List of Appendices

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A. Water Supply Reliability Study

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SAN GORGONIO
INTEGRATED REGIONAL
WATER MANAGEMENT

Water Supply Reliability Study

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National Experience. Local Focus.

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List of Abbreviations

AF	acre-feet
AFY	acre-feet per year
BHMWC	Banning Heights Mutual Water Company
cfs	cubic feet per second
CIP	Capital improvement project
Cr-6	Chromium-6
CRRF	Central Resin Regeneration Facility
CWD	Cabazon Water District
CVWD	Coachella Valley Water District
DWR	California Department of Water Resources
IRWM	Integrated Regional Water Management
GPCD	gallons per capita per day
gpm	gallons per minute
HVWD	High Valleys Water District
MBMI	Morongo Band of Mission Indians
MCL	Maximum Containment Level
M	million
MG	million gallons
mgd	million gallons per day
O&M	operations and maintenance
ppb	parts per billion
SAWPA	Santa Ana Watershed Project Authority
SBA	Strong Base Anion Exchange
SCAG	Southern California Association of Governments
SGPWA	San Gorgonio Pass Water Agency
SGPWM	San Gorgonio Pass Water Model
SU	Storage Unit
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
WEAP	Water Evaluation and Planning
WWTP	wastewater treatment plant

Chapter 1 Introduction

The Water Supply Reliability Study (Study) is one of three stand-alone studies conducted to assist in the development of the San Gorgonio Integrated Regional Water Management (IRWM) Region's first IRWM Plan. The Study is funded through a Proposition 1 IRWM Planning Grant to help the San Gorgonio Region to identify water supply reliability related needs, goals, strategies, and projects for inclusion in the IRWM Plan. The San Gorgonio IRWM Group recognizes the need to enhance future water supply reliability given the potential for future increases in water needs in the face of increasing supply variability.

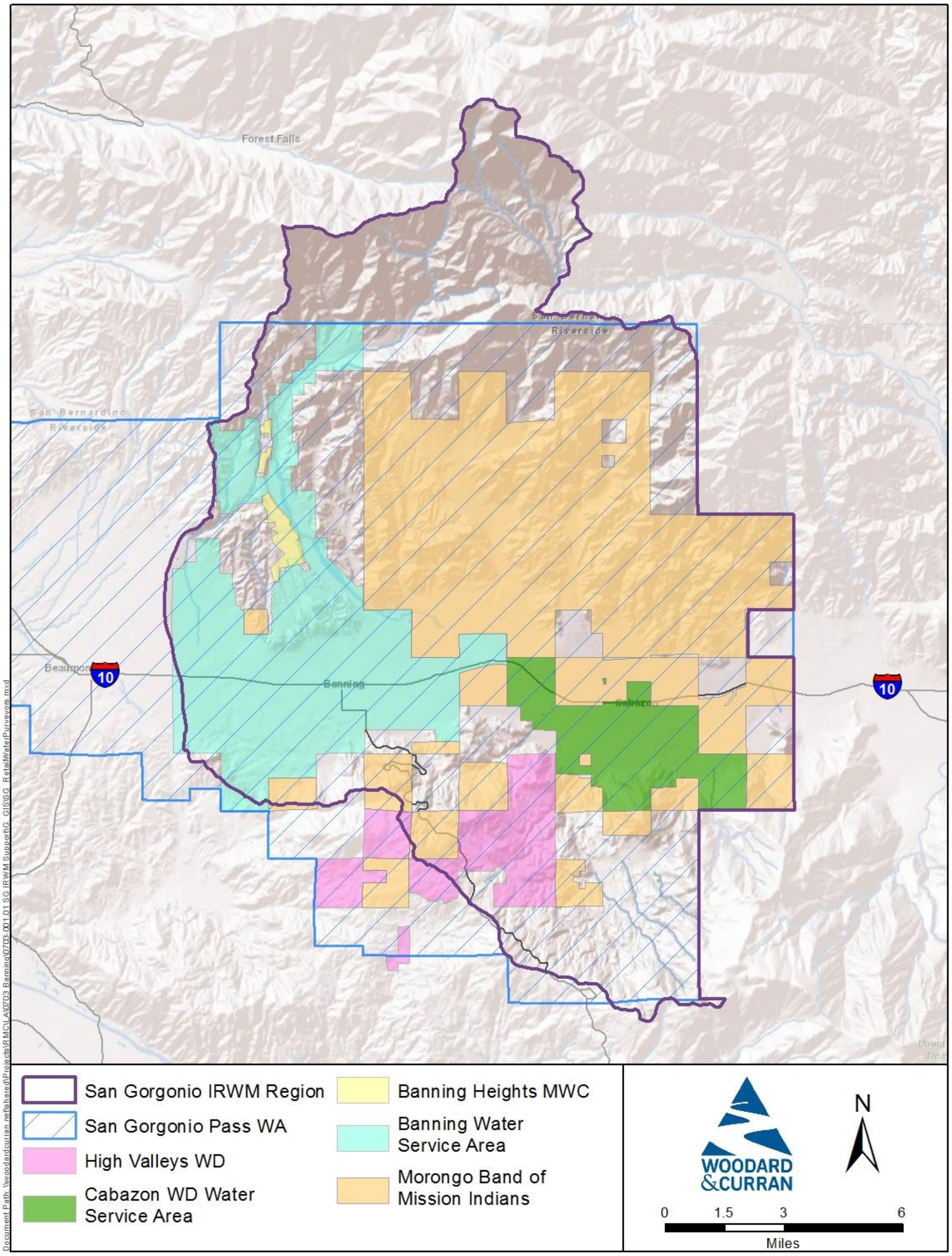
The RWMG identified an ad-hoc water supply committee to participate in the preparation of the Study (as shown in Figure 1). The committee contributed planning documents, data and other materials as well as provided valuable information at three in-person workshops held throughout the Study's development.

The planning process began with an overall assessment of current and projected baseline regional demands and supplies. A gap analysis that used Water Evaluation and Planning (WEAP) software, was then conducted to test current system reliability in response to a variety of changing hydrologic conditions. Finally, a variety of water supply reliability project concepts were developed to address the needs identified in the gap analysis. A selection of project concepts was then run through the WEAP model to determine their reliability and ability to improve reliability over the Region's baseline demand and supply. The evaluation and prioritization process assisted the IRWM stakeholder group in identifying projects to incorporate in the IRWM Plan.

The Water Supply Reliability Study is composed of the following sections:

1. Introduction
2. Baseline Assessment
3. Supply Reliability Project Concepts
4. Next Steps
5. References

Figure 1: San Gorgonio IRWM Region Water Suppliers



Chapter 2 Baseline Assessment

The baseline provides an assessment of current and projected regional demands and supplies from 2015 to 2040 assuming that no system modifications will be made in the next 25 years beyond those activities required to maintain current systems. To assess the reliability of regional water supplies, a water resources model was developed for the Region using WEAP software. The WEAP systems model was first calibrated to reflect current relationships and supply pathways between water sources and water demands within the Region. Projections of demand increases and supply availability were also included in the WEAP model to create a comprehensive baseline condition. This chapter provides a baseline assessment of projected demands and supplies, and includes a gap analysis that examines potential supply shortfalls.

2.1 Baseline Supply Assessment

Groundwater, local surface water and imported water comprise the Region's water supply portfolio, all of which are shown on Figure 2. This section provides a summary of the Region's current and projected water supplies, as well as production and transmission capacity limitations. Note that the baseline supplies described include only those supplies that were used in 2015; this discussion does not include potential new supply sources.

Groundwater

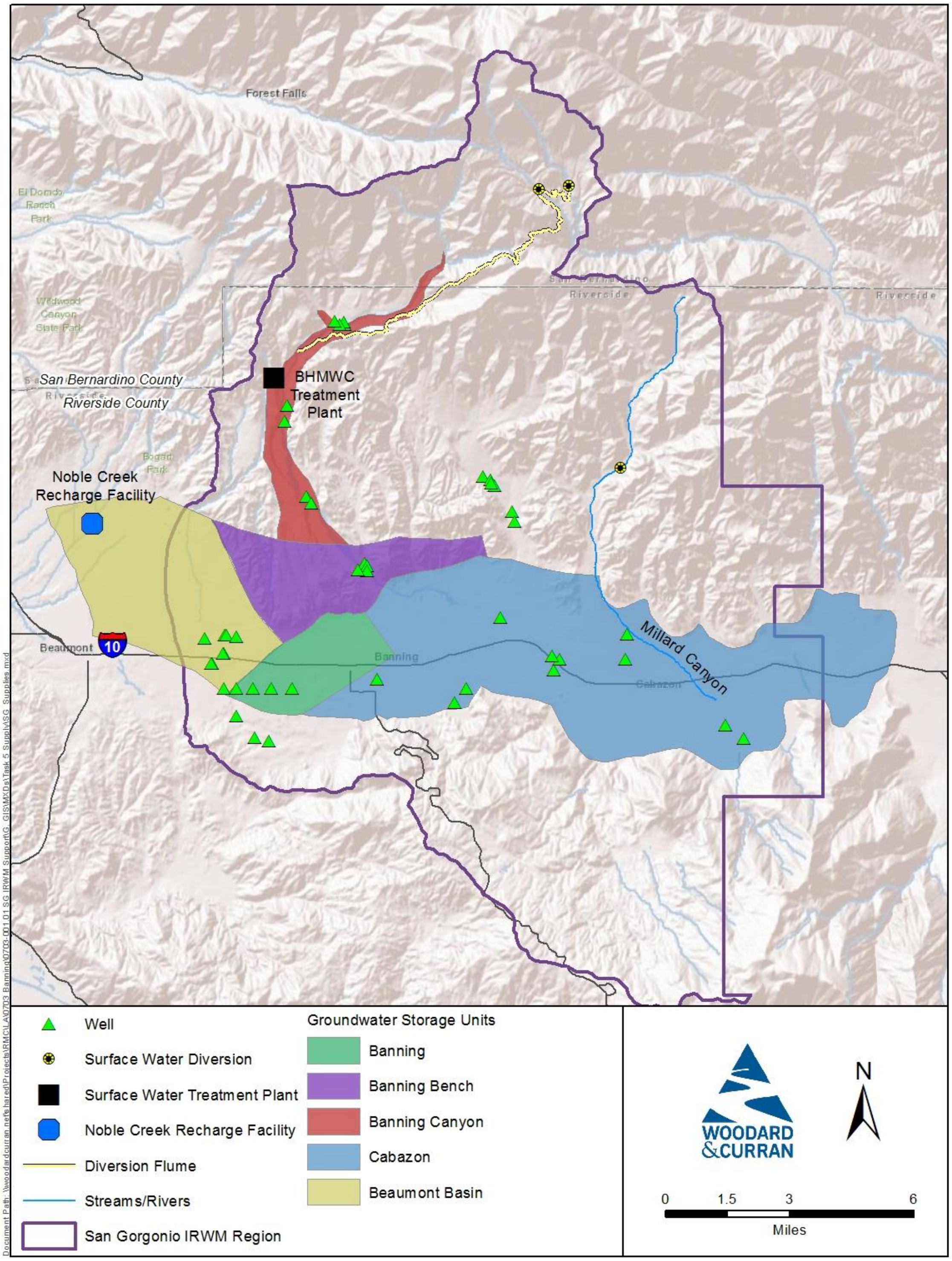
The San Gorgonio Region overlies parts of the San Gorgonio Pass Groundwater Basin, (also known as the San Gorgonio Pass Subbasin of the larger Coachella Valley Hydrologic Unit, as defined in DWR Bulletin 118). Approximately 15 miles long, the San Gorgonio Groundwater Basin includes five hydraulically-connected ground water storage units: Banning Storage Unit (SU), Banning Bench SU, Banning Canyon SU, Cabazon SU, and Beaumont Basin (see Figure 2). Banning, Cabazon Water District and the Morongo Band of Mission Indians (MBMI) all have wells in these groundwater basins, and use groundwater as their primary source of supply. High Valleys Water District receives its supply from Banning via the High Valleys Reservoir, and therefore is also dependent on groundwater as the primary source of supply. Banning Heights Mutual Water Company (BHMWC) has two wells available for pumping, but only uses groundwater when local surface water isn't available.

Beaumont Basin

The Beaumont Basin, while primarily within the Santa Ana Water Project Authority (SAWPA) IRWM Region, is included in this Study because it's a key supply source to meet demands within the Region. The primary forms of recharge are precipitation and surface water inflows that originate in the San Bernardino Mountains. Beaumont Basin is also artificially recharged with imported water from the State Water Project (SWP) at the Noble Creek Recharge Facility. Banning and the MBMI are the only purveyors within the San Gorgonio IRWM Region with rights and production wells in the Beaumont Basin.

The Beaumont Basin was adjudicated in 2004 with a safe yield of 8,650 AFY in 2015. The Beaumont Basin Watermaster re-determined the safe yield of the Beaumont Basin to be 6,700 AFY in 2015 for Overlying Parties to the Judgment. In addition, the Judgement, which was executed in 2004, stipulates that the safe yield shall be re-determined at least every 10 years. Banning has appropriative rights to 31.43% of unused overlying rights. As of 2015, Banning had appropriative rights of 2,097 AFY, which are being reduced to 1,528 AFY beginning in 2020 due to a protracted dry period in the ten-year period used to estimate safe yield. Banning's actual annual appropriation varies and is dependent on the quantity of water remaining after Overlying Right holder production. Given that Overlying Right holder production is expected to increase in the future, Banning's rights to Beaumont Basin water are likely to decrease in the future, but have not yet been estimated. The Beaumont Basin Watermaster has permitted Banning to store up to 80,000 AF of surplus appropriated water and to recharge imported water purchased from SGPWA. As of 2015, the volume of storage in that account was 46,774 AF.

Figure 2: Local Water Supplies and Production Facilities



The MBMI also has been permitted to store up to 20,000 AF of surplus water within the Beaumont Basin and currently has no water in storage. Banning's production well capacity is 7,650 gallons per minute (gpm) and the MBMI's well capacity is 5,000 gpm.

Water quality in the Beaumont Basin is considered to be good. Total dissolved solids (TDS) and nitrate are regulated by the Santa Ana Regional Water Quality Control Board (RWQCB), and are therefore closely monitored. While nitrate concentrations are well within maximum benefit goal, TDS is approximately 280 mg/L, which is approximately 85 percent of the maximum benefit goal of 330 mg/L. The Beaumont Basin Plan requires local entities to plan for desalters once TDS increases to 320 mg/L.

Additionally, hexavalent chromium (Cr-6) is a potential concern based on the previous Cr-6 maximum contaminant level of 10 µg/L set by the SWRCB. Had the SWRCB not invalidated the 10 µg/L MCL , the City of Banning would have needed to implement measures to reduce the levels of naturally occurring Cr-6 produced in some areas within the Beaumont Basin. As of the time of this Study, a new Cr-6 MCL has not been set, but the City of Banning is concerned about the potential impacts to supply reliability once an MCL is established.

Banning SU

The Banning SU is located east of Beaumont Basin and is unadjudicated. The Banning SU receives only natural recharge from precipitation, percolation from septic systems, recharge of local surface water, and underflow from Beaumont Basin and Banning Bench. Outflow consists of subsurface underflow to Cabazon SU and pumping. Given that Banning SU is unadjudicated, safe yield estimates presented in *Maximum Perennial Yield Estimates for the Banning and Cabazon Storage Units, and Available Water Supply from the Beaumont Basin* (Safe Yield Study) are used as current and projected groundwater availability estimates, and provides an estimate of 1,130 AFY. This safe yield is assumed to remain the same into the future. Banning is the only purveyor that pumps in this SU, and has a pumping capacity of 3,500 gpm.

Quality in the Banning SU is generally considered to be good, with the only concern being hexavalent chromium (Cr-6) in groundwater given a previous Cr-6 maximum contaminant level of 10 µg/L set by the SWRCB. Had the SWRCB not invalidated the 10 µg/L MCL, the City of Banning would have needed to implement measures to reduce the levels of naturally occurring Cr-6 produced in some areas with the Basin. As of the time of this Study, a new Cr-6 MCL has not been set, but the City of Banning is concerned about the potential impacts to supply reliability once an MCL is established.

Banning Bench SU

The Banning Bench SU is located north of the Banning SU and is unadjudicated. The Banning Bench SU receives only natural recharge from precipitation, recharge of local surface water, percolation from septic systems and underflow from the Banning Canyon SU. Outflow consists of subsurface underflow to the Banning and Cabazon SUs and pumping. Given that the Banning Bench SU is unadjudicated, safe yield estimates presented in *Maximum Perennial Yield Estimates for the Banning and Cabazon Storage Units, and Available Water Supply from the Beaumont Basin* (Safe Yield Study) are used as current and projected groundwater availability estimates, and provides an estimate of 1,960 AFY. This safe yield is assumed to remain the same into the future. Banning and BHMWC are the only purveyors that pumps in this SU, though it should be noted that BHMWC only uses its wells when local surface water is unavailable. Banning has a pumping capacity of 3,650 gpm in this SU while pumping capacity for BHMWC's wells is not available.

Quality in the Banning Bench SU is generally considered to be good, with the only concern noted being the need to continue recharge operations of the BHMWC wells to ensure that nitrate remains at acceptable levels.

Banning Canyon SU

The Banning Canyon SU is located north of the Banning Bench SU and is unadjudicated. The Banning Canyon SU receives only natural recharge from precipitation and recharge from local surface water. Outflow consists of subsurface underflow to the Banning Bench SU and pumping. Given that the Banning Canyon SU is unadjudicated, safe yield estimates presented in *Maximum Perennial Yield Estimates for the Banning and Cabazon Storage Units, and Available Water Supply from the Beaumont Basin* (Safe Yield Study) are used as current and projected groundwater availability estimates, and provides an estimate of 4,070 AFY. This safe yield is assumed to remain the same into the future. Banning is the only purveyor that pumps in this SU, and has a pumping capacity of 8,600 gpm.

Quality in the Banning Canyon SU is generally considered to be good, with no concerns raised by the Region's water purveyors.

Cabazon SU

The Cabazon SU is located east of the Banning SU and is unadjudicated. Cabazon SU receives only natural recharge from precipitation, percolation of treated wastewater, percolation from septic systems, recharge of local surface water, and underflow from the Banning and Banning Bench SUs. Outflow consists of subsurface underflow to the Indio subbasin, seepage into the San Jacinto tunnel (a tunnel used for the Colorado Aqueduct) and pumping. Given that the Cabazon SU is unadjudicated, safe yield estimates presented in *Maximum Perennial Yield Estimates for the Banning and Cabazon Storage Units, and Available Water Supply from the Beaumont Basin* (Safe Yield Study) are used as current and projected groundwater availability estimates, and provides an estimate of 5,265 AFY. This safe yield is assumed to remain the same into the future. Banning, Cabazon WD and the MBMI all pump in this SU. While pumping capacity is not available for the MBMI, Banning has a pumping capacity of 900 gpm and Cabazon WD has a pumping capacity of 3,800 gpm.

Quality in the Cabazon SU is generally considered to be good, with minimal water quality concerns noted by the Region's water purveyors. Wells in areas experiencing high levels of nitrates have been put out of service.

Groundwater Supply Safe Yield Summary

The current and projected groundwater supply availability is provided in Table 1.

Table 1: Average Annual Groundwater Safe Yield

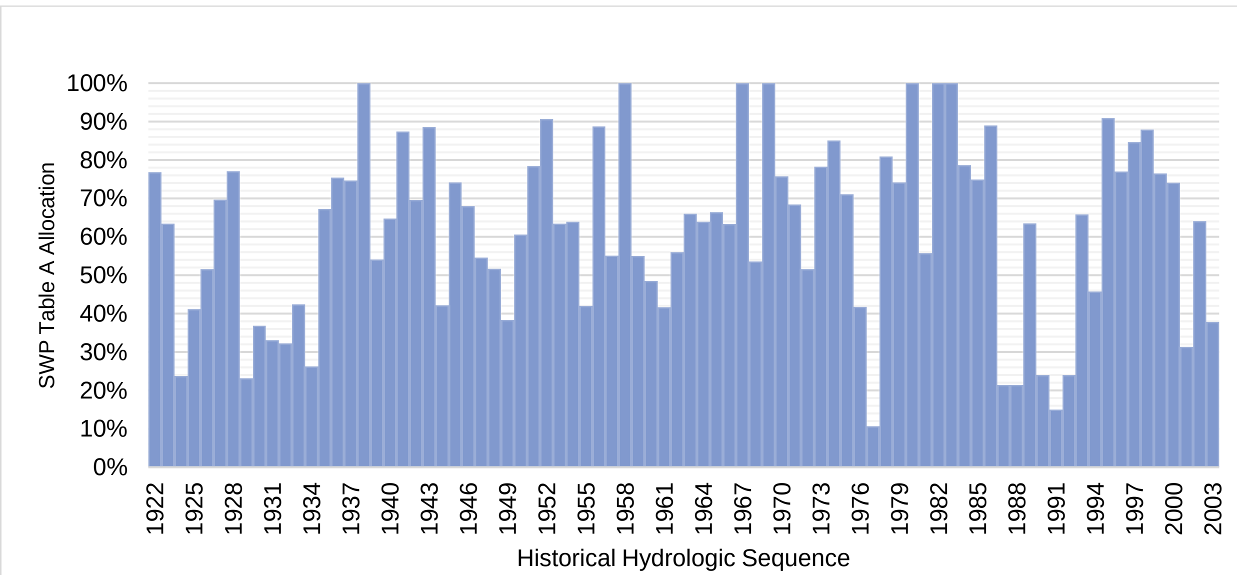
Storage Unit	Annual Groundwater Supply Availability (AFY)						
	2015	2020	2025	2030	2035	2040	2045
Banning SU	1,130	1,130	1,130	1,130	1,130	1,130	1,130
Banning Bench SU	1,960	1,960	1,960	1,960	1,960	1,960	1,960
Banning Canyon SU	4,070	4,070	4,070	4,070	4,070	4,070	4,070
Cabazon SU	5,265	5,265	5,265	5,265	5,265	5,265	5,265
Beaumont Basin	1,528	1,528	1,528	1,528	1,528	1,528	1,528
Total Groundwater Availability	**13,953**	**13,953**	**13,953**	**13,953**	**13,953**	**13,953**	**13,953**

Imported Water

Imported water supplies in the Region are provided by SGPWA, which is an SWP Table A contractor and has a service area that encompasses the Region as well as neighboring areas to the west. This means SGPWA has a water supply contract with California Department of Water Resources (DWR) for a maximum annual "Table A" entitlement of 17,300 AFY. The amount of SWP water available to SGPWA is subject to significant variability from year to year based on statewide hydrology. The availability of this supply to SGPWA is based on the results of the Existing Conditions Scenario from DWR's S*tate Water Project Final Delivery Capability Report 2015* (Delivery Capability Report). The *Delivery Capability Report* recommends that Table A contractors estimate average Table A deliveries at 62% of entitlements. For SGPWA, this equates to an annual average allocation of 10,726 AFY of Table A imported water, only a portion of which is supplied to the Region.

Historically, Table A allocations have varied widely based on statewide hydrologic conditions, environmental requirements and regulatory restrictions. The Delivery Capability Report estimates the annual reliability of current and future reliability of SWP deliveries based on hydrologic conditions (i.e. precipitation and runoff) that occurred from water years 1922 through 2003. This 82-year historical flow record includes a reasonable range of potential hydrologic conditions from wet years to critically dry periods as applied to existing facilities and regulatory requirements. Additionally, climate change impacts have been factored in to the estimates of SWP reliability. Based on this data, 62% of Table A amounts can be assumed to be delivered on average, which is equal to 10,726 AFY for SGPWA. It's assumed that the California Water Fix is included in the Table A allocations provided in the Delivery Capability Report, and will be used to maintain reliability at 62%. Figure 3 shows the sequence of Table A deliveries used in the WEAP model. It is assumed that this sequence is representative of future reliability.

Figure 3: Annual SWP Table A Allocation



In addition to Table A supplies, SGPWA has access to other supplies that can be delivered through the SWP. An agreement is in place with Yuba County Water Agency (the Yuba Accord) for purchase of 300 AFY of water through DWR. SGPWA has also entered into agreement with Kern County Water Agency to access 1,700 AFY of water rights on the Kern River previously held by the Nickel family and later transferred to Kern County Water Agency; this supply is referred to as "Nickel Water". SGPWA has purchased this supply for the next 20 years, and has first right of refusal for an additional 20 years. The Yuba Accord and Nickel Water supplies are assumed to be 100% reliable.

Table 2: Additional Imported Supplies Purchased by SGPWA

Additional Imported Supply	Annual Supply Available (AFY) 2015	2025	2035	2045
Yuba Accord[1]	300	300	300	300
Nickel Water[1]	1,700	1,700	1,700	1,700
Total Additional Imported Supplies	**2,000**	**2,000**	**2,000**	**2,000**

1. Data from SGPWA 2015 Urban Water Management Plan

Under SGPWA Resolution No. 2014-02, SGPWA has committed to take the necessary actions to provide its service area with adequate supplies of water to meeting expanding needs in its service area. However, the baseline analysis is limited to SGPWA's existing supply portfolio. Table 3 provides a summary of average imported water supplies available to SGPWA.

Table 3: Total Imported Supplies Available to SGPWA

Imported Supply	Annual Supply Available (AFY) 2015	2025	2035	2045
Table A (62% Allocation)[1]	10,726	10,726	10,726	10,726
Additional Imported Supply[1]	2,000	2,000	2,000	2,000
Total Imported Supply	**12,726**	**12,726**	**12,726**	**12,726**

1. Data from SGPWA 2015 Urban Water Management Plan

The City of Banning is the only purchaser of imported water in the Region, and purchases imported water through SGPWA for replenishment of groundwater in the Beaumont SU at the Noble Creek recharge facilities (see Figure 2), and is later pumped by the city's facilities to meet demand. There are currently no facilities in place to allow for direct delivery of imported water to the Region. Priority use of imported water is for direct use by suppliers outside of the Region. Direct use demands are expected to increase from 454 AFY in 2015 to 1,751 AFY in 2045 and reducing the volume available for conjunctive use which is considered a secondary use by SGPWA. For the purposes of this Study, it's assumed that Banning will be allocated 27.3% of Table A supplies in the future.

Table 4 provides a summary of the average available imported supplies, direct use demands, conjunctive use demands, and resulting supplies available for the Region, and estimates City of Banning allocations. As shown in the table, total conjunctive use outside the Region will continue to increase while existing imported supplies remain constant; this will require allocation of available imported water after direct demands are served according to conjunctive use demands. For the purposes of this Study, it's assumed that supply for conjunctive use will be allocated according to the conjunctive use demands shown in Table 4.

Based on increasing direct use demands, availability of imported water for Banning to purchase for conjunctive use is expected to decrease from 4,723 AF in 2015 to 1,617 AFY in 2045.

Table 4: Average Year Imported Water Uses and Supply Available to Banning

	Annual Average Imported Supply and Uses (AFY)			
	2015	2025	2035	2045
Total SGPWA Imported Water Supply	**12,726**	**12,726**	**12,726**	**12,726**
Direct Use Demands – Outside Region[1]	*454*	*767*	*1,191*	*1,751*
Available SGPWA Supply for Conjunctive Use	**12,272**	**11,959**	**11,535**	**10,975**
Conjunctive Use – Outside Region[1]	*2,773*	*17,247*	*23,287*	*27,330*
Conjunctive Use–Banning[2]	*4,723*	*4,723*	*4,723*	*4,723*
Total SGPWA Conjunctive Use	**7,496**	**21,970**	**28,010**	**32,053**
Conjunctive Use Supply Shortfall	***+4,776 (no shortfall)***	***-10,011***	***-16,475***	***-21,078***
Proportional Allocation of Conjunctive Use Supplies – Outside Region[3]	*2,773*	*9,388*	*9,590*	*9,358*
Proportional Allocation of Conjunctive Use Supplies – Banning[3]	*4,723*	*2,571*	*1,945*	*1,617*

1. Data from SGPWA 2015 Urban Water Management Plan
2. Assumes 27.3% of SGPWA imported water
3. Based on conjunctive use demand

In addition to being limited by the volume of supply available, facility capacity limitations also exist. SGPWA currently has a 20 cubic feet per second (cfs) connection to the SWP east branch. SGPWA is currently constructing an additional connection that will increase the connection capacity by 34 cfs, for a total capacity of 54 cfs. Once the new connection is complete, the limiting facility in the SWP east branch will be the Beaumont-Cherry Valley Pump Station, which has a capacity of 52 cfs.

Imported water quality from the SWP is generally low in constituents that may have health effects. Though not a health risk, chloride in SWP water can vary from over 100 mg/L to below 40 mg/L. Since imported water is recharged to the Beaumont Basin which is regulated for TDS, chloride levels in SWP water is a potential concern.

Local Surface Water

Surface water flows from the South and East forks of the Whitewater River are diverted and conveyed approximately 14 miles south for use by BHMWC and Banning through the Whitewater Flume system. Southern California Edison historically operated this diversion system and has ownership of the diversion rights of 13.26 cfs, and will soon be transferring ownership to either BHMWC or Banning. BHMWC extract approximately 1,000 AFY of Whitewater River water for direct use, with the remaining water flowing to San Gorgonio River, where it recharges Banning Canyon SU. BHMWC treats local surface water at a surface water treatment plant. At the time this Study was prepared, the capacity of the treatment plant was not available; therefore, it is assumed that the treatment plant is not a capacity constraint.

The City of Banning reports in its 2015 Urban Water Management Plan (UWMP) that the flume has historically provided a long-term average of 1,500 AFY of local surface water supply to BHMWC and Banning. Table 5 provides the local surface water diversions over the past five years (provided by BHMWC), and demonstrates both the decreased supply diverted due to damage to the flume and the volume available in wet years (2,600 AFY). Note that this table represents a shorter period of time than that used to estimate the 1,500 AFY average.

Table 5: Historical Whitewater River Diversions

Diversion Location	Annual Diversion (AF)				
	2012	2013	2014	2015	2016
East Fork[1]	1,083	1,301	720	720	320
South Fork[1]	1,301	1,301	828	828	145
Total	**2,384**	**2,602**	**1,548**	**1,548**	**465**

1. Source: BHMWC

Additionally, MBMI owns rights to divert water from Millard Canyon under three separate diversion permits (Permit numbers 485, 486 and 487). Permits 486 and 487 are diverted from the same point on Millard Canyon, including supplemental Statement S001101. Permit 485 has a separate point of diversion. From 2012 to 2016, MBMI has diverted an average of approximately 700 AFY of water for beneficial uses; this average diversion is assumed to remain as the average diversion into the future. Diversions from Millard Canyon are shown in Table 6.

Table 6: Historical Millard Canyon Diversions

Diversion Location	Annual Diversion (AF)				
	2012	2013	2014	2015	2016
Millard Canyon[1]	521	522	694	876	868

1. Source: State Water Resources Control Board. California Integrated Water Quality System. Total of diversions from permit numbers 485, 486 and 487. http://ciwqs.waterboards.ca.gov/ciwqs/ewrims/EWServlet?Redirect_Page=EWWaterRightPublicSearch.jsp&Purpose=getEWAppSearchPage

Table 7 provides a summary of the assumed local surface water diversion projections. As stated above, actual hydrologic year types will be applied to this average diversion amount in the WEAP model to provide projections of how monthly and annual hydrologic variation of local surface waters may affect water supply reliability. This is discussed further in Section 2.3.

Table 7: Projected Local Surface Water Diversions

Diversion Location	Annual Diversion (AF)					
	2020	2025	2030	2035	2040	2045
Whitewater River	1,500	1,500	1,500	1,500	1,500	1,500
Millard Canyon	700	700	700	700	700	700
Total Local Surface Water Diversions	**2,200**	**2,200**	**2,200**	**2,200**	**2,200**	**2,200**

Recycled Water

Recycled water is currently not produced or used within the Region. However, previous technical studies have explored the feasibility of using recycled water for irrigation and municipal uses within the Region. Further examination of projected use and quality of recycled water supply is taking place as part of a separate recycled water study completed in parallel with this Water Supply Reliability Study. The projects developed through the recycled water study will be considered as part of the overall San Gorgonio Water Supply Reliability Study.

Banning provides sewer service to the area within its city limits and to the unincorporated areas of Riverside County that surround the southeast portion of Banning. Collected wastewater is conveyed through sewer main lines, which are connected to the larger trunk lines. The trunk lines transport wastewater to Banning's 3.6 million gallons per day (mgd) Wastewater Treatment Plant (WWTP). The effluent is treated to secondary standards and is then discharged to percolation ponds to recharge the Cabazon SU. The MBMI also owns and operates a WWTP designed to treat up to 0.75 mgd per day.

Banning is proposing to upgrade its WWTP and construct facilities to support planned recycled water use in accordance with Banning's *2017 Integrated Water, Wastewater and Recycled Water Master Plan*, which as of this writing is in its final stages of development. Phase I of the WWTP upgrade consists of adding tertiary treatment facilities for production of recycled water. Upon completion of Phase II, which will increase treatment capacity from 3.6 mgd to 5.1 mgd, approximately 1,680 AFY of recycled water will be available to Banning for irrigation use. Banning has a projected recycled water demand of approximately 2,700 AFY for non-potable irrigation.

Given that recycled water is not currently produced in the Region and would require construction of facilities, recycled water is not included as part of the baseline supply projection.

2.2 Baseline Demand Assessment

Historical Demand

The Region is composed of five water suppliers that deliver water supplies to meet customer demands, as well as private groundwater pumpers. Demands in the Region are generally residential, with some industrial, agricultural and commercial use. Some of the largest industrial and commercial demands include the Arrowhead Water Bottling Facility, Robertson's Ready Mix, two outlet malls, and the Morongo Casino Resort.

Given that all the Region's suppliers, except Banning, supply less than 3,000 AFY to customers, UWMPs are not available to use for estimating current and projected demand for the entire Region. Different methods were used to estimate the current and projected demands based on the availability of data.

Current demand, represented as the year 2015, was estimated using the below documents and record types for each of the Region's suppliers:

1) **Banning 2015 UWMP:** Used for Banning demands
2) **2015 well production records:** Used for Cabazon Water District (CWD), Banning Heights Mutual Water Company (BHMWC), and High Valleys Water District (HVWD) demands
3) **San Gorgonio Pass Water Agency (SGPWA) 2015 Report on Water Conditions:** Used for private pumpers' demands
4) **Morongo WWTP effluent:** Used to calculate demands from those customers connected to the wastewater collection system in conjunction with assumptions for indoor (65%) and outdoor (35%) water use and applying a consumptive use factor of 20%.
5) **Septic systems on the Morongo Reservation:** Used to estimate demands from those customers not connected to the wastewater connection system, in conjunction with an estimation of 200 gpd/day of wastewater generation per septic system, and assumptions for indoor (65%) and outdoor (35%) water use and applying a consumptive use factor of 20%.
6) **Morongo Casino water use calculations:** Used to estimate Morongo Casino water use (provided in Appendix A)

The resulting demands assumed for 2015 are provided in Table 8.

Projected Demands

Demands projections were estimated using the following two methods, based on planning data available for the purveyors:

1) **Banning 2015 UWMP:** Used for Banning demand projections
2) **SGPWA 2015 Report on Water Conditions:** Used to estimate 2015 demand for private pumpers
3) **Southern California Association of Governments (SCAG) population projections:** Used to generate rates of population growth for estimation of demand projections for non-Banning purveyors

As part of its 2015 UWMP, Banning projected its demands based SCAG population projections and a demand factor of 220 gallons per capita per day (GPCD), as well as planned developments. Given that the remaining water purveyors in the Region didn't have demand projections readily available to state otherwise, it was assumed that increases in demand would equal the SCAG population growth rate.

For the areas within the Region but outside of Banning's service area, the population growth rate was calculated using SCAG population projections for unincorporated Riverside County. The assumed growth rate from 2015 to 2020 is 0.93% per year, from 2020 to 2035 is 1.48% per year, and from 2035 to 2040 is 1.19% per year. Because SCAG projections stop at 2040, the growth rate from 2040 to 2045 was as assumed to be the same as the 1.19% for the 2035-2040 time-period.

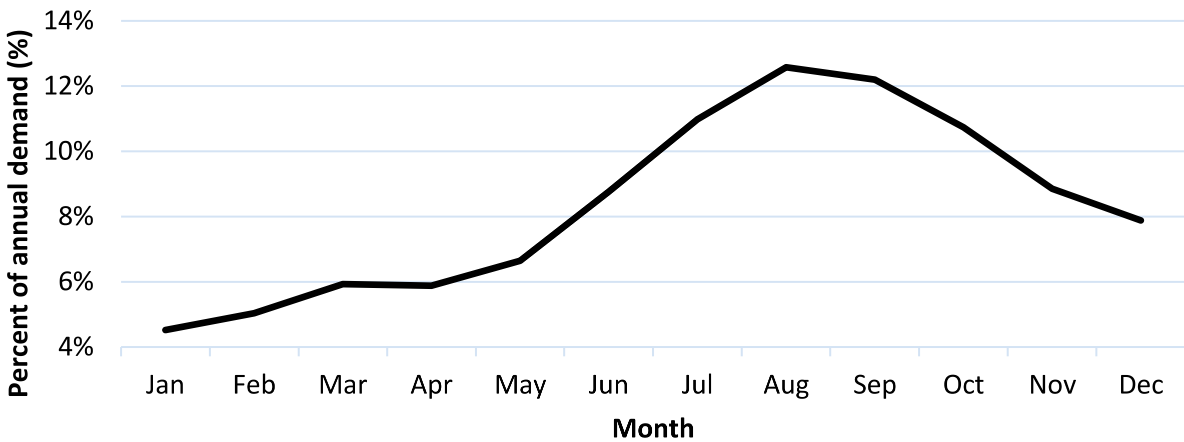
Table 8: Current and Projected Demands

Water Provider	Annual Demand (AFY)						
	2015	2020	2025	2030	2035	2040	2045
Banning[1]	6,709	10,515	11,320	12,047	12,837	13,629	14,470
HVWD[2]	65	68	73	78	83	88	93
CWD[2]	497	520	558	597	635	673	713
BHMWC[2]	105	110	118	126	134	142	150
MBMI[3]	1,750	1,831	1,967	2,102	2,238	2,370	2,510
Private Pumpers[4]	689	721	774	828	881	933	988
Region Total	**9,815**	**13,765**	**14,787**	**15,778**	**16,781**	**17,836**	**18,957**

1. Current and projected demands from the Banning 2015 UWMP.
2. HVWD, CWD, BHMWC current demands based on meter record summaries provided by each purveyor, and projected based on SCAG population growth rates.
3. MBMI demands calculated based on a demand factor applied to wastewater treatment volumes and assumed wastewater generation from septic systems, and calculations of casino water use (see Appendix A), and projected based on SCAG population growth rates.
4. Other Users / Private Pumpers demands from SGPWA's 2015 Report on Water Conditions, Non-Verified Production Data, and projected based on SCAG population growth rates.

In addition to the annual demands, an estimate of how demands vary each month was made for the purposes of understanding seasonal impacts of demand on meeting supply. Banning's demand variability, shown in Figure 4, indicates that peak water demand occurs in August (12% of total average annual demand), while minimum demand occurs in January (just over 4% of the total average annual). This monthly variability pattern was applied to all the Region's demands.

Figure 4: Banning Monthly Demand Variation



2.3 Average Supply versus Demand

Error! Reference source not found. Table 9 provides a summary of average supply versus demand as d iscussed in Sections 2.1 and 2.2, as well as the difference between supply and demand. As shown in the table, it is expected that in 2045, average annual demand may start exceeding average annual supply. To further analyze the impacts of this shortfall, a WEAP model was developed to analyze the ability of groundwater storage in wet years to buffer dry years in the near-term versus long-term, and determine whether facility capacities may be sufficient to meet higher demands in the future.

Table 9: Annual Average Supply versus Demand

	Annual Average AFY					
	2020	2025	2030	2035	2040	2045
Total Demand	13,765	14,787	15,778	16,781	17,836	18,957
Total Supply	21,493	19,882	18,888	18,593	18,298	18,163
Difference (supply minus demand)	7,727	5,095	3,110	1,812	462	-794

2.4 WEAP Model GAP Analysis

WEAP software was used to evaluate the ability of the Region's water purveyors to meet future demand under various seasons and hydrologic scenarios at current facility capacities. WEAP is a tool used for integrated water resources planning by evaluating water development and management options using detailed supply and demand inputs. The following section provides a description of the WEAP model developed for the Region, supply assumptions, and the results of the baseline reliability analysis.

WEAP Model Development

The Region's WEAP model was developed to provide an initial assessment of the reliability of baseline supplies, and the ability to meet future demands while factoring in facility capacity.

The planning horizon of the Region's WEAP model is from 2015 to 2045. Projected water demands and supplies are represented in the model as three scenarios: near-term (2025), medium-term (2030), and long-term (2045). Within each scenario, the Region's WEAP model uses as inputs the historical hydrologic sequences described in Section 2.1 to compare demand and supply assumptions, and assesses how the

Region's baseline supplies are able to meet demand under different water year types. The model also uses a monthly time step to reflect seasonal variability over the course of a year. The WEAP model uses a mass balance-based approach that factors in high-level facility capacities and resources management decisions. A screenshot of the baseline WEAP interface for the WEAP model is shown in Figure 5. The WEAP interface shows the basic linkages between supplies (in green) and demands (in red).

A conceptual diagram of the relationships between sources of supply and demands in the WEAP model is shown in Figure 6. As shown in the diagram, water supplies in the WEAP model (shown in blue) includes surface water, imported water, natural recharge of groundwater, the percolation of treated wastewater, and Banning's rights in the Beaumont Basin. Assumptions on monthly and annual supply variation are discussed below. Groundwater basins, shown in tan, incorporate the inflows and outflows discussed in Section 2.2, and are limited in capacity to allow for modeling of groundwater storage.

The model also includes demands (shown in gray) within the Region, including Banning, HVWD, CWD, BHMWC, and MBMI, as well assumptions for other users inside and outside of the Region. For demand nodes with multiple sources of supply, the priority of sequence for each supply is also indicated, where "Priority 1" represents the first supply drawn upon to meet demands. Facility capacities were input into the model.

Finally, the Banning WWTP (shown in purple) is included in the model and allows for the inclusion of treated wastewater percolation to Cabazon Basin. Note that the MBMI WWTP outflow is not included as a WWTP node in the baseline model as its location near the eastern boundary of the Cabazon SU is assumed not to provide direct groundwater supply benefits to pumpers in the Region.

Figure 5: Screenshot of Baseline WEAP Model

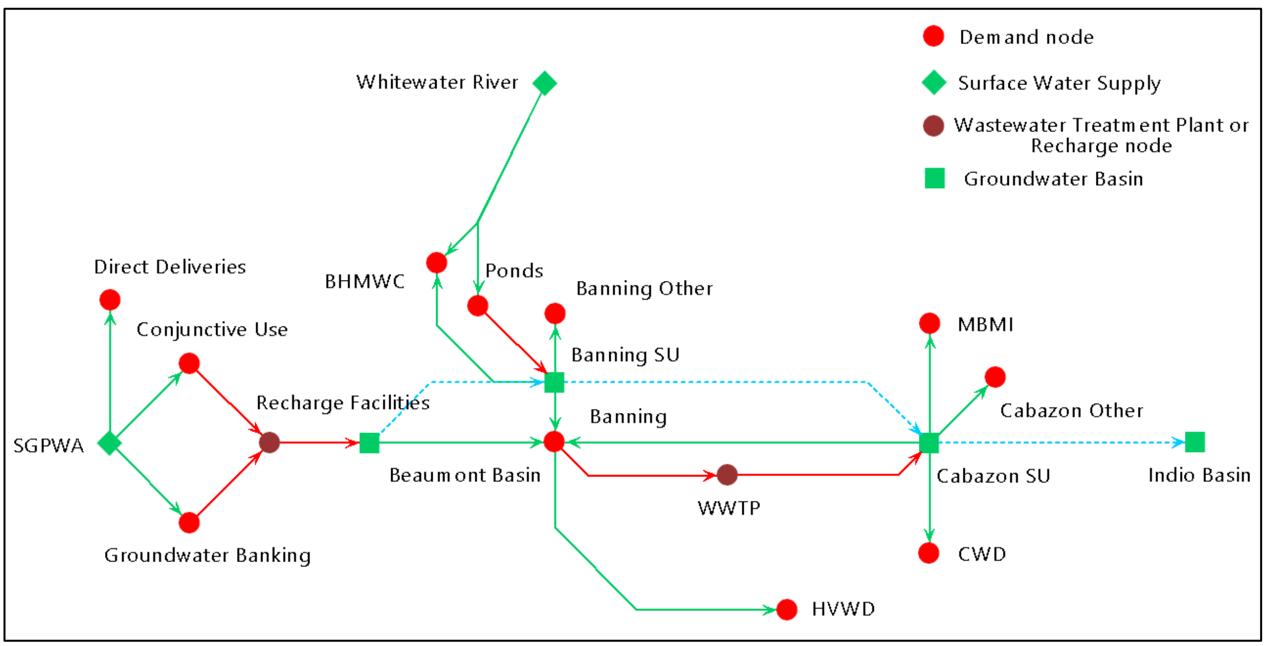
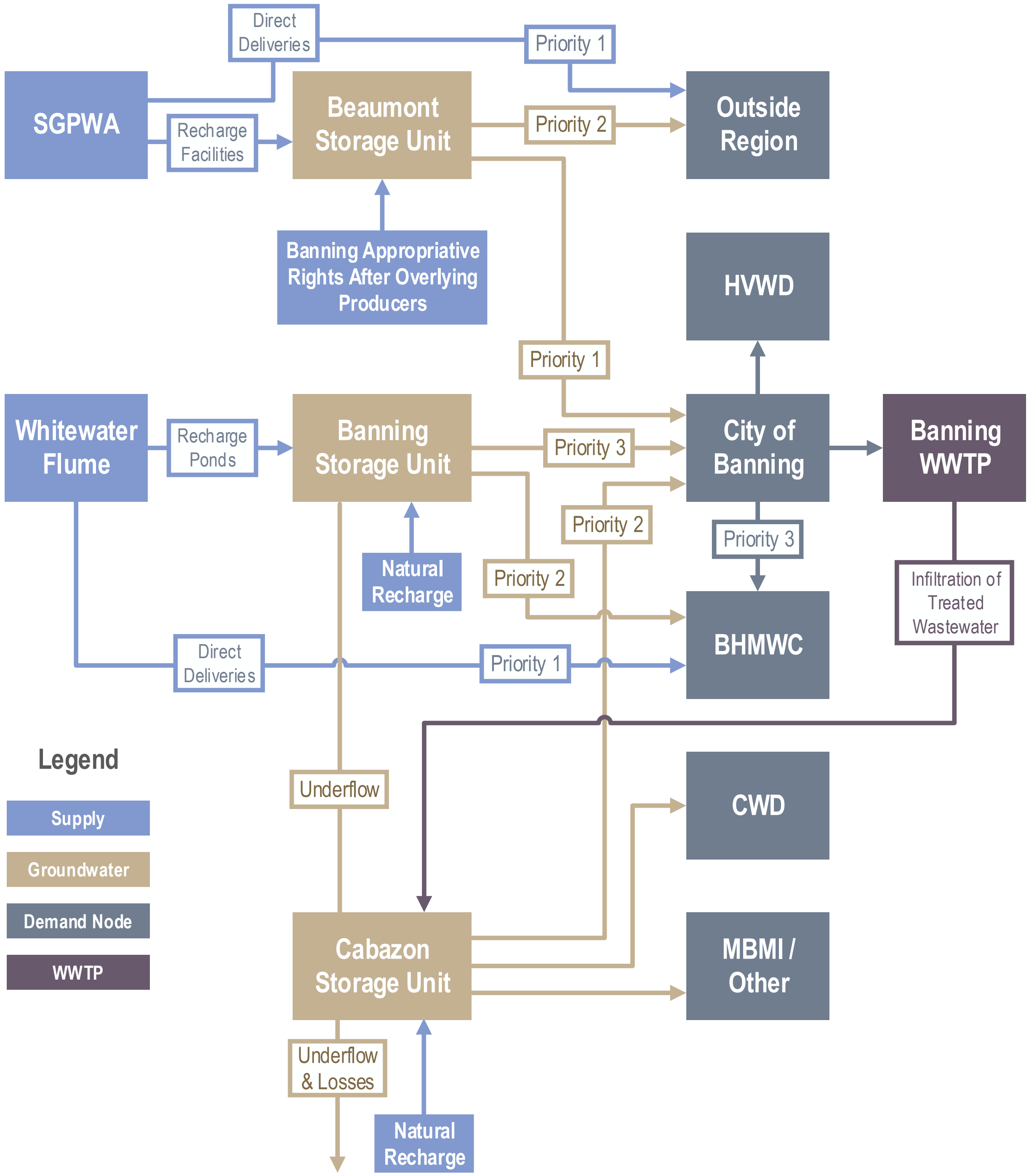


Figure 6: Conceptual Diagram of Baseline WEAP Model



Baseline Supply Assumptions

The following provides a discussion of the assumptions made when inputting baseline supplies into the model.

Imported Water Assumptions

Imported water volumes discussed in Section 2.2 were imported into the WEAP model, with annual variability applied by using the historical hydrologic sequence shown in Figure 3 for Table A water and 100% reliability for additional imported supplies (Yuba Accord and Nickel Water). In shortage years, imported water is first allocated to direct users of imported water, then to conjunctive demands as discussed in Chapter 2. The limiting facility capacity applied to imported water was the Beaumont-Cherry Valley Pump Station at 52 cfs.

Groundwater Assumptions

As discussed in Section 2.2, the availability of groundwater in the WEAP model is based on the water budgets and annual safe yields estimated in the *Safe Yield Study* (Geoscience, 2011), as well as rights to pumping in the Beaumont Basin by Banning. In the WEAP model, the Banning SU, Banning Bench SU and Banning Canyon SU are all combined into one groundwater node (referred to as the Banning SU within the model), while the Cabazon SU and Beaumont Basin are maintained as separate groundwater nodes.

In order to apply a local hydrologic sequence to the Region's groundwater supplies, natural recharge was separated from the safe yield estimates described in Section 2.2. The natural recharge for storage units in the Region includes recharge from surface runoff and streamflow in response to precipitation and snowmelt. The WEAP model estimates natural recharge values for the Banning SU and the Cabazon SU using the water budgets identified in the *2011 Safe Yield Study*, and are shown in Table 10.

Table 10: Natural Recharge Estimates (AFY)

SU	Average
Banning SU	9,815
Cabazon SU	10,460

Changes in groundwater storage in the Banning and Cabazon SUs were estimated in the WEAP model using outputs of the San Gorgonio Pass Watershed Model (SGPWM). The SGPWM was developed by the U.S. Geological Survey (USGS) using INFILv3 software. It was calibrated to estimate the long-term historic climate water budget for the San Gorgonio Pass, accounting for spatial variability in climate and watershed characteristics. The SGPWM currently uses a 100-year hydrologic sequence of water years 1913 to 2013. The monthly times series of output for groundwater recharge is presented in Figure 7. The average monthly recharge estimate is presented in Figure 8.

Pumping capacity was incorporated into the model for each purveyor, if available, as discussed in Section 2.2. For those purveyors where pumping capacity data was not available, a limiting factor was not applied.

Figure 7: Monthly Recharge for San Gorgonio Pass

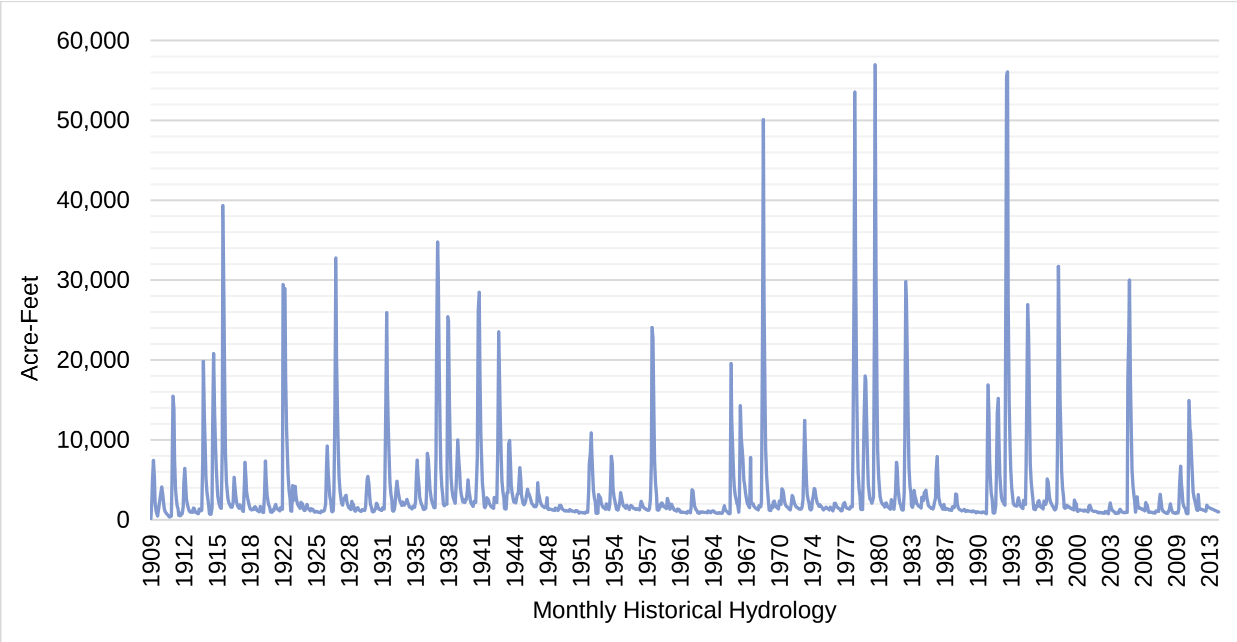
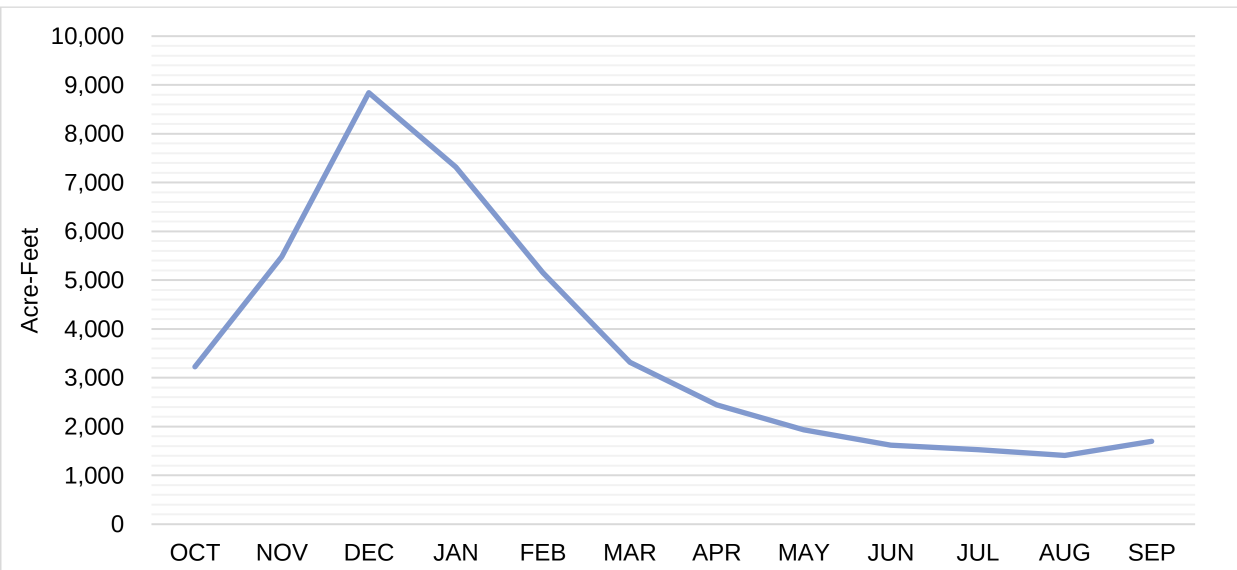


Figure 8: Monthly Average Natural Recharge for San Gorgonio Pass



The Beaumont Basin is only partially within the Region and is adjudicated. The WEAP model does not attempt to simulate the entire Beaumont SU and instead relies on the safe yield discussed in Section 2.2. In addition to the annual Safe Yield, the WEAP model simulates Banning's storage account within the Beaumont Basin. The Beaumont Basin Watermaster has permitted Banning to store up to 80,000 AF of surplus appropriated water and the recharge imported water purchased from SGPWA. As of 2015, the volume of storage in that account was 46,774 AF.

Local Surface Water Assumptions

The WEAP model l includes the use of Whitewater River via the Whitewater Flume as the primary source of supply for BHMWC. Due to seasonal and other limitations of this supply, some groundwater use by BHMWC is assumed based on historical use of this supply. Surface water supplies from the Whitewater Flume are also diverted into San Gorgonio River and percolation ponds located in the Banning Canyon SU. The contribution of the percolation ponds to subsurface groundwater flows into the Banning Bench SU is unknown. The WEAP model includes the potential functionality of these percolation ponds, but no recharge values are assumed as these values are already accounted for in the Safe Yield estimates for the Banning SU.

Model Results

The WEAP model was then run under each time step at near-, mid- and long-term demand levels to determine any gaps between supplies and demands. A gap is defined as a condition where the supplies available do not meet the demand within the same time frame. On an average annual basis, it is projected that the Region will be able to meet demands up until 2045 using previously stored local and imported water to account for the average supply input shortfall discussed in Section 2.3, and using existing facilities.

The baseline run of the WEAP model was conducted to show the reliability of the Region's supplies for the short-, mid- and long-term demand levels. Figure 9 shows the results of the WEAP model for 2045 using the full 82-year hydrologic sequence. This figure shows that under extended dry periods, the demands of the Region could exceed the total balance of supplies available to the Region for several consecutive years. *Without large surface water flows coming into the Region at regular intervals, groundwater basin recharge is insufficient to keep pace with production to meet demands.*

Figure 10 shows the net balance of inflows and outflows to the groundwater basins in the Region for the near-, mid- and long-term demands. This figure shows that the extended multi-year cycles of wet and dry periods have a long-term impact on the groundwater resources in the Region. In addition, the baseline results of the WEAP model indicate that the Region could exceed the current estimated safe yield values for the groundwater basins and/or draw from Banning's storage account in the Beaumont Basin in the medium-term (2035) scenario by approximately 200 AFY and under the long-term (2045) scenario by approximately 2,200 AFY.

Figure 9: Annual Net Supplies and Demand – Long Term (2045)

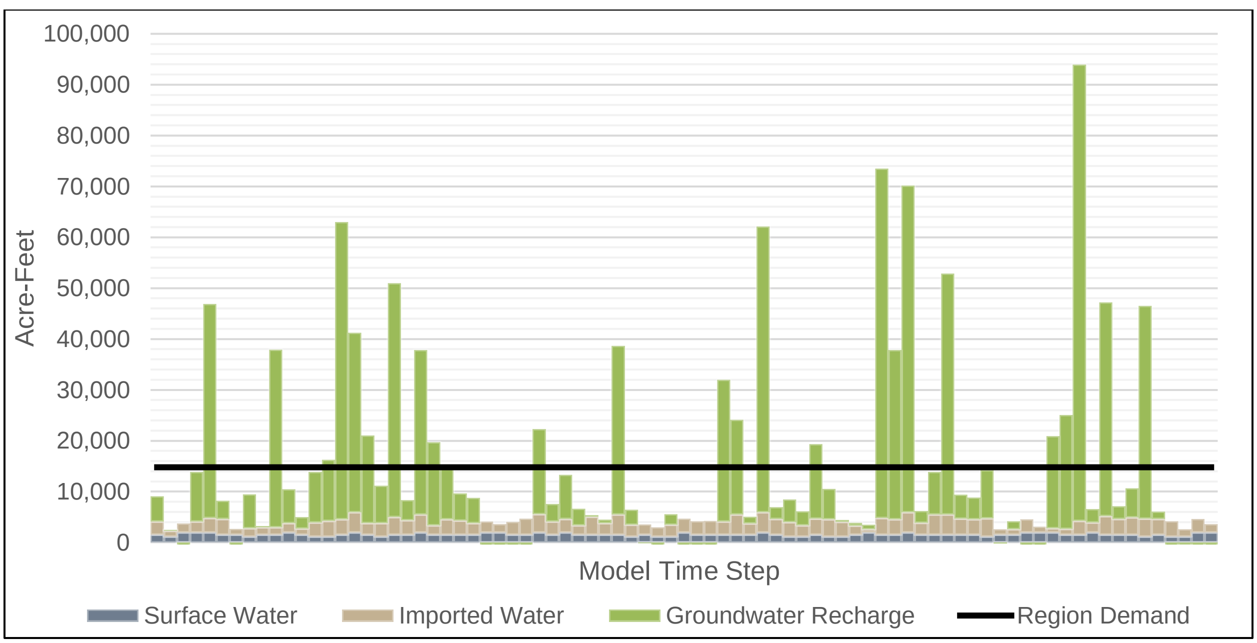
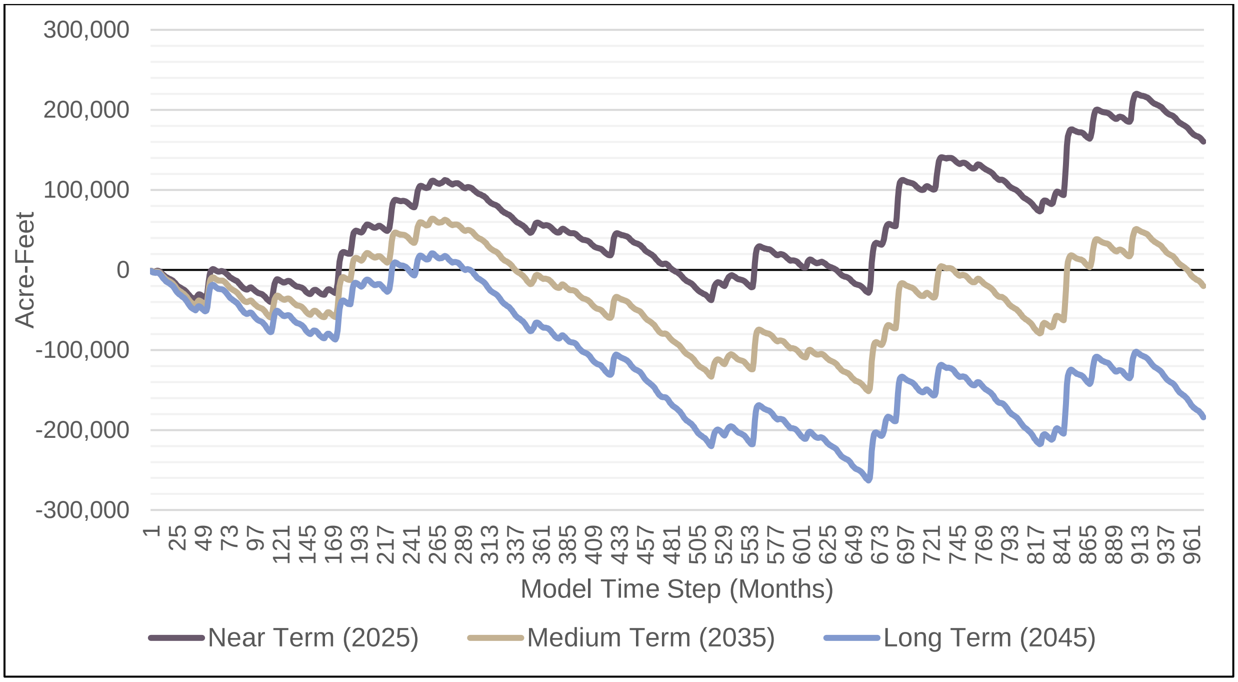


Figure 10: Net Balance of Groundwater Inflows and Outflows



Chapter 3 Supply Reliability Concerns

A number of factors can impact the ability of the Region's water suppliers to provide reliable water supply, including:

- **Seasonal or annual supply shortages:** High variability of precipitation locally and statewide could lead to shortfalls in supply.
- **Water quality:** Water supplies that exceed drinking water standards require treatment or blending with higher quality water. If treatment or blending water is unavailable, then these supplies cannot be used.
- **Aging infrastructure:** Aging infrastructure must be regularly maintained or replaced to ensure reliable production, treatment and delivery of supplies.
- **Catastrophic interruptions:** Catastrophic interruptions from earthquakes, fires, power outages or other disasters could completely interrupt supplies.
- **Climate change:** Climate change could alter the volume, timing and type of precipitation that falls Statewide and locally, which could impact the volume, timing and quality of water supply available.

The baseline assessment and WEAP model gap analysis discussed in Chapter 2, as well as direct discussion with water suppliers and review of planning documents were used to develop a summary of supply reliability concerns for the Region, and are described below.

Seasonal or Annual Supply Shortages

The gap analysis described under Section 2.3 was conducted to identify potential shortfalls in supply on a seasonal or annual basis based on historical hydrology. This modeling effort found that, while seasonal and annual variations in precipitation have been buffered by groundwater storage in the past, future demand levels are expected to begin drawing down the groundwater in storage which is indicative of the need to identify and acquire new supply sources.

Water Quality

Water supplies in the Region are generally considered to be of good quality, but must be managed as the Region becomes more reliant on its groundwater basins in the future. As described in Chapter 2, there was an MCL of 10 mg/L for Cr-6 set by the SWRCB that several City of Banning wells exceeded. The City is currently monitoring Cr-6 and awaiting a new MCL from the SWRCB prior to initiation of a treatment project. Should a similar MCL (10 mg/L) be implemented, several wells would have to be taken offline and potentially reduce pumping by up to 12,000 AFY until treatment facilities could be constructed.

While not in exceedance of an MCL, the BHMWC has stated that nitrate levels in the Banning Bench SU would increase in the absence of local surface water recharge activities currently conducted by BHMWC. Therefore, maintaining current monitoring and recharge activities are necessary to ensure good water quality in the Banning Bench SU. Nitrate levels are also a concern in the Banning SU and Cabazon SU given the number of septic systems in use. Additionally, percolation of treated wastewater to Cabazon Basin may increase nitrate levels given that treatment processes at Banning's WWTP and the MBMI's WWTP only minimally remove nitrate.

Finally, TDS (or salinity) is closely monitored in the Beaumont Basin to ensure that TDS levels in the basin do not exceed basin quality goals set by the Santa Ana RWQCB. The need to manage TDS in all of the Region's basins must be considered as part of future imported water recharge or recycled water recharge activities as these activities typically increase TDS loading to groundwater basins. Should recharge of imported and/or recycled water be used in the Region's other groundwater basins in the future, TDS will likely become a concern and need to be monitored more closely.

Aging Infrastructure

Continued maintenance and monitoring of infrastructure is necessary to maintain reliable production and delivery of drinking water to customers. Given the small sizes of the Region's water suppliers, dedicating staff and funds to these activities can be a challenge, and can sometimes result in deferred maintenance and replacement. For example, the City of Banning is currently replacing an aging transmission pipeline in Banning Canyon that, had it failed, could have resulted in the loss of a large portion of the City's water supply. Continued infrastructure improvement has been identified as a need by the Region's water suppliers.

Interruption

Given the Region's geology and geography, it is vulnerable to interruption from events such as earthquakes or fires. Several seismic fault lines lie within the Region's boundaries, making the area prone to earthquakes that could result in power outages and damage to water system facilities. Damage to water system facilities would reduce supply reliability by directly reducing the ability to deliver water or impacting treatment systems. Given that not all wells in the Region have emergency power supplies, a power outage could greatly reduce supply reliability. Additionally, the entire SWP system is at risk of earthquake related interruptions from potential levee failure at the San Francisco Bay-Delta that would lead to sea water intrusion, power failures that would make the intake pumps inoperable, or direct damage to facilities such as the aqueduct or dams.

The Region is also subject to frequent wildfires due to common hot, dry weather conditions and high velocity winds that lead to frequent red flag warnings. Local fires can result in power outages that would impact the ability to produce, treat and deliver drinking water. Fires upstream from surface supplies can impact water quality by increasing the amount of debris and erosion potential that will result in increased sediment loading in water bodies.

Climate Change

The Region has conducted a climate change analysis as part of the IRWM Plan development, and identified a number of potential climate change impacts to the Region, including increases in temperature, decreases in total precipitation, reduction in snowpack, decreases in local surface water availability and natural recharge, and decreases in SWP imports. Based on these impacts, the Region identified vulnerability issues; those vulnerability issues related to water supply reliability are listed below:

- Demand-related vulnerability issues
    - Increase in crop/irrigation demand
    - Decreased ability to use groundwater storage to buffer drought
    - Limited ability to conserve further
    - Limited ability to meet future demand due to changes in peak summer and annual demand
- Water supply-related vulnerability issues
    - Decrease in local surface water supply
    - Decrease in groundwater supply
    - Decrease in imported supply
- Water quality-related vulnerability issues
    - Increase in treatment needs and costs

Chapter 4 Supply Reliability Project Concepts

Supply project concepts were developed in coordination with the Region's water suppliers to address the supply reliability concerns discussed in Chapter 3. Table 11 provides a listing of the types of projects that could be implemented by the Region to respond to its reliability concerns.

Table 11: Project Concept Types versus Supply Reliability Concerns

Project type	Supply Reliability Concern				
	Seasonal or Annual Supply Shortage	Water Quality	Aging Infrastructure	Interruption	Climate Change
Imported water rights purchase	✓				✓
Direct imported water delivery	✓				✓
Treatment facility		✓	✓		✓
Storage tank			✓	✓	
Transmission or delivery equipment/pipeline replacement or improvement	✓		✓	✓	
New or upsized emergency connections			✓	✓	
Water use efficiency	✓	✓		✓	✓
New emergency back-up power				✓	
Local Non-potable recycled water use	✓	✓		✓	✓
Groundwater recharge with recycled water	✓	✓		✓	✓

The following sections articulate these project concepts based on key assumptions for facilities needed, volumes supplied, costs, and locations. It should be noted that the assumed locations of projects are based on those provided by the Region's water suppliers at the time of this study, but that similar projects could be implemented in other locations. Additionally, project concept descriptions identify which IRWM Plan objectives would be met.

The project concepts that could provide additional water supply were then run through the WEAP model discussed under Chapter 2 to assess whether they would help mitigate some of the gaps identified.

4.1 Project Concepts Articulation

The Region's water suppliers provided information on the below project concepts to allow for an estimation of costs and benefits. These project concepts, shown in Table 12, were first identified in other studies or CIPs, and are cited as such. Costs from these studies have been updated to reflect 2017 dollars, and facilities costs have been estimated where needed based on capital and O&M cost assumptions. Detailed cost assumptions and estimates are included in Appendix B.

Table 12: Project Concepts

Conceptual Project	Description	Supply source and Demands met	Supply reliability	Facilities	Readiness to proceed	Cost	Implementation Considerations
Imported rights purchase and imported water pipeline	Project would construct an imported water pipeline extending from the Beaumont-Cherry Valley pump station, through the City of Banning and into the Cabazon WD for recharge of imported water to the Banning Storage Unit and Cabazon Storage Unit. Alignment will connect at the Beaumont-Cherry Valley Pump Station. The project will terminate at Cabazon Basin.	Raw imported water from SWP and Sites Reservoir City of Banning and Cabazon demands = 1,800 AFY (includes a 10% recharge loss applied to 2,000 AFY)	Sites Reservoir assumed to be 100% reliable.	*Existing pump station:* Beaumont-Cherry Valley pump station *New pipeline:* 12-mile, 12-inch diameter The pipeline will generally follow the Independent SGPWA North Pass Alignment presented in the SGPWA 2009 Study, but will begin at the Beaumont-Cherry Valley pump station and go south to meet the alignment Conveyance facilities to be sized to deliver peak flows: up to 3.7 cfs (DWR allows peak delivery of SWP water during wet years) *North Banning Recharge Site (Recharges Cabazon SU)* Assuming up to 1,000 AFY, 9 months of the year. Assuming 1.5 ft recharge per day and effective recharge rate 30% less than basin area = 3.5 acres required to be purchased. Located at the Five Bridges Recharge site. *Five Bridges Site (Recharges Banning SU)* Cabazon Basin Recharge Facility Assuming up to 2,000 AFY, 9 months of the year. Assuming 1.5 ft recharge per day and effective recharge rate 30% less than basin area = 5.2 acres required to be purchased. Located at the North Banning Recharge Site. *Existing wells:* Assuming capacity sufficient in existing wells to pump recharged imported water *New wells:* Assuming existing pumping capacity is sufficient. Will confirm through WEAP analysis.	Some planning completed. This project is a variation on the North Pass Alignment described in the 2009 SGPWA Study.	Capital: $35.3M O&M: $264,000/yr Supply purchase + conveyance: $1,417/yr Unit cost: $2,900/AFY	Largest cost component: 12 miles of pipeline is required to go from the Beaumont-Cherry Valley pump station to the Cabazon Basin recharge site (North Banning Recharge Site) and Banning Basin site (Five Bridges) Assumes that no new wells are needed Assumes new imported water rights are purchased (Sites Reservoir, $1,100/AF)
Treatment Facility to Address Cr-6 MCL	Project would construct a treatment facility to treat City of Banning wells high in Cr-6 Ion exchange with centralized resin regeneration facility and dynamic well profiling with well modification	Beaumont SU and Banning SU Total well capacity of 8 non-compliant wells = 7,250 gpm City of Banning Demands = 9,600 AFY (assuming 80% of capacity)	Meeting MCL for Cr6 will increase reliability of groundwater supply that has been allocated via partial adjudication of Beaumont Basin and per the Beaumont Basin Watermaster	*Existing wells:* C3, C6, M3, C2, C4, M10, M11, M12 *New treatment:* • Strong Base Anion Exchange (SBA) treatment at four sites • Resin regeneration facility for SBA treatment (totaling 8,600 gpm) *New pipelines:* 11,500 ft raw water transmission piping *New reservoirs:* 3 new reservoirs (totaling 2.05 MG) *New pump stations:* One per treatment site Two potential sites identified for resin regeneration: 1) Coachella Valley Water District's (CVWD's) SBA CRRF (currently under construction – potential for regional facility) Or 2) Foothill West Cluster Treatment sites: 1) Well C3 2) Well C6 3) Foothill West cluster (M3, C2, C4) 4) M12 cluster (M10, M11, M12)	Feasibility planning completed	Capital: $18M to $33M O&M: $0.5M-0.7M/yr Unit cost: $160/AFY to $270/AFY	Final project sites have not been selected, therefore a range of costs are provided. Project will only be necessary if an MCL below 20 is set by the SWRCB DDW. Project costs don't include existing well O&M

Conceptual Project	Description	Supply source and Demands met	Supply reliability	Facilities	Readiness to proceed	Cost	Implementation Considerations
Emergency Connection Upsizing	Project would upsize an existing emergency connection with City of Banning and Banning Heights MWC at the northern end of their distribution system. Water would flow through their system and connect to a new connection at the southern end of their system. As an added benefit, an upsized emergency connection would also improve Banning Heights MWC's fire flow protection	Emergency supplies only Emergency City of Banning and BHMWC demands	This would increase reliability as the City of Banning's four northernmost wells will be available for use even if a pipe break occurs within a 3-mile stretch of the transmission main.	Northern connection: Upsizing existing 2" pvc pipe with 6" or 8" pipe connection. Pipe length: 600 ft. The first pipeline would connect to Banning Heights MWC's northern boundary. Southern Connection: New 8" pipe Pipe length: 4,450 ft. The second pipeline would connect to Banning Heights MWC's southern boundary	Feasibility planning	Capital: $1M O&M: $6,000/yr Unit cost: n/a	This project would improve emergency readiness for the City and BHMWC and improve BHMWC's fire flows (and therefore insurance rates), but would be difficult to quantify the benefits.
Emergency Backup Power to City of Banning Wells	The project would implement backup generators for three City of Banning wells (9,8, and C-4).	3,000 gpm (assuming 1,000 gpm/well) = 3,900 AFY (assuming 80% efficiency) City of Banning, High Valleys and BHMWC demands	This would increase reliability of pumping in the City as wells would still be functional if power was disrupted.	Three total generators. Well 8 and 9 would require one small generator each Well C-4 is bigger and is located near a residential area and daycare center. It will need a bigger generator with a particulate filter and block-wall enclosure. Generators will be adjacent to Wells 8, 9, and C-4.	Feasibility planning	Capital: $0.65M O&M: $9,000/yr Unit cost: n/a	This project would greatly improve resilience.
Installation of System-Wide Isolation Valves in the Cabazon Water District system	Project would include installation of system-wide isolation valves throughout the water system.	System Reliability Improvement Cabazon Water District demands	There are a limited number of isolation valves throughout Cabazon, which requires significant dewatering of pipelines when repairs are required. Isolation valves will reduce water waste during pipeline dewatering, improve system operation, and improve system reliability by minimizing service interruptions to customers.	Installation of isolation valves within existing distribution system.	Conceptual	Costs are yet to be developed for this project.	This project would greatly improve system operation and system reliability.
Potable Water Well in Cabazon	Project would construct a potable water well south of Interstate 10 in Cabazon.	Cabazon SU: 1,000 gpm Cabazon Water District demands	CWD's existing water system is divided by Interstate 10 and has only one pipeline connecting the north side of the water system to the south side of the water system. South of Interstate 10, there is only one well. A new well south of Interstate 10 would increase supply reliability by providing supply and system redundancy.	Well Pumping Plant with a nominal production capacity of 1,000 gpm Property acquisition required for new well	Conceptual	Capital: $4.1M O&M: $30,000 Unit Cost: n/a (providing supply redundancy, not new supply)	An application has been submitted to the State for Planning Funding.
Well Pumping Plant Improvements in Cabazon	Project would include replacement of an existing pumping unit and related electrical equipment at two existing wells, as well as installation of a new water level measuring access point at one well.	Cabazon SU Cabazon Water District Demands	Re-equipping of existing wells is necessary due to declining groundwater levels. The project would increase water supply reliability, provide system redundancy, and provide a means for CWD to measure groundwater levels.	Replacement of two existing well pumping units and related electrical equipment Installation of a new water level measuring access (sounding tube or airline) to obtain static and pumping water level measurements at two existing wells	Conceptual	Costs are yet to be developed for this project.	An application has been submitted to the State for Planning Funding.

Conceptual Project	Description	Supply source and Demands met	Supply reliability	Facilities	Readiness to proceed	Cost	Implementation Considerations
Replacement Pipeline Crossing Under Interstate 10	Project would construct a replacement pipeline crossing under Interstate 10, which is necessary to supply water south of Interstate 10 in Cabazon.	System Reliability Improvement Cabazon Water District demands	CWD's existing water system is divided by Interstate 10 and has only one pipeline interconnecting the north side of the water system to the south side of the water system. If the pipeline under Interstate 10 were to fail, then the north and south sides of the water system would be separated; the well on the south side of the system would be the only source of supply, but there is no existing tank it could discharge to for service level storage; and CWD would be unable to meet customer demands south of Interstate 10.	16" pipeline (approximately one mile in length) with a bore and jack crossing under Interstate 10	Conceptual	Capital:$3M O&M: $25,000 Unit Cost: n/a	An application has been submitted to the State for Planning Funding.
Storage tank in City of Banning	Project would construct a new 100,000 gallon storage tank to primarily be used for fire flow protection and operational flexibility in case of extended power outages.	100,000 gallons storage of existing supply City of Banning and Banning Heights MWC demands	This would increase reliability of the City of Banning, High Valleys and BHMWC water delivery system.	Potable water storage tank: 100,000-gallon tank and required pipelines between tank and distribution system (pipe length TBD) Located near Comfort Camp Wells	Conceptual	Capital: $0.65M O&M: $9,000/yr Unit cost: n/a	This project would improve resilience as there's currently no storage tank in the area, and therefore customers depend entirely on well pumping.
Potable Water Storage Tank in Southeastern Portion of Cabazon	Project would construct a new 1.0 MG storage tank within the southeastern portion of Cabazon.	System Reliability Improvement Supply: 1,000,000 gallons = 3 AF Cabazon Water District demands	There are no wells in the southeastern portion of Cabazon and the sole 0.5 MG service level tank is fed by a single pipeline, which is located in a flood zone and crosses the San Gorgonio River. If the pipeline were to fail or if the 0.5 MG tank were taken out of service, water could not be provided to the southeast portion of the system. A second, larger tank would provide fire flow protection, operational flexibility, and system redundancy.	Potable Water Storage Tank: 1.0 MG tank Property acquisition required for new tank Located in southeastern portion of Cabazon	Conceptual	Capital: $1.65M Annual O&M: $10,000 Unit Cost: TBD	This project requires land acquisition and permitting.
Potable Water Storage Tank in Northeastern Portion of Cabazon	Project would construct a new 1.0 MG storage tank within the northeastern portion of Cabazon.	System Reliability Improvement Supply: 1,000,000 gallons = 3 AF Cabazon Water District demands	CWD currently has one well and a reservoir located within the northeastern portion of the District that serves a majority of the service area south of Interstate 10. A second, larger tank would provide fire flow protection, operational flexibility, and system redundancy.	Potable Water Storage Tank: 1.o MG tank Property acquisition may be required for new tank Located in southeastern portion of Cabazon	Conceptual	Capital: $1.65M Annual O&M: $10,000 Unit Cost: TBD	This project requires permitting and may require land acquisition.
Water use efficiency	The project would implement water use efficiency measures (to be determined) in order to reduce demand for potable water. It is assumed that the Region's current GPCD is equivalent to the City of Banning's (196 GPCD), and would reduce this value by 10% to 176.4 GPCD, and in 2040 would be equivalent to water savings of 1,400 AFY.	Up to 1,400 AFY All water supplier demands	Reliability dependent on ongoing customer behavior. This project concept would offset the demand for potable water and increase supply availability for other demands.	Potential WUE programs: Turf removal rebates HET distribution or rebates High efficiency nozzle distribution Large landscape surveys and retrofits Sprinkler giveaways or rebates Smart controller rebates Urinal retrofits Water surveys Region-wide projects	Conceptual	Total cost: $0.5M to $2.3M Unit cost: $300/AFY to $1,600/AFY	A specific water use efficiency program is not yet developed. In order to better define benefits and costs, specific WUE measures need to be defined.

Imported Rights Purchase and Imported Water Pipeline

This project concept would construct an imported water pipeline extending from the Beaumont-Cherry Valley pump station, through Banning and into CWD for recharge of imported water to the Banning SU and Cabazon SU, and purchase new imported water.

New imported water would be purchased by contributing to the Sites Reservoir project, which would divert water from the Sacramento River through existing canals during high flow periods to an off-stream reservoir for later use. The reservoir would be located at a site approximately 10 miles west of Maxwell in Colusa County. Sites Reservoir would then use existing canals to deliver the water south to the State Water Project. The Sites Project Authority, which is a Joint Powers Authority formed by seven entities to pursue the development and construction of the Sites Reservoir Project, is seeking partnerships with agencies such as SGPWA to help to pay for the project. The project is scheduled to begin operation in 2029.

The new 12-mile, 12-inch pipeline would begin at the Beaumont-Cherry Valley pump station and head south to meet the Independent SGPWA North Pass Alignment presented in the SGPWA *Supplemental Water Supply Planning Study* (Supplemental Water Study) and deliver imported water to two new recharge basins within the Region. 2,000 AFY of imported supply would be purchased, and is assumed to be split for recharge between two sites in the Region.

The first recharge basin would be located at the Five Bridges Recharge site and recharge to the Banning SU. At an assumed 1.5 feet of recharge per day, the facility would require approximately 3.5 acres of land if 1,000 AFY of water is recharged over nine months of the year, at an effective recharge rate assumed to be 30% less than estimated basin area. The second recharge basin would be located at the North Banning Recharge Site and would recharge the Cabazon SU. This location would require 5.2 acres of land to recharge 1,000 AFY, assuming one foot of recharge per day and an effective recharge area 30% less than the estimated basin area.

The Beaumont-Cherry Valley pump station will help to convey the imported water to the designated recharge basins, and is assumed to be sufficient to pump water into the Region. The described pipeline alignment and recharge basins are shown in Figure 11.

It is assumed that there will be a leave-behind of 10% of all water recharged, which yields 1,800 AFY of new imported water supply available to pump. Stored water will be pumped using existing well capacity; therefore, the cost for new wells are not included in the cost estimate.

Capital cost for this option is estimated at $35 million (M) with a total operations and maintenance (O&M) costs of $264,000/year. The unit cost for the imported water pipeline option is $2,900/AF, based on 1,800 AFY of supply benefit. Detailed cost information is available in Appendix B.

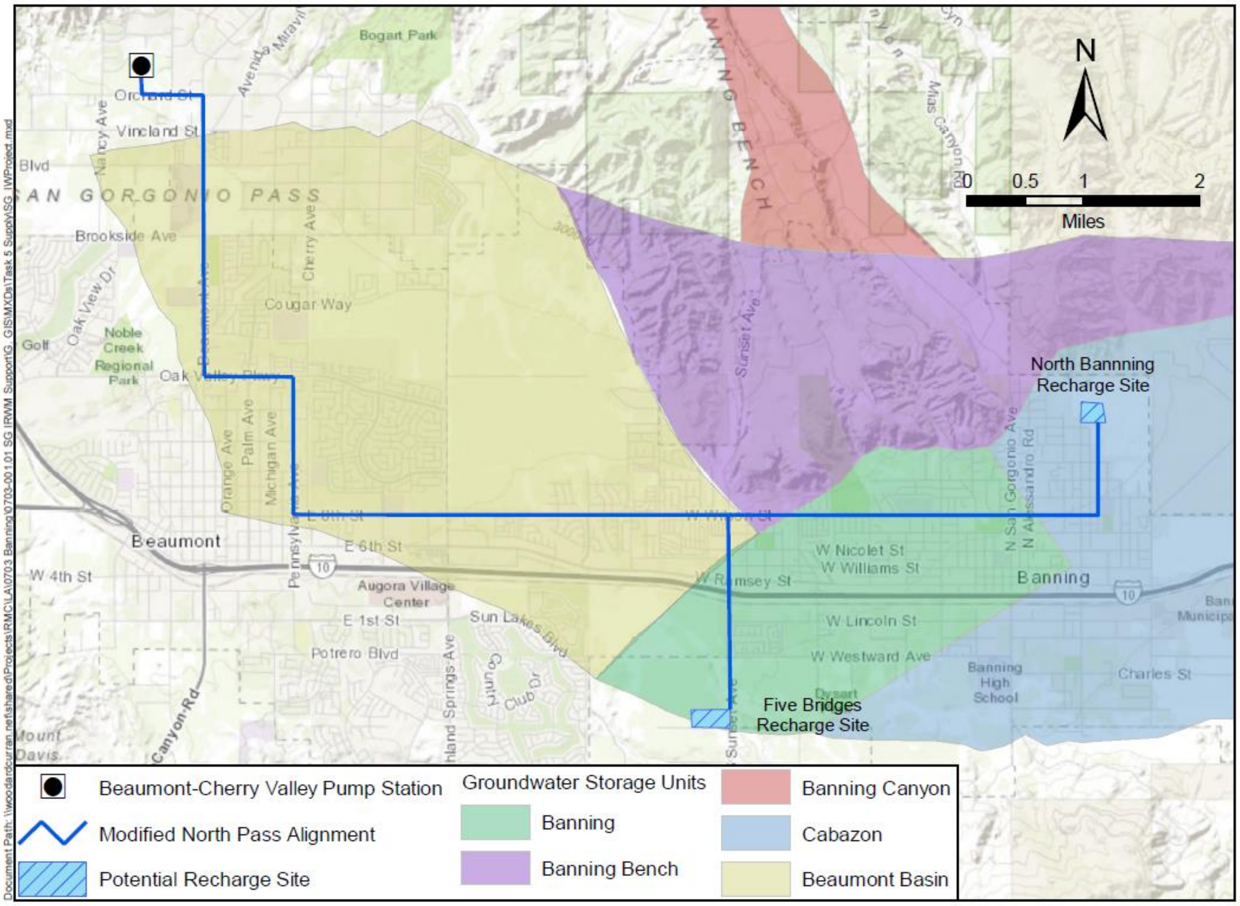
Some planning has been completed as this option is a variation on the Independent SGPWA North Pass Alignment described in the *Supplemental Water Study*. In order to move forward with this project concept, the revised North Pass alignment discussed here will need to be further evaluated, initiation of partnership discussions, preliminary design, and the purchase of imported water will need to be pursued.

This project concept would help the Region to meet the following IRWM Plan objectives:

- **Objective 1B:** Support affordable investments and agreements between local and external agencies to enhance the reliability of imported water throughout the region
- **Objective 1C:** Maximize the use of groundwater supplies, including storage of imported water
- **Objective 2B:** Form agreements between local and external agencies to support regional supply systems, conservation programs and emergency response

- **Objective 10:** Implement multi-benefit strategies, that adapt to climate change impacts for flood management, water supply, water quality, water-dependent habitat, and fire risk

Figure 11: Direct Imported Water Delivery Facilities



Treatment Facility to Address Cr-6 MCL

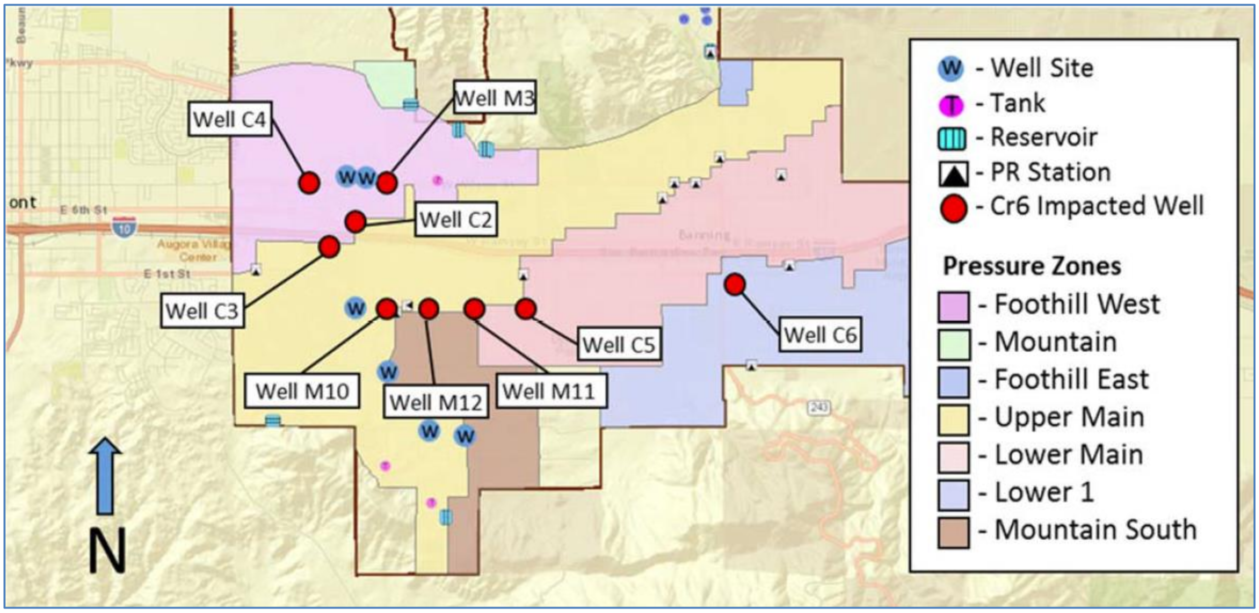
As discussed in Chapter 2, the SWRCB previously set an MCL for Cr-6 at 10 µg/L, but recently invalidated the MCL until additional analysis could be completed. The City of Banning has concerns related to Cr-6 as treatment will be necessary if an MCL were set at 20 µg/L or lower.

The City conducted an analysis of treatment options based on the previous MCL of 10 µg/L and identified a preferred treatment option. The Chromium-6 (Cr-6) treatment option would construct four Strong Base Anion Exchange (SBA) treatment facilities to treat the eight Banning wells that exceeded 10mg/L of Cr-6: C2, C3, C4, C6, M3, M10, M11, and M12 (shown in Figure 12). Four treatment sites are planned to treat single wells or groupings of wells as follows:

1. Well C3
2. Well C6
3. Foothill West Cluster (M3, C2, C4)
4. M12 Cluster (M10, M11, M12)

This project concept would require the construction of a new pump station at each of the four treatment sites and 11,500 feet of raw water transmission piping. A resin regeneration facility for SBA treatment (totaling 8,600 gpm) would also be constructed. Banning's Cr-6 Study (Hazen and Sawyer, 2016) identified two potential sites for the resin regeneration: 1) Coachella Valley Water District's (CVWD's) SBA Central Resin Regeneration Facility (CRRF), which was under construction prior to the MCL being invalidated, or 2) Foothill West Cluster. Three new reservoirs totaling 2.06 million gallons (MG) would also be required.

Figure 12: City of Banning Wells Potentially Impacted by Cr-6



*Source: City of Banning Chromium-6 Treatment and Compliance Study Memorandum, July 2016.*Figure 4.

The total well capacity of the eight non-compliant wells is 7,250 gpm or 45% of Banning's total capacity. Cr-6 treatment can help to meet 9,600 AFY of demand for Banning, assuming the wells run 80% of the time. Final sites for this option have not been selected, therefore, only a range of costs have been provided at this time. Capital costs range from $18M to $33M, with O&M costs at $0.5M/year -$0.7M/year. The unit cost of this option is $160/AF - $270/AF. Note that these costs only incorporate the cost to construct, operate and maintain the treatment systems and new pump stations; they do not include existing well operation and maintenance. An alternative method of treating Cr-6 using Stannous Chloride is currently being tested by CVWD and could prove to be more cost effective than SBA.

The next steps in implementing this project will be to re-evaluate the treatment needs based on the new MCL and any advancements in treatment technologies, followed by initiation of discussions with neighboring agencies to potentially develop a regional approach, and begin preliminary design.

This project concept would help the Region to meet the following IRWM Plan objectives:

- **Objective 2C:** Support projects to increase resilience and redundancy of local production and distribution facilities
- **Objective 5:** Remain engaged across the changing legal, institutional, and regulatory framework affecting drinking water standards

Emergency Connection Upsizing

This project concept would upsize an existing emergency connection Banning has with BHMWC at the northern end of BHMWC's distribution system. Water would flow through the BHMWC service area and connect to a new connection at the southern end of its system. The option would require Banning to upsize 600 feet of the existing 2-inch northern connection pipeline with a 6-inch or 8-inch pipeline. A new 4,450 feet of 8-inch pipeline will be constructed at BHMWC's southern boundary.

The option would increase reliability as Banning's four northernmost wells will be available for use even if a pipe break occurs within a 3-mile stretch of the transmission main. As an added benefit, an upsized emergency connection would also improve BHMWC's fire flow protection. This option would greatly improve emergency readiness, but benefits would be difficult to quantify.

The capital cost of this option is $1.0M with $6,200/year of O&M costs. A unit cost was not estimated for this project as it does not provide new or stored supply – but increases the reliability of existing supply.

This project concept would help the Region to meet the following IRWM Plan objectives:

- **Objective 2A:** Implement regional infrastructure projects to increase distribution capacity, flexibility and redundancy
- **Objective 2C:** Support projects to increase resilience and redundancy of local production and distribution facilities
- **Objective 10:** Implement multi-benefit strategies, that adapt to climate change impacts for flood management, water supply, water quality, water-dependent habitat, and fire risk

Emergency Backup Power to City of Banning Wells

This project concept would implement backup generators for three wells located in the City of Banning: Wells 8, 9, and C-4. Each generator would be implemented adjacent to their associated well.

Well 8 and Well 9 would require one small generator each, while Well C-4 would require a larger generator. Well C-4 is located in a residential area and would, therefore, require the implementation of a particulate filter and the construction of a block wall enclosure. This would increase reliability of pumping in the City as wells would still be functional if power was disrupted.

The capital cost of this option is $650,000 with $8,700/year of O&M costs. A unit cost was not estimated for this project as it does not provide new or stored supply.

This project concept would help the Region to meet the following IRWM Plan objectives (in conjunction with interconnections):

- **Objective 2A:** Implement regional infrastructure projects to increase distribution capacity, flexibility and redundancy[1]
- **Objective 2C:** Support projects to increase resilience and redundancy of local production and distribution facilities
- **Objective 10:** Implement multi-benefit strategies, that adapt to climate change impacts for flood management, water supply, water quality, water-dependent habitat, and fire risk

Banning Storage Tank

The storage tank project concept would construct a 100,000-gallon storage tank to be used primarily for fire flow protection and operational flexibility in case of extended power outages within the City of Banning. This would increase reliability of the Banning's water delivery system. The storage tank would be located near Comfort Camp wells. This project would greatly improve resilience as there is currently no storage tank in the area and therefore customers depend entirely on well pumping.

The capital cost of this option is $203,125 with $82,800/year of O&M costs. A unit cost was not estimated for this project as it does not provide new or stored supply.

This project concept would help the Region to meet the following IRWM Plan objective:

[1] Objective 2A will be met only if the project is used in conjunction with interconnections with other water suppliers

- **Objective 2C:** Support projects to increase resilience and redundancy of local production and distribution facilities
- **Objective 10:** Implement multi-benefit strategies, that adapt to climate change impacts for flood management, water supply, water quality, water-dependent habitat, and fire risk

Water Use Efficiency(WUE) Program

This project concept would implement water use efficiency measures (to be determined) in order to reduce demand for potable water. It is assumed that the Region's current GPCD is equivalent to Banning's (196 GPCD). This option would reduce this value by 10% to 176.4 GPCD, which would be equivalent to water savings of 1,400 AFY in 2040.

All water suppliers in the Region would benefit from this option. Though reliability improvement would be dependent on ongoing customer behavior. This project concept would reduce potable water demand, and therefore make supply available for other uses.

This option does not include any physical facilities, but rather would consist of a portfolio of the potential WUE programs as follows:

- Turf removal rebates
- HET distribution or rebates
- High efficiency nozzle distribution
- Large landscape surveys and retrofits
- Sprinkler giveaways or rebates
- Smart controller rebates
- Urinal retrofits
- Water surveys

Capital cost would vary based on the specific programs implemented. The potential cost range is $455,000 to $2.3M. Unit costs would range from $300/AF to $1,600/AF. These costs assume full implementation of a program in year one, and full benefits over 30 years. To better define benefits and costs, specific WUE measures and a program implementation schedule need to be defined.

This project concept would help the Region to meet the following IRWM Plan objectives:

- **Objective 1D:** Implement appropriate regional demand management, water loss reduction and other conservation programs
- **Objective 2B:** Form agreements between local and external agencies to support regional supply systems, conservation programs and emergency response
- **Objective 10:** Implement multi-benefit strategies, that adapt to climate change impacts for flood management, water supply, water quality, water-dependent habitat, and fire risk

Recycled Water

Recycled water project concepts have been developed as part of the Recycled Water Study completed concurrently with this Study. While the Recycled Water Study should be referred to for detailed information, the project concepts described will generally make improvements to local WWTPs to provide the required treatment level for reuse, facilities needed to collect additional wastewater from properties currently on septic systems, and facilities to deliver the recycled water for either non-potable reuse or groundwater recharge. These projects are expected to improve water supply reliability as they will either offset potable water demand when used directly, or will improve groundwater quality by recharging higher quality, treated wastewater than what is currently recharged at WWTP and through septic systems.

These recycled water project concepts would help the Region to meet the following IRWM Plan objectives:

- **Objective 1A:** Implement regional recycled water projects within the Region and support local recycled water projects
- **Objective 1C:** Maximize the use of groundwater supplies, including local storage of imported water
- **Objective 2A:** Implement regional infrastructure projects to increase distribution capacity, flexibility and redundancy
- **Objective 2B:** Form agreements between local and external agencies to support regional supply systems, conservation programs and emergency response
- **Objective 2C:** Support projects to increase resilience and redundancy of local production and distribution facilities
- **Objective 4A:** Reduce use of septic systems by expanding centralized collection and treatment systems
- **Objective 4B:** Increase monitoring of existing septic areas and enforcement of monitoring protocols
- **Objective 8:** Seek funding opportunities to ensure all communities have access to a reliable water supply and adequate wastewater treatment
- **Objective 10:** Implement multi-benefit strategies, that adapt to climate change impacts for flood management, water supply, water quality, water-dependent habitat, and fire risk

4.2 Options Reliability Assessment

While all the above project concepts would improve supply reliability, those project concepts that would provide additional water supply to the Region were input into the WEAP model to assess their ability to individually improve shortfalls in water supply and reduce the net decrease in groundwater inflow versus outflow. The six project concepts selected to input into the WEAP model and the supply benefit are shown in Table 13.

Table 13: Project Concepts Input into WEAP Model

Project Concept	Supply Benefit
Imported Water Rights Purchase and Direct Delivery Pipeline	1,800 AFY recharge
Water Use Efficiency	1,400 AFY direct use
Non-Potable Recycled Water for Irrigation in the City of Banning (included in the Recycled Water Study as Banning **Option 1**)	1,700 AFY direct use
Recycled Water for Irrigation and Groundwater Recharge at North Banning Recharge Site for use by the City of Banning (included in the Recycled Water Study as Banning **Option 4B**)	<u>4,800 AFY total</u> 100 AFY direct use 4,700 AFY recharge
Recycled Water for Irrigation via Septic Conversion and Sewer Extension for use by Cabazon Water District and MBMI customers (included in the Recycled Water Study as **Combined Option 1**)	800 AFY recharge

Combined Recycled Water for Irrigation and Groundwater Recharge at North Banning Recharge Site for use by the City of Banning AND Recycled Water for Irrigation via Septic Conversion and Sewer Extension for use by Cabazon Water District and MBMI customers (included in the Recycled Water Study as Banning **Option 4B and Combined Option 1**)	5,600 AFY total 100 AFY direct use 5,500 AFY recharge

Note that the recycled water project concepts listed above were selected only to serve as sample project concepts for analysis in the WEAP model, and do not represent a selection of projects to move forward with grant funding or implementation. Those decisions will be made by the Region's water suppliers at a later date.

Each supply project concept incorporates assumptions for monthly timing of supply and demand, annual hydrologic variation (if applicable), available capacity in existing facilities, and capacities for new facilities. Overall, the results of this modeling effort show that project concepts that will produce new supply (imported water) or reduce demand (water use efficiency) will improve groundwater levels, as shown in Figure 13. This figure, which shows the model run that included the imported water concept in gold and the water use efficiency project concept in green against the baseline results in blue, and illustrates that the net balance of groundwater inflow and outflow at high levels of demand are closer to zero than the baseline.

The results of the recycled water project concepts are not included in Figure 13 as wastewater from treatment and septic systems is currently recharged to local groundwater basins, and therefore the net benefit to groundwater is not significant enough to show on the chart. However, the model did confirm that the recycled water options would offset potable water demand at the volumes provided in the Recycled Water Study based on monthly variations in wastewater production and irrigation demand. Figure 14 provides the resulting regional supply portfolios that incorporates recycled water use, and illustrates the volume of recycled water used versus other supplies.

Additionally, the WEAP model indicated that the existing well capacities are sufficient to pump imported and recycled water volumes for the individual project concepts. It should be noted, however, that an analysis will need to be conducted to ensure that the location of recharge will provide the expected benefits as wells may not be located down gradient of groundwater recharge basins.

Note that these project concepts were run through the WEAP model separately, and did not model benefits or facilities impacts of combined projects.

Figure 13: Net Balance of Groundwater Inflows and Outflows in Long-Term (2045)

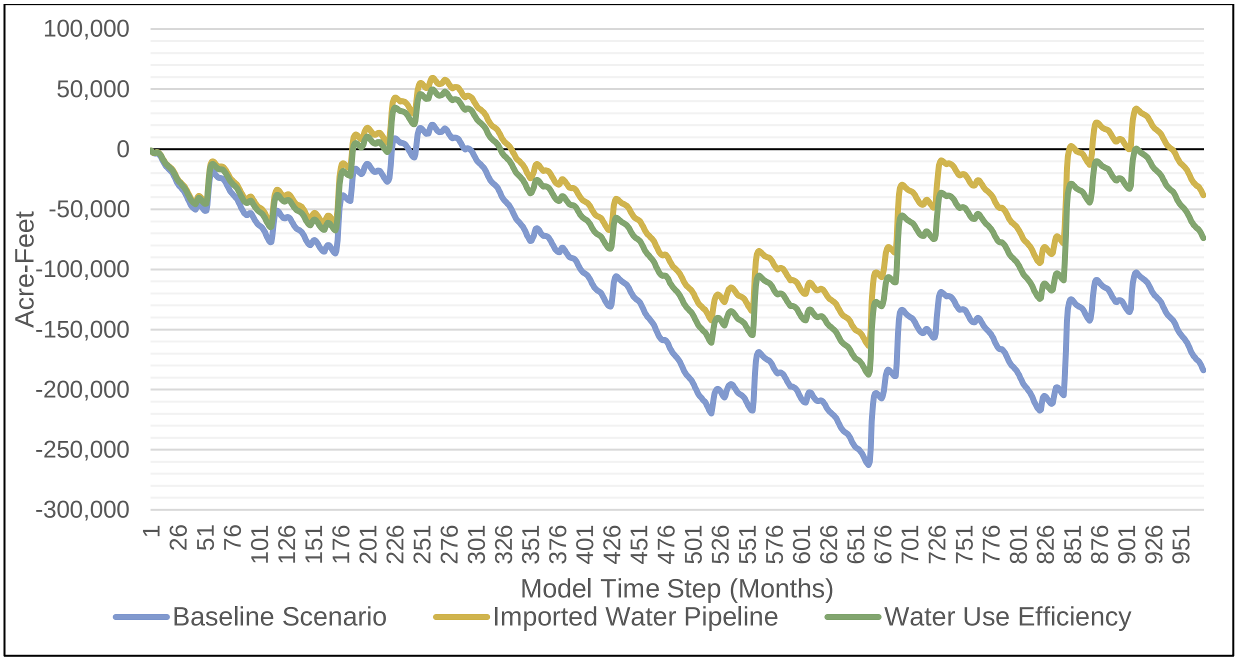
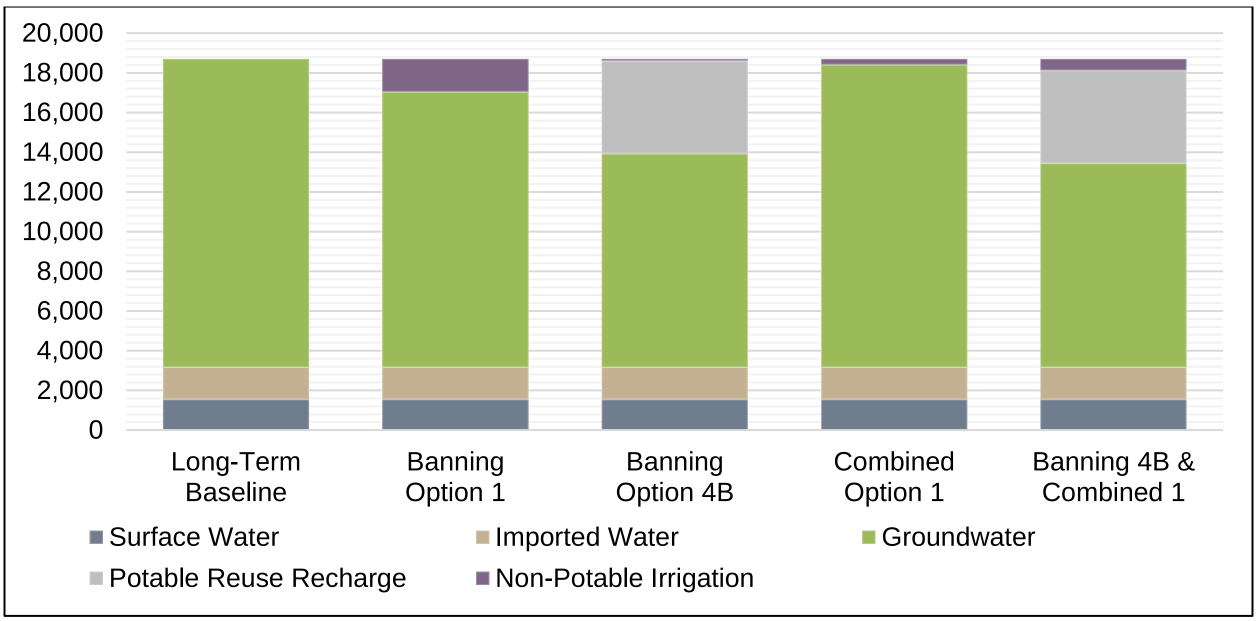


Figure 14: Regional Supply Portfolio under Recycled Water Options - Long-Term (2045)

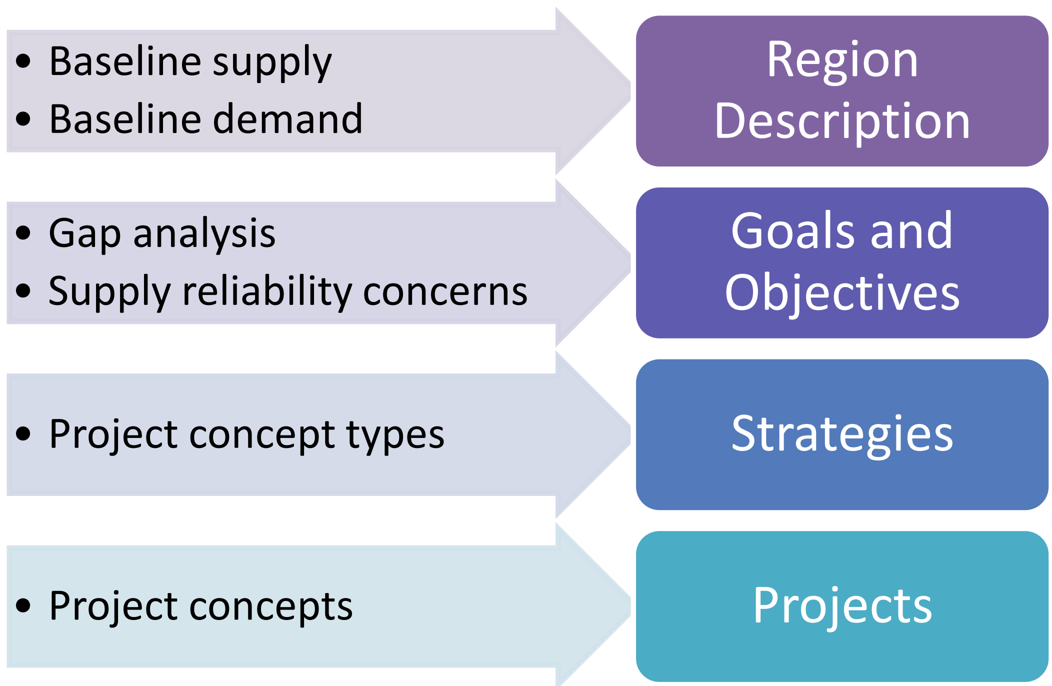


Chapter 5 Next Steps

The Water Supply Reliability Study results indicate that given currently available supplies and projected demands, the Region may face supply reliability issues in the future related to insufficient supply available on an average annual basis, annual variations in available supplies due to dry hydrologic years, aging infrastructure, water quality concerns, potential for catastrophic interruptions, and climate change impacts. The Study also identifies several project concepts that could be implemented to help mitigate these impacts and improve regional supply reliability.

As an initial step, this Study has been incorporated into relevant sections of the San Gorgonio IRWM Plan as shown in Figure 15.

Figure 15: Incorporation of the Study into the IRWM Plan



As this Study does not provide project implementation recommendations, the Region's water suppliers will need to determine which, if any, of these project concepts should be implemented. Most of the project concepts identified in this Study are currently in either the planning stage or conceptual stage. Each project will require specific facilities planning, design, and environmental assessments in order to further assess the benefits, costs regulatory coordination prior to construction/implementation.

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Appendix A - Morongo Reservation Water Demand Estimate

Appendix A: Demand Estimates for the Morongo Band of Mission Indians

Demand Description	Demand (AFY)
Urban and Rural Water Use (not including water bottled at the Arrowhead Bottling Plant and outdoor Casino demand)	1,007
Casino Water Use (outdoor)	47
Arrowhead Water Bottling Plant (bottled water)	696
Total Demand	**1,750**

Urban and Rural Water Use (not including water bottled at the Arrowhead Bottling Plant and outdoor Casino demand)

Wastewater Supply	Qty (2016)	Unit	Generation Rate (gpd/unit)	Average Flow (mgd)	Supply (AFY)	Total Demand (mgd)	Total Demand (AFY)
Morongo WWTP*	--	--	--	0.350	392	0.673	753.8
Morongo Septic Conversions	565	EDU	200	0.113	127	0.217	243.4
Arrowhead Septic Conversions**	350	employee	13	0.005	5	0.009	9.8
Total WW Supply				**0.468**	**524**		**1007.0**

Based on consumptive use factor and indoor use estimate only

Cosumptive Use Factor =	0.2
WW factor =	0.8
Residential Indoor % =	0.65
Residential Outdoor % =	0.35

Casino Water Use (outdoor)

	Area [based on aerial photos]	Units	Evapotranspiration Rate (in/yr) [CIMIS Zone 16]	Evaporation (AFY)
Pool Use	19,700	sq ft pools	62.5	2.4

Irrigation (AFY)	45	See San Gorgonio IRWM Recycled Water Study, 2017.

Arrowhead Water Bottling Plant (bottled water)

Data Source: **CIWQS** http://ciwqs.waterboards.ca.gov/ciwqs/ewrims/EWServlet?Redirect_Page=EWWaterRightPublicSearch.jsp8

SWRCB Morongo Band of Mission Indians Revocation Hearing

http://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/morongo_mission_indians/e

Permit Number	487			486		485		
License Numnber	660			659		174		
Maximum Diversion	0.5 cfs			0.16 cfs		2.5 cfs		
Face Value	362 AFY			115.8 AFY		1,809.9 AFY		
Source	Millard Canyon			Millard Canyon		Millard Canyon		
	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)
Jan-09			12.6					
Feb-09			11					
Mar-09			7.4					
Apr-09			4					
May-09			6.6					
Jun-09			5					
Jul-09			7					
Aug-09			7.4					
Sep-09			8.9					
Oct-09			11					
Nov-09			9.6					
Dec-09			11.6					
Jan-10	no data	no data	2.7	no data	no data			
Feb-10	no data	no data	2.8	no data	no data			
Mar-10	no data	no data	3.6	no data	no data			
Apr-10	no data	no data	2.5	no data	no data			
May-10	no data	no data	1	no data	no data			
Jun-10	no data	no data	0.8	no data	no data			
Jul-10	no data	no data	0.5	no data	no data			
Aug-10	no data	no data	0.5	no data	no data			
Sep-10	no data	no data	0.3	no data	no data			
Oct-10	no data	no data	0.5	no data	no data			
Nov-10	no data	no data	1	no data	no data			
Dec-10	no data	no data	1	no data	no data			
Jan-11	no data	no data	2.5	no data	no data			
Feb-11	no data	no data	3.6	no data	no data			
Mar-11	no data	no data	2.7	no data	no data			
Apr-11	no data	no data	2.7	no data	no data			
May-11	no data	no data	1	no data	no data			
Jun-11	no data	no data	1	no data	no data			
Jul-11	no data	no data	0.8	no data	no data			
Aug-11	no data	no data	0.5	no data	no data			

Permit Number	487			486		485		
License Numnber	660			659		174		
Maximum Diversion	0.5 cfs			0.16 cfs		2.5 cfs		
Face Value	362 AFY			115.8 AFY		1,809.9 AFY		
Source	Millard Canyon			Millard Canyon		Millard Canyon		
	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)
Sep-11	no data	no data	0.9	no data	no data			
Oct-11	no data	no data	1	no data	no data			
Nov-11	no data	no data	1.2	no data	no data			
Dec-11	no data	no data	1.8	no data	no data			
Jan-12	no data	no data	3.806	0	0			35.377
Feb-12	no data	no data	3.07	0	0			31.245
Mar-12	no data	no data	3.07	0	0			31.2174
Apr-12	no data	no data	5.568	0	0			36.206
May-12	no data	no data	6.28	0	0			39.523
Jun-12	no data	no data	4.3	0	0			44.624
Jul-12	no data	no data	0.06	0	0			47.753
Aug-12	no data	no data	0.363	0	0			58.304
Sep-12	no data	no data	0.0402	0	0			53.914
Oct-12	no data	no data	0.498	0	0			44.568
Nov-12	no data	no data	0.092	0	0			37.718
Dec-12	no data	no data	0.347	0	0			33.279
Jan-13	no data	no data	0.4297	0	0			59.09
Feb-13	no data	no data	0.2330	0	0			49.78
Mar-13	no data	no data	0.1777	0	0			41.46
Apr-13	no data	no data	0.0859	0	0			44.22
May-13	no data	no data	0.1722	0	0			37.96
Jun-13	no data	no data	0.1887	0	0			44.96
Jul-13	no data	no data	0.2148	0	0			28.48
Aug-13	no data	no data	0.3180	0	0			43.98
Sep-13	no data	no data	0.3081	0	0			38.36
Oct-13	no data	no data	0.3084	0	0			44.65
Nov-13	no data	no data	0.3419	0	0			38.14
Dec-13	no data	no data	0.3253	0	0			47.38
Jan-14	no data	no data	0.1350	0	0			51.43
Feb-14	no data	no data	0.0783	0	0			43.51
Mar-14	no data	no data	0.1381	0	0			47.44
Apr-14	no data	no data	0.0829	0	0			54.24
May-14	no data	no data	0.0660	0	0			56.66
Jun-14	no data	no data	0.0368	0	0			58.50
Jul-14	no data	no data	0.0997	0	0			70.66
Aug-14	no data	no data	0.0675	0	0			62.72

Permit Number	487			486		485		
License Numnber	660			659		174		
Maximum Diversion	0.5 cfs			0.16 cfs		2.5 cfs		
Face Value	362 AFY			115.8 AFY		1,809.9 AFY		
Source	Millard Canyon			Millard Canyon		Millard Canyon		
	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)
Sep-14	no data	no data	0.0552	0	0			62.80
Oct-14	no data	no data	0.0598	0	0			60.62
Nov-14	no data	no data	0.0583	0	0			78.42
Dec-14	no data	no data	0.0261	0	0			45.61
Jan-15	0	0.0460	0.0399	0	0			57.28
Feb-15	0	0.0399	0.0506	0	0			48.92
Mar-15	0	0.0506	0.0460	0	0			104.29
Apr-15	0	0.0460	0.0967	0	0			68.90
May-15	0	0.0967	0.0522	0	0			70.05
Jun-15	0	0.0522	0.0798	0	0			72.05
Jul-15	0	0.0798	0.1350	0	0			72.23
Aug-15	0	0.1350	0.0460	0	0			91.87
Sep-15	0	0.0460	0.1396	0	0			81.16
Oct-15	0	0.1396	0.0798	0	0			82.64
Nov-15	0	0.0798	0.1504	0	0			64.73
Dec-15	0	0.1504	0.9621	0	0			60.04
Jan-16	0.084	0.057	0.141	0	0	1.417	25.71	60.67
Feb-16	0.084	0.044	0.128	0	0	1.417	19.8	50.92
Mar-16	0.084	0	0.084	0	0	1.417	24.5	57.16
Apr-16	0.084	0.0018	0.0858	0	0	1.417	27.52	70.02
May-16	0.084	0	0.084	0	0	1.417	27.82	76.55
Jun-16	0.084	0	0.084	0	0	1.417	27.52	69.5
Jul-16	0.084	0	0.084	0	0	1.417	36.44	94.69
Aug-16	0.084	0	0.084	0	0	1.417	21.01	118.81
Sep-16	0.084	0.0356	0.1196	0	0	1.417	41.43	75.65
Oct-16	0.084	0.192	0.276	0	0	1.417	13.85	75.82
Nov-16	0.084	0.0019	0.0859	0	0	1.417	40.66	60.26
Dec-16	0.084	0.026	0.11	0	0	1.417	36.43	56.55

Annual Totals

Year	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Diversion for direct use (AF)	Diversion for Storage (AF)	Amount Used (AF)	Total
2012	0.0	0.0	27.5	0.0	0.0	0.0	0.0	493.7	521.2
2013	0.0	0.0	3.1	0.0	0.0	0.0	0.0	518.5	521.6
2014	0.0	0.0	0.9	0.0	0.0	0.0	0.0	692.6	693.5
2015	0.0	1.0	1.9	0.0	0.0	0.0	0.0	874.1	876.0
2016	1.0	0.4	1.4	0.0	0.0	17.0	342.7	866.6	868.0

Average			**6.9**	**0.0**	**0.0**			**689.1**	**696.1**

Appendix B - Project Concept Cost Estimates

Unit Costs

Construction costs	Unit Cost		Source
Pipeline	**$25**	per in-diam/LF	*OMWD Internal Planning reports (2017)*
Pump Station	**$6,500**	per HP	
Land Acquisition- Banning	**$164,000**	per acre	*Provided by Banning 2017*
Land Acquisition- Cabazon	**$108,900**	per acre	*Krieger and Stewart 2017 DHPO Assets Aquired by CWD*
Recharge Basin	**$95,657**	per acre	2009 Webb Study, escalated by ENR CCI
Dist. Syst. Conn.	**$500,000**		
Construction Cost Index	**8311.16**		*2008 CCI for 20-Cities Average*
Construction Cost Index	**10643.54**		*2017 CCI for 20-Cities Average (Jan-Oct)*
Storage Tank	**$1.25**	per Gallon	*Provided by Bob Krieger*
Imported Supply			
Current annual imported water cost (SGPV	**$2,000**	per acre foot	*Provided by Jeff Davis on 12/4.*
Annual imported water purchase cost (Site	**$1,100**	per acre foot	*Provided by Jeff Davis on 8/30/2017. Cost for supply only, 100% reliable.*
Annual imported water conveyance cost	**$317**	per acre foot	*Provided by Jeff Davis on 12/4.*
Implementation	**25%**	of Construction cost	
Legal/Admin/Environmental	*5%*		
Design	*8%*		
Construction Management	*8%*		
Services during Construction	*4%*		
Project Contingency	**30%**	of Capital cost	
Annual Operation & Maintenance Costs			
Pipelines	**1.0%**	of Construction cost	*RMC (2016)*
Storage	**1.0%**	of Construction cost	
Electrical Power	**$0.18**	kWh	
Financing			
Interest Rate	**4.0%**		*Increased interest rate per Progress Meeting #4*
Period	**30**	years	
Capital Recovery Factor	**0.05783**		

Imported Rights Purchase and Imported Water Pipeline						Notes
	Pipe Diam	Qty	Unit Cost	Unit	Subtotal	
New Pipeline	12	63,642	$25	per in-diam/LF	$ 19,092,600	Assumes 12.1 mile pipeline from Cherry Valley pump station
Recharge Basin at the North Banning Recharge Site		3.5	$108,900	per acre	$ 378,865	Assumes water received over 9 months, and recharge rate of 1.5 ft/day. Effective recharge rate is 30% less than estimated basin area.
Recharge Basin at the Five Bridges site		5.2	$164,000	per acre	$ 855,838	Assumes water received over 9 months, and recharge rate of 1 ft/day. Effective recharge rate is 30% less than estimated basin area.
Baseline Construction Cost					**$ 20,327,303**	
Project Contingency			30%		$ 6,098,191	
Capital Cost					**$ 26,425,494**	
Implementation			25%		$ 6,606,374	
Subtotal Project Cost					**$ 33,031,868**	
Land Acquisition		13.7	$164,000	per acre	$ 2,246,800	Uses same assumptions as the recycled water costs.
Total Project Cost					**$ 35,278,668**	
Annualized Total Project Cost			0.05783	capital recovery factor	$ 2,040,169	
Imported supply purchase + conveyance			$1,417	per AF	$ 2,834,000	
Annual O&M Cost					$ 264,255	
Total Annualized Cost					**$ 5,138,424**	
Purchase and recharge volume				AFY	2,000	
Supply benefit volume				AFY	1,800	Assumes 10% leave-behind
				$/AFY	**$ 2,900**	

Annual Operations & Maintenance Cost					Annual O&M	
			Construction Cost	Unit Cost		
New Pipeline and Recharge Facility			$ 26,425,494	1.0%	$ 264,255	
Total Annual Operations & Maintenance Cost					**$ 264,255**	

Treatment Facility to Address Cr-6 MCL			Low	High	Notes
Total Project Cost			**$ 18,000,000**	**$ 33,000,000**	*City of Banning chromium-6 Treatment and Compliance Study Memorandum, Table 24.*
Annualized Total Project Cost		0.05783	$ 1,040,942	$ 1,908,393	
Annual O&M Cost			$ 500,000	$ 700,000	*City of Banning chromium-6 Treatment and Compliance Study Memorandum, Table 24.*
Total Annualized Cost			**$ 1,540,942**	**$ 2,608,393**	
		AFY	9,600	9,600	7,250 gpm converted (assuming wells operating 80% of the year)
		$/AFY	**$ 161**	**$ 272**	

Emergency Connection Upsizing						
	Pipe Diam.	Qty	Unit Cost	Unit		Subtotal
North Connection		1	$120,000	LS	$	120,000
South Connection		1	$500,000	LS	$	500,000
						-
Baseline Construction Cost					**$**	**620,000**
Project Contingency			30%		$	186,000
Capital Cost					**$**	**806,000**
Implementation			25%		$	201,500
Subtotal Project Cost					**$**	**1,007,500**
						-
Total Project Cost					**$**	**1,007,500**
Annualized Total Project Cost			0.0578		$	58,264
Annual O&M Cost					$	6,200
Total Annualized Cost					**$**	**64,464**

Annual Operations & Maintenance Cost						Annual O&M	
			Construction Cost		Unit Cost		
North Connection			$	120,000	1.0%	$	1,200
South Connection			$	500,000	1.0%	$	5,000
Total Annual Operations & Maintenance Cost						**$**	**6,200**

Emergency Backup Power	Pipe Diam.	Qty	Unit Cost	Unit	Subtotal	Notes
Small Generator		2	$100,000	LS	$ 200,000	Costs per generator from City of Banning
Well C-4 Generator		1	$200,000	LS	$ 200,000	Costs per generator from City of Banning
					-	
Baseline Construction Cost					**$ 400,000**	
Project Contingency			30%		$ 120,000	
Construction Cost					**$ 520,000**	
Implementation			25%		$ 130,000	
Total Capital Cost					**$ 650,000**	
Annualized Total Project Cost			5.78%		$ 37,590	
Annual O&M Cost					$ 8,700	
Total Annualized Cost					**$ 46,290**	
Annual Operations & Maintenance Cost					**Annual O&M**	
Small Generator					$ 5,800	Costs per generator from City of Banning
Well C-4 Generator					$ 2,900	Costs per generator from City of Banning
Total Annual Operations & Maintenance Cost					**$ 8,700**	

Storage Tank						Notes
		Capacity	Unit Cost	Unit	Subtotal	
Storage Tank		100,000	$1.25	gallons	$ 125,000	
Baseline Construction Cost					**$ 125,000**	
Project Contingency			30%		$ 37,500	
Capital Cost					**$ 162,500**	
Implementation			25%		$ 40,625	
Subtotal Project Cost					**$ 203,125**	
Total Project Cost					**$ 203,125**	
Annualized Total Project Cost			5.78%		$ 11,747	
Annual O&M Cost					$ 82,786	
Total Annualized Cost					**$ 94,533**	
Annual Operations & Maintenance Cost					**Annual O&M**	
			Flat Rate	**Unit Cost**		
Storage Tank			$82,786		$ 82,786	
					$ -	
Total Annual Operations & Maintenance Cost					**$ 82,786**	

Water Use Efficiency					Low	High	Notes
		Qty	Unit Cost	Unit	Subtotal	Subtotal	
Low WUE unit cost		1,400	$200	$/AF	$ 280,000		
High WUE unit cost		1,400	$1,000	$/AF		$ 1,400,000	
						-	
Baseline Construction Unit Cost					**$ 280,000**	**$ 1,400,000**	
Project Contingency			30%		$ 84,000	$ 420,000	
Capital Unit Cost					**$ 364,000**	**$ 1,820,000**	
Implementation			25%		$ 91,000	$ 455,000	
Subtotal Project Unit Cost					**$ 455,000**	**$ 2,275,000**	
Total Project Unit Cost					**$ 455,000**	**$ 2,275,000**	
WUE Qty				AFY	1,400	1,400	
				$/AFY	**$ 325**	**$ 1,625**	
2015 GPCD	**10% demand decrease**	**2040 population**	**Gallons per day**	**AFY**			
196	19.6	62000	1215200	1400			

B. San Gorgonio Region Recycled Water Study

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San Gorgonio Region Recycled Water Study

Prepared by:

February 2018

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List of Abbreviations

AF	acre-feet
AFY	acre-feet per year
Banning	City of Banning
BOD	biological oxygen demand
CCR	California Code of Regulations
CDPH	California Department of Public Health
CECs	constituents of emerging concern
CEQA	California Environmental Quality Act
CH&SC	California Health and Safety Code
CWC	California Water Code
CWD	Cabazon Water District
CIWQS	California Integrated Water Quality System
DDW	Division of Drinking Water
DWQ	Division of Water Quality
DWR	Department of Water Resources
EDU	equivalent dwelling unit
EPA	United States Environmental Protection Agency
FOBs	Field Operations Branches
I-10	Interstate 10
IRWM	Integrated Regional Water Management
GAMA	Groundwater Ambient Monitoring and Assessment Program
gpd	gallons per day
gpm	gallons per minute
GRRPs	groundwater replenishment reuse projects
GWR	groundwater replenishment
lbs	pounds
MBMI	Morongo Band of Mission Indians
MCLs	maximum contaminant levels
mg	million gallons
mgd	million gallons per day
MPN	most probable number
NaCl	sodium chloride

NDN	nitrification/ denitrification
NLs	Notification Levels
NTU	nephelometric turbidity units
O&M	operation and maintenance
OWTS	Onsite Wastewater Treatment System or Systems
ROWD	Report of Waste Discharge
RRT	response retention times
RSG	Rancho San Gorgonio
RWC	recycled water contribution
RWQCB	Regional Water Quality Control Board
SAT	soil-aquifer treatment
SBR	sequencing batch reactor
SCAG	Southern California Association of Governments
SDWA	Safe Drinking Water Act
SGMA	Sustainable Groundwater Management Act
SMR	Self-Monitoring Report
SNMP	Salt and Nutrient Management Plan
SWP	California State Water Project
SWRCB	State Water Resources Control Board
TC	total coliform
TDS	total dissolved solids
TOC	total organic carbon
UV	ultraviolet
WDID	Waste Discharger Identification
WDRs	Waste Discharge Requirements
Workgroup	Recycled Water Study Stakeholder Workgroup
WRRs	water recycling requirements
WWTP	wastewater treatment plant

Chapter 1 Introduction

The San Gorgonio Regional Recycled Water Study (Study) is one of three specific planning processes conducted to assist in the development of the San Gorgonio Integrated Regional Water Management (IRWM) Region's Plan. The Study is intended to support goals and strategies identified in the IRWM Plan by identifying recycled water project options in the San Gorgonio Region (Region).

The Region does not currently produce recycled water and this study addresses the opportunities to do so through identifying recycled water project options and answering the question, "How can recycled water benefit the San Gorgonio Region." This Study also presents planning-level costs and associated unit costs for each of the options.

How can recycled water benefit the San Gorgonio Region?

As recognized in the California Department of Water Resources (DWR) IRWM Propositions 84 and 1E Guidelines, applying a regional approach to recycled water planning can lead to strategies that result in synergies and efficiencies in the utilization of financial and water resources. Local agencies and entities that have the potential to produce and/or use recycled water, shown in **Figure 1-1**, participated in the development of this Study by providing planning documents, data, and participating in in-person meetings.

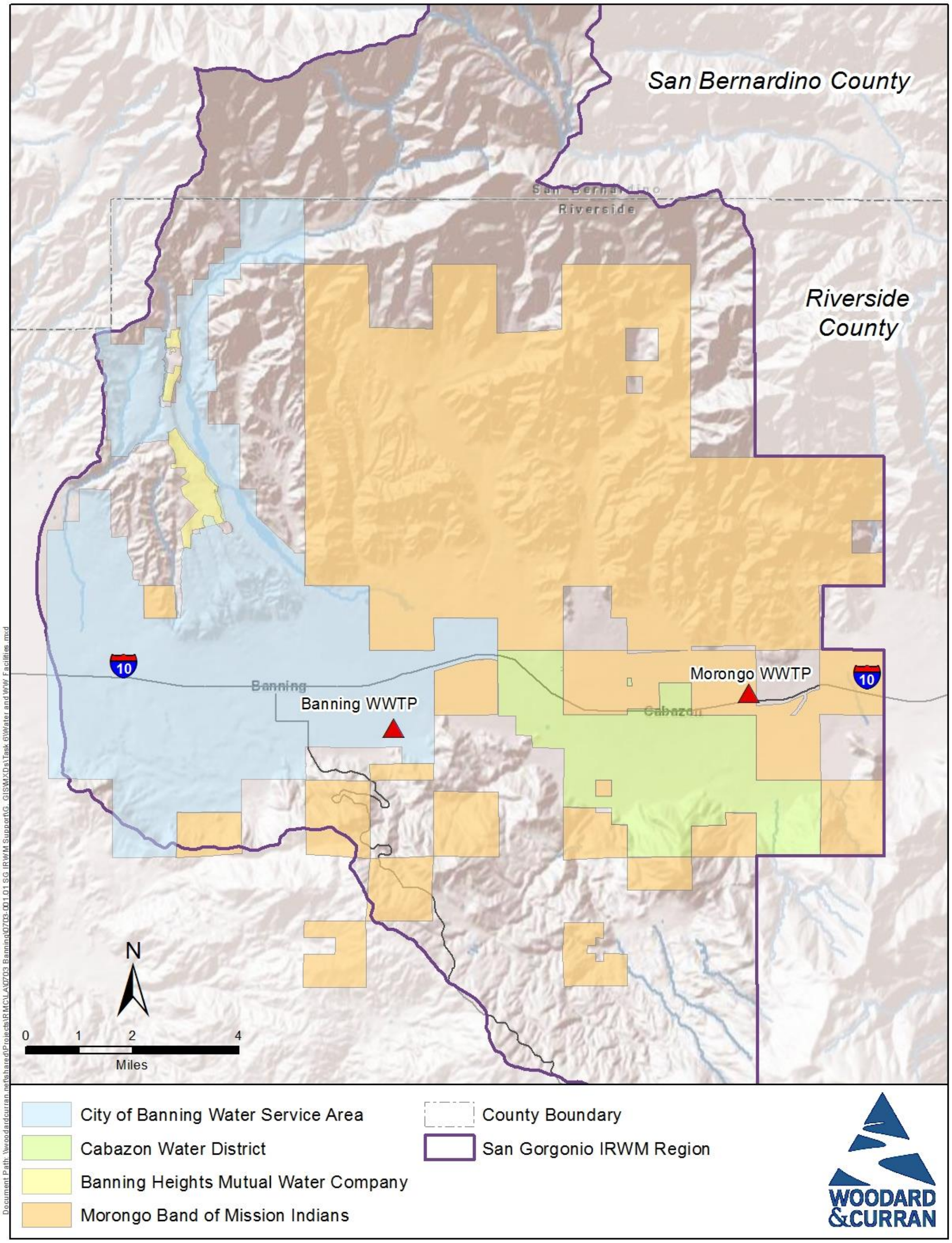
Water recycling is integral to sustainable water management because it allows water to remain in the local environment and meet the water requirements of the present and be stored for the future. Working together with the stakeholder group, this study identifies feasible recycled water projects to study further.

1.1 Planning Process

While recycled water planning has been conducted within the San Gorgonio Region by individual agencies, this Study is primarily focused on using a regional perspective and developing project concept that can achieve multiple benefits for multiple entities. To achieve the Study goal, the following planning activities have been completed:

- Solicited input from a regional stakeholder advisory group
- Reviewed literature regarding subregional wastewater treatment systems, wastewater quality and flows, groundwater basin, planned developments, and previous recycled water planning activities
- Summarized current and anticipated recycled water regulations and policies
- Described existing recycled water treatment, wastewater treatment, storage, and delivery systems
- Identified potential customers and uses
- Identified treatment options to meet recycled water quality needs
- Identified distribution system needs
- Identified potential projects and/or project concepts
- Identified potential constraints to the implementation of projects and next steps to address constraints and advance projects

Figure 1-1: Regional Recycled Water Study Stakeholders



1.2 Stakeholder Outreach

The Study Stakeholder Workgroup (Workgroup) consisted of the stakeholders listed in **Table 1-1**. The Workgroup was responsible for providing information, attending regular meetings, providing input on task execution, and reviewing draft and final draft versions of the planning document.

Table 1-1: Recycled Water Study Stakeholder Workgroup

Agency	Name
Banning Heights Mutual Water Company	Larry Ellis
Cabazon Water District	Calvin Louie
Cabazon Water District	Ellie Lemus
Cabazon Water District	Robert Krieger, Krieger and Stewart
City of Banning	Art Vela
City of Banning	Luis Cardenas
Morongo Band of Mission Indians	John Covington

Initiation of the stakeholder outreach process began in May 2017 with a request for information issued to the Workgroup. After background information was compiled, the first meeting of the Workgroup was held on June 7, 2017 to review the scope of work and discuss plan objectives. The Workgroup met throughout the Study process as summarized in **Table 1-2**. All meetings were held at City of Banning (Banning) facilities.

Table 1-2: Recycled Water Plan Workgroup Meetings

Date	Purpose
June 7, 2017	Define Recycled Water Study Objectives Overview of Recycled Water Study
July 11, 2017	Review Information Received Define Regional Goals
August 31, 2017	Quantify Recycled Water Supplies Brainstorm Recycled Water Project Options
November 16, 2017	Identify Feasible Recycled Water Project Options with Costs Identify Subregional and Regional Benefits of Each Option Select Recycled Water Projects for Further Evaluation

1.3 Literature Review

A review of background information was the first step in developing the Study. Workgroup members supplied information regarding wastewater treatment systems, wastewater quality and flows, well locations, planned developments, and previous recycled water planning activities. During meetings, the workgroup reviewed and discussed the existing system and background information. Pertinent documents reviewed during the process are summarized in

Table 1-3. Detailed references can be found in **Chapter 8**.

Table 1-3: Background Information Summary

Agency	Background Information Provided
Banning Heights Mutual Water Company	Number of onsite septic systems
Cabazon Water District	Draft Cabazon Water District Wastewater Facilities Master Plan, 2008 Initial Study and Mitigated Negative Declaration for Cabazon Wastewater Facilities Project, 2008 Water billing records
City of Banning	Recycled Water Master Plan, September 2006 Preliminary work from Master Plan update process Urban Water Management Plan, 2015 Waste Discharge Requirements Board Order R7-2016-0015, 2016 Water Supply Assessment for Rancho San Gorgonio Specific Plan, 2015 Water Supply Assessment for Butterfield Specific Plan, 2011 GIS files of existing onsite septic systems
Morongo Band of Mission Indians	Verbal communication regarding: Existing wastewater treatment facility Existing utility sleeves under I-10 Recycled water demands for potential existing and future irrigation sites

Chapter 2 Regional Setting

This chapter describes physical features, groundwater quality, and regulatory guidelines relating to recycled water use in the Region.

2.1 Physical Setting

Water Resources

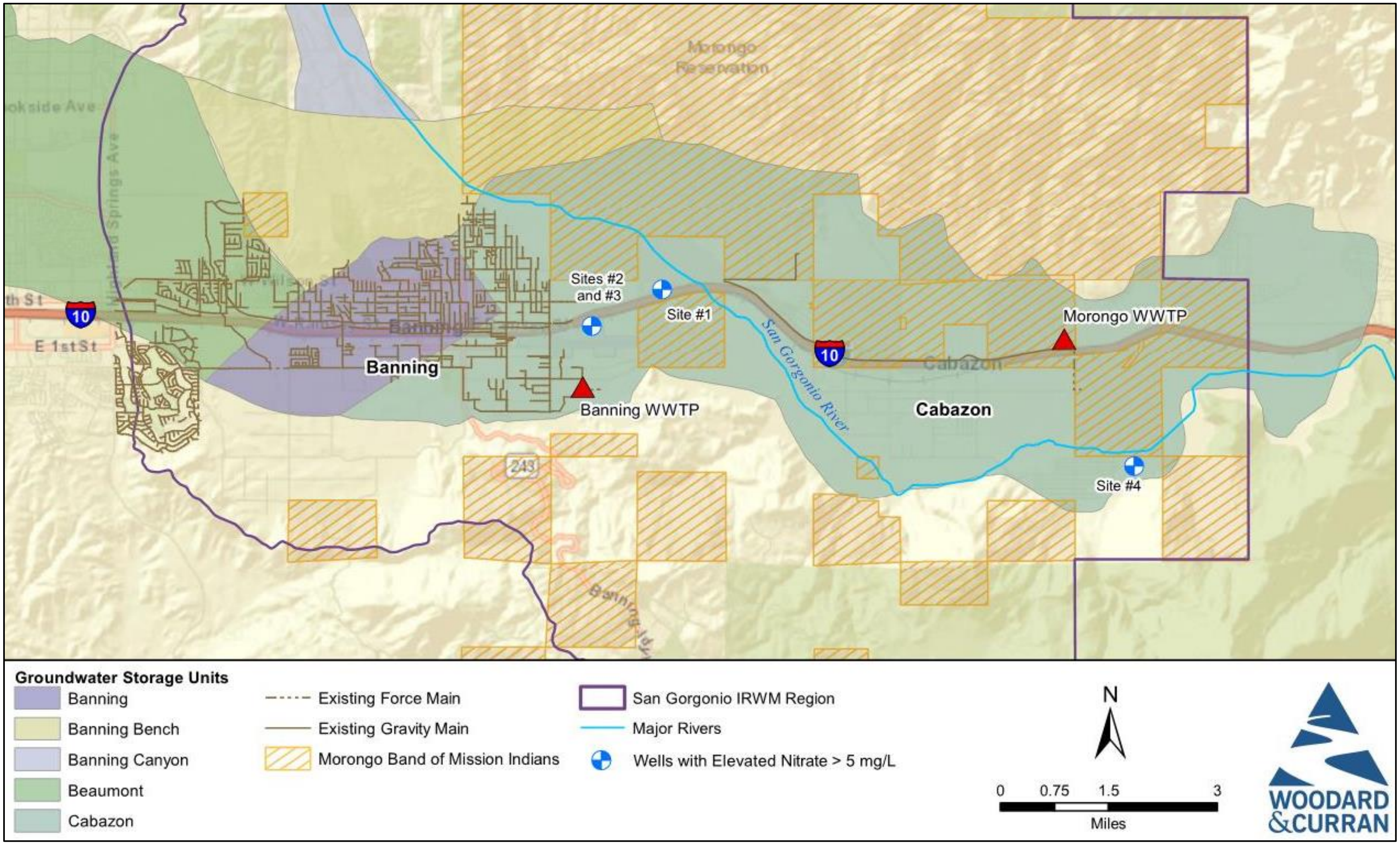
As indicated on Error! Reference source not found.**,** the San Gorgonio River bisects the Region, flowing south from the San Bernardino Mountains, eventually draining to the Coachella Valley to the southeast. The overall surface drainage pattern for the Region is from west to east.

The San Gorgonio region overlies five groundwater storage units in the San Gorgonio Hydrologic Region. There are two wastewater treatment plants (WWTPs) in the Region: the Banning and Morongo WWTPs. Both overlie the Cabazon groundwater storage unit, which has an overall groundwater flow pattern from west to east, corresponding to the regional surface drainage pattern.

Soils in the San Gorgonio Region are predominantly course-grained and sandy, which typically indicates high rates of infiltration. Further, groundwater aquifers are generally unconfined, which are ideal conditions for groundwater recharge via surface spreading.

Drinking water in the Region is supplied by groundwater. Groundwater aquifers are recharged by runoff from the surrounding mountains as well as artificial recharge of imported water from the State Water Project (SWP). Aquifers are also recharged by discharge of effluent from septic systems (also referred to as on-site water treatment systems (OWTS)) and municipal WWTPs.

Figure 2-1: San Gorgonio Region Physical Setting



Water Quality

Four wells in the GeoTracker database have nitrate levels that are over half of the maximum contaminant level (MCL) of 10 milligrams per liter (mg/L), which generally indicates contamination by human activity. Data also shows a general increase in nitrate concentrations from the 1980s to 2013, as graphed on **Figure 2-2**. High nitrate levels in groundwater are typically associated with discharges from septic tanks and wastewater treatment plants, fertilizer use, confined animal feeding operations, and certain industries.

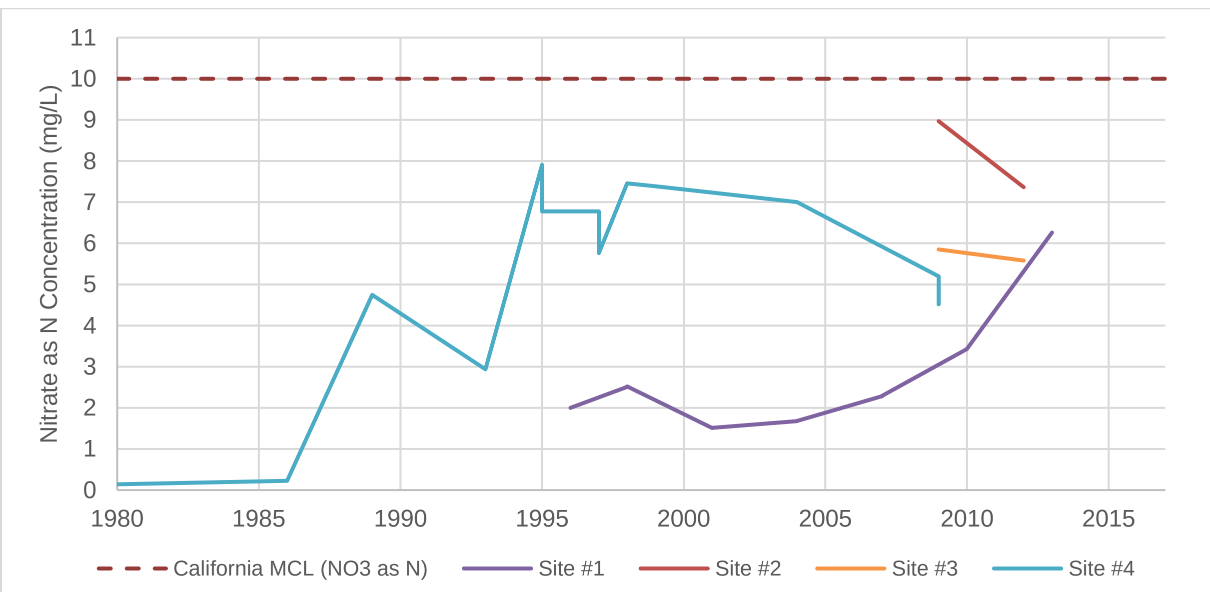
If groundwater has elevated nitrate levels, a common method of reducing the nitrate is by blending it with a different water source lower in nitrates until the concentration is reduced below the MCL. If an alternative source of water is not available, nitrate removal can be difficult and costly. Treatment methods to remove nitrate are reverse osmosis, ion-exchange, distillation, and electro-dialysis. Boiling, softening, and filtration processes do not reduce nitrate concentrations.

The Region manages elevated levels of nitrate in groundwater supplies by blending water from affected wells with other sources of supply, including imported water from the State Water Project (SWP). In other cases, the affected wells have been removed from the potable system and no longer supply drinking water.

Managing nitrogen levels in the aquifer can be achieved by reducing nitrogen from wastewater discharges. Converting OWTS to municipal sewer and adding denitrification processes to municipal WWTPs are effective methods of limiting the amount of nitrogen that percolates into the aquifer.

The Banning and Morongo WWTPs do not currently remove nitrogen, but there are plans for adding a nitrification-denitrification (NDN) upgrade to the Banning WWTP in response to Regional Board Waste Discharge Requirements (WDRs). The WDRs require an analysis of nitrogen removal alternatives by June 30, 2020, including providing recommendations and a tentative work plan and time schedule for improvements to the Banning WWTP to comply with the 10 mg/L nitrogen effluent limit.

Figure 2-2: Nitrate Concentrations in Selected Groundwater Wells, 1980 - 2013



Source: State Water Resources Control Board, GeoTracker Groundwater Ambient Monitoring and Assessment (GAMA)

2.2 Regulatory Setting for Water Reuse

This section describes the pertinent Federal, State, and local recycled water regulations and policies that apply to planning recycled water systems in the San Gorgonio Region for the protection of water quality and public health. The use of recycled water is regulated under the federal Safe Drinking Water Act, several State laws, regulations, and policies, and the federal Clean Water Act when applicable (for example, when a project involves discharge to a Water of the U.S.), with different responsibilities assigned to the State Water Resources Control Board (SWRCB), the SWRCB Division of Drinking Water (DDW), and the nine Regional Water Quality Control Boards (RWQCBs).

Appendix A provides detailed information on Federal and State regulations for recycled water.

2.2.1 Federal

There are no federal regulations for water recycling. Standards for water recycling are delegated to state and local agencies. In California, water recycling is regulated by the SWRCB and the RWQCBs, discussed further in the next section.

To improve access to safe drinking water on tribal lands, the U.S. Environmental Protection Agency (EPA) works collaboratively with tribal governments and utilities to implement the Safe Drinking Water Act (SDWA) and attain compliance with the National Primary Drinking Water Regulations. Tribal Drinking Water Coordination is divided into 10 regions across the United States. The Morongo Band of Mission Indians (MBMI) lands are within Region 9.

The EPA also provides national guidance for recycled water systems through its *Guidelines for Water Reuse* (EPA, 2012). The guidelines serve as a national overview of reuse regulations and clarify some of the variations in the regulatory frameworks that support reuse in different states and regions of the U.S.

2.2.2 State

The SWRCB was created in 1967 to protect water resources throughout California by setting and enforcing statewide policies. Within the SWRCB, the DDW regulates public drinking water systems and oversees water recycling projects. RWQCBs oversee surface water, groundwater, and coastal waters. State statutes and regulations pertaining to the use of recycled water in California can be found in the California Water Code (CWC), the California Health and Safety Code (CH&SC), and the California Code of Regulations (CCR).

Title 22 of the CCR establishes the treatment requirements for recycled water as well as the approved uses based on the level of treatment. The regulations for recycled water used for non-potable applications, such as irrigation, are different than the regulations for potable reuse applications, such as groundwater recharge into a drinking water aquifer.

Water Rights

CWC states that the WWTP owner shall hold the exclusive right to the treated wastewater. Before making a change in the point of discharge, place of use, or purpose of use of treated wastewater, the CWC requires the WWTP owner to obtain approval from the SWRCB Division of Water Rights. This is accomplished by filing a Petition for Change for Owners of Wastewater Treatment Plants (Petition for Change). Before approving the Petition for Change, the SWRCB must determine that the proposed change will not injure other legal users of water, will not unreasonably harm in-stream uses, and is not contrary to the public interest.

The project concepts included in this plan would include changing the place of use to "reuse." The Petition for Change should be filed early in the planning process in coordination with California Environmental Quality Act (CEQA) document preparation.

Recycled Water Policy

The purpose of the CWC Recycled Water Policy is to increase the use of recycled water by establishing statewide recycled water and water conservation goals and providing guidance to RWQCBs for implementing water recycling projects. The Recycled Water Policy goals are:

- To increase the use of recycled water over 2002 levels by 1 million acre-feet by 2020 and 2 million acre-feet by 2030,
- To increase the use of recycled water use over 2007 levels by 500,000 acre-feet by 2020 and 1 million acre-feet by 2030,
- To increase the amount of water conserved by urban and industrial users by 20 percent by 2020, and
- To substitute as much recycled water for potable water as possible by year 2030.

The Recycled Water Policy requires that a Salt and Nutrient Management Plan (SNMP) be developed in every groundwater basin where recycled water projects are implemented. SNMPs facilitate basin-wide management of salts and nutrients from all sources in a manner that optimizes recycled water use while ensuring protection of groundwater supply, beneficial uses, and human health.

If the Region implements a recycled water project, stakeholders would be required to develop a SNMP that establishes objectives for salts and nutrients, as well as implementation plans to meet these objectives. The objectives would then be adopted by the RWQCBs as amendments to the region's Basin Plan.

The SWRCB updates the Recycled Water Policy every five years. Stakeholder engagement for the update to the Recycled Water Policy was initiated in January 2017. A draft for public review is expected no later than March 2018. The anticipated update will address the following advancements and changes in the recycled water field:

- **New research,** including monitoring for constituents of emerging concern, bioanalytical tools, and pathogen monitoring and treatment,
- **Regulatory changes,** including uniform water recycling criteria for potable reuse projects and GWR, and the Sustainable Groundwater Management Act (SGMA)
- **Expanded uses** in the fields of agriculture, dust control, and frost protection.

Recycled Water Regulations for Non-Potable Applications

There are four classifications for recycled water to be used in non-potable applications, determined based on the end use. The highest level of non-potable recycled water is "Disinfected Tertiary Recycled Water," which can be used on sites including parks, schools, golf courses, and other landscaped areas that do not restrict access.

Non-potable recycled water classification is determined by the treatment process and the recycled water the quality, including turbidity, bacteria levels, and virus removal. Turbidity is a measure of water clarity that is measured in "Nephelometric Turbidity Units," or NTU. Bacteria levels are measured by the amount of Total Coliform (TC) bacteria, which is measured in units of "Most Probable Number" or MPN. Virus reduction is measured in log-removal quantities. The four classifications of non-potable recycled water that are currently permitted under Title 22 are summarized in **Table 2-1**.

Table 2-1: California Non-Potable Recycled Water Classifications

Treatment Level	Approved Uses	Total Coliform (TC) Standard (median)
Disinfected Tertiary Recycled Water	Spray Irrigation of Food Crops Landscape Irrigation (1) Non-restricted Recreational Impoundment	2.2 MPN/100 mL
Disinfected Secondary-2.2 Recycled Water	Surface Irrigation of Food Crops Restricted Recreational Impoundment	2.2 MPN/100 mL
Disinfected Secondary-23 Recycled Water	Pasture for Milking Animals Landscape Irrigation (2) Landscape Impoundment	23 MPN/100 mL
Undisinfected Secondary Recycled Water	Surface Irrigation of Orchards and Vineyards (3) Fodder, Fiber and Food Crops	N/A

(1) Includes unrestricted access golf courses, parks, playgrounds, school yards, and other landscaped areas
(2) Includes public-access restricted areas such as golf courses, cemeteries, and freeway landscapes
(3) Fruit cannot contact irrigation water or the ground.

In addition to the TC requirements listed in **Table 2-1**, Disinfected Tertiary Recycled Water must meet the criteria for wastewater filtration and disinfection processes, detailed as follows:

1. Filtration process that achieves recycled product water not exceeding:
   a) An average of 2 NTU within a 24-hour period;
   b) 5 NTU more than 5 percent of the time within a 24-hour period; and
   c) 10 NTU at any time.
2. Disinfection by one of the two following methods:
   a) A chlorine disinfection with a minimum product of chlorine residual (C) and contact time (t), or Ct, of 450 mg-min/L with a modal contact time of at least 90 minutes, or
   b) An alternative disinfection process, that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 5-log virus.

Table 2-2 includes a list of recycled water uses allowed by Title 22 for disinfected tertiary recycled water, the highest quality non-potable recycled water type.

Table 2-2: Title 22 Allowed Uses for Disinfected Tertiary Recycled Water (1)

Municipal Uses
Parks and playgrounds
School yards
Residential landscaping
Golf courses
Cemeteries
Freeway landscaping
Industrial and Commercial Uses
Industrial or commercial cooling
Industrial boiler feedwater
Flushing toilets and urinals
Agricultural Uses
Food crops where recycled water contacts the edible portion of the crop, including all root crops
Ornamental nursery stock and sod farms
Fodder and fiber crops and pasture for animals, including milk animals for human consumption
Indirect Potable Use
Groundwater recharge via surface spreading [2]

(1) This table does not represent an all-inclusive list of recycled water uses.
(2) GWR regulations include multiple requirements for project approval.

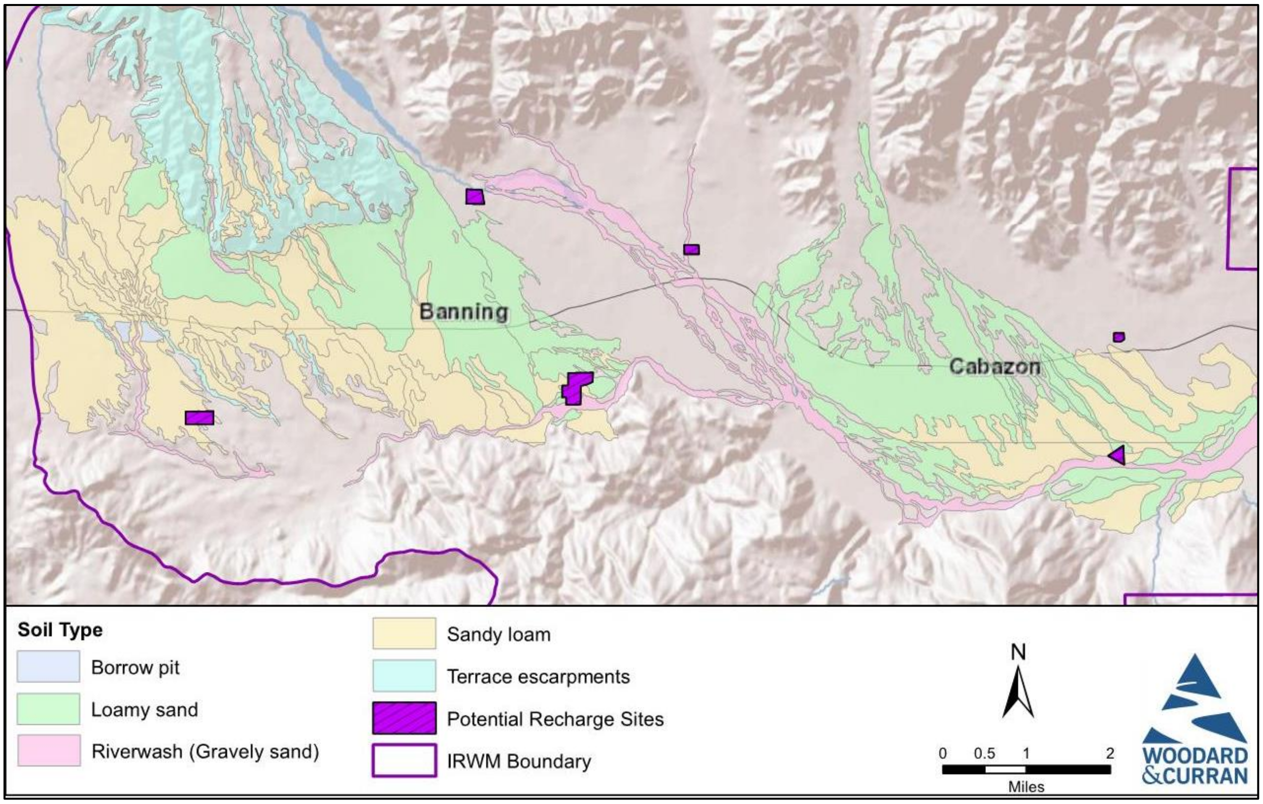
Recycled Water Regulations for Groundwater Replenishment

Groundwater replenishment (GWR) of recycled water into an aquifer that is a drinking water source has more stringent regulations than using recycled water for non-potable applications. GWR regulations also vary depending on whether the recharge is accomplished by surface application using recharge basins, or by subsurface application using injection wells. This study assumes that GWR will be accomplished by surface application.

Compared to groundwater injection, surface spreading requires less stringent water quality requirements and has lower technology maintenance requirements. At the recharge basin, the recycled water percolates into the soil, and the different soils layers provide further physical, biological, and chemical purification through a process called soil aquifer treatment (SAT). Ultimately, this water becomes part of the groundwater supply. SAT systems require unconfined aquifers free of restricting layers, and soils that are coarse enough to allow sufficient infiltration rates, but fine enough to provide adequate filtration.

Site selection for groundwater recharge is dependent on several factors, including suitability for percolation, proximity to conveyance channels and/or water reclamation facilities, and land availability. Six areas in the region have been identified as potential recharge areas, as indicated on **Figure 2-3**. Proposed recharge sites have been located in areas mapped with generally course-grained and sandy soils, which would be favorable for recharge.

Figure 2-3: Potential Recharge Areas



Source: United States Department of Agriculture National Resources Conservation Service Soil Survey

Key provisions of the GWR Regulations include the following:

- Recycled Water Contribution (RWC)
- Retention Time and Pathogen Control

Recycled Water Contribution (RWC)

RWC is defined as the recycled water applied at the GWR project divided by the total water applied (which equals recycled water + diluent water). Diluent water is an alternate source of water, such as groundwater or imported water. For GWR projects, regulations allow an initial RWC of 20 percent for at least the first year of operation. Sponsors of GWR projects in the Region would have to demonstrate through groundwater studies that enough diluent water is present to achieve a 20 percent RWC.

To qualify as an acceptable diluent water source, the source must either be a DDW-approved drinking water source or meet specified requirements. Common diluent waters are surface water (imported water), storm water, and groundwater underflow. For the San Gorgonio Region, potential sources of diluent water are increased imported water (SWP) and groundwater underflow from natural surface recharge. River diversion may also be a potential source of diluent water.

Alternatively, increased RWCs up to 100 percent can be approved if the GWR project sponsor provides studies that demonstrate that the treatment processes preceding SAT can reliably achieve levels of total organic carbon (TOC) that do not exceed 0.5 mg/L as a 20-week running average, which typically requires advanced treatment such as reverse osmosis.

Due to the difficulty in disposing brine in the Region, which does not have a brine line for ocean discharge, reverse osmosis is not expected to be part of the treatment process. This Study therefore assumes a RWC of 20% and that diluent water will be available for GWR projects. Although, low TOC in wastewater combined with high-performance SAT could ultimately increase the RWC to 50%.

Retention Time

The regulations include two requirements that relate to retention time: 1) Pathogen control; and 2) Response retention time (RRT). For pathogen control for surface spreading projects, the recycled water must meet Title 22 disinfected tertiary effluent requirements and nitrogen removal that produces a total nitrogen concentration less than 10 mg/L. The treatment system must consist of at least three separate treatment processes and achieve at least 12-log enteric virus reduction, 10-log Giardia cyst reduction, and 10-log Cryptosporidium oocyst reduction, as summarized in **Table 2-3**.

Table 2-3: Log Removal Credit Requirements

Pathogen	Log Removal Requirement
Enteric Viruses	12
Giardia Cyst	10
Cryptosporidium Oocyst	10

For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than a 1.0-log reduction. Log removal credit is allowed for virus (only) of 1-log/month of retention time. GWR projects with minimum treatment requirements (tertiary filtration, disinfection, total nitrogen) and 6 months of travel time will meet pathogen control requirements. A safety factor of 2 is applied to the travel time estimate if groundwater modeling is used to estimate retention time, increasing the minimum travel time to 12 months. A project sponsor must validate retention time using an added or intrinsic tracer within the first three months of operation.

RRT is the time recycled water must be retained underground to identify any treatment failure and implement actions so that inadequately treated recycled water does not enter a potable water system, including the time to provide an alternative water supply or treatment. The minimum RRT is 2 months.

The largest of the retention times required (Pathogen Control or RRT) is used to establish the zone within which drinking water wells cannot be constructed, which effectively establishes a boundary between potable and non-potable use of the groundwater basin. For surface spreading project with tertiary filtration, pathogen control sets the minimum retention time.

2.2.3 Local

The SWRCB divides the state into branches and regions to address local differences in climate, topography, geology, and hydrology. The DDW consists of a Northern and Southern Field Operations Branch (FOB) which are further broken down into regions. In the San Gorgonio Region, drinking water and recycled water projects are regulated by District 20 (Riverside) in the Southern FOB.

The Colorado River Regional Water Quality Control Board (Region 7) regulates surface water and groundwater within Imperial, San Bernardino, Riverside, and eastern San Diego Counties. The Colorado River Basin Plan identifies beneficial uses for the water bodies and establishes water quality objectives for groundwater and surface water bodies in the Basin.

In the Colorado River Basin Plan, beneficial uses for surface and groundwaters in the San Gorgonio Region are listed under the Coachella Planning Area. Beneficial uses of surface waters in the San Gorgonio River, which runs through the San Gorgonio Region, include municipal, agricultural, groundwater recharge, water contact recreation, cold freshwater habitats, and wildlife habitats. The Banning WWTP discharges within groundwaters of the San Gorgonio Hydrologic Unit 719.30, which has beneficial uses for municipal and domestic supply, agriculture, and industrial service supply.

Region 7 implements California’s Antidegradation Policy, which requires all State agencies to protect existing and potential uses of surface waters and groundwater. The Antidegradation policy is incorporated into Basin Plans and requires that existing water quality be maintained to the maximum extent possible; but it allows lowering of water quality if the change is “consistent with maximum benefit to the people of the state, will not unreasonably affect present and anticipated use of such water (including drinking), and will not result in water quality less than prescribed in policies.” The Antidegradation Policy also stipulates that any discharge to existing high quality waters will be required to “meet waste discharge requirements which will result in the best practicable treatment or control of the discharge to ensure that (a) pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.”

Region 7’s goal is to maintain the existing water quality of all non-degraded groundwater basins; however, in most cases, groundwater that is pumped generally returns to the basin after use with an increase in mineral concentrations, such as total dissolved solids (TDS). Under these circumstances, Region 7’s objective is to minimize the quantities of contaminants reaching any groundwater basin by establishing management practices for major discharges. Until the Regional Board can complete investigations for the establishment of management practices, the objective is to maintain the existing water quality, where feasible. The Basin Plan prohibits discharges of water softener regeneration brines and other mineralized wastes in areas where such brines can percolate to groundwaters usable for municipal and domestic supply.

If the Region develops a SNMP, the objectives that are developed for salts and nutrients would be adopted by Region 7 as amendments to the Basin Plan.

Chapter 3 Recycled Water Source Analysis

This chapter addresses the potential sources of recycled water available in the planning horizon, projected to the year 2040.

3.1 Wastewater Treatment Facilities

The San Gorgonio Region treats wastewater using municipal wastewater treatment facilities and privately-owned onsite wastewater treatment systems (OWTS). Banning and the MBMI own the two municipal wastewater treatment plants (WWTPs) in the Region. The Banning WWTP treats wastewater from its service area, which is more densely populated than other areas in the Region. The Morongo WWTP treats wastewater generated from MBMI administrative buildings and the commercial area near the Morongo Casino Resort and Spa.

OWTS, which include septic systems and sometimes cesspools in older areas, are typically the primary method of wastewater treatment for rural residential areas. In areas where municipal sewer is not yet available in the Region, some municipal, commercial and industrial parcels are also using OWTS.

OWTS typically use subsurface leach fields for effluent disposal and rely on the soil layers for further mechanical and biological treatment. OWTS have limited ability for nitrogen removal. Depending on the location, OWTS can cause or contribute to water quality issues related to nitrogen, including elevated levels of nitrate in groundwater sources.

3.1.1 Banning

Banning provides sewer service to its service area within city limits and to some unincorporated areas of Riverside County that are outside the city boundaries. Banning is responsible for the collection, conveyance, treatment, and disposal of wastewater generated within its service area and currently treats an average of 2.07 million gallons of wastewater per day (mgd).

Many parcels within Banning's wastewater service area are not yet connected to the municipal sewer. Based on a preliminary analysis of GIS data, 854 parcels using OWTS were identified, as indicated on **Figure 3-1**. Using a wastewater generation rate of 200 gallons per EDU, the wastewater volume treated in OWTS is estimated to be about 8% of the total wastewater generated in the Banning service area, as summarized in **Table 3-1**.

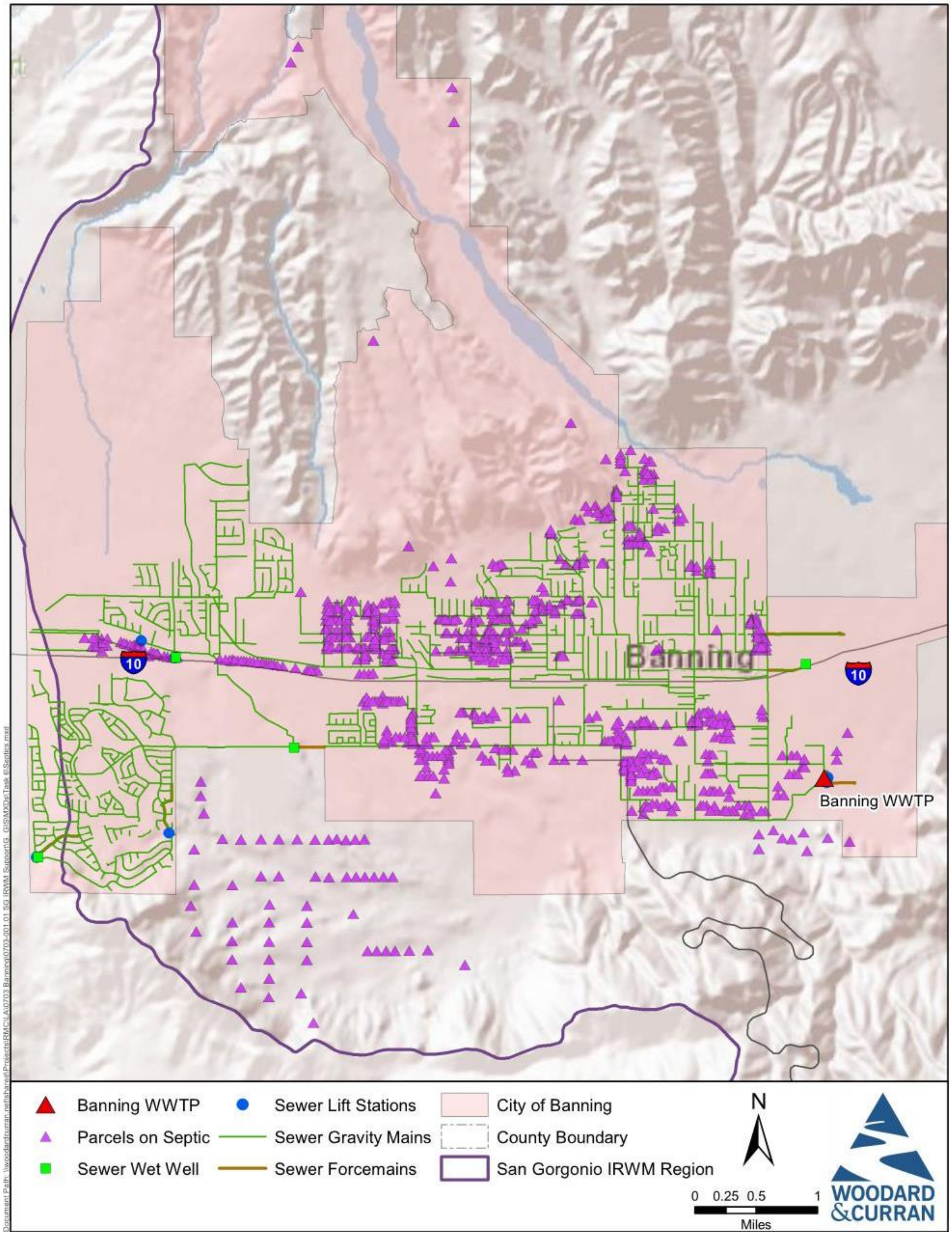
Table 3-1: Potential Wastewater Sources within Banning

Source	Quantity	Average Wastewater Generation (2016)	Flow (AFY)
Banning WWTP	-	2.07 mgd	2,320
Existing parcels on septic	854 EDUs	200 gpd / EDU	191

Source:
(1) City of Banning GIS data, 2017
(2) Banning UWMP, 2015

To encourage land owners to convert from septic to sewer, there is an ordinance that requires parcels to pay sewer fees even if they are using an OWTS. This ordinance applies to parcels developed in 1972 or later, located within 200 feet of a sewer main.

Figure 3-1: Wastewater Facilities in Banning Service Area



The Banning WWTP has a design treatment capacity of 3.6 mgd and is operated by Suez Water Environmental Service, Inc. The treatment train consists of preliminary treatment, primary treatment, secondary treatment, solids handling and disposal ponds. Untreated wastewater flows to the preliminary treatment system, which consists of a mechanical bar screen, compactor, grit removal system, classifier and cyclone separator. Wastewater from the preliminary treatment system flows to two primary clarifiers and is then pumped to two trickling filters. Effluent from the trickling filters flows to the two secondary clarifiers and then to the chlorine contact chamber. The disinfection units have not been in use since April 2000 and the chlorine contact tank is currently used as a holding tank for the final effluent water sampling and discharge to percolation ponds. Approximately 40 acres of percolation ponds are located east of the Banning WWTP and overlie the Cabazon groundwater storage unit.

Primary sludge from the two primary clarifiers is pumped to the anaerobic digester for further treatment. Secondary sludge from the secondary clarifiers is pumped to the gravity thickener for thickening and then pumped to three anaerobic digesters for further treatment. Sludge wasting from the digester is pumped to the onsite sludge drying beds to produce Class B biosolids, and a private contractor hauls the biosolids offsite to a permitted facility for disposal.

The Banning WWTP currently receives industrial wastewater from several businesses. Banning issues Industrial User Discharge Permits to verify that those businesses meet local discharge limits, which ensures that the wastewater treatment plant is protected and can meet effluent standards.

Banning is currently evaluating adding a nitrification/denitrification (NDN) process upgrade to the Banning WWTP in response to WDR provision. Banning is also planning expansion of treatment capacity that will be needed for additional projected flows from the proposed residential developments of Rancho San Gorgonio (RSG), Butterfield, and Five Bridges. Projected wastewater flows and potential recycled water generation for these future developments has been estimated within their corresponding Specific Plans and is summarized in **Section 3.2**.

3.1.2 Banning Heights

Banning Heights is an unincorporated area that encompasses the areas also referred to as Banning Bench and Mias Canyon. Water is supplied to the area by Banning, Banning Heights Municipal Water District, and private wells. The area is primarily rural residential without a municipal sewer, and wastewater treatment is provided by OWTS. This area is not likely to be connected to a municipal wastewater treatment system due to its rural nature and remote location. Wastewater produced from this area is not considered a viable source of recycled water supply for this Study.

3.1.3 Cabazon

Cabazon is an unincorporated area within Riverside County that lies to the east of the City of Banning and overlies the Cabazon groundwater storage unit. Cabazon Water District (CWD) currently serves 1,000 potable connections within a service area of approximately 13.5 square miles. There are no municipal sewers in Cabazon and all wastewater is treated onsite by septic systems.

In 2008, a draft wastewater facilities master plan was prepared for constructing a WWTP and sewer system in the Cabazon area at buildout. The master plan recommended a phased installation of sewers, force mains, pump stations, and treatment facilities. Assuming an ultimate buildout of 12,600 equivalent dwelling units (EDU) and a wastewater generation rate of 250 gpd per EDU, the master plan recommended an ultimate treatment plant capacity of 3.15 mgd (average daily flow). The master plan proposed secondary and tertiary processes with NDN, aerobic sludge digestion, and onsite subsurface effluent disposal using percolation ponds. Facilities recommended in the master plan have not yet been implemented.

This study uses information from the master plan for developing a sewer system and WWTP for the 2040 planning horizon. Based on Southern California Association of Governments (SCAG) water demand projections for unincorporated Riverside County, it is estimated that approximately 40 percent of the Cabazon area could be developed by 2040.

If a municipal sewer and WWTP were installed by 2040, it is estimated that 1,127 AFY of wastewater could be available as a source of recycled water supply within the Cabazon area by 2040. This Study uses a wastewater generation rate of 200 gpd per EDU, which is 20 percent lower than the master plan rate, to account for the decrease in water usage from 2008. **Table 3-2** summarizes the existing septic systems in Cabazon and the estimated septic systems that could potentially be converted to municipal sewer and become a source of recycled water.

Table 3-2: Potential Wastewater Sources in Cabazon Area

Wastewater Source	Septic Systems (EDU)	Average Wastewater Generation Rate (2016)	Flow (AFY)
Existing parcels on septic	1,000	200 gpd/EDU	224
2040 development (projected at 40% of Buildout)	5,032	200 gpd/EDU	1,127
Development at Buildout per Master Plan	12,579	200 gpd/EDU	2,818

Sources:

(1) Cabazon Water District, 2017

(2) Cabazon Wastewater Facilities Master Plan, 2008

3.1.4 MBMI

The MBMI Water Department provides potable water to residents and commercial enterprises on the Morongo Reservation. The MBMI Water Department currently has over 35 miles of potable distribution system, consisting of pipelines, reservoirs, wells, and approximately 15 miles of non-potable water pipelines.

The MBMI also owns and maintains a sewer system and wastewater treatment plant (Morongo WWTP) that serves a portion of the reservation. The sewer system extends from the Administration Building along Seminole Drive to the Morongo WWTP located along I-10 at Elm Street. A separate force main extends from the Arrowhead bottling plant located south of I-10 to the WWTP. The 8-inch diameter force main crosses I-10 in a sleeve beneath the freeway. Currently only industrial process water (i.e. filter backwash) is sent through this force main to the Morongo WWTP; sanitary wastewater (sewage) is treated onsite by an OWTS.

The Morongo WWTP is a secondary treatment facility designed to treat up to 750,000 gpd utilizing a sequencing batch reactor (SBR) system with a 900 mg/L biological oxygen demand load. The plant currently operates a single treatment train with an average wastewater flow of approximately 350,000 gpd. The original plant design included tertiary filters but were ultimately not installed. Treated effluent from the Morongo WWTP is discharged to percolation ponds. The 9 acres of percolation ponds are located next to the Morongo WWTP, overlying the Cabazon storage unit.

It is assumed that there are 565 residential parcels on the reservation that are using onsite septic systems. Converting each parcel to a sewer would increase wastewater flow to the Morongo WWTP by approximately 113,000 gpd (127 AFY) assuming a wastewater generation rate of 200 gpd per EDU.

Residential development is progressing at approximately 15 homes per year. Assuming 200 gallons per EDU, this would increase the wastewater production by approximately 3 AFY by 2040.

There are also some commercial and industrial properties on septic, including a Chevron gas station, the Cabazon Outlets, and the Arrowhead bottling facility. The Cabazon Outlets are conditioned to connect to sewer upon expansion, but there are no expansion plans at this time. Wastewater generated at these facilities is estimated in **Table 3-3**.

Table 3-3: Potential Wastewater Sources within MBMI

Source	Quantity	Average Wastewater Generation (2016)	Estimated Flow (AFY)
Morongo WWTP		350,000 gpd	392
Existing parcels on septic	565 EDU	200 gpd/EDU	127
Cabazon Outlets	350 parking spaces	2 per parking space	2
Arrowhead Bottling Facility	350 employees	13 per employee	5

3.2 Recycled Water Supply Potential

Wastewater available for recycled water production would be sourced from existing and planned WWTPs and septic systems that are converted to municipal sewers. There are also developments in the planning stages that are assumed to be a future source of wastewater.

3.2.1 Planned Development

In Banning, three planned developments with Specific Plans have been included in the projected wastewater supply. These developments are also areas of potential recycled water use for irrigation. Brief descriptions, taken from the Specific Plans, are summarized as follows:

Rancho San Gorgonio

The Rancho San Gorgonio (RSG) Specific Plan proposes an 831-acre master planned residential community in the southern part of Banning, 0.4 miles south of I-10 and generally bounded by Sunset Avenue and Turtle Dove Lane on the west, Coyote Trail and Old Idyllwild Road on the south, San Gorgonio Avenue (State Route 243) on the east, and portions of Westward Avenue to the north. It is anticipated that Banning, and future residents and businesses in RSG, will continue to rely on Banning's available groundwater supply. Banning also has plans to utilize recycled water for non-potable irrigation demands which will reduce the demand on potable water supplies for this proposed development.

The RSG Specific Plan utilizes recycled water for all common area irrigation demands when available. This includes median and parkway landscape areas along the major streets within the project, as well as at the various parks throughout the master planned community. Landscaping on private property at residences will be irrigated with domestic, potable water. The project's total average irrigation water demand to serve all common areas is approximately 217 AFY at project buildout for a total irrigated area of approximately 78 acres (Madole & Associates, 2015).

The project is estimated to generate an increase of approximately 0.84 mgd of average sewer flow in the Banning's sewer system. This amount equates to an average increased generation of 470 AFY in recycled water (Madole & Associates, 2015).

Butterfield

The Butterfield Specific Plan proposes a multi-use community within the 1,543–acre project area in the northwestern corner of Banning (Brownstein Hyatt Farber Schreck, 2011). The site is generally bounded by Wilson Street to the south, Highland Springs Avenue to the west; Riverside County unincorporated land to the north and northeast, and portions of Highland Home Road to the east. The San Bernardino National Forest is further north of the project site. Butterfield is to be predominately residential, single-family, detached homes. Neighborhood parks, community parks, schools, open spaces, retail and commercial parcels are also integrated into the community.

Butterfield's projected potable water demand for non-irrigation purposes at buildout is estimated at 1,600 AFY with estimated future water conservation reductions. These figures assume a development of 4,862 dwelling units (Brownstein Hyatt Farber Schreck, 2011).

The projected total irrigation water demand to serve common landscaped areas is estimated at approximately 864 AFY at project buildout (Carollo Engineers, 2017). Recycled water, as it is available, is ultimately required to meet this demand.

Butterfield's projected total average sewer flow generation is estimated at approximately 0.76 mgd at project buildout. As a potential alternative option for providing wastewater treatment to Butterfield, Banning could elect to have a satellite WWTP sited and constructed within the project area. To accommodate this alternative, the project designates approximately 2 to 5 acres for a satellite treatment plant (Brownstein Hyatt Farber Schreck, 2011). At this location, the satellite plant could treat wastewater from the project and pump back recycled water into the project's recycled water system.

Five Bridges

The Five Bridges development would consist of 548 acres, located just south of I-10 and the Union Pacific Railroad right-of-way, west of Sunset Avenue (City of Banning, 2008). Five Bridge would include 2,160 residences, mostly comprised of single-family dwellings with densities ranging from 3 units an acre to 8 units an acre, and 95 patio homes and 273 townhouses at a higher density. Also included are 51.6 acres of commercial retail space, 106.2 acres of parks and open space, and a site for a new fire station.

The projected total irrigation water demand to serve common landscaped areas is estimated at approximately 223 AFY at project buildout (Carollo Engineers, 2017). The development's projected total average sewer flow generation based on a generation rate of 200 gallons per day (gpd) per dwelling unit for the anticipated 2,160 residences is approximately 0.43 mgd at project buildout.

3.3 Assumptions for Wastewater Production

For this Study, assumptions were made to project the wastewater that would be available for recycled water use by the 2040 planning horizon using the following assumptions:

- All existing septic systems within the city of Banning's service area would be converted to municipal sewer by 2040
- Proposed future developments in Banning (Rancho San Gorgonio, Butterfield, Five Bridges) would be constructed and in service by 2040 and would produce wastewater in accordance with Specific Plans
- Banning Heights will remain on septic and will not be a source of recycled water
- 40% of Cabazon's existing and ultimate buildout would convert to municipal sewer by 2040.
- All existing septic systems in Morongo would convert to municipal sewer by 2040 and new development would proceed in accordance with the projected water demand per SCAG.

- Cabazon Outlets and Arrowhead bottling plant will convert from septic to municipal sewer by 2040.

Table 3-4 summarizes the sources of wastewater that could become sources of recycled water, projected to the planning horizon of 2040.

Table 3-4: Recycled Water Source - Wastewater Supply Projections

Source	Existing (2016) AFY	Planned (2040) AFY
Banning WWTP	2,320	2,320
Banning Septic Conversions	--	191
Rancho San Gorgonio	--	941
Butterfield	--	851
Five Bridges	--	484
Banning Subtotal	**2,320**	**4,787**
Banning Heights Septic Conversions	--	--
Banning Heights Subtotal	**0**	**0**
Cabazon Septic Conversions (1)	--	1,127
Cabazon Subtotal	**0**	**1,127**
Morongo WWTP (2)	392	485
MBMI Septic Conversions	--	127
Cabazon Outlets Septic Conversions	--	1
Arrowhead Septic Conversions	--	5
MBMI Subtotal	**392**	**618**
Total Wastewater Supply	**2,712**	**6,531**

(1) Assumes 40% of ultimate buildout per 2008 Master Plan, aligned with projected SCAG water demand increase
(2) Aligned with projected SCAG water demand increase

3.4 Existing Recycled Water Infrastructure

There is currently no recycled water infrastructure in the San Gorgonio Region; however, some existing facilities could be repurposed for recycled water use.

3.4.1 Banning

There is an existing 24-inch diameter non-potable water pipeline that supplies water to Sun Lakes development located in southwest Banning. The pipeline is over 2 miles long and is currently used for non-potable groundwater to fill an irrigation lake at the golf course. This Study assumes that the existing 24-inch pipeline could be repurposed as a recycled water pipeline.

3.4.2 Cabazon

It has been reported that irrigation pipelines were installed during construction of the Cabazon Community Center, but detailed information was not reviewed. This study therefore assumes that there is no recycled water infrastructure in the Cabazon area.

3.4.3 MBMI

The MBMI does not currently have recycled water infrastructure. There is an existing 8-inch diameter force main from the Arrowhead bottling facility that crosses under I-10 that is reportedly underutilized and could potentially be repurposed as a recycled water pipeline. There are spare conduits in a utility sleeve under I-10 that crosses the freeway. This study utilizes the existing utility sleeve for options in the Morongo and Cabazon areas that require a new recycled water pipeline crossing under I-10.

Chapter 4 Potential Recycled Water Use

This section focuses on municipal irrigation, industrial uses, and groundwater recharge.

- **Irrigation:** The potential customers identified for recycled water generally consist of parks, schools, and other landscape irrigation users that would require non-potable recycled water quality. Per the Title 22 Code of Regulations, recycled water used for landscaped areas with unrestricted access must meet quality requirements for "Disinfected Tertiary Recycled Water" described in **Section 2.2.2**. In addition to meeting minimum water quality requirements for public health protection, some turfgrass types may require additional consideration because they are sensitive to specific constituents in recycled water. Elevated levels of chloride could have negative impacts on turfgrass types that are typically used for golf course greens and tees. When switching to recycled water supplies, water quality differences are commonly managed by adapting irrigation practices, including:
  - Soil monitoring programs, including soil testing and management consultations
  - Installing electrical conductivity meters to monitor in-line water quality at time of delivery
  - Adding soil amendments, such as gypsum
  - Leaching constituents out of the upper soil layer by increasing water use by 5 – 10%
  - Blending with other water sources.
- **Industrial:** The Arrowhead bottling plant was identified as a potential industrial customer for recycled water. The bottling plant is located on MBMI property and information on the recycled water needs were not provided. Some industrial processes require higher water quality. "Disinfected Tertiary Recycled Water" is assumed sufficient for the Arrowhead bottling plant in this study, but further information would need to be provided to include the bottling plant as a recycled water customer.
- **Groundwater Recharge via Surface Spreading:** This study assumes that recycled water will be recharged via surface spreading, which requires NDN along with disinfected tertiary treatment and minimum underground retention time. Refer to **Section 2.2.2** for further information pertaining to GWR.

4.1 Non-Potable Recycled Water Demands

The potential recycled water demands identified in this Study were obtained from several sources. Banning provided preliminary information from their Integrated Master Planning effort that is currently under development. The Cabazon recycled water demands were provided by CWD in the form of water billing records, and the recycled water data for MBMI was provided from John Covington, the Reservation Services Administrator (John Covington, 2017).

Table 4-1 summarizes both the existing and future potential non-potable recycled water demands identified within the Region. There are four future developments planned within the San Gorgonio Region with recycled water demands. Three developments are in Banning, one is within the Morongo Reservation. The total estimated annual recycled water demand is approximately 3,250 AFY.

Table 4-1: Summary of Potential Recycled Water Demands

Potential Recycled Water Demands	Water Agency	End Use	Annual Demand (AFY)
Existing Demands			
Sun Lakes Development	Banning	Irrigation	850
Caltrans	Banning	Irrigation	0.4
Gilman Ranch Museum Park	Banning	Irrigation	2
Repplier Park	Banning	Irrigation	3
Banning Unified School District	Banning	Irrigation	13
Roosevelt Williams Park	Banning	Irrigation	60
Hoffer Elementary School	Banning	Irrigation	45
Neighborhood Park	Banning	Irrigation	35
Dysart Park	Banning	Irrigation	87
Banning High School	Banning	Irrigation	175
Lions Park	Banning	Irrigation	79
Sylvan Park	Banning	Irrigation	35
Mountain Ave Park	Banning	Irrigation	13
Cabazon School/Comm Ctr/Park	Cabazon	Irrigation	9
Desert Hills Premium Outlets	Cabazon	Irrigation	127
Cabazon Outlets	Cabazon	Irrigation	3
Morongo Casino Resort & Spa	MBMI	Irrigation	45
Arrowhead Bottling Plant	MBMI	Industrial/Irrigation	100
Cottonwood Rd Park	MBMI	Irrigation	160
Potrero Rd Park	MBMI	Irrigation	80
Schools	MBMI	Irrigation	10
Future Demands			
Five Bridges Development	Banning	Irrigation	223
Rancho San Gorgonio	Banning	Irrigation	217
Butterfield	Banning	Irrigation	864
RV Park	MBMI	Irrigation	10
Total			**3,245**

4.2 Groundwater Recharge

Groundwater recharge (GWR) using recycled water is most widely accomplished through surface spreading in recharge basins. Design options for spreading grounds are limited to the size and depth of the basins and the location of production wells. The subsurface flow travel time is affected by the well locations.

Recharge basins are typically operated under a wetting/drying cycle designed to optimize inflow and percolation and discourage algae growth and insect breeding in the basins. Algae can clog the bottom of basins and reduce infiltration rates and can be minimized by upstream nutrient removal or by reducing the detention time within the basins, particularly during warm summer periods when algal growth rates increase. Periodic maintenance, which involves cleaning the basin bottom by scraping the top layer of soil, is used to prevent clogging. To operate recharge basins constantly, a redundant basin is typically required for wetting/drying cycle maintenance.

Several potential recharge sites were evaluated for the Study. **Table 4-2** summarizes the estimated recharge volumes and recharge areas required for project options. The estimated infiltration rates were provided by Banning from preliminary work on the Integrated Master Plan. Refer to **Chapter 5** for more detail on recharge.

Table 4-2: Recharge Site Estimations

Recharge Basin Name	Estimated Infiltration Rates (1) (ft/day)	Estimated Basin Site (acres)	Effective Recharge Area (acres)	Volume Per Day (af)	Recharge Volume (afy)	Recharge Volume (mgd)
Banning WWTP	1	35.2	26.4	26.4	9,632	4.3
North Banning	2	8.8	6.6	13.2	4,816	4.3
North Banning-Imported & RW	2	13.7	10.3	20.5	7,487	6.7
Five Bridges	1	17.6	13.2	13.2	4,816	4.3
Cabazon	1	8.2	6.1	6.1	2,240	1.0
Morongo WWTP	1	4.5	3.4	3.4	1,232	0.55
Morongo/ Cabazon	1	6.1	4.6	4.6	1,680	0.75

Source: Preliminary work, Banning Integrated Master Plan

Based on the available recharge acreage provided in **Table 4-3**, the North Banning and Five Bridges recharge sites do not allow enough space for full basin redundancy. Basins at these sites may need to be divided into multiple smaller basins to allow for wetting/drying cycle maintenance.

Table 4-3: Available Recharge Acreage

Recharge Basin Name	Effective Recharge Area (acres)	Available Site (acres)
Banning WWTP	26.4	39.5
North Banning	10.3	14.9
Five Bridges	13.2	22.5

4.3 Necessary Treatment Plant Improvements

Improvements at each WWTP to meet anticipated permit limits and for recycled water use are discussed in this section. Recent data on effluent quality from the Banning WWTP are presented and discussed, including information on current effluent limitations and improvements anticipated to meet permit limits and for recycled water use.

4.3.1 Banning

The treatment process at the Banning WWTP currently consists of primary treatment and secondary treatment with effluent disposal through surface spreading. There are existing facilities for chlorine disinfection, but they are not currently in use.

The WWTP currently discharges approximately 2.07 mgd of secondary-treated effluent into 10 unlined percolation ponds. The WWTP's Self-Monitoring Reports (SMRs) from January 2011 through December 2015 characterize the WWTP effluent as summarized in **Table 4-4**.

Table 4-4: Banning WWTP Effluent Concentrations and Limitations

Constituent	Units	Effluent Concentrations (1)			Effluent Limit (2)	
		Average	Maximum	Minimum	30-Day Mean	7-Day Mean
Flow	mgd	2.07	2.24	1.90	3.6	N/A
20°C BOD_5	mg/L	23	27	19	30	45
TSS	mg/L	21	28	16	30	45
pH	--	7.3	7.6	7.1	6.0 - 9.0	
TDS	mg/L	426	464	380	N/A (3)	
Nitrate as N	mg/L	22	32	12	N/A (3)	
Total Nitrogen	mg/L	29	49	14	N/A (3)	

(1) From Banning WWTP Self-Monitoring Reports (January 2011 through December 2015).
(2) From the WDRs (Board Order R7-2016-0015) issued in June 2016.
(3) The WDRs identified nitrogen and TDS as constituents of concern. The MCL for total nitrogen is 10 mg/L. The WDRs limit TDS to a maximum of 300 mg/L above the domestic water supply, which is approximately 200 mg/L, so the limit would likely be approximately 500 mg/L.

Nitrogen

The WDRs also identified nitrogen as a constituent of concern. The MCL for total nitrogen is 10 mg/L. As indicated in **Table 4-4,** nitrogen levels in effluent samples are elevated above this value, which indicates that percolated water may reach the groundwater at levels above the MCL.

A provision in the WDRs requires Banning WWTP to provide a nitrogen removal analysis to evaluate the practicability of achieving a 10 mg/L total nitrogen effluent limit. By June 2020, Banning is required to submit a technical report that includes recommendation and conclusions about the tentative work plan and time schedule for the facility improvements required to accomplish nitrogen removal. Banning is currently evaluating adding a nitrification/denitrification (NDN) process upgrade to its existing 3.6 mgd secondary process along with a 2.0 mgd ultraviolet (UV) disinfection system.

TDS

The WDRs also identified salts, commonly monitored as TDS, as a constituent of concern. Per the WDRs, effluent TDS at a level of 300 mg/L above the potable water supply "reasonably protects present and anticipated beneficial uses of groundwater in the area," (typical incremental addition of dissolved salts from domestic water usage is 150 to 380 mg/L.) The level of TDS in Banning's potable water supply is approximately 200 mg/L, which would result in an effluent TDS limit of approximately 500 mg/L. As indicated in **Table 4-4**, the average TDS in the treated wastewater is about 420 mg/L, so future TDS limits in an updated WDR would not require additional treatment.

Recycled Water Upgrades

To produce recycled water for unrestricted irrigation use, the Banning WWTP would require tertiary filtration and disinfection, typically chlorination or UV. The Banning WWTP would require a capacity expansion to treat the 2040 projected wastewater flow. The current plant capacity is 3.6 mgd and the projected 2040 flow is 4.3 mgd.

Also, a chlorine residual would be required to maintain water quality in the recycled water pipeline between the water recycling facilities and recycled water customers, which is over 4 miles in some cases. Although UV meets treatment disinfection requirements, it will not maintain a disinfection residual in the distribution pipelines. Without chlorine, biogrowth can accumulate in the pipelines and create water quality issues.

In addition to meeting Disinfected Tertiary Recycled Water requirements, GWR via surface spreading requires NDN and minimum underground retention time. NDN upgrades are already planned at Banning WWTP to meet anticipated stricter effluent limits for nitrogen. Retention time estimates will require groundwater modeling.

4.3.2 Morongo WWTP

The Morongo WWTP is a secondary treatment facility designed to treat up to 750,000 gpd utilizing a sequencing batch reactor (SBR) system with a 900 mg/L biological oxygen demand load. The plant currently operates a single treatment train with an average wastewater flow of approximately 350,000 gpd; Approximately 350,000 gpd of treatment capacity is available.

The original plant design included tertiary filters, but were ultimately not installed. Treated effluent from the Morongo WWTP is discharged to 9 acres of percolation ponds located east of the Morongo WWTP and overlie the Cabazon groundwater storage unit.

The Morongo WWTP is regulated by EPA Region 9 and data regarding effluent quality were not provided. This study assumes similar effluent water quality at the Banning WWTP.

Recycled Water Upgrades

Project options in this Study utilize the existing available capacity of 350,000 gpd; capacity expansion is not considered. For unrestricted irrigation use, the Morongo WWTP would require tertiary filtration and disinfection, typically chlorination or UV. Also, a chlorine residual would be required to maintain water quality in the recycled water pipeline between the water recycling facilities and recycled water customers. Although UV meets treatment disinfection requirements, it will not maintain a disinfection residual in the distribution pipelines. Without chlorine, biogrowth can accumulate in the pipelines and create water quality issues.

In addition to meeting Disinfected Tertiary Recycled Water requirements, GWR via surface spreading requires NDN and minimum underground retention time. Retention time estimates will require groundwater modeling.

Chapter 5 Project Options

This chapter describes potential recycled water project options within the Region. To group recycled water supplies and end uses, the recycled water project options were developed within the following supply and use areas:

- Banning **(Table 5-1**)
- Cabazon (**Table 5-2)**
- Morongo (**Table 5-3)**

There is also a joint project in Banning involving the recharge of imported water that was developed in cooperation with the *Water Supply Study*. Project options were also grouped by non-potable irrigation and GWR. **Figure 5-1** depicts non-potable irrigation projects and **Figure 5-2** depicts GWR projects.

Table 5-1: Recycled Water Project Option Summary – Banning Area

Area	Option Title	Improves Groundwater Quality	Increases Water Supply	Unit cost ($/AF)	Feasible?
Banning Option 1	Non-Potable Recycled Water Irrigation South of I-10	Subregional Benefit	Subregional Benefit	$ 1,900	Yes
Banning Option 2	Non-Potable Recycled Water Butterfield Irrigation and Satellite Plant	Subregional Benefit	Subregional Benefit	N/A	No (1)
Banning Option 3	Groundwater Recharge Banning WWTP Recharge Site	Regional Benefit	Regional Benefit	$600	Yes
Banning Option 3A	Groundwater Recharge Banning WWTP Recharge Site	Subregional Benefit	Subregional Benefit	$ 700	Yes
Banning Option 3B	Groundwater Recharge North Banning Recharge Site	Regional Benefit	Regional Benefit	$ 1,000	Yes
Banning Option 3C	Groundwater Recharge Five Bridges Recharge Site	Subregional Benefit	Subregional Benefit	$ 1,000	Yes
Banning Option 4A	Irrigation South of I-10 and GWR Banning WWTP Recharge Site (Combines Options 1 and 3A)	Subregional Benefit	Subregional Benefit	$ 900	Yes
Banning Option 4B	Irrigation North of I-10 and GWR North Banning Recharge Site	Regional Benefit	Regional Benefit	$ 1,000	Yes
Banning Option 4C	Irrigation South of I-10 and GWR Five Bridges Recharge Site (Combines Options 1 and 3C)	Subregional Benefit	Subregional Benefit	$ 1,100	Yes
Banning Joint Water Supply Option	Imported and Recycled Water GWR North Banning Recharge Site	Regional Benefit	Regional Benefit	$ 1,500	Yes

(1) Due to insufficient wastewater supply, Banning Option 2 was determined to not be feasible.

Table 5-2: Recycled Water Project Option Summary – Cabazon Area

Area	Option Title	Improves Groundwater Quality	Increases Water Supply	Unit cost ($/AF)	Feasible?
Cabazon Option 1	Municipal Sewer, WWTP, Non-Potable Irrigation	Subregional Benefit	Subregional Benefit	$31,800	No (1)
Cabazon Option 2	Municipal Sewer, WWTP, Irrigation, GWR at Cabazon Property	Subregional Benefit	Subregional Benefit	$ 3,300	Yes

(1) Due to high unit cost, option is not considered to be feasible

Table 5-3: Recycled Water Project Option Summary – Morongo Area

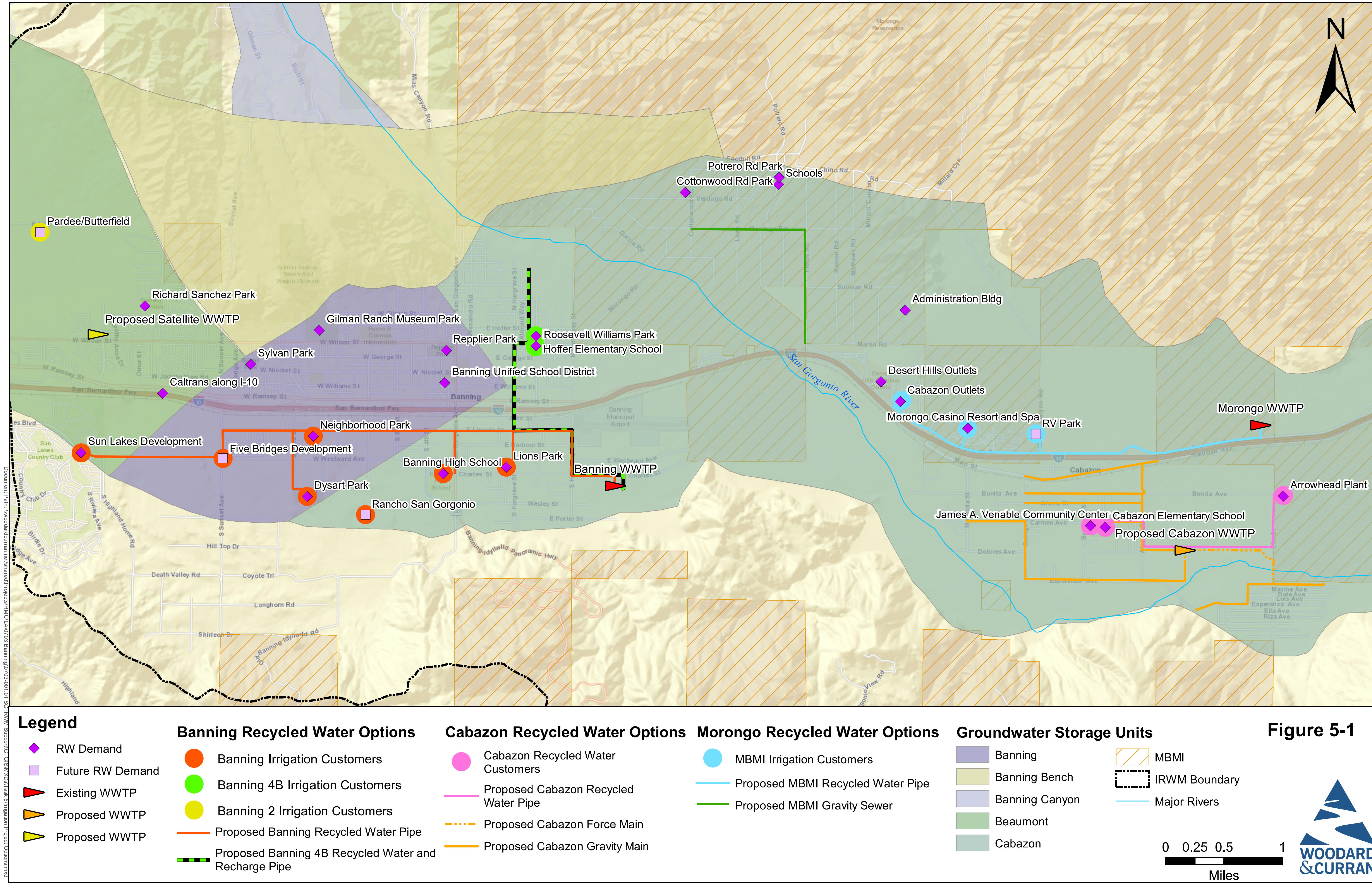
Area	Option Title	Improves Groundwater Quality	Increases Water Supply	Unit cost ($/AF)	Feasible?
Morongo Option 1	Sewer Extension, WWTP Upgrades, Non-Potable Irrigation	Subregional Benefit	Subregional Benefit	$19,100	No (1)
Morongo Option 2	Sewer Extension, WWTP Upgrades, Irrigation, GWR at Morongo WWTP	Subregional Benefit	Subregional Benefit	$ 2,400	Yes

(1) Due to high unit cost, option is not considered to be feasible

One option combines the Cabazon and Morongo areas for a cooperative project between the two stakeholders (**Table 5-4).**

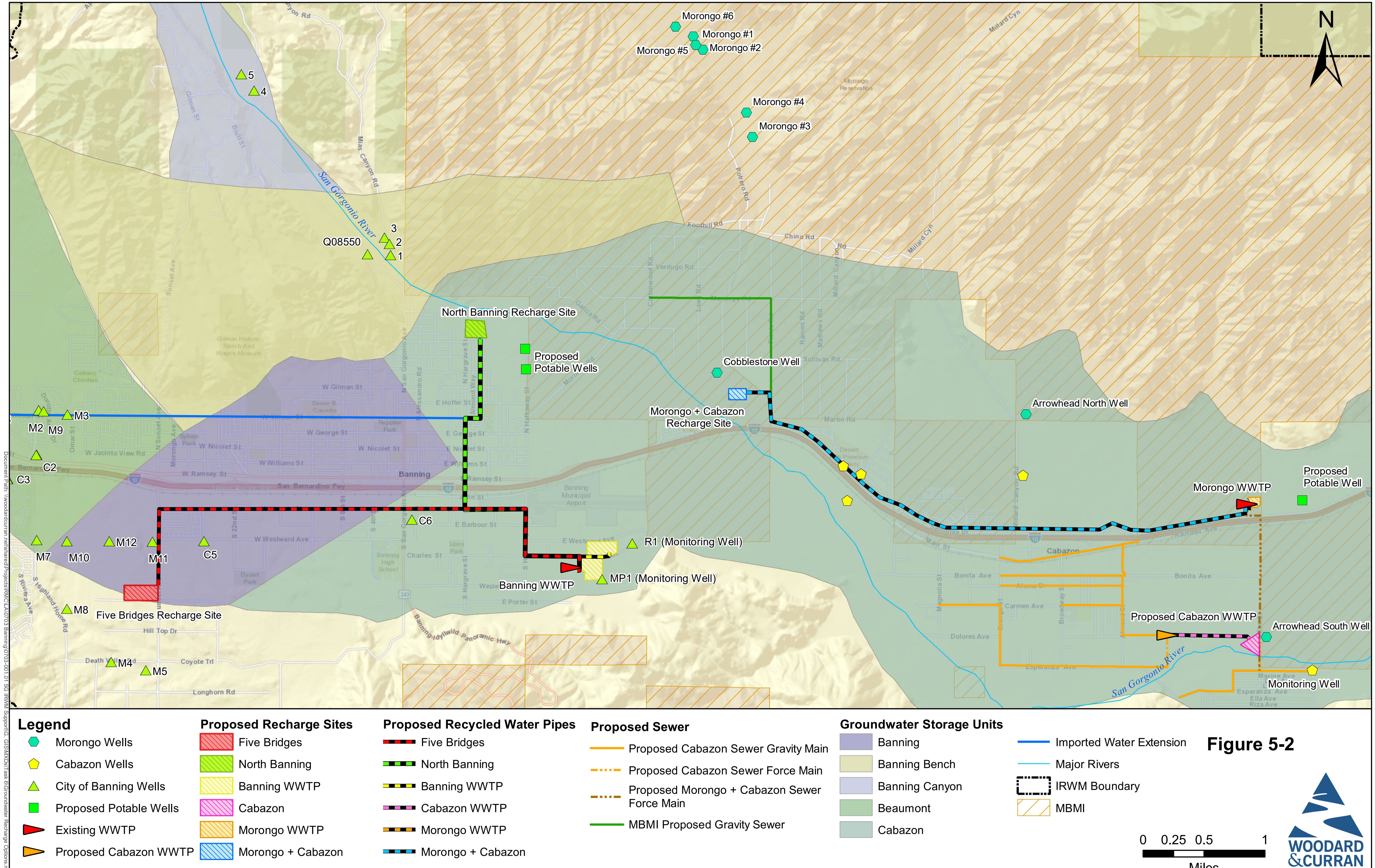
Table 5-4: Recycled Water Project Option Summary – Combined Cabazon and Morongo

Area	Option Title	Improves Groundwater Quality	Increases Water Supply	Unit cost ($/AF)	Feasible?
Combined Cabazon and Morongo Option	Cabazon Municipal Sewer, Morongo Sewer Extension, Morongo WWTP Upgrades, Irrigation, GWR at Cabazon/Morongo Recharge Site	Regional Benefit	Regional Benefit	$4,400	Yes



N
Pardee/Butterfield
Richard Sanchez Park
Proposed Satellite WWTP
Gilman Ranch Museum Park
Sylvan Park
Caltrans along I-10
Repplier Park
Roosevelt Williams Park
Hoffer Elementary School
Banning Unified School District
Potrero Rd Park
Schools
Cottonwood Rd Park
Administration Bldg
Desert Hills Outlets
Cabazon Outlets
Morongo Casino Resort and Spa
RV Park
Morongo WWTP
San Gorgonio River
Sun Lakes Development
Neighborhood Park
Five Bridges Development
Banning High School
Lions Park
Banning WWTP
Dysart Park
Rancho San Gorgonio
Arrowhead Plant
James A. Venable Community Center
Cabazon Elementary School
Proposed Cabazon WWTP
Legend
RW Demand
Future RW Demand
Existing WWTP
Proposed WWTP
Proposed WWTP
Banning Recycled Water Options
Banning Irrigation Customers
Banning 4B Irrigation Customers
Banning 2 Irrigation Customers
Proposed Banning Recycled Water Pipe
Proposed Banning 4B Recycled Water and Recharge Pipe
Cabazon Recycled Water Options
Cabazon Recycled Water Customers
Proposed Cabazon Recycled Water Pipe
Proposed Cabazon Force Main
Proposed Cabazon Gravity Main
Morongo Recycled Water Options
MBMI Irrigation Customers
Proposed MBMI Recycled Water Pipe
Proposed MBMI Gravity Sewer
Groundwater Storage Units
Banning
Banning Bench
Banning Canyon
Beaumont
Cabazon
MBMI
IRWM Boundary
Major Rivers
0 0.25 0.5 1
Miles
WOODARD &CURRAN

Figure 5-1



N
Morongo #6
Morongo #1
Morongo #5
Morongo #2
Morongo #4
Morongo #3
San Gorgonio River
Q08550
North Banning Recharge Site
Proposed
Potable Wells
Cobblestone Well
Morongo + Cabazon
Recharge Site
Arrowhead North Well
M2
M9
M3
C2
C3
Banning
C6
M7
M10
M12
M11
C5
R1 (Monitoring Well)
Banning WWTP
MP1 (Monitoring Well)
M8
Five Bridges Recharge Site
M4
M5
Morongo WWTP
Proposed
Potable Well
Cabazon
Proposed Cabazon WWTP
Arrowhead South Well
Monitoring Well
Legend
Morongo Wells
Cabazon Wells
City of Banning Wells
Proposed Potable Wells
Existing WWTP
Proposed Cabazon WWTP
Proposed Recharge Sites
Five Bridges
North Banning
Banning WWTP
Cabazon
Morongo WWTP
Morongo + Cabazon
Proposed Recycled Water Pipes
Five Bridges
North Banning
Banning WWTP
Cabazon WWTP
Morongo WWTP
Morongo + Cabazon
Proposed Sewer
Proposed Cabazon Sewer Gravity Main
Proposed Cabazon Sewer Force Main
Proposed Morongo + Cabazon Sewer Force Main
MBMI Proposed Gravity Sewer
Groundwater Storage Units
Banning
Banning Bench
Banning Canyon
Beaumont
Cabazon
Imported Water Extension
Major Rivers
IRWM Boundary
MBMI
0 0.25 0.5 1
Miles
WOODARD & CURRAN

Figure 5-2

5.1 City of Banning

Currently Banning's treated wastewater is percolated into the groundwater basin but is not extracted by Banning - the percolated water flows to other water agencies located downgradient. Recycled water projects could reclaim some of the water that would otherwise percolate into the groundwater and keep it within Banning. Recycled water projects would also produce recycled water at a higher quality than is currently produced at the Banning WWTP and could be used for non-potable irrigation and/or GWR for potable reuse.

Recycled water projects for irrigation-only projects require Tertiary Disinfected Recycled Water. Tertiary Disinfected Recycled Water quality may be permissible for GWR project options, but further study would have to be conducted to determine if sufficient underground retention time and diluent water sources are adequate. Each potential recharge site would have to be evaluated individually to determine specific wastewater treatment requirements and locations of downstream extraction wells.

Option 1: Non-Potable Recycled Water – Irrigation South of I-10

Banning Option 1 would upgrade the Banning WWTP to produce Tertiary Disinfected Recycled Water to all of the existing and planned irrigation customers south of I-10, which would otherwise be supplied by potable or non-potable groundwater. This project is depicted by the red line on **Figure 5-1**.

Banning WWTP upgrades would include adding 3.6 mgd of tertiary filtration and chlorine disinfection processes to the existing plant. To provide a balance in the timing between supply production (constant) and nighttime irrigation demands, recycled water would be stored in a new 1 million-gallon (mg) tank and then distributed through an 18-inch diameter recycled water pipeline.

The pipeline would span a 4.5-mile alignment from the Banning WWTP, located in east Banning, to the potential non-potable recycled water demands/customers located in west Banning. Two pump stations are required to limit potential high operating pressures within the pipeline. Smaller laterals from the 18-inch pipeline would service these customers identified in **Table 5-5.** Option 1 is projected to generate up to 1,666 AFY of recycled water by 2040.

Table 5-5: Banning Option 1 – Recycled Water Demands

Recycled Water Customer	Annual Demand (AFY)	Average Day Demand (mgd)	Peak Hour Demand (gpm)
Sun Lakes Development	850	0.76	1,106
Five Bridges Development	223	0.20	290
Neighborhood Park	35	0.03	137
Dysart Park	87	0.08	340
Rancho San Gorgonio	217	0.19	282
Banning High School	175	0.16	683
Lions Park	79	0.07	308
Total Irrigation Demand	**1,666**	**1.49**	**3,146**

Option 2: Non-Potable Recycled Water for Irrigation – Butterfield Satellite Plant

Banning Option 2 would construct a 0.7 mgd satellite plant, as identified in the Butterfield Specific Plan, to produce Tertiary Disinfected Recycled Water for irrigation demands at the planned Butterfield development. This project option is depicted by the yellow facilities on **Figure 5-1**. Butterfield irrigation demands are summarized in **Table 5-6**.

Table 5-6: Banning Option 2 – Recycled Water Demands

Recycled Water Customer	Annual Demand (AFY)	Average Day Demand (mgd)	Peak Hour Demand (gpm)
Butterfield Development	864	0.77	1,124
Total Irrigation Demand	**864**	**0.77**	**1,124**

A satellite treatment option is being considered because Butterfield is located on the west side of Banning, but the source of recycled water is on the east side of Banning at the WWTP. Satellite plants provide recycled water by diverting wastewater flow from a downstream WWTP and treating it closer to the customer demand. Satellite plants do not have sludge handling or effluent disposal facilities and can be constructed on relatively small footprints. The proposed satellite plant would be located at the southeast portion of the development, near the intersection of Wilson Street and Highland Home Road.

Upon assessment of this option, it was determined that the supply of wastewater (0.77 mgd) would be insufficient to meet peak irrigation demand (1.6 mgd) within the Butterfield development. Since the development would require significant supplemental water during the high irrigation months, the option was considered infeasible by the Workgroup.

Option 3: Regional Groundwater Recharge – Banning WWTP

Banning Option 3 would upgrade the Banning WWTP to produce recycled water for GWR at the existing percolation basins at the Banning WWTP. Option 3 is depicted by the yellow line on **Figure 5-2**. This option is recharge-only and does not include irrigation.

There are active wells located downgradient of the proposed recharge basin owned by MBMI and CWD. Since recycled water quality for GWR would be required to meet underground retention time requirements and diluent water requirements, the recharged recycled water, combined with diluent water sources (i.e. groundwater) could be extracted and used as potable water supply for the MBMI's and CWD's potable water systems.

WWTP upgrades would include increasing the WWTP capacity to 4.3 mgd and adding tertiary filtration, UV and chlorine disinfection processes. Since existing plant capacity is only 3.6 mgd, additional recycled water pipelines have been assumed to pump the higher flow to the existing basins. A new 18-inch diameter recycled water pipeline and pump station have been added to supply 4.3 mgd to the basins. Future engineering studies would need to be conducted to evaluate if existing pipelines are sufficient for the increased flow.

The existing 39.5 acres of percolation basins at the Banning WWTP are sufficient to recharge this level of additional production with full operational redundancy. Option 3 is projected to recharge up to 4,787 AFY into the basin by 2040.

Option 3A: Groundwater Recharge – Banning WWTP

Banning Option 3A would upgrade the Banning WWTP to produce recycled water for GWR at the existing percolation basins at the Banning WWTP. Option 3A is depicted by the yellow line on **Figure 5-2**. This option is recharge-only and does not include irrigation.

Since recycled water quality for GWR would be required to meet underground retention time requirements and diluent water requirements, the recharged recycled water, combined with diluent water sources (i.e. groundwater) could be extracted and used as potable water supply for Banning's potable water system.

Two new potable wells would be located downgradient of the existing recharge basins to capture the water that has been recharged; however, evaluation of travel time could reveal that two existing monitoring wells, R-1 and MP-1, could be converted to potable wells if diluent water and underground retention times are met.

WWTP upgrades would include increasing the WWTP capacity to 4.3 mgd and adding tertiary filtration, UV and chlorine disinfection processes. Since existing plant capacity is only 3.6 mgd, additional recycled water pipelines have been assumed to pump the higher flow to the existing basins. A new 18-inch diameter recycled water pipeline and pump station have been adding to supply 4.3 mgd to the basins. Future engineering studies would need to be conducted to evaluate if existing pipelines are sufficient for the increased flow.

The existing 39.5 acres of percolation basins at the Banning WWTP are sufficient to recharge this level of additional production with full operational redundancy. Option 3A is projected to recharge up to 4,787 AFY into the basin by 2040.

Option 3B: Groundwater Recharge – North Banning Recharge Site

Banning Option 3B would upgrade the Banning WWTP to produce recycled water for GWR at new recharge basins located at the North Banning recharge site. Option 3B is depicted by the green line on **Figure 5-2**. This option is recharge-only and does not include irrigation.

Like the other GWR options, the recycled water, combined with diluent water sources (i.e. groundwater), would be extracted and used as potable water source after underground retention time requirements and diluent water requirements are met. This project option would supply two new potable wells located downstream of the recharge site to supplement Banning's potable water system.

WWTP upgrades include increasing the WWTP capacity to 4.3 mgd and adding tertiary filtration, UV and chlorine disinfection processes.

Recycled water would be supplied through a 3-mile pipeline alignment from the Banning WWTP to the North Banning recharge site, which would include a crossing below I-10. The proposed alignment is 18-inches in diameter and includes two pump stations to limit high operating pressures within the pipeline.

The existing 14.9 acres available at the North Banning Recharge site are sufficient for the assumed 4.3 mgd recharge volume but do not allow for full operational redundancy. Option 3B is projected to recharge up to 4,787 AFY into the basin by 2040.

Option 3C: Groundwater Recharge – Five Bridges Recharge Site

Banning Option 3C would upgrade the Banning WWTP to produce recycled water for GWR at new recharge basins located at the planned Five Bridges development. Option 3C is depicted by the red line on **Figure 5-2**. This option is recharge-only and does not include irrigation.

This project option assumes that existing potable wells, M-11 and C-5, located downgradient of the recharge site, would extract the recycled water that has been recharged. Further study would be required to determine if adequate diluent water and underground retention time exist between the proposed recharge site and the existing potable wells.

WWTP upgrades include increasing the WWTP capacity to 4.3 mgd and adding tertiary filtration, UV and chlorine disinfection processes. Recycled water would be supplied through an 18-inch diameter recycled water pipeline and two pump stations. Two recycled water pump stations are required to limit high operating pressures within the 4.5-mile pipeline alignment between the Banning WWTP and the new recharge site.

The proposed 22.5 acres for the Five Bridges site are sufficient for the assumed 4.3 mgd recharge volume but do not allow for full operational redundancy. Option 3C is projected to recharge up to 4,787 AFY into the basin by 2040.

Option 4A: Irrigation and Groundwater Recharge - Banning WWTP Recharge Site

Banning Option 4A is a combination of Irrigation Option 1 (Irrigation-only) and Option 3A (GWR), and is depicted by the red and yellow lines on **Figure 5-1** and **Figure 5-2.** This option would supply irrigation customers south of I-10 (**Table 5-5**) with GWR-quality recycled water and recharge any excess to existing basins at Banning WWTP. Option 4A is projected to generate up to 4,787 AFY of recycled water supply by 2040.

Option 4B: Irrigation and Groundwater Recharge – North Banning Recharge Site

Banning Option 4B is Option 3B (GWR-only) with added irrigation customers and is depicted by the green lines on **Figure 5-1** and **Figure 5-2.** The option would supply recycled water, at GWR quality, to two potential customers north of I-10; recycled water not used for irrigation would be recharged. The customers, identified in **Table 5-7,** are located along the pipeline alignment to the recharge site and would not require significant lengths of additional piping to provide recycled water service. Option 4B is projected to generate up to 4,787 AFY of recycled water supply by 2040.

Table 5-7: Banning Option 4B Potential Recycled Water Demands

Potential Recycled Water Customer	Annual Demand (AFY)	Average Day Demand (mgd)	Peak Hour Demand (gpm)
Roosevelt Williams Park	60	0.05	234
Hoffer Elementary School	45	0.04	176
Total Irrigation Demand	**105**	**0.09**	**410**

Option 4C: Irrigation and Groundwater Recharge – Five Bridges Recharge Site

Banning Option 4C is a combination of Option 1 (Irrigation-only) and Option 3C (GWR) and is depicted by the red lines on **Figure 5-1** and **Figure 5-2.** This option would supply irrigation customers south of I-10 (**Table 5-5**) with GWR-quality recycled water and recharge any excess to new recharge basins located at the Five Bridges development. Option 4C is projected to generate up to 4,787 AFY of recycled water supply by 2040.

Option 5: Joint Water Supply Option - Imported Water Recharge and Recycled Water for Irrigation and GWR at North Banning Recharge Site

Option 5 is a modified version of Option 4B (Irrigation + GWR) with additional recharge of 2,700 AFY of imported water at the North Banning Recharge site. An imported water source benefits the GWR project by providing another source of diluent water in addition to underflow from groundwater and natural recharge. The imported amount of water would be used in calculating the recycled water contribution (RWC) percentage and could streamline approval of the GWR project.

The imported water pipeline would be extended from the existing Beaumont-Cherry Valley pump station, through the City of Banning, to the North Banning Recharge site, as depicted by the green and solid blue lines on **Figure 5-2.** 2,700 AFY of imported water would be delivered through a 12-inch diameter pipeline that spans an 11-mile alignment.

The Joint Option is projected to produce up to 4,787 AFY of recycled water supply. Of that 4,787 AFY recycled water supply, 105 AFY would be used for irrigation and 4,682 AFY would be recharged. Combined with the 2,700 AFY of imported water, up to 7,392 AFY is projected to be recharged into the basin by 2040.

The existing 14.9 acres available at the North Banning Recharge site are sufficient for the recharge volume but do not allow for full operational redundancy.

5.2 Cabazon Area

Currently, treated wastewater in the Cabazon area is percolated into the groundwater basin and is not extracted by CWD. Instead, the percolated water flows to other water agencies located downgradient. Recycled water projects could reclaim some of the water that would otherwise percolate into the groundwater and keep it as a CWD water supply.

CWD does not currently have any centralized wastewater treatment infrastructure. To implement a recycled water project within CWD, a new municipal sewer system and a new water recycling facility would need to be constructed. Existing OWTS would need to be converted to consolidate flows for treatment at the new water recycling facility. OWTS conversions would not only supply the source for recycled water production, they would also decrease the impacts on groundwater quality by reducing nitrogen loading to the groundwater supply from leach fields.

There are two options for using recycled water in the Cabazon area: irrigation and GWR. Due to its rural setting, CWD has few municipal irrigation customer opportunities, and there are no Specific Plans for future development, so irrigation demand is limited. In addition to improving groundwater quality, a municipal wastewater treatment system could potentially help spur development in the Cabazon area.

Recycled water project options in the Cabazon area include non-potable irrigation and/or GWR for potable reuse. Recycled water projects for irrigation-only projects require Tertiary Disinfected Recycled Water. Tertiary Disinfected Recycled Water quality may be permissible for GWR project options, but further studies would be required to determine if sufficient underground retention time and diluent water sources are adequate at the recharge site, to determine specific wastewater treatment requirements, and determine locations for downstream extraction wells.

Option 1: Non-Potable Recycled Water for Irrigation and Industrial Use

Cabazon Option 1, depicted by the pink line on **Figure 5-1**, would build a municipal wastewater recycling facility to produce Tertiary Disinfected Recycled Water for irrigation of the community center and industrial use at the Arrowhead bottling facility. As discussed in **Chapter 3**, the Arrowhead demand for water has been assumed to be limited to industrial and/or irrigation, not for bottling.

The project would require construction of 9.5 miles of new gravity and force mains, shown as the orange lines in **Figure 5-1** and **Figure 5-2**, and a new 1.0 mgd water recycling facility to produce Tertiary Disinfected Recycled Water. Recycled water not used for irrigation would be discharged to new percolation basins at a 10-acre parcel owned by CWD located east of the proposed water recycling facility. The site is large enough to allow full operational redundancy of the basins. Recycled water pipelines span 2.4-miles from the new water recycling facility to the recycled water customers identified in **Table 5-8.** Option 1 is projected to generate up to 109 AFY of recycled water by 2040.

Table 5-8: Cabazon Potential Recycled Water Demands

Potential Recycled Water Customer	Annual Demand (AFY)	Average Day Demand (mgd)	Peak Hour Demand (gpm)
Cabazon School/Comm Ctr/Park	9	0.01	36
Arrowhead Bottling Facility	100	0.09	260
Total Irrigation Demand	**109**	**0.10**	**296**

Option 2: Recycled Water for Irrigation, Industrial, and Groundwater Recharge

Cabazon Option 2, depicted by the solid pink lines on **Figure 5-1** and dashed pink lines on **Figure 5-2,** modifies Option 1 by adding GWR. Since Cabazon has low irrigation customer demand, this option increases the amount of recycled water captured by Cabazon. Recharge from the water recycling facility would occur at a 10-acre parcel owned by CWD located east of the proposed water recycling facility.

One potable well is proposed downstream of the recharge basin to extract recharged recycled water. Further studies would be required to determine underground retention time, diluent water sources available, and to locate the downstream extraction well. There are two existing wells located downgradient of the proposed recharge basin: one production well owned by MBMI and one monitoring well owned by CWD. Further study would be required to determine the travel time between the proposed recharge site and the existing wells or to determine if the existing CWD monitoring could be converted to a potable well. Cabazon Option 2 is projected to generate up to 1,127 AFY of recycled water by 2040 based on the projected wastewater supply discussed in **Chapter 3**.

5.3 Morongo Band of Mission Indians

Currently, treated wastewater in the Morongo area is percolated into the groundwater basin and is not extracted by MBMI - the percolated water flows to other water agencies located downgradient. Recycled water projects could reclaim some of the water that would otherwise percolate into the groundwater and keep it within the Morongo area.

MBMI currently has centralized wastewater treatment infrastructure. Some project options involve extending the existing sewer and OWTS conversions to increase wastewater flows to the Morongo WWTP. Due to existing available capacity in the Morongo WWTP, capacity expansions were not assumed.

Recycled water project options in the Morongo area include non-potable irrigation and/or groundwater recharge (GWR) for potable reuse. Recycled water projects for irrigation-only projects require Tertiary Disinfected Recycled Water. To implement a recycled water project, the existing Morongo WWTP treatment process would have to be upgraded.

Tertiary Disinfected Recycled Water quality may be permissible for GWR project options, but further studies would have to be conducted to determine if sufficient underground retention time and diluent water sources are adequate at the recharge site, to determine specific wastewater treatment requirements, and locate downstream extraction wells.

Option 1: Recycled Water for Irrigation and Septic Conversions via Sewer Extension

Morongo Option 1, depicted by the light blue line on **Figure 5-1**, would upgrade the Morongo WWTP to produce Tertiary Disinfected Recycled Water to serve irrigation to customers west of the WWTP up to the Cabazon Outlets. WWTP upgrades include adding tertiary filtration and chlorine disinfection capacity to the existing WWTP.

Recycled water would be supplied through an 8-inch diameter recycled water pipeline from a 250,000-gallon storage tank. The pipeline spans a 3-mile alignment from the Morongo WWTP to the customers identified in **Table 5-9.** Two recycled water pump stations are required to limit high operating pressures within the 3-mile long pipeline. Option 1 is projected to create up to 58 AFY of recycled water by 2040.

Table 5-9: Morongo Potential Recycled Water Demands

Potential Recycled Water Customer	Annual Demand (AFY)	Peak Hour Demand (gpm)
RV Park	10	39
Morongo Casino Resort and Spa	45	176
Cabazon Outlets	3	10
Total Irrigation Demand	**58**	**225**

Option 2: Recycled Water for Irrigation and Groundwater Recharge

Morongo Option 2 modifies Option 1 by adding GWR, and is depicted by the light blue solid line on **Figure 5-1** and dashed orange line on **Figure 5-2**. Since Morongo has a low irrigation customer demand, this option increases the amount of recycled water captured by MBMI. WWTP upgrades include adding 0.55 mgd of tertiary filtration, chlorine and UV disinfection processes to the existing plant.

GWR would occur at existing percolation basins located east of the Morongo WWTP. One potable well is proposed downstream of the recharge basin to extract recharged recycled water. Further study would be required to determine underground retention time, diluent water sources available, and to locate the downstream extraction well. Morongo Option 2 is projected to create up to 618 AFY of recycled water by 2040 based on the projected wastewater supply discussed in **Chapter 3**.

5.4 MBMI and Cabazon Area Combined Option

Cabazon and Morongo Combined Option: Groundwater Recharge via Septic Conversion and Sewer Extension

The Combined Option was developed to create a project option with regional benefit for both the Cabazon and Morongo areas. This option would utilize existing capacity in the Morongo WWTP to treat additional wastewater from Morongo and Cabazon septic conversions. The recycled water would be recharged at a site located upgradient of both Cabazon and Morongo, north of I-10, located west of the Desert Hills Outlets in Cabazon as depicted by the dashed blue line on **Figure 5-2**.

In Cabazon, the option would construct 7.5 miles of new gravity sewers and force mains, and pump 500,000 gpd of wastewater from Cabazon to the Morongo WWTP. The new sewer force main would utilize an existing sleeve under I-10 to connect to the Morongo WWTP.

This option would upgrade the existing Morongo WWTP to produce 0.75 mgd recycled water for groundwater recharge. WWTP upgrades include adding tertiary filtration, chlorine and UV disinfection processes.

Recycled water would be supplied through a 10-inch recycled water pipeline. The pipeline alignment is 4.7 miles from the Morongo WWTP to the new percolation basins. Two recycled water pump stations are required to limit high operating pressures within the pipeline.

The project is projected to recharge up to 785 AFY into the groundwater basin by 2040. The proposed 6-acres of percolation basins are sufficient for the estimated 0.75 mgd recharge volume and allows for full operational redundancy at the basin.

Potable wells downstream of the recharge site would be required to recapture the water that has been recharged. The extracted water could be used to supplement the potable water supply for both Morongo and Cabazon. Further studies would be required to determine if there is sufficient travel time from the proposed recharge site to the nearest existing potable wells.

Chapter 6 Project Costs

Costs for project options were developed using planning level unit costs presented in the following tables. These unit costs were developed based on recent similar projects constructed, databases on treatment costs for water reuse, and input from stakeholders during Workgroup meetings.

6.1 Unit Cost Criteria

Planning level construction costs for infrastructure elements, such as pipeline, pump stations, wells, and WWTP treatment upgrades, were based on the cost criteria summarized in **Table 6-1.** Special crossings include pipeline crossings beneath I-10. The estimated cost for customer retrofits for new recycled water service include valves, backflow devices, meters, piping connections, and initial backflow testing.

Table 6-1: Construction Costs

Construction costs	Cost	Unit
Pipeline	$25	per in-diam/LF
Special Crossings	$500,000	per crossing
Pump Station	$6,500	per HP
Land Acquisition- Cabazon	$108,900	per acre
Land Acquisition- Banning	$164,000	per acre
Recharge Basin	$96,000	per acre
Monitoring Well	$200,000	per well
Title 22 (Tertiary and Disinfection) WWTP	$13	per gallon
Conventional Filtration	$2,002,000	per mgd
Chlorine Contact Chamber	$1.50	per gallon
Chlorine Feed Equipment	$1,409,000	per mgd
UV Disinfection	$488,000	per mgd
Storage Tank	$1.25	per gallon
Customer Retrofits	$100,000	per site
New Potable Well	$2,348,000	per well

Planning level annual operations and maintenance (O&M) costs were based on the cost criteria summarized in **Table 6-2.** O&M costs are estimated based on the percentage of construction costs. Pump station costs also include an additional cost for electrical power.

Table 6-2: Annual Operation and Maintenance Costs

Annual Operation & Maintenance Costs		
Pipelines	1%	of Construction cost
Storage	1%	of Construction cost
Pump Station	3%	of Construction Cost
Electrical Power	$0.18	kWh

Implementation costs are for the studies, design, and environmental approvals required to construct a project, as summarized in **Table 6-3**. The costs to implement non-potable recycled water projects will be lower than GWR projects that increase the supply of potable water. The increase in implementation costs for GWR projects is related to the requirements for groundwater studies and wastewater treatment process planning and design. An additional 2% is added to the implementation cost for GWR project options.

Table 6-3: Implementation Costs

Non-Potable Irrigation Project Options	25% of Construction Cost
Legal/Admin/Environmental	*5%*
Design	*8%*
Construction Management	*8%*
Services during Construction	*4%*
Groundwater Recharge Project Options	**27% of Construction Cost**
Legal/Admin/Environmental	*5%*
Design	*8%*
Construction Management	*8%*
Services during Construction	*4%*
Groundwater Recharge Planning Process	*2%*

The interest rate and financing period used are summarized in **Table 6-4**.

Table 6-4: Financing

Financing	
Interest Rate	4.0%
Period	30 years

6.2 Estimated Project Option Costs

Using the unit costs developed for the Study, estimated capital and annualized costs were developed for each of the project options and are summarized in **Table 6-5**. Detailed unit costs are presented in the following Appendices, separated by area:

- Appendix B – Banning Project Options
- Appendix C – Cabazon Area Project Options
- Appendix D – Morongo Area Project Options
- Appendix E – Combined Cabazon and Morongo Area Project Option

Of the 15 options considered, three are not considered feasible: Banning Option 2 is not feasible due to limited wastewater supply; Cabazon Option 1 and Morongo Option 1 are infeasible due to high unit costs. The two irrigation-only project options in Cabazon and Morongo do not have sufficient customer demand to make the projects economical. GWR projects are more cost-effective in the Morongo and Cabazon areas because of the increase in the amount of recycled water. From a unit cost perspective, eight projects in the Banning area have unit costs lower than the estimated cost of imported water at $2,000 per acre-foot.

Table 6-5: Capital Cost Summary for Recycled Water Options

Regional Recycled Water Options	Capital Cost	Annualized Cost[1]	Recycled Water Supply	Unit Cost
Banning Options		Total Annual	AFY	**$/AF**
Banning Option 1	$ 46,100,000	$ 3,100,000	1,666	$ 1,900
Banning Option 2 (2)	N/A	N/A	N/A	N/A
Banning Option 3	$ 39,700,000	$ 2,300,000	4,787	$ 600
Banning Option 3A	$ 45,900,000	$ 2,700,000	4,787	$ 600
Banning Option 3B	$ 64,300,000	$ 4,700,000	4,787	$ 1,000
Banning Option 3C	$ 65,000,000	$ 4,900,000	4,787	$ 1,000
Banning Option 4A	$ 60,800,000	$ 4,300,000	4,787	$ 900
Banning Option 4B	$ 68,100,000	$ 4,900,000	4,787	$ 1,000
Banning Option 4C	$ 69,700,000	$ 5,200,000	4,787	$ 1,100
Imported + Recycled Water Recharge Option (3)	$ 99,800,000	$ 7,000,000	4,787 (3)	$ 1,500
Cabazon Options		Total Annual	AFY	**$/AF**
Cabazon Option 1	$ 50,100,000	$ 3,500,000	109	$ 31,800
Cabazon Option 2	$ 57,400,000	$ 3,700,000	1,127	$ 3,300
Morongo Options		Total Annual	AFY	**$/AF**
Morongo Option 1	$ 16,900,000	$ 1,100,000	58	$ 19,100
Morongo Option 2	$ 22,500,000	$ 1,470,000	618	$ 2,400
Morongo and Cabazon Combined Options		Total Annual	AFY	**$/AF**
Combined Option 1	$ 49,500,000	$ 3,660,000	840	$ 4,400

(1) Annualized cost based on 4% interest rate over 30-year period
(2) Due to insufficient wastewater supply, Banning Option 2 was determined to not be feasible.
(3) Also provides an additional 2,700 AFY of imported water recharge

Chapter 7 Findings and Next Steps

There is ample opportunity to produce recycled water in the San Gorgonio Region. About 2,700 AFY of wastewater generated in the San Gorgonio Region is treated in regional wastewater treatment facilities and is readily available to be recycled. By the year 2040, the volume of municipally-treated wastewater is projected to grow to approximately 6,500 AFY (**Table 3-4**) based on planning assumptions that planned communities develop and existing septic systems convert to municipal sewer.

There are generally two end uses for recycled water in the San Gorgonio Region: irrigation and groundwater recharge. This Study identifies over 20 potential irrigation sites with a total demand of over 3,000 AFY and identifies six potential groundwater recharge sites. Based on preliminary information, the generally porous soils in the Region do not appear to be a limiting factor to the amount of recycled water that can be recharged.

Of the 14 project options evaluated, 11 are considered feasible. Of the feasible projects, recycled water production ranges from 618 to 4,787 AFY, and unit costs range from $700 to $4,400 per AF. Eight project options located in Banning have unit costs lower than the estimated cost of imported water at $2,000 per acre-foot.

7.1 Findings and Implementation Considerations

Project options involving GWR are generally more cost-effective than irrigation-only options. Irrigation-only options use less recycled water than recharge options because demand is limited by seasonal customer demand, whereas recharge options can generally operate year-round. GWR options use the groundwater basin for storage, whereas irrigation options rely on constructed above-ground storage. Since utilization of infrastructure is higher and storage requirements are lower, GWR infrastructure is generally more streamlined than irrigation infrastructure.

The regulatory requirements, however, are more straightforward for irrigation project options, and would likely be able to be implemented more quickly than GWR project options. GWR would require more studies to ensure regulatory requirements are met, and therefore take longer to implement. Implementation of either type of recycled water options, irrigation or groundwater recharge, would require preparation of a SNMP for the affected groundwater basins.

Implementation of a recycled water project is not without its drawbacks. Beyond the cost of implementation, a recycled water project requires a lifetime of maintenance, monitoring, and regulatory compliance reporting. The benefits, however, include implementing regional management of water supplies and groundwater quality. Water recycling provides additional benefit to convert existing OWTS to municipal sewer because each new connection adds wastewater supply. Since OWTS and existing WWTPs do not effectively remove nitrate from wastewater, another benefit of implementing water recycling projects would be reduction of the amount of nitrate that percolates into the groundwater, which would help to alleviate the rising nitrate levels observed in some wells in the Region.

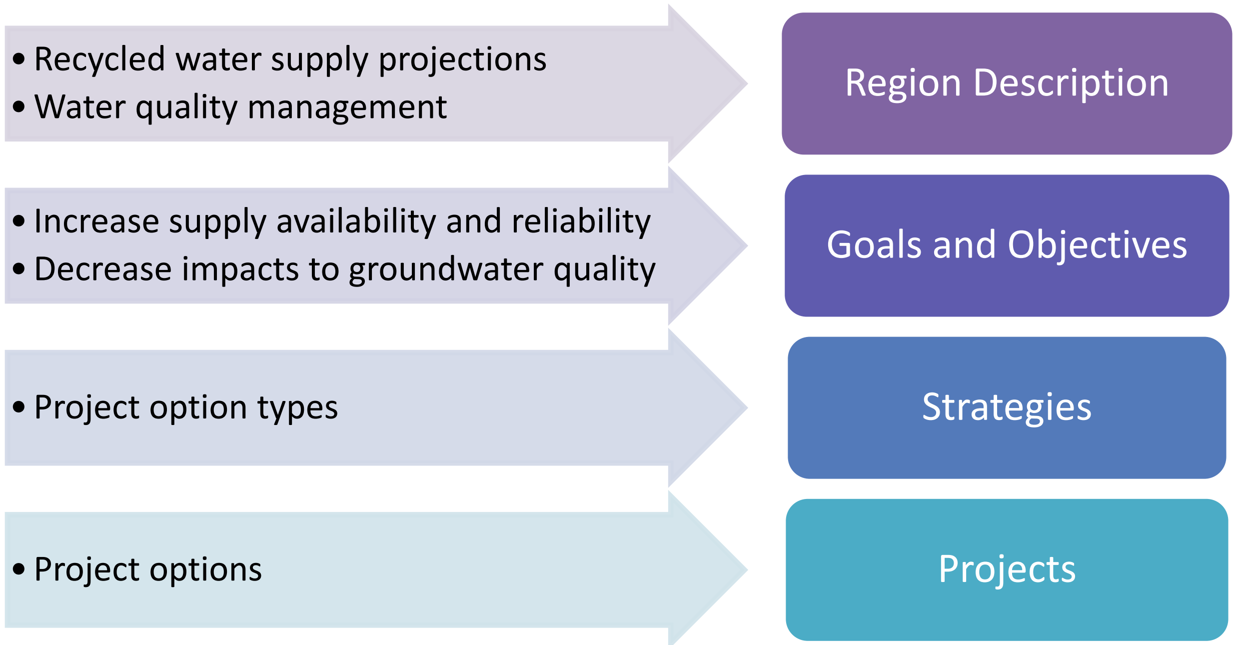
7.2 Next Steps

This Study has provided a comprehensive look at the potential for existing and future recycled water use in the San Gorgonio Region. Recycled water project options presented in this report address two specific goals of the IRWM:

- Increase regional supply availability and reliability
- Decrease impacts to groundwater quality.

As an initial step, this Study has been incorporated into relevant sections of the San Gorgonio IRWM Plan as shown in **Figure 7-1.**

Figure 7-1: Incorporation of Study into IRWM Plan



This Study does not provide recommendations for which projects should be implemented. Instead it allows stakeholders and agencies in the Region to continue the discussion on what concepts have the potential to provide the most benefits to the most entities and which options should be investigated further collectively or individually.

As this Study does not provide project implementation recommendations, the Workgroup will need to determine which, if any, of these project concepts should be implemented. The project options identified in this Study are currently in either the planning stage or conceptual stage. Each option requires specific facilities planning, design and environmental assessments to further assess the benefits, costs and regulatory coordination prior to construction/implementation.

It is important to note that implementation of any recycled water project in the Region will require a Salt and Nutrient Management Plan, which will set regional water quality objectives for the groundwater basin. Beyond this, the next steps depend on the type of projects that are chosen for implementation. Preliminary discussions with the Workgroup favor projects with regional groundwater quality benefits, including groundwater recharge at locations further up in the groundwater basin, such as the North Banning Recharge Site and the combined Cabazon and Morongo Recharge site.

Banning is currently planning groundwater quality improvement projects and recycled water projects as part of the update to the Banning Water Master Plan. To improve groundwater quality, Banning has a policy to encourage property owners with existing OWTS to convert to municipal sewer. To reduce the nitrogen percolating into the groundwater from municipally-treated wastewater, plans to add NDN improvements to the Banning WWTP are underway. Future recycled water plans to serve irrigation customers will be described in the Banning Water Master Plan update.

Recycled water project options that just involve irrigation using non-potable water are relatively straightforward from a regulatory perspective. In the Banning and Morongo areas, the next step in developing a recycled water irrigation project is to begin the preliminary design process to identify customers and plan the recycled water system, including upgrades to existing WWTPs. Implementing recycled water in the Cabazon area would require the additional step of planning a sewer collections system and new WWTP.

GWR projects will involve significant further study to determine the amount of diluent water available, travel time in the groundwater aquifer, and treatment processes needed to meet regulatory requirements for underground retention time and pathogen removal. Groundwater modeling studies would also have to be conducted to site the potable wells downstream of the recharge sites. Additional studies may be required to estimate the level of SAT at each of the proposed recharge sites.

Chapter 8 References

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Appendix A - State and Federal Recycled Water Regulations

Key California Statutes for Protection of Water Quality and Public Health

Code	Purpose
Water Rights	
CWC §1210-1212	Requires that prior to making any change in the point of discharge, place of use, or purpose of treated wastewater, approval must be obtained from the SWRCB. New SWRCB guidance has clarified that a wastewater petition for change only needs to be filed with the SWRCB Division of Water Rights if the owner of the wastewater treatment plant decreases the amount of water in a stream or other waterway.
Recycled Water Definitions	
CWC §13050, 13512, 13576, 13577, 13350, and 13552-13554	Recycled water is defined in the CWC as water, which as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and therefore considered a valuable resource.
CWC §13561	Defines direct potable reuse and indirect potable reuse for groundwater replenishment (GWR).
Water Quality	
CWC §13170	Authorizes the SWRCB to adopt State policies for water quality control.
CWC §13240-42	Authorizes RWQCB to adopt Water Quality Control Plans (Basin Plans) that assign beneficial uses for surface waters and groundwaters, and contain numeric and narrative water quality objectives that must provide reasonable protection of the beneficial uses of the groundwater. One of the factors that must be considered when establishing water quality objectives is the need to develop and use recycled water. Basin Plans must include a program of implementation for achieving the water quality objectives.
H&SC §116270 et seq.	This is the California Safe Drinking Water Act that authorizes primary and secondary maximum contaminant levels (MCLs) as included in the California Code of Regulations, Title 17 – Public Health, Chapter 5, Subchapter 1, Group 4 – Drinking Water Supplies, sections 7583 through 7630.
H&SC §116455	Requires public water systems to take certain actions if drinking water exceeds Notification Levels (NLs). NLs are health-based advisory levels established by the DDW for chemicals in drinking water that lack MCLs. When chemicals are found at concentrations greater than their NLs, certain requirements and recommendations apply.
Recycled Water Permits	
CWC §13260, 13263, 13269, 13523.1	Dischargers proposing to discharge waste that could affect the quality of waters of the state must file a report of waste discharge (ROWD) to the RWQCB. After receiving this report, the RWQCB can issue specific or general Waste Discharge Requirements (WDRs) and/or Water Recycling Requirements (WRRs) that reasonably protect all beneficial uses and that implement any relevant water quality control plans and policies. The RWQCB can also issue a Master Reclamation Permit, which is a WDR that covers multiple non-potable reuse applications and requires periodic site inspections and adoption of rules and regulations for recycled water use. A RWQCB may require a discharger to provide monitoring program reports or conduct studies.
CWC §13552.5	Authorizes the SWRCB to adopt General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water to streamline tertiary disinfected recycled water use. The General Permit was adopted in 2009; in 2014, the SWRCB adopted a new General Permit that supersedes the 2009 permit and covers all non-potable reuse applications.
H&SC §116271	Effective July 1, 2014 transfers the CDPH Drinking Water Program to the SWRCB, including water reclamation and direct and indirect potable reuse; creates the Deputy Director of the new SWRCB DDW.

Code	Purpose
CWC §13528.5	Effective July 1, 2014, the SWRCB may carry out the duties and authority granted to a RWQCB pursuant to Chapter 7 of the CWC (Water Reclamation sections 13500 – 13557, which include issuing potable reuse permits).
Recycled Water Regulations	
CWC §13500-13529.4; H&SC 116800 et seq.	Requires DDW to establish uniform statewide recycling criteria. DDW has developed these criteria for non-potable reuse and GWR and they are codified in Title 22 of the California Code of Regulations; regulations for cross connections are codified in Title 17.
CCR Title 17 and Title 22	DDW's regulations related to recycled water. Title 17 requires the protection of water systems using backflow preventers. Title 22 contains criteria for recycled water quality based on usage, requirements for dual plumbed recycled water systems, and requirements for Groundwater Replenishment Reuse Projects (GRRPs) that qualify as indirect potable reuse via surface and subsurface application, including Nitrogen Compounds Control, Diluent Water, Recycled Water Contribution (RWC), Total Organic Carbon (TOC) and Soil-Aquifer Treatment (SAT), and Response Retention Times (RRT), including tracer studies.
CWC §13540	Prohibits the use of any waste well that extends into a water-bearing stratum that is, or could be, used as a water supply for domestic purposes; injection wells or vadose zone wells used for recharge are part of this category (injection wells or vadose zone wells are considered waste wells under the CWC). An exception can be provided if (1) the RWQCB finds that water quality considerations do not preclude controlled recharge by direct injection, and (2) DDW finds, following a public hearing, that the proposed recharge will not degrade groundwater quality as a source of domestic water supply. This section of the CWC also allows DDW to make and enforce regulations pertaining to replenishment of recycled water using injection wells.
CWC §13522.5 and 13523	Requires any person who proposes to recycle or to use recycled water to file an Engineering Report with the RWQCB on the proposed use. After receiving the report, and consulting with and receiving recommendations from DDW, and any necessary evidentiary hearing, the RWQCB must issue a permit (WDRs and/or WRRs) for the use.
CWC §13562-13563	Requires DDW to adopt uniform water recycling criteria for GWR by June 30, 2014 as emergency regulations, and for surface water augmentation by December 31, 2016; and requires DDW to investigate the feasibility of developing criteria for direct potable reuse and to provide a final report on that investigation to the Legislature by December 31, 2016. By February 14, 2015, DDW must convene an expert panel to advise DDW on water recycling criteria for surface water augmentation and the feasibility of direct potable reuse.

Title 22 Groundwater Replenishment Regulations

	Surface Application	Subsurface Application
Source Control §60320.106, §60320.206	Must administer a comprehensive source control program to prevent undesirable chemicals from entering raw wastewater. The source control program must include: (1) an assessment of the fate of DDW and RWQCB-specified contaminants through the wastewater and recycled water treatment systems; (2) provisions for contaminant source investigations and contaminant monitoring that focus on DDW and RWQCB-specified contaminants; (3) an outreach program to industrial, commercial, and residential communities; and (4) an up-to-date inventory of contaminants. Note: If the agency that administers the source control program is different than the agency producing or distributing the recycled water, DDW will require an agreement between the agencies to ensure the source control requirements are met.	
Boundaries Restricting Construction of Drinking Water Wells §60320.100e, §60320.200e	Must establish (1) a "zone of controlled potable well construction," which represents the greatest of the horizontal and vertical distances reflecting the retention times required for pathogen control or for response retention time; and (2) a "secondary boundary" representing a zone of potential controlled potable well construction that may be beyond the zone of controlled potable well construction thereby requiring additional study. Note: Since it is not fully understood how the secondary boundary will be established, it is typically negotiated with DDW; this requirement may lead to more restrictions on well development and required studies and more impacts in areas with numerous production wells and/or the desire to develop new wells to capture recharge water.	
Emergency Response Plan §60320.100b	Must develop and be willing to implement a DDW-approved plan for an alternative source of potable water supply or treatment at a drinking water well if a GWR project causes the well to no longer be safe for drinking purposes.	
Adequate Managerial and Technical Capability §60320.100f, §60320.100f	Must demonstrate adequate managerial and technical capability to comply with the regulations. Note: DDW has indicated that project sponsors can use the drinking water Technical Managerial and Financial Assessment to demonstrate compliance with this requirement. http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/TMF.shtml	
Pathogen Control §60320.108, §60320.208	• Must meet Title 22 disinfected tertiary effluent requirements. • The treatment system must achieve a 12-log enteric virus reduction, a 10-log *Giardia* cyst reduction, and a 10-log *Cryptosporidium* oocyst reduction using at least 3 treatment barriers. • For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than 1.0-log reduction. • Retention time[1] credit for virus of 1-log/month (up to 6-logs) can be counted; the retention time must be validated by an added or intrinsic tracer approved by DDW. *Giardia/Cryptosporidium* Credit: If a project meets meet Title 22 disinfected tertiary effluent requirements <u>or</u> provides advanced treatment for the entire flow, <u>and</u> 6 months retention underground, a project will be credited with 10-log *Giardia* cyst reduction and 10-log *Cryptosporidium* oocyst reduction. Note: Meeting Title 22 450 CT disinfected tertiary requirements does not guarantee a 5-log virus reduction credit; will require project sponsors to have further discussion or demonstration with DDW.	• The treatment system must achieve a 12-log enteric virus reduction, a 10-log *Giardia* cyst reduction, and a 10-log *Cryptosporidium* oocyst reduction using at least 3 treatment barriers. • For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than 1.0-log reduction. • Retention time[1] credit for virus of 1-log/month; must be validated by an added or intrinsic tracer approved by DDW.

<table>
<tr><th></th><th>Surface Application</th><th>Subsurface Application</th></tr>
<tr><td>Nitrogen (N) Control
§60320.110, §60320.210</td><td colspan="2">Total N must be less than 10 mg/L as N in recycled water or recharge water before or after application.
Note: The nitrogen requirements will likely be more stringent based on the RWQCB Basin Plan groundwater objectives.</td></tr>
<tr><td>Regulated Chemicals Control
§60320.112, §60320.212</td><td colspan="2">Recycled Water: Must meet all primary Maximum Contaminant Levels (MCLs), with the exception of nitrogen compounds; for disinfection byproducts, for surface application projects, compliance can be determined in the recycled water or the recharge water before or after surface application and for subsurface application projects in the recycled water or recharge water; for secondary MCLs, compliance can be determined in recycled water or recharge water.
Diluent Water: Must meet primary and secondary MCLs based on upper limit if not historically used for recharge (except for secondary MCLs for color, turbidity, and odor).
Note: For surface spreading projects, compliance with other secondary MCLs for some types of diluent water could be an issue in establishing credit; it may be possible to receive approval for compliance after surface application under the Alternatives Section, which would address this issue.</td></tr>
<tr><td>Notification Level (NL)
§60320.120, §60320.220</td><td colspan="2">Recycled Water: Regulatory action to be taken if NL is exceeded in the recycled water or recharge water after application (excluding the effects of dilution), including additional monitoring.
Diluent Water: Must ensure that diluent water does not exceed NL and have a plan in place prior to the operation of a project on actions to be taken if exceeded; diluent water must meet NLs.
Note: With regard to implementation, DDW has noted that the evaluation of NLs can occur in recharge water (after SAT); and the regulatory language is purposefully flexible in determining credits as part of a monitoring plan proposed by the project sponsor. A chronic exceedance of an NL would be an issue for establishing diluent water credit, while an occasional exceedance would not be an issue.</td></tr>
<tr><td>Total Organic Carbon (TOC)
§60320.118, §60320.218</td><td>Surface application: TOC_{max} = 0.5 mg/L ÷ RWC in undiluted recycled water prior to application or within the zone of percolation, diluted percolated recycled water with the value adjusted to negate diluent water, or the undiluted recycled water prior to application amended using a SAT factor. The TOC shall not exceed 0.5 mg/L divided by the running monthly average (RMA) RWC based on the 20-week running average of all TOC results and the average of the last four TOC results.
Note: For surface application projects, treatment must consider the level of TOC to be achieved or a TOC alternative approved by DDW.</td><td>Recycled water TOC = 0.5 mg/L.
Note: All recycled water must undergo advanced treatment – see advanced treatment criteria.</td></tr>
<tr><td>Initial Recycled Municipal Wastewater Contribution (RWC)
§60320.116, §60320.216</td><td>• Up to 20% unless an alternative initial RWC is approved by DDW based on: (1) the review of the engineering report, (2) information obtained as a result of the public hearing, and (3) the project sponsor demonstrates that the treatment processes preceding SAT can reliably achieve a TOC 20-week running average no greater than 0.5 mg/L.
• The RWC averaging period is 120 months.
• TOC is sampled in undiluted recycled water after treatment or undiluted recycled water in the “zone of percolation.”
Note: A surface spreading project must start at a 20% RWC unless DDW has approved a higher RWC and advanced treatment is provided to meet a TOC concentration of 0.5 mg/L.</td><td>• To be determined by DDW (does not preclude starting at 100 percent).
• The RWC averaging period is 120 months, which starts 30 months after recycled water application.

Note: A subsurface application project has the possibility of starting at an RWC between 50 to 100 percent if approved by DDW.</td></tr>
</table>

	Surface Application	Subsurface Application
Increased Recycled Municipal Wastewater Contribution (RWC) §60320.116, §60320.216	For projects starting at lower initial RWCs, sequential incremental increases ≥ 50 percent and ≥ 75 percent are allowed if: • The TOC 20-week average for prior 52 weeks = 0.5 mg/L ÷ $RWC_{\text{proposed max}}$. • The increase is approved by DDW and authorized in the project permit.	Increases allowed if: The TOC 20-week average for prior 52 weeks = 0.5 mg/L. • The increase is approved by DDW and authorized in the project permit.
Advanced Treatment Criteria §60320.201	Reverse Osmosis: • Each membrane element must achieve a minimum sodium chloride (NaCl) rejection ≥ 99.0 percent and an average (nominal) NaCl rejection ≥ 99.2 percent using ASTM Method D4194-03 (2008), using the following substitute test conditions: (1) tests are operated at a recovery ≥ 15 percent; (2) NaCl rejection is based on 3 or more successive measurements; (3) influent pH between 6.5 and 8.0; and (4) influent NaCl concentration ≤ 2,000 mg/L. • During the 20 weeks of full-scale operation, the membrane produces a permeate having no more than 5 percent of the sample results having TOC > 0.25 mg/L based on weekly monitoring. Advanced Oxidation Process: Two options: • Option 1 - Conduct an occurrence study that identifies 9 indicators representing 9 functional groups, with 0.5-log removals for 7 of the indicators and 0.3-log removals for 2 of the indicators; establish at least one surrogate or operational parameter that reflects the removal of at least 5 of the 9 indicators (one of the surrogates must be monitored continuously); confirm the results using a study via challenge or spiking tests. • Option 2 - Conduct testing that includes challenge or spiking tests to demonstrate that the AOP process removes 0.5-log of 1,4-dioxane; establish surrogate or operational parameters that reflect whether the 0.5-log reduction of 1,4-dioxane is attained, and one of the surrogates can be monitored continuously.	
Application of Advanced Treatment	Advanced treatment is only needed for that portion of recycled water needed to meet the TOC/RWC requirements desired by the project sponsor.	Advanced treatment must be applied to the full recycled water volume.

	Surface Application	Subsurface Application
Soil Aquifer Treatment (SAT) Performance §60320.118	• Monitor recycled water or recharge water before and after recharge for 3 indicator constituents of emerging concern (CECs) with reductions < 90 percent triggering investigation. If a project sponsor demonstrates there are not 3 indicator compounds available and suitable for indicating a 90 percent reduction, a project sponsor may utilize an indicator compound that achieves a reduction less than 90 percent pending DDW approval of the compound and reduction criteria. • Project sponsors must conduct a DDW approved CEC occurrence study prior to operation and then every 5 years.	None.
Response Retention Time (RRT) §60320.124, §60320.224	• RRT is the time recycled water must be retained underground to identify treatment failure and implement actions so that inadequately treated recycled water does not enter a potable water system, including the plan to provide an alternative water supply or treatment. • The minimum RRT is 2 months, but must be justified by the project sponsor. • The RRT must be validated using an added tracer or a DDW approved intrinsic tracer prior to the end of the third month of operation.	
Project Planning	Method used to estimate the Retention Time to the nearest downgradient drinking water well	Virus Log Reduction Credit per Month
	Tracer study using added tracer[1]	1.0 log
	Tracer study utilizing an intrinsic tracer[1]	0.67 log
	Numerical modeling consisting of calibrated finite element or finite difference models using validated and verified computer codes used for simulating groundwater flow	0.50 log
	Analytical modeling using existing academically-accepted equations such as Darcy's Law to estimate groundwater flow conditions based on simplifying aquifer assumptions	0.25 log
	Method used to estimate Retention Time to the nearest downgradient drinking water well	Response Time Credit per Month
	Tracer study using added tracer[2]	1 month
	Tracer study utilizing an intrinsic tracer[2]	0.67 months
	Numerical modeling consisting of calibrated finite element or finite difference models using validated and verified computer codes used for simulating groundwater flow.	0.5 months
	Analytical modeling using existing academically-accepted equations such as Darcy's Law to estimate groundwater flow conditions based on simplifying aquifer assumptions.	0.25 months

<table>
<tr><th></th><th>Surface Application</th><th>Subsurface Application</th></tr>
<tr><td>Alternatives</td><td colspan="2">Allowed for all provisions in the regulations if:
• The project sponsor has demonstrated that the alternative provides the same level of public health protection.
• The alternative has been approved by DDW.
• If required by DDW or RWQCB, the project sponsor will conduct a public hearing.
• An expert panel must review the alternative <u>unless</u> otherwise specified by DDW.</td></tr>
<tr><td>Engineering Report</td><td colspan="2">The project sponsor must submit an Engineering Report to DDW and RWQCB that indicates how a GWR project will comply with all regulations and includes a contingency plan to ensure that no untreated or inadequately treated water will be used. The report must be approved by DDW.</td></tr>
</table>

(1) The retention time represents the difference from when the water with the tracer is applied at the GRRP to when either 2 percent of the initially introduced tracer concentration has reached the downgradient monitoring point, or 10 percent of the peak tracer unit value is observed at the downgradient monitoring point. With DDW approval, an intrinsic tracer may be used in lieu of an added tracer with no more credit provided than 0.67-log per month.

(2) The retention time shall be the time representing the difference from when the water with the tracer is applied at the GRRP to when either; two percent (2%) of the initially introduced tracer concentration has reached the downgradient monitoring point, or ten percent (10%) of the peak tracer unit value observed at the downgradient monitoring point reaches the monitoring point.

Federal Guidelines for Water Reuse

The EPA provides national guidance for recycled water systems through its *Guidelines for Water Reuse* (EPA, 2012). The guidelines serve as a national overview of reuse regulations and clarify some of the variations in the regulatory frameworks that support reuse in different states and regions of the U.S. There are no federal regulations for water recycling - standards for water recycling are the responsibility of state and local agencies. The Guidelines were first published in 1980 and updated in 1992, 2004, and 2012. In 2012, the drivers for water reuse center around these categories:

- Addressing urbanization and water supply scarcity
- Achieving efficient resource use
- Environmental protection, including reducing nutrient discharges, and
- Public health protection.

The current guidelines provide case studies to demonstrate best practices and lessons learned.

Federal Guidelines for Water Reuse
is a summary outlining the contents of each section of the EPA's *Guidelines for Water Reuse*, which can be found at https://watereuse.org/wp-content/uploads/2015/04/epa-2012-guidelines-for-water-reuse.pdf

Chapter	Contents
1 - Introduction	Provides motivation for water reuse, objectives, and terminology
2 - Planning and Management Considerations	Outlines steps for developing an integrated water resources plan and managing recycled water supplies
3 - Types of Reuse Applications	Discusses using recycled water for agricultural, industrial, environmental, recreational supplies, with an expanded discussion on potable reuse
4 - State Regulatory Programs for Water Reuse	Provides an overview of legal and institutional considerations for reuse including existing state standards and regulations and suggested minimum guidelines for water reuse
5 - Regional Variations in Water Reuse	Summarizes current water use in the U.S. and the need for national expansion of water reuse to meet demand, including regional drivers for water reuse and water reuse case studies
6 - Treatment Technologies for Protecting Public and Environmental Health	Provides an overview of treatment objectives and fundamental treatment processes, including an overview of industry standards
7 - Funding Water Reuse Systems	Discusses how to develop and operate a sustainable water system using sound financial decision-making processes that are tied to the system's strategic planning process.
8 - Public Outreach, Participation, and Consultation	Outlines strategies for informing and involving the public in water reuse, reflecting a shift in thinking toward a higher level of public engagement including social networking tools
9 - Global Experiences in Water Reuse	Describes growth of water reuse globally and principles for mitigating risks with input from the U.S. Agency for International Development and the International Water Management Institute
APPENDIX A	Federal and nonfederal agencies that fund research in water reuse
APPENDIX B	Inventory of water reuse research projects
APPENDIX C	State regulatory websites
APPENDIX D	Case studies on water reuse in the U.S.
APPENDIX E	Case studies on water reuse outside the U.S.
APPENDIX F	List of case studies that were included in the 2004 EPA Guidelines
APPENDIX G	Abbreviations for Units of Measure

Appendix B - Banning Area Project Cost Estimates

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San Gorgonio IRWM- Recycled Water Study

Total Capital and O&M Cost Summary

February 2018

Regional Recycled Water Options	Capital Cost	Annualized Cost			Water	Unit Cost
Banning Area Options		*Capital*	*O&M*	Total Annual	AFY	**$/AF**
Banning Option 1: NPR Irrigation South of I-10	$ 46,100,000	*$ 2,700,000*	*$ 500,000*	$ 3,100,000	1,666	$ 1,900
Banning Option 2: Butterfield Satellite Plant	N/A	*N/A*	*N/A*	N/A	N/A	N/A
Banning Option 3: Regional GWR at Banning WWTP	$ 39,700,000	*$ 2,300,000*	*$ 380,000*	$ 2,700,000	4,787	$ 600
Banning Option 3A: GWR at Banning WWTP	$ 45,900,000	*$ 2,700,000*	*$ 430,000*	$ 3,100,000	4,787	$ 600
Banning Option 3B: GWR at North Banning Recharge Site	$ 62,700,000	*$ 3,620,000*	*$ 940,000*	$ 4,600,000	4,787	$ 1,000
Banning Option 3C: GWR at Five Bridges	$ 63,400,000	*$ 3,700,000*	*$ 1,100,000*	$ 4,800,000	4,787	$ 1,000
Banning Option 4A: NPR Irrigation South of I-10 + GWR at Banning WWTP	$ 60,800,000	*$ 3,500,000*	*$ 800,000*	$ 4,300,000	4,787	$ 900
Banning Option 4B: NPR Irrigation North of I-10 + GWR at North Banning Recharge Site	$ 68,100,000	*$ 3,900,000*	*$ 1,000,000*	$ 4,900,000	4,787	$ 1,000
Banning Option 4C: NPR Irrigation South of I-10 + GWR at Five Bridges	$ 69,700,000	*$ 4,000,000*	*$ 1,200,000*	$ 5,200,000	4,787	$ 1,100
Imported and Recycled Water Option: NPR Irrigation North of I-10 + GWR at North Banning	$ 99,800,000	*$ 5,800,000*	*$ 1,200,000*	$ 7,000,000	7,487	$ 900

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San Gorgonio IRWM - Cost Assumptions

February 2018

Unit Costs		
Construction Cost Index	**8311.16**	
Construction Cost Index	**9308.82**	
Construction Cost Index	**9069.83**	
Construction Cost Index	**10643.54**	
Construction costs	**Unit Cost**	
Pipeline	**$25**	per in-diam/LF
Special Crossings	**$500,000**	per crossing
Pump Station	**$6,500**	per HP
Land Acquisition- Cabazon	**$108,900**	per acre
Land Acquisition- Banning	**$164,000**	per acre
Recharge Basin	**$96,000**	per acre
Monitoring Well	**$200,000**	per well
Title 22 (Tertiary and Disinfection) WWTP	**$13**	per gallon
Conventional Filtration	**$2,002,000**	per MGD
Chlorine Contact chamber	**$1.50**	per Gallon
Chlorine Feed Equipment	**$1,409,000**	per MGD
UV Disinfection	**$488,000**	per MGD
Recycled Water Storage Tank	**$1.25**	per Gallon
Potable Water Storage Tank	**$1.25**	per Gallon
Customer Retrofits	**$100,000**	per site
New Potable Well	**$2,348,000**	per well
Imported Supply Costs		
Imported Water Cost	**$2,000**	per acre foot
Non-Potable Implementation	**25%**	of Construction cost
Groundwater Recharge Implementation	**27%**	of Construction cost
Legal/Admin/Environmental	*5%*	
Design	*8%*	
Construction Management	*8%*	
Services during Construction	*4%*	
Groundwater Recharge Planning Process	*2%*	
Project Contingency	**30%**	of Capital cost
Annual Operation & Maintenance Costs		
Pipelines	**1%**	of Construction cost
Storage	**1%**	of Construction cost
Pump Station	**3%**	of Construction Cost
Electrical Power	**$0.18**	kWh
Financing		
Interest Rate	**4.0%**	
Period	**30**	years
Capital Recovery Factor	**0.05783**	

San Gorgonio IRWM - Recycled Water Study

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Banning Option 1: NPR Irrigation South of I-10

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Recycled Water Storage Tank		1,000,000	$1.25	per gallon	1,250,000
Recycled Water Main	18	17,400	$25	per in-diam/LF	7,830,000
Recycled Water Pipes	10	2,000	$25	per in-diam/LF	500,000
Recycled Water Pipes	8	4,700	$25	per in-diam/LF	940,000
Recycled Water Pump Station No. 1 @ WWTP	420	1	$6,500	per HP	2,730,000
Recycled Water Pump Station No. 2 @12th Street	160	1	$6,500	per HP	1,040,000
Customer Retrofits		5	$100,000	per site	500,000
Baseline Construction Cost					**28,360,400**
Implementation			25%		7,090,100
Capital Cost					**35,450,500**
Project Contingency			30%		10,635,150
Subtotal Project Cost					**46,085,650**
Total Project Cost					**46,085,650**
Annualized Total Project Cost			0.05783		2,665,138
Annual O&M Cost					463,204
Total Annualized Cost					**3,128,342**
				AFY	1,666
				$/AFY	1,878

Annual Operations & Maintenance Cost					**Annual O&M**
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No. 1 @ WWTP	254	1,391	440,000	$0.18	79,200
Recycled Water Pump Station No. 2 @12th Street	1,412	3,559	420,000	$0.18	75,600
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			13,570,400	1.0%	135,704
Recycled Water Storage Tank			1,250,000	1.0%	12,500
Recycled Water Main			7,830,000	1.0%	78,300
Recycled Water Pump Station No. 1 @ WWTP			2,730,000	3.0%	81,900
Recycled Water Pump Station No. 2 @12th Street			1,040,000	3.0%	31,200
Total Annual Operations & Maintenance Cost					**463,204**

San Gorgonio IRWM - Recycled Water Study

February 2018

Banning Option 3: Regional GWR at Banning WWTP

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Recycled Water Pipe to Spreading Basin	18	2,200	$25	per in-diam/LF	990,000
Recycled Water Pump Station	80	1	$6,500	per HP	520,000
Baseline Construction Cost					**24,044,826**
Implementation			27%		6,492,103
Capital Cost					**30,536,929**
Project Contingency			30%		9,161,079
Subtotal Project Cost					**39,698,008**
Total Project Cost					**39,698,008**
Annualized Total Project Cost			0.05783		2,295,740
Annual O&M Cost					378,240
Total Annualized Cost					**2,673,980**
				AFY	4,787
				$/AFY	559

Annual Operations & Maintenance Cost					Annual O&M
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station	4,787	8,758	520,000	$0.18	93,600
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recycled Water Pipe to Spreading Basin			990,000	1.0%	9,900
Recharge Basin			3,379,200	1.0%	33,792
Recycled Water Pump Station			520,000	3.0%	15,600
Total Annual Operations & Maintenance Cost					**378,240**

San Gorgonio IRWM - Recycled Water Study

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Banning Option 3A: GWR at Banning WWTP

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Recycled Water Pipe to Spreading Basin	18	2,200	$25	per in-diam/LF	990,000
Recycled Water Pump Station	80	1	$6,500	per HP	520,000
New Potable Well		2	$2,348,000	per well	4,696,000
Well Pipeline		2,000	$25	per in-diam/LF	50,000
Baseline Construction Cost					**28,790,826**
Implementation			27%		7,773,523
Capital Cost					**36,564,349**
Project Contingency			30%		10,969,305
Subtotal Project Cost					**47,533,654**
Total Project Cost					**47,533,654**
Annualized Total Project Cost			0.05783		2,748,876
Annual O&M Cost					425,700
Total Annualized Cost					**3,174,576**
				AFY	4,787
				$/AFY	663

Annual Operations & Maintenance Cost					Annual O&M
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station	4,787	8,758	520,000	$0.18	93,600
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recycled Water Pipe to Spreading Basin			990,000	1.0%	9,900
Recharge Basin			3,379,200	1.0%	33,792
Recycled Water Pump Station			520,000	3.0%	15,600
New Potable Well			4,696,000	1.0%	46,960
Well Pipe			50,000	1.0%	500
Total Annual Operations & Maintenance Cost					**425,700**

San Gorgonio IRWM - Recycled Water Study

February 2018

Banning Option 3B: GWR at North Banning Recharge Site

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Land Acquisition		13.7	$164,000	per acre	2,246,800
Recharge Basin		13.7	$96,000	per acre	1,315,200
Recycled Water Pipe to Spreading Basin	18	16,000	$25	per in-diam/LF	7,200,000
Recycled Water Pump Station No.1 at WWTP	280	1	$6,500	per HP	1,820,000
Recycled Water Pump Station No.2 at Williams St.	140	1	$6,500	per HP	910,000
Freeway Crossing		1	$500,000	per crossing	500,000
Monitoring Well		2	$200,000	per well	400,000
New Potable Well		2	$2,348,000	per well	4,696,000
Well Pipeline		4,000	$25	per in-diam/LF	100,000
Baseline Construction Cost					**41,722,826**
Implementation			27%		7,773,523
Capital Cost					**49,496,349**
Project Contingency			30%		14,848,905
Subtotal Project Cost					**64,345,254**
Total Project Cost					**64,345,254**
Annualized Total Project Cost			0.05783		3,721,092
Annual O&M Cost					937,560
Total Annualized Cost					**4,658,653**
				AFY	4,787
				$/AFY	973

Annual Operations & Maintenance Cost					**Annual O&M**
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No.1 at WWTP	4,787	8,758	1,830,000	$0.18	329,400
Recycled Water Pump Station No.2 at Williams St.	4,787	8,758	910,000	$0.18	163,800
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recharge Basin			1,315,200	1.0%	13,152
Recycled Water Pipe to Spreading Basin			7,200,000	1.0%	72,000
Recycled Water Pump Station No.1 at WWTP			1,820,000	3.0%	54,600
Recycled Water Pump Station No.2 at Williams St.			910,000	3.0%	27,300
New Potable Well			4,696,000	1.0%	46,960
Monitoring Well			400,000	1.0%	4,000
Well Pipe			100,000	1.0%	1,000
Total Annual Operations & Maintenance Cost					**937,560**

San Gorgonio IRWM - Recycled Water Study

February 2018

Banning Option 3C: GWR at Five Bridges

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Land Acquisition		17.6	$164,000	per acre	2,886,400
Recharge Basin		17.6	$96,000	per acre	1,689,600
Recycled Water Pipe to Spreading Basin	18	24,300	$25	per in-dia/LF	10,935,000
Recycled Water Pump Station No.1 at WWTP	400	1	$6,500	per HP	2,600,000
Recycled Water Pump Station No.2 at 12th St.	170	1	$6,500	per HP	1,105,000
Monitoring Well		2	$200,000.00	per well	400,000
New Potable Well		-	$2,348,000	per well	-
Well Pipeline		4,000	$25	per in-diam/LF	100,000
Baseline Construction Cost					**42,250,826**
Implementation			27%		7,773,523
Capital Cost					**50,024,349**
Project Contingency			30%		15,007,305
Subtotal Project Cost					**65,031,654**
Total Project Cost					**65,031,654**
Annualized Total Project Cost			0.05783		3,760,787
Annual O&M Cost					1,137,344
Total Annualized Cost					**4,898,131**
				AFY	4,787
				$/AFY	1,023

Annual Operations & Maintenance Cost					**Annual O&M**
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No.1 at WWTP	4,787	8,758	2,610,000	$0.18	469,800
Recycled Water Pump Station No.2 at 12th St.	4,787	8,758	1,110,000	$0.18	199,800
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recharge Basin			1,689,600	1.0%	16,896
Recycled Water Pipe to Spreading Basin			10,935,000	1.0%	109,350
Recycled Water Pump Station No.1 at WWTP			2,600,000	3.0%	78,000
Recycled Water Pump Station No.2 at 12th St.			1,105,000	3.0%	33,150
Monitoring Well			400,000	1.0%	4,000
Well Pipeline			100,000	1.0%	1,000
Total Annual Operations & Maintenance Cost					**1,137,344**

San Gorgonio IRWM - Recycled Water Study

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Banning Option 4A: NPR Irrigation South of I-10 + GWR at Banning WWTP

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Recycled Water Storage Tank		1,000,000	$1.25	per gallon	1,250,000
Recycled Water Main to Customers	18	17,400	$25	per in-diam/LF	7,830,000
Recycled Water Pipes	10	2,000	$25	per in-diam/LF	500,000
Recycled Water Pipes	8	4,700	$25	per in-diam/LF	940,000
Recycled Water Pump Station No. 1 @ WWTP	420	1	$6,500	per HP	2,730,000
Recycled Water Pump Station No. 2 @12th Street	160	1	$6,500	per HP	1,040,000
Recycled Water Pipe to Spreading Basin	18	2,200	$25	per in-diam/LF	990,000
Recycled Water Pump Station to Spreading Basin	80	1	$6,500	per HP	520,000
Customer Retrofits		5	$100,000	per site	500,000
New Potable Well		2	$2,348,000	per well	4,696,000
Well Pipeline		2,000	$25	per in-diam/LF	50,000
Baseline Construction Cost					**36,824,826**
Implementation			27%		9,942,703
Capital Cost					**46,767,529**
Project Contingency			30%		14,030,259
Subtotal Project Cost					**60,797,788**
Total Project Cost					**60,797,788**
Annualized Total Project Cost			0.05783		3,515,942
Annual O&M Cost					784,400
Total Annualized Cost					**4,300,342**
				AFY	4,787
				$/AFY	898

Annual Operations & Maintenance Cost					**Annual O&M**
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No. 1 @ WWTP	254	1,391	440,000	$0.18	79,200
Recycled Water Pump Station No. 2 @12th Street	1,412	3,559	420,000	$0.18	75,600
Recycled Water Pump to Spreading Basin	4,787	8,758	520,000	$0.18	93,600
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recycled Water Storage Tank			1,250,000	1.0%	12,500
Recharge Basin			3,379,200	1.0%	33,792
Recycled Water Main to Customers			7,830,000	1.0%	78,300
Recycled Water Pump Station No. 1 @ WWTP			2,730,000	3.0%	81,900
Recycled Water Pump Station No. 2 @12th Street			1,040,000	3.0%	31,200
Recycled Water Pump Station to Spreading Basin			520,000	3.0%	15,600
Recycled Water Pipe to Spreading Basin			990,000	1.0%	9,900
New Potable Well			4,696,000	1.0%	46,960
Well Pipeline			50,000	1.0%	500
Total Annual Operations & Maintenance Cost					**784,400**

San Gorgonio IRWM - Recycled Water Study

February 2018

Banning Option 4B: NPR Irrigation North of I-10 + GWR at North Banning Recharge Site

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Recycled Water Storage Tank		1,000,000	$1.25	per gallon	1,250,000
Land Acquisition		8.8	$164,000	per acre	1,443,200
Recharge Basin		8.8	$96,000	per acre	844,800
Recycled Water Pipe to Spreading Basin	18	16,000	$25	per in-diam/LF	7,200,000
Recycled Water Pump Station No.1 at WWTP	280	1	$6,500	per HP	1,820,000
Recycled Water Pump Station No.2 at Ramsey St.	220	1	$6,500	per HP	1,430,000
Freeway Crossing		1	$500,000	per crossing	500,000
Customer Retrofits		2	$100,000	per site	200,000
Monitoring Well		2	$200,000	per well	400,000
New Potable Well		2	$2,348,000	per well	4,696,000
Well Pipeline		4,000	$25	per in-diam/LF	100,000
Baseline Construction Cost					**42,418,826**
Implementation			27%		9,942,703
Capital Cost					**52,361,529**
Project Contingency			30%		15,708,459
Subtotal Project Cost					**68,069,988**
Total Project Cost					**68,069,988**
Annualized Total Project Cost			0.05783		3,936,494
Annual O&M Cost					1,013,456
Total Annualized Cost					**4,949,950**
				AFY	4,787
				$/AFY	1,034

Annual Operations & Maintenance Cost					Annual O&M
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No.1 at WWTP	4,787	8,758	1,830,000	$0.18	329,400
Recycled Water Pump Station No.2 at Ramsey St.	4,787	8,758	1,440,000	$0.18	259,200
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recycled Water Storage Tank			1,250,000	1.0%	12,500
Recharge Basin			844,800	1.0%	8,448
Recycled Water Pipe to Spreading Basin			7,200,000	1.0%	72,000
Recycled Water Pump Station No.1 at WWTP			1,820,000	3.0%	54,600
Monitoring Well			400,000	1.0%	4,000
New Potable Well			4,696,000	1.0%	46,960
Well Pipeline			100,000	1.0%	1,000
Total Annual Operations & Maintenance Cost					**1,013,456**

San Gorgonio IRWM - Recycled Water Study

February 2018

Banning Option 4C: NPR Irrigation South of I-10 + GWR at Five Bridges

	Size	Qty	Unit Cost	Unit	Subtotal
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Recycled Water Storage Tank		1,000,000	$1.25	per gallon	1,250,000
Land Acquisition		17.6	$164,000	per acre	2,886,400
Recharge Basin		17.6	$96,000	per acre	1,689,600
Recycled Water Pipe to Customers	18	17,400	$25	per in-dia/LF	7,830,000
Recycled Water Pipes	10	2,000	$25	per in-diam/LF	500,000
Recycled Water Pipes	8	4,700	$25	per in-diam/LF	940,000
Recycled Water Pump Station No. 1 @ WWTP	420	1	$6,500	per HP	2,730,000
Recycled Water Pump Station No. 2 @12th Street	230	1	$6,500	per HP	1,495,000
Recycled Water Pipe to Spreading Basin	18	2,000	$25	per acre	900,000
Customer Retrofits		4	$100,000	per site	400,000
Monitoring Well		2	$200,000	per well	400,000
New Potable Well			$2,348,000	per well	-
Well Pipeline		4,000	$25	per in-diam/LF	100,000
Baseline Construction Cost					**43,655,826**
Implementation			27%		9,942,703
Capital Cost					**53,598,529**
Project Contingency			30%		16,079,559
Subtotal Project Cost					**69,678,088**
Total Project Cost					**69,678,088**
Annualized Total Project Cost			0.05783		4,029,491
Annual O&M Cost					1,192,144
Total Annualized Cost					**5,221,635**
				AFY	4,787
				$/AFY	1,091

Annual Operations & Maintenance Cost					**Annual O&M**
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No. 1 @ WWTP	4,787	8,758	2,740,000	$0.18	493,200
Recycled Water Pump Station No. 2 @12th Street	4,787	8,758	1,500,000	$0.18	270,000
			Construction Cost	**Unit Cost**	
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recycled Water Storage Tank			1,250,000	1.0%	12,500
Recharge Basin			1,689,600	1.0%	16,896
Recycled Water Pipe to Customers			7,830,000	1.0%	78,300
Recycled Water Pipe to Spreading Basin			900,000	1.0%	9,000
Recycled Water Pump Station No. 1 @ WWTP			2,730,000	3.0%	81,900
Monitoring Well			400,000	1.0%	4,000
New Potable Well			-	1.0%	-
Well Pipeline			100,000	1.0%	1,000
Total Annual Operations & Maintenance Cost					**1,192,144**

San Gorgonio IRWM - Recycled Water Study

Imported and Recycled Water Option: NPR Irrigation North of I-10 + GWR at North Banning

	Size	Qty	Unit Cost	Unit	Subtotal
Imported Water Pipeline	12	56,340	$25	per in-diam/LF	16,902,000
Banning Title 22 Upgrades- 3.6 mgd Capacity					
Chlorine Contact Chamber		340,000	$1.50	per gallon	510,000
Chlorine Dosing System		3.6	$1,409,000	per MGD	5,072,400
Tertiary Filters		3.6	$2,002,000	per MGD	7,207,200
UV Disinfection- upgrade from 2 to 3.6 mgd		1.6	$488,000	per MGD	780,800
Upgrade 3.6 to 4.3 mgd Capacity T22 WWTP		700,000	$13	per gallon	8,964,426
Recycled Water Storage Tank		1,000,000	$1.25	per gallon	1,250,000
Land Acquisition		13.7	$164,000	per acre	2,246,800
Recharge Basin		13.7	$96,000	per acre	1,315,200
Recycled Water Pipe to Spreading Basin	18	15,700	$25	per in-diam/LF	7,065,000
Recycled Water Pump Station No.1 at WWTP	280	1	$6,500	per HP	1,820,000
Recycled Water Pump Station No.2 at Nicolet St.	220	1	$6,500	per HP	1,430,000
Customer Retrofits		2	$100,000	per site	200,000
Freeway Crossing		1	$500,000	per crossing	500,000
Monitoring Well		2	$200,000	per well	400,000
New Potable Well		2	$2,348,000	per well	4,696,000
Well Pipeline		4,000	$25	per in-diam/LF	100,000
Baseline Construction Cost					**60,459,826**
Implementation			27%		16,324,153
Capital Cost					**76,783,979**
Project Contingency			30%		23,035,194
Subtotal Project Cost					**99,819,173**
Total Project Cost					**99,819,173**
Annualized Total Project Cost			0.05783		5,772,553
Annual O&M Cost					1,185,830
Total Annualized Cost					**6,958,383**
				AFY	7,487
				$/AFY	929

Annual Operations & Maintenance Cost

	AFY	Pump Hours	kwh-yr	Unit Cost	Annual O&M
Pumping Energy					
Recycled Water Pump Station No.1 at WWTP	4,787	8,758	1,830,000	$0.18	329,400
Recycled Water Pump Station No.2 at Ramsey St.	4,787	8,758	1,440,000	$0.18	259,200
			Construction Cost	**Unit Cost**	
Imported Water Pipeline			16,902,000	1.0%	169,020
Banning WWTP Title 22 Upgrades			22,534,826	1.0%	225,348
Recycled Water Storage Tank			1,250,000	1.0%	12,500
Recharge Basin			1,315,200	1.0%	13,152
Recycled Water Pipe to Spreading Basin			7,065,000	1.0%	70,650
Recycled Water Pump Station No.1 at WWTP			1,820,000	3.0%	54,600
Monitoring Well			400,000	1.0%	4,000
Potable Well			4,696,000	1.0%	46,960
Well Pipeline			100,000	1.0%	1,000
Total Annual Operations & Maintenance Cost					**1,185,830**

Appendix C - Cabazon Area Project Cost Estimates

National Experience. Local Focus.

San Gorgonio IRWM- Recycled Water Study

Total Capital and O&M Cost Summary

February 2018

Regional Recycled Water Options	Capital Cost	Annualized Cost			Water	Unit Cost
Cabazon Area Options		*Capital*	*O&M*	Total Annual	AFY	**$/AF**
Cabazon Option 1: Septic Conversion to Municipal Sewer, WWTP, NPR Irrigation	$ 53,500,000	*$ 3,100,000*	*$ 400,000*	$ 3,500,000	109	$ 31,800
Cabazon Option 2: Septic Conversion to Municipal Sewer, WWTP, NPR Irrigation + GWR	$ 57,400,000	*$ 3,300,000*	*$ 430,000*	$ 3,700,000	1,127	$ 3,300

National Experience. Local Focus.

San Gorgonio IRWM - Cost Assumptions

February 2018

Unit Costs

Construction Cost Index	**8311.16**	
Construction Cost Index	**9308.82**	
Construction Cost Index	**9069.83**	
Construction Cost Index	**10643.54**	
Construction costs	**Unit Cost**	
Pipeline	**$25**	per in-diam/LF
Special Crossings	**$500,000**	per crossing
Pump Station	**$6,500**	per HP
Land Acquisition- Cabazon	**$108,900**	per acre
Land Acquisition- Banning	**$164,000**	per acre
Recharge Basin	**$96,000**	per acre
Monitoring Well	**$200,000**	per well
Title 22 (Tertiary and Disinfection) WWTP	**$13**	per gallon
Conventional Filtration	**$2,002,000**	per MGD
Chlorine Contact chamber	**$1.50**	per Gallon
Chlorine Feed Equipment	**$1,409,000**	per MGD
UV Disinfection	**$488,000**	per MGD
Recycled Water Storage Tank	**$1.25**	per Gallon
Potable Water Storage Tank	**$1.25**	per Gallon
Customer Retrofits	**$100,000**	per site
New Potable Well	**$2,348,000**	per well
Imported Supply Costs		
Imported Water Cost	**$2,000**	per acre foot
Non-Potable Implementation	**25%**	of Construction cost
Groundwater Recharge Implementation	**27%**	of Construction cost
Legal/Admin/Environmental	*5%*	
Design	*8%*	
Construction Management	*8%*	
Services during Construction	*4%*	
Groundwater Recharge Planning Process	*2%*	
Project Contingency	**30%**	of Capital cost
Annual Operation & Maintenance Costs		
Pipelines	**1%**	of Construction cost
Storage	**1%**	of Construction cost
Pump Station	**3%**	of Construction Cost
Electrical Power	**$0.18**	kWh
Financing		
Interest Rate	**4.0%**	
Period	**30**	years
Capital Recovery Factor	**0.05783**	

San Gorgonio IRWM - Recycled Water Study

February 2018

Cabazon Option 1: Septic Conversion to Municipal Sewer, WWTP, NPR Irrigation

	Size	Qty	Unit Cost	Unit	Subtotal
Cabazon 1 mgd Title 22 WWTP		1	$13	per gallon	12,806,323
Land Acquisition-WWTP		3	$108,900	per acre	326,700
Sewer Pipe	12	50,160	$25	in-diam/LF	15,048,000
Sewer Pump (force main)	40	1	$6,500	per HP	260,000
Recycled Water Pipe to Cabazon Customers	4	5,200	$25	in-diam/LF	520,000
Recycled Water Pump Station to Customers	10	1	$6,500	per HP	65,000
Recycled Water Pipe to Arrowhead	8	7,000	$25	in-diam/LF	1,400,000
Recycled Water Pump Station to Arrowhead	20	1	$6,500	per HP	130,000
Customer Retrofits		3	$100,000	per site	300,000
Percolation Basin		8.2	$96,000	per acre	787,200
Pipe to Percolation Basin	10	3,600	$25	in-diam/LF	900,000
Monitoring Well		2	$200,000	per well	400,000
Baseline Construction Cost					**32,943,223**
Implementation			25%		8,235,806
Capital Cost					**41,179,029**
Project Contingency			30%		12,353,709
Subtotal Project Cost					**53,532,737**
Total Project Cost					**53,532,737**
Annualized Total Project Cost			0.05783		3,095,804
Annual O&M Cost					371,193
Total Annualized Cost					**3,466,997**
				AFY	109
				$/AFY	31,779

Annual Operations & Maintenance Cost					**Annual O&M**
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station to Customers	9	1,391	20,000	$0.18	3,600
Recycled Water Pump Station to Arrowhead	100	2,087	30,000	$0.18	5,400
Sewer Pump (force main)	1,120	8,764	260,000	$0.18	46,800
			Construction Cost	**Unit Cost**	
Cabazon 1 mgd Title 22 WWTP			12,806,323	1.0%	128,063
Sewer Pipe			15,048,000	1.0%	150,480
Sewer Pump (force main)			260,000	3.0%	7,800
Recycled Water Pipe to Cabazon Customers			520,000	1.0%	5,200
Recycled Water Pipe to Arrowhead			1,400,000	1.0%	14,000
Recycled Water Pump Station to Customers			65,000	3.0%	1,950
Recycled Water Pump Station to Arrowhead			130,000	3.0%	3,900
Monitoring Well			400,000	1.0%	4,000
Total Annual Operations & Maintenance Cost					**371,193**

San Gorgonio IRWM - Recycled Water Study

February 2018

Cabazon Option 2: Septic Conversion to Municipal Sewer, WWTP, NPR Irrigation + GWR

	Size	Qty	Unit Cost	Unit	Subtotal
Cabazon 1 mgd Title 22 WWTP		1.0	$13	per gallon	12,806,323
Land Acquisition- WWTP		3	$108,900	per acre	326,700
Sewer Pipe	12	50,160	$25	in-diam/LF	15,048,000
Sewer Pump (force main)	40	1	$6,500	per HP	260,000
Recycled Water Pipe to Cabazon Customers	4	5,600	$25	in-diam/LF	560,000
Recycled Water Pump Station to Cabazon Customers	10	1	$6,500	per HP	65,000
Recycled Water Pipe to Arrowhead	8	3,300	$25	in-diam/LF	660,000
Recycled Water Pump Station to Arrowhead	20	1	$6,500	per HP	130,000
Customer Retrofits		3	$100,000	per site	300,000
Recharge Basin		8.2	$96,000	per acre	787,200
Recycled Water Pipe to Recharge Basin	10	3,600	$25	in-diam/LF	900,000
Recycled Water Pump Station to Recharge Basin	20	1	$6,500	per HP	130,000
Monitoring Well		2	$200,000	per well	400,000
New Potable Well		1	$2,348,000	per well	2,348,000
Well Pipeline		1,000	$25	in-diam/LF	25,000
Baseline Construction Cost					**34,746,223**
Implementation			27%		9,381,480.23
Capital Cost					**44,127,703**
Project Contingency			30%		13,238,311
Subtotal Project Cost					**57,366,014**
Total Project Cost					**57,366,014**
Annualized Total Project Cost			0.05783		3,317,482
Annual O&M Cost					426,395
Total Annualized Cost					**3,743,878**
				AFY	1,127
				$/AFY	3,322

Annual Operations & Maintenance Cost					Annual O&M
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station to Cabazon Customers	9	1,391	10,000	$0.18	1,800
Recycled Water Pump Station to Arrowhead	100	2,087	30,000	$0.18	5,400
Sewer Pump (force main)	1,120	8,764	260,000	$0.18	46,800
Recycled Water Pump Station to Recharge Basin	1,127	8,758	130,000	$0.18	23,400
			Construction Cost	**Unit Cost**	
Cabazon 1 mgd Title 22 WWTP			12,806,323	1.0%	128,063
Sewer Pipe			15,048,000	1.0%	150,480
Sewer Pump (force main)			260,000	3.0%	7,800
Recycled Water Pipe to Cabazon Customers			560,000	1.0%	5,600
Recycled Water Pipe to Arrowhead			660,000	1.0%	6,600
Recycled Water Pump Station to Cabazon Customers			65,000	3.0%	1,950
Recharge Basin			787,200	1.0%	7,872
Recycled Water Pipe to recharge			900,000	1.0%	9,000
Recycled Water Pump Station to Recharge Basin			130,000	3.0%	3,900
Monitoring Well			400,000	1.0%	4,000
New Potable Well			2,348,000	1.0%	23,480
Well Pipeline			25,000	1.0%	250
Total Annual Operations & Maintenance Cost					**426,395**

Appendix D - Morongo Area Project Cost Estimates

RMC water and environment | WOODARD & CURRAN

National Experience. Local Focus.

San Gorgonio IRWM- Recycled Water Study

Total Capital and O&M Cost Summary

February 2018

Regional Recycled Water Options	Capital Cost	Annualized Cost			Water	Unit Cost
Morongo Area Options		*Capital*	*O&M*	Total Annual	AFY	**$/AF**
Morongo Option 1: Septic Conversion via Sewer Extension + NPR Irrigation	$ 16,900,000	*$ 980,000*	*$ 120,000*	$ 1,100,000	58	$ 19,100
Morongo Option 2: Septic Conversion via Sewer Extension + NPR Irrigation + GWR	$ 22,500,000	*$ 1,300,000*	*$ 160,000*	$ 1,470,000	618	$ 2,400

San Gorgonio IRWM - Cost Assumptions

February 2018

Unit Costs		
Construction Cost Index	**8311.16**	
Construction Cost Index	**9308.82**	
Construction Cost Index	**9069.83**	
Construction Cost Index	**10643.54**	
Construction costs	**Unit Cost**	
Pipeline	**$25**	per in-diam/LF
Special Crossings	**$500,000**	per crossing
Pump Station	**$6,500**	per HP
Land Acquisition- Cabazon	**$108,900**	per acre
Land Acquisition- Banning	**$164,000**	per acre
Recharge Basin	**$96,000**	per acre
Monitoring Well	**$200,000**	per well
Title 22 (Tertiary and Disinfection) WWTP	**$13**	per gallon
Conventional Filtration	**$2,002,000**	per MGD
Chlorine Contact chamber	**$1.50**	per Gallon
Chlorine Feed Equipment	**$1,409,000**	per MGD
UV Disinfection	**$488,000**	per MGD
Recycled Water Storage Tank	**$1.25**	per Gallon
Potable Water Storage Tank	**$1.25**	per Gallon
Customer Retrofits	**$100,000**	per site
New Potable Well	**$2,348,000**	per well
Imported Supply Costs		
Imported Water Cost	**$2,000**	per acre foot
Non-Potable Implementation	**25%**	of Construction cost
Groundwater Recharge Implementation	**27%**	of Construction cost
Legal/Admin/Environmental	*5%*	
Design	*8%*	
Construction Management	*8%*	
Services during Construction	*4%*	
Groundwater Recharge Planning Process	*2%*	
Project Contingency	**30%**	of Capital cost
Annual Operation & Maintenance Costs		
Pipelines	**1%**	of Construction cost
Storage	**1%**	of Construction cost
Pump Station	**3%**	of Construction Cost
Electrical Power	**$0.18**	kWh
Financing		
Interest Rate	**4.0%**	
Period	**30**	years
Capital Recovery Factor	**0.05783**	

San Gorgonio IRWM - Recycled Water Study

February 2018

Morongo Option 1: Septic Conversion via Sewer Extension + NPR Irrigation

	Size	Qty	Unit Cost	Unit	Subtotal
Morongo WWTP Title 22 Upgrades					
Filters		0.55	$2,002,000	per MGD	1,101,100
Chlorine Contact Chamber		550,000	$1.50	per gallon	825,000
Chlorine Dosing System		0.55	$1,409,000	per MGD	774,950
Sewer Pipe	8	14,400	$25	in-diam/LF	2,880,000
Recycled Water Storage Tank		250,000	$1.25	per gallon	312,500
Recycled Water Pipe	8	19,000	$25	in-diam/LF	3,800,000
Recycled Water Pump Station No. 1 @WWTP	40	1	$6,500	per HP	260,000
Recycled Water Pump Station No. 1 @Casino	20	1	$6,500	per HP	130,000
Customer Retrofits		3	$100,000		300,000
Baseline Construction Cost					**10,383,550**
Implementation			25%		2,595,888
Capital Cost					**12,979,438**
Project Contingency			30%		3,893,831
Subtotal Project Cost					**16,873,269**
Total Project Cost					**16,873,269**
Annualized Total Project Cost			0.05783		975,783
Annual O&M Cost					123,756
Total Annualized Cost					**1,099,538**
				AFY	58
				$/AFY	19,106

Annual Operations & Maintenance Cost					**Annual O&M**
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No. 1 @WWTP	55	1,391	40,000	$0.18	7,200
Recycled Water Pump Station No. 1 @Casino	3	1,391	20,000	$0.18	3,600
			Construction Cost	**Unit Cost**	
Morongo WWTP Title 22 Upgrades			2,701,050	1.0%	27,011
Sewer Pipe			2,880,000	1.0%	28,800
Recycled Water Storage Tank			312,500	1.0%	3,125
Recharge Basin			432,000	1.0%	4,320
Recycled Water Pipe			3,800,000	1.0%	38,000
Recycled Water Pump Station No. 1 @WWTP			260,000	3.0%	7,800
Recycled Water Pump Station No. 1 @Casino			130,000	3.0%	3,900
Total Annual Operations & Maintenance Cost					**123,756**

San Gorgonio IRWM - Recycled Water Study

February 2018

Morongo Option 2: Septic Conversion via Sewer Extension + NPR Irrigation + GWR

	Size	Qty	Unit Cost	Unit	Subtotal
Morongo WWTP Title 22 Upgrades					
Filters		0.55	$2,002,000	per MGD	1,101,100
Chlorine Contact Chamber		550,000	$1.50	per gallon	825,000
Chlorine Dosing System		0.55	$1,409,000	per MGD	774,950
UV Disinfection System		0.55	$488,000	per MGD	268,400
Sewer Pipe	8	14,400	$25	in-diam/LF	2,880,000
Recycled Water Storage Tank		250,000	$1.25	per gallon	312,500
Recycled Water Pipe to Customers	8	19,000	$25	in-diam/LF	3,800,000
Recycled Water Pump Station No. 1 @WWTP	40	1	$6,500	per HP	260,000
Recycled Water Pump Station No. 1 @Casino	20	1	$6,500	per HP	130,000
Recycled Water Pipe to Spreading Basin	8	600	$25	in-diam/LF	120,000
Recycled Water Pump Station to Basin	10	1	$6,500	per HP	65,000
Customer Retrofits		3	$100,000	per site	300,000
Monitoring Well		2	$200,000	per well	400,000
New Potable Well		1	$2,348,000	per well	2,348,000
Well Pipeline		2,000	$25	in-diam/LF	50,000
Baseline Construction Cost					**13,634,950**
Implementation			27%		3,681,437
Capital Cost					**17,316,387**
Project Contingency			30%		5,194,916
Subtotal Project Cost					**22,511,302**
Total Project Cost					**22,511,302**
Annualized Total Project Cost			0.05783		1,301,831
Annual O&M Cost					163,420
Total Annualized Cost					**1,465,250**
				AFY	618
				$/AFY	2,373

Annual Operations & Maintenance Cost					Annual O&M
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Recycled Water Pump Station No. 1 @WWTP	55	1,391	40,000	$0.18	7,200
Recycled Water Pump Station No. 1 @Casino	3	1,391	20,000	$0.18	
Recycled Water Pump Station to Basin	618	8,758	70,000	$0.18	12,600
			Construction Cost	**Unit Cost**	
Morongo WWTP Title 22 Upgrades			2,969,450	1.0%	29,695
Sewer Pipe			2,880,000	1.0%	28,800
Recycled Water Storage Tank			312,500	1.0%	3,125
Recharge Basin			432,000	1.0%	4,320
Recycled Water Pipe to Customers			3,800,000	1.0%	38,000
Recycled Water Pump Station No. 1 @WWTP			260,000	3.0%	7,800
Recycled Water Pump Station No. 1 @Casino			130,000	3.0%	3,900
Monitoring Well			400,000	1.0%	4,000
New Potable Well			2,348,000	1.0%	23,480
Well Pipeline			50,000	1.0%	500
Total Annual Operations & Maintenance Cost					**163,420**

Appendix E - Morongo and Cabazon Area Project Cost Estimates

National Experience. Local Focus.

San Gorgonio IRWM- Recycled Water Study

Total Capital and O&M Cost Summary

February 2018

Regional Recycled Water Options	Capital Cost	Annualized Cost			Water	Unit Cost
Morongo and Cabazon Combined Area Options		*Capital*	*O&M*	Total Annual	AFY	**$/AF**
Combined Option 1: Morongo and Cabazon Septic Conversion + GWR	$ 49,500,000	*$ 2,860,000*	*$ 802,000*	$ 3,660,000	840	$ 4,400

National Experience. Local Focus.

San Gorgonio IRWM - Cost Assumptions

February 2018

Unit Costs		
Construction Cost Index	**8311.16**	
Construction Cost Index	**9308.82**	
Construction Cost Index	**9069.83**	
Construction Cost Index	**10643.54**	
Construction costs	**Unit Cost**	
Pipeline	**$25**	per in-diam/LF
Special Crossings	**$500,000**	per crossing
Pump Station	**$6,500**	per HP
Land Acquisition- Cabazon	**$108,900**	per acre
Land Acquisition- Banning	**$164,000**	per acre
Recharge Basin	**$96,000**	per acre
Monitoring Well	**$200,000**	per well
Title 22 (Tertiary and Disinfection) WWTP	**$13**	per gallon
Conventional Filtration	**$2,002,000**	per MGD
Chlorine Contact chamber	**$1.50**	per Gallon
Chlorine Feed Equipment	**$1,409,000**	per MGD
UV Disinfection	**$488,000**	per MGD
Recycled Water Storage Tank	**$1.25**	per Gallon
Potable Water Storage Tank	**$1.25**	per Gallon
Customer Retrofits	**$100,000**	per site
New Potable Well	**$2,348,000**	per well
Imported Supply Costs		
Imported Water Cost	**$2,000**	per acre foot
Non-Potable Implementation	**25%**	of Construction cost
Groundwater Recharge Implementation	**27%**	of Construction cost
Legal/Admin/Environmental	*5%*	
Design	*8%*	
Construction Management	*8%*	
Services during Construction	*4%*	
Groundwater Recharge Planning Process	*2%*	
Project Contingency	**30%**	of Capital cost
Annual Operation & Maintenance Costs		
Pipelines	**1%**	of Construction cost
Storage	**1%**	of Construction cost
Pump Station	**3%**	of Construction Cost
Electrical Power	**$0.18**	kWh
Financing		
Interest Rate	**4.0%**	
Period	**30**	years
Capital Recovery Factor	**0.05783**	

San Gorgonio IRWM - Recycled Water Study

February 2018

Combined Option 1: Morongo and Cabazon Septic Conversion + GWR

	Size	Qty	Unit Cost	Unit	Subtotal
Morongo WWTP Title 22 Upgrades					
Filters		0.75	$2,002,000	per MGD	1,501,500
Chlorine Contact Chamber		750,000	$1.50	per gallon	1,125,000
Chlorine Dosing System		0.75	$1,409,000	per MGD	1,056,750
UV Disinfection System		0.75	$488,000	per MGD	366,000
Morongo Sewer	8	14,400	$25	in-diam/LF	2,880,000
Cabazon Sewer	12	39,500	$25	in-diam/LF	11,850,000
Cabazon Sewer Pump (force main)	30	1	$6,500	per HP	195,000
Recharge Basin		6.1	$96,000	per acre	585,600
Land Acquisition		6.1	$108,900	per acre	664,290
Recycled Water Pipe to Recharge Basin	10	25,000	$25	in-diam/LF	6,250,000
Recycled Water Pump Station No.1 @ WWTP	60	1	$6,500	per HP	390,000
Recycled Water Pump Station No. 2 @ Casino	50	1	$6,500	per HP	325,000
Monitoring Well		2	$200,000	per well	400,000
New Potable Well		1	$2,348,000	per well	2,348,000
Well Pipeline		1,000	$25	in-diam/LF	25,000
Baseline Construction Cost					**29,962,140**
Implementation			27%		8,089,777.80
Capital Cost					**38,051,918**
Project Contingency			30%		11,415,575
Subtotal Project Cost					**49,467,493**
Total Project Cost					**49,467,493**
Annualized Total Project Cost			0.05783		2,860,710
Annual O&M Cost					801,529
Total Annualized Cost					**3,662,239**
				AFY	840
				$/AFY	4,360

Annual Operations & Maintenance Cost					Annual O&M
Pumping Energy	**AFY**	**Pump Hours**	**kwh-yr**	**Unit Cost**	
Cabazon Sewer Pump (force main)	560	8,764	200,000	$0.18	36,000
Recycled Water Pump Station No.1 @ WWTP	840	8,758	390,000	$0.18	70,200
Recycled Water Pump Station No. 2 @ Casino	840	8,758	330,000	$0.18	59,400
			Construction Cost	**Unit Cost**	
Morongo WWTP Title 22 Upgrades			4,049,250	1.0%	40,493
Morongo Sewer			2,880,000	1.0%	28,800
Cabazon Sewer			11,850,000	1.0%	118,500
Cabazon Sewer Pump (force main)			195,000	3.0%	5,850
Recharge Basin			585,600	1.0%	5,856
Recycled Water Pump Station No.1 @ WWTP			390,000	3.0%	11,700
Recycled Water Pump Station No. 2 @ Casino			325,000	103.0%	334,750
Recycled Water to Recharge Basin			6,250,000	1.0%	62,500
Monitoring Well			400,000	1.0%	4,000
New Potable Well			2,348,000	1.0%	23,480
Total Annual Operations & Maintenance Cost					**801,529**

C. San Gorgonio Integrated Watershed and Groundwater Model Technical Memorandum

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Technical Memorandum

San Gorgonio Integrated Watershed and Groundwater Model (SGIWGM)

Prepared For: City of Banning and SGPWA

Prepared by: Reza Namvar, David Liu

Date: February 7, 2018

Table of Contents

Acronyms

BC&CGM	Banning Canyon and Cabazon Groundwater Model
CD	Cumulative Departure from Mean
CIMIS	Caligornia Irrigation Management Information System
GSFLOW	Groundwater and Surface Water Flow
INFILv3	USGS INFILtration version model code
IRWM	Itegrated Regional Water Management
LCMMP	California Land Cover Mapping and Monitoring Program
LM	Lower Groundwater Model
MBMI	Morongo Band of Mission Indians
MODFLOW	U.S. Geological Survey Modular Finite-Difference Flow Model
MODFLOW-NWT	MODFLOW Newton-Raphson Formulation for MODFLOW-2005 Model
NLCD	National Land Cover Data
PET	Potential Evapotranspiration
PRMS	Precipitation-Runoff Modeling System
SFR	Stream Flow Routing Package for MODFLOW Model
SGIWGM	San Gorgonio Integrated Watershed and Groundwater Model
SGPWM	San Gorgonio Pass Watershed Model
STATSGO	State Soil Geographic Database
SU	Storage Unit
UM	Upper Groundwater Model

1 Introduction

The San Gorgonio Integrated Regional Water Management (IRWM) Plan development process included three adjunct technical tasks to help improve the understanding of the San Gorgonio Region's water management needs and opportunities. These planning efforts were funded through a Proposition 1 IRWM Planning Grant award in 2017.

Initially conceived as a groundwater model update, Task 7 within the Region's IRWM planning award evolved into a task focused on combining existing watershed and groundwater models into an integrated surface and groundwater model that could be used to better understand the relationship between surface and groundwater systems.

Based upon review of the existing groundwater and watershed models of the San Gorgonio Pass area, limits of the current models, the availability of the model data and files, the goals of modeling tasks, and the schedule of this project, the Groundwater Group recommended linking the existing groundwater and surface models and developing a new integrated surface water and groundwater model. This Technical Memorandum (TM) presents the results of the work completed for development of the new coupled surface water and groundwater model.

The purpose of the San Gorgonio Integrated Watershed and Groundwater Model (SGIWGM) is to summarize the work performed under Task 7: Updates to San Gorgonio Pass Subbasin Groundwater Model and consists of the following sections:

1. **Introduction** – Provides the purpose and content of the TM and acknowledges the technical support provided for performing this task.
2. **Groundwater Basin Description** – Provides a brief description of the model area.
3. **Existing San Gorgonio Pass Models** – Briefly describes the existing USGS models that were used to develop the linked watershed and groundwater model for the Cabazon and Banning Canyon subbasins.
4. **San Gorgonio Integrated Watershed and Groundwater Model (SGIWGM)** – Provides a description of SGIWGM.
5. **Summary and Recommendations** – Summarizes the work performed and the model developed under this task and recommendations for future updates and application of the model.

1.1 Acknowledgments

The authors acknowledge the individuals and agencies in the project area that contributed technical support and data to this work. The technical support and review of the modeling work by the Groundwater Group are gratefully acknowledged. The Groundwater Group consisted of the following members:

- Jeff Davis – San Gorgonio Pass Water Agency
- Art Vela – City of Banning
- Luis Cardenas – City of Banning
- Bob Krieger – Cabazon Water District
- Larry Ellis – Banning Heights Mutual Water Company

Allen Christensen of the U.S. Geological Survey provided significant technical information and support for this study. He provided data, reports and draft model files that were used to build the coupled surface water and groundwater model of the Cabazon and Banning Canyon subbasins.

2 Regional Groundwater Basin Description

The San Gorgonio IRWM Region overlies parts of the San Gorgonio Pass Groundwater Basin (also known as the San Gorgonio Pass Subbasin of the Coachella Valley Hydrologic Unit, as defined in DWR Bulletin 118). As shown in Figure 1, the San Gorgonio Groundwater Basin includes five hydraulically connected groundwater storage units (SU) of:

- Banning SU
- Banning Bench SU
- Banning Canyon SU
- Cabazon SU
- Beaumont Basin

The Banning, Cabazon, and Beaumont storage units are the most productive storage units because of the presence of thick layers of saturated aquifer. Surface runoff from the higher elevations and the canyon storage units recharges the downstream groundwater storage units. The existing groundwater model covers the Banning Canyon and Cabazon SUs. However, the existing surface water model covers the entire San Gorgonio Pass watershed.

The San Gorgonio Pass watershed area is bounded by Little San Gorgonio Peak (9,524 ft) and the San Bernardino Mountains to the north and San Jacinto Peak (10,825 ft) and the San Jacinto Mountains to the south. Land surface altitudes range from a low of 660 feet (200 m) in the valley of the Indio subbasin along the eastern boundary of the study area to a high of 9,524 feet (2,900 m) at the summit of Little San Gorgonio Peak. The southern part of the study area includes the San Jacinto Mountains which reach an altitude of 10,825 feet (3,300 m) at the summit of San Jacinto Peak.

Similar to other parts of southern California, precipitation falls primarily between October and May. The San Gorgonio Pass area experiences periods of great variability in recharge and runoff in response to variability in precipitation. As a result, the streamflow is generally ephemeral to intermittent and the episodic stream flows that discharge from higher elevations quickly infiltrate the permeable alluvial fill of the groundwater basin.

Based on spatially interpolated daily precipitation and air temperature from a network of 134 climate stations in southern California, spatially, averaged for water years 1913-2012, rainfall ranges from a minimum of about 9 inches per year (in/yr), on the valley floor at the Indio subbasin along the eastern boundary of the study area to a maximum of about 38 in/yr at the summit of Little San Gorgonio Peak (Hevesi and Christensen, 2015). Average precipitation in the San Gorgonio Pass area is 19.5 in/yr. Average potential evaporation (PET) for the San Gorgonio Pass area is about 63 inches per year (in/yr) (CIMIS, 2005) with a minimum average monthly PET of less than 2 inches for December and January and a maximum average monthly PET of about 9.5 inches for July. The easternmost part of the project area has a higher average PET of 71 in/yr while the westernmost part of the project area has a lower average PET of 55 in/yr.

Water level data from several wells in the study area are available, mostly for recent years (Figure 2). Very limited streamflow data is available for the study area. The peaks in water levels are associated with increases in precipitation and stream flows. The wells in the Banning Canyon SU and western parts of the Cabazon SU show more correlation to increased stream flows than the wells in the eastern half of Cabazon SU.

3 Existing San Gorgonio Pass Area Models

There are two USGS models developed for areas within the San Gorgonio Pass that were used to develop the SGIWGM. The first model is an existing USGS watershed model of the entire San Gorgonio Pass area (San Gorgonio Pass Watershed Model or SGPWM) that was published in 2015 (Hevesi and Christensen, 2015). The second model is an unpublished groundwater model that is being developed by USGS for the Banning Canyon and Cabazon SUs. The draft files of this groundwater model were provided by USGS to SGPWA for use in development of the SGIWGM as part of this project. This model is expected to be released in 2018 (Christensen, 2017). These two models, briefly described below, were used to develop the SGIWGM (described in Section 4).

3.1 San Gorgonio Pass Watershed Model (SGPWM)

The San Gorgonio Pass Watershed Model (SGPWM) is a daily precipitation-runoff model developed by USGS to estimate spatially and temporally distributed recharge for the groundwater basins in the entire San Gorgonio Pass area (Hevesi and Christensen, 2015). The SGPWM area is shown in Figure 3. The recharge and stream flows estimated by SGPWM were used to define the boundary conditions for groundwater models of the area.

3.1.1 Model Grid

The model area of SGPWM covers 265 square miles (about 170,000 acres) and includes three watersheds: San Timoteo Creek draining to the west, Potrero Creek draining to the south, and San Gorgonio River draining to the east. The SGPWM was developed using the USGS INFILtration version 3.0 (INFILv3) model code. A uniform grid with 150-meter (492 feet) cell size and 30,595 active model cells was used to account for spatial variability in climate and watershed characteristics that includes high relief and rugged topography. The SGPWM includes seven layers consisting of six layers to represent the root zone and one layer to represent a perched zone beneath the root zone.

3.1.2 Simulation Period

The SGPWM was used to simulate precipitation and runoff in the project area and to develop a water budget, including recharge and runoff, for water years 1913 to 2012. A 45-month (3.75 years, starting January 1, 1909) model initialization period was used for reducing uncertainty associated with the initial conditions.

3.1.3 Model Parameters

Model parameters defining the physical characteristics of the San Gorgonio Pass area consisted of topography, land cover, soils, geology, and root zone.

The land cover parameters used in this model consist of percent imperviousness, percent canopy cover, and 28 different land cover types. The percent imperviousness and canopy cover were estimated by using the 2001 National Land Cover Data (NLCD) (Homer et al., 2007). The land cover types were identified by using data from the California Land Cover Mapping and Monitoring Program (LCMMP), South Coast Project Area July 2002, Fire and Resource Assessment Program of California Department of Forestry and Fire Protection.

A total of ten (10) different soil types are included in the SGPWM model. Soil types were estimated using the State Soil Geographic Database (STATSGO) digital map and associated tables (U.S. Department of Agriculture, 1994). The soil parameters include soil porosity, residual water content, a drainage function coefficient, and upper and lower vertical saturated hydraulic conductivities (Hevesi, et al., 2003).

Daily precipitation and air temperature input were interpolated by using a modified inverse-distance-squared interpolation method and available climate records from a network of 134 climate stations throughout Southern California.

3.1.4 Model Calibration and Results

The SGPWM model was calibrated by comparing simulated and observed monthly mean streamflow, annual mean streamflow, and average monthly mean streamflow at five USGS stream gages in and near the model area.

The long-term average water budgets simulated by the SGPWM model for water years 1913-2012 indicated that the model area receives an average of 279,800 acre-feet per year (AFY) of precipitation and loses 215,700 AFY to evapotranspiration; a difference of 64,100 AFY. The model estimated that 44,400 AFY of precipitation is recharged in the area and 13,600 AFY becomes runoff leaving the model area; resulting in a total of 58,000 AFY. The remaining 6,100 AFY is contributed to sublimation and root zone storage change.

3.2 Banning Canyon and Cabazon Groundwater Model (BC&CGM)

USGS is developing the BC&CGM to evaluate the effects of pumping and climate on the long-term availability of groundwater in the Banning Canyon and Cabazon SUs. No publication have been released for this modeling work; however, USGS provided draft BC&CGM model files to SGPWA to be used for development of the SGIWGM. A brief description of the BC&CGM is provided in this subsection.

BC&CGM uses the same model grid that was used for the SGPWM (Figure 3). However, only the cells in the Banning Canyon and Cabazon SUs are kept active in the BC&CGM. BC&CGM has a uniform grid with 150-meter (492 feet) cell size. BC&CGM grid and SGPWM grid size and orientation were matched to provide a more efficient coupling of the surface and groundwater models.

BC&CGM consists of two models: the Upper Groundwater Model (UM) and the Lower Groundwater Model (LM). Both models are built based on USGS modular finite difference groundwater flow model (MODFLOW) and simulate a 100-year period of 1913 to 2012 using monthly stress periods. During each stress period of one month, all model stresses, such as stream flows, remain constant. This results in dampening the effects of short duration high stream flows by averaging daily variations of stream flows to average monthly stream flows. UM covers the Banning Canyon and Cabazon SUs while LM covers the Cabazon SU only. The stream flows and stream aquifer interaction are simulated in the UM and infiltration of precipitation and stream seepage into the bottom layer of the UM is passed on to the LM as recharge. Wells and groundwater extraction are included in the LM only. These models are further described below.

3.2.1 Upper Groundwater Model (UM)

The Upper Groundwater Model (UM) with an active area of 21,620 acres covers the Banning Canyon and Cabazon SUs (Figure 4).

Stream Simulation

Major streams including the San Gorgonio River and its tributaries are simulated in the UM using the MODFLOW Stream Flow Routing package (SFR) (Figure 5). Stream inflows are added to the SFR at boundaries of the UM where streams enter the active groundwater model area. The average total stream inflow to the UM is 57,600 AFY for the 1983-2012 period. The source of this information is not known since the model is not yet published. Thirty-year average annual stream inflows at forty (40) inflow locations are shown in Table 1. The stream inflow locations not listed in Table 1 did not provide any inflows during 1983-2012 simulation period.

Boundary Conditions

The UM connection to the surrounding area is through boundary conditions that consist of stream inflows and recharge from precipitation. Recharge from precipitation and stream seepage are added to the top layer of the model and the resulting infiltration of groundwater from top layer to bottom layer of UM is passed on to LM. The accounting of this infiltration is done using DRraiN package (DRN) in the UM and Unsaturated Zone Flow package (UZF) in the LM. Figure 6 shows distribution of the average recharge rates from UM to LM.

Faults

As shown in Figure 4, two faults are simulated in the Banning Canyon SU by the UM. The first one is in the middle of the Banning Canyon and the second one is located at the boundary of Banning Canyon and Cabazon SUs. No other faults are simulated in the UM. These two faults are set to be semi-impermeable in the UM.

Model Layers

The UM has two layers with the top layer (Layer 1) having an average thickness of about 200 feet and the lower layer (Layer 2) having a thickness of 1000 feet to 2000 feet, extending down to zero elevation (Figure 7). Layer 1 represents the upper 200 feet of aquifer material. Layer 2 is added to the model to collect the infiltration from Layer 1 by using the drain package (DRN).

Aquifer Parameters

Aquifer parameters of the UM are grouped into two zones (Figure 8). Aquifer parameters within each zone are set to be constant. Table 2 provides the values of aquifer parameters used in the UM. Aquifer parameter values are assumed to be calibrated values and were not changed in developing the linked watershed/groundwater model.

3.2.2 Lower Groundwater Model (LM)

The Lower Groundwater Model (LM) covers the Cabazon SU. The LM receives inflow from the UM and is hydraulically connected to the Banning SU on the west and Indio subbasin of the Coachella Basin on the east.

Boundary Conditions

The model connection to the surrounding area is through boundary conditions that consists of inflow from Banning SU on the west and outflow to Coachella groundwater basin on the east (Figure 9). Inflow from Banning SU is set to be constant at a rate of about 2,400 AFY for the 1983-2012 period; however, the outflow to Coachella is variable and depends on groundwater levels at the eastern boundary of the model. The annual average outflow at the eastern model boundary is 20,170 AFY for the 1983-2012 period. The numbers on Figure 9 represent the 100-year (1913 to 2012) average boundary flow rates at these two boundaries.

Recharge from precipitation and stream seepage are added to the top layer of the UM. The infiltration of groundwater from top layer to bottom layer of UM is then passed on to LM. The accounting of this infiltration is done in the UM using the DRN package and in the LM using the UZF package.

Faults

Five faults are simulated in the Cabazon SU (Figure 9). Two faults are in the western half of the LM and three faults are near the eastern boundary of the model. Similar to the UM, these faults are set to be semi-impermeable in the LM.

Model Layers

The LM has three layers with each of the top two layers having average thicknesses of about 500 feet. The lower layer (Layer 3) with a maximum thickness of about 1,500 feet is only present at deeper parts of the aquifer (Figure 10).

Aquifer Parameters

Aquifer parameters of the LM are grouped into several zones (Figures 11 and 12). Aquifer parameters within each zone are set to be constant. Table 3 provides the values of aquifer parameters used in the LM. Aquifer parameters are assumed to be calibrated values and were not changed in developing the SGIWGM.

Groundwater Extraction

Groundwater extraction in the Cabazon SU is simulated in the LM (Figure 12). The size of the circles in Figure 13 are scaled based on average monthly pumping rates of each well. Average annual groundwater extraction is 1,126 AFY for the 1983-2012 period. Some of the extraction wells of the City of Banning are not represented in the LM; however, other City of Banning wells that are located within the model area were added to the linked watershed/groundwater model as described in Section 4.

4 San Gorgonio Integrated Watershed and Groundwater Model (SGIWGM)

The SGPWM and BC&CGM developed by USGS use INFILv3 and MODFLOW-NWT model codes, respectively. These model codes are stand-alone codes and are not set up to be coupled. However, the Groundwater and Surface water FLOW (GSFLOW) model code, available from USGS, is a coupled surface water model and groundwater model that was used for development of the linked watershed and groundwater models of the San Gorgonio Pass area.

GSFLOW consists of two coupled model codes of the Precipitation-Runoff Modeling System (PRMS) and MODFLOW (Figure 14). PRMS model code is similar to INFILv3 model code. Data files of the SGPWM were converted from INFILv3 to PRMS model code. Similarly, the UM and LM data files were transferred to the groundwater model of GSFLOW (Figure 15).

For each model cell, PRMS calculates the runoff quantity for each cell based on precipitation rates falling on the cell. Based on surface elevation of each cell, the runoff is routed to downstream cells using a cascading algorithm (Figure 16) and then the runoff is directed to creeks and streams in the model area (Figure 17). Stream flows are then directed downstream and towards the boundaries of the model. When the stream flows calculated by the PRMS model reach the beginning of the streams in the groundwater model (i.e. beginning of the SFR nodes), the streamflows are passed from the PRMS model to the MODFLOW (SFR package) (Figure 18). From this point on, stream flows are routed downstream in the SFR package and streams are in hydraulic connection with the groundwater system and may lose to or gain from groundwater based on hydraulic gradient between the stream and groundwater.

After building the PRMS and MODFLOW models in GSFLOW, the resulting SGIWGM was run as a coupled model. Development of the PRMS and MODFLOW components of the GSFLOW model is described in the following subsections.

4.1 Watershed Model of SGIWGM (PRMS)

The Precipitation-Runoff Modeling system (PRMS) is a computer model that simulates the hydrologic cycle by accessing variability in climate, geology and human activities. PRMS is used as the watershed model of the SGIWGM developed for this task.

The SGPWM was developed by using the INFILv3 code. The grid cell size and geometry were selected to match the grid used for groundwater modeling of the SGP area. There are 30,592 active grid cells in this model, effectively covering the entire San Gorgonio Pass Watershed. The SGPWM separated the San Gorgonio Pass Watershed into three subbasins, the San Gorgonio River (SGR), the San Timoteo Creek (STC), and the Potrero Creek (PTC). To maintain consistency in the conversion from INFILv3 to PRMS, the SGPWM grid size, geometry, and subbasin identification were used in the PRMS model.

4.1.1 Data Transfer from INFILv3 to PRMS

ComparedCompared to the INFILv3, the PRMS model has simpler and fewerfewer required input parameters. There are two required input parameters to run the PRMS model, spatially distributed daily precipitation and temperature. The PRMS model can estimate the precipitation and temperature data from climate stations or read existing data from user input. The latter option was selected to reduce the variability of model results between INFLv3 and PRMS. The precipitation data was generated from the INFILv3 model, then it was formatted to PRMS input format. Unlike the precipitation data, the INFILv3 code uses climate station data to estimate spatially distributed daily temperature for its internal calculation only, and it lacks the capability to output of temperature data. Therefore the temperature interpolation was done using a Fortran code outside of the model with the temperature estimation equation presented in the INFILv3 manual *(USGS, 2008)*. Stream segments were added directly from the INFILv3 model since both models share the same grid property and geometry. The SGPWM includes a cascade path for runoff routing. The cascade path was slightly modified to ensure the flow paths were linked to the SFR package of the groundwater model correctly.

PRMS and INFILv3 models use different methods for simulation of some of the hydrological processes, therefore results of the two models may not be exact. To minimize the difference between the result, other optional inputs for the PRMS model such as spatially distributed daily potential evapotranspiration, ground perviousness, surface slope, aspect, soil type, vegetation cover type, and surface elevation were used. Some parameters were transferred directly; others had to be reclassified. The soil type in the INFILv3 model has 10 categories while PRMS only has 3. The soil types from the INFILv3 model were reclassified into either sand, loam, or clay by using the USDA Texture Classification method. INFILv3 has 28 categories for vegetation cover, the PRMS model can only have 5 categories. The reclassification of the 28 categories was done by identifying the properties of the vegetations and matching with the most appropriate PRMS categories. As with the spatially distributed daily precipitation data, the potential evapotranspiration data was generated by the INFILv3 simulation. This output was reformatted and used in the PRMS model as an input to further reduce the variance of the two models.

4.1.2 PRMS Results

The PRMS model is capable of outputting spatially distributed data. The precipitation (Figure 19), potential evapotranspiration (Figure 20), impervious areas (Figure 21) and temperature (Figure 22) maps were generated to compare with the INFILv3 maps found in the SGPWM model report. The map outputs from the PRMS model have a similar distribution as the map outputs found in the SGPWM model report.

More outputs from the PRMS model were generated for calibration. The evapotranspiration, runoff, and recharge data were generated for comparison between the SGPWM and PRMS models. Since the models use different approaches to estimate the hydrological cycles, minor differences between the model outputs were expected. The annual evapotranspiration (Figures 23 and 24), runoff (Figures 25 and 27), and recharge (Figures 26 and 28) for water years 1983-2012 were generated. The 30-year pattern of each graph was compared with the similar graph found in the SGPWM report. PRMS simulated recharge for 1993 (a wet year) and 2004 (a dry year) are presented in Figures 29 and 30, respectively. The patterns are the same for the two models.

4.2 Groundwater Model of SGIWGM (MODFLOW)

The MODFLOW component of the GSFLOW model was built based on data and information obtained from the UM and LM models. The UM and LM models were combined into one single groundwater model to simulate the Banning Canyon and Cabazon SUs. This combined groundwater model is briefly described below.

Model Layers

The MODFLOW model of GSFLOW has four layers: Layer 1 is the top layer of UM, Layer 2 is the top layer of LM, Layer 3 is the middle layer of LM, and Layer 4 is the bottom layer of LM. Figure 32 presents an east-west profile of the MODFLOW model along Interstate 10. No changes were made to layer elevations and thicknesses. Part of the model that covers the Banning Canyon has a single layer that is identical to top layer of the UM.

Linkage of PRMS and MODFLOW models in GSFLOW

The PRMS model simulates the stream flows from higher elevations in the model area and passes the stream flows to the MODFLOW model at the starting locations of streams in the SFR package (Figure 33). Figure 34 shows a comparison of stream inflows used in the GSFLOW groundwater model and those of the INFILv3 and UM models. Average annual total stream inflows for SGIWGM, INFILv3, and UM models are 35,200 AFY, 34,700 AFY, and 57,600 AFY, respectively. The SGIWGM stream inflows were calibrated against the INFILv3 model rather than the UM since the INFILv3 model is published. Thirty-year average annual stream inflows of UM, INFILv3, and SGIWGM models at forty (40) inflow locations are shown in Tables 1, and 4, respectively. The stream inflow locations not listed in these tables did not have any inflows during the 1983-2012 simulation period.

Groundwater Extraction

Review of the wells used in the LM model for groundwater extraction indicated that several municipal wells of the Morongo Band of Mission Indians (MBMI) and City of Banning are not included in the BC&CGM. Location and pumping data of these wells were collected, and the wells were added to SGIWGM. Figure 35 show the location of the new wells included in the SGIWGM in addition to the existing model wells shown in Figure 13.

Artificial and Incidental Recharge

An average of 1,500 AFY of Whitewater River stream flows are transferred into the model area. About a third of this water is released into the San Gorgonio River in the northern parts of the Banning Canyon to recharge groundwater and the rest is used to meet the municipal demands.

There are three general areas in the Cabazon SU that are on septic systems, Banning, Morongo, and Cabazon. Additionally, there are two wastewater treatment plants (WWTPs), one for MBMI and the other for the City of Banning. Incidental recharge from the WWTPs and areas on septic systems are included in the SGIWGM.

Figure 36 shows the location and rates of the artificial and incidental recharges as simulated in the SGIWGM.

4.3 Linked Model Runtime

GSFLOW is a complex hydrological model that simulates many components of the hydrologic cycle. As such, it has a much larger runtime compared to the runtime of models that only simulate part of the hydrologic cycle (such as MODFLOW for groundwater flow simulation or PRMS for precipitation-runoff simulation). SGPWM and BC&CGM both have a 100-year (1913-2012) simulation period to capture predevelopment conditions of the model area.

Different approaches were taken to reduce the model runtimes and have calibration completed by the deadline of December 2017. The SGPWM and the UM and LM models are developed for a 100-year (1913-2012) simulation and as such the SGIWGM was also initially developed for the 1913-2012 period. This 100-year run of SGIWGM takes several days to complete which makes it impractical to calibrate within the timeframe of this project.

To improve run times, the SGIWGM was modified to run for a 30-year (1983-2012) simulation period. This shorter simulation period allows shorter model runtimes while maintaining the capability to simulate recent 30-year conditions in the Banning Canyon and Cabazon SUs. The 30-year simulation time resulted in a shorter,impractical simulation time (Table 5).

Water flow in the San Gorgonio Pass area is from higher elevations and watersheds towards the groundwater basins and storage units with no areas of reverse flow paths identified. Based on these hydrological characteristics of the project area, the SGIWGM was run as PRMS only and MODFLOW only runs to evaluate the impact on model runtimes. Stream inflows from PRMS model were imported into the MODFLOW before running it. The 30-year PRMS-only simulation had a runtime of less than 30 minutes (Table 5) while the MODFLOW-only simulation runtime was reduced to about 3 days. However, when the MODFLOW was run as a standalone model outside of GSFLOW, the runtime was reduced to less than 5 hours (Table 5). The SGIWGM model was run using the following sequence:

1. Run PRMS model as a standalone run
2. Extract stream flows from PRMS model
3. Import stream flows into MODFLOW model
4. Run MODFLOW as a standalone run

Use of this efficient methodology resulted in timely model development and calibration.

4.4 Model Calibration

The SGIWGM calibration consisted of three major steps- streamflow calibration, groundwater elevation calibration, and groundwater outflow calibration to Coachella Basin.

Streamflow Calibration

As very limited measured stream flow data is available for the San Gorgonio Pass area, stream flow calibration consisted of comparing SGIWGM stream flows to INFILv3 stream flows. INFILv3 model is a USGS published model and its simulated stream flows were used as reference for SGIWGM model stream flow calibration. Table 4 presents the simulated stream flows of INFILv3 and SGIWGM. Model parameters of SGIWGM were adjusted to obtain stream flows close to those of INFILv3. In general, simulated stream flows for most streams of both models are very close. SGIWGM and INFILv3 generate different stream flows for four streams (inflow locations 6, 21, 54, and 59). Comparing the catchment areas of these streams indicates stream flows simulated by SGIWGM for these locations are more comparable to the corresponding catchment areas. Thus, no changes were made to the SGIWGM parameters to match the INFLv3 model stream flows. As data sources of UM model stream flows are not known at this time, no attempt was made to match GSFLOW stream flows to the UM stream flows.

Groundwater Elevation Calibration

Groundwater elevations are very sensitive to stream flows and stream-aquifer interaction processes in the San Gorgonio Pass area. Additionally, aquifer parameters such as hydraulic conductivity and storage parameters could impact the simulated groundwater elevations. It was assumed that the aquifer parameters of the UM and LM models are calibrated parameters and provide a close representation of field values. Thus, no changes were made to the aquifer properties of the model.

Groundwater elevation calibration was concentrated on stream-aquifer interaction parameters, mainly the streambed conductance and vertical hydraulic conductivity of the unsaturated zone beneath the streams in the Banning Canyon and Cabazon SUs. These two parameters were manually adjusted until a reasonable match was obtained between observed and simulated groundwater elevations at 21 calibration wells (Figure 37). There are 10 calibration wells in the Banning Canyon SU and 11 calibration wells in the Cabazon SU. Most wells have observed data for the 10 years of model simulation period - with 7 wells with 30 years of groundwater elevation data in the Banning Canyon SU and only 3 wells with 30 years of groundwater elevation data in the eastern parts of Cabazon SU. The hydrographs of simulated and observed groundwater elevations for the 21 calibration wells are presented in Figures 38a to 38u. Comparing these hydrographs with those of UM and LM models show a better calibration for SGIWGM model. In general, hydrographs show more fluctuations in Banning Canyon wells as a result of high stream-aquifer interaction in this area. SGIWGM hydrographs follow the pattern of precipitation and streamflow fluctuations during wet and dry periods. The final calibrated value of the streambed conductivity is 650 ft/day and vertical hydraulic conductivity of the unsaturated zone beneath the streams ranges from 0.5 to 5.3 ft/day, respectively.

Groundwater Outflow to Coachella Basin

The annual average simulated groundwater outflow to the Coachella Basin by the LM model is estimated to be 20,170 AFY for the 1983-2012 period. This outflow rate seems to be higher than the rate that is generally thought to be leaving the Cabazon SU towards the Coachella Basin. The general head boundary conductance at the eastern boundary of the Cabazon SU was manually adjusted until a reasonable outflow rate was obtained at this model boundary. The calibrated groundwater outflow to the Coachella Basin is 11,025 AFY. The actual quantity of outflow to Coachella Basin is not known and previous studies have used a wide range of values for this outflow. Installation of monitoring wells and collection of water level data at this area would provide valuable data for a more accurate estimation of the groundwater outflow to Coachella Basin. When new data becomes available, it will be incorporated in the future updates of the SGIWGM.

5 Summary and Recommendations

An integrated watershed and groundwater model (SGIWGM) of the San Gorgonio Pass watershed and Banning Canyon and Cabazon SUs was developed using GSFLOW modeling platform of USGS. The SGIWGM was built based on existing SGPWM of USGS and unpublished BC&CGM that is under development by USGS. The SGIWGM was calibrated to stream flows, groundwater elevations, and groundwater outflow to the Coachella Basin. Calibration results show a good qualitative and quantitative match between simulated and observed/estimated values.

The GSFLOW model is a regional model that could be used for the following:

- **Detailed Local Hydrogeologic Investigations** – There are extensive silty-sand units in parts of the Cabazon SU that may generate temporary perching conditions or reduce vertical groundwater movementflow. When additional hydrogeologic information becomes available, the model could be refined for the areas of interest for better understanding of the local conditions and use of the model for detailed local impact of projects. However, the effects of these low permeability units are localized and are not expected to impact the capability of the model to simulate the regional groundwater levels.

- **Simulation of Water Resources Management Projects** – Various IRWMP or SGMA projects that involve groundwater recharge or groundwater pumping in the Banning Canyon and Cabazon SUs could be simulated using the SGIWGM.
- **Climate Change Impact Analysis** – SGIWGM simulates the precipitation-runoff process in the San Gorgonio Pass area and could be used to evaluate the impact of climate change on precipitation rates and patterns and the resulting runoff rates and how the long-term availability of groundwater is impacted.

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Table 1 – Average Annual Stream Inflows for UM

Inflow Location Name	Inflow Location	30yr Average (AFY)	Inflow Location Name	Inflow Location	30yr Average (AFY)
Upper San Gorgonio Canyon	1	1,620	Stubbe Canyon	43	1,075
Upper San Gorgonio Canyon	2	3,950		46	65
Lower San Gorgonio Canyon	4	950		47	70
Lower San Gorgonio Canyon	6	6,700		48	115
Potrero Creek	8	60	Cottonwood Canyon	49	13,670
Potrero creek	9	3,260		50	810
	10	90		51	535
Hathaway Creek	11	1,540	Brown Creek	52	4,655
	12	35		54	220
Millard Canyon	13	3,750		57	25
	14	50		59	200
	16	120		63	105
Montgomery Creek	17	260		65	235
Banning Bench	18	130		66	175
	19	260		68	25
Smith Creek	21	425	Jenson Creek	69	1,735
	24	30		71	10
	26	160		76	635
	28	30		79	190
	29	45		80	130
	31	30		84	30
	34	495		85	745
	35	145	Falls Creek	86	7,400
	37	60	Snow Creek	87	450
	38	60		88	25
Total			**57,600 AF/yr**		

Table 2 – Aquifer Parameters for UM

Aquifer Parameters	Layer 1		Layer 2
Region ID	**10**	**11**	**11**
Kh (ft/day)	32.8	98.4	98.4
Kv (ft/day)	32.8	16.4	32.8
Sy	0.06	0.3	0.3
SS	0.00001		0.00001

Kh – Horizontal Hydraulic Conductivity
Kv – Vertical Hydraulic Conductivity
Sy – Specific Yield
SS – Specific Storage

Table 3 – Aquifer Parameters for LM

Aquifer Parameters	Layer 1					Layer 2				Layer 3
Region ID	**31**	**32**	**33**	**34**	**35**	**4**	**41**	**42**	**43**	**5**
Kh (ft/day)	1	12	50	60	5	17	6	49	.03	.06
Kv (ft/day)	63	65	65	44	65	6	20	.04	.28	.00
Sy	.04	.10	.05	.20	.15	.07	.07	.07	.07	N/A
SS	.00001					.0000000878				.00001

Kh – Horizontal Hydraulic Conductivity
Kv – Vertical Hydraulic Conductivity
Sy – Specific Yield
SS – Specific Storage

Table 4 - Average Annual Stream Inflows for SGPWM and SGIWGM

Inflow Location Name	Inflow Location	SGPWM 30yr Average (AFY)	SGIWGM 30yr Average (AFY)	Difference (AFY)	Inflow Location Name	Inflow Location	SGPWM 30yr Average (AFY)	SGIWGM 30yr Average (AFY)	Difference (AFY)
Upper San Gorgonio Canyon	1	1,280	1,670	-390	Stubbe Canyon	43	570	1,000	-430
Upper San Gorgonio Canyon	2	3,210	4,475	-1,265		46	2	40	-38
Lower San Gorgonio Canyon	4	400	955	-555		47	0	20	-20
Lower San Gorgonio Canyon	6	3,715	30	3,685		48	0	50	-50
Potrero Creek	8	10	30	-20	Cottonwood Canyon	49	250	660	-410
Potrero creek	9	810	3,510	-2,700		50	0	5	-5
	10	3	45	-42		51	90	450	-360
Hathaway Creek	11	365	1,620	-1,255	Brown Creek	52	3,075	5,075	-2,000
	12	0	40	-40		54	3,210	90	3,120
Millard Canyon	13	2,325	4,350	-2,025		57	0	7	-7
	14	0	13	-13		59	7,410	4	7,406
	16	0	130	-130		63	30	35	-5
Montgomery Creek	17	0	265	-265		65	80	80	0
Banning Bench	18	0	90	-90		66	65	55	10
	19		180	-180		68	0	9	-9
Smith Creek	21	240	1,950	-1,710	Jenson Creek	69	1,210	1,370	-160
	24	1	3	-2		71	0	4	-4
	26	365	80	285		76	440	310	130
	28	0	10	-10		79	85	110	-25
	29	365	5	360		80	0	1	-1
	31	20	15	5		84	0	4	-4
	34	215	340	-125		85	210	325	-115
	35	20	100	-80	Falls Creek	86	4,570	5,340	-770
	37	40	35	5	Snow Creek	87	15	170	-155
	38	0	20	-20		88	0	4	-4
SGPWM Total:			**34,700 AF/yr**						
SGIWGM Total:			**35,200 AF/y**						

Table 5 – SGIWGM Runtimes

	GSFLOW - Coupled	GSFLOW – PRMS Only	GSFLOW – Groundwater Only	PRMS – Standalone	Groundwater (MODFLOW) – Standalone
30-year simulation	> 5 days	< 30 minutes	~ 3 days	< 30 minutes	< 5 hours

Figure 1 – San Gorgonio Groundwater Basin Storage Units

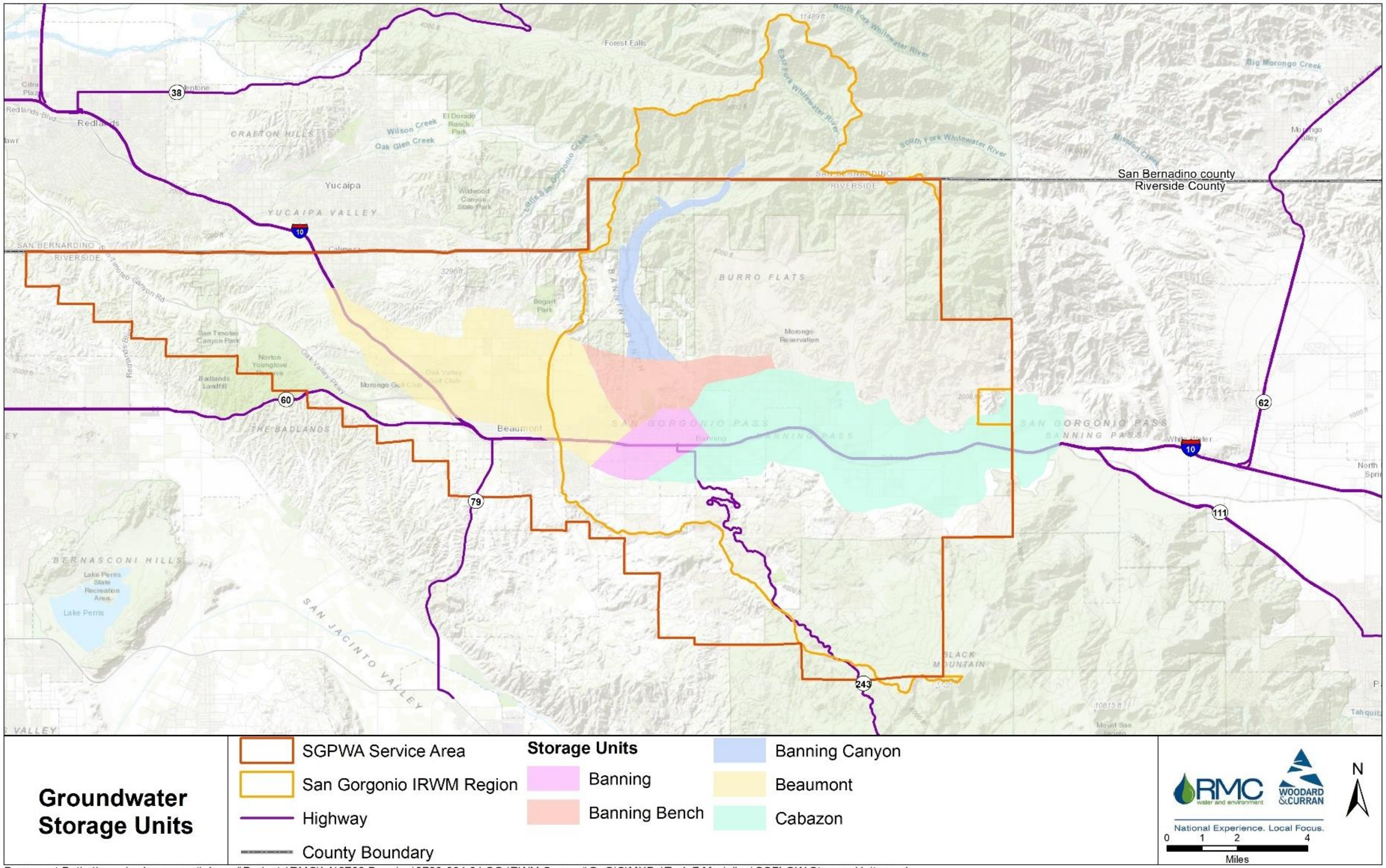

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Figure 2 – Location of sites with groundwater and surface water data.

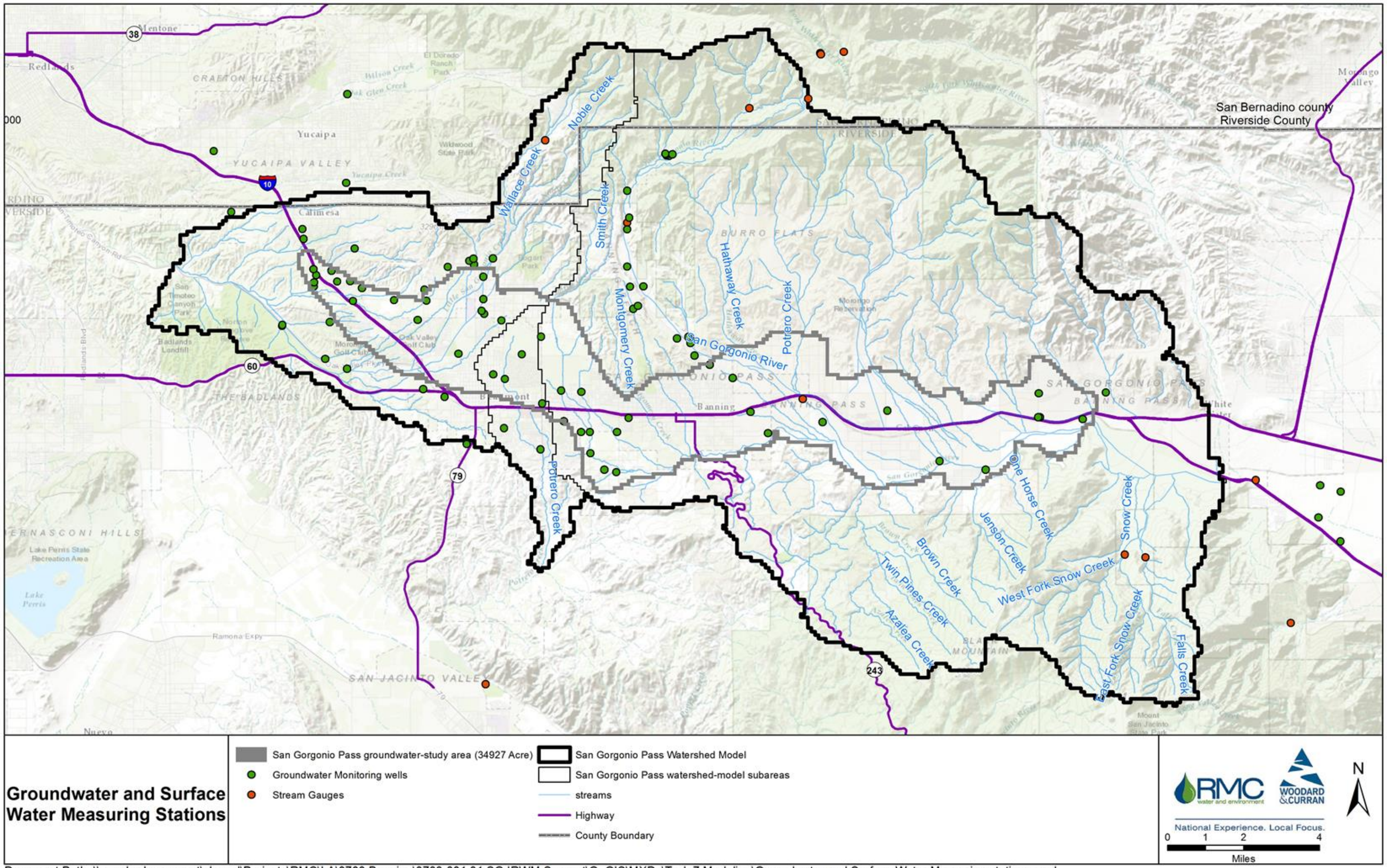

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Figure 3 – USGS San Gorgonio Pass Study Area

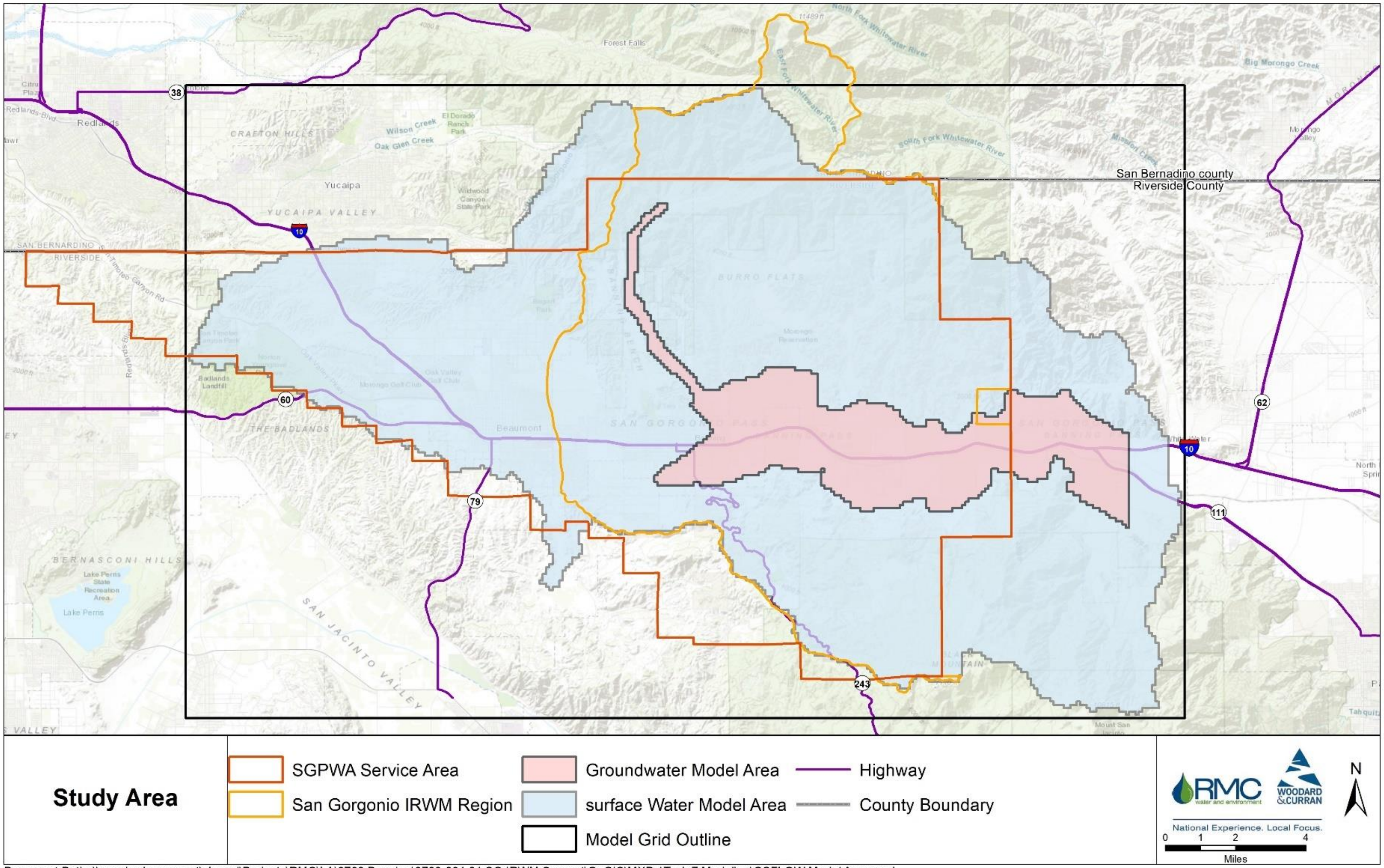

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Figure 4 – UM Features

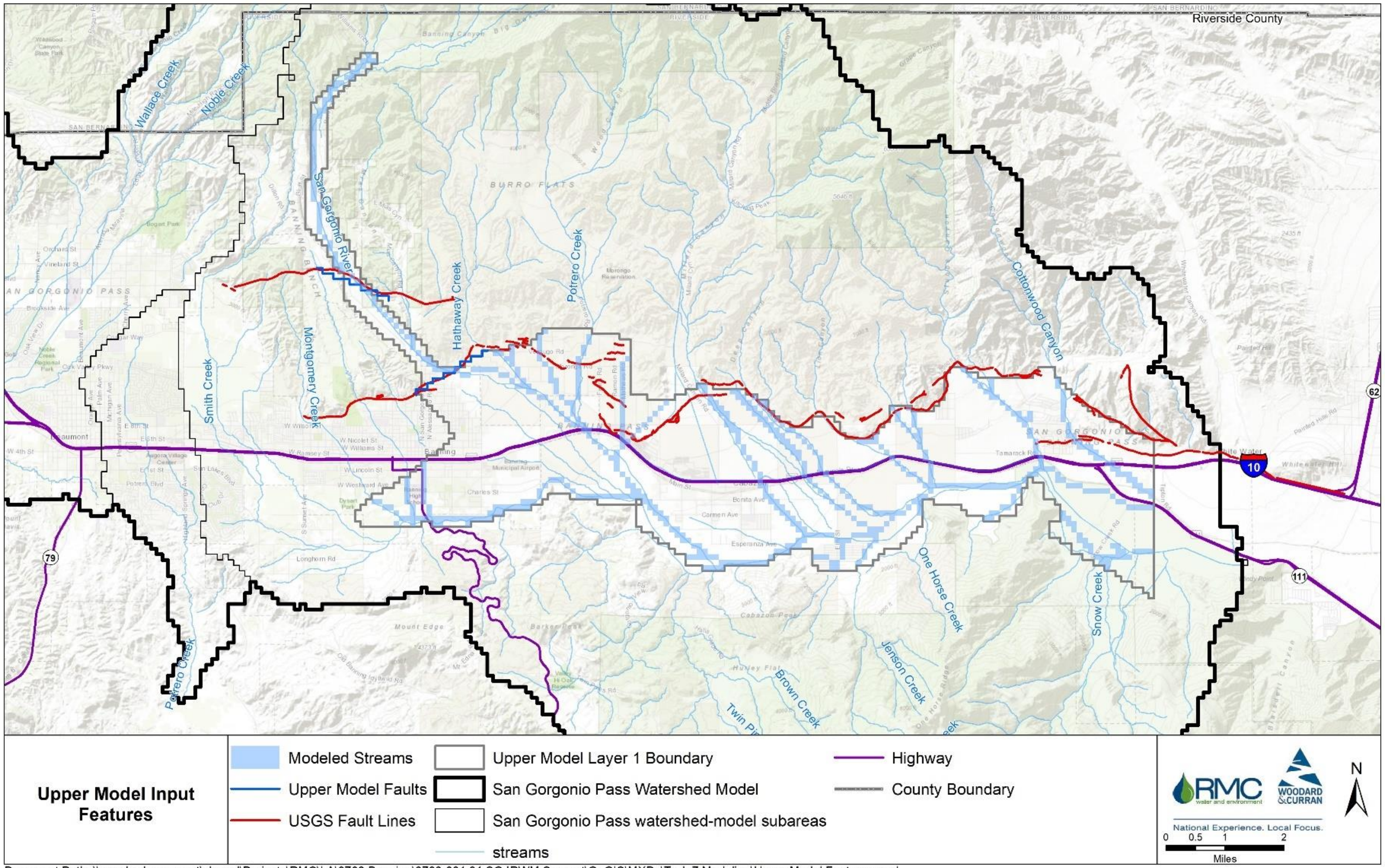

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Figure 5 - Stream Inflow Locations for the UM

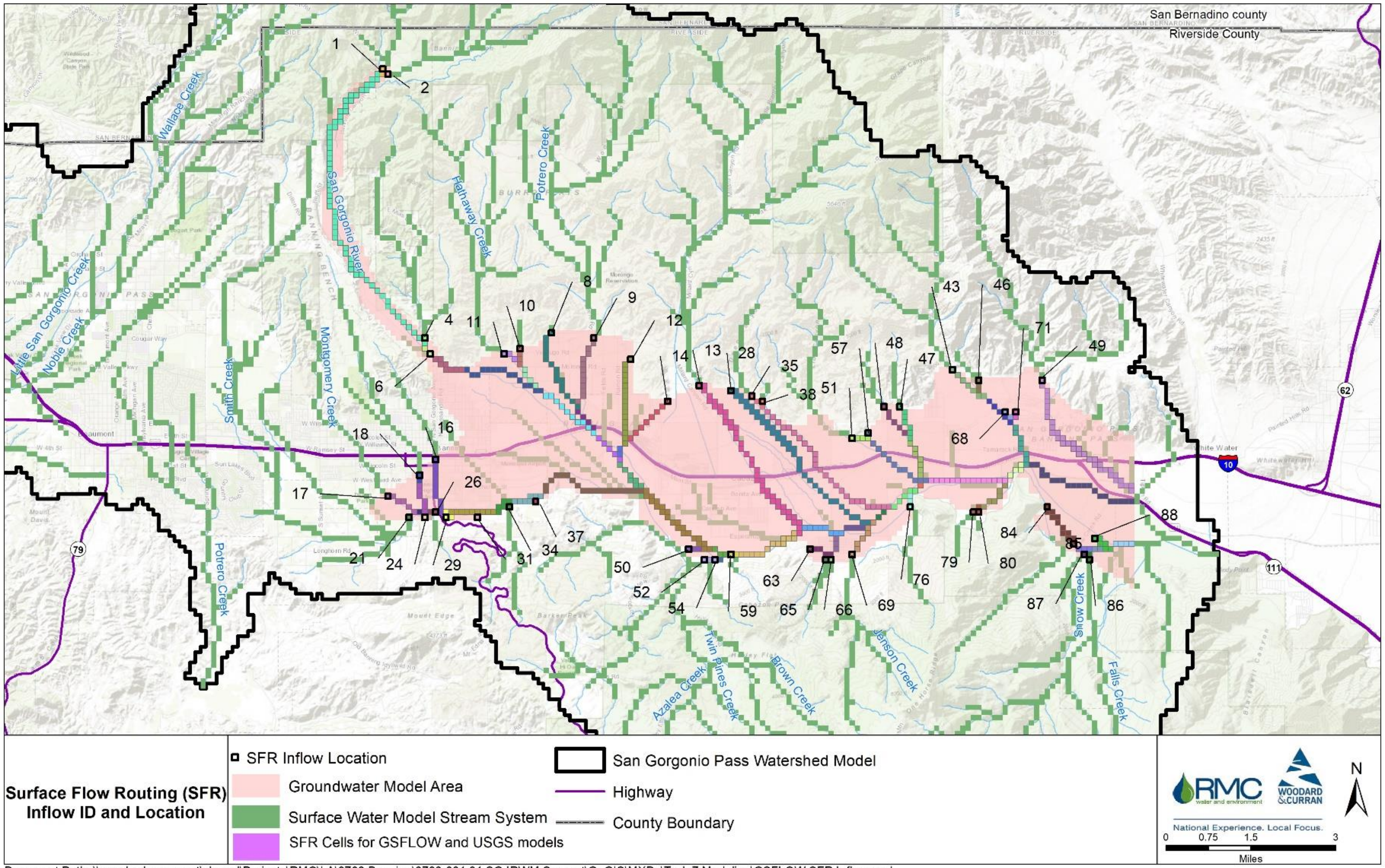

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Figure 6 – Recharge Rates from UM to LM

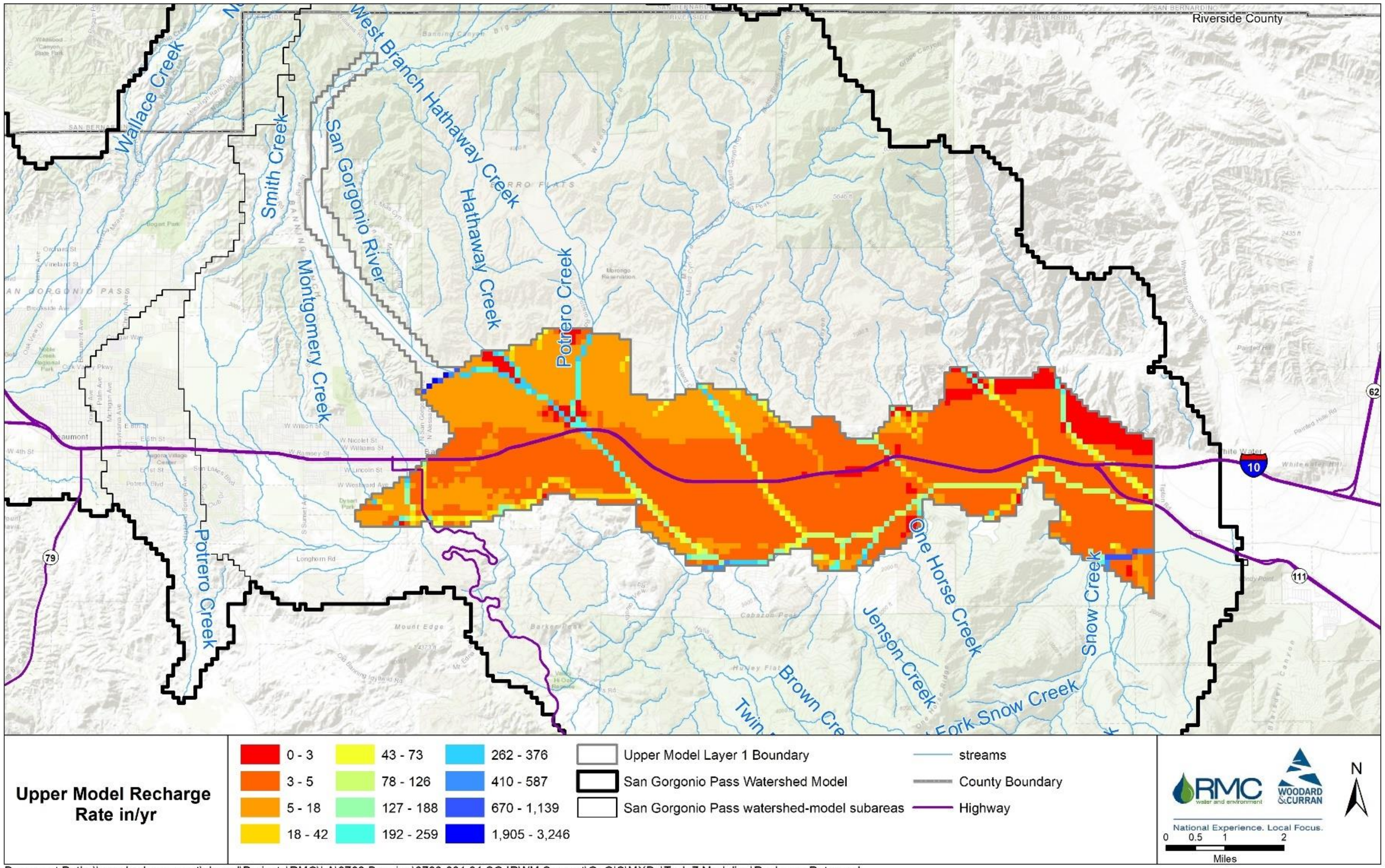

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Figure 7 – UM Cross Section A4-A4’

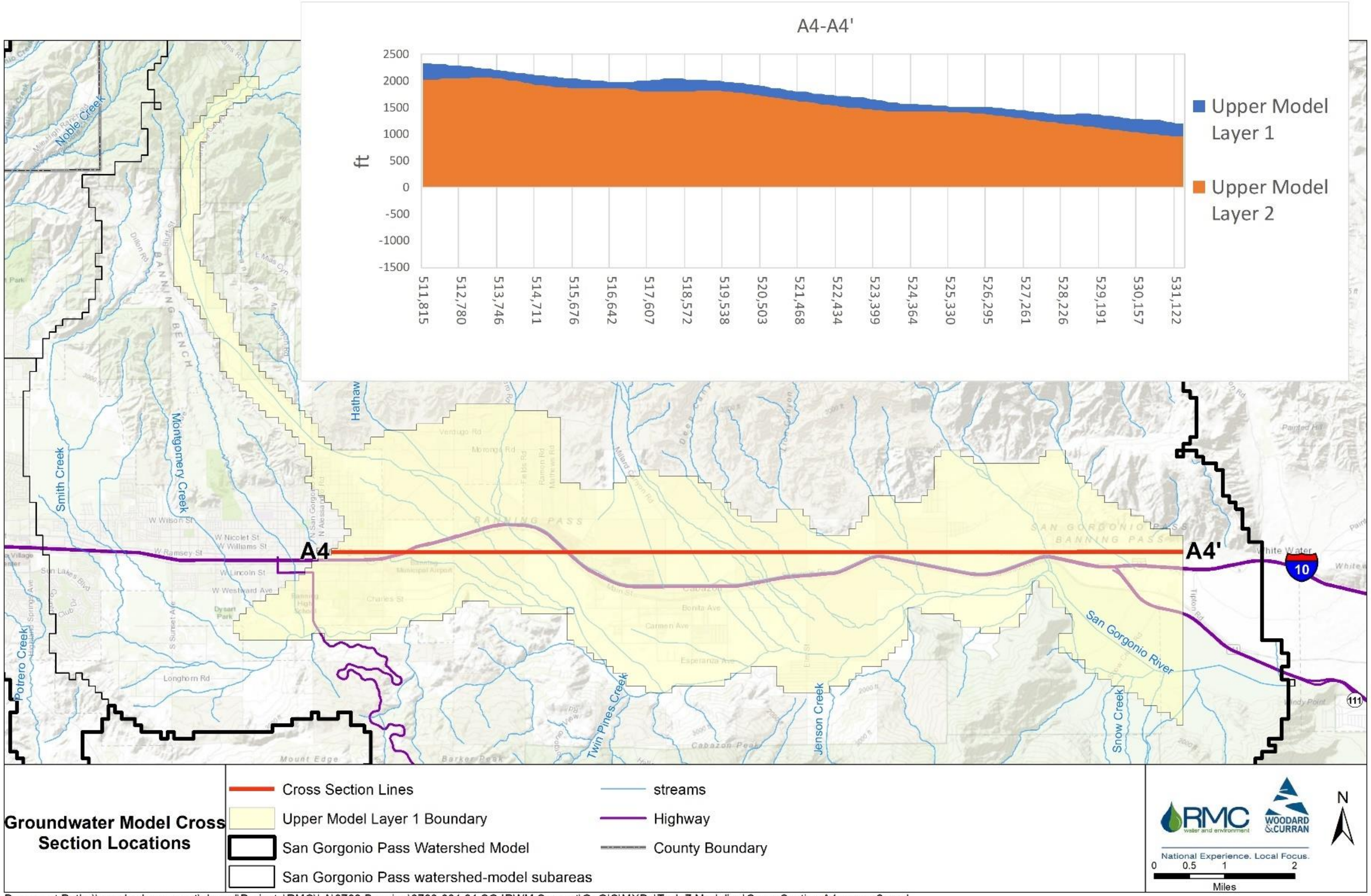

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Figure 8 – Aquifer Parameter Zones for UM

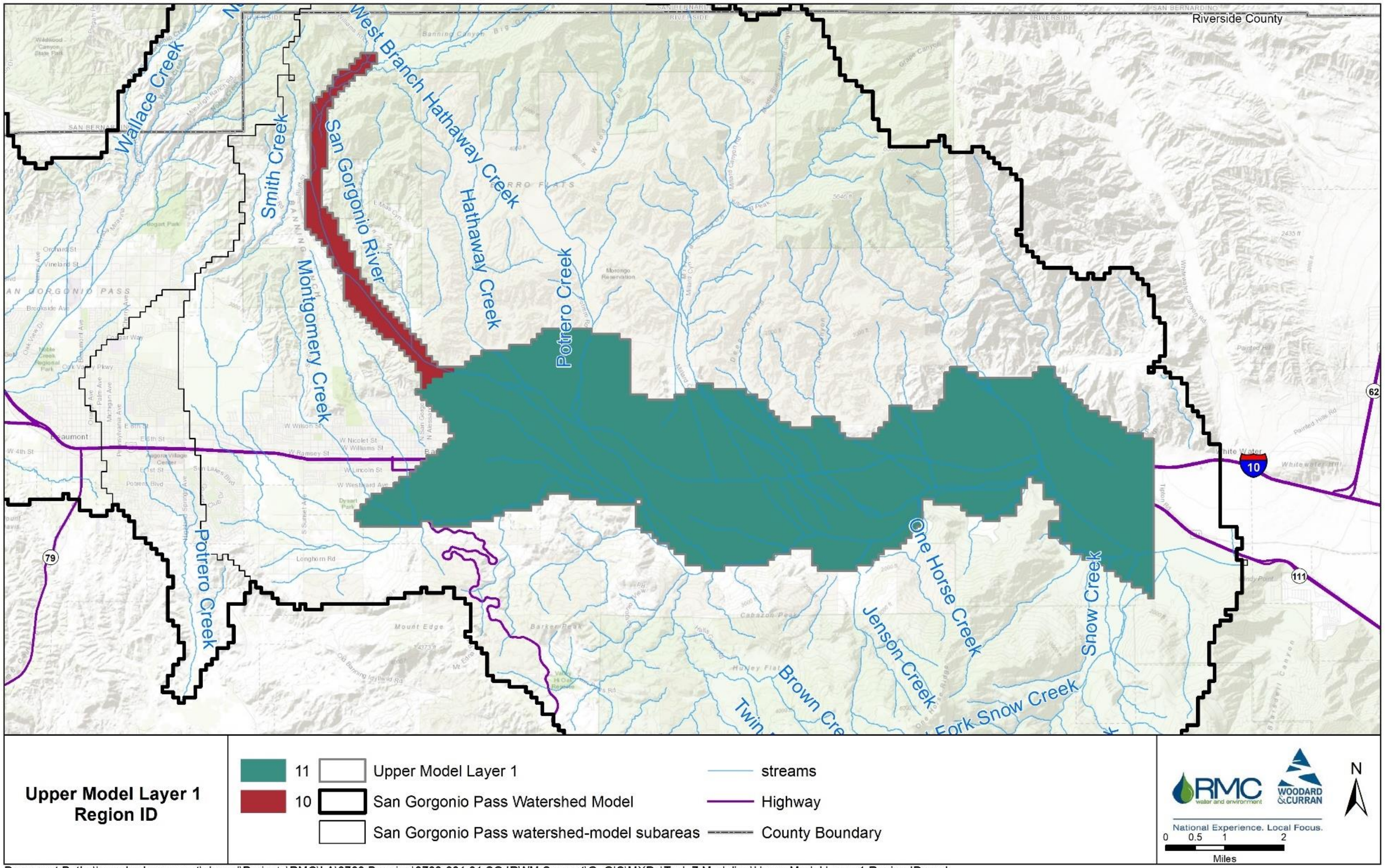

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Figure 9 – LM Features

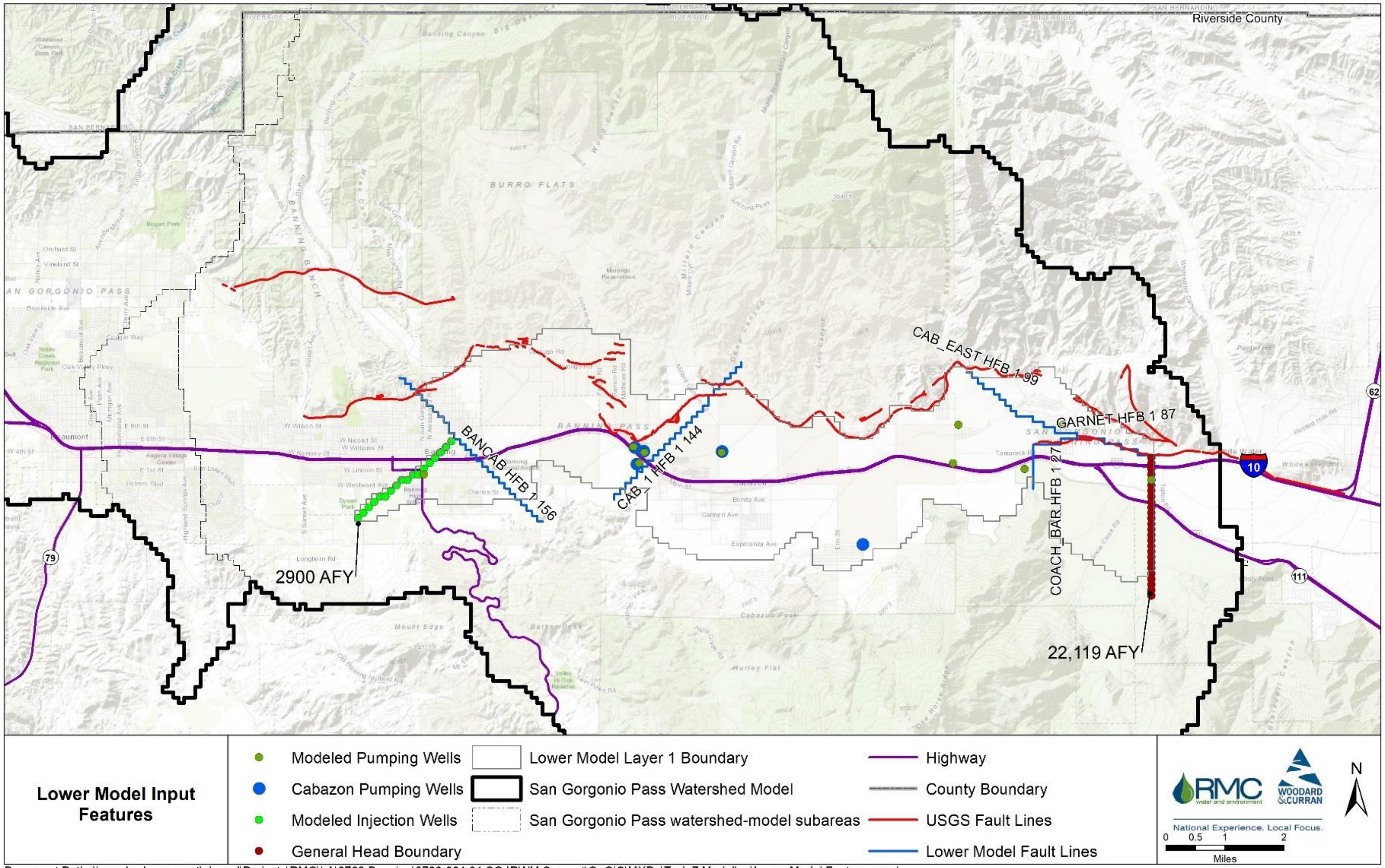

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Figure 10 – LM Cross Section A4-A4’

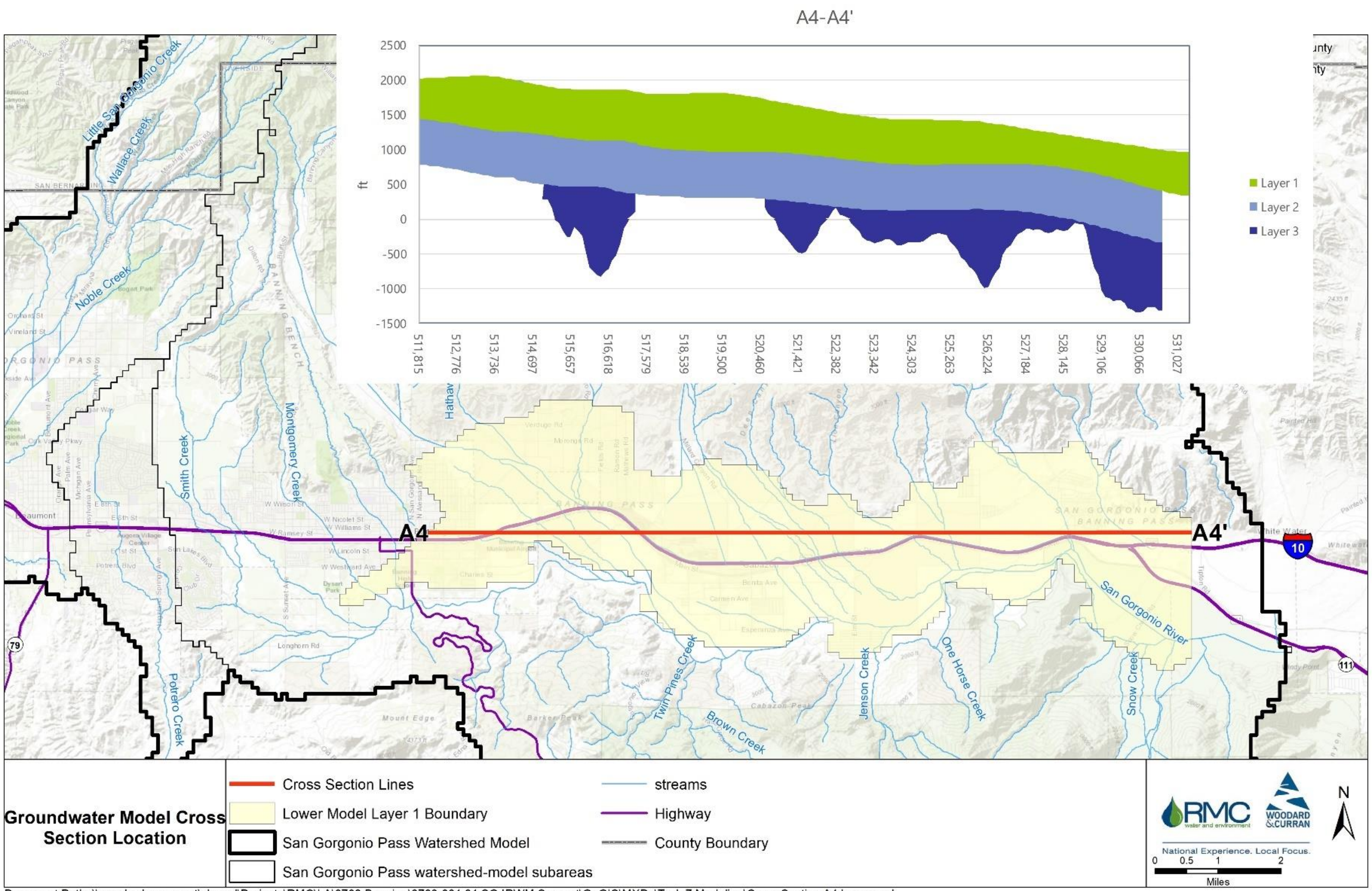

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Figure 11 – Aquifer Parameter Zones for Layer 1 of LM

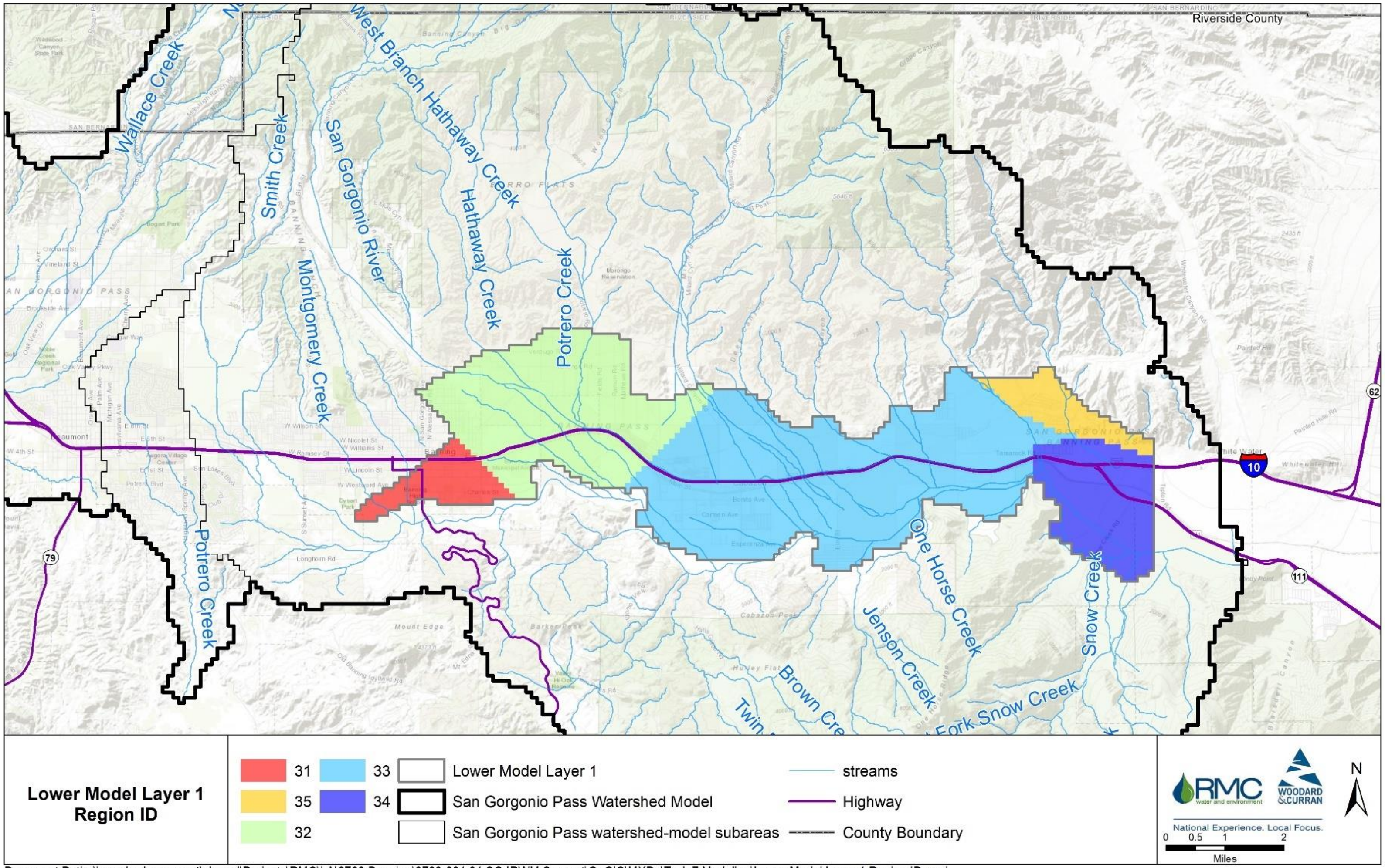

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Figure 12 – Aquifer Parameter Zones for Layer 2 of LM

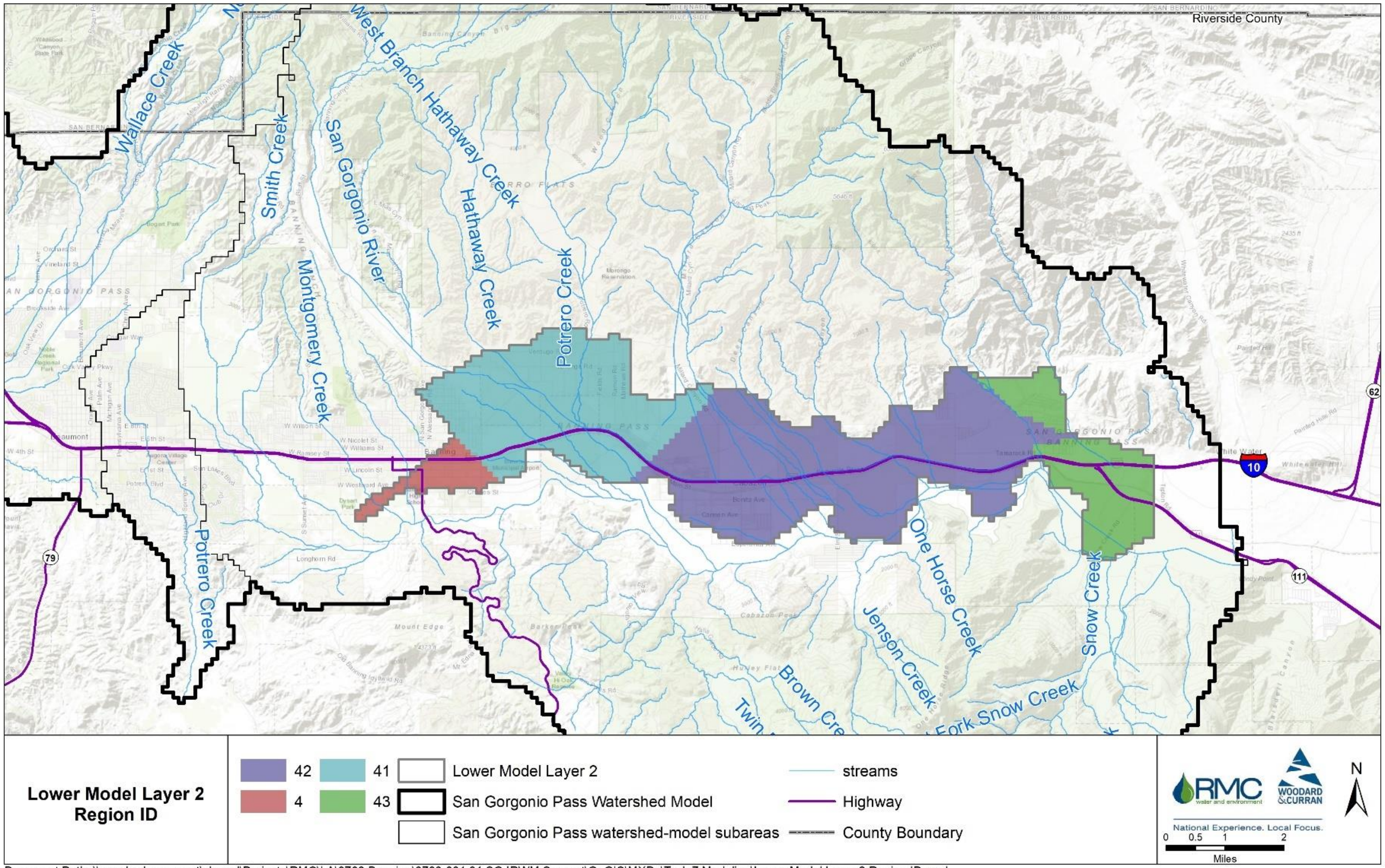

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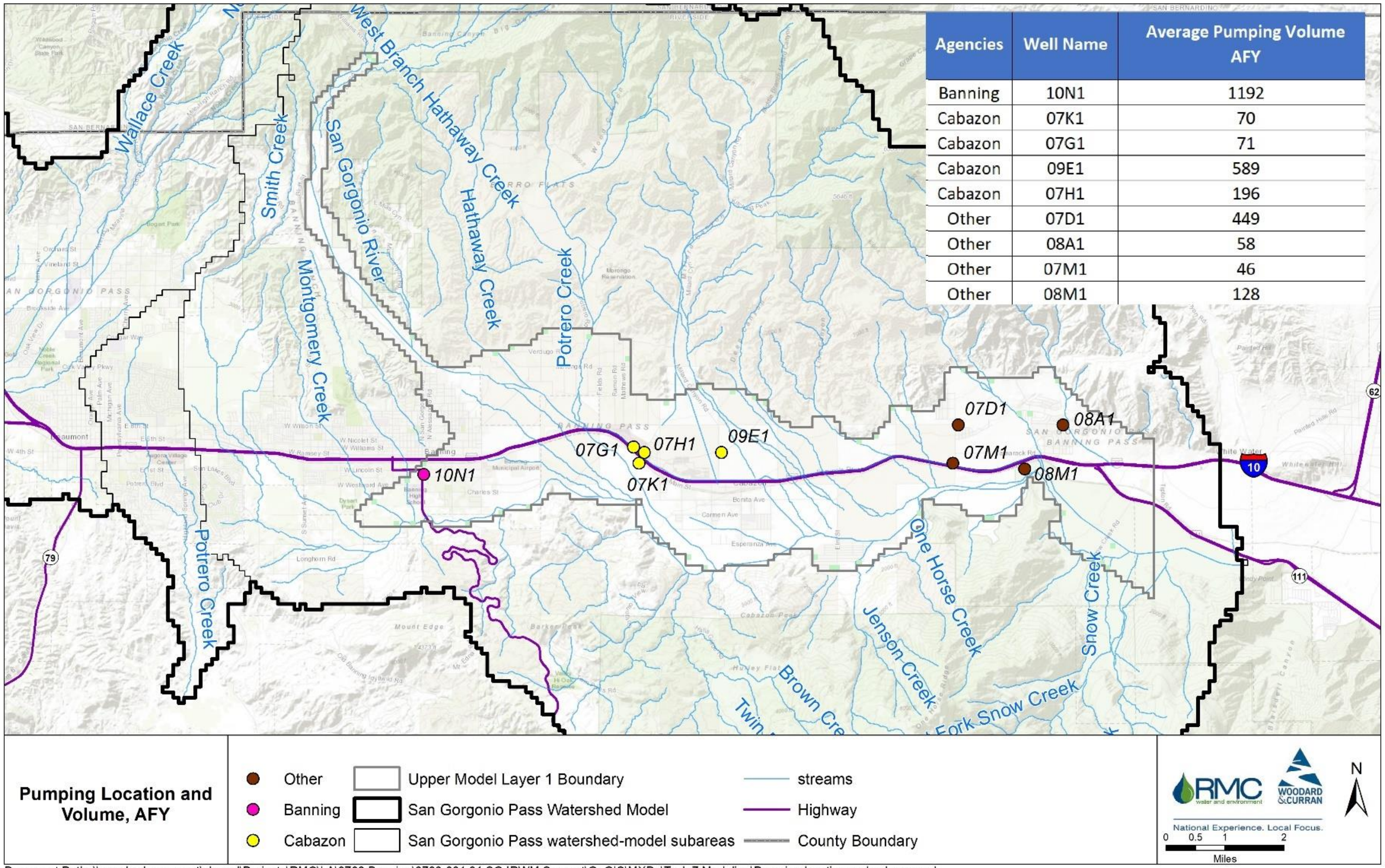
Figure 13 – Location of Wells and Average Pumping Rates for 2010-2012 period in LM



Agencies	Well Name	Average Pumping Volume AFY
Banning	10N1	1192
Cabazon	07K1	70
Cabazon	07G1	71
Cabazon	09E1	589
Cabazon	07H1	196
Other	07D1	449
Other	08A1	58
Other	07M1	46
Other	08M1	128

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Figure 14 – Schematic Diagram of the Exchange of Flow Among the Three Regions in GSFLOW (Markstrom, et al. 2008)
(The Dependency on soil moisture and head in the computation of flow among the regions also is shown)

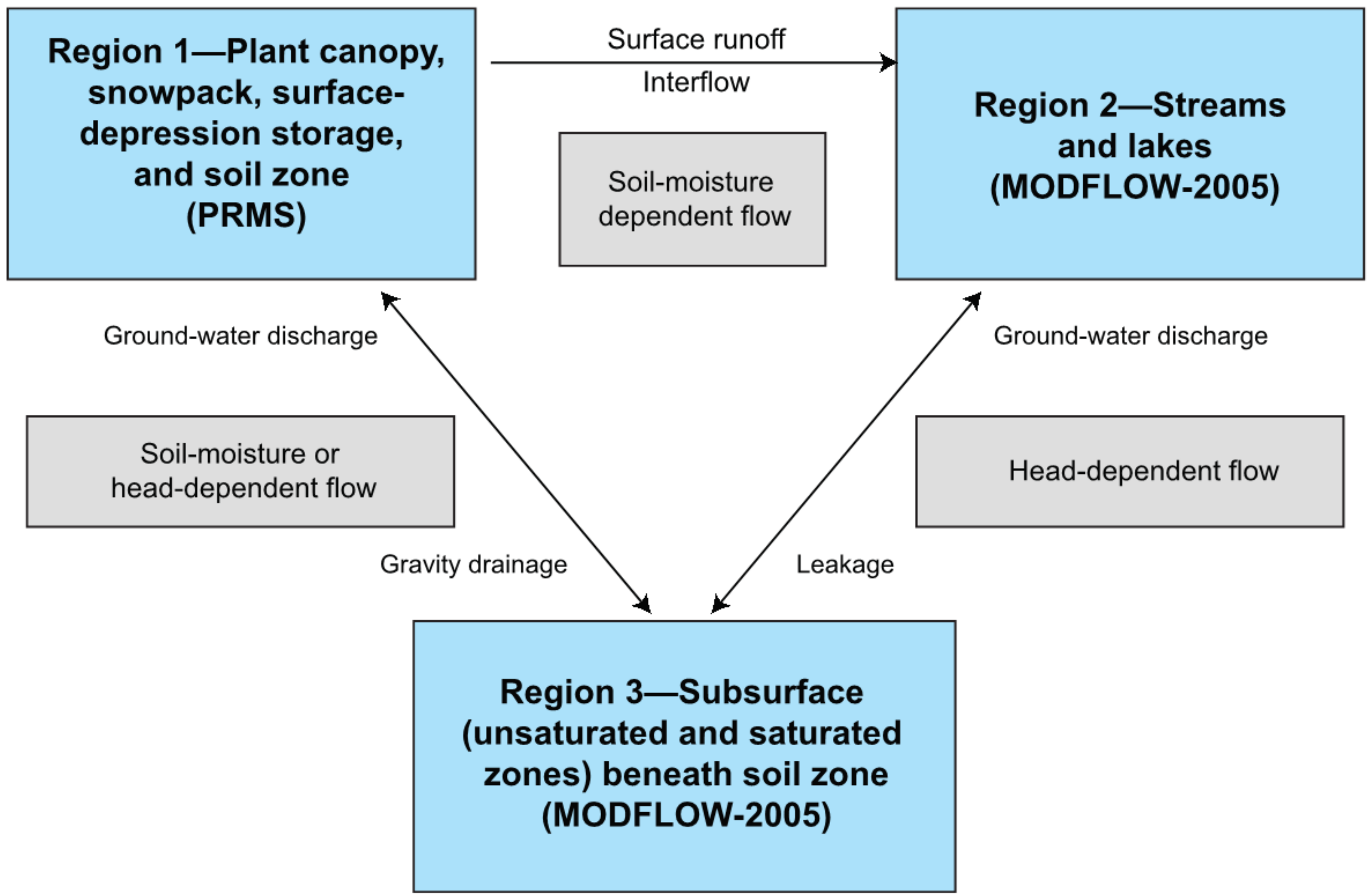

Figure 15 – SGIWGM Components of Surface Water (PRMS) and Groundwater Model (MODFLOW)

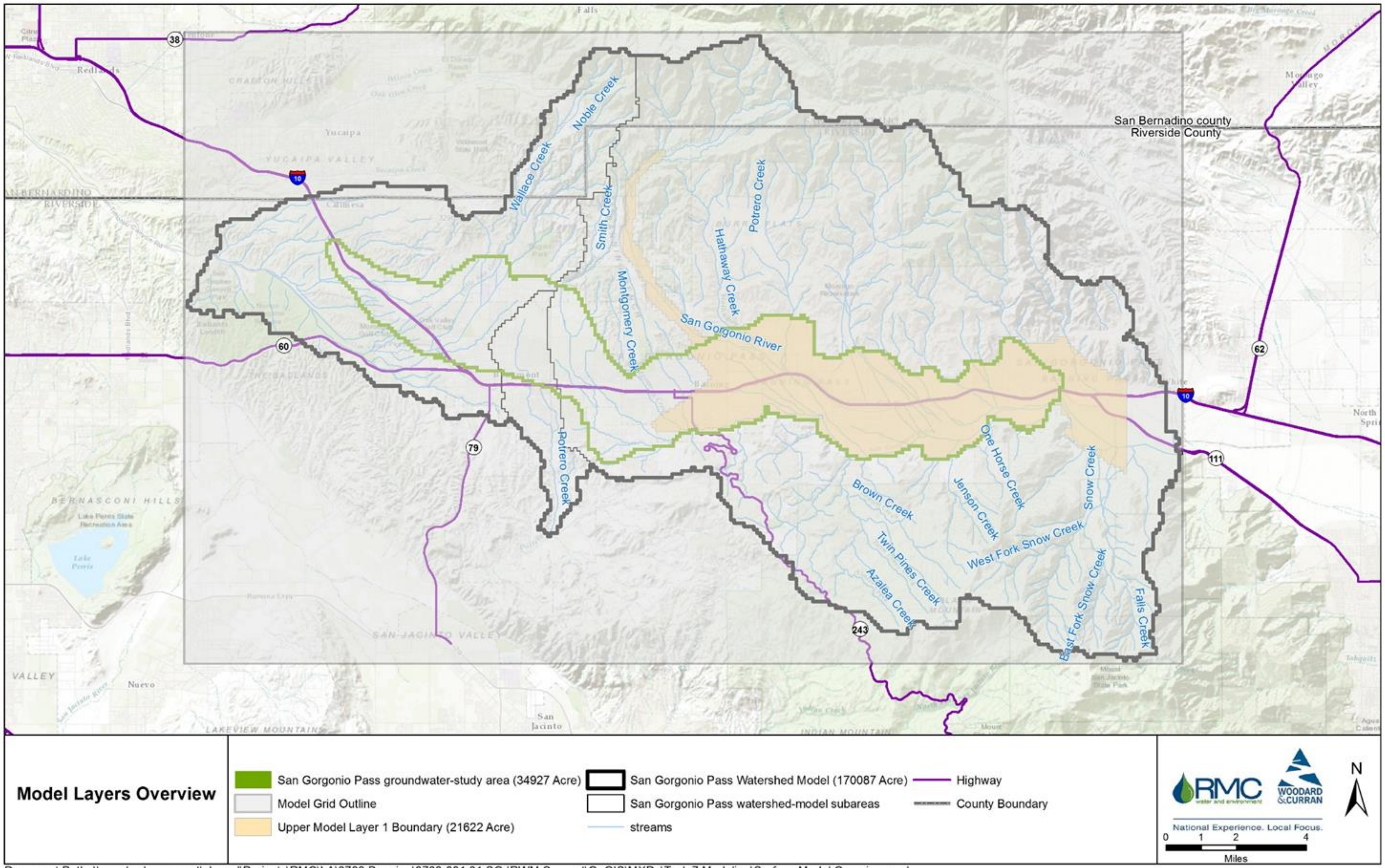

Figure 16 – SGIWGM Flow Cascade Configuration

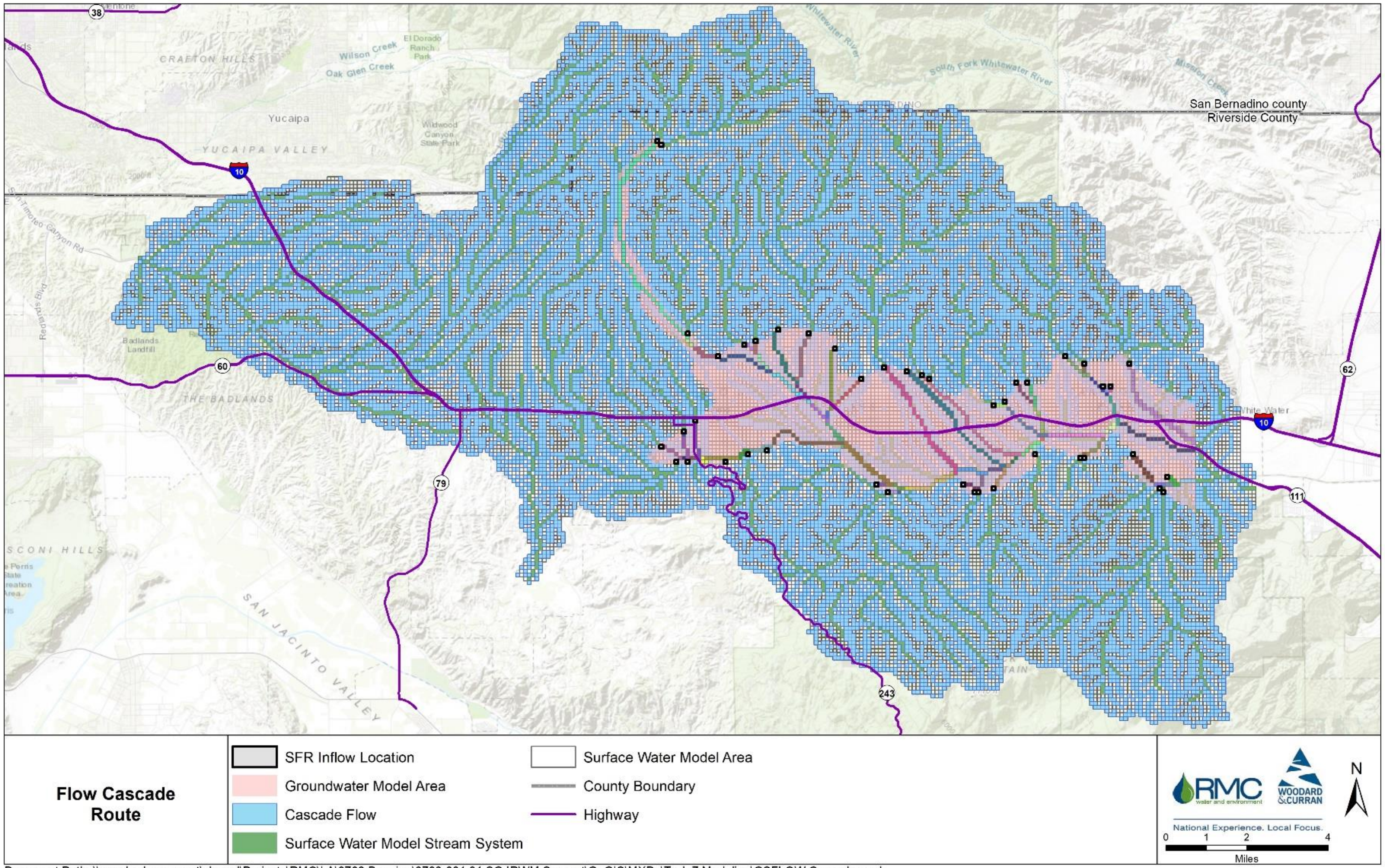

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Figure 17 – SGIWGM Stream Configuration

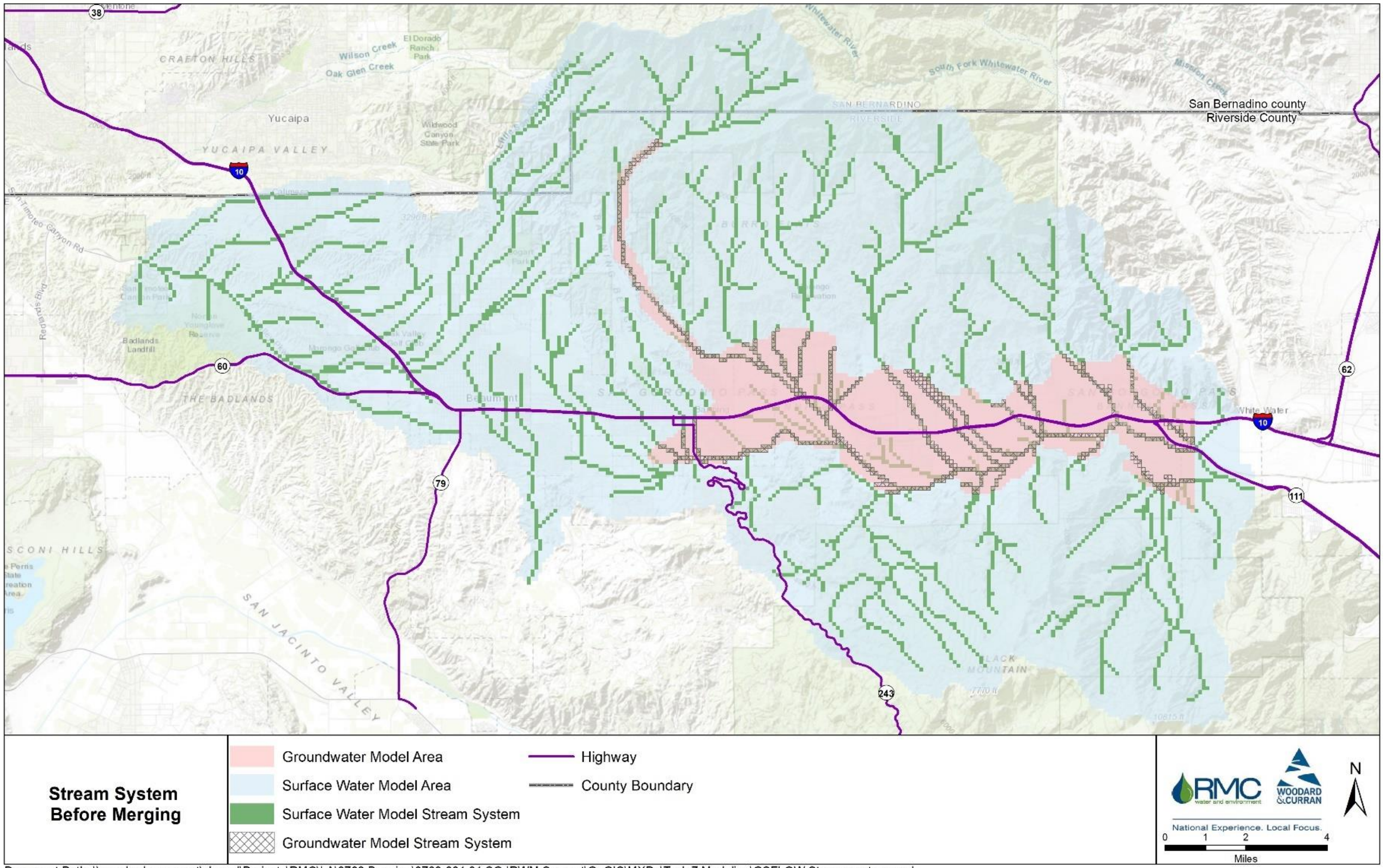

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Figure 18 – SGIWGM Streamflow Inflow Locations

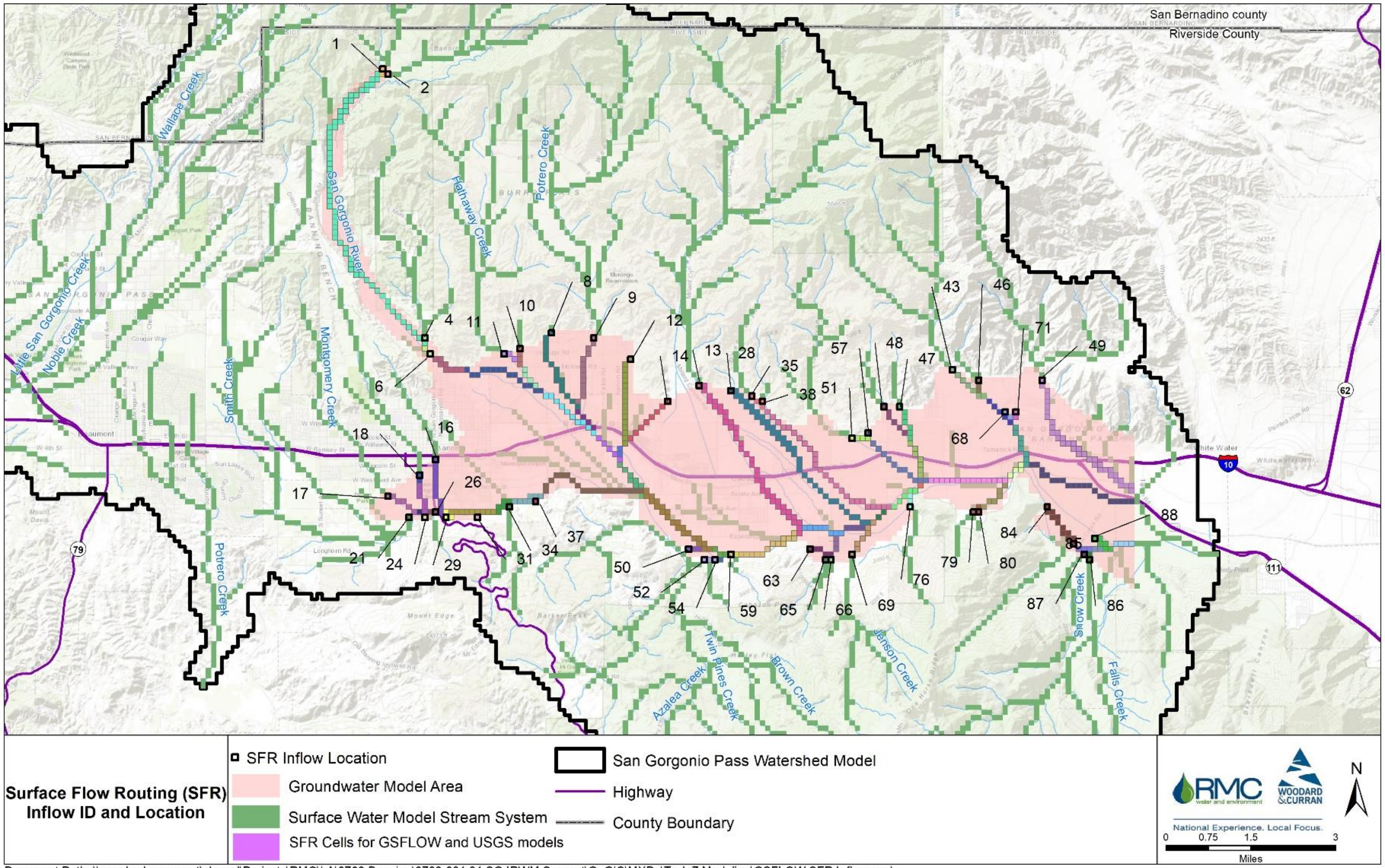

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Figure 19 – PRMS Average Precipitation (30 years, 1983-2012)
(Note: Groundwater study area refers to USGS model)

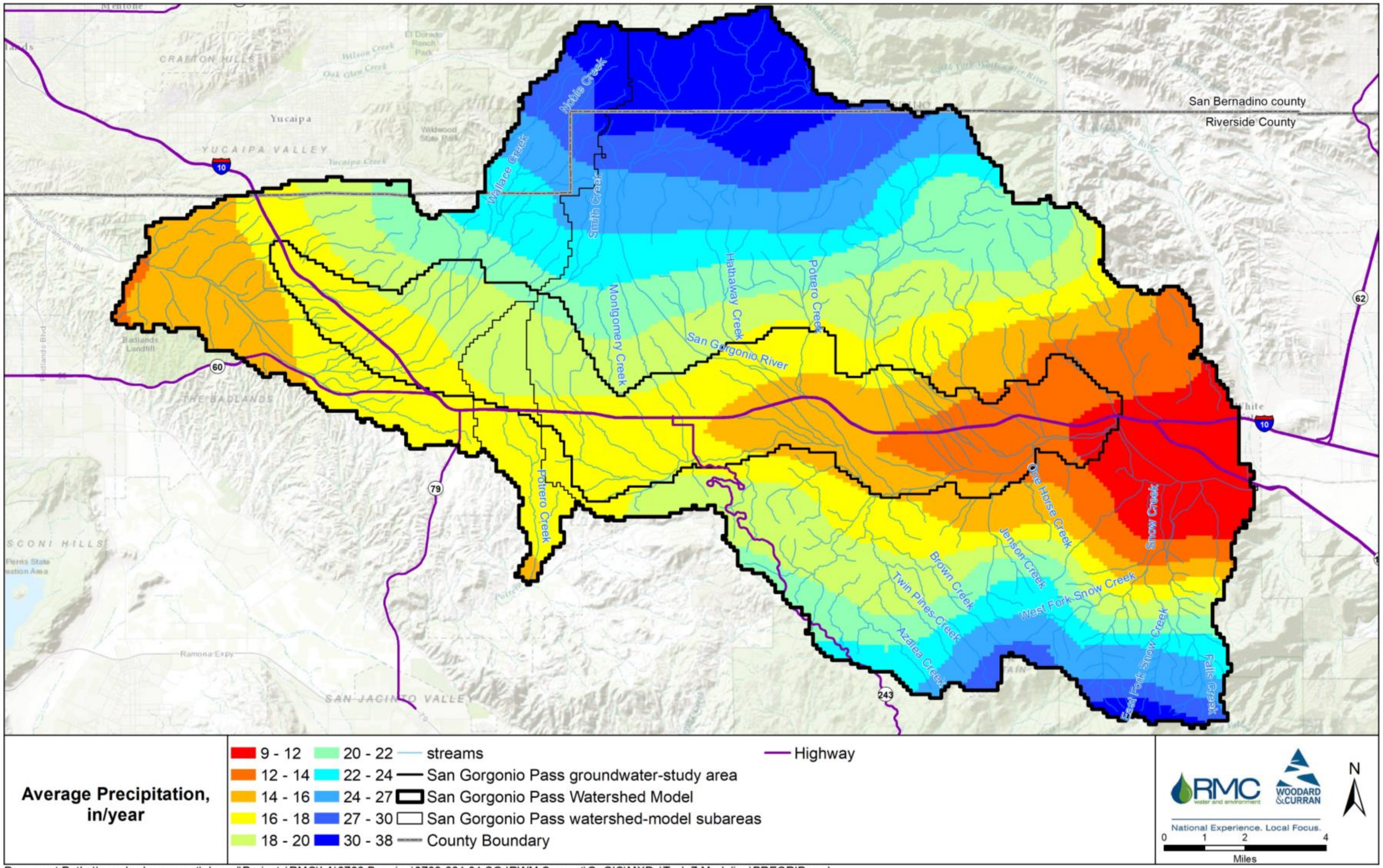

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Figure 20 – PRMS Average Potential Evapotranspiration (30 years, 1983-2012)
(Note: Groundwater study area refers to USGS model)

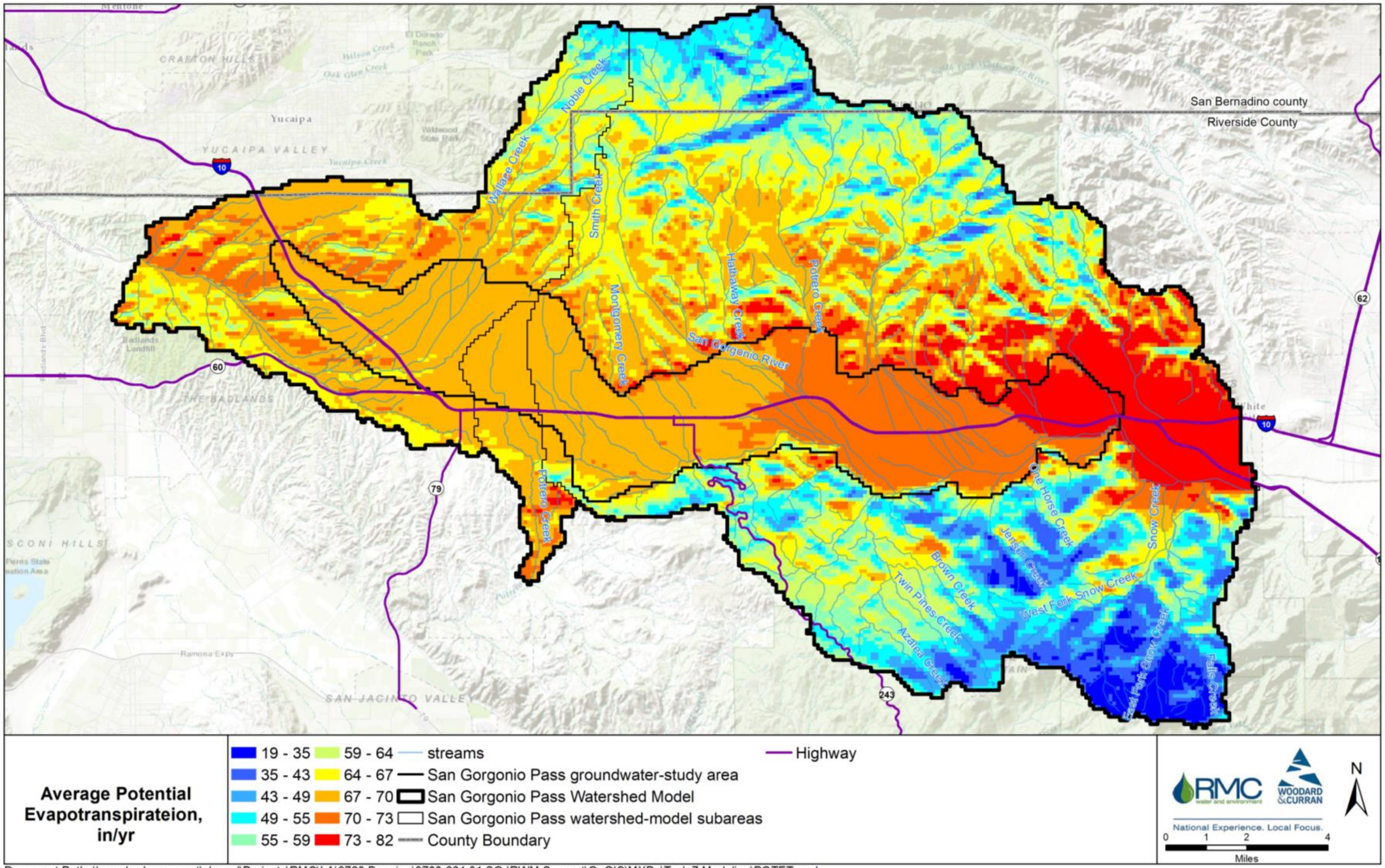

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Figure 21 – PRMS Average Imperviousness (%)
Year 2001 Data

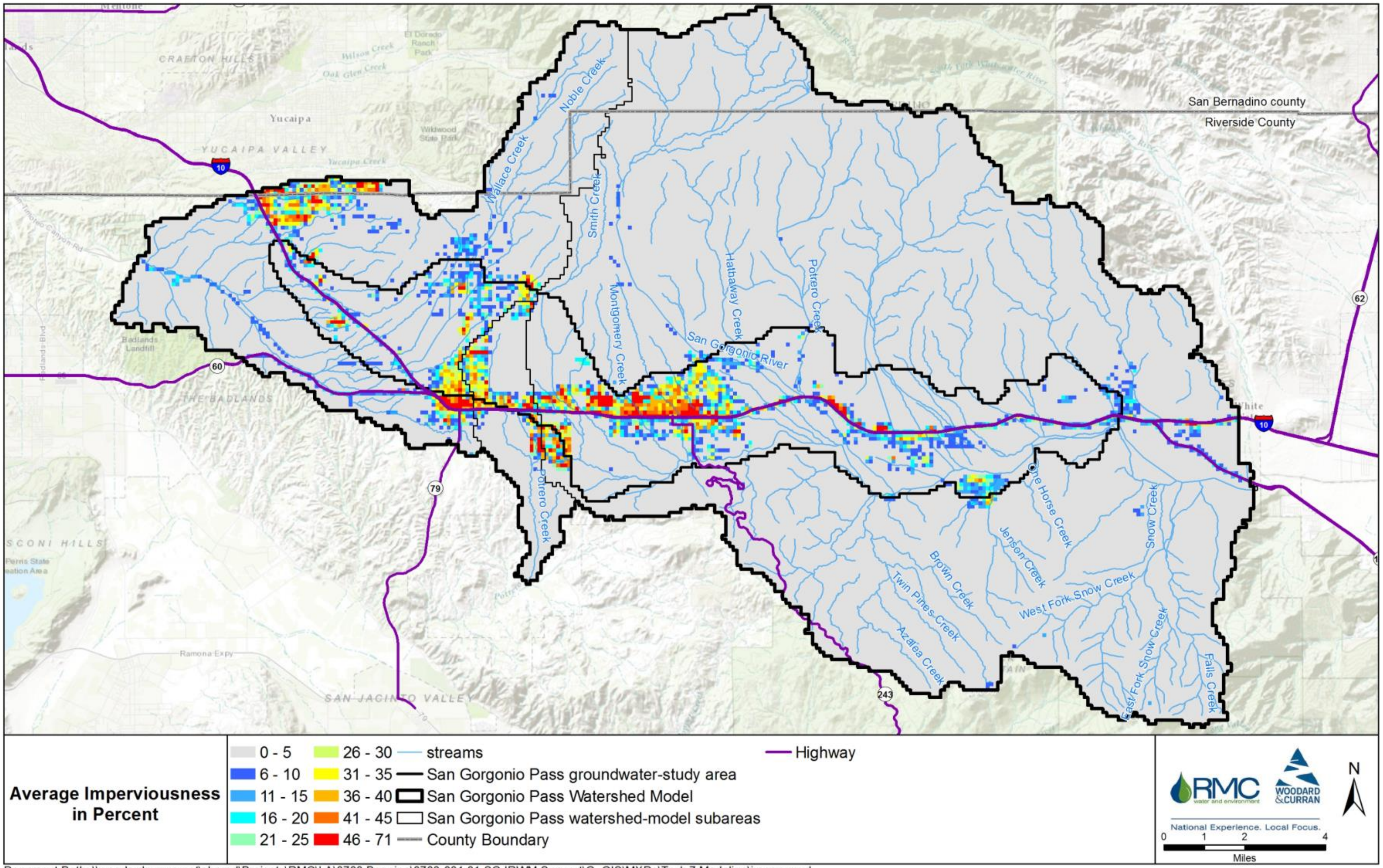

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Figure 22 – PRMS Average Temperature, °F (30 years, 1983-2012)
(Note: Groundwater study area refers to USGS model)

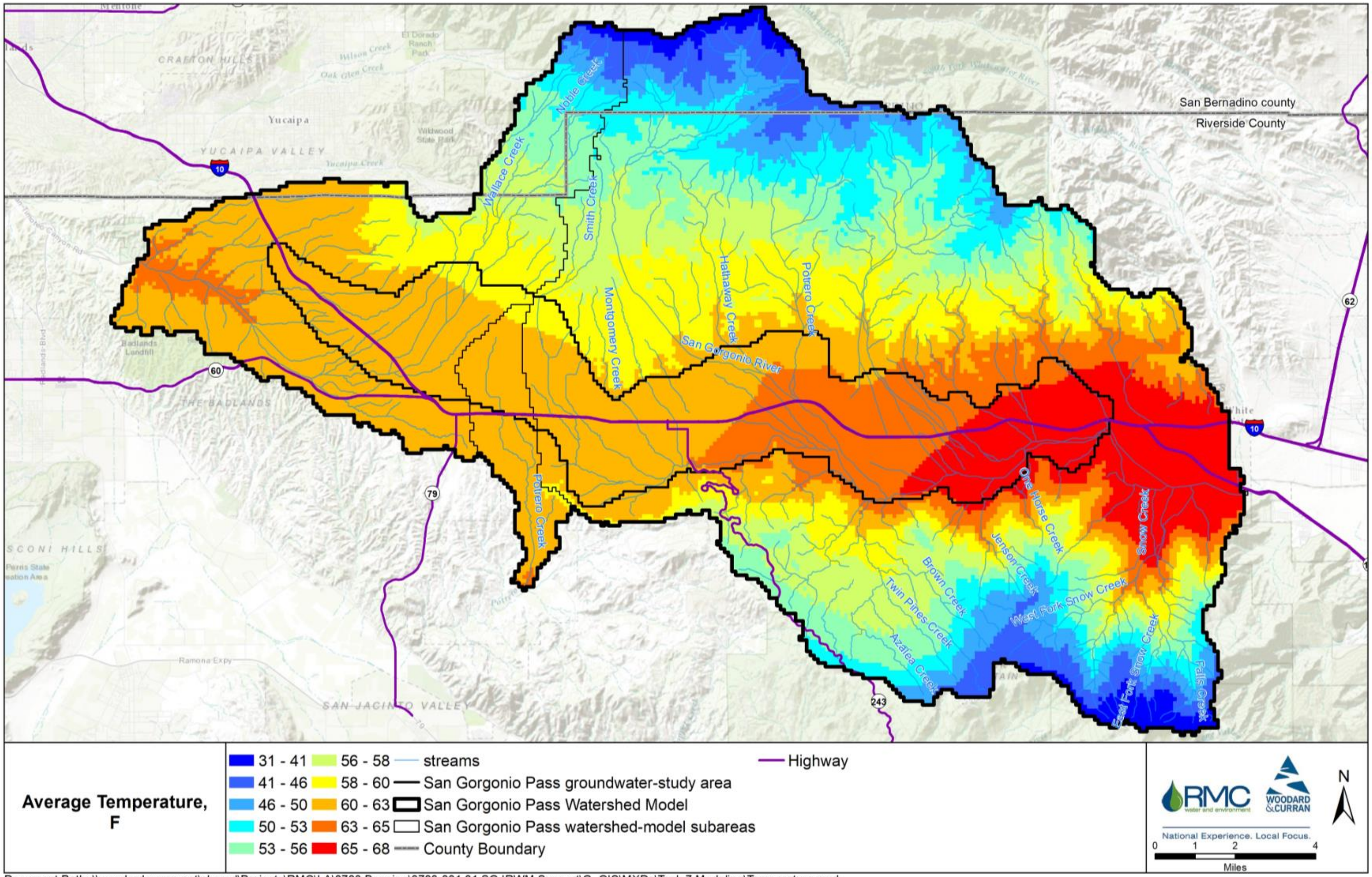

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Figure 23 – PRMS Average ET, in/yr (30 years, 1983-2012)

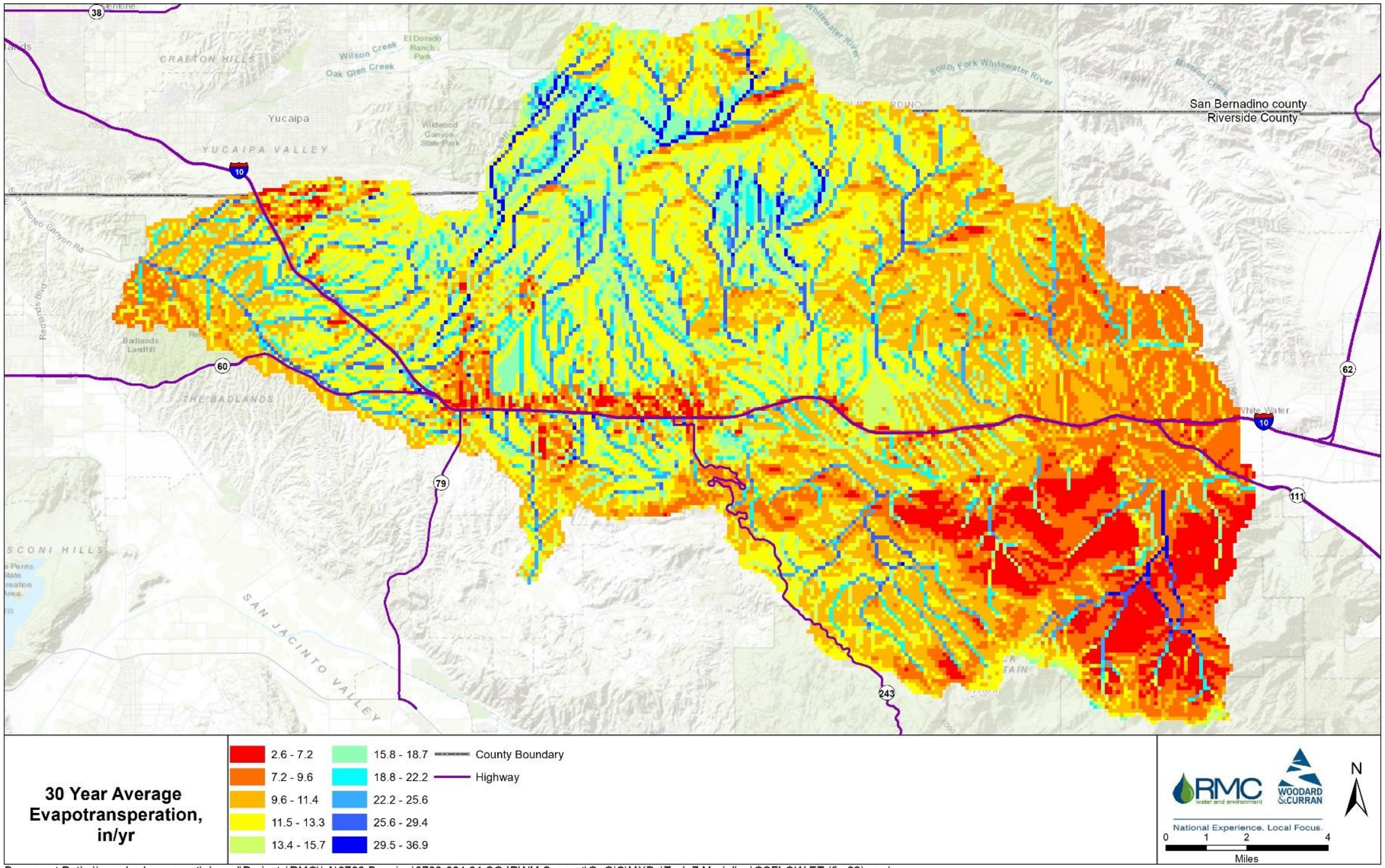

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Figure 24 – PRMS Simulated Annual ET, average across all model cells (in/yr)
(Annual cumulative departure from mean annual rain (CD) is provided as a reference)

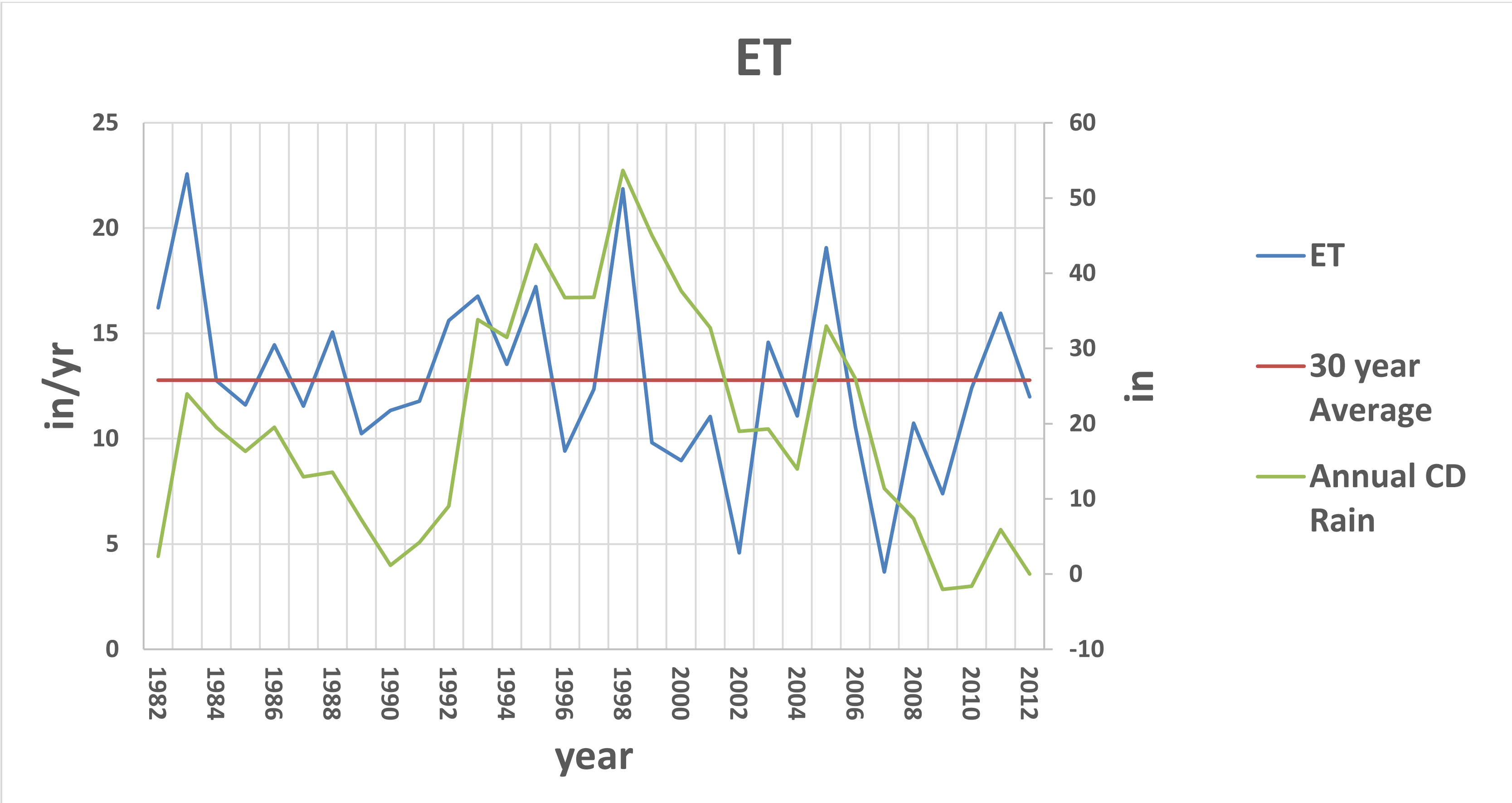

Figure 25 – PRMS Simulated Annual Runoff, average across all model cells (in/yr)
(Annual cumulative departure from mean annual rain (CD) is provided as a reference)

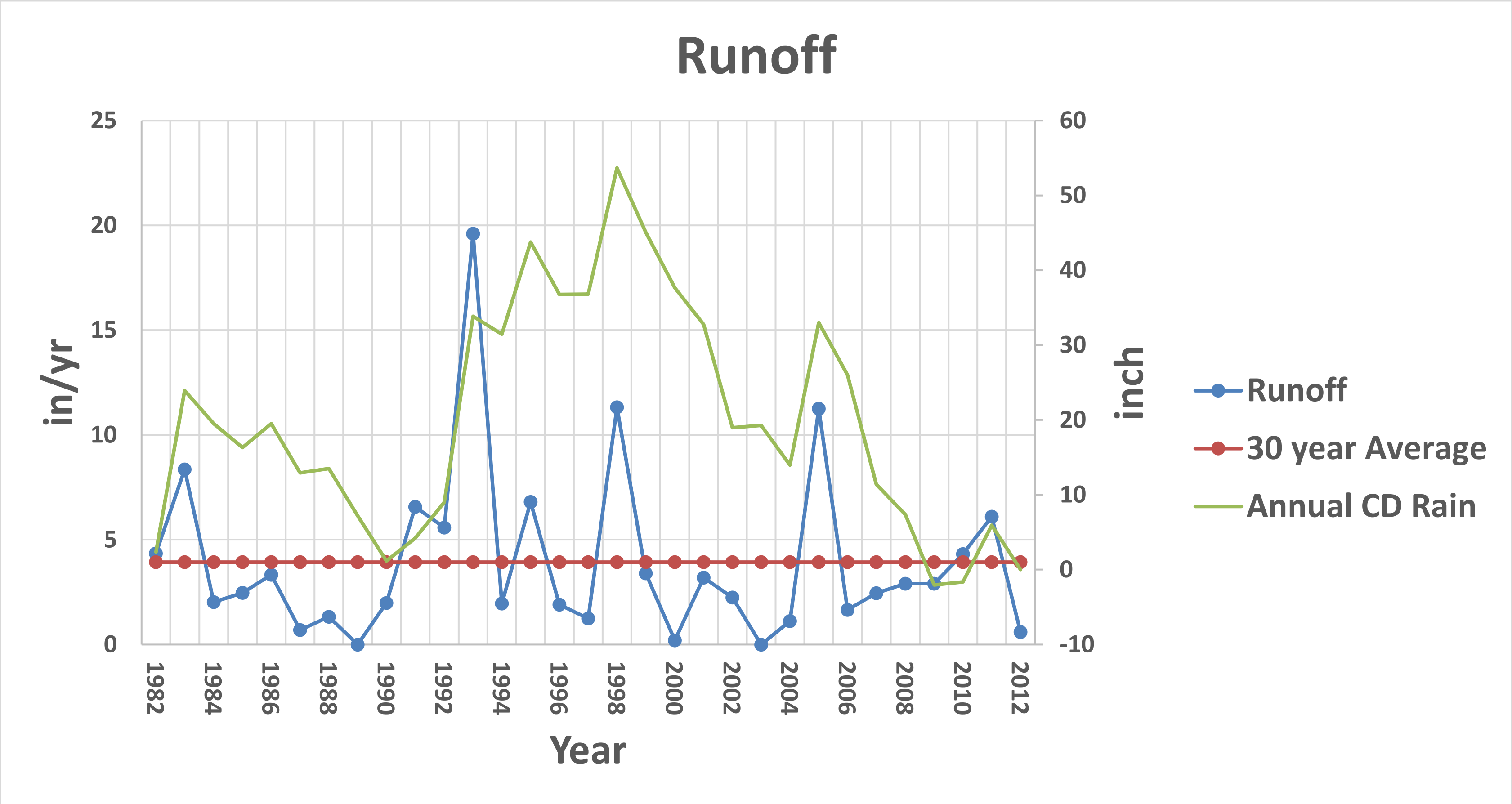

Figure 26 – PRMS Simulated Annual Recharge, average across all model cells (in/yr)
(Annual cumulative departure from mean annual rain (CD) is provided as a reference)

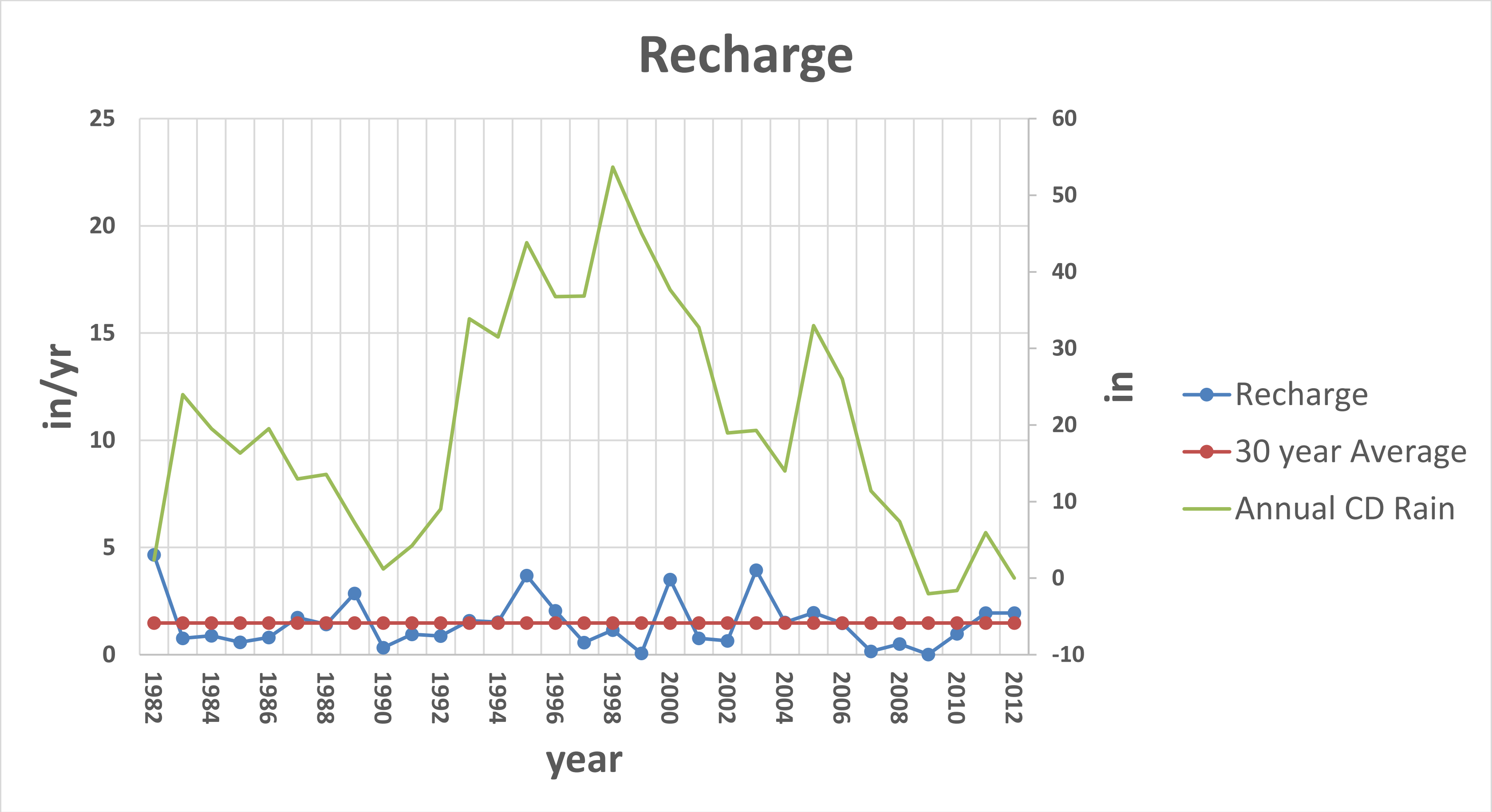

Figure 27 – PRMS Average Runoff, in/yr (30 years, 1983-2012)

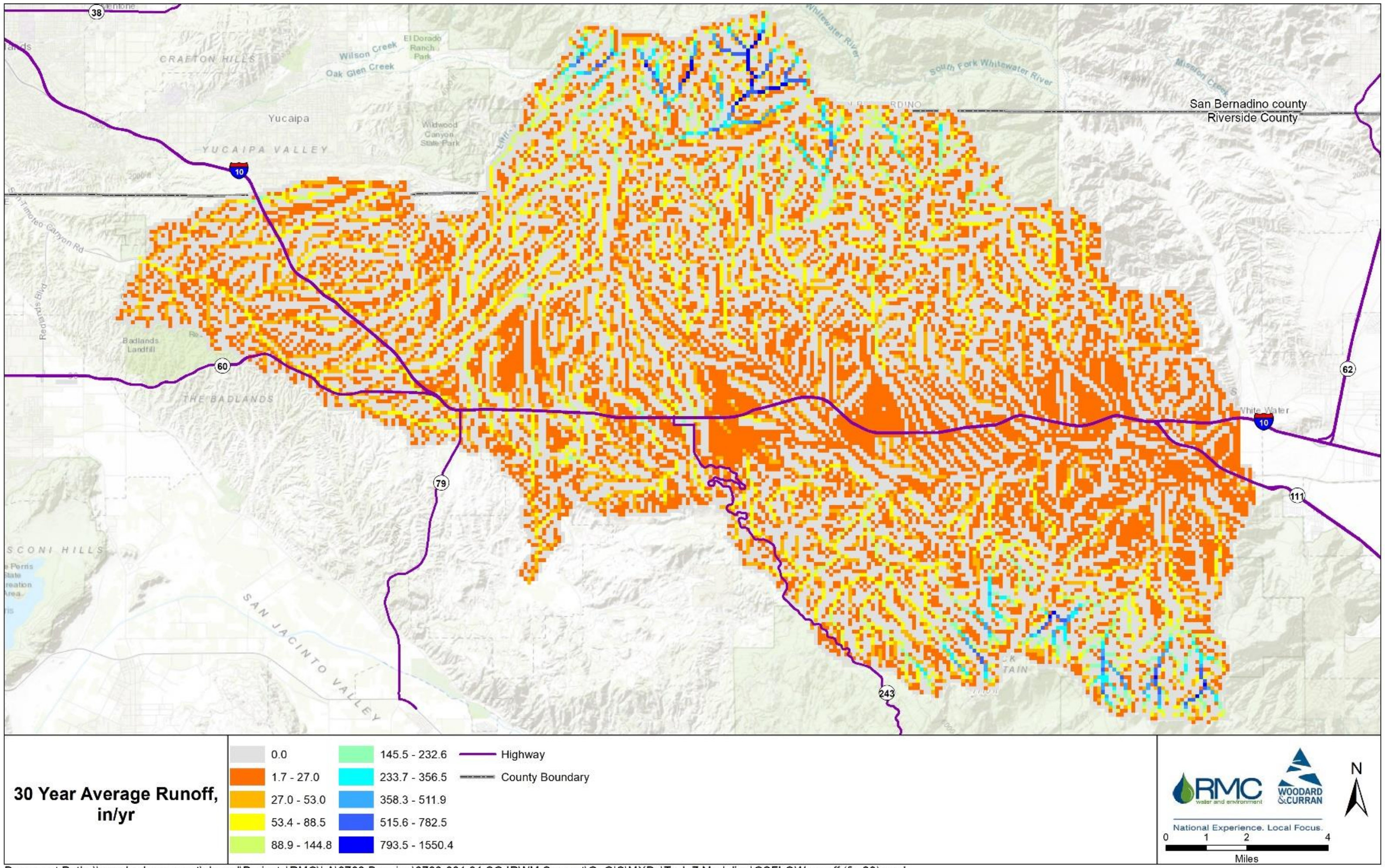

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Figure 28 – PRMS Average Recharge, in/yr (30 years, 1983-2012)

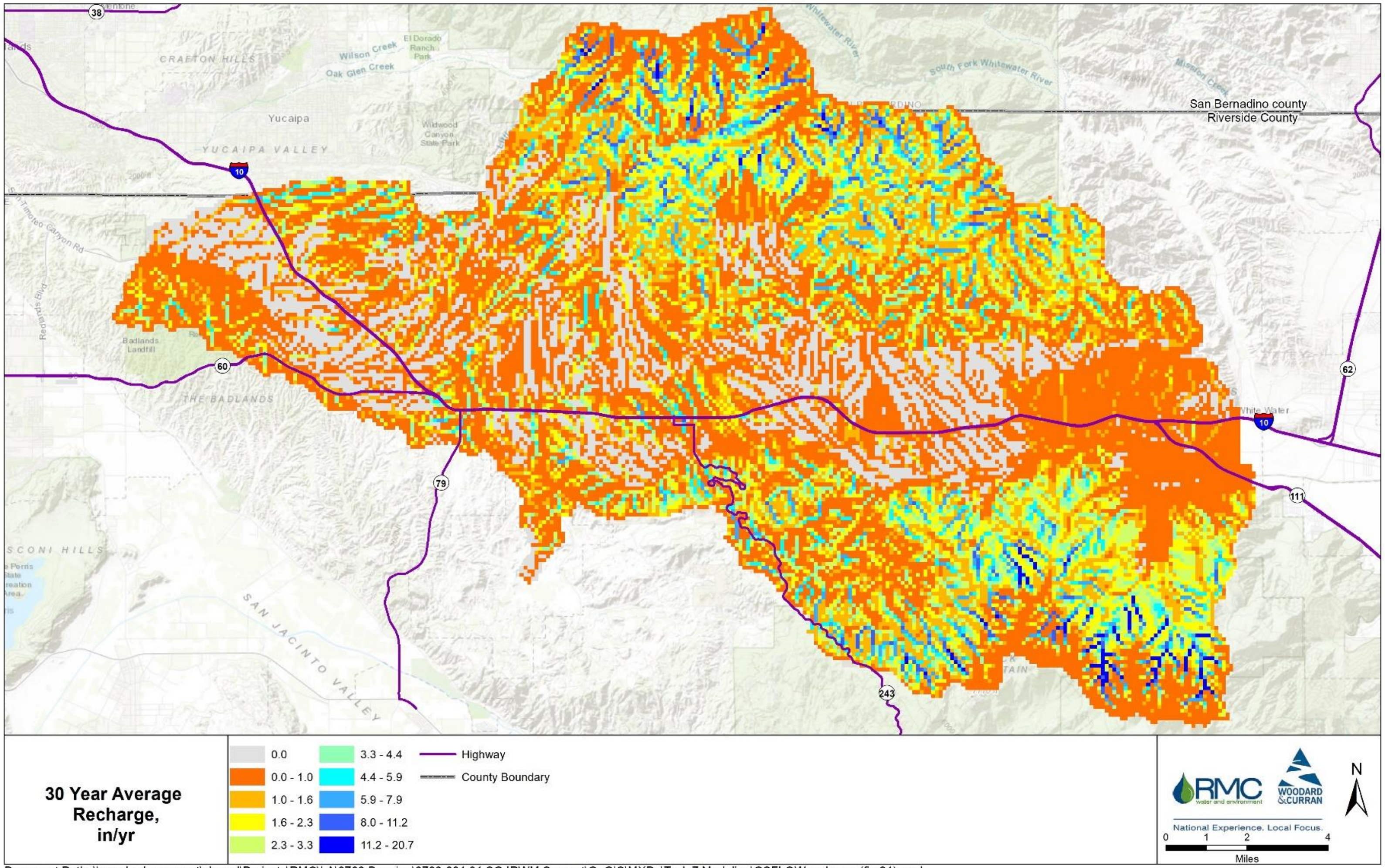

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Figure 29 – PRMS Simulated Recharge for 1993 Wet Year, AF/model cell

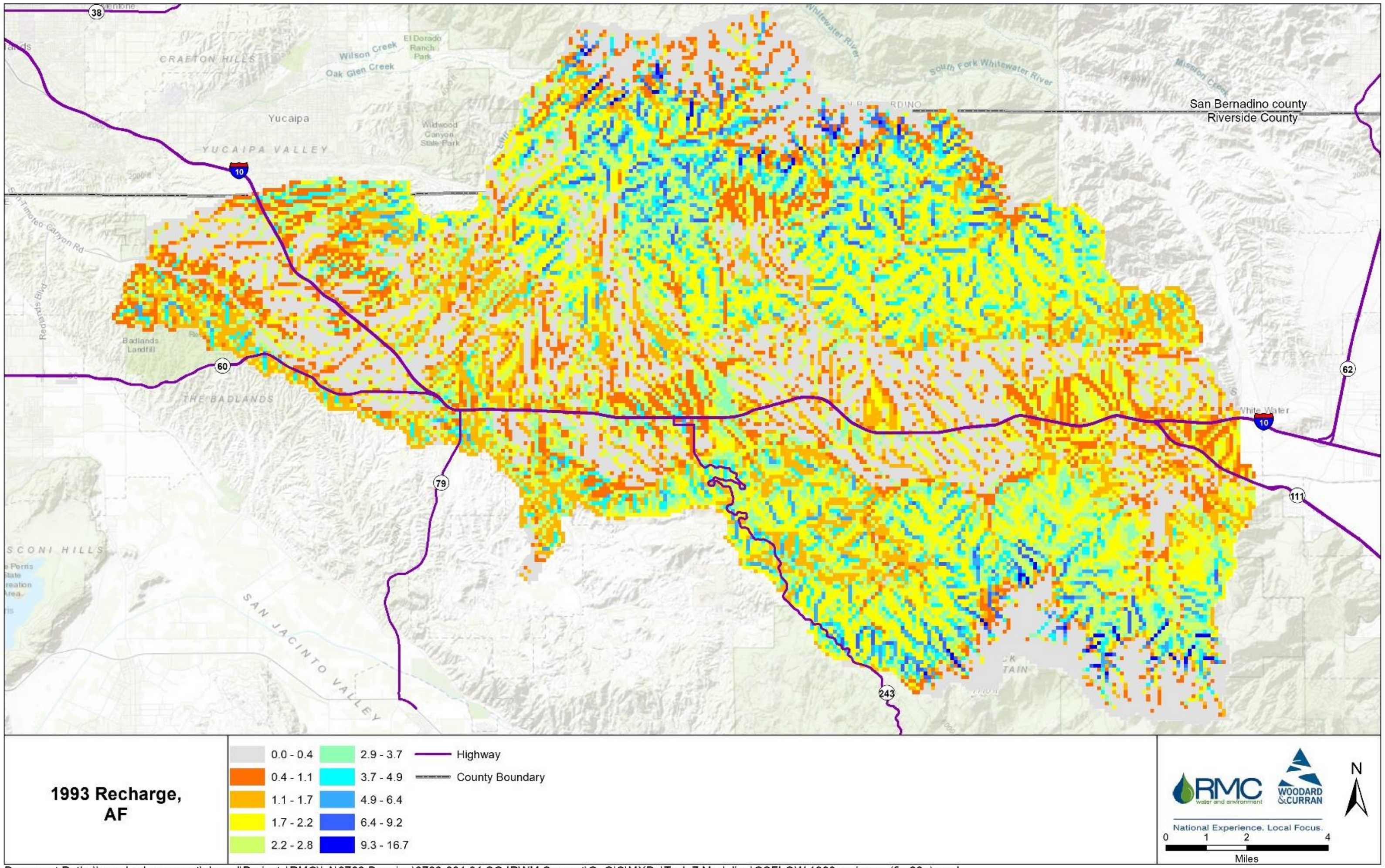

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Figure 30 – PRMS Simulated Recharge for 2004 Dry Year, AF/model cell

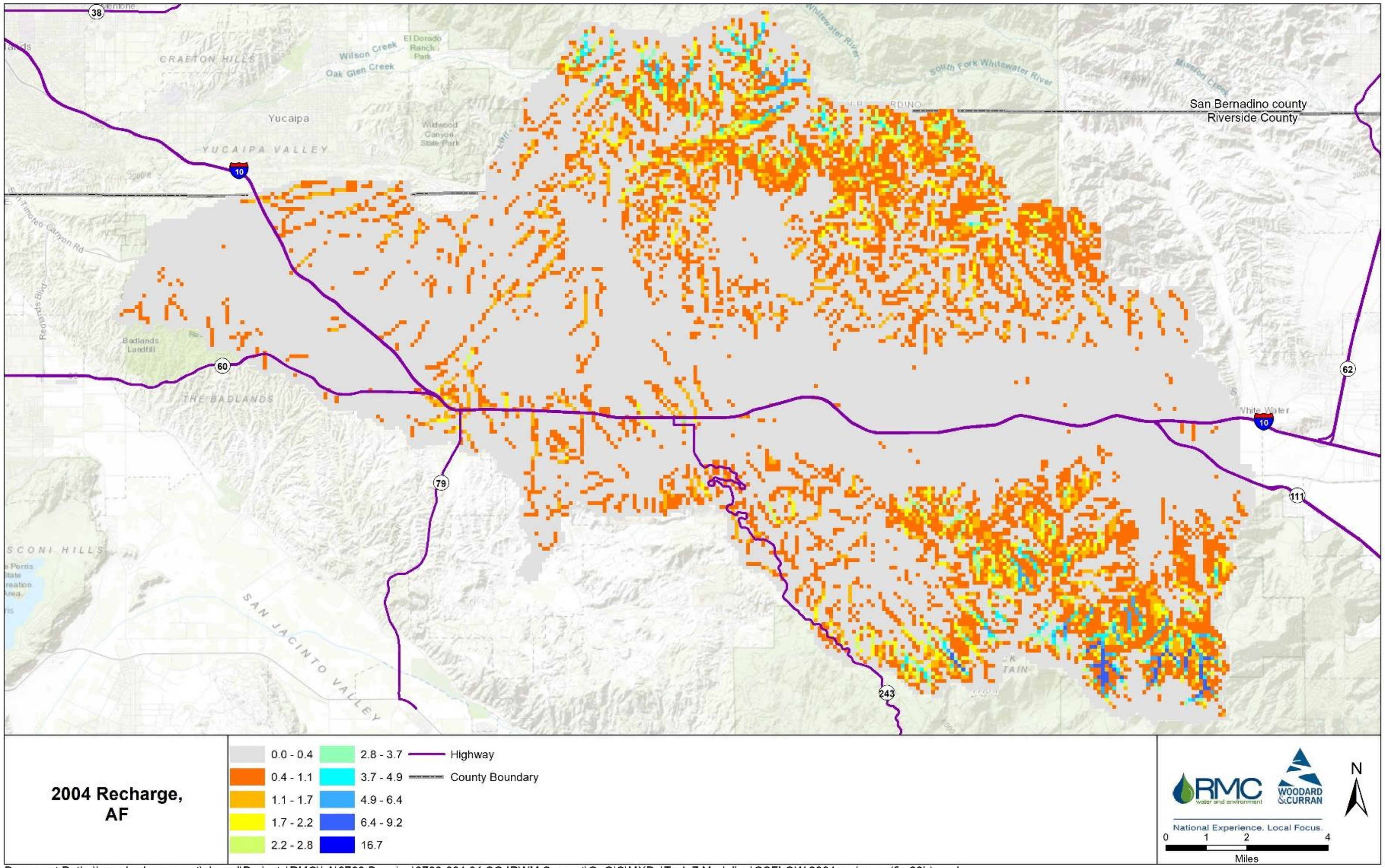

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Figure 31 – PRMS Simulated Runoff compared to INFILv3 Simulated Runoff, AFY
(PRMS simulated an average of 35,200 AFY runoff. INFILv3 simulated an average of 34,700 AFY runoff)
(Annual cumulative departure from mean annual rain (CD) is provided as a reference)

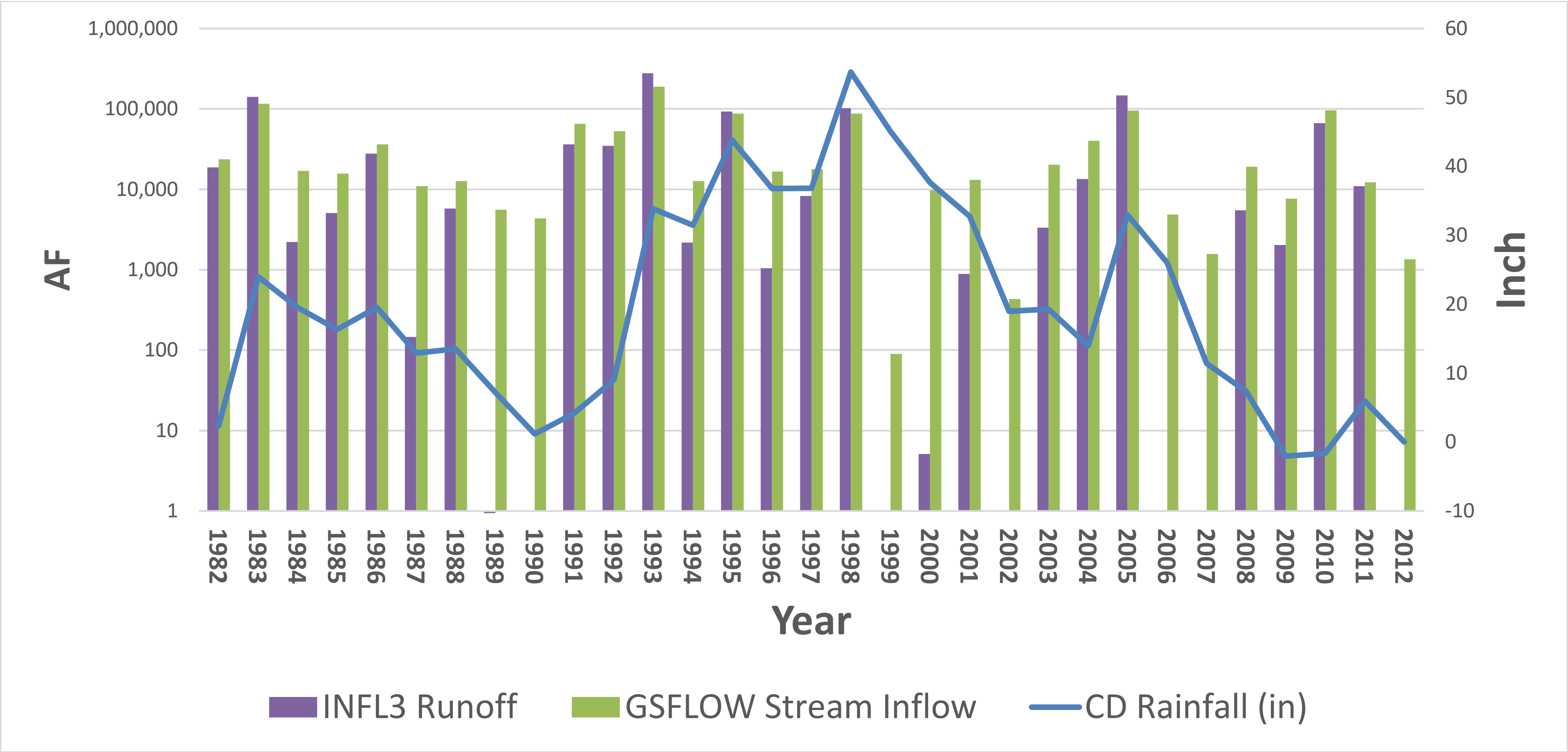

Figure 32 – SGIWGM Cross Section A4-A4'

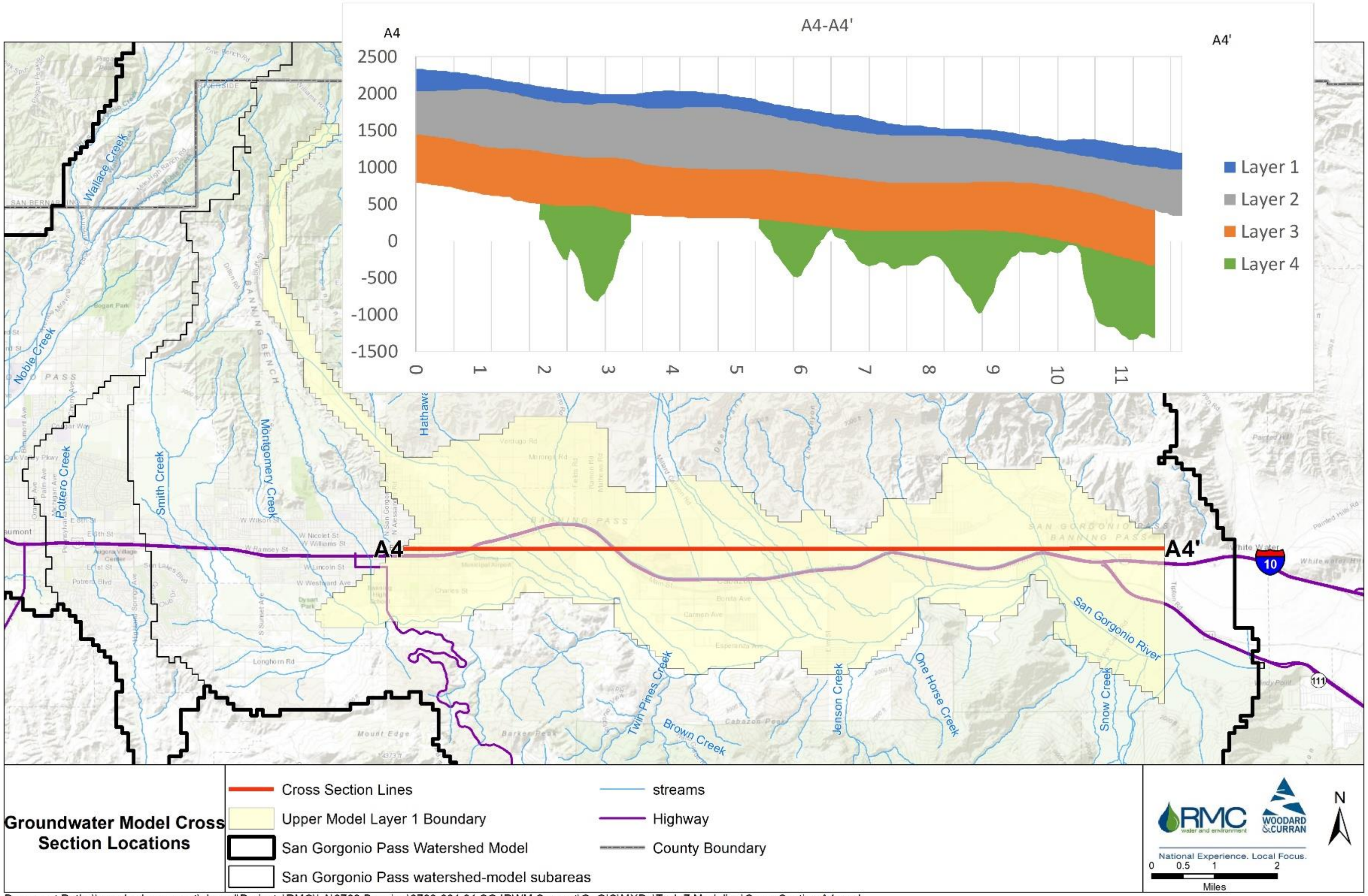

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Figure 33 – SGIWGM SFR Inflow Locations

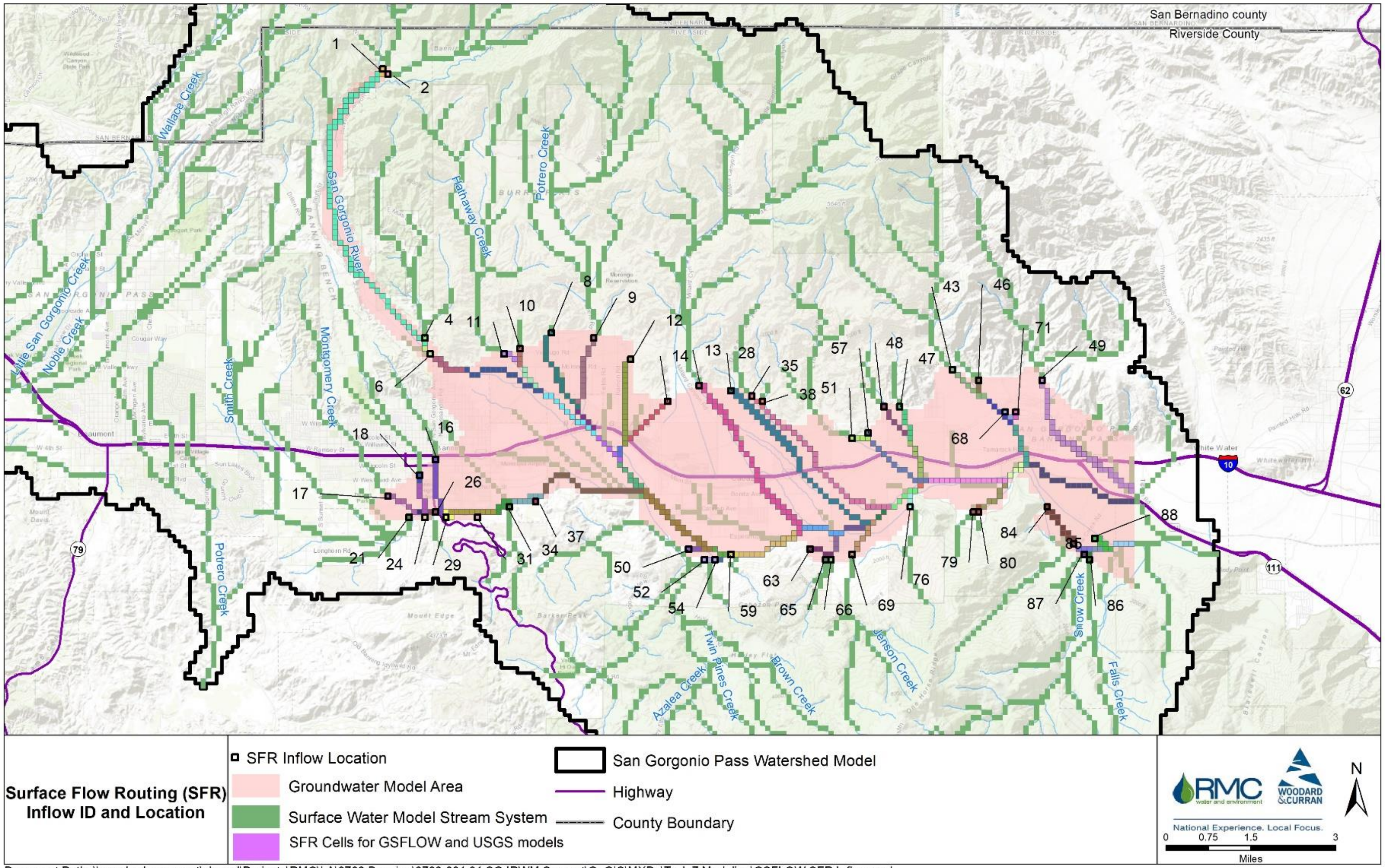

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Figure 34 – SGIWGM Stream Inflow Compared to INFILv3 and UM Stream Inflows
(Annual cumulative departure from mean annual rain (CD) is provided as a reference)

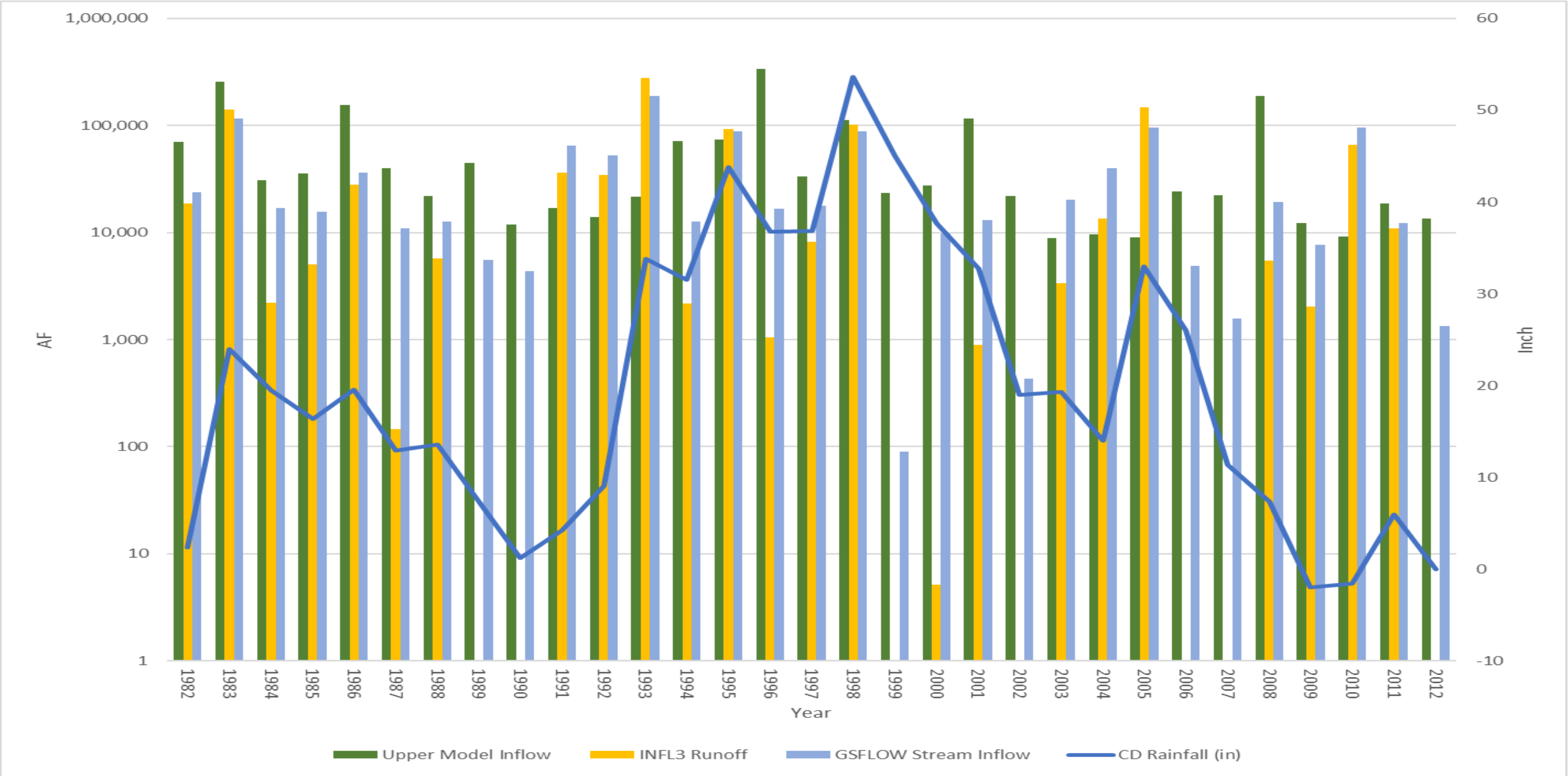
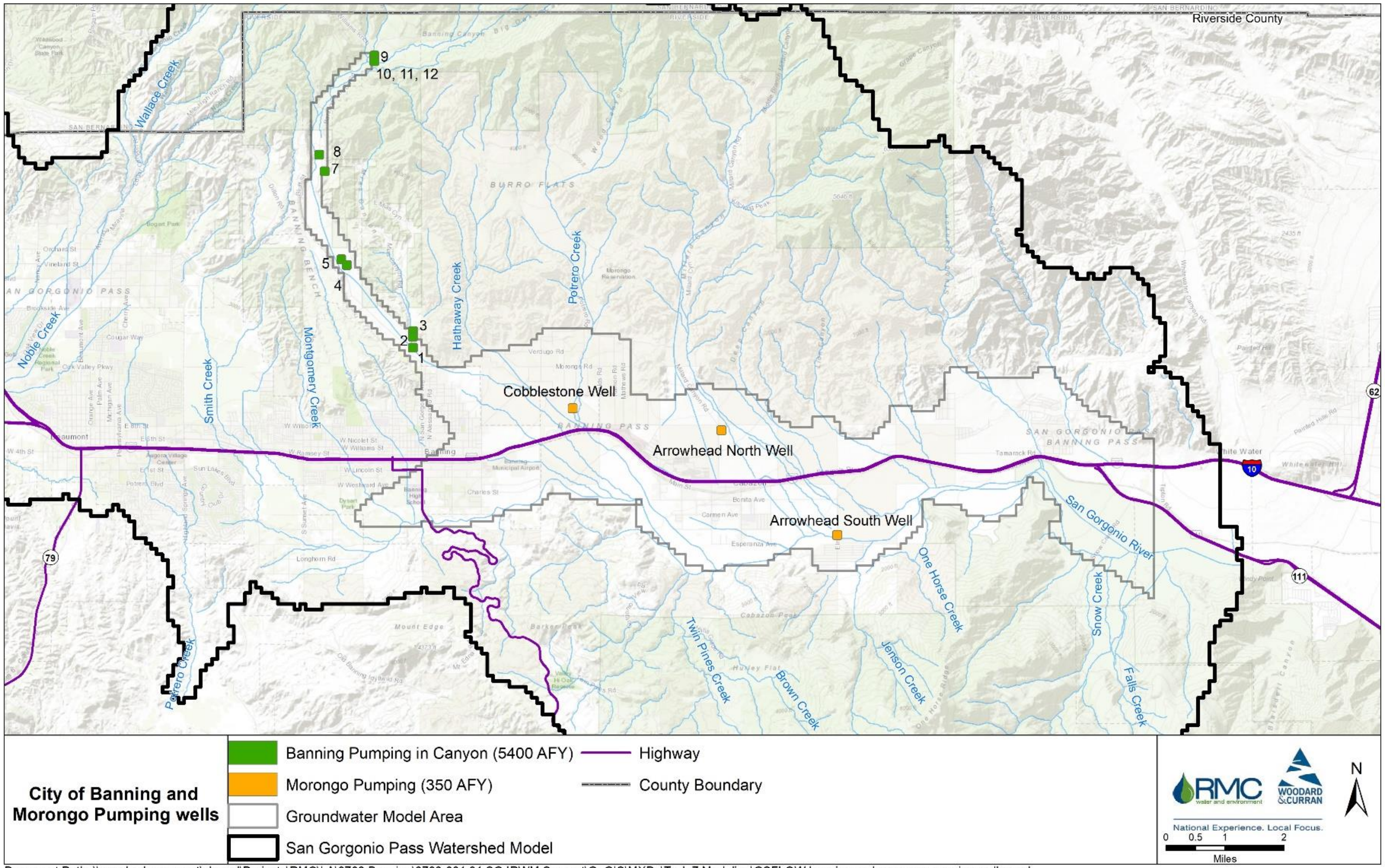


Figure 35 – Location of New Wells in the SGIWGM in Addition to the Wells Shown in Figure 13



Document Path: \\woodardcurran.net\shared\Projects\RMC\LA\0703 Banning\0703-001.01 SG IRWM Support\G. GIS\MXDs\Task 7 Modeling\GSFLOW banning and morongo pumping wells.mxd

Figure 36 –Artificial and Incidental Recharge Locations
(Note: City of Banning septic incidental recharge rate was adjusted based on area covered by SGIWGM. Banning WWTP incidental recharge rate was adjusted from 2016 reported in the Recycled Water Study report down to 2,280 AFY to reflect the lower population of the simulation period)

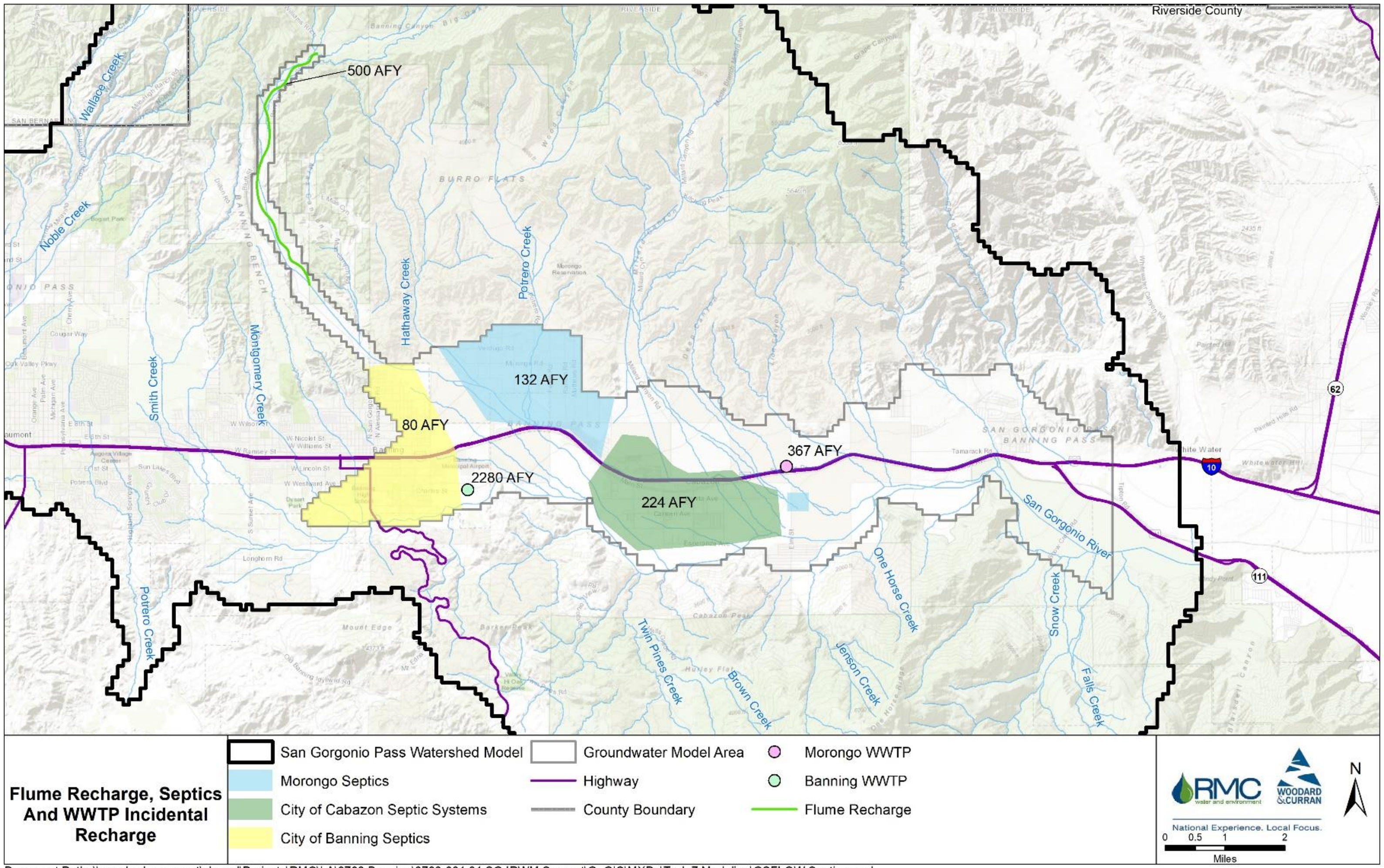


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Figure 37 – Location of Groundwater Monitoring Wells Used for Calibration of SGIWGM

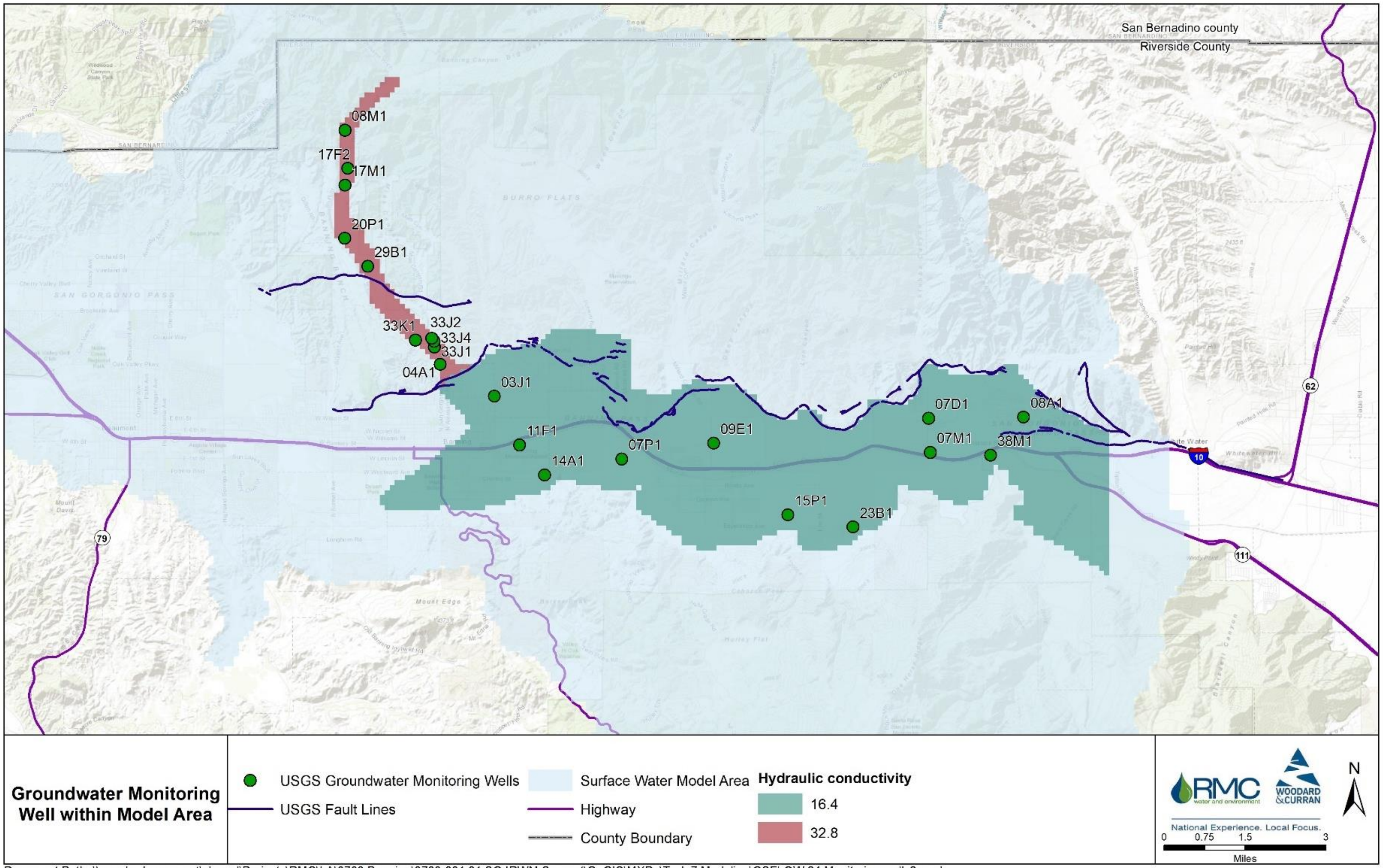

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Figure 38a - Hydrograph of Simulated and Observed Groundwater Elevations

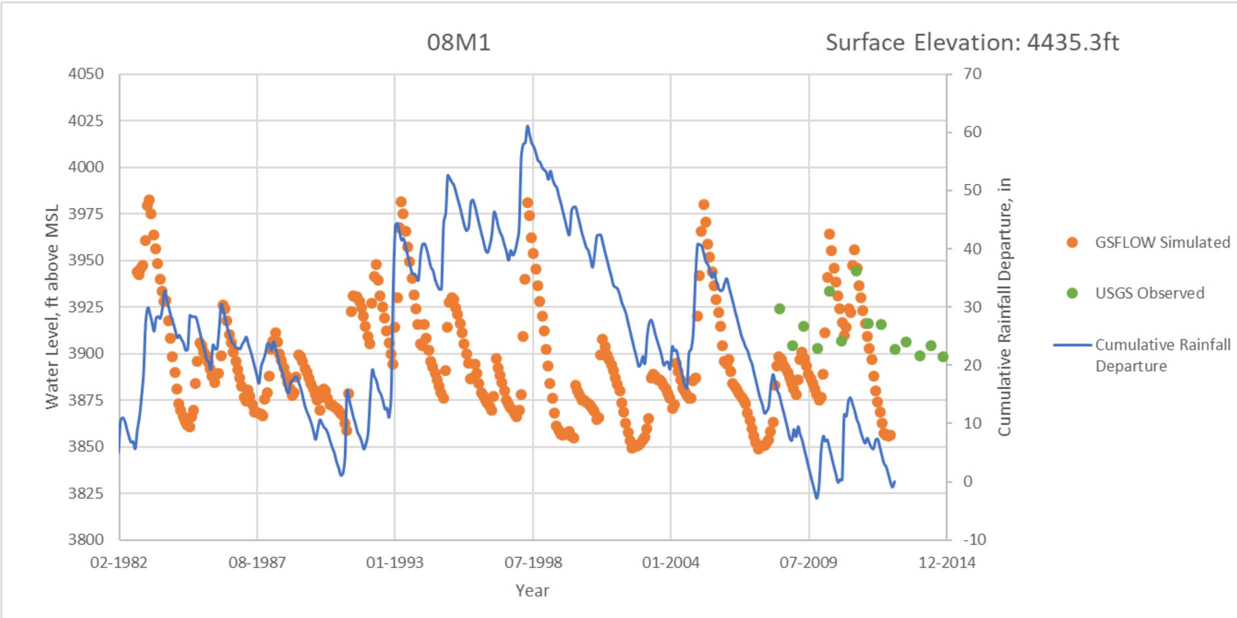


Figure 38b - Hydrograph of Simulated and Observed Groundwater Elevations

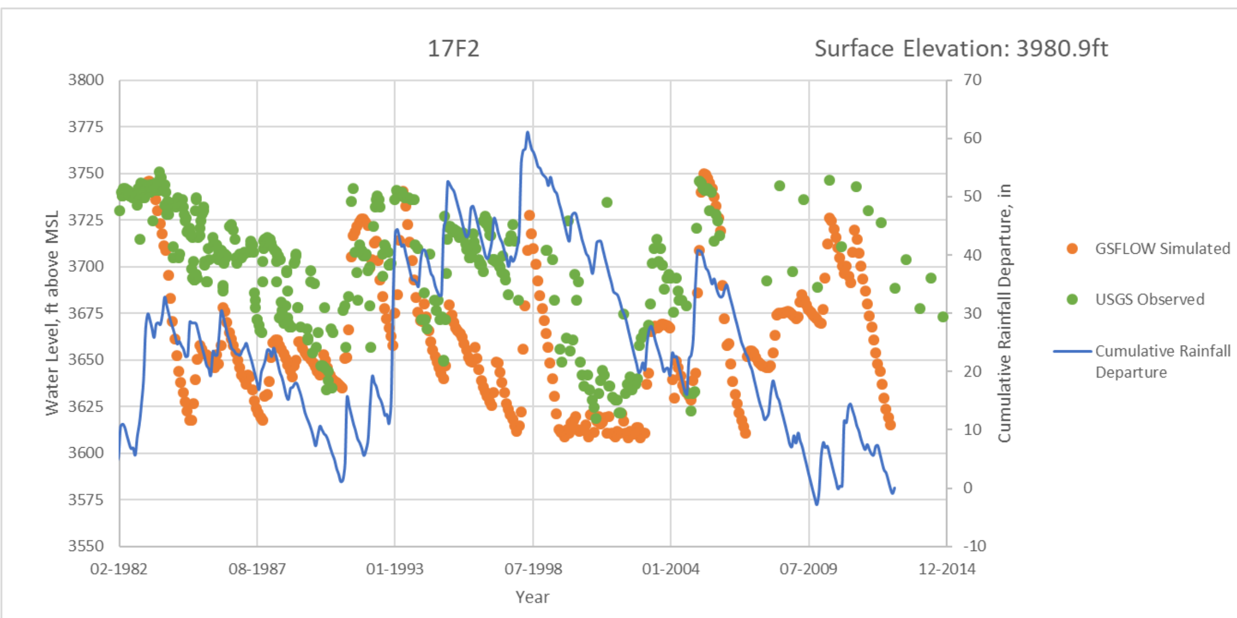


Figure 38c - Hydrograph of Simulated and Observed Groundwater Elevations

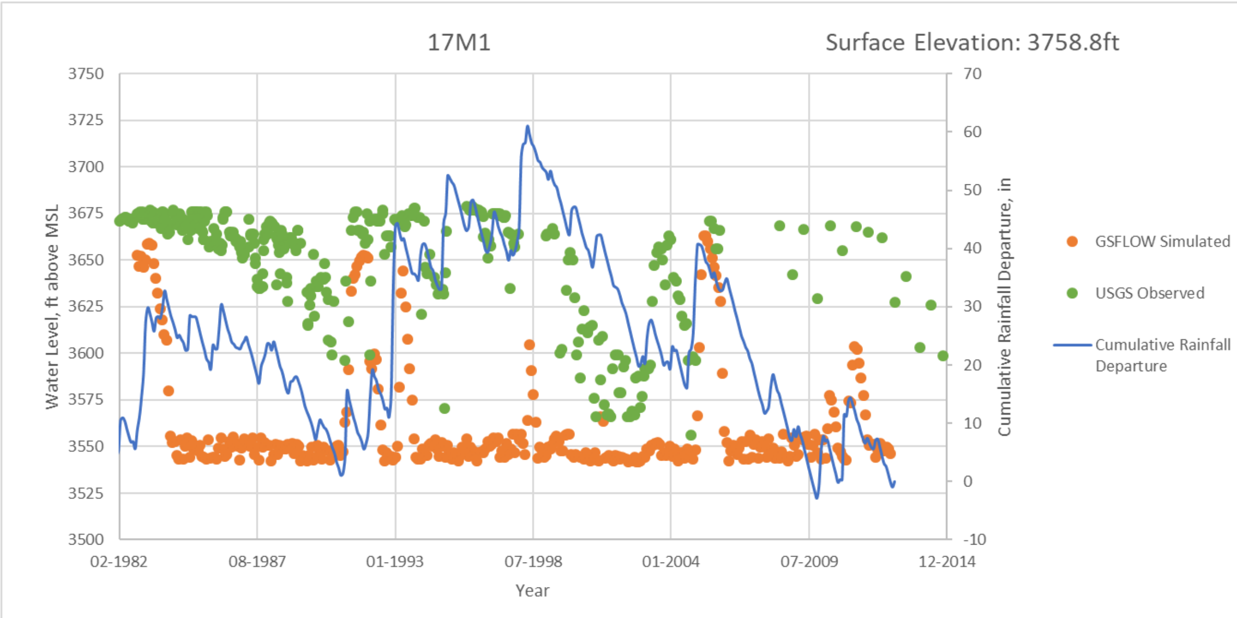


Figure 38d - Hydrograph of Simulated and Observed Groundwater Elevations

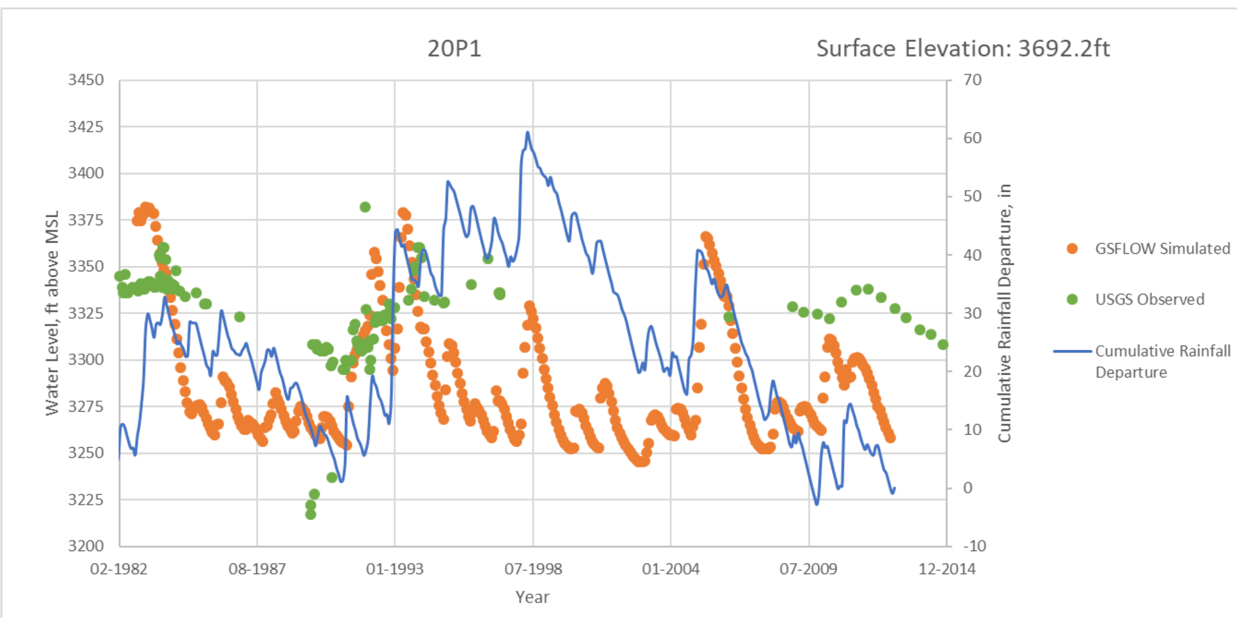


Figure 38e - Hydrograph of Simulated and Observed Groundwater Elevations

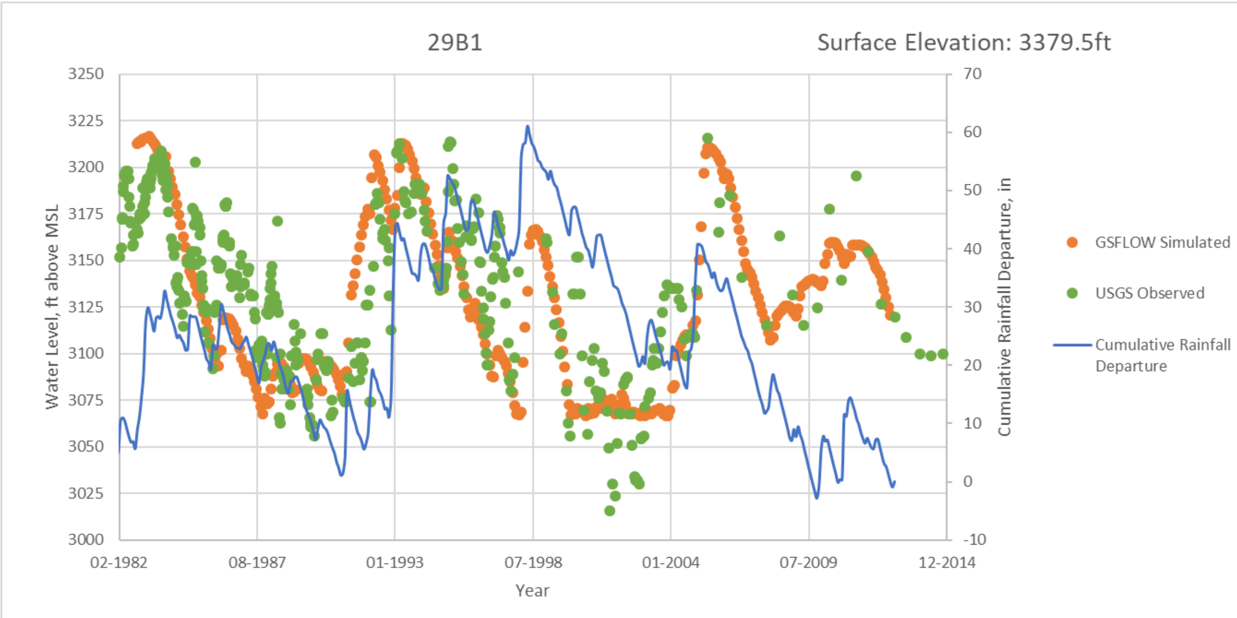


Figure 38f - Hydrograph of Simulated and Observed Groundwater Elevations

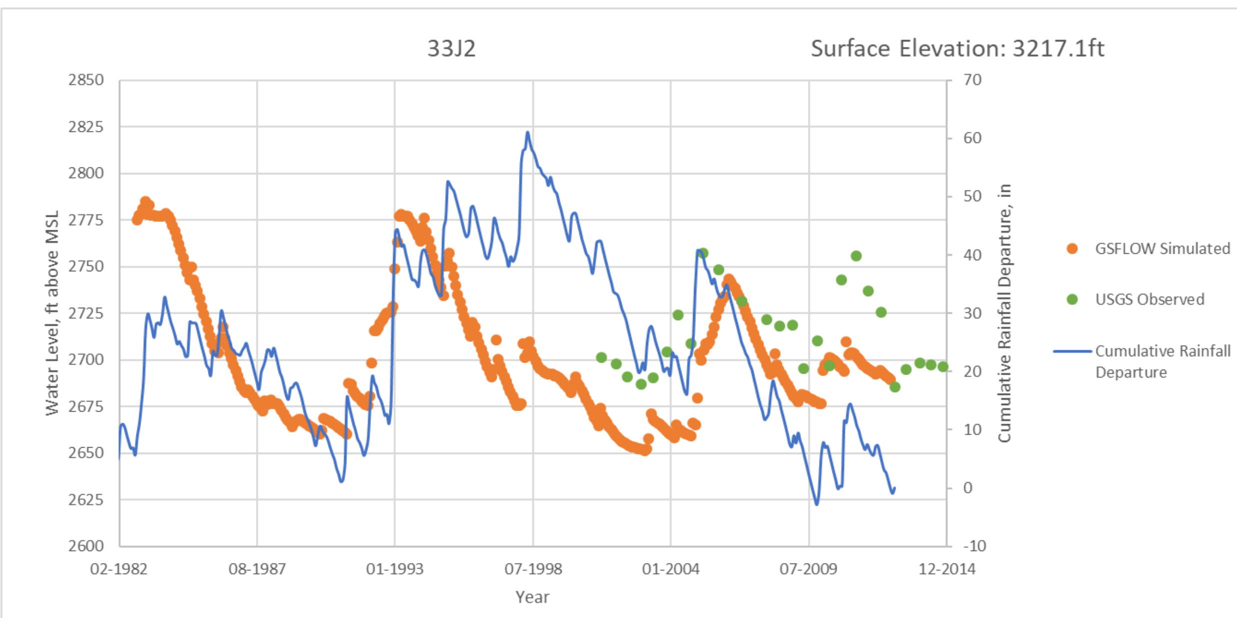


Figure 38g - Hydrograph of Simulated and Observed Groundwater Elevations

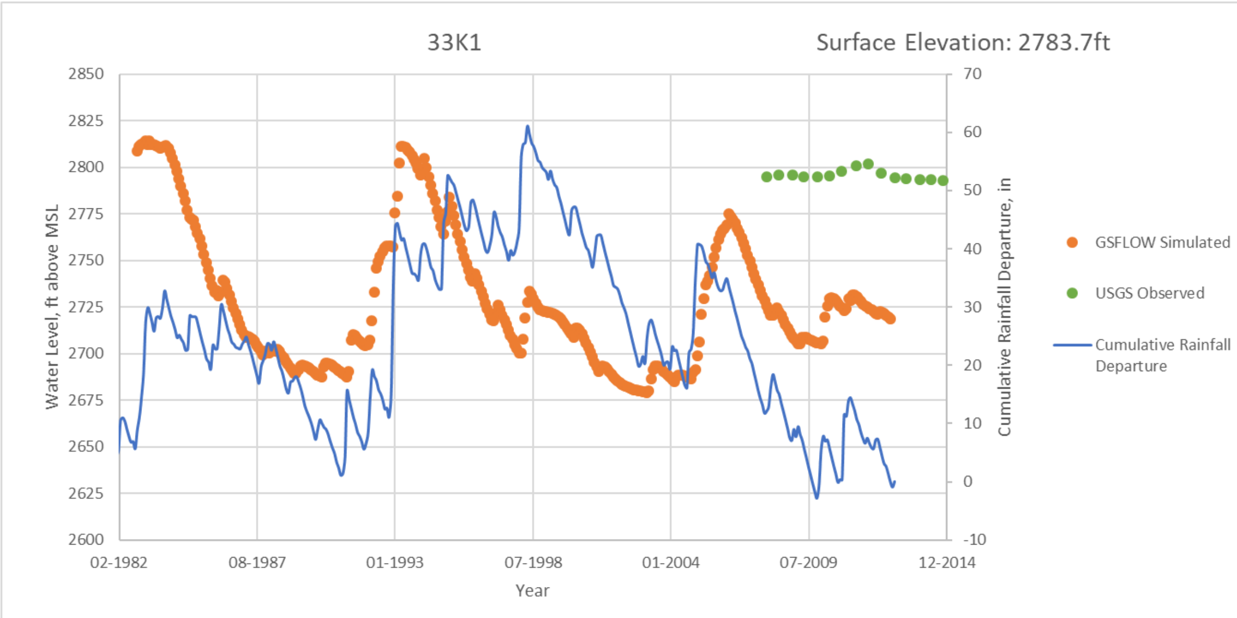


Figure 38h - Hydrograph of Simulated and Observed Groundwater Elevations

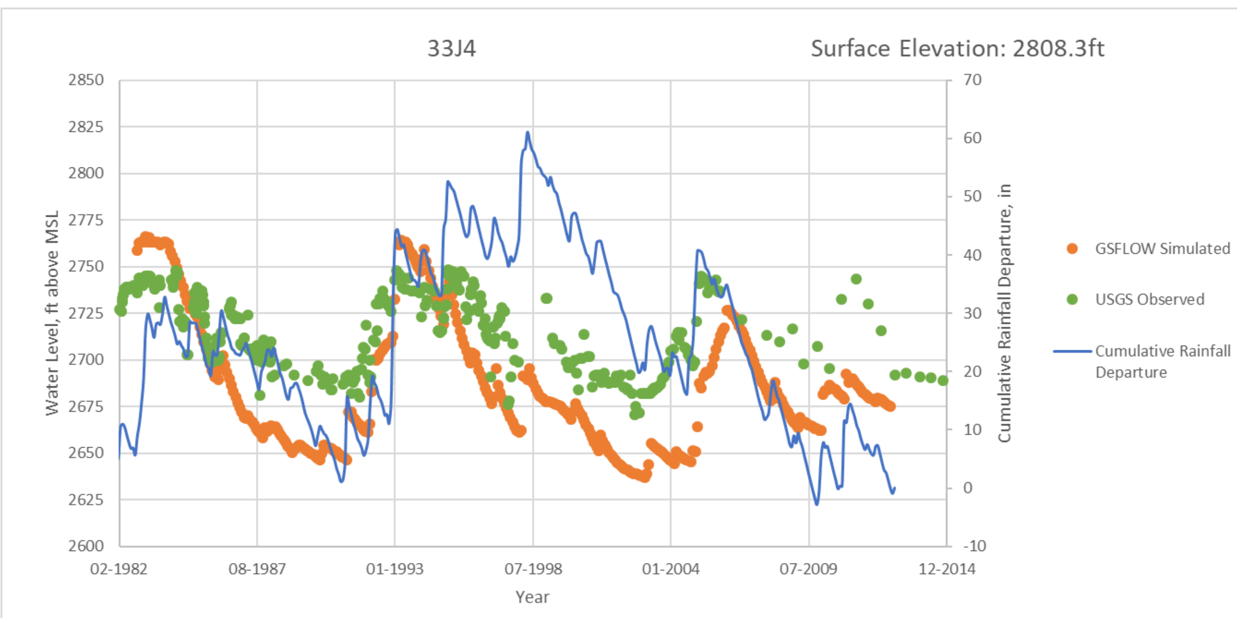


Figure 38i - Hydrograph of Simulated and Observed Groundwater Elevations

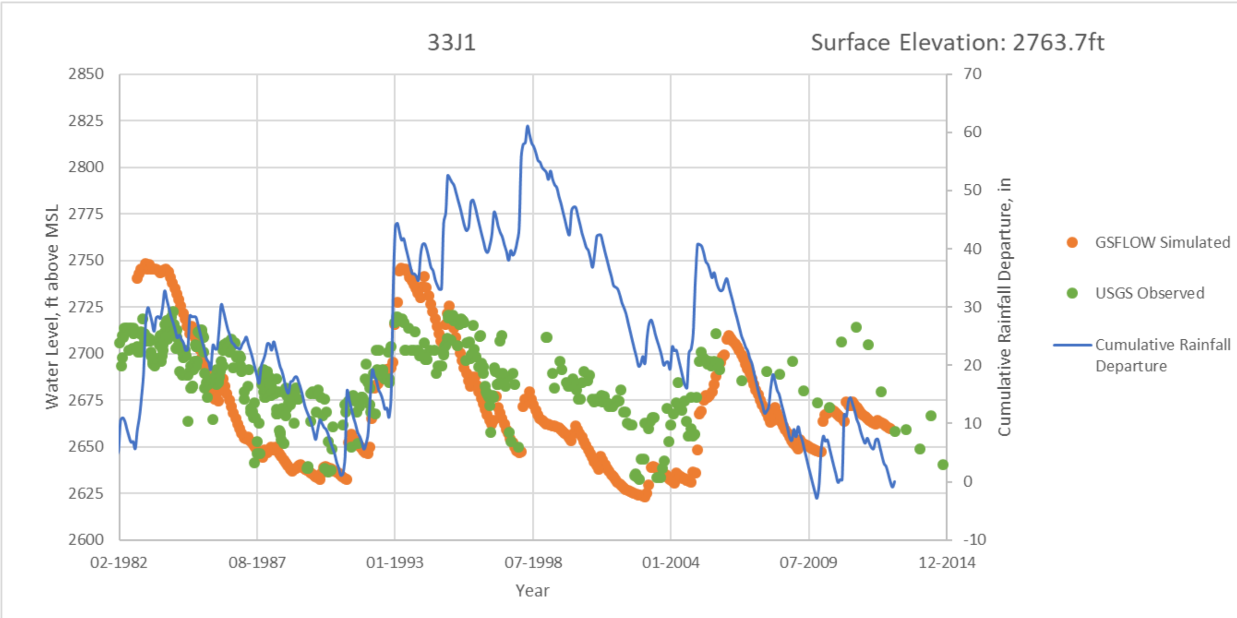


Figure 38j - Hydrograph of Simulated and Observed Groundwater Elevations

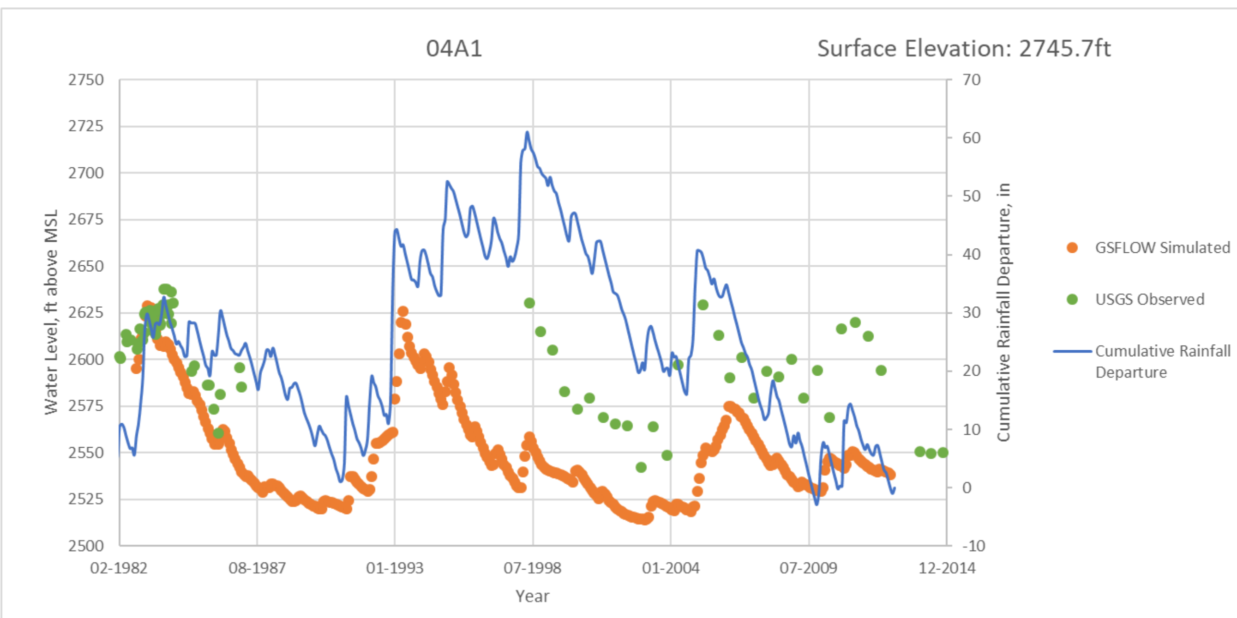


Figure 38k - Hydrograph of Simulated and Observed Groundwater Elevations

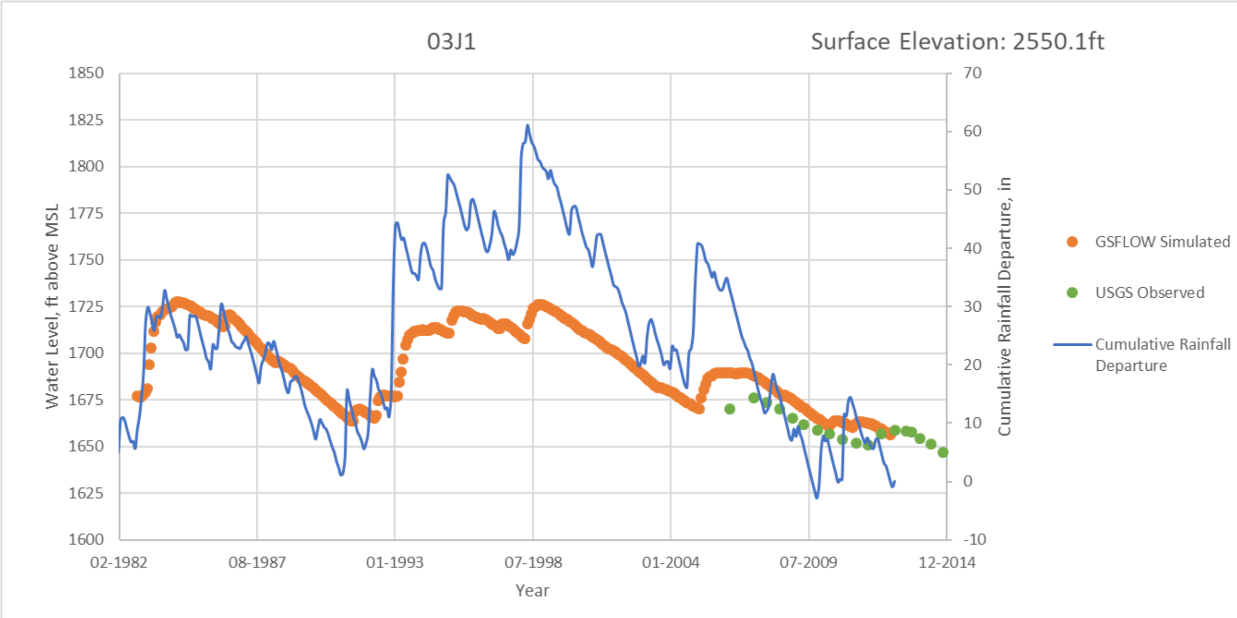


Figure 38l - Hydrograph of Simulated and Observed Groundwater Elevations

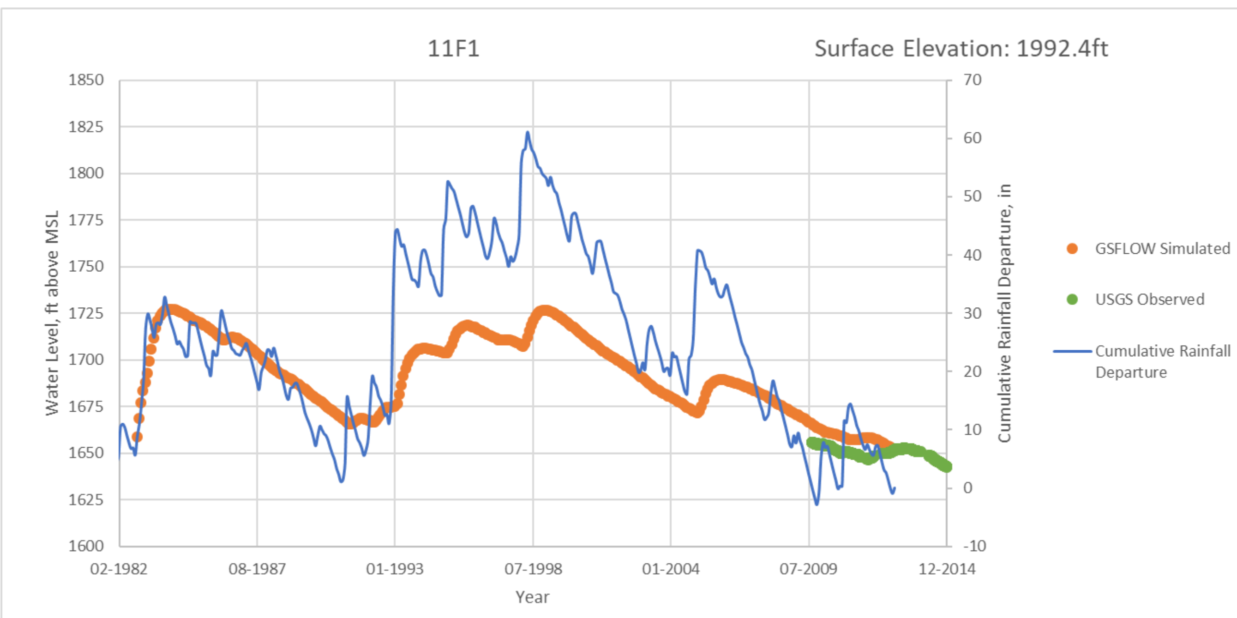


Figure 38m - Hydrograph of Simulated and Observed Groundwater Elevations

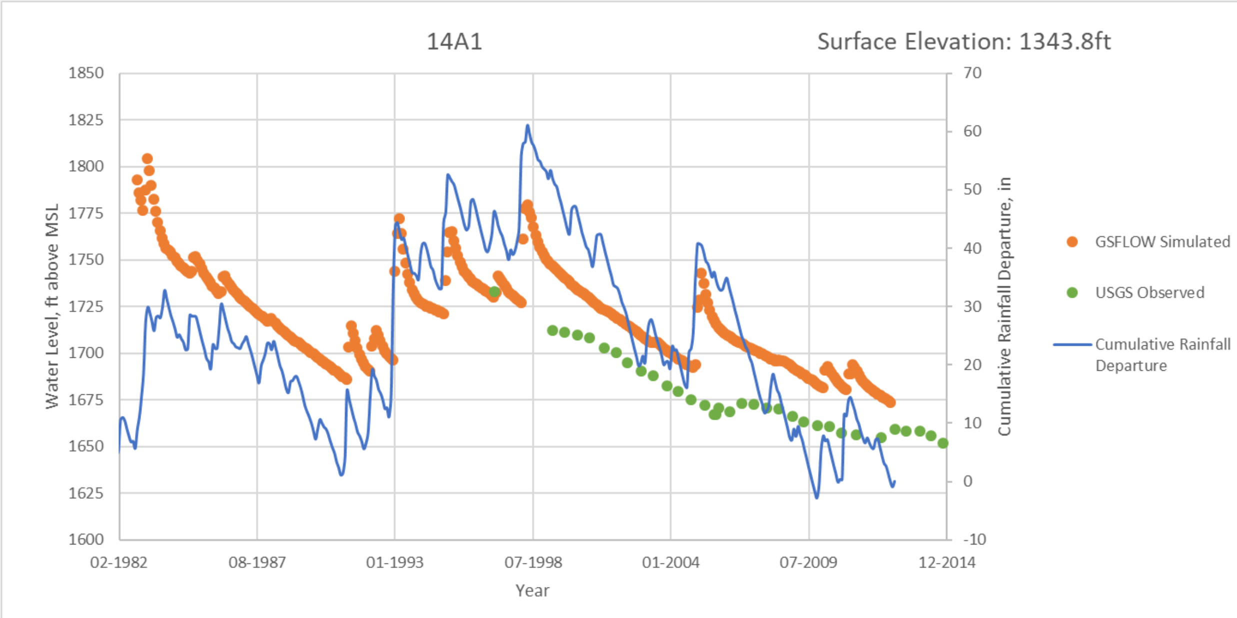


Figure 38n - Hydrograph of Simulated and Observed Groundwater Elevations

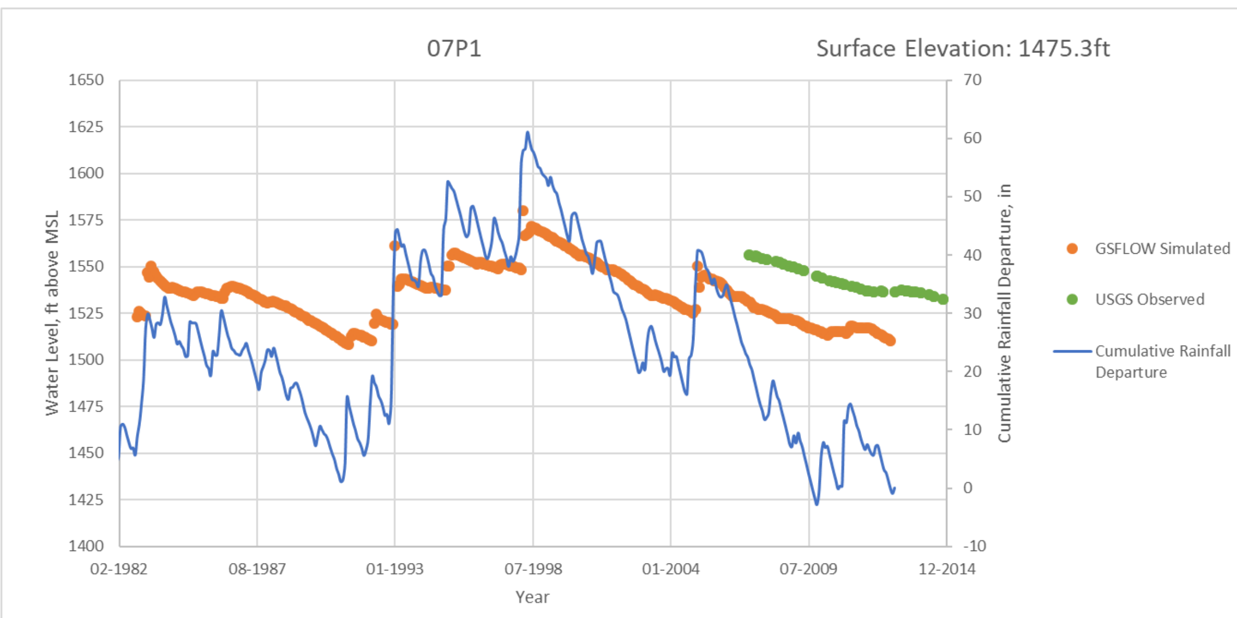


Figure 38o - Hydrograph of Simulated and Observed Groundwater Elevations

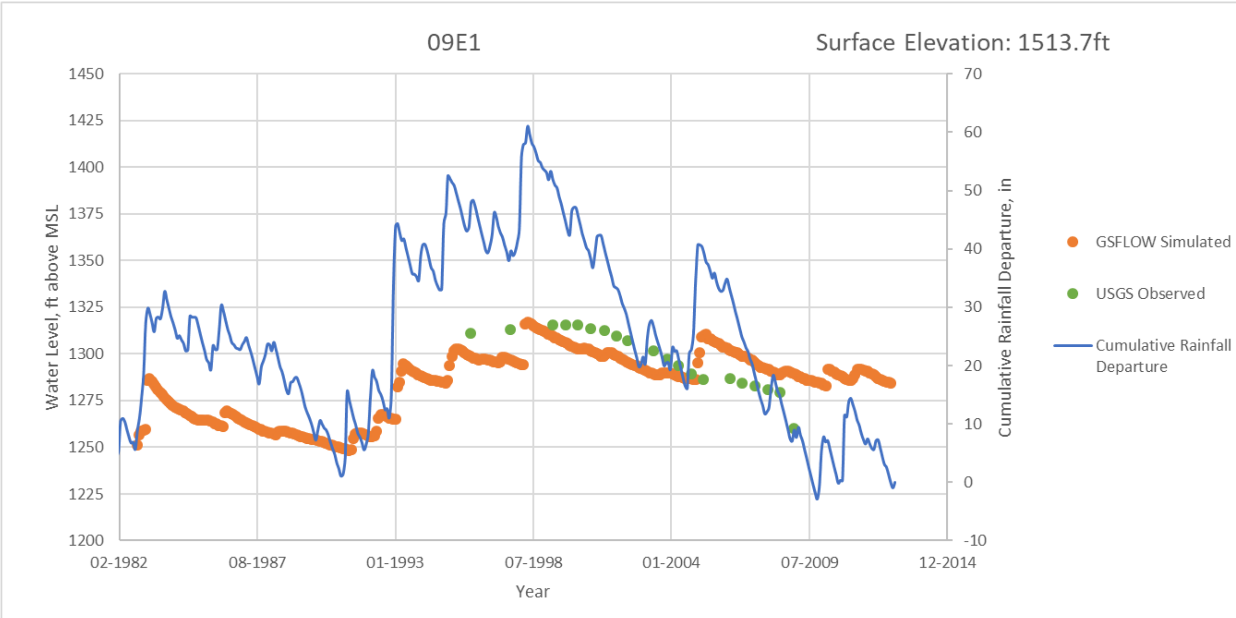


Figure 38p - Hydrograph of Simulated and Observed Groundwater Elevations

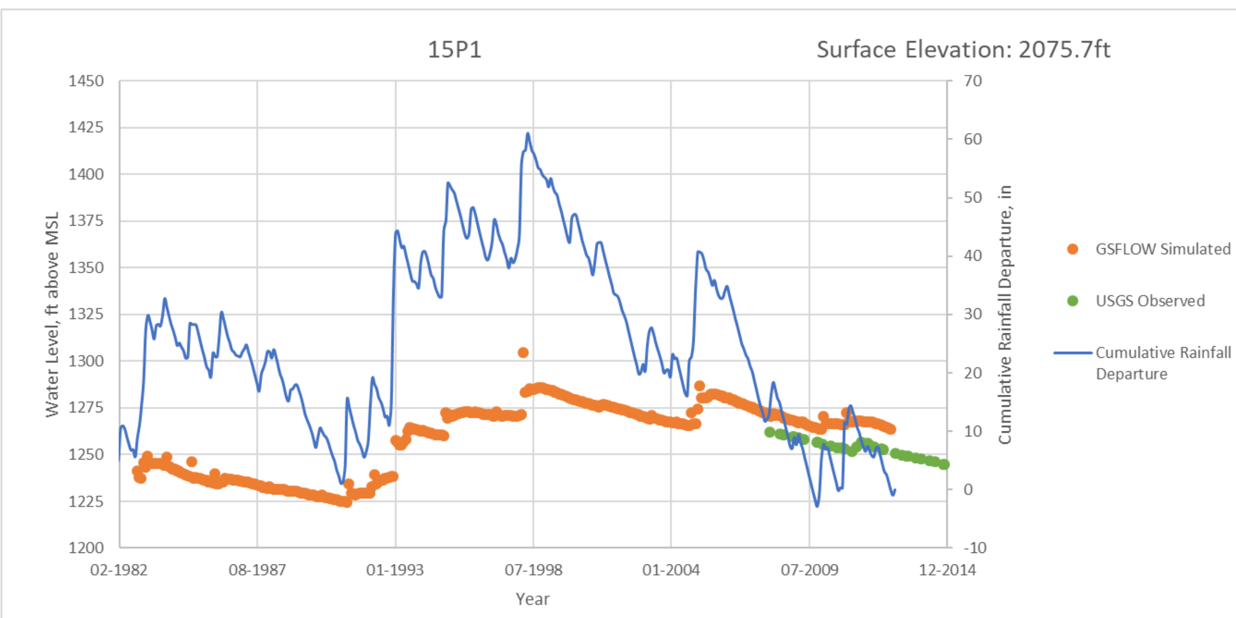


Figure 38q - Hydrograph of Simulated and Observed Groundwater Elevations

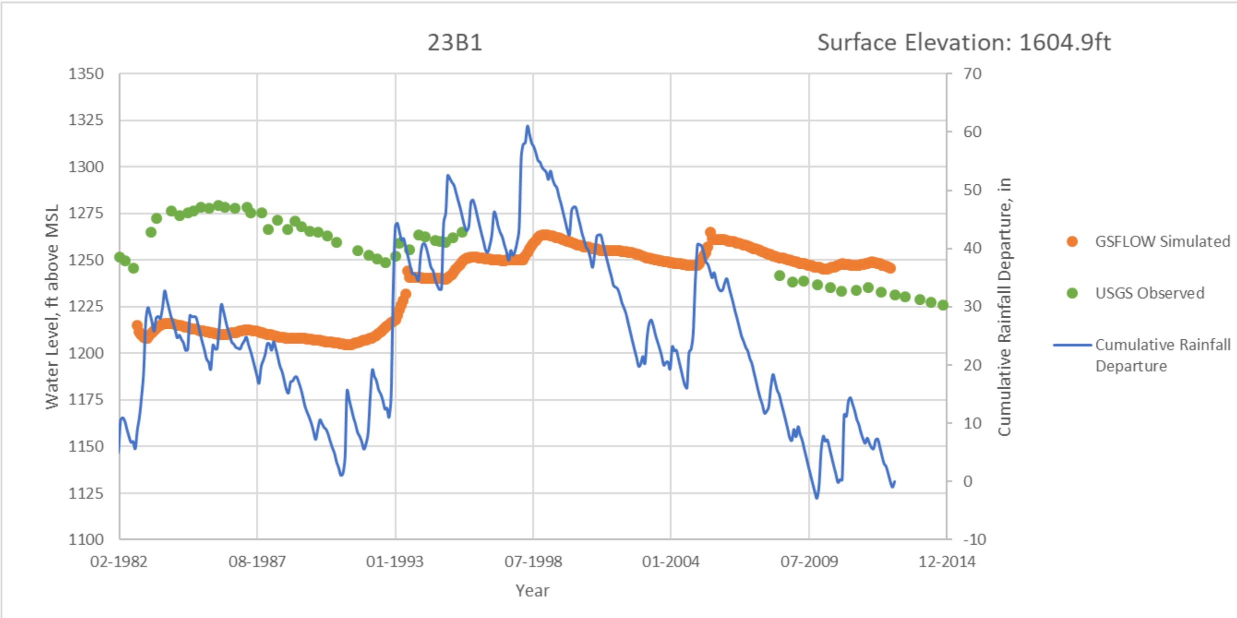


Figure 38r - Hydrograph of Simulated and Observed Groundwater Elevations

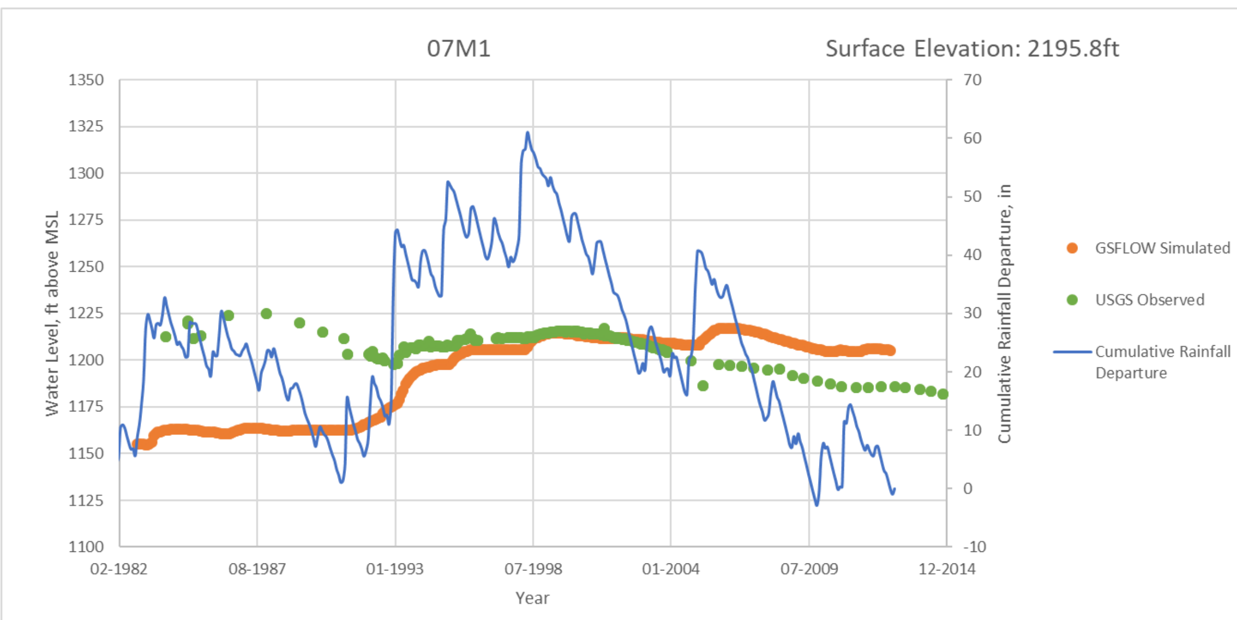


Figure 38s - Hydrograph of Simulated and Observed Groundwater Elevations

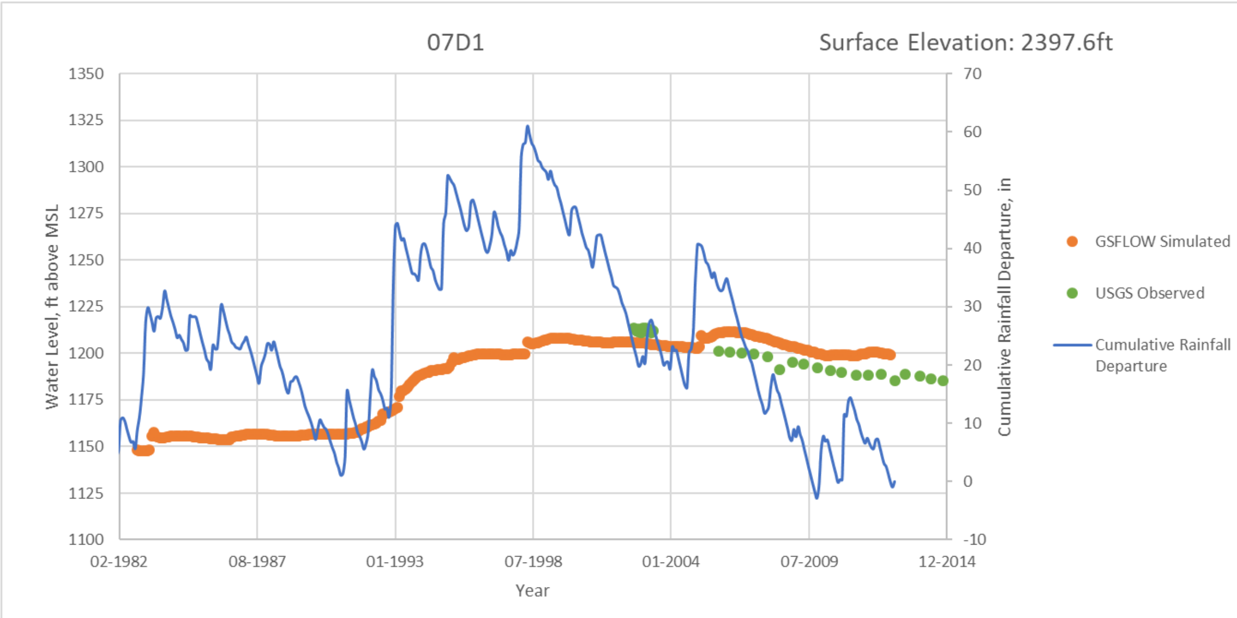


Figure 38t - Hydrograph of Simulated and Observed Groundwater Elevations

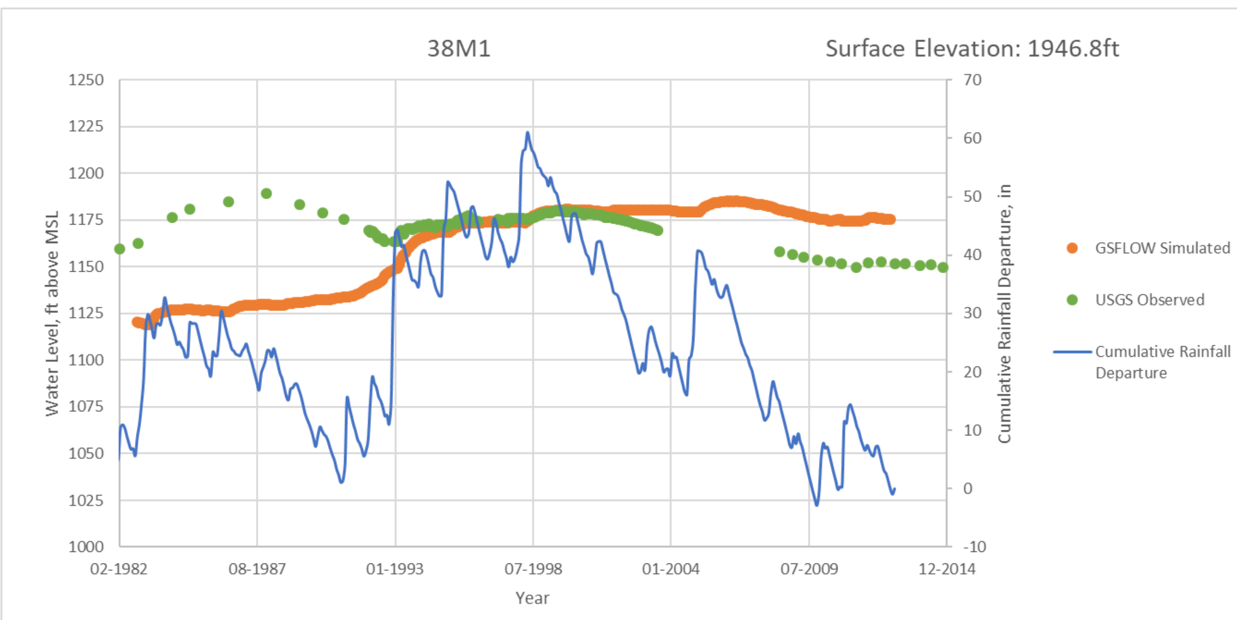
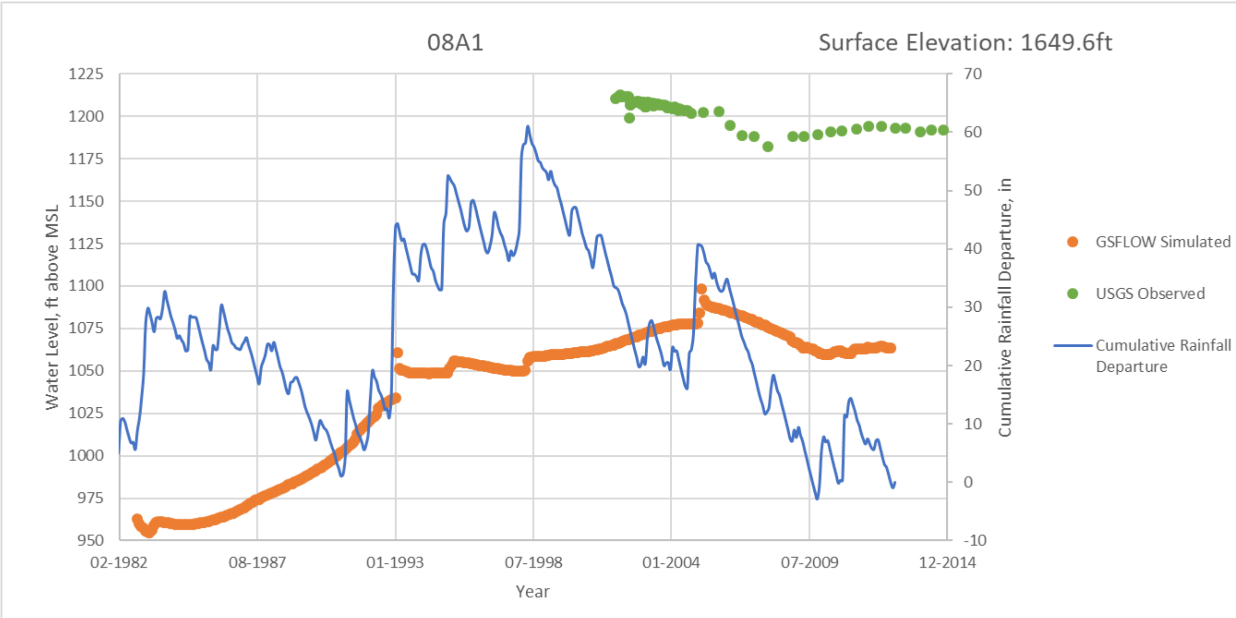


Figure 38u - Hydrograph of Simulated and Observed Groundwater Elevations



D. Memorandum of Understanding

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MEMORANDUM OF UNDERSTANDING
TO CONDUCT INTEGRATED REGIONAL WATER MANAGEMENT PLANNING
FOR THE SAN GORGONIO REGION

This Memorandum of Understanding ("MOU") is made and entered into this 23rd day of September 2016 ("Effective Date") among the CITY OF BANNING, BANNING HEIGHTS MUTUAL WATER COMPANY, CABAZON WATER DISTRICT, HIGH VALLEYS WATER DISTRICT, RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, and the SAN GORGONIO PASS WATER AGENCY, each hereinafter individually called "AGENCY" and collectively "AGENCIES".

RECITALS

A. WHEREAS, the Department of Water Resources is administering a grant program for Integrated Regional Water Management or "IRWM" Planning and;

B. WHEREAS, the AGENCIES are willing to cooperate and work collaboratively with the stakeholders of the Banning and San Gorgonio Pass area to form an IRWM Region through the Department of Water Resources' IRWM Regional Acceptance Process, prepare an IRWM Plan and implement a regional planning process for the geographic area described on Exhibit 'A' attached hereto ("Planning Region") if accepted by the Department of Water Resources in the Regional Acceptance Process; and

C. WHEREAS, the AGENCIES collectively cover the entire planning area to be covered by this IRWM Plan that contains significant need for water resources projects and programs; and

D. WHEREAS, the AGENCIES collectively have made significant investments in planning for flood control, floodplain and stormwater management, water conservation, water supply and reliability, recycled water, habitat preservation, conservation and water quality and related water management strategies; and

E. WHEREAS, the AGENCIES collectively and with the Stakeholder Advisory Committee represent entities significant to water management planning in the area; and

F. WHEREAS, the AGENCIES have the authority and willingness to act in the best interest of the Planning Region in planning and implementing IRWM efforts; and

G. WHEREAS, the AGENCIES are committed to conduct planning efforts in an open accessible process including the Stakeholder Advisory Committee and the public; and

H. WHEREAS, the CITY OF BANNING is willing to take the lead administrative role in contracting for planning, making applications for funding and implementing funded efforts on behalf of all potential project proponents and stakeholders within the Planning Region; and

I. WHEREAS, the AGENCIES collectively have the institutional and fiscal capacity and systems to carry out planning and implementation efforts; and

J. WHEREAS, the AGENCIES are collectively willing to provide funding or in-kind assistance as set forth herein and as mutually agreeable in separate board actions; and

L. WHEREAS, the AGENCIES will each benefit from their participation in this MOU.

NOW, THEREFORE, the AGENCIES hereby mutually agree as follows:

1. The CITY OF BANNING shall facilitate work required to create and maintain an IRWM Plan and submit grant applications for funding consideration under the IRWM Program.

2. Each AGENCY hereby designates its General Manager/ Chief Executive, or his or her designated representative, to represent its board as the person charged with the authority to review and approve the IRWM Plan and other IRWM related documents and efforts conducted by or on behalf of the IRWM Planning Region, subject to any individual AGENCY board approval required by law. Approval of IRWM Plans, documents and efforts shall be based on a consensus of the AGENCIES' designated representatives, to be further defined in the IRWM Plan section discussion on governance to be prepared.

3. The MOU authorizes that applications be made to the California Department of Water Resources or other State or Federal departments to obtain IRWM Planning and Implementation Grants pursuant to the Water Quality, Supply and Infrastructure Improvement Act of 2014 (Public Resources Code Section 79740 et seq.), or future sources of funding and to enter into agreements to receive grant funds for the Planning Region. Subject to reaching consensus as described in Paragraph 2, above, the City Manager of CITY OF BANNING, or his or her designee, is hereby authorized and directed to prepare the necessary data, conduct investigations, file such applications, and execute grant agreements with the California Department of Water Resources, contract to disburse funds to designated partners or sub-grantees (potentially including any one or more of the AGENCIES) and to make changes as needed to contracts or other documents to implement the IRWM process to the benefit of the Planning Region.

4. This MOU authorizes the establishment of a Stakeholder Advisory Committee (hereinafter "Committee") subject to the terms of this MOU and any applicable rules that the AGENCIES may promulgate. The AGENCIES will review and select by consensus members, to be further defined in the IRWM Plan section discussion on governance

that will be prepared, of the Committee from stakeholder organizations in the Planning Region. Stakeholders represent their agency or organization and serve at the pleasure of the AGENCIES and shall not be required (but may be asked) to contribute funds except in-kind services. No more than one representative of any organization shall be named to the Committee. The representative shall represent all interests of the organization and the Planning Region. The Committee acts in an advisory role to the AGENCIES for plan goals and priorities outreach and project integration. Stakeholders need not be a member of the Committee to participate in the planning process. The Committee may become dormant if no planning efforts are ongoing or it is no longer needed.

5. The IRWM Plan, grant applications and related efforts provided for in this MOU aggregate, compile and integrate existing plans and documents as well as solicit new projects and programs. Nothing in such existing or future plans, documents or actions, limits the authority of the AGENCIES or their powers or modifies any of the referenced plans, ordinances or actions of the AGENCIES, committee members or stakeholders.

6. Nothing contained within this MOU binds the parties beyond the scope or term of this MOU unless specifically documented in subsequent MOU amendments or contracts.

7. The AGENCIES shall provide a share of funding for management of the IRWM Program, and intend to provide a share of funding for the preparation of IRWM Planning and Implementation Grant applications, preparation of and initial IRWM Plan and updates, and management of IRWM Planning and Implementation Grant contracts with the California Department of Water Resources, as follows:

a. The CITY OF BANNING, RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, and the SAN GORGONIO PASS WATER AGENCY shall equally share funding for a consultant, or mutually agreed upon in-kind services, to manage the IRWM Program.

b. The AGENCIES intend to provide a share of funding for a consultant to prepare IRWM Planning and Implementation Grant applications. The appropriate funding share will be calculated and announced on a case by case basis as grant opportunities become available and may incorporate reimbursement from recipients of grant awards via administrative fees charged to the grant.

c. The AGENCIES intend to provide a share of funding for a consultant to prepare an IRWM Plan and subsequent updates. The CITY OF BANNING, RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, and the SAN GORGONIO PASS WATER AGENCY agree to equally share match costs for the initial planning grant to establish the IRWM Program. The funding share for future efforts to be provided by the AGENCIES shall be determined in the future during the scoping of the IRWM Plan and updates to reflect requirements by the Department of Water Resources or otherwise necessary. The cost to update the IRWM plan may be offset by IRWM Planning Grant awards.

d. The AGENCIES intend that grant recipients would bear a share of funding needed to manage IRWM Planning and Implementation Grant contracts with California Department of Water Resources via an administrative fee taken out of grant awards, as allowed under the applicable grant. The appropriate funding share will be calculated on case by case basis as grants are awarded.

8. The AGENCIES cannot be assured of the results or success of the IRWM plan and application for funding. Nothing within this MOU should be construed as creating a promise or guarantee of future funding nor shall any liability accrue to the AGENCIES from any third party or one of the AGENCIES should funding not be forthcoming. Nor shall any additional liability accrue to the CITY OF BANNING by its willingness to act as lead for contracting and application on behalf of the AGENCIES.

9. The term of this MOU is ten (10) years from its effective date shown above, unless replaced or amended in writing by other written agreement(s) or terminated by majority vote of the AGENCIES. Notwithstanding the foregoing, any AGENCY may withdraw from participation as an AGENCY, without forfeiting its ability to participate as a stakeholder, by giving to each of the other AGENCIES sixty (60) days' written notice of its intent to withdraw from participation as an AGENCY.

10. Any entity not listed herein as an AGENCY will be allowed to become an AGENCY under this MOU with the majority concurrence of all existing AGENCIES and upon the execution of this MOU terms by its governing board.

11. Any notices sent or required to be sent to any party shall be mailed to the following addresses:

CITY OF BANNING
176 E. Lincoln Street
P.O. Box 998
Banning, CA 92220

BANNING HEIGHTS MUTUAL WATER COMPANY
Board President
7091 Bluff Street
Banning, CA 92220

CABAZON WATER DISTRICT
P.O. Box 2967
Cabazon, CA 92230

HIGH VALLEYS WATER DISTRICT
47781 Twin Pines Road
Banning, CA 92220

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
1995 Market Street
Riverside, CA 92501

SAN GORGONIO PASS WATER AGENCY
1210 Beaumont Avenue
Beaumont, CA 92223

12. Each AGENCY, to the fullest extent permitted by law, shall defend, indemnify and hold harmless the other AGENCIES, and their respective consultants, and each of their directors, officers, agents, and employees from and against all liability, claims, damages, losses, expenses and other costs including costs of defense and attorneys' fees, arising or resulting from or in connection with the action(s) or omission(s) of that AGENCY, or arising or resulting from or in connection with any actions(s) or omission(s) taken by a majority of the AGENCIES with approval of the AGENCY from whom indemnification is sought..

13. This MOU is to be construed in accordance with the laws of the State of California.

14. If any provision of this MOU is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall be declared severable and shall be given full force and effect to the extent possible.

15. Any action at law or in equity brought by any of the parties hereto for the purpose of enforcing a right or rights provided for by this MOU shall be heard in a court of competent jurisdiction in the County of Riverside, State of California, and the parties hereto

waive all provisions of law providing for change of venue in such proceedings to any other county.

16. This MOU is the result of negotiations between the parties hereto and with the advice and assistance of their respective counsel. No provision contained herein shall be construed against CITY OF BANNING solely because, as a matter of convenience, it prepared this MOU in final form.

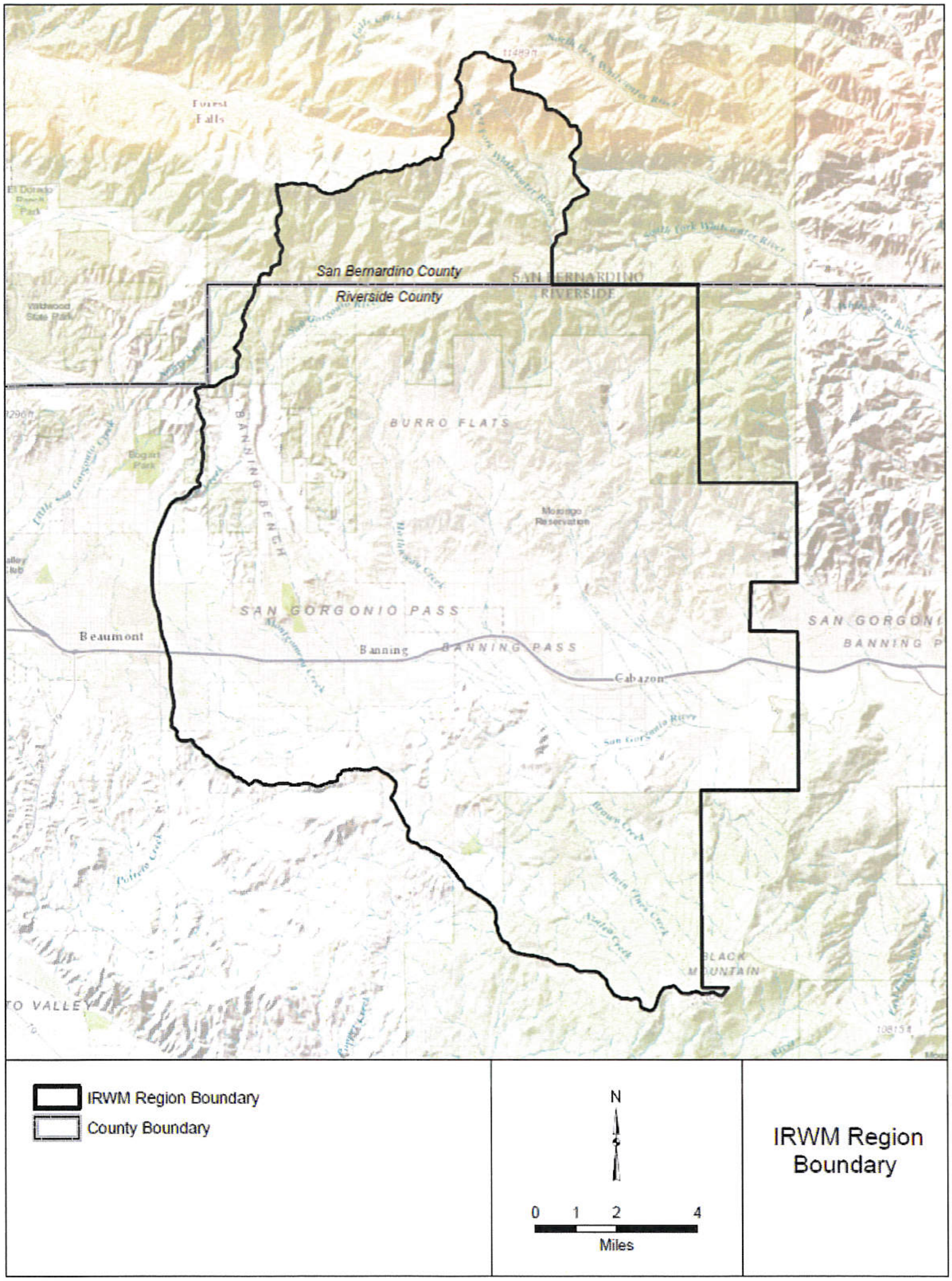
17. Any waiver by AGENCIES of any breach by the other of any one or more of the terms of this MOU shall not be construed to be a waiver of any subsequent or other breach of the same or of any other term hereof. Failure on the part of any of the respective AGENCIES to require from the others exact, full and complete compliance with any terms of the MOU shall not be construed as in any manner changing the terms hereof, or stopping the respective AGENCIES from enforcement hereof.

18. This MOU may be executed and delivered in any number of counterparts or copies, hereinafter called "COUNTERPART", by the parties hereto. When each party has signed and delivered at least one COUNTERPART to the other parties hereto, each COUNTERPART shall be deemed an original and, taken together, shall constitute one and the same MOU, which shall be binding and effective as to the parties hereto.

19. This MOU is intended by the AGENCIES hereto as their final expression with respect to the matters herein, and is a complete and exclusive statement of the terms and conditions thereof. This MOU shall not be changed or modified except by the written consent of all AGENCIES hereto.

ATTACHMENT A

MAP OF THE PLANNING REGION



RECOMMENDED FOR APPROVAL: **CITY OF BANNING**

By ______________________

MICHAEL ROCK
City Manager

Dated 9-22-16

RECOMMENDED FOR APPROVAL	BANNING HEIGHTS MUTUAL WATER COMPANY
By: [illegible]	Lawrence E. Ellis
[illegible]	Lawrence E. Ellis
Print Name	Print Name
Board President	Director

Dated Sept. 22, 2016

RECOMMENDED FOR APPROVAL: **CABAZON WATER DISTRICT**

By Robert Lynk
ROBERT LYNK
Chairman

Dated September 22-2016

RECOMMENDED FOR APPROVAL:

By ________________________
Ernest Wright
President of the Board

HIGH VALLEYS WATER DISTRICT

By ________________________
Curtis Houghton
General Manager

APPROVED AS TO FORM:

XXXXXX
County Counsel

By N/A

ATTEST:

NERA THORNTON
Clerk of the Board

By ________________________

RECOMMENDED FOR APPROVAL:	**RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT**
By ______________________ JASON UHLEY General Manager-Chief Engineer	By ______________________ MARION ASHLEY, Chairman Riverside County Flood Control and Water Conservation District Board of Supervisors
APPROVED AS TO FORM:	ATTEST:
GREG PRIAMOS County Counsel	KECIA HARPER-IHEM Clerk of the Board
By ______________________ AARON GETTIS Deputy County Counsel	By ______________________ Deputy
Dated 9-21-16	(SEAL)

RECOMMENDED FOR APPROVAL: **SAN GORGONIO PASS WATER AGENCY**

By Jeffrey W Davis
JEFF DAVIS
General Manager

Dated 3-23-17

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E. Project Nomination Form

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San Gorgonio IRMW Region
IRWM Plan Project Nomination Form

The IRWM Plan Project Nomination Form provides the essential information to be considered for inclusion in the San Gorgonio IRWM Plan. Each form will be reviewed according to the process defined within the San Gorgonio IRWM Plan for acceptance within two potential project categories:

IRWM Conceptual Projects are projects that do not yet meet the minimum criteria for acceptance as an IRWM Plan project, but do support goals and objectives of the San Gorgonio IRWM Region. To have your project be included in the IRWM Plan as conceptual project you must be able to complete Sections 1 through Question 4, highlighted in green

IRWM Plan Projects are projects that meet all DWR and the San Gorgonio IRWM Region requirements for acceptance as an IRWM Plan project. To have your project *considered as an IRWM Plan Project,* you must be able to complete all questions in this form, in both the sections highlighted in green and purple.

The completed Project Nomination Form can be emailed as an attachment to: SGIRWM@ci.banning.ca.us

1) **Project Type**	
☐ IRWM Conceptual Project	☐ IRWM Plan Project

2) General Project Information
a) Project Sponsor/Lead Agency Information
b) Project Title
c) Project type
☐ Planning ☐ Implementation
d) Project Description

e) Project Location

f) Potential Project Partners

3) Project Benefits

All Projects must align with one or more IRWM Plan Objectives and one or more Resource Management Strategies selected for use in the IRWM Plan.

a) Check which San Gorgonio IRWM Plan Objectives can be met through this project.

Goal 1. Increase regional supply availability and reliability

- ☐ Objective 1A: Implement regional recycled water projects within the Region and support local recycled water projects.
- ☐ Objective 1B: Support affordable investments and agreements between local and external agencies to enhance the reliability of imported water throughout the region.
- ☐ Objective 1C: Maximize the use of groundwater supplies, including local storage of imported water.
- ☐ Objective 1D: Implement appropriate regional demand management, water loss reduction and other conservation programs.

Goal 2. Improve resilience of regional water distribution systems

- ☐ Objective 2A: Implement regional infrastructure projects to increase distribution capacity, flexibility and redundancy.
- ☐ Objective 2B: Form agreements between local and external agencies to support regional supply systems, conservation programs and emergency response.
- ☐ Objective 2C: Support projects to increase resilience and redundancy of local production and distribution facilities

Goal 3. Develop useable tools to understand hydrologic processes

- ☐ Objective 3: Build an integrated ground and surface water model for all subbasins within the San Gorgonio Groundwater Basin for use in determining available surface water supplies, groundwater basin functionality, storage potential and recharge project feasibility.

Goal 4. Decrease impacts to groundwater quality

- ☐ Objective 4A: Reduce use of septic systems by expanding centralized collection and treatment systems
- ☐ Objective 4B: Increase monitoring of existing septic areas and enforcement of monitoring protocols

Goal 5. Increase resilience to changing water quality requirements

- ☐ Objective 5: Remain engaged across the changing legal, institutional, and regulatory framework affecting drinking water standards

Goal 6. Enhance regional flood control infrastructure

- ☐ Objective 6A: Reduce properties subject to flood hazard insurance
- ☐ Objective 6B: Enhance regional multipurpose, multiple benefit stormwater management infrastructure.

Goal 7. Protect aquatic and riparian habitat

- ☐ Objective 7: Provide continued protection consistent with the Western Riverside and Coachella Valley MSHCPs.

Goal 8. Support DACs and maintain the affordability of water

- ☐ Objective 8: Seek funding opportunities to ensure all communities have access to a reliable water supply and adequate wastewater treatment.

Goal 9. Support the economic vitality of DACs

- ☐ Objective 9: Support projects to provide safe, sustainable and livable communities and to promote future economic development of local DACs.

Goal 10. Adaptation to Climate Change

- ☐ Objective 10: Implement multi-benefit strategies, that adapt to climate change impacts for flood management, water supply, water quality, water-dependent habitat, and fire risk.

b) Check which Resource Management Strategies are features of the project:

Reduce Water Demand

- ☐ *Agricultural Water Use Efficiency*
- ☐ *Urban Water Use Efficiency*
- ☐ *Crop Idling for Water Transfers*
- ☐ *Water Meter Installation*

Improve Operational Efficiency and Transfers

- ☐ *Conveyance – Delta*
- ☐ *Conveyance – Regional/Local*
- ☐ *System Reoperation*
- ☐ *Water Transfers*

Improve Flood Management

- ☐ *Flood Risk Management*

Increase Water Supply

- ☐ *Conjunctive Management and Groundwater Storage*
- ☐ *Municipal Recycled Water*
- ☐ *Surface Storage – Regional/Local*
- ☐ *Surface Storage – CALFED (/SWP)*
- ☐ *Irrigated Land Retirement*

Improve Water Quality

- ☐ *Drinking Water Treatment and Distribution*
- ☐ *Groundwater Remediation/Aquifer Remediation*
- ☐ *Matching Water Quality to Use*
- ☐ *Pollution Prevention*
- ☐ *Salt and Salinity Management*
- ☐ *Urban Runoff Management*

Practice Resources Stewardship

- ☐ *Ecosystem Restoration*
- ☐ *Forest Management*
- ☐ *Land Use Planning and Management*
- ☐ *Recharge Areas Protection*
- ☐ *Sediment Management*
- ☐ *Watershed Management*

People and Water

- ☐ *Economic Incentives Policy*

- ☐ *Outreach and Education*
- ☐ *Water and Culture*

4) Additional Project Benefits

Answer all of the following questions

a) Check which integration and regionality features are part of the project:

- ☐ *Partnerships– Establishes partnerships through sharing data, funds, resources and infrastructure.*
- ☐ *Regionality – Implements watershed-wide or regional-scale projects.*
- ☐ *Integration – Meets objectives within multiple regional goals*
- ☐ *None of the above / Unknown*

b) Check which Disadvantaged Communities (DAC), Native American Tribal Communities (NATC) and Environmental Just Concerns (EJC) are features of the project:

- ☐ *Project provides benefits to DAC*
- ☐ *Project provides benefits to NATC*
- ☐ *Project addresses EJ* concerns*
- ☐ *None of the above / Unknown*

**Environmental Justice is defined by State Law as: "the fair treatment and meaningful involvement of all people regardless of race, color, sex national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations, and policies.*

c) Check which additional sustainability features are part of the project:

- ☐ *Measures to reduce greenhouse gas (GHG) emissions as compared to alternatives*
- ☐ *Measures to adapt to potential effects of climate change*
- ☐ *Reduce the San Gorgonio IRWM Region's reliance on the Sacramento/San Joaquin Delta*
- ☐ *None of the above / Unknown*

5) Project Cost and Funding

a) Total Estimated Project Cost

b) List Potential Sources of Funding for the Project

c) Basis for Project Cost

Describe the basis for the project cost, such as a feasibility study, partial design, etc. If a cost estimate has been prepared, please list that document here.

6) Project Feasibility

a) Project Status

Provide status of the project (e.g. initial study, planning, design, environmental review, in construction)

b) Technical Feasibility

Provide the name of supporting documents that indicate/justify project feasibility.

1.

2.

3.

c) Quantification of Project Benefits

Provide quantification of the benefits for one or more of the benefits included in your answer to Question 3 as described in the supporting documents listed above.

d) Economic Feasibility

Has a cost/benefit type analysis been conducted for the project? If so, was is conducted within the past five years, and does it include the most current data available? Please describe. If no, please indicate why.

FOR REVIEWERS ONLY

Project #:

Project Title:

Project Sponsor:

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F. IRWM Plan Project List, April 2018

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San Gorgonio IRWM Plan Project List

Project Number	Project Title	Sponsor	Project Grouping	Project Description
Plan Projects				
P-1	Fire Flow Improvements in County Areas	City of Banning	Group A	County areas within the southern part of the City of Banning Water Service Area have been identified as deficient in meeting fire flow criteria. To improve available fire flow, a combination of new pipelines and PRV stations are proposed. The project would include design and construction of the necessary facilities.
P-2	Storage Tank for Camp Comfort Wells	City of Banning	Group A	The project would construct a new 100,000 gallon storage tank to primarily be used for fire flow protection and operational flexibility in case of extended power outages. The four City of Banning wells near Camp Comfort, designated as 9, 10, 11 and 12, would pump into this storage reservoir rather than directly into the Banning Water Canyon Transmission Main. The new storage tank would provide 1,500 gpm of fire flow for up to 1 hour. For providing water to Banning Heights Mutual Water Company through the emergency inter-tie at the historical average of 35 gpm, the 100,000 gallon supply in the proposed tank would last approximately 2 days.
P-3	Wastewater Treatment Plant Upgrade	City of Banning	Group A	The proposed project will upgrade the existing City of Banning Wastewater Treatment Plant to provide tertiary treatment with the goal of producing recycled water, both for direct non-potable reuse and for groundwater augmentation. Currently the City of Banning has 90% plans and specifications, but wishes to revisit the selected treatment technology to ensure it is the most economically viable solution, before proceeding with construction. Because both the Butterfield and Rancho San Gorgonio Specific Plans depend on the availability of recycled water, they are identified as potential partners and will likely pay for the extension of the City's existing non-potable distribution system to be able to connect to the WWTP. Cabazon Water District and the Morongo Tribe are both downgradient of the City of Banning wastewater treatment plant and would benefit from the addition of tertiary treatment to achieve higher rates of nitrogen removal.
P-4	Upsizing Emergency Connection with City of Banning	BHMWC	Group A	This project would upsize an existing emergency connection between the City of Banning and Banning Heights Mutual Water Company (BHMWC) at the northern end of their respective distribution systems. An upsized emergency connection would improve BHMWC's fire flow protection. A PRV would be incorporated into the emergency connection that would also benefit Banning's system by pressurizing fire hydrants in the Banning Water Canyon that are currently not pressurized.

Project Number	Project Title	Sponsor	Project Grouping	Project Description
				A second phase of the project would allow water to flow through the BHMWC distribution system and connect back to the Banning system with a new connection at the southern end of the BHMWC system. This would increase the reliability of the City of Banning's Wells 9, 10, 11 and 12 by making their supply available to the City in the event of main breaks that require the isolation of the aging Banning Water Canyon Pipeline.
P-5	Chromium-6 Treatment	City of Banning	Group A	Design and Construction of Chromium-6 Treatment facilities at up to 9 groundwater wells in the City of Banning. Depending on the revised MCL adopted by the State, anticipated to be made public sometime in 2019, the number of wells needing treatment may need to be revised up or down. The proposed treatment technology is Strong Base Anion Exchange, although alternatives would be considered as part of preliminary design.
P-6	Main Pressure Zone Separation Project	City of Banning	Group A	The Main Pressure Zone in the City of Banning potable water system currently encompasses approximately two thirds of the service area and static pressures range from 40 psi to 235 psi. The proposed project would split the zone into Upper Main and Lower Main pressure zones to reduce static pressures in what will become the Lower Main Zone. The reduced pressures are expected to help decrease distribution system water losses due to leaks and main breaks. Additional operational benefits include the ability to isolate major outages and to better track demands in different areas of the City. The zone separation will happen by way of multiple PRV valves, to achieve redundancy and reliability. The proposed project will include design and construction of the PRV stations.
P-7	Recycled Water Distribution System Expansion (Phase 1B and 1C)	City of Banning	Group A	The proposed project would expand the City of Banning's existing non-potable distribution system with an additional 2.8 miles of 24" pipe and 0.6 miles of 8" pipe. The expansion would make it possible to connect the distribution system to the City's Wastewater Treatment Plant, which will start producing recycled water after tertiary treatment upgrades. Plans and specifications have been completed for this project.
P-8	Banning/Cabazon Pipeline	SGPWA	Group A	This project would upsize an existing emergency connection between the City of Banning and Banning Heights Mutual Water Company (BHMWC) at the northern end of their respective distribution systems. An upsized emergency connection would improve BHMWC's fire flow protection. A PRV would be incorporated into the emergency connection that would also benefit Banning's system by pressurizing fire hydrants in the Banning Water Canyon that are currently not pressurized.

Project Number	Project Title	Sponsor	Project Grouping	Project Description
				A second phase of the project would allow water to flow through the BHMWC distribution system and connect back to the Banning system with a new connection at the southern end of the BHMWC system. This would increase the reliability of the City of Banning's Wells 9, 10, 11 and 12 by making their supply available to the City in the event of main breaks that require the isolation of the aging Banning Water Canyon Pipeline.
P-9	Charles Street Septic Conversion	City of Banning	Group B	A City block along Charles Street, east of San Gorgonio Avenue, is currently on septic. Approximately 1600 feet of new 8" sewer main and 45 sewer laterals would be constructed and connected to the surrounding collections system. The additional flows to the wastewater treatment plant would be treated and made available for reuse as recycled water once the City upgrades its treatment facilities.
P-10	Victory Avenue Septic Conversion	City of Banning	Group B	A portion of Victory Avenue, west of Florida Street, is currently on septic. Approximately 600 feet of new 8" sewer main and 10 sewer laterals would be constructed and connected to the surrounding collections system. The additional flows to the wastewater treatment plant would be treated and made available for reuse as recycled water once the City upgrades its treatment facilities.
P-11	Wesley Street Septic Conversion	City of Banning	Group B	A portion of Wesley Street, between San Gorgonio Avenue and Hargrave Street, is currently on septic. Approximately 1600 feet of new 8" sewer main and 15 sewer laterals would be constructed and connected to the surrounding collections system. The additional flows to the wastewater treatment plant could be treated and made available for reuse as recycled water once the City upgrades its treatment facilities.
P-12	Dedication of Jensen Creek/Diversion Rights to Environmental Proposes	Cabazon Water District	Group B	Dedication of Cabazon Water District's Jensen Creek Stream Diversion rights to environmental purposes, specifically wildlife, with the construction of water guzzlers or similar devices within the Jensen Creek drainage area, on the lower mountainside and the grading of roads for service to the facilities.
P-13	Pipeline Rehabilitation Asset Study	City of Banning	Group B	The proposed project would conduct a study of the existing City of Banning Water Distribution System, including review of available data and additional field investigations, to develop a pipeline rehabilitation plan. Anticipated tasks would include updating the City's GIS system with complete pipeline age and material information as well as leak history and condition assessment if available.
P-14	Installation of System-Wide Isolation Valves	Cabazon Water District	Group B	Installation of isolation valves throughout the water system (within both DAC and SDAC areas). There are a limited number of isolation valves (estimated 150, of which an estimated 100 are functional) throughout Cabazon; therefore, extensive and significant

Project Number	Project Title	Sponsor	Project Grouping	Project Description
				dewatering of pipelines and waste of water results when repairs or replacements are required. The project, consisting of 45 replacement valves and 210 additional valves, will reduce water waste during pipeline dewatering for repairs and replacements, improve system operation, and improve system reliability by limiting or minimizing service interruptions to customers and limiting waste of water.
P-15	Potable Water Storage Tank in the Northcentral Portion of Cabazon	Cabazon Water District	Group B	Construction of a new 1.0 MG tank in the northcentral portion of Cabazon (a Disadvantaged Community), in order to provide fire flow, operational flexibility, and system redundancy.
P-16	Potable Water Storage Tank in the Southeastern Portion of Cabazon	Cabazon Water District	Group B	Dedication of Cabazon Water District's Jensen Creek Stream Diversion rights to environmental purposes, specifically wildlife, with the construction of water guzzlers or similar devices within the Jensen Creek drainage area, on the lower mountainside and the grading of roads for service to the facilities.
P-17	Potable Water Well in Cabazon (SDAC Area)	Cabazon Water District	Group B	The project consists of site search, selection, and acquisition; a hydrologic (aquifer zone) test well; and construction of a potable production well, a vertical turbine pumping unit, electrical service equipment and gear, plant and site piping, offsite electrical service extension and offsite water extension, and site improvements, including pump building, parking and drive pavement, and site fencing with vehicle and pedestrian gates. The District provides water service on both sides of Interstate 10 (I-10) and the Union Pacific railroad tracks, and its water system is essentially divided by I-10 and the Union Pacific railroad tracks, except for a single 8" pipeline interconnecting the north side and south side water systems. The pipeline is old (68 years, and well beyond its service life of 50 years) and is located in the western end of the District. The southeastern portion of the District's water system serves a Severely Disadvantaged Community (SDAC) with a single potable water well. Another potable water well south of I-10 would increase supply reliability and provide redundancy to the SDAC area.
P-18	Replacement Pipeline Crossing Under Interstate 10	Cabazon Water District	Group B	Construction of a 16" replacement pipeline, including conductor casing under Interstate 10 and the Union Pacific railroad tracks, connecting northern and southern portions of the water system, which are separated by Interstate 10 and the Union Pacific railroad tracks. The existing 8" pipeline is old (68 years, well beyond its service life of 50 years) and inadequate; it is unable to convey demand and fire flow from north to south simultaneously. Also, the replacement pipeline will connect to the District's existing 16" pipelines at each end of the replacement pipeline.

Project Number	Project Title	Sponsor	Project Grouping	Project Description
P-19	Wastewater Treatment Plant and Recycled Water Program	Cabazon Water District	Group B	Development, construction, and implementation of a wastewater collection, treatment, and conveyance system in order to reduce potential contamination of nitrates from entering into the Cabazon sub-basin of the Coachella Valley groundwater basin, and the concurrent construction of a recycled water system, to implement a program for making recycled water available for County Parks and Recreation facilities and other locations where feasible.
P-20	Well Pumping Plant Improvements	Cabazon Water District	Group B	Replacement of an existing pumping unit and related electrical equipment at two existing potable water wells, both located north of Interstate 10, as well as installation of a new water level measuring access port (for monitoring groundwater levels) at another existing potable water well, which is located south of Interstate 10. Water levels have declined and the existing pumping units do not perform as needed; therefore, they need to be replaced.
P-21	Emergency Standby Generator at Well Pumping Plant 1	Cabazon Water District	Group B	Installation of emergency backup power (standby generator) at one of the District's well pumping plants (Well Pumping Plant 1).
Conceptual Projects				
C-1	Altitude Valves to Maximize Emergency Storage	City of Banning	N/A	The City of Banning has existing pressure zones that stretch a considerable distance, creating slightly different Hydraulic Grade Lines (HGLs) from one end of a zone to another. Depending on seasonal demand patterns, this leads to an underutilization of existing storage reservoirs. With altitude valves that are independently controlled at each reservoir, this project aims to maximize the use of existing storage facilities. Reservoirs that have been identified as potentially benefiting from altitude valves are the three San Gorgonio Reservoirs, and the Southwest Reservoir. Another existing reservoir, the Brinton Reservoir, has an altitude valve but must be operated below capacity so as to not overflow the Southwest Reservoir. Once the other reservoirs are retrofitted with altitude valves, all reservoirs will be able to operate at their designed maximum water level, with an anticipated increase in usable storage of approximately 1.0 million gallons.
C-2	Arundo and Tamarisk Mapping and Systematic Removal	City of Banning	N/A	Arundo and Tamarisk are invasive species that thrive in the region and can crowd out native flora, thereby degrading habitat and decreasing regional biodiversity. Both arundo and tamarisk are attracted to riparian habitat, and once established are very difficult to remove. Tamarisk thickets have been known to draw large amounts of groundwater to outcompete other species. At the same time, tamarisk can concentrate

Project Number	Project Title	Sponsor	Project Grouping	Project Description
				salts on the ground surface to make the habitat inhospitable to other plant species. The initial phase of the proposed project would create a dynamic GIS map of known arundo and tamarisk that can be constantly updated, with community involvement. Community outreach and education would be a part of the initial phase. Once a substantial amount of data has been gathered for the region, an implementation phase would be undertaken to remove as many arundo and tamarisk as economically feasible using a combination of cost sharing with private homeowners and removal of these species from public lands as operating budgets allow.
C-3	Banning water Canyon Pipeline Relining	City of Banning	N/A	The City of Banning depends on the Banning Water Canyon for nearly a third of its water supply. There is a single transmission pipeline that conveys water from 11 groundwater wells and it has a history of repeated main breaks, indicating it has reached the end of its useful life. Due to the difficult terrain and few services along this transmission main, the City is proposing to reline some segments of the 100-year-old pipeline rather than replacing it entirely. The project would evaluate several methods and products for relining or otherwise rehabbing the pipeline and move forward with the selected option. The City anticipates that this alternative to replacing the pipeline will be less disruptive to the natural habitat, including portions that cross USDA Forest Service property, and result in fewer GHG emissions.
C-4	Banning Water Canyon Pipeline Replacement Phase 1A	City of Banning	N/A	The Banning Water Canyon Pipeline Replacement Phase 1A project will construct approximately 1 mile of 24" ductile iron pipe to replace existing 16" and 18" riveted steel pipe that has reached the end of its useful life. Plans for Phase 1A have been prepared, as part of the Phase 1 project, currently in construction. The main benefit of the project is increased reliability of the Banning Water Canyon system, which consists of 11 potable water wells and transmission main serving the City of Banning and, on an emergency basis, the Banning Heights Mutual Water Company. An added benefit is a reduction in system losses, both from slow leakage and main breaks. Finally, relocating the alignment of the pipe to the existing maintenance road will help protect habitat, including on USDA Forest Service properties.
C-5	Conservation Program and Community Outreach	City of Banning	N/A	Ramp up conservation efforts through consistent community outreach, on a regional scale. Educate people about rebates and technologies that can help them save money by conserving water. Promote drought-friendly landscaping; work with HOAs to remove large turf areas that do not serve a functional purpose. Pool resources for outreach materials with other stakeholders in the region.

Project Number	Project Title	Sponsor	Project Grouping	Project Description
C-6	Emergency Backup Power at Critical Productions Facilities	City of Banning	N/A	This project proposes to install emergency backup power generators at critical production facilities to ensure reliability of the potable water system in case of power outages. Three wells have been identified by the City of Banning as being a high priority for emergency power, based on their location relative to the demands of the system. These wells are Well 7, Well 8, and Well M3.
C-7	Groundwater Model Calibration	City of Banning	N/A	This project would continue the work of coupling the watershed model and various groundwater models for the region that was started as part of the San Gorgonio IRWMP. As it exists, the model is able to run, but the results do not closely resemble field measured data. The next step in development of a regional groundwater model would add the Beaumont Basin along with the Banning Bench unit, Banning Water Canyon unit, and Banning unit. Groundwater pumping data, estimated septic return flows, and wastewater discharge flows would be incorporated into the model as well as recharge data from imported water and recycled water groundwater augmentation. The benefits of having a calibrated regional model are many, among them the ability to better manage water resources for both long term and short term planning purposes.
C-8	Imported Water Recharge Facility	City of Banning	N/A	An imported water recharge facility, located in the City of Banning, in a location that would provide direct benefit to residents in the eastern portion of the San Gorgonio Pass region. This would require a pipeline from Cherry Valley to the recharge facility. It is proposed that the City of Banning would operate and maintain the recharge facility and use it for the dual purpose of recharging recycled water, anticipated to be available in the near future from the Banning Wastewater Treatment Plant. Additional potential benefits would be the use of the recharge ponds as a source of water for helicopters fighting brush fires in the area, and as outdoor recreation for local residents with walking paths around the ponds.
C-9	Location #2 Waterline Replacement	City of Banning	N/A	Location #2 Waterline Replacement is located on Nicolet Street, Cottonwood Road, George Street, and 12th Street in the City of Banning. This project will replace undersized pipes that have reached the end of their useful life, and relocate them to the street from their current location in alleyways. New high-accuracy meters, compatible with radio read technology will be installed as part of this project. This project would also install new fire hydrants at more accessible locations.
C-10	Location #3 Waterline Replacement	City of Banning	N/A	Location #3 Waterline Replacement is located on Geneva Street, Roberge Avenue, 22nd Street, sunrise Avenue, and Hays Street in the City of Banning. This project will replace undersized pipes that have reached the end of their useful life, and relocate

Project Number	Project Title	Sponsor	Project Grouping	Project Description
				them to the street from their current location in alleyways. New high-accuracy meters, compatible with radio read technology will be installed as part of this project. This project would also install new fire hydrants at more accessible locations.
C-11	Recoating of Mountain Tank	City of Banning	N/A	The Mountain Tank, an existing 268,000-gallon potable water reservoir, has an interior coating that is deteriorating and needs replacement. Plans and specifications need to be prepared to temporarily take the tank out of service while maintaining normal water deliveries to the Mountain North Zone in the City of Banning. The new tank coating will improve water quality and extend the useful life of the Mountain Tank.
C-12	Redetermination of Safe Yield	City of Banning	N/A	Re-determine the safe yield for the various groundwater units that make up the San Gorgonio Pass Subbasin, to include: Banning unit, Banning Bench unit, Banning Water Canyon unit, Cabazon unit.
C-13	Reservoirs Seismic Evaluation and Retrofits	City of Banning	N/A	The City of Banning owns nine potable water storage reservoirs, some of which were built in the 1950's. The proposed Reservoirs Seismic Evaluation and Retrofits project will evaluate existing infrastructure to identify the most critical and cost effective improvements that can increase the reliability of the City of Banning potable water storage. Anticipated improvements would be flex joints, disconnecting overflow piping currently hard plumbed as it transitions underground, and possible retrofits to the ringwall foundation.
C-14	Sewer Main Relining and Point Repairs - North Banning	City of Banning	N/A	The older parts of the City of Banning's sewer system, primarily in north Banning have been shown to have higher Infiltration and Inflow following storm events, as confirmed with flow monitoring performed in January 2017. This puts unnecessary strain on the City of Banning Wastewater Treatment Plant, to be able to treat peak flows. The proposed project would reline and repair the segments of the collection system that have been shown to be in poor condition, based on CCTV video inspections. Additionally, older manholes would be repaired and sealed. Keeping rainwater out also has the added benefit of keeping wastewater in, which would increase the annual flows to the wastewater treatment plant, making this water available after treatment as recycled water. The initial phase of the project, as proposed, would focus on data gathering and plan development for a future implementation phase.
C-15	Smart Metering	City of Banning	N/A	The City of Banning currently has approximately 10,500 water meters that are manually read each month. The proposed project would retrofit the existing meters with a compatible electronic register and radio so they can be read automatically (AMR) by a receiver placed in a vehicle that would be driven around the City. The AMR system

Project Number	Project Title	Sponsor	Project Grouping	Project Description
				would reduce mis-reads; capture smart statistics such as potential slow leaks, reverse flow, and major leak conditions; provide frequent updates for more accurate billing; and free up meter reading staff to provide a higher level of service when turn ons and turn offs are needed. A subsequent phase would install Automatic Metering Infrastructure (AMI) to read meters remotely on a continuous basis. AMI would allow both City staff and customers to access detailed consumption history reports which make it easier to conserve water and detect possible water theft.
C-16	Storm Water Capture Studies and Projects	City of Banning	N/A	Feasibility studies for storm water capture as part of new Master Planned Communities in the City of Banning, i.e., Butterfield and RSG. The improvements would bring together the benefits of flood protection and groundwater recharge. A third potential benefit would be the use of the basins for recharge using recycled water.
C-17	Water Canyon Recharge Facilities	City of Banning	N/A	This project would be to design and construct new and/or expanded basins in the Banning Water Canyon. Existing undersized recharge basins would be consolidated and enlarged to increase capacity, and enhanced with the addition of desilting basins. The primary source of water would be stormwater runoff and snowmelt.
C-18	Water Canyon Storage Reservoir	City of Banning	N/A	A proposed potable water storage reservoir near Camp Comfort in the Banning Water Canyon will increase the reliability of water service in case of power outages as well as offer operational flexibility so that wells 9, 10, 11, and 12 can be turned off periodically to allow the local aquifer to recover. The proposed reservoir will have a capacity of 180,000 gallons to offer fire flow protection of 1,500 gpm for a two hour duration.
C-19	Banning MDP – Line A-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. A-I drains the intersection of Westward Avenue and 8th Street. The line is an underground drain that extends easterly in Westward Avenue to a point of junction with Line A at 4th Street.
C-20	Banning MDP – Line A-2	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line A-2 is a future extension of the underground drain which is now completed to the intersection of Ramsey Street and 8th Street. The proposed storm drain extends westerly from 8th Street in Ramsey Street to a point approximately 600 feet west of 12th Street.

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C-21	Banning MDP – Line A-3	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line A-3 drains the intersection of 8th Street and Williams Street. The line is an underground drain that extends easterly in Williams Street to an outlet into the old Line A storm drain.
C-22	Banning MDP – Line A-4, Stage 2	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line A-4 drains a large local area north of Gilman street between Banning MDP Lines A and C. The line is an underground drain which extends some 1200 feet easterly in Gilman Street to 8th Street. From there it continues southward in 8th Street and discharges into the existing realigned segment of Line A-4, Stage 1 at Wilson St.
C-23	East Gilman Home Channel aka Banning MDP Line A	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. The East Gilman Home Channel collects runoff from a 1.14 square mile watershed, one of the major watersheds draining into Banning. The channel begins in the mouth of a canyon approximately 2,000 feet north of the intersection of Wilson Street and 16th Street, and continues southeasterly to the intersection of Nicolet and 8th Streets. Partial segments of this channel have been constructed. The connecting reaches of Line A between Williams and Nicholet St are to be constructed.
C-24	Banning MDP Line B	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line B extends northerly to Wilson Street, the Gilman Home Channel segment completed in 1972. The line proposed is a concrete lined channel located within the existing well-defined wash. A double 10' x 6' box culvert is proposed to replace the existing double 48" CMP's under Wilson Street when the street is improved in the future.
C-25	Banning MDP Line C-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line C-1 is proposed to improve the existing upstream inlet structure to provide a debris storage capacity of 0.5 ac-ft.
C-26	Banning MDP Line C-2	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line C-2 is an underground drain that relieves a drainage problem on Indian School Lane. The line extends some 500 feet westerly in Indian School Lane to an outlet into Line C.

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C-27	Banning MDP Line C	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line C is a 7'Wx6'H rectangular concrete channel that will replace the existing rock and mortar channel upstream from Wilson Street, and extend to the existing Indian Canyon Debris Basin.
C-28	Banning MDP Line D-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line D-1 is an underground drain that begins at Cherry Street, extends easterly in George Street to Hathaway Street, and continues south in Hathaway Street to confluence with Line D at Ramsey Street.
C-29	Banning MDP Line D	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Portion of Line D is constructed. Increased inlet capacity is required at several locations and some improvement of the restriction just upstream from the freeway is necessary. It is recommended that 378 feet of catch basin inlets be added. The improvement to Line D between Hathaway Street and Interstate 10 will involve the removal of an existing restricted covered channel and construction of an 8'w x 4'h RCB in Ramsey Street.
C-30	Banning MDP Line E-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line E-l is an underground drain that helps relieve drainage problem downstream on Ramsey Street. The line extends easterly in George Street to Woodland Avenue and continues southerly in Woodland Avenue to Nicolet Street.
C-31	Banning MDP Line E	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Recommended improvements for Line E consist of improving the inlet capacity on Ramsey Street by the addition of 157 lineal feet of catch basin inlets. The project will also look at feasibility of construction of a 60 inch diameter pipe parallel to existing storm drain along Ramsey Street from Sunrise Avenue and draining into the mainline channel (approximately 1200 feet).
C-32	Banning MDP Line F	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line F is an underground drain in San Gorgonio Avenue, extending from the Southern Pacific

Project Number	Project Title	Sponsor	Project Grouping	Project Description
				Railroad tracks south to an outlet at Smith Creek. Line F is needed to for flood risk management for development of properties between 4th Street and San Gorgonio Avenue.
C-33	Banning MDP Line G	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line G is an underground drain that extends southerly in Hargrave Street from Lincoln Street to the existing drain at Wesley Street.
C-34	Banning MDP Line H	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line H is an underground drain that extends southerly in Hathaway Street from Barbour Street, to an outlet at Smith Creek.
C-35	Banning MDP Line J-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line J-I is an underground drain which services the tributary area between Highland Springs Channel and Smith Creek Channel. It carries runoff from the existing 48 inch RCP, downstream to the Caltrans channel adjacent to the Interstate 10 freeway.
C-36	Banning MDP Line J-2	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line J-2 is an underground drain extending easterly in Ramsey Street some 2000 feet to the junction with Line J-I. This drain will help relieve the local drainage problem on Ramsey Street.
C-37	Banning MDP J aka Highland Springs Channel	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Major portion of Line J has been constructed along Highland Springs Avenue. The remaining portion includes the construction of the facility parallel to interstate 10.
C-38	Banning MDP – Line K-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line K-1 is a 9' x 7' RCB will drain 960 cfs from the total Smith Creek Basin peak discharge rate of 3,500 cfs, and convey these flows to Pershing Creek Channel (Line K) via Ramsey Street. This facility combines with Line K just south of Ramsey Street crossing.
C-39	Banning MDP K aka West Pershing Channel	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. West Pershing Channel includes an upstream extension of the existing channel along

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				Meridian Avenue. It is proposed to be constructed within the street right of way to the vicinity of 14th Street. At this point, the channel will extend easterly some 2200 feet to the natural channel emanating from the base of the hills. Downstream Line K channel junctions with Line L north of Ramsey Street and westerly of Omar Street. One cell of this box is to be used by proposed Line L. A rectangular concrete channel is proposed south of Ramsey Street to connect to an existing double 10' x 10' RCB under Interstate 10.
C-40	Banning MDP – Line L-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line L-I provides an outlet for the area tributary to the intersection of Wilson Street and Mountain Avenue. The line is an underground drain that extends westerly in Wilson Street from Mountain Avenue some 450 feet.
C-41	Banning MDP – Line L	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line L aka East Pershing channel has been constructed in portion as part of improvements on Tract 30793. The Channel is required to drain the 340 acre watershed tributary to the low in Wilson Street located 1300 feet east of Highland Home Road. The proposed channel extends downstream from the southern limits of the Morongo Indian Reservation, some 1200 feet south along Mountain Avenue then southwesterly to the natural low. The channel then proceeds south some 2000 feet where it junctions with Line K south of Ramsey Street.
C-42	Banning MDP – Line N-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line N-I is the upstream extension of the existing rock slope protection adjacent to the Prison Farm. It will reach to San Gorgonio Avenue along the north bank of Smith Creek. The project is intended to protect an existing City sewer line from Smith Creek flows.
C-43	Banning MDP – Line O	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line O is a drain in Sunset Avenue proposed to replace an existing 18" CMP between the SPRR and Ramsey Street. It is intended to intercept 10 year storm flows at the intersection of Ramsey Street and Sunset Avenue.

Project Number	Project Title	Sponsor	Project Grouping	Project Description
C-44	Banning MDP – Line C-3	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Line C-3 is an underground drain which collects runoff. It extends from about 35 acres tributary to Indian School Lane, southeasterly 1300 feet along a wash and outlets into Sidney Street Channel (Line C-l).
C-45	East Gilman Home Debris Basin	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. The basin is located at the upstream end of Banning MDP Line A. The maximum embankment height is 28 feet with 18.7ac-ft of debris storage.
C-46	Montgomery Creek Debris Basin	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. The basin is located at the upstream end of Banning MDP Line E. The maximum embankment height is 16 feet with 22.7ac-ft of debris storage.
C-47	Smith Creek Basin	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Smith Creek Basin is located along Smith Creek between Gilman Street and Wilson Street, is proposed to reduce the 100 year peak runoff from 6,100 cfs to 3,500 cfs. This reduction is critical due to the limited capacity of the existing double 10' x 8' RCB culvert at the Interstate 10 freeway.
C-48	Smith Creek Channel, Line I-1	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Smith Creek Channel Line I-1 is an open concrete lined channel branching off to the east from Line I about one (1) mile north of Wilson Street. It extends northeasterly some 5200 feet to the base of the foothills. This channel is intended to intercept storm runoff from approximately one (1) square mile of drainage area.
C-49	Smith Creek Channel, Line I	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. Smith Creek Channel Line I is an open concrete lined channel from the mouth of the main tributary canyon to the north, down to the existing underground storm drain at the upstream side of the Interstate 10 freeway. Reinforced concrete boxes are proposed for road crossings. Since FEMA has determined this watershed to have a high debris potential, an inlet structure with a debris storage capacity of 6 ac-ft. is proposed at the upstream end, which is some 2 miles north of Wilson Street. The channel will intercept

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				flows from approximately 2.6 square miles tributary to the mouth of the canyon. In order to maximize the flow capacity of the Interstate 10 freeway culvert at Pershing Creek and to perpetuate the Smith Creek and Pershing Creek flow patterns that exist today, a retention basin (see Smith Creek Basin) is proposed at Gilman Street, along with a proposed "split-flow" facility (see Line K- 1) in Ramsey Street.
C-50	West Gilman Home Debris Basin	RCFCWCD	N/A	This project is part of Banning Master Drainage Plan which collectively as a drainage system will protect the city of Banning from nearly 380 acres of FEMA floodplain. The basin is located at the upstream end of Banning MDP Line B. The maximum embankment height is 26 feet with 14.3 ac-ft of debris storage.

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G. Proof of Public Notice Publication

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PUBLIC NOTICE

Banning, CA – The San Gorgonio Integrated Regional Water Management Group (SGIRWMG), established in 2016, is presenting its first Integrated Regional Water Management (IRWM) Plan. IRWM plans are regional plans designed to improve collaboration in water resources management. The SGIRWMG is comprised of the following agencies: City of Banning, Banning Heights Mutual Water Company, Cabazon Water District, High Valley Water District, Riverside County Flood Control and Water Conservation District and San Gorgonio Pass Water Agency.

The IRWM Plan for the San Gorgonio Region is a result of a lengthy and collaborative effort among water retailers, water wholesalers, wastewater agencies, stormwater and flood managers, watershed groups, the business community, tribes, disadvantaged communities, and non-profit stakeholders to improve water resources planning in the San Gorgonio Region.

The Plan provides an approach for: coordinating, refining and integrating existing planning efforts within a comprehensive regional context; identifying specific regional and watershed-based priorities for implementation projects; and providing funding support for the plans, programs, and projects of existing agencies and stakeholders.

All interested stakeholders are invited to participate in the IRWM planning effort, providing an opportunity to incorporate additional stakeholder interests into the Plan. Participation is possible through several means, including attending Stakeholder Advisory meetings and public workshops, and by reviewing draft materials available online at www.sgirwm.org.

For more information and to be added to the SGIRWM Stakeholder Contact List, please email SGIRWM@ci.banning.ca.us.

Dated: March 19, 2018

3/23, 3/30