DRAFT TASK 2B-2 REPORT – ASSESSMENT OF ALTERNATIVES FOR COMPLIANCE OPTIONS USING THE GROUNDWATER/SURFACE WATER INTERACTION MODEL

Upper Santa Clara River Chloride TMDL Collaborative Process

Upper Santa Clara River Valley

Los Angeles and Ventura Counties, California

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EXECUTIVE SUMMARY

This report identifies potential alternatives to achieve compliance with various water quality objectives (WQOs) within the Upper Santa Clara River (USCR) watershed and describes results of the assessment of those alternatives utilizing the numerical Groundwater/Surface Water Interaction Model (the GSWI model, or GSWIM). This work was performed as part of the Groundwater/Surface Water Interaction Model Study that is being jointly conducted by the Santa Clarita Valley Sanitation District (SCVSD, or the District) and the Los Angeles Regional Water Quality Control Board (Regional Board) as part of the USCR Chloride Total Maximum Daily Load (TMDL). This report also satisfies the requirements of Task 9 of the USCR Chloride TMDL Implementation Schedule requiring the SCVSD to develop a report on conceptual compliance measures to meet different chloride WQOs and final waste load allocations.

This report presents the potential compliance options to the chloride TMDL issues in the SCR and the results of the assessment of those alternatives, utilizing the GSWIM. The GSWI numerical model was developed by CH2M Hill and HydroGeoLogic, Inc (HGL) (2008) for a portion of the USCR watershed to evaluate fate and transport of chloride in surface water and groundwater basins underlying Reaches 4, 5, 6 and 7 (as designated by the Regional Board) of the SCR in accordance with the chloride TMDL collaborative process. The compliance alternatives evaluated as part of this effort include:

1) Advanced Treatment and Brine Disposal;

2) Minimal Advanced Treatment / Zero Discharge and Secondary Effluent Pipeline and Outfall;

3) Alternate Water Reclamation Plant (WRP) Discharge Location; and

4) Alternative Water Resource Management (AWRM)

As required in Task 9 of the Chloride TMDL process, the report evaluated these potential chloride control measures in terms of complying with existing and revised WQOs. The Advanced Treatment and Brine Disposal alternative, the Minimal Advanced Treatment / Zero Discharge and Secondary Effluent Pipeline and Outfall alternatives, and the Alternate WRP

Discharge Location alternative were evaluated for compliance with the existing WQOs. The results of this evaluation are summarized in Table E-1.

As shown on the table, none of the alternatives were predicted to achieve compliance with the 100 mg/L WQO for chloride at all times and at all locations. Because compliance with the existing WQO was not possible at all times and all locations in the SCR receiving waters, revisions to these WQOs were considered that would still be protective of all beneficial uses in Reaches 4B, 5 and 6. An AWRM alternative was jointly developed by various TMDL stakeholders, which will achieve compliance with proposed Site-Specific Objectives (SSOs) and provide for a diverse mix of water quality and water supply benefits. The key elements of the AWRM alternative include:

- implementing measures to reduce chloride in the recycled water from the District's WRPs;
- constructing advanced treatment for a portion of the recycled water from the District's Valencia WRP;
- procuring local groundwater for release to the SCR as supplemental water during drought periods;
- constructing water supply facilities in Ventura County to facilitate export of existing salts in groundwater;
- providing alternative water supply to protect salt-sensitive agricultural beneficial uses of the SCR;
- supporting the expansion of recycled water uses within the Santa Clarita Valley; and
- revising surface water and groundwater WQOs to support all of these elements.

The AWRM alternative provides for a regional watershed solution for chloride as an alternative to compliance with the existing 100 mg/L WQO, considers the use of SSOs and water resource management facilities that would allow for the full protection of all beneficial uses, while simultaneously providing a more feasible compliance solution, maintains a chloride balance in the USCR Watershed, and provides salt export and water supply benefits to Los Angeles and

Ventura County stakeholders. The proposed SSOs are summarized on Figures E-1 and E-2. The results of the evaluation for the AWRM compliance with proposed SSOs are summarized in Table E-2. As shown on the table, the GWSWIM analysis predicts that the AWRM alternative provides for compliance with the proposed SSOs for chloride under both drought and non-drought conditions.

TABLE E-1

SUMMARY OF COMPLIANCE ALTERNATIVE ATTAINMENT FREQUENCIES

Upper Santa Clara River Chloride TMDL

Santa Clara River Valley, California

Compliance Alternative	Surface Water at Blue Cut		East Piru Basin Groundwater			West Piru Basin Groundwater		
	Surface Water WQO 100 mg/L	LRE Threshold 120 mg/L	Surface Water WQO 100 mg/L	LRE Threshold 120 mg/L	Groundwater WQO 200 mg/L	Surface Water WQO 100 mg/L	LRE Threshold 120 mg/L	Groundwater WQO 100 mg/L
Scenario 1g_UV	41.2	77.8	43.5	76.3	100.0	100.0	100.0	100.0
Advanced Treatment - 1a	66.8	99.0	55.0	99.6	100.0	100.0	100.0	100.0
Advanced Treatment - 2a	66.4	100.0	54.2	99.6	100.0	100.0	100.0	100.0
Advanced Treatment - 3a	66.1	100.0	55.3	99.8	100.0	100.0	100.0	100.0
Mimimal Discharge	65.5	87.8	62.1	98.8	100.0	100.0	100.0	100.0
Zero Discharge	63.8	80.7	68.3	97.5	100.0	100.0	100.0	100.0
Alternate WRP Location	48.9	76.0	46.1	80.5	100.0	100.0	100.0	100.0

Note: Value represents percentage of days during simulation period that chloride is predicted to be equal to or less than the WQO concentration

TABLE E-2

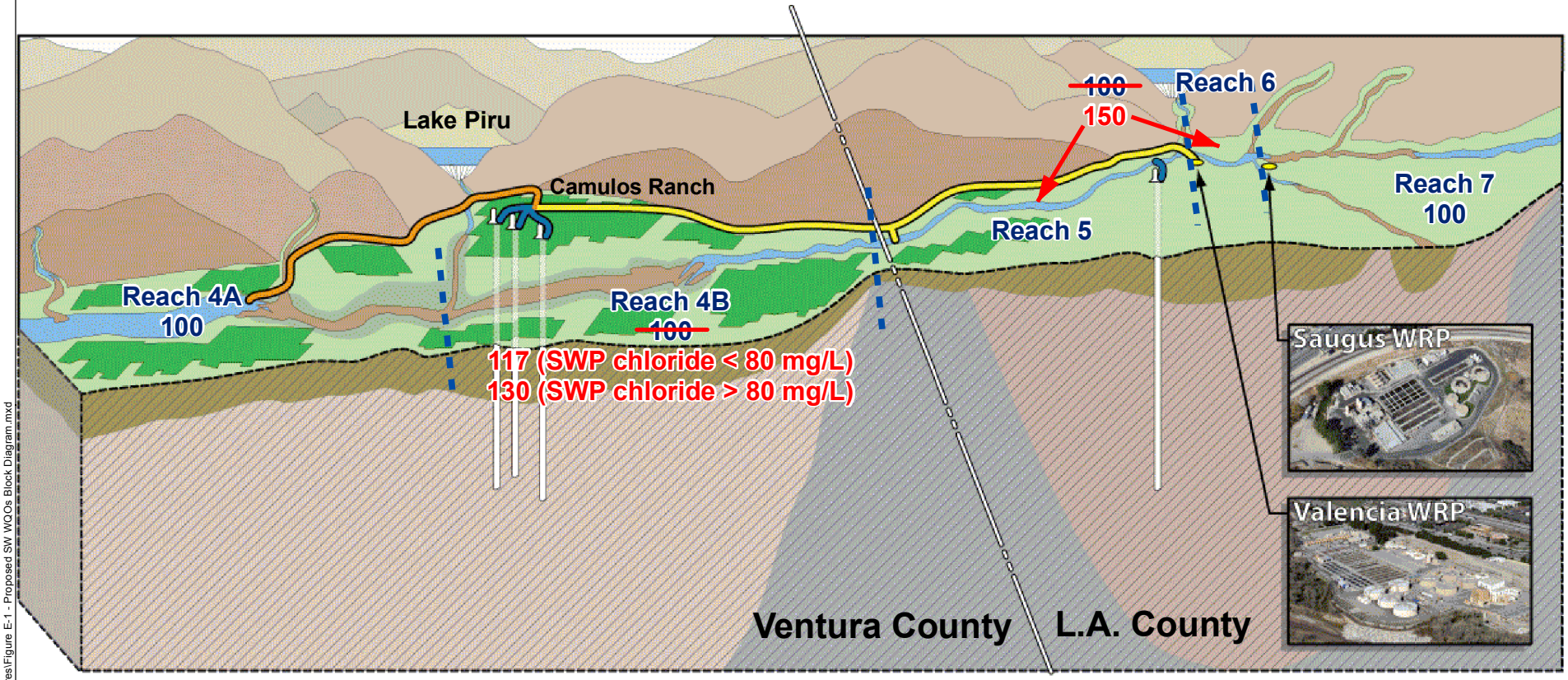
SUMMARY OF SITE SPECIFIC OBJECTIVE ATTAINMENT FREQUENCIES FOR THE AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL

Santa Clara River Valley, California

Compliance Alternative	Reach 4B (at Blue Cut)		Reach 5		Reach 6	
	Surface Water WQO During Non-Drought 117 mg/L	Suface Water WQO During Drought 130 mg/L	Surface Water WQO 150 mg/L	Groundwater WQO 150 mg/L	Surface Water WQO 150 mg/L	Groundwater WQO 150 mg/L
AWRM Alternative	99.9	99.2	98.3-99.7	100.0	98.6 - 99.7	100.0

Note: Value represents percentage of days during simulation period that chloride is predicted to be equal to or less than the WQO concentration



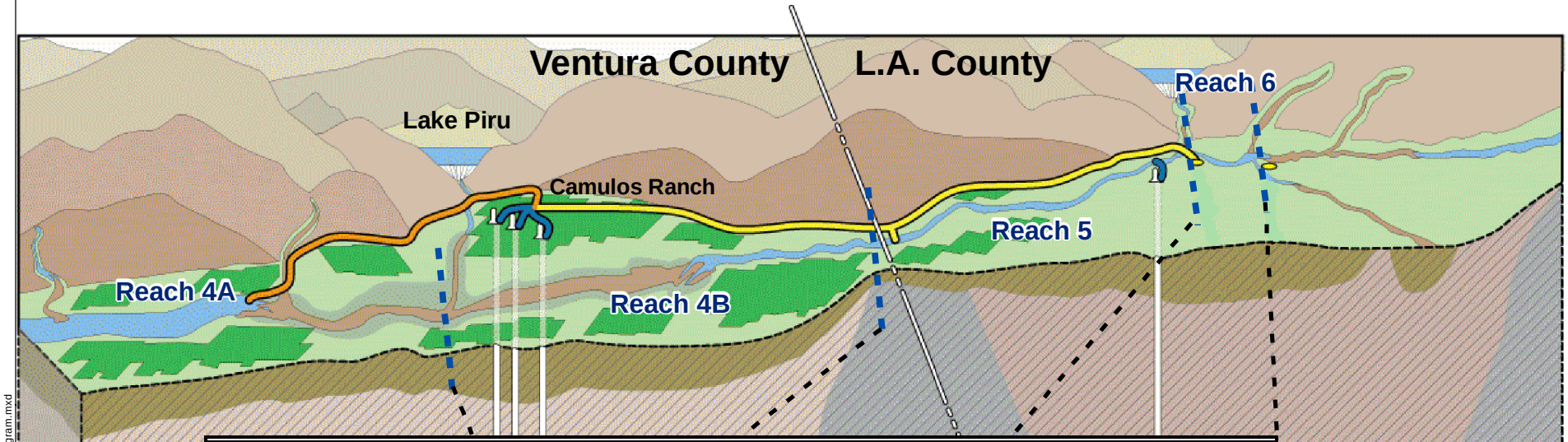
Note: Diagram not to scale

PROPOSED SITE SPECIFIC CHLORIDE OBJECTIVES FOR UPPER SCR SURFACE WATER – AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 6/11/2008	Project No. 10354
Geomatrix		Figure E-1

\\DENDC\Dept\data\Project\10354\Task 2B-2 Report\Figures\Figure E-1 - Proposed SW WQOs Block Diagram.mxd



Mineral WQO	Reach 4B East Piru	Reach 5 Castaic Valley	Reach 6 Bouquet & SF Canyons
Chloride	TBD	150	~~(100)~~ 150
TDS	TBD	1000	~~(700)~~ 1000
Sulfate	TBD	350	~~(250)~~ 450

Note: Diagram not to scale

PROPOSED SITE SPECIFIC MINERAL OBJECTIVES FOR UPPER SCR GROUNDWATER – AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 6/11/2008	Project No. 10354
Geomatrix		Figure **E-2**

\\DENDC\Deptdata\Project\10354\Task 2B-2 Report\Figures\Figure 5-23 - Proposed GW WQOs Block Diagram.mxd

1.0 INTRODUCTION

This report identifies potential alternatives to achieve compliance with various water quality objectives (WQOs) within the Upper Santa Clara River (USCR) watershed and describes results of the assessment of those alternatives utilizing the numerical Groundwater/Surface Water Interaction Model (the GSWI model, or GSWIM). This work was performed as part of the Groundwater/Surface Water Interaction Model Study that is being jointly conducted by the Santa Clarita Valley Sanitation District (SCVSD, or the District) and the Los Angeles Regional Water Quality Control Board (Regional Board) as part of the USCR Chloride Total Maximum Daily Load (TMDL). This report also satisfies the requirements of Task 9 of the USCR Chloride TMDL Implementation Schedule requiring the SCVSD to develop a report on conceptual compliance measures to meet different chloride WQOs and final waste load allocations.

1.1 UPPER SANTA CLARA RIVER CHLORIDE TMDL BACKGROUND

The Regional Board adopted the USCR Chloride TMDL in 2002, establishing chloride waste-load allocations for the SCVSD's Valencia and Saugus water reclamation plants (WRPs) at 100 mg/L. Amendments to the TMDL in 2004 and 2006 established a phased TMDL approach, which allowed for the development of several scientific studies and potential site-specific objectives (SSOs) for chloride that the Regional Board may consider as part of any revisions to the existing 100 mg/L WQO. The TMDL implementation schedule specified, among other requirements, that special scientific studies be conducted to: a) evaluate the appropriate chloride threshold for the protection of sensitive agriculture; b) evaluate the appropriate chloride threshold for the protection of endangered species; and c) develop a groundwater/surface water interaction model to evaluate the impacts of chloride loading from all sources on water quality. The results of these studies would then become the technical basis by which potential SSOs for chloride could be developed for Regional Board consideration. The TMDL required development of these studies in a collaborative process through Technical Working Groups (TWGs) to ensure substantial agreement between the Regional Board staff, SCVSD staff, and other stakeholders, regarding the scientific and technical basis for establishing WQOs for chloride. Each of the major studies conducted as part of the TMDL and their current status are summarized as follows.

Threatened and Endangered Species Chloride Threshold Study (T&Es Study) – The T&Es Study was completed in November 2007 and determined that the 1988 United States

Environmental Protection Agency ambient water quality criteria for chloride for the protection of aquatic life (230 mg/L as chronic and 860 mg/L as acute) are protective of locally important T&Es (Advent-Environ, 2007). Therefore, the chloride threshold for the protection of locally important T&Es was found to be considerably higher than the threshold range for the protection of salt-sensitive agriculture.

Agricultural Chloride Threshold Study (Ag Study) - The Ag Study was a two-part study, with a Literature Review and Evaluation (LRE) completed in September 2005 (CH2M Hill, 2005), and an evaluation of the appropriate averaging period completed in January 2008 (Newfields, 2008). The Ag Study determined that the appropriate chloride threshold for salt-sensitive agriculture (avocados, strawberries, and nursery crops) grown in the USCR watershed is a guideline chloride concentration ranging between 100 and 117 mg/L, with an averaging period for chloride concentrations of approximately 3 months.

Groundwater – Surface Water Interaction Model (GSWIM) Study – The GSWIM Study developed a calibrated numerical model that was completed in March 2008 (CH2M Hill-HydroGeoLogic, Inc [HGL], 2008, Geomatrix 2008), to evaluate the impact of WRP effluent discharges to the river on downstream surface water and groundwater in the Los Angeles and Ventura County portion of the SCR watershed. This Report presents ongoing results from application of the GSWIM to evaluate various alternatives to comply with the existing WQOs and potential SSOs in consideration. One of the alternatives described in this Report is the Alternative Water Resources Management (AWRM) Program (Section 5.0), which represents a basin-wide set of options.

Site Specific Objectives (SSO) and Anti Degradation Analysis (ADA) Study – The SSO and ADA Study is currently being developed to provide the technical and regulatory basis for the Regional Board to consider potential SSOs that support the AWRM Program, as discussed in more detail below. As part of the SSO effort, a white paper on the agricultural beneficial uses in Reaches 5 and 6 of the USCR was developed in September 2007 (SCVSD, 2007), which assessed whether salt-sensitive agriculture was an existing or potential beneficial use. The white paper concluded that salt-sensitive agriculture was not an existing or potential beneficial use for surface water or underlying groundwater that could be impacted by surface water in Reaches 5 and 6. Since salt-sensitive agriculture was not an existing or potential beneficial use for the surface waters or underlying groundwater that could be impacted by surface water in

these reaches, SSOs higher than the Ag Study threshold range of 100-117 mg/L are potentially possible, and are being considered as part of the AWRM Program (Section 5.0).

1.2 GSWIM BACKGROUND

The GSWI numerical model was developed by CH2M Hill and HGL for a portion of the USCR watershed to evaluate fate and transport of chloride in surface water and groundwater basins underlying Reaches 4, 5, 6 and 7 (as designated by the Regional Board) of the SCR in accordance with the chloride TMDL collaborative process. The GSWI model was developed as a tool to improve the understanding of the interaction between surface water and groundwater and the linkage between surface-water quality and groundwater quality with respect to chloride. The GSWIM study area is shown on Figure 1-1. The development and calibration of GSWIM is documented in the Task 2B-1 Report (CH2M Hill-HGL, 2008). GSWIM has been used by the CH2M Hill–HGL team and by Geomatrix to assess the potential relationships between chloride loading from recycled water discharges at SCVSD's Valencia and Saugus WRPs and the downstream groundwater and surface water environments for various future scenarios under a variety of future hydrology, land use, and water use assumptions developed as part of the USCR Chloride TMDL Collaborative Process by the GSWIM Study TWG consisting of the SCVSD, the Regional Board and stakeholders from both Los Angeles and Ventura County.

These future scenarios focused on identifying the effects of individual water management and treatment options on chloride levels in the surface and subsurface flow systems, including:

- Various levels of use of recycled water from the WRPs in the East Subbasin.
- Removal of residential self-regenerating water softeners (SRWS), which contribute chloride to the WRP recycled water.
- Conversion of the current bleach-based disinfection facilities, which contribute chloride to the WRP recycled water, to Ultra-Violet Light Disinfection (UV) technology at the WRPs.
- Application of advanced treatment through use of Micro-Filtration (MF) and Reverse Osmosis (RO) treatment technologies.

The results of the GSWIM analysis for these future scenarios are documented in the Task 2B-1 Report (CH2M Hill-HGL, 2008) and the Supplement to the Task 2B-1 Report (Geomatrix,

2008). This Task 2B-2 Report describes additional compliance scenarios/alternatives that involve a broader range and mix of water management options that were developed to assess overall compliance with existing WQOs and proposed SSOs for the SCR watershed and includes the development of the AWRM option described in Section 5.0.

1.3 PREVIOUS GSWIM RESULTS

The future scenario GSWIM simulations reported by CH2M Hill-HGL (2008) and Geomatrix (2008) represent potential hydrology, land use, and water use conditions during calendar years 2007 through 2030 developed collaboratively with the GSWIM Study TWG, based on historical hydrologic years 1975 through 1998. Land use build-out proceeded from 2005 conditions to estimated build-out conditions projected in 2027 which were based on the Santa Clarita Valley Area Plan, the City of Santa Clarita General Plan, the Newhall Ranch Specific Plan, the City of Fillmore Plan and the 2007 cropping data for Ventura County (CH2M Hill-HGL, 2008). Imported water rates and distribution were established for these simulations based on these future build-out plans as well as plans for increased water reuse (Kennedy/Jenks Consultants, 2002; Forma, 2003). Table 1-1 summarizes the scenario set evaluated as part of the GSWIM Study, which includes combinations of high, intermediate and low reuse of recycled water from the Valencia WRP with various levels of advanced treatment (MF/RO) or SRWS removal rates to control the chloride levels in the recycled water discharge. With respect to compliance with the existing 100 mg/L WQO and LRE guidelines of 100-120 mg/L for the SCR, results from the simulations suggested that:

- None of the scenarios simulate chloride concentrations less than the existing WQO of 100 mg/L at all times and locations in Reaches 4B, 5 and 6. Simulated daily chloride concentrations were equal to or less than the existing WQO during approximately 16 to 66 percent of the future simulation period at the top of Reach 4B at Blue Cut.

- Only Scenarios 2 a and 3a (medium and low future recycled water reuse with advanced treatment using MF/RO at the WRPs to achieve 100 mg/L in the recycled water discharge) produced surface-water chloride concentrations less than the upper bound of the avocado threshold of 120 mg/L at all times at the top of Reach 4B of the SCR at Blue Cut. The remaining scenarios produced surface-water chloride concentrations that were less than 120 mg/L during approximately 28 to 99 percent of the future simulation period.

- All of the scenarios predicted chloride concentrations in groundwater that consistently met the existing WQO of 200 mg/L in groundwater east of Piru Creek. None of the simulations predicted chloride concentrations less than the lower (100 mg/L) or upper (120 mg/L) avocado thresholds at all times during the period, with attainment ranging from 0 percent of the future simulation period for the lower threshold up to 99 percent for the upper threshold.

- All simulations predicted chloride concentrations in groundwater that consistently met the existing 100 mg/L WQO in groundwater west of the Piru Creek confluence.

Other significant observations from these future scenario simulations include:

- Simulated chloride concentrations at Blue Cut were generally related to concentrations of recycled water discharges to the SCR from the Saugus and Valencia WRPs, as modeled by the various MF-RO and SWRS removal scenarios.

- Additional sources of chloride loading, above the loading from the WRP discharges, exist between the Valencia WRP and Blue Cut, with concentrations at Blue Cut being higher than the concentration of the discharge of Valencia WRP recycled water during periods of drought. This condition is also noted for the calibration simulation but is more pronounced in the some of the future scenario simulations.

- The scenarios simulating greater reuse of recycled water (and subsequent lower WRP discharges to the SCR) show increased chloride concentration in the groundwater in the Piru Subbasin and in surface-water at Blue Cut during drought periods, as compared to scenarios simulating limited reuse of recycled water. This is due to less WRP discharge to the SCR (which has a diluting effect during drought periods to other sources of chlorides between the WRPs and Blue Cut) as well as more outdoor use of high chloride water for irrigation, which is subject to evaporation and subsequent return of more concentrated water to the SCR as runoff and base flow.

1.4 ALTERNATIVES FOR COMPLIANCE OPTIONS

This report assesses a range of options for achieving compliance with various chloride WQOs in both the East Subbasin and the Piru Basin, including the AWRM option, which involved other local stakeholders and agencies, who jointly developed a water management option

during drought and non-drought conditions. Four general alternatives, or strategies, have been identified and assessed in terms of the likelihood of achieving compliance with WQOs and proposed SSOs, including:

- Advanced Treatment and Brine Disposal – this alternative consists of constructing and operating MF/RO treatment facilities to remove chloride from the recycled water produced at the Valencia and Saugus WRPs. Sufficient advanced treatment capacity would be required to reduce all chloride concentrations in WRP recycled water to below the existing WQO of 100 mg/L for the SCR downstream of the discharges (Reaches 5 and 6). MF/RO treatment would result in a significant amount of waste brine that would require disposal, most likely through a dedicated brine conveyance pipeline from the WRPs to a new Pacific Ocean outfall in Ventura County.

- Minimal Advanced Treatment and Secondary Effluent Pipeline and Outfall – this alternative consists of constructing and operating MF/RO treatment facilities for a limited amount of WRP recycled water. The facilities would be sized to produce sufficient recycled water to meet the existing WQO of 100 mg/L, for discharge to the SCR to maintain river habitat.[1] The balance of the WRP recycled water would be conveyed to the Pacific Ocean in Ventura County via a dedicated pipeline and ocean outfall. The objective of this alternative is to export the chlorides in the WRP recycled water exceeding the existing WQOs directly to the ocean rather than discharging them locally to the SCR.

- Alternate WRP Discharge Location – this alternative consists of relocating the Valencia WRP recycled water discharge location upstream to the upper extent of Reach 7 of the SCR near the United States Geological Survey (USGS) gauging station at Lang (e.g. the Lang Gauge). The objective of this alternative is to move the discharge farther away from downstream salt-sensitive agricultural beneficial uses in Ventura County, and utilize the potential assimilative capacity in upgradient surface water and groundwater, to minimize impacts in Ventura County from the chloride in the WRP recycled water.

- Alternative Water Resource Management – this alternative consists of working with the local water supply, agricultural, and development stakeholders in Los Angeles and

Ventura Counties on a regional watershed solution to help achieve compliance with the USCR Chloride TMDL. The objective of this alternative is to identify the best set of options for compliance that results in the maximum net benefit for all water users along the river, while protecting the salt sensitive agricultural beneficial uses of the SCR in Ventura County.

The descriptions and assessments of compliance alternatives and the AWRM alternative provided in this Report are intended to fulfill a portion of the TMDL Task 9 requirements for the USCR Chloride TMDL which requires that the SCVSD:

> *Develop a pre-planning report on conceptual compliance measures to meet different hypothetical final waste load allocations. County Sanitation Districts of Los Angeles County (CSDLAC) shall solicit proposals and develop and submit a report to the Regional Board that identifies potential chloride control measures and costs based on different hypothetical scenarios for chloride water quality objectives and final waste load allocations.*

Information on the costs associated with the compliance alternatives identified in this report is discussed in a separate report submitted by the SCVSD (2008).

A variety of future scenarios were developed and simulated with GSWIM to assess the potential for the above alternatives to achieve compliance with the WQOs, as summarized on Table 1-2. The results of these scenarios are discussed in Sections 2 through 5 of this report.

[1] The minimum amount of recycled water discharge to the SCR to maintain river habitat has not been determined. For purposes of this study, a minimum discharge from each WRP is assumed based on information in the SCVSD's 2015 Santa Clarita Valley Joint Sewerage System Facilities Plan and Environmental Impact Report.

2.0 ADVANCED TREATMENT AND BRINE DISPOSAL

The Advanced Treatment and Brine Disposal alternative assumes that SCVSD would install and operate MF/RO treatment facilities at the Valencia and Saugus WRPs . Under this alternative, all flows to the WRPs would be subject to MF/RO treatment and/or blending to achieve a relatively constant recycled water discharge with a chloride concentration of 100 mg/L or lower. Operation of MF/RO treatment facilities would result in a significant stream of waste brine, which would require disposal. Given the amount of brine flow produced from MF-RO operation required to comply with the existing 100 mg/L WQO for chloride, a dedicated 43-mile brine conveyance pipeline from the WRPs to a new ocean outfall in Ventura County is required for this compliance alternative.

Model simulations for this alternative were developed assuming that WRP recycled water discharge would have a constant concentration of 100 mg/L. These simulations were performed as part of Task 2B-1 assessments, and results have been reported in detail in CH2M Hill-HGL, 2008, and Geomatrix, 2008.

Figure 2-1 presents model predicted chloride concentrations in the SCR at Blue Cut for the three simulations performed assuming a chloride concentration of 100 mg/L for all WRP discharges (labeled 1a, 2a, and 3a in Task 2B-1, assuming varying levels of water reuse over time). Also included on the graph are results from Task 2B-1 Scenario 1g_UV, which represents predicted conditions with no treatment but with other changes that are considered likely to occur, including use of UV disinfection technology, full development of recycled water reuse, and a high level of SRWS removals in the next few years. Results of Scenario 1g_UV are provided for comparison and as a means to assess potential improvement in achieving WQOs from application of advanced treatment.

Figure 2-2 shows simulated frequencies of WQO attainment from the “a” series scenarios and Scenario 1g_UV for the SCR at Blue Cut and in groundwater within the Piru Basin. In the SCR at Blue Cut, attainment frequencies of the existing 100 mg/L chloride WQO for the Advanced Treatment and Brine Disposal alternatives range from approximately 65.8% (3a) to 66.4% (1a and 2a), versus 41.2% for Scenario 1g_UV. However, the predicted improvement in attainment from advanced treatment is generally drought-dependent. As shown on Figure 2-1, model predictions indicate that the existing chloride WQO of 100 mg/L are consistently achieved during early periods in the simulation (i.e. 2007 through 2019, simulating hydrology based on 1975 through 1987). However, predicted concentrations in the SCR at Blue Cut are

consistently above the 100 mg/L WQO for an extended period generally beginning in 2019 and extending through approximately 2027 (hydrology based on 1987 through 1995, which includes drought conditions in the later 1980s and early 1990s). Maximum predicted chloride concentrations occur at the peak of the simulated drought in 2022 and 2023, and range from approximately 115 mg/L (3a) to 121 mg/L (1a).

Predicted chloride concentrations in the SCR at Blue Cut that are higher than those in WRP recycled water discharge are generally the result of other sources of salt loading to the river during drought periods. These include accumulation of chlorides at the surface due to evapoconcentration of outdoor irrigation (i.e. moisture discharged due to evapotranspiration results in increased concentrations of the chloride remaining in the near-surface system) with runoff, infiltration, and subsequent base flow of these elevated concentrated chlorides into the SCR and other ephemeral tributaries near Blue Cut.

CH2M Hill-HGL performed supplemental simulations to assess the general influence of WRP discharges on chloride mass loading in the SCR and downstream groundwater (CH2M Hill-HGL, 2008). Results from these simulations indicated that 10 to 15% of flows within the SCR at Blue Cut are derived from sources other than WRP discharges (i.e. groundwater inflows and/or surface water and tributary runoff). Geomatrix also performed a variety of simulations with GSWIM to determine how well the model was simulating all physical and chemical mechanisms contributing salt load to the SCR near Blue Cut. One significant simulation involved allowing salts to evaporate numerically with evaporating water. The results of this simulation indicated that the outdoor applied water concentrations did not increase due to evapoconcentration, instead removing vast amounts of chlorides that would otherwise remain in the system. These results were indicative of the large of amount of chloride mass that is retained at the surface when appropriately simulating evapoconcentration effects.

For chloride concentrations in groundwater east of Piru Creek in the Piru Basin, both Scenario 1g_UV and the Advanced Treatment and Brine Disposal alternatives predicted that the current WQO of 200 mg/L would be achieved 100% of the simulated time period. The advanced treatment options were predicted to improve general attainment of the stricter objectives for salt-sensitive agriculture, achieving groundwater concentrations less than 100 mg/L approximately 55% of the simulated period and achieving 120 mg/L approximately 99% of the simulated period. This represents improved conditions over those predicted in Scenario 1g_UV (100 mg/L achieved 44% and 120 mg/L achieved 76% of the simulated period). For

groundwater chloride concentrations west of Piru Creek, both Scenario 1g_UV and the Advanced Treatment and Brine Disposal alternatives predicted that the current WQO of 100 mg/L would be achieved 100% of the simulated time period.

While implementation of Advanced Treatment and Brine Disposal alternative to achieve 100 mg/L in the recycled water discharge to the river resulted in generally improved attainment of the existing 100 mg/L chloride WQO in the receiving water, the simulations did not result in full attainment of the 100 mg/L WQO for the SCR at Blue Cut at all times and in all locations of the receiving water, due to the impacts from other sources of chloride to the river. In addition, the application of MF/RO facilities at both the Valencia and Saugus WRPs to achieve 100 mg/L in its recycled water discharges to the river would entail expensive upgrades in terms of both capital facilities and significantly increased long-term operating and maintenance costs, and energy usage. Furthermore, a brine conveyance pipeline, extending approximately 43 miles from the WRPs to the ocean and ocean outfall would have to be built for the disposal of the highly concentrated wastewater brines generated from the RO facilities. Such a pipeline would be significantly more expensive than other contemplated alternatives and would require significant environmental review, planning, design and construction through an extended area, including development across both public and private right-of-ways through numerous jurisdictions.

3.0 MINIMAL ADVANCED TREATMENT AND SECONDARY PIPELINE AND OUTFALL

An option that would reduce and/or eliminate the amount of advanced treatment capacity needed to comply with the existing 100 mg/L WQO would be to discharge all or most of the WRP recycled water directly to the ocean through the construction of a secondary effluent conveyance pipeline and ocean outfall in Ventura County. This option would achieve the greatest export of chloride load from the WRPs out of the SCR watershed since most, if not all of the recycled water would be discharged into an ocean disposal pipeline. The diversion of recycled water into an ocean disposal pipeline would also serve to dilute and dispose of any highly concentrated wastewater brine waste from the RO processes necessary to maintain minimum flows for habitat in the river that meet the existing 100 mg/L WQO. Two future alternatives were developed to assess this general option:

- **Zero Discharge Alternative:** Conveyance of all recycled water discharges from the Valencia and Saugus WRPs to the Pacific Ocean off the Ventura County coast via a new secondary effluent conveyance pipeline and ocean outfall, resulting in a simulation of zero discharge from the WRPs to the SCR within the GSWIM domain. This option would reduce the chloride load from recycled water discharges to the river to zero.

- **Minimal Discharge Alternative:** Limit discharges to 4.6 million gallons per day (MGD) from the Valencia WRP and 5.0 MGD from the Saugus WRP,[2] and convey the balance of WRP recycled water discharges to the Pacific Ocean off the Ventura County coast via a new secondary effluent conveyance pipeline and ocean outfall. It is assumed that the minimal discharges from the WRPs to the SCR require compliance with the existing WQO of 100 mg/L and therefore, MF/RO treatment on a portion of the recycled water is necessary to assure that the WRP discharges comply with the 100 mg/L WQO. These discharges are assumed to have chloride concentrations at a constant value of 100 mg/L.

Both model simulations were based on assumptions used in model Scenario 1g_UV, with only modifications to the WRP discharges as described above. Figure 3-1 presents a graph illustrating the predicted discharges from the Valencia WRP under Scenario 1g_UV versus the reduction to 4.6 MGD. Discharges from the Saugus WRP were predicted in Scenario 1g_UV

[2] Estimates for minimum discharge required from each WRP are based on information in the SCVSD's 2015 Santa Clarita Valley Joint Sewerage System Facilities Plan and Environmental Impact Report.

to average approximately 5.7 MGD with minor seasonal fluctuations based on the overall plant capacity. These discharges were modified to a constant 5.0 MGD for the minimal discharge option.

Figure 3-2 presents predicted chloride concentrations in the SCR at Blue Cut from the Zero Discharge alternative, Minimal Discharge alternative, and Scenario 1g_UV simulations, while attainment frequencies for WQOs predicted by each simulation are shown on Figure 3-3. In the SCR at Blue Cut, the chloride WQO of 100 mg/L was predicted to be achieved approximately 63.8% of the simulated period for the Zero Discharge alternative and 65.5% for the Minimal Discharge alternative. These predicted attainment frequencies are comparable to those predicted for the Advanced Treatment and Brine Disposal alternative discussed in Section 2.0, with non-attainment of the 100 mg/L WQO in the receiving water at Blue Cut occurring during the predicted drought situation. Further, overall flow in the SCR at Blue Cut is predicted to decline significantly under the Zero and Minimal Discharge alternatives, as illustrated in Figure 3-4.

The drought related increases in predicted chloride concentrations in the SCR at Blue Cut are generally greater in the Zero and Minimal Discharge alternatives. Maximum predicted concentrations occur at the peak of the simulated drought in 2022 and 2023, with a maximum predicted chloride concentration of approximately 148 mg/L for the Minimal Discharge alternative and approximately 206 mg/L for the Zero Discharge alternative. As before, decreasing WRP discharge and chloride loading results in the increased influence of other chloride loading sources and mechanisms on predicted chloride concentrations in Reach 4B during drought periods.

For chloride concentrations in groundwater east of Piru Creek in the Piru Basin, both Scenario 1g_UV and the Zero and Minimal Discharge alternatives predicted that the current WQO of 200 mg/L would be achieved 100% of the simulated time period. The Zero and Minimal Discharge alternatives were predicted to improve general attainment of the stricter chloride objectives for salt-sensitive agriculture, achieving groundwater concentrations less than 100 mg/L approximately 62 and 68% of the simulated period, respectively versus 43% for Scenario 1g_UV.. The alternatives were predicted to achieve 120 mg/L approximately 98% (Zero Discharge) and 99% (Minimal Discharge) of the simulated period. This represents improved conditions over those predicted in Scenario 1g_UV (100 mg/L achieved 44% and 120 mg/L achieved 76% of the simulated period). For chloride concentrations in groundwater west of

Piru Creek, both Scenario 1g_UV and the Zero and Minimal Discharge alternatives predicted that the current WQO of 100 mg/L would be achieved 100% of the simulated time period.

As with the Advanced Treatment and Brine Disposal alternative discussed in Section 2.0, while reducing the total WRP recycled water discharge to the river is predicted to improve attainment of 100 mg/L WQO in the receiving water as compared with Scenario 1g_UV, the 100 mg/L WQO is not met at all times and all locations in the receiving waters, even if WRP discharges to the river ceased to exist (Zero Discharge) or were reduced only to those levels necessary to maintain habitat (9.6 MGD). Predicted chloride concentrations were also typically worst during drought periods. These results indicate that other sources and/or mechanisms of chloride loading are responsible for non-attainment of the existing WQO for the Zero and Minimal Discharge alternatives contemplated in this section.

4.0 ALTERNATE WRP DISCHARGE LOCATION

A third alternative to the scenarios discussed in Sections 2.0 and 3.0, would be to move the Valencia WRP discharge location upstream from its current location in Reach 5 of the SCR, to the beginning of Reach 7 of the SCR, near the USGS gauging station at Lang. This alternative would attempt to make use of potential additional assimilative capacity for chloride in areas that are currently far removed from salt-sensitive agricultural beneficial uses of SCR and groundwater supply. A simulation based on Scenario 1g_UV was developed that moved the discharge location from the current Valencia WRP outfall to an upstream location at the beginning of Reach 7. The simulated discharge location is shown on Figure 4-1. Discharge from the Saugus WRP was not changed to provide flows to support habitat in Reach 6 of the SCR.

Figure 4-2 presents predicted chloride concentrations at Blue Cut from Alternate WRP Discharge Location alternative and Scenario 1g_UV simulations, while attainment frequencies for WQOs predicted by each simulation are shown on Figure 4-3. In the SCR at Blue Cut, the chloride WQO of 100 mg/L was predicted to be achieved approximately 48.9% of the simulated period, compared to 43% for Scenario 1g_UV. Maximum predicted chloride concentrations in the SCR at Blue Cut are comparable for both simulations, with a maximum of 176 mg/L predicted in the Alternate WRP Discharge Location alternative versus 160 mg/L for Scenario 1g_UV. In addition, overall surface flows at Blue Cut are predicted to decline as shown on Figure 4-4, as a result of moving the Valencia WRP discharge location to Reach 7 of the SCR.

As expected, groundwater concentrations within the East Subbasin are predicted to increase significantly as a result of increased salt loading from the Valencia WRP discharge in Reach 7. Figures 4-5 and 4-6 show predicted chloride concentrations in groundwater at the Newhall County Water District's (NCWD) Pinetree well and Valencia Water Company's well Q2, which represent the upper and lower reaches of the alluvial aquifer underlying Reach 7 of the SCR. As shown on the graphs, maximum predicted concentrations are almost double for the Alternate WRP Discharge Location alternative over Scenario 1g_UV.

For chloride concentrations in groundwater east of Piru Creek in the Piru Basin, both Scenario 1g_UV and the Alternate WRP Discharge Location alternative predicted that the current WQO of 200 mg/L would be achieved 100% of the simulated time period. The Alternate WRP Discharge Location alternative was predicted to slightly improve general attainment of the

stricter objectives for salt-sensitive agriculture, achieving groundwater concentrations less than 100 mg/L approximately 46% of the simulated period and 120 mg/L approximately 80% of the period. This represents a small improvement over those predicted in Scenario 1g_UV (100 mg/L achieved 44% and 120 mg/L achieved 76% of the simulated period). For chloride concentrations in groundwater west of Piru Creek, both Scenario 1g_UV and the Alternate WRP Discharge Location alternative predicted that the current WQO of 100 mg/L would be achieved 100% of the simulated time period.

Moving the discharge location of the current Valencia WRP outfall to the SCR, to the beginning of Reach 7 near the USGS Lang gauge did not result in significant improvement in attainment of chloride WQOs in receiving waters over Scenario 1g_UV. This alternative involves the construction and operation of a conveyance pipeline and pumping facilities to relocate the Valencia WRP recycled water discharge approximately 16 miles upstream from the Valencia WRP to the USGS Lang gauge.

5.0 ALTERNATIVE WATER RESOURCE MANAGEMENT

Recognizing that the alternatives discussed in Sections 2.0 (Advanced Treatment and Brine Disposal), 3.0 (Minimal and/or Zero Discharge) and 4.0 (Alternate WRP Discharge Location) are not likely to achieve attainment of the existing 100 mg/L WQO at all times and all locations in the receiving water, a fourth alternative was developed that involves an alternative water resources management (AWRM) approach in conjunction with the development of SSOs, whereby the AWRM alternative was developed to achieve compliance with SSOs at all times and at all locations in the receiving water, with mitigation measures put in place to protect salt-sensitive agricultural beneficial uses and groundwater, when necessary. Therefore, the SCVSD and other stakeholders have jointly developed this regional watershed solution for chloride as an alternative to compliance with the existing 100 mg/L-WQO.

The following sections provide a description of the development and key aspects of the AWRM Program. Geomatrix worked with the TMDL stakeholders to develop individual simulations of various water management elements of the AWRM scenario and presented and discussed these results with the TMDL stakeholders on a weekly basis during the spring of 2008. The results of the GSWIM simulation of the final AWRM scenario are provided in Section 5.2.

5.1 ALTERNATIVE WATER RESOURCE MANAGEMENT DEVELOPMENT

Since November 2007, SCVSD, Ventura County Agricultural Water Quality Coalition (VCAWQC), United Water Conservation District (UWCD), and the Upper Basin Water Purveyors[3] have been working together to develop an AWRM Program for the USCR Chloride TMDL. As noted, the purpose of the AWRM Program is to develop a regional watershed solution for chloride as an alternative to compliance with the existing 100 mg/L WQO, recognizing that compliance with the existing 100 mg/L WQO at all times and all locations in the receiving water was not possible with the existing alternatives considered and would likely be a challenging and costly project, requiring many years to implement. The AWRM Program considers the use of SSOs and water resource management facilities that would allow for the full protection of all beneficial uses, while simultaneously providing a more feasible compliance solution, maintaining a chloride balance in the USCR Watershed, and providing salt export and water supply benefits to Ventura County stakeholders. Through this process, the SCVSD, VCAWQC, UWCD, and the Upper Basin Water Purveyors have come to a

[3] Castaic Lake Water Agency, Valencia Water Company, Newhall County Water District, Los Angeles County Water Works District No. 36, and the Santa Clarita Water Division of the Castaic Lake Water Agency.

conceptual agreement on the key elements of the AWRM Program. Discussion of these specific elements of the AWRM Program is presented in the following sections.

Several key elements were developed as part of the AWRM Program, which when combined result in a regional watershed solution for the USCR Chloride TMDL that benefits all stakeholders within the watershed. The key elements were developed during the stakeholder process and form the basis for the AWRM Program. The elements represent feasible management options and decisions, and include:

- implementing measures to reduce chloride in the recycled water at the District's WRP discharges;
- constructing advanced treatment for a portion of the recycled water from the District's Valencia WRP;
- procuring supplemental water (i.e. local groundwater or surface water) for release to the SCR to enhance its assimilative capacity, improve water quality conditions and attain WQOs, when needed;
- constructing water supply facilities in Ventura County;
- providing alternative water supply when necessary, to protect salt-sensitive agricultural beneficial uses of the SCR;
- supporting the expansion of recycled water uses within the Santa Clarita Valley; and
- revising the surface water and groundwater WQOs to support all of these elements.

A conceptual schematic of the application of these elements is provided in Figure 5-1. The GSWIM was used to simulate these elements to examine the resultant effects on surface water and groundwater flow and chloride concentrations. The results of the GSWIM simulation are provided in Section 5.2. Details of each of these elements are as follows:

Element No. 1: Reduction of Chloride Levels in WRP Recycled Water

As part of the AWRM Program as well as any solution to the TMDL, the SCVSD will reduce the chloride levels in the recycled water discharged from the Valencia and Saugus WRPs. Reduction in recycled water chloride levels would be achieved through enhanced source control, specifically the removal of SRWSs, which are a significant source of chloride to the District's sanitary sewer collection system, and conversion of the current beach-based disinfection facilities (which contribute an additional 10 mg/L of chloride in recycled water at each WRP) to UV disinfection technology. Through removal of SRWS and conversion to UV disinfection technologies, the incremental chloride contribution from wastewater sources above the contribution from water supply can be reduced to a level of approximately 50 mg/L. This reduction in chloride will allow for the Valencia and Saugus WRPs to comply with revised WQOs under varying water supply chloride conditions[4], and minimize the amount of advanced treatment required. As discussed below, revisions to the existing WQOs would be necessary to support this AWRM Program element.

Element No. 2 Advanced Treatment at the District's Valencia WRP

While removal of chloride loading through enhanced source control would help the Saugus and Valencia WRPs comply with revised WQOs a majority of the time, additional chloride reduction would still be necessary for compliance with downstream revised WQOs in Reach 4B, through the construction and operation of a 3 MGD advanced treatment facility using MF/RO treatment technologies at the Valencia WRP. These facilities would serve three purposes: (1) continuous removal of approximately 3,200 pounds per day[5] of chloride from the WRP recycled water; (2) reducing chloride levels in the SCR in Reach 4B, through conveyance and discharge of the high quality Valencia RO permeate water near the Los Angeles-Ventura County line, when necessary to achieve compliance with revised WQOs for this reach; and (3) providing a salt export and water supply benefit to Ventura County through delivery of the high quality Valencia RO permeate water to the Ventura County water supply facilities. These facilities and the salt export and water supply benefits associated with these facilities are discussed in greater detail below.

[4] Imported water supply chloride concentrations have often exceeded 100 mg/L during drought conditions, due to the influence of poor quality imported water supplies delivered from the State Water Project stored at the Castaic Lake Reservoir.

In addition to the advanced treatment facilities, construction of brine disposal facilities to dispose of brine waste from the RO treatment process via deep well injection would be required. Unlike the other RO options that assume a higher volume of water treated using RO and thus a more significant brine waste stream, the use of deep well injection for the AWRM option represents a more plausible and sustainable brine disposal option, based on a smaller advanced treatment facility. The brine disposal for a 3MGD MF/RO facility (AWRM Program) is estimated at 0.5 MGD.

As mentioned above, when necessary, the high quality Valencia RO permeate water would be discharged directly to the SCR near the Los Angeles - Ventura County line to reduce chloride levels in the river and comply with revised WQOs in Reach 4B. Valencia RO permeate water would be delivered to the river when chloride levels in the State Water Project (SWP) water stored in the Castaic Lake Reservoir are greater than or equal to 80 mg/L. In addition to discharging this high quality Valencia RO permeate water to the river, the GSWIM study also found that the use of additional supplemental water released to the SCR, discussed in more detail below, is needed in certain critical conditions of extreme drought to assure compliance with the revised WQOs in Reach 4B. A schematic of this operational management of the Valencia RO deliveries to the SCR is presented in Figure 5-2.

For conditions when the chloride levels in the SWP water stored in the Castaic Lake Reservoir are below 80 mg/L, the high quality Valencia RO permeate water does not need to be delivered to the SCR to comply with revised WQOs for Reach 4B. In fact, results from the GSWIM simulation (Section 5.2) suggest that this condition occurs approximately 76% of the time, which then would allow for the high quality Valencia RO permeate water to be delivered to the water supply facilities to be developed in Ventura County, in order to blend high saline groundwater[6] underlying Reach 4B and produce a blended water supply that can be discharged into the wetted portions of Reach 4A of the SCR to comply with the existing 100 mg/L WQO for this reach. The discharge of this blended water supply in the wetted reaches of the SCR, where the "Dry Gap" ends, allows for greater flow in the river, which ultimately can then be diverted at the Freeman Diversion to increase water supplies for Ventura County. This

[5] The chloride load removed by RO is based on the long-term average Valencia WRP final effluent chloride concentration of 117 mg/L, over the projected model period 2007-2030. The chloride load removed by RO is variable and dependent on the amount of chloride in the water supply and recycled water

[6] The groundwater in Reach 4B of the SCR currently has chloride concentrations as high as approximately 150 mg/L.

operational management of the Valencia RO deliveries to the Ventura County water supply facilities is presented conceptually on Figure 5-1.

Element No. 3: Procuring Local Groundwater for Supplemental Water Releases to the Santa Clara River

Recognizing that conducting environmental studies, permitting, designing and constructing an MF/RO facility at the Valencia WRP will take a significant period of time, the AWRM Program includes a commitment (contingent upon the necessary environmental assessments required under the California Environmental Quality Act and compliance with Regional Board permit limits), to provide supplemental water pumped from the Saugus Aquifer or some other local water resource to the SCR as an interim measure prior to completion of the AWRM Program facilities. Additionally, as discussed previously, results from the GSWIM simulation suggest that release of supplemental water to the SCR would be required during extreme drought conditions to comply with revised WQOs for Reach 4B. These supplemental waters would be delivered through contractual arrangements between the SCVSD and the Upper Basin Water Purveyors.

Element No. 4: Ventura County Salt Export and Water Supply Benefits

In order to export accumulated salt in groundwater in East Piru and provide water supply benefits for Ventura County, a key element of the AWRM Program is the construction of the Ventura County water supply facilities, as shown conceptually in Figure 5-1. These facilities would allow for salt export and water supply benefits by blending high quality Valencia RO permeate water with the more saline groundwater in East Piru, to develop a blended water supply that is less than 95 mg/L in chloride. The Ventura County water supply facilities would be comprised of the following:

- 10 groundwater extraction wells in the East Piru groundwater basin;
- a 12-mile RO permeate pipeline from the Valencia WRP to the East Piru extraction wells; and
- a 6-mile conveyance pipeline for the blended East Piru groundwater and Valencia WRP RO water (East Piru Pipeline) for discharge to Reach 4A of the SCR, downstream of the "Dry Gap."

These facilities would be utilized to deliver high quality RO permeate water for a water supply and salt export benefit, when RO permeate water is not needed for compliance with revised WQOs.

Through the blending of high quality Valencia RO permeate water with more saline groundwater underlying Reach 4B, a new blended water supply can be developed and managed that will not only export salt accumulated in groundwater in the East Piru basin, but comply with downstream surface water WQOs, and ultimately increase water supplies in Ventura County through increased flows at the Freeman Diversion (Bachman, 2008). In addition, the extraction of more saline groundwater underlying Reach 4B, will allow for greater recharge of high quality storm flows in the SCR, which are typically low in chloride, lowering chloride levels in the groundwater. GSWIM results showing predicted reductions in chloride levels in groundwater under Reach 4B are presented in Section 5.2.

*Element No. 5: Protection of Salt-Sensitive Agriculture in Reach 4*B

The AWRM Program recognizes that chloride levels in Reach 4B of the SCR may exceed the protective range for salt sensitive agriculture (100 - 117 mg/L chloride concentration), as determined by the Ag. Study (CH2M HILL, 2005). In order to protect this salt sensitive agricultural beneficial use along Reach 4B of the SCR, the AWRM Program proposes to provide surface water diverters along this reach of the SCR with a suitable alternative water supply, when chloride concentrations in surface water exceed 117 mg/L (making surface water quality unsuitable for the direct irrigation of salt-sensitive crops). Alternative water supplies of suitable water quality will be provided to temporarily protect salt-sensitive agricultural uses in Reach 4B. The use of alternative water supplies allows for the full protection of beneficial uses, during temporary and intermittent periods when water quality due to extreme drought conditions does not support those beneficial uses.

Element No. 6: Supporting the Expansion of Recycled Water Uses in the Santa Clarita Valley

The AWRM Program includes provisions to support recycled water uses in the Upper Basin Water Purveyor service areas. Increasing recycled water uses in the Santa Clarita Valley will not only improve water supply reliability in the area, but also reduce the chloride loading directly discharged to the SCR from the WRP discharges.

Element No. 7: Revisions to Surface Water and Groundwater WQOs to support the AWRM Program

As indicated above, the feasibility of the AWRM Program is dependent upon revising the existing WQOs for surface water and groundwater to various levels that support the different elements of the AWRM Program. Proposed revisions to surface water and groundwater chloride WQOs are discussed in Section 5.3.

5.2 GWSIM SIMULATION OF THE AWRM ELEMENTS

Geomatrix performed a number of simulations using the GSWIM in an iterative process during development of the final AWRM alternative to test and assess the feasibility and results of many of the individual elements discussed in the previous section. Simulations included evaluation of the impact of supplemental flows on chloride concentrations in the SCR, quantification of salt export from pumping groundwater in the Piru Basin, optimization of the number and location of wells used for potential water supply and salt export pumping, optimization of the locations on the SCR for both assimilative capacity enhancement and salt export discharges, assessment of volumes and impacts of groundwater pumping for supplemental supplies, and assessment of volumes of supplemental water pumping required to achieve various chloride threshold concentrations in the SCR. Results from these model simulations were regularly presented and distributed to the stakeholders as part of the working process toward a final AWRM scenario.

5.2.1 GSWIM Input and Development for the AWRM Alternative

The final AWRM alterantive was simulated using GSWIM based on the following considerations:

- Scenario 1g_UV was used as a base case for the final AWRM simulation, which includes an assumption of recycled water reuse in the East Subbasin in accordance with Castaic Lake Water Agency's recycled water master plan, removal of self-regenerating water softeners and the implementation of UV disinfection at the WRPs.

- While a variety of concentration thresholds were evaluated by the model, the final AWRM water routing and supplemental water pumping requirements were developed based on achieving chloride concentrations less than 117 mg/L in Reach 4B of the SCR during periods when SWP concentrations are less than 80 mg/L (generally during non-

drought conditions) and achieving chloride concentrations less than 130 mg/L in Reach 4B of the SCR, during periods when SWP concentrations are greater than 80 mg/L (generally during drought conditions). Figure 5-3 presents the simulated non-drought and drought periods, as defined by simulated SWP concentrations. As shown on the figure, non-drought periods represent approximately 76% of the simulation, with drought periods representing the remaining 24%.

- 3.5 MGD was subtracted from predicted Valencia WRP discharges to account for 3.0 MGD of RO permeate water for available use (at an assumed chloride concentration of 10 mg/L) with approximately 0.5 MGD lost to brine waste in the MF/RO process. For the GSWIM simulations, the 3 MGD high quality RO permeate water was then utilized in the following manner, in order of priority of use: (1) discharged directly to the SCR to achieve compliance with the Reach 4B SSO, when Reach 4B receiving water chloride concentrations were predicted to exceed the upper end of the LRE guidelines (117 mg/L); (2) mixed with groundwater pumping in Reach 4B to provide an alternative water supply, when Reach 4B surface water exceeded 117 mg/L, to protect salt-sensitive agricultural uses; and (3) mixed with groundwater pumping in Reach 4B to provide water supply and salt export benefits to Ventura County, when Valencia RO permeate water is not needed to comply with Reach 4B WQOs and/or is not needed to provide an alternative water supply to Reach 4B surface water diverters. .

- A total of 10 new groundwater extraction wells were simulated within the San Pedro Formation (model layers 4 and 5) in the eastern portion of the Piru Basin, as shown on Figure 5-4. The pumping rates for the East Piru extraction well network were developed based on an estimate of groundwater concentrations mixed with the available high quality RO permeate water at 10 mg/L chloride to achieve a blended water chloride concentration of 95 mg/L chloride or less, which would comply with Reach 4A chloride WQO of 100 mg/L, plus a factor of safety. Figure 5-5 presents the estimated pumping rates over time for the extraction wells. The blend of extracted groundwater and RO permeate water is routed in the East Piru Pipeline and discharged to the SCR near the Fillmore Fish Hatchery, as shown on Figure 5-6. This particular location is where the “Dry Gap” historically ends, and where surface flows in the SCR are perennial, which ensures that flow and salt export out of the basin occurs.

- During conditions of drought (i.e. when SWP supplies have concentrations greater than 80 mg/L chloride), additional supplemental water (above the 3.0 MGD RO permeate water from the Valencia WRP) is required to achieve compliance with the Reach 4B SSO. It was assumed that this supplemental water could be derived from pumping the lower chloride Saugus aquifer in the Eastern Basin (that has a simulated chloride concentration of approximately 60 mg/L), and releasing this pumped groundwater to the SCR to further lower chloride concentrations in the receiving waters in Reach 4B to achieve the SSO. The amount of Saugus aquifer water that would be released as supplemental water would be replaced as supply with an equivalent amount of imported water procured from State Water Project through the use of Castaic Lake Water Agency facilities, keeping the total groundwater pumping the same. Figure 5-7 presents estimated supplemental water pumping requirements derived from both MF/RO treated water and from pumping of the Saugus aquifer, along with assumed SWP concentrations for reference. Supplemental water from the Saugus aquifer was simulated as being pumped equally from a total of three wells (two future wells to be owned an operated by the Castaic Lake Water Agency and the Valencia Water Company (VWC) well 206), as shown on Figure 5-8. During periods when the Saugus aquifer was being pumped as a source of the supplemental water, the total groundwater available for supply was reduced by that amount and it was assumed to be derived from all remaining VWC wells per the Urban Water Management Plan, in a similar fashion to Scenario 1g_UV.

- Supplemental water discharges were simulated to be added to the SCR immediately upgradient of Blue Cut, as shown on Figure 5-9.

- Portions of the 3 MGD RO permeate water from the Valencia WRP were blended with the extracted groundwater underlying Reach 4B to provide an alternative water supply to Reach 4B surface water diverters when chloride concentrations in the river exceed 117 mg/L.

5.2.2 GSWIM Results for the AWRM Alternative

With the development of the final AWRM alternative, attainment frequencies for the SSOs proposed in Section 5.3 of this report were evaluated. Simulated surface water and groundwater chloride concentrations, flows and groundwater levels associated with the AWRM

alternative are evaluated and discussed in Section 5.2.2.1, while benefits related to salt export capability of the AWRM alternative are discussed in Section 5.2.2.2.

5.2.2.1 Surface Water and Groundwater - AWRM Alternative

Figure 5-10 presents chloride concentrations for surface water predicted at Blue Cut for the AWRM alternative. Also included on the figure are results from Scenario 1g_UV and the Zero Discharge alternative for comparison. As shown on the figure, the AWRM alternative is predicted to generally achieve chloride concentrations of less than the 117 mg/L threshold at Blue Cut during non-drought periods and the 130 mg/L threshold during drought periods. Figure 5-11 presents predicted cumulative surface flows at Blue Cut. As shown in the figure, the AWRM scenario results in approximately 60,000 acre-ft less surface flows at Blue Cut over the simulated period than Scenario 1g_UV, primarily due to the reduction of Valencia WRP discharges to the river that are being diverted for MF-RO treatment and utilized for water supply, salt export and/or as an alternative water supply, as well as the loss of flow as brine waste..

Figure 5-12 presents predicted attainment frequencies for the AWRM alternative for various chloride thresholds (100 mg/L, 117 mg/L and 130 mg/L) for surface water at Blue Cut. As shown on the figure, the AWRM alternative is predicted to achieve attainment of the Reach 4B chloride SSO of 117 mg/L in non-drought conditions (SWP chloride < 80 mg/L) 99.9% of the simulation time period, versus 90.7% for Scenario 1g_UV. During drought conditions (SWP chloride > 80 mg/L), the AWRM alternative is predicted to achieve attainment of the Reach 4B chloride SSO of 130 mg/L 99.2% of the simulation period, versus 45.0% for Scenario 1g_UV. Thus the AWRM alternative is predicted to achieve the proposed Reach 4B surface water SSOs at virtually all times during the simulation period.

Figure 5-13 presents predicted attainment frequencies for the AWRM alternative for surface and groundwater along SCR Reaches 5 (between the Valencia WRP and Blue Cut) and 6 (between the Saugus and Valencia WRPs). The SSO for chloride in both surface and groundwater in these reaches is 150 mg/L. Attainment of the 150 mg/L chloride SSO is predicted to range from 98 to 100% in surface water along Reaches 5 and 6, while groundwater concentrations (based on an average from production wells along the reaches) are always predicted to be less than 150 mg/L.

Figure 5-14 presents predicted attainment frequencies for the AWRM alternative for groundwater beneath the Piru Basin (Reaches 4A and B). Average groundwater chloride concentrations from production wells in the eastern portion of the Piru Basin under Reach 4B are predicted to be less than 130 mg/L 99.9% of the simulation period, versus 90.2% for Scenario 1g_UV. This represents a general predicted reduction in chloride concentrations in groundwater in the Piru Basin over the Scenario 1g_UV. Figure 5-15 presents simulated groundwater concentrations for a well located within Reach 4B in the eastern portion of the Piru Basin (designated V-0013). As shown on the figure, concentration reductions of approximately 20 mg/L are evident during general drought periods (model years 2008 through 2011 and 2021 through 2023, representing hydrology from 1976 through 1979 and 1989 through 1991, respectively). Simulated groundwater chloride concentrations for wells located in the central and western portions of Piru Basin (designated V-105 and V-176, respectively) are shown on Figures 5-16 and 5-17. As shown on the figures, chloride concentrations are predicted to improve through implementation of the AWRM alternative, as compared to the Scenario 1g_UV.

The impact of the AWRM alternative on groundwater elevations was also assessed for both the 10 well water supply and salt export system proposed for the Piru Basin, as well as from pumping water from the Saugus aquifer for supplemental water flows. Figure 5-18 presents the predicted groundwater elevations in the Piru Basin near the simulated extraction well systems (in a well designated V-0036). A comparison of the AWRM scenario and Scenario 1g_UV indicates that additional groundwater depression during dry periods is predicted. However, groundwater levels are predicted to respond quickly to storm flow periods that result in "re-filling" of the basin. In addition, the predicted water levels in the well in response to the AWRM alternative are generally consistent with historically observed water levels (i.e. the pumping of groundwater for salt export is not predicted to produce lower water levels than historically observed) (Bachman, 2008).

Figure 5-19 presents a map of groundwater level differences in the Saugus aquifer surrounding the wells simulated for use as dilution pumping. The groundwater level differences plotted on the map represent predicted differences between the AWRM alternative and the Scenario 1g_UV at the end of the period of maximum pumping (at the end of September of model year 2023, corresponding to the hydrology of 1991) in model layer 8 (note the wells are simulated to be screened in model layers 4 to 8). As shown on the figure, maximum groundwater level differences of up to 30 feet are predicted near the simulated wells. In general, groundwater

levels in the Saugus formation were predicted to recover to "pre-AWRM pumping" levels in approximately 5 months after pumping has ceased, as shown in Figure 5-20 (representing conditions at the end of February, model year 2024). As noted previously, any Saugus aquifer groundwater utilized as supplemental water to the SCR is replaced in the simulation with imported SWP water and served in-lieu of Saugus aquifer water that would otherwise be served to Santa Clarita Valley residents.

5.2.2.2 Salt Export Capabilities of the AWRM Alternative

The GSWIM results for Scenario 1g_UV at Blue Cut were also utilized to evaluate the amount of chloride loading in excess of the existing surface water 100 mg/L WQO and proposed 117 mg/L SSO for Reach 4B, as well as the amount of salt export achieved through the use of RO, and the East Piru extraction wells. In addition, Dr. Steve Bachman (2008) evaluated that amount of chloride loading from coastal salt water intrusion that is prevented as a result of the AWRM alternative, in comparison with the Minimal Discharge alternative, discussed in Section 3.0. Dr. Bachman (2008) further evaluated the increase in surface flows that can be diverted at the Freeman Diversion, which can be directly used for in-lieu deliveries of water supply as opposed to pumping groundwater in overdraft areas of the Oxnard Plain. Based on Dr. Bachman's analysis, greater than 10,000 AFY of water supply at the Freeman Diversion could be achieved with the AWRM alternative, which would also substantially reduce the amount of chloride loading from salt-water intrusion in the Oxnard Plain.

The salt export from East Piru Basin and resultant reduction in coastal saltwater intrusion provided by the increased water supply benefits, vastly outweigh the incremental loading above the WQO that occurs during extreme drought conditions, when SWP chloride levels are elevated. A comparison of the yearly excess chloride loading above the existing 100 mg/L WQO and proposed 117 mg/L SSO in Reach 4B, with the predicted yearly chloride export through the extraction wells and prevention of saline intrusion are shown in Figure 5-21. As shown on the figure, salt export from East Piru Basin is approximately 6 times greater than the incremental loading above 100 mg/L, and almost 70 times the incremental loading above 117 mg/L. The resulting reduction in coastal salt water instruction is approximately 17 times greater than the loading above 100 mg/L and 200 times the loading above 117 mg/L, representing a significant reduction in salt load in the SCR watershed. In addition, significant chloride load is also removed by RO of wastewater at the Valencia plant for the AWRM alternative.

5.3 PROPOSED REVISIONS TO THE CHLORIDE WATER QUALITY OBJECTIVES

The feasibility of the AWRM Program is dependent upon revising the existing WQOs for surface water and groundwater to various SSOs that support the different elements of the AWRM alternative. A summary of the recommended SSOs for surface water and groundwater, in support of the AWRM alternative, is presented in Table 5-1 and shown graphically on Figures 5-22 and 5-23. The regulatory and technical justification for these SSOs is discussed extensively in the TMDL Task 7 and 8 Report (Larry Walker and Associates, 2008).

Through revision of these surface water and groundwater WQOs, the amount of advanced treatment required to achieve compliance with these SSOs is significantly reduced, which allows for the disposal of brine wastes generated from the RO processes through deep well injection as opposed to the construction of a 43-mile brine line through Ventura County with an associated ocean outfall. Preliminary feasibility studies on deep well injection for brine disposal indicate that the brine waste from a 3 MGD RO production facility could potentially allow for as much as 20 years of brine disposal capacity (CH2M Hill, 2008). The use of brine concentration and zero liquid discharge technologies could further improve RO recoveries, and minimize brine generation and increase brine disposal capacities of deep well injection. In addition, a revision of these WQOs would better facilitate the permitting of recycled water uses in the Santa Clarita Valley, which will improve water supply reliability in the area, and reduce the direct chloride loading from recycled water that can now be beneficially reused, as opposed to being discharged to the SCR.

In Ventura County, the proposed SSOs support an AWRM alternative, which will substantially increase water supplies and help to prevent coastal salt water intrusion in the Oxnard Plain, due to overdraft conditions. As noted in Bachman (2008), the AWRM alternative will increase the amount of surface flows in the SCR that can be diverted at the Freeman Diversion, and be delivered to overdraft areas in the Oxnard Plain in-lieu of groundwater pumping in those areas, resulting in a potential reduction of chloride loading from salt water intrusion. Furthermore, the AWRM alternative indicates an overall improvement in water quality for groundwater and surface water throughout Piru Basin. Ultimately, the cumulative benefits of the AWRM alternative will improve water quality in surface water and groundwater, improve water supplies to Ventura County, protect all beneficial uses, and reduce the amount of advanced treatment and associated brine disposal needed for compliance.

6.0 SUMMARY AND CONCLUSIONS

This report presents the potential compliance options to the chloride TMDL issues in the SCR and the results of the assessment of those alternatives, utilizing the GSWIM. The compliance alternatives evaluated as part of this effort include:

1) Advanced Treatment and Brine Disposal;

2) Minimal Advanced Treatment / Zero Discharge and Secondary Effluent Pipeline and Outfall;

3) Alternate WRP Discharge Location; and

4) Alternative Water Resource Management

As required in Task 9 of the Chloride TMDL process, the report evaluated these potential chloride control measures in terms of complying with existing and revised WQOs. The Advanced Treatment and Brine Disposal alternative, the Minimal Advanced Treatment / Zero Discharge and Secondary Effluent Pipeline and Outfall alternative, and the Alternate WRP Discharge Location alternative were evaluated for compliance with the existing WQOs. The results of this evaluation are summarized in Table 6-1.

Because compliance with the existing 100 mg/L WQO was not possible at all times and all locations in the SCR receiving waters, revisions to these WQOs were considered that would still be protective of all beneficial uses in Reaches 4B, 5 and 6. An AWRM alternative was jointly developed by various TMDL stakeholders, which will achieve compliance with proposed SSOs and provide for a diverse mix of water quality and water supply benefits. The key elements of the AWRM alternative include:

- implementing measures to reduce chloride in the recycled water from the District's WRPs;

- constructing advanced treatment for a portion of the recycled water from the District's Valencia WRP;

- procuring local groundwater for release to the SCR as supplemental water during drought periods;

- constructing water supply facilities in Ventura County to facilitate export of existing salts in groundwater;

- providing alternative water supply to protect salt-sensitive agricultural beneficial uses of the SCR;

- supporting the expansion of recycled water uses within the Santa Clarita Valley; and

- revising surface water and groundwater WQOs to support all of these elements.

The AWRM alternative provides for a regional watershed solution for chloride as an alternative to compliance with the existing 100 mg/L WQO, considers the use of SSOs and water resource management facilities that would allow for the full protection of all beneficial uses, while simultaneously providing a more feasible compliance solution, maintains a chloride balance in the USCR watershed, and provides salt export and water supply benefits to Los Angeles and Ventura County stakeholders. The results of the evaluation for the AWRM compliance with proposed SSOs are summarized in Table 6-2.

7.0 REFERENCES

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TABLES

TABLE 1-1

GSWIM INITIAL SCENARIOS MATRIX

Upper Santa Clara River Chloride TMDL

Santa Clara River Valley, California

GSWIM Scenarios			
Compliance Option	**Reuse Scenario 1 High Water Reuse**	**Reuse Scenario 2 Intermediate Water Reuse**	**Reuse Scenario 3 Low Water Reuse**
MF/RO at 100 mg/L (Saugus and Valencia WRPs)	1a	***2a***	3a
MF/RO at 120 mg/L (Saugus and Valencia WRPs)	1b	***2b***	3b
MF/RO at 150 mg/L (Saugus and Valencia WRPs)	***1c***	***2c***	***3c***
MF/RO at 160 mg/L (Saugus and Valencia WRPs)	*1d*	*2d*	*3d*
Chloride Loading Above Water Softeners (0% SRWS removal)	***1e***	***2e***	***3e***
Chloride Loading Above Water Softeners (50% SRWS removal)	1f	2f	3f
Chloride Loading Above Water Softeners (100% SRWS removal)	1g	***2g***	3g

Notes:

Scenarios performed by Geomatrix Consultants, Inc. are shown in ***bold italics and underlined.*** Scenarios that were not performed are shown in *italics*.

The remaining scenarios were performed by CH2M HILL. Scenarios 2e and 2g were conducted using chloride loadings computed by assuming additional wastewater treatment using an ultraviolet (UV) treatment process. SRWS refers to Self Regenerating Water Softeners.

TABLE 1-2

GSWIM SIMULATIONS OF ALTERNATIVE COMPLIANCE OPTIONS

Upper Santa Clara River Chloride TMDL

Santa Clara River Valley, California

GSWIM Alternative Compliance Scenarios			
Compliance Alternatives	**Elements**	**Potential Benefits**	**Infrastructure Requirementrs**
Advanced Treatment	Treat all Valencia and Saugus WRP discharages to 100 mg/L	Chloride mass removal, reduced concentrations in SCR at Blue Cut	Installation and operation of MF/RO treatment at both WRPs and development of 43 mile brine discharge piping to ocean
Zero Discharge	Divert all Valencia and Saugus WRP discharges to ocean	Chloride mass removal	Development of 43 mile discharge piping to ocean to accommodate all WRP discharge, plus new ocean outfall
Minimal Discharge	Treat 4.6 MGD of Valencia WRP discharge and 5.0 MGD of Saugus discharge using MF/RO, all other discharges to ocean	Chloride mass removal, maintain minimal SCR flows for habitat	Installation and operation of MF/RO treatment at both WRPs and development of 43 mile brine waste and WRP discharge piping to ocean, plus new ocean outfall
Alternate WRP Discharge Location	Move Valencia WRP discharge location to top of SCR Reach 7	Better use of basin assimilative capacity	Development of 16 miles of pipeline for alternative discharge
Alternative Water Resource Management	Treat 3 MGD of Valencia WRP discharges using MF/RO, develop salt export pumping in Piru Basin, use dilution flows to moderate chloride concentrations in SCR	Basin-wide approach, chloride mass removal, reduced concentrations in SCR at Blue Cut, water supply benefits in Ventura County	Installation and operation of MF/RO treatment at Valencia WRP, 12-mile permeate pipeline for RO flows, outfall to SCR near Blue Cut, brine discharge via deep-well injection, installation of 100 well water supply system and piping in Piru Basin, replacement water for dilution flows during drought

TABLE 5-1

PROPOSED REVISIONS TO MINERAL WATER QUALITY OBJECTIVES TO SUPPORT THE AWRM

Upper Santa Clara River Chloride TMDL

Santa Clara River Valley, California

Proposed Revisions to WQOs for Surface Waters			
Mineral WQO	**Reach 4B**	**Reach 5**	**Reach 6**
Chloride	117 mg/L (SWP chloride less than 80mg/L) 130 mg/L (SWP chloride less than 80mg/L) *Previous WQO = 100 mg/L*	150 mg/L (12-month average) *Previous WQO = 100 mg/L*	150 mg/L (12-month average) *Previous WQO = 100 mg/L*
Total Dissolved Solids	1,300 mg/L (no change from previous)	1,000 mg/L (no change from previous)	1,000 mg/L (no change from previous)
Sulfate	600 mg/L (no change from previous)	400 mg/L (no change from previous)	450 mg/L *Previous WQO = 300 mg/L*
Proposed Revisions to WQOs for Groundwater			
Mineral WQO	**East Piru**	**Castaic Valley**	**Santa Clara - Bouquet and San Franciscito Canyons**
Chloride	TBD *Previous WQO = 200 mg/L*	150 mg/L (no change from previous)	150 mg/L *Previous WQO = 100 mg/L*
Total Dissolved Solids	TBD *Previous WQO = 2,500 mg/L*	1,000 mg/L (no change from previous)	1,000 mg/L *Previous WQO = 700 mg/L*
Sulfate	TBD *Previous WQO - 1,200 mg/L*	350 mg/L (no change from previous)	450 mg/L *Previous WQO - 250 mg/L*

TABLE 6-1

SUMMARY OF COMPLIANCE ALTERNATIVE ATTAINMENT FREQUENCIES

Upper Santa Clara River Chloride TMDL

Santa Clara River Valley, California

Compliance Alternative	Surface Water at Blue Cut		East Piru Basin Groundwater			West Piru Basin Groundwater		
	Surface Water WQO 100 mg/L	LRE Threshold 120 mg/L	Surface Water WQO 100 mg/L	LRE Threshold 120 mg/L	Groundwater WQO 200 mg/L	Surface Water WQO 100 mg/L	LRE Threshold 120 mg/L	Groundwater WQO 100 mg/L
Scenario 1g_UV	41.2	77.8	43.5	76.3	100.0	100.0	100.0	100.0
Advanced Treatment - 1a	66.8	99.0	55.0	99.6	100.0	100.0	100.0	100.0
Advanced Treatment - 2a	66.4	100.0	54.2	99.6	100.0	100.0	100.0	100.0
Advanced Treatment - 3a	66.1	100.0	55.3	99.8	100.0	100.0	100.0	100.0
Mimimal Discharge	65.5	87.8	62.1	98.8	100.0	100.0	100.0	100.0
Zero Discharge	63.8	80.7	68.3	97.5	100.0	100.0	100.0	100.0
Alternate WRP Location	48.9	76.0	46.1	80.5	100.0	100.0	100.0	100.0

Note: Value represents percentage of days during simulation period that chloride is predicted to be equal to or less than the WQO concentration

TABLE 6-2

SUMMARY OF SITE SPECIFIC OBJECTIVE ATTAINMENT FREQUENCIES FOR THE AWRM ALTERNATIVE

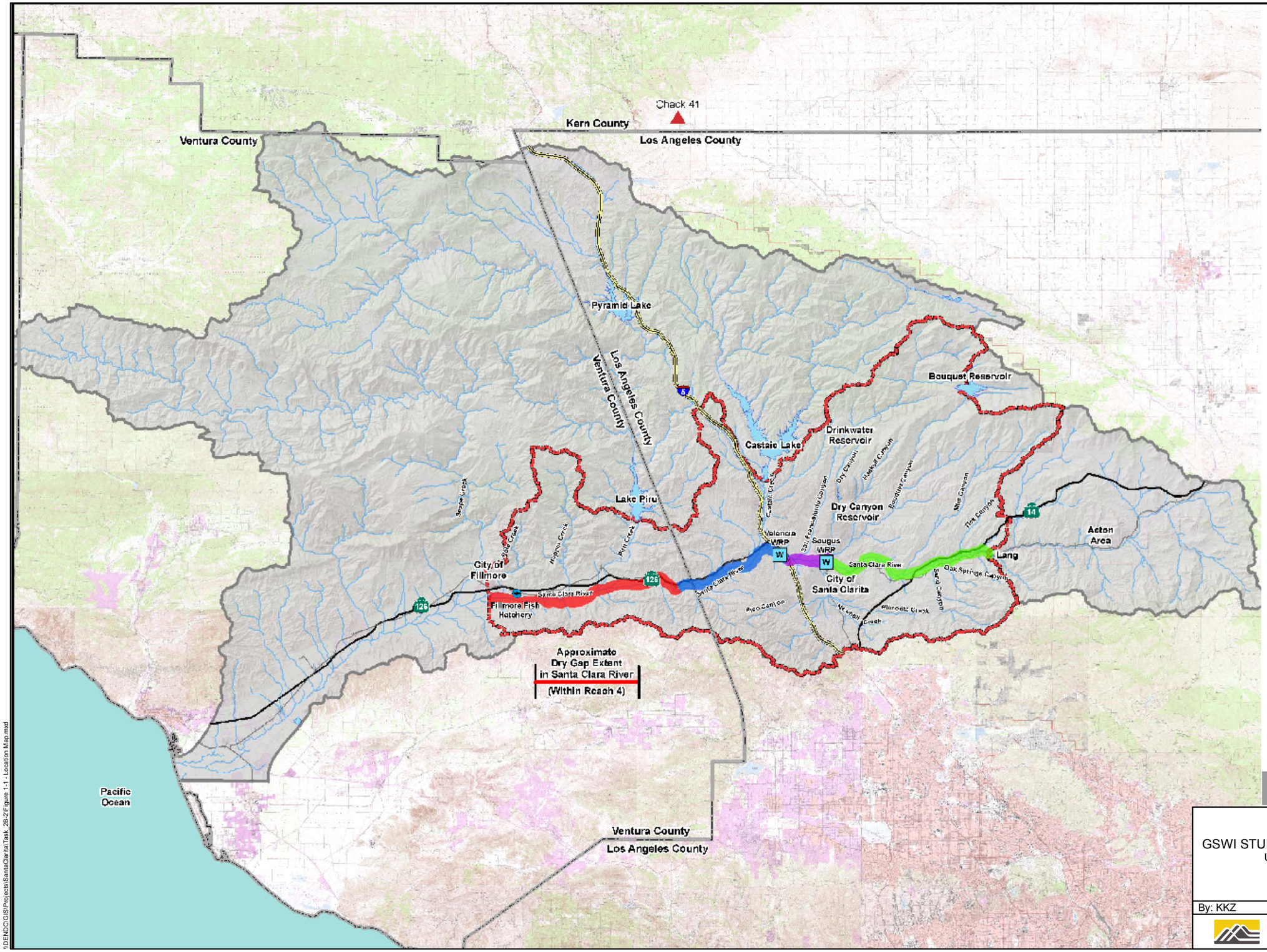
Upper Santa Clara River Chloride TMDL

Santa Clara River Valley, California

Compliance Alternative	Reach 4B (at Blue Cut)		Reach 5		Reach 6	
	Surface Water WQO During Non-Drought 117 mg/L	Suface Water WQO During Drought 130 mg/L	Surface Water WQO 150 mg/L	Groundwater WQO 150 mg/L	Surface Water WQO 150 mg/L	Groundwater WQO 150 mg/L
AWRM Alternative	99.9	99.2	98.3-99.7	100.0	98.6 - 99.7	100.0

Note: Value represents percentage of days during simulation period that chloride is predicted to be equal to or less than the WQO concentration

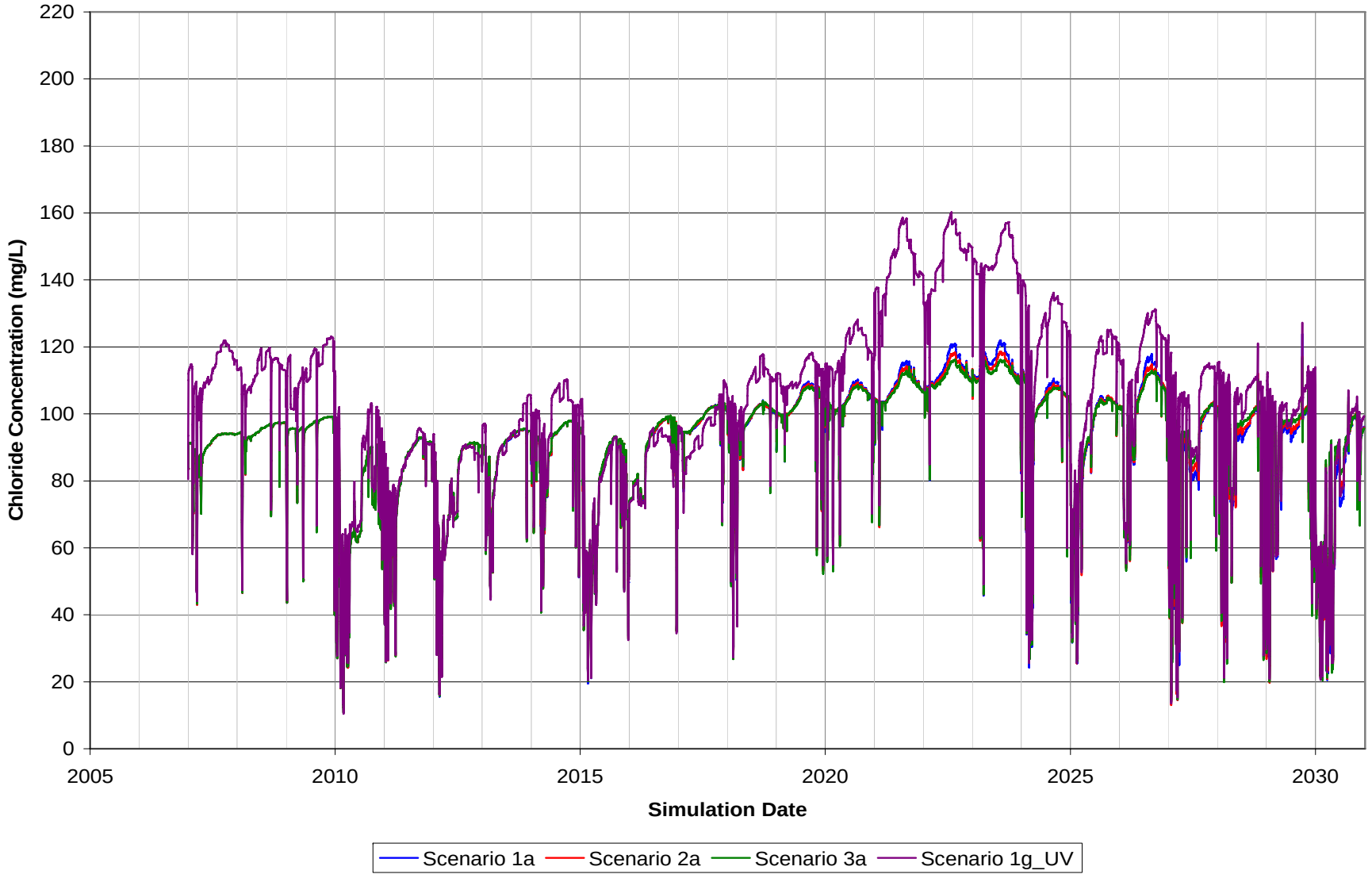
FIGURES



GSWI STUDY AREA AND SURROUNDING VICINITY
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix		Figure 1-1

\\DENDC\GIS\Projects\SantaClarita\Task_2B-2\Figure 1-1 - Location Map.mxd



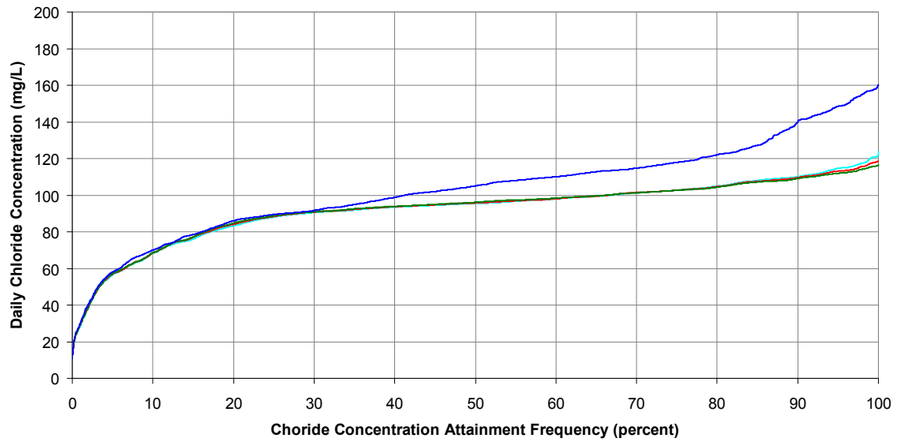
Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS AT BLUE CUT FOR THE ADVANCED TREATMENT ALTERNATIVES
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

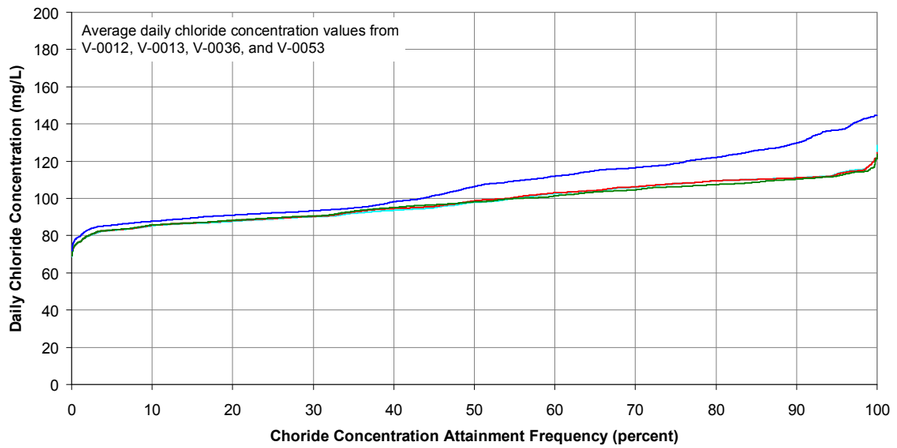
Project No.
10354

Figure
2-1

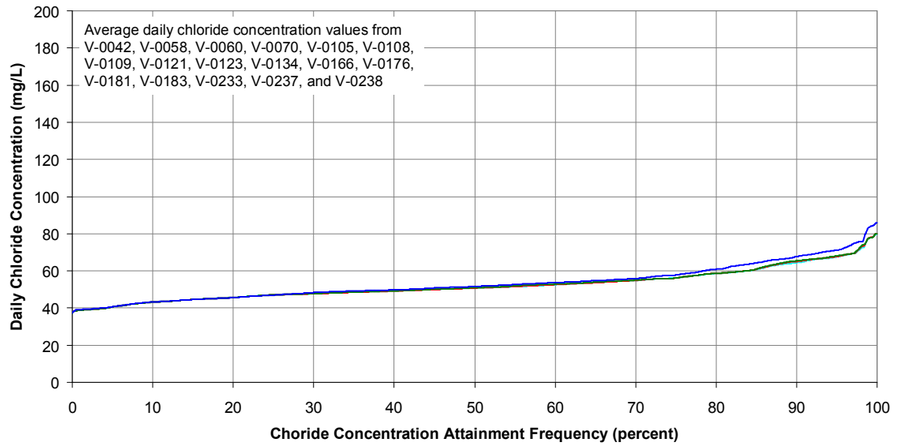
Blue Cut



Groundwater East of Piru Creek



Groundwater West of Piru Creek



Daily Chloride Threshold Attainment Frequencies (percent)

Explanation

- High Reuse; 100 mg/L Chloride in Saugus and Valencia WRP Discharge (Scenario 1a)
- Intermediate Reuse; 100 mg/L Chloride in Saugus and Valencia WRP Discharge (Scenario 2a)
- Low Reuse; 100 mg/L Chloride in Saugus and Valencia WRP Discharge (Scenario 3a)
- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners (Scenario 1gUV)

Blue Cut

Simulation	Surface Water WQO	Avocado Threshold	
	100 mg/L	100 mg/L	120 mg/L
Scenario 1a	66.8	66.8	99.0
Scenario 2a	66.4	66.4	100.0
Scenario 3a	66.1	66.1	100.0
Scenario 1gUV	41.2	41.2	77.8

Groundwater East of Piru Creek

Simulation	Surface Water WQO	Avocado Threshold	
	100 mg/L	100 mg/L	120 mg/L
Scenario 1a	55.0	55.0	99.6
Scenario 2a	54.2	54.2	99.6
Scenario 3a	55.3	55.3	99.8
Scenario 1gUV	43.5	43.5	76.3

Groundwater West of Piru Creek

Simulation	Surface Water WQO	Avocado Threshold	
	100 mg/L	100 mg/L	120 mg/L
Scenario 1a	100.0	100.0	100.0
Scenario 2a	100.0	100.0	100.0
Scenario 3a	100.0	100.0	100.0
Scenario 1gUV	100.0	100.0	100.0

Notes:

1. Attainment frequency represents the percent of time during the future simulation period that chloride concentrations were at or below the indicated daily chloride concentration.

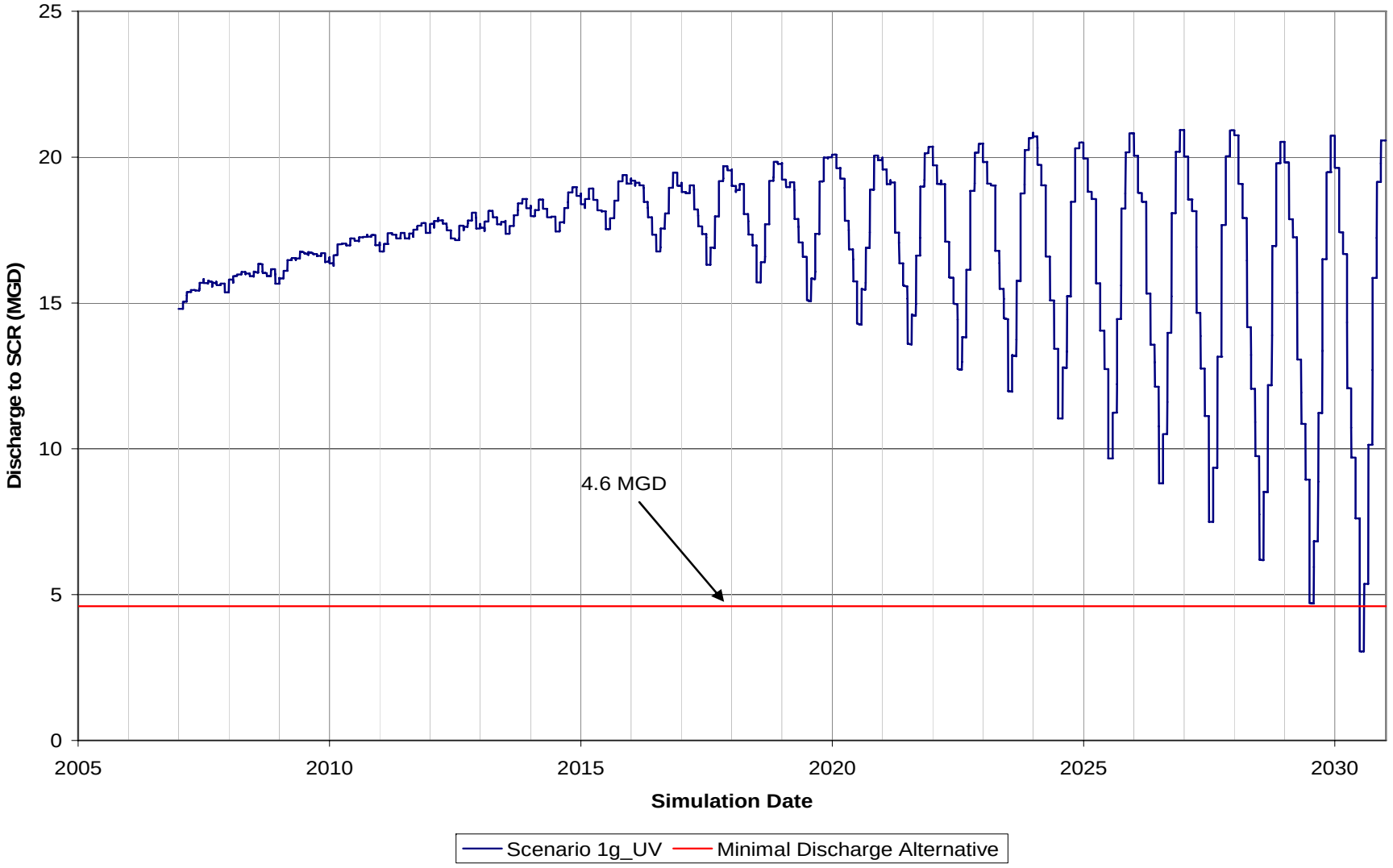
D R A F T

SIMULATED DAILY CHLORIDE ATTAINMENT FREQUENCIES AT BLUE CUT AND PIRU BASIN GROUNDWATER - ADVANCED TREATMENT ALTERNATIVES

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	2-2

\\DENDC\Depdata\Project\10354\Task 2B-2 Report\Figures\Figure 2-2 - Attainment Frequencies 1a 2a 3a 1gUV.mxd

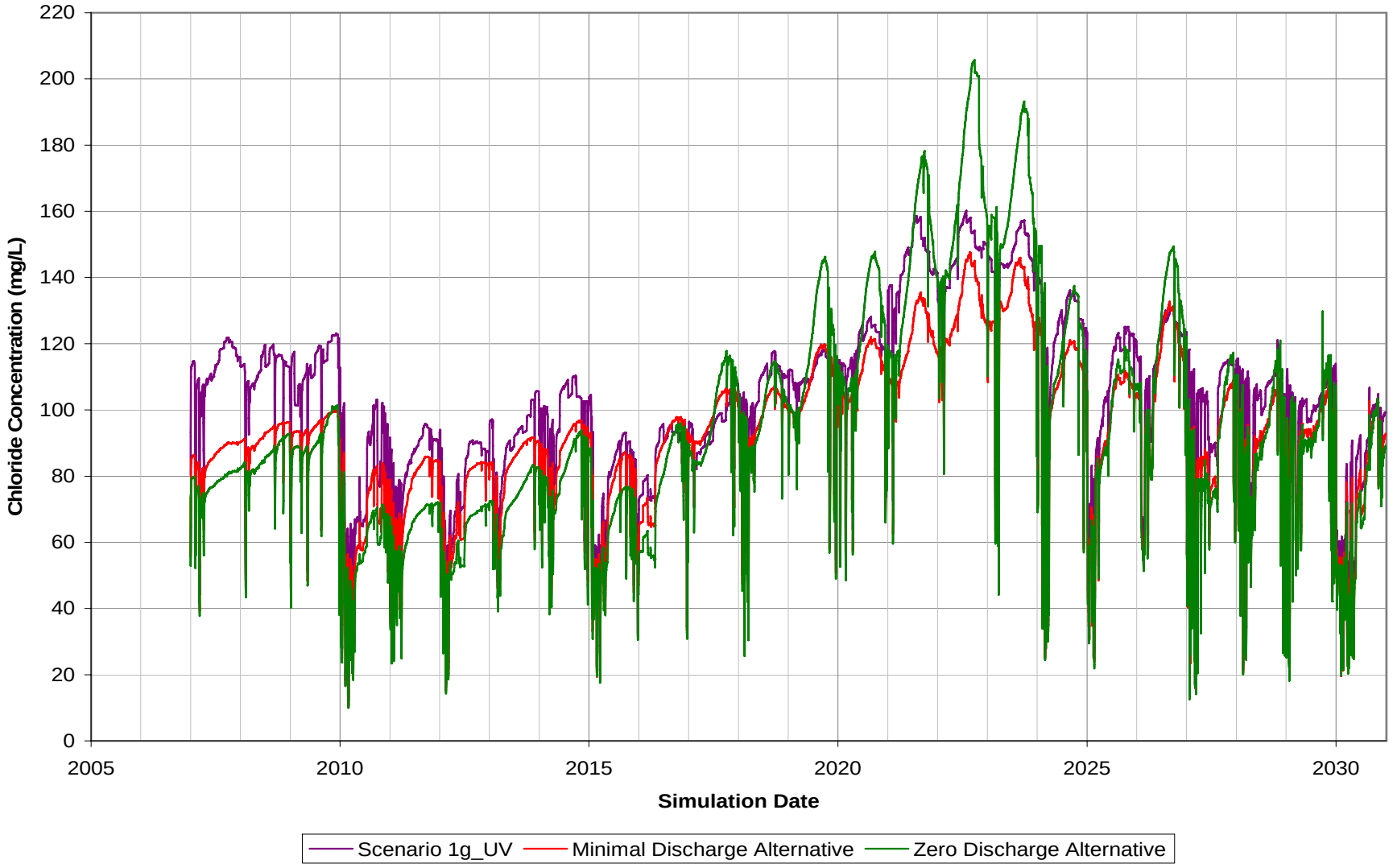


Geomatrix

SIMULATED DISCHARGES FROM THE VALENCIA WRP FOR THE MINIMAL DISCHARGE ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
3-1



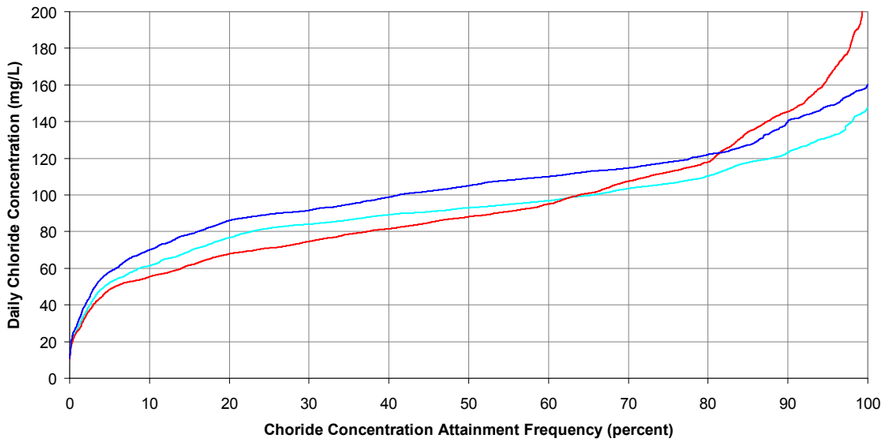
Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS AT BLUE CUT FOR THE ZERO AND MINIMAL DISCHARGE ALTERNATIVES
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

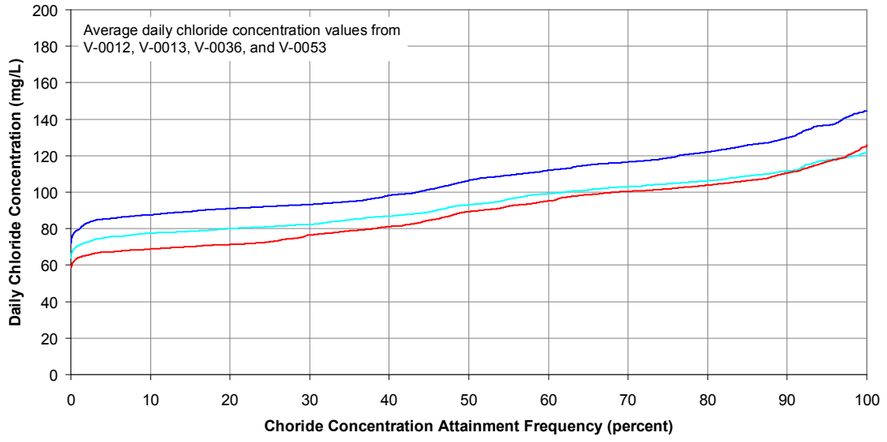
Project No.
10354

Figure
3-2

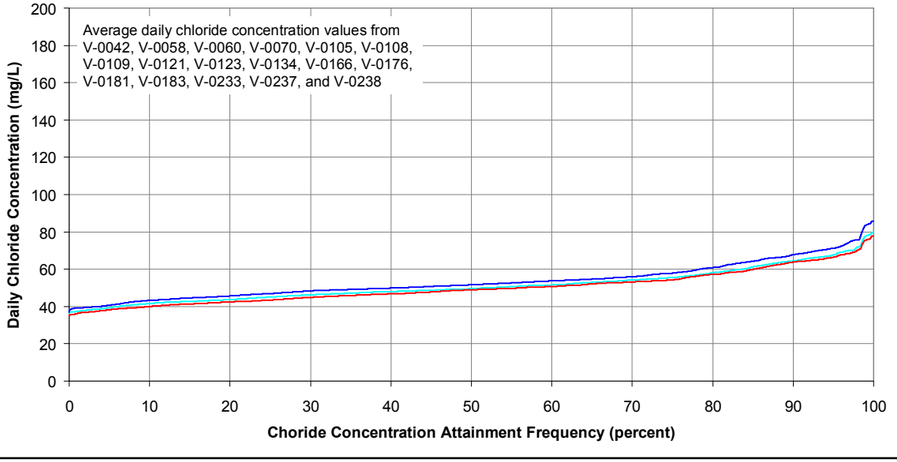
Blue Cut



Groundwater East of Piru Creek



Groundwater West of Piru Creek



Daily Chloride Threshold Attainment Frequencies (percent)

Explanation

- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners with Minimal WRP Discharge Alternative
- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners with Zero WRP Discharge Alternative
- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners (Scenario 1gUV)

Blue Cut

Simulation	Surface Water WQO	Avocado Threshold	
	100 mg/L	100 mg/L	120 mg/L
Minimal Discharge Alternative	65.5	65.5	87.8
Zero Discharge Alternative	63.8	63.8	80.7
Scenario 1gUV	41.2	41.2	77.8

Groundwater East of Piru Creek

Simulation	Surface Water WQO	Avocado Threshold	
	100 mg/L	100 mg/L	120 mg/L
Minimal Discharge Alternative	62.1	62.1	98.8
Zero Discharge Alternative	68.3	68.3	97.5
Scenario 1gUV	43.5	43.5	76.3

Groundwater West of Piru Creek

Simulation	Surface Water WQO	Avocado Threshold	
	100 mg/L	100 mg/L	120 mg/L
Minimal Discharge Alternative	100.0	100.0	100.0
Zero Discharge Alternative	100.0	100.0	100.0
Scenario 1gUV	100.0	100.0	100.0

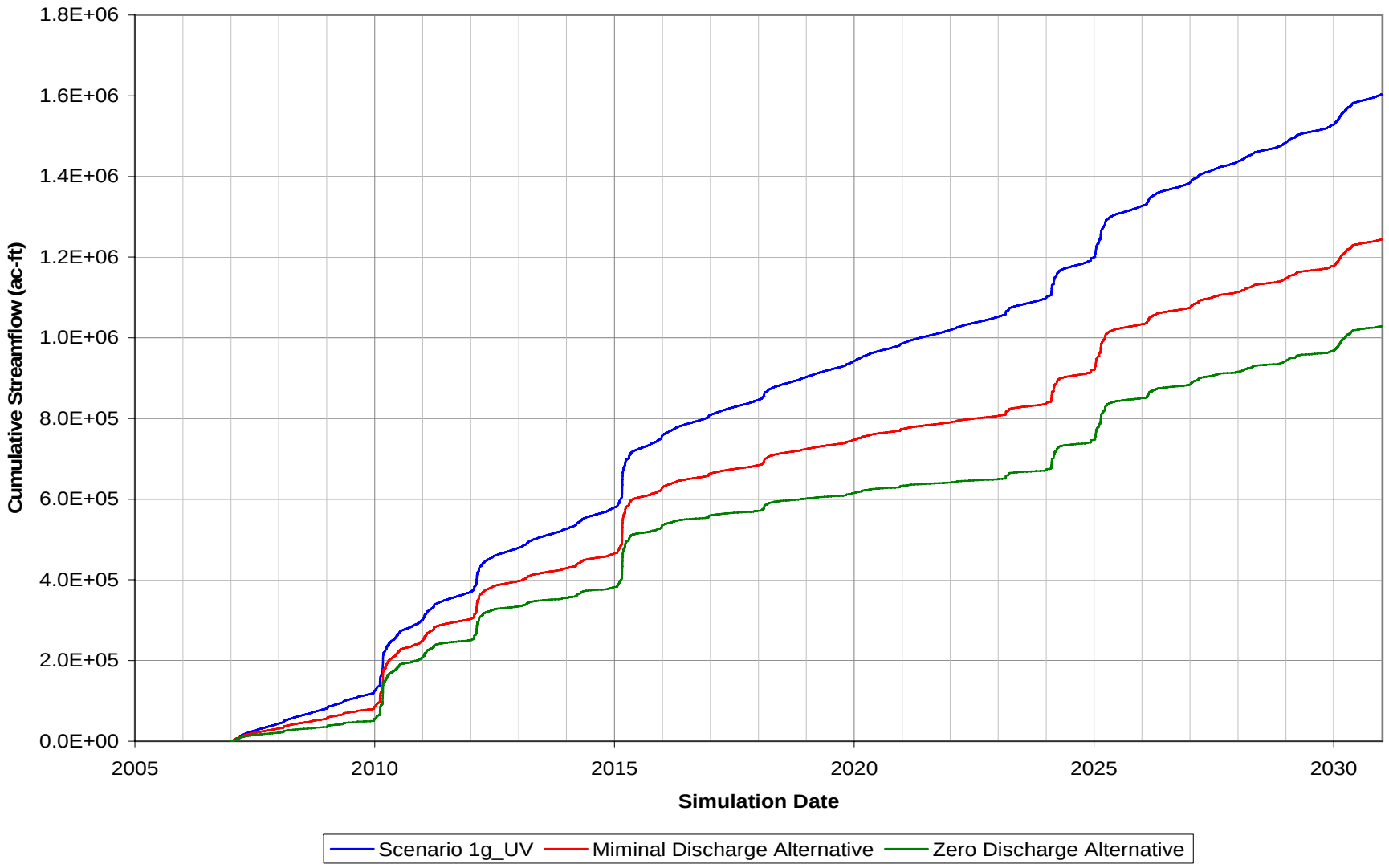
Notes:
1. Attainment frequency represents the percent of time during the future simulation period that chloride concentrations were at or below the indicated daily chloride concentration.

D R A F T

SIMULATED DAILY CHLORIDE ATTAINMENT FREQUENCIES AT BLUE CUT AND PIRU BASIN GROUNDWATER - ZERO AND MINIMAL DISCHARGE ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	3-3

\\DENDC\Depdata\Project\10354\Task 2B-2 Report\Figures\Figure 3-3 - Attainment Frequencies Zero Disch Min Disch 1gUV.mxd

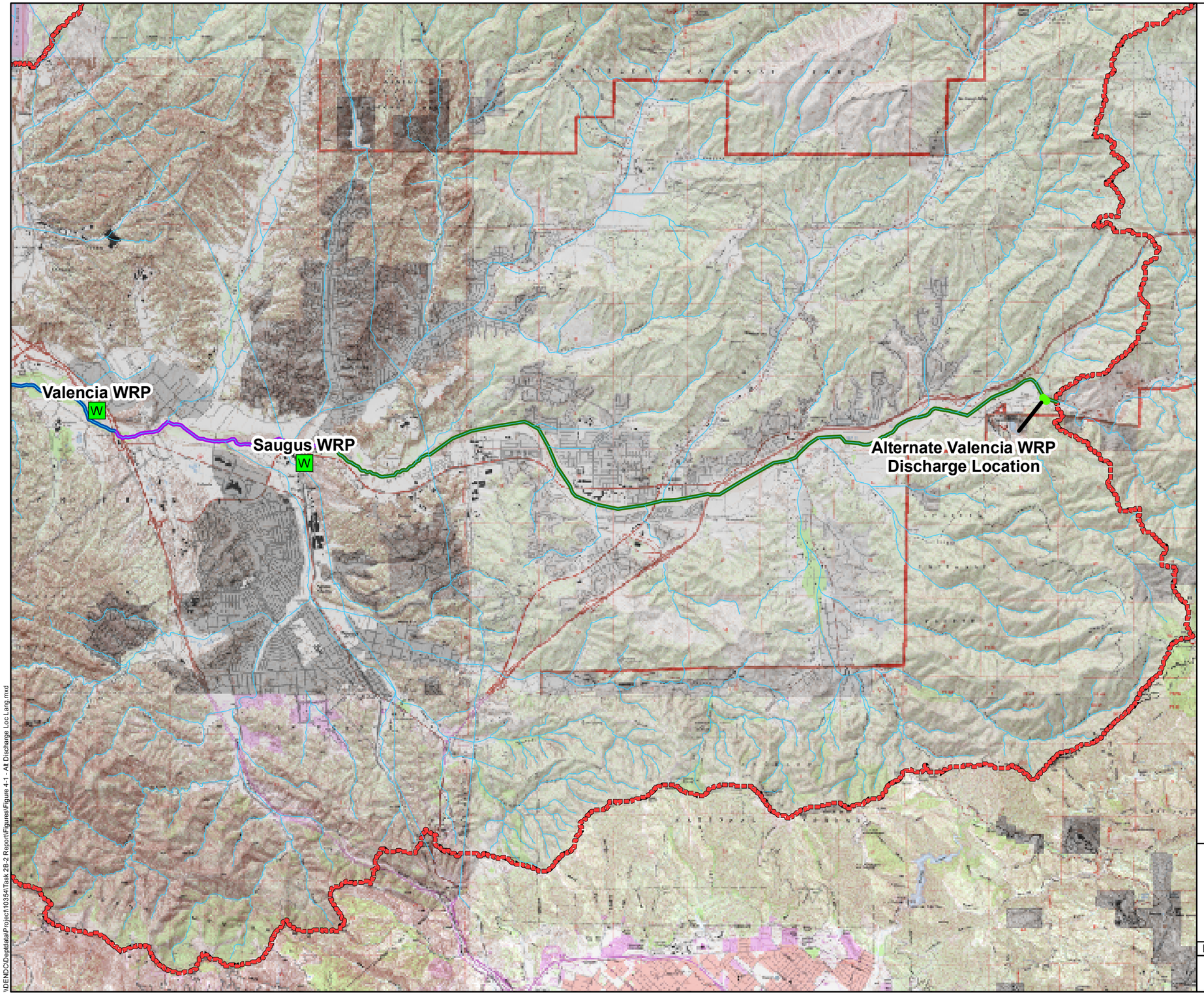


Geomatrix

SIMULATED CUMULATIVE SURFACE FLOWS AT BLUE CUT FOR THE ZERO AND MINIMAL DISCHARGE ALTERNATIVES
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
3-4



Explanation

- GWSI Study Area
- W — WRP Location
- Alternate Valencia WRP Discharge Location
- Streams

Santa Clara River Reaches (RWQCB)

- Reach 4
- Reach 5 (Chloride TMDL Reach)
- Reach 6 (Chloride TMDL Reach)
- Reach 7

N

0 0.5 1 2 3 4
Miles

D R A F T

SIMULATED ALTERNATE LOCATION FOR VALENCIA WATER RECLAMATION PLANT DISCHARGES

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix		Figure **4-1**

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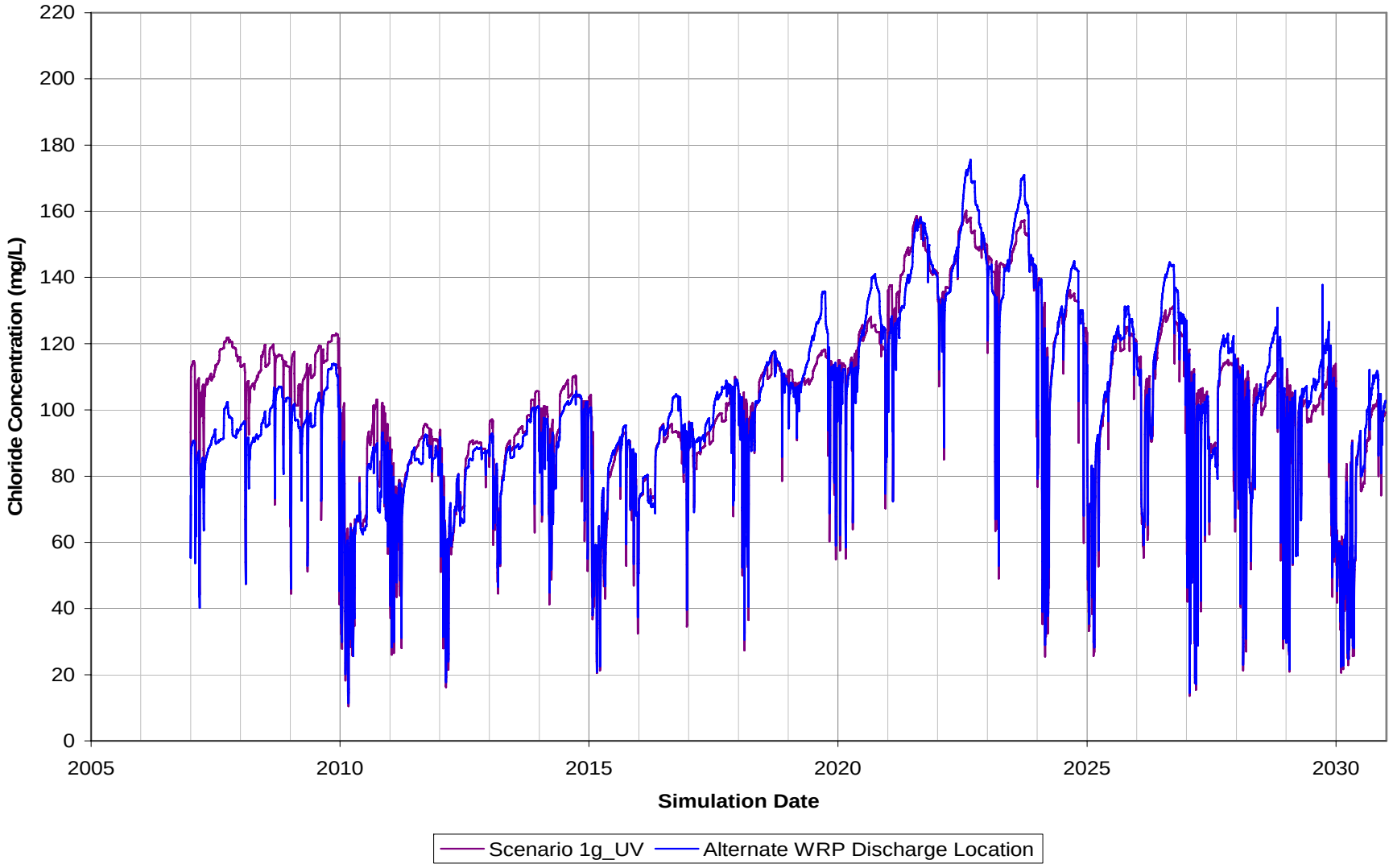


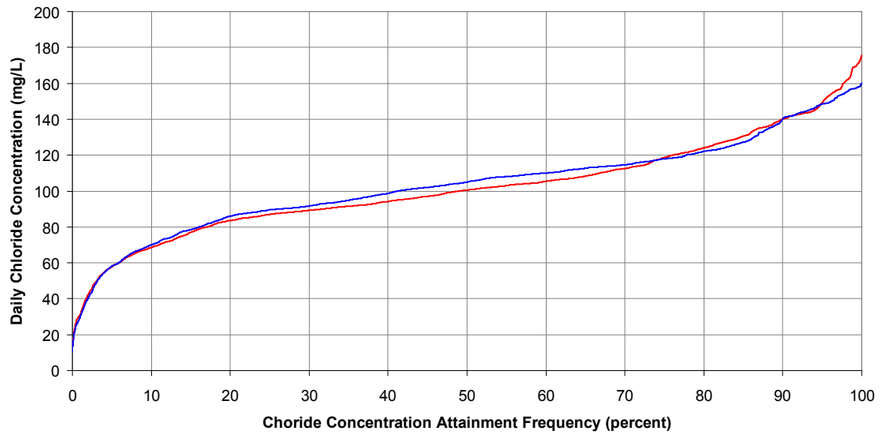
Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS AT BLUE CUT FOR THE ALTERNATE WRP DISCHARGE LOCATION ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

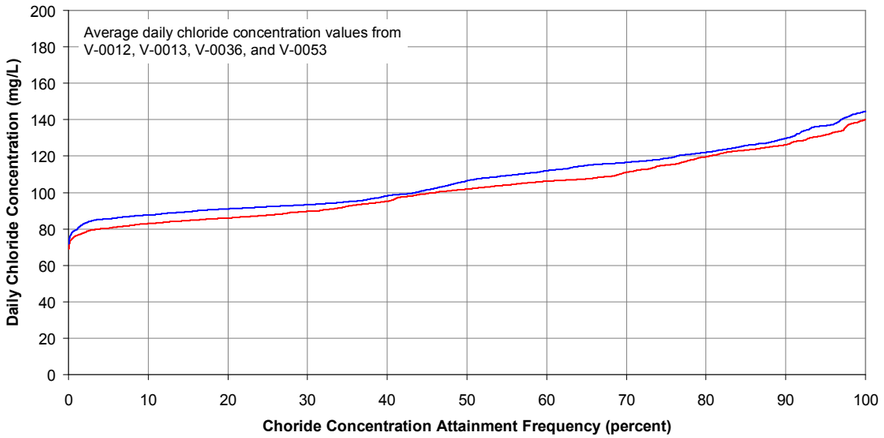
Project No.
10354

Figure
4-2

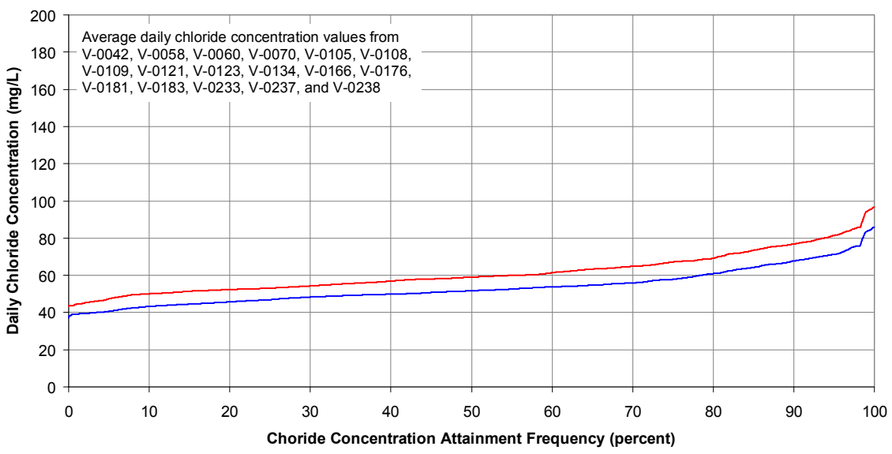
Blue Cut



Groundwater East of Piru Creek



Groundwater West of Piru Creek



Daily Chloride Threshold Attainment Frequencies (percent)

Explanation

- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners with Alternate WRP Discharge Location Alternative
- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners (Scenario 1gUV)

Blue Cut

Simulation	Surface Water WQO 100 mg/L	Avocado Threshold 100 mg/L	Avocado Threshold 120 mg/L
Alternate Discharge Location	48.9	48.9	76.0
Scenario 1gUV	41.2	41.2	77.8

Groundwater East of Piru Creek

Simulation	Surface Water WQO 100 mg/L	Avocado Threshold 100 mg/L	Avocado Threshold 120 mg/L
Alternate Discharge Location	46.1	46.1	80.5
Scenario 1gUV	43.5	43.5	76.3

Groundwater West of Piru Creek

Simulation	Surface Water WQO 100 mg/L	Avocado Threshold 100 mg/L	Avocado Threshold 120 mg/L
Alternate Discharge Location	100.0	100.0	100.0
Scenario 1gUV	100.0	100.0	100.0

Notes:
1. Attainment frequency represents the percent of time during the future simulation period that chloride concentrations were at or below the indicated daily chloride concentration.

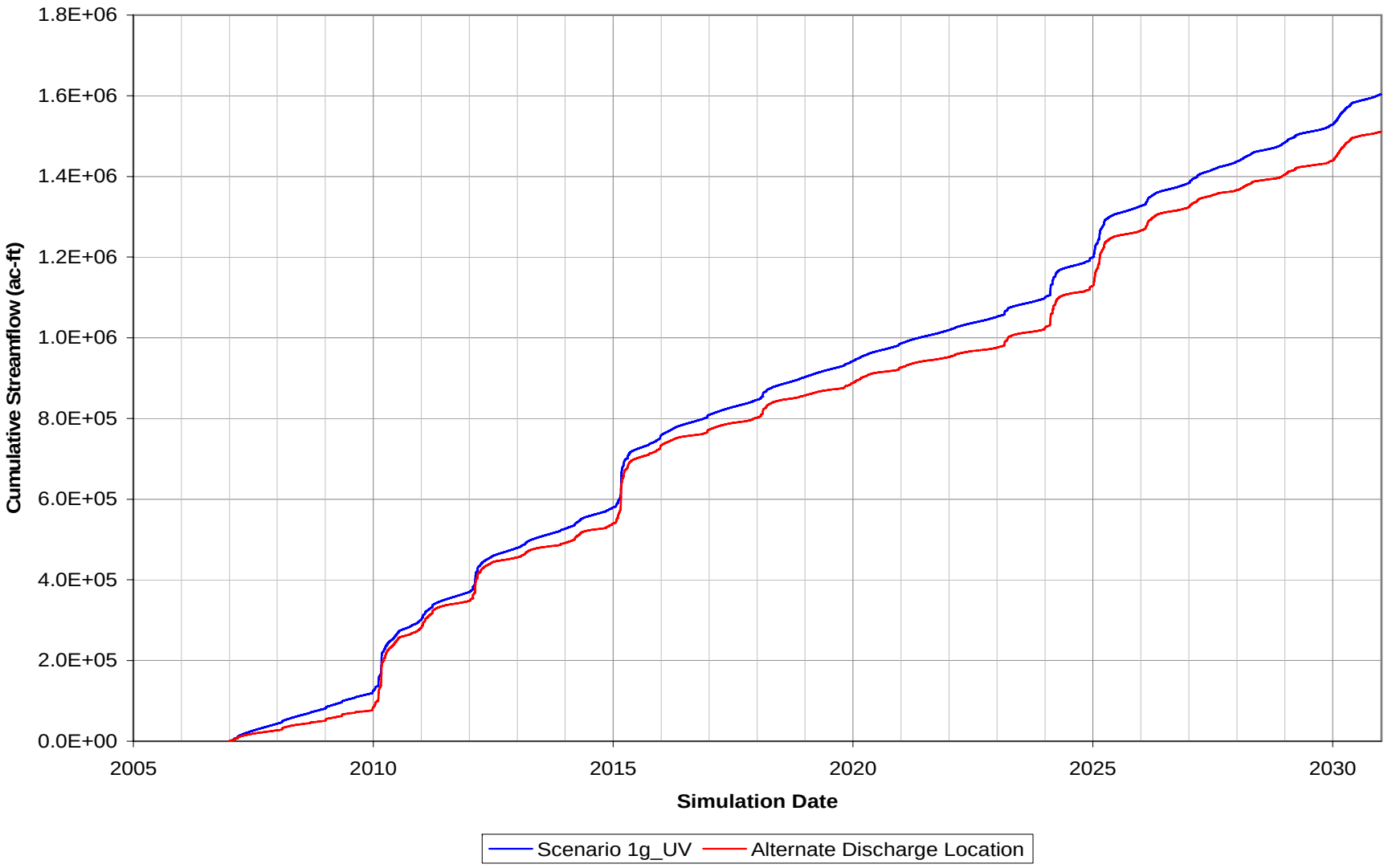
D R A F T

SIMULATED DAILY CHLORIDE ATTAINMENT FREQUENCIES AT BLUE CUT AND PIRU BASIN GROUNDWATER - ALTERNATE DISCHARGE LOCATION ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	4-3

\\DENDC\Depdata\Project\10354\Task 2B-2 Report\Figures\Figure 4-3 - Attainment Frequencies Alt Dsch Loc 1gUV.mxd

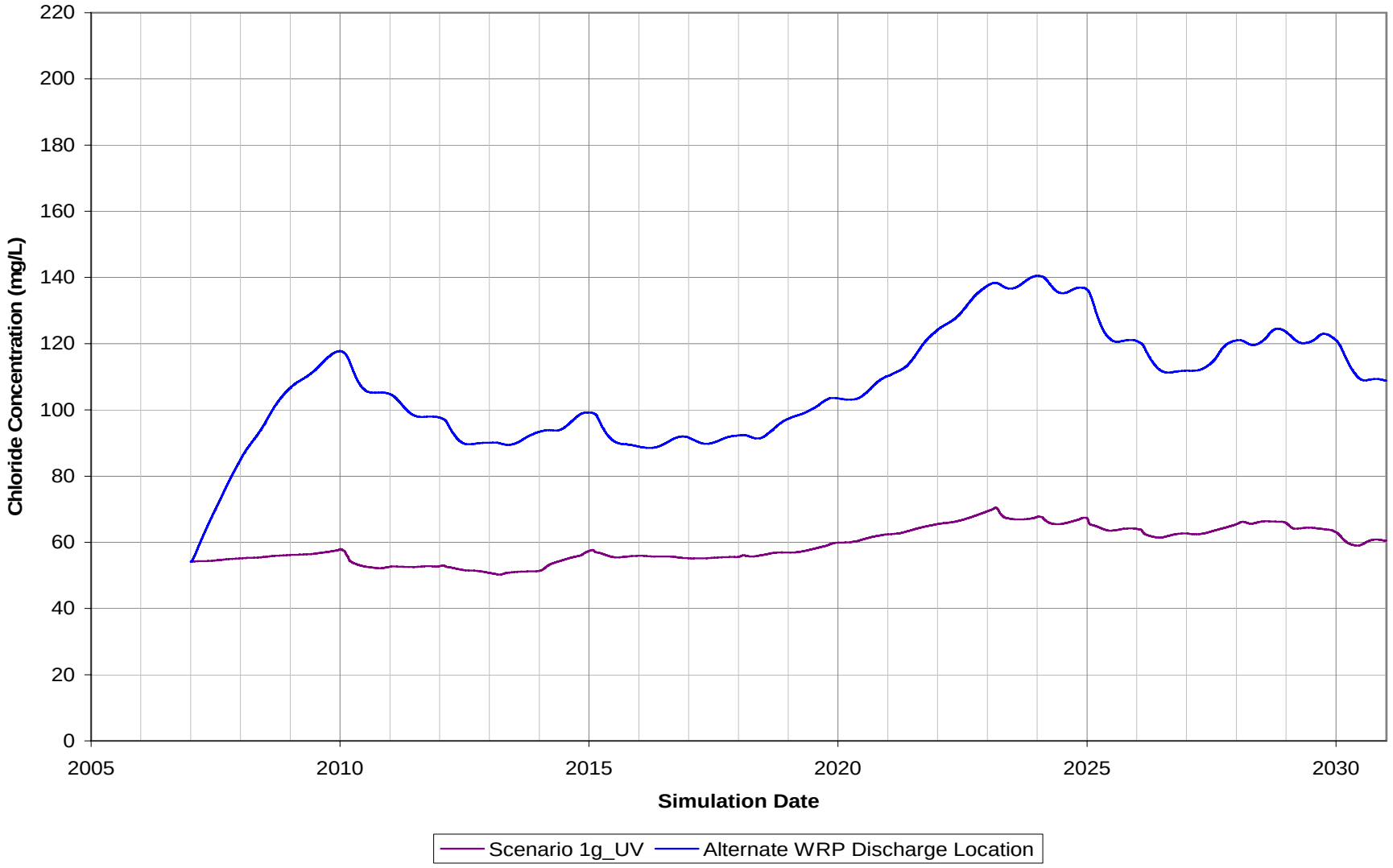


Geomatrix

SIMULATED CUMULATIVE SURFACE FLOWS AT BLUE CUT FOR THE ALTERNATE WRP DISCHARGE LOCATION ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
4-4

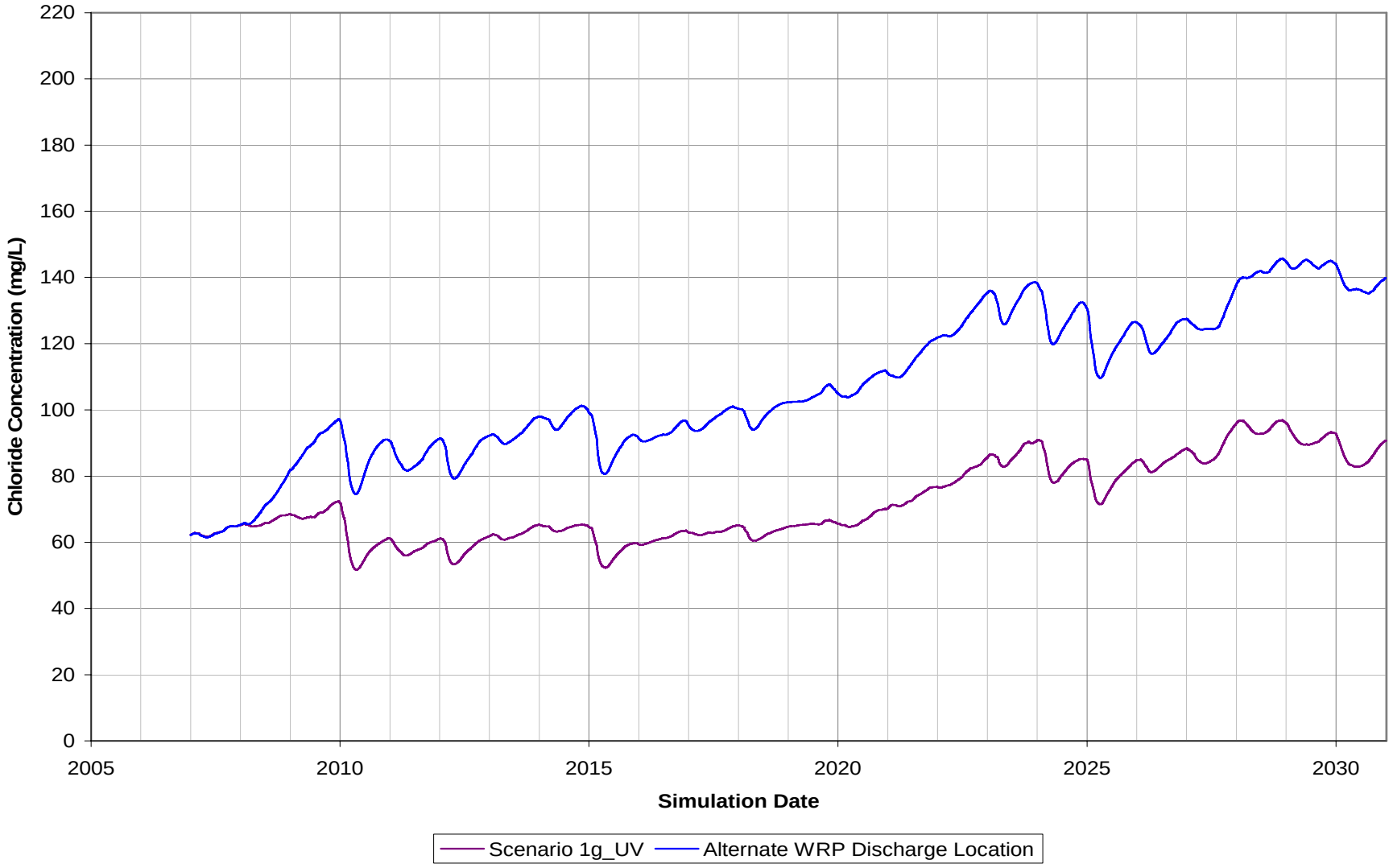


Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS IN NCWD'S PINETREE WELL, ALTERNATE WRP DISCHARGE LOCATION ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
4-5

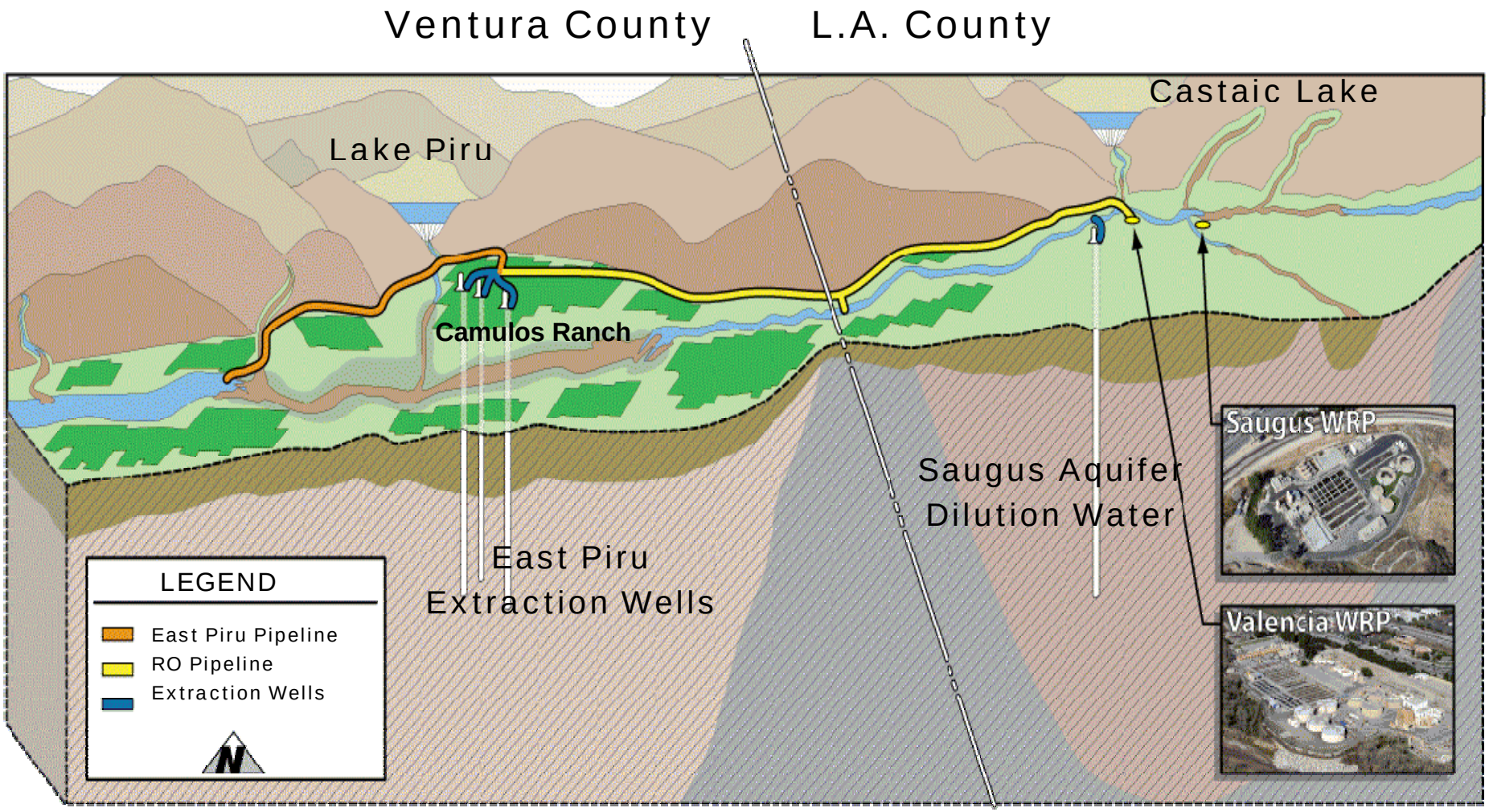


Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS IN VWC'S Q2 WELL, ALTERNATE WRP DISCHARGE LOCATION ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
4-6

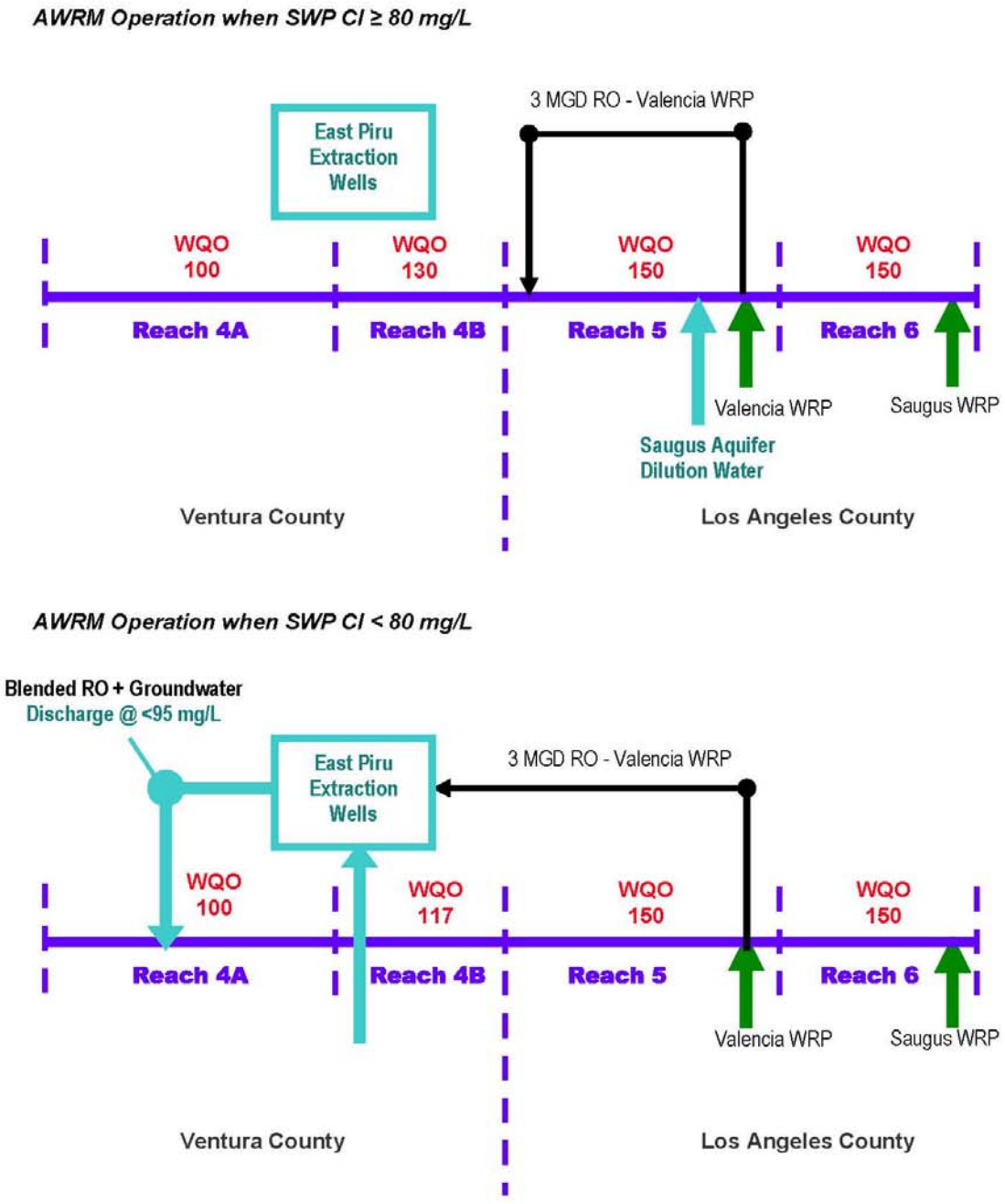


Geomatrix

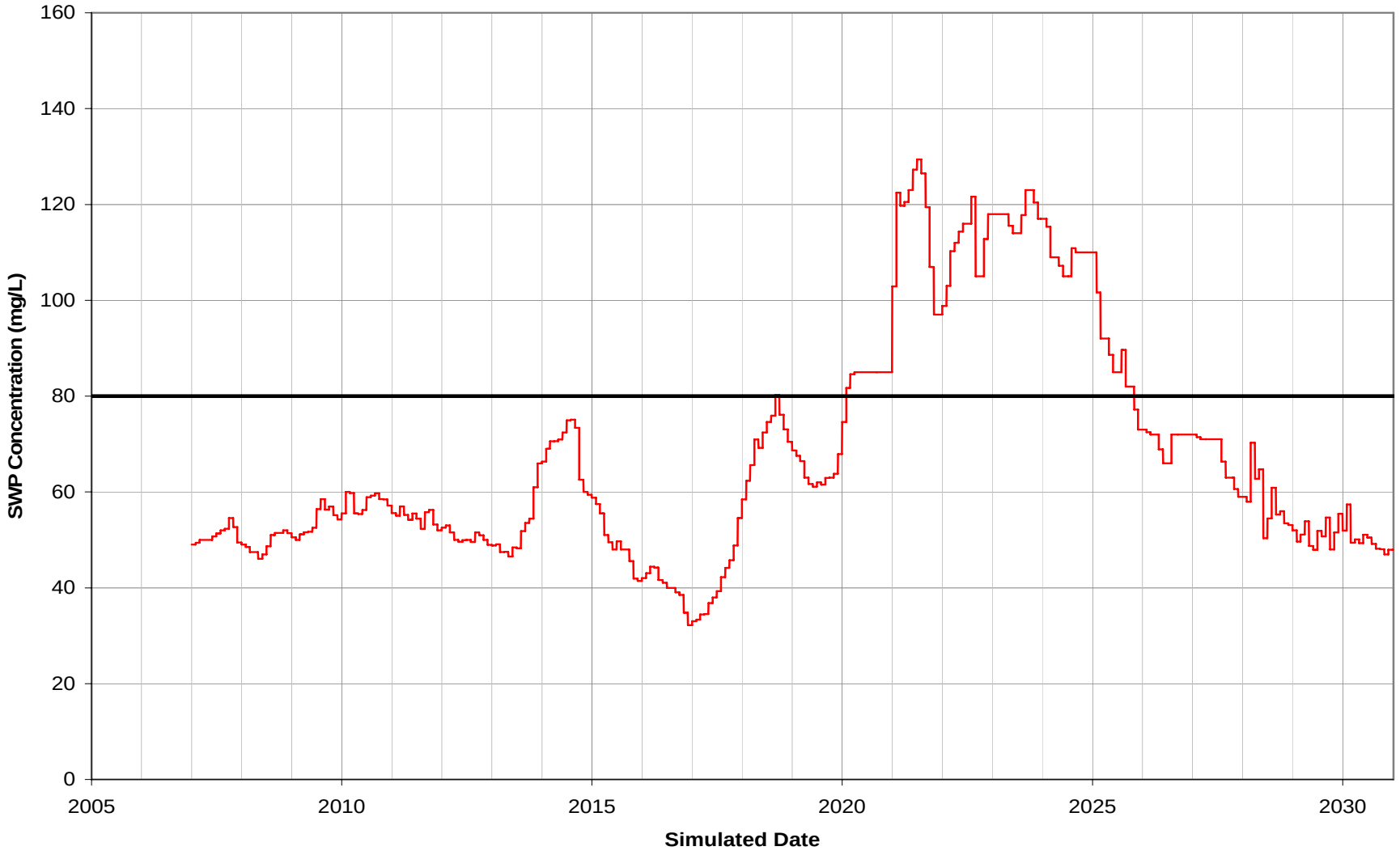
CONCEPTUAL SCHEMATIC SHOWING AWRM ELEMENTS
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-1



Geomatrix	CONCEPTUAL OPERATIONS OF THE AWRM ALTERNATIVE Upper Santa Clara River Chloride TMDL Santa Clara River Valley, California	Project No. 10354 Figure **5-2**

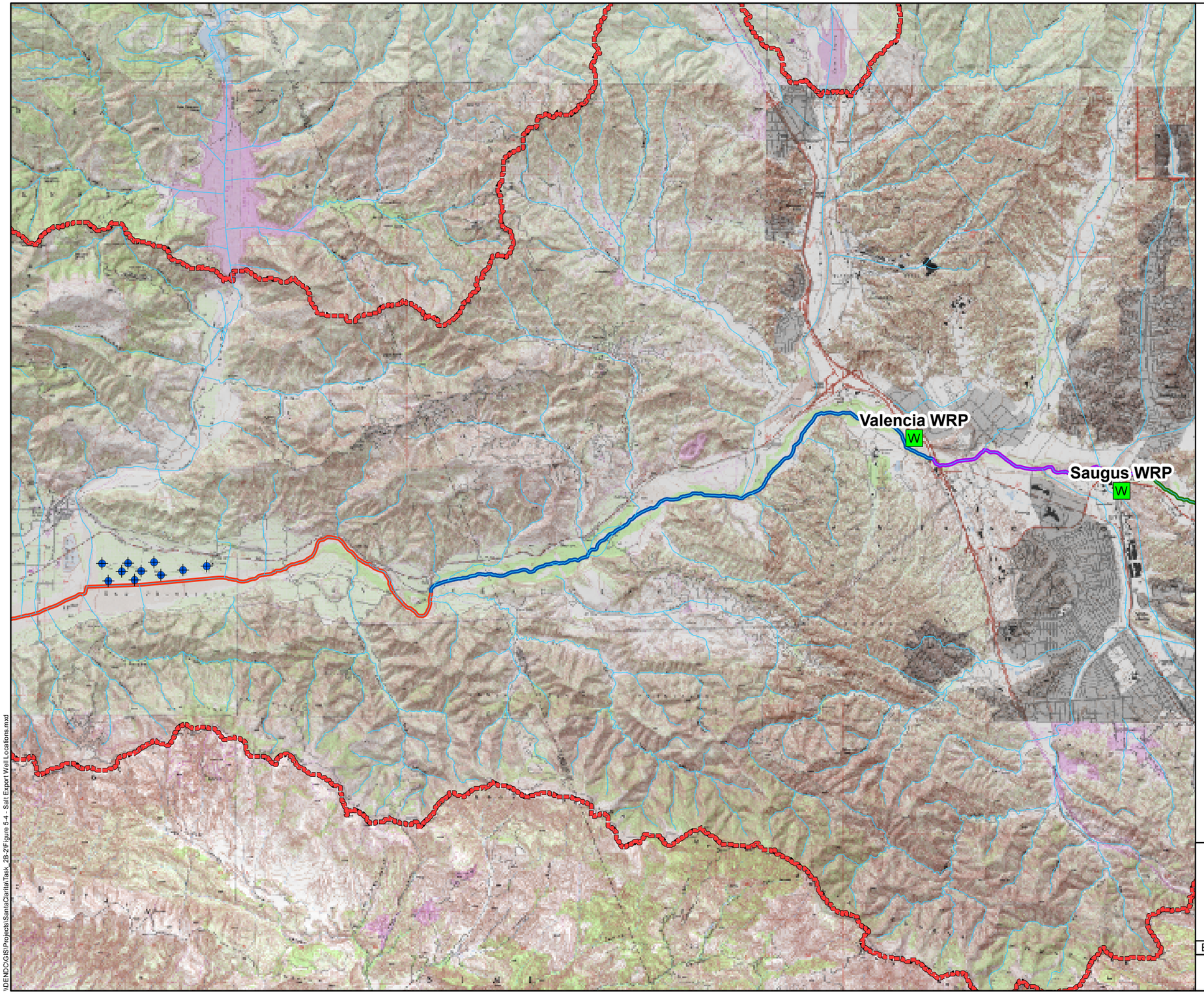


Geomatrix

SIMULATED STATE WATER PROJECT CHLORIDE CONCENTRATIONS – AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-3



Explanation

- GWSI Study Area
- W WRP Location
- Salt Export Wells
- Streams

Santa Clara River Reaches (RWQCB)

- Reach 4
- Reach 5 (Chloride TMDL Reach)
- Reach 6 (Chloride TMDL Reach)
- Reach 7

N

0 0.5 1 2 3 4

Miles

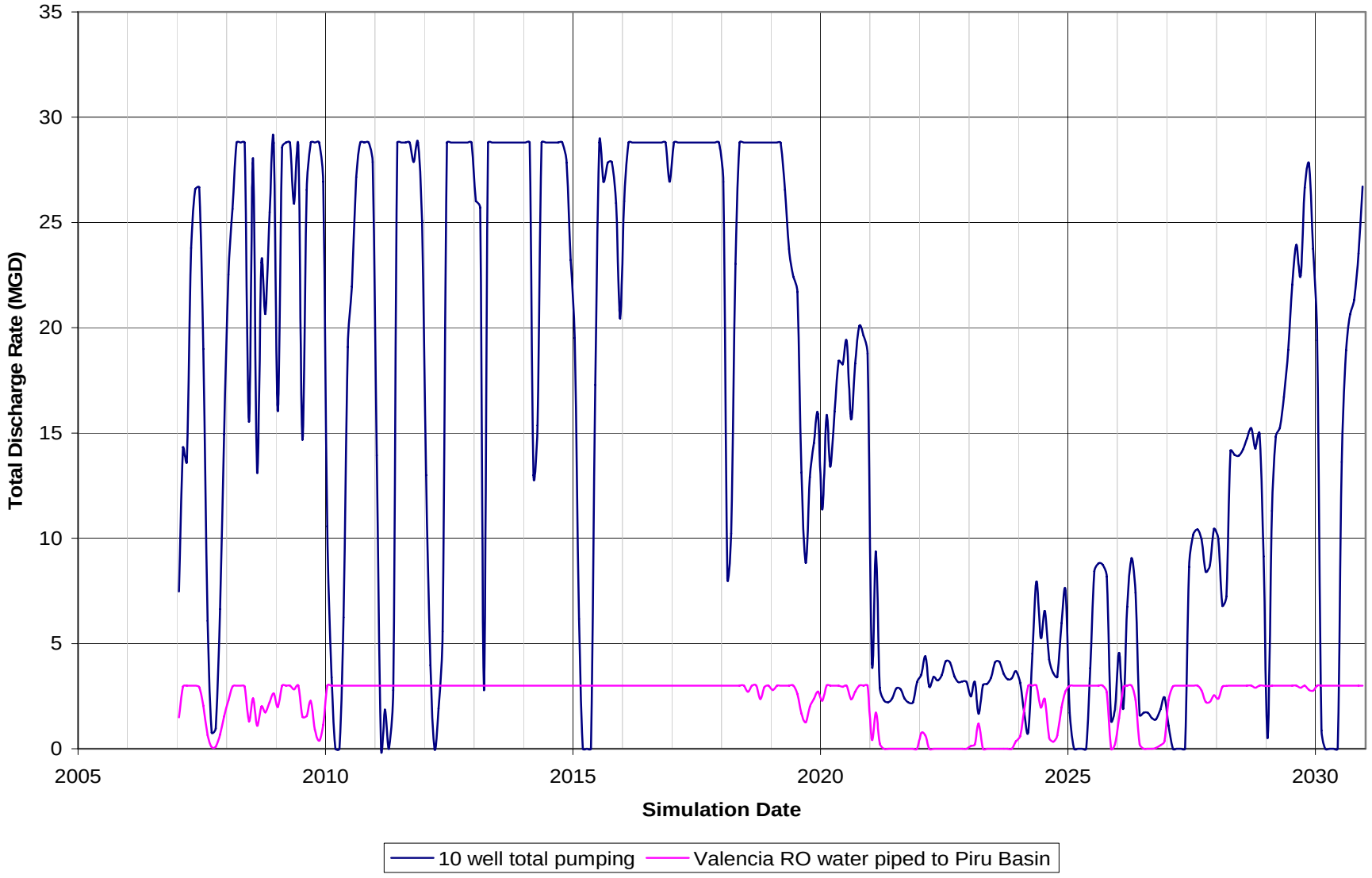
D R A F T

LOCATION OF SIMULATED SALT EXPORT WELLS
NEAR PIRU CREEK

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	5-4

I:\DENDOC\GIS\Projects\SantaClarita\Task_2B-2\Figure 5-4 - Salt Export Well Locations.mxd

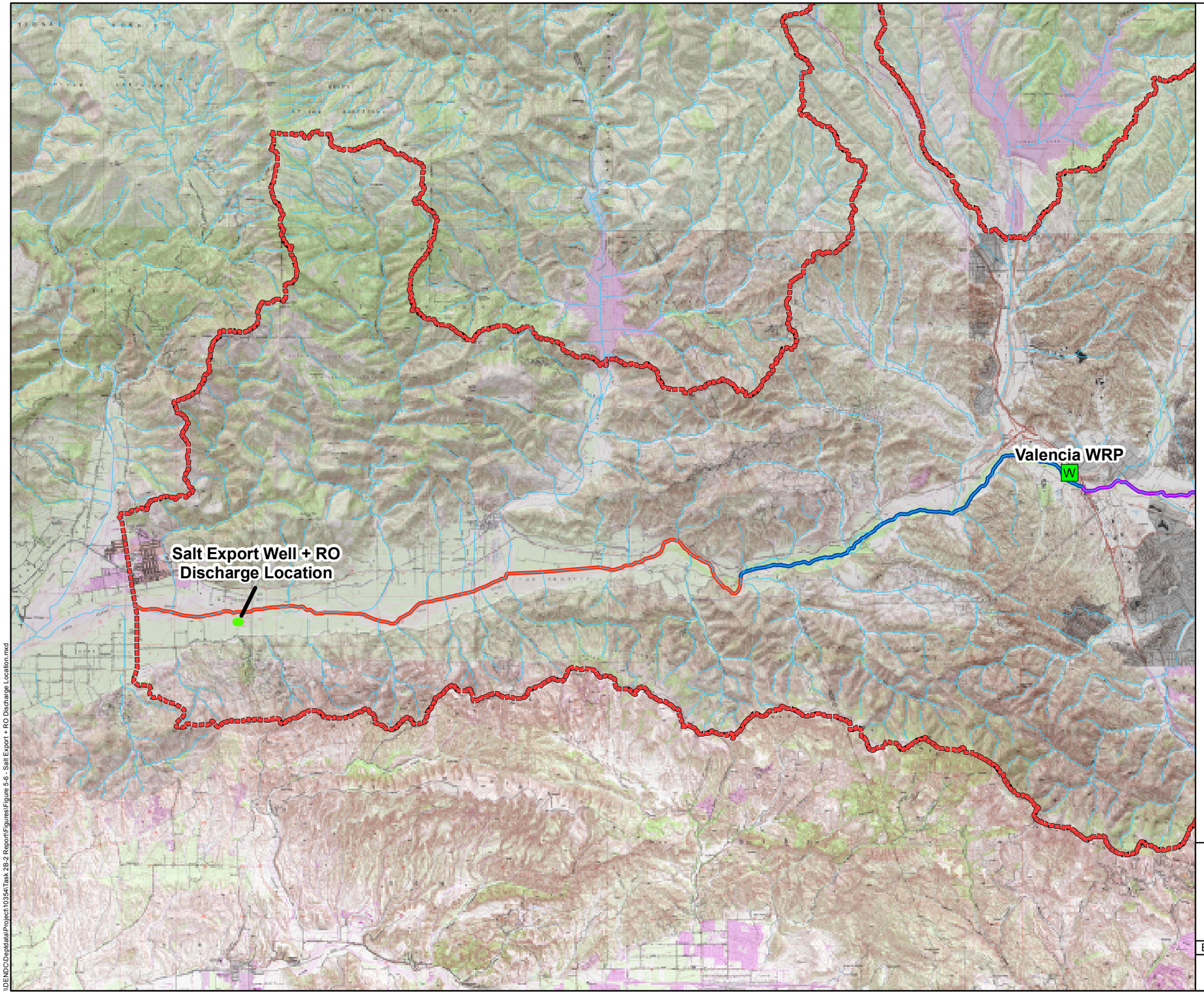


Geomatrix

SIMULATED PUMPING RATES FOR SALT EXPORT WELLS, AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-5



Explanation

- GWSI Study Area
- W WRP Location
- Salt Export Well + RO Discharge Location
- Streams

Santa Clara River Reaches (RWQCB)

- Reach 4
- Reach 5 (Chloride TMDL Reach)
- Reach 6 (Chloride TMDL Reach)
- Reach 7

N

0 0.5 1 2 3 4 5
Miles

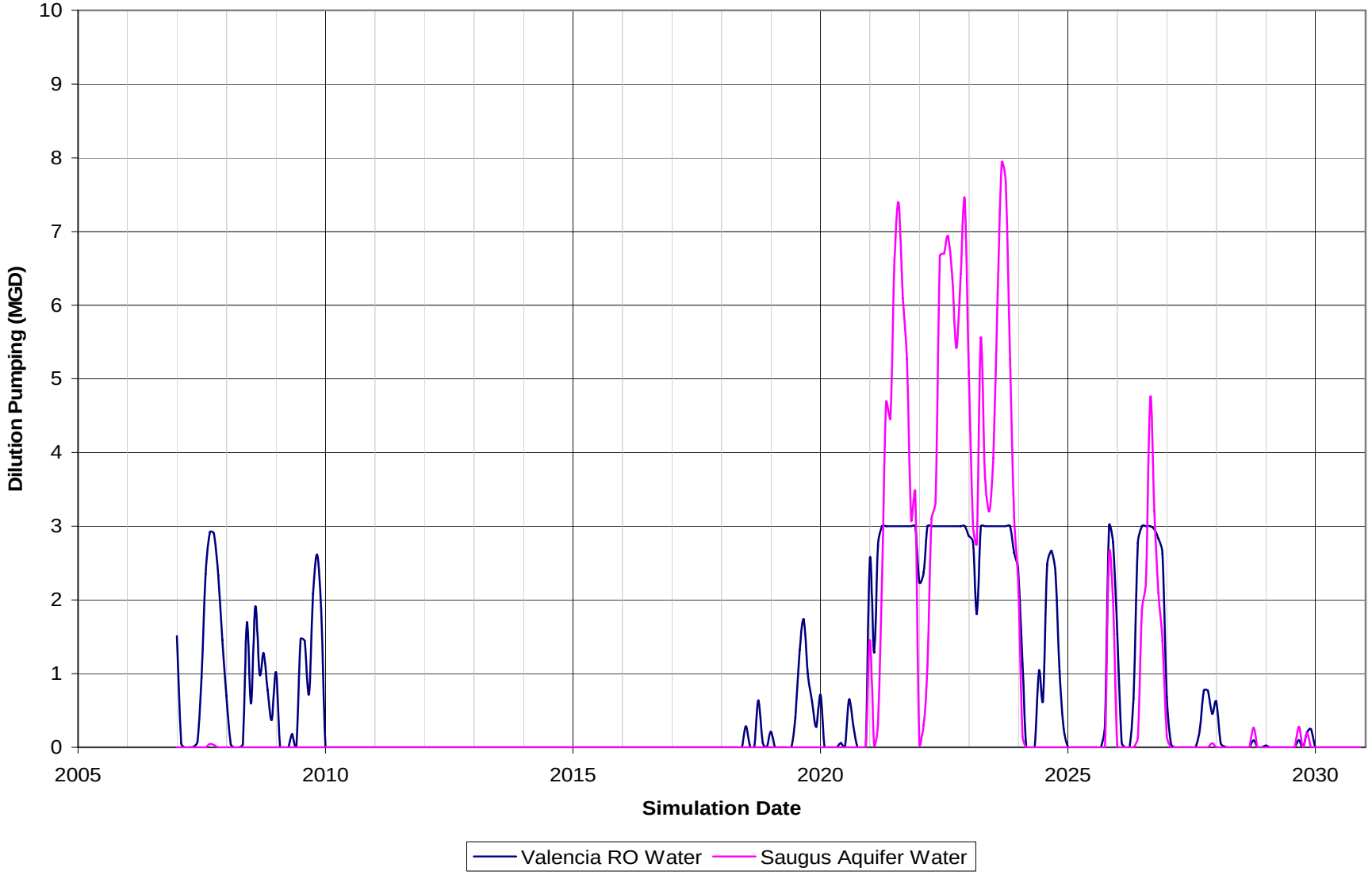
D R A F T

SIMULATED DISCHARGE LOCATION FOR MIX OF SALT EXPORT WELL PUMPING AND VALENCIA WRP RO WATER

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	5-6

\\DENDC\Depdata\Project\10354\Task 2B-2 Report\Figures\Figure 5-6 - Salt Export + RO Discharge Location.mxd

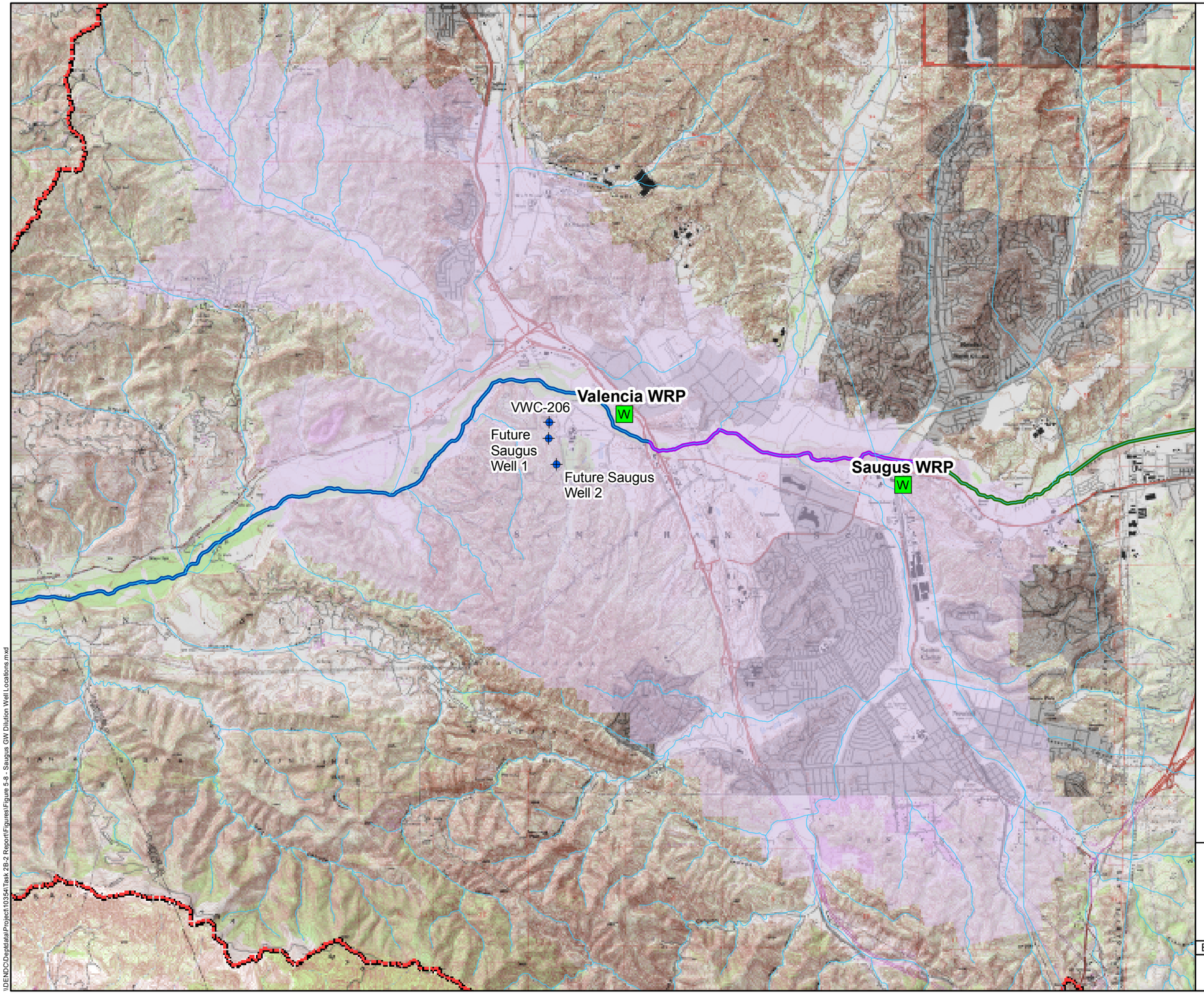


Geomatrix

SIMULATED RATES OF SUPPLEMENTAL WATER DISCHARGES - AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-7



Explanation

- GWSI Study Area
- W — WRP Location
- Saugus Aquifer Supplemental Pumping Well
- Streams

Santa Clara River Reaches (RWQCB)

- Reach 4
- Reach 5 (Chloride TMDL Reach)
- Reach 6 (Chloride TMDL Reach)
- Reach 7

N

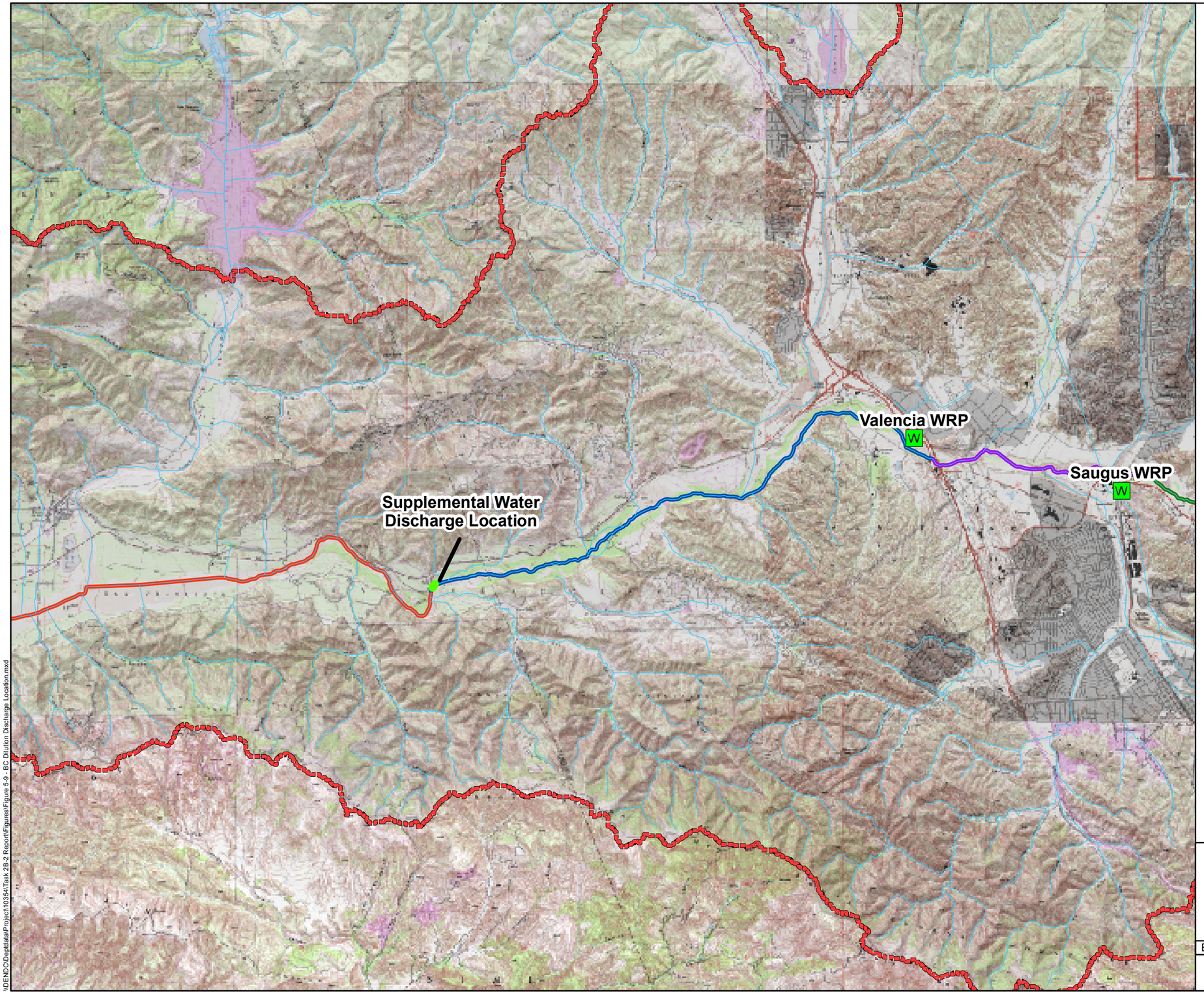
0 0.5 1 2 3 4
Miles

D R A F T

SIMULATED PUMPING LOCATIONS FOR SAUGUS SUPPLEMENTAL WATER – AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	5-8

\\DENDC\Dept\data\Project\10354\Task 2B-2 Report\Figures\Figure 5-8 - Saugus GW Dilution Well Locations.mxd



Explanation

- GWSI Study Area
- W WRP Location
- Supplemental Discharge Location
- Streams

Santa Clara River Reaches (RWQCB)

- Reach 4
- Reach 5 (Chloride TMDL Reach)
- Reach 6 (Chloride TMDL Reach)
- Reach 7

N

0 0.5 1 2 3 4

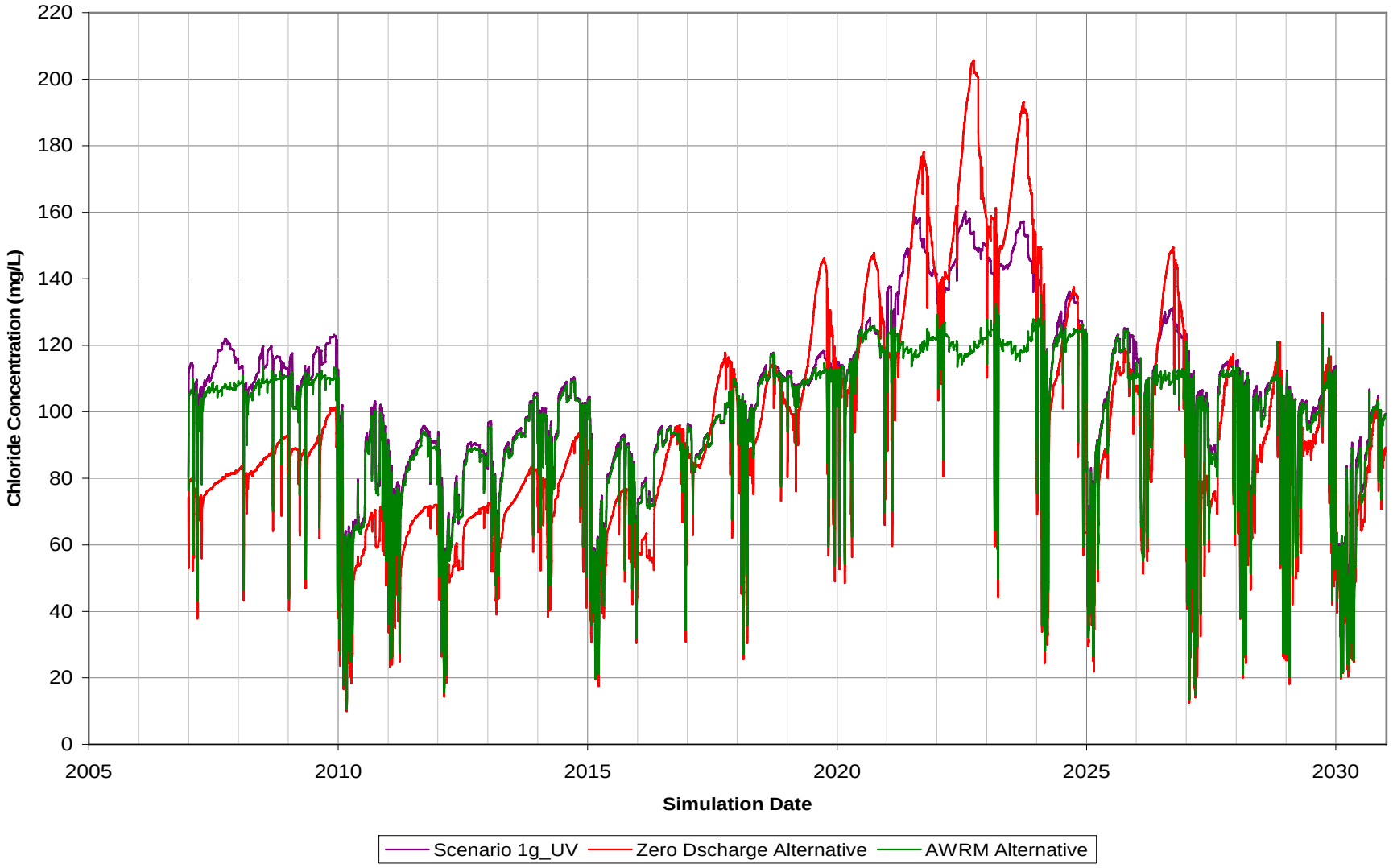
Miles

D R A F T

SIMULATED DISCHARGE LOCATION FOR
DISCHARGES OF SUPPLEMENTAL WATER
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	5-9

I:\DENDC\Dept\data\Project\10354\Task 2B-2 Report\Figures\Figure 5-9 - BC Dilution Discharge Location.mxd

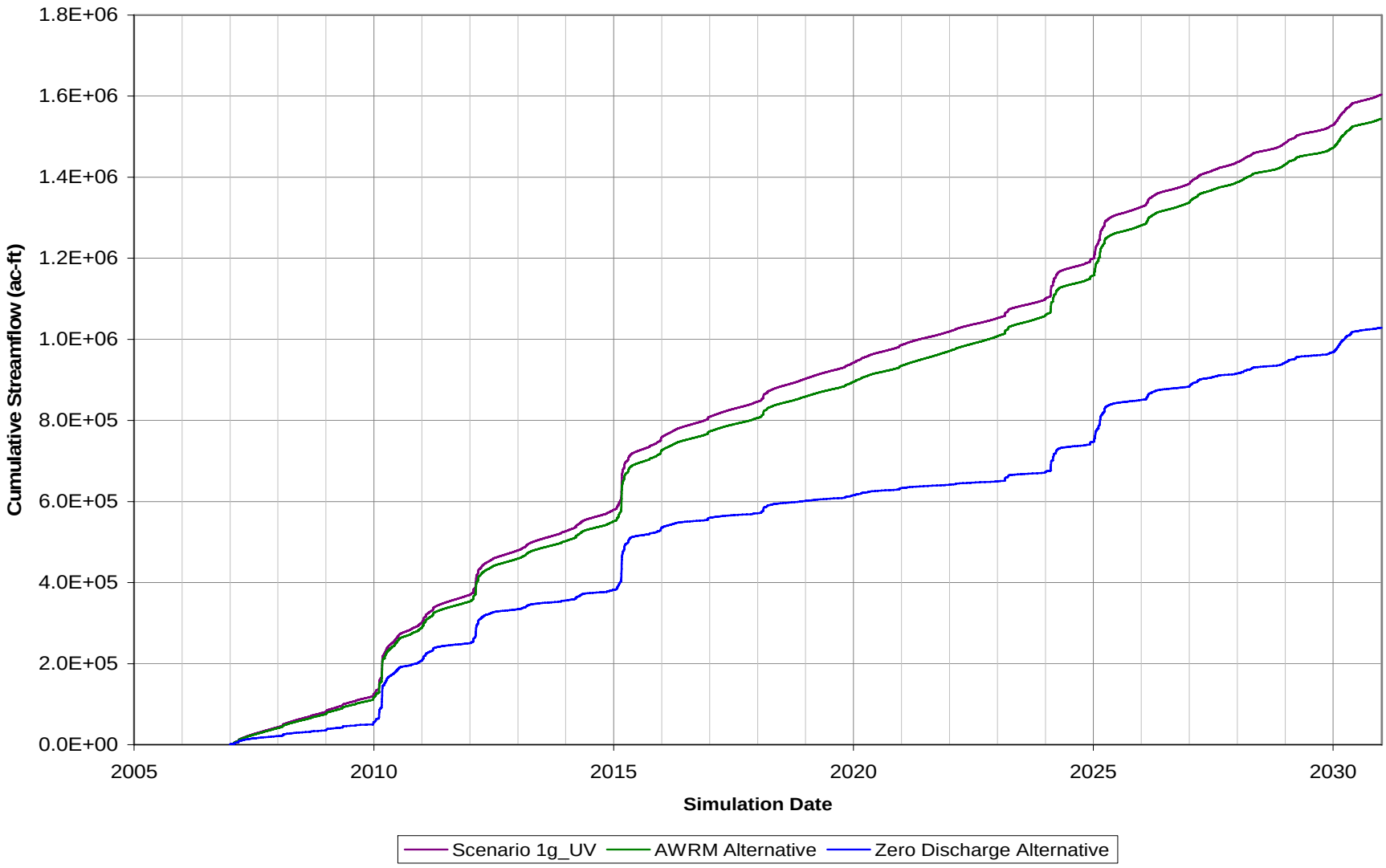


Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS AT BLUE CUT FOR THE AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-10



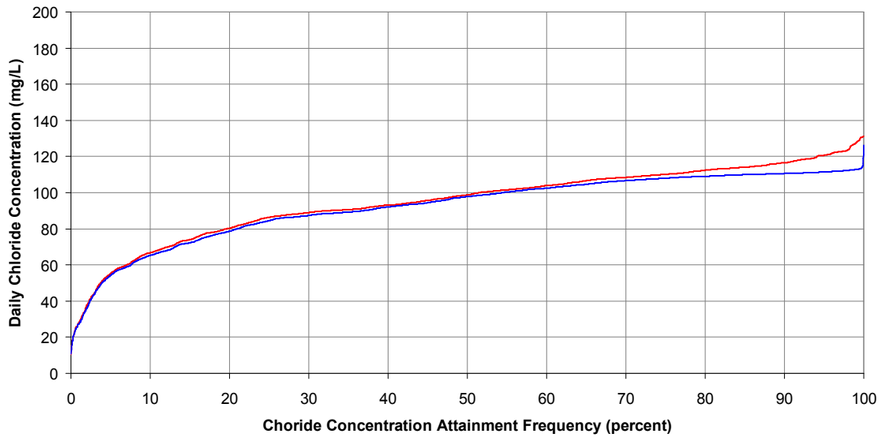
Geomatrix

SIMULATED CUMULATIVE SURFACE FLOWS AT BLUE CUT FOR THE AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

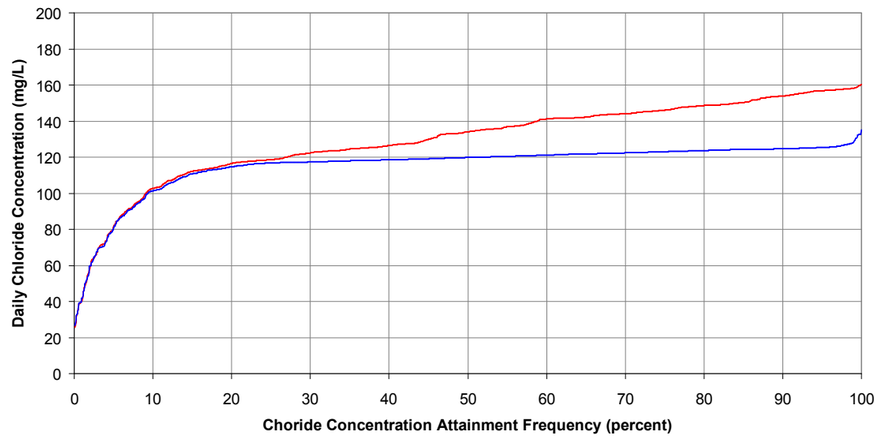
Project No.
10354

Figure
5-11

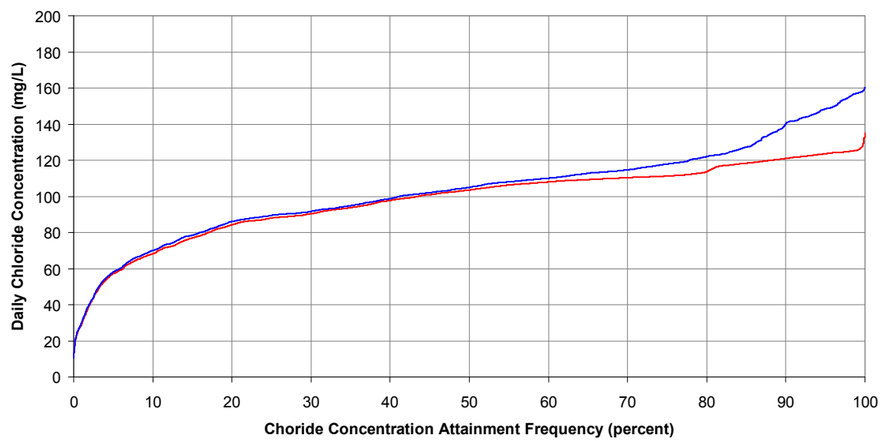
Blue Cut - Non-Drought



Blue Cut - Drought



Blue Cut - Combined



Daily Chloride Threshold Attainment Frequencies (percent)

Explanation

- High Reuse; AWRM Alternative
- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners (Scenario 1gUV)

Blue Cut - Non-Drought

Simulation	Chloride Concentration Threshold		
	100 mg/L	117 mg/L	130 mg/L
AWRM Alternative	54.5	99.9	100.0
Scenario 1gUV	51.5	90.7	99.5

Blue Cut - Drought

Simulation	Chloride Concentration Threshold		
	100 mg/L	117 mg/L	130 mg/L
AWRM Alternative	9.3	26.8	99.2
Scenario 1gUV	9.1	20.6	45.0

Blue Cut - Combined

Simulation	Chloride Concentration Threshold		
	100 mg/L	117 mg/L	130 mg/L
AWRM Alternative	43.5	82.1	99.8
Scenario 1gUV	41.2	73.6	86.3

Notes:

1. Attainment frequency represents the percent of time during the future simulation period that chloride concentrations were at or below the indicated daily chloride concentration.
2. "Drought" refers to time periods when simulated imported State Water Project (SWP) water chloride concentrations are greater than 80 mg/L (2,130 simulation days), and "non-drought" refers to time periods when simulated imported SWP water chloride concentrations are less than 80 mg/L (6,636 simulation days).

DRAFT

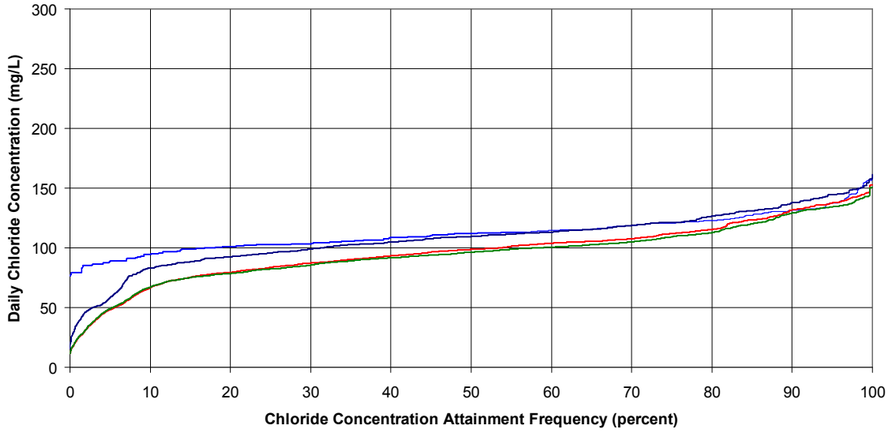
SIMULATED DAILY CHLORIDE ATTAINMENT FREQUENCIES AT BLUE CUT DURING DROUGHT AND NON-DROUGHT - AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

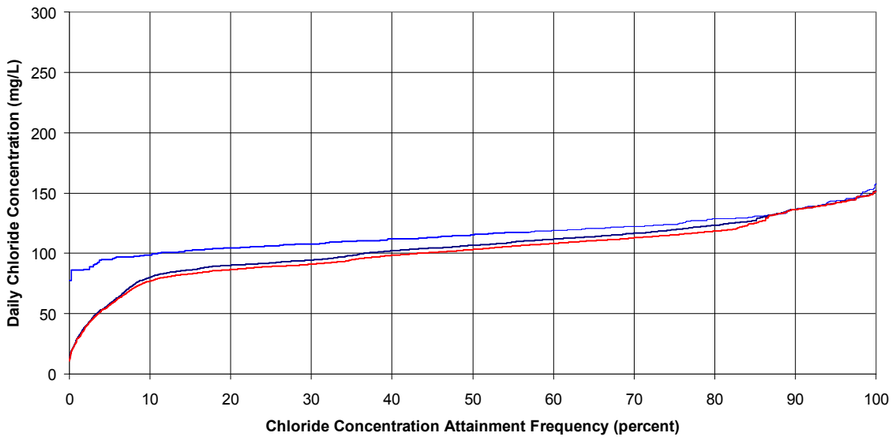
By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix		Figure 5-12

\\DENDC\Dept\data\Project\10354\Task 2B-2 Report\Figures\Figure 5-12 - Attainment Frequencies AWRM Alt 1gUV Blue Cut Drought & Non-Drought & Combined.mxd

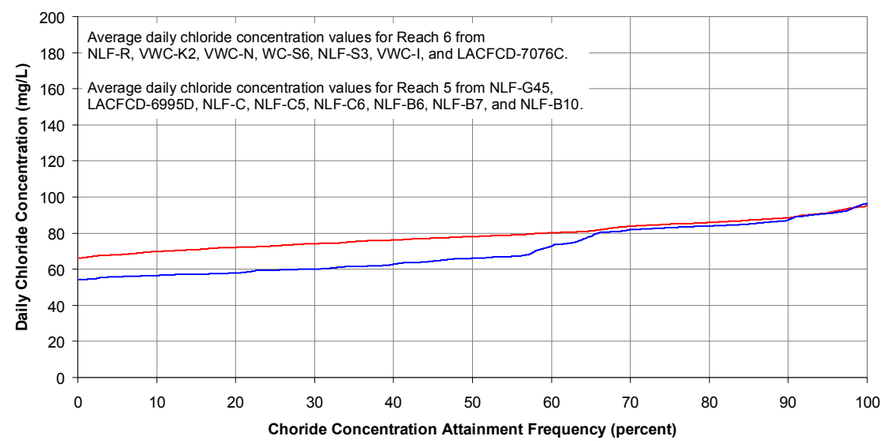
Reach 6 - Surface Water



Reach 5 - Surface Water



Reaches 5 and 6 - Average Groundwater



Daily Chloride Threshold Attainment Frequencies (percent)

Reach 6 - Surface Water

Location	Chloride Concentration Threshold 150 mg/L
Saugus WRP	98.7
SCR-RB	98.6
Old Road Bridge	99.7
SCR-RC	99.7

Reach 5 - Surface Water

Location	Chloride Concentration Threshold 150 mg/L
Valencia WRP	98.3
SCR-RD	99.6
SCR-RE	99.7

Reaches 5 and 6 - Average Groundwater

Location	Chloride Concentration Threshold 150 mg/L
Reach 6	100.0
Reach 5	100.0

Explanation

Reach 6 Surface Water
Saugus WRP Discharge to SCR
SCR-RB
Old Road Bridge
SCR-RC

Reach 5 Surface Water
Valencia WRP Discharge to SCR
SCR-RD
SCR-RE

Reaches 5 and 6 Average Groundwater
Reach 6
Reach 5

Notes:
1. Attainment frequency represents the percent of time during the future simulation period that chloride concentrations were at or below the indicated daily chloride concentration.

D R A F T

SIMULATED DAILY CHLORIDE ATTAINMENT FREQUENCIES IN GROUNDWATER AND SURFACE WATER IN REACHES 5 AND 6 - AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

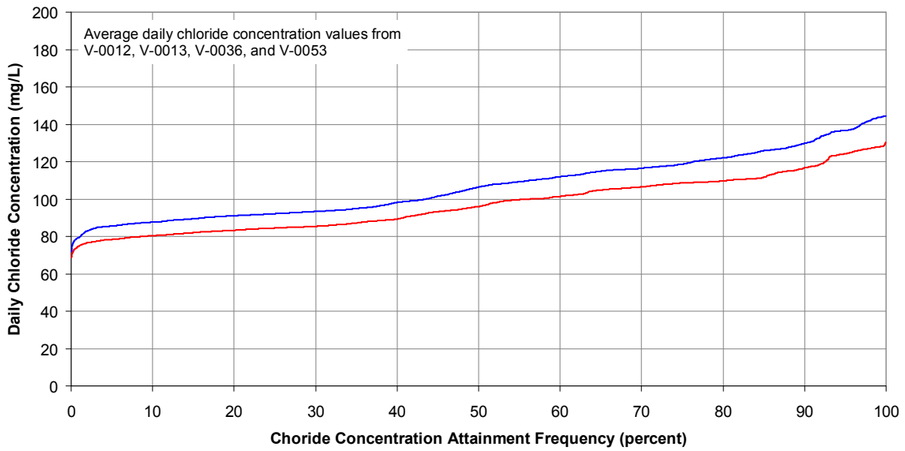
By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix		Figure 5-13

I:\DEND\C\Dept\data\Project\10354\Task 2B-2 Report\Figures\Figure 5-13 - Attainment Frequencies AWRM Scen Reaches 5 & 6 SW & GW.mxd

Daily Chloride Threshold Attainment Frequencies (percent)

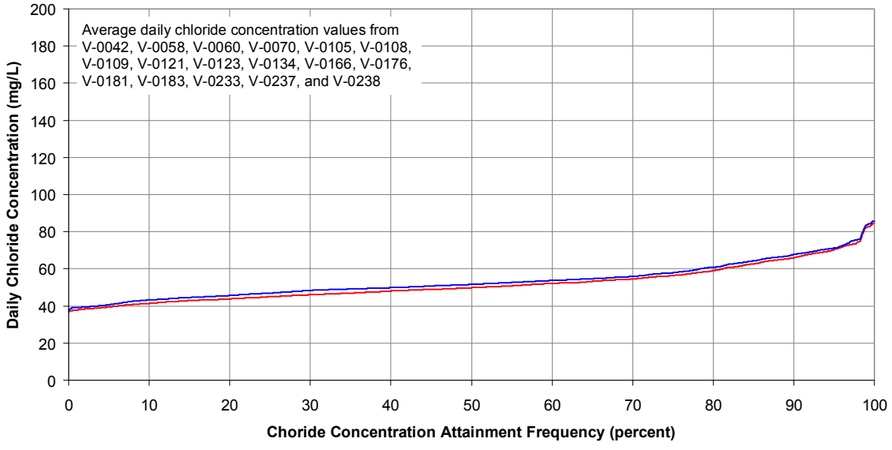
Explanation
- High Reuse; AWRM Alternative
- High Reuse; 100 Percent Removal of Self Regenerating Water Softeners (Scenario 1gUV)

Groundwater East of Piru Creek



Simulation	Chloride Concentration Threshold		
	100 mg/L	117 mg/L	130 mg/L
AWRM Alternative	56.3	90.4	99.9
Scenario 1gUV	43.5	71.3	90.2

Groundwater West of Piru Creek



Simulation	Chloride Concentration Threshold		
	100 mg/L	117 mg/L	130 mg/L
AWRM Alternative	100.0	100.0	100.0
Scenario 1gUV	100.0	100.0	100.0

Notes:
1. Attainment frequency represents the percent of time during the future simulation period that chloride concentrations were at or below the indicated daily chloride concentration.

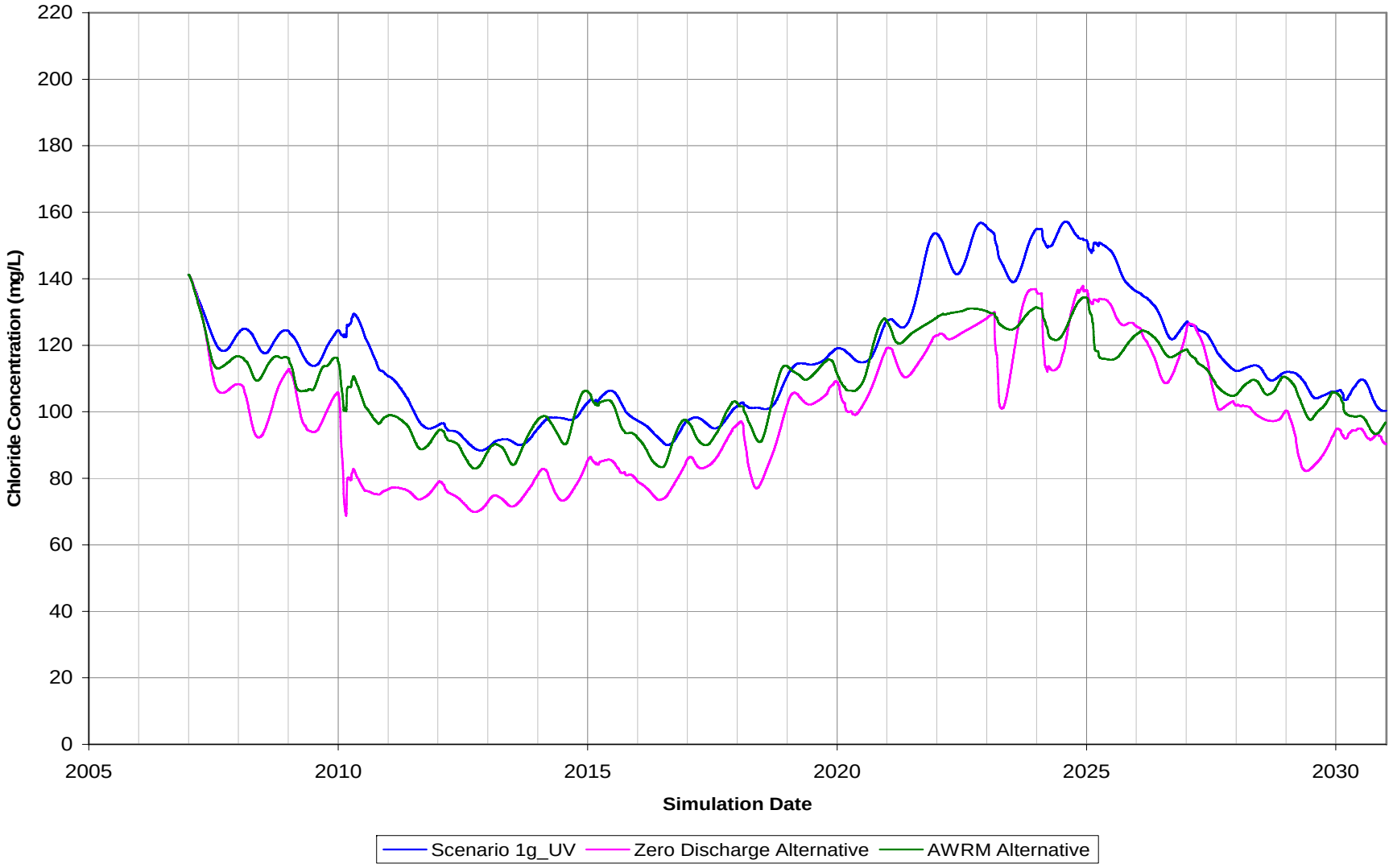
D R A F T

SIMULATED DAILY CHLORIDE ATTAINMENT FREQUENCIES IN PIRU BASIN GROUNDWATER - AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix		Figure 5-14

\\DENDC\Depts\data\Project\10354\Task 2B-2 Report\Figures\Figure 5-14 - Attainment Frequencies AWRM Alt 1gUV.mxd

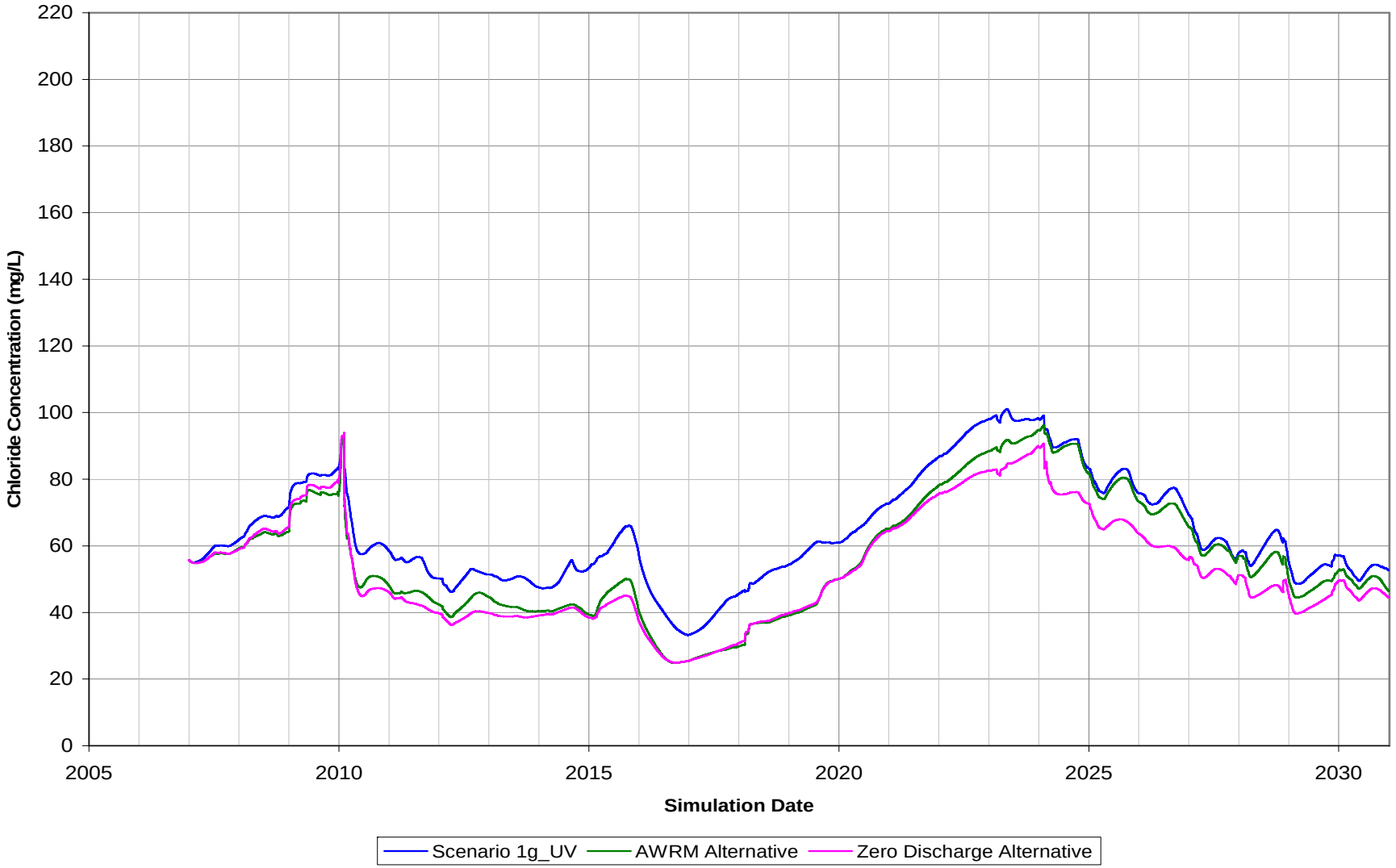


Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS IN PIRU BASIN WELL V-0013, AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-15

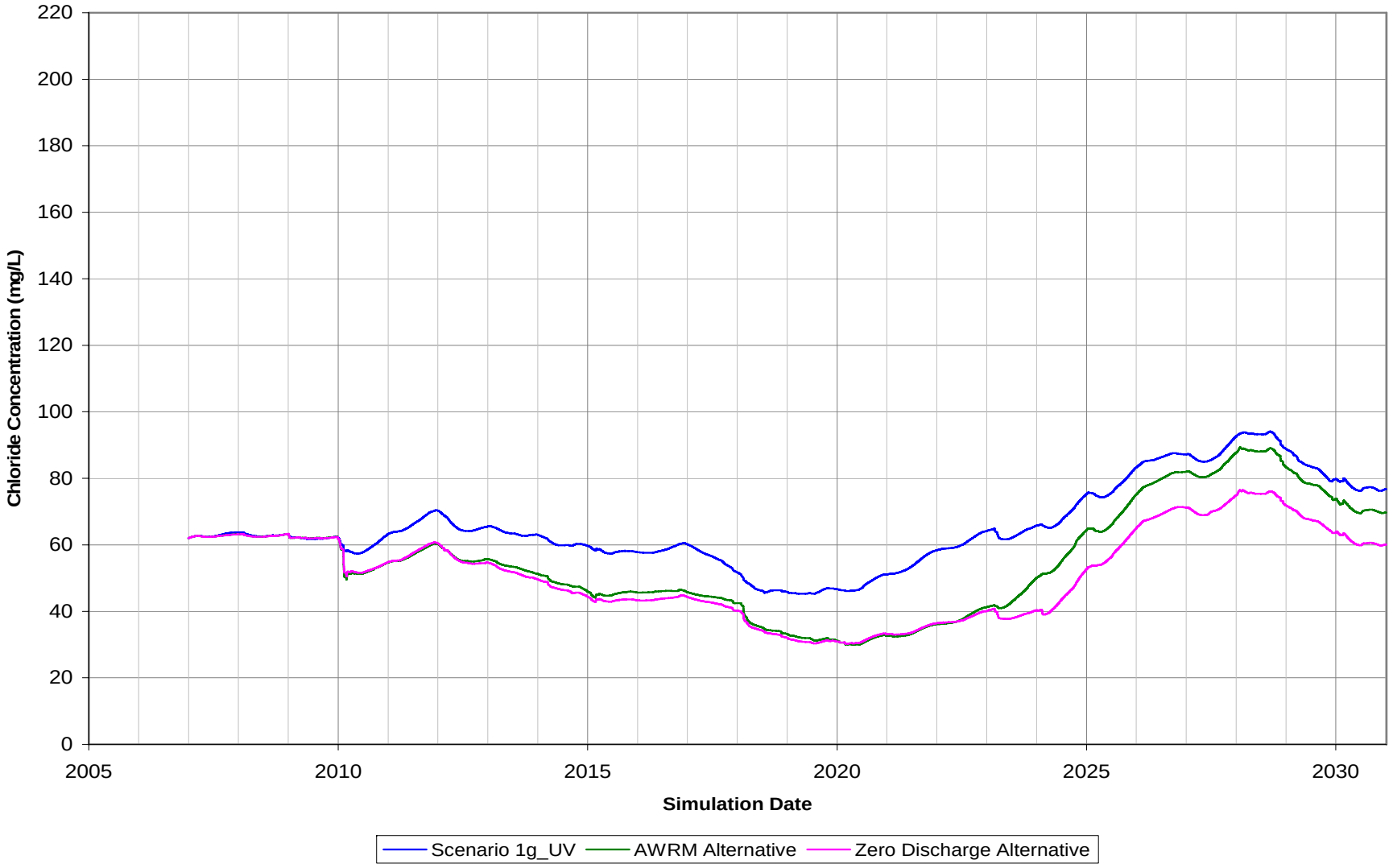


Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS IN PIRU BASIN WELL V-0105, AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-16

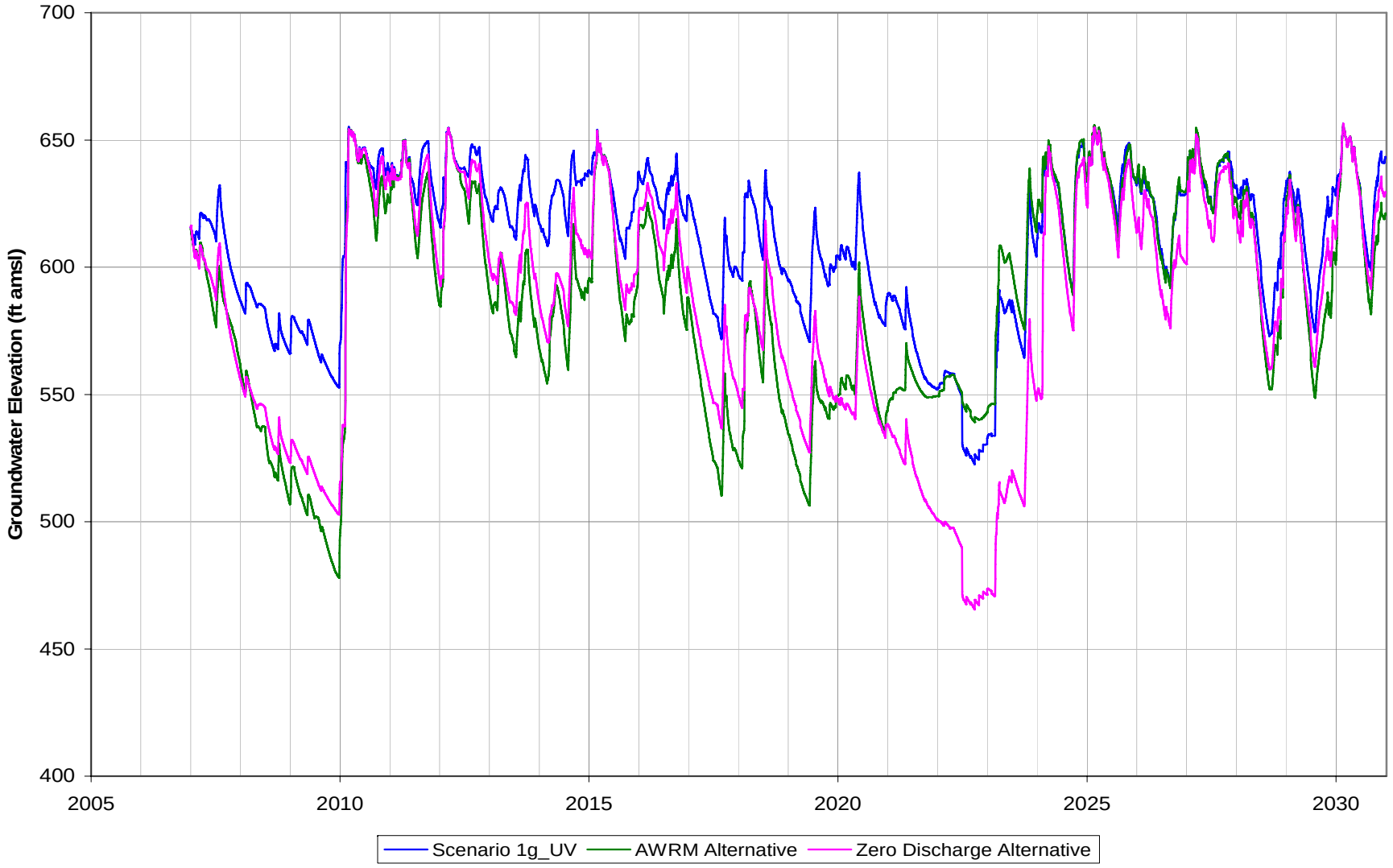


Geomatrix

SIMULATED CHLORIDE CONCENTRATIONS IN PIRU BASIN WELL V-0176, AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-17

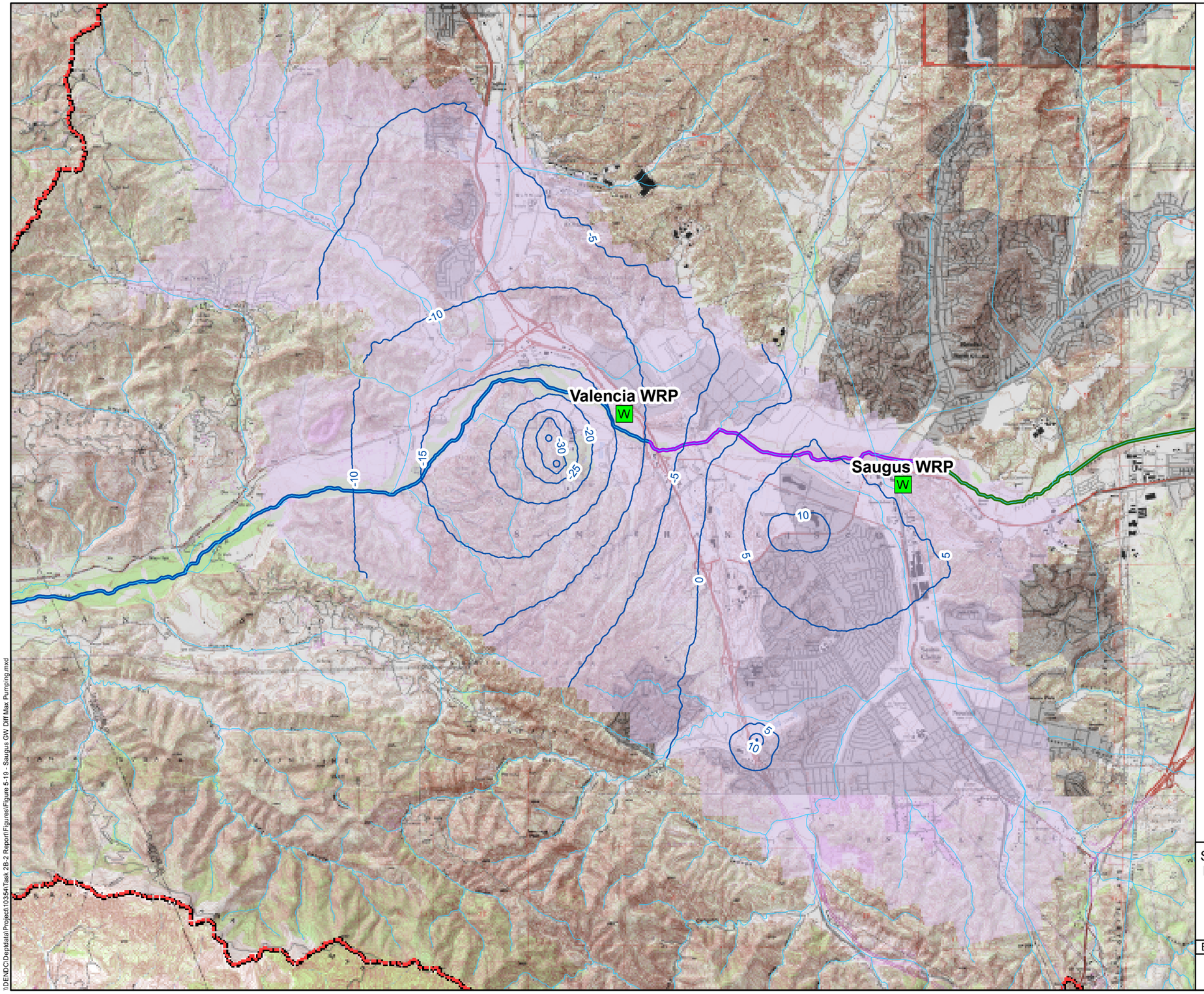


Geomatrix

SIMULATED DAILY GROUNDWATER ELEVATIONS IN PIRU BASIN WELL V-0036, AWRM ALTERNATIVE
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No.
10354

Figure
5-18



Explanation

- GWSI Study Area
- W — WRP Location
- -10 — Difference in Groundwater Level (feet) September 2023
- Streams

Santa Clara River Reaches (RWQCB)

- Reach 4
- Reach 5 (Chloride TMDL Reach)
- Reach 6 (Chloride TMDL Reach)
- Reach 7

N

0 0.5 1 2 3 4

Miles

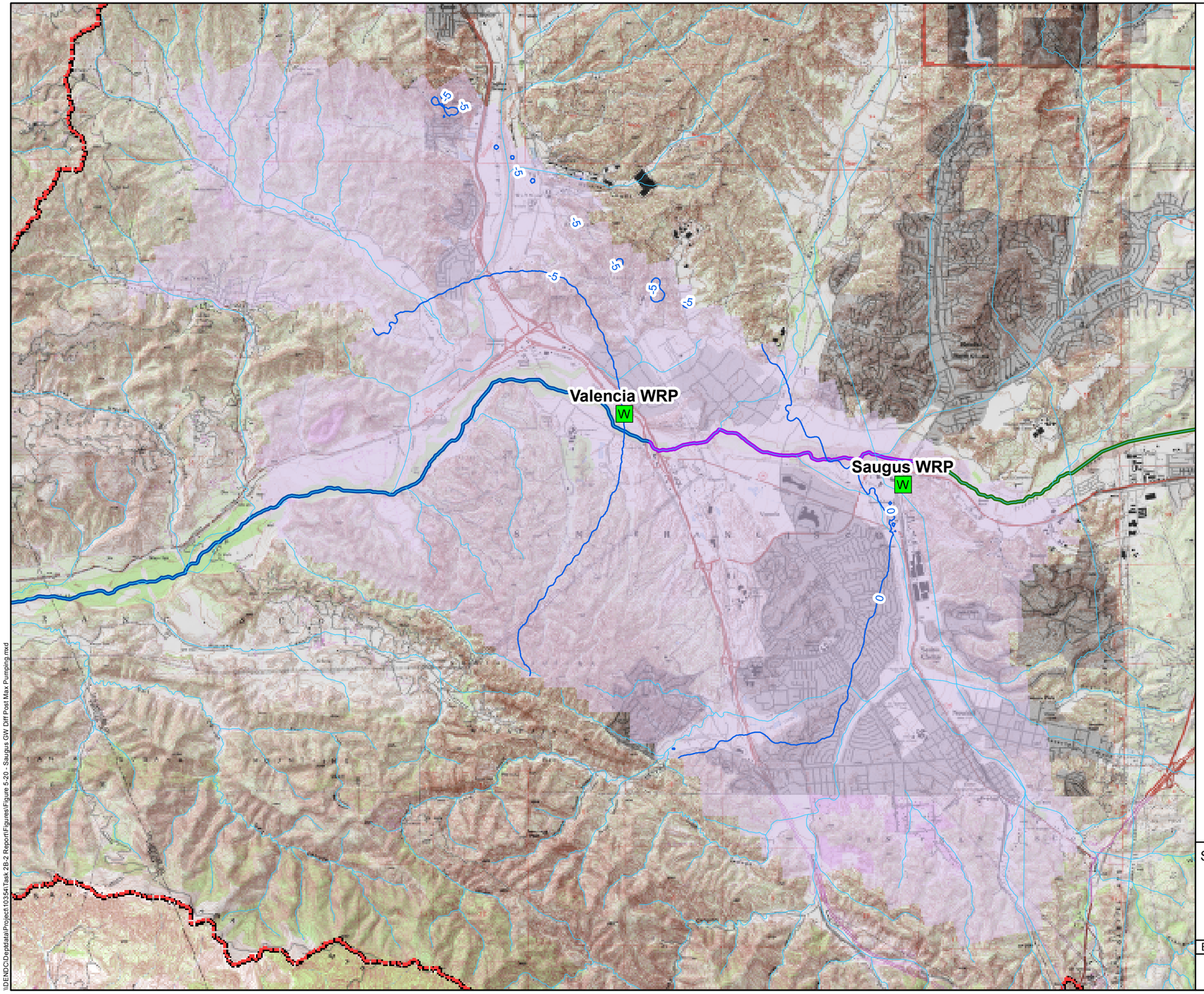
DRAFT

SIMULATED GROUNDWATER LEVEL DIFFERENCES NEAR SAUGUS SUPPLEMENTAL WELLS DURING A PERIOD OF MAXIMUM PUMPING - AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	5-19

\\DENDC\Depdata\Project\10354\Task 2B-2 Report\Figures\Figure 5-19 - Saugus GW Diff Max Pumping.mxd



Explanation

- GWSI Study Area
- W — WRP Location
- -10 — Difference in Groundwater Level (feet) February 2024
- Streams

Santa Clara River Reaches (RWQCB)

- Reach 4
- Reach 5 (Chloride TMDL Reach)
- Reach 6 (Chloride TMDL Reach)
- Reach 7

N

0 0.5 1 2 3 4

Miles

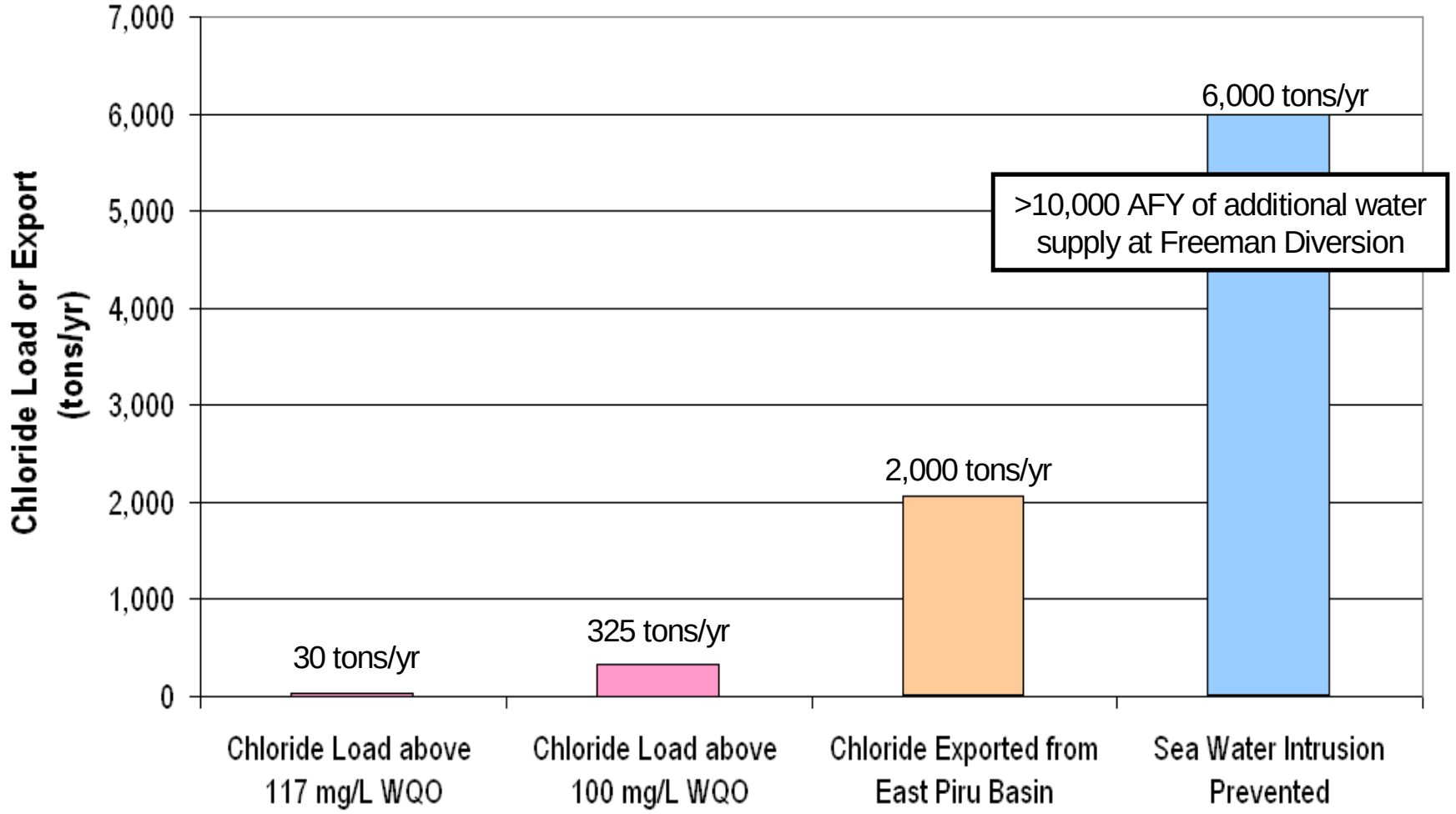
DRAFT

SIMULATED GROUNDWATER LEVEL DIFFERENCES NEAR SAUGUS SUPPLEMENTAL WELLS AFTER MAXIMUM PUMPING HAS CEASED - AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 5/1/2008	Project No. 10354
Geomatrix	Figure	5-20

\\DENDC\Depdata\Project\10354\Task 2B-2 Report\Figures\Figure 5-20 - Saugus GW Diff Post Max Pumping.mxd



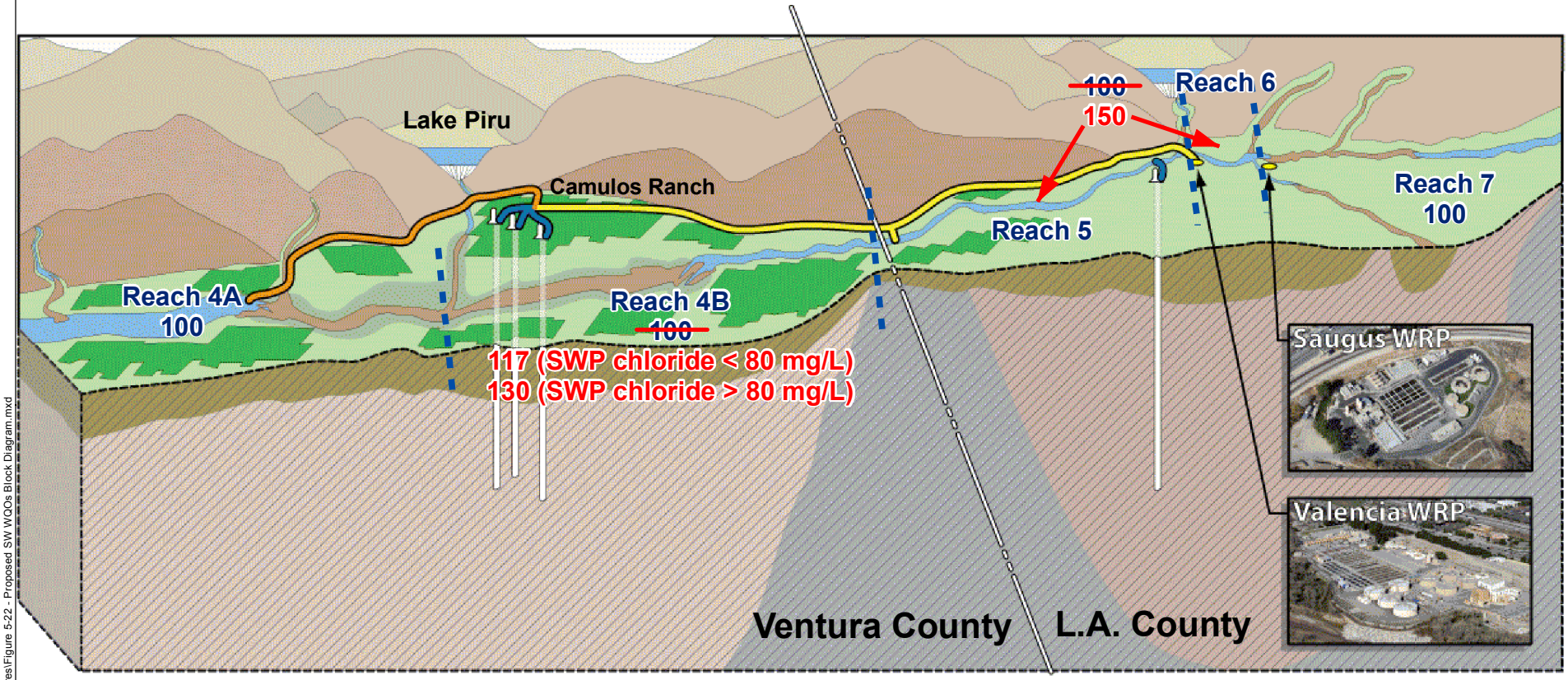
Source: Bachman (2008)

Geomatrix

PREDICTED CHLORIDE LOAD BALANCE WITH THE AWRM PROGRAM
Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

Project No. 10354

Figure **5-21**



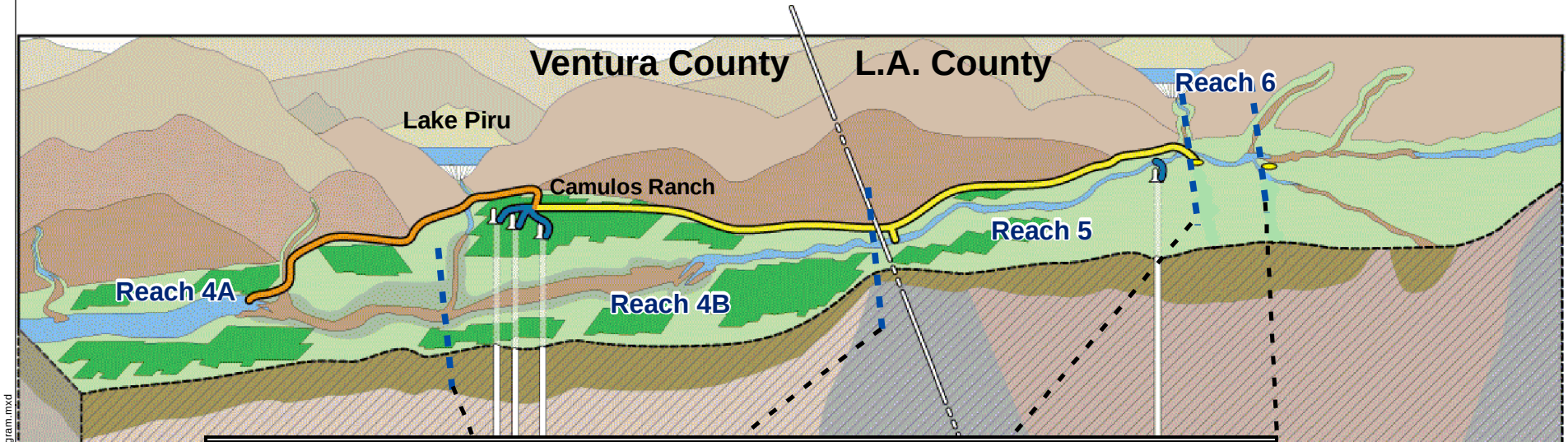
Note: Diagram not to scale

PROPOSED SITE SPECIFIC CHLORIDE OBJECTIVES FOR UPPER SCR SURFACE WATER – AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 6/11/2008	Project No. 10354
Geomatrix		Figure 5-22

\\DENDC\Dept\data\Project\10354\Task 2B-2 Report\Figures\Figure 5-22 - Proposed SW WQOs Block Diagram.mxd



Mineral WQO	Reach 4B East Piru	Reach 5 Castaic Valley	Reach 6 Bouquet & SF Canyons
Chloride	TBD	150	~~(100)~~ 150
TDS	TBD	1000	~~(700)~~ 1000
Sulfate	TBD	350	~~(250)~~ 450

Note: Diagram not to scale

PROPOSED SITE SPECIFIC MINERAL OBJECTIVES FOR UPPER SCR GROUNDWATER – AWRM ALTERNATIVE

Upper Santa Clara River Chloride TMDL
Santa Clara River Valley, California

By: KKZ	Date: 6/11/2008	Project No. 10354

Geomatrix

Figure **5-23**

\\DENDC\Deptdata\Project\10354\Task 2B-2 Report\Figures\Figure 5-23 - Proposed GW WQOs Block Diagram.mxd