2018 MAC Plan Response to Public Comments

Comment #	Commenter	Section	Public Draft PDF pg #	Plan Text/Context	Comment	Response
1	Calaveras Public Utility District	N/A	N/A	2018 MAC Plan Project List	Please include the Middle Fork Ditch Pipeline and Hydroelectric Power Project in the MAC 2018 Plan to support CPUD and their infrastructure needs.	The project has been added to a new Appendix F of the Plan, but will not be scored, prioritized, nor included in the main body of the Plan.
2	East Bay Municipal Utility District	N/A	N/A	2018 MAC Plan Project List	Please include the Middle Fork Ditch Pipeline and Hydroelectric Power Project in the MAC 2018 Plan to support CPUD and their infrastructure needs.	The project has been added to a new Appendix F of the Plan, but will not be scored, prioritized, nor included in the main body of the Plan.
3	Foothill Conservancy	1.1.1	13	Consequently, one of the primary purposes in establishing the MAC Region has been to promote and facilitate a collaborative planning process to develop program and project solutions which address future Amador, Calaveras, and East Bay water resource needs.	Should be "that," not "which"	Text edited as suggested.
4	Foothill Conservancy	1.1.1	13	Since the 1920s, the Mokelumne River has been the primary source of water used by East Bay Municipal Utility District (EBMUD) to serve East Bay communities. Thus, for nearly one hundred years, the local governments and water agencies of Amador and Calaveras Counties have competed with EBMUD and the environment for Mokelumne River water supply.	add San Joaquin County	Text edited as suggested.
5	Foothill Conservancy	1.1.1	13	However, as the foothill and East Bay communities continue to grow, so does the need for additional water supply.	That's sort of an arguable statement. EBMUD's demand is flat and neither Amador nor Calaveras are anywhere close to needing additional water supply.	Comment noted. The IRWM Plan does not have a specific planning horizon; supply/demand tables are from other planning efforts with specified planning horizons and are included to provide context.
6	Foothill Conservancy	1.1.1	14	The hydrologic boundary of the Mokelumne River watershed was selected to represent the eastern MAC regional boundary because (1) this area is the headwaters of the river system which is a critical water supply source for MAC Region communities, and (2) lands adjacent to and east of this boundary are generally contained in watersheds which drain eastward to the Carson River watershed, away from the MAC Region.	See earlier that/which comment and check throughout document. See https://www.quickanddirtytips.com/education/grammar/which-versus-that-0 for correct usage info	Text edited as suggested.
7	Foothill Conservancy	1.1.1	14	This border was determined to be the best western extent of the MAC Region because (1) the water supply issues facing the western portions of Amador and Calaveras counties must be addressed by water agencies with the authority and jurisdiction to do so (AWA and Calaveras County Water District [CCWD]); and (2) other than the western portion of Calaveras County that overlies the Eastern San Joaquin Groundwater Basin, the groundwater resource issues that predominately characterize the Eastern San Joaquin IRWM Region are very different from the predominately surface water issues that must be addressed by the MAC Region.	CPUD and JVID?	Text edited as suggested.
8	Foothill Conservancy	1.1.3	18	Watersheds within the Mokelumne Wilderness area drain to the Mokelumne River on the west slope and the Carson River on the east slope.	Should be Humboldt-Toiyabe	Text edited as suggested.

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9	Foothill Conservancy	1.1.3	19	As the Mokelumne River flows westward from the watershed's western Sierra Nevada origins, the main river and its tributaries pass through several lakes and reservoirs, including Upper and Lower Blue lakes, Twin Lake, Meadow Lake, Lower Bear River Reservoir, Mosquito Lake, Salt Springs Reservoir, Tiger Creek Reservoir, Lake Amador, and Pardee Reservoir.	add Upper Bear?	Text edited as suggested.
10	Foothill Conservancy	1.1.3	19	Mine effluent discharged into the river through these decades has impacted the area's natural resources.	vague term	The word "impacted" has been updated to "impaired."
11	Foothill Conservancy	1.1.3	19	Pacific Gas & Electric Company (PG&E), EBMUD, and JVID also use the river for hydroelectric generation.	JVID's hydro comes from Jackson Creek, not the Mokelumne	Added "and it's tributarties" after "river" to include Jackson Creek in the description.
12	Foothill Conservancy	1.1.3	19	Restoration activities are also taking place on National Forest lands in the upper watershed through land and resource management decisions made by the Eldorado and Stanislaus National Forests	The salmon habitat restoration work is in the lower Moke watershed, not the upper Moke watershed.	Updated the sentence to reference the lower watershed instead of the upper watershed.
13	Foothill Conservancy	1.1.3	19	This designation, if passed by the California legislature, would recognize the recreational and scenic values of the proposed sections of the Mokelumne River and would general prohibit new dams on these sections in order to protect those values.	Please include information on the PG&E hydro settlement and improvements made to flows, aquatic habitat, and recreation resulting from the settlement. If you need info, let us know. Also, please update the text to indicate that 37 miles of the NF and main Mokelumne from just below Salt Springs Dam to just upstream of Pardee Reservoir were designated a California Wild and Scenic River on June 27, 2018.	Text edited as suggested.
14	Foothill Conservancy	1.1.3	19	The combined area of the Lower Mokelumne River and Cosumnes River watersheds within the MAC Region (i.e., the portions lying within Amador and Calaveras counties) is about 122 square miles in size.	I think you should lower case "Lower" here. Have never seen the Mokelumne called the "Lower Mokelumne River"	Text edited as suggested.
15	Foothill Conservancy	1.1.3	19	Land uses within the portion of the Lower Mokelumne River watershed contained in the MAC Region are predominately grazing, recreation, water storage within Camanche Reservoir, and very sparse residential/ranchette development. Water stored in Camanche Reservoir, a flood control and recreation reservoir, is used for downstream fisheries, recreation, hydroelectric generation and water supply.	Add vineyards. Also, so you want to reference the new Buena Vista casino that's going to open next year?	Text edited as suggested. Added "commercial development" to encompass the new casino.
16	Foothill Conservancy	1.1.3	20	New Hogan Dam was constructed on the Calaveras River in 1963 for flood control as well as municipal, industrial and irrigation purposes. Releases from New Hogan Dam currently control flows on the Lower Calaveras River. The upper watershed above New Hogan reservoir covers 363 square miles with an average annual runoff of about 166,000 AF.	mention that NH is an Army Corps dam?	Text edited as suggested.
17	Foothill Conservancy	1.1.3	20	Table 1-1: Agencies with Major Water Resources Management Responsibilities in the Region	Add Army Corps of Engineers (New Hogan)	Text edited as suggested.
18	Foothill Conservancy	1.1.3	21	Table 1-1. PG&E owns and operates the 206 megawatt Mokelumne River Hydroelectric Project (FERC license 137, reissued October 2011).	Date is wrong on new license. Issued 2001, not 2011.	Text edited as suggested.

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19	Foothill Conservancy	1.1.3	21	Table 1-1. Two tunnels, the Tiger Creek conduit and the Electra tunnel, are together 25 miles long and transport water around the North Fork Mokelumne's natural riverbed.	The Tiger Creek Conduit is nearly entirely an open, concrete flume. It's not a tunnel.	The term "tunnels" updated to "conveyance facilities."
20	Foothill Conservancy	1.1.3	21	Established in 1905 as an agency of the U.S. Department of Agriculture, it manages public lands in national forests and grasslands, including the Stanislaus National Forest and El Dorado National Forest within the MAC Region.	Eldorado is the forest name. One word.	Text edited as suggested.
21	Foothill Conservancy	1.1.3	22	Overdraft of the groundwater in this subbasin has created groundwater depressions in areas near Stockton and east of Lodi. The Cosumnes Subbasin of the San Joaquin Valley Basin is located north of and adjacent to the Eastern San Joaquin Groundwater Subbasin.	Should mention that the Cosumnes Subbasin is overdrafted to the point that it goes dry every summer. See study I will attach with our comments	Unable to corroborate that the Cosumnes Subbasin goes dry every summer. The paper indicates that the Cosumnes River does go dry every year or nearly every year, which may be exacerbated by low groundwater levels.
22	Foothill Conservancy	1.1.4	25	Table 1-3 Amador County	There are a number of other, smaller special districts that have water and sometimes WWT responsibilities in the region, including the Pine Grove CSD, Fiddletown CSD, and others. See Amador County LAFCO Municipal Services Review for info	Text edited as suggested. Eight new Amador County special districts that provide water service added to table based on LAFCO MSR.
23	Foothill Conservancy	1.1.4	27	Stakeholder and Special Interest Groups	"special interest" is a generally seen as a somewhat derogatory term	"Special Interest" wording removed.
24	Foothill Conservancy	1.1.4	27	Stakeholder and Special Interest Groups	Add info on Amador-Calaveras Consensus Group?	Text edited as suggested.
25	Foothill Conservancy	1.1.4	27	Foothill Conservancy: The Foothill Conservancy's stated mission is to protect, restore, and sustain the natural and human environment in Amador and Calaveras counties for the benefit of current and future generations. The Conservancy has been actively involved in water resource issues for many years, and its members serve on the RPC, Mokelumne Forum, and other stakeholder organizations involved with water resource issues in the MAC Region.	add "land use, and watershed"	Text edited as suggested.
26	Foothill Conservancy	1.1.4	27	The Conservancy has been actively involved in water resource issues for many years, and its members serve on the RPC, Mokelumne Forum, and other stakeholder organizations involved with water resource issues in the MAC Region	Mokelumne Forum no longer exists. You might mention that FC is a signatory to the settlement agreement for the PG&E project and sits on the Ecological Resources Committee that manages its adaptive management plan. "many years" is kind of vague. Have been engaged since 1989 and as a CA nonprofit corporation since 1990.	Text edited as suggested.
27	Foothill Conservancy	1.1.4	27	Alpine Watershed Group: This organization operates similar to a watershed council. The Alpine Watershed Group works to preserve and enhance the natural system functions of Alpine County's watersheds for future generations.	You might mention that this is a county entity.	Text edited as suggested.

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28	Foothill Conservancy	1.1.5	29	Amador Water System: The Amador Water System conveys Mokelumne River water transported via PG&E's Electra Tunnel to Lake Tabeaud. Lake Tabeaud then feeds the Amador Canal, transporting water to treatment plants in Sutter Hill and Ione. The 23-mile Amador Canal was replaced in 2008 with an 8-mile pipeline project. Ione and Tanner water treatment plants, located in Ione and Sutter Hill, respectively, are owned and operated by AWA and provide treated surface water to AWA's service area.	Seems odd to reference the canal and then say it was replaced. Revise?	Text edited to say that a portion of the Canal was replaced with a pipeline.
29	Foothill Conservancy	1.1.5	29	Water from Lake Tabeaud is conveyed by pipeline to the Tanner WTP where it is treated for use by the customers of Jackson, Sutter Creek, Amador City, and Drytown.	add Plymouth	Text edited as suggested.
30	Foothill Conservancy	1.1.5	30	The New York Ranch reservoir, located just southwest of the intersection of Ridge and Climax Roads, currently serves as a holding basin for water flowing via the Amador Canal from Lake Tabeaud to the Tanner Reservoir near Sutter Hill.	Capitalize Reservoir. Is this still accurate?	Text edited as suggested. Confirmed with AWA General Manager that the statement is still accurate.
31	Foothill Conservancy	1.1.5	30	Electra and Middle Bar Runs: This small, scenic canyon on the Upper Mokelumne River, upstream of Pardee Reservoir, is a popular whitewater run. Located below PG&E's Electra powerhouse, this narrow, 1,000-foot-deep, wooded canyon is also a favorite place for other recreational activities such as fishing, picnicking, wading, wildflower viewing, gold panning, and spiritual rejuvenation.	Good to include this, but why not include the other reaches of the river used for recreation? Tiger Creek Dam Run, Ponderosa Run, Devil's Nose, etc. See WS study for details and FC website.	Added Tiger Creek Dam, Ponderosa, and Devil's Nose Runs, and moved information on recreation up to the description of the upper watershed rather than including it in the "Major Water-Related Infrastructure" section.
32	Foothill Conservancy	1.1.6	31	Figure 1-8: MAC Region Land Use	This isn't really very accurate. Most of Amador County below the 1,500-foot elevation is grassland and oak savannah and woodlands, not "forest". Maybe get new maps from the counties?	Added language to clarify that "forested" land includes grassland, oak savannah, and woodlands.
33	Foothill Conservancy	1.1.6	31	General land use trends in the MAC Region include development of rural and agricultural areas and a shift from grazing to viticulture and from viticulture to residential development.	I don't think we're seeing much vineyard to residential development in our counties. Data source?	Removed reference to viticulture to residential development.
34	Foothill Conservancy	1.1.6	31	In recent years, Amador County has experienced increased urbanization and decreased farming and agriculture, though continued agriculture and preservation of agriculture lands is encouraged by the county. Primary farming commodities in the County include wine grapes and cattle. Grazing on public lands is still a custom and part of the County's culture. Large land holdings for timber harvesting of softwood forests exist in areas designated as Timberland Preservation Zones (TLZ), but significant urbanization pressures continue.	data source? Yes, some increased urbanization, but I think we're seeing more cropland. Please verify ag info for both counties with Dept of Conservation and county ag depts. Timberland Preserves are TPZ, not TLZ. We're also not seeing a lot of timberland in Amador converting to residential uses, and in the Amador County general plan update, SPI (primary timberland owner) did not ask for zoning changes to its timberlands. This is more residential conversion pressure on grazing lands and oak woodlands in the western part of both counties	Edited text as suggested: Removed reference to decreased farming and agriculture, updated TPZ, removed "significant" as a descriptor for the urbanization pressures on the TPZ, and added reference to residential conversion pressure on grazing lands and oak woodlands.

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35	Foothill Conservancy	1.1.6	32	The General Plan establishes target development densities within each of these categories such that Community Development Lands will be developed at higher densities and Natural Resource Lands density will be restricted to ensure future use, conservation, and the use of resources. Currently, Natural Resource Lands comprise approximately 55 percent of the land area (22 percent of that designated for Timber or Dam Areas), whereas 43 percent of the total area is designated as Community Development Lands. The remaining 2 percent is designated for the City of Angels and its sphere of influence. The Calaveras County General Plan is completing a comprehensive update to its General Plan with implementation expected in 2019. This IRWMP is not intended to drive the General Plan Update process or to influence growth in the County.	Why not base this description on the draft GP?	Edited text as suggested, updated land use categories based on draft GP.
36	Foothill Conservancy	1.1.6	32	Culture	Please reference the native people who lived in this region for thousands of years. There were both MiWuk and Washoe people in the region and their ancestors continue to live here today. "California Gold Rush" is usually capitalized.	Edited text as suggested.
37	Foothill Conservancy	1.1.6	32	The area is now known for its vineyards and wines, small town charm and hospitality, scenic open space, and rich history.	add recreational opportunities and high quality of life	Edited text as suggested.
38	Foothill Conservancy	1.1.6	35	Table 1-5: Median Household Income Statistics	This data seems a bit old	This data is from 2010 to 2014, which was the most up to date data available while this Plan Update was being developed.
39	Foothill Conservancy	1.1.6	35	Table 1-5: Median Household Income Statistics	Isn't Kirkwood wholly w/in the MAC region?	No, a portion of Kirkwood is in a part of Alpine County that is not included in the MAC Region.
40	Foothill Conservancy	1.1.6	36	Table 1-6: Special-Status Species Potentially within the MAC Region	Could you also list other special status species, including Forest Service and CDFW species of special concern and CNPS rare species?	In order to keep the list concise and specific, no new species were added. However, text refering the reader to the U.S. Forest Service Species of Special Concern, California Dept. of Fish and Wildlife Species of Special Concern, and the California Native Plant Society Rare Plant lists was added.
41	Foothill Conservancy	1.1.6	36	Table 1-6: Special-Status Species Potentially within the MAC Region	Sure about this? Believe they are found only on the Merced River	Edited text as suggested, limestone salamander removed from table.
42	Foothill Conservancy	1.1.6	37	Table 1-6: Special-Status Species Potentially within the MAC Region	Missing Irish Hill Buckwheat, or are you lumping it with Ione buckwheat?	Irish Hill and Ione Buckwheat are combined on the Federal list but kept seperate on the State list. Added Irish Hill buckwheat as a separate line item to Table 1-6.

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43	Foothill Conservancy	1.2.1	38	Demands were estimated based on the projected population growth described in the Amador County General Plan Housing Element Update (PMC, 2015) and historical water use per connection (connections are expected to increase proportionally with population).	It should be pointed out somewhere that historical water use is not a reasonable basis on which to calculate future demand (see Pac Inst analysis and BIA fact sheet)	Sentence has been edited to indicate that while there are a variety of methods that can be used to project demands, AWA demands were estimated using projected population growth and historical water use per connection.
44	Foothill Conservancy	1.2.1	39	Lake Camanche Village will switch to surface water by 2020. The implementation of the Camanche Area Regional Water Supply Project depends on coordination between EBMUD, AWA, and CCWD.	Also depends on resolving a current issue with PG&E re where AWA water can be used	Added PG&E to the list of entities coordinating the switch to surface water.
45	Foothill Conservancy	1.2.1	39	The reduction in losses associated with pipeline conveyance allows surface water in excess of the Amador Water System demand to remain in the Mokelumne River and be incidentally captured in EBMUD's reservoirs.	and evaporation	Text edited as suggested.
46	Foothill Conservancy	1.2.1	39	The reduction in losses associated with pipeline conveyance allows surface water in excess of the Amador Water System demand to remain in the Mokelumne River and be incidentally captured in EBMUD's reservoirs.	That's not quite true. The water saved is diverted through the Project 137 Tiger Creek Conduit and returned to the river at Electra.	Edited text to add this information.
47	Foothill Conservancy	1.2.1	39	AWA is not pursuing any other water transfers or exchanges at this time.	AWA has been approached by BAWSCA for a trial transfer	Updated Plan with information about the potential AWA-BAWSCA transfer.
48	Foothill Conservancy	1.2.1	39	Footnotes of Table 1-8: Current and Planned Water Supplies, AFY; Source: AWA, 2016. Footnotes: 1. It is anticipated AWA will obtain additional water rights in CAWP, increasing the right from 1,150 to 2,200 AFY. 2. Recycled water is not supplied by AWA but it is used in a small portion of its service area. Future supply includes existing and projected recycled water use in AWA's service area. 3. Quantities transferred to EBMUD are incidental and not guaranteed for any specific amount; therefore, they are not projected. 4. Total does not reflect amount of water incidentally transferred out of supply to EBMUD.	It would be helpful if these sources cited the actual document	Text edited as suggested.
49	Foothill Conservancy	1.2.1	40	Table 1-9: Historical and Projected Supply and Demand Comparison; Referencing Introduction (Section 1.1.1 Comment in Second paragraph: However, as the foothill and East Bay communities continue to grow, so does the need for additional water supply.)	This table nicely demonstrates why AWA does not need to develop additional water supply in the planning horizon, contrary to the statement in the introduction to this document.	Comment noted. The IRWM Plan does not have a specific planning horizon; this table is included to provide context and is from other planning efforts with specified planning horizons.
50	Foothill Conservancy	1.2.1	41	Table 1-10: CCWD Current and Projected Supply and Demand, AFY; Referencing Introduction (likely Section 1.1.1 Comment in Second paragraph: However, as the foothill and East Bay communities continue to grow, so does the need for additional water supply.)	Again, this table demonstrates why the initial statement about needing to increase supply is not valid.	Comment noted. The IRWM Plan does not have a specific planning horizon; this table is included to provide context and is from other planning efforts with specified planning horizons.

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51	Foothill Conservancy	1.2.1	42	CCWD's water supplies are currently projected to be sufficient to meet demands for the two water systems within the region for a 20-year horizon. However, variability in supply availability and dependence on local, aging infrastructure have caused CCWD to plan for additional water supply, system redundancy, and upgraded infrastructure to avoid water shortages.	If you look at the preceding table, supply exceeds demand in nearly all places by significant amounts through 2040.	Comment noted. The IRWM Plan does not have a specific planning horizon; this table is included to provide context and is from other planning efforts with specified planning horizons.
52	Foothill Conservancy	1.2.1	42	Population is expected to grow more quickly in Bear Valley, Kirkwood, Markleeville, and Woodfords than in other parts of the county, in part due to the increased availability of public water and sewer services.	Can you cite a source for expected population growth in Kirkwood and Bear Valley? While both have plans for population expansion, we believe that the number of full-time residents has not grown much, at least at Kirkwood.	Countywide population projections are available from the California Department of Finance. Text edited to say that population growth is more likely in Bear Valley, Kirkwood, Karleeville, and Woodfords than in other parts of the county.
53	Foothill Conservancy	1.2.1	42	EBMUD's position in the hierarchy of Mokelumne water users is established by a variety of agreements between Mokelumne water rights holders, the appropriative water rights permits and licenses which have been issued by the State, pre-1914 rights, and riparian rights.	you might add "court decisions" to this since the Lodi Decrees are very important in this context	Text edited as suggested.
54	Foothill Conservancy	1.2.2	43	Currently, the Amador Water System and the Central Amador Water Project have yearly Mokelumne River surface water allotments of 15,000 AF and 1,150 AF, respectively.	Don't think "allotments" is the right word here. Maybe "rights to use," since AWA's 15TAF water is contractual and held by PG&E?	Text edited as suggested.
55	Foothill Conservancy	1.2.2	43	AWA would thus not have access to the full additional 1,050 AFY upon approval of the water right but would have to apply to the SWRCB for an appropriate quantity every year, based on expected demand.	Is that correct?	Yes. Language clarified.
56	Foothill Conservancy	1.2.1	43	EBMUD diverts supplies at Pardee Reservoir, conveying stored Mokelumne River supplies to its primary users in the East Bay portion of the San Francisco Bay Area via the Pardee Tunnel, Mokelumne Aqueducts, and Lafayette Aqueducts.	Should this document mention that EBMUD also gets water from other sources, and generally characterize them?	Local surface water and CVP water added as additional sources of EBMUD supply.
57	Foothill Conservancy	1.2.2	43	The winter snow pack in the Sierra Nevada serves as the primary source of water for the Mokelumne River.	isn't snowpack one word now?	Yes, update made.

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58	Foothill Conservancy	1.2.2	44	Groundwater quantity and quality in the MAC IRWMP region varies considerably between well sites due to the small and unpredictable yields of the fractured rock system that typifies the foothill geology. Groundwater accounts for approximately four percent of AWA's total water supplies. It is only used in the communities of La Mel Heights and Lake Camanche Village. There are two wells in La Mel Heights which have safe yields of 50 and 56 AFY, respectively. In the Lake Camanche Village area, AWA operates 4 wells that have the capacity to pump approximately 1,500 AFY of water from the Cosumnes Subbasin portion of the San Joaquin Valley Groundwater Basin.	Is Camanche Village over a fractured-rock aquifer? Seems too low in elevation for that.	The fractured-rock descriptor is for typical foothill geography and is meant to describe the majority of the MAC Region and not specifically Camanche Village.
59	Foothill Conservancy	1.2.2	45	Bear River, Table 1-12: Impaired Water Bodies within the MAC Region	Not sure that's correct. Check with PG&E, but we recall that they concluded that the copper is in the rock used to build Lower Bear River Dam and leaches into the river from the dam.	The table only includes the pollutants and sources listed on the SWRCB 303(d) list. However, this information has been added to the "Surface Water Quality" section.
60	Foothill Conservancy	1.2.2	45	Camanche Reservoir, Table 1-12: Impaired Water Bodies within the MAC Region	Penn Mine, Poison Lake and other historical mining uses?	The table only includes the pollutants and sources listed on the SWRCB 303(d) list. However, this information has been added to the "Surface Water Quality" section.
61	Foothill Conservancy	1.2.2	45	Lower Mokelumne River, Table 1-12: Impaired Water Bodies within the MAC Region	Penn Mine, Poison Lake and other historical mining uses for all the heavy metals?	The table only includes the pollutants and sources listed on the SWRCB 303(d) list. However, this information has been added to the "Surface Water Quality" section.
62	Foothill Conservancy	1.2.2	45	Rattlesnake Creek, Table 1-12: Impaired Water Bodies within the MAC Region	Historical mining activities?	The table only includes the pollutants and sources listed on the SWRCB 303(d) list. However, this information has been added to the "Surface Water Quality" section.
63	Foothill Conservancy	1.2.2	45	Amador Lake, Table 1-12: Impaired Water Bodies within the MAC Region	Historical mining activities?	The table only includes the pollutants and sources listed on the SWRCB 303(d) list. However, this information has been added to the "Surface Water Quality" section.
64	Foothill Conservancy	1.2.2	45	Table 1-12: Impaired Water Bodies within the MAC Region	While Pardee may not be listed on the impaired water body list, there is a fish advisory on it. Should you include that info here?	The table only includes the pollutants and sources listed on the SWRCB 303(d) list. However, this information has been added to the "Surface Water Quality" section.
65	Foothill Conservancy	1.2.2	46	Figure 1-11: Cosumnes Subbasin and AWA Wells in Lake Camanche Village	This figure shows Camanche Dam in San Joaquin County, which we think it is. Earlier, the text says it's two miles upstream of the Amador/Calaveras/San Joaquin county line.	The text reads "the Camanche Dam is located within two miles of the county line that separates San Joaquin County from Amador and Calaveras counties."
66	Foothill Conservancy	1.2.2	46	Table 1-13: Historic Groundwater Levels in Cosumnes Subbasin	See paper attached to our comment e-mail.	Comment noted.

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67	Foothill Conservancy	1.3.5	67	Water Quality, Table 1-16: MAC Region Vulnerabilities	Add "and runoff attenuation"	Text edited as suggested.
68	Foothill Conservancy	1.3.5	67	Hydropower, Table 1-16: MAC Region Vulnerabilities	Flows in the NF Mokelumne are governed by the FERC license and are not subject to shifts in demand	Comment noted.
69	Foothill Conservancy	1.3.5	67	Ecosystem and Habitat, Table 1-16: MAC Region Vulnerabilities	See note re FERC-required flows	Comment noted.
70	Foothill Conservancy	1.3.5	71	Sediment and pollutants collected from upstream could be concentrated downstream and in reservoirs, leading to water quality issues and the disturbance of critical habitats and drinking water sources.	While this is generally true, in the North Fork Mokelumne watershed, PG&E dams capture most of the sediment upstream. See Mokelumne Avoided Cost Analysis.	Comment noted. The text indicates that sediment could be concentrated in reservoirs.
71	Foothill Conservancy	1.3.5	71	Temperatureinduced declines in alpine/subalpine forest are expected to occur, in addition to major shifts from evergreen conifer forest to mixed evergreen conifer forests and expansion of grasslands (Hayhoe et al., 2004).	Suggest you reference more-current analyses	Many sources from the past few years have been used in the climate change analysis included in the Plan. Although the Hayhoe reference is from 2004, the findings summarized in the Plan are consistant with updated sources.
72	Foothill Conservancy	1.3.5	71	Increasing stress on ecosystems resulting from rising temperatures will reduce trees' capacity to resist pest attacks while increasing pest survival rates, accelerating their development and allowing them to expand their range.	This is the subject of a lot of scientific debate. Some forest pathologists believe that trees that are naturally resistant to pests will survive, propagate, and make forests more resilient. See papers by Dr. Diana Six and others.	Text updated to include this information.
73	Foothill Conservancy	1.3.5	71	Increased wildfires also favor grasses, which re-establishes more rapidly than slower growing woody life forms after burning (Hayhoe et al., 2004).	True in mixed-conifer zone? More-current data source?	Reference can be updated if a more current source is provided.
74	Foothill Conservancy	1.3.5	72	PG&E owns and operates the Mokelumne River Hydroelectric Project (FERC license no. 137), which consists of a series of storage and regulating reservoirs and associated tunnels and pipelines that supply water to four hydropower generating units located primarily on the North Fork of the Mokelumne River.	add "canals"	Text edited as suggested.
75	Foothill Conservancy	1.3.5	72	In October 2011, FERC issued the Mokelumne River Project a 30-year license.	2001	Text edited as suggested.
76	Foothill Conservancy	1.3.5	72	Hydropower is often generated during high demand periods, which may be compromised if facilities are forced to spill due to higher magnitude flows or to accommodate early arrival of flows. Peak energy demands typically occur during the summer, so decreases in summertime flows may decrease the ability of hydropower to help meet these demands.	Again, please note that flows in the PG&E project-affected reaches are set in the FERC license and are not subject to user demand or climate change for the duration of the 30-year license.	This section is discussing energy demand, not water demand. Added "energy" qualifier to the "high demand periods" to clarify.

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Comment #	Commenter	Section	Public Draft PDF pg #	Plan Text/Context	Comment	Response
77	Foothill Conservancy	1.3.5	74	While the RPC determined that all seven of the vulnerability categories are important, the potential climate change impacts that will affect the MAC Region have a greater likelihood of affecting the Region's water supply availability and reliability, ecosystems, and hydropower production more so than flooding, water quality, or water demand. Additionally, water supply and the ecosystem are already at the forefront of water resources issues to address in the Region. Flooding is not currently a major issue in the region and there are existing reservoirs that can be operated to help manage flood flows in the future. While demand hardening is a concern, water purveyors and users in the Region are in the process of reducing water use through the implementation of water conservation measures and BMPs and believe they can continue to reduce water use into the future.	It should be noted that Amador and Calaveras agencies have barely begun to implement water conservation programs and that HH water use should decline in the future as older homes are upgraded with high-efficiency water fixtures and appliances and newer homes are built to comply with modern efficiency standards	Comment noted. The text states that water purveyors and users are currently reducing water use through conservation and will continue to reduce water use in the future.
78	Foothill Conservancy	1.4.1	76	Inadequate supply and infrastructure to meet growth projected by the general plans of Amador County and its cities	AWA data shows adequate water supply into the foreseeable future	Comment noted. The IRWM Plan does not have a specific planning horizon; this table is included to provide context and is from other planning efforts with specified planning horizons.
79	Foothill Conservancy	1.4.1	76	Watershed protection versus community economic needs	What does this mean?	This bullet point alludes to the potential conflict over land use and water use between watershed protection and economic development.
80	Foothill Conservancy	1.4.1	76	Projected population increases expediting the transport of contaminants to water bodies (UMRWAP)	Since UMRWRAP was done, growth rates have declined drastically in our counties	Conflict removed.
81	Foothill Conservancy	1.4.2	76	PG&E pumped storage project on North Fork of the Mokelumne River versus preserving or restoring river natural systems	PG&E no longer has a preliminary permit for a pumped-storage project. An LLC does.	Removed reference to PG&E.
82	Foothill Conservancy	1.4.2	76	Environmental Protection section	While it may not have been discussed at the RPC, SPI's even-aged management is a clear environmental threat	Conflict added.
83	Foothill Conservancy	1.4.3	76	Promoting and improving water-related recreation opportunities versus recreational water quality impacts	What does this mean?	This bullet point alludes to the potential conflict between increased recreational activities (camping, boating) and water quality impacts from those activities.
84	Foothill Conservancy	2.1	78	In turn, the UMRWA Board of Directors has established an Integrated Regional Water Management Planning program and has provided funding to undertake the first phase of a multi-phase process to update the 2006 MAC Plan.	delete 'has" in both instances	Text edited as suggested.
85	Foothill Conservancy	2.1.1	82	Table 2-3: Regional Participants Committee	The Cal-Am Forestry Team is not a formal organization. It's a group of individuals who have joined together to work on forest projects.	Added "group" to the table title to include entities not classified as "agencies" or "organizations"
86	Foothill Conservancy	3.1.2	95	Table 3-3: Policy 3 - Practice Resource Stewardship Goals, Objectives and Performance Measures	ACCG?	Text edited as suggested.
87	Foothill Conservancy	3.1.2	95	Table 3-3: Policy 3 - Practice Resource Stewardship Goals, Objectives and Performance Measures	ACCG?	Text edited as suggested.

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Comment #	Commenter	Section	Public Draft PDF pg #	Plan Text/Context	Comment	Response
88	Foothill Conservancy	3.1.2	95	Table 3-3: Policy 3 - Practice Resource Stewardship Goals, Objectives and Performance Measures	tribes?	Text edited as suggested.
89	Foothill Conservancy	3.2.1	109	subsidence activities, such as traditional hunting, fishing, and collecting plants for food sources that would be affected by poor water quality or inadequate water flows;	should be "subsistence," not "subsidence"	Text edited as suggested.
90	Foothill Conservancy	3.2.1	109	researching, identifying, and mitigating impacts of stream flows that prevent Native Americans from participating in their traditional cultural activities;	Is this bullet in the right section? Seems like it belongs in the cultural RMS	Text edited as suggested.
91	Foothill Conservancy	3.2.1	109	Because the MAC region does not experience significant fog cover, this RMS is not considered feasible and has been screened from further evaluation.	Interesting to drop this, as the western part of the district sees significant amounts of radiation fog in the winter months. Reconsider?	To reconsider this RMS, information about the amount of fog cover and the feasibility of fog collection in the Region would need to be provided. This RMS can be reconsidered during subsequent updates.
92	Foothill Conservancy	3.2.1	110	Rainfed agriculture involves performing all crop irrigation with rainfall. Rainfall quantity is difficult to predict, and rainfall is typically experienced in winter months, as opposed to during the summer growing season. Further, because agriculture in the MAC region is primarily limited to small-scale operations, the potential benefit associated with rainfed agriculture is limited. As such, this RMS is considered infeasible and has been screened from further evaluation.	Much of the agriculture in the MAC region is dry farming, so we're not sure why this was dropped. We also know of ag producers in the region that capture rainwater in the winter months and use it to irrigate in the dry season. Reconsider?	Because agriculture in the MAC Region is primarily limited to small-scale operations, the potential benefit associated with impementing rainfed agriculture is limited. For this reason, this RMS was dropped. This RMS can be reconsidered during subsequent updates.
93	Foothill Conservancy	3.3	111	The MAC Region will need to enhance existing water supplies and improve its flexibility in managing those supplies to meet demands.	AWA and CCWD info indicate otherwise	Supply/demand forecasts show decreasing supply availability. Supply must be effectively managed to enable agencies to continue meeting demands.
94	Foothill Conservancy	3.3	112	Surface Storage, Table 3-8: Addressing Regional Climate Change Vulnerabilities with Resource Management Strategies	Don't see how surface storage improves water quality. Generally, it degrades WQ in streams.	Surface storage can improve water quality if it is blended with a lesser quality supply.
95	Foothill Conservancy	3.3	112	Surface Storage, Table 3-8: Addressing Regional Climate Change Vulnerabilities with Resource Management Strategies	Questionable	Additional surface storage can contribute to water supply reliability by storing additional water for use during dry periods.
96	Foothill Conservancy	3.3	112	Surface Storage, Table 3-8: Addressing Regional Climate Change Vulnerabilities with Resource Management Strategies	Questionable	Additional surface storage can contibute to water supply availability by storing additional water.
97	Foothill Conservancy	3.3	113	Land Use Planning and Management - Water Suply Availability, Table 3-8: Addressing Regional Climate Change Vulnerabilities with Resource Management Strategies	Good land use planning can extend water supply availability	Checkmark added.
98	Foothill Conservancy	3.3	116	Table 3-9: No Regret Adaptation Strategies in the MAC Region - System Reoperation	isn't this contemplated in an AWA project?	Yes. Checkmark added.
99	Foothill Conservancy	3.3	116	Table 3-9: No Regret Adaptation Strategies in the MAC Region - Precipitation Enhancement	PG&E has a cloud-seeding program in the Mokelumne watershed now	Checkmark added.
100	Foothill Conservancy	3.3	116	Table 3-9: No Regret Adaptation Strategies in the MAC Region - Sediment Management	Isn't this part of some of the forest restoration projects being contemplated?	Yes. Checkmark added.

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101	Foothill Conservancy	3.3	116	Table 3-9: No Regret Adaptation Strategies in the MAC Region - Water and Culture & Water-dependent Recreation	These last two are listed in the RMSs that are part of the plan, which must mean they are contemplated in the future	While these RMS are included in the Plan, they are not considered "no-regret" climate change adaptation strategies applicable to the region.
102	Foothill Conservancy	3.3	116	Table 3-9: No Regret Adaptation Strategies in the MAC Region	This table appears to represent current approaches and leave out future approaches?	This table represents "no-regret" strategies to adapt to climate change impacts and does not differentiate current or future strategies.
103	Foothill Conservancy	3.3	118	Table 3-10: Applicability of CWP Resource Management Strategies to GHG Mitigation	good forest and watershed management will reduce emissions from wildfire	Checkmark added.
104	Foothill Conservancy	4.1.2	121	In Step 2 of the Tier 1 prioritization process, each project was compared with the list of RMS. These strategies are discussed in Chapter 3 and include the following.	Earlier, the document says some of these were deemed to not be appropriate for the MAC plan?	All RMS were provided on the Project Information Form to give project proponents opportunities to submit a wide range of projects.
105	Foothill Conservancy	4.1.4	129	Table 4-1: MAC Region Water Management Issues Addressed by IRWM Projects; There are inadequate water supplies in Amador and Calaveras counties to serve development and provide drought protection in the future.	This "problem" is inconsistent with the supply data provided by the water agencies and detailed in the plan.	Comment noted. The IRWM Plan does not have a specific planning horizon; supply data is included to provide context and is from other planning efforts with specified planning horizons.
106	Foothill Conservancy	4.1.4	129	Table 4-1: MAC Region Water Management Issues Addressed by IRWM Projects; There are inadequate water supplies in Amador and Calaveras counties to serve development and provide drought protection in the future.	The Surface Storage Feasibility Study was discussed in MokeWISE and rejected. It is highly controversial and we ask that it be removed from the plan.	Section 4.3 of the Plan states that: "inclusion of a project in the IRWM Plan indicates that it passed the screening requirements outlined in Section 4.1, but does not necessarily reflect endorsement by the Regional Participants Committee (RPC)." The AWA Board will discuss removing the Surface Storage Feasibility Study from the Plan during their meeting on October 25, 2018.
107	Foothill Conservancy	4.1.4	130	Table 4-1: MAC Region Water Management Issues Addressed by IRWM Projects; The Stanislaus National Forest in the upper headwaters of the Middle Fork Mokelumne River requires restoration and maintenance to improve forest resiliency, watershed conditions, meadow function, and wildlife and ethno-botanical connectivity and diversity.	Unclear how the problem fits the study, which is all about water yield.	The project, if study recommendations were implemented, would provide multiple benefits, including forest restoration and increased water yield.
108	Foothill Conservancy	4.1.4	130	Table 4-1: MAC Region Water Management Issues Addressed by IRWM Projects; Salmon and steelhead populations have significantly decreased in the upper Mokelumne River.	Suggested rewrite: "Chinook salmon and steelhead populations have been blocked from their historic spawning habitat in the upper Mokelumne River by downstream dams."	Text edited as suggested.
109	Foothill Conservancy	4.1.6	132	RPC representation on related stakeholder groups, such as the Amador and Calaveras Consensus Group that is currently working with the Bureau of Land Management and the USFS on forest restoration and fuel reduction projects.	It's "Amador-Calaveras Consensus Group,' and it works on private lands as well as federal public lands	Edited text to correct ACCG name and add this information.
110	Foothill Conservancy	4.2.2	135	Table 4-2: Major Planning Reports Used to Create the MAC IRWMP; Final EIR, Volume One: Updated Water Supply Master Program	Did you not look at the final, revised WSMP 2040 too?	This reference has been added to the table.

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111	Foothill Conservancy	4.2.2	136	Table 4-2: Major Planning Reports Used to Create the MAC IRWMP; Water Resources and Land Use Planning, Watershedbased Strategies for Amador and Calaveras Counties	Is this the Local Government Commission report?	Yes. This has been added to the References section.
112	Foothill Conservancy	4.2.3	139	Water-Related Conservation Goals	You may want to add some information about changes to the Amador County zoning code made as a result of the settlement of Foothill Conservancy's general plan lawsuit. The changes improve stream setback requirements and impose new findings for development in high and very-high fire areas and an accountability/tracking system that includes water and wastewater measures.	Edited text to add this information.
117	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type	Should this be "Potential negative impacts?"	To be consistent with DWR Guidelines, the term "impact" is used.
113	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Groundwater Use; Conjunctive Use Regional Impacts	Add: Diminished high flows and flooding that benefit aquatic species,including anadromous fish	Text added as suggested.
114	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Groundwater Use; Conjunctive Use Interregional Impacts	Add: Diminished high flows and flooding that benefit aquatic species,including anadromous fish	Text added as suggested.
122	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Potable Water Supply Projects	Add for all in this category: Potential growth-inducing impacts. In Amador County, providing water or WW to property can facilitate GP and zoning changes to higher land use densities (5-acre parcels to 1-acre parcels)	Text added as suggested.
115	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Potable Water Supply Projects	Add adverse impacts to cultural resources to all new facility projects	Text added as suggested.
116	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Potable Water Supply Projects; Storage Facilities or Storage Operations Regional Impacts	Add: Loss of recreational and scenic values	Text added as suggested.
124	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Conservation Projects; Outreach and Education Regional Impacts	This doesn't make sense unless coupled with the benefit of keeping more water in the rivers and tributaries	Text added as suggested to Regional Benefits.
118	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Conservation Projects; Economic Incentives Regional Benefits	Add: Reduced ratepayer costs for water	Text added as suggested.
119	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Conservation Projects; Economic Incentives Regional Benefits	Add: Preservation or improvement of streamflows and aquatic habitat	Text added as suggested.
120	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Conservation Projects; Economic Incentives Interregional Benefits	Add: Reduced ratepayer costs for water	Unclear how economic incentives would reduce ratepayer costs for water on an interregional scale.
121	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Conservation Projects; Economic Incentives Interregional Benefits	Add: Preservation or improvement of streamflows and aquatic habitat	Text added as suggested.
123	Foothill Conservancy	4.3	141	Table 4-3: Potential Impacts and Benefits by Project Type; Wastewater Projects Regional Impacts	Add for all in this category: Potential growth-inducing impacts. In Amador County, providing water or WW to property can facilitate GP and zoning changes to higher land use densities (5-acre parcels to 1-acre parcels)	Text added as suggested.

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125	Foothill Conservancy	4.3	142	Table 4-3: Potential Impacts and Benefits by Project Type; Recycled Water Projects Regional Benefits	Add to all in category: Lower cost than developing new water supply	Text added as suggested.
126	Foothill Conservancy	4.3	142	Table 4-3: Potential Impacts and Benefits by Project Type; Flood Management Projects; Storm Drains or Channels Regional Benefits	Couldn't flood management projects also have aquatic habitat benefits by creating or maintaining wetlands?	Yes, text added as suggested.
127	Foothill Conservancy	4.3	143	Table 4-3: Potential Impacts and Benefits by Project Type; Ecosystem Restoration and Protection Projects; Land Conservation Regional Impacts	To whom? Not clear	Added "development and resource extraction" to clarify.
128	Foothill Conservancy	4.3	143	Table 4-3: Potential Impacts and Benefits by Project Type; Ecosystem Restoration and Protection Projects; Land Conservation Regional Benefits	Add: Carbon sequestration and protection of cultural and recreational resources	Text added as suggested.
129	Foothill Conservancy	4.3	143	Table 4-3: Potential Impacts and Benefits by Project Type; Water-Based Recreation Projects; Parks, Access, and Trails Regional Benefits	Add: Health benefits	Text added as suggested.
130	Foothill Conservancy	4.3.1	144	A more reliable and high quality water supply. Additional water supplies and conjunctive use lead to enhanced water supply reliability and assist with the improvement of water quality. Water quality projects ensure that existing water quality is sustained and protected. Reliable and high quality water is directly linked to economic and environmental health and well-being.	Development of additional water supplies can come at a cost to instream water quality	Text edited to clarify that this benefit is referring to delivered water quality. Instream water quality impacts that may occur as a result of any particular project would be identified on a project-by-project basis during CEQA or NEPA analysis.
131	Foothill Conservancy	4.3.1	144	Improved regional water supply and reliability for the East Bay, Amador County, Calaveras County and San Joaquin County, achieved through several water storage projects, will reduce pressure on the Delta to serve the region in times of significant drought.	None of the projects in the plan is intended to benefit East Bay water supply, except perhaps for exploring more conjunctive use.	Comment noted.
132	Foothill Conservancy	4.3.1	144	Interregional Benefits and Impacts	You might want to use "could," not "will," in these bullets.	Text edited as suggested.
133	Foothill Conservancy	4.3.1	145	The MAC Plan Update also has the potential to benefit resources beyond local and regional water resources. Improved surface water quality will benefit the local ecosystem. Enhanced tree cover, while viewed as a habitat enhancement, may also directly benefit regional air quality through the creation of microclimates and the filtering capacity provided by trees.	Do any of the project intend to enhance tree cover?	While enhanced tree cover may be a tangential benefit of some of the projects, it is not a primary objective or motivation for the included projects so reference to enhanced tree cover has been removed.
134	Foothill Conservancy	4.3.2	147	Avoiding costs of imported water supply by increasing the use of recycled water, creating new water supply sources within the region, or capturing and reusing stormwater.	"imported water supply" seems like an odd term to use in a source-county IRWM. Not one of the counties in the MAC Region imports water.	While no agencies currently import water, importing water would be a more expensive alternative to the sources currently being used.
135	Foothill Conservancy	4.3.2	148	Public outreach programs and components can help promote and increase water conservation, educate about forest stewardship which can improve water resources, discourage illegal dumping of trash and litter in watercourses, and encourage appropriate water management practices including appropriate collection and disposal of hazardous liquid wastes and pharmaceuticals.	add "avoid erosion and sedimentation"	Text edited as suggested.

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Comment #	Commenter	Section	Public Draft PDF pg #	Plan Text/Context	Comment	Response
136	Foothill Conservancy	4.3.2	148	Public outreach programs and components can help promote and increase water conservation, educate about forest stewardship which can improve water resources, discourage illegal dumping of trash and litter in watercourses, and encourage appropriate water management practices including appropriate collection and disposal of hazardous liquid wastes and pharmaceuticals.	suggest deleting "in watercourses," since dumping in watersheds also poses a risk to WQ	"Watercourses" replaced with "watersheds."
137	Foothill Conservancy	4.3.2	149	Habitat Protection, Restoration, and Enhancement	Add: Prescribed fire.	Text edited as suggested.
138	Foothill Conservancy	4.3.2	149	There is already evidence that wildfires are becoming more frequent, longer, and more widespread, and they are expected to increase in frequency and severity due to climate change (CDM, 2011).	There's actually a great deal of disagreement about this. If you'd like to see a paper on the areas on which western fire scientists do agree, pls advise and we'll provide it.	Text states that there is evidence not necessarily consensus that wildfires are becoming more frequent, longer, and more widespread.
139	Foothill Conservancy	4.3.2	149	Open space preservation is a benefit that can be achieved through implementation of land conservation projects. Preserving open space contributes to other benefits such as environmental and recreational benefits, as well as stormwater control, reduced runoff, and flood management benefits.	also carbon sequestration and economic benefits from the value of scenic beauty, which attracts tourists to our counties	Text updated to include this information.
140	Foothill Conservancy	4.3.2	151	Reduced Discharges to Mokelumne and Calaveras Rivers	See earlier note on this. Water that isn't needed for irrigation or HH use will stay in streams, so it seems odd to conclude that streamflows would be reduced by efficiency projects.	While efficiency projects would reduce discharges to the rivers since water use would be reduced, the water would not be drawn from the river to start with, so streamflows would likely not be impacted in a significant way. Section removed.
141	Foothill Conservancy	4.3.2	151	Impacts Section	Add Culltural, scenic, recreational and historical resource impacts section - construction can damage or destroy these valuable resources	Section added.
142	Foothill Conservancy	4.4.1	153	Table 4-4: Funding Sources for Development of the IRWM Plan and Implementation of Projects	Add foundation grants?	Foundation grants are included in this.
143	Foothill Conservancy	4.4.1	154	Local, State, and Federal Grant Programs	add foundation grants?	Foundation grants are included in this.
144	Foothill Conservancy	5.2.2	171	Table 5-3: Sources of IRWMP Data; Upper Mokelumne River Watershed Council	Council no longer exists	Removed from list.
145	Foothill Conservancy	5.2.2	171	Table 5-3: Sources of IRWMP Data	Fish and Wildlife, not Fish and Game	Name updated.
146	Foothill Conservancy	5.2.2	171	Table 5-3: Sources of IRWMP Data	USFS and BLM?	US Forest Service already on the list. Bureau of Land Management added.
147	Foothill Conservancy	5.2.2	171	Table 5-3: Sources of IRWMP Data	Capitalize "water" in Department of Water Resources	Text updated.
148	Foothill Conservancy	5.2.2	171	Table 5-3: Sources of IRWMP Data	Add DTSC? CalFire? Sierra Nevada Conservancy?	Table updated to include these three references.
149	Foothill Conservancy	5.2.2	171	Table 5-3: Sources of IRWMP Data	Add ACCG -- has a monitoring program, and Project 137 ERC/PG&E	Table updated to include these references.
150	Foothill Conservancy	6	178	Add in Ref into Reference list	Add CNRA Mokelumne River Wild and Scenic River Study Report 2018?	Reference added.
151	Foothill Conservancy	6	180	Add in Ref into Reference list	Add Pacific Institute analysis of AWA long-term water need study	Source not referenced in the text.

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Acronyms

°F	Degrees Fahrenheit
AB	Assembly Bill
ACCG	Amador-Calaveras Consensus Group
AC-GMA	Amador County Groundwater Management Authority
ACS	American Community Survey
AF	Acre-foot
AFY	Acre-foot per Year
ARSA	Amador Regional Sanitation Authority
AWA	Amador Water Agency
AWS	Amador Water System
AWWA	American Water Works Association
BAWSCA	Bay Area Water Supply and Conservation Agency
BMP	Best Management Practice
CAAP	Climate Adaptation Advisory Panel
CABY	Cosumnes, American, Bear & Yuba
CalEPA	California Environmental Protection Agency
Cal Water	California Water Service Company
CAMRA	Calaveras-Amador-Mokelumne River Authority
CANS	Camanche North Shore
CARB	California Air Resources Board
CARWSP	Camanche Area Regional Water Supply Plan
CAS	Climate Adaptation Strategy
CASS	Camanche South Shore
CAT	Climate Action Team
CAWP	Central Amador Water Project
CCTAG	Climate Change Technical Advisory Group
CCWD	Calaveras County Water District
CDP	Census Designated Places
CDPH	California Department of Public Health
CEC	California Energy Commission
CEIC	California Environmental Information Catalog
CEQA	California Environmental Quality Act

CERES	California Environmental Resources Evaluation System
cfs	Cubic feet per second
CIEA	California Indian Environmental Alliance
CII	Commercial, industrial, institutional
CPUD	Calaveras Public Utility District
CREAT	Climate Resilience Evaluation and Awareness Tool
CRWU	Climate Ready Water Utilities
CSA	County Service Area
CT	Centroid timing
CWC	California Water Code
CWP	California Water Plan
DAC	Disadvantaged community
DMS	Data management system
DWR	Department of Water Resources
Eastside GSA	Eastside San Joaquin Groundwater Sustainability Agency
EBMUD	East Bay Municipal Utility District
EDAs	Economically Distressed Areas
EDUs	Equivalent Dwelling Units
EIRs/EISs	Environmental Impact Reports/Environmental Impact Statements
EJ	Environmental justice
EO	Executive Order
FEMA	Federal Emergency Management Act
FERC	Federal Energy Regulatory Commission
GAMA	Groundwater Ambient Monitoring Assessment
GBA	Groundwater Banking Authority
GCMs	General circulation models
GHG	Greenhouse gas
GMP	Groundwater Management Plan
GO	General Obligation
GPCD	Gallons per capita per day
GSAs	Groundwater Sustainability Agencies
GSP	Groundwater Sustainability Plans
GWA	Groundwater Authority
GWMP	Groundwater Management Plan
IPCC	Intergovernmental Panel on Climate Change

IRWM	Integrated regional water management
IRWMP	Integrated regional water management plan
JPA	Joint powers authority
JVID	Jackson Valley Irrigation District
LFD	Low flow duration
LTNS	Long Term Needs and Water Supply Study
MAC	Mokelumne/Amador/Calaveras
MAC Region	MAC IRWMP Region
MAF	Mean annual flow
MCFA	Mountain Counties Funding Area
MGD	Million gallons per day
MHI	Median household income
MokeWISE	Mokelumne Watershed Interregional Sustainability Evaluation
MOU	Memorandum of understanding
MRF	Mokelumne River Forum
MW	Megawatts
NDWAC	National Drinking Water Advisory Council
NEPA	National Environmental Policy Act
NGOs	Non-governmental organizations
NOAA	National Oceanic and Atmospheric Administration
NPS	Non-point source
O&M	Operation and maintenance
OPR	Office of Planning and Research
PAC	Project Advisory Committee
PG&E	Pacific Gas and Electric Company
Plan	Integrated regional water management plan
Prop 84	Proposition 84
QA/QC	Quality assurance/quality control
RAP	Region Acceptance Process
RCP	Representative Concentration Pathway
RMS	Resource management strategy(ies)
RPC	Regional Participants Committee
RWMG	Regional water management group
SB	Senate Bill
SEWD	Stockton East Water District

SGMA	Sustainable Groundwater Management Act
SMUD	Sacramento Municipal Utility District
SOI	Sphere of influence
SPI	Sierra Pacific Industries
SRF	State Revolving Fund
SWAMP	Surface Water Ambient Monitoring Program
SWE	Snow water equivalent
SWRCB	State Water Resources Control Board
TLZ	Timberland Preservation Zone
TM	Technical memorandum
TMDL	Total maximum daily load
T-S	Tuolumne-Stanislaus
UMRWA	Upper Mokelumne River Watershed Authority
UMRWAP	Upper Mokelumne River Watershed Assessment and Planning Program
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	United State Forest Service
USGS	United States Geological Survey
UV	ultraviolet
UWMP	Urban Water Management Plan
VOCs	Volatile organic compounds
WARMF	Watershed Analysis and Risk Management Framework
WDL	Water Data Library
WET-CAT	Water-Energy group
WID	Woodbridge Irrigation District
WSMP	Water Supply Management Program
WTP	Water treatment plant
WWTP	Wastewater treatment plant
WY	Water year

Update Overview

In November 2006, the Mokelumne/Amador/Calaveras (MAC) regional partners completed the MAC Integrated Regional Water Management Plan (IRWMP or Plan). The 2006 version of the MAC IRWMP (MAC Plan) was based on guidelines and standards included in Proposition 50 as interpreted by the California Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB). In September 2008, Governor Schwarzenegger signed SBxx 1, which contains appropriations for the IRWM program from Propositions 84 and 1E (Prop 84/1E) along with criteria that DWR must apply in updating statewide standards for IRWMPs. These revised State standards for IRWMPs were released in August of 2010 and provided the guidelines by which the MAC Plan Update will be prepared. The MAC Plan Update was developed to comply with the 2012 Guidelines ~~which~~ that were finalized by DWR in December 2012.

The MAC IRWMP update began in 2008 with a reconstituted stakeholder committee (called the Regional Participants Committee or RPC), the development of Governing Procedures to guide the RPC's work, and the preparation of a Community Outreach Plan. This update is being conducted under a governance structure different than that developed for the original plan development. Specifically, the Upper Mokelumne River Watershed Authority (UMRWA), a regional water management group as defined by the California Water Code, has assumed lead agency responsibility for the preparation and adoption of the updated IRWMP, and has established two subcommittees to oversee the document update. A Regional Participants Committee (or RPC) was formed to directly oversee the Plan update. The Board Advisory Committee has also been established (replacing the earlier Steering Committee) with Board representatives from three UMRWA member agencies. This committee is charged with reconciling conflicts that may occur at the RPC, providing guidance to the Executive Officer and consultants, and ultimately recommending the updated plan for adoption by the UMRWA governing board. In addition to the updating of selected Plan sections in 2008, UMRWA also completed the Region Acceptance Process (RAP), as required by DWR, in order to become an approved IRWM region. Furthermore, because IRWM Plans are not required to follow the exact outline of the IRWM Plan Standards, the 2013 Plan Update applied a revised organization that provides a more logical progression of topics and information, hopefully making the Plan a more useful tool for the region's water managers.

This 2018 MAC Plan Update was initiated to capture updated regional information since the 2013 MAC Plan was developed and respond to updated state requirements. All required Plan elements as identified in the 2016 IRWM Plan Standards are met by this MAC Plan 2018 Update, as summarized in the following table. Appendix A includes the Standards Review Form which indicates the location of each requirement outlined in the 2016 IRWM Plan Standards.

Location of IRWM Plan Standards in MAC IRWM Plan Update

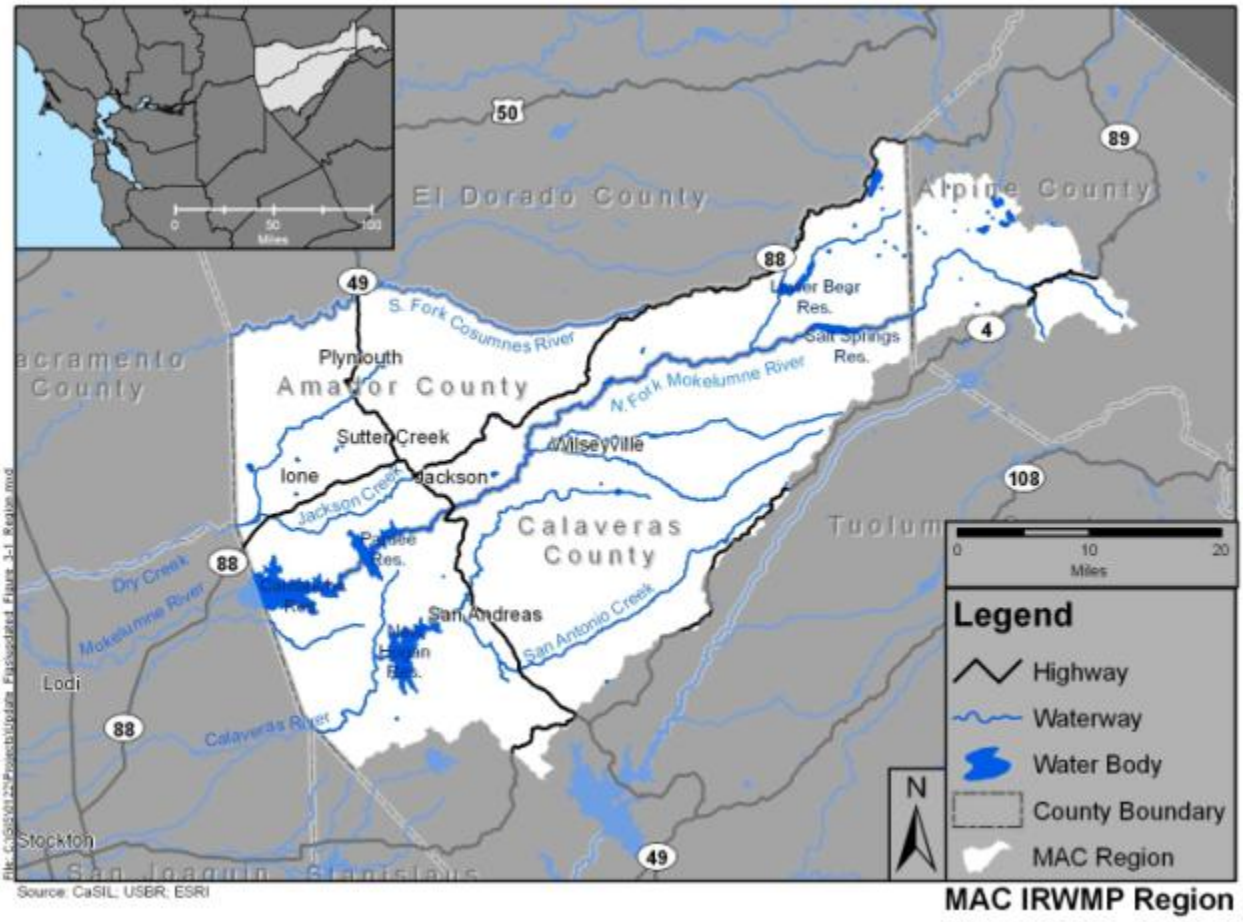
Plan Standard No.	IRWM Plan Standard	MAC IRWMP Update Section
1	Governance	Section 2 Governance
2	Region Description	Section 1 MAC Region
3	Objectives	Section 3.1 Policies, Goals, Objectives, and Performance Measures
4	Resource Management Strategies	Section 3.2 Resource Management Strategies
5	Integration	Section 2.4 Integration and Section 4.1.5 Project Integration
6	Project Review Process	Section 4.1 Project Review Process
7	Impact and Benefit	Section 4.3 Impact and Benefit Analysis
8	Plan Performance and Monitoring	Section 5.1 Plan Performance and Monitoring
9	Data Management	Section 5.2 Data Management
10	Finance	Section 4.4 Financing Plan
11	Technical Analysis	Section 4.5 Technical Analysis
12	Relation to Local Water Planning	Section 4.2 Coordination with Water and Land Use Agencies
13	Relation to Local Land Use Planning	Section 4.2 Coordination with Water and Land Use Agencies
14	Stakeholder Involvement	Section 2.3 Stakeholder Involvement
15	Coordination	Section 2.5 Coordination with Other IRWM Regions and State/Federal Agencies
16	Climate Change	Various locations, see Appendix A

1. MAC Region

1.1. Regional Geography

The MAC IRWMP Region (MAC Region) incorporates all of Amador County and sizeable portions of Alpine and Calaveras counties. Included within the region's boundary are cities, water and irrigation districts, watershed management areas, portions of groundwater basins, disadvantaged communities, and large tracts of federally-owned and private lands. Figure 1-1 shows the MAC Region.

Figure 1: MAC Region



The approximately 950,000 acre region (about 1,460 square miles) is located in the Sierra Nevada foothills, approximately 45 miles southeast of Sacramento. Situated in a transitional zone between the San Joaquin Valley and the Sierra Nevada, the region stretches across varied topography and microclimates. Warm, dry summers and mild winters are predominant in the western foothills with temperature ranging from the middle 30s to the high 90s (in degrees Fahrenheit, ^{o}F). Mild summers and cold winters characterize the mountainous eastern region with temperatures ranging from the low 20s to the middle 80s. Hot, dry summers and mild winters prevail in the Central Valley portion of the region with temperatures ranging from middle 30s to highs in excess of 100^{o}F.

The primary sources of water in the region are the Mokelumne and Calaveras River watersheds (and to a lesser extent, the Cosumnes River watershed), with snowmelt and rainfall from the Sierra Nevada transported via the rivers and their tributaries. Although the region is famous for its historic mining and existing active mines (asbestos, gold, industrial minerals, limestone, sand, and gravel), current land uses also include cattle ranching, orchards, timber, vineyards, and row crops.

The MAC Region was formed using physical, political, and social boundaries. The Mokelumne River watershed forms the eastern border, while the Calaveras River watershed forms the southern boundary. The Amador County boundary generally follows the Mokelumne watershed boundary and roughly defines the northern border. The western boundary of the region extends to intersection of the San Joaquin County and the Calaveras County boundaries. This region was defined based on similar water supply and demand characteristics and the opportunities to facilitate water resources protection, development, and security.

1.1.1. Regional Boundary

The boundaries of the MAC Region were determined using a variety of physical, political, and water management considerations as discussed below. The primary physical determinant in establishing the region was the Mokelumne River watershed. The secondary determinant was the Calaveras River watershed. These two rivers and their watersheds are the predominant water features in the region, and during the past 150 years, have supported a myriad of activities including hydropower generation, agriculture, mining, timber harvesting, cattle grazing, domestic water supply, recreation, fisheries and more. The upper reaches of the watershed include large portions of the Eldorado and Stanislaus National Forests.

The Mokelumne River is the boundary between Amador and Calaveras Counties, and the Eldorado and Stanislaus National Forests. The river has long served the needs of cities, communities, and forested habitats within these counties as well as for downstream users in San Joaquin County. Since the 1920s, the Mokelumne River has been the primary source of water used by East Bay Municipal Utility District (EBMUD) to serve East Bay communities. Thus, for nearly one hundred years, the local governments and water agencies of Amador and Calaveras Counties have competed with EBMUD, San Joaquin County, and the environment for Mokelumne River water supply. During this period, there have been many water rights decisions, court decrees, agreements, and contracts pertaining to the Mokelumne River, some of which have settled, to some degree, the many disputes that have arisen between Amador and Calaveras agencies, downstream Mokelumne River users in San Joaquin County, and EBMUD. However, as the foothill and East Bay communities continue to grow, so does the need for additional water supply. Consequently, one of the primary purposes in establishing the MAC Region has been to promote and facilitate a collaborative planning process to develop program and project solutions thatwhich address future Amador, Calaveras, and East Bay water resource needs.

While the Mokelumne River represents a key central feature in the MAC Region, the geographic boundaries of the region define its relationship to neighboring regions. Presented below are the four primary regional boundaries and the reasons these boundaries were used in defining the MAC Region.

Northern Boundary: The northern boundary defining the MAC Region is the political boundary of Amador County. The county boundary was selected as the MAC Region's northern border because (1) the City of Plymouth, the one incorporated community outside the Mokelumne River watershed in Amador County, receives water from the Mokelumne River by Amador Water Agency (AWA); and (2) the entire area south of the county boundary lies within Amador County and within AWA's service area. Both of these two Amador agencies (the County and AWA) are members of UMRWA, the regional water management group responsible for the MAC Plan Update and implementation.

It should be noted that the southern boundary of the Cosumnes, American, Bear & Yuba (CABY) IRWM region encroaches into the northern area of the MAC Region. The CABY IRWM region uses the South Fork Cosumnes River watershed boundary as its regional delineator. In the Plymouth area, the Amador County border and Cosumnes River watershed boundaries overlap, resulting in an overlapping boundary between the two regions. This overlap is not considered to be a significant planning obstacle and the entities involved in IRWM development have agreed to communicate information on proposals relevant to the overlapping area.

Southern Boundary: The Calaveras River watershed forms the southern boundary of the MAC Region. This watershed lies within Calaveras County. The Calaveras River watershed was selected to represent the southern border of the MAC Region because (1) the proximity of the Calaveras River watershed and New Hogan reservoir to the Mokelumne River and Camanche Reservoir may present feasible water management opportunities during the regional planning process; (2) western Calaveras County overlies the upper reach of the Eastern San Joaquin Groundwater Basin that provides conjunctive use opportunities; (3) the Stanislaus River watershed, south of the Calaveras River watershed, is a major water source for communities in southern Calaveras and Tuolumne Counties; and (4) the Stanislaus River watershed is included in the Tuolumne-Stanislaus IRWM region.

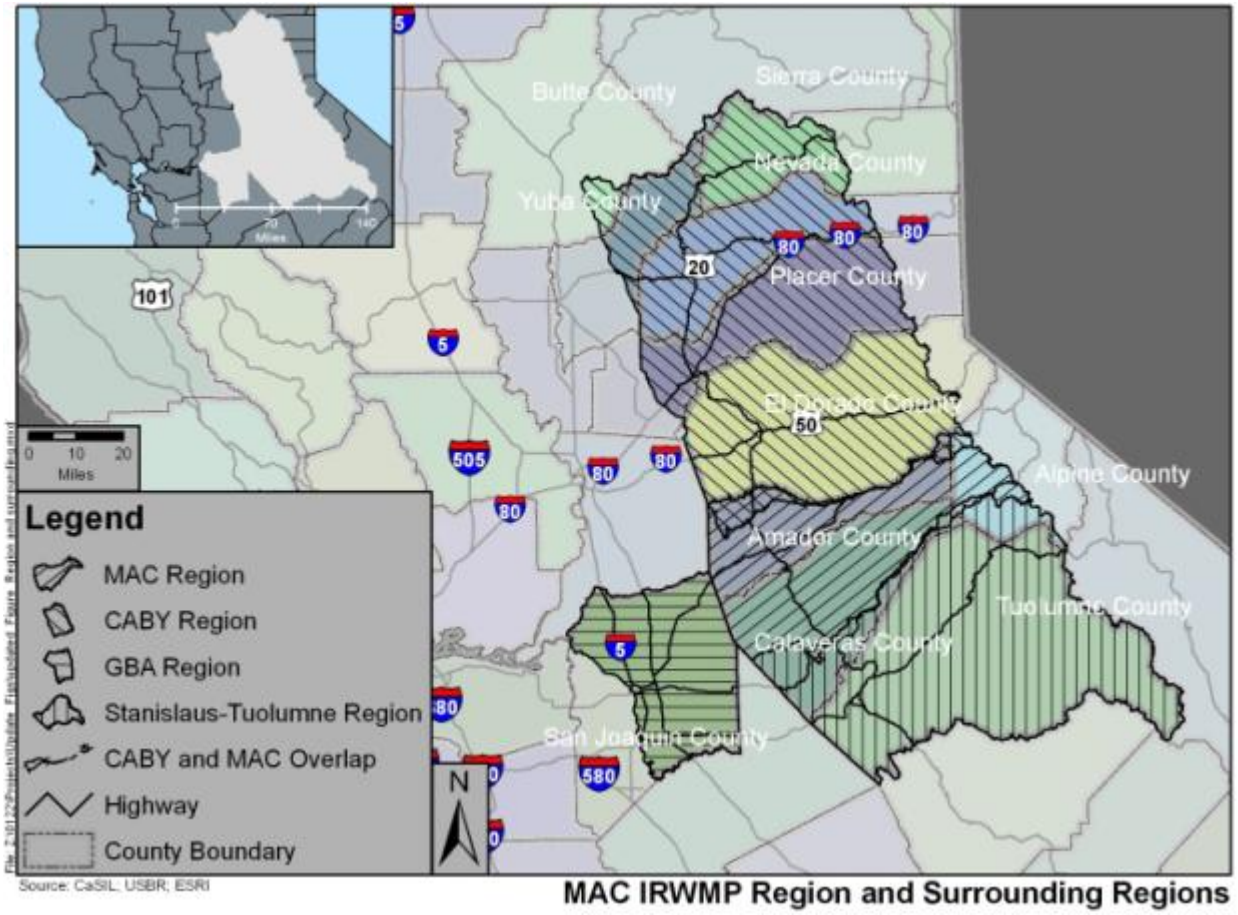
Eastern Boundary: The eastern MAC boundary is defined by the eastern-most portion of the Mokelumne River watershed, which lies in Alpine County. There is also a small portion of the South Fork American River watershed (a portion of Amador County near Kirkwood Meadows) included in the region along the eastern boundary. The hydrologic boundary of the Mokelumne River watershed was selected to represent the eastern MAC regional boundary because (1) this area is the headwaters of the river system which is a critical water supply source for MAC Region communities, and (2) lands adjacent to and east of this boundary are generally contained in watersheds ~~which~~ that drain eastward to the Carson River watershed, away from the MAC Region.

Western Boundary: The political boundaries that separate Amador and Calaveras counties from their western neighbor, San Joaquin County, form the western boundary of the MAC Region. This border was determined to be the best western extent of the MAC Region because (1) the water supply issues facing the western portions of Amador and Calaveras counties must be addressed by water agencies with the authority and jurisdiction to do so (AWA, ~~and~~ Calaveras County Water District [CCWD], Jackson Valley Irrigation District [JVID], and Calaveras Public Utilities District [CPUD]); and (2) other than the western portion of Calaveras County that overlies the Eastern San Joaquin Groundwater Basin, the groundwater resource issues that predominately characterize the Eastern San Joaquin IRWM Region are very different from the predominately surface water issues that must be addressed by the MAC Region.

1.1.2. Neighboring and Overlapping Regions

The MAC Region has three neighboring IRWM regions. To the north is the CABY Region, which generally encompasses the Cosumnes, American, Bear and Yuba river watersheds. The Eastern San Joaquin region is near the western boundary of the MAC Region, and the Tuolumne-Stanislaus integrated water management region is immediately south. For each of these neighboring regions, the nature of its interface with the MAC Region – overlapping or adjacent – and the primary differences between the neighboring regions and the MAC Region are described below. Figure 1-2 shows the geographic relationship of these neighboring regions to the MAC Region.

Figure 2: MAC ~~IRWMP~~ Region and Surrounding Regions



CABY Region: The CABY Region, which lies directly north of and adjacent to the MAC Region, overlaps the MAC Region in two locations. These overlaps between the two regions are in part due to CABY's preference to establish all of its boundaries coincident with hydrologic boundaries. The MAC Region instead has factored physical, political and water management considerations in determining region boundaries.

These different approaches to establishing regional boundaries result in two overlap areas: the northwest corner of Amador County, which lies within the South Fork Cosumnes River watershed (hereafter referred to as the *Cosumnes Overlap*), and the northeast corner of Amador County, which lies within the South Fork American River basin (referred to as the *American Overlap*).

The vast majority of the *Cosumnes Overlap* area is sparsely developed and contained within unincorporated Amador County. The balance of the area is contained within the City of Plymouth, also located in Amador County. The City of Plymouth obtains water from the Mokelumne River and provides domestic water to its city customers. Both Amador County and the City of Plymouth are represented on the MAC Plan RPC, and the current MAC Plan includes projects located in this area.

The *American Overlap* area is also entirely within Amador County. This area, and contiguous adjacent lands that lie within El Dorado and Alpine counties, comprise the uppermost 'headwaters' of the South Fork American River. Aside from the Kirkwood Ski Area, this area is very sparsely developed with seasonal homes and cabins. There are no representatives from this overlap area serving on the MAC Plan RPC.

CABY and MAC Region officials have discussed the two overlap areas and acknowledge the different approaches used by the two regions in formulating their boundaries. In June 2009 the two regions entered into an MOU outlining methods for communication and collaboration.

Eastern San Joaquin Region: The eastern border of the East San Joaquin Region is near the western border of the MAC Region. The county line between Amador County and San Joaquin County, and the county line between Calaveras County, Stanislaus County, and portions of San Joaquin County constitute the interface between the two regions. The two regions have remained separate IRWM regions because the water supply issues are significantly different (predominately groundwater in the East San Joaquin Region versus surface water in the MAC Region), the number of agencies and non-governmental organizations interested in water resource issues is significant in both the valley and the foothills, and the travel distances between the outlying areas of the two regions are great and therefore would be an impediment to participation.

The MAC Region and the Eastern San Joaquin Region have been engaged in regular coordination and communication for more than ten years. The Mokelumne River Forum, a facilitated discussion between agencies involved in both regions, was effective in developing improved understanding among the valley interests and the foothill interests. This improved understanding resulted in a four-party agreement between San Joaquin, Amador and Calaveras counties and EBMUD to jointly investigate water supply and conjunctive use opportunities. That collaborative engagement resulted in UMRWA and the Eastern San Joaquin GWA entering into an MOU in October 2012 which lead to the two regions receiving a $605,000 Prop 84 planning grant to prepare the Mokelumne Watershed Interregional Sustainability Evaluation. The MokeWISE final report was completed in June 2015.

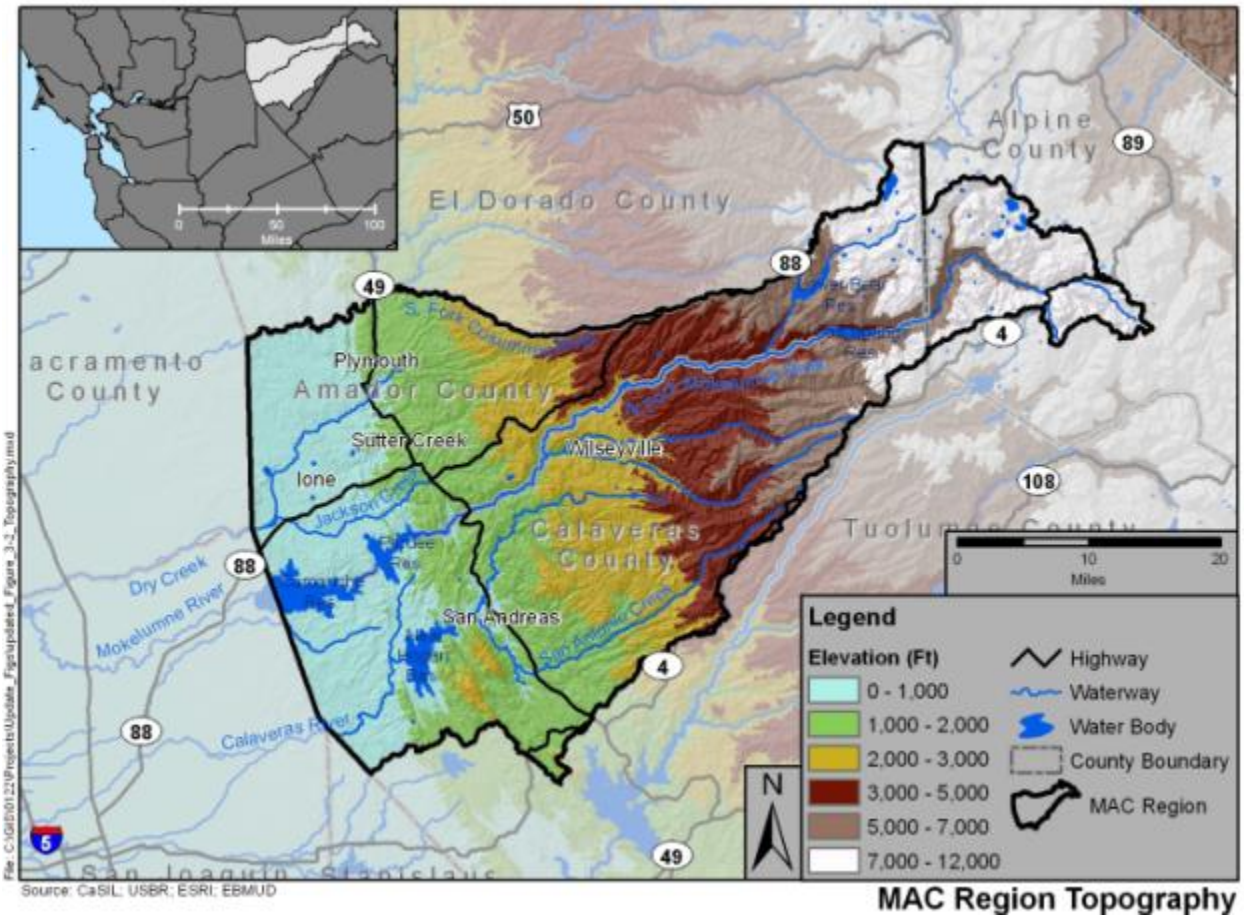
Tuolumne-Stanislaus Region: The Tuolumne-Stanislaus (T-S) Region is immediately south of the MAC Region with its northern boundary reflecting the watershed boundary of the North Fork Stanislaus River. The southern boundary of the MAC Region, as stated previously, is the southern boundary of the South Fork of the Calaveras River. CCWD, a MAC region member, is also participating in the T-S IRWM program and will serve as a liaison between the IRWM regions. By participating in both IRWM efforts, CCWD will keep members of both regions informed of progress and activity and will identify potential conflicts in the event they arise.

1.1.3. Internal Water-Related Boundaries

The following sections present the water-related components of the MAC Region. These components include the physical elements - both natural and human-made - and institutional elements (i.e., the groups that manage these components or influence their management) as described in Section 1.1.4 of this Plan.

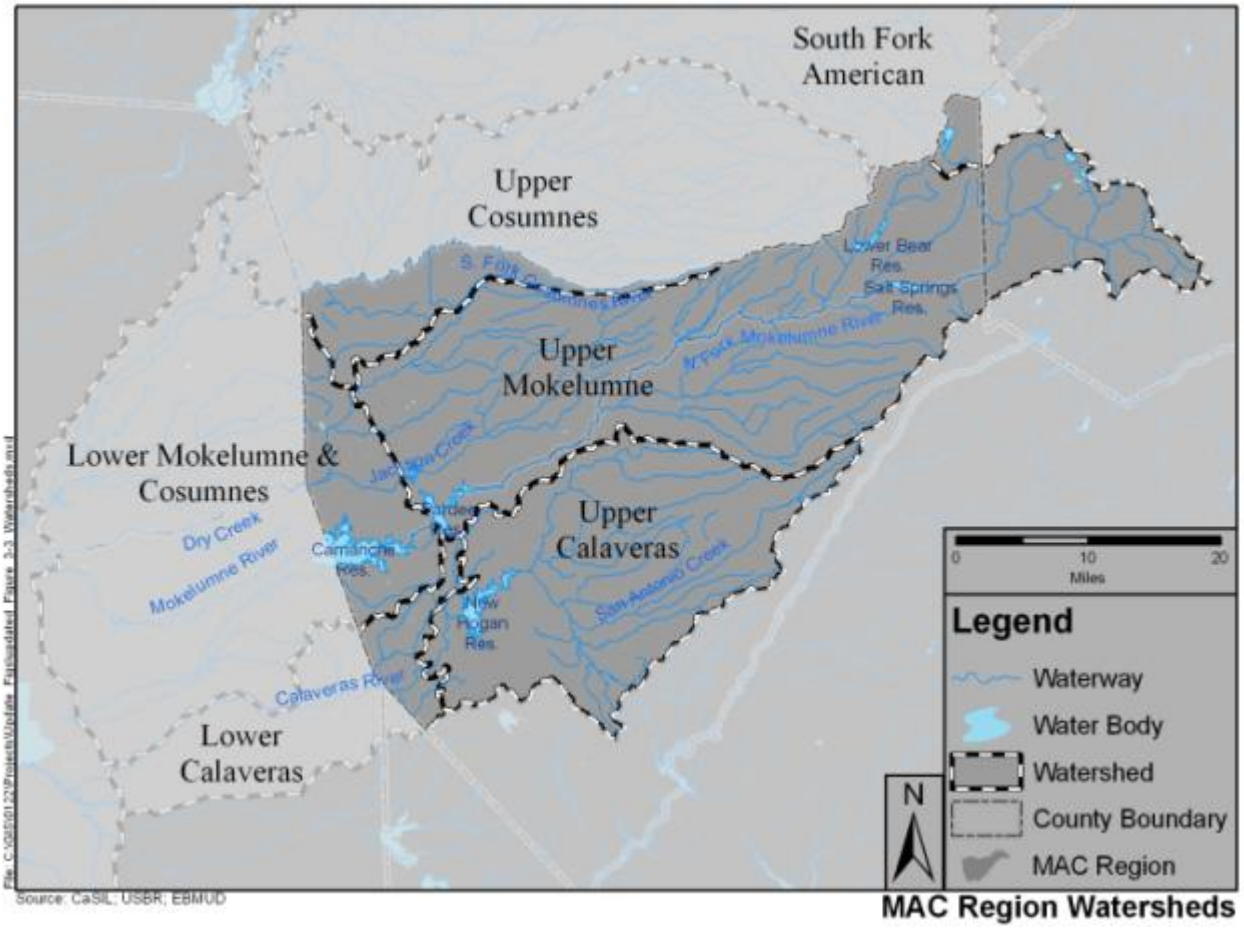
The topography of the MAC Region varies greatly. The western boundary of the MAC Region is in the Central Valley, west of the City of Ione, which is very close to sea level. The eastern boundary of the MAC Region is in the Sierra Nevada at the headwaters of the Mokelumne River at an elevation well over 10,000 feet. The terrain from east to west becomes gentler as the mountains and foothills give way to the Central Valley. Figure 1-3 depicts the topography of the region.

Figure 3: MAC Region Topography



The topography of the MAC Region has defined multiple watersheds within the region. The two watersheds (Mokelumne and Calaveras) that comprise the bulk of the region are described below. The watersheds of the region, as defined by the California Interagency Watershed Mapping Committee, are shown in Figure 1-4.

Figure 4: MAC Region Watersheds



Mokelumne River Watershed

The Mokelumne River originates in the Sierra Nevada and flows west to its confluence with the Cosumnes River in the Central Valley (San Joaquin County). With a watershed encompassing approximately 630 square miles, the annual average runoff of the Mokelumne River at Pardee Reservoir is 753,000 acre-feet (AF), with the majority of flow derived from snowmelt. Annual precipitation and streamflow in the Mokelumne River are extremely variable both month to month and year to year. Streamflow is influenced by upstream diversions and regulated by reservoir storage operations for hydroelectric power generation and water supply. The Mokelumne River watershed is typically subdivided into the ~~Upper~~ upper Mokelumne River watershed and l~~L~~ower Mokelumne River watershed. The ~~Upper~~ upper Mokelumne River watershed extends from its headwaters within the Stanislaus National Forest in western Alpine County, past Pardee Reservoir downstream. The l~~L~~ower Mokelumne River watershed begins just downstream of Pardee Reservoir through northeastern San Joaquin County to the river's confluence with the Cosumnes River.

Upper Mokelumne River Watershed

The ~~Upper~~ upper Mokelumne River watershed is approximately 550 square miles in area and includes portions of the 105,165 acre Mokelumne Wilderness. The Mokelumne Wilderness, a federally designated wilderness area protected under the Wilderness Act of 1964, straddles the crest of the central Sierra Nevada within the Stanislaus, Eldorado, and Humboldt-Toiyabe National Forests and within portions of Calaveras, Alpine, and Amador counties. Watersheds within the Mokelumne Wilderness area drain to the Mokelumne

River on the west slope and the Carson River on the east slope. The ~~Upper~~ upper Mokelumne River watershed is defined as all lands that drain into the North Fork, Middle Fork, South Fork, and Main Stem of the Mokelumne River and to Pardee Reservoir, the downstream boundary. The North Fork watershed is the largest tributary at 370 square miles and contributes 85 percent of the river flow. The ~~Upper~~ upper Mokelumne River watershed topography is rugged, with elevations ranging from 600 to 10,400 feet. The watershed contains important habitat for sensitive species, is used by outdoor recreation enthusiasts throughout the year, and is the source of drinking water for one and a half million people living both within and outside of the watershed.

As the Mokelumne River flows westward from the watershed's western Sierra Nevada origins, the main river and its tributaries pass through several lakes and reservoirs, including Upper and Lower Blue lakes, Twin Lake, Meadow Lake, Upper Bear River Reservoir, Lower Bear River Reservoir, Mosquito Lake, Salt Springs Reservoir, Tiger Creek Reservoir, Lake Amador, and Pardee Reservoir. Early settlers used the Mokelumne River during the second half of the 19th century for mining, hydropower development, and transportation. The most notable effects on the river, however, resulted from mining activity following the discovery of gold in 1848 and copper in 1861. Gold mining in the Mokelumne River watershed peaked in 1854 and declined steadily thereafter. Copper was discovered in 1861 and the area was mined heavily between 1899 and 1919. Mine effluent discharged into the river through these decades has ~~impacted~~ impaired the area's natural resources.

Today, the Mokelumne River is used as a water supply for AWA, ~~Calaveras Public Utilities District (~~CPUD~~)~~, CCWD, ~~Jackson Valley Irrigation District (~~JVID~~)~~ and EBMUD. Pacific Gas & Electric Company (PG&E), EBMUD, and JVID also use the river and its tributaries for hydroelectric generation. PG&E's Mokelumne River Project began in 1972 and is currently operated under 30-year operating license based on a 2001 settlement agreement between PG&E, U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Land Management, California Dept. of Fish and Game, California Dept. of Boating and Waterways, Friends of the River, Natural Heritage Institute, American Whitewater and Foothill Conservancy. This settlement addresses the ecological and recreation effects of stream flows in all of the river reaches and creeks affected by the project to balance the needs of the environment, recreation, and power generation.

The Mokelumne River watershed includes many opportunities for recreational activities, including whitewater boating, fishing, camping, picnicking, swimming, gold panning, hiking, climbing, canyoneering, gorge scrambling, hunting, and wildlife viewing. The Devil's Nose, Tiger Creek Dam, Ponderosa, and Electra-Middle Bar runs include class II-V rapids for whitewater boating. Restoration activities began on the river in 1992 to improve the impacted aquatic community, resulting in increased salmon runs over those observed following the water project developments in decades past. Restoration activities are also taking place on National Forest lands in the ~~upper~~ lower watershed through land and resource management decisions made by the Eldorado and Stanislaus National Forests. In 2018, the California National Resources Agency published the *Mokelumne River Wild and Scenic River Study Report* which recommended that ~~portions~~ 37 miles of the North Fork and Main Stem of the Mokelumne River between Salt Springs Dam and Pardee Reservoir be designated as a California Wild and Scenic River. This designation, which was~~if~~ passed by the California legislature and signed into law by the Governor on June 27th 2018, ~~would~~ recognizes the recreational and scenic values of the proposed sections of the Mokelumne River and ~~would~~ generally prohibits new dams on these sections in order to protect those values. Figure 5 shows some examples of the scenic and recreational values found on the Mokelumne River.

Figure 5: Scenic and Recreational Values of the Mokelumne River

Source: Foothill Conservancy

Lower Mokelumne River Watershed

Following its confluence with the Cosumnes River, the lLower Mokelumne River flows into the San Joaquin River at Libordi Shoals. The combined area of the lLower Mokelumne River and Cosumnes River watersheds within the MAC Region (i.e., the portions lying within Amador and Calaveras counties) is about 122 square miles in size. It contains the stretch of the lLower Mokelumne River that flows from Pardee Reservoir to Camanche Reservoir. The Camanche Dam is located within two miles of the county line that separates San Joaquin County from Amador and Calaveras counties.

Land uses within the portion of the lLower Mokelumne River watershed contained in the MAC Region are predominately grazing, recreation, vineyards, water storage within Camanche Reservoir, and very sparse residential, /ranchette, and commercial development. Water stored in Camanche Reservoir, a flood control and recreation reservoir, is used for downstream fisheries, recreation, hydroelectric generation and water supply.

Calaveras River Watershed

The 470-square mile Calaveras River watershed contains lands located in Calaveras and San Joaquin counties. The majority of the watershed lies in Calaveras County with the smaller western-most portion of the watershed located in San Joaquin County. The Calaveras River is tributary to the San Joaquin River.

Like the Mokelumne River, the Calaveras River watershed may be divided into the Upper Calaveras River watershed and the Lower Calaveras River watershed, with the dividing line occurring just west of New Hogan Reservoir. Flow in the Calaveras River is primarily derived from rainfall with small contributions by snowmelt. New Hogan Dam was constructed by the Army Corps of Engineers on the Calaveras River in 1963 for flood control as well as municipal, industrial and irrigation purposes. Releases from New Hogan

Dam currently control flows on the Lower Calaveras River. The upper watershed above New Hogan reservoir covers 363 square miles with an average annual runoff of about 166,000 AF.

The Lower Calaveras River – Mormon Slough area is below New Hogan Dam. The watershed for this portion of the river encompasses approximately 115,000 acres and receives up to 90,000 AF of surface water supply from the Calaveras River. The four main tributaries below New Hogan are Cosgrove Creek, South Gulch, Indian Creek, and Duck Creek. Cosgrove Creek contributes the most flow to the Calaveras River, which has been as much as 8,500 AF in some years.

As with the Mokelumne River, land and water resource management decisions for the Calaveras River are made by a variety of entities, including many of the same organizations as for the lLower Mokelumne River. The major agencies that manage water resources within the MAC Region are listed in Table 1-1 (a comprehensive list including smaller agencies is included Appendix B). One additional organization involved in the preservation and management of the Calaveras River is the Calaveras River Watershed Stewardship Group. They focus on the lower Calaveras River below the New Hogan Dam. Members of this group include the U.S. Fish and Wildlife Service (USFS), the California Department of Fish and Game, Stockton East Water District, CCWD, National Oceanic and Atmospheric Administration (NOAA) Fisheries, DWR, City of Stockton, and California Department of Conservation.

Table 1-1: Agencies with Major Water Resources Management Responsibilities in the Region

Agency Name	Location and Services Provided
Alpine County	For portions of Alpine County within the MAC Region, Alpine County, and its affiliated Alpine County Water Agency, has water management responsibilities related to water quality, water-dependent recreation and several small community service areas located on the western slope of the Sierra Nevada mountains.
Amador Water Agency (AWA)	AWA provides water and wastewater services to residents of Amador County. AWA uses water from the North Fork of the Mokelumne River for 6,900 service connections in western Amador County, including the City of Plymouth.
Amador County	Amador County is authorized to carry out flood control and stormwater management through its Public Works Department and the implementation of environmental health programs.
~~Alpine County~~	~~For portions of Alpine County within the MAC Region, Alpine County, and its affiliated Alpine County Water Agency, has water management responsibilities related to water quality, water-dependent recreation and several small community service areas located on the western slope of the Sierra Nevada mountains.~~
Amador Regional Sanitation Authority (ARSA)	A JPA consisting of Amador County, Sutter Creek and Amador City for the primary purpose of transporting effluent from the secondary treatment facility at Sutter Creek to the treatment facility at Ione.
Army Corps of Engineers (Army Corps)	The Army Corps owns and operates New Hogan Reservoir for flood control as well as municipal, industrial and irrigation purposes.
Calaveras County Water District (CCWD)	CCWD provides water and wastewater services to its customers in its service area which coincides with Calaveras County boundaries.
Calaveras Public Utility District (CPUD)	CPUD provides water to San Andreas, Mokelumne Hill and outlying areas.

Agency Name	Location and Services Provided
Calaveras County	The county is authorized to carry out flood control and stormwater management through its Public Works Department and the implementation of environmental health programs.
East Bay Municipal Utility District (EBMUD)	EBMUD provides water and wastewater services to its service area within Alameda and Contra Costa counties near San Francisco and also to its recreation areas at Pardee and Camanche North Shore in Amador County and Camanche South Shore in Calaveras County.
City of Ione	The City has secondary and tertiary wastewater treatment facilities and relies on AWA for potable water service.
City of Jackson	The City relies on AWA for water service but maintains its own wastewater treatment facilities.
City of Plymouth	The City supplies domestic sanitary sewer facilities, storm sewer, water treatment and wastewater treatment facilities to city residents. Water service is provided primarily by AWA.
City of Sutter Creek	The City provides local wastewater treatment services to city residents of Sutter Creek and Martell. AWA provides the City's water services.
Jackson Valley Irrigation District (JVID)	Organized in 1956 and contains 12,800 acres along Jackson Creek in Amador County. Owned by farmers and ranchers to control, distribute, salvage any water, including sewage for beneficial use, and irrigation.
Pacific Gas and Electric Company (PG&E)	PG&E owns and operates the 206 megawatt Mokelumne River Hydroelectric Project (FERC license 137, reissued October 200~~1~~1). The project spans over 90 miles of the North Fork Mokelumne River and adjacent streams. Seven storage reservoirs, four powerhouses, and many tunnels and flumes, most initially constructed by PG&E in the 1920s, create the Mokelumne River Project. Two ~~tunnels~~conveyance facilities, the Tiger Creek conduit and the Electra tunnel, are together 25 miles long and transport water around the North Fork Mokelumne's natural riverbed.
Upper Mokelumne River Watershed Authority (UMRWA)	The UMRWA is a Joint Powers Authority comprised of six water agencies (AWA, CCWD, CPUD, EBMUD, JVID and Alpine County Water Agency) and the counties of Amador, Calaveras and Alpine. UMRWA's goals include enhancing water supply, protecting water quality and the environment, reducing forest fuels and improving forest health. UMRWA's role is to perform water resource planning for the region, facilitate forest fuels reduction and restoration projects, secure grant funding, and leverage federal and state investments for widespread regional benefit.
U.S. Forest Service (USFS)	Established in 1905 as an agency of the U.S. Department of Agriculture, it manages public lands in national forests and grasslands, including the Stanislaus National Forest and Eld~~ D~~orado National Forest within the MAC Region. The Forest Service manages national forests for multiple uses and benefits and for the sustained yield of renewable resources such as water, forage, wildlife, wood, and recreation for the American people.

Groundwater

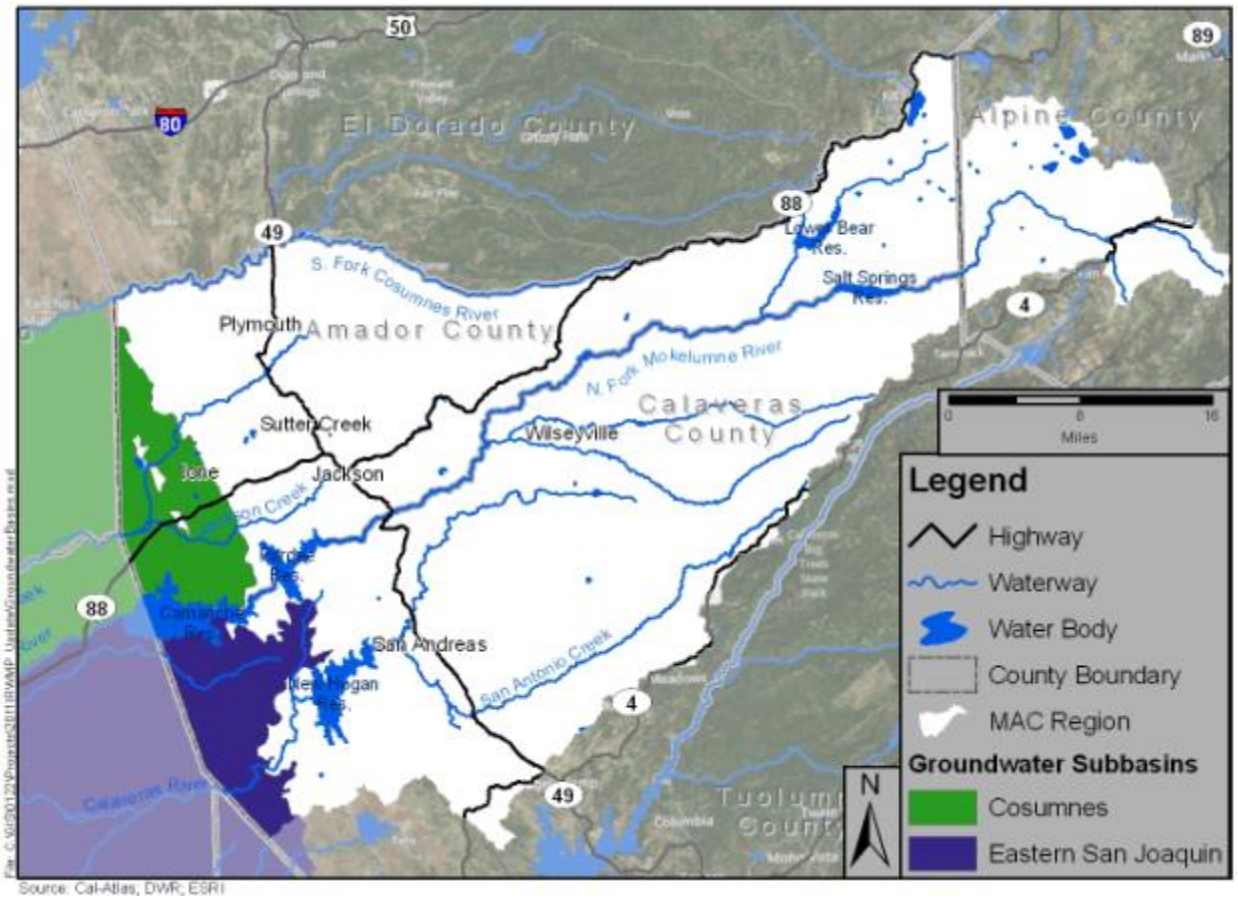
Groundwater is used in the Amador County portion of the MAC Region. Groundwater quantity and quality in this area varies considerably between well sites due to the small and unpredictable yields of the fractured rock system that typifies the underlying geology. Groundwater accounts for approximately four percent of AWA's total water supply, and it is currently only used in the communities of La Mel Heights and Lake Camanche Village at a total rate of approximately 200 acre-feet per year (AFY). Wells serving the Lake Camanche Village area of Amador County are located within the Cosumnes Subbasin portion of the San Joaquin Valley Groundwater Basin. The Cosumnes Subbasin is approximately 439 square miles in size and is bounded on the north and west by the Cosumnes River, on the east by the bedrock of the Sierra Nevada Mountains, and on the south by the Mokelumne River.

A portion of western Calaveras County overlies the Eastern San Joaquin Subbasin. This subbasin is a part of the larger San Joaquin Valley Groundwater Basin. This groundwater subbasin extends from the western corner of the County west of the cities of Stockton and Lodi. Use of groundwater for irrigation and municipal purposes has resulted in a continuous decline of available groundwater over the past 45 years. As of 1990, annual groundwater extractions in San Joaquin County had exceeded the estimated safe yield. Overdraft of the groundwater in this subbasin has created groundwater depressions in areas near Stockton and east of Lodi. The Cosumnes Subbasin of the San Joaquin Valley Basin is located north of and adjacent to the Eastern San Joaquin Groundwater Subbasin. In 2014, the state legislature passed the Sustainable Groundwater Management Act (SGMA) which outlines a process for achieving groundwater basin sustainability. Several Groundwater Sustainability Agencies (GSAs) have been formed to jointly manage the sustainable extraction and recharge of groundwater from the Eastern San Joaquin Subbasin and the Cosumnes Subbasin.

Groundwater resources are known to exist in other areas of the MAC Region, although there are no officially delineated groundwater basins defining these areas. In fact, most of the groundwater used within the region is obtained from areas outside of the Eastern San Joaquin Groundwater Subbasin. This groundwater may be found in hard rock formations and extracted in relatively small amounts from fractured rock, faults, or changes in rock strata.

Groundwater does not account for any of CCWD's water supply, except for service in the Wallace area. The larger communities included in Calaveras County are served by public water systems (e.g., CCWD and CPUD), while the remainder of the County is served either by small public water systems (less than 200 service connections) or individual domestic wells. In 2007, CCWD updated its adopted 2001 AB 3030 Groundwater Management Plan per SB 1938 requirements for the Camanche/Valley Springs area (which overlies the Eastern San Joaquin Groundwater Subbasin in western Calaveras County). CCWD has also completed a hydro-geologic assessment of groundwater conditions in the area. In 2008, CCWD was awarded a Proposition 50 Local Groundwater Assistance grant of $250,000 as part of a $425,000 total project budget to install nested monitoring wells and upgrade its groundwater monitoring activities. Because groundwater levels have declined in the basin, CCWD is moving toward integration of its surface water supplies with management of its share of the Eastern San Joaquin Valley Groundwater Basin. The groundwater basins in the MAC Region are shown in Figure 1-5.

Figure 6: Groundwater Basins in the MAC Region



1.1.4. Internal Institutional Boundaries

The following sections describe the institutions or groups that have varying degrees of responsibility or involvement related to the management of the water resources and infrastructure within the MAC Region. These groups are organized and presented in the following order: county governments, city governments, special districts, joint powers agencies, stakeholder ~~and special interest~~ groups, PG&E, and federal and state agencies.

County Governments

The MAC Region is contained within the boundaries of Amador, Calaveras, and Alpine counties. The region is sparsely inhabited and contains just five incorporated cities. The total combined population of the three counties was 84,405 (State of California, 2018). Individual total county populations are shown in Table 1-2.

Table 1-2: MAC Region County Populations

	Alpine County	Amador County	Calaveras County
Number of Inhabitants in Entire County	1,154	38,094	45,157

Source: State of California, 2018

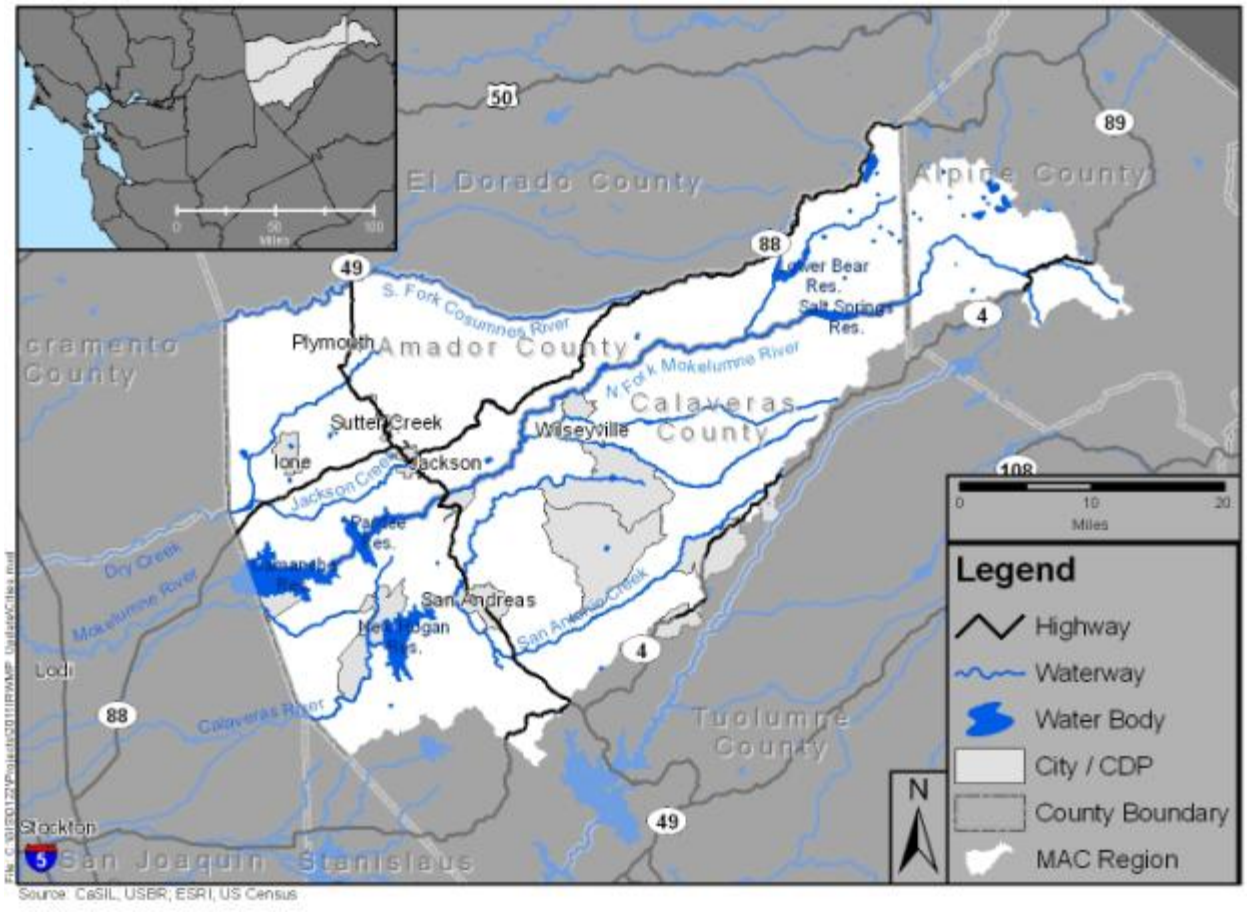
The Boards of Supervisors for these three counties are responsible for overseeing a variety of services for county residents, primarily in unincorporated areas, but in some cities as well. Such countywide services include voter registration, health and welfare programs, court and law enforcement operations, jail facilities, the recording of official documents, tax assessment and collection, and social services. The supervisors are also responsible for providing some municipal-type services for residents of unincorporated areas. These include planning, zoning, and land use regulation, street maintenance, and in some cases sewage disposal, water, parks and recreational facilities, and other municipal services, although these needs are frequently met by special districts or cities as discussed below.

City Governments

There are five municipalities within the MAC Region, all of which are located in Amador County: Amador City (2018 population - 186); Ione (2018 population - 8,058), Jackson (2018 population - 4,679), Plymouth (2018 population - 1,002) and Sutter Creek (2018 population - 2,479) (State of California, 2018). Although there is one incorporated city within Calaveras County (Angels Camp), this city is outside the MAC Region. Alpine County has no incorporated cities.

These city governments are responsible for providing services which directly affect the lives of their residents. To varying degrees, they provide fire and police protection, construct and maintain streets, provide facilities for sewage and storm drainage, and other community services. Additionally, each of the cities prepares land use plans and administers planning and zoning codes. There are Census Designated Places (CDPs) in Calaveras County which include Arnold, Dorrington, Forest Meadows, Mokelumne Hill, Mountain Ranch, Railroad Flat, Rancho Calaveras, San Andreas, Valley Springs, Wallace, and West Point. CDPs are geographic entities that serve as census data collection points in areas with concentrated population, housing, and commercial structures that are not within an incorporated city. The cities and CDPs within the MAC Region are shown in Figure 1-6.

Figure 7: MAC IRWMP City and CDP Boundaries



Special Districts

Special districts are units of local government established by the residents within the MAC Region to provide one or more special services not otherwise available. The special districts within the MAC Region that provide water-related services are shown in Table 1-3.

Table 1-3: Water-Related Special Districts within the MAC Region

County	Special Districts
Alpine	Alpine County Water Agency
Amador	Amador Water Agency Jackson Valley Irrigation District East Bay Municipal Utility District Drytown County Water District Fiddletown Community Services Kirkwood Meadows Public Utility District Pine Grove Community Services District Rabb Park Community Services District River Pines Public Utility District Volcano Community Services District Willow Springs Water District
Calaveras	Calaveras County Water District Calaveras Public Utility District East Bay Municipal Utility District Mokelumne Hill Sanitary District Valley Springs Public Utility District San Andreas Sanitation District

Joint Powers Authorities and Groundwater Sustainability Agencies

Under provisions of the California Government Code, two or more public agencies may come together under a joint powers authority (JPA) to provide more efficient government services or solve a service delivery problem. Several JPAs have been formed within the MAC Region to address water resource management and related matters. GSAs have been formed in response to the SGMA requirement to develop Groundwater Sustainability Plans (GSP) to address groundwater issues in the two groundwater basins that overlap with the MAC Region.

Upper Mokelumne River Watershed Authority (UMRWA): UMRWA is a JPA comprised of the three MAC Region counties (Alpine, Amador, and Calaveras) and six special districts which provide water and related services to areas within the MAC Region. UMRWA is fully described in Chapter 2 of this Plan.

Amador Regional Sanitation Authority (ARSA): ARSA is a JPA consisting of Amador County, Sutter Creek, and Amador City. The JPA's primary purpose is to transport effluent from the secondary treatment facility at Sutter Creek to the tertiary treatment facility at Ione. Mule Creek State Prison and the Preston School of Industry, a California Youth Authority facility, also discharge to ARSA facilities.

Calaveras-Amador-Mokelumne River Authority (CAMRA): CAMRA is a JPA established in 1997 between Amador County, Calaveras County, CCWD, CPUD, AWA and JVID. The Authority provides an institutional vehicle for the counties and local water-related special districts to discuss water related issues and concerns.

Amador County Groundwater Management Authority (AC-GMA): AC-GMA is a JPA consisting of AWA, Amador County, and JVID that was formed in 2017 in response to SGMA to study the portion of the Cosumnes Subbasin that overlaps with Amador County. AC-GMA is a participant in the Cosumnes Subbasin SGBMA Working Group.

Cosumnes Subbasin SGMA Working Group (Cosumnes Working Group): The Cosumnes Working group is a GSA formed in 2017 to develop and implement a GSP for the Cosumnes Groundwater Subbasin. The Cosumnes Working Group consists of the Omochumne-Hartnell Water District, Sloughhouse Resource Conservation District, Galt Irrigation District, Clay Water District, City of Galt, Amador County Groundwater Management Authority, and Sacramento County.

Eastern San Joaquin Groundwater Authority (GWA): GWA is a JPA whose members include representatives from 17 GSAs and California Water Service Company (Cal Water). The GWA was formed to facilitate the joint development and implementation of a single GSP for the entire Eastern San Joaquin Subbasin. The 17 participating GSAs include: Central Delta Water Agency, Central San Joaquin Water Conservation District, City of Lathrop, City of Lodi, City of Manteca, City of Stockton, Eastside San Joaquin GSA, Linden County Water District, Lockeford Community Services District, North San Joaquin Water Conservation District, Oakdale Irrigation District GSA, San Joaquin County, San Joaquin County No. 2 (Cal Water), South Delta Water Agency, South San Joaquin GSA, Stockton East Water District, Woodbridge Irrigation District.

Eastside San Joaquin Groundwater Sustainability Agency (Eastside GSA): The Eastside GSA is a cooperative multi-agency GSA established by Memorandum of Understanding in 2017 consisting of Calaveras County, CCWD, Rock Creek Water District, and Stanislaus County. The Eastside GSA covers the portions of the Eastern San Joaquin Subbasin within Calaveras and Stanislaus Counties that are not already within another GSA boundary totaling about 150 square miles. The Eastside GSA is a member of the GWA JPA for the purpose of developing and implementing the GSP for the Eastern San Joaquin Subbasin.

Stakeholder ~~and Special Interest~~ Groups

Regional Participants Committee (RPC): The RPC is a diverse committee organized with the primary objective of bringing stakeholder interests to the forefront during the development and administration of the MAC Plan. Members of the RPC represent the views of their respective organizations or interest groups within the community, commit time to take part in the plan development and updating processes, and work collaboratively with other RPC members, project staff, and UMRWA representatives. The RPC is more fully described in Section 2.2.1 of this Plan.

Foothill Conservancy: The Foothill Conservancy's stated mission is to protect, restore, and sustain the natural and human environment in Amador and Calaveras counties for the benefit of current and future generations. The Conservancy has been actively involved in water resource issues ~~for many years~~since 1989, and its members serve on the RPC~~, Mokelumne Forum,~~ and other stakeholder organizations involved with water resource, land use, and watershed issues in the MAC Region. The Conservancy is a signatory to the settlement agreement for the PG&E Mokelumne River Hydroelectric Project and sits on the Ecological Resources Committee that manages its adaptive management plan.

Alpine Watershed Group: This county organization operates similar to a watershed council. The Alpine Watershed Group works to preserve and enhance the natural system functions of Alpine County's watersheds for future generations.

Amador-Calaveras Consensus Group (ACCG): The ACCG is a community-based organization with a stated mission to create fire-safe communities, healthy forests and watersheds, and sustainable local economies.

Pacific Gas and Electric Company

PG&E is the owner and operator of the Mokelumne River Hydroelectric Project (Federal Energy Regulatory Commission [FERC] license No. 137). The project consists of a series of storage and regulating reservoirs and associated tunnels and pipelines which supply water to four hydropower generating units located primarily on the North Fork of the Mokelumne River. PG&E operates the project in accordance with FERC license requirements and other operating obligations. A new FERC license, issued to PG&E in October 2001, requires the company to work with a stakeholder committee to adaptively manage project operations in a manner that balances the needs of recreation and the environment with power generation needs.

Federal and State Agencies

A number of federal and state agencies influence water resource decisions within the MAC Region to some degree. Which agency or agencies have influence, and the extent of their influence, depends on the nature of the water resource matter being considered. Those agencies which would typically be expected to have input on water-related projects and programs in the MAC Region are listed in Table 1-4.

Table 1-4: Federal and State Agencies with MAC Region Jurisdictions

Federal Agencies	State Agencies
U.S. Forest Service (Eldorado National Forest and Stanislaus National Forest)	Department of Water Resources
Bureau of Land Management	State Water Resources Control Board
Environmental Protection Agency	Department of Fish and Game
U.S. Army Corps of Engineers	Department of Public Health
U.S. Fish and Wildlife Service	Regional Water Quality Control Board
Federal Energy Regulatory Commission	Department of Parks and Recreation
	Department of Transportation

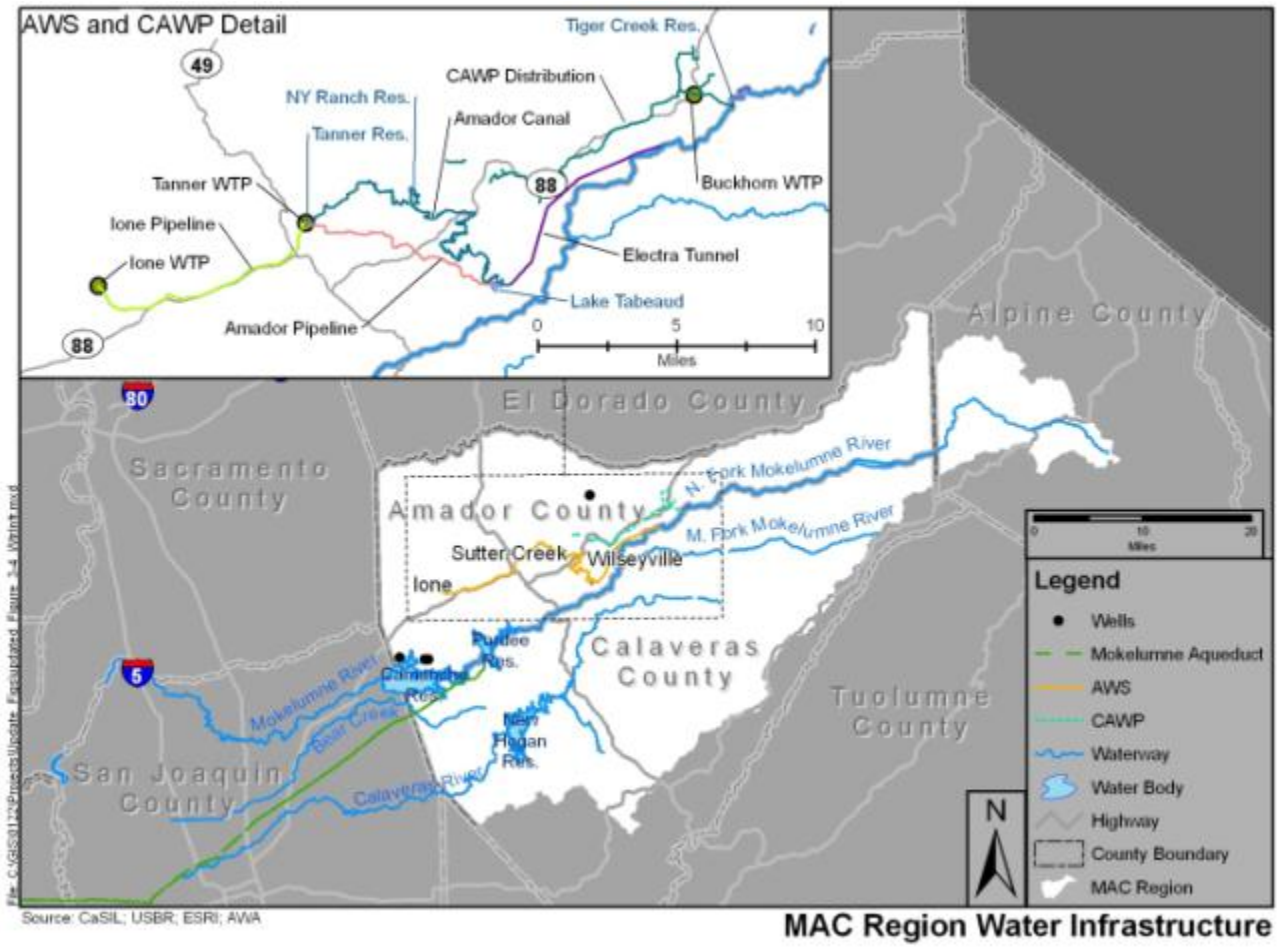
The USFS and the Bureau of Land Management are major landowners in the watershed and are described below.

- The USFS, established in 1905 as an agency of the U.S. Department of Agriculture, manages public lands in national forests and grasslands, including the Stanislaus National Forest and Eld ~~D~~orado National Forest within the MAC Region. The Stanislaus National Forest encompasses about 898,000 acres on the western slope of the Sierra Nevada, located between Lake Tahoe and Yosemite. The Eld ~~D~~orado National Forest is located in the central Sierra Nevada within El Dorado, Amador, Alpine, and Placer counties.
- The Bureau of Land Management is an agency within the U.S. Department of Interior responsible for managing natural resources and administers 264 million acres of public lands, located primarily in the 12 Western states, including California. The mission of the Bureau of Land Management is to sustain the health, diversity, and productivity of public lands for the use and enjoyment of future generations.

1.1.5. Major Water-Related Infrastructure

Surface water provides the majority of water supply in the MAC Region. Associated with the surface water bodies within the region are several major water-related projects. Figure 1-7 shows the major water infrastructure within the study region and highlights the regions dependence on the Mokelumne and Calaveras rivers. The water infrastructure includes major conveyances, water treatment plants, pump stations, and water storage facilities.

Figure 8: MAC Region Water Infrastructure



MAC Region Water Infrastructure

Amador Water System: The Amador Water System conveys Mokelumne River water transported via PG&E's Electra Tunnel to Lake Tabeaud. Lake Tabeaud then feeds the Amador Canal, transporting water to treatment plants in Sutter Hill and Ione. ~~The 23-mile~~A portion of the Amador Canal was replaced in 2008 with an 8-mile pipeline project. Ione and Tanner water treatment plants, located in Ione and Sutter Hill, respectively, are owned and operated by AWA and provide treated surface water to AWA's service area.

Calaveras Public Utilities District (CPUD) System: CPUD operates Schaads Reservoir on the Middle Fork of the Mokelumne River, a pump station on the South Fork of the Mokelumne River, the 2,000 AF Jeff-Davis Reservoir near Glencoe, a 1.5 million gallon storage tank in Mokelumne Hill, a 3.0 million gallon storage tank in San Andreas, and 20 miles of connecting pipeline to serve water to San Andreas, Mokelumne Hill, Paloma, Railroad Flat, Glencoe, and outlying areas.

Camanche Area Regional Water Supply Project (CARWSP) Phase 1: East Bay Municipal Utility District's CARWSP project consists of a 2 million gallons per day (MGD) regional water treatment plant located at Camanche South Shore (the prior location of an outdated EBMUD Water Treatment Plant [WTP]), a nearly 6,000 linear foot 12-inch raw water pipeline from Mokelumne Aqueduct to the new WTP, and treated water pipelines and appurtenances to deliver treated surface water from the WTP to the services areas of Camanche North and South Shores, and Lake Camanche Village.

Camanche Dam and Reservoir: Owned and operated by EBMUD, Camanche Reservoir has a capacity of 417,120 AF. Camanche Reservoir is primarily operated for flood control and to meet downstream flow requirements and riparian needs. Hydroelectric power generation also occurs at the Camanche Reservoir. The reservoir regulates Mokelumne River water flows pursuant to agreements and entitlements held by WID and the North San Joaquin Water Conservation District, both located within San Joaquin County.

Central Amador Water Project (CAWP) System: The Central Amador Water Project System provides treated water to upcountry communities in Amador County such as Pine Grove, Pioneer, and the Mace Meadows areas. Water is diverted from the PG&E regulator reservoir in Tiger Creek (a component of PG&E's Mokelumne River hydroelectric project) and it flows by gravity to the Buckhorn Treatment Plant (owned and operated by AWA) in Pioneer to be treated and distributed to customers of Pine Grove, Pine Acres, Sunset Heights, Fairway Pines, Jackson Pines, Pioneer, Gayla Manor, Ranch House Estates, Pine Park East, Toma Lane, Sierra Highlands, Silver Lake Pines, Ridgeway Pines, Rabb Park, and Mace Meadows.

Groundwater Wells: Two groundwater wells, located in the La Mel Heights subdivision, are used by AWA to supply La Mel Heights customers. Four groundwater wells located in the Lake Camanche area are used to supply Lake Camanche residents. CCWD maintains three wells, of which two are currently active, to serve the Wallace service area.

Ione Pipeline: The Ione Pipeline transports raw water from the Tanner Reservoir to the Ione WTP where it is treated for use by customers of Ione.

Jenny Lind System: The source of water for the Jenny Lind Improvement District is an infiltration gallery one mile below the New Hogan Dam on the Calaveras River. Water allocation is highly dependent on the water year. CCWD's water allocation for this system from storage in New Hogan Reservoir is 30,928 AFY plus riparian water rights of 350 AFY. Water for the system is treated at the Jenny Lind WTP which has an existing capacity of 6 MGD.

Lake Tabeaud: Used by AWA to divert water from the Mokelumne River, Lake Tabeaud has a storage capacity of 1,170 AF. Water from Lake Tabeaud is conveyed by pipeline to the Tanner WTP where it is treated for use by the customers of Jackson, Sutter Creek, Amador City, Plymouth, and Drytown.

Mokelumne Aqueducts: Raw water from Pardee Reservoir is moved through the Pardee Tunnel to the three Mokelumne Aqueducts near Valley Springs in Calaveras County. All three steel pipelines extend 82.2 miles from the Pardee Tunnel to the east end of the Lafayette Aqueduct in Walnut Creek, east of San Francisco Bay.

New Hogan Dam and Reservoir: New Hogan Dam and Reservoir stores approximately 317,000 AF of water for municipal, industrial, irrigation, and flood control purposes. Flood control releases are controlled by the U.S. Army Corp of Engineers with Stockton East Water District operating the reservoir at all other times. Up to 84,100 AFY of conservation storage is reserved under contract with the US Bureau of Reclamation for CCWD and Stockton East Water Districts consumptive and hydropower uses within the project service area boundaries.

New York Ranch Reservoir: The New York Ranch R-~~r~~eservoir, located just southwest of the intersection of Ridge and Climax Roads, currently serves as a holding basin for water flowing via the Amador Canal pipeline from Lake Tabeaud to the Tanner Reservoir near Sutter Hill.

Pardee Dam and Reservoir: Owned and operated by EBMUD, Pardee Reservoir has a capacity of 197,950 AF and is operated as a water supply reservoir. Water from Pardee is conveyed by the Mokelumne

Aqueducts to the EBMUD service area approximately 91 miles away. Hydroelectric power generation (30 megawatts) is produced at the Pardee Powerhouse.

Tanner Reservoir: Tanner Reservoir stores raw water transferred from Lake Tabeaud via the Amador Canal pipeline. The raw water is then transferred to the Ione WTP via the Ione Pipeline for treatment and subsequent distribution to customers in Ione.

~~Electra and Middle Bar Runs: This small, scenic canyon on the Upper Mokelumne River, upstream of Pardee Reservoir, is a popular whitewater run. Located below PG&E's Electra powerhouse, this narrow, 1,000-foot-deep, wooded canyon is also a favorite place for other recreational activities such as fishing, picnicking, wading, wildflower viewing, gold panning, and spiritual rejuvenation.~~

Mokelumne River Fish Hatchery: The Mokelumne River Fish Hatchery is owned by EBMUD and operated by the California Department of Fish and Game. The fish hatchery raises and releases anadromous fish on the Mokelumne River, in addition to obtaining and maintaining data regarding the condition of fish stock in the river.

West Point/Wilseyville System: Sources of water for the West Point and Wilseyville water systems are Bear Creek and the Middle Fork of the Mokelumne River. CCWD has water rights for a year-round diversion of 4 cubic feet per second (cfs) and 150 AF of storage rights on Bear Creek for a total potential supply of 1,830 AF.

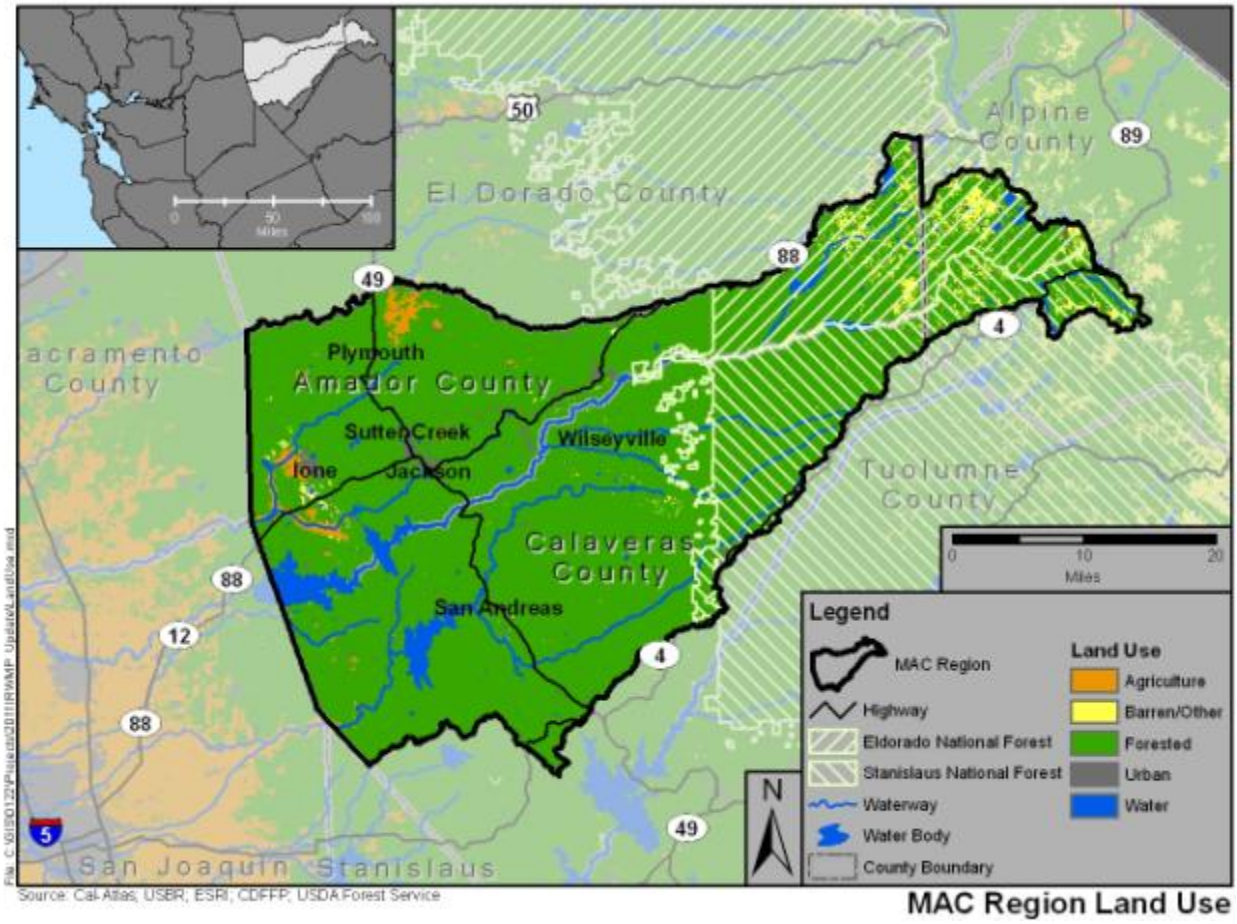
1.1.6. Social and Cultural Makeup

This section describes the social and cultural makeup of the MAC Region, discusses important cultural values, identifies the disadvantaged communities (DACs) in the region, and describes the economic conditions and important economic trends within the region.

Land Use

Land use data are critical for identifying and evaluating a multitude of water resources management characteristics including water use, wastewater production, stormwater runoff, environmental habitats, and other natural resources. Land use data are available from DWR, the United States Geological Survey (USGS) and local governmental agencies. Figure 1-8 summarizes the major land uses in the MAC Region. Most of the land within the MAC Region is "forested", which includes grassland, oak savannah, and woodlands in the western portion of the region. Development within the region, both urban and rural, is clustered around the major cities and highways. Agriculture, grazing, and open space dominate, representing a relatively large portion of the total regional land use. Other industries outside the urban setting include mining and timber harvesting, cattle grazing, where the majority of the land cover is forest, shrub and grassland.

Figure 9: MAC Region Land Use



MAC Region Land Use

General land use trends in the MAC Region include development of rural and agricultural areas and a shift from grazing to viticulture ~~and from viticulture to residential development~~.

Amador County

In recent years, Amador County has experienced increased urbanization ~~and decreased farming and agriculture~~, though continued agriculture and preservation of agriculture lands is encouraged by the county. Primary farming commodities in the County include wine grapes and cattle. Grazing on public lands is still a custom and part of the County's culture. Large land holdings for timber harvesting of softwood forests exist in areas designated as Timberland Preservation Zones (TP~~L~~Z), but ~~significant~~ urbanization pressures continue. There is also residential conversion pressure on grazing lands and oak woodlands in the western part of the County. Amador County recently updated its General Plan, which was adopted in October 2016. The General Plan identified the greatest challenge facing successful implementation as insufficient available water and wastewater services. Though the MAC Plan Update is not intended influence growth in Amador County, the implementation of some of the projects included in the Plan could potentially have land use implications.

Calaveras County

Its General Plan divides Calaveras County into ~~two categories based on land use~~several land use categories: Natural Resource Lands, Rural Transition, Residential Lands, Mixed Use Lands, Commercial Lands, Industrial Lands, and Other Lands. ~~and Community Development Lands.~~ Natural Resource Lands are used for agriculture, timber and mining, or contain sensitive habitat. The Rural Transition, Residential Lands,

Mixed Use Lands, Commercial Lands, and Industrial Lands ~~Community Development Lands~~ are already developed or slated for future development. The General Plan establishes target development densities within each of these categories such that Rural Transition, Residential Lands, Mixed Use Lands, Commercial Lands, and Industrial Lands ~~Community Development Lands~~ will be developed at higher densities and Natural Resource Lands density will be restricted to ensure future use, conservation, and the use of resources. Currently, Natural Resource Lands comprise approximately 55 percent of the land area (22 percent of that designated for Timber or Dam Areas), whereas 43 percent of the total area is designated as ~~Community Development Lands~~current or future development. The remaining 2 percent is designated for the City of Angels and its sphere of influence. The Calaveras County General Plan is completing a comprehensive update to its General Plan with implementation expected in 2019. This IRWMP is not intended to drive the General Plan Update process or to influence growth in the County.

Alpine County

Due to Alpine County's topography, minimal development pressure, and citizen appreciation for the conservation of the forest and mountain meadow environment, development will be concentrated in Kirkwood and Bear Valley, two ski-resort communities, consistent with the Land Use Element of Alpine County's General Plan. This will allow much of the County to remain designated as Open Space or Wilderness. Two types of residential subdivisions are recognized – standard and conservation. Lots in a standard subdivision will be a minimum of 20 acres whereas in a conservation subdivision, residential lot sizes will be reduced, provided that the overall density of development does not exceed one residential lot per 20 acres of land. Lands not included in residential lots shall be retained as open space. County population is expected to maintain similar levels to today with small fluctuations. Any increase in population would increase demands for public services and facilities, including fire protection, sewage disposal, water systems, and other utilities. Limited availability of water and sewer services is considered a major constraint to development in general (Alpine County, 2017).

Culture

The Miwok and Washoe people and their ancestors are among the native peoples who have lived in the MAC Region for thousands of years. K~~Also k~~nown as the "Heart of the Mother Lode", the first non-native settlements in the MAC Region started ~~MAC Region was first developed~~ when the California Gg~~o~~ld R~~r~~ush began. Cities were developed around and nearby local mines to support the prospectors and hard rock miners. Evidence of the area's past is visible, with many historic buildings still standing as part of the current local culture. The area is now known for its vineyards and wines, small town charm and hospitality, scenic open space, ~~and~~ rich history, recreational opportunities and high quality of life.

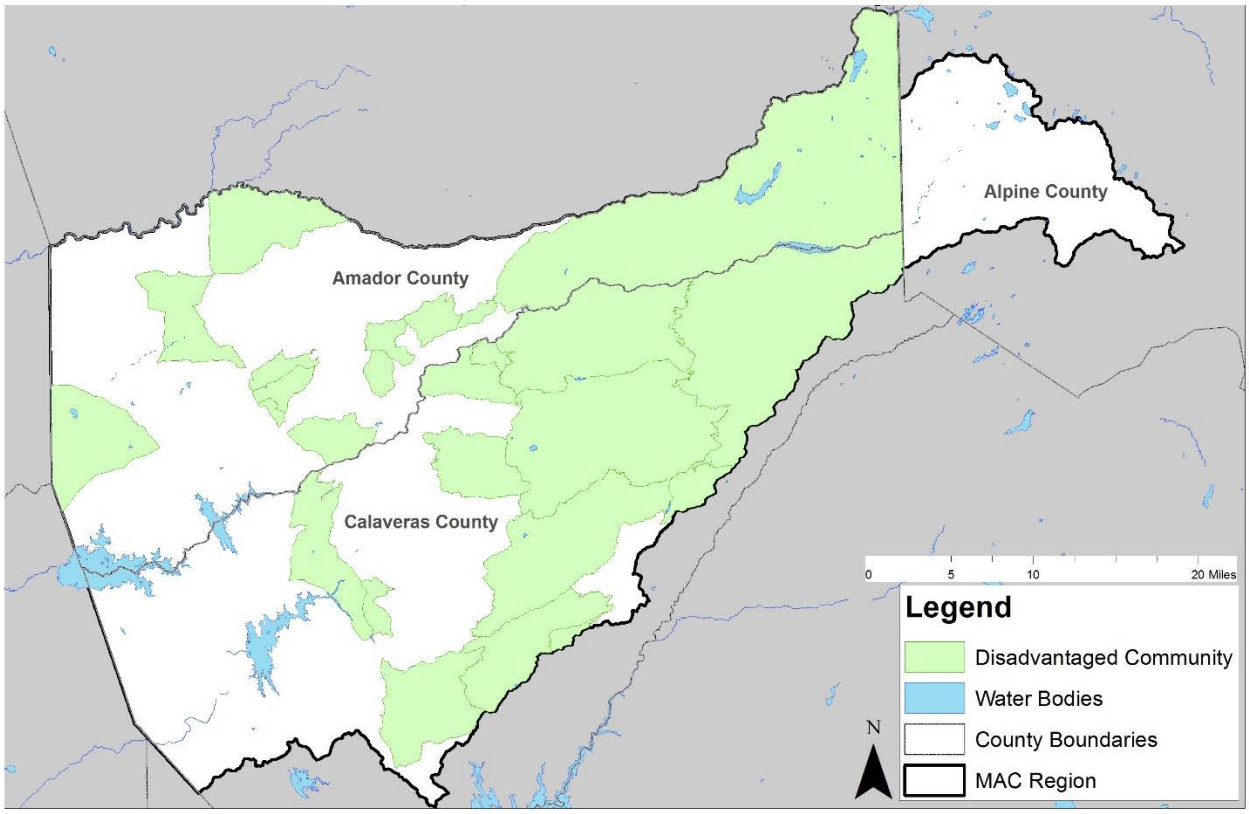
The MAC Region is home to approximately 83,000 people, translating to an approximate population density of 55 people per square mile on average. The population density in rural areas is about 40 people per square mile. This low population density minimizes urban impacts to the region's water features, making the region valuable as a watershed and ideal for habitat and natural resources.

Disadvantaged Communities

According to the Prop 1 Guidelines, a "disadvantaged community" (DAC) is defined by the State of California as a community with an annual median household income (MHI) that is less than 80 percent of the statewide MHI (Public Resources Code, 75005[g]). The U.S. Census Bureau's American Community Survey (ACS) includes MHI data compiled for the 5-year period from 20~~0~~10 to 2014. A community with an MHI of $49,191 or less is considered a DAC. The Census collects and compiles data for multiple census geographies including Place, Block Group, and Tract. A census tract is a region defined for the purpose of taking a census and usually coincides with city boundaries, towns, or other administrative areas. The U.S. defines census tracts as "relatively homogeneous units with respect to population characteristics, economic status, and living conditions, census tracts average about 4,000 inhabitants." Census tracts are subdivided

into block groups which generally contain between 600 and 3,000 people with an optimum size of 1,500 people. Census places are designated each decennial census to provide data for settled concentrations of population that are identifiable by name. Figure 1-9 shows the census block groups within the MAC Region that qualify as DACs. The census block groups that are disadvantaged constitute 75% of the area of region.

Figure 10: MAC Region DACs – Census Block Groups



Based on the American Community Survey (ACS) census place data, as shown in Figure 1-10, the cities or communities of Jackson, San Andreas, Sutter Creek, Pine Grove, Red Corral, Mountain Ranch, Pioneer, Plymouth, West Point, Rail Road Flat, Amador City, Martell, and Fiddletown, are DACs. Murphys, Avery, River Pines, and Kirkwood are DACs that are partially located in the MAC Region. There are no DACs in the portion of Alpine County within the MAC Region.

Figure 11: MAC Region DACs - Census Places

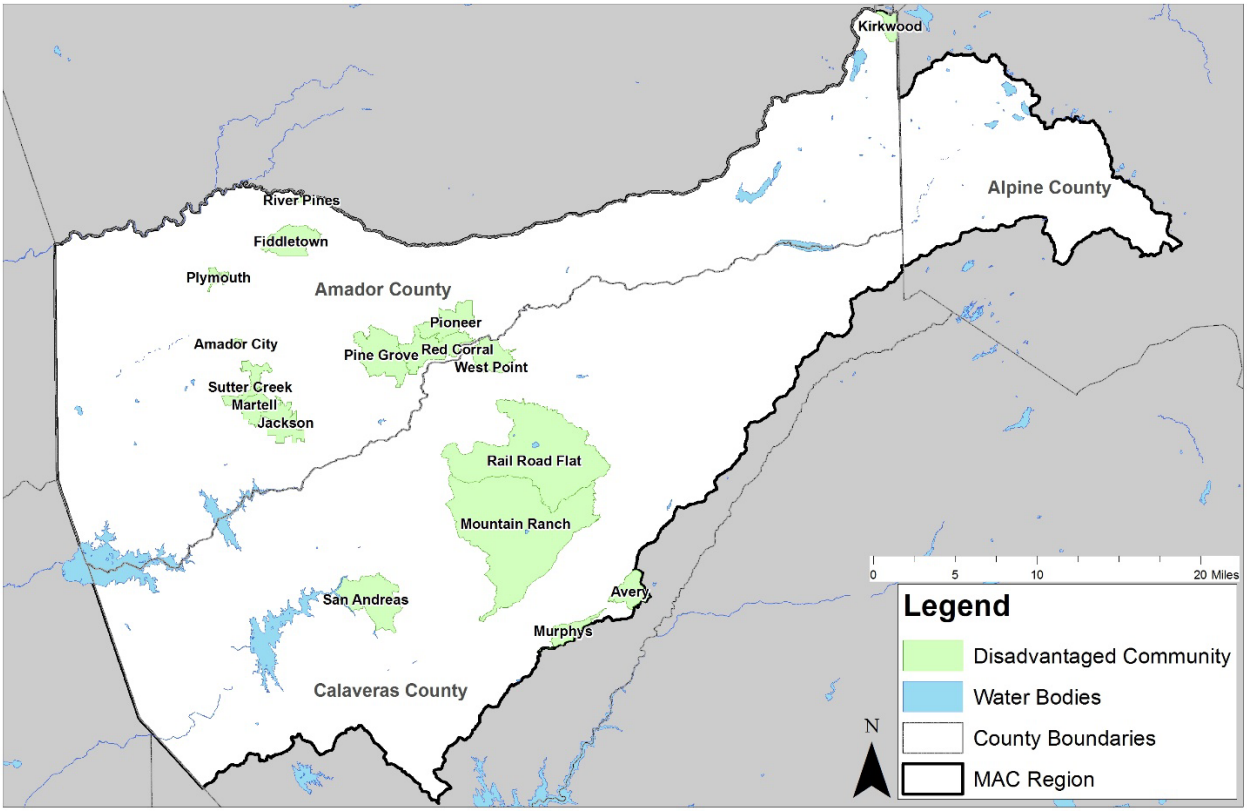


Table 1-5 summarizes the Census/ACS data and the MHI statistics.

Environmental justice is addressed by providing all stakeholders with ample opportunities for involvement in decision-making processes and ensuring that minority and/or low-income populations do not bear disproportionate quality of life, human health, and/or environmental impacts. DACs existing with the MAC Region and increases in water or wastewater service rates that could accompany the implementation of several projects discussed herein could affect these communities. A priority of the RPC is to seek external grant funding or subventions to offset the cost of implementing new, and often expensive, projects. External funding assistance will help offset costs to existing ratepayers in the region - especially those ratepayers with a limited ability to pay - and will help to ensure that those ratepayers are affected as little as possible. Additionally, the MAC IRWMP projects will be reviewed for compliance with California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), and any other local, state, and federal requirements. Through any necessary environmental documentation review (to be completed by project proponents prior to implementing projects and not as part of the IRWM Plan), compliance with Executive Order 12898 will be addressed on a project-by-project basis.

Construction of project facilities will create short-term environmental impacts (noise, dust, traffic disruption) potentially affecting neighboring land uses. A preliminary analysis of the areas affected by construction of project facilities will assist in minimizing adverse impacts to minority and/or low-income populations.

Table 1-5: Median Household Income Statistics

Census Designated Place (County)	Median Household Income (5-year average, 2010-2014)	Percent of State MHI
California	$61,489 (80% = $49,191)	
Jackson (Amador)	$41,745	68%
San Andreas (Calaveras)	$40,613	66%
Sutter Creek (Amad0r)	$41,071	67%
Murphys[1] (Calaveras)	$46,885	76%
Pine Grove (Amador)	$48,571	79%
Red Corral (Amad0r)	$30,431	49%
Mountain Ranch (Calaveras)	$38,630	63%
Pioneer (Amador)	$42,614	69%
Plymouth (Amador)	$44,531	72%
West Point (Calaveras)	$28,262	46%
Avery[1] (Calaveras)	$31,719	52%
Rail Road Flat (Calaveras)	$29,922	49%
River Pines[1] (Amador)	$48,285	79%
Amador City (Amador)	$48,750	79%
Kirkwood[1] (Amador)	$39,375	64%
Martell (Amador)	$13,508	22%
Fiddletown (Amador)	$42,500	69%

Footnotes:
1. Not wholly within the MAC Region.

DAC Involvement Program

In 2016, DWR's Proposition 1 allocated $1.3 million dollars to the Mountain Counties Funding Area for the DAC Involvement Program (DACI Program). The three main goals of the DACI Program are to: 1) encourage Regions to work collaboratively to involve DACs and Economically Distressed Areas (EDAs) in IRWM planning efforts; 2) identify water management-related needs of DACs/EDAs; and 3) develop strategies and long-term solutions that address the identified needs. The DACI Program provides a unique opportunity for the MAC Region to explore these barriers and DAC needs.

The Sierra Institute for Community and Environment is coordinating the DACI grant program for the Mountain Counties Funding Area (MCFA). The program includes three main projects: (1) identification and outreach of "DAC" and Tribal, (2) Community Capacity and Needs Assessment Workshops, and (3) Technical Support Workshops and tools. The MAC Region will engage as appropriate as the program continues to unfold.

1.1.7. Ecological and Environmental Resources

The MAC Region is a largely natural area with significant portions designated as rural or open space, including large portions of two national forests. The region is host to an abundance of water features in the

form of rivers, creeks, ponds, lakes, and reservoirs. As such, the region provides a great deal of varied habitat for numerous species. There are a number of special-status biological species in the MAC Region. Table 1-6 summarizes the species found in Amador, Calaveras, or Alpine counties that are listed in the by the U.S. Fish and Wildlife Service or by the California Department of Fish and Wildlife designated as "Threatened," "Endangered," or "Candidate," with the latter indicating that the species is under consideration for official listing in the future. This list of special-status species is not exhaustive, as there may be more species on the U.S. Forest Service Species of Special Concern, California Dept. of Fish and Wildlife Species of Special Concern, and the California Native Plant Society Rare Plant lists in the MAC Region that do not appear in Table 1-6.

Table 1-6: Special-Status Species Potentially within the MAC Region

Common Name	CA State Status	Federal Status
Mammals		
North American wolverine	Threatened	Candidate
San Joaquin kit fox	Threatened	Endangered
Sierra Nevada red fox	Threatened	--
Birds		
Bald eagle	Endangered	Delisted
Great gray owl	Endangered	--
Pacific fisher	--	Candidate
Southwestern willow flycatcher	Endangered	Endangered
Swainson's hawk	Threatened	--
Reptiles		
Giant garter snake	Threatened	Threatened
Amphibians		
California red-legged frog	--	Threatened
California tiger salamander	Threatened	Threatened
Foothill yellow-legged frog	Candidate	--
~~Limestone salamander~~	~~Threatened~~	~~--~~
Sierra Nevada yellow-legged frog	Threatened	Endangered
Yosemite toad	--	Threatened
Fish		
Central Valley steelhead	--	Threatened
Delta smelt	Endangered	Threatened
Lahontan cutthroat trout	--	Threatened
Longfin smelt	Threatened	Candidate
Paiute cutthroat trout	--	Threatened
Invertebrates		
Conservancy fairy shrimp	--	Endangered

Common Name	CA State Status	Federal Status
Valley elderberry longhorn beetle	--	Threatened
Vernal pool fairy shrimp	--	Threatened
Vernal pool tadpole shrimp	--	Endangered
Plants		
Chinese Camp brodiaea	Endangered	Threatened
Colusa grass	Endangered	Threatened
Fleshy owl's-clover	Endangered	Threatened
Hartweg's golden sunburst	Endangered	Endangered
Irish Hill buckwheat	Endangered	Endangered
Ione buckwheat	Endangered	Endangered
Ione manzanita	--	Threatened
Red Hills vervain	Threatened	Threatened
Sacramento Orcutt grass	Endangered	Endangered
Webber's ivesia	--	Threatened
Whitebark pine	--	Candidate

Source: U.S. Fish & Wildlife Service, 2018 and California Department of Fish and Wildlife, 2018

In addition to these special-status species, the MAC Region is home to a wide variety of plant and animal life in many different environments, including riparian, wetland, forest, and alpine. Wildlife in the area includes noteworthy rainbow and brown trout fisheries, black bear and deer populations, furbearers, 119 different bird species - including peregrine falcons, cliff swallows, spotted owls, and many more - and a vast array of amphibians and reptiles, including foothill yellow-legged frogs, western fence lizards, Gilbert skink, western rattlesnake, and pacific treefrog. Non-native, invasive aquatic and terrestrial species are also present in the region which can threaten biological diversity. Non-native plants can alter nutrient cycles, hydrology, wildfire frequency, and hybridize with native species, as well as spread into protected areas and wildlands and reduce the species and communities these sites were created to protect.

1.2. Water Resource Conditions

1.2.1. Water Supplies and Demands

The regional water supplies and demands included in this section are agency estimates based on the best available information and projections. Demands are very sensitive to population and land use, and the increasing demands reflect regional trends. To help offset increasing demands, agencies are implementing demand management measures as described in their respective Urban Water Management Plans (UWMPs).

Amador County

AWA provides potable water and raw water to more than 14,000 people in its four service areas, Amador Water System, Central Amador Water Project System, La Mel Heights, and Lake Camanche Village, for municipal, industrial, and irrigation uses. Demands have flattened during the recent economic recession

and drought, but AWA continues to manage its water supplies and demands over a range of normal and emergency conditions.

As part of the 2015 UWMP, AWA calculated its baseline daily per capita water use and interim and urban water use targets as required by Senate Bill x7-7 (SBx7-7). As a result, future water demands were calculated assuming the required reduction in daily per capita water use would be achieved in future years. While there are a variety of methods to project demands, AWA d~~D~~emands were estimated based on the projected population growth described in the Amador County *General Plan Housing Element Update* (PMC, 2015) and historical water use per connection (connections are expected to increase proportionally with population).

The domestic sector of AWA's water service customers includes permanent and seasonal, single and multi-family residences. Since JVID is the primary supplier of agricultural water, AWA supplies relatively little water for agricultural uses. AWA also serves water or recycled water to several commercial/industrial consumers and golf courses. Past and projected water demands are shown in Table 1-7.

Table 1-7: AWA Past and Projected Water Demands (AFY)

Water Use	2005	2010	2015	2020	2025	2030	2035	2040
Total Potable Deliveries[1]	3,312	3,129	2,292	4,036	4,355	4,674	4,931	5,190
Sales to Other Water Agencies[2]	1,683	1,377	1,156	1,617	1,745	1,873	1,977	2,080
Additional Water Uses and Losses[3]	4,738	3,901	3,150	4,948	5,599	5,710	5,800	5,889
TOTAL	**9,733**	**8,407**	**6,598**	**10,601**	**11,699**	**12,257**	**12,708**	**13,159**

Source: *Amador Water Agency 2015 Urban Water Management Plan* ~~AWA, 2016.~~

Footnotes:

1. Water deliveries include deliveries to the following: single family residential, multi-family residential, commercial/institutional, industrial.
2. Sales to other water agencies includes sales to Drytown County Water District, City of Jackson, Mace Meadows Water Association, Pine Grove Community Services District, City of Plymouth, Rabb Park Community Services District.
3. Additional water uses and losses includes Recycled Water, Raw Water Billed, Raw Water Losses, Recycled Water and System Losses.

Surface water accounts for approximately 96 percent of AWA's total water supply and it is the sole source of water for the Amador Water System and the Central Amador Water Project. Groundwater accounts for the remaining four percent of AWA's total water supply and is only used in the La Mel Heights community and Lake Camanche Village. Total recent groundwater pumping has accounted for 200-300 AFY of AWA's water supply. Due to growth in the area and concerns over groundwater quality and basin overdraft, the Lake Camanche Village area is planning to phase out the use of groundwater. The Camanche Area Regional Water Supply Project is a joint surface water treatment plant project between EBMUD, AWA, and CCWD to supply surface water to this area and is currently underway and expected to be completed within the next five years.

The La Mel Heights area has restricted growth potential and build-out will be achieved in the next five years. Therefore, the amount of groundwater projected to be pumped is held constant after the year 2020. To help

meet the water demand of La Mel Heights, AWA completed the construction of a second well which has a yield of 50 AFY. The old well has been retained as a back-up source.

Table 1-8 summarizes AWA's current and future water supplies. Future water supplies were developed as part of AWA's 2015 Urban Water Management Plan and are based on the following assumptions.

- La Mel Heights will reach build out in 2020 and not require additional water supply.
- Lake Camanche Village will switch to surface water by 2020. The implementation of the Camanche Area Regional Water Supply Project depends on coordination between EBMUD, AWA, PG&E, and CCWD.

AWA previously used the Amador Canal to transfer the Amador Water System surface water from Lake Tabeaud to Tanner Reservoir, but almost half of the diverted water was lost due to open ditch conveyance leakage and evaporation. As a result, the Amador Transmission Pipeline was constructed. The reduction in losses associated with pipeline conveyance allows surface water in excess of the Amador Water System demand to remain in the Mokelumne River or be diverted through the Tiger Creek Conduit and returned to the river at Electra and be incidentally captured in EBMUD's reservoirs. EBMUD participated in funding the pipeline but was not guaranteed a specific amount of water. As Amador Water System water demand increases, incidental transfer to EBMUD reservoirs will be reduced. AWA is currently initiating discussions over terms for a potential one-time pilot water transfer with the Bay Area Water Supply and Conservation Agency (BAWSCA). BAWSCA would purchase the water used in the one-time pilot water transfer to test the physical and institutional issues of transferring a new water supply into the San Francisco Regional Water System. AWA is not pursuing any other water transfers or exchanges at this time. AWA does not currently produce any recycled water, but in the future it anticipates development of recycled water projects within its service area, including projects planned by the City of Plymouth and Lake Camanche Village.

Table 1-8 describes current and projected maximum water supplies available to AWA.

Table 1-8: Current and Planned Water Supplies, AFY

Water Type	2010	2015	2020	2025	2030	2035	2040
Surface Water[1]	16,150	16,150	17,200	17,200	17,200	17,200	**17,200**
Supplier Produced Groundwater	296	420	420	420	420	420	**420**
Recycled Water[2]	0	622	723	1,264	1,264	1,264	**1,264**
Incidental Transfer to EBMUD[3]	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**
TOTAL[4]	**16,446**	**17,1912**	**18,343**	**18,884**	**18,884**	**18,884**	**18,884**

Source: AWA, 2016.

Footnotes:

1. It is anticipated AWA will obtain additional water rights in CAWP, increasing the right from 1,150 to 2,200 AFY.
2. Recycled water is not supplied by AWA but it is used in a small portion of its service area. Future supply includes existing and projected recycled water use in AWA's service area.
3. Quantities transferred to EBMUD are incidental and not guaranteed for any specific amount; therefore, they are not projected.
4. Total does not reflect amount of water incidentally transferred out of supply to EBMUD.

Comparing supply and demand as presented in Table 1-9 highlights the decreased future margin of confidence that AWA will be able to provide its future customers. Projects within the IRWMP will help to increase that margin to better accommodate current and future water demands (AWA, 2016).

Table 1-9: Historical and Projected Supply and Demand Comparison

	2010	2015	2020	2025	2030	2035	2040
Water Supply[1]	16,446	17,569	18,343	18,884	18,884	18,884	**18,884**
Water Demand[2]	8,407	9,052	10,601	11,699	12,257	12,708	**13,159**
Difference	**8,039**	**8,517**	**7,742**	**7,185**	**6,627**	**6,176**	**5,725**

Footnotes:
1. Water supplies as shown in Table 1-8.
2. Water demands as shown in Table 1-7.

Calaveras County

Since the 1990s and until the economic downturn in the late 2000s, Calaveras County exhibited one of the fastest growing populations in the State. From 1990 to 2000 the County's population increased by 12.4 percent and then further increased by another 12.4 percent between 2000 and 2010. However, population growth has slowed and the total population of Calaveras County has stayed constant from 2000 through 2018 (State of California, 2018). Adjacent areas in San Joaquin Valley are preparing plans to deal with a population of over one million people, and spillover population effects may occur in Calaveras County.

Calaveras County boundaries overlap three separate watersheds. Only the Calaveras River watershed is currently included in the MAC region. In the future, the region definition may be modified to include specific rapidly expanding water systems outside of the current southern boundary of the region. This section will be updated with quantity and demand for these systems as the regional definition is expanded.

CCWD

CCWD is the primary water service provider to Calaveras County. CCWD is participating in the IRWMP with the goal of enhancing its ability to efficiently use supplies among all of its service areas and conjunctively use its surface and groundwater supplies. CCWD faces challenges associated with rapid development, growth in agricultural development, failing groundwater supplies, and annexation of small water supply systems. The projects anticipated under the IRWMP would protect and promote the health and welfare of Calaveras County residents by improving CCWD's ability to protect against localized drought, regulatory uncertainty, infrastructure limitations and other localized system issues.

CCWD provides water service to nearly 17,000 municipal and residential/commercial customer connections through five independent water systems located throughout the County. CCWD's boundaries align with Calaveras County's boundary, but CCWD does not provide water and/or wastewater services to all communities in the county, as some are served by private wells or other public or private agencies. CCWD services municipal, residential, and commercial customers from the following sources to the following six independent water systems within Calaveras County:

- Jenny Lind – Calaveras River
- Sheep Ranch – Calaveras River
- West Point/Wilseyville – Mokelumne River
- Wallace – Groundwater
- Copper Cove/Copperopolis – Stanislaus River
- Ebbetts Pass – Stanislaus River

These service areas are geographically distinct and do not currently interact or connect with one another. In the past, decisions were made to keep the water systems local. Regional systems may become more attractive due to the potential for economies of scale and system redundancy. However, since the water systems currently remain local, no redundancy is in place to protect individual water systems, should their

water supplies be unavailable. Regional projects proposed in this IRWMP may improve interconnectivity of the existing water systems, improving reliability of all systems. Of the five service areas, the Jenny Lind, West Point/Wilseyville, Sheep Ranch, and Wallace systems are within the MAC Region.

CCWD service areas include primarily domestic and light commercial uses, with no major industry or large agricultural demands. Most of Calaveras County is rural, with many small communities. Some of these communities, particularly those on the western border, are rapidly urbanizing.

Surface water is the sole source of supply for five of CCWD's six systems. CCWD obtains its water supplies from three main watersheds that drain the western slope of the Sierra Nevada. The Stanislaus River watershed serves communities along the Highway 4 corridor (communities not within the MAC region). The Calaveras River watershed serves the Jenny Lind and Sheep Ranch service areas while the Mokelumne River watershed serves West Point/Wilseyville. Three of CCWD's systems incorporate recycled water to irrigate golf courses, and CCWD is seeking to expand its recycled water use to additional agricultural users and public activities where water is unavailable.

Groundwater is not a reliable source of supply in much of the County due to the small and unpredictable yields of the local fractured rock system. CCWD does supply a small amount of groundwater to customers in the Wallace service area. CCWD has adopted a Groundwater Management Plan (GWMP) to address a 30,000-acre alluvial area within the San Joaquin Valley Groundwater Basin, located in the Camanche/Valley Springs region in the northwest corner of Calaveras County (DWR Bulletin 118). The GWMP includes efforts to protect water supply reliability such as conjunctive use, groundwater recharge projects, as well as other measures. CCWD's water supplies and demands for the four water systems in the MAC region are included in Table 1-10.

Table 1-10: CCWD Current and Projected Supply and Demand, AFY

System	2015	2020	2025	2030	2035	2040
Calaveras River (Jenny Lind and Sheep Ranch)						
Supply						
Surface Water	8,437	31,665	31,665	31,665	31,665	31,665
Recycled Water	139	199	233	267	301	336
Total Supply	8,576	31,864	31,898	31,932	31,966	32,001
Demand						
Potable	1,517	2,320	2,435	2,526	2,599	2,644
Recycled	139	199	233	267	301	336
Raw	1,561	1,813	2,459	3,103	3748	4,391
Total Demand	3,217	4,332	5,127	5,896	6,648	7,371
Mokelumne River (West Point/Wilseyville)						
Supply	2,030	2,030	2,030	2,030	2,030	2030
Demand	141	207	217	224	231	237
Groundwater (Wallace)						
Supply	65	65	65	65	65	65
Demand	45	62	66	69	71	72

Source: CCWD, 2016.

Combined with projected growth and potential environmental demands, CCWD is examining cost-effective alternatives to maximize supply through increased storage to provide improved supply reliability. CCWD's water supplies are currently projected to be sufficient to meet demands for the two water systems within the region for a 20-year horizon. However, variability in supply availability and dependence on local, aging infrastructure have caused CCWD to plan for additional water supply, system redundancy, and upgraded infrastructure to avoid water shortages.

CPUD

Calaveras Public Utility District (CPUD) obtains its water at a diversion dam and pump station near the confluence of the Licking Fork and South Fork of the Mokelumne River. Water is pumped to Jeff Davis Reservoir and gravity-fed to a treatment plant, where it is then conveyed to storage tanks in the communities of Rail Road Flat, Mokelumne Hill, Paloma, and San Andreas. CPUD also derives a small amount of agricultural water from the Calaveras River. CPUD's boundaries cover 21,543 acres, including areas within and around the communities of Mokelumne Hill and San Andreas. CPUD's Sphere of Influence (SOI) is L-shaped, covering an area of approximately 64,553 acres. In 2017, CPUD's water sales were 1,542 AF, approximately 14 percent of its water rights. CPUD serves approximately 1,985 connections within the following customer classes: single-family residential (82 percent), multi-family residential (6 percent), commercial (12 percent), and agricultural (less than 1 percent).

CPUD's SOI may expand to encompass a total of 179,464 acres in future years. The areas proposed for inclusion in the SOI currently rely on groundwater sources, which vary dramatically in availability and quality. The need for water in the proposed CPUD SOI depends on multiple factors including: continued growth in the area, density of new development, desire to have high quality water, need for fire protection, and availability of grants and loans to fund expansion of the distribution system.

According to the *Calaveras County Mokelumne River Long Term Water Needs Study*, CPUD's water demand is expected to grow to 2,238 AFY by 2030, 3,332 AFY by 2070, and 4,491 AFY by 2100. CPUD's water rights from the Mokelumne River amount to 10,950 AFY, so available water rights should be sufficient to meet demands through 2100; however, this demand is greater than what CPUD's existing facilities can meet. CPUD has proposed piping some of their water from storage in Schaads Reservoir to supplement Jeff Davis Reservoir to increase its ability to meet future customer demand.

Alpine County

Alpine County has experienced relatively slow, steady population growth. Population ~~is expected to grow more quicklygrowth is more likely~~ in Bear Valley, Kirkwood, Markleeville, and Woodfords than in other parts of the county, in part due to the increased availability of public water and sewer services. In contrast, much of the county is served by on-site wells and septic systems.

Extra-Regional Demands

EBMUD is the primary user of Mokelumne River water outside the MAC Region. On an average annual basis, approximately 90 percent of the water used by EBMUD comes from the Mokelumne River watershed. The remaining water supply for EBMUD is made up of local surface water and Central Valley Project water. EBMUD has water rights that allow for delivery of up to 325 MGD from the Mokelumne River, subject to annual runoff and senior water rights of other users. EBMUD's position in the hierarchy of Mokelumne water users is established by a variety of agreements between Mokelumne water rights holders, the appropriative water rights permits and licenses which have been issued by the State, court decisions, pre-1914 rights, and riparian rights.

EBMUD's Mokelumne River supply facilities include Pardee Dam and Reservoir, located near Valley Springs, and Camanche Dam and Reservoir, located approximately 10 miles downstream. EBMUD diverts

supplies at Pardee Reservoir, conveying stored Mokelumne River supplies to its primary users in the East Bay portion of the San Francisco Bay Area via the Pardee Tunnel, Mokelumne Aqueducts, and Lafayette Aqueducts.

1.2.2. Water Quality Conditions

The MAC F~~IRWMP r~~egion obtains the majority of its supplies from the Mokelumne and Calaveras river watersheds. In Amador County, only 4 percent of the domestic or treated water supply is from groundwater sources, and 96 percent of supply is from the Mokelumne River. Calaveras County derives nearly all its water supply from surface water, as does the portion of Alpine County located with the MAC R~~IRWMP r~~egion.

Surface Water

Surface Water Supplies

The winter snow-pack in the Sierra Nevada serves as the primary source of water for the Mokelumne River. There are four water systems in Amador County that draw water from the Mokelumne River watershed. Currently, the Amador Water System and the Central Amador Water Project have yearly rights to use ~~Mokelumne River surface water allotments of~~ 15,000 AF and 1,150 AF of Mokelumne River surface water~~, respectively~~. The Lake Camanche Area and La Mel Heights service areas pump groundwater within the watershed. Currently, JVID has water rights up to 3,850 AFY from Pardee Reservoir for agricultural irrigation. JVID's permit includes provisions for the reversion of up to 2,200 AFY to upstream diverters within Amador County. In 1978, AWA obtained a reversion of 1,150 AFY for CAWP, leaving an additional potential reversion of 1,050 AFY. The reversion causes a subtraction from what JVID may divert and an addition to what AWA may divert so that there is not net increase in direct diversions from the Mokelumne River.

AWA has filed a water right application with the SWRCB requesting the reversion of the remaining 1,050 AFY, increasing the total potential CAWP water right to 2,200 AFY. JVID and AWA have agreed that the reversion would occur incrementally year-by-year based on projected annual increases in demand in the CAWP service area. AWA would thus not have access to the full additional 1,050 AFY upon approval of the water right but would notify ~~have to apply to~~ the SWRCB and JVID regarding how much of the 1,050 acre-feet of water it would need in the forthcoming year. The SWRCB would then subtract that amount from JVID's allocation and add it to AWA's allocation. ~~for an appropriate quantity every year, based on expected demand.~~ Additionally, CPUD pumps 1540-1930 AFY from the South Fork of the Mokelumne River. EBMUD has water rights and facilities to divert 325 MGD (approximately 364,072 AFY) from the Mokelumne River. CCWD uses Bear Creek water (a tributary of the Mokelumne River) as a primary source of water. The Mokelumne River serves as a backup source for the West Point, Wilseyville, and Bummerville water systems. The reliance on Mokelumne River both inside and outside of the MAC Region is summarized in Table 1-11.

Table 1-11: Water Systems' Reliance on the Mokelumne River

Water System	Reliance on Mokelumne River
Amador Water System	Up to 15,000 AFY from Mokelumne River
Central Amador Water Project	Up to 2,200 AFY from Mokelumne River[1]
JVID	Up to 2,800 AFY from Pardee Reservoir[1]
CPUD	Up to 10,950 AFY from of Mokelumne River
EBMUD	Up to 364,072 AFY from the Mokelumne River
CCWD	Uses Bear Creek, tributary to the Mokelumne River as primary source of water
West Point, Wilseyville, Bummerville	Relies on Mokelumne River as backup source

Footnotes:

1. CAWP and JVID water rights presented with the expectation of the full reversion of 1,050 AFY from JVID to CAWP

Communities in Calaveras County within the MAC Region also rely heavily on the Calaveras River as a source of water. Unlike the Mokelumne River, the Calaveras River depends almost totally on rainfall. River flows are controlled by New Hogan Dam and Reservoir, which is operated by Stockton East Water District (SEWD) and the U.S. Army Corps of Engineers. Both SEWD and CCWD have rights to the yield from New Hogan, with SEWD's supplies subject to reduction based on CCWD's future demands.

Surface Water Quality

The Mokelumne River provides high quality source water for most of the year. According to the 2015 AWA UWMP Update, the water may become somewhat turbid during storm events. Additionally, there are some potential water quality issues at specific locations in the MAC Region. Table 1-12 summarizes the impaired water bodies within the MAC Region listed on the State Water Resources Control Board 303(d) list. Known surface water impairment issues include copper in Bear River likely from the rock used to build Lower Bear River Dam and heavy metal contamination of Bear River, Camanche Reservoir, Lower Mokelumne River, Rattlesnake Creek, and Amador Lake likely resulting from historical mining activities. Although it is not included in the 303(d) impaired water body list, there is a fish advisory on Pardee Reservoir. There is no evidence of nitrate, arsenic, perchlorate, or hexavalent chromium contamination of surface water resources in the MAC Region.

Flooding

Flooding is a concern for many areas within the MAC IRWM planning region. Many cities and communities are included in 100-year floodplains (of both the Mokelumne River and its tributaries), including Sutter Creek, Jackson, Ione, and Mokelumne Hill. In some cases, like in the City of Plymouth, flooding is due to an inadequate storm drainage system that is unable to handle heavy storms during winter and spring seasons. The Calaveras County General Plan discusses three basic types of potential flood hazards: stream-side overbank flows, areas of flat terrain with slow surface drainage, and inundation due to structural dam failure. Flooding can occur from heavy rainfall, rapid snow melt, saturated soils, or a combination of these conditions. Also, increasing development leads to an increase in impervious surface areas and a decrease in natural vegetative cover, which reduces the detention and attenuation characteristics of the overland areas. Documented flooding in the past has caused the following general damages and impacts to areas within the region.

- Property Damage: Extensive water damage to building contents.

- Structural Damage: Structural damage to residential and commercial buildings, as well as sewer system pipes/infrastructure.
- Business/Economic Impact: Some businesses must close for a period of time after flooding.
- Road/School/Other Closures: Bridges routinely close during high-water periods and floods.
- Federal Emergency Management Act (FEMA) funds have been available after floods in the past to assist with recovery.

Groundwater

Groundwater quantity and quality in the MAC R~~IRWMP r~~egion varies considerably between well sites due to the small and unpredictable yields of the fractured rock system that typifies the foothill geology. Groundwater accounts for approximately four percent of AWA's total water supplies. It is only used in the communities of La Mel Heights and Lake Camanche Village. There are two wells in La Mel Heights which have safe yields of 50 and 56 AFY, respectively. In the Lake Camanche Village area, AWA operates 4 wells that have the capacity to pump approximately 1,500 AFY of water from the Cosumnes Subbasin portion of the San Joaquin Valley Groundwater Basin. Recent historical pumping from the Lake Camanche Village area has been between 190 and 290 AFY. The well locations overlying the Cosumnes Subbasin are shown in Figure 1-11.

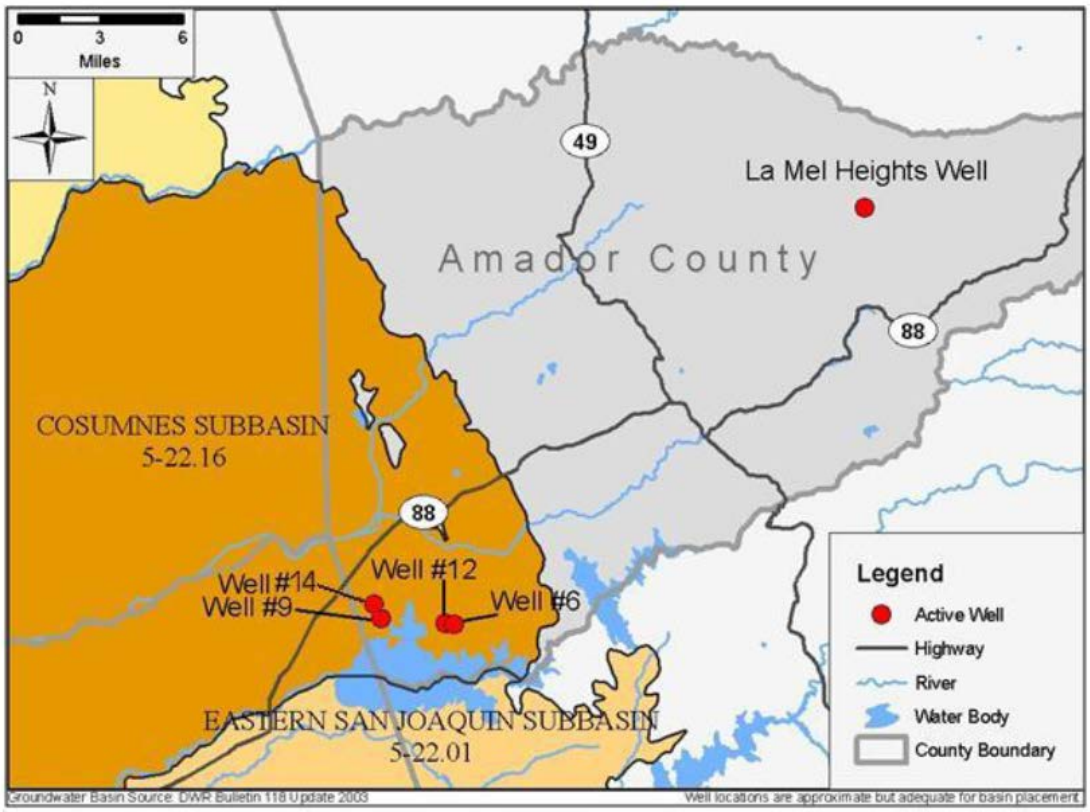
Table 1-12: Impaired Water Bodies within the MAC Region

Water Body	Pollutant	Potential Sources	Estimated Size Affected[1]
Bear Creek	Copper	Unknown	43 miles
	Pathogens	Unknown	
	Diazinon (Pesticide)	Agriculture	
	Low Dissolved Oxygen	Unknown	
Bear River	Copper	Unknown	5.4 miles
	Low pH	Unknown	8.4 miles
Lower Calaveras River	Mercury	Multiple	7.6 miles
	Pathogens	Urban Runoff/Storm Sewer	
	Chlorpyrifos (Pesticide)	Agriculture	
	Diazinon (Pesticide)	Agriculture	
	Organic Enrichment/Low Dissolved Oxygen	Unknown	
	Toxicity	Unknown	21 miles
Camanche Reservoir	Copper	Unknown	7,389 acres
	Zinc	Unknown	
	Mercury	Unknown	
Five Mile Slough (Alexandria Place to Fourteen Mile Slough)	Diazinon (Pesticide)	Urban Runoff/Storm Sewer	1.6 miles
	Chlorpyrifos (Pesticide)	Urban Runoff/Storm Sewer	
	Organic Enrichment/Low Dissolved Oxygen	Unknown	
	Pathogens	Unknown	
Lower Mokelumne River	Copper	Unknown	34 miles
	Zinc	Unknown	
	Dissolved Oxygen	Unknown	
	Chlorpyrifos (Pesticide)	Agriculture	
	Mercury	Multiple	
	Toxicity	Unknown	
Mosher Slough (upstream of I-5)	Pathogens	Unknown	3.5 miles
New Hogan Lake	Mercury	Unknown	3,180 acres
Rattlesnake Creek	Pathogens	Unknown	0.9 miles
Amador Lake	High pH	Unknown	299 acres
	Mercury	Unknown	

Source: 2014-2016 Clean Water Act Section 303(d) List of Impaired Waters, California Region 5.
Footnotes:

1. Affected Area may not be entirely within MAC Region.

Figure 12: Cosumnes Subbasin and AWA Wells in Lake Camanche Village



The Cosumnes Subbasin is approximately 439 square miles in size and is bounded on the north and west by the Cosumnes River, on the east by the bedrock of the Sierra Nevada, and on the south by the Mokelumne River. The groundwater level has paralleled the available surface water supply over the past 25 years. Table 1-13 summarizes the rise and fall of groundwater levels.

Table 1-13: Historic Groundwater Levels in Cosumnes Subbasin

Time Period	Change in Level	Change from Reference Level[1]
Mid-1960s	0	0
Mid-1960s - 1980	-20 to -30 feet	-20 to -30 feet
1980-1986	5 to 10 feet	-10 to -25 feet
1987-1992	-10 to -15 feet	-20 to -40 feet
1993-2000	15 to 20 feet	-5 to -20

Source: California's Groundwater Bulletin 118 Updated 2/06

Footnotes:

1. Reference level is taken to be the groundwater level during the mid-1960s.

As shown in Table 1-13, the groundwater levels in 2000 were approximately the same or slightly higher than those in the mid-1980s. The groundwater storage capacity is estimated to be about 6,000,000 AF with an average specific yield of 7.4 percent. Basin inflows are estimated to be about 269,500 AFY. Water leaves

the Subbasin through subsurface flow (144,600 AFY), urban extraction (35,000 AFY), and agricultural extraction (94,200 AFY). The Cosumnes Subbasin SGMA Working Group comprised of seven agencies is currently developing a roadmap for developing a Groundwater Sustainability Plan, which must be in place by 2022.

Groundwater makes up a small portion CCWD's water supply for the Camanche/Valley Springs area. Located in the northwestern portion of Calaveras County, the Camanche/Valley Springs area is part of the Eastern San Joaquin Subbasin, which is identified by DWR Bulletin 118 as being in the San Joaquin Valley Groundwater Basin. The Eastern San Joaquin Subbasin is approximately 1,105 square miles in size and is bounded on the south, southwest, and west by the Modesto, Delta-Mendota and Tracy Subbasins, respectively, and on the northwest and north by the Solano, South American, and Cosumnes Subbasins. The Solano and South American Subbasins are located in the Sacramento Valley Groundwater Basin. The Eastern San Joaquin Subbasin is drained by the San Joaquin, Stanislaus, Calaveras and Mokelumne Rivers. Based on a 1990 study by the U.S. Bureau of Reclamation, annual groundwater extractions total about 731,000 AFY, which exceeds the estimated safe yield of 618,000 AFY; hence the Subbasin was determined to be in a state of overdraft. The Eastern San Joaquin Subbasin is currently being managed under an AB3030 Groundwater Management Plan (GMP), prepared by the Northeastern San Joaquin County Groundwater Banking Authority. The Camanche/Valley Springs area is managed under a separate GMP, adopted by CCWD in 2001, for investigation of opportunities to improve management of groundwater resources in western Calaveras County. Recent CCWD groundwater pumping for the Camanche/Valley Springs area has been between 10 and 70 AFY. Like the Cosumnes Subbasin, stakeholders in the Eastern San Joaquin Subbasin are also collaborating on the development of a Groundwater Sustainability Plan to achieve equilibrium within the basin and meet the requirements of SGMA.

Imported Water

CCWD does not import water from outside the basin, but it has purchased water from CPUD in the past. During summer and fall months, water from the Middle Fork of the Mokelumne River stored in Schaad's Reservoir is supplied to the West Point area if the Bear Creek supply is inadequate. An agreement between CCWD and CPUD allows exchange of up to 150 AFY. AWA does not purchase water from other water suppliers or import water from another region.

Recycled Water

Several of the RPC members currently use recycled water to meet part of their water demands. The City of Ione operates a tertiary treatment facility, Castle Oaks Wastewater Reclamation Plant, which treats ARSA effluent from the City of Sutter Creek plant and produces a disinfected tertiary Title 22 effluent suitable for unrestricted reuse. The disinfected tertiary effluent is currently used to irrigate the Castle Oaks Golf Course. Additionally, a portion of the secondary effluent from the Sutter Creek Wastewater Treatment Plant conveyed to the ARSA outfall is delivered to the Bowers and Hoskins Ranches to irrigate land used for cattle grazing. The amount of water delivered to each plot is unknown, but it has been approximated using an irrigated pasture application rate of 2.5 AFY per acre of pasture. The recycled water use at these sites in not projected to increase due to the limited acreage of these sites.

CCWD also uses recycled water to meet demands in the Valley Springs area of the Jenny Lind Water System service area. In 2015, the La Contenta WWTP treated 147 AF of wastewater and provided 139 AF of recycled water. The treatment plant consists of extended aeration activated sludge, clarification, sand filtration, and disinfection to Title 22 tertiary standards. In 2008, CCWD added an ultraviolet (UV) system to replace chlorine for disinfection purposes. The treated effluent is stored and used for golf course irrigation at the La Contenta Golf Course.

Table 1-14 summarizes the current and projected recycled water uses in the MAC Region. The City of Plymouth and Lake Camanche Village are each planning to implement recycled water projects in 2020 and 2025, respectively. The projected recycled water use for each of these projects is summarized in Table 1-14.

Table 1-14: Recycled Water Uses in the MAC Region, AFY

User Type	Treatment Level	2015	2020	2025	2030	2035	2040
Golf Course Irrigation (Castle Oaks)[1]	Tertiary	622	583	583	583	583	583
Bowers Ranch Irrigation[2]	Secondary	100	100	100	100	100	100
Hoskins Ranch Irrigation[3]	Secondary	150	150	150	150	150	150
Agricultural Irrigation[4]	Secondary, Disinfected - 23	0	140	140	140	140	140
Landscape Irrigation[5]	Tertiary	0	0	541	541	541	541
Golf Course Irrigation (La Contenta)[6]	Tertiary	139	199	233	267	301	336
TOTAL		1,011	1,172	1,747	1,781	1,815	1,850

Footnotes:

1. Source: AWA, 2016.
2. Approximate delivery from ARSA. Based on 40 acres of cow pasture and an Irrigated Pasture application rate of 2.5 AFY/acre.
3. Approximate delivery from ARSA. Based on 60 acres of cow pasture and an Irrigated Pasture application rate of 2.5 AFY/acre.
4. Source: AWA, 2016. Agricultural irrigation is from the implementation of the City of Plymouth's recycled water project.
5. Source: AWA, 2016. Landscape irrigation is from the implementation of the Lake Camanche Village Recycled Water Project.
6. Source: CCWD, 2016.

1.3. Climate Change

There is a general scientific consensus that global climate conditions are changing and will continue to change as a result of the continued build-up of greenhouse gases (GHGs) in the Earth's atmosphere. Changes in climate can affect municipal water supplies through modifications in the timing, amount, and form of precipitation, as well as water demands and the quality of surface runoff. These changes can affect all elements of water supply systems, from watersheds to reservoirs, conveyance systems, and treatment plants.

Planning for and adapting to anticipated changes in climate will be essential to ensuring water supply reliability for all users and to protecting sensitive infrastructure against more frequent and extreme precipitation and wildfire events. This Plan summarizes anticipated climate change impacts on the State of California and the MAC Region, evaluates the impacts of those changes on water resource management, assesses and prioritizes the vulnerabilities of regional infrastructure to anticipated climate change impacts, and provides recommended adaptation and mitigation strategies to address uncertainty and reduce GHG emissions. In addition, a plan for ongoing data collection to fill data gaps and monitor the frequency and magnitude of local hydrologic and atmospheric changes is provided.

1.3.1. Background

Research conducted by the DWR, the United States Bureau of Reclamation (USBR), the American Water Works Association (AWWA), and the Intergovernmental Panel on Climate Change (IPCC), among others, indicates that North America will likely experience increased land and water temperatures and greater climatic variability in this century. While the impacts of climate change will be experienced differently by different regions and watersheds, water supply systems that exhibit the following characteristics are most likely to be impacted by climate change:

- Depend on surface storage for water supply and flood control;
- Depend on late spring snowmelt;
- Are sensitive to climatic variability;
- Contain biological habitats that are sensitive to water temperatures, quality and runoff timing;
- Are located in arid parts of western North America;
- Are located near coastal areas.

Because the primary sources of water in the MAC Region are the Mokelumne and Calaveras River watersheds, which rely on snowmelt and rainfall from the Sierra Mountain Range, the water supply systems within the Region display many of these characteristics. However, predicting future climate conditions and potential impacts on water resources is not an exact science. Detailed analysis relies on assumptions about future carbon emissions and coarse disaggregation of data from global and regional climate models into regional weather patterns.

1.3.2. Statewide Observation and Projections

In 2005, Governor Arnold Schwarzenegger signed Executive Order S-3-05, ordering the State of California to assess the impacts of climate change on various sectors of the California economy, including the State's water supply. In response to the Governor's order, DWR, in collaboration with recognized industry and academic experts, prepared a report describing the progress made to incorporate climate change into water resources planning (DWR, 2006c). The report presented empirical evidence that the State's climate has indeed been changing over the course of the 20th century, and it documented a methodology for forecasting future climate conditions by downscaling information from general circulation models (GCMs) to assess potential climate change impacts on the State's water resources. DWR has continued to collaborate with industry and academic experts to publish updated research and guidance regarding anticipated climate change impacts on California's water resources. Of particular interest to water agencies around the state is *Perspectives and Guidance for Climate Change Analysis*, published by DWR in collaboration with the Climate Change Technical Advisory Group (CCTAG) in 2015. This document recommends 10 specific GCMs using two different emissions scenarios for California water managers to use when planning for climate change impacts on water resources. These 10 GCMs were selected because they are thought to adequately represent hydrologic conditions specific to California and they project a broad range of climate futures. The two selected emission scenarios, RCP (representative concentration pathway) 4.5 and RCP 8.5 project lower and higher projected future emissions, respectively. The RPC 4.5 projection shows a moderate increase in GHG emissions through 2040, and then a leveling-off or decrease in emissions. The RPC 8.5 projection shows increasing GHG emissions through 2100. These two emission scenarios were selected based on availability of data for most GCMs and because they are thought to be reasonable bounds for projected emissions over the next century. Table 1-15 lists the 10 DWR-recommended GCMs and summarizes their projected climate change impacts to temperature and precipitation to the region east of Sacramento, which includes the MAC Region.

Table 1-15: Change in Annual Temperature (°F) and Water Year Precipitation (in.) for Region East of Sacramento from Each of the 10 DWR-Recommended GCMs

	Change in Annual Temperature (°F) 2070-2099 minus 1961-1990		Change in Precipitation (in.) WY 2070-2099 minus WY 1961-1990	
Model Name	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
ACCESS-1.0	6.0	9.5	-1.5	-5.6
CCSM4	4.7	7.8	1.3	1.3
CESM1-BGC	4.1	7.8	3.4	10.8
CMCC-CMS	5.1	9.1	3.3	-0.2
CNRM-CM5	6.7	10.3	7.9	9.9
CanESM2	6.4	10.5	3.7	7.9
GFDL-CM3	6.8	10.1	-2.0	-4.5
HadGEM2-CC	6.4	11.1	-0.2	-1.8
HadGEM2-ES	6.9	10.9	-0.4	0.5
MIROC5	6.1	8.3	-3.8	-1.0

Source: DWR and CCTAG, 2015.
Footnotes:
GCM = global climate model, RCP = Representative Concentration Pathway, WY = water year
Red shading indicates model simulations that show relatively high warming; tan shading indicates simulations that show drying. For GCM background information and affiliated Research institutions, see the CMIP5 Coupled Model Intercomparison Project at http://cmip-pcmdi.llnl.gov/cmip5/availability.html.

These global emission scenarios and climate models can be downscaled to model climate change projections for areas as small as 6 km^2. Downscaling can occur dynamically or statistically. Dynamical downscaling includes running a high-resolution climate model for a specific region using observed data to create boundary conditions. Statistical downscaling consists of developing statistical relationships between local climatic variables, such as precipitation, with large-scale predictors, such as pressure fields, and then applying these statistical relationships to the large-scale predictors produced by GCMs. Once the climate data, specifically temperature and precipitation, have been downscaled to the region of interest, they can be applied to hydrologic models of that region to project shifts in regional hydrology under climate change. The data can either be used to perturb historical hydrology, resulting in shifts in magnitude and seasonal timing of streamflow but not in inter-annual variability, or the regional climate data can be used to generate new streamflow projections, which results in inter-annual streamflow patterns that differ from historical patterns. These projected hydrographs can be used to model water resource impacts. This process of translating global emissions scenarios and climate models to regional water resource impacts is summarized in Figure 1-12.

DWR published *California Climate Science and Data for Water Resources Management* in 2015 that summarizes anticipated temperature and precipitation changes predicted by the state-recommended GCMs under the RCP 4.5 and RCP 8.5 emission scenarios for the entire state as well as for 11 regions around California.

Figure 13: Summary of Climate Change Modeling

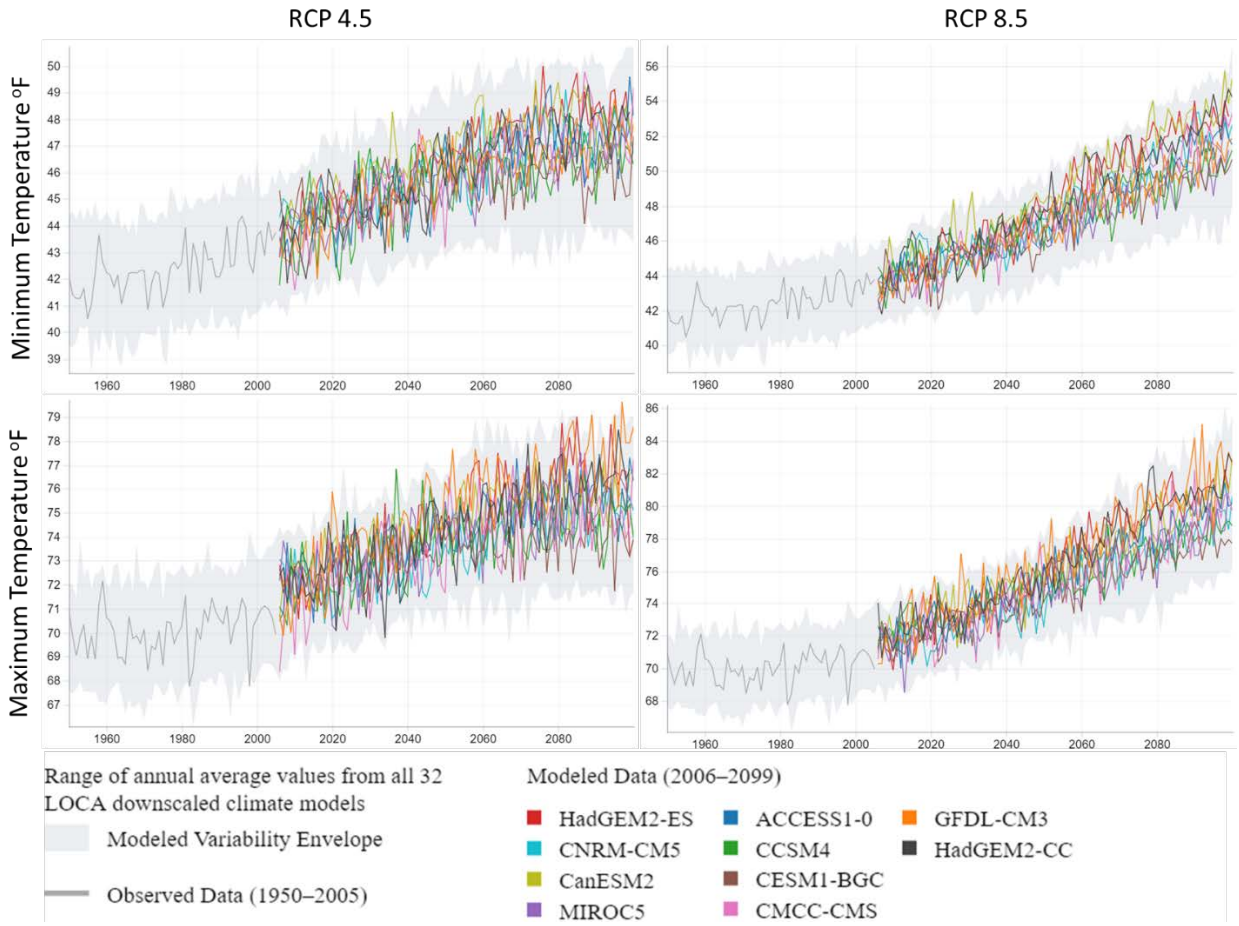
Temperature and Precipitation Changes

Predicting future climate conditions and the potential associated impacts on water resources relies on several key assumptions including future emissions of GHGs, GCM representation of the real climate system, and natural variability in climate and weather, so all climate projections include a significant level of uncertainty. While it is generally accepted that temperatures will increase in California over the next century, the rate of temperature rise and specific changes in regional precipitation patterns are less certain.

California's average temperature has increased by 1.1 to 2 °F in the last one hundred years, with maximum annual temperatures increasing 0.4 to 1.6 °F and minimum annual temperatures increasing 1.6 to 2.5 °F. Projections for California published by Scripps Institution of Oceanography indicate that by 2060-2069, mean temperatures will be 3.4 to 4.9 °F higher than there were from 1985-1994 (DWR, 2015). Under the moderate emissions scenario RCP 4.5, the average projection of the 10 GCMs recommended by DWR predict a statewide average annual maximum temperature increase of 5.1 °F and minimum temperature increase of 3.8 °F for the period from 2090-2099 as compared to the period from 1996 to 2005. The average projection for the high emissions scenario RCP 8.5 predicts an average annual maximum temperature increase of 9.3 °F and a minimum temperature increase of 8.2 °F across the state for the same period (CEC, 2018). These climate model projections are shown in Figure 1-13. Increases in temperature are not likely to be felt uniformly throughout the year and across California. Model projections generally project that winters will be colder and summers will be longer and hotter than under historical climate conditions. Additionally, inland areas are likely to experience more extreme warming than coastal areas (DWR, 2015). These non-uniform warming trends are among the reasons that regional approaches to addressing climate change are important.

Historical trends in precipitation do not show a statistically significant change in average precipitation in California over the last century. However, a key change in precipitation patterns has been more winter precipitation falling as rain instead of snow, leading to increased streamflow in the winter and decreased streamflow in the spring and summer, when water demands are the greatest (DWR, 2015). Additionally, recent drought years may indicate that California could face increasingly frequent and severe droughts even as precipitation and streamflow variability may lead to increased flooding.

Figure 14: California Temperature Projections Under Climate Change (California Energy Commission, 2018)



While temperature projections exhibit high degrees of agreement across various models and emissions scenarios, projected changes in precipitation are more varied. The wettest projection of the DWR-recommended GCMs predicts a 19 to 27% *increase* in statewide average annual precipitation for 2070-2099 as compared to the period from 1976-2005, while the driest projection predicts a 5 to 12% *decrease* in statewide average annual precipitation for the same period (California Energy Commission, 2018). Climate projections therefore imply an increase in the uncertainty of future precipitation conditions. While different models project varied increases and decreases in annual average precipitation, seasonal and inter-annual variability in precipitation is excepted to increase overall. Storms are expected to increase in severity, such that a greater percentage of annual precipitation is experienced in a smaller number of events. Longer, more intense dry periods are anticipated under warmer conditions in the future as are more intense rainfall events, leading to both increased risk of drought and increased risk of flooding. As with temperature projections, precipitation projections are not uniform across the state. Most GCM projections predict drier conditions in Southern California and wetter conditions in Northern California (DWR, 2015), further underscoring the need for regional approaches to address climate change vulnerabilities.

Sea Level Rise, Snowpack Reduction, and Extreme Events

In the last century, the California coast has seen a sea level rise of 7 inches (DWR, 2015). Sea level rise is expected to continue and accelerate as the climate warms due to land ice melting and draining more water

into the ocean and ocean warming which causes water expansion. By 2100, the sea level along the California coast is projected to rise by 0.5 to 6 inches compared to 2000 levels. Sea level rise along the California coast may be uneven, as regional factors including ocean and atmospheric circulation patterns, melting ice sheets, and tectonic plate movement may make the sea level rise greater south of Cape Mendocino than north of Cape Mendocino (DWR, 2015). Rising seas along the coast increase the risk of storm surge and flooding for coastal communities and habitats. Sea level rise will likely impact water resources through impacts to water infrastructure along the coast and in the San Francisco-San Joaquin Delta and through saltwater intrusion into groundwater and the Delta.

The average April 1st snowpack in the Sierra Nevada region has decreased in the last half century (Howat and Tulaczyk, 2005, CCSP, 2008). As the climate warms, snowpack in the Sierra Nevada (a primary storage mechanism for California's water supply) is anticipated to continue to shrink. By the end of the century, Sierra Nevada snowpack is projected to shrink by 48-65% from the 1961-1900 average (DWR, 2015) due to warmer temperatures causing faster snowmelt and more precipitation to fall as rain than snow. Increased spring runoff earlier in the year will impact areas across the state that rely on snowpack to store water supply until it is needed in the summer.

Finally, many extreme events are expected to become more frequent, including wildfires, floods, droughts, and heat waves. In contrast, freezing spells are expected to decrease in frequency over most of California (CNRA, 2009). The combination of drier and warmer weather compounds expected impacts on water supplies and ecosystems in the Southwestern United States and California with wildfires expected to continue to increase in frequency and severity (CCSP, 2009).

1.3.3. Legislative and Policy Context

In order to address currently-predicted climate change impacts to California's water resources, DWR's IRWM Program Guidelines require that IRWM Plans describe, consider, prioritize, and address the effects of climate change on their region, and consider reducing GHG emissions when developing and implementing projects. Part of this process involves framing the IRWM analysis and response actions in the context of State legislation and policies that have been formed to address climate change. The following summarizes the legislation and policies that were considered as part of this IRWM Plan.

Executive Order (EO) S-3-05 (2005)

EO S-3-05, signed on June 1, 2005 by Governor Arnold Schwarzenegger, is a key piece of legislation that has laid the foundation for California's climate change policy. This legislation recognized California's vulnerabilities to the impacts of climate change, including vulnerabilities of water resources. EO S-3-05 established three GHG reduction targets for California:

- By 2010, reduce GHG emissions to 2000 California levels
- By 2020, reduce GHG emissions to 1990 California levels
- By 2050, reduce GHG emissions to 80 percent below 1990 California levels

In addition to establishing GHG reduction targets for California, EO S-3-05 required the head Secretary of the California Environmental Protection Agency (CalEPA) to establish the Climate Action Team (CAT) for State agencies to coordinate oversight of efforts to meet these targets. As laid out in the EO, the CAT submits biannual reports to the governor and State legislature describing progress made toward reaching the targets.

There are currently 10 sub-groups within CAT, one of which is the Water-Energy group (also known as WET-CAT). WET-CAT was tasked with coordinating the study of GHG effects on California's water supply system, including the development of GHG mitigation strategies for energy consumption related to water

use. Since the adoption of the Assembly Bill 32 Scoping Plan (see the following section), WET-CAT has been working on the implementation and analyses of the following opportunities for greenhouse gas savings in the water sector:

1. Water Use Efficiency
2. Recycled Water
3. Water Systems Efficiency
4. Stormwater Reuse
5. Renewable Development

Assembly Bill 32: The California Global Warming Solutions Act of 2006 (2006)

Assembly Bill 32 (AB 32), the California Global Warming Solutions Act of 2006 laid the foundation for California's response to climate change. In 2006, AB 32 was signed by Governor Schwarzenegger to codify the mid-term GHG reduction target established in EO S-3-05 (reduce GHG emissions to 1990 levels by 2020). AB 32 directed the California Air Resources Board (CARB) to develop discrete early actions to reduce GHG emissions by 2007, and to adopt regulations to implement early action measures by January 1, 2010.

Climate Change Scoping Plan (2008) and First Update to Climate Change Scoping Plan (2014)

AB 32 required CARB to prepare a Scoping Plan to identify and achieve reductions in GHG emissions in California. The Climate Change Scoping Plan, adopted by CARB in December 2008, recommends specific strategies for different business sectors, including water management, to achieve the 2020 GHG emissions limit. The First Update to the Climate Change Scoping Plan builds upon the original Scoping Plan with new strategies and recommendations. The Scoping Plan will continue to be updated every five years.

Senate Bill 97 (2007)

Senate Bill 97 (SB 97) recognized the need to analyze greenhouse gas emissions as part of the CEQA process. SB 97 directed the Governor's Office of Planning and Research (OPR) to develop, and the Natural Resources Agency to adopt, amendments to the CEQA Guidelines to address the analysis and mitigation of greenhouse gas emissions. On December 31, 2009, the Natural Resources Agency adopted amendments to the CEQA Guidelines and sent them to the California Office of Administrative Law for approval and filing with the Secretary of State (http://www.ceres.ca.gov /ceqa/guidelines/). The CEQA Guidelines are not prescriptive; rather they encourage lead agencies to consider many factors in performing a CEQA analysis and maintain discretion with lead agencies to make their own determinations based on substantial evidence.

Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water (2008)

DWR, in collaboration with the State Water Resources Control Board (SWRCB), other state agencies, and numerous stakeholders, has initiated a number of projects to begin climate change adaptation planning for the water sector. In October 2008, DWR released the first state-level climate change adaptation strategy for water resources in the United States, and the first adaptation strategy for any sector in California. Entitled *Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water,* the report details how climate change is currently affecting the state's water supplies and sets forth ten adaptation strategies to help avoid or reduce climate change impacts to water resources.

Central to these adaptation efforts will be the full implementation of IRWM plans, which address regionally-appropriate management practices that incorporate climate change adaptation. These plans will evaluate and provide a comprehensive, economical, and sustainable water use strategy at the watershed level for California.

Executive Order S-13-08 (2008)

Given the potentially serious threat of sea level rise to California's water supply and coastal resources, and the subsequent impact it would have on our state's economy, population, and natural resources, Governor Schwarzenegger issued EO S-13-08 to enhance the state's management of climate impacts from sea level rise, increased temperatures, shifting precipitation, and extreme weather events. This order required the preparation of the first California Sea Level Rise Assessment Report (by the National Academy of Sciences) to inform the State as to how California should plan for future sea level rise; required all state agencies to consider a range of sea level rise scenarios for the years 2050 and 2100 in order to assess potential vulnerabilities of proposed projects and, to the extent feasible, reduce expected risks and increase resiliency to sea level rise; and required the Climate Action Team to develop a state strategies for climate adaptation, water adaptation, ocean and coastal resources adaptation, infrastructure adaptation, biodiversity adaptation, working landscapes adaptation, and public health adaptation.

California Climate Adaptation Strategy (2009)

In response to the passage of EO S-13-08, the Natural Resource Agency wrote the report entitled *2009 California Climate Adaptation Strategy* (CAS) to summarize the best known science on climate change impacts in the state, to assess vulnerability, and to outline possible solutions that can be implemented within and across the state agencies to promote climate change resilience. The document outlined a set of guiding principles that were used in developing the strategy, and resulted in the preparation of 12 key recommendations as follows:

1. Appoint a Climate Adaptation Advisory Panel (CAAP) to assess the greatest risks to California from climate change and to recommend strategies to reduce those risks, building on the Climate Change Adaptation Strategy.
2. Implement the 20x2020 water use reductions and expand surface and groundwater storage; implement efforts to fix Delta water supply, quality, and ecosystems; support agricultural water use efficiency; improve statewide water quality; improve Delta ecosystem conditions; and stabilize water supplies as developed in the Bay Delta Conservation Plan.
3. Consider project alternatives that avoid significant new development in areas that cannot be adequately protected from flooding, wildfire, and erosion due to climate change.
4. Prepare, as appropriate, agency-specific adaptation plans, guidance or criteria.
5. For all significant state projects, including infrastructure projects, consider the potential impacts of locating such projects in areas susceptible to hazards resulting from climate change.
6. The CAAP and other agencies will assess California's vulnerability to climate change, identify impacts to state assets, and promote climate adaptation/mitigation awareness through the Hazard Mitigation Web Portal and My Hazards Website, as well as other appropriate sites.
7. Identify key California land and aquatic habitats that could change significantly during this century due to climate change.
8. The California Department of Public Health will develop guidance for use by local health departments and other agencies to assess mitigation and adaptation strategies, which include impacts on vulnerable populations and communities, and assessment of cumulative health impacts.
9. Communities with General Plans and Local Coastal Plans should begin, when possible, to amend their plans to assess climate change impacts, identify areas most vulnerable to these impacts, and develop reasonable and rational risk reduction strategies using the CAS as guidance.
10. State fire-fighting agencies should begin immediately to include climate change impact information into fire program planning to inform future planning efforts.
11. State agencies should meet projected population growth and increased energy demand with greater energy conservation and an increased use of renewable energy.
12. New climate change impact research should be broadened and funded.

GHG Reporting Rule (2009)

On September 22, 2009, the U.S. Environmental Protection Agency (USEPA) released the Mandatory Reporting of Greenhouse Gases Rule (74FR56260, Reporting Rule) which requires reporting of GHG data and other relevant information from large sources and suppliers in the United States. Starting in 2010, facility owners that emit 25,000 metric tons of GHGs or more per year were required to submit to the USEPA an annual GHG emissions report with detailed calculations of facility GHG emissions. These activities dovetail with the AB 32 reporting requirements in California.

Senate Bill 375 (2008)

The Sustainable Communities and Climate Protection Act of 2008 (SB 375) was passed to enhance the State's ability to reach its AB 32 goals by promoting good planning with a goal of more sustainable communities. SB 375 required the CARB to develop regional greenhouse gas emission reduction targets for passenger vehicles and 2020 and 2035 GHG emission targets for each region covered by one of the State's 18 California's metropolitan planning organizations (MPOs). Each of the MPOs then prepare a sustainable communities' strategy that demonstrates how the region will meet its GHG reduction target through integrated land use, housing and transportation planning. Once adopted, these sustainable communities' strategies are incorporated into the region's federally enforceable regional transportation plan.

California Water Plan Update (2009 & 2013)

The *California Water Plan* (CWP) provides a collaborative planning framework for elected officials, agencies, tribes, water and resource managers, businesses, academia, stakeholders, and the public to develop findings and recommendations and make informed decisions for California's water future. The plan, updated every five years, presents the status and trends of California's water-dependent natural resources, water supplies, and agricultural, urban, and environmental water demands for a range of plausible future scenarios and evaluates different combinations of regional and statewide resource management strategies to reduce water demand, increase water supply, reduce flood risk, improve water quality, and enhance environmental and resource stewardship. In the 2009 update, the CWP provided statewide water balances for eight water years (1998 through 2005), demonstrating the state's water demand and supply variability. The updated plan built on the framework and resource management strategies outlined in the CWP Update 2005 promoting IRWM and improved statewide water and flood management systems. The CWP Update 2009 provided the following 13 objectives to help achieve the CWP goals:

1. Expand integrated regional water management
2. Use and reuse water more efficiently
3. Expand conjunctive management of multiple supplies
4. Protect surface water and groundwater quality
5. Expand environmental stewardship
6. Practice integrated flood management
7. Manage a sustainable California Delta
8. Prepare Prevention, Response and Recovery Plans
9. Reduce energy consumption of water systems and uses
10. Improve data and analysis for decision-making
11. Invest in new water technology
12. Improve tribal water and natural resources
13. Ensure equitable distribution of benefits

The plan acknowledges an uncertain future with respect to population, land use, irrigated crop area, environmental water, background water conservation, water demands and climate change variability. To address this, the CWP Update 2009 presents 27 resource management strategies to provide a range of

choices and building blocks to address future uncertainty. Finally, the *2009 CWP Update* provided regional reports that summarize regional settings and water conditions, provide regional water balance summaries, and describes regional water quality, flood management, and regional water and flood planning and management. The summaries also provide a summary of challenges facing each of the hydrologic regions and provided future scenarios for the region.

The CWP Update 2013 built on the vision of the 2009 Update by including the above objectives and adding four new goals:

14. Protect and enhance public access to the State's waterways, lakes, and beaches
15. Strengthen alignment of land use planning and integrated water management
16. Strengthen alignment of government processes and tools
17. Improve integrated water management finance strategy and investments

As in the 2009 Update, the 2013 Update considers annual water balances for the ten year period from 2001 through 2010 and re-confirmed earlier findings regarding the highly variable nature of the State's water supplies and demands. The 2013 Update also noted that urban water users are more adaptable to supply limitation than other users and that groundwater use increases in drier years when surface supplies decline. The 2013 formed the basis of DWR's 2015 California Climate Science and Data for Water Resources Management, which recommends specific GCMs for water resources planning within California and summarized current climate projections through the end of the century for 11 regions around California.

Climate Ready Utilities (2010)

In the fall of 2009, the USEPA convened a Climate Ready Water Utilities (CRWU) Working Group under the National Drinking Water Advisory Council (NDWAC). This working group prepared a report that documents 11 findings and 12 recommendations relating to the development of a program enabling water and wastewater utilities to prepare long-range plans that account for climate change impacts. The report, delivered to the USEPA in 2010, also included an adaptive response framework to guide climate-ready activities, and the identification of needed resources and possible incentives to support and encourage utility climate readiness. This report resulted in the preparation of the USEPA's Climate Ready Water Utilities Program and the development of tools and resources to support water and wastewater utilities in their planning. These tools and resources include:

- Climate Resilience Evaluation and Awareness Tool (CREAT): a software tool to assist utility owners and operators in understanding potential climate change impacts and in assessing the related risks to their utilities.
- Climate Ready Water Utilities Toolbox: a searchable toolbox that contains resources that support all states of the decision process, from basic climate science through integration of mitigation and adaptation into long-term planning.
- Adaptation Strategies Guide: an interactive guide to assist utilities in gaining a better understanding of what climate-related impacts they may face in their region and what adaptation strategies can be used to prepare their system for those impacts.
- Climate Ready Water Utilities and Climate Ready Estuaries: USEPA initiative working to coordinate their efforts and support climate change risk assessment and adaptation planning.

National Water Program 2012 Strategy: Response to Climate Change (2012) and EPA Office of Water Climate Change Adaptation Implementation Plan (2014)

The USEPA and released its *National Water Program 2012 Strategy: Response to Climate Change* to address climate change impacts on water resources and the USEPA's water programs. The report identifies core programmatic elements of the strategy in the form of programmatic visions, goals and strategic actions,

with each long-term vision (or outcome) documented with an identified set of goals that reflect the same long-term time frame as the vision and several strategic actions to be implemented in the next three to eight years to pursue the longer-term goals and visions. The report also includes ten guiding principles for implementing the strategy outlined in the vision, goals and strategic actions and recommendations for cross-cutting program support. The USEPA published *Implementation Plan* in 2014 to outline the actions planned to meet the vision and goals described in the *2012 Strategy*.

California Water Action Plan (2014) and Update (2016)

The California Water Action Plan and Update were released by Governor Brown's administration to provide a five-year roadmap for the state to move toward sustainable water management in the face of population growth and climate change. This Plan describes 10 actions to be undertaken by the state through collaboration with local and regional water entities:

1. Make conservation a California way of life
2. Increase regional self-reliance and integrated water management across all levels of government
3. Achieve the co-equal goals for the Delta
4. Protect and restore important ecosystems
5. Manage and prepare for dry periods
6. Expand water storage capacity and improve groundwater management
7. Provide safe water for all communities
8. Increase flood protection
9. Increase operational and regulatory efficiency
10. Identify sustainable and integrated financing opportunities

Adaption to and mitigation of climate change are addressed throughout the Plan. The Plan recognizes that climate change impacts include increased variability of water supply availability, threats to biodiversity, exacerbated flooding risk, more frequent and severe droughts, and snowpack reduction. The Plan encourages investment in projects that adapt to these threats and projects that mitigate them through the reduction of GHG emissions.

Executive Order B-30-15 (2015) and Senate Bill 32 (2016)

EO B-30-15 was signed April 29, 2015 by Governor Brown to establish a statewide GHG reduction target of 40 percent below 1990 levels by 2030. SB 32 was then signed by Governor Brown on Sept 8, 2016 to codify this goal. AB 197 directs the State Air Resources Board to adopt California is currently on track to meet or exceed the goal of reducing GHG emissions to 1990 levels by 2020 and the new target of a 40 percent reduction below 1990 levels by 2030 will make it possible to reach the state's ultimate goal of reducing emissions to 80 percent below 1990 levels by 2050. These targets are scientifically established to meet the goal of limiting global warming below 2 degrees Celsius, which is the threshold above which scientists estimate severe climate disruption.

Senate Bill 1425 (2016)

SB 1425 requires the Cal EPA to develop a registry for GHG emissions resulting from the water-energy nexus. This registry, created and maintained by the nonprofit organization The Climate Registry, may be used by water utilities to voluntarily enter in the GHG emissions information relating to the operation of their water systems in order to establish emission baselines in the water industry and track and reward transparency and reductions in emissions.

1.3.4. Regional Climate Change Projections and Impacts

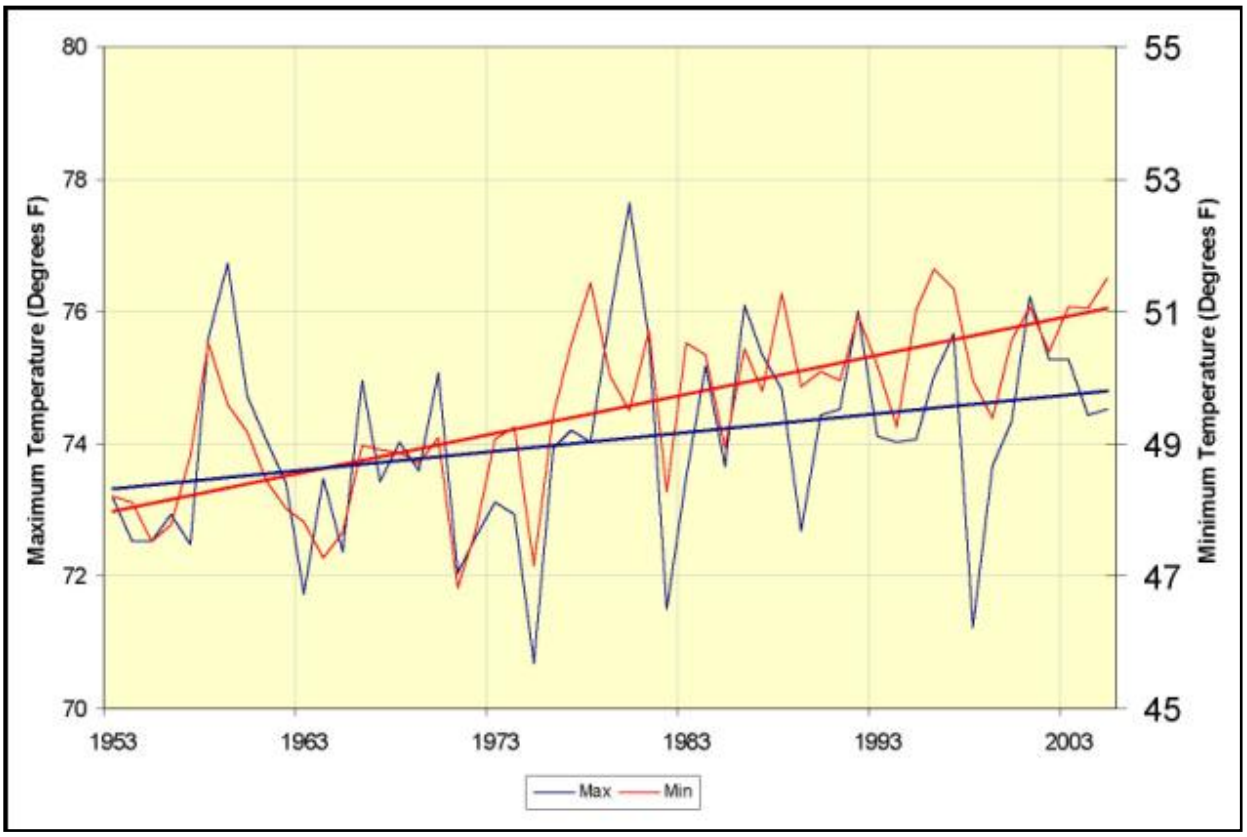
The regional climate change projections and impacts described herein are summarized from the following sources:

- Cal-Adapt GCM projections downscaled for the MAC Region. Climate projections for annual averages of maximum temperature, minimum temperature, and precipitation, snowpack, wildfire, and stream flow from the 10 DWR-recommended GCMs downscaled for the MAC Region are readily available from the Cal-Adapt website. Cal-Adapt is a visualization tool and data portal that draws from climate change data and research from the Scripps Institution of Oceanography at the University of San Diego; the University of Colorado, Boulder; the Geospatial Innovation Facility at the University of California, Berkeley; UW Hydro Computation Hydrology at the University of Washington; the University of California, Merced; and DWR. These projections reflect the most up-to-date climate data available for the MAC Region.
- EBMUD as part of the Water Supply Management Program (WSMP) 2040. Because the ~~Upper~~ upper Mokelumne River w~~W~~atershed is the primary source of EBMUD's water supply, the approach, methodology, and results focused on the ~~Upper~~ upper Mokelumne River w~~W~~atershed. Additionally, the WSMP focused on climate change impacts to the central portion of the Sierra Nevada. Given the breadth of GCM regionalization, anticipated climatic changes in temperatures and/or precipitation as modeled for the u~~U~~pper Mokelumne River w~~W~~atershed can also be considered applicable to the adjacent Calaveras River w~~W~~atershed and to the MAC Region as a whole. The climate change portion of the WSMP was completed in 2006, so it uses GCM and emission scenarios that are older versions of the models currently recommended by DWR. However, the trends and projections developed in the study are generally consistent with updated findings and the specificity of the WSMP to the u~~U~~pper Mokelumne River w~~W~~atershed still makes it a useful reference.
- AWA as part of the Long Term Needs and Water Supply Study (LTNS). Like the WSMP, the LTNS focuses on Amador County and the Mokelumne River w~~W~~atershed, but can be considered applicable to Calaveras County, Alpine County, the Calaveras River ~~Watershed~~watershed, and the MAC Region as a whole. The LTNS was completed in 2017 and uses three models selected from the 10 DWR-recommended GCMs to analyze climate change impacts on water supply and demand in Amador County.

Temperature Changes

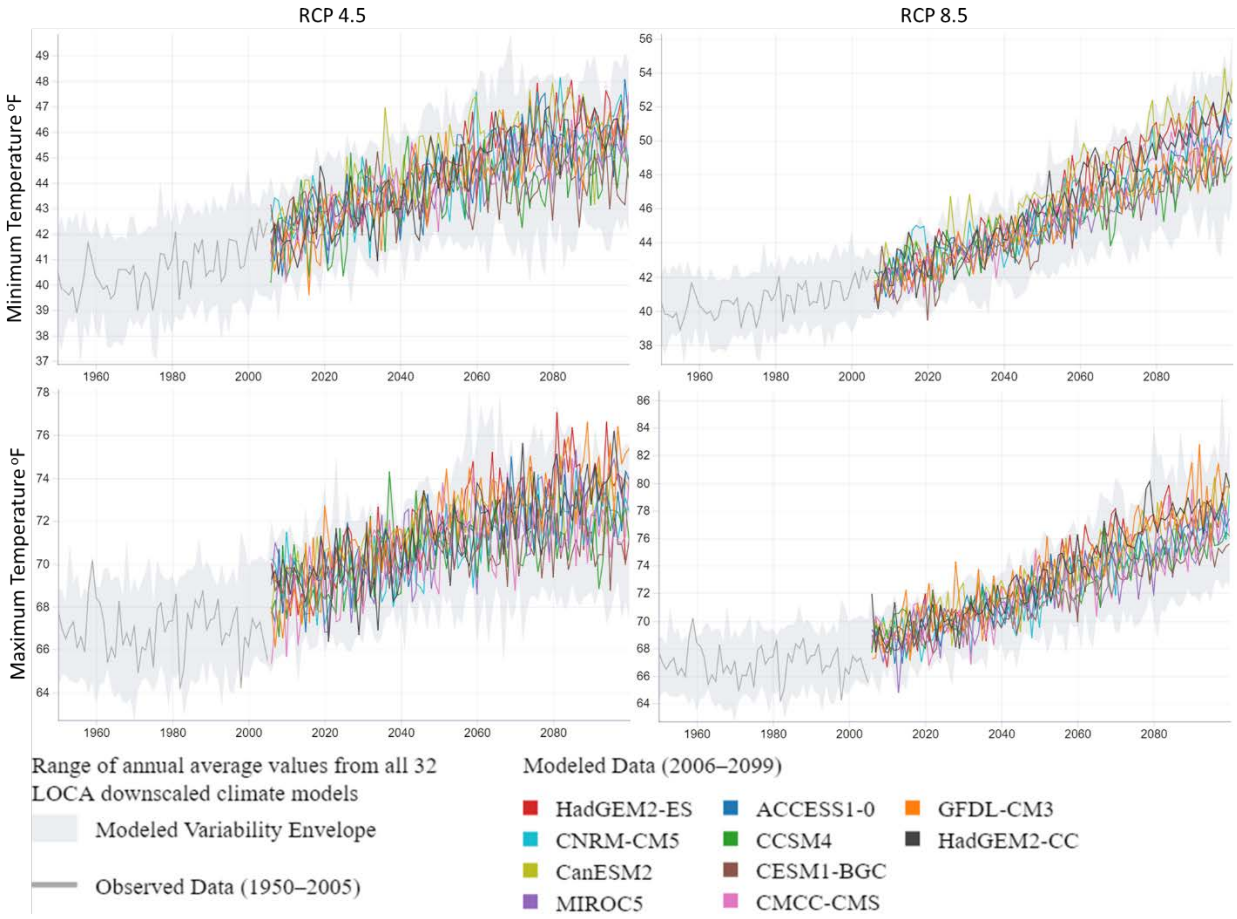
Climate change is expected to cause an increase in regional air temperatures in future years, likely leading to an increase in water temperature in the Mokelumne and Calaveras Rivers and watershed reservoirs. The effects of climate change have already been directly observed on the Mokelumne River watershed. Figure 1-14 shows maximum and minimum temperature at Camp Pardee, adjacent to Pardee Reservoir in Amador County (EBMUD, 2006). The data shown in this graph clearly depicts an upward trend in both minimum and maximum annual temperatures since 1950. Evidence of warming trends is also apparent in winter temperatures in the Sierra Nevada; an increase of almost 4 ^{o}F was observed during the second half of the 20th century.

Figure 15: Camp Pardee Average Annual Temperature



Under the moderate emissions scenario RCP 4.5, the average projection from the ten GCMs recommended by DWR predict an average annual maximum temperature increase in the MAC Region of 6.2 °F and minimum temperature increase of 3.9 °F for the period from 2090-2099 as compared to the period from 1996 to 2005. The average projection from the DWR-recommended GCMs under the high emissions scenario RCP 8.5 predicts an average annual maximum temperature increase of 10.5 °F and a minimum temperature increase of 8.2 °F in the MAC Region for the same period (California Energy Commission, 2018). These GCM projections are shown in Figure 1-15.

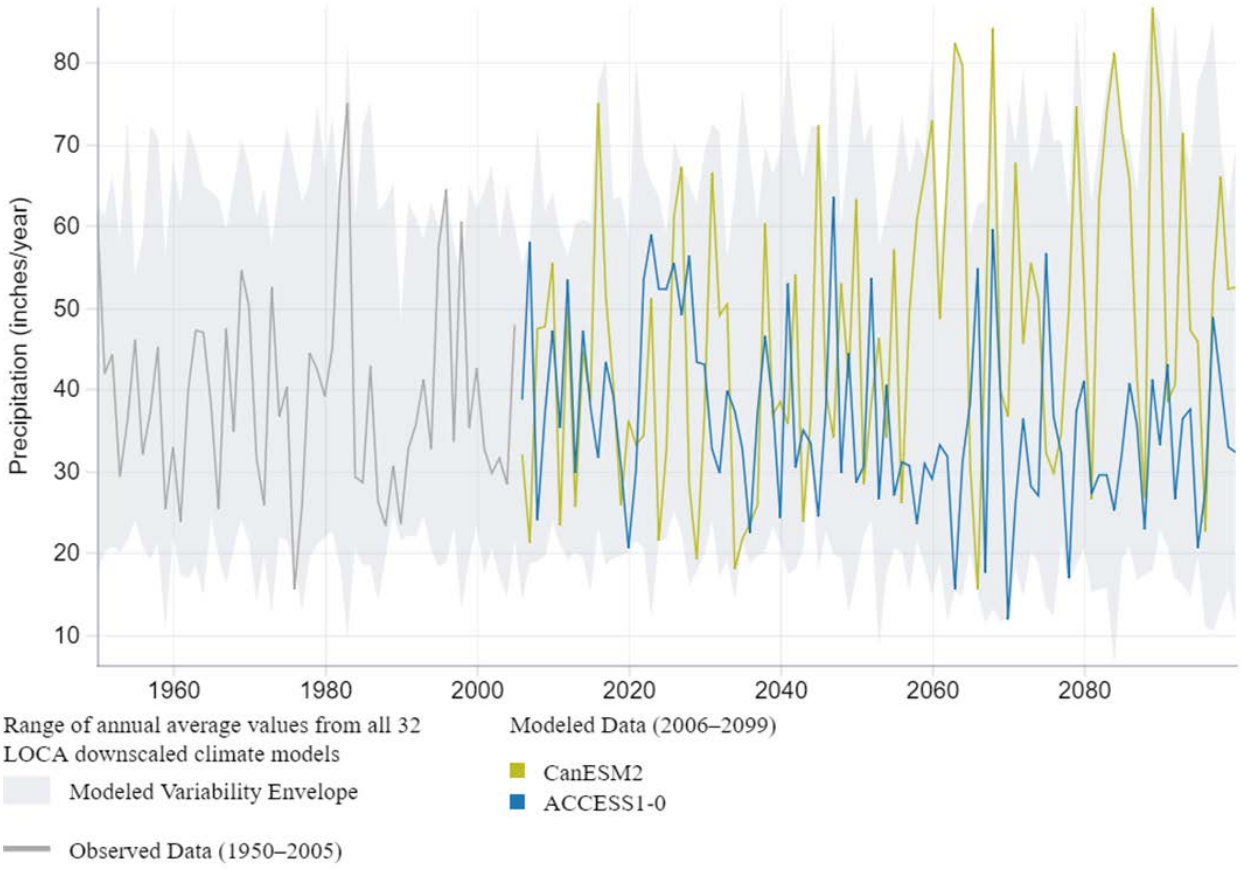
Figure 16: MAC Region Temperature Projections Under Climate Change (California Energy Commission, 2018)



Precipitation Changes

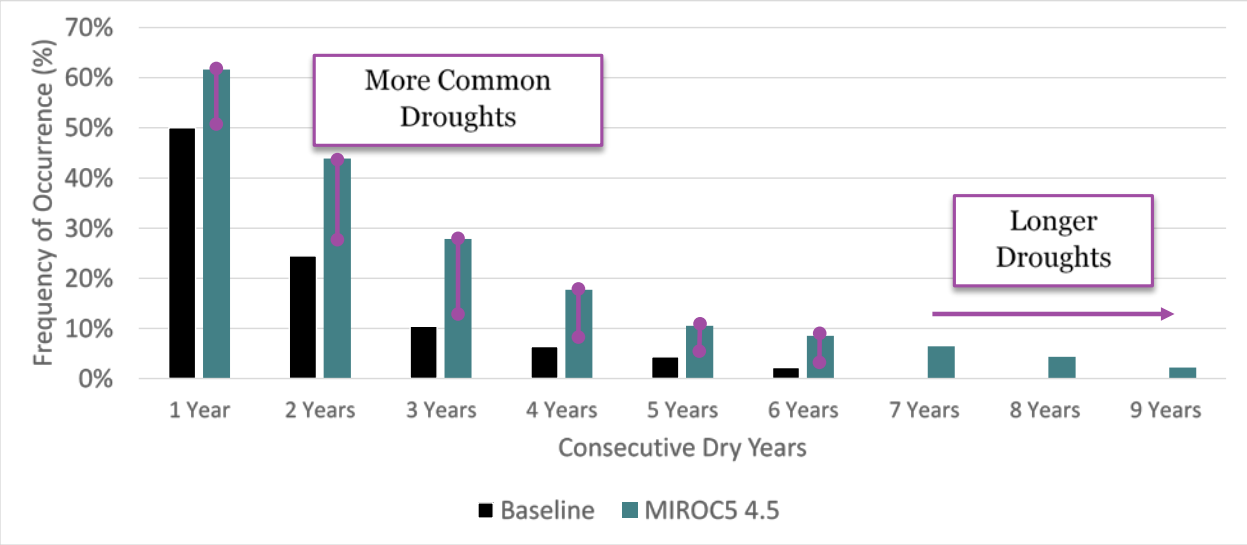
Similar to statewide projections, GCMs that have been downscaled to the MAC Region show a greater degree in variability for predicted changes in precipitation than for temperature. The wettest projection of the DWR-recommended GCMs predicts a 16 to 36% increase in average annual precipitation in the MAC Region for 2070-2099 as compared to the period from 1976-2005, while the driest projection predicts a 2 to 16% decrease in average annual precipitation in the MAC Region for the same period (California Energy Commission, 2018). The precipitation projections for the MAC Region for the wettest and driest GCMs under the RCP 8.5 emissions scenario are shown in Figure 1-16.

Figure 17: Wettest and Driest Precipitation Projections for MAC Region (California Energy Commission, 2018)



Historically, there have been several significant droughts of note in the MAC Region: 1929 to 1934, 1976 and 1977, 1987 to 1992, and 2012-2015. Droughts like these may become more frequent as precipitation patterns shift under climate change. Although GCMs predict different increases and decreases in precipitation in the future, they typically show increased inter-annual variability. Higher variability means that wet years may be more wet, dry years may be more dry, and the distribution of wet and dry years is likely to change. While some GCMs that predict an overall increase in precipitation over historical levels also predict shorter and less frequent drought, some models that predict approximately the same average level of precipitation or less precipitation than historical levels predict droughts that are more frequent and severe. Figure 1-17 shows the results of a drought projection analysis from the AWA LTNS that indicates that a warm-dry GCM predicts more frequent droughts (defined as consecutive years below historical median precipitation) of every length and significantly longer droughts than seen in the past for Amador County.

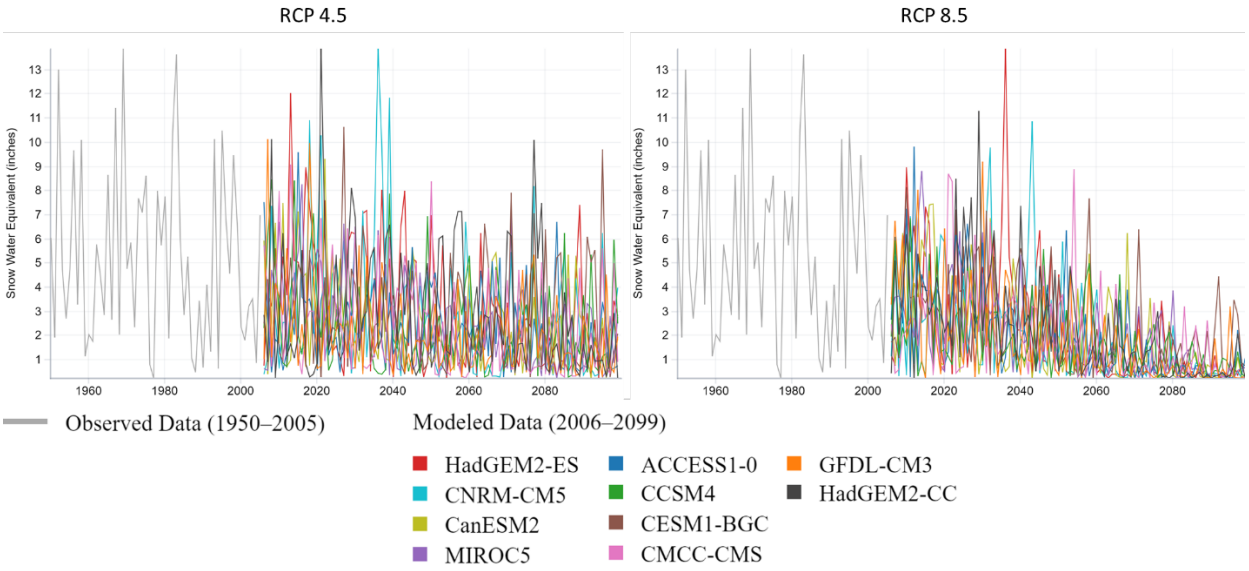
Figure 18: Projected Frequency of Consecutive Years Below Historical Median Precipitation (AWA, 2017)



Snowpack

Spring snowpack, as measured by snow water equivalent (SWE), has been declining in the MAC Region since 1950. This decline is expected to continue and accelerate under all climate scenarios as temperatures rise, melting snow earlier and causing more precipitation to fall as rain rather than snow. Under a high-emission, high-warming scenario, the *Fourth National Climate Assessment* projects that the Sierra Nevada mountains could experience a 22% reduction in winter snow-water equivalent by 2050 and an 89% reduction by 2100 (USGCRP. 2017). For the 10 DWR-recommended GCMs, the average projection under the lower-emission RCP 4.5 scenario is a decrease in spring SWE of 51% in the period from 2070-2099 as compared to 1976-2005 in the MAC Region, while the average projection under the higher-emission RCP 8.5 scenario is a decrease in spring SWE of 85% for the same period (California Energy Commission, 2018). This significant decline under both emission scenarios for all 10 DWR-recommended GCMs is shown in Figure 1-18.

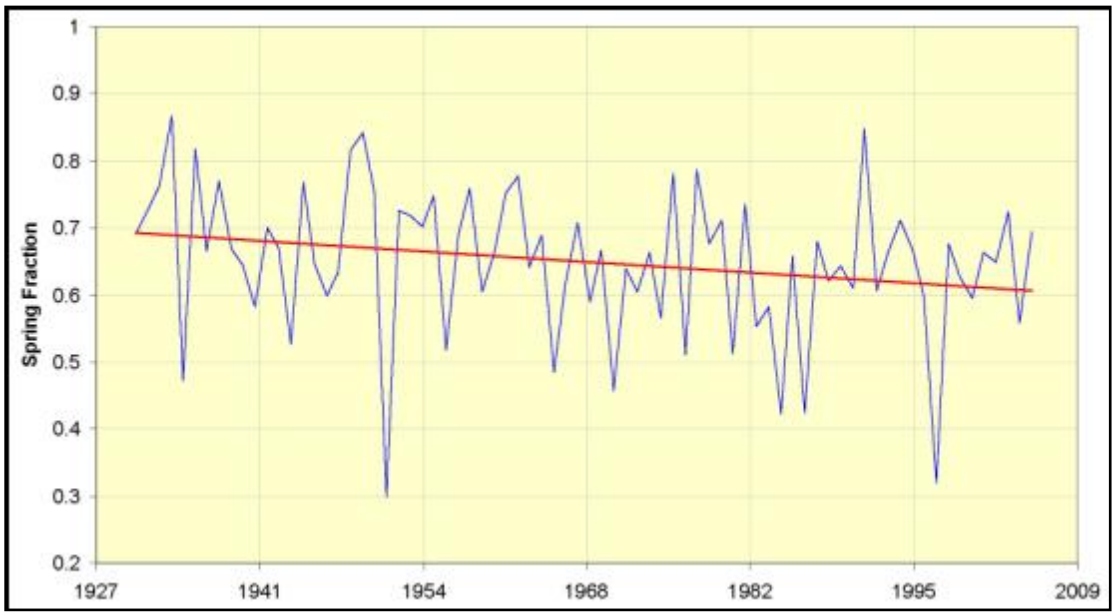
Figure 19: Snow Water Equivalent Projections for MAC Region (California Energy Commission, 2018)



Stream Flow

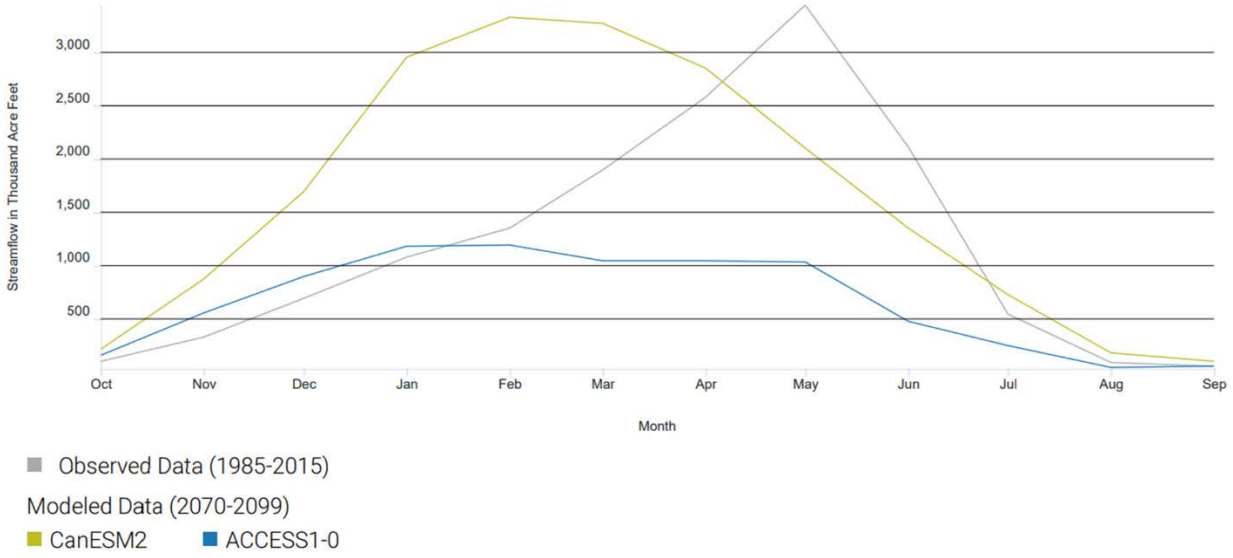
As described above, warming temperatures under climate change will cause more precipitation to fall as rain than snow and will cause snow to melt earlier in the year, causing a shift in runoff and streamflow patterns regardless of absolute precipitation increases or decreases. Peak streamflow is projected to shift earlier in the year than historical flows. This projected future trend appears to correspond with observed data, as shown in Figure 1-19, which shows the April to July Mokelumne River flows as a fraction of a water year. In this figure, there is a downward trend in the fraction of river flows occurring during the spring runoff period (EBMUD, 2006); similar responses would be expected in the Calaveras River. As winter and early spring flows increase as precipitation shifts from snowfall to rainfall, summer and autumn flows during wet years will be relatively drier as a result of flashier storms that do not replenish soil moisture from snowmelt.

Figure 20: April – July Flow as Fraction of Water Year – Mokelumne River



Modeled unimpaired flows on the Mokelumne River at Pardee Reservoir under the RCP 4.5 emissions scenario project a slight shift in peak streamflow from May to April, while the GCMs under the RCP 8.5 emissions scenario project a dramatic shift in peak flow from May to February by the end of the century. Figure 1-20 shows this shift in streamflow under the wettest and the driest of the 10 DWR-recommended GCMs under RCP 8.5. Streamflow on the Mokelumne under the wettest climate change scenario may increase by as much as 124% for the period from 2070-2099 compared to the period from 1986-2015, or it may decrease by approximately 24% under the driest climate change scenario for the same period (California Energy Commission, 2018). Regardless of streamflow increase or decrease, the shift in peak streamflow timing will impact water management and reservoir operation throughout the MAC Region.

Figure 21: Projected Monthly Average Streamflow on the Mokelumne River at Pardee Reservoir Under Climate Change and Observed Data (California Energy Commission, 2018)



Wildfire

Wildfire is a serious threat throughout California and in the MAC Region. Among the many destructive effects of wildfire are water resources impacts including flooding within the burn and downstream areas as well as water quality impacts due to increased sediment flow from burn areas. The risk of wildfire is generally predicted to increase under climate change as summers get longer, hotter, and drier. A wildfire model developed at the University of California Merced uses statistical relationships between historical climate, vegetation, population density, and fire history data to project annual average of area burned under four of the 10 DWR-recommended climate models. Under the RCP 4.5 emission scenario, the annual average area burned in the MAC Region is expected to increase by 37-68 percent by the end of the century, while GCMs using the RCP 8.5 emission scenario project an increase in annual average area burned of 80-151 percent (California Energy Commission, 2018).

1.3.5. Regional Water Resource Vulnerability

Primary water users in the MAC Region include agriculture, the environment, and urban users. Water supplies are derived from groundwater, surface water, and some recycled water, with surface water from the Mokelumne and Calaveras Rivers providing the majority of water supply in the Region. Groundwater is used in some areas of the MAC region, but quantity and quality vary considerably due to small and unpredictable yields from the fractured rock system and limited alluvial basins that typify the underlying geology. Groundwater accounts for approximately four percent of AWA's total water supply and is only used in the communities of La Mel Heights and Lake Camanche Village. Wells serving Lake Camanche Village are located within the Cosumnes Subbasin of the San Joaquin Valley Groundwater Basin. A portion of western Calaveras County overlies the Eastern San Joaquin Subbasin (also of the San Joaquin Valley Groundwater Basin), which is overdrafted due to extraction of groundwater for irrigation and municipal purposes exceeding the basin's safe yield.

Declining Sierra Nevada snowpack, earlier springtime runoff, and reduced spring and summer streamflows will likely affect the availability and quality of surface water supplies and may potentially shift reliance to groundwater resources, which are already of limited quantity and quality in many places.

Other anticipated regional impacts resulting from climate change (increased air temperatures and variable precipitation) include changes to water quality; increased flooding, wildfires and heat waves, and impacts to ecosystem health. Earlier springtime runoff will increase the risk of winter flooding as capturing earlier runoff to compensate for future reductions in snowpack would take up a large fraction of the available flood protection space, forcing a choice between winter flood prevention and maintaining water storage for use during dry periods in summer and fall.

The identified vulnerabilities within the MAC Region are summarized in Table 1-16 and further described in the following sections. These vulnerabilities have been informed by vulnerability assessment included in the *Climate Change Handbook for Regional Water Planning* (USEPA, 2011), which has been completed for the MAC Region and is included in Appendix C.

Table 1-16: MAC Region Vulnerabilities

Vulnerability	Description
Water Demand	Vulnerable to increased agricultural demands due to longer growing season, increased temperatures and evapotranspiration rates, and more frequent/severe droughts. Vulnerable to increased urban and commercial, industrial and institutional (CII) demand due to increased outside temperatures. Vulnerable to increases in all demands due to more frequent and severe droughts.
Water Supply	Water supply *availability* is vulnerable to streamflow and storage decreases due to decreases in precipitation and more frequent and severe droughts. Water supply *reliability* is vulnerable to shifts in timing of seasonal runoff and to increased intensity and variability of precipitation patterns.
Water Quality	Vulnerable to degraded surface and groundwater quality resulting from lower flows and increased overdraft conditions, a reduction of meadows that can provide contaminant reduction, more frequent/severe droughts and storm events increasing runoff attenuation and turbidity in surface supplies.
Flood Management	Vulnerable to more severe, flashy storm events and earlier springtime runoff leading to increased flooding, and a reduction of meadows which help reduce floods in the winter.
Hydropower	Vulnerable to increased customer demand combined with changes in timing of seasonal runoff and flashier storm systems affecting reservoir storage.
Ecosystem and Habitat	Vulnerable to decreased snowpack, more frequent/severe droughts and wildfires, shift in seasonal runoff, increased low flow periods and increased water temperatures (degraded water quality).

Water Demand

In addition to urban uses, water use in the MAC Region is dominated by forestry and agricultural uses, including grazing, wine grapes, and timber harvesting. In general, agricultural water demand varies based on precipitation and temperature, and will likely see a total increase under future climate change conditions

due to temperature increases, even if precipitation increases and decreases are uncertain. Fruit and nut crops, such as the wine grapes and walnuts that make up a large portion of the agricultural industry in the MAC Region, are particularly climate sensitive. The effects of increased air temperatures on agriculture will include faster plant development, longer growing seasons, changes to reference evapotranspiration and possible heat stress for some crops. Additionally, rising temperatures are projected to increase the frequency of heat waves, which could also lead to increased water use, further exacerbating low flow conditions (Hayhoe et al., 2004). Without accounting for evapotranspiration rates, agricultural crop and urban outdoor demands are expected to increase in the Sacramento Valley (located on the western edge of the MAC Region) by as much as six percent in the future (Chung et al., 2009). The agricultural community may respond to these climate-induced changes primarily by increasing the acreage of land fallowing and retirement, augmenting crop water requirements by groundwater pumping, improving irrigation efficiency, and shifting to high-value and salt-tolerant crops (Hopmans et al., 2008).

As these changes to the agricultural community occur and water use becomes more efficient, demand will likely harden and it may become difficult to conserve further if needed. Additionally, increased seasonal variability in demand due to increased agricultural demands during the spring and summer growing season will impact water system operation and management and may require upgrades or changes to infrastructure. Other seasonal water uses, such as landscape irrigation and industrial cooling, will also likely increase with increased temperatures due to climate change and will further exacerbate seasonal demand variability.

The inter-annual variability of water demands is projected to increase with climate change as droughts become more common and more severe. As with seasonal variability, drought will primarily increase irrigation and cooling demands. Although future total levels of precipitation are uncertain, if total precipitation decreases as predicted by some models, total demand in the region may increase by up to 13 percent (AWA, 2017). The AWA LTNS climate change analysis also projected an increase in total demand on AWA's system of three percent for the warm-wet climate scenario that was evaluated in the study, as increased temperatures may increase demand more than increased precipitation may decrease demand.

Water Supply

The primary source of water in the MAC Region is surface water from the Mokelumne and Calaveras Rivers. Sierra Nevada snowpack serves as the primary source of water for the Mokelumne River while the primary source of supply to the Calaveras River is rainfall. Reduced snowpack, variations in precipitation, and the shift in the timing of spring snowmelt have the potential to significantly impact surface water supplies from both rivers.

A small portion of the water supply in the MAC Region is from groundwater from the Eastern San Joaquin and Cosumnes groundwater subbasins. Although climate change will likely impact groundwater supplies around California, impacts within the MAC Region are not likely to be severe since water users in the region are more reliant on surface water supplies.

Water Supply Availability

Although some GCMs predict higher or lower total precipitation in the future due to climate change, there is a general consensus among the models selected by DWR as representative of California's hydrology that precipitation will become more variable and droughts are likely to become more frequent and severe. This will impact water supply availability, or the total volume of water available for use, in the MAC Region.

MOCASIM modeling completed for the Mokelumne River projects a decrease in unallocated water below Camanche Dam from an average of 253,500 AFY in 2010 to an average of 230,000 AFY in 2040 due to climate change impacts (UMRWA, ESJGBA, and RMC 2015). Impacts to storage (measured at Pardee

Reservoir) are expected to be moderately susceptible to shifts in early springtime runoff and increased customer demands, and very susceptible to decreases in annual runoff volumes. Shifts in springtime runoff on the Mokelumne River could result in an approximate 5 percent decrease in effective system storage. Additionally, decreasing Mokelumne River runoff by 10 and 20 percent could result in average decreases in effective system storage of 12 and 24 percent. This potential projected decrease in available water from the Mokelumne River is an important vulnerability for local water agencies and other water users as they must meet rising future demands.

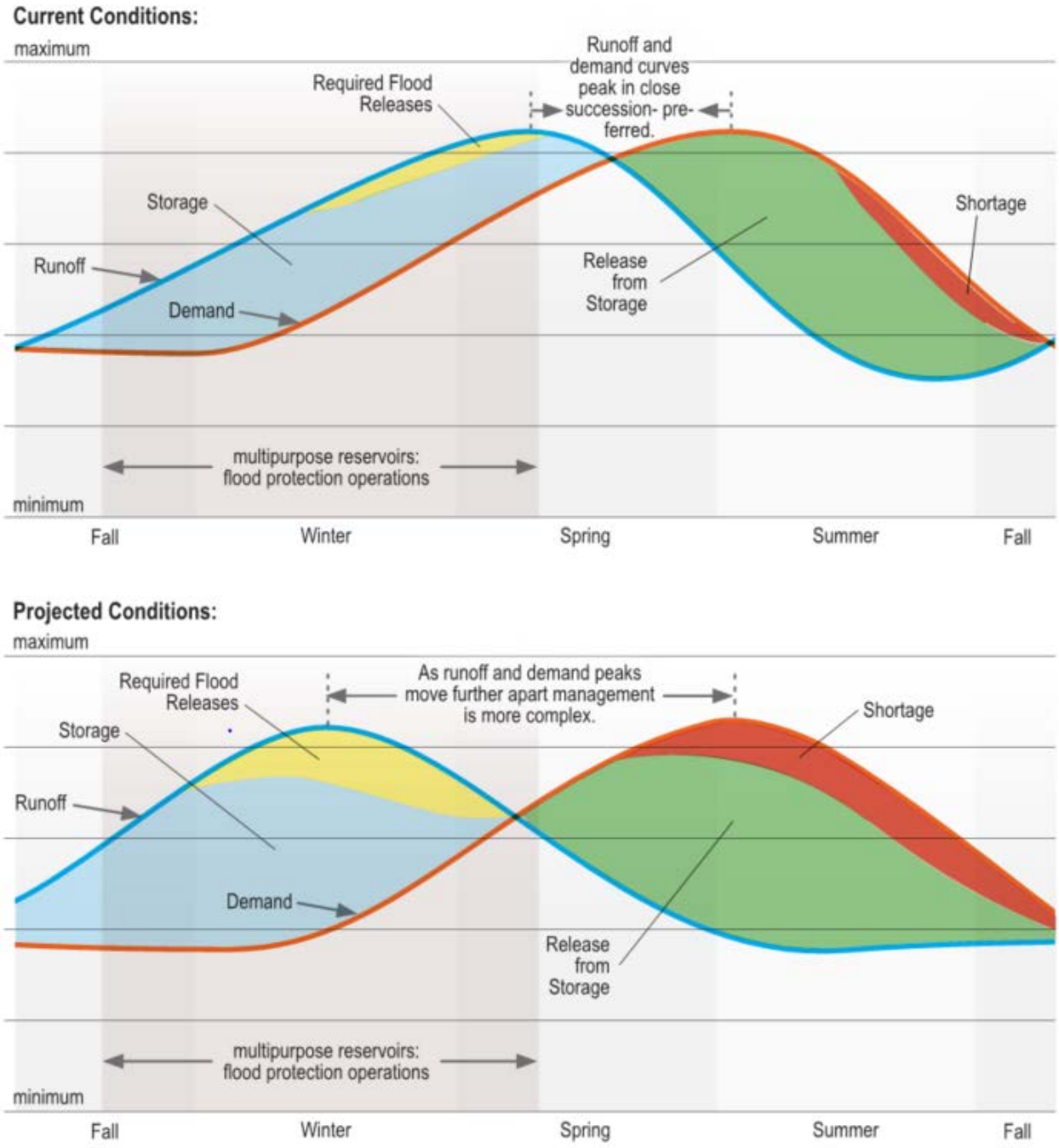
Water Supply Reliability

Since increased temperatures due to climate change are anticipated to decrease snowpack and impact streamflow patterns, Mokelumne River flows are likely to become less predictable and thus, reliable. Water supply reliability is defined in this section as year to year consistency in water supply that allows water users to rely on the Mokelumne River as a water supply source when they need it. Since more precipitation will fall as rain and snow will melt more quickly and earlier in the year, peak streamflow is projected to shift from late spring and summer to late winter and spring. Projections show that 38 to 58 percent of streamflow could shift from the current peak flow months of April-July to occur from December-March (AWA, 2017 and see Streamflow section above). For the Mokelumne River watershed, a 38 percent shift in spring/summer runoff to winter/spring would be equivalent to releasing approximately 173,000 AF of water from storage in the upper watershed in winter, which would significantly impact current water management practices. Much of this excess winter runoff would be unusable unless it can be stored until the high-demand summer months. Figure 1-21 shows how increasing the time between peak streamflow and peak demand as expected under climate change conditions increases the risk of water shortage and increases water management complexity.

Changes in water availability and timing may also affect the value of water rights statewide as mid- and late-season natural stream flow become more variable (and therefore less valuable) and the value of rights to stored water (which has a higher degree of reliability) increase. Senior users without access to storage could face unprecedented water shortages due to reduced summertime flows (Hayhoe et al., 2004).

Since declining Sierra Nevada snowpack, earlier springtime runoff, reduced spring and summer stream flows, and extended low flow conditions due to drought will likely decrease the reliability surface water supplies, reliance to groundwater resources may increase. The Eastern San Joaquin groundwater subbasin is already overdrafted, and climate change will likely impact how and when groundwater in this subbasin is recharged. Furthermore, groundwater is currently considered unreliable in many areas throughout the MAC Region. Increased groundwater pumping would further exacerbate existing groundwater quality and quantity issues.

Figure 22: Earlier Runoff Impacts to Water Reliability (DWR, 2015)



Water Quality

Shifts in temperature and precipitation due to climate change may affect surface water quality, impacting both municipal and environmental uses. Water quality can be impacted by both extreme increases and decreases in precipitation. Increases in storm event severity and earlier snowmelt may result in increased turbidity in surface water supplies, while decreases in summertime precipitation may leave contaminants more concentrated in low streamflow conditions (DWR, 2008). Higher water temperatures and shallower

reservoirs may exacerbate reservoir water quality issues associated with reduced dissolved oxygen levels and increased algal blooms (DWR, 2008). Additionally, as the occurrence of wildfires increases, additional sediment could be deposited into water bodies and turbidity may become a greater concern. Sediment and pollutants collected from upstream could be concentrated downstream and in reservoirs, leading to water quality issues and the disturbance of critical habitats and drinking water sources. These potential changes could result in challenges for surface water treatment plants and require additional monitoring to quantify changes in source water quality and better control of finished water quality (CUWA, 2007). Water quality concerns not only impact drinking water supplies, but also wastewater treatment processes. The altered assimilative capacity of receiving waters may increase wastewater treatment requirements, and wastewater collection systems could be inundated in flooding events.

Climate change may also impact groundwater quality if precipitation decreases. This would decrease groundwater percolation and dissolved concentrations in groundwater will increase, further decreasing local groundwater quality.

Flooding

The MAC Region is vulnerable to increases in the severity of flooding in the future due to climate change. Extreme precipitation events are likely to become more common, increasing the likelihood of extreme weather events and floods. Rising snowlines will also increase the surface area in watersheds receiving precipitation as rain instead of snow (DWR, 2008), thereby increasing storm-related runoff.

There are multiple reservoirs operated within the MAC Region for both water supply and flood control purposes. Camanche Reservoir is primarily operated for flood control and to meet downstream flow requirements and riparian needs. New Hogan Dam was constructed on the Calaveras River in 1963 for flood control, as well as municipal, industrial, and irrigation purposes. Flood control releases are controlled by the U.S. Army Corps of Engineers, with Stockton East Water District operating the reservoir at all other times. Flooding is a concern in the MAC Region; many cities and communities are included in FEMA designated 100-year and 500-year flood zones. Flooding can occur from heavy rainfall, rapid snowmelt, saturated soils, or a combination of these conditions. In some cases, flooding may due to an inadequate storm drainage system, unable to handle heavy, more intense storms during winter and springtime. This existing vulnerability to flooding will increase with climate change due to increases in rainfall event intensity, early snowmelt, and shifts in peak precipitation and streamflow to earlier in the spring and winter.

Ecosystem and Habitat

The MAC Region is a largely natural area containing two national forests and significant areas designated as rural or open space, providing habitat for numerous species and a wide variety of plant and animal life in many different environments including riparian, wetland, forest, and alpine habitats. Temperature-induced declines in alpine/subalpine forest are expected to occur, in addition to major shifts from evergreen conifer forest to mixed evergreen conifer forests and expansion of grasslands (Hayhoe et al., 2004). Increasing stress on ecosystems resulting from rising temperatures ~~will~~ may reduce trees' capacity to resist pest attacks while increasing pest survival rates, accelerating their development and allowing them to expand their range. Alternatively, some forest pathologists predict that tress that are naturally resistant to pests will survive, propagate, and make forests more resilient. As discussed in the *Wildfire* section of this Plan, hotter and drier future conditions will likely increase the total average annual are burned in the MAC Region. Wildfires will likely play a significant role in converting woodlands to grassland as potential decreases in moisture shift the competitive balance in favor of the more drought-tolerant grasses and increases in grass biomass provide more fine fuels to support more frequent fires. Increased wildfires also favor grasses, which re-establishes more rapidly than slower growing woody life forms after burning (Hayhoe et al., 2004).

While climate change conditions may convert more land in the MAC Region from forest to meadow, meadow ecosystems services are likely to be negatively impacted by climate change. Persistent low flow conditions, as anticipated under climate change, deplete meadow groundwater reserves and soil moisture, reducing the downstream benefits of meadows. Meadows provide ecosystem services such as maintaining summertime flow during dry periods and reducing floods in winter; providing aquatic and riparian habitat for birds, fish, amphibians, and insects; promoting riparian vegetation rather than conifer or dry shrub vegetation that increases wildfire risks; and improving downstream water quality. The Mokelumne River watershed is considered vulnerable to increases in low flow conditions, and as a result, could experience habitat loss as a result of climate change. The Calaveras River watershed, having relatively little meadow area, is considered to be more resilient to increases in low flow conditions.

Section 1.1.7 of this Plan lists the threatened and endangered species found in the MAC Region. These species are considered particularly vulnerable to climate change, as changes in temperature, precipitation, snowpack, and other climate factors are likely to disrupt their already-fragile ecosystem. Warmer surface water affects the chemical composition of surface waters in the MAC Region (for example, decreasing levels of dissolved oxygen) in addition to directly impacting aquatic and riparian habitats. Warmer freshwater temperatures, along with changes in seasonal stream flows, are projected to cause sharp reductions in salmon populations and increased risks of extinction for some Central Valley subpopulations (Ackerman and Stanton, 2011). Increased risk of wildfire also threatens both land-based and aquatic species.

Hydropower

PG&E owns and operates the Mokelumne River Hydroelectric Project (FERC license no. 137), which consists of a series of storage and regulating reservoirs and associated tunnels, ~~and~~ pipelines, and canals that supply water to four hydropower generating units located primarily on the North Fork of the Mokelumne River. The Mokelumne River Project has a generating capacity of 206 MW. In October 20~~0~~1, FERC issued the Mokelumne River Project a 30-year license. EBMUD also generates electricity at its dams at Pardee and Camanche reservoirs. The Pardee Hydropower Powerhouse typically generates approximately 140 million KWh of energy during years of median runoff, and the Camanche Powerhouse generates approximately 45 million KWh annually. EBMUD sells this energy to the Sacramento Municipal Utility District (SMUD). The Calaveras River has only one hydropower facility with a total online capacity of 3.3 MW, owned by CCWD and operated by Modesto Irrigation District under FERC issued license 2903; expiring in 2032.

The primary source of water for hydropower generation in the MAC Region is snowmelt from the Sierra Nevada. As previously described, the streamflow modeling completed under climate change conditions showed that peak runoff on the Mokelumne River may shift up to three months earlier. Changing volumes of snowfall and snowpack in the Sierra Nevada and the changing seasonal melting patterns may require changes in reservoir operations, impacting electrical generation capabilities, flood protection, water storage and deliveries. Additionally, increasing temperatures will also increase energy demands, especially during peak demand times (DWR, 2008). Hydropower is often generated during high energy demand periods, which may be compromised if facilities are forced to spill due to higher magnitude flows or to accommodate early arrival of flows. Peak energy demands typically occur during the summer, so decreases in summertime flows may decrease the ability of hydropower to help meet these demands.

Other

Climate change will also affect the MAC Region in other ways, including impacting recreation and tourism industries (and therefore the Region's economy). Projections of decreased snowpack have the potential to affect the ski industry in Alpine County (part of the MAC Region) since the ski resorts are within the elevations impacted by reduced snowpack due to temperature increases. These temperature increases will

also delay the beginning of ski season and impact the economic viability of the industry (Hayhoe et al., 2004).

Sea level rise is not a direct climate change impact to the MAC Region given its geographical location far removed from the ocean. While some inland areas in California that rely on water from the Sacramento-San Joaquin Delta may be impacted by sea level rise due to saltwater intrusion into the Delta, the MAC Region will not be affected because it does not rely on the Delta for water supply. Therefore, the MAC Region has no direct sea level rise-related vulnerabilities. Sea level rise may indirectly affect the MAC Region through future required stream releases from upstream rivers (such as the Mokelumne and Calaveras Rivers) necessary to maintain salinity fronts in the Sacramento-San Joaquin Delta.

Prioritized Vulnerabilities

The MAC Region's prioritized vulnerabilities to anticipated climate change impacts were confirmed by the RPC at its June 2018 meeting. Members considered regional understanding and sensitivities and identified regional goals and objectives. Table 1-17 shows the results of the RPC assessment of potential climate change impacts and regional vulnerabilities.

Table 1-17: RPC Assessment of Climate Change Vulnerabilities and Impacts

Climate Change Impact	Vulnerability						
	Water Demand	Water Supply Availability	Water Supply Reliability	Water Quality	Flooding	Ecosystem and Habitat	Hydropower
More frequent/severe droughts	✓	✓		✓		✓	✓
Shifts in timing of seasonal precipitation and runoff	✓		✓		✓	✓	✓
Decreased snowpack in Sierra Nevada/more precipitation falling as rain instead of snow		✓	✓		✓	✓	✓
More severe/flashier storm events			✓	✓	✓	✓	✓
Increased low flow periods	✓	✓		✓		✓	✓
Increased air temperatures & ET rates	✓			✓		✓	
Reduction of alpine meadows				✓	✓	✓	
Increased water temperatures				✓		✓	
Longer growing season	✓						
Increased demands exacerbating groundwater overdraft		✓					
More frequent/severe wildfires				✓	✓	✓	
Changes in forest composition and cover				✓	✓	✓	

Based on this assessment, the RPC prioritized climate change vulnerabilities in two tiers with five of the vulnerabilities being identified as highest priorities for the MAC Region, and the remaining two being high priorities. The prioritized vulnerabilities for the Region are as follows:

1. Highest Priorities: Water Supply Availability, Water Supply Reliability, Ecosystem and Habitat, Hydropower[1], and Water Quality
2. High Priorities: Flood Management and Water Demand

While the RPC determined that all seven of the vulnerability categories are important, the potential climate change impacts that will affect the MAC Region have a greater likelihood of affecting the Region's water supply availability and reliability, ecosystems, and hydropower production more so than flooding, water quality, or water demand. Additionally, water supply and the ecosystem are already at the forefront of water resources issues to address in the Region. Flooding is not currently a major issue in the region and there are existing reservoirs that can be operated to help manage flood flows in the future. While demand

[1] Refers to climate change impacts to existing hydropower operations in the Region as discussed in previous sections.

hardening is a concern, water purveyors and users in the Region are in the process of reducing water use through the implementation of water conservation measures and BMPs and believe they can continue to reduce water use into the future.

1.3.6. Adaptation and Mitigation

Global climate modeling carries a significant degree of uncertainty resulting from varying sensitivity to changes in atmospheric forcing (e.g., CO_2, aerosol compounds), unpredictable human responses, and incomplete knowledge about the underlying geophysical processes of global change. Even though current scenarios encompass the "best" and "worst" cases to the greatest degree possible based on current knowledge, significant uncertainty associated with future global GHG emission levels remains, especially as timescales approach the end of the century. Despite the level of uncertainty surrounding the exact climate changes that will occur in specific regions, there is growing consensus that most regions will experience increased average and peak temperatures and precipitation patterns will shift from historical conditions.

Considering the level of uncertainty associated with climate change projections, the prudent approach to addressing climate change incorporates a combination of adaptation and mitigation strategies. Climate adaptation includes strategies (policies, programs or other actions) that seek to bolster community resilience in the face of unavoidable climate impacts (CNRA and CEMA, 2012), where mitigation strategies include best management practices (BMPs) or other measures that are taken to reduce GHG emissions.

The MAC Region's vulnerabilities to climate change can be addressed through various Resource Management Strategies (RMS). The RMS proposed for the MAC Region are discussed in Section 3.2 of this Plan and their ability to address regional climate change vulnerabilities is discussed in Section 3.3. RMS include both adaptation and mitigation strategies.

1.3.7. Plan for Further Data Gathering

Identifying and implementing appropriate adaptation strategies requires having the data necessary to (1) understand the magnitude of climate change impacts and associated vulnerabilities and (2) plan for strategy implementation in a timely manner. To aid in this understanding, the MAC Region has developed a data gathering and analysis approach to collecting and assimilating data related to the prioritized climate change vulnerabilities.

As an umbrella document, the MAC Plan Update is intended to coalesce and build upon available planning information and studies, not supersede them. Currently, significant data collection efforts are underway at the state, national, and international levels by agencies including DWR, the California Energy Commission, the CARB, the USEPA, and the IPCC, among others. In order to ensure that the MAC Plan is responsive to projected climate change impacts and prioritized vulnerabilities, it will be critical to assimilate the data and information being collected through these avenues into future Plan updates. Further, a variety of project-specific data and information will be collected as part of the project performance and monitoring program (described in Section 5.1). This data could contribute additional information on climate change information on the regional level that could be used to augment information developed at the state and national levels.

In conjunction with future MAC IRWM Plan updates, the available body of climate change information, data, and literature will be evaluated and incorporated into the vulnerabilities analysis and throughout the Plan, as appropriate. In addition, the data collection tables completed in support of the Plan-level and project-level monitoring will be revised, as appropriate, to include additional climate change parameters.

At a minimum the following data collection and analysis actions will be implemented as part of future plan updates to ensure that the plan adequately addresses prioritized climate change vulnerabilities:

- Review statewide and regional available data at the following sites:
  - California Energy Commission and the Geospatial innovation Facility at University of California, Berkeley Cal-Adapt Website - http://cal-adapt.org/
  - DWR IRWM Climate Change Document Clearinghouse –
  - http://www.water.ca.gov/climatechange/docs/IRWM-ClimateChangeClearinghouse.pdf
  - DWR's Climate Change Program Website – https://www.water.ca.gov/Programs/All-Programs/Climate-Change-Program
  - DWR and USEPA Climate Change Handbook – https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Integrated-Regional-Water-Management/Files/Climate_Change_Handbook_Regional_Water_Planning.pdf
  - State of California Climate Change Portal – http://www.climatechange.ca.gov
  - CARB website – http://www.arb.ca.gov/cc/cc.htm
  - The California CAT website – http://climatechange.ca.gov/climate_action_team/index.html
  - CEQA Greenhouse Gas Analysis Guidance for DWR Grantees –
  - http://www.water.ca.gov/climatechange/docs/Guidance%20For%20Grantees-%20Calculating%20GHGs%20for%20CEQA2011.pdf
  - California Climate Action Registry. http://www.climateactionreserve.org/about-us/california-climate-action-registry/
  - California Climate Adaptation Planning Guide – http://resources.ca.gov/climate/safeguarding/local-action/
  - Center for Biological Diversity. 2007. The California Environmental Quality Act on the Front Lines of California's Fight Against Global Warming. http://www.biologicaldiversity.org/publications/papers/CBD-CEQA-white-paper.pdf
- Review national and international data at the following sites:
  - USEPA Inventory of U.S. Greenhouse Gas Emissions and Sinks - https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks
  - World Resources Institute and World Business Council for Sustainable Development. N.d. *The Greenhouse Gas Protocol for Project Accounting*. http://www.wri.org/publication/greenhouse-gas-protocol-ghg-protocol-project-accounting
- Update plan performance monitoring and project-specific monitoring data collection tables to include climate change parameters as appropriate.

1.4. Water Resource Issues and Major Conflicts

The following list of water resource conflicts and issues in the MAC Region was developed for the 2013 MAC Plan and confirmed by the RPC at their June 2018 meeting. This list was compiled from two sources, including the Upper Mokelumne River Watershed Assessment and Planning Project (UMRWAP) and a facilitated discussion with the RPC. The potential conflicts and issues were organized under the following seven topic headings.

1. Land Use and Water Use Conflicts
2. Environmental Protection
3. Water Quality Conflicts
4. Supply Management
5. Forest Management
6. Fire Management
7. Economic Impacts

Specific conflicts in each area are summarized in the following sections. Conflicts identified through the UMRWAP are denoted as such.

1.4.1. Land Use and Water Use Conflicts

- Amador County General Plan housing element resulting in more development in areas with no water/wastewater infrastructure
- Inadequate supply and infrastructure to meet growth projected by the general plans of Amador County and its cities
- Problems with providing infrastructure in dispersed, low density areas
- Watershed protection versus community economic needs
- Groundwater overdraft versus development approvals
- Insufficient groundwater quantity and quality to accommodate growth
- ~~Projected population increases expediting the transport of contaminants to water bodies (UMRWAP)~~
- Inconsistency and disagreement over the basis of the water demand projections presented in the UWMPs

1.4.2. Environmental Protection

- P~~PG&E p~~umped storage project on North Fork of the Mokelumne River versus preserving or restoring river natural systems
- Third party impacts from reuse and conservation (reduced return flows)
- Protecting and improving fish passage on lower Mokelumne and Calaveras Rivers versus river-sourced water supply development needs and opportunities
- Management of federal lands resulting in environmental impacts
- Invasive species
- Even-aged management of forestry resources

1.4.3. Water Quality Conflicts

- Promoting and improving water-related recreation opportunities versus recreational water quality impacts
- Groundwater overdraft in the Eastern San Joaquin Groundwater Basin contributing to deteriorating groundwater quality levels in the portion of the basin underlying Calaveras County
- Wastewater discharge water quality impacts
- Failing septic system contaminant leakage to surface water and groundwater versus body contact recreation and drinking water (UMRWAP)
- Wastewater treatment levels and technology versus environment and benefits
- Improper disposal of household wastes (UMRWAP)
- Wastewater treatment plant overflows during high precipitation events (UMRWAP)
- Inactive mines without restoration causing leaching of soils with high mineral content and surface runoff of contaminants to water bodies (UMRWAP)
- Increased impervious surfaces exacerbating flooding and contributing contaminants to surface waters versus designing streets and compact development with techniques to reduce peak flows, minimize runoff, and remove contaminants during flow (UMRWAP)
- Roads and road maintenance practices that contribute to erosion, peak runoff, and transport of sediments and contaminants in runoff to surface waters (UMRWAP)

1.4.4. Supply Management

- New water supply versus recycled water versus conservation of supplies
- Stormwater management and rights to use this water
- Climate change impacts
- Water rights concerns
- Supplies not matched to use (e.g., industrial users receiving potable supplies)
- White water recreation versus flat water recreation

- Meadows require rehabilitation to increase water sequestration and slow water release throughout dry season

1.4.5. Forest Management

- Timber harvesting disturbance of vegetation and soils which contributes loadings to surface waters (UMRWAP)
- Increased vegetation densities outside the natural range of variability

1.4.6. Fire Management

- Vegetation and soil disturbances caused by wildfires which contribute sediment loadings to surface waters (UMRWAP)
- Fire response to protect landowner and water quality objectives versus managing naturally-occurring fires (UMRWAP)
- Biomass removal of excess fuels in forested landscapes
- Costs of timber management

1.4.7. Economic Impacts

- Costs of projects and financing
- Aging existing water and wastewater infrastructure
- Drinking water regulations failing to realistically reflect human health protection needs (treatment levels too onerous) causing added infrastructure needs to meet regulations
- Local economic opportunities versus out of region resources
- Cost of vegetation treatments and biomass removal

2. Governance

2.1. UMRWA - Regional Water Management Group

In 2005, a group of water-related public agencies in Amador and Calaveras Counties signed a Memorandum of Understanding committing to the preparation of the first MAC IRWMP. Signatories of the 2005 memorandum included AWA, EBMUD, CCWD, Amador County, City of Jackson, City of Sutter Creek, City of Plymouth, and the ARSA. This initial regional plan, which was adopted in December 2006, was based on guidelines and standards associated with Proposition 50. With the passage of Propositions 84 and 1E, and subsequent revisions to the Integrated Regional Planning Act resulting from SBxx1, new IRWMP guidelines and standards have been established. Concurrently, the expansion of interest in regional water resources planning in Amador and Calaveras County has led to the evolution of the MAC region planning process. Specifically, the Upper Mokelumne River Watershed Authority (UMRWA or Authority), a regional water management group (RWMG), has assumed a leadership role for updating and administering the MAC Plan.

Established in the year 2000 as a joint powers agency, UMRWA is a 'regional water management group' as defined by California Water Code Section 10537. UMRWA was selected as the lead agency for the RWMG due to its history in promoting and developing stakeholder-supported regional solutions to water resource problems. In turn, the UMRWA Board of Directors ~~has~~ established an Integrated Regional Water Management Planning program and ~~has~~ provided funding to undertake the first phase of a multi-phase process to update the 2006 MAC Plan. UMRWA is comprised of six water agencies and the counties of Amador, Calaveras and Alpine. The six water agencies are AWA, CCWD, CPUD, EBMUD, JVID and ACWA.

The Authority has been engaged in a wide variety of water resource matters since its inception in 2000. At the time it was formed, the Authority's attention was focused on PG&E's anticipated divestiture of its hydropower assets (pursuant to California's energy deregulation program) and the Authority's acquisition of PG&E's Mokelumne River Project. When the federal court approved PG&E's bankruptcy reorganization plan, Authority member concerns regarding the divestiture of the Mokelumne River project were generally abated and Authority acquisition efforts halted. With acquisition of PG&E's Mokelumne Project no longer an objective, the Authority in 2005 refocused its attention on water quality issues, potential watershed projects and cooperative water supply planning efforts between the Authority's member agencies.

As a JPA, UMRWA is comprised of local public agencies with water resource management responsibilities in the region. The individual member agencies that comprise the Authority, along with their statutory basis, water management authorities, and intentions regarding adoption of the MAC Plan, are presented in Table 2-1.

Table 2-1: UMRWA JPA Member Agencies

Member Agency	Statutory Basis	Water Management Authority	Expect MAC Plan Update Adoption
Alpine County	A political subdivision of the State of California	Storm water, flood control, watershed protection, environmental health	Yes
Alpine County Water Agency	A water agency formed pursuant to a special act of the California Legislature	Water, wastewater	Yes
Amador County	A political subdivision of the State of California	Storm water, flood control, watershed protection, environmental health	Yes
Amador Water Agency	A water agency formed pursuant to a special act of the California Legislature	Water, wastewater	Yes
Calaveras County	A political subdivision of the State of California	Storm water, flood control, watershed protection, environmental health	Yes
Calaveras County Water District	A California water district	Water, wastewater, hydropower	Yes
Calaveras Public Utility District	A California public utility district	Water, wastewater	Yes
East Bay Municipal Utility District	A California municipal utility district	Water, wastewater, hydropower	Yes
Jackson Valley Irrigation District	A California irrigation district	Water, wastewater, hydropower	Yes

2.2. Governance Structure

UMRWA is the regional water management group for the MAC region. UMRWA is governed by a Board of Directors consisting of eight Directors, each serving in his or her individual capacity as Director of the Board. Directors are appointed by the governing bodies of each of the Authority's member agencies, with Alpine County and Alpine County Water Agency together appointing one Director. Each member agency may also appoint one or more alternate Directors. Each Director and alternate Director serves at the pleasure of the governing body which appointed them.

The Authority Board of Directors (Board) conducts regularly scheduled meetings, with at least one regular meeting each calendar quarter. All meetings are called, noticed, and conducted pursuant to the Ralph M. Brown Act. Five directors constitute a quorum for transacting business, and affirmative votes by five Directors is required for action. The minutes of all Board meetings are recorded by the Authority Secretary. The Board selects the Chairperson and Vice-Chairperson. An Executive Officer, appointed by the Board and serving at its pleasure, administers the Authority's affairs. Amador County Counsel serves as Authority Counsel. EBMUD Finance Director serves as Authority Treasurer and Controller.

Upon assuming leadership of the MAC region planning process, the UMRWA Board of Directors approved the Authority's Integrated Regional Water Management Planning Program in May 2008 and funded phase 1 of the MAC Plan Update in July 2008. When establishing the program, the Board set the following goal: *Develop an updated MAC Plan which addresses a broad range of water-related and environmental stewardship needs through effective stakeholder participation and is comprehensive and competitive with other plans*. The Board of Directors also established a three-tiered governance structure to guide the regional water resource planning and management process. This structure is intended to best meet the needs of a variety of MAC region stakeholders while achieving an updated MAC Plan which meets the Board's goals. Implementation of a three-tiered structure involving the Regional Participants Committee (RPC), the Board Advisory Committee, and the Board (all summarized in the following sections) is expected to: (1) create a fair and open plan update process, (2) ensure that the special funding provided by member agencies is efficiently spent, (3) provide a systematic decision-making process with the Governing Board being the final arbiter of disputes, and (4) yield a useful and successful updated MAC Plan. This structure is depicted in Figure 2-1 below.

Figure 23: MAC ~~IRWMP~~ Region Governance Structure

Besides the UMWRA member agencies, other anticipated participants in the MAC region IRWM planning process, including other public agencies, private corporations, DACs and non-governmental organizations (NGOs), are identified and listed in Table 2-2. The third column in the table indicates the participant's working relationship in the MAC regional planning process as either RPC member or stakeholder. The RPC members are presently participating in the planning process. Stakeholders are those organizations that have not participated despite being invited. Many of these stakeholders are expected to participate in the planning process in the future, either through the RPC or through the public outreach process. The committees are further described in the following sections.

Table 2-2: Other Regional Planning Participants

Participant Categories	Organizations/Stakeholders	Working Relationship w/MAC Plan
Wastewater agencies	Amador Regional Sanitation Authority	Stakeholder
Cities and special districts	Amador City	Stakeholder
	City of Ione	Stakeholder
	City of Jackson	Stakeholder
	City of Plymouth	Stakeholder
	City of Sutter Creek	Stakeholder
	Mokelumne Hill Sanitation District	Stakeholder
	Wallace Community Services District	Stakeholder
	Golden Vale Subdivision	Stakeholder
	Amador Resource Conservation District	RPC Member
Electrical corporation	Pacific Gas and Electric	Stakeholder
Stewardship organizations	Amador Fly Fishers	Stakeholder
	Foothill Conservancy	RPC member
	Alpine Watershed Group	Stakeholder
	Upper Mokelumne Watershed Council	Stakeholder
	Trout Unlimited, Sac-Sierra Chapter	Stakeholder
	Amador Tuolumne Community Action Agency	RPC Member
	Calaveras Amador Forestry Team	RPC Member
	Amador Fire Safe Council	RPC Member
	Calaveras Planning Coalition	Stakeholder
	Amador Calaveras Consensus Group	Stakeholder
Industry organizations	Sierra Pacific Industries	Stakeholder
Disadvantaged communities	City of Jackson	Stakeholder
	City of Plymouth	Stakeholder
	Mokelumne Hill	Stakeholder
	West Point	Stakeholder
Federal agencies	U.S. Forest Service	Stakeholder
Native American Tribal Communities	Buena Vista Rancheria	RPC Member*

* indicates the entity was not a member of the RPC for the entire development of the MAC IRWM planning process and was therefore a stakeholder and an RPC member.

2.2.1. Regional Participants Committee (RPC)

The RPC is a diverse committee organized for the purpose of bringing stakeholder interests to the forefront during the regional planning process and the development of the MAC IRWMP Update. RPC participation provides for balanced access and opportunity for participation in the IRWM planning process. Members of the RPC are expected to represent the views of their agency, community organization, or interest group,

commit time to take part in the process, and work collaboratively with other RPC members and project staff. Table 2-3 below lists the organizations, agencies, or groups represented on the committee.

Table 2-3: Regional Participants Committee

Sector	Agency/Organization/Group
Cities and Special Districts	Amador Water Agency Calaveras County Water District Calaveras Public Utility District East Bay Municipal Utility District Jackson Valley Irrigation District
Community/Environmental Organizations	Foothill Conservancy Amador Fire Safe Council Amador Resource Conservation District Amador Tuolumne Community Action Agency Calaveras Amador Forestry Team
Native American Tribal Communities	Buena Vista Rancheria

For virtually any stakeholder process to run smoothly and be successful, it is helpful for those involved to agree at the outset on the purpose of the process and the procedures by which the group will govern its discussions and decision-making. For this RPC process, a set of governing procedures has been established by the RPC. The key aspects of the *Governing Procedures Guidelines* follow.

- The goal of this planning process is to have RPC members engaged in discussion and reach consensus on MAC Plan content and recommendations. Straw votes may be taken from time to time to gauge the level of agreement on specific issues. Efforts should be made to accommodate the concerns of all parties.
- The RPC will serve as the MAC Plan's primary advisory body. In that capacity, the RPC is expected to provide advice, support and constructive criticism. Project staff will incorporate or otherwise reflect the comments and recommendations of the committee members into MAC Plan work products.
- With the RPC's consent, new committee members may be added to the RPC after the first meeting is held.
- Every member will check back with their respective organization or constituency and will keep them aware of the ongoing RPC process and actions. Input from senior staff and/or governing boards of the RPC members will be communicated back to the RPC at its next meeting. Any dissension from the respective organizations' decision-making bodies that could affect acceptance of RPC recommendations will be clearly communicated at each meeting so a solution can be sought.
- Outstanding issues or concerns of RPC members will be brought to the RPC first. Members will not communicate their concerns and issues outside of the committee without first bringing them to the RPC.
- Every member is responsible for communicating their position on issues under consideration. It is incumbent upon each member to state the interests of the organization or group they represent. Voicing these interests is essential to enable meaningful dialogue and full consideration of issues by the RPC. If a RPC member does not attend a RPC meeting or communicate their viewpoint on an issue, it is assumed that they agree with decisions and recommendations made by the RPC.

The decision-making process to be followed by RPC has been established by the committee itself. This process is described as follows:

- The RPC decision-making process has been established to have RPC members contribute their knowledge and opinions to the overall project. The decision-making goal is to have all RPC members agree on the item at hand, with no member objecting to a decision, action, or recommendation. Members should use "can they live with it" as their standard.
- In any instance in which all members don't agree on the decision or action at hand, then the person or persons who disagree must put forward a reasonable alternative. If, after due consideration, agreement on the matter at hand cannot be reached, the RPC will determine how to resolve the impasse.

For the purposes of preparing the 2018 MAC IRWMP, the RPC met three times beginning in June 2018 and ending in October 2018. The meeting notes for these RPC meetings are included in Appendix D and are posted on UMRWA's website.

2.2.2. Board Advisory Committee

The Board Advisory Committee has been established by the UMRWA Board of Directors to perform a prescribed set of functions related to the regional planning process and the development of the updated MAC Plan. Meetings of the Board Advisory Committee are held as needed by conference call and are open meetings. Members include AWA, CCWD, and EBMUD. Board Advisory Committee members are expected to:

- Make decisions by unanimous agreement of all committee member agencies.
- Respond to and resolve questions that may arise at RPC meetings.
- Present unresolved RPC matters to the Board of Directors for resolution.
- Advise the Board on all matters related to the MAC Plan update.
- Recommend the updated Plan to the Board for approval.

2.2.3. UMWRA Board of Directors

The UMRWA Board of Directors is the policy board that governs the Authority and the business that it transacts. Among its duties are the approval of the regional planning process, resolution of disputes the Board Advisory Committee is unable to satisfactorily resolve, authorization to apply for grants, approval of the Authority budget, hiring of consultants, and approval of contracts. The Board will also be the first public body to adopt the updated MAC Plan and will in turn solicit the approval of other agencies and organizations in the MAC region.

2.2.4. Public Participation

The general public, including DACs and Tribal communities, are provided opportunities to participate in the MAC IRWM planning process. The MAC region strives to open avenues of communication with the general public and offers opportunities to provide feedback on the Plan Update and water-related projects. Information regarding the MAC IRWM planning process and Plan Update is communicated to the general public through emails, local media, and a MAC Plan website (www.umrwa.org/irwm). General public was also invited to attend two community meetings, held in conjunction with the first RPC meeting and last RPC meeting. The first meeting provided an introduction to the IRWM planning process and kicked off the project solicitation process, and the last meeting allowed public comment on the Draft Plan Update.

A public comment period was held from September 20, 2018 through October 11, 2018 where members of the public were encouraged to review and provide comment on the Plan. The 2018 MAC Plan Public Draft was posted to the UMRWA website and emailed to interested stakeholders. During this period, over 150 comments were received. A response to comment matrix is included in Appendix E.

2.2.5. Benefits of Governance

The MAC governance Structure, described in this section, provides the following benefits to the Region's IRWM Program:

- Provides a structure for implementing public outreach and involvement: The Governance Structure and public outreach approach have been vetted by participating agencies and members of the Board, RPC, Steering Committee and general stakeholders. A *Community Outreach Plan* was developed and endorsed by the RPC and guides public involvement through the MAC planning process and facilitates relationship building by promoting the active participation of stakeholders.
- Facilitates effective decision-making: By implementing a three-tiered structure with clearly defined participants and roles, decision-making is streamlined, transparent and fair.
- Encourages balanced access and opportunity for participation in the IRWM process: The wide participation by stakeholders and RPC members from all relevant areas of water resources management in the region ensures that stakeholders have balanced access to the process. In addition, holding public, open meetings as well a stakeholder outreach process provides ample opportunity for participation in the IRWM planning process.
- Allows effective communication – both internal and external to the IRWM region: The RPC serves as an effective forum for communication to stakeholders internal and external to the Region, as well as neighboring IRWM regions.
- Manages long term implementation of the IRWM Plan: While individual project proponents are responsible for implementing the projects identified in the IRWM Plan to the extent feasible, the RWMG is responsible for compiling data and information on benefits, impacts, and plan performance over time through the IRWM program, to the extent funding is available to allow these activities to occur.
- Coordinates with neighboring IRWM efforts and State and federal agencies: Through the IRWM Plan updates, the Authority interfaces with neighboring IRWM regions, as well as State and federal agencies. In addition, having a formal role for stakeholders who are not official RPC members provides a vehicle for participation by these entities.
- Includes a collaborative process to establish plan objectives: As described above, the RPC makes decisions according to the adopted *RPC Governing Procedures Guidebook*. The decision-making goal is to have all RPC members agree on the item at hand, with no member objecting to a decision, action or recommendation.
- Provides a process for incorporating interim changes and formal changes to the IRWM Plan: The governance structure establishes clear roles and responsibilities. In the event that interim and/or formal changes are needed, the Board would direct the RPC to oversee completion and incorporation of changes.
- Identifies responsibilities for updating or amending the IRWM Plan: Each group identified in the governance structure has specific responsibility with respect to IRWM Plan updates. The RPC is tasked with overseeing the consultant updating the Plan; the Steering Committee is charged with advising the Board on all matters related to the Plan Update, and the Board is responsible for ultimately approving the Plan Update.

2.3. Stakeholder Involvement

2.3.1. Community Outreach Plan

A primary element of the MAC regional planning process is community outreach. A *Community Outreach Plan* was developed and endorsed by the RPC. This plan guides public involvement throughout the MAC regional planning process and facilitates relationship-building by promoting the active participation of local stakeholders. The key outreach goal of the Plan is: "To ensure sufficient representation and active

participation of community interests to achieve a technically and politically viable update to the existing Plan."

To achieve that goal, a three-tiered approach to stakeholder participation and general community outreach has been established. These three tiers are described below.

Tier One was the formation of a committee to represent the interests of stakeholders within the MAC region. This Regional Participants Committee, or RPC, serves as the venue for bringing stakeholder interests to the MAC Plan update discussion. It has a central and guiding role in the MAC regional planning process. RPC participants were solicited through letters sent to individuals and organizations with known stakeholder interests (e.g., participants in the drafting of the 2006 MAC IRWMP), by notices published in local papers, and by announcement during the October 2008 Community Meeting which targeted the general public (see Tier 2 discussion, below). For the 2018 MAC Plan Update, existing RPC members were emailed at the onset of the update process to confirm involvement and ask for potential additional members. A balanced and diverse representation of community stakeholder interests has been achieved, including special outreach efforts to secure the input of geographically-distant Alpine County interests and Disadvantaged Communities throughout the region. The RPC is described in more detail in Section 2.2.1.

Tier Two ensures that the general public living within the MAC region has an opportunity to be involved in the project, learn about project developments, and provide input into RPC work products. Communication with the general public is accomplished through four methods: individual RPC member outreach to community members, coworkers, and professional associations; local media involvement to inform the general public of progress being made in developing the updated MAC Plan; a MAC Plan website to provide easy access to IRWM materials and updates; and community workshops to provide a forum for additional community input and engagement. Community workshops are the primary format for informing the general public about MAC Plan Update activities and to solicit comments and answer questions on MAC Plan work products. Workshops are held to coincide with the drafting of key project work products. Community workshops are hosted at suitable facilities that are centrally-located. The Senior Community Center and the Amador County Board of Supervisors chambers, both of which are located in Jackson, have often been used for meetings of this nature and are likely locations for future meetings.

Tier Three is designed to ensure that the interests of Disadvantaged Communities and Native American Tribes in the MAC region are represented and accounted for in the MAC Plan update process. By soliciting and encouraging participation in the MAC Plan update process by individuals who understand the issues facing disadvantaged communities (DACs), we can help to ensure that the needs of low-income communities are considered in plan development, and that DACs do not experience disproportionate adverse impacts associated with IRWM plan implementation. Representation by DACs is shown in Table 2-4. Objectives of Tier 3 include the following.

- Solicit involvement by individual representatives of DACs and tribes within the MAC region and encourage participation by those representatives as members of the RPC.
- Encourage RPC members to specifically advocate and represent the interests of those DACs and tribes that do not have designated community representatives on the RPC, but that lie within the RPC member's jurisdiction or area of special interest.
- Inform representatives and residents of DACs and tribes of the IRWM program via flyers and newspaper notices about opportunities to get involved with the MAC Plan update process and participate in development, integration, and prioritization of projects.

Table 2-4: Disadvantaged Community Representation

Disadvantaged Community	Supporting Public Agency
Jackson	Amador Water Agency
Plymouth	Amador Water Agency
Mokelumne Hill	Calaveras County Water District
Rail Road Flat	Calaveras County Water District
San Andreas	Calaveras Public Utility District
West Point	Calaveras County Water District

2.3.2. Stakeholder Input in IRWMP Update 2018

Stakeholders will be integral to all aspects of the IRWM planning process, including the IRWMP Update. Table 2-5 presents the planned RPC meetings and the associated topics to be covered at each. The first and last RPC meetings will coincide with community workshops where general public provide feedback.

Table 2-5: Scheduled RPC Meetings

RPC Meeting No.	Meeting Topic/Purpose	Meeting Date
1	Plan Update process and schedule; confirm vision, goals, and objectives and project solicitation and prioritization process; present updated region description, governance, DAC/EDA, climate change, and resource management strategies sections	June 28, 2018
2	Integrate and prioritize projects; present updated monitoring plan and relation to local land use and water planning sections	August 30, 2018
3	Draft plan review and endorsement	October 25, 2018

2.3.3. Coordination with Stakeholders

Information regarding the MAC IRWM planning process is communicated to the RPC by email and postings on the MAC Plan website. Information is communicated to the general public through email, local media, and a dedicated MAC Plan section of the UMRWA website. Emails are facilitated by a community and stakeholder database as well as utilizing the email lists by each RPC member agency. The community and stakeholder database has been developed based on project databases created previously for UMWRA's Upper Mokelumne River Watershed Assessment and Planning Project and the 2006 MAC IRWMP. These two databases were initially combined into a single database for the 2013 MAC Plan Update. This community database contains the names and key contact information of interested public and potential stakeholders, as well as media contacts. As new contacts are made, either through the RPC, community meetings, or other venues, the community database is augmented.

The local media provide a credible and economical approach to achieving widespread dissemination of key project information. Studies show that information presented to the public through a third party, such as the media, is more readily believed by the public, as opposed to advertising or other methods of information coming directly from the source. Local newspapers, such as the Record Courier, Calaveras Enterprise, and

the Amador Ledger Dispatch, are contacted and provided with descriptions of upcoming workshops and related information for publication.

In an effort to continue to make all relevant information available to a vast breadth of stakeholders, a MAC Plan section of the UMRWA website has been developed for the MAC regional planning process. This website provides information about the overall DWR IRWM program, and specifically the MAC IRWMP and updates, as well as who they can contact regarding interest in the process. Useful links to other websites are provided and documents may be downloaded. In addition to those interested obtaining information from the website, there will be a link allowing viewers to leave anonymous comments and/or suggestions, thereby further contributing to the process.

Additionally, as projects are developed, solicited, and prioritized, project proponents and others will coordinate in order to maximize benefits, reduce redundancies and identify and implement potential efficiencies.

2.4. Integration

The MAC region allows for maximizing opportunities for integration of water management activities and the IRWMP Update integrates water management programs and projects. Project integration is discussed in detail in Section 4.1.5.

The governance structure, previously described, fosters integration by allowing a diverse group of stakeholders and interested parties to participate at all levels of the IRWM planning process. Cities, water agencies/district, irrigation districts, wastewater agencies, NGOs, DACs, private corporations, public utility districts, community organizations, watershed stakeholders, and the general public can each play a key role in the planning process, and specifically in the MAC Plan Update, regardless of their ability to contribute to the process financially. With a diverse group of participants in the planning process, different views can be represented and through collaboration, a multi-benefit, implementable Plan Update can be prepared. Resource integration has occurred through the creation of UMRWA by combining six water agencies and two counties into one Joint Powers Authority, providing a focus and lead voice to the IRWM planning process in the MAC region.

2.5. Coordination with Other IRWM Regions and State and Federal Agencies

The Department of Water Resources is currently developing a PSP for the Proposition 1 IRWM Implementation Grant Program. The initial concept developed by DWR includes a pre-application workshop which emphasizes cooperation and increases coordination between DWR and the applicant. Regions in each Funding Area must coordinate to prepare for the pre-application workshop with DWR, which includes preparing Project Information Forms for projects that each Region is considering submitting for funding. The MAC Region is one of the ten regions in the Mountain Counties Funding Area and will coordination with the other regions in the Funding Area to prepare for the pre-application workshop. For additional details as to how the MAC Region coordinates with overlapping and immediately surrounding regions, please refer to Section 1.1.2.

Should State or federal funding be acquired for IRWMP implementation, UMWRA, as the official RWMG will coordinate with the appropriate agencies. On-going coordination would be required during project implementation and after as the projects are monitored and data is collected.

Separately, projects that are implemented will require certain State and federal approvals such as permits and/or environmental documentations. Projects would be compliant with the CEQA and NEPA, as

necessary. Completion of CEQA/NEPA documentation would require coordination with various State and federal agencies.

In order to remain current on climate change activities occurring at the State and national levels, the RWMG should stay involved with California Natural Resources Agency's Safeguarding California Plan process to help shape updates to that document through their participation. In addition, agencies that are part of the MAC IRWM effort are encouraged consider joining The Climate Registry (www.theclimateregistry.org).

2.6. Plan Adoption and Future Updates

Upon completion of this MAC Plan Update, each UMRWA member agency will adopt it and any other agency that wishes to do so can also. It is recommended that any proponent with a project included in the update also adopt the plan. Regardless of grant funding, the MAC Plan is a living document and will continue to be updated in the future. The following are examples of when the MAC Plan may be updated in the future.

- To comply with updated IRWM Guidelines, per DWR.
- To update the project list and project evaluation.
- To incorporate results of plan performance monitoring and/or project monitoring.

3. Policies, Goals, Objectives, and Strategies

3.1. Policies, Goals and Objectives

The policies, goals and objectives of the MAC region were formed through a collaborative stakeholder process. These policies, goals, and objectives form the backbone of the MAC Plan and provide the rationale for IRWM decision-making. This chapter discusses the MAC region's hierarchy of water resource policies, goals, and objectives and the process used to develop them.

Development of regional policies, goals, and objectives is an essential step in the IRWM planning process. Broad based water resource policies sit at the top of the hierarchy employed in this plan. The region's goals, which are next in the hierarchy, are statements of intended outcomes which serve to broadly outline the IRWMP direction. The region's objectives are actions that support fulfillment of the goals. Performance measures represent the final level in the hierarchy and are used to track the progress that is being made to achieve the objectives. Goals and objectives were initially established for the MAC region as part of the process leading to the development of the 2006 IRWMP. Those initial goals and objectives have been revisited and revised in conjunction with the MAC Plan updating process described below.

3.1.1. Process for Setting Policies, Goals and Objectives

A consensus-based approach was used to develop the MAC region's goals and objectives. During development of the 2006 IRWMP, all of the regional participants were invited to submit goals and objectives, regardless of whether or not they were signatories to the Plan MOU. The ideas submitted by the RPC were reflective of the needs of the regional conflicts, issues, and priorities. These goals and objectives were then refined by the group over several months, resulting in a collaboratively-developed set of regional goals and objectives that were included in the 2006 IRWMP.

As part of the 2012 MAC Plan update, the RPC elected to also consider the Statewide Priorities as described in the Propositions 84 & 1E Guidelines (DWR, 2010) in the development of policies, goals and objectives. In addition, the RPC considered objectives detailed in the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (also referred to as the Basin Plan), the 20x2020 water efficiency goals, and the requirements of CWC §10540(c). For each policy multiple goals and objectives were established.

As part of the 2018 MAC Plan update process, the regional policies, goals, and objectives developed in 2012 were reviewed to verify that current water resources management conditions in the region and statewide priorities were reflected. As a result of this review, a fifth policy with two new goals and four new objectives, was added. The RPC, representing a broad set of stakeholder interests, was the primary venue for reviewing and updating the water resource policies, goals, and objectives contained in this updated IRWM Plan.

POLICY 1: MAINTAIN AND IMPROVE WATER QUALITY

- *Goal:* Reduce sources of contaminants.
  - Objectives:
    - Reduce abandoned mine flows and sediments.
    - Reduce leakage from septic systems.

  - Increase bulky waste pickup programs, avoid illegal dumping, and increase collection of illegally dumped trash.
  - Identify informal recreation and camping sites with recurring waste issues and initiate remedial actions.
  - Manage fire fuels to reduce wildfire impacts.
  - Increase public awareness of how contaminated water resources affect quality of life.
  - Track increase of small county-monitored water systems.

- *Goal:* Manage stormwater flows and transport of sediment and contaminants.
  - Objectives:
    - Reduce stormwater runoff from peak storm events.
    - Promote development of community-based flood protection strategies.
    - Reduce water quality impacts from vehicle uses and road maintenance practices.
    - Minimize water quality impacts from livestock grazing.

POLICY 2: IMPROVE WATER SUPPLY RELIABILITY AND ENSURE LONG-TERM BALANCE OF SUPPLY AND DEMAND

- *Goal:* Ensure sufficient firm yield water supply.
  - Objectives:
    - Promote comprehensive water supply planning including climate change.
    - Encourage diverse water supply portfolios to meet agency demands.
    - Plan and develop water supply projects that optimize water right entitlements and county of origin protections.
    - Ensure that demand projections are supportable and realistic.
    - Balance long-term regional supply and demand in water supply plans.

- *Goal:* Maintain and improve water infrastructure reliability.
  - Objectives:
    - Implement leak detection and repair and replacement programs.
    - Develop regional water treatment and transmission projects.
    - Construct water system interties where appropriate.

- *Goal:* Promote water conservation, recycling and reuse for urban and agricultural uses.
  - Objectives:
    - Establish and implement water conservation programs based on best management practices.
    - Maximize use of recycled water from wastewater treatment plants.
    - Move toward a reduction in demands through water-neutral development.

- *Goal*: Develop appropriate drought mitigation measures.
  - Objectives:
    - Promote preparation and adoption of drought contingency plans.

POLICY 3: PRACTICE RESOURCE STEWARDSHIP

- *Goal:* Protect, conserve, enhance, and restore the region's natural resources.
  - Objectives:

  - Integrate natural resource conservation into water resource planning projects and programs.
  - Promote water resource projects that achieve an equitable balance between conflicting interests while minimizing harm to natural resources and incorporating natural resource protection, mitigation, and restoration.
  - Identify opportunities to protect, enhance or restore aquatic and terrestrial habitats in the Mokelumne and Calaveras river watersheds.

- *Goal:* Maintain or improve watershed ecosystem health and function.
  - Objectives:
    - Avoid, minimize or mitigate adverse effects on or improve or restore watershed and ecological processes, systems, structures, and resources when implementing projects.

- *Goal:* Minimize adverse effects cultural resources.
  - Objectives:
    - Avoid, minimize or mitigate adverse effects on cultural resources when implementing projects.

- *Goal:* Identify opportunities for public access, open spaces, and other appropriate recreational benefits and avoid harm to existing or planned recreational uses.
  - Objectives:
    - Promote inclusion of public access, non-motorized trails, open space and other suitable and feasible recreational features in new and existing water resource projects and associated lands while avoiding harm to existing or planned recreational uses.

POLICY 4: FOCUS ON AREAS OF COMMON GROUND AND AVOID PROLONGED CONFLICT

- *Goal:* Prioritize projects that have the best likelihood of being completed in the planning horizon.
  - Objectives:
    - Identify high controversy projects and work towards common ground solutions.

POLICY 5: PREPARE FOR CLIMATE CHANGE

- *Goal:* Mitigate against climate change impacts.
  - Objectives:
    - Implement mitigation strategies that reduce energy consumption, ultimately reducing GHGs.
    - Support carbon sequestration and using renewable energy, when possible, to support regional objectives.
    - Consider strategies adopted by CARB in its AB 32 Scoping Plan when developing projects to meet objectives.

- *Goal:* Adapt to climate change.
  - Objectives:
    - Support projects that consider changes in the amount, intensity, timing, quality, and variability of runoff and recharge.

3.1.2. Measuring Objectives

To track the extent to which the MAC Region's objectives are being achieved, a series of performance measures have been established. These performance measures and their associated water resource goals and objectives are presented below in Table 3-1, Table 3-2, Table 3-3 and Table 3-4.

Table 3-1: Policy 1 - Maintain and Improve Water Quality Goals, Objectives and Performance Measures

Objectives	Performance Measures	Monitoring/Reporting Agency
Goal: Reduce sources of contaminants		
Reduce abandoned mine flows and sediments.	Number of mines known to cause water quality issues for which remedial actions are implemented. Abandoned mines are defined as those in the Office of Mine Reclamation database plus other locally known mines.	U.S. Forest Service (USFS), Bureau of Land Management (BLM), California Department of Conservation, California Department of Toxic Substances Control
Reduce leakage from septic systems.	Number of problem septic systems identified; number of problem septic systems corrected; number of problem septic systems eliminated	County Environmental Health
Increase bulky waste pickup programs, avoid illegal dumping, and increase collection of illegally dumped trash.	Number of new bulky waste pickup dates; estimated tons of illegal waste picked up; number of campaigns or other measures undertaken to stop illegal dumping.	BLM, USFS, County Solid Waste Management Departments, Sierra Pacific Industries, PG&E
Identify informal recreation and camping sites with recurring waste issues and initiate remedial actions.	Number of identified problem sites; number of identified sites for which remedial actions are initiated.	USFS, BLM, Counties, EBMUD
Manage fire fuels to reduce wildfire impacts.	Number of acres on which fire fuel reduction measures are implemented.	USFS; CAL FIRE, Sierra Pacific Industries, Amador-Calaveras Consensus Group, Amador Fire Safe Council, Calaveras Foothills Fire Safe Council
Increase public awareness of how contaminated water resources affect quality of life and public health.	Number of school classrooms, articles in local newspapers and water agency newsletters, and other programs that receive water quality-related curriculum.	CSRCD; UMRWA, CAMRA, AWA, CCWD
Track increase of small county-monitored water systems.	Number of small water supply systems monitored annually by the counties.	County Environmental Health Departments

Objectives	Performance Measures	Monitoring/Reporting Agency
Goal: Manage stormwater flows and transport 0f sediments and contaminants		
Reduce stormwater runoff from peak storm events.	Number of local jurisdictions adopting low impact design (LID) measures; number of public education actions taken to encourage the reduction of stormwater runoff (e.g., newspaper articles, water agency newsletters, NGO newsletters)	City and county land use agencies, AWA, CCWD, JVID, Stewardship Through Education
Promote development of community-based flood protection strategies.	Number of acres affected by adopted protection strategies; presence of floodplain development avoidance measures in city and county general plans.	City and county land use agencies
Reduce water quality impacts from vehicle uses and road maintenance practices.	Number of public works agencies implementing road design and maintenance BMPs; actions to address water quality impacts of concentrated OHV sites.	CalTrans; County PW Departments; USFS, BLM
Minimize water quality impacts from livestock grazing.	Number of grazing permits requiring off-stream watering; livestock management actions taken to prevent meadow compaction, overgrazing, etc.	BLM, EBMUD, USFS, Cattlemen's Association

Table 3-2: Policy 2 - Improve Water Supply Reliability Goals, Objectives and Performance Measures

Objectives	Performance Measures	Monitoring/Reporting Agency
Goal: Ensure sufficient firm yield water supply		
Promote comprehensive water supply planning including climate change.	Number of local water supply plans that consider climate change and incorporate best available climate science into their planning process.	AWA, CCWD, CPUD, JVID, EBMUD
Encourage diverse water supply portfolios to meet agency demands.	Number of water agency plans which consider multiple supplies and conjunctive use operations, including for example but not limited to, demand management, water reuse, and water neutral development.	AWA, CCWD, CPUD, JVID, EBMUD
Plan and develop water supply projects that optimize water right entitlements and county of origin protections.	Number of supply projects in planning that optimize entitlements and protections.	AWA, CCWD, CPUD, JVID, EBMUD
Ensure that demand projections are supportable and realistic.	Number of water demand projections that use the best available land use, demographic, and other data.	Cities, counties, water purveyors, RPC members, LAFCO
Balance long-term regional supply and demand in water supply plans.	Number and/or percent of water agency plans that seek to balance supply and demand in their long-range planning processes.	AWA, CCWD, CPUD, JVID, EBMUD, LAFCO

Objectives	Performance Measures	Monitoring/Reporting Agency
Goal: Maintain and improve water infrastructure reliability		
Implement leak detection and repair and replacement programs.	Number of water agencies with established leak detection and repair programs.	AWA, CCWD, CPUD, JVID, EBMUD
Develop regional water treatment and transmission projects.	Number of regional treatment and transmission projects constructed.	AWA, CCWD, CPUD, JVID, EBMUD
Construct water system interties where appropriate.	Number of newly constructed interties between qualified systems.	AWA, CCWD, CPUD, JVID, EBMUD
Goal: Promote water conservation, recycling, and reuse for urban and agricultural uses		
Establish and implement water conservation and efficiency programs based on best management practices.	Percent of agencies meeting SB X7-7's 20 percent reduction in per capita by 2020. If reduction target is not being met, percent of measures that are being implemented.	AWA, CCWD, CPUD, JVID, EBMUD's local use, County agriculture departments, Foothill Conservancy, Calaveras Planning Coalition
Maximize use of recycled water from wastewater treatment plants.	Number of wastewater treatment plants producing and delivering recycled water; number of efforts to promote increased use of recycled water; percent of wastewater reclaimed.	AWA, CCWD, ARSA, EBMUD, Mokelumne Hill, San Andreas Sanitary District, Valley Springs Community, and the cities of Ione, Jackson, and Plymouth
Move toward a reduction in demands through water-neutral development.	Number of new water-neutral commercial, industrial, or residential development projects; number of land use agencies that are working towards developing water neutral results within the watershed.	County and city land use agencies
Goal: Develop appropriate drought mitigation measures.		
Promote preparation and adoption of drought contingency plans.	Number of water agencies with adopted drought contingency plans.	AWA, CCWD, CPUD, JVID, EBMUD

Table 3-3: Policy 3 – Practice Resource Stewardship Goals, Objectives and Performance Measures

Objectives	Performance Measures	Monitoring/Reporting Agency
Goal: Protect, conserve, enhance, and restore the region's natural resources		
Integrate natural resource conservation into water resource planning projects and programs.	Number of agencies with policies requiring incorporation of principles and standards for resource conservation in project planning; number of projects that have implemented an optional natural resource conservation component.	Cities, counties, AWA, CCWD, CPUD, JVID, EBMUD
Promote water resource projects that achieve an equitable balance between	Percent or ratio of fully mitigated impact by projects.	AWA, CCWD, CPUD, JVID, EBMUD, cities and counties, community organizations

Objectives	Performance Measures	Monitoring/Reporting Agency
conflicting interests while minimizing harm to natural resources and incorporating natural resource protection, mitigation, and restoration.		
Identify opportunities to protect, enhance, or restore aquatic and terrestrial habitats in the Mokelumne and Calaveras river watersheds.	Number of projects and/or land area identified that target habitat improvements in Mokelumne and Calaveras river watersheds.	Cities, counties, AWA, CCWD, CPUD, JVID, EBMUD, ACCG
Goal: Maintain or improve watershed ecosystem health and function		
Avoid, minimize, or mitigate adverse effects on or improve or restore watershed and ecological processes, systems, structures, and resources when implementing projects.	Number of projects and/or land area that avoid, minimize, or mitigate adverse impacts; number of projects and or land area that improve or restore watershed ecosystem function.	Cities, counties, AWA, CCWD, CPUD, JVID, EBMUD, USFS, BLM, ACCG
Goal: Minimize adverse effects on cultural resources		
Avoid, minimize, or mitigate adverse effects on cultural resources when implementing projects.	Number of projects which avoid, minimize, or mitigate adverse cultural resource impacts and/or enhance cultural resources.	Cities, counties, tribal communities, AWA, CCWD, CPUD, JVID, EBMUD
Goal: Identify opportunities for public access, open spaces, and other appropriate recreational benefits and avoid harm to existing or planned recreational uses		
Promote inclusion of public access, non-motorized trails, open space, and other suitable and feasible recreational features in new and existing water resource projects and associated lands while avoiding harm to existing or planned recreational uses.	Number of projects which include feasible open space and recreational features.	Cities, counties, AWA, CCWD, CPUD, JVID, EBMUD, Calaveras Parks and Recreation Commission, Amador County Recreation Agency, California Department of Boating and Waterways, Coast to Crest Trail Council

Table 3-4: Policy 4 – Focus on Areas of Common Ground and Avoid Prolonged Conflict

Objectives	Performance Measures	Monitoring/Reporting Agency
Goal: Prioritize projects that have the best likelihood of being completed in the planning horizon.		
Identify high controversy projects and work towards common ground solutions.	Percent of projects that have parties working on common ground solutions	AWA, CCWD, CPUD, JVID, EBMUD, resource agencies

Table 3-5: Policy 5 – Prepare for Climate Change

Objectives	Performance Measures	Monitoring/Reporting Agency
Goal: Mitigate against climate change impacts		
Implement mitigation strategies that reduce energy consumption, ultimately reducing GHGs.	Number of projects that contribute to a reduction in GHG emissions	AWA, CCWD, CPUD, JVID, EBMUD, Amador County Air Pollution Control District (APCD), Calaveras County APCD
Support carbon sequestration and using renewable energy, when possible, to support regional objectives.	Number of projects that sequester carbon and/or use renewable energy	AWA, CCWD, CPUD, JVID, EBMUD, resource agencies, Amador County Air Pollution Control District (APCD), Calaveras County APCD
Consider strategies adopted by CARB in its AB 32 Scoping Plan when developing projects to meet objectives.	Number of CARB strategies implemented	AWA, CCWD, CPUD, JVID, EBMUD, resource agencies, Amador County Air Pollution Control District (APCD), Calaveras County APCD
Goal: Adapt to climate change impacts		
Support projects that consider changes in the amount, intensity, timing, quality, and variability of runoff and recharge.	Number of projects that consider changing streamflow conditions	AWA, CCWD, CPUD, JVID, EBMUD, resource agencies

3.1.3. Prioritizing Objectives

The RPC chose not to prioritize the MAC Plan objectives because all are equally important and implementation of projects that contribute to any of the objectives would benefit the Region.

3.2. Resource Management Strategies

The Prop 1 IRWM Guidelines require consideration of the *California Water Plan Update 2013* (CWP) RMS in identifying projects and water management approaches for the region. A RMS, as defined in the *California Water Plan 2013 Update* (DWR, 2013), is a technique, program, or policy that helps local agencies and governments manage their water and related resources. RMS are being considered in the MAC IRWM planning process to meet the region's objectives and as part of the project review process.

A wide range of RMS will be required to achieve the MAC Region's goals and objectives, identified in Section 3.1. A comprehensive range of RMS, including all of the RMS covered in the *California Water Plan 2013 Update* (DWR, 2013), were evaluated for their ability to assist the Region in achieving its goals and objectives. Those RMS which are feasible to implement and will assist the Region in achieving its goals and objectives were incorporated into the MAC Plan Update. Those RMS that will not assist the region in achieving its goals and objectives, or are not feasible to implement, have been eliminated from further consideration. The following sections document the RMS which have been evaluated and incorporated into the IRWM Plan.

3.2.1. Strategies Evaluated

The MAC IRWM Plan considered each RMS listed in the *California Water Plan Update 2013* for its ability to assist the region in achieving its goals and objectives. The *California Water Plan Update 2013* identified eight categories of RMS applicable to water management in California.

Table 3-6 presents the eight categories of RMS considered for the MAC IRWM Plan. These strategies include all the resource management approaches identified by the *California Water Plan Update 20*13 A variety of approaches to water management must be considered to fully address the regional goals and objectives. Though all the RMS identified by the *California Water Plan Update 2013* were considered, not all are appropriate for meeting the Region's goals and objectives.

The following sections discuss each RMS and their applicability to the MAC Region. Table 3-7 indicates how the regionally-appropriate RMS contribute to meeting each of the IRWM Plan regional goals. Most goals have multiple strategies that can be integrated to form a successful project to fulfill one or multiple regional goals.

Agricultural Water Use Efficiency

Agricultural water use efficiency can achieve reductions in the amount of water used for agricultural irrigation. This strategy could increase the MAC region's net water savings, improve water quality, provide environmental benefits, improve flow and timing, and increase energy efficiency.

Several strategies recommended by the *California Water Plan Update 2013* to achieve agricultural water savings and benefits include:

- improving irrigation system technology and management of water, both on-farm and at the irrigation district level to minimize water losses;
- adjusting irrigation schedules to decrease the amount of water applied;
- installing remote monitoring to allow districts to measure flow, water depth, and improve water management and controls; and
- developing community educational conservation activities to foster water use efficiency.

Although the extent of agricultural water uses in the Region is limited, agricultural water use efficiency will be an important component of the MAC region's future water resources portfolio. This RMS is consistent with the overall regional goal to Improve Water Supply Reliability and has been included in the IRWM Plan.

Table 3-6: RMS from the CWP Update 2013

Reduce Water Demand	Agricultural Water Use Efficiency Urban Water Use Efficiency
Improve Operational Efficiency and Transfers	Conveyance – Delta Conveyance – Regional/local System Reoperation Water Transfers
Increase Water Supply	Conjunctive Management & Groundwater Storage Desalination – Brackish & Seawater Precipitation Enhancement Recycled Municipal Water Surface Storage – CALFED Surface Storage – Regional/local
Improve Water Quality	Drinking Water Treatment and Distribution Groundwater/Aquifer Remediation Matching Quality to Use Pollution Prevention Salt & Salinity Management Urban Stormwater Runoff Management
Improve Flood Management	Flood Risk Management
Practice Resources Stewardship	Agricultural Land Stewardship Ecosystem Restoration Forest Management Land Use Planning and Management Recharge Area Protection Sediment Management Watershed Management
People and Water	Economic Incentives (Loans, Grants, Water Pricing) Outreach and Engagement Water and Culture Water-Dependent Recreation
Other Strategies	Crop Idling for Water Transfers Dewvaporation or Atmospheric Pressure Desalination Fog Collection Irrigated Land Retirement Rainfed Agriculture Waterbag Transport/Storage Technology

Table 3-7: Applicable Resource Management Strategies and Contribution to IRWM Plan Goals

Resource Management Strategy	Regional Goals												
	Reduce sources of contaminants	Manage stormwater flows and transport of sediments and contaminants	Ensure sufficient firm yield of water supply	Maintain and improve infrastructure reliability	Promote water conservation, recycling and reuse for urban and agricultural uses	Develop appropriate drought mitigation measures	Protect, conserve, enhance, and restore the region's natural resources	Maintain or improve watershed ecosystem health and function	Minimize adverse effects on cultural resources	Identify opportunities for public access, open spaces, and other appropriate recreational benefits and avoid harm to existing or planned	Prioritize projects that have the best likelihood of being completed in the planning horizon	Mitigate against climate change impacts	Adapt to climate change impacts
Agricultural Water Use Efficiency	●		●			●		●			●	●	●
Urban Water Use Efficiency	●		●			●		●			●	●	●
Conveyance – Regional/local			●	●	●	●					●		●
System Reoperation			●	●	●	●					●	●	●
Water Transfers			●	●	●	●					●		●
Conjunctive Management & Groundwater Storage			●		●	●					●	●	●
Precipitation Enhancement			●		●	●					●		●
Recycled Municipal Water	●		●		●	●					●		●
Surface Storage – Regional/local			●		●	●					●		●
Drinking Water Treatment and Distribution		●	●		●	●					●	●	●
Groundwater/Aquifer Remediation			●								●	●	●
Matching Quality to Use			●		●	●					●	●	●
Pollution Prevention	●	●					●	●	●		●		●
Salt and Salinity Management	●	●					●	●	●		●		●
Urban Stormwater Runoff Management	●	●	●		●	●					●		●
Flood Risk Management	●	●				●			●		●		●
Agricultural Lands Stewardship	●	●									●		●
Ecosystem Restoration	●	●				●	●	●		●	●	●	●
Forest Management	●	●				●	●	●	●	●	●	●	●
Land Use and Planning	●	●			●		●	●	●	●	●	●	●
Recharge Area Protection	●	●	●		●	●	●	●	●		●		●
Sediment Management	●	●					●	●	●		●		●
Watershed Management	●	●				●	●	●	●	●	●	●	●
Economic Incentives (Loans, Grants and Water Pricing)	●	●	●	●	●	●	●	●		●	●	●	●
Outreach and Engagement	●	●	●		●	●	●	●	●	●	●	●	●
Water and Culture			●		●	●			●		●	●	●
Water-Dependent Recreation		●								●	●		

Urban Water Use Efficiency

Urban water use efficiency strategies can assist in managing increasing water needs of growing populations in the MAC region. Urban water use efficiency strategies can reduce water demand through technological and behavioral improvements by decreasing indoor and outdoor residential, commercial, institutional, and industrial water use. Several approaches recommended by the *California Water Plan Update 2013* to increase urban water use efficiency include:

- implementing programs such as BMPs;
- reviewing the Urban Water Management Plan to ensure 20 percent water use reductions are achieved by 2020;
- installing water efficient landscapes;
- encouraging gray water and rain water capture to increase water conservation and improve water quality;
- increasing public outreach and encouraging community involvement; and
- funding incentive programs for small districts and economically DACs.

This RMS is consistent with the overall regional goal to Improve Water Supply Reliability and has been included in the IRWM Plan.

Conveyance – Delta

Water suppliers in the MAC Region do not depend on Delta conveyance for water supply. As such, this RMS has been excluded from further consideration.

Conveyance – Regional/local

Several strategies identified by the *California Water Plan Update 2013* for improving regional/local conveyance of water supplies include:

- improving aging infrastructure, increasing existing capacities, and/or constructing new conveyance facilities;
- replacing or improving canal structures to improve an irrigation district's ability to manage and control water in the district and reduce spillage; and
- constructing alternative water conveyance pipelines to improve water supply reliability.

The MAC region has identified improved interregional connectivity as a strategy to assist in achieving the overall goal to Improve Water Supply Reliability. As such, this RMS has been included for further consideration.

System Reoperation

System reoperation strategies change existing operation and management procedures for existing reservoirs and conveyance facilities to increase water related benefits from these facilities. Some of the potential benefits of system reoperation strategies include: increasing water supply reliability, additional flexibility to respond to extreme hydrologic events, and improving the efficiency of existing water uses.

Several system reoperation strategies identified by the *California Water Plan Update 2009* include:

- establishing a baseline hydrology and enhanced description of present water management system components;
- considering possible climate change effects in reoperation projects; and
- collaborating between federal, state, and local agencies on system reoperation studies.

System reoperation could assist the MAC region in achieving the overall goal to Improve Water Supply Reliability. As such, this RMS has been included for further consideration.

Water Transfers

Water Transfers are defined in the California Water Plan as temporary or long-term change in the point of diversion, place of use, or purpose of use due to transfer or exchange of water or water rights in response to water scarcity. Benefits to establishing water transfers include improving economic stability and environmental conditions for receiving areas. Compensation for water transfers can fund beneficial projects/activities for the IRWM region, reduce water rates, and/or improve facilities.

Several water transfer strategies identified by the *California Water Plan Update 2009* include:

- developing and implementing groundwater management plans, monitoring programs;
- allowing community participant for identifying and responding to conflicts caused by transfer;
- refining current methods of identifying and quantifying water savings for transfers using crop idling, crop shifting, and water use efficiency measures; and
- improving coordination and cooperation among the local, state, and federal agencies to facilitate sustainable transfers.

Water transfers could assist the MAC region in achieving the overall goal to Improve Water Supply Reliability in dry years. As such, this RMS has been included for further consideration.

Conjunctive Management & Groundwater Storage

Conjunctive Management and Groundwater Storage refers to the coordinated and planned use and management of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. This strategy could assist in improving water supply reliability and sustainability, reducing groundwater overdraft and land subsidence, protecting water quality, and improving environmental conditions. Conjunctive management and groundwater storage strategies identified by the *California Water Plan Update 2013* include:

- implementation of monitoring, assessment, and maintenance of baseline groundwater levels;
- encouraging local water management agencies to coordinate with tribes and other agencies involved in activities that might affect long term sustainability of water supply and water quality; and
- local groundwater monitoring and management activities and feasibility studies to increase the coordinated use of groundwater and surface water.

Conjunctive Management and Groundwater Storage could assist the MAC region in achieving the overall goal to Improve Water Supply Reliability in dry years. As such, this RMS has been included for further consideration.

Desalination – Seawater and Brackish

Because the MAC region is not located near any brackish or saline water supplies, this strategy is not feasible and has been excluded from further evaluation.

Precipitation Enhancement

Precipitation enhancement artificially stimulates clouds to produce more rainfall or snowfall than would naturally occur, potentially increasing water supply. Recommendations identified by the *California Water Plan Update 2013* for implementing precipitation enhancement projects include:

- seeking State support for development and funding of new projects;
- collecting data and evaluations of existing California precipitation enhancement projects to perform research on the effectiveness of the technology; and
- investigating the potential of augmenting Colorado River Water supply through cloud seeding.

Precipitation enhancement has been implemented in the MAC region in the past, with uncertain benefits. However, assuming precipitation enhancement is effective in increasing precipitation, it could assist the region in achieving the overall goal to Improve Water Supply Reliability. As such, this RMS has been included for further consideration.

Recycled Municipal Water

Use of recycled municipal water provides a drought-resistant water supply that offsets the use of potable supplies for non-potable demands. Water recycling has been implemented throughout the MAC region and increased recycled water use is projected in future years. Recycled municipal water strategies identified by the *California Water Plan Update 2013* and *Water Recycling 2030: Recommendations of California's Recycled Water Task Force* include:

- increasing funding availability for water reuse/recycling facilities and infrastructure;
- creating education curriculum for public schools and institutions of higher learning to educate on recycled water;
- engaging the public in an active dialogue and encouraging participation in the planning process of water recycling projects,
- providing resources (i.e., funding) to agencies that will perform comprehensive analysis of existing water recycling projects to estimate costs, benefits, and water deliveries; and
- assessing water recycling technology to determine least costly and environmentally appropriate technology based on location and need.

Recycled municipal water has been and will continue to be a key strategy for achieving the overall goal to Improve Water Supply Reliability. As such, this RMS has been included for further consideration.

Surface Storage – CALFED

The MAC region does not benefit from surface storage in the Delta. As such, this RMS will not benefit the region and has been screened from further consideration.

Surface Storage – Regional/local

This RMS focuses on regional and local surface storage alternatives to expand surface storage capacity. Benefits of expanding regional/local surface storage include: improved flood management, ecosystem management, emergency water supply, river and lake recreation, capture of surface water runoff, and water supply reliability against catastrophic events and droughts. Regional/local surface storage strategies identified by the *California Water Plan Update 2013* include:

- developing a comprehensive methodology for analyzing project benefits and costs by local agencies;
- continued studies, research, and dialogue to identify a common set of tools for determining cost and benefits of surface storage projects;
- adaptively managing operations of existing surface storage facilities;
- rehabilitating and/or enlarging existing surface storage infrastructure; and
- developing water purchasing agreements to buy water from other agencies that own storage reservoirs with substantial water supplies.

Regional/local surface storage could assist the region in achieving the overall goals to Maintain and Improve Water Quality through reduced flood impacts and Improve Water Supply Reliability through enhanced storage. As such, this RMS has been included for further consideration.

Drinking Water Treatment and Distribution

The MAC region provides high-quality drinking water that meets all State and Federal water quality regulations. However, aging infrastructure must be continually rehabilitated and/or replaced to continue

to provide high quality drinking water supplies. Several drinking water treatment and distribution strategies identified by the *California Water Plan Update 2009* include:

- Working closely with CDPH to quantify the total needs for water system infrastructure improvement and replacement;
- regionalizing and consolidating public water systems;
- developing incentives to allow water systems to reduce waste of limited water resources;
- researching and developing of new treatment technologies;
- providing additional funding for water supply, water treatment, and infrastructure projects to ensure safe and reliable supply of drinking water for individuals and communities;
- public water systems joining the California WARN program which provides mutual aid and assistance more quickly than through SEMS; and
- creating source control and reduction programs to address pharmaceuticals and personal care products.

Drinking water treatment and distribution projects are critical to providing high quality drinking water to the region's residents. As such, this RMS has been included for further consideration.

Groundwater/Aquifer Remediation

Several groundwater remediation/aquifer remediation strategies identified by the *California Water Plan Update 2013* include:

- limiting potentially contaminating activities in recharge areas;
- identifying historic commercial and industrial sites with contaminated discharges and responsible parties to remediate sites;
- implementing source water protection measures; and
- establishing and supporting funding for detecting emerging contaminants by commercial laboratories and installing wellhead treatment systems.

Groundwater sources in the MAC region are of high quality. However, as development pressures increase in the future, protection of groundwater recharge areas and groundwater quality will become more and more important to preserving these high quality water supplies. As such, this RMS has been included for further consideration.

Matching Quality to Use

Matching water quality to use involves utilizing water for suitable end uses based on water quality. This includes reserving high quality potable supplies for potable use, while using lower quality recycled water supplies for non-potable use. As a result, this RMS is directly related to the following RMS: Pollution Prevention, Recycled Municipal Water, Salt and Salinity Management, and Groundwater/Aquifer Remediation. Several strategies for matching water quality to use identified by the *California Water Plan Update 2009* include:

- managing water supplies to optimize and match water quality to the highest possible use and to the appropriate technology;
- encouraging upstream users to minimize the impacts of non-point urban and agricultural runoff and treated wastewater discharges;
- supporting the development of salt management plans;
- reviewing projects to determine the potential impacts from wastewater elimination into local streams; and
- supporting research into solutions to the potential conflicts between ecosystem restoration projects and the quality of water for drinking water purposes.

This RMS may assist the region in achieving its goals to Maintain and Improve Water Quality and to Improve Water Supply Reliability. As such, this RMS has been included for further consideration.

Pollution Prevention

Pollution prevention assists in maintaining and improving source water quality. Benefits of pollution prevention include reduced water treatment requirements, enhanced habitat and natural resource conditions, and improved water supply reliability resulting from decreased variability. Pollution prevention strategies identified by the *California Water Plan Update 2009* include:

- developing proper land management practices that prevent sediment and pollutants from entering source waters;
- establishing drinking water source and wellhead protection programs to protect drinking water sources and groundwater recharge areas from contamination;
- identifying communities relying on groundwater contaminated by anthropogenic sources for drinking water and take appropriate regulatory action; and
- addressing improperly destroyed, sealed and abandoned wells that can serve as potential pathways for groundwater contaminants.

Pollution prevention is a critical component of the region's overall goal to Maintain and Improve Water Quality. In addition, this RMS will assist in achieving the overall goal to Practice Resource Stewardship. By reducing water quality variability, this RMS may further assist in addressing the overall goal to Improve Water Supply Reliability. As such, this RMS has been included for further consideration.

Salt and Salinity Management

Salinity management assists in protecting water resources from accumulation of salts which can impair water quality. Several salt and salinity management strategies identified by the *California Water Plan Update 2009* include:

- developing a regional salinity management plan, and interim and long-term salt storage, salt collection, and salt disposal management projects;
- monitoring to identify salinity sources, quantifying the level of threat, prioritizing necessary mitigation action, and working collaboratively with entities and authorities to take appropriate action;
- reviewing existing policies to address salt management needs and ensure consistency with long-term sustainability;
- collaborating with other interest groups to optimize resources and effectiveness;
- identifying environmentally acceptable and economically feasible methods for managing salt; and
- providing funding for research and projects and prioritizing funding based on greatest needs.

While salinity management is not an issue for the MAC region in the near term, enacting sound management practices can assist in protecting water resources in the long-term, contributing to the overall goal to Maintain and Improve Water Quality. As such, this RMS has been included for further consideration.

Urban Stormwater Runoff Management

Urban stormwater runoff management strategies seek to manage both stormwater and dry weather runoff to minimize soil erosion and sedimentation problems, reduce surface water pollution, protect natural resources, protect and augment groundwater supplies, and improve flood protection. Urban runoff management strategies identified by the *California Water Plan Update 2009* include:

- coordinating efforts with agencies, stakeholders, and the public to decide how urban runoff management should be integrated into work plans;
- encouraging public outreach and education concerning funding and implementation of urban runoff measures;
- designing recharge basins to minimize physical, chemical, or biological clogging;
- working with community to identify opportunities to address urban runoff management;
- providing incentives for the installation of low impact development features on new and existing developments; and
- emphasizing source control measures and strong public education/outreach efforts as being the most effective way to manage urban runoff in this highly arid region.

Successful implementation of this RMS could assist the MAC region in achieving all four of its overall policies. As such, this RMS has been included for further consideration.

Flood Risk Management

Flood waters can create erosion problems, which directly impact water quality. In addition, degraded flood waters can transport pollutants to receiving waters. Several flood risk management strategies identified by the *California Water Plan Update 2013* include:

- Structural approaches that can consist of:
  - Setting back levees
  - Modifying channels to include lining (i.e., concrete, rip rap) to improve conveyance of floodflows
  - High flow diversions into adjacent lands to temporarily store flows
  - Improved coordination of flood operations
  - Maintaining facilities to secure the long-term preservation of flood management facilities
- Land use management approaches that consist of:
  - Floodplain function restoration to preserve and/or restore the natural ability of undeveloped floodplains to absorb, hold, and release floodwaters
  - Floodplain regulation
  - Development and redevelopment policies
  - Housing and building codes
- Disaster Preparedness, Response, and Recovery for flood risk management approaches such as:
  - Information and education
  - Disaster preparedness
  - Post-flood recovery

Flood risk management may assist the region in achieving its goals to Maintain and Improve Water Quality, to Practice Resource Stewardship, and to Prepare for Climate Change. As such, this RMS has been included for further consideration.

Agricultural Lands Stewardship

Agricultural lands stewardship involves conserving and improving land for conservation purposes as well as protecting open spaces and rural communities. This can assist in protecting environmentally sensitive lands, recharging groundwater, improving water quality, providing water for wetland protection and restoration, and increasing carbon sequestration within soil. Agricultural land stewardship strategies identified by the *California Water Plan Update 2013* include:

- stabilizing streambanks to slow bank erosion and filter drainage water from the fields;
- installing windbreaks (i.e., trees and/or shrubs) along field boundaries to help control soil erosion, conserve soil moisture, improve crop protection among many other benefits;

- performing conservation tillage to increase water infiltration and soil water conservation and reduce erosion and water runoff; and
- encouraging irrigation tailwater recovery to help capture and reuse irrigation runoff water to benefit water conservation and off-site water quality.

Agricultural lands stewardship can assist the MAC region in achieving its goals to Maintain and Improve Water Quality and Practice Resource Stewardship. As such, this RMS has been included for further consideration.

Ecosystem Restoration

Ecosystem restoration strategies are key to enhancing the region's rich natural resources. Potential benefits of ecosystem restoration include improved water quality and quantity for aquatic species and human consumption. Several ecosystem restoration strategies identified by the *California Water Plan Update 2013* include:

- increasing the use of setback levees and floodwater bypasses;
- creating programs that support and funds the identification of stream flow needs;
- establishing biological reserve areas that connect or reconnect habitat patches;
- expanding riparian habitat;
- devising climate change adaptation plans that benefit ecosystems, water, and flood management;
- reproducing natural flows in streams and rivers;
- controlling non-native invasive plant and animal species; and
- filtering of pollutants and recharging aquifers.

This RMS is fundamental to achieving the region's goal to Practice Resource Stewardship, and it may assist in achieving the goals to Maintain and Improve Water Quality and Improve Water Supply Reliability. As such, this RMS has been included for further consideration.

Forest Management

Much of the MAC region is characterized by forest, making forest management a critical strategy in the region. Forest management strategies focus on improving the availability and quality of water for downstream users on both publicly and privately owned forest lands. Potential benefits of forest management strategies include interception of rainfall, reduction of urban runoff, increased energy-efficient shade during hot weather, reduced flooding and increased dry-season base flows, and protection from surface erosion and filtering pollutants. Forest management strategies identified by the *California Water Plan Update 2013* include:

- establishing long-term monitoring to understand hydrologic changes resulting from possible climate change effects through the installation of stream gages, precipitation stations, water-quality and sediment monitoring stations, and long-term monitoring wells;
- increasing research efforts into identifying effective BMPs for forest management and the effects of wildfires;
- assessing sediment sources and erosion processes in managed and unmanaged forested watersheds;
- increasing multi-party coordination of forest management;
- improving communication between downstream and upstream water users; and
- developing public education campaigns for water users.

Forest management will be critical to achieving all four of the region's overall policies. As such, this RMS has been included for further consideration.

Land Use Planning and Management

Land use planning and management employs policies, ordinances, and regulations to limit development in flood-prone areas and encourages land uses that are compatible with floodplain functions. Strategies identified by the *California Water Plan Update 2013* include:

- implementing policies and regulations that restrict or prohibit development within floodplains;
- restricting the size and placement of structures;
- preventing new development from proving adverse flood impacts to existing structures;
- encouraging reduction of impervious areas;
- requiring floodproofing of buildings; and
- encouraging long-term restoration of streams and floodplains.

Land use planning and management will help the Region meet its goals of Maintain and Improve Water Quality and Practice Resource Stewardship. As such, this RMS has been included for further consideration.

Recharge Area Protection

Recharge area protection protects recharge areas from pollution, which protects and maintains the water quality of groundwater supplies. Several recharge area protection strategies identified by the *California Water Plan Update 2013* include:

- expanding research into surface spreading and the fate of chemicals and microbes in recharge water;
- increasing funding for the identification and protection of recharge areas;
- creating education and media campaigns to increase public awareness and knowledge on the importance of recharge areas and relevancy to groundwater;
- requiring source water protection plans; and
- developing methods for analyzing the economic benefits and costs of recharge areas.

Recharge area protection is an important component to protecting the region's groundwater supplies and will assist the region in achieving its overall goal to Maintain and Improve Water Quality. As such, this RMS has been included for further consideration.

Sediment Management

Sediment management relates to managing the sand, silt, or clay, suspended in or settled on the bottom of a water body. Pollutants, including those from stormwater, may also be absorbed onto fine-grained sediments and complicate management of contaminated sediment. Several sediment management strategies identified by the California Water Plan Update 2013 include:

- source management by preventing soil loss and adverse sediment flows from land use activities;
- sediment transport management by introducing or leveraging natural functions that create optimal sediment transport; and
- sediment deposition management by identifying and achieving optimum benefits from sediment deposits and mitigating negative impacts.

Sediment management is critical to protecting the quality of the Region's surface water supplies and will contribute to the Region's Maintain and Improve Water Quality policy. As such, this RMS has been included for further consideration.

Watershed Management

Watershed management involves coordinating and integrating the management of numerous physical, chemical, and biological processes at the watershed level to generate multiple benefits. Watershed management strategies identified by the *California Water Plan Update 2013* include:

- creating a scientifically valid tracking and reporting method to document changes in the watershed;
- assessing the performance of projects and programs;
- providing watershed information to better inform local land use decision makers on how to maintain and improve watershed functions; and
- using watershed approaches in which all RMS strategies are coordinated.

Watershed management has been - and will continue to be – an important framework for managing the water resources in the MAC region, and this strategy will assist the region in achieving all four of its overall policies. As such, this RMS has been included for further consideration.

Economic Incentives (Loans, Grants and Water Pricing)

Economic incentives including low interest loans, grants, and water rates and rate structures can influence water management, amount of water use, time of use, wastewater volume, and source of supply. Several urban runoff management strategies identified by the *California Water Plan Update 2009* include:

- instituting loans and grant programs that support better regional water management;
- adopting policies that promote long-run water use efficiency;
- developing modeling tools for economic analyses of economic incentives as well as guidelines and ranking criteria for grant and loan awards; and
- exploring innovative financial incentives.

Economic incentives can help to further projects and programs, assisting the region in achieving all four of its overall policies. As such, this RMS has been included for further consideration.

Outreach and Engagement

Outreach and engagement activities use tools and practices to facilitate contributions by public individuals and groups toward good water management outcomes. These contributions may include adopting water-wise practices, promoting collaboration and interdisciplinary approaches to solving problems, and ensuring access to water management information and decision-making. There are several outreach and engagement strategies identified by the *California Water Plan Update 2013*, including:

- providing information about problems, solutions, alternatives, and opportunities related to water in California;
- obtaining public feedback on analysis, alternatives, and/or decisions regarding water in California;
- working with the public to ensure public concerns and aspiration are understood and considered by water managers;
- partnering with the public to develop alternatives and identify preferred solutions for water in California; and
- providing the public with opportunities to make decisions related to water in California.

This RMS is fundamental to achieving the region's goal to Focus on Areas of Common Ground and Avoid Prolonged Conflict, and it may assist in achieving the goals to Maintain and Improve Water Quality, Improve Water Supply Reliability, and Practice Resource Stewardship. As such, this RMS has been included for further consideration.

Water and Culture

The California Water Plan Update 2013 is the first update to include a resource management strategy based on the relationship between water and culture. This RMS works to consider culture and cultural activities in the framework of water management. Utilizing cultural considerations in the framing, development, and

promotion of management decisions is vital to ensuring legal compliance and sustainable practices. Cultural activities that relate to water identified by the *California Water Plan Update 2013* include:

- subsistence~~dence~~ activities, such as traditional hunting, fishing, and collecting plants for food sources that would be affected by poor water quality or inadequate water flows;
- recreation activities that could be impacted by poor water quality, including swimming, boating, and kayaking;
- spiritual activities that draw upon the cleaning, healing, and renewing properties of water;
- researching, identifying, and mitigating impacts of stream flows that prevent Native Americans from participating in their traditional cultural activities; ~~and~~
-
- historic preservation, particularly of objects that are directly related to water infrastructure; and
- public art, which has recorded and served as an integrated expression of water in California.

Because of the MAC Region's unique location in the upper watershed, water is very much a part of the Region's identify and culture. As such, this RMS has been included for further consideration.

Water-Dependent Recreation

This strategy provides for adequate access to water-related recreation activities. Water-dependent strategies identified by the *California Water Plan Update 2013* include:

- using existing data and new surveys to determine recreational needs;
- partnering with schools to provide drowning prevention programs primarily aiming at youth from urban and low income families;
- developing partnerships with universities to coordinate monitoring of public recreation use, equipment, and emerging water recreation trends;
- developing a procedure to incorporate climate change assessments within all infrastructure planning, budgeting, and project development; and
- ~~researching, identifying, and mitigating impacts of stream flows that prevent Native Americans from participating in their traditional cultural activities; and~~
- developing invasive species preventative measures.

Water-based recreation holds significant value to the residents and stakeholders in the MAC region, and this RMS will assist in achieving the region's overall goal to Practice Resource Stewardship. As such, this RMS has been included for further consideration.

Crop Idling for Water Transfers

Agriculture in the MAC region is primarily limited to small-scale operations, and the potential benefit associated with crop idling for water transfers is limited. As such, this RMS has been screened from further evaluation.

Dewvaporation or Atmospheric Pressure Desalination

Dewvaporation or atmospheric pressure desalination would heat brackish water until deposits of fresh water as dew are collected from the opposite side of a heat transfer wall. Because brackish supplies are not present in the MAC region, this strategy is not considered feasible. As such, this RMS has been screened from further evaluation.

Fog Collection

Fog collection is a form of precipitation enhancement that has not yet been implemented in California. This strategy is generally most appropriate for coastal regions that experience significant fog cover. Because the

MAC region does not experience significant fog cover, this RMS is not considered feasible and has been screened from further evaluation.

Irrigated Land Retirement

Irrigated land retirement involves removing farmland from active use to increase water availability for other uses. Because agriculture in the MAC region is primarily limited to small-scale operations, the potential benefit associated with irrigated land retirement is limited. As such, this RMS has been screened from further evaluation.

Rainfed Agriculture

Rainfed agriculture involves performing all crop irrigation with rainfall. Rainfall quantity is difficult to predict, and rainfall is typically experienced in winter months, as opposed to during the summer growing season. Further, because agriculture in the MAC region is primarily limited to small-scale operations, the potential benefit associated with rainfed agriculture is limited. As such, this RMS is considered infeasible and has been screened from further evaluation.

Waterbag Transport/Storage Technology

Waterbag transport/storage technology involves storing water from areas with unallocated freshwater supplies in large inflatable bladders and towing them to an alternate region. Because the MAC region is not located in an area which could receive towed waterbags, this strategy is considered infeasible and has been screened from further evaluation.

3.2.2. Strategies Selected

The following RMS from the *California Water Plan Update 2013* were selected for inclusion in the MAC Plan Update for their ability to assist the MAC region in achieving its overall goals.

- Agricultural Water Use Efficiency
- Urban Water Use Efficiency
- Conveyance – Regional/local
- System Reoperation
- Water Transfers
- Conjunctive Management & Groundwater Storage
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage – Regional/local
- Drinking Water Treatment and Distribution
- Groundwater Aquifer Remediation
- Matching Quality to Use
- Pollution Prevention
- Salt and Salinity Management
- Urban Stormwater Runoff Management
- Flood Risk Management
- Agricultural Lands Stewardship
- Ecosystem Restoration
- Forest Management
- Land Use Planning and Management
- Recharge Area Protection
- Sediment Management
- Watershed Management
- Economic Incentives (Loans, Grants and Water Pricing)

- Outreach and Engagement
- Water and Culture
- Water-Dependent Recreation

3.3. Addressing Climate Change Vulnerabilities

As discussed in Section 1.3.5, climate change is likely to have negative impacts within the MAC Region, including impacts on water demand, water supply reliability, water supply availability, water quality, flooding, ecosystem and habitat, and hydropower. Because the MAC Region is not located near the ocean, sea level rise is not considered a regional climate change vulnerability. The RMSs relevant to the Region can help address these regional climate change vulnerabilities as indicated in Table 3-8. Table 3-9 identifies the MAC Region's No Regret adaptation strategies and Table 3-10 indicates which region appropriate RMS can help mitigate climate change. The following sections summarize how the RMS in each category contribute to climate change adaptation and mitigation.

Reduce Water Demand

Reducing existing and future water demands can reduce pressure on limited water supplies and help the region adapt to the potential climate change impacts of less precipitation, shifting of springtime snowmelt, and overall water-related uncertainties. Reducing water demand is a significant strategy to address supply reliability and adapt to and mitigate climate change impacts. By reducing water demand in the Region through the agricultural and urban water use efficiency strategies, GHG emissions associated with the energy needed to produce, treat and convey water also decrease. Implementing water use efficiency measures also helps the Region adapt to climate change by making conservation a way of life. These strategies can help address potential climate change impacts to water demand and water supply.

Improve Operational Efficiency and Transfers

Optimizing was supply system operations can maximize efficiency, both in terms of water usage and energy usage. Improving operational efficiency and transfers can be achieved through the RMS: conveyance – regional/local, system reoperation, and water transfers. These strategies can help the MAC Region address climate change vulnerabilities related to supply, water quality, flooding, and hydropower generation. For example, improving conveyance systems reduces water loss and the GHG emissions associated with diverting, pumping, treating, and distributing water that is ultimately lost. Similarly, system reoperation encourages efficiencies that can lead to GHG emission reductions. Transfers can also help mitigate climate change if the transferred water eliminates the need to use a more energy-intensive source of water.

These RMSs can help adapt to climate change as well by providing larger conveyance capacity and storage to withstand changing conditions. Aspects of system reoperation can also help adapt to the impacts of a reduced snowpack and increased flooding by maximizing system efficiencies and resilience. Transfers can help the MAC Region improve water supply reliability and provide flexibility in the future when there are increased water demands and potentially less reliable water supplies.

Increase Water Supply

As water demands increase due to longer growing seasons, higher temperatures, and longer droughts, the future of existing water supply sources becomes less certain. The MAC Region will need to enhance existing water supplies and improve its flexibility in managing those supplies to meet demands. RMSs that increase drought-resistant, local water supplies are key for mitigating climate change. Increased storage, for example, can help reduce the likelihood that a transfer is needed to meet demand, thereby potentially eliminating the GHG emissions associated with conveying transferred water. Additionally, water recycling provides a local supply that may use less energy than other water supplies, helping to mitigate climate change impacts through associated GHG emissions. Recycled water is already used in the MAC Region to

irrigate golf courses and some agricultural irrigation; agencies are interested in continuing to use recycled water and expanding its use for agricultural purposes and urban landscape irrigation.

Table 3-8: Addressing Regional Climate Change Vulnerabilities with Resource Management Strategies

Resource Management Strategies	MAC IRWM Region Climate Change Vulnerabilities						
	Water Demand	Water Supply Reliability	Water Supply Availability	Water Quality	Flooding	Ecosystem and Habitat	Hydropower
Reduce Water Demand							
Agricultural Water Use Efficiency	✓	✓	✓			✓	✓
Urban Water Use Efficiency	✓	✓	✓			✓	✓
Improve Operational Efficiencies and Transfers							
Conveyance – Regional/Local		✓	✓	✓	✓		
System Reoperation		✓	✓		✓		✓
Water Transfers		✓	✓				
Increase Water Supply							
Conjunctive Management & Groundwater Storage		✓	✓	✓	✓	✓	
Precipitation Enhancement			✓			✓	✓
Recycled Municipal Water		✓	✓				
Surface Storage – Regional/Local		✓	✓	✓	✓		✓
Improve Water Quality							
Drinking Water Treatment and Distribution		✓	✓	✓			
Groundwater/Aquifer Remediation			✓	✓			
Matching Quality to Use	✓	✓	✓	✓			
Pollution Prevention		✓	✓	✓		✓	

Resource Management Strategies	MAC IRWM Region Climate Change Vulnerabilities						
	Water Demand	Water Supply Reliability	Water Supply Availability	Water Quality	Flooding	Ecosystem and Habitat	Hydropower
Salt and Salinity Management		✓		✓		✓	
Urban Stormwater Runoff Management		✓	✓	✓	✓	✓	
Improve Flood Management							
Flood Risk Management		✓	✓		✓	✓	
Practice Resource Stewardship							
Agricultural Lands Stewardship	✓			✓		✓	
Ecosystem Restoration		✓		✓	✓	✓	✓
Forest Management		✓		✓	✓	✓	✓
Land Use Planning and Management	✓	✓	✓	✓	✓	✓	✓
Recharge Area Protection		✓	✓	✓	✓	✓	
Sediment Management		✓		✓		✓	
Watershed Management		✓	✓	✓	✓	✓	✓
People and Water							
Economic Incentives (Loan, Grants, and Water Pricing)	✓	✓	✓	✓	✓	✓	✓
Outreach and Engagement	✓	✓	✓	✓	✓	✓	✓
Water and Culture	✓	✓	✓	✓	✓	✓	✓
Water-Dependent Recreation				✓	✓	✓	✓

Strategies that help increase water supplies serve as valuable climate change adaptation tools as well. For example, implementing conjunctive management and groundwater storage helps coordinate the use of both surface and groundwater resources to maximize the availability and reliability of water supplies. In the future, when timing and availability of supplies are less certain, conjunctive management could help the MAC Region adapt to climate change. Another adaptation strategy is to develop a project that provides additional local surface storage as a means of helping a water system adjust to altered streamflow timing resulting from earlier snowpack melting. Additional storage capacity could also help the MAC Region adapt to the anticipated increased precipitation variability. Increased surface storage could allow ecosystem and water managers to make real-time decisions that are not available otherwise. Added storage provides greater flexibility for capturing surface water runoff, managing supplies to meet seasonal water demands, helping manage floods from extreme storm events, and responding to extreme weather conditions such as droughts. Rehabilitation and possible enlargement of existing dams and infrastructure can potentially eliminate the need for new reservoir storage.

Improve Water Quality

Water quality improvement strategies apply to all types of water supplies and phases of distribution, and include improving drinking water treatment and distribution, groundwater/aquifer remediation, matching water quality to use, pollution prevention, salt and salinity management, and urban stormwater runoff management. These RMSs address improving water quality prior to contamination, treating contaminated supply sources, and ensuring quality water that meets regulations. These strategies can also help climate change mitigation and adaption.

Strategies that improve water quality can provide significant climate change mitigation benefits. The Region can help mitigate climate change, for example, by improving energy efficiency related to water treatment and distribution. Pollution prevention activities, such as reduced vehicle use and reduced fertilizer application, also help reduce the release of GHG emissions. Additionally, managing urban runoff and capturing stormwater for beneficial reuse can help decrease the energy required to import water.

These RMSs are also important tools for adapting to climate change. Climate change impacts can pose a number of challenges for surface water treatment plants, including increased monitoring and treatment flexibility necessary to quantify and treat for source water quality changes in order to maintain finished water quality. Continued growth statewide will result in increased stress on the limited water resources available for domestic, agricultural, and industrial uses. Improving water treatment technologies and matching quality to end use can provide the flexibility required to adapt to uncertain future conditions. In recent years, as point sources of pollution have become regulated and controlled, “non-point source” (NPS) pollution has become a primary concern for water managers. Urban runoff management, including green infrastructure, encompasses a broad range of activities to manage both stormwater and dry weather runoff. Stormwater capture and reuse projects can reduce the burden on wastewater treatment plants and augment water supplies, helping communities adjust to climate change impacts on water quality and water supply.

Improve Flood Management

While the MAC Region does not currently experience significant flooding impacts, climate change is anticipated to cause more frequent and more severe flooding, which may result in increased vulnerability for the MAC Region. Flood management involves emergency planning, general planning activities, and policy changes. Improving flood management can help a region adapt to not only potential flooding but many other related climate change impacts, including ecosystem and water quality vulnerabilities. If floodplain restoration is incorporated into a flood management strategy, this strategy can also help mitigate climate change by sequestering carbon in newly formed or restored floodplains.

Practice Resources Stewardship

Practicing resource stewardship helps maintain and restore important natural ecosystem functions that contribute to sustainable water resources management. These strategies can play an important role in mitigating climate change while simultaneously protecting key resources. For example, agricultural land stewardship can help mitigate climate change by increasing carbon sequestration and limiting management practices that increase GHG emissions. Ecosystem restoration can also be used to expand vegetated areas to sequester carbon. GHG emission reductions can also be achieved by protecting recharge areas that allow use of local groundwater sources rather than other more energy-intensive water supplies. Sediment management strategies can also offset GHG emissions associated with sediment removal practices.

The resource stewardship strategies are also climate change adaptation tools. Land use planning and management promotes sharing information across sectors and allows regional planning for adverse impacts associated with climate change. Better management of agricultural lands, for instance, can lead to flexible cropping patterns, protection and enhancement of wildlife habitats, and prevention of wildfires with effective grazing. The MAC Region contains significant upland forest areas that drain to the region's water supplies. While the Upper Mokelumne River Watershed Authority, as the Regional Water Management Group, is not responsible for managing these upland forested areas, protection of those lands is important to ensure high quality surface runoff supplies. Proper forest management would improve water quality, help reduce wildfires, and improve ecosystem and habitat within the Region. Additional stream gages and precipitation stations could help establish and confirm climate trends and evaluate hydroclimatic and geologic conditions. Water quality and sediment monitoring stations would allow quantification of the effects of climate change as well as forest management activities on surface water quality (CDM, 2011). Structuring watershed management to provide multiple benefits, such as improved water quality, increased biodiversity, and restored ecological function, can help the MAC Region adapt to a changing climate.

People and Water

Engaging the community in water resources is an important component of the IRWM Program. Several strategies target the connection between people and water to better implement water projects and programs. Like the other RMSs, the People and Water strategies can help mitigate and adapt to climate change. Outreach and engagement can help mitigate climate change when efforts are focused on reducing a community's carbon footprint and encouraging water and energy conservation. The MAC Region can work to identify opportunities for water recycling and renewable energy and to promote water-dependent recreation activities that encourage residents to engage in less energy-intensive activities. Additionally, through outreach and engagement, communities can adapt to climate change by leveraging resources, collaborating on monitoring efforts, and improving information sharing. Through the IRWM program and other planning processes, the MAC Region can work with community stakeholders to increase open space for recreation and promote resilient ecosystems.

Other Strategies

Additional conservation and demand reduction measures, such as crop idling, irrigated land retirement, and rainfed agriculture can also provide climate change mitigation and adaptation benefits. However, the RMS in this category are not applicable for the MAC Region and were therefore not included.

No Regret Adaptation Strategies

No regret adaptation strategies are those that make sense for current hydrologic conditions, while also helping the region to adapt to anticipated climate change impacts. Table 3-9 presents the No Regret adaptation strategies for the MAC Region. At present, the region is either already implementing these strategies or plans to implement them in the foreseeable future.

Table 3-9: No Regret Adaptation Strategies in the MAC Region

Resource Management Strategies	No Regret Strategy
Agricultural Water Use Efficiency	✓
Urban Water Use Efficiency	✓
Conveyance-Regional/Local	✓
System Reoperation	✓
Water Transfers	
Conjunctive Management and Groundwater Storage	✓
Precipitation Enhancement	✓
Recycled Municipal Water	✓
Surface Storage-Regional/Local	✓
Drinking Water Treatment and Distribution	✓
Groundwater/Aquifer Remediation	✓
Matching Quality to Use	✓
Pollution Prevention	✓
Salt and Salinity Management	✓
Urban Stormwater Runoff Management	
Flood Risk Management	✓
Agricultural Lands Stewardship	✓
Ecosystem Restoration	✓
Forest Management	✓
Land Use Planning and Management	✓
Recharge Area Protection	✓
Sediment Management	✓
Watershed Management	✓
Economic Incentives	
Outreach and Engagement	✓
Water and Culture	
Water-dependent Recreation	

Mitigation/GHG Reduction Strategies

Water distribution can require significant energy. In California, 19% of the state's electricity and 30% of its natural gas is used for water-related activities (CEC, 2005). As the MAC Region solicits and prioritizes projects for inclusion in its IRWM Plan, it must consider GHG emissions from the projects and ways to potentially mitigate climate change.

As described in Chapter 1, increasing GHG concentrations contribute to warming trends and climate change impacts. Because the water industry is a significant GHG contributor, reducing GHGs generated in the

conveyance, treatment, and distribution of water and wastewater poses a significant opportunity to help achieve the GHG emission goals set by AB32.

The variation in temperature and precipitation projections from different emissions scenarios simulated using the GCMs illustrates the importance of implementing adaptation measures now to address climate impacts already taking place. GHG emission reductions must be achieved through cooperation at the global, national, regional, and local levels to prevent or mitigate continued climate change impacts later in the century. Major components of climate change mitigation strategies include:

1. Improve Energy Efficiency
2. Reduce Emissions
3. Carbon Sequestration

Almost all resource management strategies identified by the *2013 CWP Update* can potentially reduce GHG emissions and mitigate climate change impacts. A list of Region applicable strategies and how they contribute to climate change mitigation is included in Table 3-10.

Table 3-10: Applicability of CWP Resource Management Strategies to GHG Mitigation

Resource Management Strategies	Greenhouse Gas Mitigation		
	Energy Efficiency	Emissions Reduction	Carbon Sequestration
Reduce Water Demand			
Agricultural Water Use Efficiency	✓	✓	
Urban Water Use Efficiency	✓	✓	
Improve Operational Efficiency and Transfers			
Conveyance-Regional/Local	✓	✓	
System Reoperation	✓	✓	
Water Transfers	*	*	
Increase Water Supply			
Conjunctive Management and Groundwater Storage	*	*	
Precipitation Enhancement	✓		
Recycled Municipal Water	*	*	
Surface Storage-Regional/Local	*	✓	
Improve Water Quality			
Drinking Water Treatment and Distribution	✓	✓	
Groundwater/Aquifer Remediation	*	*	
Matching Quality to Use	*	*	
Pollution Prevention		✓	
Salt and Salinity Management		✓	
Urban Stormwater Runoff Management	✓	✓	

Resource Management Strategies	Greenhouse Gas Mitigation		
	Energy Efficiency	Emissions Reduction	Carbon Sequestration
Improve Flood Management			
Flood Risk Management			✓
Practice Resource Stewardship			
Agricultural Lands Stewardship			✓
Ecosystem Restoration			✓
Forest Management		✓	✓
Land Use Planning and Management	✓	✓	✓
Recharge Area Protection			✓
Sediment Management		✓	✓
Watershed Management	✓	✓	✓
People and Water			
Economic Incentives	✓	✓	✓
Outreach and Engagement	✓	✓	
Water and Culture	*	*	
Water-dependent Recreation			✓

Source: adapted from CDM, 2011.

Key:

✓ indicates that, in general, this will provide a beneficial effect

X indicates that, in general, this will provide an adverse effect

* indicates that this may provide either beneficial or adverse effects

4. Implementing Projects and Programs

4.1. Project Review Process

4.1.1. Procedure for Submitting Projects and Programs

Project solicitation is the process by which agencies, organizations, and/or members of the public can submit project concepts for inclusion in the IRWMP. To be considered for the IRWMP, projects must be able to be effectively described; however, they can be in any stage of development, from conceptual to design. There are many benefits to submitting a project for inclusion in the IRWMP, including raising local awareness of the potential project and associated benefits and positioning the project for potential State funding.

One project solicitation period was implemented as part of the MAC IRWMP update 2018. An advanced announcement for a call for projects was emailed to the stakeholder contact list and posted on the MAC IRWMP website informing participants that the project solicitation period would be held from July 9, 2018 to August 6, 2018. A project information form was developed and distributed on July 9, 2018 for the project solicitation. The form was emailed to the stakeholder contact list and posted on the website. In addition, RPC members were asked to distribute the form to others that might be interested and announce the process at their respective meetings. Project information forms were required to be submitted to the project team by August 6, 2018. If there was a project included in the 2013 IRWMP that an agency or stakeholder wanted included in the 2018 MAC Plan Update, they were requested to resubmit the project to ensure any updates to the project and status were included in the Update. Forty-seven projects were collected for the 2018 MAC IRWM Plan Update; completed project information forms are included in Appendix F~~E~~.

Forms submitted after the due date have been appended to the MAC Plan Update (Appendix G) but have not been included in the Plan sections. An official project solicitation process for the MAC region may be authorized by the UMRWA Board every two years, at a minimum, in which the RPC will meet to review the prioritized list and provide feedback. More frequent calls for projects may be conducted as deemed appropriate by the UMRWA Board of Directors. During the periodic project solicitation processes, projects submitted after the due date will be added, and the project list will be prioritized.

4.1.2. Procedure for Review and Selection of Projects/Programs

The project review process developed for the MAC Plan Update implemented a two-tiered approach of screening followed by evaluating projects, as depicted in Figure 4-1. The result of this process was a list of projects that meet regional IRWMP goals and statewide water resource management priorities while favoring projects which provide significant regional benefit. The order of prioritized projects does not reflect the recommended implementation order or priority of projects to individual agencies and organizations, but rather to the region. The review process for the MAC Plan Update considered the following factors:

- How the project contributes to Plan goals, and its status and strategic implementation
- How the project addresses Resource Management Strategies and Statewide Priorities
- The technical and economic feasibility of the project
- How the project incorporates climate change mitigation and adaptation actions

- How the project incorporates disadvantaged community and Native American tribal community benefits
- How the project provides multi-agency benefits and addresses environmental justice impacts

After a project was submitted for inclusion in the MAC Plan Update, it went through a basic screening process. In order to be included in the IRWMP, each project met at least one regional goal, at least one Statewide Priority, and at least two RMS. This screening process is depicted as Steps 1 and 2 of Tier 1 as shown in Figure 4-1. Projects that do meet the minimum screening requirements may be modified or merged with another project to increase benefits to the region and meet the specified criteria for inclusion in the IRWMP. At the completion of the preliminary screening, all 47 projects remained for evaluation and prioritization.

Tier 1 - Screening, Step 1

Step 1 of Tier 1 compared projects with the Statewide Priorities and the MAC Plan Update regional goals (see Chapter 3 of this document for more details). Projects must meet at least one regional goal and at least one Statewide Priority to move forward to Step 2.

Tier 1 - Screening, Step 2

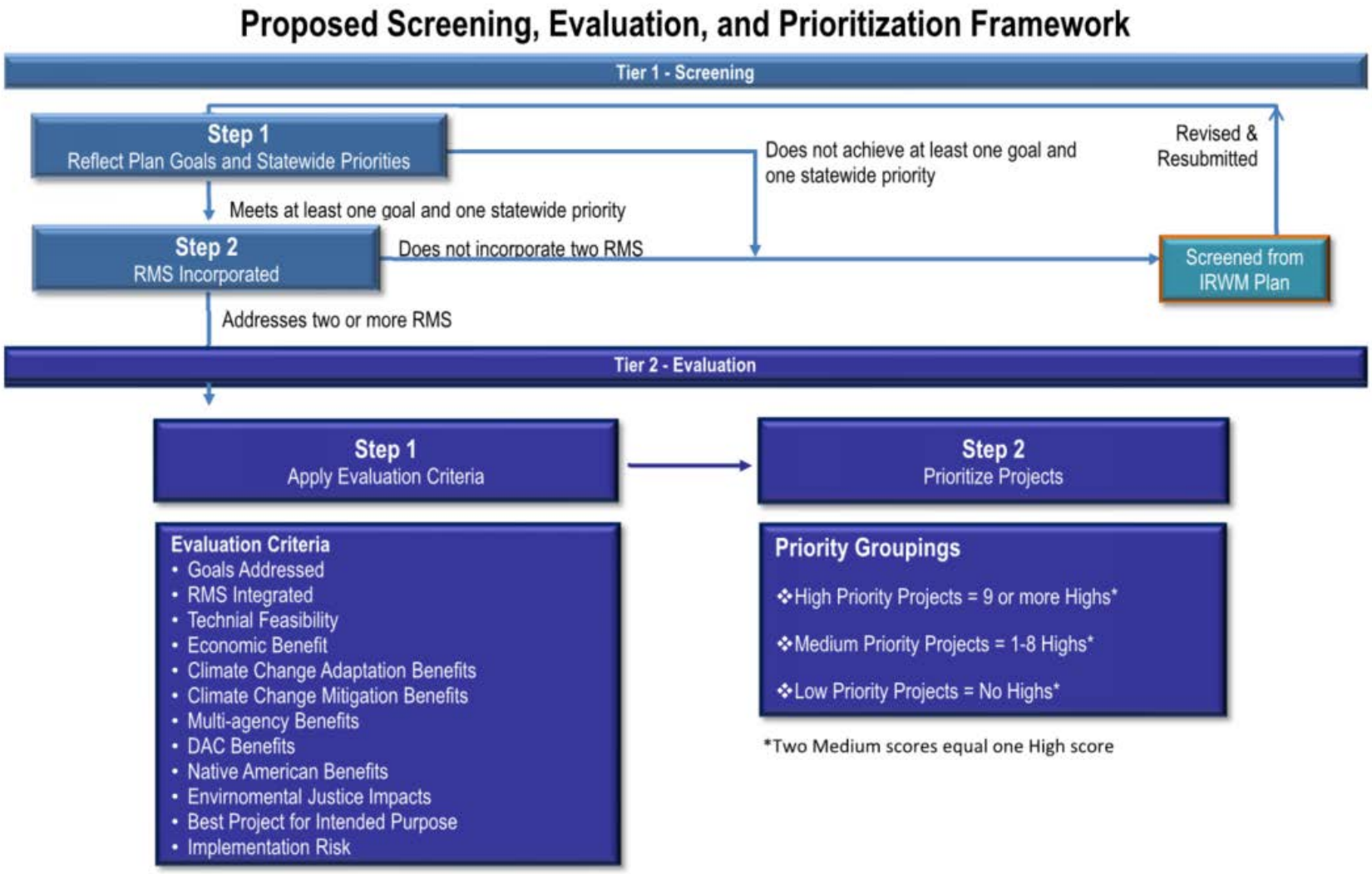
In Step 2 of the Tier 1 prioritization process, each project was compared with the list of RMS. These strategies are discussed in Chapter 3 and include the following.

- Agricultural Water Use Efficiency
- Urban Water Use Efficiency
- Conveyance - Delta
- Conveyance – Regional/Local
- System Reoperation
- Water Transfers
- Conjunctive Management & Groundwater Storage
- Desalination – Brackish & Seawater
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage - CALFED
- Surface Storage – Regional/Local
- Drinking Water Treatment and Distribution
- Groundwater/Aquifer Remediation
- Matching Quality to Use
- Pollution Prevention
- Salt and Salinity Management
- Urban Stormwater Runoff Management
- Flood Risk Management
- Agricultural Lands Stewardship
- Ecosystem Restoration
- Forest Management
- Recharge Area Protection
- Sediment Management
- Watershed Management
- Economic Incentives (Loans, Grants and Water Pricing)
- Outreach & Engagement
- Water & Culture
- Water-Dependent Recreation
- Crop Idling for Water Transfers
- Dewvaporation or Atmospheric Pressure Desalination
- Fog Collection
- Irrigated Land Retirement
- Rainfed Agriculture
- Waterbag Transport/Storage Technology

In order to move forward and be included in the IRWMP, each project must incorporate at least two of the RMS above.

Together, these two preliminary screening steps identified the projects that met both regional goals and objectives and the State's priorities for the IRWM planning process. Projects that met the minimum requirements of addressing at least one regional goal, one statewide priority, and two RMS were included in the MAC Plan Update and passed to Tier 2 of the evaluation and prioritization process.

Figure 24: Project Review and Prioritization Process



4.1.3. Evaluation and Prioritization of Projects and Programs

The purpose of project prioritization is to identify those projects with highest value to the MAC region, as defined in the MAC Plan Update. The means by which this prioritization is achieved can vary significantly, but for a process that aims to achieve integrated and regional results, the selection of projects to be implemented must ultimately be achieved through consensus. The RPC is responsible for project review based on the information in the project information forms and the identified evaluation criteria. For the purposes of the MAC Plan Update, consensus is defined as the process by which agreement is reached by a group as a whole. It is important to note that inclusion of a project in the MAC Plan does not reflect endorsement by any or all members of the RPC or UMRWA.

The Tier 2 process yielded the prioritized list of IRWMP projects by utilizing a two-step evaluation process.

Tier 2, Step 1 – Apply Evaluation Criteria

Step 1 of the Tier 2 process involves assessment of project benefits in several areas. Due to the conceptual nature of many of the projects and incomplete data, these projects were evaluated qualitatively. This evaluation focused on the following twelve evaluation criteria.

Criterion 1: Address MAC Plan Goals. The specific goals each project met were identified to determine how well each project met regional needs. Projects were rated as follows.

Low = Addresses less than 2 specific regional goals

Medium = Addresses 2 - 4 specific regional goals

High = Addresses 5 or more specific regional goals

Criterion 2: Integrate with State RMS. In order to recognize multi-benefit, integrated projects, projects were assessed for the degree of RMS integration. Projects were rated as follows.

Low = Incorporates 2 RMS

Medium = Incorporates 3 - 5 RMS

High = Incorporates 6 or more RMS

Criterion 3: Ensure Technical Feasibility. The IRWMP seeks to promote projects that are not only economically feasible, but technically feasible as well. Projects were qualitatively assessed based on implementation feasibility, given knowledge about the project, location, and whether there are data gaps. Projects were rated as follows.

Low = Insufficient technical knowledge or supporting data to sustain claimed benefits/values

Medium = Adequate technical knowledge and supporting data to defend claimed benefits/values although some gaps may exist

High = Ample technical knowledge and supporting data to uphold claimed benefits/value

Criterion 4: Maximize Economic Feasibility. Project benefits and costs were qualitatively assessed to establish a high level determination of economic feasibility. Projects were rated as follows.

Low = Lower benefit-cost ratio

Medium = Mid-range estimated benefit-cost ratio

High = High estimated benefit-cost ratio

Criterion 5: Incorporate Climate Change Adaptation Benefits. In order to recognize the potential implications of climate change in long-term planning, projects were assessed for their contribution to climate change adaptation. Projects were rated as follows.

Low = Climate Change Adaptation Benefits Are Unlikely

Medium = Adaptation Benefits Are Likely

High = Adaptation Benefits Have Been Demonstrated

Criterion 6: Incorporate Climate Change Mitigation Benefits. In order to recognize the potential implications of climate change in long-term planning, projects were assessed for their contribution to climate change mitigation of greenhouse gas (GHG) emissions. Projects were rated as follows.

Low = Climate Change Mitigation Benefits Are Unlikely

Medium = Mitigation Benefits Are Likely

High = Mitigation Benefits Have Been Demonstrated

Criterion 7: Provide Multi-agency/Entity Benefits. As a regional program, the IRWM Plan promotes projects with multiple partners. A project that benefits more than one agency may benefit a larger population, utilize economies of scale, reduce regional conflicts, and may be more likely to incorporate multiple benefits in multiple resource areas. Projects were rated as follows.

Low = Benefits 1 agency/entity

Medium = Benefits 2 agencies/entities

High = Benefits 3 or more agencies/entities

Criterion 8: Maximize Disadvantaged Community (DAC) Benefits. Projects were assessed to identify projects that provide targeted benefits to address the critical water supply, water quality, and resource management needs of local DACs. Projects were rated as follows.

Low = Provides no DAC benefits

Medium = May provide some benefits to one or more DACs

High = Provides targeted benefits to one or more DACs

Criterion 9: Maximize Native American Benefits. Projects were assessed to identify projects that provide targeted benefits to address the critical water supply, water quality, and resource management needs of tribal communities. Projects were rated as follows.

Low = Provides no Native American tribal community benefits

Medium = May provide some benefits to one or more Native American tribal communities

High = Provides targeted benefits to one or more Native American tribal communities

Criterion 10: Minimize Environmental Justice (EJ) Impacts. Projects were assessed to identify projects that minimize environmental justice impacts. Projects were rated as follows.

Low = Has environmental justice impacts

Medium = May have environmental justice impacts

High = Does not have environmental justice impacts

Criterion 11: Minimize Implementation Risk. To help identify projects that may have significant challenges achieving successful implementation and conversely, identify projects that have minimal institutional, political, and legal obstacles, this criterion was applied to the projects. Projects were rated as follows.

Low = High implementation risk due to documented institutional barriers such as regulatory, environmental, or permitting obstacles, and high degree of controversy, potential legal challenge, or potential partners' uncertainty

Medium = Moderate implementation risk due to documented institutional barriers such as regulatory, environmental, or permitting obstacles, and high degree of controversy, potential legal challenge, or potential partners' uncertainty

High = Minimal implementation risk due to documented institutional barriers such as regulatory, environmental, or permitting obstacles, and high degree of controversy, potential legal challenge, or potential partners' uncertainty

Criterion 12: Best Project for Intended Purpose. This criterion was applied to the projects to recognize that sometimes projects that may have the greatest likelihood of being realized to achieve a specific purpose may not always be the best projects from an economic, environmental, or social perspective. Projects were rated as follows.

Low = Other alternatives clearly exist that will be better to meet the intended need from a social, environmental, and economic perspective

Medium = Other alternatives exist that may be preferable from a social, environmental, and economic perspective

High = Project is the best possible alternative to meet the stated need from a social, environmental, and economic perspective

Tier 2, Step 2 – Prioritize Projects

In Step 2 of the Tier 2 process, the projects were prioritized based on their overall scores. The projects received a final score of High, Medium, or Low, which were determined as follows.

High = Received 9 or more Highs on evaluation criteria. Two Mediums on evaluation criteria are equivalent to one High

Medium = Received 1 to 8 Highs on evaluation criteria

Low = Received no High scores on evaluation criteria

Results

During the project solicitation period, seven agencies/entities submitted 47 projects for consideration. All 47 projects were prioritized using the evaluation methodology previously described. The application of this process generated 18 Medium priority projects and 29 High priority projects.

The project list and the associated scores (as of August 2018) are included in Appendix H~~F~~. The spreadsheets developed during the evaluation are also presented in Appendix H~~F~~; Tier 1, Step 1 through Tier 2, Step 2 are demonstrated in the spreadsheets. Implementing the projects identified and evaluated through the Project Review Process will assist in addressing specific water management issues in the MAC Region. Table 4-1 summarizes the issues that will be addressed by project implementation.

4.1.4. Process for Updating the Project List

The MAC Plan Update is a living document and project needs can change frequently. Therefore, the project list will be updated periodically. When deemed appropriate by the RWMG, a project solicitation process will be conducted, project information forms will be completed by interested stakeholders, and the project proposals will be evaluated by the RPC per Plan criteria. The RWMG will convene a meeting (or several if needed) to facilitate the review of project proposals and evaluation, review and approve the updated list, and publish and post on the UMRWA website (www.umrwa.org).

Table 4-1: MAC Region Water Management Issues Addressed by IRWM Projects

Problem	Objective/Solution	Project(s) Meeting Objective
Current farming practices in Amador County emit carbon into the atmosphere, contributing to climate change.	Assist and educate farmers and ranchers in Amador County to implement carbon farm planning projects to achieve enhanced carbon sequestration.	1 – Soil Health & Climate Resilient Agriculture Education Program
The groundwater basins in and around Amador County are overdrafted and groundwater is not a reliable supply in times of drought.	Study the feasibility of a conjunctive use program to recharge groundwater basins using surface water during wet years and sustainably use groundwater during drought and/or implement projects to reduce, improve, or eliminate undesirable groundwater conditions.	2 – Groundwater Banking Conjunctive Use Study 28 - SGMA Implementation for Amador County
Groundwater quantity and quality conditions in Amador County are not well understood.	Identify aquifer parameters throughout Amador County such as safe yield, contaminants, seasonal groundwater levels, perched aquifers, deep aquifers, fractured rock, etc.	3 – Groundwater Capacity in Amador County
Sediment buildup has decreased the water storage capacity of PG&E reservoirs.	Study the potential of rehabilitating and expanding the PG&E reservoirs to increase water storage capacity by dredging sediment.	5 – PG&E Storage Recovery
The distribution, collection and treatment systems for the Amador Water Agency are old, antiquated, undersized, and various locations suffer from various states of disrepair.	Use computer modeling and master planning to identify necessary replacement and modifications to the water and wastewater systems within Amador County to improve water supply delivery and meet minimum fire flow requirements, as well as improve wastewater conveyance and treatment.	9 – Amador Water Agency System Computer Modeling 10 – Amador Water Agency Master Plan
Some residents in Amador County along the Amador Canal do not have access to treated water and use raw water from the Canal for domestic use in their homes.	Study options to bring a treated water pipeline to these residents to provide treated water and adequate fire flow.	21 – Amador Water Agency Treated Water Supply Study

Problem	Objective/Solution	Project(s) Meeting Objective
Community leachfield systems around Amador County may be contributing to rising nitrate in the groundwater.	Analyze nitrate level rise in all of the community leachfield systems to develop a course of action for the best possible long term solution to minimize nitrate level rise in the groundwater.	22 - Amador Water Agency Treated Water Supply Study
Martell's wastewater collection system contains old lift stations that require increasing maintenance and repair. Additionally, wastewater in parts of Martell is pumped twice before being sent to Sutter Creek for treatment and disposal.	Eliminate double pumping of wastewater by reducing the number of lifte stations within the Martell area and expand and update those that would remain.	23 - Martell Wastewater Lift Station Reduction Project
The Tanner WTP is aging and is in need of major improvements.	Rehabilitate the Tanner WTP including all control valves, computer control, and other equipment.	26 – Tanner WTP Rehabilitation and Efficiency Project
The New York Ranch Reservoir has been designated as a conservation area and there is a need to further investigate a number of issues to fully implement the Natural Resource Conservation and Management Plan proposed for the reservoir area.	Investigate water diversions from the upper gulch, role of groundwater, maintenance of existing structures and facilities, dry season conditions, a water management strategy, enhancing conditions for special status species, and upland habitat enhancement and develop a public access plan to protect cultural resources.	30 – New York Ranch Reservoir Conservation and Management Study
CCWD's water meters are located in a variety of box types and are arduous, inefficient, and time-consuming to read.	Implement an upgraded meter replacement pilot project.	33 – West Point Automated Meter Reading Project
The usable storage in Wilson Lake is significantly diminished due to the fact that the dam was not designed with a seepage cutoff and has no functional outlet controls.	Rehabilitate Wilson Lake and conjunctively restore the mountain meadow habitat upstream.	35 - Wilson Dam Meadow Restoration and Habitat Enhancement Plan
High country meadow habitats have been degraded.	Restore high-elevation meadows to approximate natural function to provide water supply, water storage, and ecosystem enhancement benefits.	37 - Mokelumne High Country Meadow Restoration

Problem	Objective/Solution	Project(s) Meeting Objective
Noxious and nonnative weeds and plants have been proliferating along Amador and Calaveras County waterways.	Develop maps of noxious weed infestations along local waterways and to work with community and river/water stakeholders to explore eradication options and develop an eradication plan.	38 - Riparian Noxious Weed Abatement Plan
No landowner's guide currently exists for the uUpper Mokelumne wWatershed.	Develop a watershed landowner's guide for the uUpper Mokelumne Waters Shed area.	40 - Upper Mokelumne Watershed Landowner Guide
The City of Jackson's sewer lines were installed in the 1930s in the City's creek beds. These aging sewer lines are in need of replacement and are at risk of polluting local creeks with wastewater.	Develop a conceptual design and feasibility study to review the possibility of removing the City's sewer mains from Jackson Creek.	41 – Jackson Creek Sewer Line Relocation – Conceptual Design/Feasibility Study
Small water systems, particularly those that serve DACs, frequently do not have adequate resources to construct and maintain adequate water treatment and distribution facilities.	Identify, catalogue, and assess water systems that serve small DACs in the MAC Region.	43 – MAC Region DAC Small Communities Water Needs Assessment
Sedimentation occurs in watershed streams and other water bodies in the Mokelumne River wWatershed and adversely impacts water quality and aquatic resources	Identify the current level and sources of sediment delivery to the Mokelumne River Watershed and select, prioritize, and implement restoration actions to improve watershed conditions.	44 - North Fork Mokelumne Watershed Erosion Control & Water Quality Restoration Plan 45 – North Fork Mokelumne Watershed Erosion Control & Water Quality Restoration Project 46 - Upper Mokelumne Erosion and Water Quality Assessment and Restoration Plan 47 – South Fork Mokelumne River Watershed Restoration
There currently is no emergency backup for the CAWP or AWS water systems.	Provide redundancy & emergency backup supplies for CAWP and AWS.	14 – Upper-Lower Water System Reliability Intertie Project
The Amador Canal has significant leakage and water loss.	Reduce water loss by converting the canal to a pipeline.	4 – Amador Canal Water Conservation Project
AWA has limited treatment capacity at its Ione and Tanner WTPs.	Increase the water treatment capacity available to AWA.	13 – Ione WTP Planning Study

Problem	Objective/Solution	Project(s) Meeting Objective
AWA's existing water distribution system suffers from low pressures, leaving the community with minimal water supply and inadequate fire protection.	Study the system and identify prioritized improvements to enhance fire protection.	17 – CAWP Fire Protection Project 16 – Amador Water Agency Low Pressure Fire Flow Improvements
Along Highway 88 from Buckhorn to Martell, leach fields are relied upon, which have contributed to increased nitrate levels in surrounding soils and impacted groundwater quality.	Collect septic tank effluent from these communities and deliver it to a regional plant for wastewater treatment.	11 – Highway 88 Corridor Wastewater Trunkline Study
The communities of Jackson, Sutter Creek, Amador City, and Martell all have independently operated wastewater treatment facilities in need of repair and upgrades. Additionally, Amador County's water supplies are vulnerable to drought.	Replace the wastewater treatment facilities with a new regional wastewater treatment and recycling plant to bolster Amador County's non-potable water supply.	13 – Regional Wastewater Treatment and Recycling Project
The Camanche water system is currently configured such that filling old storage tanks reduces domestic pressure and fire protection, leading to fluctuating system water quality and potential vulnerability during firefighting events.	Install a transmission line that will eliminate the need for the old storage tanks to provide additional supply and fire flow protection.	15 – Lake Camanche Transmission Main Project
The service laterals in the Camanche water system were installed in the late 1970's and as they age, they become subject to severe longitudinal cracking. They regularly leak and fail, causing significant damage to other infrastructure and substantial water loss.	Repair and replace the service laterals in the Camanche water system.	20 – Lake Camanche Water Service Replacement – Phase IV
There are inadequate water supplies in Amador and Calaveras counties to serve development and provide drought protection in the future.	Increase potable and recycled water supplies in the counties.	6 – Lower Bear River Reservoir Expansion Project 7 – Surface Storage Feasibility Study 8 – Lake Camanche Recycling Water Project 27 – Water Storage Reoperation Study
The Sheep Ranch WTP is currently out of compliance according to CDPH	Upgrade the WTP to ensure compliance	32 – Sheep Ranch Water Treatment & Distribution Compliance Project
The areas surrounding Lake Camanche, served by EBMUD, AWA, and CCWD have a poor quality and unreliable water supply.	Create a new, reliable water supply for the Camanche Area.	12 – Camanche Area Regional Water Supply Project Phase II

Problem	Objective/Solution	Project(s) Meeting Objective
The West Point WTP is currently in violation with the CDPH regarding a backup filter system.	Install a backup filtration system at the West Point WTP.	34 – West Point WTP Drinking Water Compliance Project
Chinook salmon and steelhead populations have been blocked from their historic spawning habitat in the upper Mokelumne River by downstream dams.~~Salmon and steelhead populations have significantly decreased in the upper Mokelumne River.~~	Study fish habitat improvement programs and implement a program to move spawning salmon and steelhead to restore populations.	39 – Restoring the Upper Mokelumne's Anadromous Fish 29 – Fishery Habitat Improvements
Water demands must be reduced in order to offset potable water supplies and meet State requirements.	Implement a conservation program including residential surveys, high-efficiency washer rebate program, ultra low-flow toilet replacement program, lead detection, master metering, and education programs.	36 – Amador Household Water Efficiency Project 31 – MAC Conservation Program Implementation
The Stanislaus National Forest in the upper headwaters of the Middle Fork Mokelumne River requires restoration and maintenance to improve forest resiliency, watershed conditions, meadow function, and wildlife and ethno-botanical connectivity and diversity.	Implement landscape restoration treatments.	42 – Hemlock Forest Restoration Water Yield Project Study
The existing Ione Clearwell Cover is over twenty years old and The Ione and Tanner WTPs have floating covers on water storage facilities and which are prone to has developed numerous pinhole leaks that are possible sources of contamination as identified in various CDPH annual inspections.	Replace the covers with a newer, more resilient material structural roof or dome or a concrete tank that would better protect the quality of the treated water.	1934 – Ione Clearwell Cover Replacement Floating Covers Replacement Project
CDPH stated AWA must invest and improve the condition of the Buckhorn system's distribution storage tanks due to deteriorated conditions.	Replace and eliminate the deteriorating tanks.	18 – CAWP Tanks Replacement and Consolidation Project
The Lake Camanche Village Wastewater Treatment Plant has been overwhelmed by large storm events in the past. Additionally, many homes surrounding the Wastewater Treatment Plant are currently using individual septic systems that have or are expected to fail.	Upgrade the treatment facility to adequately address large storm events and to serve customers that are currently using individual septic systems near the treatment plant.	25 – Lake Camanche Regional Wastewater System

4.1.5. Project Integration

The RPC developed the project review and evaluation process to foster integration and identify project efficiencies and maximize benefits. The high priority projects, as identified through the project review process, integrate RMS and tend to be multi-benefit projects. The more RMS a project integrates, and the more benefits it will achieve, the more likely it is to receive a High score. Of the 47 projects submitted for inclusion in the MAC Plan Update, 33 projects received High scores for the RMS Integrated evaluation criteria, meaning each project integrates at least 6 RMS. 24 of the 33 projects that received High scores for RMS integration, received final High scores as well. When projects integrate multiple RMS there is the opportunity to take advantage of synergies in water management.

There are a number of projects in the MAC Plan Update that showcase how integrating a project can yield better results. One example of this is the CARWSP. This project is structured to integrate a number of resource management strategies, foster collaboration among three water suppliers in the region, and provide significant water supply and water quality benefits to disadvantaged communities. The CARWSP planning process was enabled by a Proposition 84 IRWM planning grant received by the MAC IRWM Region from DWR. Phase I of CARWSP, a $3M project, was implemented with $1.4M in grant funding from DWR's Proposition 84 – Round 2 Program. Completed in 2013, Phase I constructed a regional water treatment plant at Camanche South Shore to increase water quality supply reliability.

CARWSP Phase II, included in the 2018 MAC Plan Update, would connect AWA's system to EBMUD's treated surface water via an intertie valve and would pump the water to two 0.5 MG storage tanks at AWA's Tank 9 site. AWA would then be able to abandon wells 6 and 12 and reduce the output of wells 9 and 14 and blend surface water with groundwater. This project would eliminate the contamination issues associated with well over draft, allow the aquifer to recharge, manage groundwater resources, and provide an adequate supply with better quality to the ratepayers of Lake Camanche in both the short and long term.

4.1.6. Considerations for Future Updates

The IRWM planning process is an evolutionary process, in which each plan update generates new thoughts, ideas, and lessons learned. In order to ensure that future plan updates consider the lessons learned during this update, the RPC documented several considerations to be addressed in future updates. The RPC identified the following recommendations for future Plan updates.

- Allow for additional time for critical vetting of project submittals to ensure that project issues are addressed and there is consensus on project scoring.
- Consider integrating groundwater management more thoroughly into the IRWM plan. While the region is primarily served by surface water supplies, groundwater will be an increasingly important supply in coming years.
- Add more detailed cost and financing information to project summaries as the project mature and more information becomes available.
- Consider adding the creation of a DMS to future updates.
- Update the MAC Outreach and Communications Plan to include:
  - A process for identifying and engaging key stakeholder groups that are not currently participating in the IRWM planning process, including land use planning entities, DACs, and Native American tribes, among others. A process for ensuring greater participation by DACs should be identified as a high priority. In addition, participation in the IRWM planning process by planning departments, health departments, transportation agencies, fire districts, California Department of Fish and Game, the Regional Water Quality Control Board, and other entities should be encouraged.
  - A Policy for collecting and addressing public comments as part of future updates.

- Guidance for information collection, review, and acceptance for inclusion in the MAC IRWM Plan.
- Incorporation of additional stakeholder outreach meetings, focused on engaging key stakeholder groups that do not have time to commit to attending monthly RPC meetings, yet whose input is valuable. These meetings will be held at a greater frequency than the general public outreach meetings and will be geared toward providing meaningful input for the RPC's consideration.
- RPC representation on related stakeholder groups, such as the ~~Amador and Calaveras Consensus Group~~ACCG that is currently working with privately-owned lands as well as with the Bureau of Land Management and the USFS on forest restoration and fuel reduction projects.

- Update the regional conflicts discussion.
- When identifying data gaps in future updates, list specific data gaps identified by previous studies and consider requesting grant funds to fill data gaps.
- Perform a GHG emissions assessment for the project included in the Plan. Note: GHG emissions assessments will be performed for projects soliciting funding through the IRWM program. A high level, qualitative GHG assessment was completed as part of the project evaluation process in order to determine whether projects are likely to have climate change mitigation benefits.

4.2. Coordination with Water and Land Use Agencies

4.2.1. IRWM Water Planning History

The first MAC integrated regional water management planning effort was completed in 2006. This initial effort was based on a cooperative endeavor between the "partnering agencies" which included AWA, CCWD, Amador County, City of Jackson, City of Sutter Creek, City of Plymouth, ARSA, and EBMUD. These partnering agencies which included local water planners (e.g., AWA, CCWD, EBMUD), land use agencies (e.g., Amador County), wastewater agencies (e.g., ARSA, City of Jackson), and disadvantaged communities (e.g., Sutter Creek and Jackson), entered into a Memorandum of Understanding (MOU) in October 2006 for the purpose of funding the development of the first MAC Plan and coordinating water resources planning and implementation activities.

The first MAC Plan process included other entities and stakeholders with interests in regional water planning in addition to the partnering agencies. These stakeholders played an essential role in plan development by providing a variety of ideas, values, perspectives, and cultures that represented the diversity present within the region. These stakeholder participants, representing a wide array of organizations with planning roles and responsibilities, included Calaveras County, Calaveras Public Utilities District, Eastern San Joaquin Groundwater Banking Authority, City of Ione, Jackson Valley Irrigation District, City of Lodi, Pacific Gas and Electric Company, Protect Historic Amador Waterways, and the Upper Mokelumne River Watershed Council. These stakeholders participated and provided input through their attendance at stakeholder meetings, by direct correspondence, and via other communications. The geographic boundary developed and used during this initial MAC regional planning process was broader than what is reflected in the current MAC region. The primary difference is that areas within Eastern San Joaquin County, which remain within the Northeastern San Joaquin County Groundwater Banking Authority's (GBA) IRWM region, have been removed from the MAC region. This area was initially included in both regions (thus constituting an overlap area) because of the interest of both regions in evaluating mutually-beneficial conjunctive use opportunities. Subsequent to the completion of the two regions' initial IRWM plans, it was decided that eliminating the overlap area, and thereby eliminating the associated governance complications, was a better approach. Thus, the decision to delete what is essentially a portion of the l~~L~~ower Mokelumne River watershed from the MAC region was made in conjunction with the GBA region. The resulting change in the adjoining region's boundary was subsequently approved by DWR as part of the 2009 RAP process.

The cooperative planning that resulted in the MAC region's initial regional plan has not always been the norm. For many decades, the competing water needs of Amador and Calaveras counties and EBMUD presented obstacles to cooperative development of water resource solutions. These decades of rivalry and discord had rendered cooperative regional water planning an impossible challenge until recently. With the creation of the UMRWA in 2000 and ongoing regional water resource planning venues promoted by the Integrated Regional Water Management Act and the Mokelumne River Forum, new opportunities to work together to develop solutions to today's water resource problems began to emerge. The boundary of the MAC region was configured in part to reflect this history, and in part to further opportunities for these historically competitive interests to work cooperatively to find mutually-acceptable water management solutions.

Several of the Authority's recent initiatives and accomplishments, briefly described below, are indicative of the local water planning conducted in the region, its ties to regional water resource planning and programs in the MAC Region, and interconnectivity with the IRWMP Update.

Mokelumne Watershed Interregional Sustainability Evaluation (MokeWISE) – Through the first inter-regional integrated regional water management planning effort funded by DWR, MAC Region stakeholders, along with stakeholders in Eastern San Joaquin, completed a holistic assessment of water management options. The Mokelumne Collaborative Group, the stakeholder group leading the MokeWISE effort, evaluated opportunities for integrated and collaborative water management, identified actions with broad support amongst participating stakeholders, and developed a multi-regional conceptual plan to implement the preferred projects. The MokeWISE Program, completed in 2015, resulted in a broadly-supported water resources program that will help us better prepare for an uncertain future.

Upper Mokelumne River Watershed Assessment and Planning Project - One of the Authority's milestone tasks, this $1.3 million project was completed in December 2007. The project was undertaken to advance the understanding of watershed water quality and related environmental issues, and to develop tools which will facilitate the long-term evaluation and management of u~~U~~pper Mokelumne River watershed water and natural resources. Funding for the project was provided by Authority member agencies ($317,500) and by grants from Propositions 50 and 84 ($950,000). Development of this comprehensive watershed project was guided by a Project Advisory Committee (PAC), which included stakeholders representing a diverse set of watershed interests such as water, resource management, environmental resources, agriculture, timber, recreation and national forest lands. Baseline watershed water quality was characterized, providing a reference point for assessing water quality impacts associated with future changes in the watershed. Also, a physical hydrologic watershed model was developed using the Watershed Analysis and Risk Management Framework (WARMF) tool. The WARMF model was used to analyze the watershed's existing hydrologic and water quality characteristics as to simulate how water quality conditions could change based on changes to land uses and activities. Activities and reports prepared as part of this project included:

- *Wildfire Models* – Fire behavior was modeled throughout the watershed to gain a better understanding of high risk areas and potential impacts from wildfires. *FlamMap* was used to determine the relative hazard and flammability of selected watershed areas. This model allows prediction of fire behavior on a spatial basis by modeling flame length, heat release, rate of spread and type of fire (e.g., surface fire, crown fire). The *FARSITE* model was used to simulate potential fire behavior and predict where and how fast fire would spread from pre-selected burn ignition sites in the watershed. The fire behavior simulation outputs were used to develop three new categories of land use/land cover for the watershed based on burn severity: low, moderate and high. The spatial distribution of the burn severity categories for each selected ignition site was used as an input to the WARMF model to simulate potential effects on water resources resulting from wildfires in specific vulnerable areas of the watershed.

- *Water Quality Vulnerability Zones* – Areas within the watershed considered to have very high to moderate vulnerability to water quality contamination were identified based on key physical characteristics of the watershed including slope, soils, vegetation and proximity to water. A map was developed identifying watershed vulnerability zones.
- *Watershed Assessment* – The water quality in the uUpper Mokelumne River watershed was assessed in a three-step process. Guided by the stakeholder PAC, water quality benchmarks were established, specific water quality parameters of concern were identified, and selected parameters exhibiting historical exceedances were analyzed to determine source locations and characteristics.
- *Upper Mokelumne River Watershed Management Plan* – A management plan was prepared, addressing the findings of the watershed assessment by coupling scientifically valid data and technically-based recommendations to maintain and improve source water quality with stakeholder understanding and support. The PAC-guided plan contains a series of recommended management actions designed to reduce sources of contaminants, manage contaminated flows and sediments, and encourage regulatory and institutional controls.
- *Water Conservation Plan: A Guide for Assisting Authority Members Prepare Water Agency Conservation Plans* – This plan was prepared to provide UMRWA member water agencies with guidance in establishing individual agency-specific water conservation plans and thus aid in their efforts to improve water conservation and water recycling. The plan is designed to serve as a resource document for water agency staff and it includes basic water conservation plan elements found throughout the water utility industry. It also includes recommended water conservation measures and programs which may be adapted to fit the specific needs of water agencies in the region.

4.2.2. Local Water Planning Documents

The MAC IRWMP and this update were developed based on collaborative discussions regarding regional needs, proposed projects, and teaming for regional effectiveness. As various regional stakeholders shared their needs and objectives, similarities and opportunities for collaboration were identified. The RPC began developing a regional plan to bring about integrated projects for the benefit of the region, building on these similarities and opportunities. During plan preparation and development, data and water management strategies were collected from a number of existing local and/or sub-regional planning documents and were integrated into the regional strategies presented in this document. Examples of local planning documents reviewed during the IRWMP development and update include Urban Water Management Plans, Water Supply Master Plans, Capital Improvement Plans, Recycled Water Master Plans, project Environmental Impact Reports/Environmental Impact Statements, and grant applications for other state and federal programs. Table 4-2 summarizes key planning reports used in the IRWMP preparation process and update.

Table 4-2: Major Planning Reports Used to Create the MAC IRWMP

Document Title/Description	Publication Date	Agency(ies)/ Entity(ies)	Relation to IRWMP
Calaveras County Mokelumne River Long-Term Water Needs Study	October 2017	CCWD	For understanding current and future water needs in Calaveras County.
Cosumnes & Mokelumne Rivers Floodplain Integrated Resources Management Plan	January 2006	Southeast Sacramento County Agricultural Water Authority	For understanding of regional integrated planning for floodplain, riparian and riverine environments along the Cosumnes and Mokelumne Rivers.

Document Title/Description	Publication Date	Agency(ies)/ Entity(ies)	Relation to IRWMP
County Water Master Plan	April 1995	CCWD	For general understanding of local water resources issues in Calaveras County.
Eldorado National Forest Land and Resource Management Plan, as amended		USFS	Directly related to management of forest and water resources within the Eldorado NF portion of the u~~U~~pper Mokelumne.
Final EIR, Volume One: Updated Water Supply Master Program	September 1993	EBMUD	Discusses groundwater storage/ conjunctive use as an alternative with groundwater storage to occur in the Lodi area.
Long-Term Water Needs and Supply Study	July 2017	AWA	For climate change impacts on water supply and reliability.
Lower Mokelumne Watershed Stewardship Plan	May 2002	San Joaquin County Resource Conservation District	For general understanding of existing watershed studies and planning along the Mokelumne River.
Mokelumne Watershed Avoided Cost Analysis	April 2014	Sierra Nevada Conservancy	Provides analysis and cost-effectiveness of landscape level fuel reduction projects to reduce wildfire risk and threat to water quality in Mokelumne Watershed
Multi-Hazard Mitigation Plan	June 2006	Amador County	For general information regarding mitigation strategies for reducing potential losses resulting from fire, flood and other possible hazards. Directly relates to several projects.
Power Fire GRAIP Watershed Roads Assessment	2016	USFS Rocky Mountain Research Station	Documents many forms and quantities of road erosion in the 2004 Power Fire area in the North Fork of the Mokelumne watershed and recommends priorities for watershed restoration
Report to the Amador Local Agency Formation Commission, Amador County Municipal Services Review	August 2008	Amador County	A countywide water and wastewater municipal services review – a State-required comprehensive study of services within a designated geographic area.
Stanislaus National Forest Land and Resource Management Plan, as amended	April 2010	USFS	Directly related to management of forest and water resources within the Stanislaus NF portion of the u~~U~~pper Mokelumne.
Upper Mokelumne River Watershed Assessment and Planning Project	November 2005	Upper Mokelumne River Watershed Authority	For general understanding of existing watershed studies and planning along the Mokelumne River.

Document Title/Description	Publication Date	Agency(ies)/ Entity(ies)	Relation to IRWMP
Urban Water Management Plan	2016	AWA	For understanding of Amador-area urban water needs, management and planning objectives.
Urban Water Management Plan	2016	CCWD	For understanding of Calaveras-area urban water needs, management and planning objectives.
Urban Water Management Plan	2016	EBMUD	For understanding of EBMUD service-area urban water needs, management and planning objectives.
Various County General Plans	Various	Amador, Calaveras, San Joaquin and Alpine Counties, City of Ione, Jackson, Lodi, Plymouth, Sutter Creek and Amador City	For general understanding of local land use, environmental/water resources, economic, and administrative management issues.
Water and Wastewater Municipal Service Review for Calaveras Agency Formation Commission	April 2011	Calaveras County	A countywide water and wastewater municipal services review – a State-required comprehensive study of services within a designated geographic area.
Water Resources and Land Use Planning, Watershed-based Strategies for Amador and Calaveras Counties	December 2008	Amador and Calaveras Counties	For understanding relationship of water and land use planning.
Water Supply Management Program 2040	April 2012	EBMUD	For understanding of EBMUD service-area urban water needs, management and planning objectives and for source of climate change analysis for the MAC Region.

The IRWMP will also be used as a source of information for other documents as well. It is intended to serve as an umbrella document, referencing and integrating many documents while also acting as a consolidated source of information. Figure 4-2 depicts this relationship.

Figure 25: Relationship between IRWMP and Local Planning Documents

The MAC IRWMP is not intended to drive or direct other planning processes. However, as other planning documents are prepared and/or updated, future MAC Plan updates should incorporate those documents and their findings as appropriate.

4.2.3. Current and Future Relationships with Local Land Use Agencies

Local water and land use agencies have a history of coordinating on shared topics and interests, such as planning for infrastructure for water and wastewater facilities to address unmet and future needs. As previously described, land use agencies including cities and counties have participated to varying degrees in the MAC IRWM planning process since 2006.

Efforts to further enhance land use and water management planning and coordination through the MAC update process have been hindered by the lack of available staff resources at both local land use planning agencies and water districts. County land use planners (as noted above) have been fully engaged in ongoing efforts to update county General Plans. Local water agencies, with insufficient funding to hire staff planners and/or engineers to perform planning functions, have not been able to engage in coordinated planning exercises. Consequently, there is some frustration among MAC Update stakeholders that there is insufficient collaboration between land use planners and water agency managers to effectively plan and fully develop projects and programs which best meet the MAC Region's needs. While views as to the appropriate level of communication and coordination between land use planners and water resource managers varies quite significantly amongst stakeholders, almost all agree that a higher level of communication and coordination would be beneficial.

Engaging other land managers responsible for planning and developing lands within the MAC Region, including the USFS, BLM and Sierra Pacific Industries (SPI), has also been a challenging endeavor. In prior updates, the USFS has been a member of the RPC, but was unable to participate in this update process due to many competing obligations. The BLM and SPI have not participated, in part due to the lack of available personnel.

Relationship between Land Use Planning and Water Management

The primary mechanism for coordination between land use planners and water managers has traditionally been through updates to the county General Plans. This coordination occurred in developing the Water Element Goals & Policies Report for the Calaveras County General Plan Update (MWH, 2009). The Report was developed through a collaborative process among the Water Element Group, which included water and wastewater agency staff and directors, County staff, and representatives of public and private interests. Nine co-equal goals were developed in that process, one of which is to "promote interagency communication and cooperation between land use and water and wastewater entities, so that they may optimize utilization of their resources and provide the highest level of dependable, yet affordable, service, while respecting individual entities water rights and interests." Five policies were identified to meet the goal, all of which directly align with the MAC IRWM planning process:

- 8.1 Water and Wastewater Infrastructure: The County shall work with water and wastewater agencies in the planning, development, and construction of water and wastewater facilities needed to transmit, treat, store, and distribute potable water supplies, and to collect, convey, treat and dispose of wastewater pursuant to adopted General Plan policies, urban water management plans, water supply agreements, and master facilities plans.
- 8.2 Cooperation: The County shall support cooperative interregional planning efforts that have as a high priority the protection of existing water rights of local Calaveras County agencies.
- 8.3 Funding Sources: The County shall work with local agencies to identify and pursue alternative funding sources that can be used for projects that improve the water resources management opportunities in Calaveras County.
- 8.4 Water Supply Reliability: The County shall encourage water agencies to develop plans for responding to droughts and the effects of predicted global climate change, including contingency plans and the sharing of water resources to improve overall water supply reliability for the existing and future needs of the county.
- 8.5 Data Sharing: The County shall share relevant data and encourage water/wastewater agencies to share data to assist in planning activities.

In November 2012, Calaveras County decided it would not include a Water Element and instead, only include elements required by state law. The September 2016 Planning Commission Recommended Draft General Plan includes several water-related goals in the Conservation and Open Space and Public Facilities and Services elements, including the following.

Water-Related Conservation and Open Space Goals

- Goal COS-2: High quality and abundant water resources.

Water-Related Public Facilities and Services Goals

- Goal PF2A: Adequate water, water storage capacity, fire flow, and wastewater treatment for new and existing development, with no decline in service levels to existing County residents.
- Goal PF2B: Efficient use of water resources.

Amador County completed an update of its General Plan in 2016. Like Calaveras County, the Amador County General Plan does not include a Water Element; however, the Land Use, Economic Development, and Conservation elements include a series of goals aimed at protecting water supply and water quality, including the following.

Water-Related Land Use Goals

- Goal LU-4: Ensure adequate wastewater treatment, storage, and disposal capacity exists to serve the county's current and future demand.
- Goal LU-6: Ensure that safe and adequate water supply, wastewater disposal, and public services are available prior to development.

Water-Related Economic Development Goals

- Goal E-10: Encourage alternative means of providing water to agricultural users.

Water-Related Conservation Goals

- Goal C-1: Ensure that all future development permitted in the county can be provided adequate amounts of water.
- Goal C-2: Maintain and improve water supply planning and infrastructure.
- Goal C-3: Minimize negative effects of sewage treatment on water quality.
- Goal C-4: Minimize negative effects of point and non-point sources on water quality.
- Goal C-5: Reduce the negative effects of new development on stormwater runoff and non-point source water pollution.

The General Plans are developed with these water-related goals in mind and serve as the blueprint for development throughout the Region. Water managers use the land use projections, as well as maps approved for development by local planning departments, to develop water demand projections, which are then included in their local planning documents. In this way, coordination between land use managers and water managers is maintained. The Amador County zoning code was changed as a result of the settlement of Foothill Conservancy's General Plan lawsuit. The changes improve stream setback requirements and impose new findings for development in high and very-high fire areas. They also add an accountability and tracking system that includes water and wastewater measures.

Plans to Further Collaboration between Land Use Planners and Water Managers

The following actions are proposed to further collaboration between land use planners and water managers in the region in the future.

- Although some land use planning representatives participate in the MAC IRWM planning process, several relevant land use planning agencies (e.g., county planners, BLM, SPI) are not currently represented. In future MAC Plan update activities, participation by these land use agencies and agencies with land use authority will be solicited and encouraged to participate in an effort to create a proactive relationship between land use planners and water managers, as well as foster communication between land use managers and the RWMG and agencies/entities participating in the IRWM planning process.
- During future General Plan updates, the MAC IRWM program may elect to form a workgroup of the RPC tasked with tracking and participating the General Plan updates and reporting back to the RPC on specific decisions being made related to water resources and opportunities to get actively involved. In this way, the IRWM program could serve as a regional forum to coordinate with General Plan updates.
- Periodic City-County-Water Agency Planning Meetings: The RWMG can encourage city and county planners and local water managers to hold joint planning meetings at regular intervals to improve communication and efficiencies. Joint planning meetings can be held at the staff level and/or by governing boards. Both options provide value in different ways, and both should be explored.
- Water Resource Planning Forum: To develop a better understanding and mutual appreciation of the issues and constraints faced by land use and water managing agencies (including the mission, priorities, and decision-making organization of these entities) the RWMG could host a forum where agency representatives present targeted information regarding their organization's mission, constraints,

overlapping areas of interest, potential conflicts in priorities or objectives, and potential areas for improved coordination.

Through these actions, collaboration and more effective coordination between and among land use planners and water managers would be enhanced in coming years.

4.3. Impact and Benefit Analysis

The MAC IRWMP partners and stakeholders recognize the importance of pursuing and integrating multiple resource management strategies to achieve the greatest and most equitable benefit for the region. The MAC region stakeholders understand that implementing the MAC Plan Update will result in regional and localized benefits and potential impacts that must be addressed as part of the IRWM planning process for the Region. This section provides an overview of potential benefits and impacts from implementation of projects or programs included in the MAC Plan Update which implement the Plan. It should be noted that inclusion of a project in the IRWM Plan indicates that it passed the screening requirements outlined in Section 4.1, but does not necessarily reflect endorsement by the Regional Participants Committee (RPC). In addition, inclusion of a project in the IRWM Plan does not commit the Regional Water Management Group or RPC member(s) to implement the project. Implementation, if undertaken, is the responsibility of the project proponent. Prior to implementation and/or construction of any project included in this Plan, individual environmental review, compliant with CEQA, NEPA, and any other local, state and/or federal requirements as applicable, will be completed by the project proponents.

The potential impacts and benefits that implementing the projects included in the MAC Plan Update could achieve are shown in Table 4-3, and are described in more detail in the following sections. To capture updated project information, this section will be updated as part of normal Plan management activities.

Table 4-3: Potential Impacts and Benefits by Project Type

Project Type	Within the MAC Region		Interregional	
	Potential Impacts	Potential Benefits	Potential Impacts	Potential Benefits
Groundwater Projects				
Groundwater Supply Development	Water quality degradation Reduced groundwater availability and reliability	Increased groundwater storage/recharge Improved water supply reliability Improved water quality Reduced land subsidence and/or fissuring Local prosperity	Water quality degradation Reduced groundwater availability and reliability	Increased groundwater storage/recharge Improved water supply reliability Improved water quality Local prosperity
Conjunctive Use	Water quality degradation Reduced groundwater availability and reliability Diminished high flows and flooding that benefit aquatic species, including anadromous fish	Increased groundwater storage/recharge Improved water supply reliability Improved water quality Reduced land subsidence and/or fissuring Improved water management coordination Local prosperity	Water quality degradation Reduced groundwater availability and reliability Diminished high flows and flooding that benefit aquatic species, including anadromous fish	Increased groundwater storage/recharge Improved water supply reliability Improved water quality Reduced land subsidence and/or fissuring Improved water management coordination Local prosperity
Potable Water Supply Projects				
Conveyance Facilities	Land use compatibility (rights-of-way) Disturbance of habitat, ~~and~~ endangered species, and cultural resources Growth inducing	Improved water supply reliability	None	None
Storage Facilities or Storage Operations	Land use compatibility (rights-of-way) Disturbance of habitat, endangered species, and cultural resources ~~Disturbance of habitat and endangered species~~Growth inducing Loss of recreational and scenic values	Improved water quality (through reduced groundwater pumping) Improved water supply reliability	None	Improved water quality (through reduced groundwater pumping)
Treatment Facilities	Energy consumption Land use compatibility (rights-of-way) Disturbance of habitat, endangered species, and cultural resources ~~Disturbance of habitat and endangered species~~Growth inducing	Improved water supply reliability Improved water quality Economic benefits	None	None
Salinity Management	Growth inducing~~None~~	Improved water quality Long-term sustainability of water supplies Local prosperity	None	Improved water quality Long-term sustainability of water supplies Local prosperity
Conservation Projects				
Outreach and Education	Reduced discharges to Mokelumne and Calaveras Rivers	Improved water supply reliability Public education and environmental awareness Reduced withdrawals from Mokelumne and Calaveras Rivers	Reduced discharges to Mokelumne and Calaveras Rivers	Improved water supply reliability Public education and environmental awareness Preservation or improvement of streamflows and aquatic habitat Reduced ratepayer costs for water

Project Type	Within the MAC Region		Interregional	
	Potential Impacts	Potential Benefits	Potential Impacts	Potential Benefits
Economic Incentives	Reduced discharges to Mokelumne and Calaveras Rivers	Improved water supply reliability Avoided costs of imported water supply Avoided costs of water supply infrastructure Local prosperity Preservation or improvement of streamflows and aquatic habitat Reduced ratepayer costs for water	Reduced discharges to Mokelumne and Calaveras Rivers	Improved water supply reliability Avoided costs of imported water supply Avoided costs of water supply infrastructure Local prosperity
Wastewater Projects				
Conveyance Facilities	Land use compatibility (rights-of-way) Disturbance of habitat and endangered species Growth inducing	Improved water supply reliability	None	None
Treatment Facilities	Energy consumption Land use compatibility (rights-of-way) Disturbance of habitat and endangered species Growth inducing	Improved water supply reliability Improved water quality Avoided costs of imported water supply Local prosperity	None	Improved water quality
Septic to Sewer Conversion	Land use compatibility (rights-of-way) Disturbance of habitat and endangered species Growth inducing	Improved water quality Local prosperity	None	None
Recycled Water Projects				
Conveyance Facilities	Land use compatibility (rights-of-way) Disturbance of habitat and endangered species Water quality degradation	Improved water supply reliability Increased nutrient levels for landscape irrigation Potable water offsets Lower cost than developing new water supply	None	Improved water supply reliability Potable water offsets
Treatment Facilities	Land use compatibility (rights-of-way) Disturbance of habitat and endangered species	Improved water supply reliability Potable water offsets Improved water quality Local prosperity Lower cost than developing new water supply	None	Improved water supply reliability Potable water offsets Improved water quality
Salinity Management	None	Improved water quality Improved water supply reliability Local prosperity Lower cost than developing new water supply	None	Improved water quality Improved water supply reliability Local prosperity
Urban Runoff Management Projects				
Stormwater Capture and Reuse/Recharge	Water quality degradation	Increased groundwater storage/recharge Improved water supply reliability Reduced land subsidence and/or fissuring	Water quality degradation	Increased groundwater storage/recharge Improved water supply reliability Avoided costs of imported water supply

Project Type	Within the MAC Region		Interregional	
	Potential Impacts	Potential Benefits	Potential Impacts	Potential Benefits
		Avoided costs of imported water supply Local prosperity		Local prosperity
Diversion to Sewer	Disturbance of habitat and endangered species	Improved water quality Flood control enhancement Increased recycled water	None	None
Pollution Prevention	None	Improved water quality	None	Improved water quality
Flood Management Projects				
Storm Drains or Channels	Land use compatibility (rights-of-way) Disturbance of habitat and endangered species Increased sedimentation and erosion Economic impacts	Flood control enhancement Increased groundwater storage/recharge Avoided costs of flood damage Local prosperity Aquatic habitat benefits through creating or maintaining wetlands	None	None
Ecosystem Restoration and Protection Projects				
Land Conservation	Development and extraction ~~E~~economic impacts	Improved water quality Flood control enhancement Habitat protection, restoration, and enhancement Open space preservation Carbon sequestration Protection of cultural and recreational resources	None	None
Invasive Species Removal	Disturbance of habitat and endangered species Increased sedimentation and erosion	Improved water quality Flood control enhancement Habitat protection, restoration, and enhancement	None	None
Restoration/Revegetation/Fuels Management	Disturbance of habitat and endangered species	Improved water quality Flood control enhancement Habitat protection, restoration and enhancement Reduced threat of wildfires	None	None
Water-Based Recreation Projects				
Reservoir Recreation	Water quality degradation	Enhanced recreation and public access Local prosperity	None	None
Parks, Access, and Trails	Disturbance of habitat and endangered species Increased sedimentation and erosion	Enhanced recreation and public access Local prosperity Health benefits	None	None

4.3.1. Plan Implementation Benefits and Impacts

Regional Impacts and Benefits

Implementation of the MAC Plan Update will lead to numerous benefits including, at a minimum:

- **A more reliable and high quality water supply.** Additional water supplies and conjunctive use lead to enhanced water supply reliability and assist with the improvement of delivered water quality. Water quality projects ensure that existing water quality is sustained and protected. Reliable and high quality water is directly linked to economic and environmental health and well-being.
- **Cost-effective and multi-beneficial projects.** Opportunities for multi-beneficial projects, which can achieve a multitude of goals and objectives for several stakeholders rather than a single entity, provide increased value to stakeholders and the communities they serve. Integrated planning and collaboration can lead to multi-benefit projects that achieve cost savings through cost-sharing opportunities, economies of scale, resource sharing, and other mechanisms. Existing resources can be optimized, duplication of efforts avoided, and larger scale efforts developed to provide cost savings to all involved.
- **Shared experience and resources.** The completion of the MAC Plan Update and implementation of the Plan facilitates knowledge sharing and equips agencies to overcome future challenges by coordinating resources, more effectively meeting the needs of the region as a whole. In addition to direct quantitative benefits of Plan implementation, such as new or more reliable water supplies, indirect benefits are expected to result from avoiding the negative impacts of not implementing the projects.
- **Increased regional understanding.** Agencies and stakeholders are working together as a cohesive group to solve water resource problems in a consensus-based approach, resulting in a deeper understanding of the effects of each individual project on other agencies and stakeholders. This deeper understanding, in turn, reduces interagency conflicts that may prevent projects from gaining the necessary support for successful implementation.
- **Improved local understanding of water resources issues.** Through consistent and coordinated public outreach and education programs, local understanding of regional water resources issues, conflicts, and solutions will improve. Maintaining a consistent message will improve public understanding of water resource management issues and encourage the acceptance and understanding of integrated projects.

Potential impacts of implementation of the MAC Plan could include a variety of temporary construction-related impacts during project construction, including dust, noise, and traffic generation. Other impacts may include increased costs associated with water infrastructure financing. Additional impacts may be identified on a project-by-project basis during CEQA or NEPA analyses.

Interregional Benefits and Impacts

The projects included in this Plan Update benefit not only the local agencies and residents of the MAC region, but multiple watersheds (Mokelumne, Cosumnes, and Calaveras River watersheds), the Delta, the EBMUD service area, and members of the public throughout California. Specific ways in which the projects contained in the Plan Update provide benefits beyond the MAC region include the following:

- Reduced effluent discharges (and associated pollutant loadings) into the Mokelumne and Calaveras Rivers due to increased recycled water use upstream, promoting improved water quality both in the Mokelumne and Calaveras Rivers and downstream in the Delta.
- Improved regional water supply and reliability for the East Bay, Amador County, Calaveras County and San Joaquin County, achieved through several water storage projects, could~~will~~ reduce pressure on the Delta to serve the region in times of significant drought. Additional wastewater reuse projects could~~will~~ also reduce the demand for upstream potable water, potentially increasing downstream supplies.

- Conjunctive use projects could~~will~~ increase water supply reliability within the region and in San Joaquin County, resulting in increased surface water supply availability in dry years and reduced pressure on the San Joaquin River as a water supply.

Most likely, though project dependent, construction-related impacts would not impact other IRWM regions, as project and program facilities would be implemented within the MAC region with temporary and local impacts, if any.

The MAC Plan Update also has the potential to benefit resources beyond local and regional water resources. Improved surface water quality will benefit the local ecosystem. ~~Enhanced tree cover, while viewed as a habitat enhancement, may also directly benefit regional air quality through the creation of microclimates and the filtering capacity provided by trees.~~ By optimizing water supply operations and implementing conjunctive use, additional surface water supplies may be available for hydropower generation to benefit statewide energy resources.

Benefits and Impacts to DACs, EJ-Related Concerns, and Native American Tribal Communities

Protection of the people and economy of DACs and Native American tribal communities in the region, and correction of environmental justice concerns are priorities for the MAC Plan Update. Environmental justice is addressed by ensuring that all stakeholders have access to the MAC planning decision-making process and that minority and/or low-income populations, such as DACs and Native American tribal communities, do not bear disproportionately high and adverse human health or environmental impacts. Working on a regional basis aids in protecting the economy of the MAC region and minimizing direct monetary impacts felt by DACs and Native American tribes in the region through the stabilization of water and wastewater utility rates. Implementation of the region's flood control projects will protect the local cities from disastrous flood damage, as was experienced in the winter and spring of 2006. Regional coordination has been and will continue to be achieved through the noticing of public meetings, to be held as needed to address public and stakeholder concerns, conducting routine reviews to ensure that DACs are not being adversely affected by project and Plan implementation, and by using grant monies receive to help offset project implementation costs.

Similar to DACs, Native American Tribes in the MAC Region are encouraged to participate. Focused outreach to Native American communities within the MAC Region was completed as part of the Plan update. Outreach methods included phone calls, emails, and coordination with the California Indian Environmental Alliance (CIEA), an organization working to outreach and collaborated with California Indian Tribes and Native American communities to increase engagement with IRWMs. According to the Bureau of Indian Affairs, there are four federally recognized tribes within the MAC Region including:

- The Ione Band of Miwok Indians
- The Jackson Band of Miwuk Indians
- The California Valley Miwok Tribe, generally known as the "Sheep Ranch Tribe"
- Buena Vista Rancheria of Me-Wuk Indians of California

Buena Vista Rancheria of Me-Wuk Indians of California is an active member of the RPC and engaged in the planning process. Through the project review process, UMRWA and the RPC have sought to minimize impacts to these communities and provide for equitable benefits associated with project implementation. Impacts to DACs and Native American tribes will be kept to a minimum, and ongoing coordination and public involvement will aid in preventing possible impacts. Construction of project facilities will create short-term environmental impacts (noise, dust, traffic disruption) at neighboring communities. A preliminary analysis of the areas affected by construction of project facilities will ensure that these

construction nuisance impacts will not be borne predominantly by any minority population or low-income group.

4.3.2. Project/Program Impacts and Benefits

The potential benefits and impacts summarized in Table 4-3 are described in more detail in the following sections. Additionally, the projects included in the MAC Plan Update by project type are summarized in the table included in Appendix I~~G~~. For each project, potential benefits and impacts are assumed to be similar to those identified for the specific project type.

Benefits

Increased Groundwater Storage/Recharge

The Eastern San Joaquin subbasin, within the San Joaquin Valley Groundwater Basin, extends from the western corner of Calaveras County west of the cities of Stockton and Lodi. Use of groundwater for irrigation and municipal purposes has resulted in a continuous decline of available groundwater over the past 40 years. As of 1990, annual groundwater extractions in San Joaquin County had exceeded the estimated safe yield. Overdraft of the groundwater in this subbasin has created groundwater depressions in areas near Stockton and east of Lodi. Groundwater recharge could help improve the state of the subbasin. Groundwater improvement programs may include projects to:

- Enhance conjunctive management and groundwater storage
- Aquifer storage and recovery
- Stormwater capture and recharge
- Construction of new and/or rehabilitation of spreading grounds/recharge basins
- Improvement to groundwater monitoring
- Hydrogeologic investigations and groundwater modeling

Improved Water Supply Reliability

Improving water supply reliability in the MAC Region is Policy 2, developed as part of the Regional Goals and Objectives. Projects that diversify the Region's water supply portfolio, create new supplies, improve efficiencies of existing supplies, or offset potable water supplies will improve the MAC region's water supply reliability. Projects that would achieve this benefit include:

- Water use efficiency and water conservation projects
- New water supply pipelines and/or rehabilitation/repair projects
- Water system tie-ins, interconnections, and diversion structures
- Water transfer projects
- Groundwater extraction and/or treatment projects
- Water storage and treatment projects
- Upgrading wastewater treatment facilities to produce recycled water
- Water quality protection projects

Improved Water Quality

Policy 1, as described in Chapter 3, Policies, Goals, Objectives, and Strategies, is to Maintain and Improve Water Quality. Different types of projects contribute to different types of water quality improvements. For example, groundwater recharge projects can improve groundwater quality in the overdrafted Eastern San Joaquin groundwater subbasin, while treatment improvement projects will improve potable water quality. Projects that improve water quality include, but are not limited to:

- Stormwater projects (e.g., stormwater capture and recharge or stormwater management to reduce volume of urban runoff discharged to surface waters)

- Upgrading wastewater treatment plants
- Groundwater monitoring and assessment
- Conversion of septic systems to municipal sewers
- Conjunctive management and groundwater storage
- Sewer collection improvements
- Water treatment projects
- Ecosystem restoration and revegetation projects
- Land conservation
- Salinity management
- Forest health/fuel reduction/watershed improvement projects

Reduced Land Subsidence and/or Fissuring

Land subsidence occurs when groundwater is excessively pumped from a groundwater basin; the clay layers in the aquifer settle and the ground surface in the area lowers, eventually creating a cone of depression. Projects that will reduce groundwater pumping or increase groundwater recharge will help reduce land subsidence and fissuring. These projects include:

- Enhance conjunctive management and groundwater storage
- Stormwater capture and recharge
- Construction of new and/or rehabilitation of spreading grounds/recharge basins
- Improvement to groundwater monitoring
- Hydrogeologic investigations and groundwater modeling

Local Prosperity

Local prosperity can be achieved by:

- Avoiding costs of imported water supply by increasing the use of recycled water, creating new water supply sources within the region, or capturing and reusing stormwater.
- Avoiding costs of water supply infrastructure with the implementation of water conservation and water use efficiency projects.
- Avoiding flood damage costs.
- Avoiding impacts to the economy (e.g., businesses and agriculture) associated with water supply interruption.
- Increased tourism with enhanced recreational opportunities and improved water quality.
- Benefits to the regional economy associated with constructing and maintaining proposed IRWM projects.

Additionally, as previously stated, working on a regional basis aids in protecting the economy of the MAC region and minimizing direct monetary impacts felt by DACs in the region through the stabilization of water and wastewater utility rates. IRWM planning and collaboration can lead to multi-benefit projects that achieve cost savings through cost-sharing opportunities, economies of scale, resource sharing, and other mechanisms. Existing resources can be optimized, duplication of efforts avoided, and larger scale efforts developed to provide cost savings to all involved.

Long-term Sustainability of Water Supplies

Some groundwater basins throughout California contain salts and nutrient levels exceeding water quality objectives established in Water Quality Control Plans (Basin Plans). The high salt and nutrients concentrations could be from natural conditions and irrigation with surface water, groundwater, and recycled water. Salinity management is key in contributing to the long-term sustainability of groundwater supplies. Groundwater quality varies throughout the MAC region with overdraft in portions of the Eastern San Joaquin or Cosumnes Groundwater Subbasins. As new water supplies are developed, recycled water

use increases, and groundwater recharge projects are implemented, the importance of salinity management will increase.

Public Education and Environmental Awareness

Many water conservation, water quality protection, and water supply projects include public education and environmental awareness components, creating multi-benefit projects or programs. Public outreach programs and components can help promote and increase water conservation, educate about forest stewardship which can improve water resources, discourage illegal dumping of trash and litter in ~~watercourses~~watersheds, avoid erosion and sedimentation, and encourage appropriate water management practices including appropriate collection and disposal of hazardous liquid wastes and pharmaceuticals.

Increased Nutrient Levels for Landscape Irrigation

Depending on the nutrients supplied by the recycled water available, increasing the use of recycled water for landscape irrigation through construction of additional conveyance facilities could significantly reduce the amount of fertilizer required for the areas irrigated.

Potable Water Offsets

The benefits of potable water offsets will be achieved by stormwater and recycled water projects. As new non-potable water supplies are identified and the use for irrigation or other beneficial uses are implemented, surface water and groundwater in the MAC region will be freed up for other uses. The Eastern San Joaquin subbasin can be replenished as groundwater pumping is reduced and flows in the Mokelumne River and other surface water bodies in the watershed can increase as diversions are reduced. Potable water offsets are also tied to improved water supply reliability and diversification of the region's water supply portfolio. Projects that would provide potable water offsets include:

- Recycled water treatment and conveyance projects.
- Stormwater capture and reuse/recharge.
- Conversion of septic systems to centralized sewer collection systems to increase the amount of recycled water available.

Flood Control Enhancement

Flooding is a concern for many areas within the MAC IRWM planning region. Many cities and communities are included in 100-year floodplains (of both the Mokelumne River and its tributaries), including Sutter Creek, Jackson, Ione, and Mokelumne Hill. In some cases, like in the City of Plymouth, flooding is due to an inadequate storm drainage system, unable to handle heavy storms during winter and spring seasons. The Calaveras County General Plan discusses three basic types of potential flood hazards: stream-side overbank flows, areas of flat terrain with slow surface drainage, and inundation due to structural dam failure. Flooding can occur from heavy rainfall, rapid snow melt, saturated soils, or a combination of these conditions. Also, increasing development leads to an increase in impervious surface areas and a decrease in natural vegetative cover, which reduces the detention and attenuation characteristics of the overland areas. To reduce potential property and structure damage, and economic impacts, flood control enhancement may be provided by projects that:

- Capture and divert stormwater.
- Improve levee systems (e.g., floodwalls or setback levees).
- Install pervious pavement.
- Protection and manage floodplains.
- Construct regional flood control infrastructure.

Increased Recycled Water

By centralizing sewer collection systems in areas that may still be on septic, a greater volume of wastewater will be treated at the wastewater treatment facilities, creating more recycled water for beneficial uses. Increasing the amount of recycled water available for landscape, golf course, and school irrigation, industrial uses, and other uses, will lead to other benefits such as potable water offsets and increased nutrient levels for landscape, previously discussed.

Habitat Protection, Restoration, and Enhancement

Projects that contribute to habitat protection and restoration have the ability to enhance the MAC Region's ecosystems and protect threatened, endangered, and sensitive species. The following types of projects would provide this benefit:

- Land conservation.
- Water quality protection projects that would result in surface water quality improvement.
- Invasive species removal.
- Restoration and enhancement of special aquatic features (e.g., wetlands, springs, bogs).
- Stormwater management and pollution prevention.
- Debris cleanup and habitat restoration.
- Meadow restoration.
- Forest fuels reduction.
- Road management activities to reduce runoff to streams.
- Prescribed fire.

Reduced Threat of Wildfire

Wildfire degrades water quality through the erosion of soils and introduction of large amounts of bedload sediment, turbidity, organic and other chemicals to surface waters which adversely impacts downstream water treatment facilities. Wildfire degraded waters also kills aquatic wildlife. With climate change, fires are becoming bigger and hotter and produce more and more sediment and chemical runoff. Wildfires threaten property, lives, and ecosystems, and can adversely impact flood management and erosion. Ecosystem Restoration and Protection activities such as forest restoration can help reduce the threat of wildfire. There is already evidence that wildfires are becoming more frequent, longer, and more widespread, and they are expected to increase in frequency and severity due to climate change (CDM, 2011).

Open Space Preservation

Open space preservation is a benefit that can be achieved through implementation of land conservation projects. Preserving open space contributes to other benefits such as environmental and recreational benefits, as well as stormwater control, reduced runoff, ~~and~~ flood management benefits, carbon sequestration, and economic benefits from increased tourism due to scenic beauty.

Enhanced Recreation and Public Access

Reservoirs, parks, and the wilderness within the MAC Region are used by outdoor recreation enthusiasts throughout the year. Enhancing recreation and public access in the region will be achieved by projects that:

- Conserve and preserve open space and access to public land.
- Remove and control invasive species.
- Improve water quality.
- Provide appropriate sanitation facilities at recreation sites.
- Road management activities to reduce runoff to streams.
- Improve opportunities for public outreach and environmental education.

Impacts

Implementation of the projects described in this plan may also have quantitative and/or qualitative impacts if the MAC Plan Update and/or its component projects are not managed or implemented properly.

These impacts may include increased project costs to agencies and ratepayers, delayed construction and/or operation of planned facilities leading to delayed water supply and other benefits, negative impacts to surface water and/or groundwater quality, and more limited operational flexibility, especially in times of drought, leading to increased water rationing and associated pressure on water users and the environment.

Project-specific environmental compliance processes will be completed by project proponents prior to project implementation. These processes will determine the significance of project-related impacts. Each project will comply with CEQA and NEPA, if applicable prior to and throughout implementation.

Negative impacts that could be associated with the implementation of projects and programs included in the MAC Plan Update are similar to those of other water infrastructure projects. In general, temporary, site-specific impacts related to construction and potential long-term impacts associated with project operation are anticipated. Short-term, site-specific construction impacts from implementing physical project facilities may include increased traffic and/or congestion; noise; and impacts to public services, utilities, and aesthetics. Other potential, longer-term impacts are described in more detail below.

Water Quality Degradation

Groundwater-related projects, such as projects that increase groundwater pumping or implement conjunctive use, could degrade water quality if not operated appropriately for the groundwater basin and conditions. In addition, projects that involve the implementation of potentially contaminating activities in groundwater recharge areas could result in negative impacts to groundwater quality. Surface water quality could similarly be impacted by projects that encourage recreation and/or intensive development have the potential to increase loading of nutrients, bacteria, and other contaminants to adjacent surface water bodies, negatively impacting water quality for water supply and environmental needs.

Recreation-related projects also have the potential to increase erosion and sedimentation. Increased motor vehicle traffic and foot traffic can increase erosion and sedimentation to adjacent water bodies, negatively affecting water quality for water supply and the environment/habitat purposes. Water quality issues associated with increased erosion and sedimentation can be detrimental to aquatic communities. Additionally, storm drains and channel modifications that are implemented to manage flood flows can contribute to erosion and sedimentation. Projects that allow use of motorized watercraft may introduce organic contaminants to water bodies.

Reduced Groundwater Availability and Reliability

There are groundwater quality issues in many areas within the Eastern San Joaquin groundwater subbasin, as well as the Cosumnes subbasin. Projects that impact water quality and/or yield could reduce overall groundwater availability and water supply reliability to users depending on the source. Increased groundwater pumping in the Eastern San Joaquin subbsain would contribute to existing overdraft conditions, potentially degrading water quality and further decreasing overall reliability.

Land Use Compatibility (rights-of-way)

A potential impact of any project that includes construction of physical facilities is land use compatibility. The types of projects that could potentially have land use compatibility, or rights-of-way issues, include:

- Water conveyance facilities
- Storage tanks or reservoirs
- Treatment plants

- Wastewater collection
- Recycled water distribution facilities

Construction of new facilities outside of disturbed areas such as roads could result in disturbance of otherwise undisturbed areas and may result in loss of open space and habitat.

Disturbance of Habitat and Endangered Species

The MAC Region is a largely natural area with significant portions designated as rural or open space, including large portions of the Stanislaus and Eld ~~D~~orado National Forests. The region provides habitat for numerous species, including special-status species (i.e., endangered, threatened, sensitive, or candidate). Projects that involve facility construction have the ability to disturb surrounding habitat and endangered species, depending on the location, type of construction, and facilities. All projects implemented will comply with CEQA and NEPA, as applicable, and as part of the process, will identify and implement mitigation measures for potential environmental impacts as necessary.

Energy Consumption

The water sector plays a significant role in California's energy consumption. Implementing certain projects may increase energy use. Water and wastewater treatment projects that require significant amounts of power may result in increased energy consumption in the region. Increased energy consumption can increase greenhouse gas emissions, further exacerbating projected climate change impacts.

~~Reduced Discharges to Mokelumne and Calaveras Rivers~~

~~Agricultural and urban water use efficiency projects (i.e., water conservation) could reduce the quantity of water discharged to the Mokelumne and Calaveras rivers, effectively reducing streamflows and impacting aquatic habitat.~~

Economic Impacts

Implementation of certain projects may have associated long-term economic impacts to agencies and ratepayers. Project financing has historically provided a challenge in the MAC Region. Even when grants and/or low-interest loans are available to subsidize project capital costs, agency rate revenues are sometimes insufficient to properly operate and maintain the project. Because funds available to implementing agencies are generally limited it will be important to evaluate financing methods and avenues for potential projects prior to implementation such that potential economic impacts on ratepayers and agencies in the Region can be minimized.

Disturbance of Cultural, Scenic, Recreational, and Historical Resources

Projects that involve facility construction have the ability to disturb valuable cultural, scenic, recreational, and historical resources, depending on the location, type of construction, and facilities. All projects implemented will comply with CEQA and NEPA, as applicable, and as part of the process, will identify and implement mitigation measures for potential cultural, scenic, recreational, and historical resource impacts as necessary.

4.4. Financing Plan

Given the low density development in the MAC region, project financing has always proven to be a major obstacle, often preventing projects from proceeding to implementation. Demands on agencies' and cities' limited funds continue to increase, construction costs continue to rise, existing aging infrastructure requires upgrades to meet growing demands, and future state legislation threatens to shift substantial property tax revenues away from special districts to the state general fund. In this economic climate, agencies are challenged to balance costs associated with supply water for new growth while ensuring the highest standards of water quality and supply reliability for existing customers, protect and enhance the sensitive

ecosystems within the region, and minimize costs incurred by end-users. Further, projects that benefit the environment but do not provide new water or a measurable improvement to water supply reliability and/or water quality are wholly dependent upon public assistance for implementation.

4.4.1. Funding Sources and Mechanisms for Planning and Implementation

MAC IRWM regional stakeholders recognize the importance of maintaining the highest standards of cost-effectiveness for the development of, and future updates to, the MAC Plan, as well as projects and programs considered for implementation. Regional stakeholders are concerned about not passing on the costs of unnecessary or poorly justified MAC Plan-related activities to ratepayers in the form of increased water and wastewater rates. Agencies within the region have explored a variety of potential regional water resource planning and implementation funding vehicles including the State Revolving Fund, Proposition 50, 84, 1E, 1, and 68, Hazard Mitigation Grant Program, and other State and Federal grant and loan programs, in addition to rate revenues, bond financings, assessments, and potential county and municipal revenue sources. The development of this MAC Plan Update is being funded by UMRWA funding (budgeted specifically for this update). Additionally, UMRWA member agency staff have contributed significant time and resources to completing the Plan Update, coordinating and participating on the Regional Participants Committee, and organizing stakeholder outreach efforts. The MAC region is committed to developing a useful and implementable IRWM Plan, which includes Plan performance monitoring and updating the Plan in the future to help ensure the Plan responds appropriately to current day conditions and issues.

With regard to projects and programs which implement this updated MAC Plan, estimated costs for each IRWM Plan project are shown in Appendix I~~C~~, along with potential funding sources (exclusive of additional local, state or federal grant monies). It should be recognized that each implementing organization has a unique set of revenue and financing methods and sources. This IRMWP does not provide an exhaustive list of funding sources available. Many of the same funding sources and/or mechanisms would be used for continued development of the IRWM Plan and for project/program implementation. The various potential funding sources for both updating the IRWM Plan and implementing projects are listed in Table 4-4. The funding mechanisms are further described in the following sections.

Capacity Fees

Capacity fees are used almost universally by water agencies as a measure to achieve and maintain equity among its past, present and future customers. For a growing water agency, capacity fees can represent more than half of the total revenue in any given year, and as such are very important to existing as well as future customers. Capacity fees are typically charged per connection, measured in equivalent dwelling units (EDUs). A single connection may encompass more than one EDU. In addition to the connection fee aspect of capacity fees, water agencies may also assess other fees, e.g., Commercial Acreage Fee (per acre) and Other Service Fee (per acre).

In some cases, if a developer builds a water pipeline or large water facility required by a water agency as a condition of development, then as partial or full payment for the water facility, a water agency may give fee credits to the developer in lieu of the developer paying fees. If the value of the water facility exceeds the amount of credits, a reimbursement agreement is typically executed authorizing payment to the developer of the remaining amount owed over a period of time which does not typically exceed a defined time period. Capacity fees can be controversial if not structured to achieve equity.

Table 4-4: Funding Sources for Development of the IRWM Plan and Implementation of Projects

Funding Mechanisms	Continued Development of the IRWM Plan	Project/Program Implementation	Certainty & Longevity of Funding
Capacity Fees		✓	Dependent upon rate structure adopted by project proponents
User Fees		✓	Dependent upon rate structure adopted by project proponents
User Rates/Recovery		✓	Dependent upon rate structure adopted by project proponents
General or Capital Improvement Funds	✓	✓	Dependent upon budgets adopted by project proponents and participating agencies
Bonded Debt Service		✓	Dependent upon debt carried by project proponents & bond market
Local, State, or Federal Grant Programs	✓	✓	Dependent upon future local, state, and federal budgets, and success in application process
Low-interest Loan Programs		✓	Dependent upon future local, state, and federal budgets, and success in application process

User Fees

Monthly user fees are assessed by some water agencies where an argument can be made that new facilities directly benefit existing customers. This is especially true for water agencies that are developing conjunctive use water systems where the existing customers may have paid for the groundwater component when they paid the development fee (through the purchase of the home). The surface water and/or recycled water component is a new water supply for a water agency that is needed for conjunctive use with groundwater supplies. In many cases, income from this monthly revenue source is used to pay debt service on debt financed assets.

User Rates/Rate Recovery

User rates or rate recovery pays for the operations and maintenance of a water agency or public utility's system. Within a water agency user rate, there is a fixed cost component that covers costs that do not vary with the amount of supplied water, such as labor and overhead expenses, and a variable cost component that covers costs that are based on the amount of pumping and applied chemicals to meet the water demands of the customers and vary with the amount of supplied water, such as the electrical and chemical costs. A water agency customer pays a monthly fixed rate and a variable rate based on the metered usage.

In cases in which billing is not based on a metered usage, a single monthly rate is assessed that combines the average of the fixed and variable rates.

General or Capital Improvement Funds

General or capital improvement funds are monies that an agency sets aside to fund general operations and/or facility improvements, upgrades and, sometimes, development. These funds are usually part of their overall revenue stream and may or may not be project-specific.

Bonded Debt Service (Revenue Bonds)

In cases in which a large facility is needed to support current services and future growth, revenue bonds are issued to pay for new capital. In this way, a large facility can be paid for by bonded debt service at the time of construction with repayment of the debt service over a 20- to 30-year timeframe. This is a preferred approach to paying for high cost facilities because it avoids the perceived over-collection of fees from past customers that go toward facilities that serve present and future customers. The downside to bonded debt is that it cannot be accomplished with capacity fees alone due to the variability and uncertainty of new development over time. A user rate is needed as a bond document covenant in the event that development fees are not adequate to make the required annual payment for the debt service.

Local, State, and Federal Grant Programs

Grant programs at either the local, state, or federal level are periodically available to the region. In the past, UMRWA has applied for and received planning grant funding through the DWR IRWM grant program. The 2011/2012 MAC Plan Update was funded by Prop 84, Round 1 planning monies. Additionally, UMRWA and members of the MAC RPC have applied for and obtained state and federal funding for studies and projects benefiting the region. These monies typically require that local matching funds be available. The matching requirement shows a local commitment to promoting and completing the study or project. A grant is typically administered and contracted by a single agency within the region that works directly with the state or federal granting agency. Grants typically carry relatively high administration cost because extensive grant reporting may be required, and typically only a small portion of the grant may be used to cover grant administration.

In the past, the region has actively sought external funds for development of the MAC IRWMP and implementation of regional projects and programs. Examples of past sources of funding include:

- Federal Funding (Corps, Reclamation, FEMA)
- State Funding (Proposition 13, CALFED, Proposition 50, Proposition 84, Proposition 1)
- Local Funding (impact fees, user rates, tax assessments)

These efforts are expected to continue to fund implementation of the projects and programs developed in the MAC Plan Update.

Low-interest Loan Programs

Several funding agencies provide low-interest loans for implementation of water resource-related projects. Low-interest loans can save the implementing agency significant amounts of money by reducing interest payments as compared with traditional bonds. SWRCB offers low-interest loans for wastewater and recycled water projects through its Clean Water State Revolving Fund (SRF) loan program, CDPH administers a similar SRF loan program for drinking water-related projects, and the California Infrastructure and Economic Development Bank (I-Bank) administers the Infrastructure SRF loan program for financing implementation projects such as sewage collection and treatment, water treatment and distribution, and water supply projects.

The Clean Water SRF program generally has approximately $200 to $300 million available in loans each year to help cities, towns, districts, Native American tribal governments, and any designated and approved management agency under Section 208 of the Clean Water Act to construct publicly-owned facilities including wastewater treatment, local sewers, water reclamation facilities, nonpoint source projects, and development and implementation of estuary comprehensive conservation and management plans. The interest rate is half of the most recent General Obligation (GO) Bond Rate at the time of the funding commitment. Over the last five years, the Clean Water SRF loan interest rate has ranged from 1.5% to 2.1%. Amounts available through the CDPH Safe Drinking Water SRF loan program vary, but approximately $100 to $200 million is available annually.

Available loan funding is dependent upon federal appropriations to each program. In the past, DWR has also offered low-interest loans for construction and feasibility studies for new local water supplies to local public agencies. The funding source, Proposition 82, has been exhausted for these loans, therefore, they are no longer available. It is possible that future low-interest loan programs may become available to fund projects and programs included in the MAC Plan Update.

4.4.2. Support and Financing for Operation and Maintenance of Implemented Projects

Ongoing support and financing of the operation and maintenance (O&M) of projects in this Plan Update are expected to derive from many of the same sources that were identified to fund project implementation. Support and financing will likely come primarily from local sources, including user rates, fees and assessments. Since regional projects and programs often involve multiple partner agencies, the range of local sources available is broadened. The details of financing these larger, multi-partner projects are typically worked out on a project-by-project basis. Large multi-purpose projects typically adhere to standard cost accounting and cost of service principles which are typically described and codified in the agreements for ownership, and operation and maintenance of facilities is typically developed as part of a project financing package.

O&M costs of proposed implementation projects must be evaluated as the overall viability of a particular project effort is determined. Any project that is advanced for implementation consideration must include an analysis to determine ability to operate and maintain the project and project benefits. The annual fiscal impact on user rates, and the willingness of ratepayers to accept any increased cost of service as may be required for project implementation, must be included in this analysis. The need for water and the economic hardship impacts that would occur, should the new source not be available, may also be considered as part of the analysis. Any benefits derived from replacing and/or updating existing systems can also be considered.

For non-water supply projects, alternate criteria must be considered in evaluating the region's ability to provide ongoing support. For example:

- Wastewater costs, using strict cost-of-service principles, can be considerable (including O&M costs). Cost recovery is primarily a function of an agency's ability to charge fees for wastewater collection and treatment of wastewater.
- Watershed improvement projects are designed to minimize the need for ongoing operation and maintenance expenses. Costs associated with monitoring and/or staff support to track and implement projects and studies can potentially be covered through membership contributions, grants, or by other non-profit funding vehicles not necessarily available to governmental agencies.
- Projects focused on providing water quality benefits must be designed to employ a process that allows for low-cost operation and maintenance. For example, debris build-up (and hence the need for its removal) must be a consideration in the system design.

To improve the MAC region's ability to provide ongoing support to priority projects, agencies and stakeholders in the region should work together to minimize associated O&M costs and gain savings from economies of scale.

4.5. Technical Analysis

The MAC Plan Update has been developed using sound technical information, analyses, and methods. Information and documents were collected from various sources including AWA, CCWD, EBMUD, Sierra Nevada Conservancy, and USFS, as well as Amador and Calaveras counties, and the cities within those counties. Multiple local water planning documents were reviewed and used to prepare the MAC Plan. These include UWMPs, WSMPs including EBMUD's comprehensive WSMP 2040 (completed in 2011), project Environmental Impact Reports/Environmental Impact Statements (EIRs/EISs) and feasibility studies, and grant applications for other state and federal programs. Section 4.2.1 and 4.2.2 summarize some of the key planning reports used in the MAC IRWM planning process and update. Additionally, the documents cited in the References section were reviewed and used in development of the MAC Plan Update.

The technical information included in these plans and studies is very suitable for developing the MAC Plan Update. While some are project-specific documents, others address water management issues on a local or regional basis. This allows for an understanding of regional issues shared by multiple entities in the Mokelumne Watershed as well as more specific, localized issues. Because some of the documents used in the update process are focused on understanding and solving local water resource issues, such as the *New York Ranch Reservoir Conservation and Management Plan*, there is a basis for not only the specific issues, but also potential solutions.

A regional study and management plan heavily relied upon in the update process is the UMRWAP. MokeWISE, another collaborative regional effort was also relied upon during this MAC Plan Update. Both of these efforts are described in more detail in Section 4.2.1 above. Other studies were used to inform projects in the Plan, including the Mokelumne Avoided Cost Analysis and the Power Fire GRAIP Watershed Roads Assessment.

The MAC Plan Update consists of projects, programs, studies, and planning activities that local and regional planners have found to be technically feasible based on similar projects, pilot studies, technical analyses, benefit analyses, cost estimating, modeling and simulation efforts and data assessments.

As each project moves closer to design and implementation, technical and economic analyses will be conducted to confirm project feasibility and to provide any necessary feedback to modify the project's plan to improve its likelihood of success. Table 4-5 summarizes project-specific documentation that supports the technical feasibility of the project included in the MAC Plan Update, and therefore, the technical feasibility of Plan implementation.

Table 4-5: Documents Supporting the Technical Feasibility of MAC Plan Update Implementation

	Proponent	Project	Documentation Regarding Technical Feasibility of Project
1	ARCD	Soil Health & Climate Resilient Agriculture Education Program	Carbon Farming Leaflet, Pelayo Alvarez, January 2018 Marin Carbon Project. Impacts of organic matter amendments on carbon and nitrogen dynamics in grassland soils (2014): Ryals_et_al_2014 Effects of organic matter amendments on net primary productivity and greenhouse gas emissions in annual grasslands (2013): Ryals-and-Silver-EcoApps2013
2	AWA	Groundwater Banking Conjunctive Use Study	
3	AWA	Groundwater Capacity in Amador County	
4	AWA	Amador Canal Water Conservation Project	Ken Zeier. A Study on the Feasibility of Supplying Potable Water to Customers along the Upper Section of the Amador Canal in Central Amador County, 2009. Standard design from American Water Works Association and Fire Code, and Industry practice for 20 psi at minimum flow rate from a 6-inch pipeline or greater
5	AWA	PG&E Storage Recovery	
6	AWA	Lower Bear River Reservoir Expansion Project	Bear River Water Supply Alternatives for Amador Water Agency and Calaveras County Water District revised in 2005
7	AWA	Surface Storage Feasibility Study	
8	AWA	Lake Camanche Recycling Water Project	Similar designs and concepts used throughout western United States, including many Title 22 recycled water projects throughout California.
9	AWA	Amador Water Agency System Computer Modeling	
10	AWA	Amador Water Agency Master Plan	
11	AWA	Highway 88 Corridor Wastewater Treatment, Transportation, Disposal	
12	AWA	Camanche Area Regional Water Supply Project Phase II	2012 CARWSP Alternatives Evaluation, Tammy Qualls, P.E. - RMC Lindsey Wilcox - RMC 2013 Camanche Area Regional Water Supply Plan (CARWSP) Feasibility Study and Conceptual Design, Lindsey Wilcox – RMC 2015 CARWSP II Design and environmental in progress, Marc Nakamoto RMC

	Proponent	Project	Documentation Regarding Technical Feasibility of Project
13	AWA	Ione WTP Planning Study	2004-Ione Water Treatment Plant Feasibility Study- Boyle Engineering 2008-Tanner Regional WTP Preliminary Design Report- Stantec Engineering
14	AWA	Upper-Lower Water System Reliability Intertie Project	Ken Zeier, Amador Canal Potable Water Feasibility Report, 2009
15	AWA	Lake Camanche Transmission Main Project	2009 Technical Information Engineering Report for the Camanche System
16	AWA	Amador Water Agency Low Pressure Fire Flow Improvements	Standard design from American Water Works Association and Fire Code, and Industry practice for 20 psi at minimum flow rate from a 6-inch pipeline or greater
17	AWA	CAWP Fire Protection Project	1995 CAWP Master Plan- HDR Engineering, Inc. 1995 Master Plan and Connection Fee for Amador County Water Agency, Improvement District No. 1- Engineering alliance, Inc, Bartholomew Engineering, Inc. Standard design from American Water Works Association and Fire Code, and Industry practice for 20 psi at minimum flow rate from a 6-inch pipeline or greater.
18	AWA	CAWP Tanks Replacement Project	Standard design from American Water Works Association for steel storage tanks and all are existing water storage tank sites.
19	AWA	Floating Covers Replacement Project	Standard design from American Water Works Association for steel storage tanks
20	AWA	Lake Camanche Water Service Replacement-Phase IV	
21	AWA	Amador Water Agency Treated Water Supply Study	Study on the Feasibility of Supplying Potable Water to Customers Along the Upper Section of the Amador Canal in Central Amador County, Ken Zeier, P.E., 2009 Standard design from American Water Works Association and Fire Code, and Industry practice for 20 psi at minimum flow rate from a 6-inch pipeline or greater.
22	AWA	Community Leachfield Groundwater Nitrate Study	
23	AWA	Martell Wastewater Lift Station Reduction Project	
24	AWA	Regional Wastewater and Recycling Project	Amador County Regional Wastewater Management Plan 2013 – A Regional Approach for Reuse – Aegis Engineering
25	AWA	Lake Camanche Regional Wastewater System	
26	AWA	Tanner WTP Rehabilitation and Efficiency Project	2008 – Tanner Regional WTP Preliminary Design Report – Stantec Engineering
27	AWA	Water Storage Reoperation Study	

	Proponent	Project	Documentation Regarding Technical Feasibility of Project
28	AWA	SGMA Implementation for Amador County	
29	AWA	Fishery Habitat Improvements	
30	AWA	New York Ranch Reservoir Conservation and Management	2007- New York Ranch Reservoir Conservation and Management Plan- Edith Read, Center for Natural Lands Management & Jim Robins, Alnus Ecologic 2008- Technical Report, New York Ranch Reservoir Model, HIS Hydrologic Systems 2010- New York Ranch Reservoir Natural Resource Conservation & Management Plan- Jim Robins, Alnus Ecologic
31	AWA	MAC Conservation Program Implementation	Amador Water System Leak Detection and Repair Project – 2013 Amador Water Agency Water Conservation Plan – 2010 Residential Indoor Water Conservation study: Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes – EBMED and US EPA – 2003
32	CCWD	Sheep Ranch Water Treatment & Distribution Compliance Project	
33	CCWD	West Point Automated Meter Reading Project	
34	CCWD	West Point WTP Drinking Water Compliance Project	
35	CCWD	Wilson Dam Meadow Restoration and Habitat Enhancement Plan	Calaveras County Mokelumne River Long-Term Water Needs Study (2017) CCWD and CPUD, ECORP Consulting, West Point Water Supply Master Plan (Draft) 2018, ECORP Consulting
36	Foothill Conservancy	Amador Household Water Efficiency Project	Amador Water Agency Conservation Plan. 2009. Pacific Institute's analysis of AWA's Long-Term Water Needs Study. 2017. Conservation and efficiency best practices and measures developed by the California Urban Water Conservation.
37	Foothill Conservancy	Mokelumne High Country Meadow Restoration	American Rivers' 2012 "Evaluating and Prioritizing Meadow Restoration in the Sierra,"
38	Foothill Conservancy	Riparian Noxious Weed Abatement Plan	
39	Foothill Conservancy	Restoring the Upper Mokelumne's Anadromous Fish	"Salmonid Habitat Analysis on the uUpper Mokelumne River; Assessing the potential for Chinook salmon reintroduction above Pardee Dam," Cramer Fish Sciences; Rocko Brown, Ph.D; Joseph Merz, Ph.D; Mike Beakes, Ph.D; 2018.
40	Foothill Conservancy	Upper Mokelumne Watershed Landowner Guide	

	Proponent	Project	Documentation Regarding Technical Feasibility of Project
41	Jackson	Jackson Creek Sewer Line Relocation – Conceptual Design/Feasibility Study	
42	UMRWA	Hemlock Forest Restoration Water Yield Project Study	An ecosystems management strategy for Sierra mixed-conifer forests. General Technical Report PSW-GTR-220. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California, USA. 2 Collins, B. M., Everett, R. G., & Stephens, S. L. (2011) Impacts of fire exclusion and recent managed fire on forest structure in old growth Sierra Nevada mixed-conifer forests. Ecosphere, 2(4): 1-14. 3 Podolak, K., Edelson, D., Kruse, S., Aylward, B., Zimring, M., & Wobbrock, N. (2015) Estimating the Water Supply Benefits from Forest Restoration in the Northern Sierra Nevada. An unpublished report of The Nature Conservancy prepared with Ecosystem Economics. San Francisco, CA. 4 Final California Water Plan Update 2013 A restoration framework for federal forests in the Pacific Northwest. Journal of Forestry, 110(8), 429-439. 6 Seymour, R. S., & White, A. S. (2002). Natural disturbance regimes in northeastern North America - evaluating silvicultural systems using natural scales and frequencies. Forest Ecology and Management, 155(1), 357-367. 7 Covington, W.W. (2000) Helping western forests heal. *Nature*, 408:135-136. 8 Chmura, D. J., Anderson, P. D., Howe, G. T., Harrington, C. A., Halofsky, J. E., Peterson, D. L., ... & Clair, J. B. S. (2011). Forest responses to climate change in the northwestern United States: ecophysiological foundations for adaptive management. Forest Ecology and Management, 261(7), 1121-1142. 9 Harrison, B. & Bales, R.C. (2015). Forests and water in the Sierra Nevada: Sierra Nevada watershed ecosystem enhancement project. Sierra Nevada Research Institute Report, 11. 12 Goulden, M. L., & Bales, R. C. (2014) Mountain runoff vulnerability to increased evapotranspiration with vegetation expansion. Proceedings of the National Academy of Sciences, 111(39), 14071-14075. 13 Sierra Nevada Adaptive Management Project. http://snamp.cnr.berkeley.edu. 14 Kings River Experimental Watersheds Project, Pacific Southwest Research Station
43	UMRWA	MAC Region DAC Small Communities Water Needs Assessment	
44	UMRWA	North Fork Mokelumne Watershed Erosion Control & Water Quality Restoration Plan	Power Fire GRAIP Watershed Roads Assessment, USFS Rocky Mountain Research Center, April 2016

	Proponent	Project	Documentation Regarding Technical Feasibility of Project
45	UMRWA	North Fork Mokelumne Watershed Erosion Control & Water Quality Restoration Project	Power Fire GRAIP Watershed Roads Assessment, USFS Rocky Mountain Research Center, April 2016
46	UMRWA	Upper Mokelumne Erosion and Water Quality Assessment and Restoration Plan	Power Fire GRAIP Watershed Roads Assessment, USFS Rocky Mountain Research Center, April 2016
47	CAFT	South Fork Mokelumne River Watershed Restoration	

5. Plan Administration

This chapter describes how the MAC Plan will be maintained and administered following its adoption by the RWMG. Included in this chapter are two separate but related sections: Plan Performance and Monitoring, and Data Management.

5.1. Plan Performance and Monitoring

The intent of the Plan Performance and Monitoring section is to substantiate that the MAC Region: is efficiently making progress towards meeting the MAC Plan objectives, is implementing projects listed in the plan, and is ensuring that each project in the MAC Plan is monitored to comply with all applicable rules, laws, and permit requirements. This chapter describes the general process that will be employed to track MAC Plan performance and to monitor progress being made to implement the projects contained in this plan.

5.1.1. Tracking and Reporting MAC Plan Performance

A MAC Plan Performance Review will be conducted, at a minimum, every three years (or as deemed appropriate by the RWMG) to evaluate progress made toward achieving Plan objectives. The Plan Performance Review will be administered by the RWMG and supported by the RPC or, at its discretion, by a subcommittee of the RPC.

Two tables will be generated with each Plan Performance Review: one that addresses the extent to which the MAC Plan's objectives have been met, and one that describes progress made in implementing the projects listed in the MAC Plan. The first table, which will be entitled 'Progress Toward Achieving Plan Objectives,' will report the performance measure data collected and submitted by the reporting agencies for each of the MAC Plan objectives listed in Chapter 3.

The second table, which will be entitled "Status of Project Implementation" will list all of the projects in Chapter 4 of the MAC Plan, their implementation status, and funding source. Projects that have been fully implemented will be highlighted separately.

Templates of these tables are provided below.

Table 5-1: Example Reporting Template: Progress toward Achieving Plan Objectives[1]

Objectives	Performance Measures	Monitoring/Reporting Result
Goal: Reduce sources of contaminants		
Reduce abandoned mine flows and sediments.	Number of mines known to cause water quality issues for which remedial actions are implemented. Abandoned mines are defined as those in the Office of Mine Reclamation database plus other locally known mines.	
Reduce leakage from septic systems.	Number of problem septic systems identified; number of problem septic systems corrected; number of problem septic systems eliminated	
Increase bulky waste pickup programs, avoid illegal dumping, and increase collection of illegally dumped trash.	Number of new bulky waste pickup dates; estimated tons of illegal waste picked up; number of campaigns or other measures undertaken to stop illegal dumping.	
Identify informal recreation and camping sites with recurring waste issues and initiate remedial actions.	Number of identified problem sites; number of identified sites for which remedial actions are initiated.	
Manage fire fuels to reduce wildfire impacts.	Number of acres on which fire fuel reduction measures are implemented.	
Increase public awareness of how contaminated water resources affect quality of life and public health.	Number of school classrooms, articles in local newspapers and water agency newsletters, and other programs that receive water quality-related curriculum.	

Objectives	Performance Measures	Monitoring/Reporting Result
Track increase of small county-monitored water systems.	Number of small water supply systems monitored annually by the counties.	

Footnotes:

1. This template includes the performance measures to be reported on for Policy 1, Goal 1 only. Similar tables will be prepared and completed for the remaining goals under Policy 1, as well as Policies 2 – 5, as part of the MAC Plan Performance Review.

Table 5-2: Example Reporting Template: Status of Project Implementation

	Proponent	Project	Status of Project Implementation
1	Amador Resource Conservation District	Soil Health & Climate Resilient Agriculture Education Program	
2	AWA	Groundwater Banking Conjunctive Use Study	
3	AWA	Groundwater Capacity in Amador County	
4	AWA	Amador Canal Water Conservation Project	
5	AWA	PG&E Storage Recovery	
7	AWA	Lower Bear River Reservoir Expansion Study	
8	AWA	Surface Storage Feasibility Study	
9	AWA	Lake Camanche Recycling Water Project	
10	AWA	Amador Water Agency System Computer Modeling	
11	AWA	Amador Water Agency Master Plan	
13	AWA	Highway 88 Corridor Sewer Trunk Line Study	
14	AWA	Ione WTP Planning Study	
15	AWA	Upper-Lower Water System Reliability Intertie Project	
16	AWA	Lake Camanche Transmission Main Project	
17	AWA	Amador Water Agency Low Pressure Fire Flow Improvements	
19	AWA	CAWP Fire Protection Project	
20	AWA	Floating Covers Replacement Project	
21	AWA	Lake Camanche Water Service Replacement – Phase IV	
22	AWA	Amador Water Agency Treated Water Supply Study	
23	AWA	Community Leachfield Groundwater Nitrate Study	
24	AWA	Martell Wastewater Lift Station Reduction Project	

	Proponent	Project	Status of Project Implementation
25	AWA	Regional Wastewater Treatment and Recycling Project	
26	AWA	Lake Camanche Regional Wastewater System	
27	AWA	Tanner WTP Rehabilitation and Efficiency Project	
28	AWA	Water Storage Reoperation Study	
29	AWA	SGMA Implementation for Amador County	
30	AWA	Fishery Habitat Improvements	
31	AWA	New York Ranch Reservoir Conservation and Management	
32	AWA	MAC Conservation Program Implementation	
33	CCWD	Sheep Ranch Drinking Water Treatment & Distribution Compliance Project	
34	CCWD	West Point Automated Meter Reading Project	
35	CCWD	West Point Water Treatment Plant Drinking Water Compliance Project	
36	CCWD	Wilson Dam Meadow Restoration and Habitat Enhancement Plan	
37	Foothill Conservancy	Amador Household Water Efficiency Project	
38	Foothill Conservancy	Mokelumne High Country Meadow Restoration	
39	Foothill Conservancy	Riparian Noxious Weed Abatement Plan	
40	Foothill Conservancy	Restoring the Upper Mokelumne's Anadromous Fish	
41	Foothill Conservancy	Upper Mokelumne Watershed Landowner Guide	
42	City of Jackson	Jackson Creek Sewer Line Relocation - Conceptual Design/Feasibility Study	
43	UMRWA	Hemlock Forest Restoration Water Yield Project Study	
44	UMRWA	MAC Region DAC Small Communities Water Needs Assessment	

	Proponent	Project	Status of Project Implementation
45	UMRWA	North Fork Mokelumne Watershed Erosion Control & Water Quality Restoration Plan	
46	UMRWA	North Fork Mokelumne Watershed Erosion Control & Water Quality Restoration Project	
47	UMRWA	Upper Mokelumne Erosion and Water Quality Assessment and Restoration Plan	

5.1.2. Project-Specific Data Collection and Monitoring Plans

Proponents of projects implemented as part of the MAC Region IRWM Program will be required to develop project-specific monitoring plans prior to or in conjunction with project implementation. Project proponents will be responsible for collecting the data consistent with MAC Plan requirements for compatibility with statewide databases, performing the monitoring activities, validating the data consistent with MAC Plan requirements for compatibility with statewide databases, and reporting both to UMRWA and to appropriate state databases. For projects that receive implementation grant funding from DWR, UMRWA (as the RWMG) will act as the overseeing entity, ensuring that each project proponent prepares its project-specific monitoring plan(s) and implements the plan(s) accordingly. Monitoring plans will include schedules with an estimated timeline of monitoring activities, which UMRWA will use as a guideline for overall program implementation. Data collected and analyses performed as part of the performance monitoring plans will be reported to UMRWA and appropriate statewide databases on a quarterly basis, along with required documentation and an evaluation of project performance. This will help ensure that implemented projects fulfill MAC Plan objectives as originally intended.

Project-specific monitoring plan requirements will vary based on the type of project being implemented. All projects must adhere to appropriate State guidelines for monitoring, depending upon the type of data being collected, in order to be implemented through the IRWM Plan. These include:

- Projects that involve surface water quality must meet the criteria for and be compatible with the Surface Water Ambient Monitoring Program (SWAMP, http://www.waterboards.ca.gov/water_issues/programs/swamp/tools.shtml.
- All projects that involve groundwater quality must meet the criteria for and be compatible with Groundwater Ambient Monitoring and Assessment Program (GAMA, http://www.waterboards.ca.gov/gama/.
- All projects that involve groundwater levels and/or supply must meet the criteria for and be compatible with the California Statewide Groundwater Elevation Monitoring Program (CASGEM, https://www.water.ca.gov/Programs/Groundwater-Management/Groundwater-Elevation-Monitoring--CASGEM).
- All projects that involve wetland restoration must meet the criteria for and be compatible with the State Wetland and Riparian Area Monitoring Plan (WRAMP, http://www.waterboards.ca.gov/mywaterquality/monitoring_council/wetland_workgroup/docs/2010/tenetsprogram.pdf).

All project-specific monitoring plans must include the following:

1) A table describing what is being monitored for the project (e.g., water quality, water depth, flood frequency), and effects the project may have on habitat or particular species (before and after construction).
2) Measures to remedy or react to problems encountered during monitoring.
3) Location of monitoring.
4) Monitoring frequency.
5) Monitoring protocols/methodologies and quality assurance and quality control (QA/QC) procedures, including who will perform the monitoring.
6) A description of how those monitoring protocols/methodologies and QA/QC procedures are consistent with requirements for applicable statewide databases including SWAMP, GAMA, and WRAMP)
7) An identified data management system (DMS) that will be used or procedures to keep track of what is monitored.

8) Procedures and a schedule for incorporating collected data into statewide database(s).
9) Procedures and a schedule for reporting to UMRWA confirmation of data submittal to appropriate statewide database(s).
10) Procedures to ensure the monitoring schedule is maintained and that adequate funding is available to maintain monitoring of the project throughout the scheduled monitoring timeframe

The project sponsor will be responsible for completed data collection in accordance with the approved project-specific monitoring plan, which will clearly identify monitoring and analytical techniques and QA/QC procedures to be implemented and will describe how those techniques are compatible with the requirements of appropriate statewide database(s). The individual project sponsor will be responsible for reviewing the data collection and QA/QC protocols to validate that data was collected in accordance with QA/QC procedures required as part of the project monitoring program. In addition, project proponents will be responsible for "spot-checking" all data for accuracy at the time of entry to the database to identify any apparent errors. Once data collection and QA/QC has been complete in accordance with provisions of the approved project-specific monitoring plan, the project sponsor will submit the compatible data to the appropriate statewide database, as well as to UMRWA for inclusion in the Region's centralized data management system (DMS). The project sponsor will also provide UMRWA with confirmation that the data has been submitted to the appropriate statewide database.

UMRWA will maintain a centralized DMS on the UMRWA electronic file system, which will house all original data provided by project sponsors. The data will be maintained by UMRWA and copies of all data will be available to stakeholders and members of the public through UMRWA's MAC IRWMP website. Data management is discussed in greater detail in the following section.

5.1.3. Using the Information Collected

The Plan Performance Review process will include an adaptive management component which will allow the RWMG to respond to lessons learned from analyzing collected performance measure and project monitoring data. With this information, the RWMG, through the RPC, may consider modifying IRWM Plan objectives, performance measures, the applicability of selected resource management strategies, and the project review and prioritization process. These actions may in turn determine the types of projects that will be selected and implemented in the future.

Local agencies implementing projects as part of IRWM Plan implementation will monitor for the parameters identified in order to identify when their projects may not be fulfilling their objectives. This information will be fed back into the project's decision-making structure to adapt the project to better meet its overall objectives. Only by consistent monitoring and analysis can projects successfully achieve their objectives. Monitoring will also provide a clear reporting mechanism for the public, decision-makers, and regional planners to determine the planned versus actual value of the project. Whenever the MAC Plan is updated in the future and regional objectives are revisited, the RPC will discuss and evaluate the MAC Plan Update implementation. The results of project-specific monitoring efforts will be utilized to identify areas where Plan implementation may need to be modified to best achieve Plan objectives moving forward.

For those projects included in this IRWMP that may be implemented independently from the MAC Region IRWM Program, project sponsors will be encouraged to prepare and administer project-specific monitoring plans that are generally consistent with the monitoring plans described above. During the Plan Performance Review, the RWMG will assess the extent to which the MAC Plan's objectives have been met, based on the projects and programs completed throughout the Region. In this way, progress made toward achieving Plan objectives by projects implemented outside of the IRWM Program will be assimilated into the Plan Performance Review, though specific monitoring data may not be made available by project sponsors to the centralized DMS.

5.2. Data Management

The Data Management section is intended to ensure the efficient use of available data, describe stakeholder access to data, and ensure the data generated by IRWM implementation activities can be integrated into existing State databases.

To this end, the MAC Plan Update has established standard data management documentation practices for IRWM Plan projects and programs that are required to be followed for projects and programs implemented as part of the IRWM program. Projects and programs implemented outside of the IRWM Program are encouraged to follow similar protocols to maximize usefulness and compatibility of data collected throughout the region, and to improve potential integration into statewide databases. The data proposed to be collected and anticipated reporting procedures are presented in the sections below. For the purposes of this plan, the term data refers to and includes technical documentation (such as designs, feasibility studies, and reports), as well as technical information collected as part of project or program planning, design, implementation, and operation.

5.2.1. MAC Region Data Needs

Throughout the MAC Region, a variety of local, state and federal agencies and non-governmental organizations collect valuable water quality data, but that data is not assembled in a uniform or collaborative manner, and in many cases is neither compatible nor comparable. Much of the data that is collected is program-specific with limited applicability region-wide. The MAC Region's IRWM planning process can help facilitate better information sharing and identify data needed by the region's agencies and organizations, project proponents, and stakeholders to more efficiently analyze and understand water quality and environmental conditions within the region.

Procedural data needs in the MAC Region include the following.

- Uniform data management protocols for MAC Plan projects to allow broader sharing and comparability
- Centralized data management to provide a means for addressing regional questions about the condition of water resources in the region.

In addition, the following data needs that are broadly applicable to the MAC Region were identified through the Upper Mokelumne River Watershed Assessment and Planning Project and RPC discussions conducted as part of MAC Plan updates.

- Water quality, temperature, and streamflow monitoring data throughout the Region to assist in tracking water quality trends.
- Information on non-water quality related watershed conditions.
- Additional information on the location and extent of septic system-related water quality issues in the Region.
- Project specific information, such as project financing solutions

5.2.2. Data Collection Techniques

Data associated with the design and implementation of projects included in the MAC Plan Update will depend upon project type, but may include streamflow, surface water deliveries, groundwater elevations, groundwater pumping, precipitation, water demand, locations and sizes of water-related facilities, political and agency boundaries, land use, contaminant plume location and extent, water quality data, locations of sensitive habitats and species, and hydrogeologic and hydrologic data. These data will be collected from various federal, state, and local sources, some of which are shown in Table 5-3. Data may also be developed by project sponsors using numerical models such as HEC, H2ONet, and various hydraulic and hydrologic

models. Working with the project sponsors, the agencies shown in Table 5-3, and regional stakeholders, the MAC IRWM Program will continue to search for data relevant to the MAC IRWM resource management strategies on an ongoing basis. Any identified data gaps will be filled through the identification of new data sources or new or expanded monitoring activities.

Table 5-3: Sources of IRWMP Data

Federal	State	Local
National Climate Data Center National Resource Conservation District Army Corps of Engineers Bureau of Reclamation U.S. Fish & Wildlife Service U.S. Geologic Survey National Marine Fisheries Service U.S. Environmental Protection Agency The Nature Conservancy U.S. Forest Service Bureau of Land Management	California Irrigation Management Information System (CIMIS) Department of Fish & ~~Game~~Wildlife Department of Public Health Department of W~~w~~ater Resources State Water Resources Control Board & the Regional Water Quality Control Board California Natural Diversity Database California Department of Pesticide Regulation California Energy Commission Department of Toxic Substances Control CAL FIRE Sierra Nevada Conservancy	Amador County Alpine County Calaveras County City Planning Departments Amador-Calaveras Consensus Group PG&E /Project 137 ERC ~~Upper Mokelumne River Watershed Council~~ Northeastern San Joaquin Groundwater Banking Authority Mokelumne, Calaveras, and Cosumnes River Water Purveyors Stakeholders

Data collected in conjunction with MAC Plan implementation projects will vary based on the type and scope of each individual project. Table 5-4 outlines the types of data expected to be collected by project type. These data will include, at a minimum, data relevant to surface water, groundwater, water quality, stormwater, and ecosystem restoration.

Table 5-4: Data to be Collected through IRWM Project Implementation

Data Type	Project Type					
	Water Supply	Recycled Water	Water Quality	Stormwater and Flood Management	Ecosystem Restoration	Groundwater Management
Stream & River Flows	✓		✓		✓	
Stream & River Water Quality	✓	✓	✓	✓	✓	
Locations of Sensitive Habitats & Species			✓		✓	
Surface Water Deliveries	✓		✓			✓
Groundwater Pumping	✓		✓			✓
Hydrogeologic						✓
Precipitation	✓		✓	✓		✓
Water Demand	✓	✓				✓
Water Related Facilities	✓	✓	✓	✓		✓
Political and Agency Boundaries	✓	✓	✓	✓	✓	✓
Land Use	✓	✓	✓	✓	✓	✓
Contaminant Plume Locations and Extents	✓		✓			✓

As described in Section 5.1 Plan Performance and Monitoring, MAC Region project proponents implementing projects through the IRWM Program will be required to prepare project-specific monitoring plans that adhere to the data collection techniques and procedures established by the following statewide programs. Data collected will be compatible with statewide databases because the project-specific monitoring plans will be developed based on guidance provided for applicable statewide database. Project sponsors will be responsible for submitting data to the appropriate statewide databases. This will ensure compatibility of data among projects implemented through the IRWM Program, as well as compatibility with relevant statewide databases.

SWAMP: Typical data collection techniques for surface waters include both field measurements and laboratory analysis. Field measurements are either collected using meters or field kits for a common list of constituents including but not limited to: water temperature, pH, conductivity, dissolved oxygen and turbidity. For an example of a field data sheet and complete list of SWAMP-required fields go to: http://swamp.mpsl.mlml.calstate.edu/wp-content/uploads/2009/04/swamp_sop_field_measures_water_sediment_collection_v1_0.pdf.

There is a large list of possible constituents that are measured in surface waters that require laboratory analysis. Typical laboratory analysis includes fecal indicator bacteria, metals, nutrients, persistent organic

pollutants, and turbidity. SWAMP provides guidance on methods and quality assurance. This guidance can be found at:

http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/qaprp082209.pdf.

Biological monitoring is helpful for determining the health of a system and whether it is able to sustain a diverse community of benthic macro invertebrates. Standard operating procedures for determining a stream's physical/habitat condition and benthic invertebrate assemblages can be found at:

http://swamp.mpsl.mlml.calstate.edu/wp-content/uploads/2009/04/swamp_sop_bioassessment_collection_020107.pdf.

Projects collecting surface water data will be required to adhere to the SWAMP data collection protocols.

GAMA: The GAMA Priority Basin Project is grouped into 35 groundwater basin groups called "study units." Each study unit is sampled for common contaminants regulated by the California Department of Public Health (CDPH), and also for unregulated chemicals. Testing for these chemicals—usually at detection levels well below those achieved by most laboratories—will help public and private groundwater users to manage this resource. Results from the Northern San Joaquin study unit, which includes the western-most portion of the MAC Region (Amador and Calaveras Counties), can be found at http://pubs.usgs.gov/fs/2011/3089/. Some of the chemical constituents that are sampled by the GAMA Priority Basin Project include:

- Low-level volatile organic compounds (VOCs)
- Low-level pesticides
- Stable isotopes of oxygen, hydrogen, and carbon
- Emerging contaminants (pharmaceuticals, perchlorate, chromium VI, and other chemicals)
- Trace metals (arsenic, selenium, lead, and other metals)
- Radon, radium, and gross alpha/beta radioactivity
- General ions (calcium, magnesium, fluoride)
- Nutrients, including nitrate, and phosphates
- Bacteria: total and fecal coliform bacteria

Projects collecting groundwater data will be required to adhere to GAMA data collection protocols.

WRAMP: The WRAMP is intended to track trends in wetland extent and condition to determine the performance of wetland, stream, and riparian protection programs in California. The program defines standardized assessment methods and data management with the goal of minimizing new costs and maximizing public access to assessment information. Additional information on the WRAMP program can be found at the following location http://www.waterboards.ca.gov/mywaterquality/monitoring_council/wetland_workgroup/docs/2010/tenetsprogram.pdf

All projects that involve wetland restoration must meet the criteria for and be compatible with the State Wetland and Riparian Area Monitoring Plan.

As described in Section 5.1 Plan Performance and Monitoring, individual project sponsors will be responsible for collecting data in accordance with the approved project-specific monitoring plan, which will clearly identify monitoring and analytical techniques and QA/QC procedures to be implemented and will describe how those techniques are compatible with the requirements of appropriate statewide database(s). The individual project sponsor will be responsible for reviewing the data collection and QA/QC protocols

to validate that data was collected in accordance with QA/QC procedures required as part of the project monitoring program. In addition, project proponents will be responsible for "spot-checking" all data for accuracy at the time of entry to the database to identify any apparent errors. Once data collection and QA/QC has been complete in accordance with provisions of the approved project-specific monitoring plan, the project sponsor will submit the compatible data to the appropriate statewide database, as well as to UMRWA for inclusion in the Region's centralized data management system (DMS). The project sponsor will also provide UMRWA with confirmation that the data has been submitted to the appropriate statewide database.

5.2.3. Existing Monitoring Efforts

There are several ongoing monitoring efforts within the region that may generate information useful to the IRWM planning program, including those by the US Forest Service, EBMUD, PG&E, and others. For example, several programs are currently completing baseline mapping of vegetation and wildlife on the Mokelumne River, as well as historical and ongoing surveys of birds, amphibians, reptiles and small mammals. Additionally, Mokelumne River streamflows, water levels, and water quality monitoring are conducted on an ongoing basis. These efforts are being conducted to fulfill regulatory requirements or support watershed studies.

All agencies in the region providing water supply and water and wastewater treatment services are also conducting regulatory monitoring operations. As part of their regular operating procedures, these agencies conduct both influent and effluent water quality analyses.

5.2.4. The MAC Region DMS

UMRWA will maintain a centralized DMS on the EBMUD server, which will house all original data provided by project sponsors. The procedure for submitting data for inclusion in the DMS is as follows.

1. The project sponsor completes monitoring and data collection in accordance with the approved project-specific monitoring plan, including QA/QC procedures.
2. The project sponsor validates data consistent with data validation protocols outlined in the project-specific monitoring plan.
3. The project sponsor "spot-checks" data for accuracy at the time of entry to the database to identify any apparent errors.
4. The project sponsor submits the data to the appropriate statewide database.
5. The project sponsor submits the data to UMRWA for inclusion in the Region's centralized data management system (DMS).
6. The project sponsor provides UMRWA with confirmation that the data has been submitted to the appropriate statewide database.
7. UMRWA maintains the data in the centralized database.
8. UMRWA disseminates the data to stakeholders and members of the public through the MAC Plan webpage.

Data collected will be compatible with statewide databases because the project-specific monitoring plans will be developed based on guidance provided for applicable statewide database. While project sponsors will be responsible for submitting data to the appropriate statewide databases, UMRWA will be able to confirm that this has been done based on the confirmation of submittal required.

The DMS will serve the important function of assisting the RWMG in its goal to share collected data by requiring consistent methodologies for data collection and housing all data in a centralized location that is

easily accessed by stakeholders and members of the public. In this way, the DMS assists the RWMG in accomplishing the objectives of improved data comparability and accessibility.

5.2.5. Data Dissemination

Data collection, review, and dissemination are activities that occur during both the MAC Plan update process, and subsequently during the implementation of the updated MAC Plan. During the update process, data has been disseminated primarily via project-specific documentation and associated meetings, inter-agency collaboration on issues and projects of mutual interest, discussion at ongoing stakeholder/RPC and UMRWA meetings, and through website postings. Project proponents, RPC members, and IRWM planning participants are all jointly responsible for data dissemination. In the past, coordination among regional members and other relevant agencies in the development of data has occurred for several specific projects, including the Raise Lower Bear Reservoir project, EBMUD's WSMP 2040, and the Upper Mokelumne River Watershed Assessment Project. UMRWA Board and committee meetings, and meetings of the RPC, have served as venues for sharing data on subjects ranging from climate change to public health dangers of swimming in certain local waters. Environmental documentation processes (i.e., CEQA and NEPA) have also allowed for dissemination of data developed for review by interested stakeholders and the public. These methods will continue to be employed.

As described previously, all data will be housed in a centralized DMS on the EBMUD server, maintained by UMRWA. All data collected will be made available to stakeholders and members of the public through the MAC IRWM webpage (http://umrwa.org/docs.html). Hard copies and CDs may be available to interested parties without Internet access. Periodic updates of the MAC IRWMP will be distributed in a similar manner.

Dissemination of data to statewide programs administered by both the SWRCB and DWR will support statewide data needs. As described previously, individual project sponsors will be responsible for submitting data to the appropriate statewide database(s) consistent with the approved project-specific monitoring plan. UMRWA will confirm that this submittal has occurred based on the project sponsor's confirmation reporting.

In addition, MAC IRWM planning participants have supported statewide data needs in the past through voluntary participation and will continue to do so in the future by making collected data available to programs such as the California Environmental Resources Evaluation System (CERES), Surface Water Ambient Monitoring Program (SWAMP), Groundwater Ambient Monitoring Assessment (GAMA) program, and the California Environmental Information Catalog (CEIC) when appropriate and feasible. Data will also be disseminated to DWR for inclusion in its databases, such as the Water Data Library (WDL), which contains groundwater level and water quality data. Finally, stakeholders, agencies, and the public may request all publicly available IRWMP data (i.e., non-proprietary and non-confidential) from any of the MOU signatories for this IRWMP.

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Appendix A: DWR IRWMP Standards Review Form

Appendix B: Other Agencies with Water Resource Management Responsibilities in the Region

Appendix C: MAC Region Climate Change Vulnerabilities

Appendix D: RPC Meeting Summaries

Appendix E: Response to Public Comments

Appendix FE: Project Information Forms

Appendix G: Other Project Information Forms

Appendix HF: Project List and Associated Scores

Appendix IG: Project Type and Financing Summary