction of wastewater conveyance and treatment projects, drinking water treatment and distribution projects, desalination, and water recycling projects	Planning, preliminary engineering, design, environmental review, revenue forecasting, construction, land acquisition, capitalized interest	Federal assistance may not exceed 80% of project costs.	Letters of Interest accepted during selection periods. FY 2018 solicited letters of interest from April-July 2018. 62 Letters of Interest applied for $9.1B; 39 projects selected to apply for $5B in loans	$5B was available in 2018. Minimum project size for large communities (population > 25,000) is $20M; for small communities is $5M. Interest rate greater or equal to U.S. Treasury rate of similar maturity, based on the weighted average life of the loan. Loans for 35 years or useful life of project, whichever is less. WIFIA received a 2-year $100M reauthorization at end of 2018.	51% non-WIFIA; (up to 80% of project costs can be covered by federal funds, using a combination of programs)	6 Non-refundable application fees of $25,000 (small communities) or $100,000 (>25,000 people). Total fees: $250K-$500K plus possibly additional fees for administration of loan. Low funding amount available. National program. Better local/state options.
Website	https://www.epa.gov/wifia									