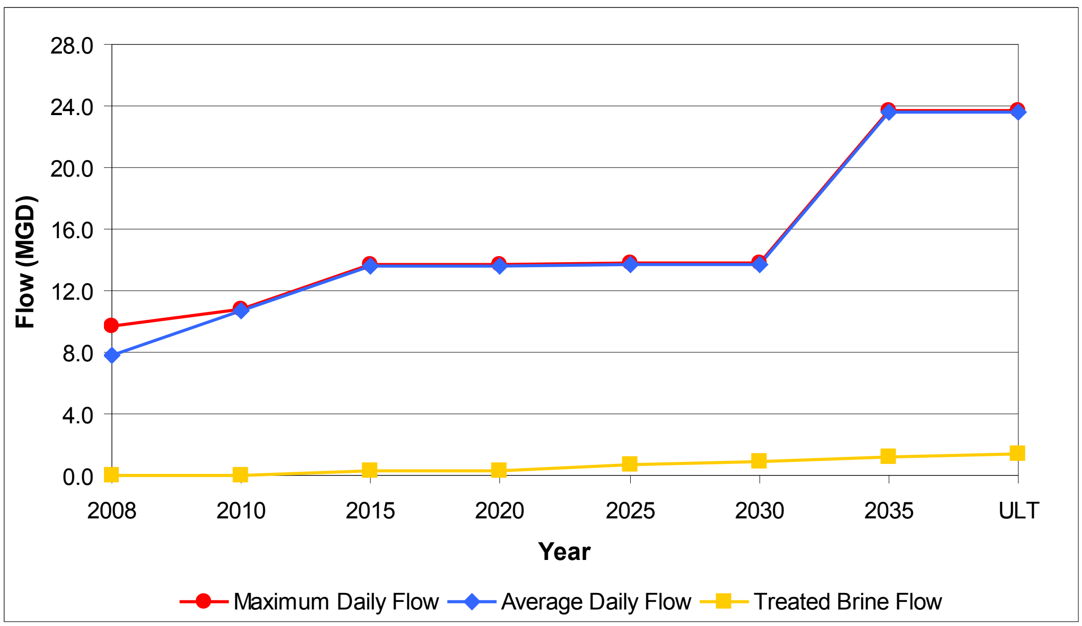
3.3.2 Regional Summary

Brine-Concentrate Flow Summary

In the Inland Empire region, projected brine-concentrate flows increase from 7.83 mgd in 2008 to 23.60 mgd by 2035. Figure 3.15 presents a summary of these projected flows. A majority of this flow (over 99 percent) is generated from existing and planned groundwater desalters. The remaining brine-concentrate flow is from advanced treated MF/RO processes at WWTPs/WRPs. Chino Desalter I and the Temescal Desalter are currently the primary generators of brine-concentrate; however, in the future, the planned Lower Bunker Hill Desalter and the Yucaipa Valley Regional Water Supply Renewal Project will generate most of the flow. As shown in Figure 3.15, only a small amount of brine-concentrate treatment is planned in the region. The Santa Rosa WWTF will implement a small volume-reduction technology facility (0.3 mgd) starting by 2015 to reduce the amount of brine-concentrate flow entering the SARI system. By 2025, the amount of brine-concentrate flow treatment using volume-reduction technology is projected to increase to 0.08 mgd when the Grass Valley WWTF begins operation of a brine concentrator. Treatment of brine-concentrate will expand in 2035 when the BBARWA WWTF begins operations of a facility with volume-reduction technology.

FIGURE 3.15 BRINE-CONCENTRATE FLOW SUMMARY FOR THE INLAND EMPIRE REGION



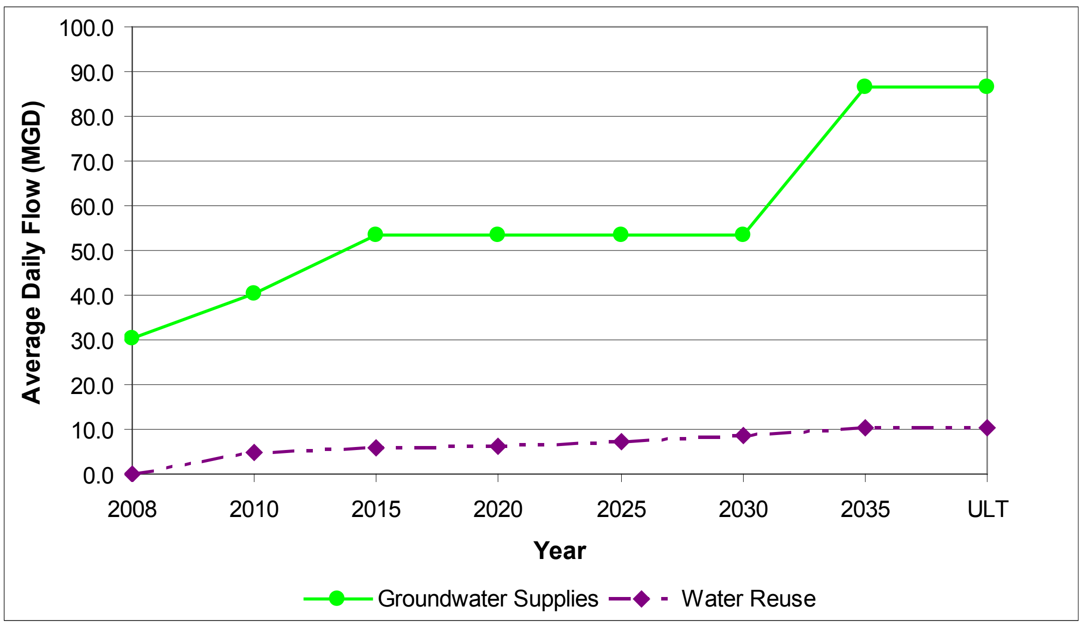
Note: Brine generation is from wastewater treatment and groundwater desalting.

Water Supply Summary

The scarcity of water supply continues because of the limited availability of imported water and the drought, which make even more important the development of reliable and locally controlled water supplies. Groundwater desalting and water reclamation are two methods of developing new reliable and locally controlled water supplies. Consequently, developing a long-term plan for brine-concentrate management for the Inland Empire region is of importance. The Inland Empire has been investigating and implementing projects to address salinity impacts for a number of years. In fact, nine desalters are either existing or planned to be operation in the region by 2010. These desalters are being implemented for two reasons—(1) to maintain the salt balance in the region and (2) to develop a locally controlled, reliable water supply.

As shown in Figure 3.16, over 30 mgd of water is currently generated from the use of RO treatment processes. In the future, the amount of water supply is projected to be approximately 97 mgd, which is more than a threefold increase and will generate approximately 24 mgd of brine-concentrate. Groundwater supplies generated from these treatment processes increase from approximately 30 mgd to nearly 87 mgd by 2035. The use of RO to recover water from WWTPs/WRPs for water reuse will result in an increase of water supply from approximately 0.012 mgd in 2008 to approximately 10.27 mgd by 2035.

FIGURE 3.16 WATER SUPPLIES THAT RESULT IN GENERATION OF BRINE-CONCENTRATE IN THE INLAND EMPIRE REGION



Note: Figure includes WWTP/WRPs, groundwater recharge, seawater intrusion barrier, and brackish groundwater.

Specific Brine-Concentrate Management Projects and Issues

In the Inland Empire region, a majority of brine-concentrate generated is disposed of via the SARI system. Even with the available discharge mechanisms in the region, there are a number of locations where limitations in discharge capacity or increased water reuse might benefit from implementation of different brine-management strategies. These potential projects and issues were identified from deficiencies noted in the data, information from survey respondents, or information obtained via the regional meetings. In the Inland Empire region, six potential projects and issues were identified, each of which is described below.

SARI Capacity Issues – The SARI system capacity is limited at Reach 8 to 30 mgd of flow. Some concern arises due to potential projects and existing discharges that this capacity could be exceeded. As seen in Figure 3.17, the SARI system connects Orange County to the Inland Empire at Prado Dam. The SARI system has two main existing feeders—the existing Temescal Valley Regional Interceptor (TVRI) and the SARI Reach IV system that extends to the San Bernardino WRP. In addition to the existing system, three additional extensions are planned for the SARI system. They are the Eastern Municipal Water District (EMWD) brineline, Temecula Valley brineline, and the Yucaipa-SARI pipeline. The EMWD brineline extension and the Temecula Valley brineline will connect to the TVRI at the Railroad Canyon WWRF. The Yucaipa-SARI extension will connect industrial users and the Henry N. Wolcholz WWTP to the SARI system at the San Bernardino WRP.

Figure 3.18 shows the projected flows in Reach 1 of the SARI pipeline. Projections show that there is approximately 10 mgd of available capacity during maximum daily flows. However, as shown in Figure 3.19, projections for available capacity in Reach 8 (SARI Reach IV) of the SARI system differ based on source of the projections. OCSD provided flow projections in Reach 8 (SARI Reach IV) of 15 mgd for 2008 and increasing to approximately 20 mgd in 2035. For the same reach, Santa Ana Watershed Project Authority (SAWPA) projections were 13 mgd in 2008 and increasing to over 28 mgd by 2035. In addition, the Upper SARI Planning Study estimated flows to be over 13 mgd in 2008 and increasing to over 35 mgd by 2020.

These projections exceed the 30-mgd capacity of the SARI Reach 8/Reach IV; therefore, SAWPA and its member agencies are looking for opportunities to reduce or remove flow to the SARI system. Currently, SAWPA is investigating the long-term viability of the SARI system for salt export. Two ways exist to reduce flow in the SARI system—(1) remove domestic wastewater flows entering the system and build a separate system to handle these flows, and (2) implement brine-concentrate volume-reduction or -elimination technologies. Brine-concentrate management can be implemented on the SARI system at local agency facilities or at a centralized location.

In addition to capacity issues, the SARI system also has solids settlement problems and scaling in its system. Suspended solids (SS) concentrations of 100 mg/L have been measured in the SARI system in portions of the pipeline receiving primarily groundwater brine with SS of less than 1 mg/L. Also, the SARI has occurrences of SS concentrations of over 200 mg/L in composite flow from all dischargers.

Suspended solids could be driven by the existence of a supersaturated condition for calcium, magnesium, and silica. These constituents precipitate in the pipeline causing the formation of suspended solids and sedimentation, which occur primarily when the brine is not sufficiently diluted by other flows. Under normal operating conditions, brine constitutes approximately 25 percent of the flow.

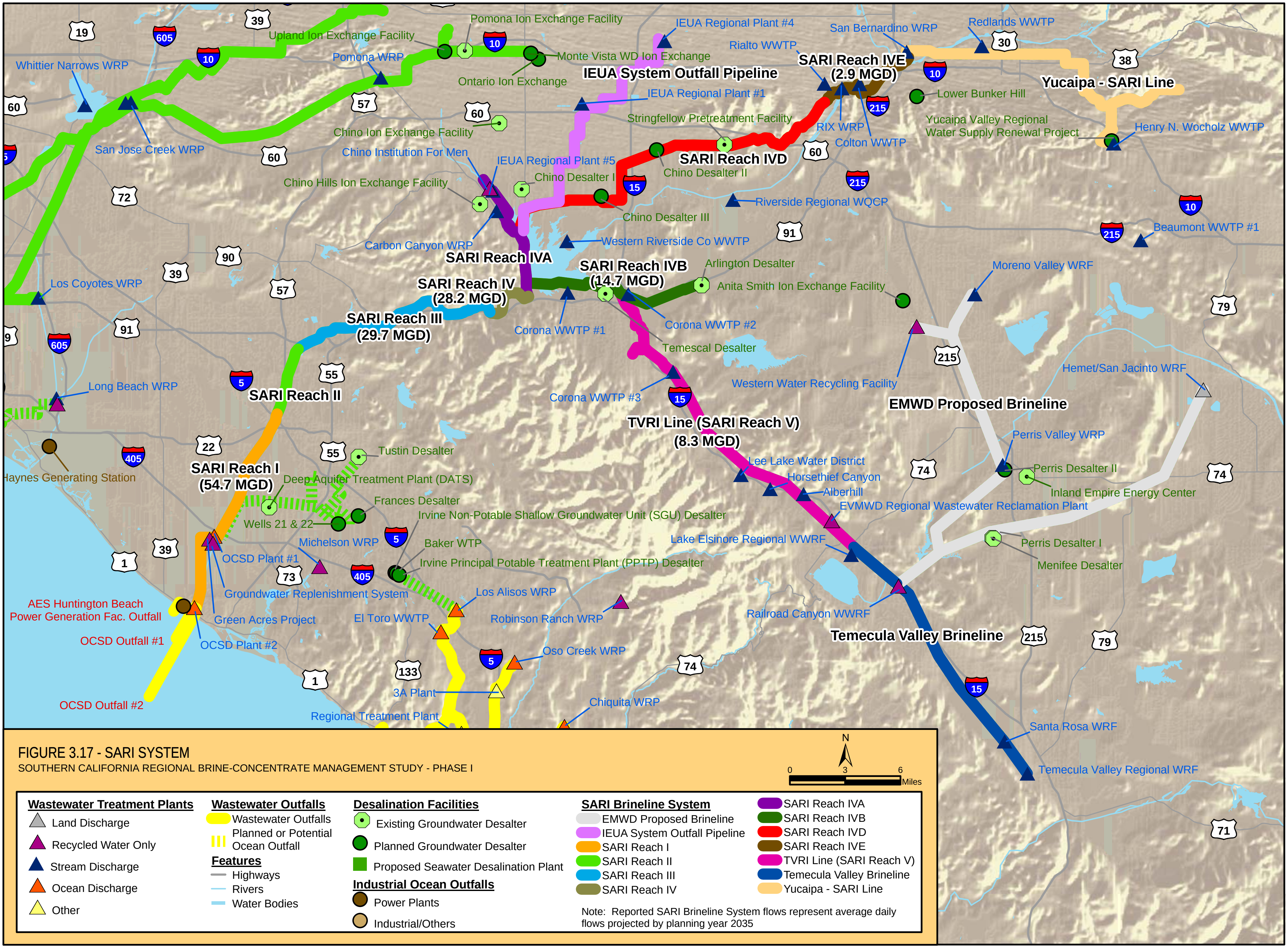


FIGURE 3.17 - SARI SYSTEM

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/24/09

FIGURE 3.18 FLOW SUMMARY FOR SARI REACH 1

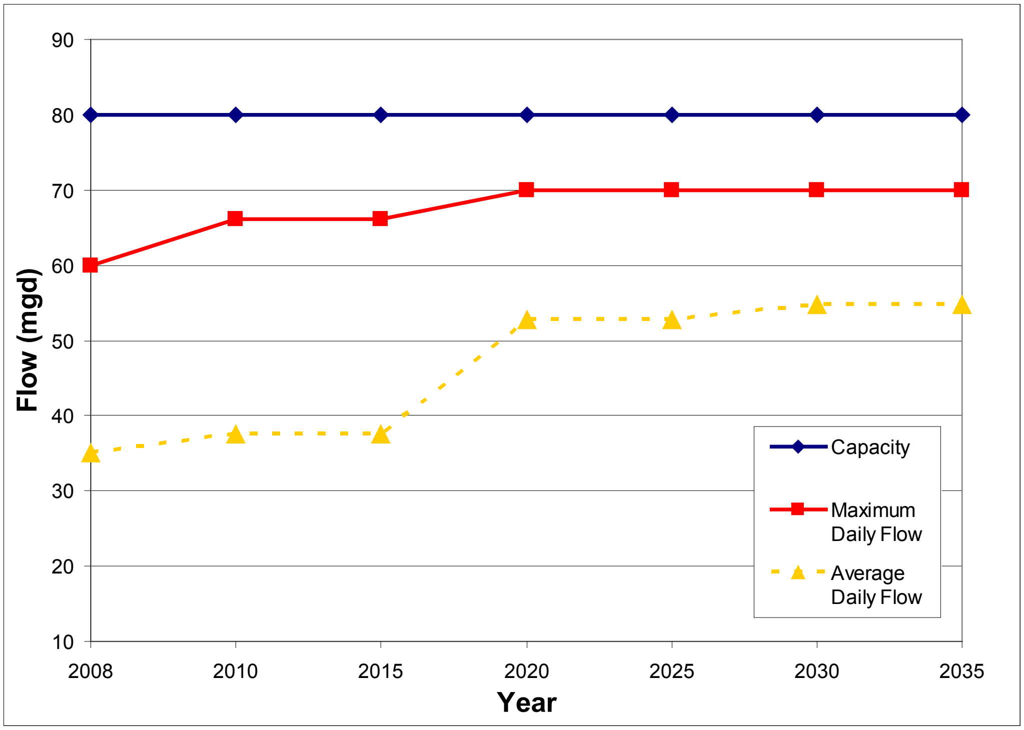
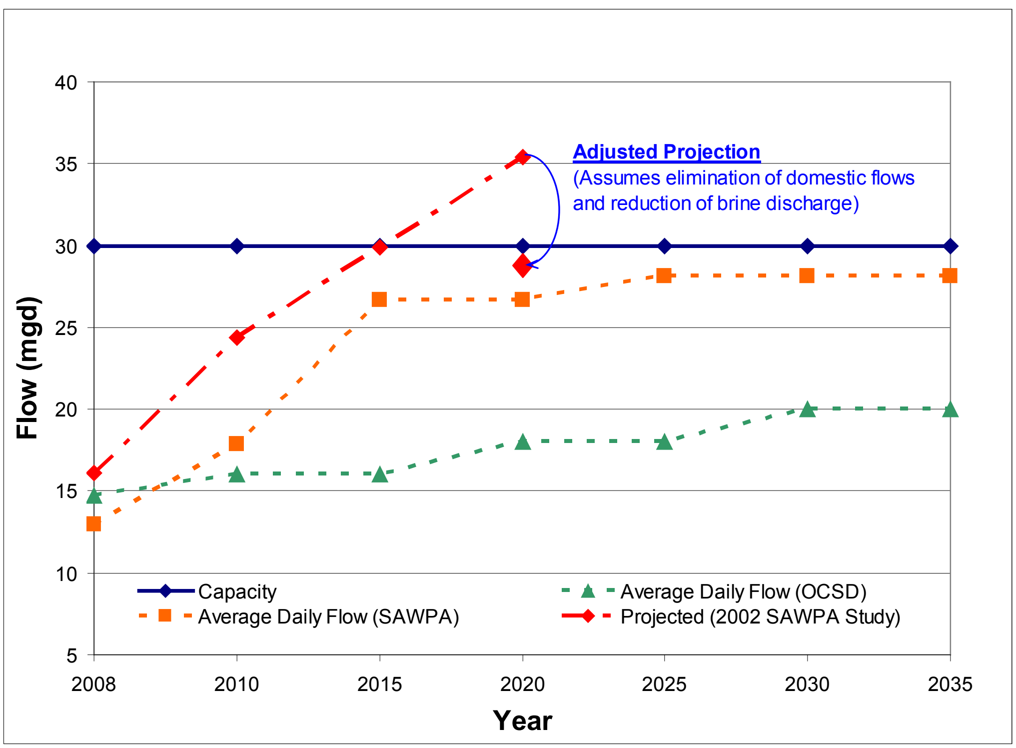


FIGURE 3.19 FLOW SUMMARY COMPARISON FOR SARI REACH 8 (SARI REACH IV)



Creation of a funding mechanism to fund SARI upgrades, such as a sinking fund, is being investigated. Implementation of technologies to reduce or eliminate brine-concentrate could be a solution to this issue and are being investigated as part of SAWPA's Salinity Watershed Management Program. In addition, this study will investigate the pros and cons of centralized versus satellite facilities.

Chino Desalters – The Chino Basin Desalter Authority (CBDA) has worked with Western MWD to pilot test pellet softening at the Arlington Desalter. The purpose of the pilot test was to evaluate if pellet softening reduces a scale-forming mineral and thereby reduces scale formation in the SARI line. Another advantage for the use of pellet softening is the reduction in the amount of brine-concentrate discharge to the SARI system. The CBDA is considering implementing this technology at the Arlington and Chino desalting facilities.

Ion Exchange Facility (Chino Hills Desalter) – The City of Chino Hills is considering connecting the Chino Hills Desalter to the SARI system due to cost considerations of discharging to the Sanitation Districts of Los Angeles County Brine Interceptor system. SARI disposal costs are cheaper if the disposal has higher concentrations of BOD or other organics; however, disposal via the Brine Interceptor system is cheaper if TDS is the only constituent found in high concentrations. The Chino Hill IX Facility is operated intermittently to reduce nitrates and salts.

Santa Rosa WRF Brine-Concentrate Management – Rancho California Water District (RCWD) is planning to implement a multiple regional project that will help reduce water demands from the State Water Project. One project proposed as part of this effort is to build a demineralization/desalination plant to reduce TDS levels to less than 500 mg/L in recycled water from EMWD's Temecula Valley WRP. This will enable up to 16,000 afy of recycled water to be reused in the basin for agricultural use. However, current plans include approximately 5 mgd of advanced treatment, which will include MF followed by RO. This treatment will result in the need to implement a volume-reduction technology by 2015 to reduce flow to the TVRI/SARI system. Brine-concentrate generation from the RO system will be approximately 0.3 mgd by 2015 and will expand to 0.7 mgd by ultimate buildout. If a brine-concentrate volume reduction technology system is employed, then the reject stream would be reduced to 0.002 mgd by 2015 and 0.003 mgd by ultimate buildout. This project will require the construction of the Temecula Valley brineline extension of the TVRI/SARI system.

EMWD Brine-Concentrate Volume Reduction – EMWD is investigating expanding the EMWD brine management system that connects to the TVRI/SARI system. Currently, this system connects EMWD's groundwater desalters to the TVRI/SARI system. In the future, EMWD is considering allowing industrial dischargers to dispose brine in the EMWD brine management system. In addition to expanding the brine management system, EMWD has been investigating a number of different brine-concentrate volume reduction and zero liquid discharge technologies. These technologies include electrodialysis reversal (EDR), membrane distillation, forward osmosis, slurry precipitation and reverse osmosis (SPARRO), Salt Solidification and Sequestration (SALT_PROC), brine concentrator, evaporation ponds, and precipitative softening (PS)/RO. EMWD recently completed pilot testing a number of these technologies; however, no decision has been made on what technology to implement.

City of Corona Temescal Desalter – The City of Corona might need to reduce the amount of brine-concentrate discharged to the SARI system. A likely volume-reduction technology to be used is PS as a pretreatment for RO, which would be similar in nature to the pellet softening being tested at the Arlington Desalter and would need to be pilot tested prior to implementation.

San Bernardino WRP – The City of San Bernardino is considering implementing advanced treatment at the San Bernardino WRP for treatment of recycled water for groundwater recharge in the Bunker Hill basin. Up to 15 mgd of RO might be added to the San Bernardino WRP. If this project is implemented, a brine-concentrate management technology could be implemented to reduce the amount of brine-concentrate disposed of via the SARI system to that amount owned in the system by the City of San Bernardino.

Big Bear Groundwater Recharge Project – BBARWA has proposed the implementation of advanced treatment to produce recycled water for groundwater recharge. The advanced treatment proposed at the BBARWA Facility consists of MF, RO, followed by ultraviolet disinfection (UV) with advanced oxidation (e.g., the addition of hydrogen peroxide). A natural by-product of the RO component of this treatment train is the production of a concentrate (reject) stream. The BBARWA Advanced Treatment Facility (ATF) will be a 1.17-mgd plant that will produce approximately 160,000 gallons per day (gpd) of concentrate (reject) stream. This reject stream would either be further reduced or disposed using a brine-concentrate management technology.

Lake Arrowhead Groundwater Recharge Projects – The Lake Arrowhead CSD has identified potential need for advanced treatment to produce recycled water for indirect potable reuse project (IPR) at Lake Arrowhead. The IPR project would provide advanced treatment at the Grass Valley WWTP for up to 1.5 mgd. The process would produce approximately 1.1 mgd (approximately 1,200 afy) of product water and approximately 0.4 mgd of concentrate. The quantity of concentrate would be further reduced using a brine concentrator then conveyed via the existing wastewater disposal outfall pipeline to evaporation ponds at the existing wastewater disposal site in Hesperia.

3.4 Orange County Region

Sixteen wastewater facilities, 10 groundwater desalters, and 4 outfall systems exist or are planned in the Orange County region. Figures 3.20 and 3.21 show the major WWTPs/WRPs, groundwater desalters, and brine conveyance facilities in North Orange County and South Orange County, respectively. Conveyance facilities in this region include brinelines, WWTP interties, as well as private and public outfalls. The publicly owned outfalls in the region are the OCSD outfall (which receives flow from the SARI system), the Aliso Creek outfall, and the San Juan Creek outfall.

3.4.1 Brine-Concentrate Facilities

As part of the survey, 12 facilities were identified as existing or planned brine-concentrate generators and are listed in Table 3.4. Figures 3.22 through 3.25 show the locations of these brine-concentrate facilities, as well as the relative scale of projected brine-concentrate flows for the 2010 and ultimate timeframes for both North and South Orange County. In Orange County, the generation of brine-concentrate increases to nearly four times the 2008 level (12.87 mgd) to approximately 46.05 mgd by ultimate buildout. The Groundwater Replenishment (GWR) System is the major brine-concentrate source from 2008 through 2015. By 2015, the South Orange Coastal Ocean Desalination Project comes online and will generate 15 mgd brine-concentrate that will be discharged through the South Orange County Wastewater Authority's (SOCWA) San Juan Creek Ocean Outfall. These two sources will comprise over 80 percent of the brine-concentrate that will be generated under the ultimate buildout conditions. Information about these facilities is provided in Attachment C.

Three publicly owned outfall facilities are in the Orange County region, two of which are in South Orange County. The OCSD outfall is projected to convey 12.84 mgd of brine-concentrate from wastewater and groundwater desalter sources by 2010 and 23.49 mgd by 2030. This system receives flows from four WWTPs/WRPs and four groundwater desalters in Orange County in addition to the flows from facilities in the Inland Empire through the SARI brineline. The SARI brineline originates in the Inland Empire region and conveys brine-concentrate flow from the Inland Empire region and from North Orange County. In addition to the SARI system, flows from the Francis Desalter, Deep Aquifer Treatment System (DATS), Wells 21 and 22, and the Tustin Desalter are planned to be conveyed to the OCSD outfalls via the Orange County regional brineline.

The two remaining publicly owned outfall facilities are located in South Orange County. The Aliso Creek outfall is projected to convey approximately 1.06 mgd of brine-concentrate flow by 2010 and 2.01 mgd by 2015 from one WWTPs/WRPs and three groundwater desalters through two brinelines or system interties operated by SOCWA. The SOCWA effluent transmission main conveys brine-concentrate, processed wastewater, and unused recycled water flows from the Irvine Ranch Water District (IRWD) Baker WTP, Irvine Principal Potable Treatment Plant Desalter (PPTP), Irvine Non-Potable Shallow Groundwater Unit Desalter (SGU), Los Alisos WRP, El Toro WWTP, Regional Treatment Plant, and the Coastal Treatment Plant. The upper portion of this main is proposed to connect the IRWD Baker WTP, PPTP, and SGU to the existing transmission main at Los Alisos WRP.

FIGURE 3.20 - MAJOR WASTEWATER, GROUNDWATER, AND OUTFALL FACILITIES IN THE NORTH ORANGE COUNTY REGION

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/24/09

FIGURE 3.21 - MAJOR WASTEWATER, GROUNDWATER, AND OUTFALL FACILITIES IN THE SOUTH ORANGE COUNTY REGION

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/31/09

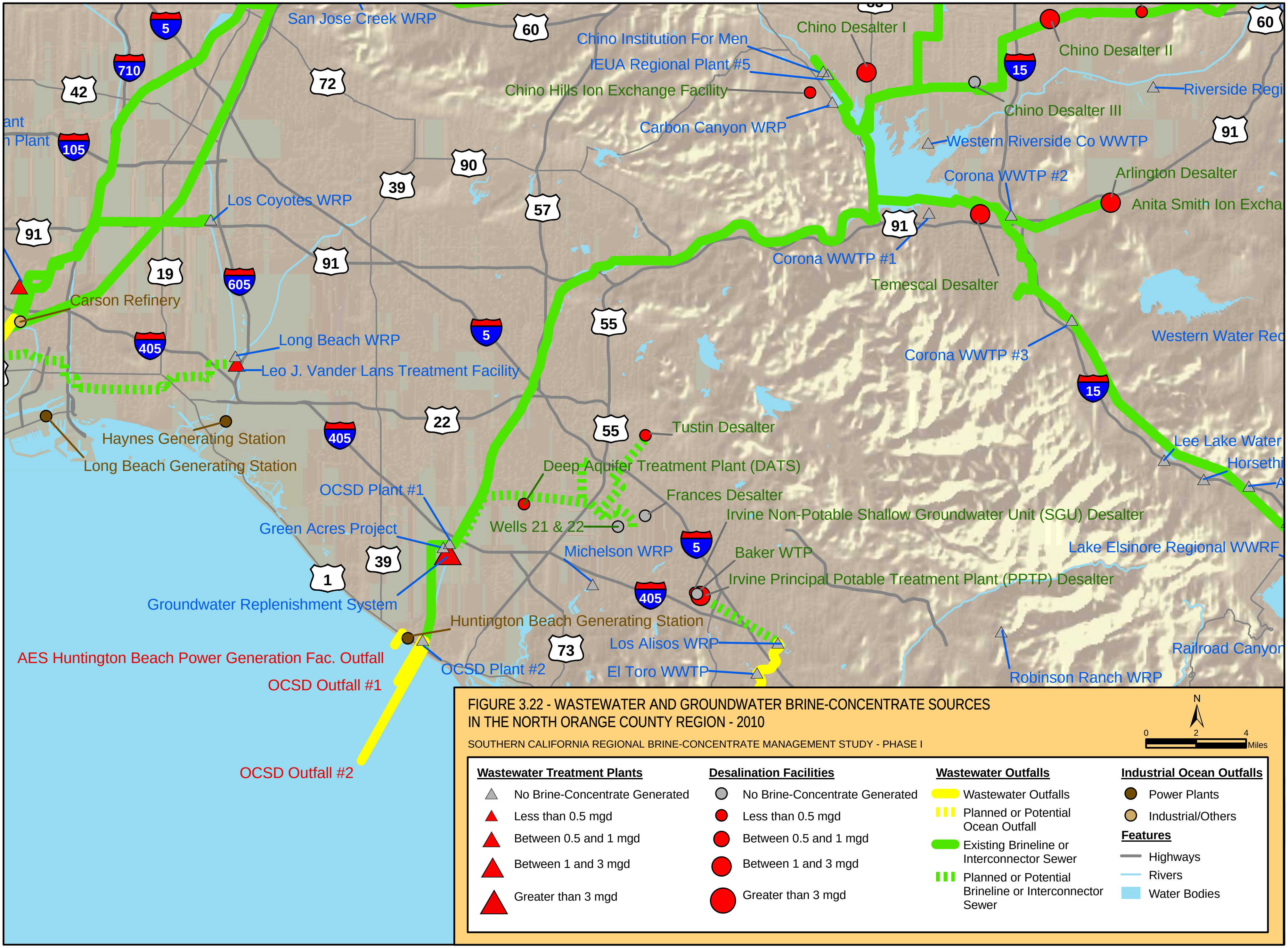


FIGURE 3.22 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE NORTH ORANGE COUNTY REGION - 2010

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/24/09

TABLE 3.4
WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE ORANGE COUNTY REGION

Orange County Region		Current (as of end of 2008)		Planning Year 2010		Planning Year 2015		Planning Year 2020		Planning Year 2025		Planning Year 2030		Planning Year 2035		Planning Year Ultimate	
Facility Name	**Facility Owner**	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)
WASTEWATER TREATMENT PLANT INFORMATION																	
Groundwater Replenishment System	OCWD	10.68	10.68	12.35	12.35	17.65	17.65	17.65	17.65	17.65	17.65	17.65	17.65	23.00	23.00	23.00	23.00
Coastal Treatment Plant	SOCWA	-	-	-	-	0.15	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15	0.20
GROUNDWATER CLEAN-UP AND DESALTER INFORMATION																	
Deep Aquifer Treatment Plant (DATS)	IRWD	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Frances Desalter	IRWD/OCWD	-	-	-	-	-	-	-	-	-	-	-	-	2.50	2.50	2.50	2.50
Tustin Desalter	IRWD/OCWD	0.32	0.32	0.32	0.48	0.32	0.48	0.32	0.48	0.32	0.48	0.32	0.48	0.32	0.48	0.32	0.48
Wells 21 & 22	IRWD	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Baker WTP	IRWD	-	-	-	-	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
City of San Juan Capistrano Groundwater Desalter	City of San Juan Capistrano	0.60	0.60	1.20	1.20	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Irvine Non-Potable Shallow Groundwater Unit (SGU) Desalter	IRWD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irvine Principal Potable Treatment Plant (PPTP) Desalter	IRWD	0.88	0.88	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
South Coast Water District – Groundwater Recovery Facility	South Coast Water District	0.22	0.22	0.22	0.22	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
South Orange Coastal Ocean Desalination Project	Five-agency JPA	-	-	-	-	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Total		**12.87**	**12.87**	**15.31**	**15.47**	**37.99**	**38.20**	**37.99**	**38.20**	**37.99**	**38.20**	**37.99**	**38.20**	**45.84**	**46.05**	**45.84**	**46.05**

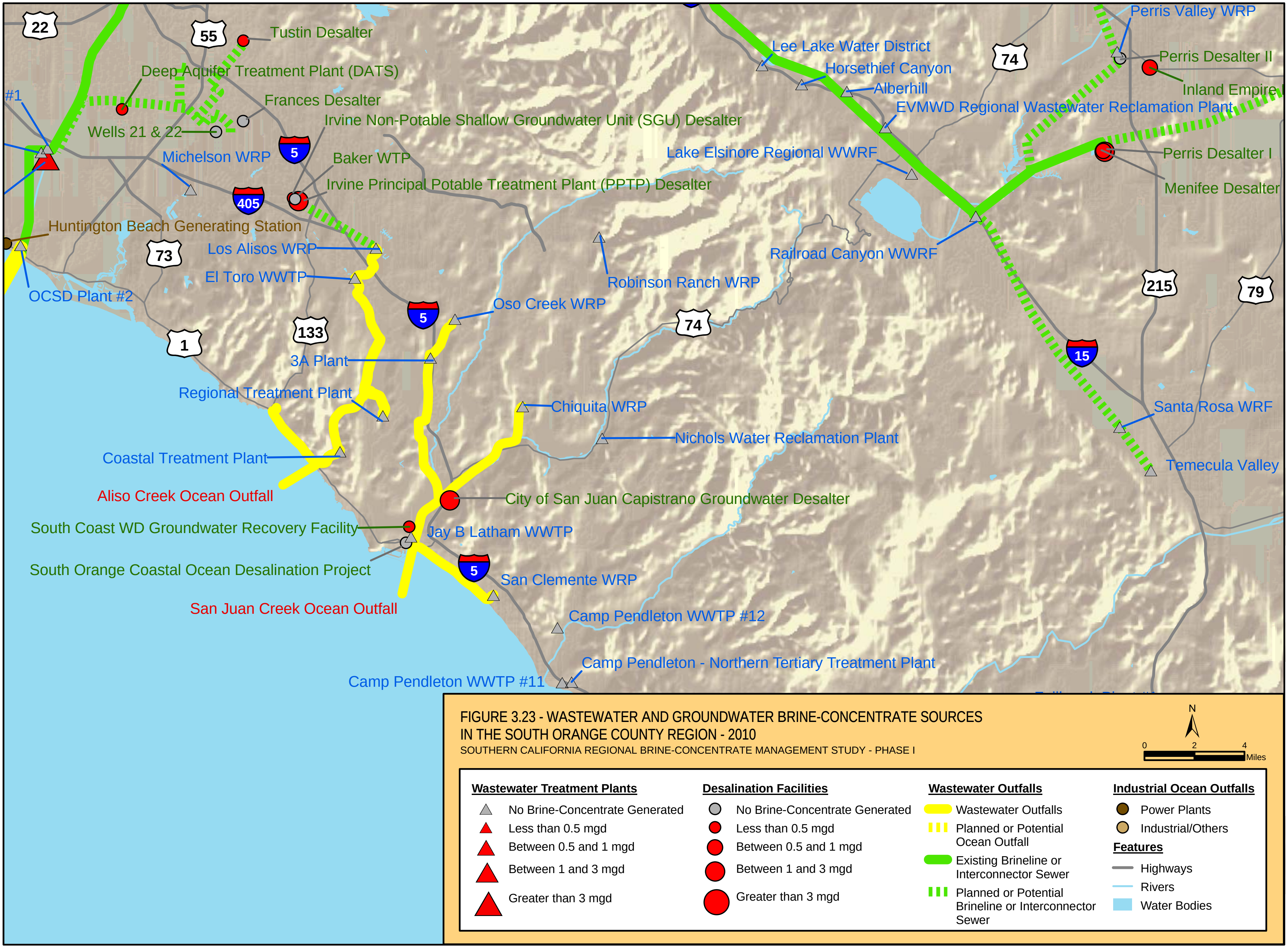


FIGURE 3.23 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE SOUTH ORANGE COUNTY REGION - 2010
SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/24/09

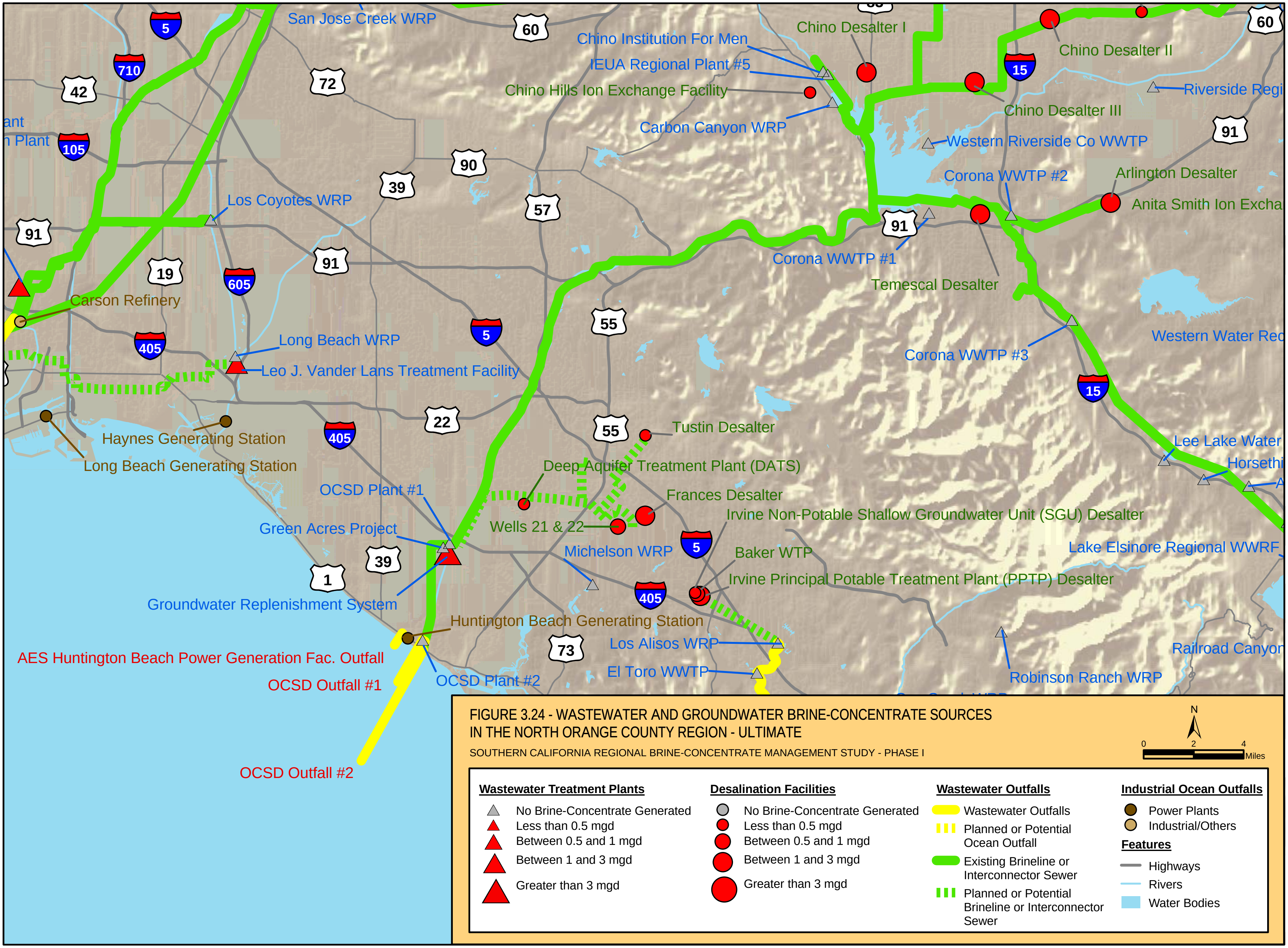


FIGURE 3.24 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE NORTH ORANGE COUNTY REGION - ULTIMATE

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/20/09

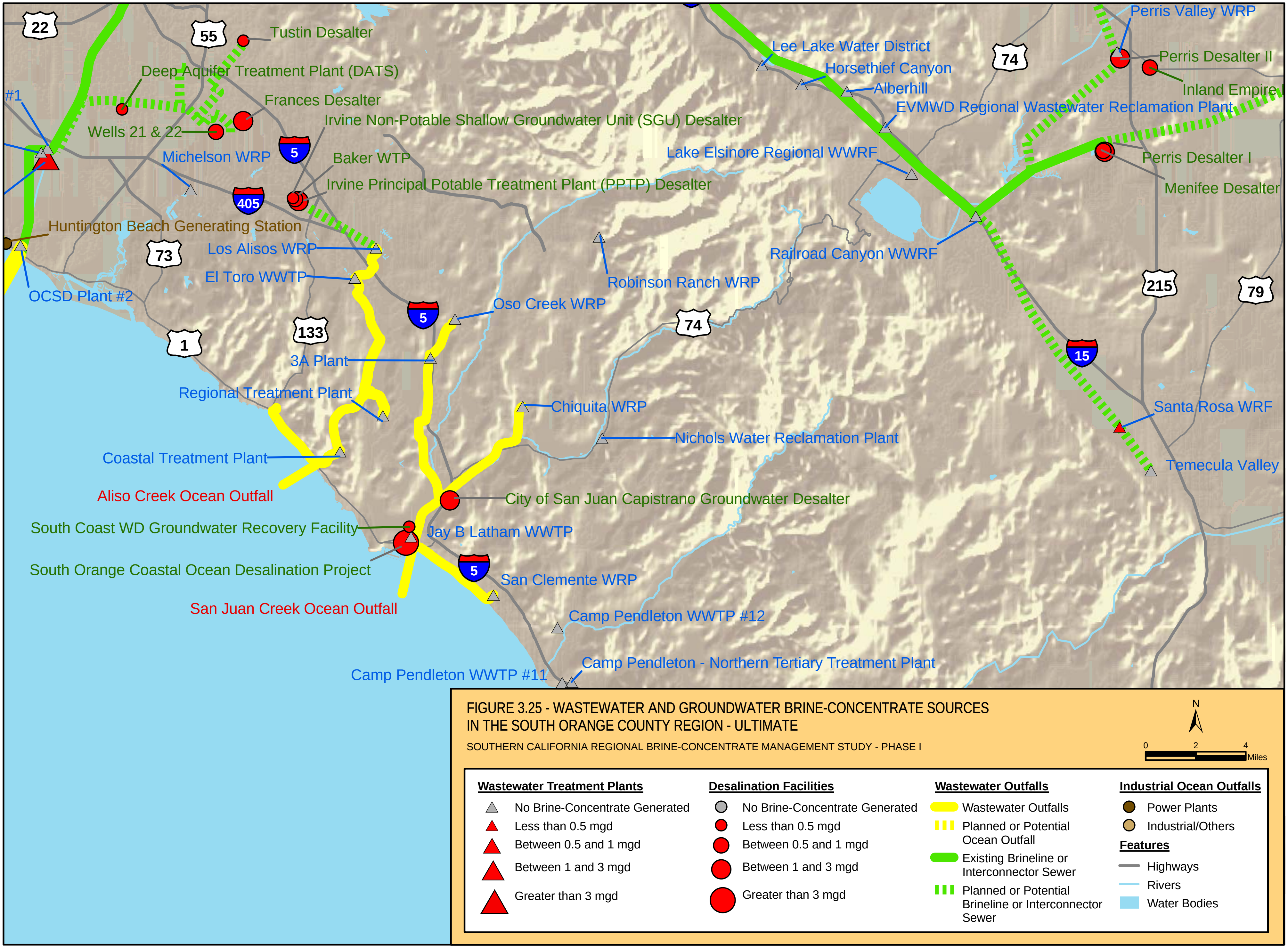


FIGURE 3.25 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE SOUTH ORANGE COUNTY REGION - ULTIMATE

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/20/09

The San Juan Creek outfall conveys brine-concentrate, processed wastewater, and unused recycled water flows from five WWTPs/WRPs, two groundwater desalters, and the proposed South Orange Coastal Ocean Desalination Project via system interties to the ocean. This outfall is projected to discharge over 1.4 mgd of brine-concentrate by 2010 and up to 16.83 mgd by 2015. The increase in brine-concentrate flows is primarily from the South Orange Coastal Ocean Desalination Project.

In addition to the publicly owned outfall facilities, the Orange County region has three major NPDES permits for power plants discharging to the ocean. One of these outfalls is located near the OCSD outfalls in Huntington Beach and discharges to the ocean. The other two industrial outfall facilities are located in San Clemente and discharge to the ocean through a designated private outfall.

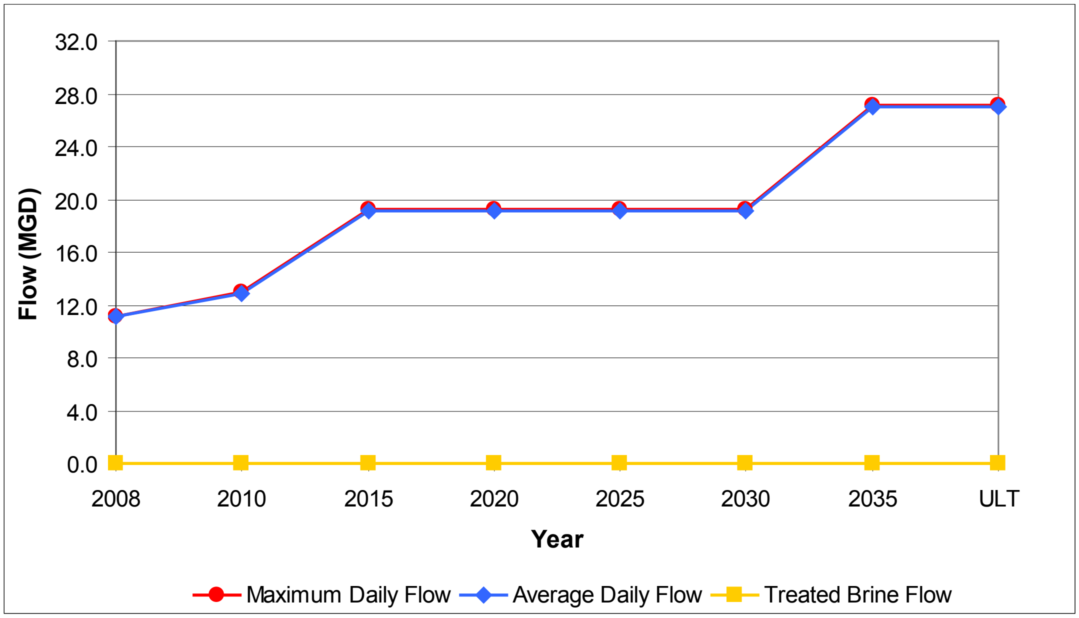
The Nichols WRP, operated by the Santa Margarita Water District, and the Robinson Ranch WRP, operated by the Trabuco Canyon Water District reuse 100 percent of their wastewater for irrigation.

3.4.2 Regional Summary

Brine-Concentrate Flow Summary

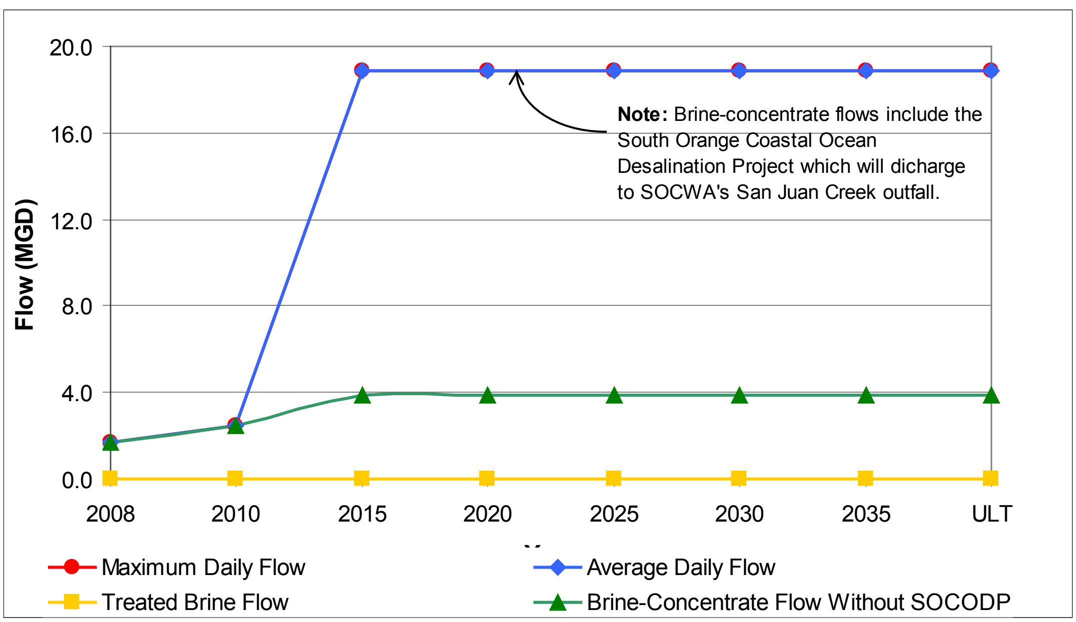
In the Orange County region, projected brine-concentrate flows increase from 12.87 mgd in 2008 to 45.84 mgd by 2035. Figures 3.26 and 3.27 show a summary of these projected flows for both North and South Orange County. Currently, a majority of the brine-concentrate flow (83 percent) is generated from the GWR System. By 2015, over half (20.19 mgd) of the brine-concentrate generated in the County will be from groundwater desalters and the proposed South Orange Coastal Ocean Desalination Project. As shown in Figures 3.28 and 3.29, no agencies are currently planning to implement brine-concentrate reduction or ZLD treatment technologies. The number of facilities generating brine-concentrate increases from 7 facilities in 2008 to 11 facilities by 2015, and to 12 facilities for ultimate buildout when the Frances Desalter comes online.

FIGURE 3.26 BRINE-CONCENTRATE FLOW SUMMARY FOR NORTH ORANGE COUNTY REGION



Note: Brine generation is from wastewater treatment and groundwater desalting.

FIGURE 3.27 BRINE-CONCENTRATE FLOW SUMMARY FOR SOUTH ORANGE COUNTY REGION



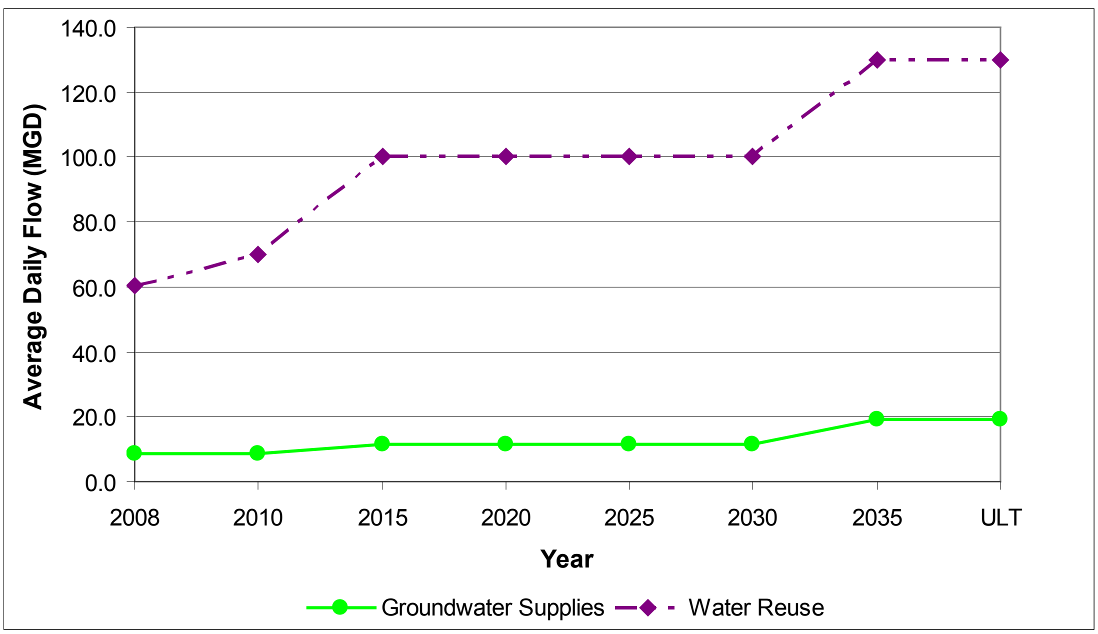
Note: Brine generation is from wastewater treatment and groundwater desalting. These projections include the South Orange Coastal Ocean Desalination Project.

Water Supply Summary

The scarcity of water supply continues because of the limited availability of imported water and the drought, which make even more important the development of reliable and locally controlled water supplies even more important. Groundwater desalting and water reclamation are two methods of developing new reliable and locally controlled water supplies. Consequently, developing a long-term plan for brine-concentrate management for the Orange County region is of great importance.

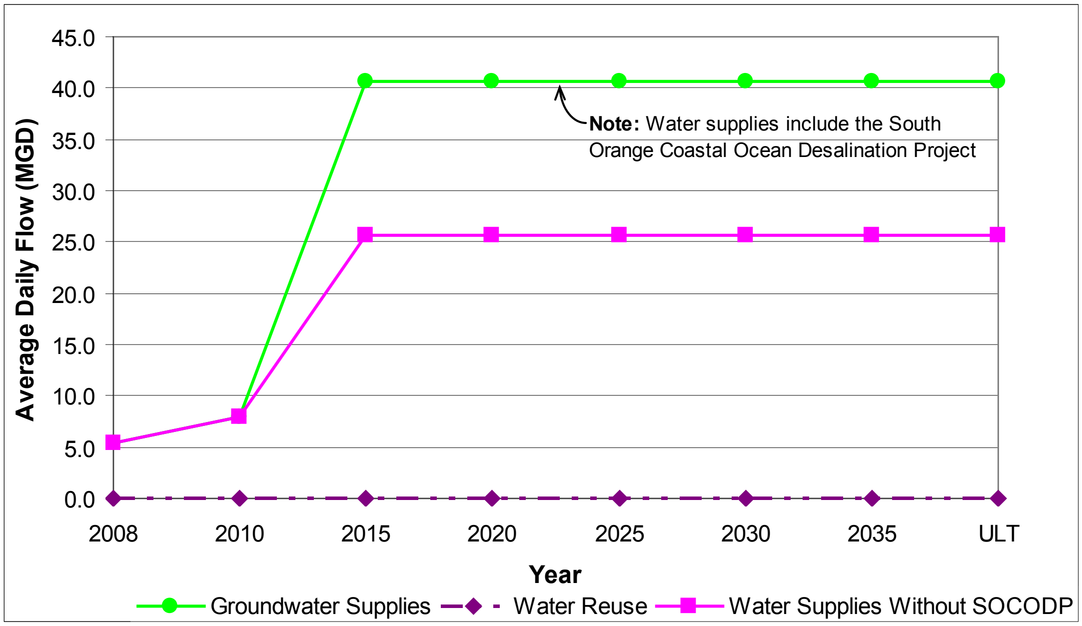
As shown in Figures 3.28 and 3.29, approximately 74.4 mgd of water supply in Orange County is currently produced from the use of RO treatment processes (69.0 mgd in North Orange County and 5.4 mgd in South Orange County). In the future, the amount of water supply is projected to reach approximately 189.7 mgd (149 mgd in North Orange County and 40.7 mgd in South Orange County). These water supplies produced via facilities that will generate approximately 45.84 mgd of brine-concentrate. This water supply includes the proposed South Orange Coastal Ocean Desalination Project which is planned to discharge brine reject through SOCWA's San Juan Creek Ocean Outfall. This is the only seawater desalination facility in southern California that is planned to discharge out an existing wastewater outfall. All other planned seawater desalination facilities are planned to discharge out existing private outfalls or via new outfalls. The use of RO to recover water from WWTPs/WRPs will result in increased water supply from approximately 60.52 mgd in 2008 to a potential of 130 mgd at the OCWD's GWR System.

FIGURE 3.28 WATER SUPPLIES THAT RESULT IN GENERATION OF BRINE-CONCENTRATE FOR NORTH ORANGE COUNTY REGION



Note: Figure includes WWTP/WRPs, groundwater recharge, seawater intrusion barrier, and brackish groundwater.

FIGURE 3.29 WATER SUPPLIES THAT RESULT IN GENERATION OF BRINE-CONCENTRATE FOR SOUTH ORANGE COUNTY REGION



Note: Figure includes WWTP/WRPs, groundwater recharge, seawater intrusion barrier, and brackish groundwater.

Specific Brine-Concentrate Management Projects and Issues

In the Orange County region, a majority of brine-concentrate produced is disposed via three ocean outfalls. Even with the available discharge mechanisms in the region, there are a number of locations where limitations in discharge capacity or increased water reuse might benefit from implementation of different brine-management strategies. These potential projects and issues were identified from deficiencies noted in the data, information from survey respondents, or information obtained via the regional meetings. In the Orange County region, five potential projects and issues were identified, each of which is described below.

Moulton Niguel WD (MNWD) Golf Course Recycled Water Projects – The MNWD is currently working with three golf courses to potentially serve recycled water to their greens. Advanced treatment might be required for water serving the greens, which would create a brine-concentrate waste stream. The golf courses are currently investigating potential onsite brine-concentrate disposal mechanisms, including using the existing ponds on the course as evaporation ponds.

OCSD Outfall Water Quality Limitations – OCSD might not be able to continue to meet WDR if brine-concentrate levels do not have adequate blending with wastewater. OCSD has stringent WDR limits for ammonia and hardness, which restricts the amount of brine-concentrate that can be discharged. This could become a significant issue if the use of recycled water for groundwater recharge increases in Orange County and the Inland Empire while the amount of domestic wastewater is decreased in the SARI system. If a brine-concentrate management technology is required, the efficacy of the technology can be tested at the OCWD membrane test laboratory.

Newport Back Bay Nitrogen-Selenium Program – This is a 5-year program to address nitrogen and selenium in the Newport Bay Watershed to be in compliance with the requirements of an NPDES permit (Order Number R8-2004-0021) issued by the Santa Ana Regional Water Quality Control Board. Studies have found that ambient groundwater concentrations in the watershed frequently exceed numeric limits for selenium established in the permit. A pilot/demonstration project was completed in 2006 that identified RO as a potential best management practice (BMP) for the treatment and removal of nitrogen and selenium. The brine-concentrate from the pilot test was disposed of via OCSD sewers. If RO is implemented across the watershed to reduce nitrogen and selenium levels in groundwater, a second process, such as a brine concentrator, might be added to obtain higher water recovery rates. The addition of brine-concentrate management technologies would enable Orange County to maximize water supply from the groundwater treatment.

South Coast Water District (SCWD) Groundwater Recovery Project – The SCWD uses greensand filtration and RO to recover groundwater with high concentrations of TDS, iron, and manganese. Currently, the project is having difficulty complying with discharge limitations due to the high concentrations of iron and manganese in the backwash water. The discharge is considered an industrial discharge and must comply with stringent water quality requirements. SCWD is considering implementing new technologies to treat brine-concentrate prior to discharge to the ocean that would comply with permit limits.

South Orange Coastal Ocean Desalination Project – The San Juan Creek Outfall could have problems complying with WDR requirements because of particulates in the flows from the proposed South Orange Coastal Ocean Desalination Project. This new desalination project will consist of approximately one-third of the flow in the San Juan Creek outfall. Therefore, constituents of concern in the desalination ocean concentrate (such as turbidity, settleable solids, pH levels, metals, arsenic, iron, and manganese) will affect the quality of the water that is discharged from the outfall. In addition, this project could face the same regulations that are driving the SCWD to implement brine-concentrate management due to high concentrations of iron and manganese.

3.5 San Diego County Region

Thirty-three wastewater facilities, 13 groundwater desalters, and 6 publically owned outfall systems exist or are planned in the San Diego County region. Figure 3.30 shows the major WWTPs/WRPs, groundwater desalters, and brine conveyance facilities. Conveyance facilities in this region include brinelines, WWTP interties, as well as public and private outfalls. The two largest outfalls in the region are the Point Loma outfall and the South Bay ocean outfall.

FIGURE 3.30 - MAJOR WASTEWATER, GROUNDWATER, AND OUTFALL FACILITIES IN THE SAN DIEGO COUNTY REGION

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

N
0 3 6 Miles

Wastewater Treatment Plants
- Land Discharge
- Recycled Water Only
- Stream Discharge
- Ocean Discharge
- Other

Desalination Facilities
- Existing Groundwater Desalter
- Planned Groundwater Desalter
- Proposed Seawater Desalination Plant

Industrial Ocean Outfalls
- Power Plants
- Industrial/Others

Wastewater Outfalls
- Wastewater Outfalls
- Planned or Potential Ocean Outfall
- Existing Brineline or Interconnector Sewer
- Planned or Potential Brineline or Interconnector Sewer

Features
- Highways
- Rivers
- Water Bodies

3.5.1 Brine-Concentrate Facilities

As part of the survey, 18 facilities were identified as existing or planned sources of brine-concentrate as listed in Table 3.5. Figures 3.31 and 3.32 show the locations of these brine-concentrate facilities and the relative scale of projected brine-concentrate flows for the 2010 and ultimate timeframes. In the San Diego region, the maximum daily generation of brine-concentrate increases more than eightfold between 2008 (2.7 mgd) and the ultimate buildout of these facilities (22.7 mgd). In 2010, two users are projected to generate over 60 percent of the brine-concentrate—the Richard Reynolds Groundwater Demineralization Facility and the Camp Pendleton Advanced Water Treatment Plant (AWTP). By ultimate buildout, the Carlsbad WRP, North City WRP, and the Mission Basin Desalting Facility are projected to replace these facilities as the largest sources of brine-concentrate (almost 50 percent of the total flow). Information about these facilities is provided in Attachment C.

Six publicly owned outfall facilities are in the San Diego County region. These outfalls are the proposed Camp Pendleton outfall, Oceanside outfall, Encina outfall, San Elijo outfall, Point Loma outfall, and the South Bay outfall. The proposed Camp Pendleton outfall is projected to convey 1.29 mgd of brine-concentrate by 2010. This system will receive flows from the Camp Pendleton WWTP No. 13, Camp Pendleton AWTP, and Camp Pendleton Southern Tertiary Treatment Plant.

The Oceanside outfall receives treated wastewater flows from the Camp Pendleton WWTP No. 1 and No. 2, La Salina WWTP, San Luis Rey WWTP, and Fallbrook Plant No. 1 via three brinelines/interties. This outfall is projected to receive 0.6 mgd of brine-concentrate by 2010 and up to 3.9 mgd by 2035 from the Mission Basin Desalting Facility.

The Encina outfall receives discharges from the Carlsbad WRP, the Encina WPCF and the Gafner WRF. Flow from the Carlsbad WRP and Gafner WRF are conveyed to the ocean outfall via the Leucadia County Water District Brineline. The Encina outfall is projected to convey 0.6 mgd of brine-concentrate by 2010 and 2.4 mgd by 2035 from the Carlsbad WRP.

The San Elijo outfall system consists of an outfall and two brinelines or system interties. The Hale Avenue WRF and the San Elijo WRF discharge to the ocean outfall. Also, the proposed San Pasqual Groundwater Desalter may connect to the outfall via the proposed San Pasqual Groundwater Desalter brineline. This outfall is projected to discharge up to 1.9 mgd of brine-concentrate by 2015 from these facilities. In addition, the Palomar Energy Plant in Escondido discharges 1.0 mgd of brine from its cooling process directly to this outfall line.

TABLE 3.5
WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE SAN DIEGO COUNTY REGION

San Diego County Region		Current (as of end of 2008)		Planning Year 2010		Planning Year 2015		Planning Year 2020		Planning Year 2025		Planning Year 2030		Planning Year 2035		Planning Year Ultimate	
Facility Name	**Facility Owner**	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)
WASTEWATER TREATMENT PLANT INFORMATION																	
Carlsbad WRP	Encina Joint Powers Authority	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	2.40	2.40	2.40	2.40
Hale Avenue WRF	City of Escondido	-	-	-	-	0.90	0.90	0.90	0.90	0.90	0.90	1.35	1.35	1.35	1.35	1.35	1.35
North City WRP	City of San Diego	0.19	0.52	0.19	0.52	0.19	0.52	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60
Padre Dam WRF	Padre Dam MWD	-	-	-	-	0.23	0.45	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
San Vicente WWTP	Ramona MWD	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
GROUNDWATER CLEAN-UP AND DESALTER INFORMATION																	
Balboa Park Groundwater Desalination Facility	City of San Diego	-	-	-	-	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Camp Pendleton AWT Plant	Camp Pendleton	-	-	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Mission Basin Desalting Facility	City of Oceanside	0.60	0.66	0.60	0.60	0.60	0.60	1.91	1.91	1.91	1.91	1.91	1.91	3.90	3.90	3.90	3.90
Mission Valley Groundwater Desalination	City of San Diego	-	-	-	-	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Otay River Desalination Plant	Sweetwater Authority/ Otay Water District	-	-	-	-	0.70	0.70	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Rainbow MWD Desalination Facility	Rainbow MWD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.67	0.67
Ramona Desalting Facility	Ramona MWD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.06
Rancho del Rey Well Desalination	Otay Water District	-	-	-	-	-	-	-	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Richard Reynolds Groundwater Demineralization Facility (Phase I and II)	Sweetwater Authority	0.80	0.91	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
San Diego Formation Groundwater Desalination Facility	City of San Diego/San Diego County Water Authority	-	-	-	-	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.45	0.45

TABLE 3.5
WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE SAN DIEGO COUNTY REGION (CONTINUED)

San Diego County Region		Current (as of end of 2008)		Planning Year 2010		Planning Year 2015		Planning Year 2020		Planning Year 2025		Planning Year 2030		Planning Year 2035		Planning Year Ultimate	
Facility Name	Facility Owner	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)	Average Daily Brine/ Concentrate Flow (MGD)	Maximum Daily Brine/ Concentrate Flow (MGD)
San Dieguito Desalting Facility	San Dieguito Basin Task Force	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.34	1.34
San Pasqual Groundwater Desalter	City of San Diego	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Santee Desalination Facility	Padre Dam MWD/ Helix WD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.75	0.75
Total		**2.21**	**2.71**	**4.20**	**4.53**	**7.78**	**8.33**	**15.37**	**15.37**	**15.42**	**15.42**	**15.87**	**15.87**	**19.66**	**19.66**	**22.72**	**22.72**

FIGURE 3.31 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE SAN DIEGO COUNTY REGION - 2010

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

N
0 3 6 Miles

Wastewater Treatment Plants
- No Brine-Concentrate Generated
- Less than 0.5 mgd
- Between 0.5 and 1 mgd
- Between 1 and 3 mgd
- Greater than 3 mgd

Desalination Facilities
- No Brine-Concentrate Generated
- Less than 0.5 mgd
- Between 0.5 and 1 mgd
- Between 1 and 3 mgd
- Greater than 3 mgd

Wastewater Outfalls
- Wastewater Outfalls
- Planned or Potential Ocean Outfall
- Existing Brineline or Interconnector Sewer
- Planned or Potential Brineline or Interconnector Sewer

Industrial Ocean Outfalls
- Power Plants
- Industrial/Others

Features
- Highways
- Rivers
- Water Bodies

\\cheron\projects\USBR\381333BrineStudy\GIS 08/24/09

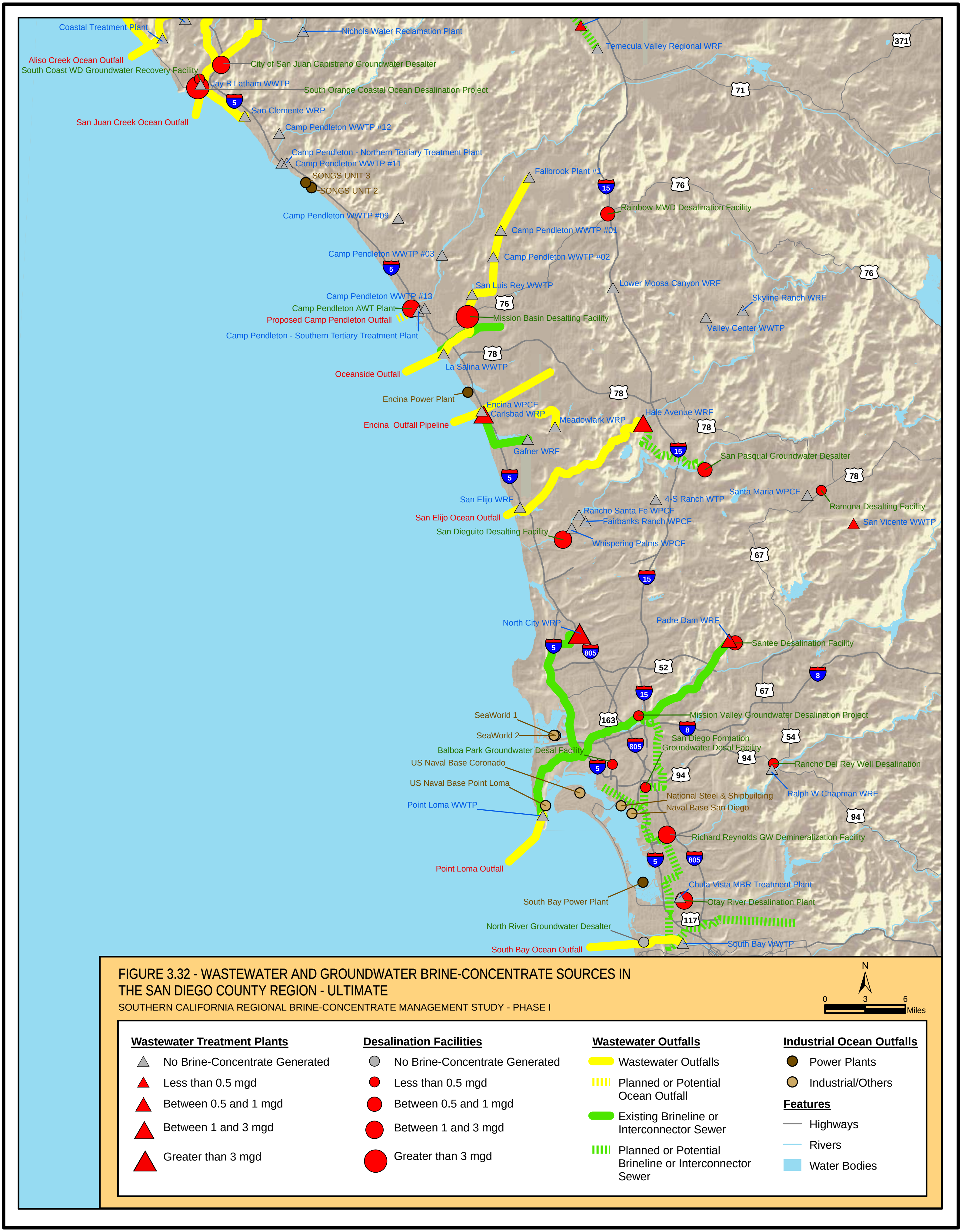


FIGURE 3.32 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN THE SAN DIEGO COUNTY REGION - ULTIMATE

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/20/09

The Point Loma outfall is projected to convey 0.19 mgd of brine-concentrate by 2010 and up to 6.11 mgd by the ultimate condition. This system receives flows from the North City WRP, Padre Dam WRF, Point Loma WWTP, Santee Desalination Facility, and potentially the Mission Valley Groundwater Desalination project and the proposed Balboa Park Groundwater Desalination Facility. The Padre Dam WRP, Mission Valley Groundwater Desalination project, and the Santee Desalination Facility will discharge flow to the Point Loma ocean outfall via East Mission Gorge Interceptor System.

The South Bay ocean outfall (SBOO) is planned to receive flows from the South Bay WWTP, Chula Vista Membrane Bioreactor (MBR) Treatment Plant, North River Groundwater Desalter, Otay River Desalination Plant, Richard Reynolds Groundwater Demineralization Plant, San Diego Formation Groundwater Desalination Facility, International Boundary Water Commission Treatment Plant and potentially the Mission Valley Groundwater Desalination Project. This flow will be conveyed via four brinelines or system interties to the ocean and includes the planned San Diego Regional Brine Conveyance System that is expected to discharge through the SBOO by 2015. The SBOO is projected to discharge 2.4 mgd of brine-concentrate by 2015 and another 4.0 mgd of flow from the Chula Vista MBR plant. Based on the SDCWA's recent draft report, *San Diego Regional Concentrate Conveyance System Feasibility Study (2008),* up to 12.55 mgd of flow would be conveyed through this system by 2035. This flow includes processed wastewater effluent, RO reject flows from groundwater desalters, as well as planned industrial brine discharges.

In addition to the publicly owned outfall facilities, the San Diego County region has two major NPDES permits for power plants, three for naval base facilities, two for shipbuilding facilities, and there is an outfall at SeaWorld. Four naval facilities and the South Bay Power Plant discharge to San Diego Bay and South San Diego Bay; SeaWorld discharges to Mission Bay; the Encina Power Plant discharges to the ocean near the Encina outfall.

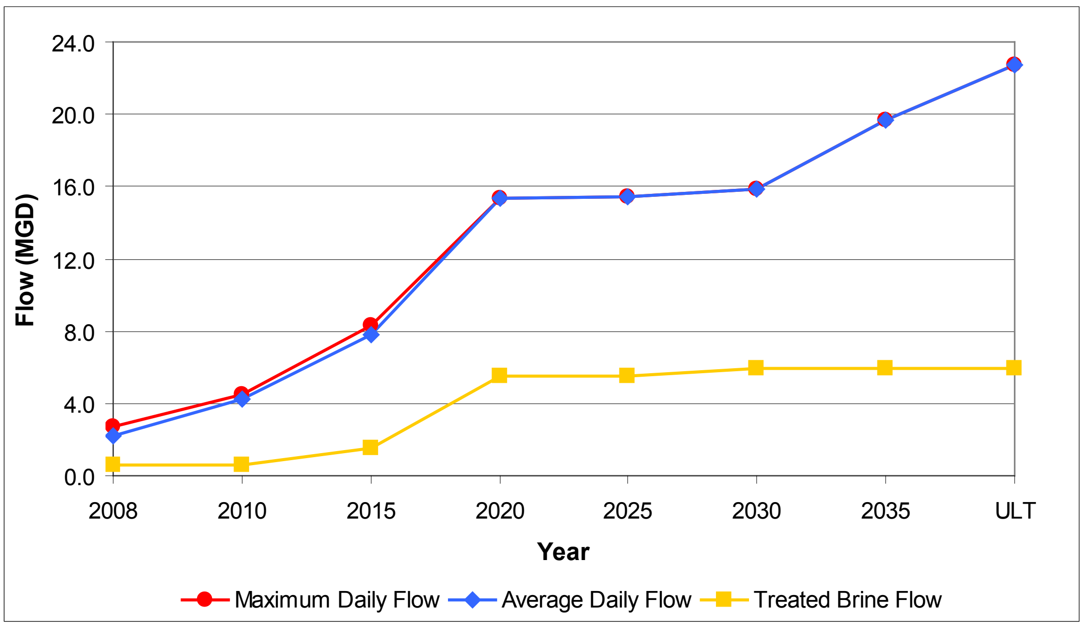
In addition to the outfall facilities, several wastewater treatment and desalting facilities discharge to streams and percolation ponds in San Diego County. The Santa Maria Water Pollution Control Facility (WPCF) and San Vicente WWTP, both of the Ramona MWD, discharge wastewater using stream discharge. Stream discharge to the San Luis Rey River originates from the Rainbow MWD Desalination Facility. Currently, Richard Reynolds Groundwater Demineralization Facility discharges to the Sweetwater River but will discharge to the San Diego regional brineline in the future. In addition, the Fairbanks Ranch WPCF, Lower Moosa Canyon WRF, Skyline Ranch WRF, and Whispering Palms WPCF discharge to percolation ponds. Camp Pendleton WWTP No. 3, No. 9, and No. 11 also discharge to percolation ponds for recharge as a seawater intrusion barrier.

3.5.2 Regional Summary

Brine-Concentrate Flow Summary

In the San Diego County region, projected average daily brine-concentrate flows will increase from 2.7 mgd in 2008 to approximately 22 mgd at buildout. Figure 3.33 shows a summary of these projected flows. A majority of this flow (over 60 percent) is generated from existing and planned groundwater desalters. The remaining brine-concentrate flow is from advanced treated MF/RO processes at WWTPs/WRPs. The Richard Reynolds Groundwater Demineralization Facility is currently the primary generator of brine-concentrate; however, in the future, the Mission Valley Desalting Facility and North City WRP will add to the flows. As shown in Figure 3.33, a number of different agencies currently are planning to implement brine-concentrate reduction or zero liquid discharge (ZLD) treatment technologies. These facilities include the Hale Avenue WRF (1.35 mgd at ultimate buildout) and San Vicente WWTP (0.02 mgd at ultimate buildout) that generate brine-concentrate.

FIGURE 3.33 BRINE-CONCENTRATE FLOW SUMMARY FOR THE SAN DIEGO COUNTY REGION



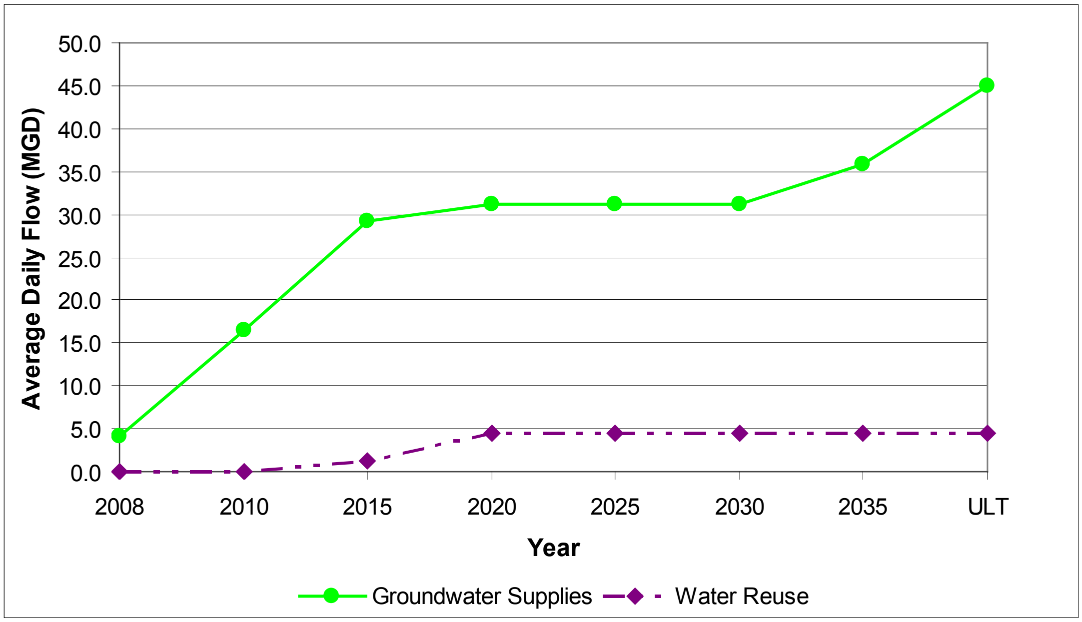
Note: Brine generation is from wastewater treatment and groundwater desalting.

Water Supply Summary

The scarcity of water supply continues because of the limited availability of imported water and the drought, which make even more important the development of reliable and locally controlled water supplies, especially in San Diego County where a majority of the water supply is imported. Groundwater desalting and water reclamation are two methods of developing new reliable and locally controlled water supplies. Consequently, developing a long-term plan for brine-concentrate management for the San Diego County region is of great importance.

As shown in Figure 3.34, more than 4 mgd of water supply is currently generated from the use of RO treatment processes. In the future, the amount of water supply is projected to be approximately 49 mgd. This is more than a tenfold increase in water supplies that will be created by facilities that will generate approximately 22 mgd of brine-concentrate. Groundwater supplies generated from RO membrane treatment processes increase from approximately 4.1 mgd to 45.0 mgd at buildout. The use of RO to recover water from WWTPs/WRPs results in an increase of water supply from 0 mgd in 2008 to 4.5 mgd by 2020.

FIGURE 3.34 WATER SUPPLIES THAT RESULT IN GENERATION OF BRINE-CONCENTRATE IN THE SAN DIEGO COUNTY REGION



Note: Figure includes WWTP/WRPs, groundwater recharge, seawater intrusion barrier, and brackish groundwater.

Specific Brine-Concentrate Management Projects and Issues

In the San Diego County region, a majority of brine-concentrate generated is disposed of via six ocean outfall systems. Even with the available discharge mechanisms in the region, there are a number of locations where limitations in discharge capacity or increased water reuse might benefit from the implementation of different brine-management strategies. These potential projects and issues were identified from deficiencies noted in the data, information from survey respondents, or information obtained via the regional meetings. In the San Diego County region, five potential projects and issues were identified, each of which is described below.

North San Diego Farming Brine/Concentrate Project(s) – In the northern San Diego region, the majority of growers have parcels of 10 acres or less, which causes difficulties in implementing the requirements of monitoring and reporting for these operations. The RWQCB is developing a conditional waiver (No. 4) for discharges from agricultural and nursery operations. This waiver will require monitoring and installation of management measures (MMs) or BMPs for discharges from agricultural and nursery operations if discharges contain pollutants that can percolate to groundwater or infiltrate to surface waters via runoff. Discharges are defined to include emissions from growing operations, irrigation return flows, and stormwater runoff. Currently, agricultural and nursery operations are required to install MMs and BMPs; however, no enrollment, monitoring, or reporting requirement exists.

The new conditional waiver will require enrollment in a monitoring group by December 31, 2010. For agricultural operations, the new waiver will specify that discharging pollutants with the ability to adversely affect the beneficial uses of water should be minimized or eliminated, and it will prohibit altering surface water unless a permit to do so has been approved. This new waiver condition, coupled with increasing costs for imported water, forces agricultural and nursery operators to investigate the use of RO. RO could be used to improve water quality from locally controlled degraded groundwater that is not currently usable because of its high TDS. One limitation to the implementation of RO by local users is the disposal of brine-concentrate.

Camp Pendleton – Currently, Camp Pendleton has five WWTPs located in the southern portion of the base. There is a plan to consolidate WWTPs No. 1, No. 2, No. 3, and No. 13, construct a new regional WWTP, and maximize the use of tertiary-treated effluent on the base. This new treatment plant will manage 2.71 mgd of average day influent and have a maximum capacity of 5 mgd. Excess flow from the new WWTP will be discharged using the existing Oceanside ocean outfall. In the northern portion of the base, construction of an Advanced Water Treatment Facility and a new ocean outfall are planned. The AWTF would include granulated activated carbon and RO processes to reduce the concentrations of TDS, TOC, and corrosivity in the groundwater. This plant would construct a new ocean outfall near to or connect to the existing outfall at the San Onofre Nuclear Generating Station (SONGS).

Ramona MWD – The Ramona MWD is implementing RO to address TDS and nutrient loading concerns in the basin. The RWQCB established a TDS limit of 550 mg/L on the WDR for the San Vicente and Santa Maria WWTPs. The limit required the installation of RO to comply with discharge limits and to use recycled water in the area. Currently, the brine-concentrate from the RO unit is being disposed of at a landfill, but the Ramona MWD is constructing evaporation ponds as a long-term disposal mechanism.

City of Escondido Groundwater Recharge Project – The City of Escondido is investigating the potential for a groundwater recharge project using advanced treated water from the Hale Avenue WRF. For this project, 6 mgd of RO would be treated and recharged in the San Pasqual basin. Brine-concentrate from this project would be disposed of via the existing San Elijo outfall. However, there is limited available capacity in the outfall and this project might exceed this capacity. Consequently, a study is needed to determine if the outfall can manage the brine-concentrate, and if not, to determine what the best method is to reduce brine-concentrate volumes so that the outfall capacity is not exceeded.

San Pasqual Groundwater Desalter Brineline – The City of San Diego is investigating the recovery of degraded groundwater from the San Pasqual basin. The proposed 5-mgd San Pasqual desalter would be located at the site of the existing San Pasqual Water Reclamation Plant, which has recently been shut down by the City. The City of San Diego is currently conducting an 18-month demonstration study for this desalter. The demonstration plant uses nanofiltration and RO membranes to demineralize the groundwater.

The full-scale facility would produce about 1 mgd of brine-concentrate. Potential disposal options evaluated include: sewer disposal through Escondido's HARRF and subsequent San Elijo Outfall; a 7-mile brine line directly to the San Elijo Outfall; and ZLD. Each of these options has drawbacks including: limited capacity of the San Elijo Outfall, salt loading at HARRF, and costs associated with a brine line or ZLD as a result the City of San Diego is conducting a brine minimization study.

The study is evaluating an innovative approach to maximize the overall RO recovery and minimizing the amount of brine requiring disposal. The reduced flow could be disposed into the closer and smaller City of San Diego's sewer line that flows to the North City WRP. This additional brine disposal opportunity significantly reduces the need for infrastructure development and improves the City of San Diego's ability to permit and construct a full-scale groundwater recovery plant.

Mission Valley Groundwater Desalination Project – The City of San Diego is considering desalination of brackish groundwater in the Mission Valley area. This project would be located along the San Diego River near the intersection of Interstates 8 and 15. The project would result in the generation of 2,000 afy of potable water. The desalination process would generate 0.4 mgd of brine-concentrate by 2015. The brine-concentrate would be disposed of in the East Mission Gorge Interceptor System or in the proposed South Bay Ocean Outfall System.

City of San Diego Indirect Potable Reuse Project – The City of San Diego was granted a waiver from secondary treatment standards and has been permitted by the USEPA and RWQCB to use chemically enhanced primary treatment at its Point Loma WWTP. The waiver status is tentative, and is subject to a 5-year review and renewal process. The City of San Diego is actively investigating alternative methods that can off load wastewater flow to the Point Loma WWTP and also increase local water supplies. San Diego is currently performing demonstration testing for an Indirect Potable Reuse (IPR) project at the North City WRP. The City of San Diego is also conducting a study to identify opportunities to increase recycling and beneficial reuse within the service area of the San Diego and Metro Participating Agencies. The outcome of these studies, which will be completed over the next several years, may lead to changes in the brine volumes through the Point Loma Outfall and /or the SBOO from what is represented in this report. Total recycled water beneficial use volumes may also change.

San Diego County Regional Brineline System – SDCWA, in association with the City of San Diego, City of Chula Vista, Otay Water District, and the Sweetwater Authority, evaluated the feasibility of establishing an environmentally sound and cost-effective method to manage the disposal of brine-concentrate flows generated within south San Diego County. The study focused on southern San Diego County, which includes the cities of San Diego, National City, Chula Vista, and Imperial Beach. The study also investigated using this regional brineline to serve the eastern San Diego area cities of El Cajon, La Mesa, and Santee. The concentrate flows would be discharged to the ocean via the existing South Bay Ocean Outfall (SBOO).

The San Diego County Regional Brineline System would generally follow a north to south alignment along the coast of San Diego Bay between the Sweetwater River and the SBOO. Three potential system extensions were identified, which could be implemented as a need arises. These are the Mission Valley Alignment, the City of San Diego Alignment, and the Otay Mesa Alignment. The San Diego County Regional brineline would collect brine-concentrate flows from wastewater treatment plants, groundwater desalters, and industrial dischargers in southern San Diego County. Potential users include facilities that, either currently or in the future, will produce highly saline flows that do not require municipal wastewater treatment, or previously treated flows that do not require additional treatment, prior to ocean discharge. Potential municipal users include groundwater desalination facilities, water treatment plants, and wastewater treatment and recycling facilities. Potential industrial/institutional users include the United States Navy, energy plants, and correctional facilities.

The concentrate flow identified from the potential users in the region is between 11 and 13 mgd. The construction of a regional brineline system could facilitate the development of between 20 and 40 mgd of new water supplies and potentially reduce or eliminate the impacts from current concentrate management practices. The new water supply projects that are currently being evaluated include the proposed expansion of the Reynolds Desalination Plant, the Otay River Desalination Plant, the San Diego Formation Desalination Plant, the Mission Valley Desalination Plant, and the Chula Vista MBR Treatment Plant.[1]

[1] San Diego County Water Authority, *San Diego Regional Concentrate Conveyance System Feasibility Study,* December 2008.

3.6 Brine-Concentrate Water Quality

Water quality data submitted as part of the survey from agencies is provided in Attachment C. Representative examples of water quality characteristics for brine-concentrate streams from brackish groundwater and a wastewater sources are presented in Table 3.6. The brackish groundwater sample is based on the water quality projections of the EMWD Menifee Desalter RO brine-concentrate. Water quality projections for the wastewater RO brine-concentrate are based on data from the OCWD's GWR System. Although these sample water qualities provide good representations of constituent concentrations in brine-concentrate, water quality is case specific and varies by location, source water characteristics, and upstream use (for wastewater). While the water quality for both of the samples has a similar concentration of salts, including sodium, calcium, chloride, and TDS, the wastewater sample has higher concentrations of organics such as TOC, nitrite-N, and ammonia-N. The groundwater has higher concentrations of some naturally occurring compounds including barium.

Key water quality parameters are either a regulatory or operational concern when treating or reducing brine-concentrate. The parameters are summarized in Tables 3.7 and 3.8 for wastewater and brackish groundwater brine-concentrate cases. Potential treatment processes for mitigating these parameters are included in these tables and include EDR, vibratory shear enhanced processing (VSEP), PS/RO, enhanced membrane system (EMS), and mechanical and thermal evaporation.

TABLE 3.6
RO CONCENTRATE WATER QUALITY EXAMPLES

Parameter	Unit	Brackish Water RO Concentrate Water Quality [a]	Wastewater RO Concentrate Water Quality [b]
Total Organic Carbon (TOC)	mg/L	1.5	69
Total Hardness ($CaCO_3$)	mg/L	3,500	1,920
Calcium (Ca)	mg/L	990	513
Magnesium (Mg)	mg/L	234	154
Sodium (Na)	mg/L	890	1,380
Potassium (K)	mg/L	26	91
Total Alkalinity ($CaCO_3$)	mg/L	650	910
Sulfate (SO_4)	mg/L	470	1,660
Chloride (Cl)	mg/L	2,440	1,425
Nitrate (as NO_3)	mg/L	88	22
Fluoride (F)	mg/L	0.1	5.0
pH	-	7.2-7.4	7.9
Total Dissolved Solids (TDS)	mg/L	5,700	6,200
Aluminum	µg/L	NA	184
Antimony	µg/L	NA	1.0
Arsenic	µg/L	NA	3.0

TABLE 3.6
RO CONCENTRATE WATER QUALITY EXAMPLES

Parameter	Unit	Brackish Water RO Concentrate Water Quality [a]	Wastewater RO Concentrate Water Quality [b]
Barium	µg/L	660	273
Cadmium	µg/L	NA	8.1
Chromium (Hexavalent)	µg/L	NA	10.0
Copper	µg/L	NA	13.2
Iron	µg/L	26	710
Manganese	µg/L	8	5
Mercury	µg/L	NA	0.12
Nickel	µg/L	NA	133
Selenium	µg/L	NA	7.0
Silica	mg/L	180	145
Silver	µg/L	NA	1.0
Nitrite-N	µg/L	100	200 to 500
Cyanide	µg/L	NA	35
Ammonia-N	µg/L	1,000	75,000 to 100,000

Notes:
[a] Based on EMWD Menifee Desalter RO Concentrate Water Quality Projections
[b] Based on OCWD GWR RO Concentrate Water Quality Projections

TABLE 3.7
KEY WATER QUALITY PARAMETERS IN WASTEWATER RO CONCENTRATE

Constituent	Regulatory Concern	Operational Concern	Mitigation/ Treatment Options
Total Organic Carbon (TOC)	None	Promotes organic/ microbiological fouling on membranes. Reduces efficiency of UV disinfection.	Membrane fouling can be best managed by pretreatment and flux selection.
Microbial Parameters	Title 22 disinfected tertiary effluent criteria should be met for coliform.	Promotes microbiological fouling.	Provide adequate disinfection per Title 22 requirements
Nitrogen	Depends upon usage	Ammonia increases chlorine demand. Nitrite, if present, may increase NDMA formation.	
Iron and Manganese	None.	May oxidize or form complexes with other constituents and promote membrane fouling.	Microfiltration/ultrafiltration and RO will reduce Fe/Mn levels to below the regulatory limits.

TABLE 3.7
KEY WATER QUALITY PARAMETERS IN WASTEWATER RO CONCENTRATE

Constituent	Regulatory Concern	Operational Concern	Mitigation/ Treatment Options
Total Dissolved Solids (TDS)	Between 500 and 1,000 mg/L TDS for irrigation water can affect sensitive plants (i.e., citrus). At 1,000 to 2,000 mg/L, TDS can affect crops. TDS for other types of reuse depends on specific use.	High TDS is a direct indicator of elevated levels of sparingly soluble salts that promote membrane scaling, and cause a loss in productivity and deterioration in permeate quality. The sparingly soluble salts of concern include calcium carbonate ($CaCO_3$), calcium sulfate ($CaSO_4$), barium sulfate ($BaSO_4$), calcium phosphate ($Ca_3(PO_4)_2$), strontium sulfate ($SrSO_4$), calcium fluoride (CaF), and silica (SiO_2).	pH adjustment and chemical addition can reduce certain forms of inorganic scaling.
pH	None	If the pH is too high, it may increase the precipitation tendency of water for carbonate and phosphate salts.	Chemical pretreatment for pH adjustment may be required.
Sodium	Excessive sodium in irrigation water as indicated by sodium adsorption ratio (SAR) (when sodium exceeds calcium by more than a 3:1 ratio) contributes to soil dispersion and structural breakdown.	None	Post-treatment may be required. Add salts of divalent cations (i.e., calcium, magnesium) to improve SAR.
Chloride	Excessive chloride (that is, more than 250 mg/L) can cause leaf injury in plants	None	Remove chloride using ion exchange, RO or EDR.
Boron	USEPA recommends maximum 0.75 mg/L boron in irrigation water as a long-term goal.	None	
Silica	None.	Silica can limit recovery of NF and RO membranes. Despite antiscalant use, a silica concentration of 140 to 150 mg/L in RO concentrate will limit RO recovery at 50 percent.	Use lime or caustic to increase pH to retard silica scaling.

TABLE 3.8
KEY WATER QUALITY PARAMETERS IN RO CONCENTRATE

Constituent	Regulatory Concern	Operational Concern	Mitigation/ Treatment Options
Total Organic Carbon (TOC)	None	Promotes organic/microbiological fouling on membranes. Reduces efficiency of ultraviolet disinfection.	Membrane fouling can be best managed by pretreatment and flux selection.
Nitrate	There is no nitrate limit for agricultural irrigation.	Nitrate-N is nutrient and supports microbial growth on nanofiltration (NF), RO, EDR systems.	
Iron and Manganese	None.	May oxidize or form complexes with other constituents and promote membrane fouling.	RO will reduce Fe/Mn levels to below the regulatory limits.
Total Dissolved Solids (TDS)	Between 500 and 1,000 mg/L, TDS in water can affect sensitive plants (that is, citrus). At 1,000 to 2,000 mg/L, TDS can affect crops. Therefore, the acceptable TDS levels for irrigation are somewhere between 500 and 2,000 mg/L. TDS for other types of uses depends on specific requirements.	High TDS is a direct indicator of elevated levels of sparingly soluble salts that promote membrane scaling and cause a loss in productivity and deterioration in permeate quality. The sparingly soluble salts of concern include calcium carbonate ($CaCO_3$), calcium sulfate ($CaSO_4$), barium sulfate ($BaSO_4$), calcium phosphate ($Ca_3(PO_4)_2$), strontium sulfate ($SrSO_4$), calcium fluoride (CaF), and silica (SiO_2).	pH adjustment and chemical addition can reduce certain forms of inorganic scaling.
pH	None	If the pH is too high, it may increase the precipitation tendency of water for carbonate and phosphate salts.	Chemical pretreatment for pH adjustment may be required
Sodium	Excessive sodium in water as indicated by sodium adsorption ratio (SAR) (when sodium exceeds calcium by more than a 3:1 ratio) contributes to soil dispersion and structural breakdown.	None	Post-treatment may be required. Add salts of divalent cations (i.e., calcium, magnesium) to improve SAR.
Chloride	Excessive chloride (that is, more than 250 mg/L) can cause leaf injury in plants.	None	Remove chloride using ion exchange, RO or EDR.

TABLE 3.8
KEY WATER QUALITY PARAMETERS IN RO CONCENTRATE

Constituent	Regulatory Concern	Operational Concern	Mitigation/ Treatment Options
Boron	USEPA recommends maximum 0.75 mg/L boron in water as a long-term goal.	None	
Silica	None.	Silica can limit recovery of NF and RO membranes. Despite antiscalant use, a silica concentration of 180 mg/L in RO concentrate will limit RO recovery to 35 percent.	Use lime or caustic to increase pH to retard silica scaling.

3.7 Southern California Overview

There are 119 wastewater facilities, 53 groundwater desalters, and 19 outfall systems that exist or are planned in southern California. Figure 3.35 shows the major WWTPs/WRPs, groundwater desalters, and brine conveyance facilities. Conveyance facilities include brinelines, as well as public and private outfalls. Currently, a majority of the brine-concentrate generated in the study area is disposed of using ocean outfall. The existing facilities that produce brine-concentrate include 10 WWTPs/WRPs and 22 groundwater desalters. The largest generator of brine-concentrate in the study area is the OCWD's GWR project.

3.7.1 Brine-Concentrate Flow Summary

Table 3.9 provides a summary of the brine-concentrate generation for the current (2008) and ultimate buildout conditions. As shown in Figure 3.36, the generation of brine-concentrate increases from approximately 32.3 mgd in 2008 to over 135 mgd in ultimate buildout. In 2012, there is a 15-mgd increase in brine-concentrate generation when the South Orange Coastal Ocean Desalination Project comes online. Another significant project, the Groundwater Reliability Improvement Project, is projected to produce approximately 7.25 mgd in Los Angeles County by 2020. In addition, Calleguas' SMP Phase 2DEF will be completed, along with a number of groundwater desalters and, in San Diego County, with the North City WRP expansion. The OCWD's Groundwater Replenishment System is currently being designed to be expanded to 132.19 mgd and could reach 130 mgd in the ultimate condition if influent flows increase over time.

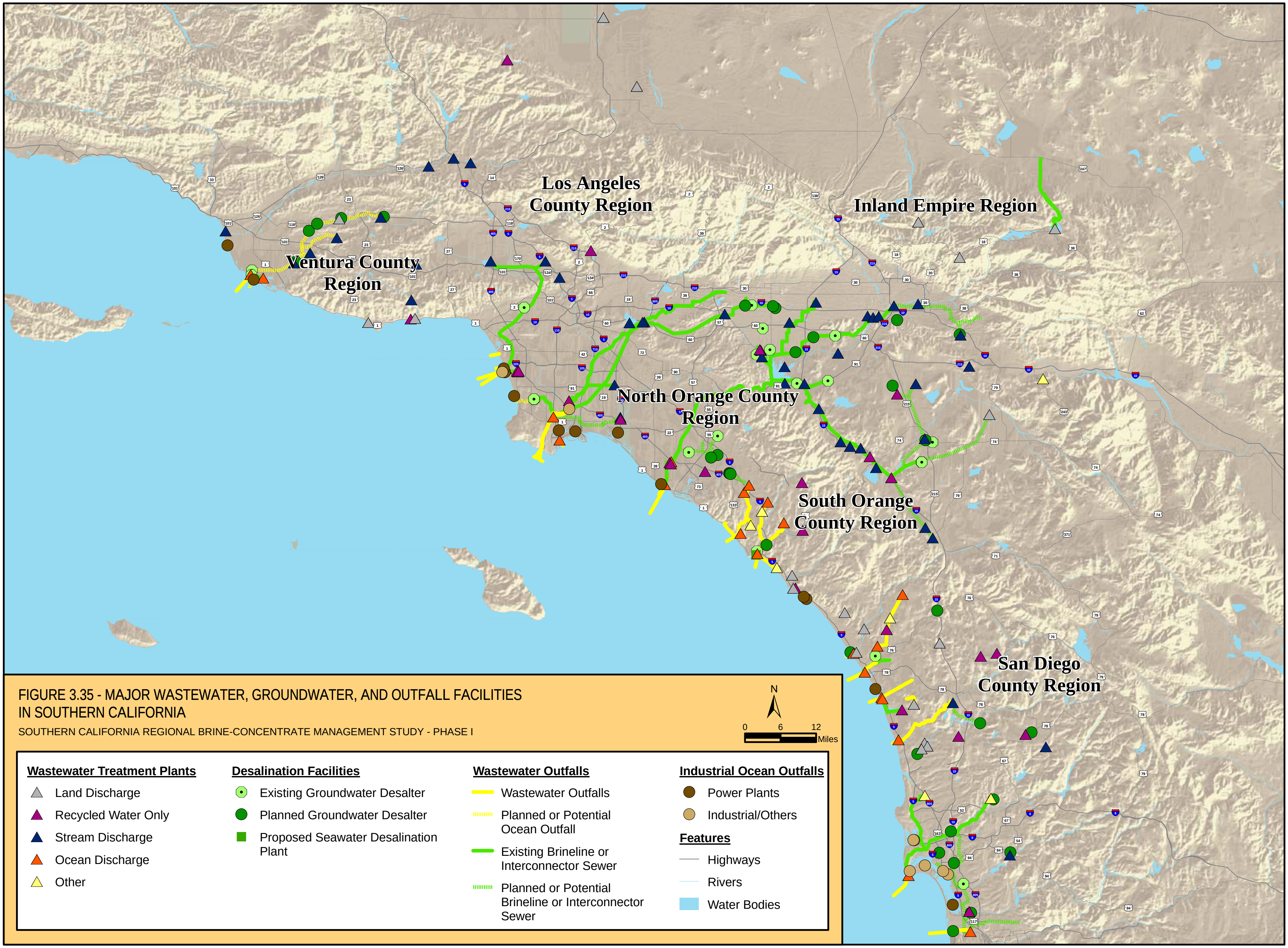


FIGURE 3.35 - MAJOR WASTEWATER, GROUNDWATER, AND OUTFALL FACILITIES IN SOUTHERN CALIFORNIA

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/26/09

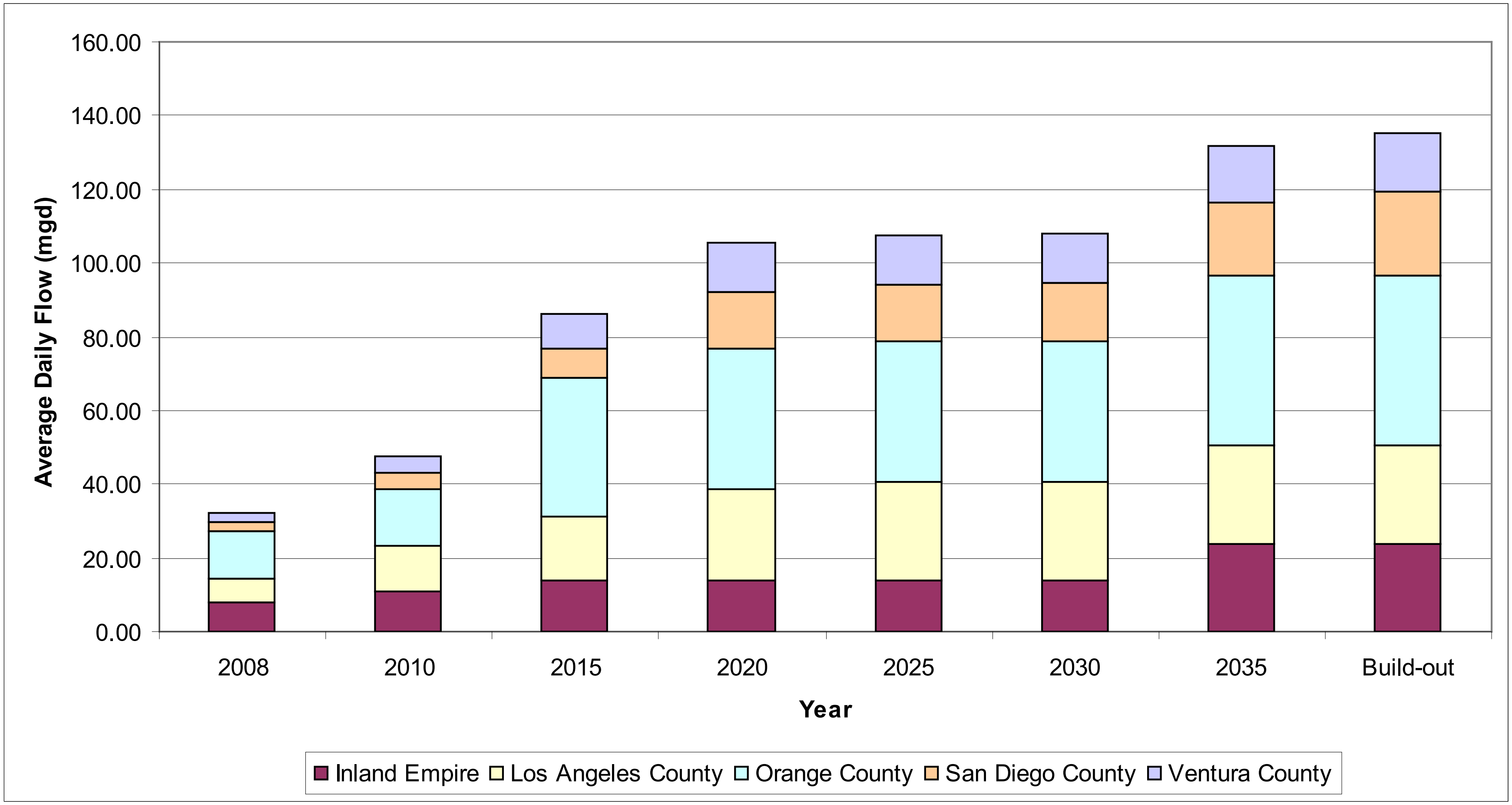
TABLE 3.9
SUMMARY OF BRINE-CONCENTRATE GENERATED IN SOUTHERN CALIFORNIA FOR THE EXISTING AND ULTIMATE CONDITIONS

Region	Average Daily Brine-Concentrate Generated (mgd)		
	Groundwater Desalters	WWTP	Total
EXISTING (2008)			
Inland Empire	7.83	0.00	7.83
Los Angeles County	1.43	5.28	6.71
North Orange County	0.49	10.68	11.17
South Orange County	1.70	0.00	1.70
San Diego County	1.40	0.81	2.21
Ventura County	2.68	0.00	2.68
Total	**15.53**	**16.77**	**32.30**
FUTURE (ULTIMATE BUILDOUT – POST 2035)			
Inland Empire	23.46	0.14	23.60
Los Angeles County	7.42	19.65	27.07
North Orange County	3.99	23.00	26.99
South Orange County[1]	18.70	0.15	18.85
San Diego County	13.35	9.37	22.72
Ventura County	9.05	6.79	15.84
Total	**75.97**	**59.10**	**135.07**

Notes:

[1]Groundwater values for the South Orange County region include brine flows from the proposed South Orange Coastal Ocean Desalination Project which will discharge brine via SOCWA's San Juan Creek Ocean Outfall

FIGURE 3.36 SUMMARY OF BRINE-CONCENTRATE GENERATED IN SOUTHERN CALIFORNIA BY REGION



The final increase in generation of brine-concentrate is driven by the construction of the Chino Desalter III, Bunker Hills Desalter, Yucaipa Regional Water Supply Renewal Project, expansion of the Oxnard AWTP, and expansion of the Mission Valley Groundwater Desalter. Figures 3.37 and 3.38 show the locations of the brine-concentrate facilities and the relative scale of projected brine-concentrate flows for the 2010 and ultimate timeframes. As shown in Figure 3.39, a number of different agencies are currently planning to implement brine-concentrate reduction or ZLD treatment technologies. For ultimate buildout, these agencies are planning to reduce their brine-concentrate flows to the following levels: Oxnard AWTP (6.56 mgd), Santa Rosa WRP (0.005 mgd), Grass Valley Water Treatment Facility (0.08 mgd), BBARWA WWTP (0.06 mgd), Hale Avenue WRF (1.35 mgd), and San Vicente WWTP (0.02 mgd).

3.7.2 Water Supply Summary

The scarcity of water supply continues because of the limited availability of imported water and the drought, which make even more important the development of reliable and locally controlled water supplies, especially in southern California where a large portion of the water supply is imported. Groundwater desalting and water reclamation are two methods of developing new reliable and locally controlled water supplies. Consequently, developing a long-term plan for brine-concentrate management within the study area is of great importance.

As shown in Figure 3.40, over 148 mgd of water supply is currently produced from the use of RO treatment processes in southern California. The amount of water supply is projected to be over 500 mgd in the future. This is over a threefold increase in water supplies produced by facilities that will generate approximately 135.5 mgd of brine-concentrate. Groundwater supplies generated from RO membrane treatment processes increase from approximately 72.8 mgd to 251.8 mgd at buildout. The South Orange Coastal Ocean Desalination Project is projecting a 15-mgd supply and will discharge brine via the SOCWA's San Juan Creek Ocean Outfall. The use of RO to recover water from WWTPs/WRPs results in an increase of water supply from approximately 75.4 mgd in 2008 to 249.9 mgd by buildout.

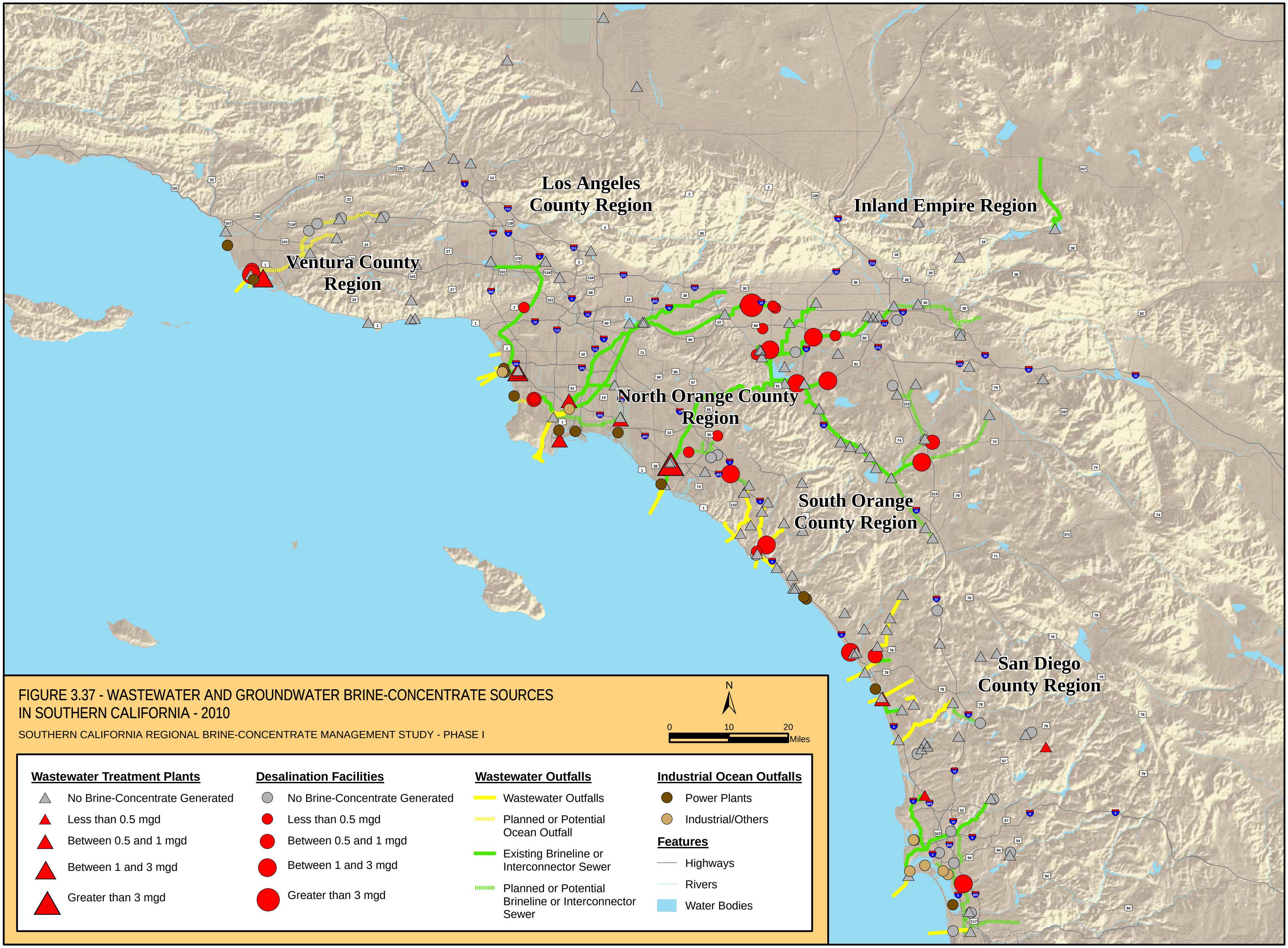


FIGURE 3.37 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN SOUTHERN CALIFORNIA - 2010

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

\\cheron\projects\USBR\381333BrineStudy\GIS 08/26/09

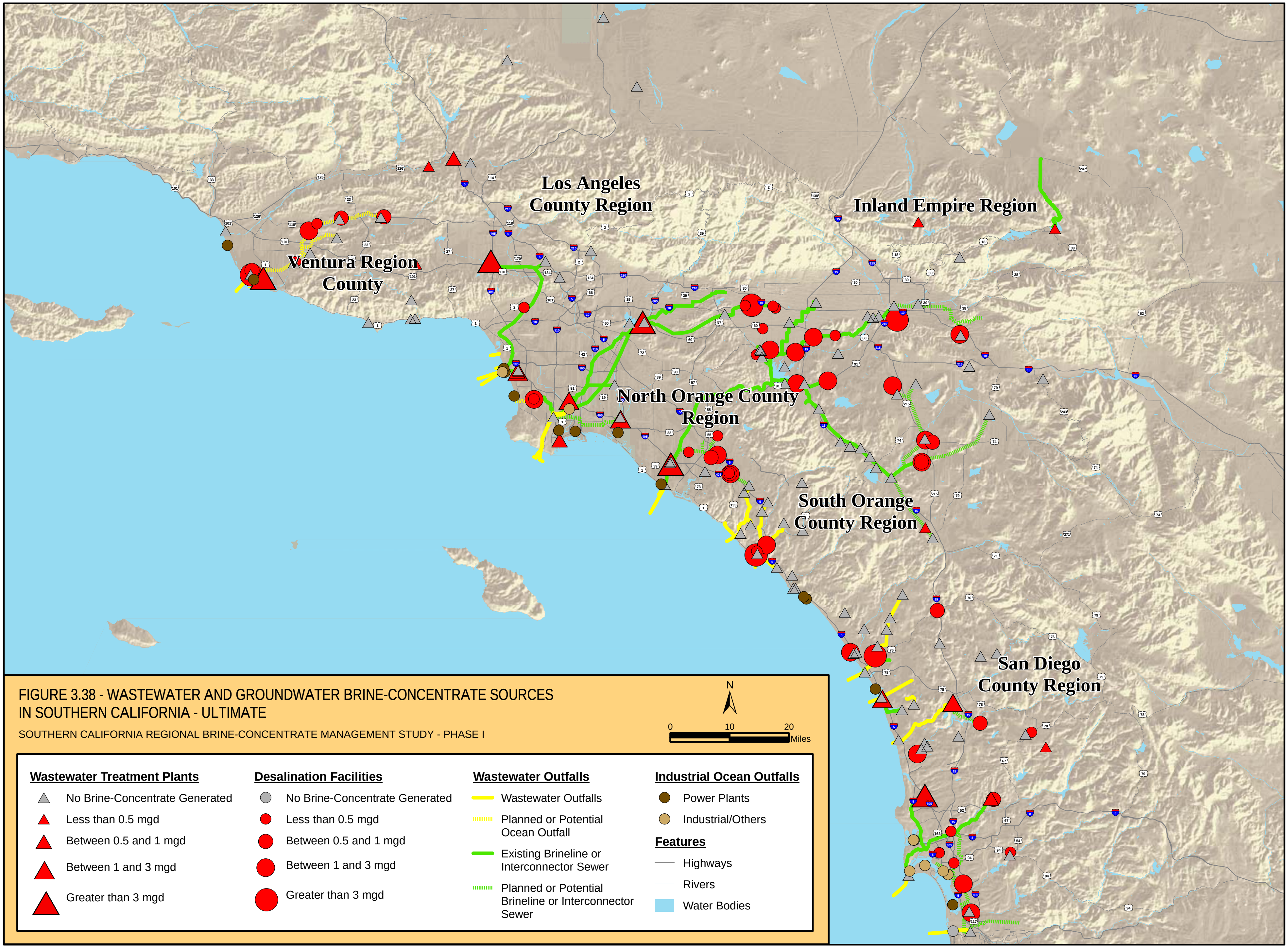
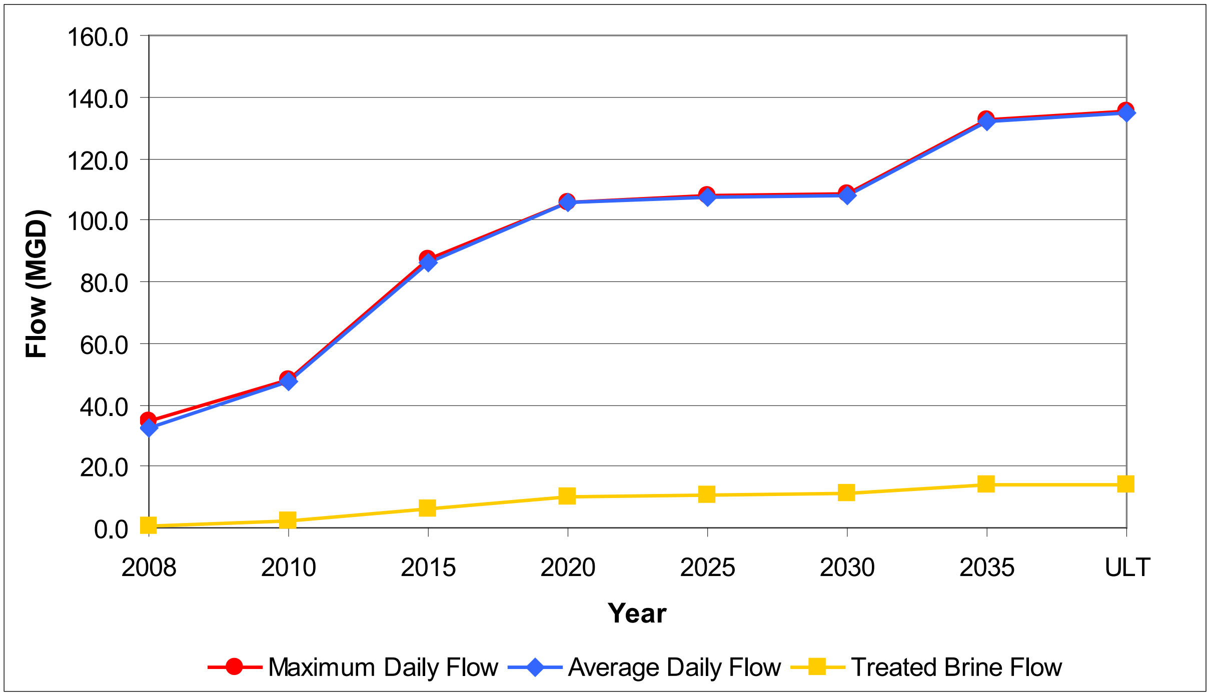


FIGURE 3.38 - WASTEWATER AND GROUNDWATER BRINE-CONCENTRATE SOURCES IN SOUTHERN CALIFORNIA - ULTIMATE

SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

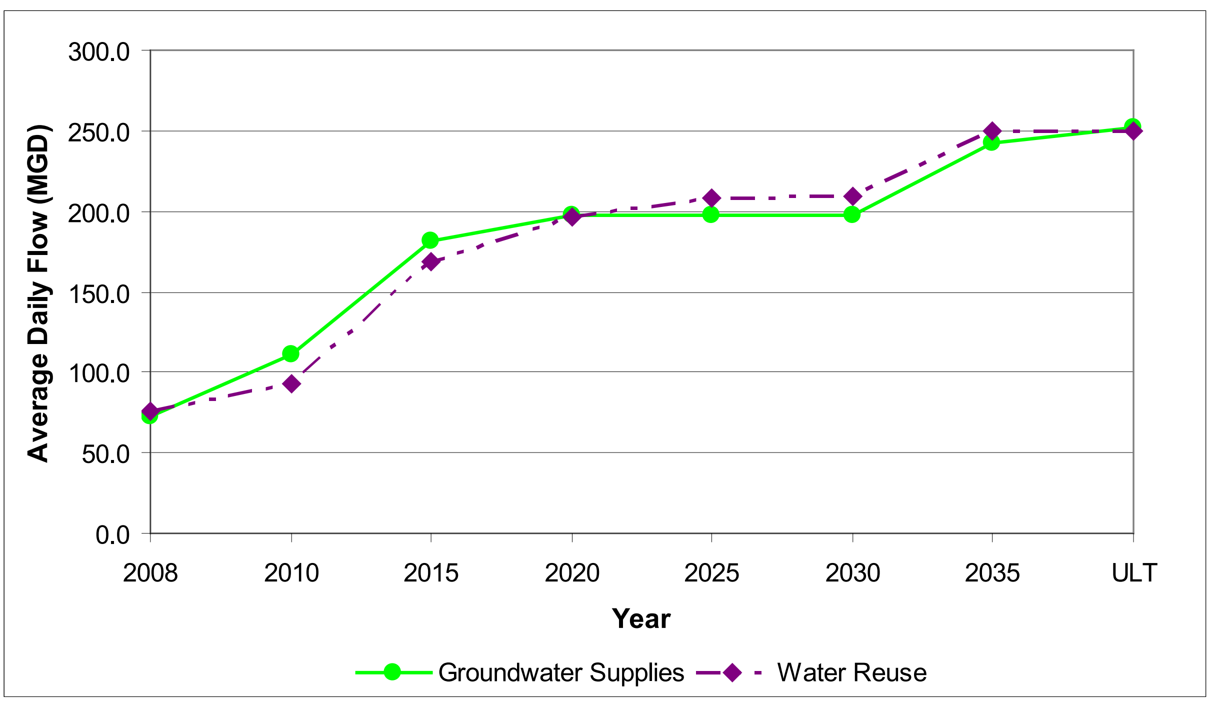
\\cheron\projects\USBR\381333BrineStudy\GIS 08/26/09

FIGURE 3.39 BRINE-CONCENTRATE FLOW SUMMARY FOR SOUTHERN CALIFORNIA



Note: Brine generation is from wastewater treatment and groundwater desalting. These projections include the South Orange Coastal Ocean Desalination Project.

FIGURE 3.40 WATER SUPPLIES THAT RESULT IN THE GENERATION OF BRINE-CONCENTRATE IN SOUTHERN CALIFORNIA



Note: Figure includes WWTP/WRPs, groundwater recharge, seawater intrusion barrier, brackish groundwater and 15 mgd from the South Orange Coastal Ocean Desalination Project.

3.7.3 Comparison of Survey Results with Past Reclamation Studies

The results of the survey were compared with the Initiative, another Reclamation effort that quantified the amount of brine-concentrate generated in southern California. The Initiative scenarios were as follows:

- Moderate Scenario – This scenario is based on a moderate expansion level of recycled water use, inclusion of desalter facilities that will be online by 2010 (that is, a moderate level of groundwater desalting), and a moderate increase in effluent discharges and flows in brine-concentrate in pipelines. In addition, the maximum recycled water contribution factor for groundwater recharge was assumed to be 100 percent where available capacity exists within a groundwater basin. The amount of brine-concentrate generated in this scenario is based upon the planned advanced treatment processes (RO, for example) that are planned to be in place by 2010.
- Maximum Scenario – This scenario is based on the projected maximum levels of water reuse, implementation of planned and proposed desalter facilities that will be online by 2040 (that is, a maximum level of groundwater desalting), and a maximum or long-term increase of effluent discharges and flows in brine-concentrate in pipelines. In addition, the maximum recycled water contribution factor for groundwater recharged is assumed to be 100 percent where available capacity exists within a groundwater basin. The amount of brine-concentrate produced in this scenario is based upon the planned advanced treatment processes (RO, for example) that are planned to be in place by 2040.
- Extreme-Case Scenario 1 – This scenario focuses on estimating the amount of brine-concentrate produced if regulation changes require all recycled water to be treated using advanced treatment processes (for example, RO) and the planned and proposed 2010 groundwater desalter facilities are implemented. Moderate levels of projected reuse and groundwater desalting are assumed for this scenario. Analysis of this scenario provides an opportunity to illustrate how recycled water regulation changes could affect the amount of brine-concentrate produced in the 2010 timeframe.
- Extreme-Case Scenario 2 – This scenario focuses on estimating the amount of brine-concentrate produced if regulation changes require all recycled water to be treated using advanced treatment processes (such as RO) and all planned and proposed 2040 groundwater desalter facilities are implemented (that is, maximum level of reuse and groundwater desalting). Analysis of this scenario provides an opportunity to illustrate how recycled water regulation changes could affect the amount of brine-concentrate produced in the 2040 timeframe.

- Extreme-Case Scenario 3 – This scenario focuses on estimating the amount of brine-concentrate produced if regulation changes are aggressive and require the implementation of advanced treatment processes (such as RO) on all inland discharges and on other water reuse facilities. Maximum levels of projected reuse and WWTP capacities are assumed for this scenario, as well as all planned and proposed groundwater desalter facilities for 2040 (that is, maximum level of groundwater desalting). This scenario illustrates how regulation changes for inland discharges could affect the amount of brine-concentrate produced in the 2040 timeframe.
- Extreme-Case Scenario 4 – This scenario focuses on estimating the amount of brine-concentrate produced if regulation changes are aggressive, requiring the implementation of advanced treatment processes (such as RO) on all wastewater dischargers and water reuse facilities. Maximum levels (2040) of projected reuse and WWTP capacities are assumed for this scenario. Under this scenario, advanced treatment for all WWTP flows are assumed, as well as implementation of planned and proposed 2040 groundwater desalter facilities (that is, a maximum level of groundwater desalting). Analysis of this scenario will be limited due to the uncertainties in the projections; however, the projections for this condition are intended to illustrate the wide range or variability of projections for brine-concentrate production in southern California.

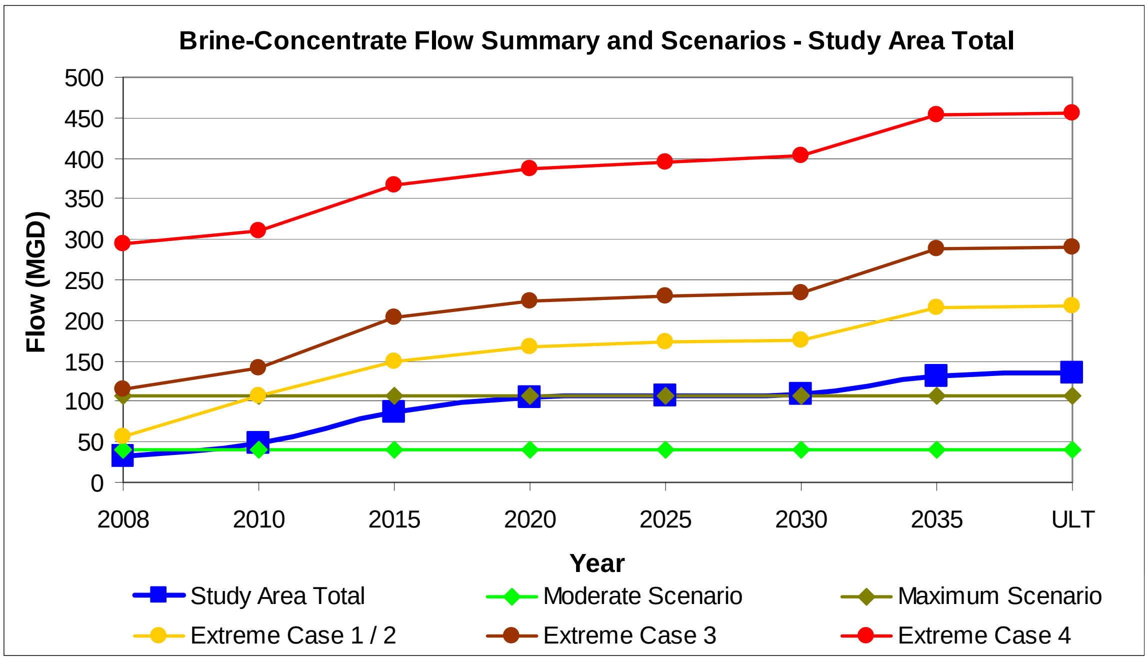
A synopsis of these scenarios can be seen in Figure 3.41. These scenarios encompass the full range of possible regulatory actions that could occur.

FIGURE 3.41 SCENARIO DEFINITIONS

		Conditions Included in Scenario that Produce Brine/Concentrate:								
Scenario Name	**Description**	**Existing/ Planned Advanced Treatment at Water Recycling Plant**	**Moderate Level (Year 2010) Groundwater Recharge with TDS Exceedance of BPO**	**Maximum Level (Year 2040) Groundwater Recharge with TDS Exceedance of BPO**	**Moderate (Year 2010) Water Recycling**	**Maximum (Year 2040) Water Recycling**	**All Inland Wastewater Dischargers**	**All Wastewater Dischargers**	**Groundwater Desalting Facilities Online by Year 2010**	**Groundwater Desalting Facilities Online by Year 2040**
Moderate	Advanced treatment implemented to meet BPOs in Year 2010	✓	✓						✓	
Maximum	Advanced treatment implemented to meet BPOs in Year 2040	✓		✓						✓
Extreme 1	Advanced treatment implemented on all recycled water produced in Year 2010	✓			✓				✓	
Extreme 2	Advanced treatment implemented on all recycled water produced in Year 2040	✓				✓				✓
Extreme 3	Advanced treatment implemented on all inland wastewater discharges and water recycled in Year 2040	✓				✓	✓			✓
Extreme 4	Advanced treatment implemented on all wastewater flows in Year 2040	✓						✓		✓

The survey data of the Initiative and this study were consistent in projecting a fairly consistent amount of brine-concentrate. As seen in Figure 3.42, the study survey data are consistent with the Initiative's moderate scenario (that is, the study area total data cross the moderate scenario data at 2010). In addition, the survey data are consistent with the Initiative's maximum scenario. As Figure 3.42 shows, the study area total data have a higher value than the Initiative's maximum scenario at buildout, which would be approximately equivalent to 2040. The difference between the two values is approximately 26 mgd. The correlation of these data demonstrates that the projections in the Initiative are still valid for the extreme-case scenarios. Changes in the regulations can drastically increase not only the need for RO processes but also the generation of brine-concentrate. If these RO processes are implemented, existing brine-concentrate management measures will not be adequate to manage the amount of brine-concentrate generated, and additional volume reduction, treatment, or disposal mechanisms for brine-concentrate will be needed.

FIGURE 3.42 BRINE-CONCENTRATE FLOW SUMMARY AND SCENARIOS FOR SOUTHERN CALIFORNIA



4 Lessons Learned and Challenges for Brine-Concentrate Projects

4.1 Introduction

This section of the report is focused on providing lessons learned and challenges that have faced projects that currently are being or have been studied or constructed. Three case studies are provided, they are:

- Calleguas MWD Salinity Management Program
- South Bay Ocean Outfall Study
- Laguna County DWI Project

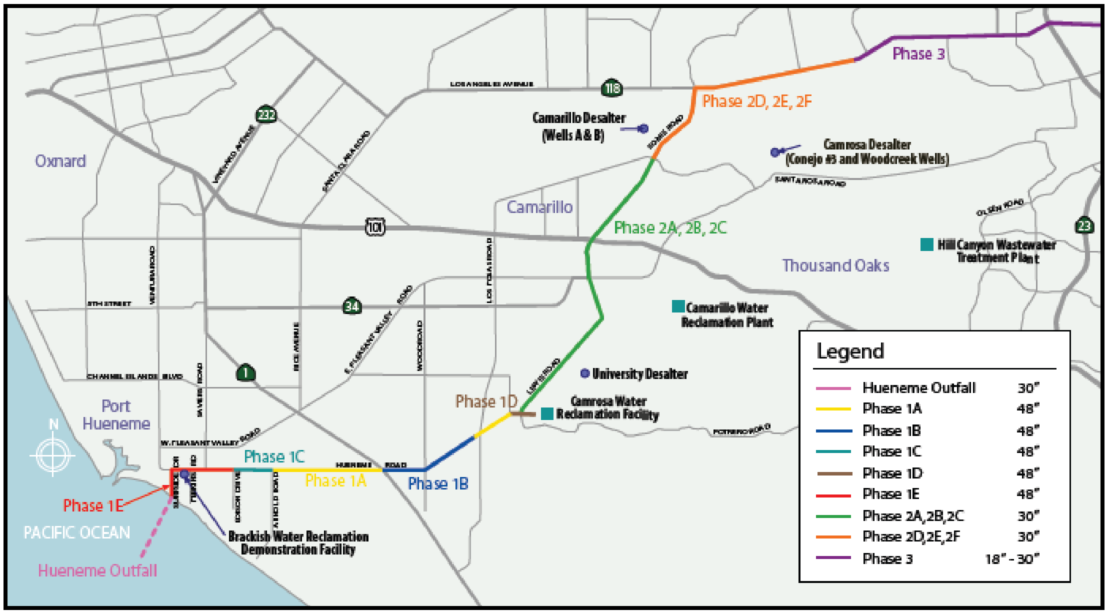
In addition to the information provided in this report, these and other case studies and project implementation information are contained with the *Institutional Issues Report, Regulatory Issues and Trends Report,* and the *Brine-Concentrate Treatment and Disposal Options Report*, all of which were also developed as part of this study.

4.2 Calleguas MWD Salinity Management Program

4.2.1 Project Description

The Calleguas Regional Salinity Management Program (SMP) consists of a pipeline that collects brine-concentrate from municipal wastewater treatment plants, industrial dischargers, and groundwater desalting facilities in the Ventura County region. The SMP will extend from the city of Simi Valley in the east to Port Hueneme in the west, through the cities of Moorpark, Camarillo, Oxnard, and areas of unincorporated Ventura County. The SMP will be constructed incrementally in phases and will ultimately connect to the proposed Hueneme Outfall shown in Figure 4.1. The first phase of the SMP has been completed, with the last phase planned for completion in 2019. A list of the SMP phases and scheduled construction completion dates are provided in Table 4.1. Pipeline sizes range from 18 to 48 inches and have capacities ranging from 8 to 20 mgd. Implementation of the SMP is being coordinated under the Calleguas Creek Watershed Management Plan (CCWMP), whose Board includes representatives from cities, water agencies, agricultural interests, natural resource agencies, and environmental organizations.

FIGURE 4.1 CALLEGUAS REGIONAL SALINITY PIPELINE



Source: Calleguas Regional Salinity Management Project, Channel Counties Water Utilities Association, 2008.

TABLE 4.1
PHASED SCHEDULE FOR COMPLETION OF THE SALINITY MANAGEMENT PROJECT

SMP Phase	Anticipated Year of Completion
SMP Phase 1A	2004
SMP Phase 1B	2009
SMP Phase 1C	2008
SMP Phase 1D	2009
SMP Phase 1E	Construction to begin in 2009
SMP Phase 2A	Construction to begin in 2013
SMP Phase 2B	Construction to begin in 2014
SMP Phase 2C	Construction to begin in 2015
SMP Phases 2DEF	Construction to begin in 2016
SMP Phases 3ABC	Construction to begin in 2019

4.2.2 Brine Management

The purpose of the SMP is twofold—to remove salt that is building up in the watershed and to improve the reliability of water supplies by developing local groundwater sources in Ventura County. The Calleguas Creek Watershed is experiencing increasing salinity levels in its groundwater due to ongoing point and nonpoint source pollution from urbanization and agriculture. This creates problems for water recycling, agriculture, and habitat. To use the groundwater for potable purposes, it must first be blended with imported water to reduce TDS concentrations and comply with drinking water quality requirements.

In addition to water quality issues, there are also water supply issues. Ventura County is largely dependent on imported water sources from the State Water Project (SWP). Local groundwater sources are not readily usable because of quality concerns regarding TDS and other salts. These salts can be removed through the use of RO membranes; however, these membranes produce a brine-concentrate that must then be managed and disposed. By providing a discharge mechanism, the SMP will enable local brackish groundwater resources to be desalinated and utilized for potable purposes, reducing dependence on imported water and improving local water supply reliability.

4.2.3 Implementation Issues

Originally, the SMP project investigated using an existing outfall in the Oxnard area; however, there were two key constraints that limited their use. One constraint was the limit on copper that could be discharged through an existing industrial outfall such as the Ormond Beach effluent pipeline, which is owned and operated by Reliant Energy, LLC. The power plant outfall does not provide adequate dilution for copper and would require additional treatment due to the configuration of the outfall (the outfall is too shallow and short for adequate dilution to occur). Another option was to discharge through the existing Oxnard ocean outfall; however, this outfall did not have available capacity. In addition, using either of the existing outfalls would require re-permitting the outfall to comply with the Ocean Plan water quality standards and with updated NPDES requirements. Consequently, the SMP included construction of a new ocean outfall.

A key issue of concern associated with obtaining an NPDES permit is the capability to provide an adequate visual mixing zone for the brine-concentrate to protect the marine habitat. At existing refinery and power plant outfalls, updating the NPDES permit might be difficult if the existing outfall does not provide adequate mixing and if existing water quality limits preclude the discharge of non-ocean sources of water. Limits on metals are of particular concern because NPDES limits are often below drinking water quality reflecting their bases on the Ocean Plan. For example, the Calleguas MWD SMP new ocean outfall requires a dilution ratio of 72 to 1 based on RWQCB requirements. This ratio is more than sufficient for compliance with the Ocean Plan objectives. To obtain that limit, the Calleguas MWD had to demonstrate by modeling the impact of the ocean outfall configuration on the marine environment.

Qualifications for obtaining a permit to discharge brine-concentrate via an ocean outfall are slightly more stringent than typical NPDES permits for WWTPs. The RWQCB will issue a temporary permit for discharge during design and construction of the treatment facility based on an Environmental Impact Report being in place, acceptable quality and quantity of brine-concentrate, and an approved outfall design. However, the permanent discharge permit will not be issued until the full-scale facility has passed rigorous brine-concentrate quality tests to determine constituent concentrations. For the SMP, the permit application process required the following:

- Outfall diffuser modeling
- Water quality modeling
- Sampling of anticipated flows

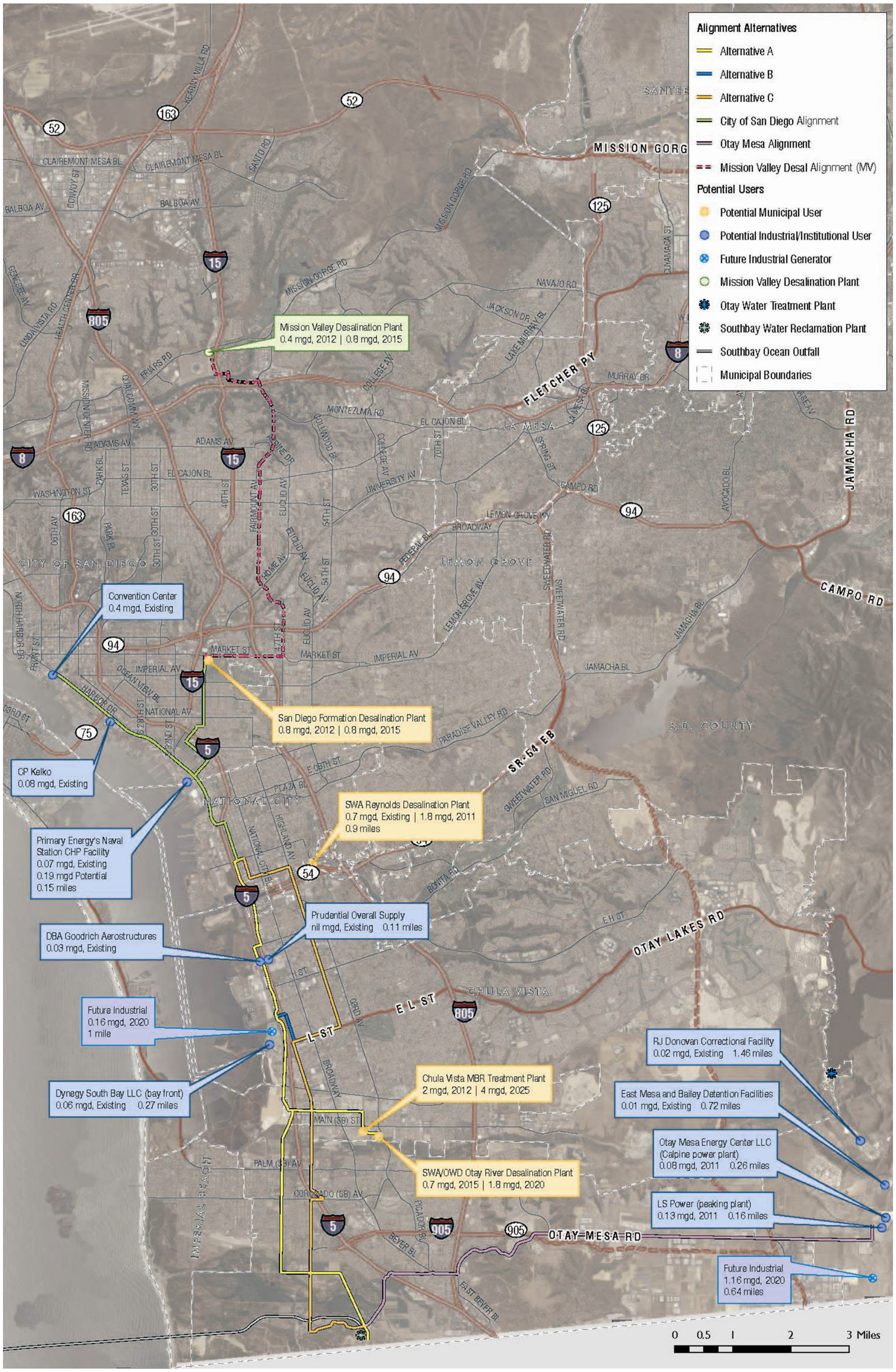
In addition, the quality of the brine-concentrate had to pass a bioassay test prior to issuance of the ocean discharge permit. Instances have occurred when a permanent permit was not issued for an ocean outfall based on results from the bioassay tests on the brine-concentrate.

4.3 South Bay Ocean Outfall Study

4.3.1 Project Description

The SDCWA, in association with the City of San Diego, Otay Water District, and the Sweetwater Authority, evaluated the feasibility of establishing an environmentally sound and cost-effective method to manage the disposal of brine-concentrate flows generated in San Diego County. The study focused on southern San Diego County, including the cities of San Diego, National City, Chula Vista, and Imperial Beach. The study also investigated using the South Bay ocean outfall regional brineline to serve the eastern San Diego area cities of El Cajon, La Mesa, and Santee. The concentrate flows would be discharged to the ocean via the existing SBOO. The San Diego County Regional Brineline System would consist of the Mission Valley desalination brineline, the City of San Diego brineline, and the Otay Mesa brineline, as shown in Figure 4.2. The Regional Brineline would collect brine-concentrate flows from wastewater treatment plants, groundwater desalters, and industrial dischargers in southern San Diego County. Potential users include facilities that, either currently or in the future, will produce highly saline flows that do not require municipal wastewater treatment, or previously treated flows that do not require additional treatment, prior to ocean discharge. Potential municipal users include groundwater desalination facilities, water treatment plants, and wastewater treatment and recycling facilities. Potential industrial/institutional users include the United States Navy, energy plants, and correctional facilities.

FIGURE 4.2 SAN DIEGO COUNTY REGIONAL BRINELINE



Source: San Diego Regional Concentrate Conveyance System Feasibility Study, San Diego County Water Authority, 2008.

The maximum brine-concentrate flow identified from the potential users is 10.7 mgd. Construction is scheduled to begin in 2012. The City of San Diego brineline is anticipated to convey an average daily flow of 0.12 mgd by 2012. The Mission Valley desalter brineline is anticipated to convey an average daily flow of 1.60 mgd by 2012. The Otay Mesa brineline is anticipated to convey an average daily flow of 0.44 and 1.10 mgd by 2012 and 2020, respectively. The San Diego County regional brineline is anticipated to convey an average daily flow of 6.04 and 9.30 mgd by 2012 and 2025. The maximum capacity of the South Bay ocean outfall is 258 mgd (by gravity) and 333 mgd (pumped), with a current average daily flow of 28 mgd (25 mgd from IBWC and 3 mgd from SBWRP).

4.3.2 Brine Management

The purpose of this project is to implement a regional concentrate conveyance facility that would facilitate the development of new, local, reliable water supplies in San Diego County through desalination of brackish groundwater and recycling of wastewater. The proposed conveyance system would reduce salt loadings to the San Diego region by the following means:

- Using existing wastewater treatment and water recycling facilities
- Producing backwash water or other waste streams by potable water treatment plants
- Discharging high-salinity, nonsanitary flows, by industrial operations such as correctional facilities, academic campuses, or hospitals

In 2007, the SDCWA relied on local supplies for 24 percent of its water supply and on imported water from MWDSC for the remaining 76 percent. The 2020 goal for SDCWA is to reduce reliance on imported water from MWDSC to 29 percent of its water supply. To reduce reliance on imported water, SDCWA needs to further develop local groundwater supplies and manage brine-concentrate. Implementation of a regional brineline would facilitate the development of local brackish groundwater supplies in San Diego County and enable SDCWA to export salts from the area.

A regional concentrate conveyance system would require a means of discharging brine-concentrate to the ocean. Consequently, the use of the SBOO for discharge of brine-concentrate is critical to the success of the proposed San Diego Regional Brineline System. The owners of the SBOO, the City of San Diego, and the International Boundary Water Commission support the concept of using the SBOO for brine-concentrate management. The SBOO has sufficient capacity to accommodate projected flows, which are estimated to range between 5 mgd and 15 mgd. The design capacity of the SBOO is 333 mgd under pumped conditions and 258 mgd under gravity-flow conditions.

4.3.3 Implementation Issues

Constraints associated with this project primarily involve institutional and organizational issues. For this project to move forward, a number of agencies in the South Bay would need to pool financial resources. To accomplish this, a new organization structure or agreement would have to be developed among these agencies. Possible organizational structures include multiple owners, joint power authority, single owner with contracts, and single owner special district. The institutional structure selected will depend on several issues, including financial viability, circumstances at the time and on how many partners are involved.

Another constraint is the quality of the groundwater sources. Development of the local groundwater sources will involve reclaiming low-quality source water, which would require advanced treatment technologies and would result in higher generation of brine-concentrate.

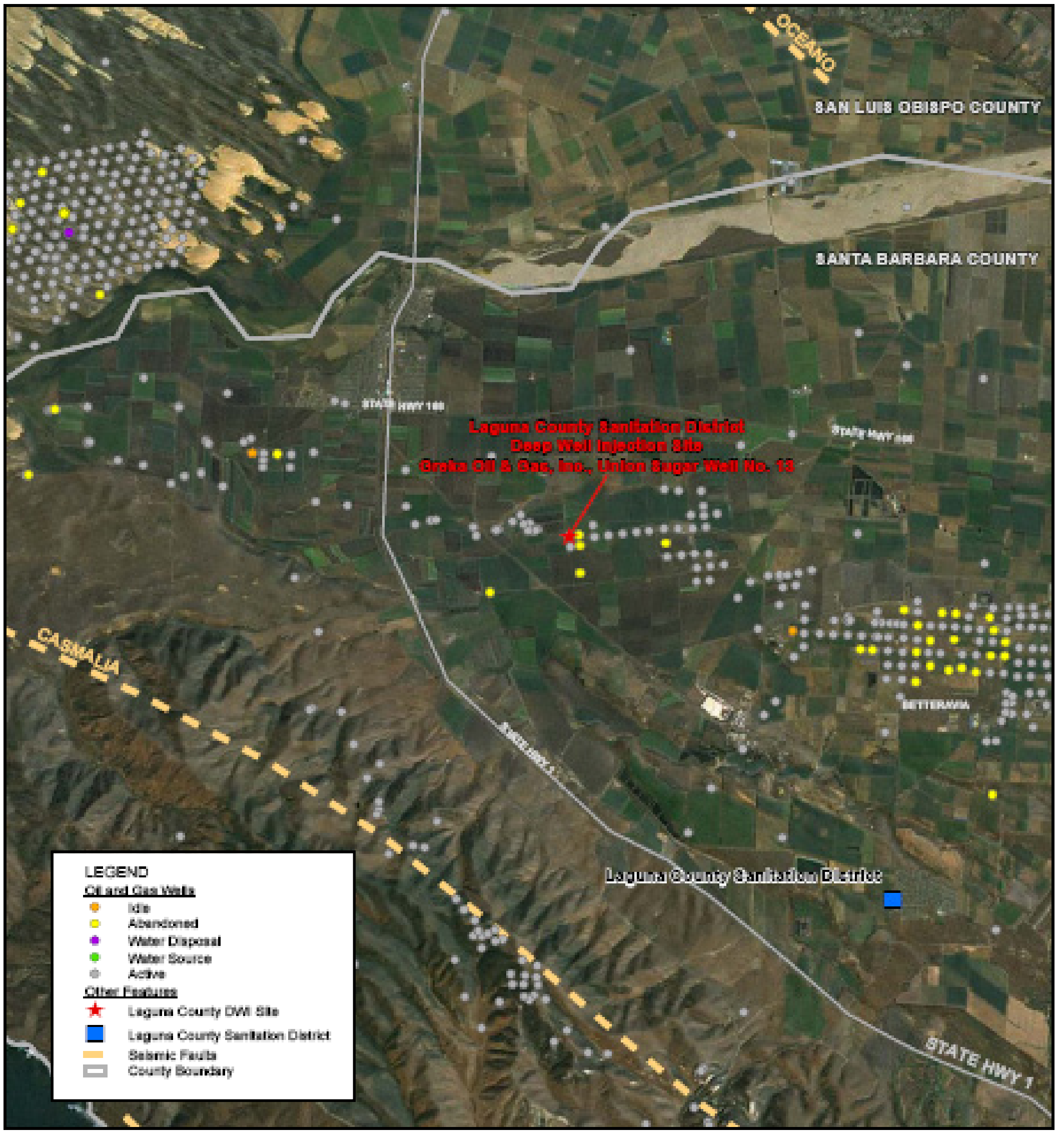
4.4 Laguna County Deep Well Injection Project

4.4.1 Project Description

The Laguna County Sanitation District currently disposes of brine-concentrate via deep well injection. The injection well is an abandoned oil well owned by Greka Oil & Gas, Inc. and operated by Union Sugar (Well No. 13). The well is located in the Santa Maria Valley Oil Field, northeast of Highway 1 in Santa Barbara County, as shown in Figure 4.3.

Brine-concentrate is generated during reverse osmosis treatment of wastewater at the Laguna County Sanitation District WRP. The WRP is located at the western end of Dutard Road near Black Road on a 20-acre parcel (No. 113-240-005) in Santa Maria, California. The average daily flow through the WRP is approximately 2.4 mgd. The treatment facility serves the unincorporated areas of Santa Maria, portions of the city of Santa Maria, and the unincorporated community of Orcutt. The plant processes include screening and grit removal, primary clarification, trickling filters, secondary clarification, membrane filtration (including RO for a portion of the flow) and ultraviolet irradiation. Reverse osmosis brine-concentrate is disposed of into a Class I nonhazardous injection well. The plant is regulated by the RWQCB – Central Coast Region under WDRs and Master Reclamation Permit Order 01-042 adopted May 22, 2001. The injection well is regulated by USEPA permit number CA/000001.

FIGURE 4.3 LAGUNA COUNTY SANITATION DISTRICT DEEP WELL INJECTION SITE



4.4.2 Brine Management

The use of injection well technology from the LCSD WRP has been a successful means of RO brine-concentrate management and disposal. Deep well injection to dispose of liquid wastes is an environmentally and technically sound waste disposal method. Deep well injection of liquids began in the petroleum industry to dispose of oilfield wastes and to enhance oil production. Disposal of salt water by injection has been in practice since the 1930s. Today, injection wells are known to exist in almost every state, and a wide range of industries use deep well disposal including food processing, pharmaceutical, paper, mining, automotive, chemical, and petrochemical industries. In some areas, municipalities used deep well injection for wastewater effluent disposal. In California, a significant number of Class II injection wells are used by the oil and gas industry.

The suitability of this technology for a specific application depends on the presence of geologic formations that have the natural capability to store and confine the wastes. The capability of geologic formations to confine liquid is demonstrated in some areas by the presence of oil and gas, often at high pressures. Accumulation of these reserves requires sufficient confinement to prevent them from moving to the surface for millions of years.

For a DWI disposal system to be feasible, geologic formations must have permeability and thickness sufficient for wells to accept the volume of fluid at a rate of disposal and pressure that do not compromise overlying confinement. At least one confining layer is required to minimize the potential for the injected fluids to migrate into the USDW. Water quality in the injection zone must generally include TDS concentrations of over 10,000 mg/L to comply with permitting requirements for Class I nonhazardous injection.

4.4.3 Implementation Issues

Although the LCSD DWI site has been implemented, several issues are associated with implementation of DWI for brine-concentrate disposal in general. USEPA requires that Class I nonhazardous waste injection wells be located in geologically stable areas that are free of transmissive fractures or faults through which injected fluids could travel to drinking water sources. Numerous faults traverse southern California, but the continuity and conveyance capacity these faults are not always known. The well operator must verify that there are no wells or other artificial pathways between the injection zone and USDWs through which fluids can travel. The site-specific geologic properties of the subsurface around the well offer another safeguard against the movement of injected wastewaters to a USDW.

Southern California has been extensively penetrated by oil, gas, and injection wells over the last 60 years, with much of the drilling completed in the 1950s. A number of these wells have been plugged and abandoned since they were drilled. There are limited data available on the exact methods and materials used to plug and abandon some of these wells. A detailed review/study is required to evaluate how each of these previously abandoned wells was abandoned or plugged. Depending on the methods used to abandon the wells, remedial plugging might be required to comply with requirements of USEPA. This could require reentering, drilling out existing surface plugs, and replugging at a significant cost.

Another issue facing the use of DWI is that fluids could be forced upward from the injection zone through transmissive faults or fractures in the confining beds, which, like abandoned wells, can act as pathways for waste migration to USDWs. Faults or fractures could have formed naturally prior to injection in the confining zone. Artificial fractures could also be created by injecting wastewater at excessive pressures. To reduce this risk, injection wells would need to be located such that they inject below a confining bed that is free of known transmissive faults or fractures. During well processes, the operators must monitor injection pressures to ensure that fractures are not propagated in the injection zone or initiated in the confining zone.

The brine-concentrate and receiving formation need to be compatible to avoid geochemical reactions in the subsurface. Although quality testing will be completed before injection to minimize incompatibilities, excessive plugging of the formation caused by unforeseen geochemical interactions between the injectate and formation materials or formation fluids could occur.