INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

IWVGA
INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

AUGUST 2023

TITLE XVI FEASIBILITY STUDY

STETSON ENGINEERS INC.

Northern California • Southern California • Arizona • Colorado • Oregon

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

Indian Wells Valley Groundwater Authority

Title XVI Feasibility Study

AUGUST 2023

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LIST OF ACRONYMS

AAD	Average Annual Daily
ADMM	Average Daily Maximum Month
AF	Acre-feet
AFY	Acre-feet per year
Anti-degradation Policy	Statement of Policy with Respect to Maintaining High Quality Waters of California
AOP	Advanced Oxidation Process
AVEK	Antelope Valley – East Kern Water Agency
Basin	Indian Wells Valley Groundwater Basin
BOD	Biochemical Oxygen Demand
BOR	United States Bureau of Reclamation
BWQMP	Background Water Quality Monitoring Plan
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CDO	Cease and Desist Order
CECs	Constituents of Emerging Concerns
CEQA	California Environmental Quality Act
City	City of Ridgecrest
CY	Calendar Year
cy/yr	Cubic Yard Per Year
DBPs	Disinfectant Byproducts
DDW	State Water Resources Control Board, Division of Drinking Water
Delta	Sacramento – San Joaquin Delta
DRI	Desert Research Institute
DWR	California Department of Water Resources
EA	Environmental Assessment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EKAPCD	East Kern Air Pollution Control District
FAT	Full Advanced Treatment
GMF	Granular Media Filtration
GPCD	Gallons Per Capita - Day
GRR	Groundwater Replenishment Using Recycled Water
GRRP	Groundwater Replenishment Using Recycled Water Project
GSA	Groundwater Sustainability Agencies
GSP	Groundwater Sustainability Plan
hp	Horsepower
Initial Study	Initial Environmental Study
Inyokern CSD	Inyokern Communities Services District
IPR	Indirect Potable Reuse
IWVGA	Indian Wells Valley Groundwater Authority
IWVWD	Indian Wells Valley Water District
LADWP	Los Angeles Department of Water and Power
Lahontan Basin Plan	Water Quality Control Plan for the Lahontan Region
MCL	Maximum Contaminant Level
MDAB	Mojave Desert Air Basin
MF	Membrane Filtration
MGD	Million Gallons Per Day

mg/L	Milligrams Per Liter
Navy	United States Navy
NAWS	Naval Air Weapons Base
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Research Institute
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
P&P Memo	Provost & Pritchard Consulting Group Technical Memorandum
Project	IWVGA Recycled Water Project
PRVs	Pressure Reduction Valves
PVC	Polyvinyl Chloride
Recycled Water Policy	SWRCB Water Quality Control Plan for Recycled Water
Regional Board	Regional Water Quality Control Board
RO	Reverse Osmosis
RWC	Recycled Water Contribution
SAT	Soil Aquifer Treatment
SGMA	California Sustainable Groundwater Management Act
SNMP	Salt and Nutrient Management Plan
SRF	State Revolving Fund
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
Tech Memo	Technical Memorandum
TDS	Total Dissolved Solids
TN	Total Nitrogen
TOC	Total Organic Carbon
Trussell	Trussell Technologies, Inc.
TSS	Total Suspended Solids
UV	Ultraviolet
UV/AOP	Ultraviolet/Advanced Oxidation Process
VOCs	Volatile Organic Compounds
WDRs	Waste Discharge Requirements
WIFIA	Water Infrastructure Finance and Innovation Act
WQO	Water Quality Objectives
WRP	Water Recycling Plant
WRR	Water Recycling Requirements
WWTF	Wastewater Treatment Facility
WY	Water Year

1.0 – Introduction

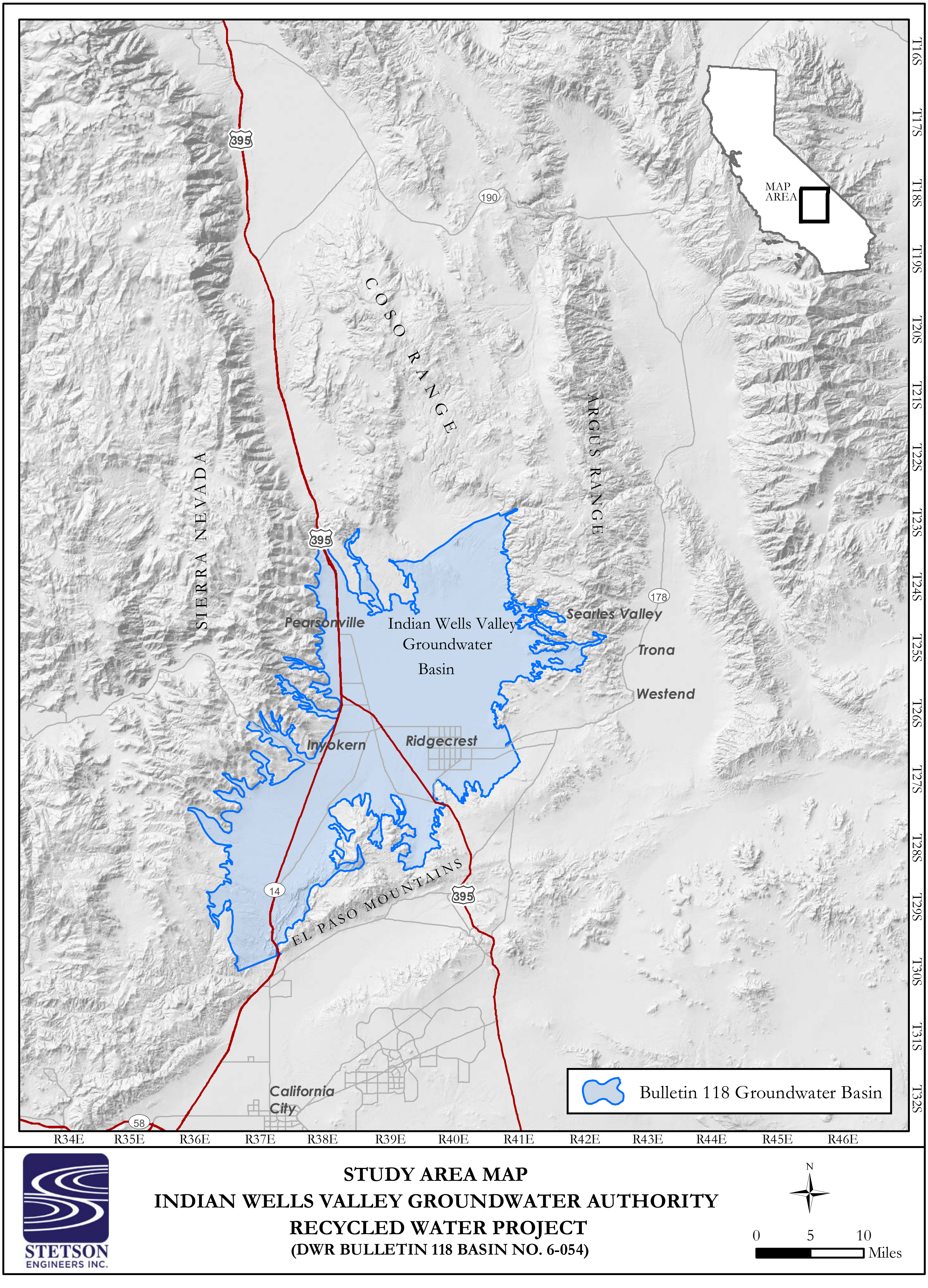
1.1 – Background

The Indian Wells Valley Groundwater Authority (IWVGA) has completed this Feasibility Study for the proposed IWVGA Recycled Water Project (Project) following the guidelines in the United States Bureau of Reclamation's Reclamation Manual, Directives and Standards, WTR 11-01, Title XVI Water Reclamation and Reuse Program and Desalination Construction Program Feasibility Study Review Process. The IWVGA is the non-federal sponsor for this project.

The goal of the proposed Project is to develop a local, reliable source of water for groundwater recharge within the Indian Wells Valley Groundwater Basin (Basin). The Project would provide tertiary and advanced treatment of recycled water and injection wells to recharge up to 1,654 acre-feet per year (AFY) into the Basin upon completion of the City of Ridgecrest's (City) Wastewater Treatment Facility (WWTF) in calendar year (CY) 2026, and up to 2,792 AFY into the Basin by CY 2070 based on estimated population growth.

1.2 – Study Area

The study area for the proposed Project covers the entire Basin. The Basin is located in the northwestern part of the Mojave Desert in southern California. The general location of the Basin is presented in Figure 1-1. The Basin is bordered on the west by the Sierra Nevada Mountain Range, on the north by the Coso Range, on the east by the Argus Range, and on the south by the El Paso Mountains. Surface water flow from the surrounding mountain ranges drains to China Lake, a large normally dry lake, or playa, located in the central north-east part of the Basin. A map of the study area for this project is presented in Figure 1-1.



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STUDY AREA MAP
INDIAN WELLS VALLEY GROUNDWATER AUTHORITY
RECYCLED WATER PROJECT
(DWR BULLETIN 118 BASIN NO. 6-054)

The Basin underlies approximately 600 square miles of land area in portions of Kern County, Inyo County, and San Bernardino County, with the majority (approximately 73 percent) being in Kern County. The City is the only incorporated community in the Basin and covers an area of approximately 20 square miles with a population of approximately 35,000 people. Unincorporated communities in the Basin include the communities of Inyokern in Kern County and Pearsonville in Inyo County, along with other smaller communities.

The California Sustainable Groundwater Management Act of 2014 (SGMA) established a statewide framework to help protect groundwater resources over the long-term. SGMA requires local agencies to form Groundwater Sustainability Agencies (GSA) for high and medium priority basins. The IWVGA is the exclusive GSA for the Basin.

In the “Sustainable Groundwater Management Act, 2018 Basin Prioritization Process and Results” document, the California Department of Water Resources (DWR) identified the Basin as a critically over drafted basin of high priority due to roughly six decades of pumping groundwater in excess of the natural Basin yield, a condition commonly known as overdraft. In accordance with SGMA, the IWVGA adopted a Groundwater Sustainability Plan (GSP) for the Basin in January of 2020 (provided on IWVGA’s website: https://iwvgsp.com/), after a mandatory review and public comment period, DWR approved the GSP in January 2022.

The GSP contains management programs that culminate in the absence of undesirable and unsustainable groundwater conditions within 20 years in order to provide long-term sustainable groundwater management. One of the GSP’s management programs is the development and beneficial use of recycled water generated at the City WWTF. The beneficial use of recycled water will support sustainable management of the Basin by replacing existing groundwater demands for landscape irrigation or indirect potable reuse through basin recharge.

1.3 – City WWTF

The City operates wastewater collection, treatment, and disposal facilities that serve the Ridgecrest community as well as the China Lake Naval Air Weapons Station (NAWS). The City's WWTF was originally constructed in 1946 at a location near the southeastern City limits. During the 1970s, the WWTF was relocated to the NAWS base, where it operates today. The WWTF is currently within the NAWS boundary and is located in the northeast portion of the City, approximately 3.5 miles northeast of the City center, as shown in Section 4. The WWTF is currently designed to handle an average flow of 3.6 million gallons per day (MGD) and a peak hourly flow of 5.7 MGD. Overall, the existing WWTF is operating beyond its useful life since most of its components were constructed from 45 to nearly 75 years ago, except for the headworks which were upgraded in 2006. The City and the United States Navy (Navy) negotiated and executed a new land lease agreement in November 2020 in order to upgrade and expand the existing WWTF.

The City plans to expand and upgrade the existing WWTF in two-phases. The Phase 1 WWTF will be constructed with a design average annual daily (AAD) flow of 3.6 MGD and an average daily maximum month (ADMM) flow of 4.0 MGD. The Phase 2 WWTF will be constructed with a design AAD flow of 5.4 MGD and a ADMM flow of 5.9 MGD. The Phase 2 project will commence at a future date in which the City's Phase 1 WWTF capacity is determined to be insufficient to serve the growing populations of both the City and the NAWS. The existing WWTF will be demolished and replaced with the new expanded and upgraded WWTF. Based on recent project schedules, the City currently plans to begin construction of the new WWTF by the 4th quarter of 2024 and may finish construction as soon as the 4th quarter of 2026.

1.4 – IWVGA Recycled Water Project

The recycled water project discussed in the IWVGA's GSP consisted of applying recycled water from the City's WWTF for new beneficial uses. The beneficial uses were prioritized based on their ability to directly replace groundwater demands with recycled water to offset current pumping, where available, and to mitigate overdraft conditions. Consequently, the recycled water project discussed in the IWVGA's GSP was developed with an emphasis on landscape irrigation, and any available recycled water in excess of landscape irrigation demands would be used for groundwater replenishment. The IWVGA's GSP also included provisions for additional evaluation of potential recycled water projects, including industrial use of recycled water and direct potable reuse. Based on prior discussions with the IWVGA's Technical Advisory Committee (TAC) and more recent discussions with IWVGA Staff and the City, the alternatives to be evaluated for potential uses of recycled water from the City's new WWTF include: (1) Landscape Irrigation with tertiary treated recycled water; (2) Groundwater Replenishment via Surface Spreading of tertiary treated recycled water; and (3) Groundwater Replenishment via Deep Injection of full advanced treated recycled water. Although groundwater replenishment via surface spreading is included as an alternative in this Feasibility Study, IWVGA's TAC has reviewed available hydrogeologic information, previous hydrogeologic studies, and information from a surface spreading pilot project and concluded surface spreading of recycled water is not viable in the Basin due to significant uncertainty regarding whether the recycled water would reach the groundwater table. Consequently, Alternative 2 is considered infeasible and unfavorable. However, to provide a complete consideration of all options, Alternative 2 is included in this Feasibility Study. Further details regarding the evaluation of all three (3) alternatives is presented in Section 4, Section 5, and Section 6.

Consistent with the State Water Resources Control Board's (SWRCB) "Recycled Water Policy", IWVGA included the construction of a water recycling plant (WRP) as a critical sustainability measure within the GSP. The proposed WRP will consist of tertiary and/or full advanced treatment facilities depending on the alternative determined to be the most favorable. The potential locations of the proposed WRP for each of the three (3) alternatives are provided in Section 4.

1.5 – Objectives

This Title XVI Feasibility Study presents the key elements of a complete feasibility study report as required by the United States Bureau of Reclamation (BOR) *Manual Directives and Standards WTR-11-01* and include references indicating where supporting documentation to this study can be found. The purpose of this study is to address the following topics and provide references to the various reports and studies completed for the proposed Project.

- Statement of Problem and Needs
- Water Recycling Opportunities
- Description of Alternatives
- Economic Analysis
- Selection of Water Recycling Project
- Environmental Consideration and Potential Effects
- Legal and Institutional Requirements
- Financial Capability
- Research Needs

2.0 – Statement of Problem and Needs

2.1 – Background

Groundwater is the sole source of water in the Basin; however, the Basin has been in a state of overdraft since the early 1960s as a result of groundwater pumping exceeding the natural basin yield. As further discussed in Section 2.4, in Water Year (WY) 2022, the estimated total groundwater production was approximately 21,160 AF, 2.8 times the estimated sustainable yield of 7,650 AFY indicating overdraft conditions are continuing in the Basin. This annual groundwater production estimate is the best engineering estimate available based on data derived from sources. However, current litigation has brought into question the accuracy of some self-reported groundwater production data due to inconsistencies with reported groundwater production and documented and stated water use. Accordingly, actual groundwater production in WY 2022 may be higher than this estimate. The significant annual reduction of groundwater in storage is directly related to chronic lowering of groundwater levels and water quality degradation in the Basin.

The Basin includes relatively coarse-grained alluvial aquifers with clay and silt interbeds, and low permeability thick clay and silt deposits associated with lacustrine and playa depositional environments. These fine-grained materials are prone to inelastic compaction when the groundwater table is lowered to below historical levels. As a result, areas underlain by extensive fine-grained materials have a high to very high susceptibility to land subsidence. However, land subsidence has not occurred in the past few years. The Basin is located within the tectonically active eastern California shear zone, and also subject to direct tectonic changes in ground elevations, as well as soft sediment deformation and compaction of fine-grained units due to seismic activity.

Groundwater levels have been experiencing significant declines in almost all areas of the Basin. Groundwater levels remain stable in some locations within the Basin near recharge and discharge zones, as well as in the El Paso area which is separated by a fault from the principal aquifer. Declining water levels have historically impacted and are currently impacting shallow production wells, requiring wells to be deepened, re-drilled, or abandoned as a water source. Many shallow wells are located in disadvantaged communities, exacerbating the financial impact of required well modifications and/or replacements.

Currently, substantial groundwater in the Basin is of good quality; however, there are regions with poorer water quality due to high concentrations of total dissolved solids (TDS) and/or arsenic. Within the Basin, groundwater moves from the mountains toward the China Lake playa, through coarse-grained alluvial deposits into fine-grained lacustrine deposits. This groundwater movement can cause dissolution of evaporites (caused by high evaporation rates at earlier times), resulting in high TDS concentrations[1]. Increased pumping can exacerbate this process causing ions to be leached from clay and lacustrine deposits resulting in increased TDS concentrations. TDS samples indicate concentrations have increased over time in some of the northwest area wells where high rates of pumping may have migrated naturally occurring saline water. Historically, some wells sampled within the Basin have shown arsenic concentrations in groundwater above California's current arsenic maximum contaminant level (MCL) (10 µg/L). The groundwater most strongly affected by arsenic above the MCL occurs in the southeast area of the Basin and beneath the NAWS.

The DWR approved GSP contains seven (7) management actions and projects, including the beneficial use of recycled water generated from the City WWTF, that culminate in the absence of undesirable and unsustainable groundwater conditions (e.g. chronic lowering of groundwater levels and water quality degradation) within 20 years in order to provide long-term sustainable groundwater management. The beneficial use of recycled water

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[1] TriEcoTt – a joint venture of TriEco LLC and Tetra Tech EM Inc., 2013. Final Technical Justification for Beneficial Use Changes for Groundwater in Salt Wells Valley and Shallow Groundwater in Eastern Indian Wells Valley. Prepared for the Department of the Navy. February 2013.

represents an important sustainable management action because of the potential to either replace existing groundwater demands for irrigation or for potable water through possible direct potable, or increase the replenishment of the Basin as a new source of basin recharge.

2.2 – Current Water Supplies

The only current source of supply of potable water for the Indian Wells Valley is groundwater from the Basin. Streams and other surface waters in the Indian Wells Valley are ephemeral due to low annual precipitation and therefore are not a reliable source of water. Currently, there are no imported water supplies available to the Basin. The only existing imported water infrastructure near the Basin is the Los Angeles Aqueduct which is owned by the Los Angeles Department of Water and Power (LADWP). The Los Angeles Aqueduct transports water from Owens Valley exclusively for LADWP's use. Water users within the Indian Wells Valley do not have rights to use water from the Los Angeles Aqueduct.

Residents of the Indian Wells Valley are served groundwater through private domestic wells, small cooperative groups sharing wells, small mutual water companies, a very small Inyokern Communities Services District (Inyokern CSD), and the Indian Wells Valley Water District (IWVWD). The Navy produces and distributes groundwater for on-station water uses at the NAWS. Searles Valley Minerals, Inc. produces groundwater from the Basin for use in its minerals recovery and processing operations in the Searles Valley (located east of the Basin) and for potable use in the small communities of Trona, Westend, Argus, and Pioneer Point in the Searles Valley. In addition, a small number of farms located in the Indian Wells Valley rely on the Basin's groundwater supplies for their agricultural operations, including several smaller family farms. All but one of the farms has agreed to discontinue their operations in the coming months. The outlier farm is a 1,600-acre Pistachio orchard. The estimated water demands of this orchard are 4.5 AF of water per acre farmed land for a total of 7,200 AFY.

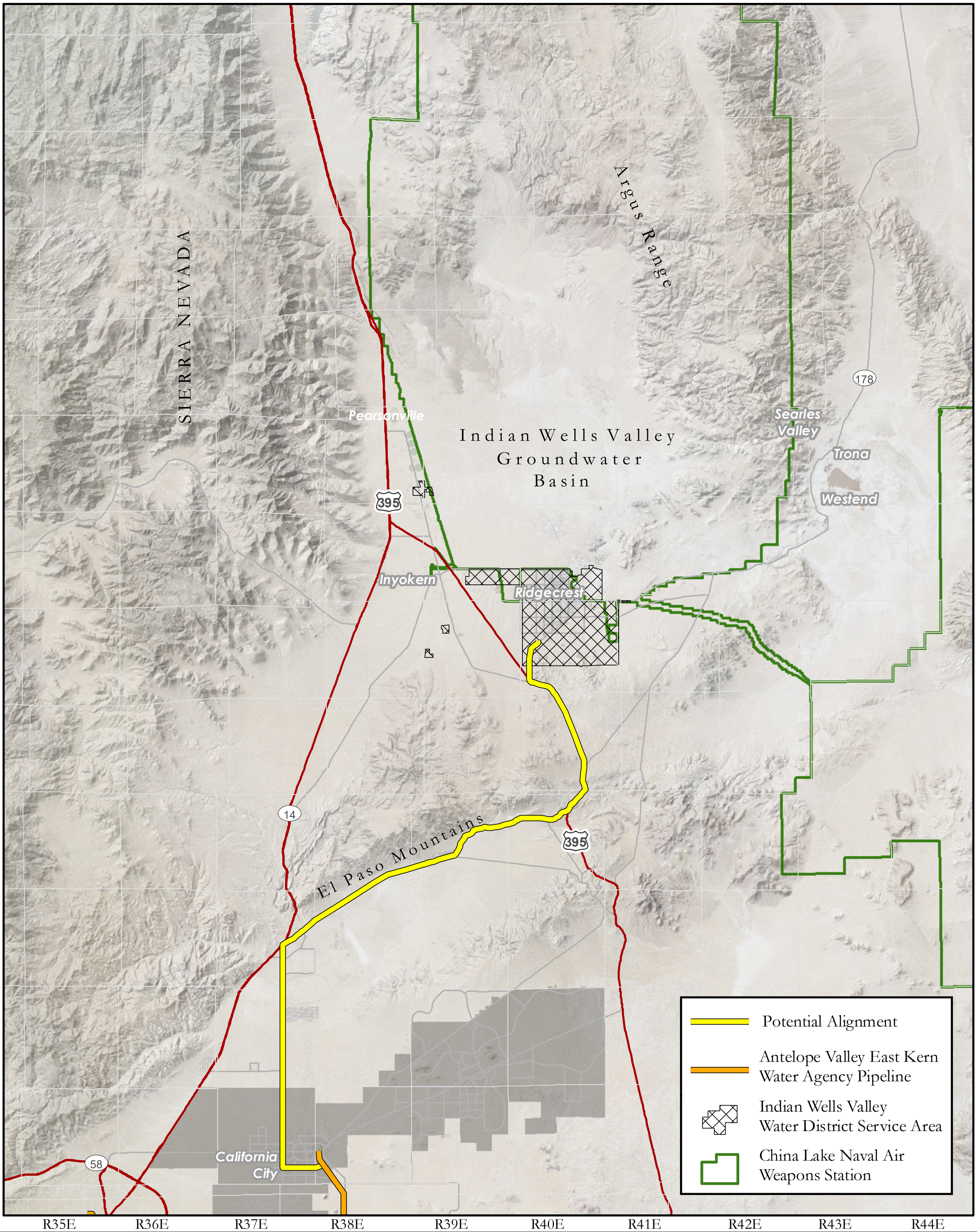
The sustainable yield of the Basin is estimated to be 7,650 AFY based on measured groundwater levels and computer modeling, and the recommendation of IWVGA's TAC. IWVGA's GSP recommended projects and management actions to achieve Basin sustainability that are intended to culminate in managing the Basin within the sustainable yield without undesirable and unsustainable groundwater conditions in the Basin. The estimated sustainable yield of 7,650 AFY represents the groundwater supply that is currently available on a sustainable basis.

As previously discussed, the Basin has been in a state of overdraft since the early 1960s as a result of groundwater pumping exceeding the natural basin yield. As further discussed in Section 2.4, in WY 2022, the estimated total groundwater production was approximately 21,160 AF, 2.8 times the estimated sustainable yield of 7,650 AFY indicating overdraft conditions are continuing in the Basin. Although the only currently available water supply for the Indian Wells Valley is groundwater from the Basin, SGMA requires IWVGA to sustainably manage the Basin, which will require balancing the water budget of the Basin by reducing water demands, and developing supplemental water supplies, including recycled water.

2.3 – Potential New Water Supplies

In addition to the Project, the GSP includes a proposed Imported Water Project to develop sufficient alternative water supplies to achieve sustainable management of the Basin. The Imported Water Project includes a proposed pipeline of approximately 50 miles and associated water conveyance facilities to bring in water supplies from outside of the Basin. The primary source of imported water will be water from Northern California that must be transported through the Sacramento-San Joaquin Delta (Delta). The Delta is the hub of California's two largest surface water delivery projects, California's State Water Project and the federal Central Valley Project. Both of these surface water delivery projects face significant challenges exporting water from the Delta, including limitations on the rate of exporting of water to protect endangered fish in the Delta, lawsuits regarding protection and restoration of the ecosystem of the Delta, and an aging levee system that protects farms and cities from flooding. The Project will reduce the amount of water that will need to be imported from the Delta to the Basin.

The IWVGA has recently received a $7.6 million grant through DWR for planning and design-level activities, environmental compliance, and right-of-way acquisition, for the Imported Water Project. IWVGA's Imported Water Project is planned to begin water deliveries in 2035. The imported water pipeline would convey treated water from a point on the California City Feeder in California City to a connection point with IWVWD in or around the City of Ridgecrest. The California City Feeder is owned and operated by the Antelope Valley – East Kern Water Agency (AVEK). The potential pipeline alignment is provided in Figure 2-1.



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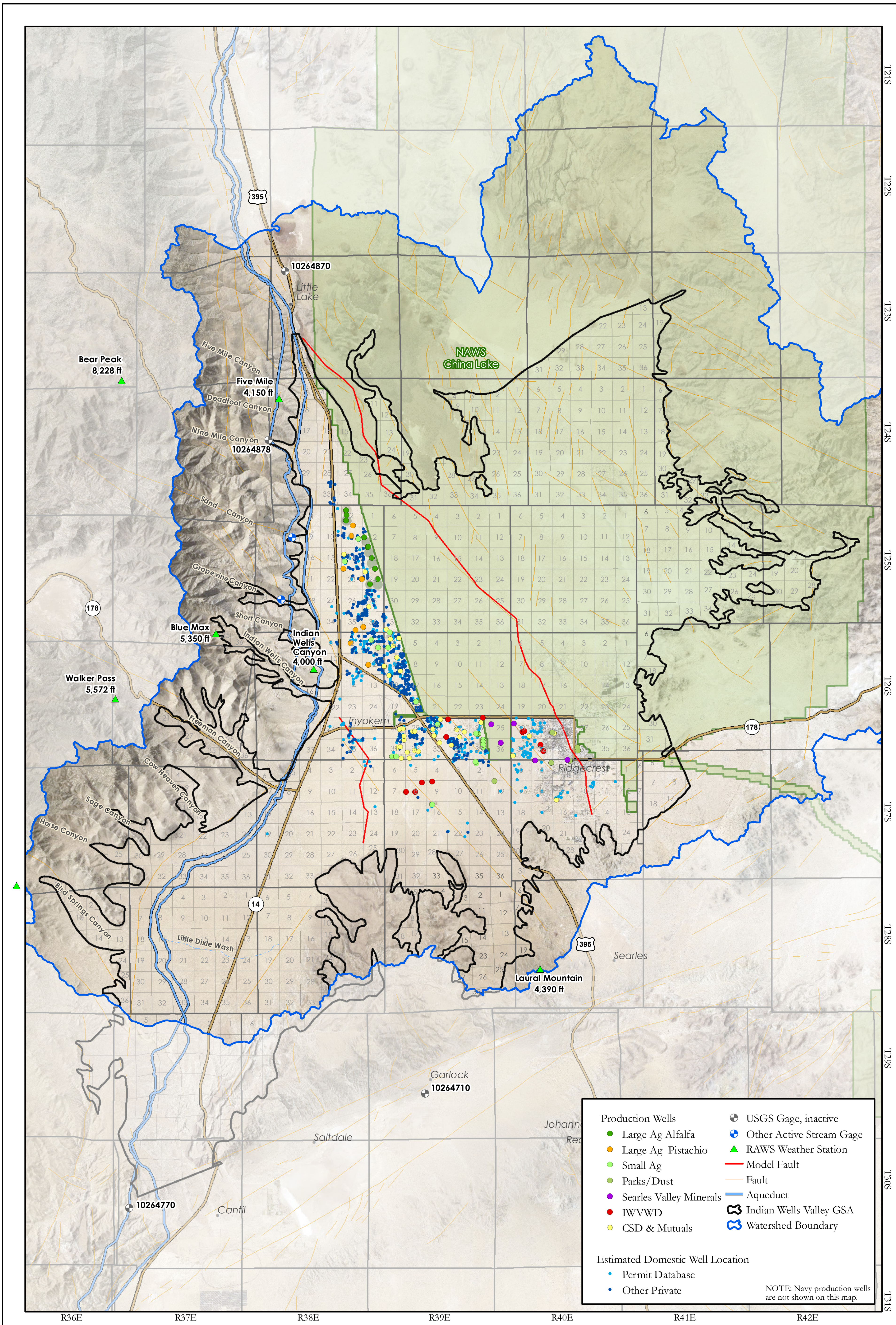
IMPORTED WATER PIPELINE
INDIAN WELLS VALLEY GROUNDWATER AUTHORITY
POTENTIAL PIPELINE ALIGNMENT

2.4 – Current Water Demands

Groundwater from the Basin is produced from approximately 930 wells. Figure 2-2 provides the location of the production wells in the Basin. Since 2018, the IWVGA has been actively engaged in efforts to improve the accuracy of annual groundwater production estimates, however, despite these efforts, data gaps in the records for annual groundwater production within the Basin still exist. These gaps are partially due to inaccuracies of the current self-reporting of groundwater production by groundwater producers to the IWVGA, non-compliant groundwater producers who do not report production data, and groundwater producers present in the Basin that are not subject to reporting (i.e. *de minimis* extractors).

FIGURE 2-2



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PRODUCTION WELL LOCATION MAP

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The best engineering estimate of WY 2022 pumping is derived from the combination of all pumping records and sources available to IWVGA and is presented in the final column in Table 2-1, below. Attachment 1 provides a more detailed breakdown of pumping categories and the data source for each value.

Table 2-1: Indian Wells Valley Groundwater Basin Groundwater Production Estimates

Water Use Sector	**Estimated No Action Projections WY 2022** (AF)	**WY 2022 Reported Pumping** (incomplete) [3]	**WY 2022 Total Estimated Pumping** (AF) [6, 7]
Urban	7,010	6,050	6,060
Industrial	2,910	2,370	2,370
Agriculture	22,520[2]	8,230	9,570
Other – Federal [1]	2,040	1,710[4]	1,710
Other – Domestic/ Mutuals/Co-Ops/Community Services District	1,380	180 [5]	1,450
TOTAL	**35,860**	(incomplete)	**21,160**

1 Federal groundwater use is for NAWS China Lake and are provided by the U.S. Navy.

2 This value includes planned agricultural projections provided by pumpers and probably overestimates future agricultural groundwater production.

3 These values underestimate actual groundwater production in WY 2022 because not all non-de minimis groundwater producers submit data regularly to the IWVGA and because some groundwater producers were not required to report their groundwater production during WY 2022.

4 Federal entities are not required to report monthly production to the IWVGA for the purpose of the fee; however, though not required, the U.S Navy reported monthly production to the IWVGA for the Annual Report.

5 *De minimis* users (those that produce less than 2 acre-feet per year (AFY) or those that have four or fewer connections) are not required to report monthly production to the IWVGA for the purpose of the fee.

6 See Attachment 1 for a more detailed table.

7 Actual pumping may be higher than estimated.

Table 2-2 below shows recent annual groundwater production estimates. Estimated urban, industrial, and agricultural groundwater use within the Basin has decreased since WY 2019 (the first year an Annual Report was prepared). However, federal groundwater use at NAWS China Lake has increased in WY 2022 compared to WY 2019. The groundwater use reduction is due to the implementation of management actions included in IWVGA's GSP, including the implementation of groundwater production fees. In WY 2022, the estimated total groundwater production was 2.8 times the estimated sustainable yield of 7,650 AFY indicating overdraft conditions are continuing in the Basin.

Table 2-2: Total Estimated Pumping by Water Year

Water Year	**Total Estimated Pumping** (AF)
WY 2019	22,800
WY 2020	21,990
WY 2021	20,800
WY 2022	21,160

2.5 – Projected Water Supplies and Demands

The Desert Research Institute (DRI), a non-profit research arm of the Nevada System of Higher Education, is a recognized world leader in basic and applied environmental research. The DRI was initially hired by the Navy in 2016 to update a groundwater flow model for the Basin. The DRI developed a groundwater pumping database and groundwater flow model for the Basin, based partially on several earlier groundwater modeling efforts, to represent historical Basin conditions and develop future groundwater management scenarios.

After peer review of the DRI groundwater flow model, the flow model was modified and recalibrated for development of the GSP. The re-calibrated model provides the historical water budgets and are the platform used for the SGMA simulations of baseline conditions and management scenarios. Model assumptions, construction, and performance are detailed in Appendix 3-H of the GSP. The GSP modeling effort provides tools necessary for estimating the groundwater aquifer's hydrologic water budget, identifying data gaps, assessing groundwater level and quality trends, determining sustainability criteria, and evaluating different strategies to provide long-term sustainable groundwater management for the Basin. The numerical model also provides ongoing analysis and support as needed for the annual reports and periodic evaluations that will be required for submittal to DWR.

The numerical model was used to simulate the Basin baseline conditions with the purpose of understanding future projected conditions if the GSP were not implemented, or under "no action" conditions. The baseline model run was used as one of the tools to evaluate the proposed projects and management actions included in the GSP. The simulated baseline total annual pumping and the distribution of the pumping by water use categories are provided in Table 2-3.

Table 2-3. Baseline Pumping Distribution by Water Use

Water Use	**2020** 34,900 AF	**2040** 36,700 AF	**2070** 38,100 AF
Agriculture	62%	62%	59%
Industrial	8%	8%	8%
City/Municipal/Domestic	24%	25%	28%
U.S. Navy	6%	6%	5%

Under "no action" conditions, overdraft conditions will continue to exist due to significant and increasing groundwater extractions. The simulated water budget representing baseline conditions are provided in Table 2-4.

Table 2-4. Baseline Conditions Water Budget. (2020 through 2070 WY averages)

Water Budget Element[1]	Estimated Volume (AFY)
Inflows	
Mountain Front Recharge[2]	7,650
Total Inflow	**7,650**
Outflows	
ET	1,620
Interbasin Subsurface Flow	40
Groundwater Extractions	36,870
Total Outflow	**38,530**
Change of Groundwater in Storage	**-30,880**

[1] Annual acre-feet per water year (October – September) based on monthly groundwater model values.

[2] Long-term average recharge.

The numerical model was also used to simulate Basin conditions and behavior resulting from implementation of the proposed projects and management actions included in the GSP. This scenario was used to further develop certain sustainable management criteria. The expected total annual groundwater pumping and the distribution of the pumping by water use resulting from the implementation of the proposed projects and management actions included in the GSP is provided in Table 2-5.

Table 2-5. Pumping Distribution by Water Use from GSP Implementation.

Water Use	2020 20,800 AF	2040 11,200 AF	2070 14,000 AF
Agriculture	40%	0%	0%
Industrial	10%	3%	3%
City/Municipal/Domestic	40%	79%	83%
U.S. Navy	10%	18%	15%

The modeling results showed that the expected greatly reduced annual groundwater pumping due to the implementation of the proposed management programs and projects, including the Project, eliminate undesirable impacts and result in sustainable management of the Basin. The Project is a critical component of the plan to bring the Basin into sustainability.

3.0 – Water Recycling Opportunities

3.1 – Existing Wastewater Reclamation and Reuse

The only existing wastewater treatment facilities in the Basin are operated by the Inyokern CSD and the City. Areas of the Basin not served by the Inyokern CSD and City wastewater facilities rely on individual septic systems to treat and dispose of wastewater. The only existing reuse of treated wastewater is the use of treated wastewater from the City WWTF for irrigation of 33 acres of alfalfa crops and the NAWS golf course, and to indirectly support habitat for the endangered Mojave Tui Chub fish species. Currently only 1,525 AFY of the 2,455 AFY of treated wastewater from the City WWTF is reused. The location of the Inyokern CSD WWTF, the City WWTF, and the reuse sites are shown in Figure 3-1. The existing treatment facilities and treated wastewater reuses are discussed below.

3.1.1 – Inyokern CSD WWTF

The community of Inyokern is located in the western portion of the Basin, approximately 7 miles west of the City (see Figure 1-1). Water and wastewater services for the community of Inyokern are provided by Inyokern CSD. Wastewater flows through a series of clay and polyvinyl chloride (PVC) pipes to the Inyokern CSD WWTF, which is located east of the Brown Road adjacent to Highway 395. The Inyokern CSD WWTF has a design capacity of 0.035 MGD with average daily flows of 0.029 MGD (33 AFY) and provides primary and secondary treatment to its wastewater through an aerated lagoon system. The final effluent generated at the Inyokern CSD WWTF is currently not of sufficient quality for any beneficial uses of recycled water and is instead disposed of through evaporation/percolation ponds located at the Inyokern CSD WWTF. The location of the Inyokern CSD WWTF, including the evaporation/percolation ponds, is provided in Figure 3-1.

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EXISTING WASTEWATER TREATMENT AND REUSE SITES

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

3.1.2 – Current City WWTF Operations

According to the City's 2015 Draft Facility Plan (see Appendix A), the existing WWTF has a permitted capacity of 3.60 MGD and currently treats an average annual flow of approximately 2.20 MGD. AAD flow during CY 2020 was approximately 2.20 MGD, with approximately 1.61 MGD (73%) attributable to the City and 0.59 MGD (27%) attributable to the NAWS. Influent biochemical oxygen demand (BOD) concentrations at the WWTF have generally ranged from 188 milligrams per liter (mg/L) to 260 mg/L for ADMM flows between 2005 and 2018. ADMM BOD increased to 370 mg/L in 2019 and 320 mg/L in 2020[2]. A technical memorandum dated July 10, 2021, prepared by Provost & Pritchard Consulting Group (P&P Memo) suggests that the increased ADMM BOD may be the result of lower per-capita wastewater flows: Organic matter concentrations in wastewater typically remain constant, but decreases in diluting water volumes would produce higher BOD. Additionally, the Draft Facility Plan reported influent nitrogen concentrations (as total nitrogen (N)) of 39 mg/L in 2015.

The existing WWTF provides pretreatment, primary treatment, and secondary treatment to wastewater received from both the City and the NAWS. Wastewater flows throughout the WWTF entirely by gravity, but pumps are used to convey primary sludge and digested sludge throughout the sludge treatment process. Pumps are also used to convey secondary-treated effluent for application (effluent disposal) at City-owned alfalfa fields. The City has historically applied biosolids from the WWTF to the alfalfa fields but has discontinued this practice. Currently, biosolids are stockpiled and tested before disposal at the Kettleman Hills landfill in Kings County. A process flow diagram for the existing WWTF is included in Figure 4-1 of the City's 2015 Draft Facility Plan (see Appendix A).

The conveyance and treatment facilities at the existing WWTF are described in detail below.

[2] AAD BOD also increased in 2019 (191 mg/L) and 2020 (226 mg/L), compared to historic values. From 2005 to 2018, the maximum AAD BOD was 166 mg/L, which occurred in 2007.

3.1.2.1 – Influent Flow, Pretreatment, and Primary Treatment

A total of four (4) influent channels enter the WWTF: One City channel and three Navy channels, one of which was abandoned when residential housing on NAWS was moved off-station to the City and other nearby areas. WWTF influent from the City's sewer trunk is measured by a 12-inch Parshall Flume, and total plant influent from both the City's sewer trunk and the NAWS service area is measured through two (2) 18-inch throat Parshall Flumes. WWTF influent from the NAWS service area is not directly measured but is determined by subtracting the City's contribution to WWTF influent from the total measured WWTF influent. All four influent channels combine at a point before pretreatment, which consists of headworks facilities including two auger grinders, a vortex grit chamber, and a grit classifier for off-site disposal.

Grit chamber effluent flows into primary sedimentation facilities, which consist of three rectangular clarifiers (Tank No. 1, 2 & 4) and one circular clarifier (Tank No. 3). Tank No. 4 had been retired from service at the time of preparation of the Draft Facility Plan, and City staff have indicated that Tank No. 3 has also been retired from service since the Draft Facility Plan was prepared. The two other primary sedimentation tanks operate at a surface overflow rate ranging from 600 gallons per square foot per day to 1,200 gallons per square foot per day. According to the Draft Facility Plan, the primary sedimentation facilities are beyond their expected life due to concrete degradation, worker access safety concerns, and obsolete equipment.

3.1.2.2 – Sludge Handling

Primary sludge from the primary clarifiers is collected via a sludge pump station and pumped to two 40-foot diameter anaerobic digesters, which are used to treat primary sludge by reducing its volatile organic compounds (VOCs) content. The anaerobic digesters are equipped with floating covers, heaters, and mixers to increase process efficiency, and digester gas is used to fuel the hot water heat exchangers. Sludge leaving the digesters is dewatered and dried on eight unlined solar sludge drying beds[3]. Historically, dried sludge has been stockpiled and tested before being either applied at the City-owned alfalfa fields or disposed at the Kettleman Hills landfill in the San Joaquin Valley in central California. However, as mentioned above, the City no longer applies dried sludge at the alfalfa fields.

3.1.2.3 – Secondary Treatment and Effluent Disposal

The primary effluent from the clarifiers flows by gravity to secondary treatment, which is achieved via seven (7) facultative ponds that span approximately 114 acres and are clay-lined to limit infiltration and percolation. The effluent is split and diverted either to pond Unit A (Ponds 1 through 4) or pond Unit B (Ponds 5 through 7). Primary effluent diverted to Unit A begins in Pond 1, flows through Pond 2 and Pond 4, and is subsequently either discharged into evaporation/percolation ponds or discharged into Pond 3, which has aeration facilities, prior to application for beneficial uses. Primary effluent diverted to Unit B flows through all three Unit B ponds before being discharged into evaporation/percolation ponds. A total of four (4) evaporation/percolation ponds are located at the existing WWTF, though two of these ponds (Ponds 8 & 11) have been taken out of service. Pond 8 has been taken out of service due to decreased influent flows and due to seepage into Pond 11. Pond 11 has been taken out of service due to excessive

[3] During winter months when weather conditions do not support drying, the sludge drying beds provide sludge storage. According to the Draft Facility Plan, the drying beds provide sufficient drying capacity during the summer months to account for freshly digested and dewatered sludge as well as stored sludge accumulated during the winter months.

seepage into NAWS facilities, as documented in a 1989 Cease and Desist Order (CDO 6-89-119) issued by the Lahontan Regional Board.

3.1.2.4 – Current Secondary-Treated Wastewater Beneficial Uses

Flow diverted into Pond 3 is pumped for irrigation of City-owned alfalfa fields or irrigation of the NAWS golf course. One pump located at Pond 3 delivers Pond 3 water through a 4-mile, 20-inch diameter force main to the City-owned alfalfa fields. The force main discharges into one of four ponds from which water is pumped to a center pivot irrigation system for irrigation of approximately 33 acres of alfalfa crops. Currently, 220 AFY of treated wastewater from the City WWTF is used to irrigate the alfalfa crops.

A separate pump located at Pond 3 is operated by the Navy and used to deliver treated effluent for irrigation of the NAWS golf course. Pressure sand filters and chlorine contact structures were constructed by the Navy to provide additional treatment prior to delivery at the NAWS golf course. However, the high algae content of Pond 3 has prevented the sand filters from being operated successfully, so the sand filters are currently bypassed. Currently, 500 AFY of treated wastewater from the City WWTF is used to irrigate the NAWS golf course. The new land lease agreement between the City and the Navy requires that the City provide 325 AFY of recycled water to the Navy for non-potable uses of recycled water at the NAWS, including for irrigation of the golf course.

One evaporation/percolation pond (Pond 10) is presumed to provide seepage flow to the nearby habitat for the endangered Mojave Tui Chub fish species. The Tui Chub habitat consists of two seeps, referred to as Lark Seep and G-1 Seep, which are connected through a series of man-made channels originally constructed during the 1950s and 1960s to divert seeping groundwater away from nearby roads and facilities. Currently, it is estimated approximately 805 AFY of seepage flow is provided to the Tui Chub Habitat. The new land lease agreement between the City and the Navy requires that the City provide 200 AFY of recycled water to the Navy for use in maintaining the Tui Chub habitat.

3.2 – Plans for City WWTF Upgrade and Expansion

As previously discussed in Section 1, the City's current plans to expand and upgrade the existing WWTF consist of a two-phase project. The Phase 1 WWTF will be constructed with a design AAD flow of 3.6 MGD and an ADMM flow of 4.0 MGD. The Phase 2 WWTF will be constructed with a design AAD flow of 5.4 MGD and an ADMM flow of 5.9 MGD. The Phase 2 project will commence at a future date when the City's Phase 1 WWTF capacity is determined to be insufficient to serve the growing populations of both the City and the NAWS. The existing WWTF will be demolished and replaced with the new expanded and upgraded WWTF. Based on recent project schedules, the City currently plans to begin construction of the new WWTF in the 4th quarter of 2024 and may finish construction as soon as the 4th quarter of 2026.

3.3 – City WWTF Effluent Quantity

The City's goal for use of treated effluent from the City WWTF is to encourage water purveyors to develop new beneficial uses of recycled water to the greatest extent possible. The P&P Memo details a population and flow rate analysis conducted as part of the 2015 Draft Facility Plan and serves as the most recent source of information available on City population projections, per-capita water use, and City WWTF influent flow rates. As shown on Table 3-1, historic AAD influent flow rates from 2001 through 2020 have ranged from a minimum of 2.18 MGD in 2015 to a maximum of 2.62 MGD in 2010. AAD influent flow in 2020 was approximately 2.20 MGD. Contributions to total City WWTF influent from both the City and the NAWS are also shown on Table 3-1.

Table 3-1
Historic City of Ridgecrest WWTF Average Annual Daily (AAD) Flows

Year	Total Influent Flow		NAWS Contribution			City Contribution		
	[MGD]	[AFY]	[MGD]	[AFY]	[%]	[MGD]	[AFY]	[%]
2001	2.52	2,823	-	-	-	-	-	
2002	2.52	2,823	-	-	-	-	-	
2003	2.58	2,890	-	-	-	-	-	
2004	2.52	2,823	-	-	-	-	-	
2005	2.51	2,812	-	-	-	-	-	
2006	2.57	2,879	-	-	-	-	-	
2007	2.49	2,789	-	-	-	-	-	
2008	2.57	2,879	-	-	-	-	-	
2009	2.55	2,856	0.747	837	29.3%	1.803	2,020	70.7%
2010	2.62	2,935	0.709	794	27.1%	1.911	2,141	72.9%
2011	2.46	2,756	0.756	847	30.7%	1.704	1,909	69.3%
2012	2.50	2,800	0.843	944	33.7%	1.657	1,856	66.3%
2013	2.30	2,576	0.636	712	27.7%	1.664	1,864	72.3%
2014	2.31	2,588	-	-	-	-	-	
2015	2.18	2,442	0.657	736	30.1%	1.523	1,706	69.9%
2016	2.25	2,520	0.693	776	30.8%	1.557	1,744	69.2%
2017	2.44	2,733	0.609	682	25.0%	1.831	2,051	75.0%
2018	2.25	2,520	0.494	553	22.0%	1.756	1,967	78.0%
2019	2.21	2,476	0.537	602	24.3%	1.673	1,874	75.7%
2020	2.20	2,464	0.586	656	26.6%	1.614	1,808	73.4%

The P&P Memo provides projections for population and total City WWTF influent based on 2020 U.S. Census population data for the City. Three annual population growth rates (1.8%, 1.2%, and 0.8%) were assumed to generate projections of population and WWTF influent flow through 2050 assuming per-capita wastewater flow contribution of either 85 gallons per capita-day (gpcd) or 75 gpcd. As discussed in the P&P Memo, actual historic growth rates in the City were approximately 1.03% per year from 2000 to 2010 and approximately 0.57% per year from 2010 to 2020, but growth in the City remains highly dependent on NAWS staffing levels, which are highly variable. The population and City WWTF influent flow rate projections from the P&P Memo were recreated in this analysis (see Table 3-2) to document the projections on an annual basis rather than on a 5-year basis as provided in the P&P Memo. The projections were also recreated to forecast population and City WWTF influent flow rates through 2070, which corresponds to the end of the planning and implementation horizon referenced in the SGMA and in IWVGA's adopted GSP. A separate set of projections (see Table 3-3) was prepared assuming an annual population growth rate of 1.0% per year, which is similar to growth trends documented in both the recycled water project discussion presented in the IWVGA's GSP as well as the City's General Plan update[4].

[4] City of Ridgecrest. *General Plan Public Draft*. Prepared by Matrix Design Group Inc. October 2008

Table 3-2
City of Ridgecrest WWTF: Average Annual Daily (AAD) Influent Flow Rate Projections

Year	Projected Population Growth Rate of 1.80% per Year					Projected Population Growth Rate of 1.20% per Year					Projected Population Growth Rate of 0.80% per Year				
	Population	WWTF Influent Flow (assuming per-capita contribution of 85.0 gpcd)		WWTF Influent Flow (assuming per-capita contribution of 75.0 gpcd)		Population	WWTF Influent Flow (assuming per-capita contribution of 85.0 gpcd)		WWTF Influent Flow (assuming per-capita contribution of 75.0 gpcd)		Population	WWTF Influent Flow (assuming per-capita contribution of 85.0 gpcd)		WWTF Influent Flow (assuming per-capita contribution of 75.0 gpcd)	
		[MGD]	[AFY]	[MGD]	[AFY]		[MGD]	[AFY]	[MGD]	[AFY]		[MGD]	[AFY]	[MGD]	[AFY]
2005	26,272	2.23	2,501	1.97	2,207	26,272	2.23	2,501	1.97	2,207	26,272	2.23	2,501	1.97	2,207
2010	27,616	2.35	2,629	2.07	2,320	27,616	2.35	2,629	2.07	2,320	27,616	2.35	2,629	2.07	2,320
2015	28,417	2.42	2,706	2.13	2,387	28,417	2.42	2,706	2.13	2,387	28,417	2.42	2,706	2.13	2,387
2020	29,217	2.48	2,782	2.19	2,455	29,217	2.48	2,782	2.19	2,455	29,217	2.48	2,782	2.19	2,455
2021	29,743	**2.53**	2,832	2.23	2,499	29,568	**2.51**	2,815	2.22	2,484	29,451	**2.50**	2,804	**2.21**	2,474
2022	30,278	**2.57**	2,883	2.27	2,544	29,923	**2.54**	2,849	2.24	2,514	29,687	**2.52**	2,827	**2.23**	2,494
2023	30,823	**2.62**	2,935	2.31	2,589	30,282	**2.57**	2,883	2.27	2,544	29,924	**2.54**	2,849	**2.24**	2,514
2024	31,378	**2.67**	2,988	2.35	2,636	30,645	**2.60**	2,918	2.30	2,575	30,163	**2.56**	2,872	**2.26**	2,534
2025	31,943	**2.72**	3,041	2.40	2,684	31,013	**2.64**	2,953	2.33	2,605	30,404	**2.58**	2,895	**2.28**	2,554
2026	32,518	2.76	3,096	2.44	2,732	31,385	2.67	2,988	2.35	2,637	30,647	2.60	2,918	2.30	2,575
2027	33,103	2.81	3,152	2.48	2,781	31,762	2.70	3,024	2.38	2,668	30,892	2.63	2,941	2.32	2,595
2028	33,699	2.86	3,209	2.53	2,831	32,143	2.73	3,060	2.41	2,700	31,139	2.65	2,965	2.34	2,616
2029	34,306	2.92	3,266	2.57	2,882	32,529	2.76	3,097	2.44	2,733	31,388	2.67	2,989	2.35	2,637
2030	34,924	**2.97**	3,325	2.62	2,934	32,919	**2.80**	3,134	2.47	2,766	31,639	**2.69**	3,012	**2.37**	2,658
2031	35,553	3.02	3,385	2.67	2,987	33,314	2.83	3,172	2.50	2,799	31,892	2.71	3,037	2.39	2,679
2032	36,193	3.08	3,446	2.71	3,041	33,714	2.87	3,210	2.53	2,832	32,147	2.73	3,061	2.41	2,701
2033	36,844	3.13	3,508	2.76	3,095	34,119	2.90	3,249	2.56	2,866	32,404	2.75	3,085	2.43	2,722
2034	37,507	3.19	3,571	2.81	3,151	34,528	2.93	3,287	2.59	2,901	32,663	2.78	3,110	2.45	2,744
2035	38,182	**3.25**	3,635	2.86	3,208	34,942	**2.97**	3,327	2.62	2,936	32,924	**2.80**	3,135	**2.47**	2,766
2036	38,869	3.30	3,701	2.92	3,265	35,361	3.01	3,367	2.65	2,971	33,187	2.82	3,160	2.49	2,788
2037	39,569	3.36	3,767	2.97	3,324	35,785	3.04	3,407	2.68	3,006	33,452	2.84	3,185	2.51	2,810
2038	40,281	3.42	3,835	3.02	3,384	36,214	3.08	3,448	2.72	3,042	33,720	2.87	3,211	2.53	2,833
2039	41,006	3.49	3,904	3.08	3,445	36,649	3.12	3,489	2.75	3,079	33,990	2.89	3,236	2.55	2,856
2040	41,744	**3.55**	3,975	3.13	3,507	37,089	**3.15**	3,531	2.78	3,116	34,262	**2.91**	3,262	**2.57**	2,878
2041	42,495	3.61	4,046	3.19	3,570	37,534	3.19	3,574	2.82	3,153	34,536	2.94	3,288	2.59	2,901
2042	43,260	3.68	4,119	3.24	3,634	37,984	3.23	3,617	2.85	3,191	34,812	2.96	3,315	2.61	2,925
2043	44,039	3.74	4,193	3.30	3,700	38,440	3.27	3,660	2.88	3,229	35,090	2.98	3,341	2.63	2,948
2044	44,832	3.81	4,269	3.36	3,766	38,901	3.31	3,704	2.92	3,268	35,371	3.01	3,368	2.65	2,972
2045	45,639	**3.88**	4,345	3.42	3,834	39,368	**3.35**	3,748	2.95	3,307	35,654	**3.03**	3,395	**2.67**	2,995
2046	46,461	3.95	4,424	3.48	3,903	39,840	3.39	3,793	2.99	3,347	35,939	3.05	3,422	2.70	3,019
2047	47,297	4.02	4,503	3.55	3,973	40,318	3.43	3,839	3.02	3,387	36,227	3.08	3,449	2.72	3,043
2048	48,148	4.09	4,584	3.61	4,045	40,802	3.47	3,885	3.06	3,428	36,517	3.10	3,477	2.74	3,068
2049	49,015	4.17	4,667	3.68	4,118	41,292	3.51	3,932	3.10	3,469	36,809	3.13	3,505	2.76	3,092
2050	49,897	**4.24**	4,751	3.74	4,192	41,788	**3.55**	3,979	3.13	3,511	37,103	**3.15**	3,533	**2.78**	3,117

Table 3-2
City of Ridgecrest WWTF: Average Annual Daily (AAD) Influent Flow Rate Projections

Year	Projected Population Growth Rate of 1.80% per Year					Projected Population Growth Rate of 1.20% per Year					Projected Population Growth Rate of 0.80% per Year				
	Population	WWTF Influent Flow (assuming per-capita contribution of 85.0 gpcd)		WWTF Influent Flow (assuming per-capita contribution of 75.0 gpcd)		Population	WWTF Influent Flow (assuming per-capita contribution of 85.0 gpcd)		WWTF Influent Flow (assuming per-capita contribution of 75.0 gpcd)		Population	WWTF Influent Flow (assuming per-capita contribution of 85.0 gpcd)		WWTF Influent Flow (assuming per-capita contribution of 75.0 gpcd)	
		[MGD]	[AFY]	[MGD]	[AFY]		[MGD]	[AFY]	[MGD]	[AFY]		[MGD]	[AFY]	[MGD]	[AFY]
2051	50,795	4.32	4,836	3.81	4,267	42,289	3.59	4,026	3.17	3,553	37,400	3.18	3,561	2.81	3,142
2052	51,709	4.40	4,923	3.88	4,344	42,796	3.64	4,075	3.21	3,595	37,699	3.20	3,589	2.83	3,167
2053	52,640	4.47	5,012	3.95	4,422	43,310	3.68	4,124	3.25	3,639	38,001	3.23	3,618	2.85	3,192
2054	53,588	4.55	5,102	4.02	4,502	43,830	3.73	4,173	3.29	3,682	38,305	3.26	3,647	2.87	3,218
2055	54,553	4.64	5,194	4.09	4,583	44,356	3.77	4,223	3.33	3,726	38,611	3.28	3,676	2.90	3,244
2056	55,535	4.72	5,288	4.17	4,666	44,888	3.82	4,274	3.37	3,771	38,920	3.31	3,706	2.92	3,270
2057	56,535	4.81	5,383	4.24	4,750	45,427	3.86	4,325	3.41	3,816	39,231	3.33	3,735	2.94	3,296
2058	57,553	4.89	5,480	4.32	4,835	45,972	3.91	4,377	3.45	3,862	39,545	3.36	3,765	2.97	3,322
2059	58,589	4.98	5,578	4.39	4,922	46,524	3.95	4,430	3.49	3,909	39,861	3.39	3,795	2.99	3,349
2060	59,644	5.07	5,679	4.47	5,011	47,082	4.00	4,483	3.53	3,955	40,180	3.42	3,826	3.01	3,376
2061	60,718	5.16	5,781	4.55	5,101	47,647	4.05	4,537	3.57	4,003	40,501	3.44	3,856	3.04	3,403
2062	61,811	5.25	5,885	4.64	5,193	48,219	4.10	4,591	3.62	4,051	40,825	3.47	3,887	3.06	3,430
2063	62,924	5.35	5,991	4.72	5,286	48,798	4.15	4,646	3.66	4,100	41,152	3.50	3,918	3.09	3,457
2064	64,057	5.44	6,099	4.80	5,381	49,384	4.20	4,702	3.70	4,149	41,481	3.53	3,949	3.11	3,485
2065	65,210	5.54	6,209	4.89	5,478	49,977	4.25	4,758	3.75	4,199	41,813	3.55	3,981	3.14	3,513
2066	66,384	5.64	6,321	4.98	5,577	50,577	4.30	4,816	3.79	4,249	42,148	3.58	4,013	3.16	3,541
2067	67,579	5.74	6,434	5.07	5,677	51,184	4.35	4,873	3.84	4,300	42,485	3.61	4,045	3.19	3,569
2068	68,795	5.85	6,550	5.16	5,780	51,798	4.40	4,932	3.88	4,352	42,825	3.64	4,077	3.21	3,598
2069	70,033	5.95	6,668	5.25	5,884	52,420	4.46	4,991	3.93	4,404	43,168	3.67	4,110	3.24	3,627
2070	71,294	6.06	6,788	5.35	5,989	53,049	4.51	5,051	3.98	4,457	43,513	3.70	4,143	3.26	3,656

Notes

1) Values in **red** correspond to WWTF Influent AAD Flow Projections through 2050, as shown in Table 4 of Provost & Pritchard report dated July 10, 2021.

Table 3-3
City of Ridgecrest WWTF: Average Annual Daily (AAD) Influent Flow Rate Projections

Year	Projected Population Growth Rate of 1.00% per Year				
	Population	WWTF Influent Flow (assuming per-capita contribution of 85.0 gpcd)		WWTF Influent Flow (assuming per-capita contribution of 75.0 gpcd)	
		[MGD]	[AFY]	[MGD]	[AFY]
2005	26,272	2.23	2,501	1.97	2,207
2010	27,616	2.35	2,629	2.07	2,320
2015	28,417	2.42	2,706	2.13	2,387
2020	29,217	2.48	2,782	2.19	2,455
2021	29,509	2.51	2,810	2.21	2,479
2022	29,804	2.53	2,838	2.24	2,504
2023	30,102	2.56	2,866	2.26	2,529
2024	30,403	2.58	2,895	2.28	2,554
2025	30,707	2.61	2,924	2.30	2,580
2026	31,014	2.64	2,953	2.33	**2,606**
2027	31,324	2.66	2,982	2.35	2,632
2028	31,637	2.69	3,012	2.37	2,658
2029	31,953	2.72	3,042	2.40	2,684
2030	32,273	2.74	3,073	2.42	2,711
2031	32,596	2.77	3,104	2.44	2,738
2032	32,922	2.80	3,135	2.47	2,766
2033	33,251	2.83	3,166	2.49	2,793
2034	33,584	2.85	3,198	2.52	2,821
2035	33,920	2.88	3,230	2.54	**2,850**
2036	34,259	2.91	3,262	2.57	2,878
2037	34,602	2.94	3,295	2.60	2,907
2038	34,948	2.97	3,327	2.62	2,936
2039	35,297	3.00	3,361	2.65	2,965
2040	35,650	3.03	3,394	2.67	2,995
2041	36,007	3.06	3,428	2.70	3,025
2042	36,367	3.09	3,463	2.73	3,055
2043	36,731	3.12	3,497	2.75	3,086
2044	37,098	3.15	3,532	2.78	3,117
2045	37,469	3.18	3,568	2.81	3,148

2046	37,844	3.22	3,603	2.84	3,179
2047	38,222	3.25	3,639	2.87	3,211
2048	38,604	3.28	3,676	2.90	3,243
2049	38,990	3.31	3,712	2.92	3,276
2050	39,380	3.35	3,749	2.95	3,308
2051	39,774	3.38	3,787	2.98	3,341
2052	40,172	3.41	3,825	3.01	3,375
2053	40,574	3.45	3,863	3.04	3,409
2054	40,980	3.48	3,902	3.07	3,443
2055	41,390	3.52	3,941	3.10	3,477
2056	41,804	3.55	3,980	3.14	3,512
2057	42,222	3.59	4,020	3.17	3,547
2058	42,644	3.62	4,060	3.20	3,583
2059	43,070	3.66	4,101	3.23	3,618
2060	43,501	3.70	4,142	3.26	3,655
2061	43,936	3.73	4,183	3.30	3,691
2062	44,375	3.77	4,225	3.33	3,728
2063	44,819	3.81	4,267	3.36	3,765
2064	45,267	3.85	4,310	3.40	3,803
2065	45,720	3.89	4,353	3.43	3,841
2066	46,177	3.93	4,397	3.46	3,879
2067	46,639	3.96	4,441	3.50	3,918
2068	47,105	4.00	4,485	3.53	3,957
2069	47,576	4.04	4,530	3.57	3,997
2070	48,052	4.08	4,575	3.60	**4,037**

As shown on Table 3-3, the total projected City WWTF influent flows in CYs 2026, 2035, and 2070 are 2,606 AF, 2,850 AF, and 4,037 AF, respectively. These years correspond to the anticipated completion dates of the new City WWTF (2026), the IWVGA's Imported Water Project (2035), and the GSP planning and implementation horizon (2070). The City is currently obliged to commit 325 AFY of secondary-treated effluent from the City WWTF to the NAWS golf course and 200 AFY for maintenance of the local Tui Chub habitat. These commitments take priority over any recycled water alternatives explored in this Title XVI Feasibility Study. Currently, the City may apply secondary-treated effluent to its alfalfa fields for irrigation until recycled water alternatives are fully developed. For the purpose of estimating available recycled water for the alternatives, this analysis assumes that the City will not commit any recycled water for alfalfa field irrigation after the alternatives are fully developed, and therefore, the City's priority commitments for providing recycled water total 525 AFY. Consequently, the total projected secondary effluents available for additional treatment and/or beneficial uses that do not require additional treatment in CYs 2026, 2035, 2070 are **2,081 AF**, **2,325 AF**, and **3,512 AF**, respectively. It should be noted that these quantities may be further reduced if significant losses are incurred during sludge generation as part of secondary treatment and, if constructed, primary clarification. The City is currently preparing an updated Facility Plan to identify the treatment facilities to be installed at the City's new WWTF; therefore, such losses are not estimated at this time but may be updated upon completion of the updated Facility Plan.

For alternatives such as landscape irrigation and groundwater replenishment, tertiary treatment processes that may incur additional losses of secondary-treated effluent will be required for the purpose of permitting. The losses incurred during tertiary treatment occur during media filtration, as a portion of filter discharge is typically used for backwashing to regenerate pore space between the filter media. Media filters (e.g. granular media filtration) are generally designed for a recovery of at least 96%, meaning that 4% of available secondary-treated effluent would be lost to backwashing during the filtration process. For alternatives that required advanced treatment facilities for the purpose of permitting (i.e. subsurface groundwater replenishment/injection), additional losses of tertiary-treated effluent will be incurred through membrane filtration (MF) and reverse osmosis (RO) brine generation. MF may result in losses of available tertiary-treated effluent as high as 8%. RO may result in losses of available tertiary-treated effluent between 10% to 19%. Table 3-4 and Table 3-5 summarize the potential treatment losses to the tertiary and advanced treatment processes and the resulting potentially available recycled water in 2026, 2035, and 2070, for the beneficial use for the Project. Table 3-4 corresponds with the implementation of a 2-Stage RO treatment process (e.g. 81% recovery), whereas Table 3-5 corresponds with the implementation of a 3-Stage RO treatment process (e.g. 90% recovery).

Table 3-4
Estimated Quantities of Recycled Water Available for Beneficial Uses
(2-Stage Reverse Osmosis)
(all values in Acre-Feet Per Year)

Item	CY 2026	CY 2035	CY 2070
Total WWTF Influent Flow	2,606.0	2,850.0	4,037.0
Treatment Losses - Primary/Secondary Clarifiers	0.0%	0.0%	0.0%
Total Secondary Effluent Flow	2,606.0	2,850.0	4,037.0
City Recycled Water Commitment (Golf Course)	325.0	325.0	325.0
City Recycled Water Commitment (Tui Chub Habitat Maintenance)	200.0	200.0	200.0
City Recycled Water Commitment (Alfalfa Fields)	0.0	0.0	0.0
Total Secondary Effluent available for Beneficial Uses	2,081.0	2,325.0	3,512.0
Treatment Losses - Granular Media Filtration	4.0%	4.0%	4.0%
(in AF)	83	93	140
Granular Media Filter Effluent Flow	1,998	2,232	3,372
Treatment Losses - Membrane Filtration (MF)	8.0%	8.0%	8.0%
(in AF)	160.0	179.0	270.0
MF Effluent Flow	1,838.0	2,053.0	3,102.0
Treatment Losses - Reverse Osmosis (RO)	19.0%	19.0%	19.0%
(in AF)	349.0	390.0	589.0
RO Effluent to Post-Treatment and Distribution	**1,489.0**	**1,663.0**	**2,513.0**

Table 3-5
Estimated Quantities of Recycled Water Available for Beneficial Uses
(3-Stage Reverse Osmosis)
(all values in Acre-Feet Per Year)

Item	CY 2026	CY 2035	CY 2070
Total WWTF Influent Flow	2,606.0	2,850.0	4,037.0
Treatment Losses - Primary/Secondary Clarifiers	0.0%	0.0%	0.0%
Total Secondary Effluent Flow	2,606.0	2,850.0	4,037.0
City Recycled Water Commitment (Golf Course)	325.0	325.0	325.0
City Recycled Water Commitment (Tui Chub Habitat Maintenance)	200.0	200.0	200.0
City Recycled Water Commitment (Alfalfa Fields)	0.0	0.0	0.0
Total Secondary Effluent available for Beneficial Uses	2,081.0	2,325.0	3,512.0
Treatment Losses - Granular Media Filtration	4.0%	4.0%	4.0%
(in AF)	83	93	140
Granular Media Filter Effluent Flow	1,998	2,232	3,372
Treatment Losses - Membrane Filtration (MF)	8.0%	8.0%	8.0%
(in AF)	160.0	179.0	270.0
MF Effluent Flow	1,838.0	2,053.0	3,102.0
Treatment Losses - Reverse Osmosis (RO)	10.0%	10.0%	10.0%
(in AF)	184.0	205.0	310.0
RO Effluent to Post-Treatment and Distribution	**1,654.0**	**1,848.0**	**2,792.0**

3.4 – Potential Beneficial Uses of Recycled Water

With exception of the City's commitments to irrigation of the NAWS golf course and maintenance of the Tui Chub habitat, potential beneficial uses of recycled water in the Basin include the following:

- Landscape Irrigation
- Groundwater Recharge via Surface Spreading
- Groundwater Recharge via Deep Injection

3.5 – Implementation Considerations

To implement the proposed Project, new facilities and infrastructure will need to be constructed. As such, it will be necessary for the proposed Project to comply with various permitting and regulatory requirements. Current severe drought conditions in California have increased community support for the implementation of new recycled water projects such as the proposed Project.

3.6 – Jurisdiction

Recycled water supplies within the Basin are provided by the City WWTF. In November 2020, IWVGA entered into an agreement with the City for the option to purchase effluent from the City WWTF. Under the agreement, the City is obliged to commit 325 AFY of secondary-treated effluent from the City WWTF to the NAWS golf course and 200 AFY for maintenance of the local Tui Chub habitat. These commitments take priority over any potential recycled water uses including the recycled water alternatives explored in this Feasibility Study. The IWVGA has the option to purchase the available secondary effluent remaining after the City meets these obligations. A copy of the Option Agreement between the City and IWVGA is provided in Appendix B.

4.0 – Description of Alternatives

4.1 – Identification of Alternatives

As discussed in Section 3, the quantities of projected secondary effluent that will be available for either additional treatment or for beneficial uses that do not require additional treatment are as follows:

- 2,081 AF by 2026
  - Corresponds to estimated completion date of the new City WWTF
- 2,325 AF by 2035
  - Corresponds to estimated completion date of IWVGA imported water interconnection project
- 3,512 AF by 2070
  - Corresponds to end of planning and implementation horizon for IWVGA's GSP

The recycled water project discussed in the IWVGA's GSP consisted of applying recycled water from the City's WWTF for new beneficial uses. The beneficial uses were prioritized based on their ability to directly replace groundwater demands with recycled water to offset current pumping, where available, and to mitigate overdraft conditions. Consequently, the recycled water project discussed in the IWVGA's GSP was developed with an emphasis on landscape irrigation, and any available recycled water in excess of landscape irrigation demands would be used for groundwater replenishment. The IWVGA's GSP also included provisions for additional evaluation of potential recycled water projects, including industrial use of recycled water and direct potable reuse. Further discussion of the recycled water project discussed in IWVGA's GSP is provided in Appendix 5-C of the GSP (see Appendix C). Based on prior discussions with the IWVGA's

TAC and more recent discussions with IWVGA Staff and the City, the alternatives to be evaluated for potential uses of recycled water from the City's new WWTF are:

- Alternative 1: Tertiary Treatment and Landscape Irrigation (non-potable)
- Alterative 2: Tertiary Treatment and Surface Spreading
- Alternative 3: Tertiary and Advanced Treatment and Subsurface (Deep) Injection

The three alternatives will be evaluated in terms of a number of criteria described in Section 4.2. Research needs, if any are necessary to move the process forward, will be identified and described in Section 10. The evaluation conducted was a preliminary planning level treatment and cost analysis.

A schematic of the three alternatives is shown in Figure 4-1. The reuse alternatives are fed secondary effluent from a WWTF employing oxidation ditch technology, to be discussed further below. There are two indirect potable reuse (IPR) alternatives shown, surface spreading and subsurface injection.

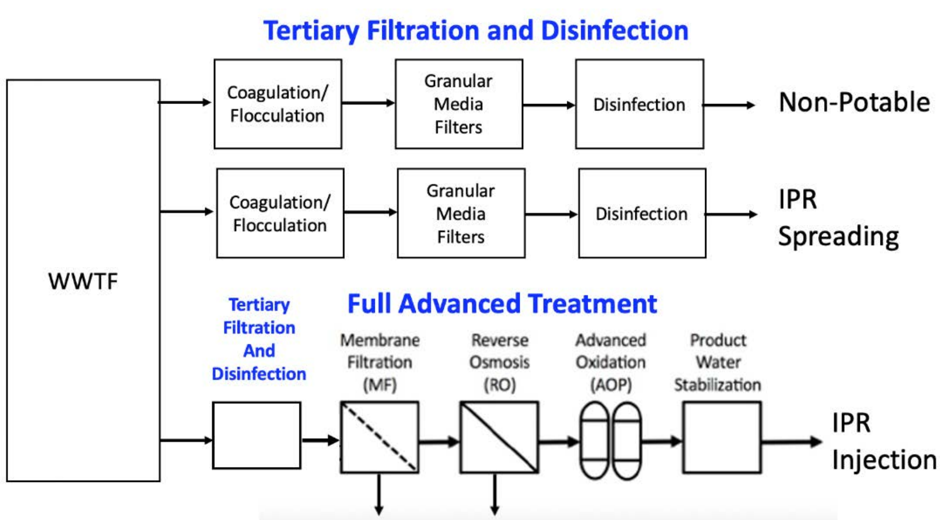


Figure 4 – 1: Process Flow Diagrams of Alternatives.

4.2 – Descriptions of Alternatives

4.2.1 – Alternative 1: Tertiary Treatment and Landscape Irrigation

For Alternative 1, the IWVGA WRP will consist of tertiary treatment facilities (e.g. granular media filtration (GMF) and ultraviolet (UV) disinfection) and is anticipated to be constructed at the new City WWTF. As previously discussed in Section 1, the City and the Navy negotiated and executed a new land lease agreement in November 2020 in order to upgrade and expand the existing WWTF. The existing WWTF will be demolished and replaced with the new expanded and upgraded WWTF. Although the new City WWTF will only provide secondary treatment, the City plans to make room for future tertiary filtration and disinfection facilities at its new WWTF. Tertiary treated water produced at the WRP would be used to irrigate various landscaped areas located south of the City WWTF within the City, NAWS, and IWVWD (Total of approximately 144 acres). Further details regarding these landscaped areas are provided in Table 4-1.

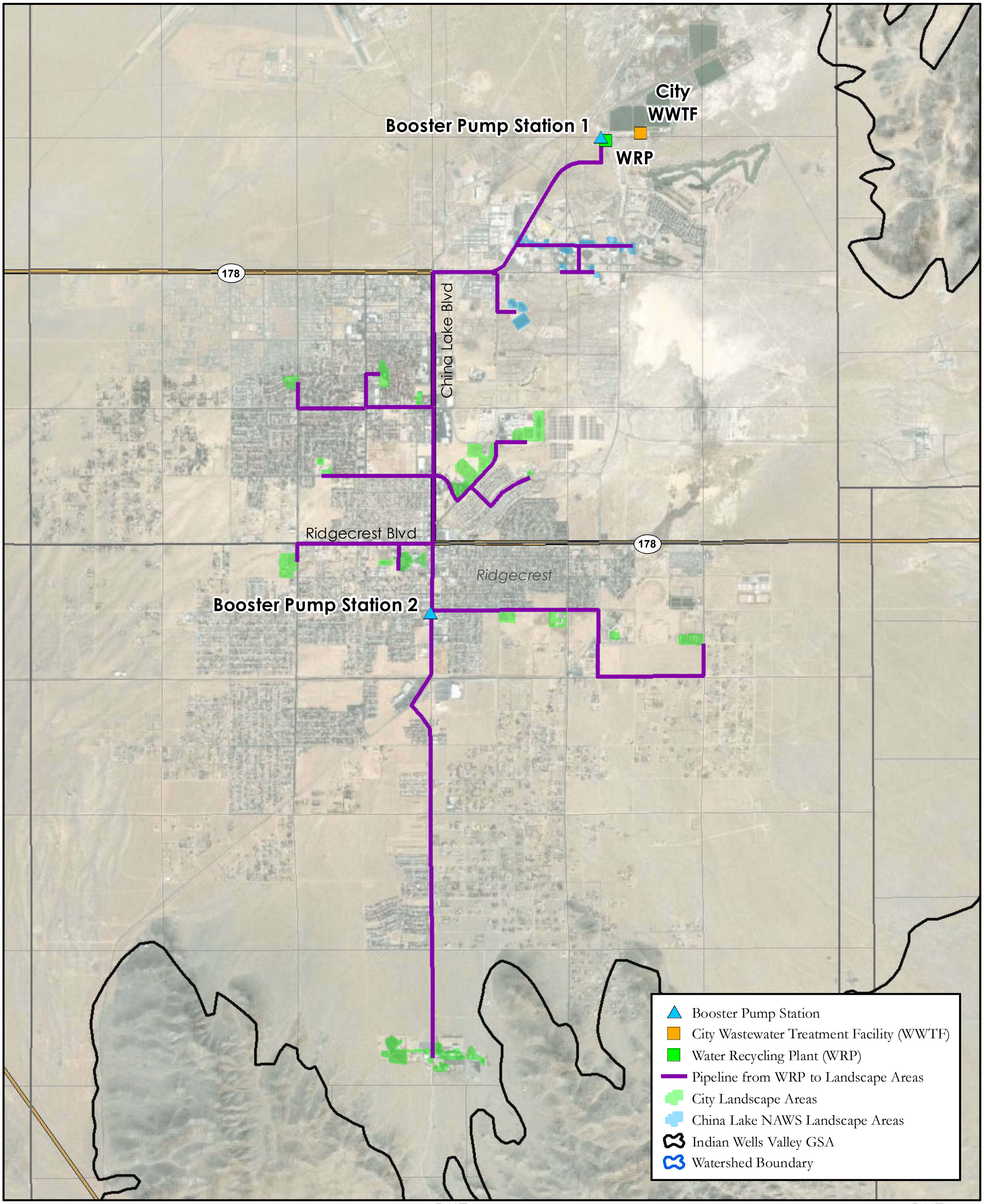
Table 4-1. Landscape Irrigation Water Demands.

Description	Landscape Area (acres)	Applied Irrigation Rate (feet per year)	Annual Water Demand (AFY)[5]
City of Ridgecrest			
City Hall	8.6	7.8	67.2
Jackson Park	29.9	7.8	234.2
Kerr-McGee Sports Complex	10.8	7.8	84.2
Pearson Park	4.1	7.8	31.1
Subtotal	**53.4**	**-**	**416.7**
Indian Wells Valley Water District			
Burroughs High School	16.9	7.8	131.8
Cerro Coso Community College	25.0	7.8	194.0
Desert Memorial Park (Cemetery)	5.5	7.8	42.7
Desert Empire Fairgrounds	1.5	7.8	11.7
Gateway Elementary School	3.8	7.8	29.4
Heritage Village	5.5	7.8	43.2
Las Flores Elementary School	1.5	7.8	11.6
Mesquite High School	1.6	7.8	12.1
Pierce Elementary School	0.4	7.8	3.4
Upjohn Park	5.0	7.8	39.0
Subtotal	**66.7**	**-**	**518.9**
Navy			
Fields located on Blandy Ave.	12.2	7.8	94.8
Fields located on Forrestal St.	8.0	7.8	62.5
Fields located on Inyokern Rd.	2.0	7.8	15.3

[5] Slight variations may exist due to rounding.

Solar Park	2.0	7.8	15.4
Subtotal	**24.1**	**-**	**188.0**
Total	**144.2**	**-**	**1,123.6**

Conveyance facilities for Alternative 1 include approximately 93,316 feet of pipeline, one (1) booster pump station consisting of seven (7) 200 horsepower (hp) booster pumps (6 active; 1 backup), one (1) booster pump station consisting of three (3) 200 hp booster pumps (2 active; 1 backup), connections to existing irrigation mains, recycled water meters, pressure reduction valves (PRVs), and backflow prevention devices. Figure 4-2 shows the locations of the WRP, City WWTF, conveyance facilities, and landscape irrigation areas that would be served.



STETSON ENGINEERS INC.

ALTERNATIVE 1
LANDSCAPE IRRIGATION
INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

N

0 0.5 1 Miles

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4.2.2 – Alternative 2: Tertiary Treatment and Surface Spreading

For Alternative 2, the IWVGA WRP will also consist of tertiary treatment facilities (e.g. GMF and UV Disinfection). Similar to Alternative 1, the WRP for Alternative 2 is assumed to be constructed at the new City WWTF. The spreading grounds for Alternative 2 are assumed to be constructed approximately 11 miles west of the City WWTF near the Inyokern Airport. Conveyance facilities for Alternative 2 include approximately 64,343 feet of pipeline, one (1) booster pump station consisting of seven (7) 200 hp booster pumps (6 active; 1 backup), four (4) percolation ponds (covering a total surface area of 12 acres), and two (2) down gradient monitoring wells. Figure 4-3 shows the locations of the WRP, City WWTF, conveyance facilities, and spreading grounds.

Document Path: J:\in2652\IWV_Alt_2_Surface_Spreading.mxd

STETSON ENGINEERS INC.

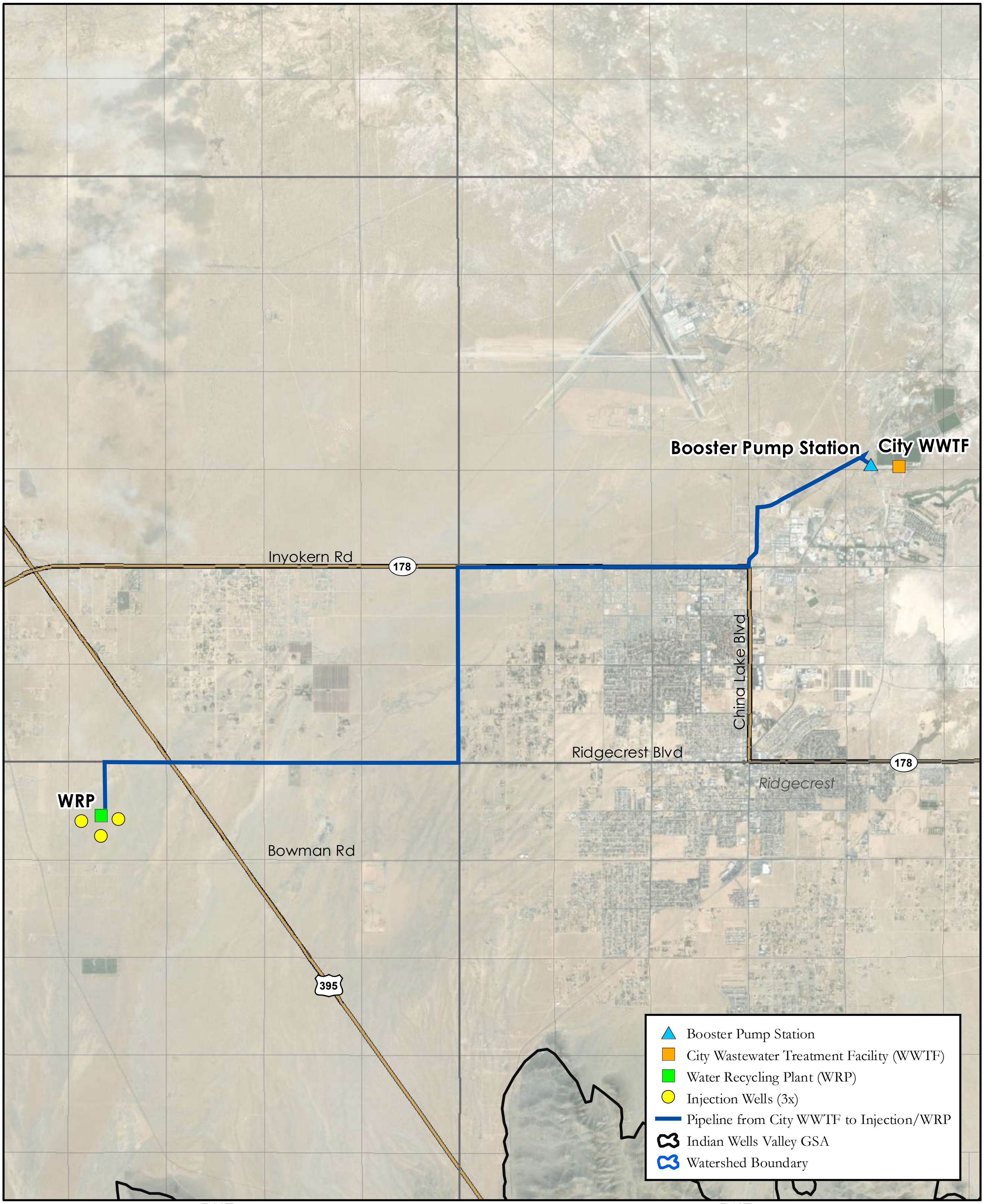
ALTERNATIVE 2
SURFACE SPREADING
INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

N

0 0.75 1.5 Miles

4.2.3 – Alternative 3: Tertiary and Advanced Treatment and Subsurface Injection

For Alternative 3, the IWVGA WRP will consist of both tertiary treatment facilities (e.g. GMF and UV Disinfection) and full advanced treatment (FAT) facilities (e.g., MF, RO, Ultraviolet/Advanced Oxidation Processes (UV/AOP), and evaporation ponds). The WRP for Alternative 3 is anticipated to be constructed within a vacant area located approximately 9 miles southwest of the City WWTF. This location provides enough space to accommodate the tertiary treatment facilities, FAT facilities, evaporation ponds, and deep injection wells needed to provide groundwater replenishment to the Basin. The exact locations of the deep injection wells are yet to be determined. However, a preliminary evaluation of IWVWD's Well 36 (located just north of the area) suggests that this location may be suitable for deep injection as per Article 5.2 of the Title 22 California Code of Regulations (CCR). This preliminary evaluation is provided in Appendix D. Conveyance facilities for Alternative 3 include approximately 58,957 feet of pipeline, one (1) booster pump station consisting of seven (7) 200 hp booster pumps (6 active; 1 backup), three (3) deep injection wells (2 active; 1 backup), and two (2) down gradient monitoring wells. Figure 4-4 shows the locations of the WRP, City WWTF, conveyance facilities, and injection wells.



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STETSON ENGINEERS INC.

ALTERNATIVE 3
DEEP INJECTION
INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

N

0 0.5 1 Miles

4.3 - Alternatives Analysis

Trussell Technologies, Inc. (Trussell) performed a Treatment and Cost Evaluation in support of an alternatives analysis for each of the three (3) alternatives discussed in this Feasibility Study., The evaluation is presented in a Technical Memorandum (Tech Memo) provided in Appendix E. This section summarizes Trussell's findings in support of an alternatives analysis for the three (3) alternatives: landscape irrigation (Title 22, non-potable); surface spreading; and deep injection. Trussell's Tech Memo incorporates regulatory requirements/water quality goals, source water quality (including identifying data limitations), preliminary, planning level design criteria, and preliminary, planning level cost analysis. Further details regarding each of the elements in the evaluation are provided in Appendix E.

4.3.1 – Identification of Regulatory Requirements and Water Quality Goals

The regulatory requirements for each of the three alternatives are summarized below. They serve as the basis for the water quality goals that lead into the design criteria developed in Section 4.3.3.

4.3.1.1 – Alternative 1: Tertiary Treatment with Landscape Irrigation

Title 22 Recycled Water Criteria

Non-potable landscape irrigation is regulated under Title 22 of the California Code of Regulations. The Title 22 CCR regulations stipulate three levels of treatment for the reclaimed water: disinfected secondary 2.2, disinfected secondary 23, and disinfected tertiary recycled water. Disinfected tertiary recycled water has the most stringent criteria to meet and is for unrestricted use. Under Title 22 CCR Section 60301.230, disinfected tertiary recycled water is defined as a filtered and later disinfected wastewater that meets the criteria shown in Table 1 of Trussell's Tech Memo. This project will meet the requirements of disinfected tertiary recycled water for unrestricted use. If UV disinfection is used in the project, the UV system must meet National Water Research Institute

(NWRI) Ultraviolet Disinfection Guidelines for Disinfection and Water Reuse (3rd ed., 2012).

Waste Discharge Requirements

WWTFs in California are regulated by Regional Water Quality Control Boards (Regional Boards). The local Regional Board issues Waste Discharge Requirements (WDRs), which are issued to WWTF that discharge to land or groundwater. The Regional Board issues National Pollutant Discharge Elimination System (NPDES) permits for facilities that discharge to surface waters.

The City's Draft Facility Plan considered the WDRs. WDRs for the City of Ridgecrest and U.S. Department of Defense, China Lake Naval Air Weapons Station Wastewater Treatment Facility are specified in Regional Board Order 6-00-56. Water recycling requirements (WRR) are handled separately under Regional Board Order 6-84-36 for the China Lake NAWS Golf Course and Regional Board Order 6-93-85 for the City of Ridgecrest Irrigation Site. Copies of the Regional Board Orders are provided under Appendix F.

The City WWTF currently discharges all of its effluent to land through a series of percolation/evaporation ponds, NAWS golf course irrigation, and alfalfa irrigation. The future WDRs will likely be different. The effluent water quality for land application must comply with the water quality objectives (WQO) established for both surface and groundwater under the Water Quality Control Plan for the Lahontan Region (Lahontan Basin Plan) (see Appendix G), as well as with the Salt and Nutrient Management Plan.

In addition, there are provisions for reliability and redundancy that must be incorporated into the design of tertiary filtration facilities to assure Title 22 effluent water quality requirements are achieved.

4.3.1.2 – Alternatives 2 & 3: Groundwater Replenishment Using Recycled Water Regulations

The Groundwater Replenishment Using Recycled Water (GRR) regulations (i.e. Articles 5.1 and 5.2 of the Title 22 CCR) were promulgated on June 18, 2014 and govern recycled water surface spreading and deep injection projects. The water quality regulatory requirements under GRR regulations are summarized in Table 3 of Trussell's Tech Memo. The regulatory requirements listed in Table 3 and Table 4 of Trussell's Tech Memo apply to both surface spreading and deep injection.

Under the GRR, there are also differences between the surface spreading and subsurface injection alternatives, described below.

4.3.1.2.1 – Alternative 2: Groundwater Replenishment via Surface Spreading (Article 5.1, Title 22 CCR)

For a spreading GRR project (GRRP), the recycled municipal wastewater must receive treatment that meets:

- The definition of oxidized wastewater under Title 22 CCR Section 60301.650
- The definition of filtered wastewater under Title 22 CCR Section 60301.320
- The definition of disinfected tertiary recycled water under Title 22 CCR Section 60301.230.

Additional regulatory requirements for surface spreading are summarized in Table 5 of Trussell's Tech Memo.

4.3.1.2.2 – Alternative 3: Groundwater Replenishment via Subsurface Injection (Article 5.2, Title 22 CCR)

The GRR also has provisions for subsurface application (i.e. deep injection). The project must involve treatment of an oxidized wastewater as defined in Title 22 CCR Section 60301.650. The treatment requirement for deep injection goes far beyond what is required for non-potable reuse and surface spreading applications. The treatment required is referred to as FAT. FAT requires RO treatment followed by an advanced oxidation process (AOP). A typical FAT train also includes MF, which is included to protect the RO system from any larger solids. The entire recycled municipal wastewater stream must be treated by FAT prior to subsurface injection.

Additional requirements of a subsurface injection GRRP are summarized in Table 6 of Trussell's Tech Memo.

4.3.2 – Source Water Quality Evaluation

Understanding the source water quality is key to plan the level of treatment and the treatment processes necessary to achieve the water quality goals discussed previously. Since the future WWTF is not yet constructed, there is no secondary effluent data for the new WWTF available for evaluation. Additionally, given the large differences between the treatment train at the current WWTF and the planned treatment train for the future facility, current data from the existing WWTF is not suitable to evaluate for the Project. Therefore, Trussell's Tech Memo evaluates secondary effluent water quality parameters from other Southern California wastewater treatment plants employing a secondary treatment process similar to the process proposed for the City's new WWTF. Section 2.2 of Trussell's Tech Memo discusses the evaluation of source water quality. The results of this evaluation were used to evaluate treatment requirements for each Project alternative.

4.3.3 – Treatment Evaluation

Section 2.3 of Trussell's Tech Memo describes the treatment evaluation conducted for each Project alternative (See Appendix E). The results of the evaluation are presented below.

The design flows for the City WWTF are shown in Table 4-2.

Table 4-2. Design Flows for the new WWTF.

Phase	Flow (mgd)	Flow (AFY)
Phase 1	3.6	4030
Phase 2	5.4	6050

The design basis for the recycled water/potable reuse project will align with the City's future Phase 2 secondary effluent flow (5.4 mgd). The Operation and Maintenance Cost evaluation in this Feasibility Study will be based on the City's Phase 1 flow of 3.6 mgd.

4.3.3.1 – Alternative 1: Tertiary Treatment with Landscape Irrigation

As previously described, tertiary treatment consists of filtration of secondary effluent followed by disinfection. Several filtration processes can be used to fulfill this prerequisite such as GMF, cloth filters, membrane filters, among others. Likewise, different disinfectants exist and can be used as the choice for tertiary treatment, for example combined chlorine, UV light, free chlorine, ozone, chlorine dioxide, etc. Section 2.3.1 of Trussell's Tech Memo (See Appendix E) presented pros and cons of each filtration and disinfection process and developed design criteria for each.

4.3.3.2 – Alternative 2: Tertiary Treatment with Surface Spreading

For surface spreading, the GRR requires that the water meet Title 22 recycled water unrestricted use standards. The wastewater is subject to oxidation (biological treatment), filtration, and disinfection. This level of treatment is the same as that for Alternative 1 and is described in Section 2.3.1 of Trussell's Tech Memo (See Appendix E). No treatment train beyond what was presented in Section 2.3.1 of Trussell's Tech Memo is proposed, but it is noted that an ozonation step could provide destruction of constituents of emerging concerns (CECs) and improve the removal of Total Organic Carbon (TOC) through the soil aquifer treatment (SAT) process, allowing more water to be spread. The removal of CECs aids in public perception.

<u>Microorganism Control</u>

The GRR pathogen goal of the water is discussed in Section 2.1 of Trussell's Tech Memo. 12-log, 10-log and 10-log are required for enteric virus, *Giardia* cyst and *Cryptosporidium* oocyst, respectively. No additional pathogen control suggestion is provided besides those discussed in Section 2.4.1 of Trussell's Tech Memo. The retention time of the water underground is important for microorganism control in a surface spreading project. 1-log virus removal is credited per month water is maintained underground. If the water is underground for more than 6 months, 10-log removal of *Giardia* cyst and *Cryptosporidium* oocyst are credited. Trussell's Tech Memo recommends a retention time greater than 6 months be targeted for the purpose of microorganism control.

Diluent Water, Recycled Wastewater Contribution, and TOC control

Diluent water, recycled wastewater contribution (RWC) and TOC control are regulated under GRR Section 60320.114, GRR Section 60320.116, and GRR Section 60320.118, respectively.

The initial maximum allowable TOC concentration for surface water spreading projects is 2.5 mg/L. The estimated TOC concentration downstream of the tertiary filtration and disinfection is 7 mg/L. This exceeds the maximum allowed TOC concentration of 2.5 mg/L. The Project may be able to meet the TOC requirement if the Project can receive credit for TOC removal that naturally occurs as the recycled water travels through the soil beneath the spreading basins to the groundwater table and sufficient dilution from subsurface flow can be demonstrated.

4.3.3.3 – Alternative 3: Tertiary and Advanced Treatment with Subsurface Injection

The subsurface injection alternative requires both tertiary treatment and FAT. Tertiary treatment is discussed above and in Section 2.3.1 of Trussell's Tech Memo. FAT technologies (e.g. MF, 2-Stage RO, 3-Stage RO, evaporation ponds, UV/AOP and post treatment) for Alternative 3 are evaluated in more detail in Section 2.3.3 of Trussell's Tech Memo (See Appendix E).

4.3.4 – Cost Analysis

A preliminary cost analysis was performed for the treatment technologies and conveyance facilities considered herein and is summarized in the following Sections. The costs considered were capital costs and operations and maintenance costs (O&M). Capital costs for the treatment technologies were estimated considering the City's Phase 2 flow (5.4 mgd) whereas Capital Costs for the conveyance facilities and O&M costs for both were calculated based on the City's Phase 1 flow (3.6 mgd). Values were rounded up to the nearest thousand. Further details on the calculations for each respective Alternative's cost estimates can be found in Appendix H of this Feasibility Study, as well as the Appendix of Trussell's Tech Memo.

4.3.4.1 – Alternative 1: Tertiary Treatment with Landscape Irrigation

Filtration

Cost estimates were performed for the three options considered for tertiary treatment (GMF, cloth filters, and MF). Capital costs were estimated based on costs from other plants in California using the same technology and same model of product as the ones listed herein. The prices were adjusted for 2022 prices (i.e., inflation rate), and based on the number of trains or units used compared to the original application.

The capital, electrical and chemical costs for each option, GMF, cloth filters, and MF, respectively, are presented in Section 2.4 of Trussell's Tech Memo.

To compare the tertiary filtration technologies, a present worth calculation using 30 years of capitalization period was used, and the results are laid out in Table 4-3.

Table 4-3. Present Worth Comparison for the Tertiary Filtration Technologies.

	Capital	O&M (30-years)[1]	Total (30 years)
GMF	$ 6,000,000	$ 1,410,000	$ 7,410,000
Cloth Filter	$ 2,350,000	$ 1,350,000	$ 3,700,000
MF	$ 9,360,000	$ 6,320,000	$ 15,680,000

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

From the cost estimation table, MF could be eliminated due to high capital and O&M costs. Given the expected secondary effluent water quality previously discussed and the water quality goals for the options considered herein, GMF is believed to be the most appropriate technology selection for tertiary treatment. When compared to cloth filters, the GMF is extremely reliable to meet the turbidity goals. It is easy to operate, its use is widespread in recycled water applications (both potable and non-potable), it requires minimal manual maintenance, and, unlike cloth filters, it can handle flow variation, and it has not presented problem with bryozoans as previously discussed have shown to be a problem for some cloth filter installations.

Additionally, cloth filters are only recommended as a polishing step when the secondary effluent quality is excellent. Given the uncertainty of the secondary effluent quality due to the operations at the City WWTF and IWVGA's tertiary filtration facilities being performed by separate entities, there is a real risk that the water quality goal of total suspended solids (TSS) below 30 mg/L (Section 2.1 of Trussell's Tech Memo) will not be achieved consistently for the cloth filters. For the same reason, there is an increased risk that cloth filters would not reliably achieve the required effluent turbidity for either potable or non-potable reuse purposes.

Chlorination is the industry standard for disinfection, but it has several important disadvantages compared to UV including a larger footprint, more site work/construction, elevated disinfection byproducts (DBPs) levels, longer permitting time including a tracer study required for approval, and a non-modular configuration that lacks expandability. In contrast, the UV system offers several advantages compared to chlorination including less difficult permitting, smaller footprint, and modular design. For these reasons, UV was considered as the disinfection technology. Capital and O&M costs were also estimated for the UV disinfection and are presented in Section 2.4 of Trussell's Tech Memo.

A present worth calculation was also performed for the tertiary treatment in total, as presented in Table 4-4.

Table 4-4. Present Worth for Tertiary Filtration and Disinfection.

	Capital	O&M (30 years)[1]	Total (30 years)
GMF	$ 6,000,000	$ 1,410,000	$ 7,410,000
UV Disinfection	$ 2,820,000	$ 1,180,000	$ 4,000,000
Total for Tertiary Treatment	$8,820,000	$ 2,590,000	$ 11,410,000

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

<u>Conveyance</u>

Conveyance facilities for Alternative 1 include approximately 93,316 feet of pipeline, one (1) booster pump station consisting of seven (7) 200 hp booster pumps (6 active; 1 backup), one (1) booster pump station consisting of three (3) 200 hp booster pumps (2 active; 1 backup), connections to existing irrigation mains, recycled water meters, PRVs, and backflow prevention devices.

Capital and O&M costs were estimated for the conveyance facilities associated with Alternative 1. Table 4-5 summarizes the findings.

Table 4-5. Preliminary, Planning Level Costs for Alternative 1 Conveyance Facilities.

Parameter	Cost
Capital Costs	$ 51,761,000
Total O&M Costs per Year	$ 930,000

Summary

A present worth calculation was performed for the tertiary treatment and conveyance facilities in total, as presented in Table 4-6. The total annual cost and cost per AF over 30 years are also provided. The cost per AF was estimated using the average annual recycled water demand for landscape irrigation of 1,124 AFY.

Table 4-6. Present Worth, Annual Cost, and Cost Per AF for Alternative 1.

	Capital	O&M (30 years)[1]	Total (30 years)
GMF	$ 6,000,000	$ 1,410,000	$ 7,410,000
UV Disinfection	$ 2,820,000	$ 1,180,000	$ 4,000,000
Conveyance	$ 51,761,000	$ 16,090,000	$ 67,851,000
Total for Tertiary Treatment with Landscape Irrigation	$ 60,581,000	$ 18,680,000	$ 79,261,000
		Annual Cost =	**$ 2,642,000**
		Cost Per AF =	**$ 2,351.39**

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

4.3.4.2 – Alternative 2: Tertiary Treatment with Surface Spreading

Treatment

The preliminary, planning level treatment costs for Alternative 2 are the same as for Alternative 1 presented in Section 4.3.4.1.

Conveyance

Conveyance facilities for Alternative 2 includes approximately 64,343 feet of pipeline, one (1) booster pump station consisting of seven (7) 200 hp booster pumps (6 active; 1 backup), four (4) percolation ponds (covering a total surface area of 12 acres), and two (2) down gradient monitoring wells.

Capital and O&M costs were estimated for the conveyance facilities associated with Alternative 2. Table 4-7 summarizes the findings.

Table 4-7. Preliminary, Planning Level Costs for Alternative 2 Conveyance Facilities.

Parameter	Cost
Capital Costs	$ 54,221,000
Total O&M Costs per Year	$ 2,026,800

Summary

A present worth calculation was performed for the tertiary treatment and conveyance facilities in total, as presented in Table 4-8. The total annual cost and cost per AF over 30 years are also provided. The cost per AF was estimated using the total tertiary effluent flow available for surface spreading of 3,372 AFY in CY 2070.

Table 4-8. Present Worth, Annual Cost, and Cost Per AF for Alternative 2.

	Capital	O&M (30 years)[1]	Total (30 years)
GMF	$ 6,000,000	$ 1,410,000	$ 7,410,000
UV Disinfection	$ 2,820,000	$ 1,180,000	$ 4,000,000
Conveyance	$ 54,221,000	$ 35,050,000	$ 89,271,000
Total for Tertiary Treatment with Surface Spreading	$ 63,041,000	$ 37,640,000	$ 100,681,000
		Annual Cost =	**$ 3,356,000**
		Cost Per AF =	**$ 995.26**

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

4.3.4.3 – Alternative 3: Tertiary and Advanced Treatment with Subsurface Injection

Treatment

Cost estimates for the MF, 2-Stage RO, 3-Stage RO, UV/AOP processes and evaporation ponds as the RO concentrate management choice were performed using capital and O&M costs, as previously explained. The summary of the capital and O&M costs for the FAT treatment processes (MF, 2 – Stage RO, 3 – Stage RO, UV/AOP) along with the post treatment are presented in Table 4-9 through Table 4-13; whereas the evaporation pond costs are presented in Table 4-14. A summary of the FAT systems is presented in Table 4-15 and Table 4-16. These FAT cost estimations do not include the tertiary treatment costs discussed previously in Section 4.3.4.1.

Table 4-9. MF Preliminary, Planning Level Cost Estimation.

Parameter	Cost
Capital Costs	$ 9,360,000
Electrical Costs per Year	$ 255,000
Chemical Costs per Year (NaOCl for chloramine; Ammonium Sulfate for chloramine; NaOCl for MC and RC; Citric Acid for MC and RC; NaOH for citric acid neutralization; Sodium bisulfate for NaOCl quenching)	$ 205,000
Total O&M Costs per Year	$ 460,000

Table 4-10. 2-Stage Conventional RO Preliminary, Planning Level Cost Estimation.

Parameter	Cost
Capital Costs	$ 16,800,000
Electrical Costs per Year	$ 854,000
Chemical Costs per Year (Antiscalant; Sulfuric Acid; NaOH for CIP; Citric Acid for CIP; Citric Acid for NaOH CIP neutralization; NaOH for Citric Acid CIP neutralization)	$ 176,000
Total O&M Costs per Year	$ 1,030,000

Table 4-11. 3-Stage Conventional RO Preliminary, Planning Level Cost Estimation.

Parameter	Cost
Capital Costs	$ 19,600,000
Electrical Costs per Year	$ 1,478,000
Chemical Costs per Year (Antiscalant; Sulfuric Acid; NaOH for CIP; Citric Acid for CIP; Citric Acid for NaOH CIP neutralization; NaOH for Citric Acid CIP neutralization)	$ 179,000
Total O&M Costs per Year	$ 1,657,000

Table 4-12. UV/AOP Preliminary, Planning Level Cost Estimation.

Parameter	Cost
Capital Costs	$ 5,180,000
Electrical Costs per Year	$ 92,000
Chemical Costs per Year (hydrogen peroxide)	$ 38,000
Total O&M Costs per Year	$ 130,000

The post treatment costs are presented in Table 4-13.

Table 4-13. Post Treatment Preliminary, Planning Level Cost Estimation.

Parameter	Cost
Capital Costs	$ 580,000
Electrical Costs per Year	$ 11,000
Chemical Costs per Year (calcium chloride and caustic soda)	$ 423,000
Total O&M Costs per Year	$ 434,000

Cost estimation was also performed for the evaporation ponds (Table 4-14), using the 2-stage RO permeate flow. Note that if 3-stage conventional RO is used (0.45 mgd concentrate flow instead of 0.93 mgd), the capital per year will decrease correspondingly. The O&M costs for the evaporation ponds were estimated based on a 30-year life cycle of the liners, at which point the cells will be taken offline for the removal of all solids and replacement of the liner. Solids removal over a 20-year life cycle equates to around 2,900 cubic yard per year (cy/yr). Estimated prices for disposal yield a cost of about $240/cy.

Table 4-14. Evaporation Pond Preliminary, Planning Level Cost Estimation.

Parameter	Cost for 2-Stage RO
Capital Costs	$ 49,330,000
O&M Costs per Year	$ 710,000

Present worth calculations were performed to estimate the O&M costs in a 30-year period for the FAT technologies using 2-Stage RO and 3-Stage RO, and they are summarized in Table 4-15 and Table 4-16 below.

Table 4-15. Present Worth Comparison among the FAT Technologies Using the 2-Stage RO (Recovery at 81%).

	Capital	O&M (30 years)[1]	Total (30 years)
MF	$ 9,360,000	$ 7,960,000	$ 17,320,000
2-Stage RO (81% Recovery)	$ 16,800,000	$ 17,820,000	$ 34,620,000
UV/AOP	$ 5,180,000	$ 2,250,000	$ 7,430,000
Post-Treatment	$ 580,000	$ 7,510,000	$ 8,090,000
Evaporation Ponds	$ 49,330,000	$ 12,280,000	$ 61,610,000
Total for FAT (2-Stage RO)	$ 81,250,000	$ 47,820,000	$ 129,070,000

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

Table 4-16. Present Worth Comparison among the FAT Technologies Using the 3-Stage RO (Recovery at 90%).

	Capital	O&M (30 years)[1]	Total (30 years)
MF	$ 9,360,000	$ 7,960,000	$ 17,320,000
3-Stage RO (90% Recovery)	$ 19,600,000	$ 28,660,000	$ 48,260,000
UV/AOP	$ 5,180,000	$ 2,250,000	$ 7,430,000
Post-Treatment	$ 580,000	$ 7,510,000	$ 8,090,000
Evaporation Ponds	$ 49,330,000	$ 12,280,000	$ 61,610,000
Total for FAT (3-Stage RO)	$ 84,050,000	$ 58,660,000	$ 142,710,000

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

Conveyance

Conveyance facilities for Alternative 3 includes approximately 58,957 feet of pipeline, one (1) booster pump station consisting of seven (7) 200 hp booster pumps (6 active; 1 backup), three (3) deep injection wells (2 active; 1 backup), and two (2) down gradient monitoring wells.

Capital and O&M costs were estimated for the conveyance facilities associated with Alternative 3. Table 4-17 summarizes the findings.

Table 4-17. Preliminary, Planning Level Costs for Alternative 3 Conveyance Facilities.

Parameter	Cost
Capital Costs	$ 47,370,000
Total O&M Costs per Year	$ 2,233,600

Summary

A present worth calculation was performed for the tertiary treatment, full advanced treatment, and conveyance facilities in total, as presented in Table 4-18 and Table 4-19. Table 4-18 corresponds to FAT using 2-Stage RO, whereas Table 4-19 corresponds to FAT using 3-Stage RO. The total annual cost and cost per AF over 30 years are also provided. The cost per AF presented in Table 4-18 was estimated using the total 2-Stage RO effluent flow available for deep injection of 2,513 AFY in CY 2070. The cost per AF presented in Table 4-19 was estimated using the total 3-Stage RO effluent flow available for deep injection of 2,792 AFY in CY 2070.

Table 4-18. Present Worth, Annual Cost, and Cost Per AF for Alternative 3 (2-Stage RO).

	Capital	O&M (30 years)[1]	Total (30 years)
Total Tertiary Treatment (GMF & UV Disinfection)	$8,820,000	$ 2,590,000	$ 11,410,000
Total for FAT (2-Stage RO)	$ 81,250,000	$ 47,820,000	$ 129,070,000
Conveyance	$ 47,370,000	$ 38,630,000	$ 86,000,000
Total for Tertiary and FAT (2-Stage RO) with Subsurface Injection	$ 137,440,000	$ 89,040,000	$ 226,480,000
		Annual Cost =	**$ 7,549,000**
		Cost Per AF =	**$ 3,003.98**

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

Table 4-19. Present Worth, Annual Cost, and Cost Per AF for Alternative 3 (3-Stage RO).

	Capital	O&M (30 years)[1]	Total (30 years)
Total Tertiary Treatment (GMF & UV Disinfection)	$8,820,000	$ 2,590,000	$ 11,410,000
Total for FAT (3-Stage RO)	$ 84,050,000	$ 58,660,000	$ 142,710,000
Conveyance	$ 47,370,000	$ 38,630,000	$ 86,000,000
Total for Tertiary and FAT (3-Stage RO) with Subsurface Injection	$ 140,240,000	$ 99,880,000	$ 240,120,000
		Annual Cost =	**$ 8,004,000**
		Cost Per AF =	**$ 2,866.76**

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

4.4 – Non-Federal Funding Opportunities

The non-Federal funds used if Title XVI funds are available or in the event that Federal Funding is not provided, would include bond sales supported by IWVGA water extraction fees paid by water users and property assessments. IWVGA has the authority to set fees and assessments to fund its activities and projects. These would cover any additional capital costs. If Federal Funding were not provided, IWVGA will pursue State and Local funding sources to fund the capital cost of the Project. Such funding sources include the Proposition 218 State Revolving Fund (SRF) loan from the SWRCB and grants from DWR. In addition, IWVGA will also apply for loans under the U.S. Environmental Protection Agency's (EPA) Water Infrastructure Finance and Innovation Act (WIFIA) program to fund the Project. IWVGA will fund the operations, maintenance, and replacement costs through the fees and assessments discussed above. The financial capability of IWVGA is discussed further in Section 9.

5.0 – Economic Analysis

As previously discussed, groundwater is the sole source of water in the Basin. However, the Basin has been in a state of overdraft since the 1960s as a result of groundwater pumping exceeding the natural basin yield. In WY 2022, the estimated total groundwater production was 2.8 times the estimated sustainable yield of 7,650 AFY indicating overdraft conditions are continuing in the Basin. This significant reduction of groundwater in storage is directly related to land subsidence, chronic lowering of groundwater levels, and water quality degradation in the Basin. The economic impacts from these conditions include the need to drill deeper wells to replace wells that can no longer produce groundwater due to declining groundwater levels and relocating wells due to declining water quality. The Project will provide tertiary treatment and/or full advanced treatment of the available secondary effluent from the City WWTF. The treated recycled water, that otherwise would be discharged into evaporation ponds, can then be put to beneficial use, which will help alleviate overdraft conditions in the Basin. Each project alternative provides a reliable and drought resistant source of recycled water. In addition, the Project will help prevent dramatic increases to water rates that would impact the local economy due to decreased reliance of imported water and will indirectly benefit disadvantaged communities located in the Basin.

An economic analysis was conducted for this Feasibility Study to facilitate alternative comparisons. The economic analysis includes a life cycle cost analysis that accounts for the costs associated with the useful life of the Project components. It assumed that each project alternative has an overall project life of 30 years. The cost summary of each project alternative is provided in Table 5-1 below. Additional project cost details are provided in Section 4 and Appendix H.

Table 5-1. Present Worth, Annual Cost, and Cost Per AF Comparison for Alternatives 1-3.

Alternative	Capital	O&M (30 years)[1]	Total (30 years)	Total Annual Cost[2]	Cost Per AF
Alternative 1: Tertiary Treatment with Landscape Irrigation	$ 60,581,000	$ 18,680,000	$ 79,261,000	$ 2,642,000	$ 2,351.39
Alternative 2: Tertiary Treatment with Surface Spreading	$ 63,041,000	$ 37,640,000	$ 100,681,000	$ 3,356,000	$995.26
Alternative 3: Tertiary and FAT (2-Stage RO) with Subsurface Injection	$ 137,440,000	$ 89,040,000	$ 226,480,000	$ 7,549,000	$ 3,003.98
Alternative 3: Tertiary and FAT (3-Stage RO) with Subsurface Injection	$ 140,240,000	$ 99,880,000	$ 240,120,000	$ 8,004,000	$ 2,866.76

1 A Present Worth Calculation was performed to calculate the O&M cost using a discount rate of 4.0%, an annual percent inflation of 4.8%, and a capitalization period of 30 years.

2 Total Annual Cost is calculated by dividing the Total Cost by 30 years.

In the event that none of the Project alternatives could be implemented, the non-project alternative would be IWVGA's Imported Water Project as discussed in Appendix 5-B of the GSP (See Appendix I). The GSP assumed that 5,000 AFY of imported water would be required to reduce basin-wide reliance on groundwater and balance annual groundwater production with annual recharge. The estimate of the required quantity of imported water needed assumed the Project would be implemented. Additional imported water will be needed if the Project is not implemented. The Imported Water Project includes a proposed approximately 50-mile-long pipeline and associated water conveyance facilities to bring in water supplies from outside of the Basin. The imported water pipeline would convey treated potable water from a point on the California City

Feeder in California City to a connection point with IWVWD in or around the City of Ridgecrest. The California City Feeder is owned and operated by AVEK.

As detailed in Appendix 5-B of the GSP, based on a 30-year cost amortization at a 4% interest rate, the total annual cost for the Imported Water Project with AVEK is approximately $21,231,000. Assuming an annual demand of 5,000 AFY, the total cost per AF of imported water is estimated to be approximately $4,250 per AF. Further details regarding the cost estimation for the Imported Water Project are included in Appendix 5-B of the GSP (see Appendix I).

The cost per AF for the non-project alternative is significantly higher than any of the three (3) project alternatives discussed in this Feasibility Study. It is important to note that the primary source of imported water will be water from Northern California that must be transported through the Delta. As discussed in Section 2, the Delta is the hub of California’s two largest surface water delivery projects, California’s State Water Project and the federal Central Valley Project. Both of these surface water delivery projects face significant challenges exporting water from the Delta, including limitations on the rate of exporting of water to protect endangered fish in the Delta, lawsuits regarding protection and restoration of the ecosystem of the Delta, and an aging levee system that protects farms and cities from flooding. The Project will reduce the amount of water that will need to be imported from the Delta to the Basin.

Of the three (3) project alternatives, Alternative 1 and Alternative 2 have the lowest cost per AF at $2,351.39 per AF and $995.26 per AF, respectively. Because the Basin continues to be overdrafted, it is imperative that all of the available secondary effluent be put to beneficial use to achieve sustainable management of the Basin. Since the landscape water demands are only 1,124 AFY, Alternative 1 leaves 2,388 AFY of unused secondary treated effluent that would be disposed of in evaporation ponds. Therefore, Alternative 1 does not meet the goals of the Project.

Alternative 2 is anticipated to utilize all of the total secondary effluent available for beneficial use from the City WWTF (e.g. 3,512 AFY). However, there are issues regarding Alternative 2 that may affect the feasibility of the Project. As discussed in Section 4.3.3.2, surface spreading requires additional evaluation regarding identification of diluent water sources to meet the TOC requirement. Regarding TOC, there is limited water quality data available. The initial maximum allowable TOC concentration for surface water spreading projects is 2.5 mg/L. The estimated TOC concentration downstream of the tertiary filtration and disinfection is 7 mg/L. This exceeds the maximum allowed TOC concentration of 2.5 mg/L. The Project may be able to meet the TOC requirement if the Project can receive credit for TOC removal that naturally occurs as the recycled water travels through the soil beneath the spreading basins to the groundwater table and sufficient dilution from subsurface flow can be demonstrated. In addition, there is significant uncertainty as to where and how water recharged through surface spreading will reach the aquifers used for water supply due to the hydrogeology of the Basin. Therefore, Alternative 2 is not considered a viable option. Further details regarding the hydrogeological conditions of the Basin as it pertains to Alternative 2 are discussed in Section 6.

Alternative 3 is the highest cost Project alternative due to the need for advanced treatment facilities in addition to the tertiary treatment facilities that would be used in Alternative 1 and Alternative 2. Regardless of whether Alternative 3 utilizes 2-Stage RO or 3-Stage RO, Alternative 3 is expected to produce higher quality recycled water that will most likely remain in compliance with future water quality standards and regulations. In addition, the subsurface injection method for recharging the Basin included in Alternative 3 is feasible, whereas it is uncertain if the surface spreading method to recharge the Basin included in Alternative 2 is feasible due to the hydrogeological conditions of the Basin (see Section 6). Therefore, Alternative 3 is the most feasible Project alternative to achieve the goals of the Project, as it would provide the highest quality recycled water and it will utilize all the available secondary treated effluent to effectively replenish the Basin.

6.0 – Selection of Proposed Alternative

6.1 – Review of Alternatives

6.1.1 – Alternative 1: Tertiary Treatment and Landscape Irrigation

The IWVGA's GSP identified existing landscaped areas that may be irrigated with recycled water and estimated a total irrigation demand of approximately 1,124 AFY of recycled water. The estimated landscape irrigation water demands do not fully utilize the 2,081 AFY of secondary treated wastewater that is projected to be available in 2026 nor would it utilize the 3,512 AFY of secondary treated wastewater that is projected to be available from the City's new WWTF in 2070 (see Section 3). Consequently, Alternative 1 is considered unfavorable because of its inability to maximize the use of "new water".

6.1.2 – Alternative 2: Tertiary Treatment and Surface Spreading

Groundwater in the Basin is present in a dual-aquifer system – commonly referred to as the shallow aquifer and the deep (principal) aquifer – defined by three water-bearing zones, characterized from the shallowest to deepest as the shallow hydrogeologic zone, and the deep hydrogeologic zone. The occurrence of groundwater in the shallow hydrogeologic zone is limited to the eastern and northern portions of the Indian Wells Valley, where it occurs under unconfined conditions on top of low permeability lacustrine clay layers. The lacustrine clay layers separate the shallow hydrogeologic zone from the upper intermediate hydrogeologic zone and act as a barrier between the shallow and deep aquifers. As a result, groundwater flow between water-bearing zones appears to be minimal, and artificial sources of recharge (e.g. aqueduct and pipe leakage, treated wastewater seepage, and infiltration from irrigation water) have a greater influence on recharge to the shallow hydrogeologic zone than to the intermediate and deep hydrogeologic zones. The shallow aquifer also has generally poorer water quality than the deep aquifer, with concentrations of TDS, arsenic, chloride, and sulfate commonly exceeding primary and secondary drinking water standards[6].

In early 2021, the IWVGA began a reconnaissance-level investigation to identify potentially viable locations for surface spreading in the Basin based on a review of land ownership, geology, depth to groundwater, and prior literature and technical studies. The investigation made findings for a preferred surface spreading site but indicated that additional hydrogeologic field investigations and pilot testing would be required in the future to assess physical viability for surface spreading. A copy of the investigation is provided in Appendix J. At its meeting on January 6, 2022, IWVGA Staff presented these findings to IWVGA's TAC, and based on information presented in the investigation, the TAC members concluded that surface spreading is not currently viable in the Basin due to significant uncertainty as to where and how the water recharged through spreading will percolate into the aquifers that are used for pumping. Consequently, Alternative 2 is considered infeasible and unfavorable.

6.1.3 – Alternative 3: Tertiary and Advanced Treatment and Deep Injection

Alternative 3 provides the following benefits:

- Meets the goal of the Project to develop a new local, reliable source of water.
- Allows all of the available treated wastewater to be put to beneficial use.
- Contributes to reducing the ongoing overdraft of the Basin by recharging a new source of water.
- Reduces the amount of water that will need to be imported from the Delta to the Basin.
- Reduces the required capacity of the proposed facilities to import water from the Delta to the Basin.
- Is more economical than the proposed Imported Water Project

[6] TriEcoTt – a joint venture of TriEco LLC and Tetra Tech EM Inc., 2013. Final Technical Justification for Beneficial Use Changes for Groundwater in Salt Wells Valley and Shallow Groundwater in Eastern Indian Wells Valley. Prepared for the Department of the Navy. February 2013.

6.2 – Alternative Selection

As previously stated, Alternative 1 is considered unfavorable because of its inability to maximize the use of “new water”, and Alternative 2 is considered infeasible and unfavorable due to the significant uncertainty as to where and how the water recharged through spreading will percolate into the aquifers that are used for pumping. Based on these disadvantages and the benefits provided by Alternative 3, discussed above, Alternative 3 has been determined to be the most feasible and favorable alternative for recycled water use.

7.0 – Environmental Consideration and Potential Effects

7.1 – Environmental Compliance

The proposed Project is subject to federal and state environmental regulations, specifically the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). IWVGA will prepare an Initial Environmental Study (Initial Study) for the Project, in accordance with CEQA, to address and analyze the potential impacts discussed in this Feasibility Study. Similarly, either an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) for the proposed Project will be prepared in compliance with NEPA.

7.2 – Environmental Impacts

The potential environmental impacts for the proposed pipeline, injections wells, monitoring wells, booster pump stations, and treatment facilities are divided into the following categories discussed below: Land Use, Aesthetics and Cultural Resources, Air Quality, Hazardous Materials, Aquatic Resources, and Water Quality. In compliance with the CEQA, an Initial Study for the Project will be completed in the future to evaluate the significance of these potential environmental impacts. The results of the Initial Study will determine if an Environmental Impact Report (EIR) is necessary. Similarly, either an EA or an EIS for the proposed Project will be prepared in compliance with NEPA.

7.2.1 – Land Use

At this time a final WRP site location has not been selected for the proposed Project, but for the purpose of this Feasibility Study, a site location for the WRP, including conveyance facilities, is provided in Figure 4-4 for the selected alternative discussed in Section 6 (i.e, Alternative 3). The proposed WRP site location is suitable for the proposed treatment facilities needed for Alternative 3. The proposed WRP site, including conveyance facilities, is located in seismically active areas identified by the California Geological

Survey of the Department of Conservation. Therefore, the project site is potentially subject to ground shaking and other seismic related events such as landslides and liquefaction and will be designed to meet current California standards to withstand such events.

The proposed Project is not anticipated to make significant changes to the geology and soil environment in the study area. During construction, there is greater risk of topsoil erosion, however proper construction practices should minimize impacts.

The environmental review process will evaluate the significance of the potential impacts on land use including seismic stability, soil conditions, and land use practices.

7.2.2 – Aesthetics & Cultural Resources

The proposed Project is not anticipated to have a significant impact on aesthetics and cultural resources. There are no known existing scenic resources or historic sites in the study area that will be obstructed or damaged, During the construction phase, there will be slightly reduced visibility, increased noise levels, and traffic interruptions that may be a nuisance to residents; however, once operational, the Project should have only a minor visual and audible footprint that should not be obtrusive to the public. Based on preliminary review of previous cultural resource studies conducted in the study area, there are no known existing cultural resource sites at the proposed facility location. In the unlikely event that a previously unknown cultural resource is discovered during Project development, an appropriate expert would be consulted before proceeding. During the environmental review process, the proposed Project's potential impacts to aesthetics and cultural resources will be evaluated in more detail, including potential impacts to paleontological, archaeological, scientific, and Native American cultural resources.

7.2.3 – Biological Resources

IWVGA does not anticipate that the proposed Project will negatively impact the biological resources in the study area. During the environmental review process, the proposed Project's potential impacts to biological resources will be evaluated in more detail.

7.2.4 – Air Quality

The proposed Project is located within the Mojave Desert Air Basin (MDAB) region and air quality is regulated by the East Kern Air Pollution Control District (EKAPCD). Project construction may result in pollutant emissions from construction equipment and vehicles. Mitigation may be necessary to maintain emissions levels within regulatory limits. Once operational, the proposed Project should not emit toxic or hazardous pollutants and should not violate EKAPCD's existing Air Quality Plans.

7.2.5 – Hazardous Materials

The proposed conveyance facilities for the Project are not anticipated to pose a risk of contamination with hazardous materials. With the exception of vehicle and machinery fuel required for construction and maintenance, these elements do not involve the use or transport of hazardous materials.

The proposed FAT facilities in Alternative 3 require storage and use of potentially hazardous materials for the treatment processes. Additionally, the RO treatment yields a brine waste product that will need to be properly discharged as to not negatively impact the environment. All necessary and prudent precautions will be implemented to prevent any contamination or hazardous situation. Associated personnel will follow Occupational Safety and Health Administration (OSHA) standards and practices during construction and operations of the Project.

The environmental impacts of the proposed Project resulting from hazardous materials will be addressed during the environmental review process.

7.2.6 – Aquatic Resources

The proposed Project is not anticipated to negatively impact aquatic resources in the study area. The environmental impacts on aquatic resources resulting from the use of recycled water will be addressed during the environmental review process.

7.2.7 – Water Quality

The WRP tertiary treated, and full advanced treated recycled water are anticipated to meet current Title 22 water quality requirements as established by the State Water Resources Control Board, Division of Drinking Water (DDW). In addition to Title 22 requirements, water quality is locally governed by the Lahontan Regional Board as described in Chapter 3 of the Lahontan Basin Plan (See Appendix G). The Lahontan Regional Board has established groundwater basin objectives to meet secondary water quality standards, including standards for sulfate, chloride, boron, and TDS. The results from anticipated pilot testing of the WRP treatment facilities will be used to determine anticipated groundwater quality after groundwater replenishment. The environmental impacts on water quality resulting from the use of recycled water will be addressed in more detail during the environmental review process.

8.0 – Legal and Institutional Requirements

8.1 – Interagency Agreements

As previously discussed in Section 3, IWVGA entered into an agreement with the City for the option to purchase recycled water in November 2020. Under the agreement, the City is obliged to commit 325 AFY of secondary-treated effluent from the City WWTF to the NAWS golf course and 200 AFY for maintenance of the local Tui Chub habitat. These commitments take priority over any potential recycled water uses including the recycled water alternatives explored in this Feasibility Study. The IWVGA has the option to purchase the available secondary effluent remaining after the City meets these obligations.

8.2 – General Regulatory Requirements

In general, statewide water recycling regulatory criteria are codified in Title 22 CCR, Division 4, Chapter 3. A portion of the regulatory criteria for indirect potable reuse projects are codified in Title 22 CCR, Division 4, Chapter 17, Article 9. In addition, cross-connection control regulations that address the protection of public water supplies from cross-connection with non-potable systems are codified in Title 17 CCR, Subchapter 1, Group 4. Additional requirements are described in SWRCB's adopted Water Quality Control Policy for Recycled Water (Recycled Water Policy), which was adopted in 2009 to encourage the safe use of recycled in a manner that implements state and federal water quality laws and also protects public health and the environment. For the selected alternative presented in Section 6 (i.e., Alternative 3), the IWVGA has identified the relevant regulatory, permitting, environmental, and legal compliance requirements from the CCR and the Recycled Water Policy.

8.2.1 – Lahontan Basin Plan Objectives

The Lahontan Basin Plan[7] designates beneficial uses for surface water and groundwater throughout the Lahontan Regional Board's jurisdiction and also establishes narrative and numeric water quality objectives that must be attained or maintained to protect existing and potential beneficial uses. For groundwater basins designated with municipal and domestic water supply beneficial uses (i.e. the Basin, although a portion of the Basin was de-designated for those uses), the Lahontan Basin Plan establishes regional water quality objectives for bacteria, general chemical constituents with maximum contaminant levels, radioactivity, and taste & odor for the Lahontan Region; no specific water quality standards for groundwater are established for the Basin. These regional water quality objectives are listed below:

- Coliform Bacteria
  - The median concentration of coliform organisms over any seven-day period shall be less than 1.1 / 100 mL.
- Chemical Constituents
  - In general, ground waters shall not contain concentrations of chemical constituents that adversely affect the beneficial uses. The concentration of certain chemical constituents shall not exceed the primary or secondary MCLs based upon the following drinking water standards specified in Title 22 of the CCR:
    - Table 64431-A (Inorganic Chemicals)
    - Table 64431-B (Fluoride)
    - Table 64444-A (Organic Chemicals)
    - Table 64449-A (Secondary Maximum Contaminant Levels – Consumer Acceptance Limits)
    - Table 64449-B (Secondary Maximum Contaminant Levels – Ranges)

[7] California Regional Water Quality Control Board Lahontan Region. *Water Quality Control Plan for the Lahontan Region, North and South Basins*. With January 2016 Amendments.

- Radioactivity
    - The concentrations of radionuclides shall not exceed the limits specified in Table 4 of § 64443 of Title 22 of the CCR.
- Taste and Odor
    - Ground water shall not contain taste or odor-producing substances in concentrations that cause nuisance or that adversely affect beneficial uses. At a minimum, concentrations shall not exceed secondary MCLs specified in Table 64449-A and Table 64449-B of Title 22 of the CCR.

The future alternative beneficial use(s) of recycled water in the Basin shall not adversely affect the Basin's existing water quality conditions and shall not cause the Basin (at a local level or at a Basin-wide level) to fall out of compliance with the regional water quality objectives established in the Lahontan Basin Plan.

8.2.2 – Anti-degradation Policy

In 1968, the SWRCB adopted the Statement of Policy with Respect to Maintaining High Quality Waters of California (Anti-degradation Policy), which is documented in SWRCB Resolution No. 68-16. The Anti-degradation Policy generally requires that high-quality water bodies (including groundwater) be maintained to the maximum extent possible. The Anti-degradation Policy allows for lowering of existing high-quality water only if the change is consistent with maximum benefit to the people of the state, does not unreasonably affect present and potential beneficial uses, and does not result in water quality lower than applicable standards (i.e. primary and secondary MCLs).

As pertaining to the potential recycled water alternatives in the Basin, the Anti-degradation Policy would require in general that recycled water generated at the City's WWTF receive sufficient treatment such that the Basin's local and overall quality shall not degrade upon receiving the recycled water through irrigation percolation, replenishment, septic tank runoff, etc.

8.2.3 – Salt & Nutrient Management Plan

The Recycled Water Policy established by the SWRCB requires that a salt and nutrient management plan (SNMP) be prepared for each groundwater basin in California. SNMPs characterize basin-wide salt and nutrient loadings to demonstrate the preservation or attainment of the relevant basin water quality objectives. A SNMP for the Basin was approved by the Lahontan Regional Board in 2018. The SNMP employed a GIS-based model to estimate loading of salts (TDS) and nutrients (i.e. nitrate) in the Basin using land use characteristics and existing water use practices. The SNMP concluded that the Basin as a whole has assimilative capacity for salts and nitrate, though localized salinity issues in specific portions of the Basin were not addressed.

The SWRCB's Recycled Water Policy requires that SNMPs include an anti-degradation analysis demonstrating that existing and reasonably foreseeable future projects (including beneficial uses of recycled water) will cumulatively satisfy the requirements of the Anti-degradation Policy. The IWVGA (or other appropriate agency) in the Basin will need to update the Basin's current SNMP to prepare an updated salt and nutrient balance that accounts for loadings resulting from the selected recycled water alternative.

8.2.4 – CEQA/NEPA Environmental Compliance

As discussed in Section 7, the proposed Project is subject to federal and state environmental regulations, specifically NEPA and CEQA. IWVGA will prepare an Initial Study for the Project, in accordance with CEQA, to address and analyze the potential impacts discussed in this Feasibility Study. Similarly, either an EA or an EIS for the proposed Project will be prepared in compliance with NEPA.

8.3 – Requirements for Indirect Potable Reuse – Subsurface Applications (Alternative 3)

As discussed in Section Title 22, Division 4, Chapter 3, Article 5.2 of the CCR contains a set of regulations for GRRPs involving groundwater recharge with recycled water via subsurface applications such as deep injection wells. Recycled water used for subsurface applications must not only meet disinfected tertiary recycled water quality but also undergo advanced treatment through reverse osmosis and advanced oxidation. DDW has established the following regulatory criteria that must be met for a GRRP using subsurface applications to demonstrate regulatory compliance.

8.3.1 – Pathogenic Microorganism Control

Similar to GRRPs using surface applications, GRRPs using subsurface applications must be designed and operated such that the recycled municipal wastewater used as recharge water receives treatment that achieves at least 12-log enteric virus reduction, 10-log Giardia cyst reduction, and 10-log Cryptosporidium oocyst reduction. The treatment train shall consist of at least three separate treatment processes. For each pathogen (i.e. virus, Giardia cyst, or Cryptosporidium oocyst), a separate treatment process may be credited with no more than 6-log reduction, with at least three processes each being credited with no less than 1-log reduction. Additional log virus reduction credits may be granted based on the amount of retention time demonstrated by the GRRP.

8.3.2 – Underground Retention Time

Similar to GRRPs using surface applications, underground retention time in an aquifer serves two purposes: (1) provide time to respond to potential system failures; and (2) allow for reduction of microbial and chemical contaminants. For each month of retention time underground, the GRRP can be credited with an additional 1-log virus reduction. A minimum retention time of 2 months is required to allow sufficient response time to identify treatment failures and implement appropriate corrective measures, but the actual retention time must be justified and submitted to the SWRCB for approval. For the purpose of siting a GRRP location during project planning, underground retention time can be determined using either analytical modeling, numerical modeling, or a tracer study. If numerical modeling is employed to estimate underground retention time, then the GRRP will be credited with only half the underground residence time as shown by the model. For example, if numerical modeling results indicate 4 months of underground retention time, then a GRRP will be credited for only 2 months. If a tracer study using an added tracer is performed to determine underground retention time, then a GRRP will be credited for the same time as shown by the tracer study.

8.3.3 – Response Retention Time

The recycled water applied by a GRRP must be retained underground for a period of time necessary to allow for sufficient response time to identify treatment failures and implement appropriate corrective actions. During planning, the response retention time is determined based on the method used to establish underground retention time. If numerical groundwater modeling is used for establishing underground retention time, then the GRRP will be credited with only half the underground residence time as shown by the model. If a tracer study is performed using an added tracer, then the response retention time will be the same as the underground retention time determined by the tracer study.

8.3.4 – Recycled Water Contribution

For GRRPs using subsurface applications, the initial maximum RWC may be up to 100% but will be based on, though not limited to, DDW's review of the Title 22 Engineering Report, information obtained from public hearings, and demonstration that the treatment processes will reliably achieve TOC concentrations no greater than 0.5 mg/L. The RWC may be increased from the initial maximum if the RWC does not exceed the quotient of 0.5 mg/L divided by the maximum TOC concentration of the recycled water before application. Hence, if the TOC concentration is 1 mg/L, then the RWC cannot be greater than 0.5 mg/L divided by 1 mg/L, or 50%.

8.3.5 – Permitting Requirements

Similar to GRRPs using surface applications, as required by the CCR, various planning-phase documents must be submitted to and approved by the SWRCB, DDW, and/or the Lahontan Regional Board for GRRPs using subsurface applications. The submittals may include a Title 22 Engineering Report, a Section 1211 Petition for changes to permitted discharge locations, a Section 1602 Lake and Streambed Alteration Agreement, a Background Water Quality Monitoring Program, an Operation Optimization Plan, and a Report of Waste Discharge Form for issuance of WDRs. These documents are briefly summarized below.

The Title 22 Engineering Report provides an overall description of the recycled water system/uses, the means for compliance with CCR monitoring requirements and regulatory criteria (including a Monitoring Plan), and a contingency plan which assures that no untreated or inadequately treated wastewater will be delivered for beneficial use(s). The Title 22 Engineering Report must also include a hydrogeologic assessment of the GRRP's setting. The hydrogeologic assessment must include the following items:

- Qualifications of individual(s) preparing the assessment
- General description of the geologic and hydrogeologic setting of groundwater basins that will potentially be affected by the GRRP
- Stratigraphic description of aquifers that will potentially be affected by the GRRP including composition, extent, and physical properties
- Description of seasonal impacts to potentially affected aquifers (based on 4 rounds of consecutive quarterly monitoring)
- Existing hydrogeology and anticipated hydrogeology as a result of the GRRP
- Maps showing quarterly groundwater elevation contours, vector flow directions and hydraulic gradients

A Section 1211 Petition is submitted by the owner of a WWTF to the SWRCB to document a diversion of water away from a previously permitted discharge point that will experience a decrease in flow. A Section 1211 Petition may be required for the IWVGA's recycled water project because the use of recycled water in the Basin may decrease existing discharges to evaporation/percolation ponds that provide seepage flow to the local Tui Chub habitat. Submittal of the Section 1211 Petition is typically followed by a public notice issuance, protest period, public hearing or field investigation, and SWRCB Order.

The California Department of Fish and Wildlife (CDFW) must be notified if a recycled water project involves activities that may divert or obstruct natural surface water flows; change or use any material from a surface water body; or dispose of materials into any surface water body. Section 1602 Lake and Streambed Alteration Agreement must be submitted to CDFW if a recycled water project activity substantially adversely affects fish and wildlife (i.e. Tui Chub) resources.

A Background Water Quality Monitoring Plan (BWQMP) must be submitted to DDW and the Lahontan Regional Board for review and approval prior to GRRP background water quality monitoring. The BWQMP would document the methodology for establishing baseline Basin water quality conditions, particularly in the vicinity of the GRRP, as well as estimated budgets and schedules for implementing the background water quality monitoring. Potential monitoring items that may be addressed in the BWQMP include streamflow and water quality of surface water bodies; water levels and water quality at existing production and monitoring wells; locations for new monitoring wells to aid in GRRP monitoring; and soil conditions in the vicinity of the replenishment location.

An Operation Optimization Plan must be submitted to DDW for review and approval prior to GRRP start-up. The Operation Optimization Plan identifies and describes the operation, maintenance, analytical methods, and monitoring necessary for the GRRP to meet the relevant regulatory requirements for GRRPs using subsurface applications, and the reporting of monitoring results to DDW and the Regional Board.

If a GRRP using subsurface applications is pursued as a beneficial use of recycled water, the City would need to apply for new WDRs that would establish limits on pollutant concentrations for the purpose of protecting public health as pertaining to groundwater replenishment. The City would need to submit a Report of Waste Discharge Form (Form 200) and the necessary supplemental information with the Lahontan Regional Board.

9.0 – Financial Capability of Sponsor

IWVGA is the non-Federal project sponsor of the proposed Project, and as such, is responsible for the implementation and funding of the proposed Project.

9.1 – Project Schedule

The proposed Project is ready for the next stages of implementation. Grant funding is being pursued for preliminary design, environmental review, and permitting for the proposed Project, including preparation of a DDW required Title 22 Engineering Report. It is anticipated these activities will begin in 2023 and may be completed in 2025. Construction on the proposed Project is anticipated to begin by 2026.

9.2 – Funding Sources and Capability

The proposed Project consists of design and construction of tertiary treatment facilities and advanced treatment facilities, injection wells, and conveyance facilities. The associated costs are discussed in Section 4 and summarized in Section 5. The IWVGA is seeking Title XVI funding for a portion of the capital costs. If Title XVI funds are received, remaining capital costs would be funded through State and Local funding and bond sales supported by IWVGA water extraction fees paid by water users and property assessments, of which IWVGA has the authority to set fees and assessments to fund its activities and projects. If Title XVI funds were not available, IWVGA will pursue the federal EPA WIFIA loan, mentioned in Section 4.4, to fund the capital costs for the proposed Project. Any additional costs will be funded through bond sales supported by IWVGA fees and assessments. If Federal Funding were not available, IWVGA would pursue State and Local funding sources such as the Proposition 218 SRF Loan from the SWRCB and use bond sales if needed.

10.0 – Research Needs

The project could benefit from additional research to fill data gaps related to each of the three alternatives. The secondary effluent goals are driven by regulations and include effluent BOD, TSS, and total nitrogen (TN). Meeting these effluent goals for these constituents in secondary effluent may cause difficulty in meeting turbidity regulatory requirements for tertiary treated water, noting that there is no effluent turbidity regulatory requirement for secondary effluent. This challenge applies to all three alternatives given that all involve tertiary filtration and disinfection.

There are additional data gaps that affect the individual alternatives. A source of diluent water is a key driver for the spreading option, as it will not be possible to spread reuse water that exceeds the maximum TOC concentration of 2.5 mg/L. The feed water quality is a key component for the FAT train required for the deep injection option. Some data can be collected now because it does not change significantly through upstream treatment. This would include mineral analysis for RO. Because the FAT process is complex and because public perception is a key component, most injection projects construct a demonstration facility and operate it to mitigate potential challenges with water quality and to assuage any public perception concerns. The objectives for the research are to mitigate data gaps associated with the proposed treatment alternatives and to carry out research that will address public perception challenges from a treatment perspective through operation of a demonstration facility for deep injection. The basis for BOR participation in the research is its necessity to assure success of the BOR-funded full-scale project under WaterSMART.

The timeframe for the research is as follows. Data should be collected quarterly for one year to account for seasonal variations. Some data can be collected immediately (e.g., groundwater mineral analysis) while key data associated with the secondary effluent (TSS, BOD, TN) should not be collected until after the new WWTF is constructed and operational. It should be assumed the demonstration project will last a minimum of three years, with one year to design and build the demonstration facility and two years of operation to accomplish the objectives for the facility.