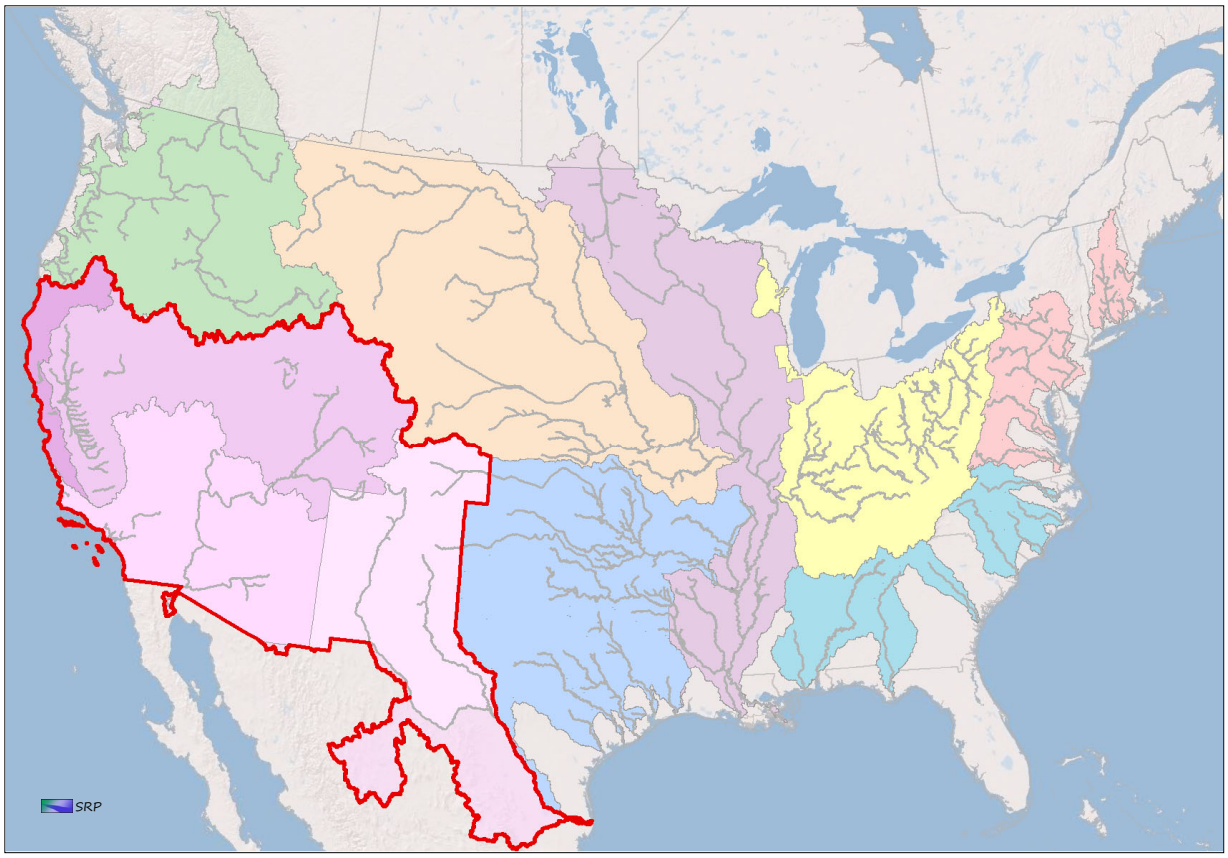
Sustainable Rivers Program

Environmental Opportunities for Rivers and Reservoirs in the South Pacific



Regional Operations and Water Management Meeting

South Pacific Division and Albuquerque, Los Angeles, Sacramento, and San Francisco Districts

January 2024

Executive Summary

The South Pacific Operations and Water Management Meeting was held November 1-2, 2023. The purpose of the meeting was to identify environmental improvement opportunities at U.S. Army Corps of Engineers (Corps; USACE) involved reservoirs and related Civil Works water management infrastructure in the South Pacific region that are feasible to implement and are likely to provide compelling potential benefits. This report documents the meeting and the discussions held in plenary and breakout sessions. This is not a decision document; no specific recommendations are made. However, this report is intended for use by district and regional Corps staff considering opportunities and priorities for environmental improvement at water management infrastructure in the South Pacific region.

The South Pacific region is defined as the geographic area containing four Corps Districts within South Pacific Division: Albuquerque, Los Angeles, Sacramento, and San Francisco (Figure 1). Districts are responsible for Corps Civil Works water resource projects within a geographic area that encompasses major river basins to include Rio Grande and the Sacramento, San Joaquin, and Colorado Rivers. Additional responsibilities include reservoir management in the Russian, Arroyo Valle, Kings, Kaweah, Tule, and Kern River basins in California, the Truckee River basin in Nevada, rivers that flow to the Great Salt Lake in Utah, headwaters of the Arkansas and Canadian Rivers in Colorado and New Mexico, and several dry dams in Southern California. More than 83 reservoirs, affecting flows for over 8,142 river miles within the region, were considered.

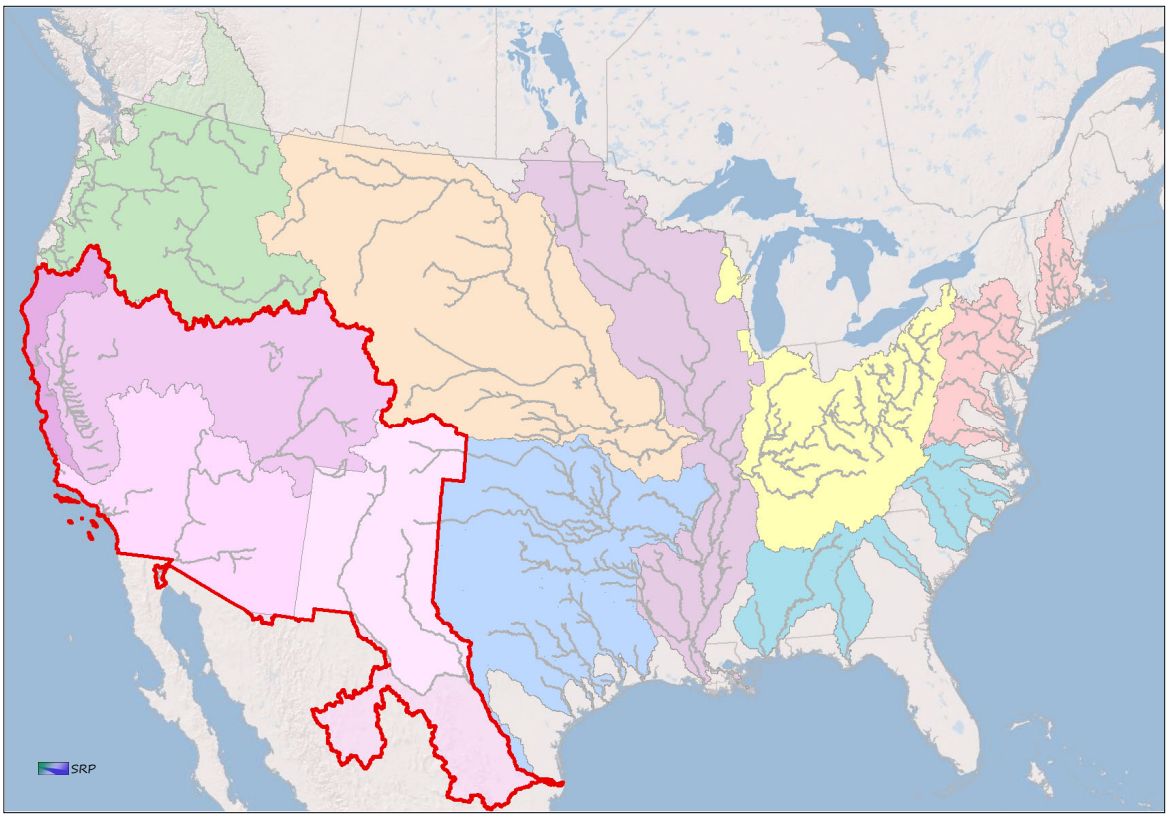


Figure 1. Geographic scope of the South Pacific Regional Meeting.

In formulating and evaluating environmental opportunities, location-based teams followed these steps:

1) list possible environmental improvement actions associated with reservoirs and water management infrastructure;
2) rate environmental potential of each action;
3) rate degree to which each action has been implemented;
4) select environmental actions with unrealized implementation; and,
5) rank reservoirs and water management infrastructure according to which are most promising for operational changes related to selected actions.

Identified actionable ideas, or combinations of environmental action and candidate reservoir, are highlighted in the report and summarized in Table 1.

Table 1. Priority actionable ideas, South Pacific region.

Location-based team	Environmental Action	Reservoir(s)
Albuquerque	Manage distribution of depositing sediments (encourage sediment flux)	Cochiti, Jemez Canyon, John Martin
Albuquerque	Reallocations	Abiquiu, Jemez Canyon, Santa Rosa
Albuquerque	Ecological flow targets	Abiquiu, Santa Rosa
Albuquerque	Physical habitat - Subimpoundment creation or restoration	Galisteo, Jemez Canyon
Albuquerque	Invasive species control - native plant establishments	Galisteo, Jemez Canyon
Los Angeles	Invasive species control - native plant establishments	Hansen, Prado, Santa Fe, Whittier Narrows
Los Angeles	Water level management for amphibians	Alamo, Hansen, Mojave River, Prado, Santa Fe, Whittier Narrows
Los Angeles	Groundwater recharge for downstream ecological benefits	Hansen, Lopez, Prado, San Antonio, Santa Fe, Whittier Narrows, Seven Oaks, Modified Roosevelt, Twitchell
Los Angeles	Ecological flow targets (fish and vegetation; downstream)	Alamo, Mojave River, Seven Oaks, Twitchell
Sacramento	Management of fisheries (in pool)	Richard L. Schafer, Buchanan
Sacramento	Ecological flow targets - floodplain, riparian, wetland, fisheries	Isabella
Sacramento	Debris management	Richard L. Schafer, Buchanan, Black Butte
Sacramento	Seasonal wetlands for amphibians and birds	Farmington

San Francisco	Water Quality - Temperature	Coyote Valley, Warm Springs
San Francisco	Water Quality - Turbidity	Coyote Valley, Warm Springs
San Francisco	Rate of change management for bank integrity (water quality considerations)	Coyote Valley, Warm Springs

Meeting participants (Appendix A) were comprised of staff from the Corps, including representatives of South Pacific Division and the four districts, and The Nature Conservancy (TNC).

This report details content of the meeting and is structured to follow the meeting agenda (Appendix B).

The South Pacific meeting was the sixth in a series of regional Operations and Water Management meetings. Previous regional meetings were conducted in the Upper Midwest (involving Kansas City, Omaha, Rock Island, St. Paul, and St. Louis districts) in September 2019, South (involving New Orleans, Memphis, Vicksburg, Galveston, Little Rock, Fort Worth, and Tulsa districts) in September 2020, Pacific Northwest (involving Seattle, Portland, and Walla Walla districts) in November 2020, North Atlantic (involving Baltimore, New England, New York, Norfolk, and Philadelphia districts) in October 2021, and South Atlantic (involving Charleston, Jacksonville, Mobile, Savannah, and Wilmington) in February 2023.

The intent of these regional meetings and associated reports is to identify and document environmental opportunities at water infrastructure that are feasible to implement with compelling potential benefits. It is acknowledged that full assessment and implementation of those opportunities would likely involve collaborations with partner and regulatory agencies and stakeholders. Actionable ideas - pairings of environmental action and infrastructure project with feasibility and anticipated environmental benefits - are simply ideas judged worthy of further consideration (Table 1).

Introduction and Objective

The goal of the South Pacific Regional Operations and Water Management meeting was to identify environmental opportunities at Corps-involved reservoirs that are feasible to implement with compelling potential benefits.

By many measures (e.g., number of reservoirs, total storage, geographic distribution), the Corps is the largest water management organization in the nation. A reservoir survey completed in 2013 identified 465 reservoirs with federally authorized flood storage. The majority (356) of these reservoirs were owned and operated by the Corps. Additionally, the Corps has approximately 180 locks and dams on rivers nationwide. Considering environmental opportunities for all of these water bodies is daunting given differences in their size, location, and purpose(s).

Contemplating opportunities at finer spatial scales becomes more practical as similarities in hydrology, landscape, water bodies, and water resources management create a common context for sharing experiences and formulating alternative management strategies. Environmental opportunities and challenges also trend regionally, as considerations begin to focus on shared ecological community types, flyways, and habitats. The South Pacific Regional Operations and Water Management meeting was

convened with this premise – that regional characteristics of water and ecological systems can underpin a productive dialogue about water management infrastructure operations for environmental benefits.

Meeting participants provided expertise in water management infrastructure operations, water management, water quality, natural resources management, environmental planning, and ecology. Collectively, the group began the formulation process by listing key environmental actions associated with water management infrastructure. Participants then split into location-based teams (based on geographical areas of responsibility of the four participating Corps districts and experience). Each team scored the potential environmental benefits and current implementation feasibility level of each identified action (for all water management infrastructure, collectively). Teams then ranked specific actions with unrealized environmental benefits for individual projects within their area, according to which were the most promising candidates for operational changes and selected highest ranked actions to carry forward.

Sustainable Rivers Program

The Sustainable Rivers Program (SRP) is a national partnership between the Corps and TNC. The mission of SRP is to improve the health and life of rivers by changing water management infrastructure operations to restore and protect ecosystems, while maintaining or enhancing other authorized project purposes.

The SRP began in 1998 with an initial collaboration to improve the ecological condition of the Green River, Kentucky. The Program was formally established in 2002 and included eight river systems. As of 2023, the SRP includes more than 90 Corps water management infrastructure projects in 45 river systems influencing 12,183 river miles (Figure 2). It is the largest scale and most comprehensive program for implementing environmental flows below Corps reservoirs.

Environmental flows are defined as the quantity, timing, and quality of water flows required to sustain ecosystems. For water management infrastructure operators, environmental flows manifest as management decisions that manipulate water and land-water interactions to achieve ecological or environmental goals. The SRP process for environmental flows has three phases: (1) advance; (2) implement; and (3) incorporate. Advancing environmental flows involves engaging stakeholders in a science-based process to define the flow needs of riverine ecosystems. Implementation involves testing the effectiveness and feasibility of the defined flows. Incorporation involves formally including environmental flow strategies in reservoir operations policy (e.g., water control manual updates). Environmental flows were the founding objective of the SRP and remain the key focus. In recent years, the Program began exploring other water management infrastructure-oriented actions with potential to produce environmental benefits.

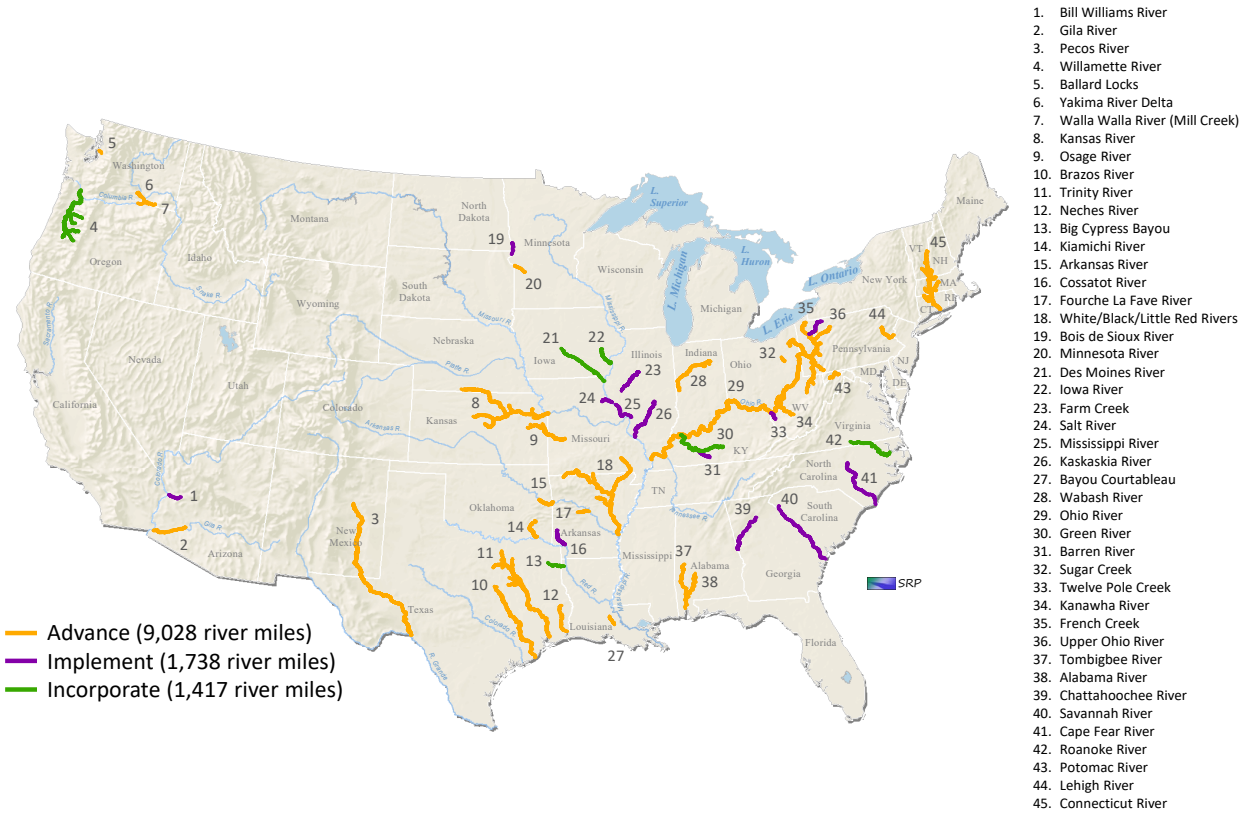


Figure 2. Status of rivers engaged in the Sustainable Rivers Program, 2023.

Importantly, this report and associated meeting are not about SRP. SRP has promoted the concept of regional meetings for several years with the intent of providing a venue for broad consideration of environmental actions at rivers and reservoirs. The South Pacific meeting was the sixth in a series of regional Operations and Water Management meetings sponsored by the SRP. Previous regional meetings were conducted in the Upper Midwest (involving Kansas City, Omaha, Rock Island, St. Paul, and St. Louis districts) in September 2019, South (involving New Orleans, Memphis, Vicksburg, Galveston, Little Rock, Fort Worth, and Tulsa districts) in September 2020, Pacific Northwest (involving Seattle, Portland, and Walla Walla districts) in November 2020, North Atlantic (involving Baltimore, New England, New York, Norfolk, and Philadelphia districts) in October 2021, and South Atlantic (involving Charleston, Jacksonville, Mobile, Savannah, and Wilmington) in February 2023.

South Pacific Regional Rivers and Reservoirs

For the purposes of this meeting, the South Pacific region is comprised of the geographic areas of 4 Corps Districts, Albuquerque (SPA), Los Angeles (SPL), Sacramento (SPK), and San Francisco (SPN), which are parts of the Corps' South Pacific Division (SPD). Collectively, the Districts are involved with 83 reservoirs with federally authorized flood space. Nearly half (41) of these reservoirs are owned and operated by the Corps. The others (42) are owned and operated by entities other than the Corps, with

the Corps prescribing guidance for the management of the federal authorized flood space (Figure 3). These reservoirs are often referred to as Section 7 reservoirs in reference to the portion of the Flood Control Act of 1944 that authorized the Corps to prescribe regulations for the use of reservoir storage dedicated to flood risk management for all facilities constructed wholly or in part with federal funds. Twenty-three of the Corps reservoirs and three of the Section 7 reservoirs are dry dams. Dry dams are typically smaller and more single purpose than other reservoirs with federally authorized flood space. Most were constructed solely for flood risk management and many release water passively, storing water only when inflows exceed the physical capacity of always open outlets. Hoover Dam, located on the Arizona-Nevada border, was categorized as a "big river" reservoir due to the amount of water and drainage area regulated, which separated this reservoir from the others.

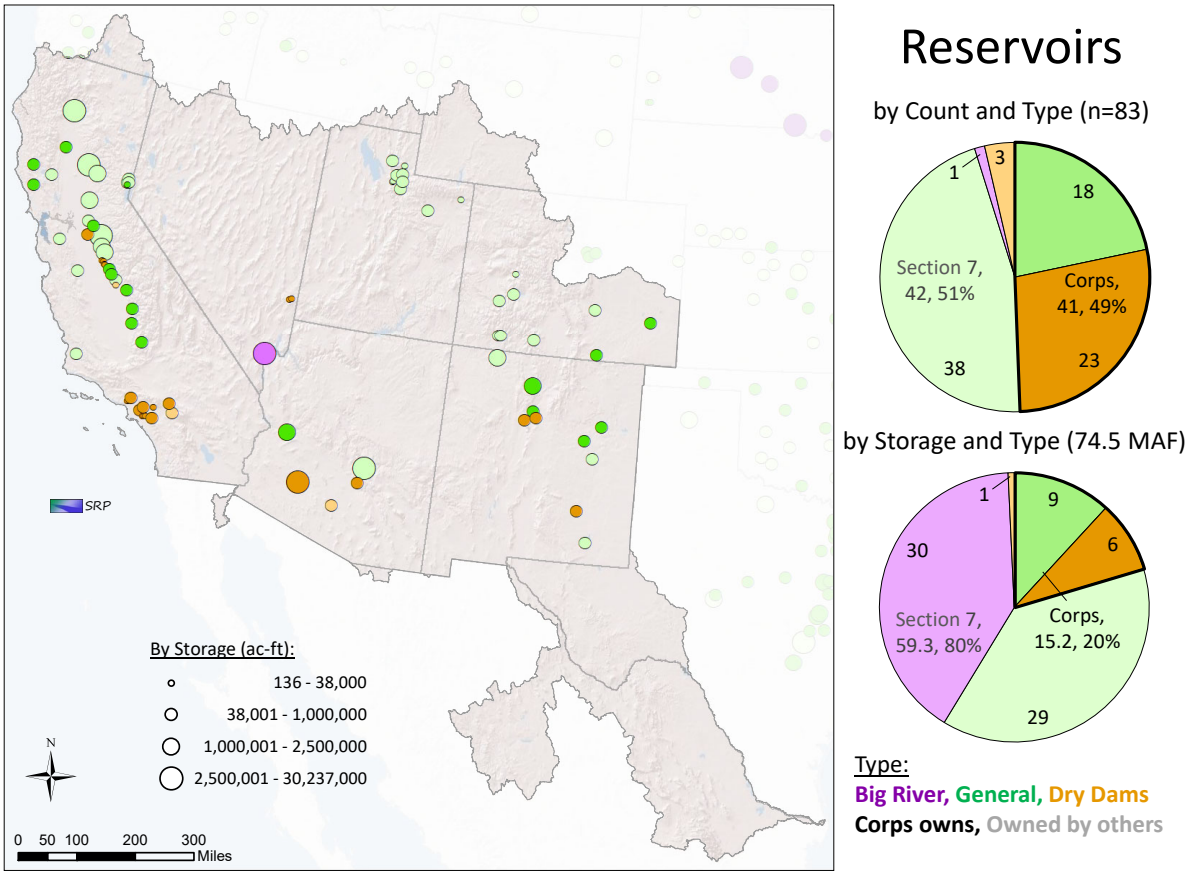


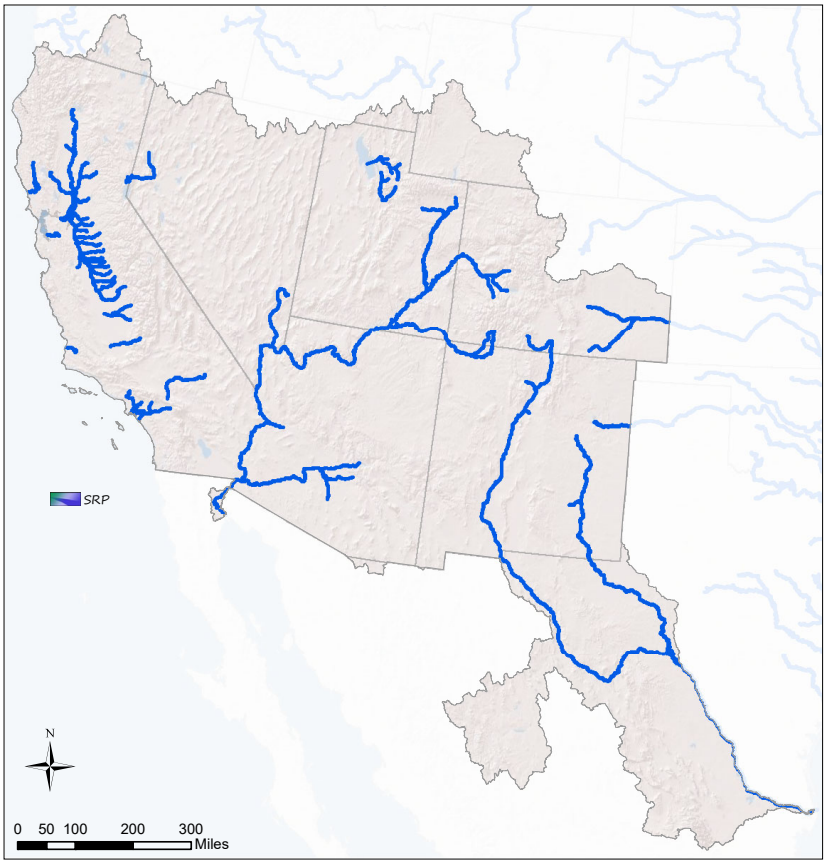
Figure 3. Corps-involved reservoirs in the South Pacific region.

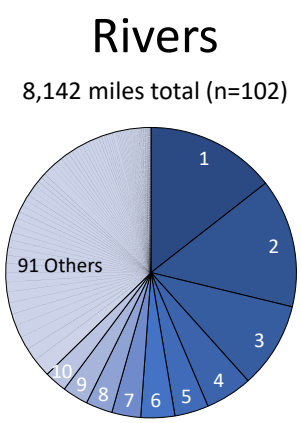
Based on the National Inventory of Dams (NID 2016), Corps-involved dams contain 74.5 million acre-feet (MAF) of storage, which is 47% of all surface water reservoir storage in the region. Table 2 provides a summary of the reservoirs.

Table 2. South Pacific region reservoir count and storage.

	Count						Storage (millions of acre-feet; MAF)					
	Corps		Section 7			NID (all)	Corps		Section 7			NID (all)
	General	Dry dams	General	Big river	Dry dams		General	Dry dams	General	Big river	Dry dams	
SPA	6	3	5	-	-	912	4.3	0.7	3.7	-	-	15.9
SPK	9	5	30	-	1	2,767	2.5	0.1	20.9	-	0.03	82.1
SPL	1	15	2	1	2	931	1.4	5.6	3.8	30.2	0.5	52.9
SPN	2	-	1	-	-	412	0.6	-	0.1	-	-	7.1
Total	18	23	38	1	3	5,022	8.8	6.4	28.6	30.2	0.6	158.1

The river network below the Corps-involved reservoirs consists of 102 different named rivers. The Rio Grande is the longest with a total of 1,174 river miles from its confluence with the Conejos River below Platoro Dam to Amistad, a reservoir on the mainstem Rio Grande near Del Rio, Texas. Below Amistad (and outside of the South Pacific region), the Rio Grande travels an additional 470 river miles to the Gulf of Mexico. The Colorado River has the second longest length within the region with the Pecos, Sacramento, Green, San Joaquin, Gila, San Juan, and Arkansas completing the list of top ten longest rivers. The combined lengths of blank or unlabeled reaches also fell in the top ten (Figure 4).





#	Name	Miles
1	Rio Grande	1,174
2	Colorado River	1,169
3	Pecos River	781
4	*unlabeled reaches*	425
5	Sacramento River	308
6	Green River	307
7	San Joaquin River	261
8	Gila River	241
9	San Juan River	234
10	Arkansas River	202
11...	91 Others	2,876
Total		8,142

Figure 4. Rivers below Corps-involved reservoirs in the South Pacific region.

The total number of river miles in the region below Corps involved dams is 8,142. Of these, 1,668 river miles are below Corps dams, 3,342 are below Section 7 dams, and 3,132 are below a combination of both Corps and Section 7 dams. Roughly a third of the total (2,828 river miles) are below reservoirs that have an authorized purpose related to the environment (fish and wildlife, water quality, or recreation) though many of the other reaches have endangered species considerations. Table 3 provides a summary of the rivers.

Table 3. River miles below Corps-involved dams. Tallies provided by area of responsibility and purpose.

	River Miles by Area of Responsibility			River Miles by Purpose				
	Corps	Section 7	Both	Enviro	Hydro	Both	Neither	Total
SPA	411	477	1,869	202	1,256	0	1,299	2,757
SPK	600	2,293	537	274	1,064	1,366	726	3,429
SPL	542	537	726	71	293	800	642	1,806
SPN	115	34	0	0	0	115	34	150
Total	1,668	3,342	3,132	546	2,613	2,281	2,701	8,142

Reservoir-centric Environmental Efforts within the South Pacific Region

This section provides a summary of presentations from the four participating districts about ongoing reservoir-centric environmental efforts in the region.

Albuquerque District (SPA)

Albuquerque District Area of Responsibility covers southern Colorado, all of New Mexico and western Texas. Within SPA, there are 14 federally managed projects on major waterways. These federal projects include authorized purposes such as flood risk management (FRM), water supply, recreation, and hydropower. Figure 5 is a district map depicting the different water basins as well as key projects.

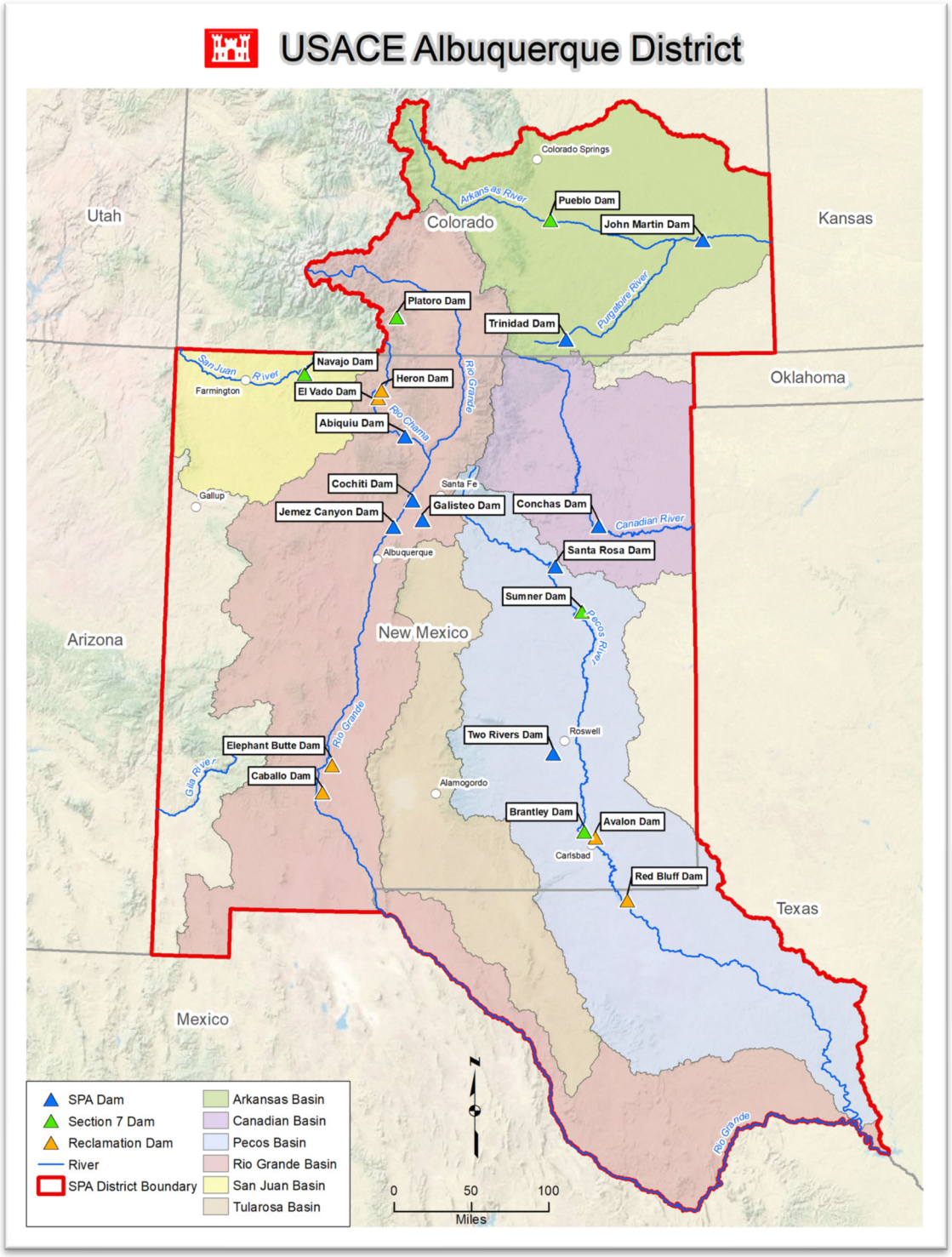


Figure 5. Albuquerque District project location map.

Water management in the Rio Grande basin is complex. Several federal and state agencies with differing missions and methods are responsible for legislating, managing, and distributing water. Within the Rio Grande basin, the Corps manages Abiquiu, Cochiti, Jemez Canyon, and Galisteo Dams. Abiquiu

Reservoir and Dam was initially authorized solely for flood and sediment control. Subsequent legislation added authority for water supply storage. Additionally, Los Alamos holds a FERC permit for "run of the river" hydroelectric power generation. Moving through the Rio Grande, Cochiti Lake and Dam is the only Corps dam on the Rio Grande mainstem. It is authorized for FRM and sediment control and to hold a permanent pool for recreation and the conservation of fish and wildlife. Jemez Canyon and Galisteo dams are dry dams authorized solely for FRM and sediment control. Within the Rio Grande basin, there is one Section 7 dam, Platoro Dam on the Conejos River, that is owned and operated by Reclamation for irrigation water supply and for FRM by the Corps.

Within the Arkansas basin, the Corps owns and operates Trinidad Dam on the Purgatoire River and John Martin Dam on the Arkansas River for FRM. Additionally, Trinidad stores water for the Purgatoire River Water Conservancy District and the City of Trinidad and John Martin stores water for irrigation districts in the States of Colorado and Kansas. Outside of the irrigation season, no releases from these reservoirs are made. Within the Arkansas River basin, there is one Section 7 dam, Pueblo Dam, that is owned and operated by Reclamation to store transmountain water for municipal, industrial, and irrigation water supply.

Within the Pecos basin, the Corps owns and operates Santa Rosa and Two Rivers dams. Two Rivers is a dry dam that is operated solely for FRM. Santa Rosa is authorized for FRM and irrigation storage and stores water for the Carlsbad Irrigation District about 150 miles downstream of the dam. Additionally, the Corps manages Sumner and Brantley dams for FRM as Section 7 projects. Within the Canadian basin, the Corps owns and operates Conchas Dam for FRM and water supply for two irrigation districts.

In San Juan basin, there is one Section 7 dam, Navajo Dam, that is owned and operated by Reclamation for water supply and by Albuquerque District for FRM.

Los Angeles District (SPL)

Within SPL, there are 19 to 21 federally managed FRM projects depending on how they are categorized. Managed watersheds include Los Angeles County Drainage Area (LACDA), Santa Ana River, Mojave River, and Cuyama Watershed/Twitchell Dam in California; Gila River and Bill Williams River watersheds in Arizona; and the Muddy River watershed in Nevada. Facilities within these managed watersheds fall into three categories: 1) A general reservoir which includes Alamo Dam, 2) Dry dams with gates which include 12 facilities, and 3) Dry dams without gates which are the final 4 facilities. Of the 19 to 21 facilities, 5 are Section 7 dams where the Corps manages the flood control space but does not operate the project. Authorized and approved purposes include FRM, fish and wildlife benefits under varying terminology, water conservation, and recreation. In general, the priority purpose is flood control. Of the Corps operated dams in SPL, only one has a permanent pool, Alamo Dam. See Figure 6 for locations of SPL dams and reservoirs.

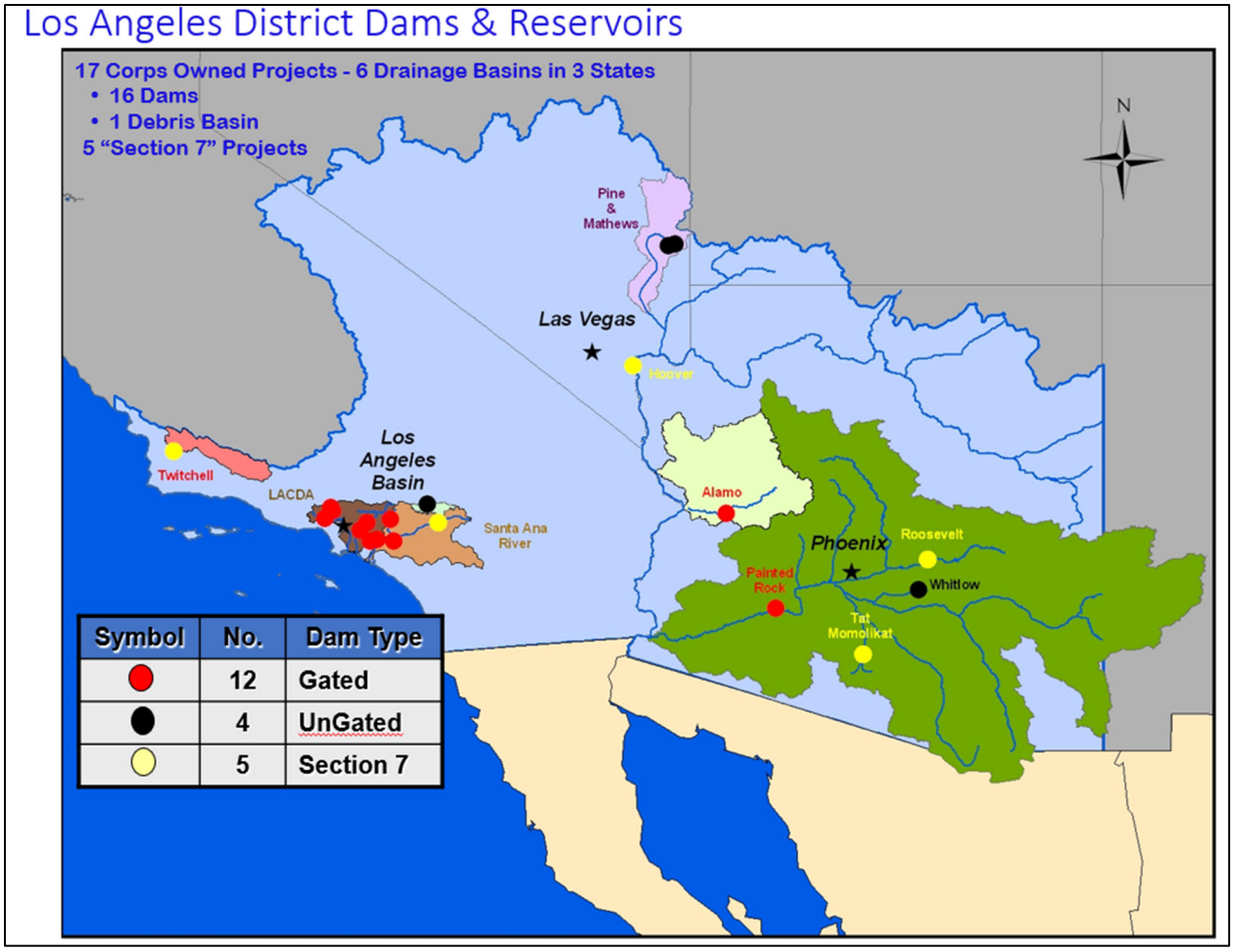


Figure 6. Los Angeles District project location map.

The LACDA watershed drains to the Los Angeles River or the San Gabriel River, terminating in the Pacific Ocean, and involves management of 7 dams (Figure 7). This region is a highly urbanized arid environment with infrequent high velocity flows. Because of the urban setting, there are high demands on the Corps facilities for water supply, flood protection, and recreation. Operational considerations include flood protection, high fire potential and related sediment and debris inflows at reservoirs. Most of these facilities are gated and flows can be controlled, however, waters are released to concrete channels with limited to no ecological communities (Figure 8).

The SPL currently does environmental and inventory work to document habitat biodiversity and endangered species presence/absence across LACDA projects, as well as invasive species management at Hanson Dam, and habitat enhancement and restoration at Whittier Narrows around the Nature Center. Most of the land within the reservoir is dry and leased to local governments and used for parks and recreation.

Figure 7. Overview of the Los Angeles County Drainage Area (LACDA) watershed and facilities.

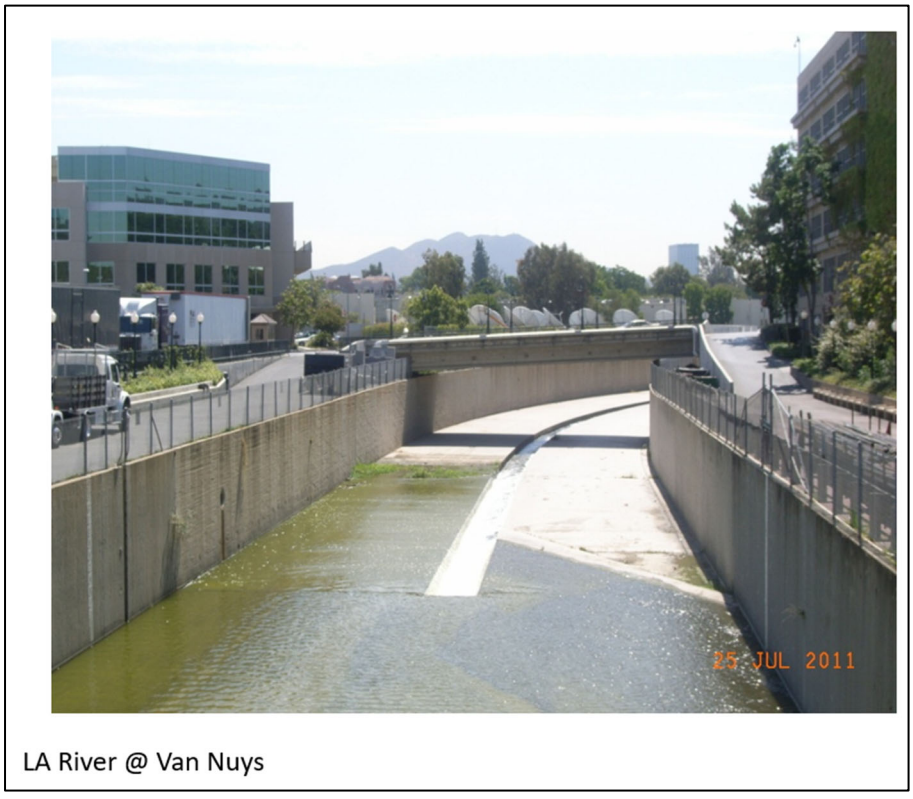


Figure 8. Channel of the Los Angeles River at Van Nuys (USACE photo).

The Santa Ana River watershed is characterized by a natural headwaters region in the San Bernadino Mountains that descends through the flatlands of Inland Empire and a highly urban region downstream of Prado Dam from Riverside County to Orange County. Prado Dam (Figure 9) was constructed to protect coastal Orange County from flooding. The SPL currently has extensive restoration activities in Prado Dam and along the Santa Ana River below Prado Dam. Within Prado Basin the Orange County Water Agency (OCWA) and Santa Ana Watershed Protection Agency (SAWPA) manages for endangered species, including the Least Bell's Vireo, Southwestern Willow Flycatcher, Arroyo Toad, Santa Ana River Sucker, and other state and federally listed species or species of concern. The SPL is a partner with OCWA and SAWPA in these activities. One Section 7 project, Seven Oaks Dam, is located in the headwaters of the river in the San Bernardino Mountains. Seven Oaks was constructed in 2000 and has only one authorized purpose of FRM. There is a current legal action affecting SPL and the current operations of Seven Oaks Dam.

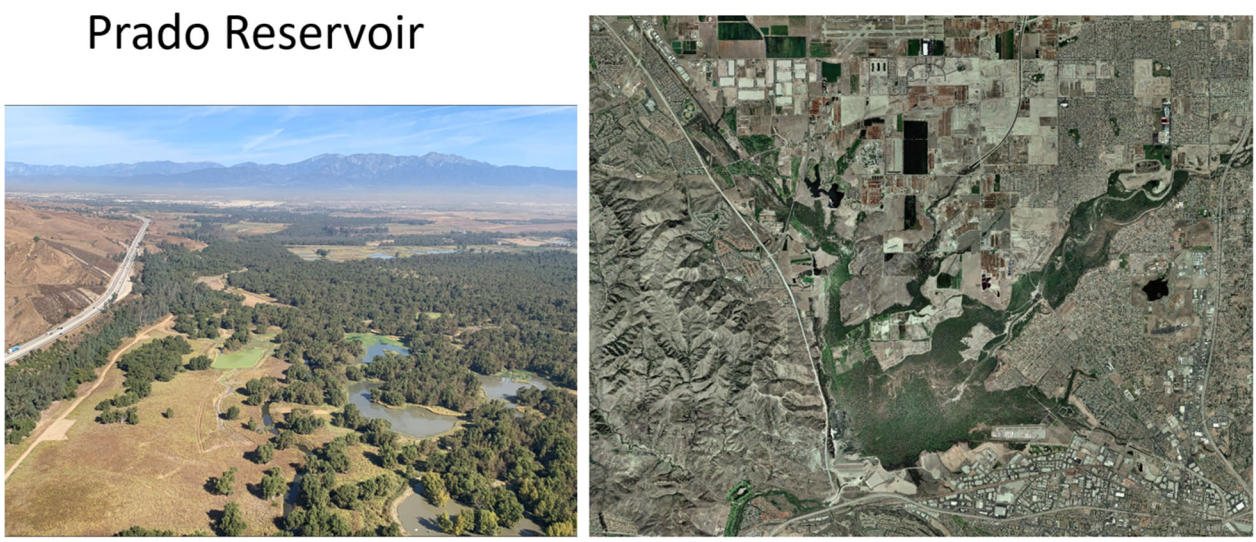


Figure 9. USACE photo and aerial map of Prado Reservoir.

The Bill Williams River watershed is located in western Arizona. River flows are managed by Alamo Dam, which is located on the mainstem Bill Williams, 30 miles upstream from its confluence with the Colorado River. The Bill Williams below Alamo is one of the last 'undisturbed' native habitats in the Lower Colorado River drainage. The watershed above Alamo (Figure 10) is mostly mountainous and undeveloped. Alamo is the only SPL project with a permanent impoundment. It is a popular fishing and recreation lake that was one of the original 8 SRP projects. There are many competing interests making operational decisions complicated. Releases are currently made for the benefit of downstream habitat, an authorized purpose added after construction of the dam.

Figure 10. Photo of the Alamo Dam and Lake (USACE photo).

The Gila River watershed is a 50,000 square miles drainage covering much of Arizona. Painted Rock (Figure 11) is the last reservoir before the Gila joins the Lower Colorado River. This project is dry nearly all the time but is also the only project that has ever spilled in SPL. The Salt River Project is a major water manager in the Phoenix vicinity. Project operations are solely for FRM except at Theodore Roosevelt Dam where there is an effort to allow capture of water that might encroach into the flood control space.

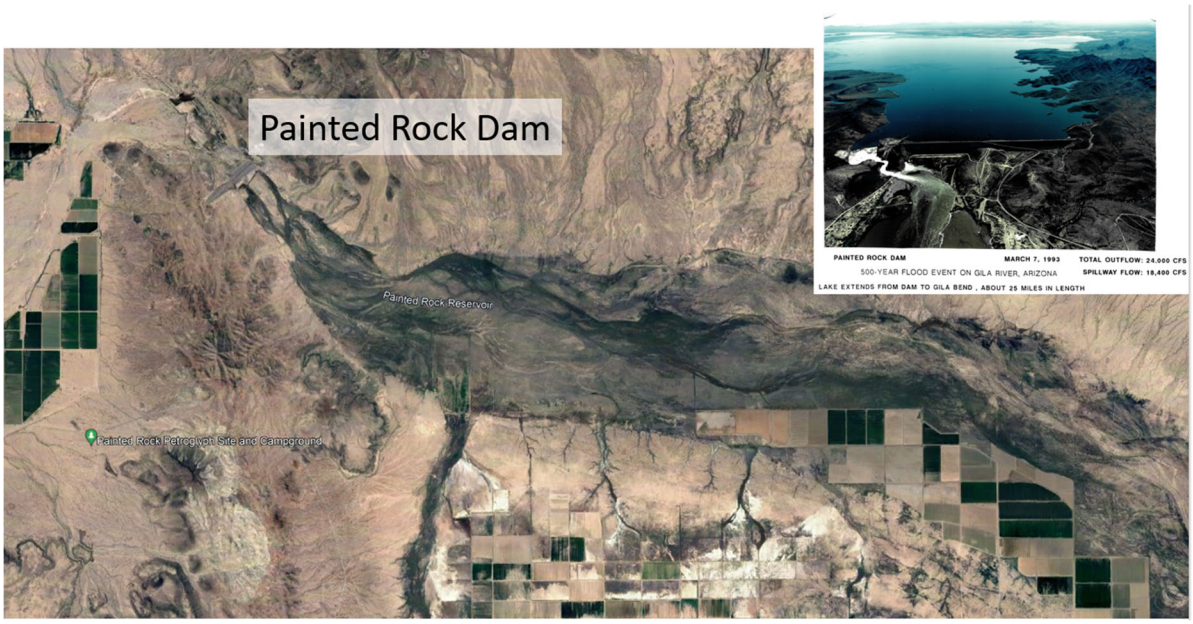


Figure 11. USACE photo and aerial imagery of Painted Rock Reservoir.

Mathews Canyon and Pine Canyon Dams (Figures 12 and 13) are remote, small ungated projects on Clover Creek. They exist to protect a major east-west rail line.

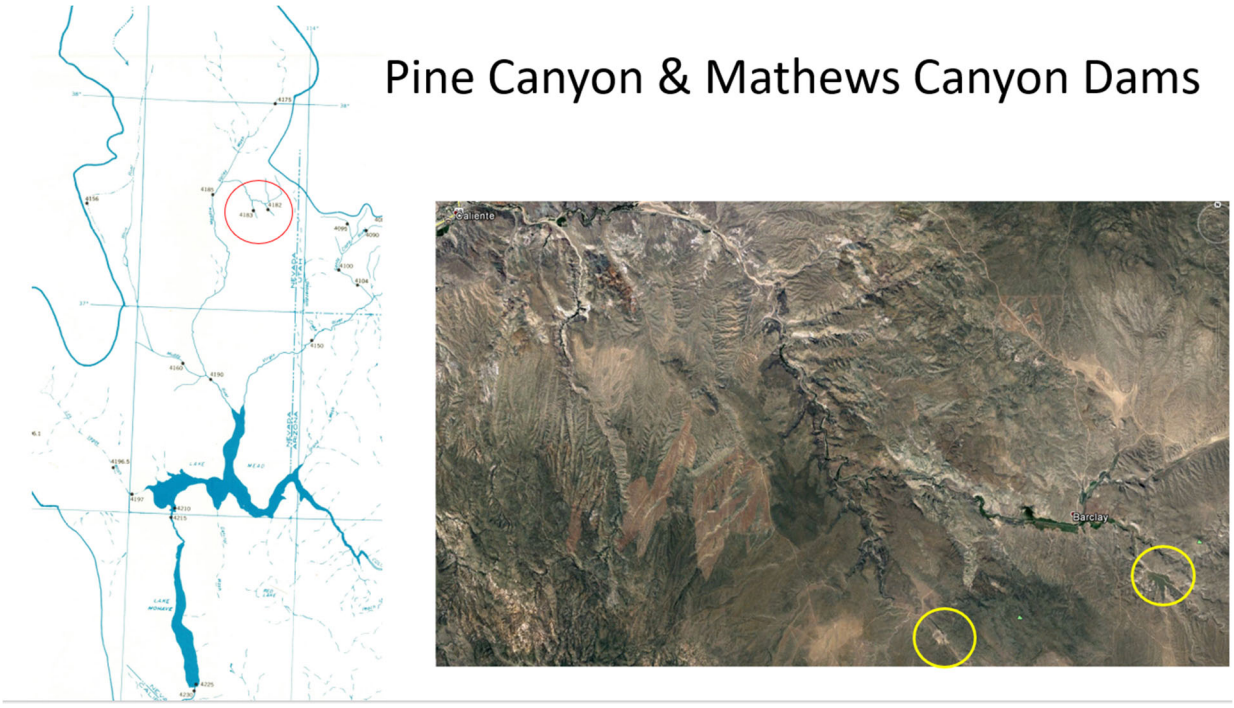


Figure 12. Aerial imagery and location map of the Pine Canyon and Mathews Canyon Dams.

Figure 13. Photos of Mathews Canyon Reservoir and Pine Canyon looking downstream (USACE photos).

Mojave River Dam (Figures 14 and 15) is an ungated dam protecting downstream communities. The river flows northward and terminates in the Mojave Desert.

Figure 14. Mojave River looking upstream at Mojave River Dam (USACE photo).

Figure 15. Mojave Dam outlet post-storm (upstream end of outlet; USACE photo).

Twitchell Dam (Figures 16 and 17) is a Bureau of Reclamation project primarily operated for water conservation that also contains flood control space. It is located above the Santa Maria River which drains to the Pacific Ocean.

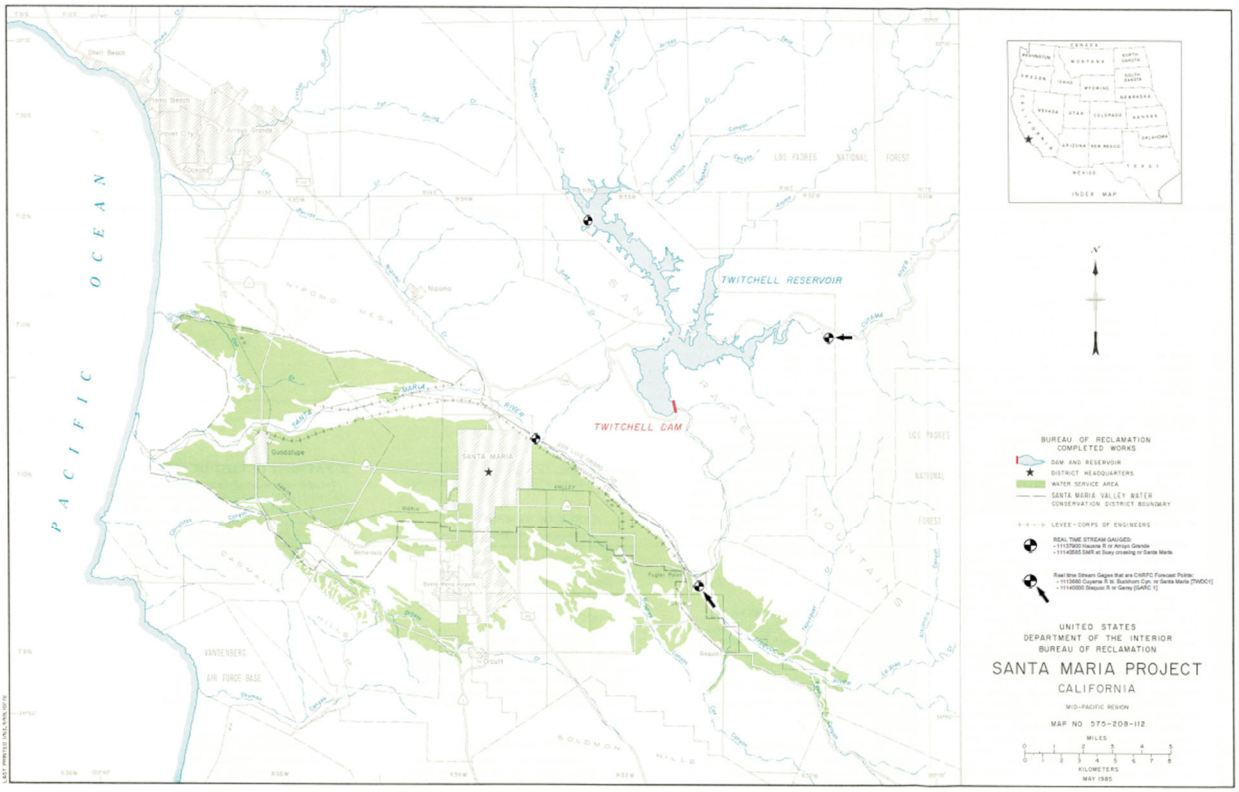


Figure 16. Location map of Twitchell Dam.

Figure 17. Twitchell Dam and Spillway (USACE photo).

Sacramento District (SPK)

Sacramento District owns and operates 18 water resource projects, which include 15 flood risk management projects and 3 navigation projects (Figure 18). These projects are operated and maintained by the District's Operations Division. These projects encompass 390 miles of shoreline, over 2.7 million acre-feet of water, 20,000 surface acres of water, 45,000 acres of land, management of 32 boat ramps, 100 miles of trails, 60-day use areas, and 35 campgrounds. The recreation areas serve over 4 million visitors annually with an economic benefit of over $133 million. The SPK is also responsible for inspecting and ensuring effective maintenance programs on 1,600 miles of locally maintained flood damage reduction levees and projects with 143 systems dispersed throughout the Great Central Valley of California, the Great Basin of Utah and Nevada, and the Upper Colorado River Basin.

Additionally, there are 31 Section 7 multiple-purpose water management projects for which SPK prescribes flood control operation rules. Sacramento District also supports San Francisco District's Water Management Section through data management of two multiple-purpose Corps owned and operated projects in the Russian River Basin and one multiple-purpose Section 7 project.

All of the SPK-owned projects are located in California and the Section 7 projects are located throughout California, Utah, and Colorado. The U.S. Bureau of Reclamation (USBR), with the exception of Little Dell and Mountain Dell Dams, owns all of the projects outside California. The Corps built Little Dell and the City and County of Salt Lake built Mountain Dell, with both being owned and operated by the City and County of Salt Lake.

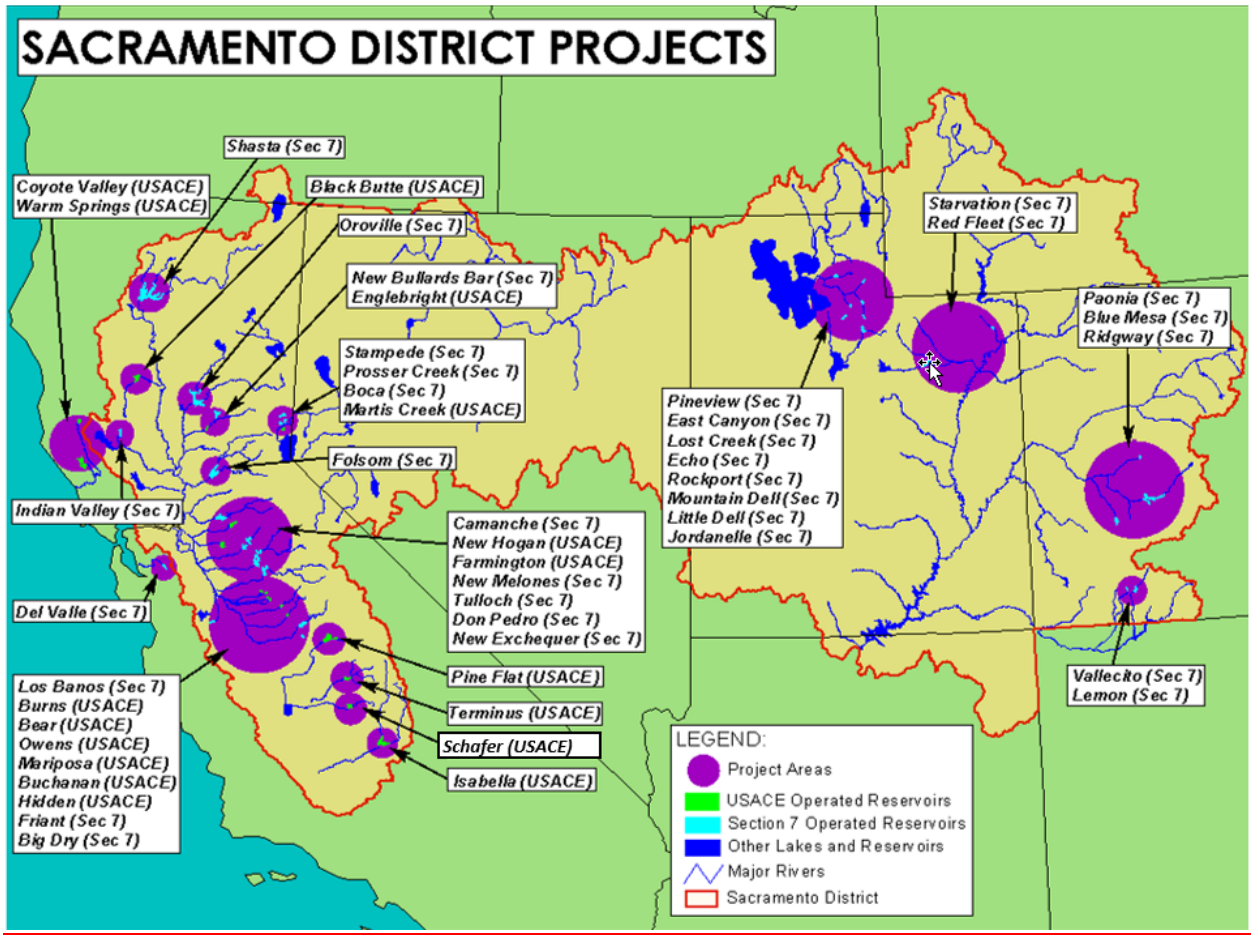


Figure 18. Sacramento District project location map.

San Francisco District (SPN)

There are three reservoirs within SPN's area of responsibility: Lake Mendocino, Lake Sonoma, and Lake Del Valle. Lake Mendocino and Lake Sonoma are located within the Russian River watershed within Mendocino and Sonoma Counties of California (Figure 1Figure 39). Both reservoirs are owned and operated by SPN and are authorized for water supply, flood risk management, and recreation. Lake Mendocino impounds water on the East Fork Russian River, a tributary to the Russian River. Lake Sonoma impounds water on Dry Creek, a tributary to the Russian River (Figure 20). Inflow to Lake Mendocino is from rainfall-runoff and a diversion of flows from the Eel River (north of the Russian River watershed) via the Potter Valley Project. Inflow to Lake Sonoma is only from rainfall-runoff.

The National Marine Fisheries Service (NMFS) issued a Biological Opinion for listed species on the Russian River in 2008. A new biological opinion is expected to be issued by NMFS in 2024. Resulting from a recommendation provided by the 2008 Biological Opinion, the district has partnered with the local non-federal sponsor to construct restoration measures in select reaches of Dry Creek downstream of Lake Sonoma.

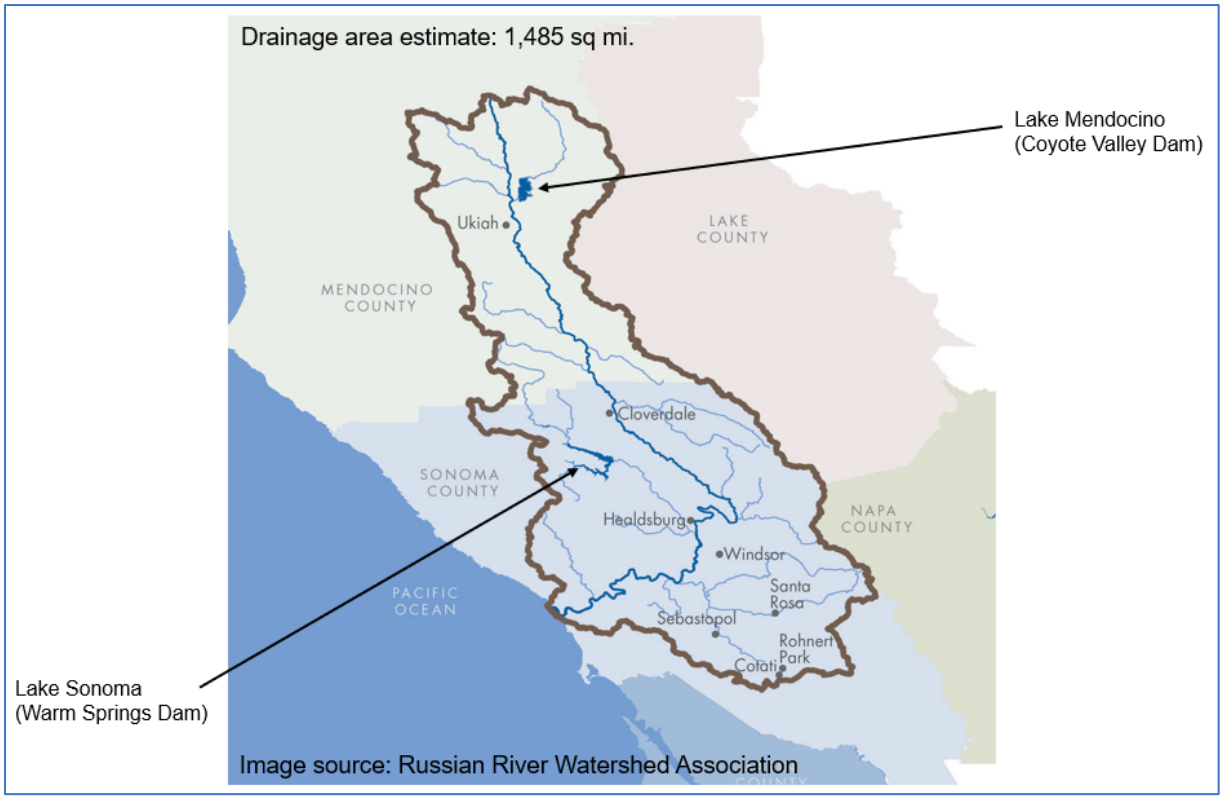


Figure 39. Location map of Russian River watershed.

The existing water control plans for both Lake Mendocino and Lake Sonoma require release decisions to be made based on water on the ground and not forecasted conditions. San Francisco District has been conducting research and development for Forecast Informed Reservoir Operations (FIRO) within the watershed since 2008. Real time implementation of FIRO has been occurring since 2019 via temporary deviations to the existing water control plans. The existing water control plans are in the process of being updated as part of the larger overall update to water control manuals in the present time with expected completion by 2026.

Figure 20. Photo of Lake Sonoma (photo by Patrick Sing, USACE).

Lake Del Valle is located within the Alameda Creek watershed within Alameda County of California. The reservoir is owned and operated by the California Department of Water Resources (DWR), but SPN has flood control responsibility per Section 7 of the Flood Control Act of 1944. The reservoir impounds water on Arroyo Valle, a tributary to Alameda Creek. Inflow to the reservoir is from rainfall-runoff and from a pipeline diversion that can be made by DWR's South Bay Aqueduct (Figure 21).

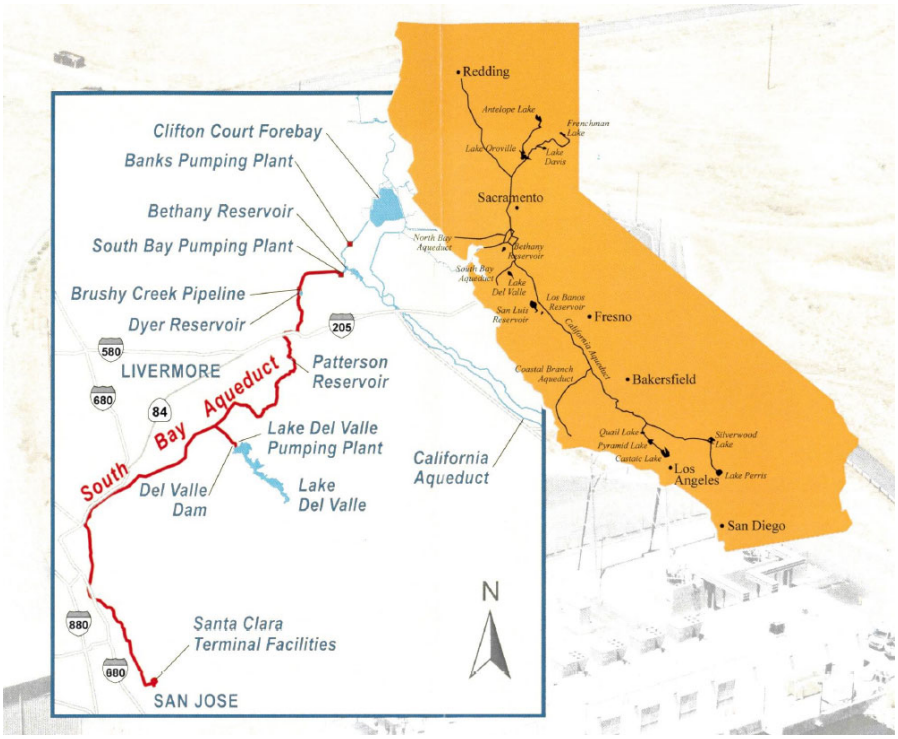


Figure 21. Map of South Bay Aqueduct connection to Lake Del Valle.

Environmental Opportunity Matrix and Ongoing Environmental Work

The Environmental Opportunity Matrix was initially developed for use in the Upper Midwest Regional Operations and Water Management meeting. Its intended use is to help identify priority environmental actions and opportunities effectively and comprehensively for the region. The matrix evolved through the subsequent South, Pacific Northwest, North Atlantic, South Atlantic, and now South Pacific regional meetings. Meeting participants were provided a copy of the matrix prior to the meeting and asked to review the list of potential environmental actions and objectives, particularly with a view toward adding any unlisted actions pertinent to Corps water resource infrastructure in the South Pacific region. At the end of the first plenary session, the matrix was reviewed again by the entire group.

During the first breakout session, each team was asked to use the matrix to consider environmental actions associated with Corps water resource infrastructure in their respective areas of responsibility. Each action was scored based on potential and implementation. Scores are per team; values reflect status for each team's entire portfolio of projects (per reservoir type).

Potential ("Pot.") is a measure of the degree to which an action is likely to produce benefits. Implementation ("Imp.") is a measure of how much of that potential has already been realized. Both measures are reported as either: 0 (none), 1 (low), 2 (moderate), or 3 (high). For potential, a "0" ranking is an activity that has no potential for providing environmental benefits even if it were implemented. For implementation, a "0" ranking means there has been no implementation. In interpreting the scoring, a "3-2" would be a very promising action with moderate fulfillment; a "1-3" would characterize an action with limited possibilities that has already been highly achieved. An implementation value less than 3 indicates that there are unrealized environmental benefits.

Table 4a addresses environmental opportunity at general reservoirs with multiple purpose storage while Table 4b addresses dry dam reservoirs. Green highlighting identifies actions selected by each team for consideration during the next breakout session.

Table 4a. Potential and implementation of environmental actions per location-based team (general reservoirs).

Potential (Pot.) is a measure of the degree to which an action is likely to produce benefits.
Implementation (Imp.) is a measure of how much of that potential has been realized.

Both measures are reported as either: 0 (none), 1 (low), 2 (medium), 3 (high), or not applicable (n.a.).
n.a. means that the office does not have the infrastructure (e.g. no dry dams)

Values are per office. In other words, measures of potential and implementation are reported for each office's entire portfolio of projects.

Denotes environmental flow actions and objectives--traditional focus of SRP
Denotes environmental actions selected by location-based teams for per project

Reservoir Project Types		Environmental Action/Objectives	SPA		SPL		SPK		SPN	
			Pot.	Imp.	Pot.	Imp.	Pot.	Imp.	Pot.	Imp.
General	In pool	Support - Water Level management for fisheries	2	1	2	3	2	1	0	0
		Support - Water level management for mussels	0	0	0	0	0	0	0	0
		Support - Water level management for overwinter biota	2	0	3	2	2	0	0	0
		Support - Water level management for vegetation (riparian)	2	0	3	0	0	0	0	0
		Support - Water level management for vegetation (wetlands)	2	0	1	1	1	0	1	0
		Support - Water level management for waterfowl	2	0	1	0	2	0	1	0
		Support - Water level management for shorebirds, gulls, other migrants	2	1	1	0	1	0	0	0
		Suppress - Level management for fisheries	0	0	2	0	1	0	0	0
		Suppress - Level management for mussels	1	0	1	0	1	2	0	0
		Suppress - Level management for overwinter biota	0	0	0	0	0	0	0	0
		Suppress - Level management for vegetation	1	0	3	0	0	0	0	0
		Suppress - Level management for waterfowl	0	0	0	0	0	0	0	0
		Suppress - Water level management for shorebirds, gulls, other migrants	0	0	0	0	0	0	0	0
		Pool rate of change management for bank integrity (WQ considerations)	0	0	2	2	0	0	1	0
		Water Quality - Pathogens	0	0	1	0	0	0	3	2
		Water Quality - Nutrients	0	0	1	0	1	0	0	0
		Water Quality - Temperature	0	0	1	0	0	0	3	2
		Water Quality - Management of harmful algal blooms	2	0	1	0	1	0	0	0
	Connect Up and Down	Manage distribution of depositing sediments (encourage sediment flux)	3	1	1	0	1	0	3	0
		Reallocations	3	1	1	1	1	0	1	0
		Sediment management - bed and bank	1	0	2	2	1	0	0	0
		Restrict passage of invasives	0	0	0	0	2	2	0	0
		Debris management	0	0	1	0	3	1	0	0
	Ecological flow targets	Geomorphic process support	3	1	3	2	1	0	1	0
		Floodplain connectivity	3	1	3	2	2	0	0	0
		Riparian management	3	1	3	2	2	0	0	0
		Wetland management	3	1	3	2	2	0	0	0
		Life stage support - Fisheries	3	1	3	2	2	2	3	2
		Life stage support - Benthics	1	0	3	2	1	0	3	0
		Life stage support - Mussels	0	0	0	0	1	0	3	0
		Life stage support - Waterfowl	0	0	3	2	1	0	0	0
		Life stage support - Shorebirds, Gulls, other migrants	2	1	3	2	1	0	0	0
		Life stage support - Herps	1	0	3	2	1	0	1	0
	Downstream	Rate of change management for bank integrity (WQ considerations)	2	1	0	0	0	0	3	1
		Physical habitat creation (use of dredged material, oxbows/floodplain restoration)	2	2	3	0	1	0	0	0
		Recreation	1	1	2	2	1	0	1	0
		Water Quality - Dissolved Gas (management of gas bubble trauma)	0	0	1	0	0	0	0	0
		Water Quality - Nutrients	0	0	1	0	0	0	0	0
		Water Quality - Temperature	0	0	1	0	1	0	3	2
		Water Quality - Turbidity	0	0	1	0	0	0	3	0

Table 4b. Potential and implementation of environmental actions per location-based team (dry dams).

Potential (Pot.) is a measure of the degree to which an action is likely to produce benefits.
Implementation (Imp.) is a measure of how much of that potential has been realized.

Both measures are reported as either: 0 (none), 1 (low), 2 (medium), 3 (high), or not applicable (n.a.).
n.a. means that the office does not have the infrastructure (e.g. no dry dams)

Values are per office. In other words, measures of potential and implementation are reported for each office's entire portfolio of projects.

Denotes environmental actions selected by location-based teams for per project consideration

Reservoir Project Types		Environmental Action/Objectives	SPA		SPL		SPK		SPN	
			Pot.	Imp.	Pot.	Imp.	Pot.	Imp.	Pot.	Imp.
Dry Dams	In Pool	Physical habitat - Subimpoundment creation or restoration (ponds work)	3	1	3	0	1	0	n.a.	n.a.
		Physical habitat - Riffle creation or restoration (stream work)	2	0	3	0	1	0	n.a.	n.a.
		Physical habitat - Permanent wetland creation (water quality / habitat improvements	1	0	3	0	0	0	n.a.	n.a.
		Physical habitat - Seasonal wetland creation (vernal pools / seasonal wetlands)	2	1	3	0	2	0	n.a.	n.a.
		Invasive species control - native plant establishments	3	1	3	1	0	0	n.a.	n.a.
		Support - Water level management for amphibians	1	0	3	0	2	0	n.a.	n.a.
		Support - Water level management for fisheries	0	0	3	0	0	0	n.a.	n.a.
		Support - Water level management for water birds	1	0	3	0	2	0	n.a.	n.a.
		Support - Water level management for vegetation	1	0	3	0	1	0	n.a.	n.a.
		Suppress - Water level management for vegetation	0	0	0	0	0	0	n.a.	n.a.
		Recreation	1	0	3	1	1	1	n.a.	n.a.
	Connect Up and Down	Upstream sediment management partnerships	1	0	3	0	1	0	n.a.	n.a.
		Manage distribution of depositing sediments	2	1	3	1	1	0	n.a.	n.a.
		Sediment management - bed and banks	2	0	3	0	1	0	n.a.	n.a.
		Debris management	1	0	3	1	2	0	n.a.	n.a.
		Fish Passage	1	0	1	0	0	0	n.a.	n.a.
		Groundwater recharge for downstream ecological benefits	2	0	3	2	1	0	n.a.	n.a.
	Downstream	Riparian management for habitat conditions	2	0	2	1	1	0	n.a.	n.a.
		Subimpoundment creation or restoration (ponds work)	1	0	2	1	0	0	n.a.	n.a.
		Riffle creation or restoration (stream work)	0	0	2	0	1	0	n.a.	n.a.
		Permanent wetland creation - water quality / habitat improvements	0	0	2	0	0	0	n.a.	n.a.
		Seasonal wetland creation - vernal pools / seasonal wetlands	1	0	2	0	1	0	n.a.	n.a.
		Ecological flow targets (especially herps and vegetation)	2	0	2	0	0	0	n.a.	n.a.
		Water quality for ecological purposes	0	0	2	0	0	0	n.a.	n.a.
		Ecological flow targets (fish and vegetation)*	-	-	3	1	-	-	n.a.	n.a.

* Added and considered by SPL

Illustration of Reservoir Review

As background and information for the next focus session, a national review of environmental flow potential for reservoirs was presented. The review involved three questions, with each culminating in rankings of all 465 reservoirs with federally authorized flood space. The three questions were: 1) how influential could the reservoir be, 2) in terms of hydrologic alteration, what is the reservoir actually doing, and 3) what is the reservoir able to do? Each of these questions involved a different assessment. All were designed to sort the whole portfolio of reservoirs according to their relative promise as a candidate for environmental flow operations.

Two reservoirs, Two Rivers Dam in Albuquerque District and Whittier Narrows Dam in Los Angeles District, were unusual in that each regulated two streams, had separate dams capable of releasing water to those streams, and had impoundments that merged into a single water body at high water levels. Two Rivers and Whittier Narrows are dry dams.

The "potential to influence" investigation involved a GIS exercise based on the storage volume of each reservoir and its corresponding mean annual flow at the dam and at points placed along the stream network below the dam. A value of storage divided by mean annual flow was computed at each point. Computed values decreased with distance from dam because the corresponding watershed area and

associated mean annual flows increased. Computed values were multiplied by corresponding river reach lengths and summed for the full flow path, from dam to receiving lentic water body. Summed values were then sorted, ranked, and categorized as high, middle, and lower thirds within the region for display purposes (Figure 22). The total number of reservoirs in the "potential to influence" investigation for South Pacific Region was 84 (81 plus Two Rivers with Rocky and Diamond A dams treated as one, Whittier Narrows to San Gabriel River, and Whittier Narrows to Rio Hondo).

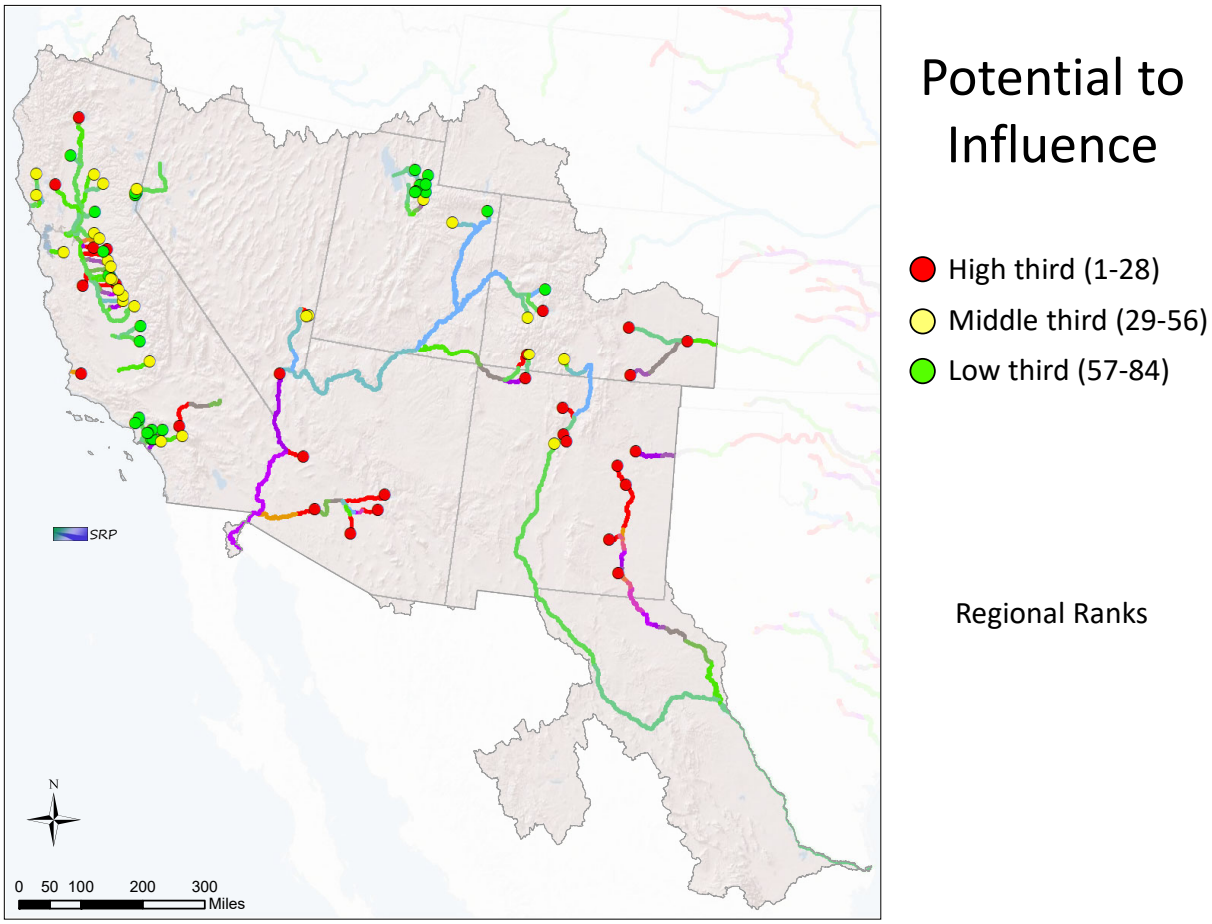


Figure 22. Results of the potential to influence assessment for the South Pacific region. Categories are based on regional rankings.

The "hydrologic alteration" assessment involved a statistical comparison of reservoir inflows and outflows. Differences in low flows, high flows, monthly volumes, and variability were all computed, expressed as a scale between 0 and 10 and then summed for the four metrics. The resulting sums were sorted, ranked, and categorized as high, middle, and lower thirds for display purposes (Figure 23). The total number of reservoirs in the "hydrologic alteration" investigation for South Pacific Region was 83 (81 plus Two Rivers - Rocky Dam, Two Rivers - Diamond A Dam, Whittier Narrows to San Gabriel River, and Whittier Narrows to Rio Hondo and minus Seven Oaks Dam and Twitchell Dam due to missing data).

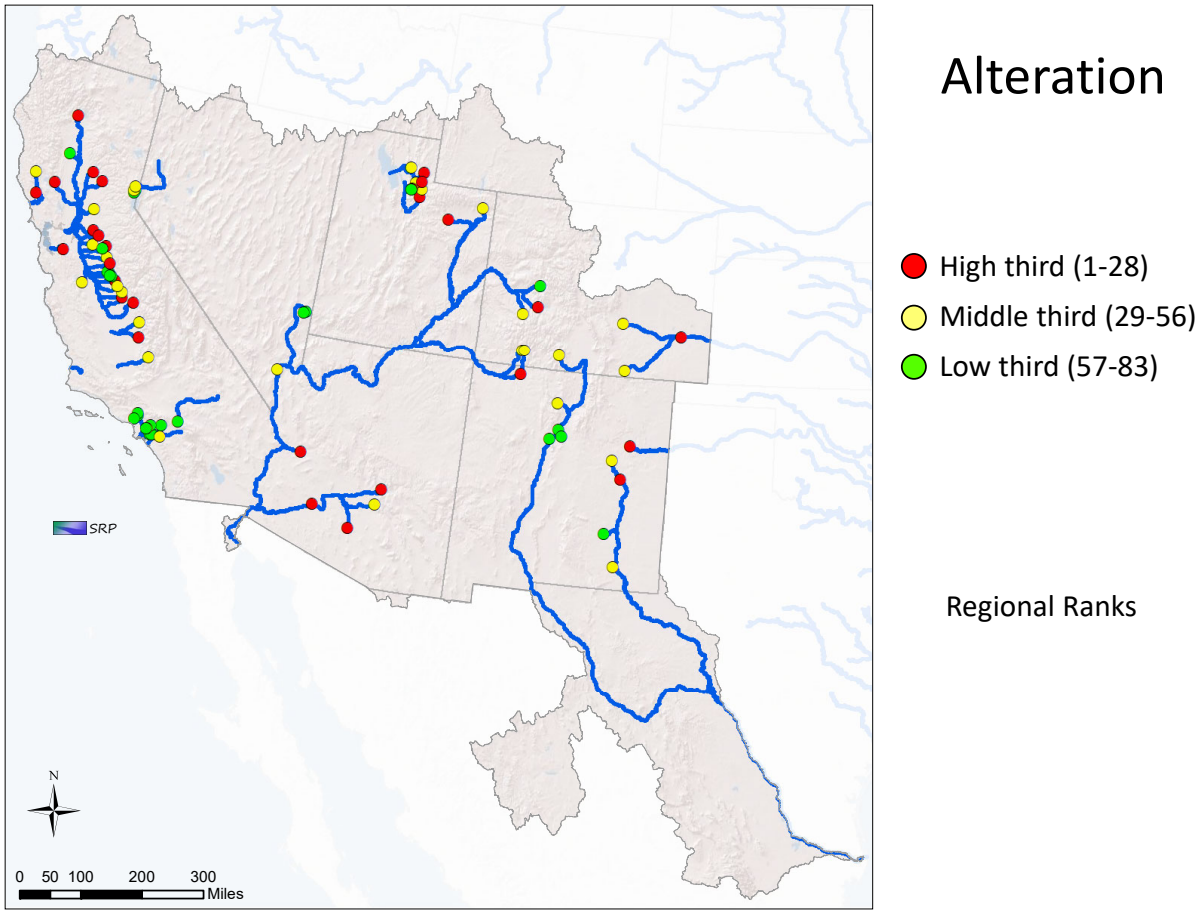


Figure 23. Results of the hydrologic alteration assessment for the South Pacific Region. Categories are based on regional rankings.

The "characteristics" assessment considered each reservoir's authorities, operational flexibility, temperature management, fish passage, and channel condition. Reservoirs with federally authorized flood space have an average of 4 and as many as 8 authorized purposes per reservoir. Each authority accrued points for the reservoir (fish and wildlife +5, water quality +2.5, recreation +2.5, and all others -2 each). The total of the points was used as the score for the authorities portion of the assessment. Operational flexibility was estimated by computing the percentage of each reservoirs outflow that occurred between 0 and 20% of flood space encroached and then placing the percentage for each reservoir on a 0 to 10 scale. A reservoir's ability to manage outflow temperatures was scored on a scale from 0 to 10 with 0 being no ability, 5 being limited ability, and 10 being able to operate for water temperature with no expressed limitations. A reservoir's ability to pass fish was scored on a scale from 0 to 10 based on reported effectiveness, with 10 being free passage. Channel condition involved a comparison of a reservoir's objective flow (high flow limit) and its maximum non-damaging flow. When objective flow was equal to the maximum non-damaging flow a score of 0 was assigned. When objective flow was less than the maximum non-damaging flow the percent difference between the two values increased to a maximum of 10 when maximum non-damaging flow doubled the objective flow (differences greater than double were capped at a score of 10). When objective flow was greater than

the maximum non-damaging flow the percent difference between the two values decreased to 0 as the maximum non-damaging flow decreased to 0. Scores for each of the five metrics were summed. Scores for the authorities and operational flexibility metrics were judged to be more important than the other metrics and given two shares each (added twice). The resulting sums were sorted, ranked, and categorized as high, middle, and lower thirds for display purposes (Figure 24). The total number of reservoirs in the "characteristics" investigation for South Pacific Region was 85 (81 plus Whittier Narrows to San Gabriel River, Whittier Narrows to Rio Hondo, Two Rivers - Rocky Dam, and Two Rivers - Diamond A Dam).

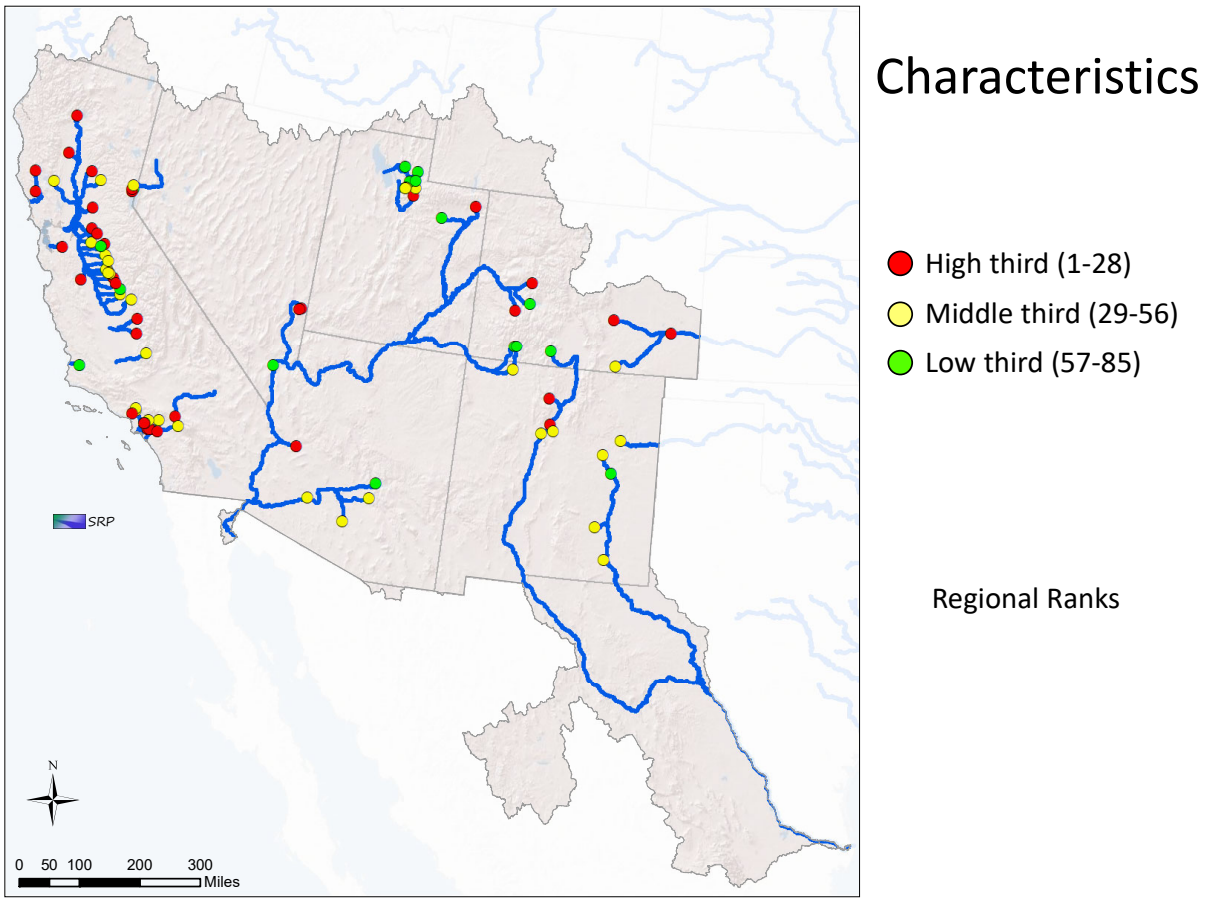


Figure 24. Results of the characteristics assessment for the South Pacific region. Categories are based on regional rankings.

Prioritization of Reservoirs

Location-based teams were provided with information from the national review of environmental flow potential and tasked with prioritizing infrastructure within their area of responsibility. Each team selected 3 to 7 environmental actions from Tables 4a and 4b, including "General (Reservoirs) – Downstream – Environmental flows (e-flows)", which was required. Other environmental actions were selected by the teams that have unrealized environmental benefits or were of importance to note.

Teams were tasked with prioritizing reservoirs within their area of responsibility for each selected environmental action. Results for each team are detailed below. Green highlighting shows the priority actionable ideas that are summarized in Table 1.

Albuquerque District (SPA)

The following environmental actions were selected for prioritization:

1. Manage distribution of depositing sediments (encourage sediment flux) (general, connect up and down)
2. Reallocations (general, connect up and down)
3. Ecological flow targets (general, downstream)
4. Physical habitat - Subimpoundment creation or restoration (dry dams, in pool)
5. Invasive species control - native plant establishments (dry dams, in pool)

Reservoirs were prioritized for each of these actions based on a combination of restoration need and potential ecological benefit. Actionable ideas that were deemed to have the most potential are highlighted in green (Table 5).

Table 5. Reservoir prioritization for SPA. Green highlighting indicates actionable ideas. Bold indicates ideas described in the "Actionable Ideas and Discussion" section.

Project name	Manage distribution of depositing sediments (encourage sediment flux) (General) (Pot. 3; Imp. 1)	Reallocations (General) (Pot. 3; Imp. 1)	Ecological flow targets (General) (Pot. 3; Imp. 1)	Physical habitat - Subimpoundment creation or restoration (Dry Dams) (Pot. 3; Imp. 1)	Invasive species control - native plant establishments (Dry Dams) (Pot. 3; Imp. 1)
Abiquiu Dam	4	**2**	2		
Cochiti Dam	2	1	1		
Conchas Dam	9	10	11		
Galisteo Dam	7	14	14	**2**	2
Jemez Canyon Dam	**1**	11	6	**1**	1
John Martin Dam	3	4	5		
Santa Rosa Dam	5	**3**	3		
Trinidad Dam	8	5	4		
Two Rivers Diamond A Dam	6	12	7	3	3
Platoro Dam (USBR)	13	9	12		
Pueblo Dam and Reservoir (USBR)	12	8	13		
Brantley Dam and Reservoir (USBR)	10	7	9		
Sumner Dam and Reservoir (USBR)	11	6	8		
Navajo Dam (USBR)	14	13	10		

Los Angeles District (SPL)

The following environmental actions were selected for prioritization:

1. Invasive species control - native plant establishments (dry dams, in pool)
2. Support - Water level management for amphibians (dry dams, in pool)
3. Groundwater recharge for downstream ecological benefits (dry dams, connect up and down)
4. Ecological flow targets (fish and vegetation) (dry dams, downstream)

Each of the environmental actions were prioritized for each of the flood control dams listed in Table 6 below, however some of these actions were considered not applicable. The connect up and downstream for groundwater recharge for ecological benefits was considered to have a high benefit potential for many SPL dams due to the amount of retention pond infrastructure that is owned and operated by local agencies such as Los Angeles County Department of Public Works and Orange County Water District. Though this environmental action has a medium implementation, there is more opportunity to increase collaboration with these agencies through operational changes that could also assist with realizing benefits for in pool support for amphibians at the dams (identified below), which currently have none of those benefits realized. Reservoirs were prioritized for each of these actions based on a combination of restoration need and potential ecological benefit (Table 6). SPL only ranked the highest potential candidates for each action.

Table 6. Reservoir prioritization for SPL. Green highlighting indicates actionable items.

	Environmental Opportunities			
Project name	**Invasive species control - native plant establishments (Dry Dams) (Pot. 3; Imp. 1)**	**Support - Water level management for amphibians (Dry Dams) (Pot. 3; Imp. 0)**	**Connect Up and Down - Groundwater recharge for downstream ecological benefits (Dry Dams) (Pot. 3; Imp. 1)**	**Downstream - Ecological flow targets (fish and vegetation) (Dry Dams) (Pot. 3; Imp. 1)**
Alamo Dam		6		2
Brea Dam				
Carbon Canyon Dam				
Fullerton Dam				
Hansen Dam	2	3	3	
Lopez Dam			9	
Mathews Canyon Dam				
Mojave River Dam		1		4
Painted Rock Dam				
Pine Canyon Dam				
Prado Dam	3	2	1	
Salinas Dam				
San Antonio Dam			7	
Santa Fe Dam	1	4	2	
Sepulveda Dam				
Whitlow Ranch Dam				
Whittier Narrows Dam	4	5	4	
Tat Momolikat				
Seven Oaks Dam			5	1
Hoover Dam				
Modified Roosevelt Dam			6	
Twitchell Dam			8	3

Sacramento (SPK)

The following environmental actions were selected for prioritization:

1. Management of fisheries (general, in pool)
2. E-flow targets - floodplain, riparian, wetland, fisheries (general, downstream)
3. Debris management (general and dry dams, connect up and down)
4. Seasonal wetland for amphibians and birds (dry dams, in pool)

Reservoirs were prioritized for each of these actions based on a combination of restoration need and potential ecological benefit (Table 7).

Table 7. Reservoir prioritization for SPK. Green highlighting indicates actionable ideas.

	Environmental Opportunites			
Project name	**Management of Fisheries - In Pool (General) (Pot. 2; Imp. 1)**	**Eflow targets - floodplain, riparian, wetland, fisheries (General) (Pot. 2; Imp. 1)**	**Debris Management (General and Dry Dams) (Pot. 3; Imp. 1)**	**Seasonal wetland for amphibians and birds (Dry Dams) (Pot. 2; Imp. 0)**
Richard L. Schafer Dam	1	4	2	
New Hogan Dam	2	2	8	
Buchanan Dam	3	7	6	
Black Butte Dam	4	1	5	
Pine Flat Dam	5	5	4	
Terminus Dam	6	6	3	
Hidden Dam	7	8	7	
Isabella Dam	8	3	9	
Martis Creek Dam	9	9	16	
Bear Dam			14	5
Burns Dam			13	4
Farmington Dam			10	1
Harry L. Englebright Dam			1	
Mariposa Dam			11	2
North Fork Dam			15	
Owens Dam			12	3
New Bullards Bar Dam	6	8	1	
Shasta Dam	1	10	2	
Oroville Dam	3	9	3	
Friant Dam	7	1	4	
New Exchequer Dam	10	2	5	
New Melones Dam	2	3	6	
Camanche Dam	4	4	7	
Folsom Dam	9	7	8	
Don Pedro Dam	5	5	9	
Tulloch Dam	8	6	10	
Indian Valley Dam	11	11	11	
Los Banos Dam	12	12	12	
Prosser Dam	13	13	13	
Boca Dam	14	14	14	
Stampede Dam	15	15	15	
Ridgway Dam	16	16	16	
Vallecito Dam	17	17	17	
Lemon Dam	18	18	18	
Blue Mesa Dam	19	19	19	
Paonia Dam	20	20	20	
Jordanelle Dam	21	21	21	
Starvation Dam	22	22	22	
Red Fleet Dam	23	23	23	
Pineview Dam	25	25	25	
Echo Dam	26	26	26	
East Canyon Dam	27	27	27	
Wanship Dam	28	28	28	
Lost Creek Dam	29	29	29	
Mountain Dell Dam	30	30	30	
Little Dell Dam	31	31	31	
Big Dry Creek Dam			32	6

San Francisco District (SPN)

The following environmental actions were selected for prioritization:

1. Water quality - Temperature (general, in pool)
2. Water quality - Turbidity (general, downstream)
3. Life stage support – Fisheries (general, downstream)
4. Rate of change management for bank integrity (WQ considerations) (general, downstream)

Reservoirs were prioritized for each of these actions based on a combination of restoration need and potential ecological benefit (Table 8).

Table 8. Reservoir prioritization for SPN. Green highlighting indicates actionable ideas.

	Environmental Opportunities			
Project name	**Water Quality - Temperature (General) (Pot. 3; Imp. 2)**	**Water Quality - Turbidity (General) (Pot. 3; Imp. 0)**	**Life stage support - Fisheries (General) (Pot. 3; Imp. 2)**	**Rate of change management for bank integrity (WQ considerations) (General) (Pot. 3; Imp. 1)**
Coyote Valley Dam	2	1	1	2
Warm Springs Dam	1	2	2	1
Del Valle Dam	3	3	3	3

Trends in infrastructure management and in environmental opportunities

South Pacific Division (SPD) delivers watershed-based, resilient solutions integrating design and operational innovations as well as nature-based features to reduce the risk of riverine and coastal flood damage, provide recreation opportunities, and perform environmental stewardship in 10 western states. The SPD portfolio consists of 57 inland structures at 46 dams, 2,521 miles of levees, and 36 miles of coastal structures. SPD also hosts an Engineering with Nature Proving Ground. SPD rigorously pursues optimization of benefits from existing federal infrastructure, of which SRP is a welcome opportunity.

SPD has many opportunities to integrate environmental opportunities into water operations at its reservoirs, which could result in significant environmental benefits to species and the overall ecology at the local and regional scale. Operational changes providing e-flows at specific times of the year can increase water velocities and reduce water temperatures which can improve downstream habitat for native fishes, many of which are protected under the Endangered Species Act. Opportunities to improve channel geomorphology and riparian habitat can also improve habitat for native fishes and riparian wildlife.

SPD is leading the way in FIRO with one completed pilot study (Lake Mendocino) and four additional, ongoing pilots (Lake Sonoma in the Russian River Basin, Prado Dam and Seven Oaks Dam in the Santa

Ana River Basin, and New Bullards Bar and Oroville Dams in the Yuba-Feather River Basin). FIRO works by integrating weather and water forecasts into reservoir operations planning and decision-making. This allows water managers to anticipate and respond to changing conditions more effectively. The benefits of FIRO are additional water resources to be available for both water supply and environmental enhancement.

SPD is currently engaged in updating all project water control manuals and drought contingency plans. Water control manual updates are required to comply with environmental regulations but can also contribute to environmental enhancement. Districts should review Engineer Regulation 1110-2-240, particularly related to stakeholder communication and participating in the water control manual update process. Updating water control manuals provides an opportunity for districts to engage resource agencies, tribes, and other stakeholders to identify opportunities to leverage environmental opportunities through operational changes and, where applicable, Engineering with Nature.

Actionable Ideas and Discussion

In the final breakout session, teams reconvened to further refine their prioritization of reservoirs. Each location-based team identified actionable ideas. An actionable idea is the pairing of a selected **Environmental action** and **Reservoir(s)** deemed to be compelling in accordance with potential environmental benefits and feasible to implement. This section details actionable ideas for each team.

Albuquerque District (SPA)

The SPA team identified 12 actionable ideas (Table 5, green highlighting). This section details 5 of those 12 actionable ideas (Table 5, green highlighting, bold) noted by the team as highest priority (most immediately feasible) and not otherwise being conducted or considered by an ongoing study.

Manage distribution of depositing sediments (encourage sediment flux) was scored as "Pot. 3; Imp. 1". The Middle Rio Grande has been impacted by a reduction in sediment flux due to upstream reservoirs. **Jemez Canyon Dam** is located on a tributary to the Rio Grande and is currently operated as a dry dam. Opportunities exist to mobilize sediments (mechanically or through water operations) in the reservoir pool and pass downstream into the Rio Grande and enhance habitat.

Reallocations was scored as "Pot. 3; Imp. 1". There are limited opportunities district-wide to reallocate space within existing authority. However, there are opportunities that would allow more flexibility for water users to consider environmental flow opportunities. Section 337 of WRDA 2020 allows for concurrent storage of USBR San Juan-Chama Project water (imported from the Colorado Basin) and Rio Grande system water. This allows more flexibility for water users to move water from upstream reservoirs for environmental and recreation purposes, in particular in the Wild and Scenic portion of the Rio Chama between Reclamation owned El Vado Reservoir downstream to **Abiquiu Reservoir**.

There is currently no minimum pool in **Santa Rosa Lake** and the reservoir can be drawn down to essentially zero storage at the request of Carlsbad Irrigation District. This has extremely detrimental impacts on the lake's fisheries, surface recreations, and water quality. As the volume and level is dropped, the lake becomes more susceptible to algal blooms.

Creation of a minimum pool could be a complementary action with the creation of the environment pool created through reallocation of existing storage. This action would likely require a congressional reauthorization. A source of water would have to be identified, and funding would likely be needed to acquire the water to maintain the minimum pool.

Ecological flow targets was scored as "Pot. 3; Imp. 1". There are limited opportunities district-wide to manage water for ecological flow targets within existing authority. Outside of flood risk management operations, all storage and release decisions are made by the respective water users. However, there are opportunities to inform water management decisions for ecological flow targets, in particular downstream of **Santa Rosa Reservoir**.

In FY22, SPA launched a Pecos River SRP project. Representatives from irrigation districts and multiple state and federal agencies, including the U.S. Fish and Wildlife Service (USFWS) and USBR, are working together to assess opportunities for new flow patterns. The Pecos runs through New Mexico and Texas to the Rio Grande. The Corps manages the **Santa Rosa Dam** in the headwaters of the river; USBR manages two downstream dams, Sumner and Brantley. Although the Pecos River is an arid western river, SPA's vision is to return some of the natural seasonal variability to the river. Sensitivities around water rights and allocations to irrigation districts will supersede environmental flows, but with science-supported considerations based on SRP recommendations, there is greater likelihood of finding options to improve hydrology through variations in dam operations.

An SRP Pecos literature review and state of the science report were completed in early 2022. In July 2022, Albuquerque District hosted a two-day virtual ecological flows workshop that examined opportunities for coordinated ecological flow releases at **Santa Rosa**, Sumner, and Brantley dams. Representatives from Irrigation Districts joined the Corps and TNC at the workshop. SPA is in the process of completing an environmental flows workshop report. Opportunities include environmental flow releases from **Santa Rosa Dam**, working with irrigation districts and federal and state resource agencies. SPA is looking to see if there are opportunities to manage block releases in ways that could benefit the entire system of stakeholders. Next steps include designing and implementing a monitoring program and testing and implementing new ecological flow releases when conditions permit.

Physical habitat - Subimpoundment creation or restoration (dry dams) was scored as "Pot. 3; Imp. 1". The Corps owns and operates three dry dams in SPA. There are opportunities to create and enhance habitat within the reservoir pools of these dry dams. **Galisteo Dam** is located approximately 20 miles southwest of Santa Fe in the high desert of New Mexico on Galisteo Creek, a tributary of the Rio Grande. There are opportunities to restore native species habitat upstream by planning and implementing physical modifications to the streambed and riparian areas that are part of the Galisteo reservoir pool. Specifically, these efforts could reestablish native riparian vegetation, remove non-native Saltcedar, and enhance wetlands and amphibian habitat by contouring land to better support inundation.

Los Angeles District (SPL)

The SPL team identified 4 actionable ideas (Table 6, green highlighting).

Invasive species control - native plant establishment (dry dams, in pool) was scored as "Pot. 3; Imp. 1". A recent survey found approximately 3.5 acres of the non-native, highly invasive Saltcedar (*Tamarix sp.*,

Figures 25 and 26) within the upstream basin of the **Santa Fe Dam**. Saltcedar is associated with dramatic changes in geomorphology, groundwater availability, soil chemistry, fire frequency, plant community composition, and native wildlife diversity. The areas of highest density of Saltcedar infestation are found where the San Gabriel River meets the Dam inlet apron in the upstream basin.

Figure 25. Photo of Saltcedar infestation at Santa Fe Dam (USACE photo).

Figure 26. Photo of Saltcedar infestation at Santa Fe Dam (USACE Photo).

Support - Water level management for amphibians (dry dams, in pool) was scored as "Pot. 3; Imp. 0". **Mojave River Dam** is an ungated dam located at the confluence of the Deep Creek and West Fork Mojave Rivers. Lands immediately upstream and downstream of the dam are classified as environmentally sensitive and support at least three federal listed species and designated critical habitat for the endangered Arroyo Toad and Southwestern Willow Flycatcher within the riparian corridor. Throughout the year, the dam receives upstream releases of water from the California State Water Project for the purpose of groundwater recharge (water conservation) with no consideration to the effects of these pulses on species, such as the Arroyo Toad (Figures 27 and 28), during peak breeding season, which generally occurs from May to July. Because these upstream releases of water are not coordinated with Corps operation and maintenance (O&M) activities, they have, at times, hindered the Corps' ability to perform needed repairs and maintenance within the channel. To date SPL, the State Water Project, the Mojave Water Agency, the Lahontan Regional Water Quality Control Board, USFWS and other stakeholders have not met to explore flexibilities that may exist within the State Water Project current release schedule that could improve environmental flows to better support Arroyo Toad breeding, nor for coordination of O&M activities within the channel.

Figure 27. Photo of Arroyo Toad (USACE photo).

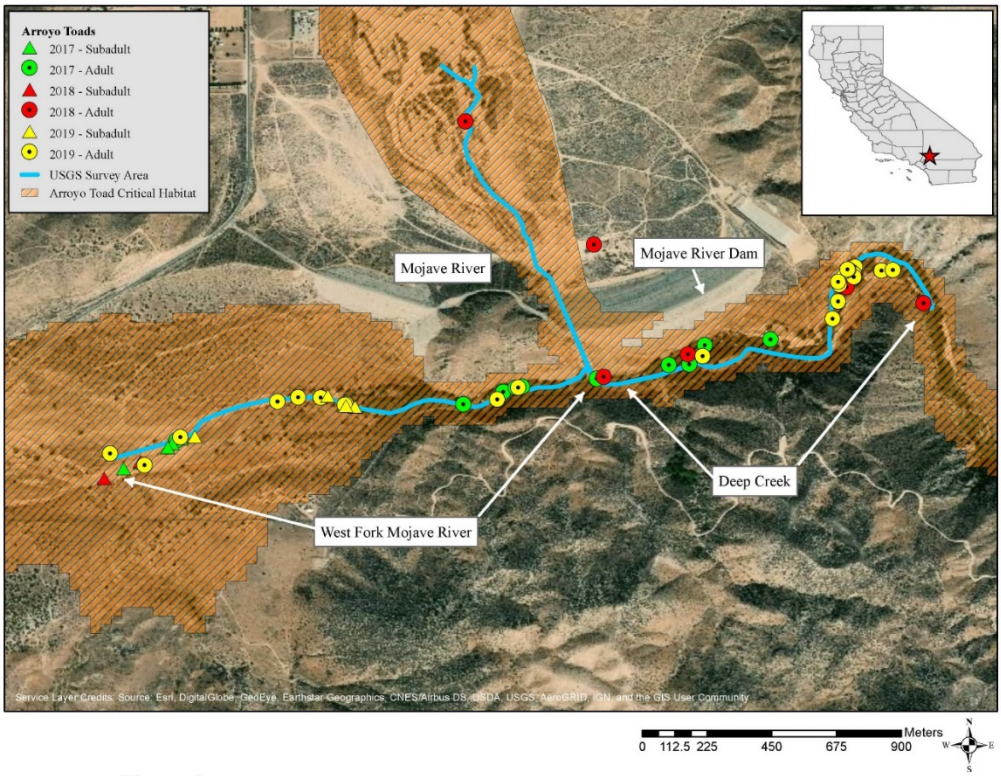


Figure 28. Survey area and results for the Arroyo Toad (*Anaxyrus californicus*) adults and subadults along Deep Creek, West Fork Mojave River, and the Mojave River, San Bernardino County, 2017–2019.

Connect Up and Down - Groundwater recharge for downstream ecological benefits was scored as "Pot. 3; Imp. 2". A high likelihood of producing groundwater recharge benefits was assigned because of the large amount of retention ponds or basins that have been constructed and operated and maintained by local agencies such as Los Angeles County and Orange County downstream of several SPL Dams (see Figure 29 for an example of downstream retention ponds at **Hansen Dam**). The need to capture water from storm events and local runoff for groundwater recharge is greatly needed in SPL's area of responsibility due to the large population and limited water available in recent years. The limited water availability is due to extended years of drought caused by the effects of climate change. However, climate change has also led to severe rainfall events, producing large pools of water within SPL's reservoirs. SPL currently realizes some of these benefits by coordinating with these local agencies and limiting the amount of downstream discharge that is able to be diverted into these retention ponds. However, due to infiltration rates and volume capacities, some of these discharges are not able to be captured. Additional benefits may be realized by updating operations at these dams, such as holding longer pools to allow for continuous discharge into the retention ponds and creating additional retention ponds within the reservoirs. Furthermore, additional benefits may also be realized through collaboration meetings with partners to determine capabilities and resources available.

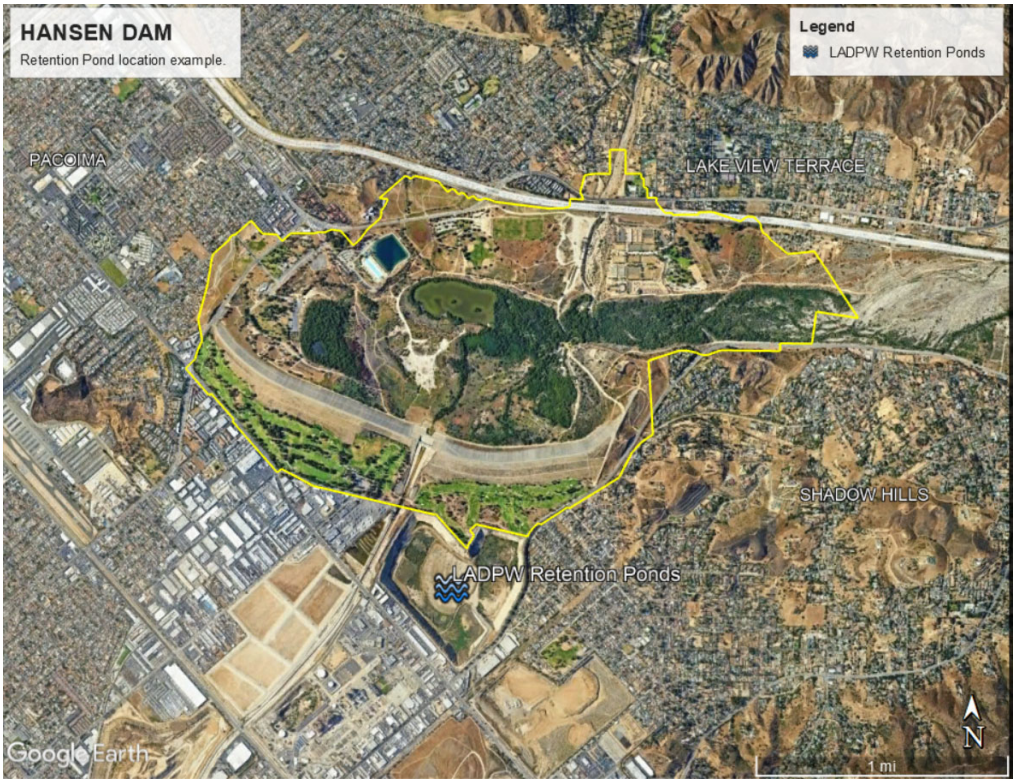


Figure 29. Example of retention pond infrastructure downstream of Hansen Dam.

Downstream - Ecological flow targets (fish and vegetation) was scored as "Pot. 3; Imp. 1". **Seven Oaks Dam** began operation in 2000 and is managed by Orange County Water District for the sole purpose of FRM. The pool behind **Seven Oaks Dam** is typically empty to nearly empty. During high flow events water is present and releases are coordinated to manage the buffer pool at Prado Dam. Water flows from **Seven Oaks Dam** 38 miles downstream through the Santa Ana River prior to reaching Prado Dam. Habitat and species are negatively impacted by seasonal low flows in the section of the Santa Ana River between the dams. The **Seven Oaks Dam** WCM needs updating to improve groundwater recharge and water conservation for human use and endangered species management (improving conditions for listed plants and animals). As a result, an interagency FIRO was initiated, which includes SPL Corps representatives. The FIRO team is working to improve and utilize weather forecasting to determine opportunities to balance FRM with water retention for water supply and increase seasonal water flows.

Sacramento District (SPK)

The SPK team identified 7 actionable ideas (Table 7, green highlighting). This section details 4 of those 7 actionable ideas (Table 7, green highlighting, bold) noted by the team as highest priority (most immediately feasible) and not otherwise being conducted or considered by an ongoing study.

Management of fisheries - In pool was scored as "Pot. 2; Imp. 1". Fishery management at **Schafer Dam**, **Success Lake**, was identified as a potential environmental action. The Corps currently partners with California State Fish and Wildlife Service to stock fish populations at this location. Additionally, the

Corps participates in an annual fish habitat creation project by inserting Christmas trees into the lake to become fish habitat. **Success Lake** is one of the most popular lakes in California for fishing (Figure 30). Due to its small size, **Success Lake** is a prime location to potentially manage water operations for improved fishery.

Figure 30. Photo of a caught fish on Success Lake (USACE photo).

E-flow targets - floodplain, riparian, wetland, fisheries was scored as "Pot. 2; Imp. 1". Environmental flows are currently being implemented at **Isabella Dam** and Lake (Figure 31), as part of release decision requirements. There may be further opportunities to investigate the benefits of those flows and adjust for efficiency or realize other benefits to downstream floodplains, riparian habitats, wetlands, and fisheries. This action would likely require coordination with the U.S. Forest Service as that agency operates and maintains the reservoir. The Corps is only responsible for the dam.

Figure 31. Photo of the Kern River below Isabella Dam (USACE photo).

Debris management was scored as "Pot. 3; Imp. 1". Contracts for debris management are currently in place throughout the Sacramento District, specifically at **Schafer Dam**, **Success Lake**. Further opportunities to utilize the debris (Figure 32) was recognized to combine efforts with ongoing in pool fisheries management to create more habitat structures with native plant species.

Figure 32. Debris piles below Schafer Dam after a high flow event (USACE photo).

Seasonal wetland for amphibians and birds (dry dams) was scored as "Pot. 2; Imp. 0". **Farmington Dam** was identified as a prime location as a dry dam to consider an environmental action for enhancing seasonal wetlands for amphibians and birds. The dam includes gate structures that can regulate the outflows of storm flows. An opportunity may exist to modify the gate operations to enhance the seasonal wetlands and vernal pools within the pool area. This could potentially benefit the threatened California Tiger Salamander (Figure 33), since the project is located within a unit of listed critical habitat for this species. Project authorities would need to be reviewed prior to doing this action.

Figure 33. Photo of the threatened California Tiger Salamander (photo borrowed from the Center for Biological Diversity taken at the Jepson Prairie Preserve).

San Francisco District (SPN)

The SPN team identified 6 actionable ideas (Table 8, green highlighting).

Water quality - Temperature was scored as "Pot. 3; Imp. 2". Depth of reservoir is the most significant factor in downstream temperature. Measures that reduce the need for outflows and sustain and prolong deep reservoir and cold-water pool, improve the success of listed species in the Russian River and health of hatchery programs at **Lake Mendocino** and **Lake Sonoma**. As part of the research and development associated with FIRO, consideration is being given to the magnitude of releases from the reservoir to determine if the flood risk management mission of the reservoir can be met while simultaneously accommodating concerns associated with water security and deeper cold-water pool.

The district has been implementing FIRO in real-time via temporary deviations to the existing water control plan. The district proposes continuing these efforts to determine opportunities that lessen the magnitude of flood control releases, if forecasted weather conditions are dry, and allow the district to safely store additional water within the flood control space. Similarly, the district has drafted a SOP to

leverage multi-level intake valves at **Lake Sonoma** to better manage water temperature released to the downstream.

Water quality - Turbidity was scored as "Pot. 3; Imp. 0". Outflows from **Coyote Valley Dam** (**Lake Mendocino**) have persistent turbidity that is higher than in the unregulated portion of the Russian River, above the confluence with the East Fork Russian River, which may adversely affect Chinook salmon and steelhead. The district has collected monitoring data at multiple locations downstream and convened a turbidity technical advisory committee (TAC) to help address this issue.

Streamflow models, with water quality modules (e.g., HEC-RAS), already exist for the Russian River. The district proposes modeling scenarios that compare different outflow ramping rates, flood control outlet gate positions, etc., to examine the effects on turbidity. The "best" operational scenario(s) will be determined and tested in-river within the constraints of the existing and future updated water control plan.

Rate of change management for bank integrity (water quality considerations) was scored as "Pot. 3; Imp. 1". Millions of dollars have, and will be invested in the future, on ecosystem restoration measures on Dry Creek downstream of **Lake Sonoma**. As part of the research and development associated with FIRO, consideration is being given to the timing and magnitude of releases from the reservoir to determine if the flood risk management mission of the reservoir can be met while simultaneously accommodating concerns associated with erosion damage to the constructed ecosystem restoration measures.

The district has been implementing FIRO in real-time via temporary deviations to the existing water control plan. The district proposes continuing these efforts to determine opportunities to lessen the duration and magnitude of flood control releases, if forecasted weather conditions are dry, and allow the district to safely store additional water within the flood control space.

Conclusion

The South Pacific Regional Operations and Water Management Meeting was held November 1-2, 2023. The South Pacific region is defined as the geographic area containing four Corps Districts within South Pacific Division (SPD): Albuquerque (SPA), Los Angeles (SPL), Sacramento (SPK), and San Francisco (SPN). Teams for each District collaborated to determine environmental opportunities at water management infrastructure projects that are feasible to implement and are likely to provide compelling potential benefits. More than 83 reservoirs, affecting flows for over 8,142 river miles within the region, were considered.

In formulating and evaluating environmental opportunities, location-based teams followed these steps:

1. list possible environmental improvement actions associated with reservoirs and water management infrastructure;
2. rate environmental potential of each action;
3. rate degree to which each action has been implemented;
4. select environmental actions with potential and unrealized implementation; and,

5. rank reservoirs and water management infrastructure according to which projects are most promising for operational changes related to selected actions.

A key outcome of the meeting is the list of “actionable ideas”, each of which is a pairing of an environmental action with unrealized implementation possibilities at a water management infrastructure project with potential to enact related operational changes. There were 29 actionable ideas identified during the workshop involving 15 Corps reservoirs and 12 Corps dry dams (Table 1).

This tally is worthy of reflection. In a day and a half, 28 participants identified 29 actionable ideas. In other words, Table 1 includes 29 potential ways to get more environmental benefits from already built, public, water management infrastructure - just do more of this (action) at this location (infrastructure). This does not mean making the changes would be easy or always generate the anticipated benefits. However, these actionable ideas do clearly connect water resources management to ecosystem management and illustrate the unrealized potential of infrastructure to be used as tools in the restoration and management of ecosystems.

It is hoped that the meeting outcomes can be used by participating districts and South Pacific regional partners to initiate future implementation of as many of the identified actions as possible using the suite of environmental restoration and management tools and authorities at their disposal, including the Sustainable Rivers Program.

This was the sixth regional meeting supported by the Sustainable Rivers Program. From a Program perspective, the meeting was done to 1) identify environmental opportunities at reservoirs in the South Pacific and 2) cultivate a forum about environmental considerations at reservoirs. The Corps has several recurring meetings that focus on water management and involve multiple Districts. To the knowledge of SRP, none are specific to environmental considerations. SRP will continue to advance these regional meetings and help implement the resulting ideas with the overall goal of incorporating environmental strategies into the operations of Corps water management infrastructure.

Appendix A - South Pacific Region - Operations and Water Management Meeting Participants

District	Name	Organization	Location-based Team
SPA			
	Garret Ross	Corps	Albuquerque
	Nabil Shafike	Corps	Albuquerque
	Derrick Dunlap	Corps	Albuquerque
	Ryan Gronewold	Corps	Albuquerque
	Sarah Moore	Corps	Albuquerque
	Brian Johnson*	Corps	Albuquerque
	Jim Howe*	TNC	Albuquerque
SPL			
	R. Brian Paul	Corps	Los Angeles
	Jon Rishi	Corps	Los Angeles
	Richard Alcala	Corps	Los Angeles
	Jon Sweeten	Corps	Los Angeles
	Van Crisostomo	Corps	Los Angeles
	Michelle Mattson*	Corps	Los Angeles
SPK			
	Zeffy Ruvalcaba	Corps	Sacramento
	Jenna Peterson	Corps	Sacramento
	Jenny Fromm	Corps	Sacramento
	Mick Porter	Corps	Sacramento
	Hilary Coleman	Corps	Sacramento
	John Hickey*	Corps	Sacramento
SPN			
	Nicholas Malasavage	Corps	San Francisco
	Patrick Sing	Corps	San Francisco
	Elizabeth Campbell	Corps	San Francisco
	Rheannon Hart*	Corps	San Francisco
TNTCX			
	Brian Zettle	Corps	Sacramento
SPD Reps			
	Cuong Ly	Corps	All SPD Teams
	John Keever	Corps	All SPD Teams
	Brian Dela Barre	Corps	All SPD Teams
	Cynthia Jo Fowler	Corps	All SPD Teams

*SRP Team Member

Appendix B - South Pacific Region - Operations and Water Management Meeting Agenda

NOVEMBER 1-2, 2023

SOUTH PACIFIC REGION - OPERATIONS AND WATER MANAGEMENT MEETING

Meeting goal is to identify environmental opportunities at water infrastructure that are feasible to implement with compelling potential benefits. Participants provide expertise in reservoir operations, water management, water quality, natural resources management, environmental planning, and ecology. Meeting provides a venue for consideration of environmental actions at rivers and water infrastructure of the South Pacific Region.

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KEY EVENT DATES

AUGUST-SEPTEMBER COORDINATION WITH PARTICIPANTS

SEPTEMBER-OCTOBER DISTRIBUTION OF MATERIALS

NOVEMBER OPERATIONS AND WATER MANAGEMENT MEETING

MEETING LOCATION:

Tin Barn, Building 518, Presidio of Monterey (PoM)

OPERATIONS AND WATER MANAGEMENT MEETING - SOUTH PACIFIC REGION

Wednesday, November 1, 2023 – Tin Barn, Building 518

9:00 am - 9:30 am

Introductions and Meeting Objectives. Session includes welcome, introductions, meeting overview, and meeting objectives.

9:30 am - 10:00 am

SRP Brief. History and status of the Sustainable Rivers Program (SRP). As of 2022, SRP has engaged 44 river systems and 90+ Corps reservoirs. SRP focuses on environmental flows (environmental flows), including a process for advancing, implementing, and incorporating environmental flows into reservoir operations, while exploring a broader set of strategies about environmental opportunities at water infrastructure.

10:00 am - 10:30 am

Regional Rivers and Reservoirs. Results from ongoing GIS analyses are used to summarize rivers and reservoir systems of the South Pacific Region. Details include number, volume, purposes, and potential influence of Corps reservoirs in region.

10:30 am - 10:45 am Break

10:45 am - 11:30 am

"Water Infrastructure"-centric Environmental Efforts within Region. SRP efforts in the South Pacific Region include work on the Bill Williams, Gila, and Pecos Rivers and Galisteo Creek. Session includes presentations about SRP and other environmental projects within region (perspectives from participating Districts).

11:30 am - 12:30 pm

Focus Session: Ongoing Environmental Work at Water Infrastructure Projects within Region. Interactive group exercise (with reporting to conclude session) related to current environmental activities. Three topics or questions will be explored:

1) Identify environmental opportunities at reservoirs. Define potential and implementation per office.
2) What opportunities are underrepresented and feasible?
3) What are limitations to implementation?

12:30 am - 1:30 pm Working Lunch (at the venue)

1:30 pm - 2:00 pm Continuation of Previous Focus Session

2:00 pm - 2:30 pm

National Reservoir Review. Review of project authorizations and basic capabilities of Corps reservoirs to operate for environmental purposes, including which reservoirs have fish and wildlife, water quality, and/or recreation as an authorized purpose.

2:30 pm - 4:00 pm

Focus Session: Prioritization of Water Infrastructure Projects within Region. Location-based teams will be provided with information from a national reservoir review and tasked with prioritizing candidate infrastructure projects within their area of interest/expertise. Prioritizations will be done for environmental flow potential and two or three of the most promising environmental activities identified in the previous Focus Session. Teams will also develop ideas about how data provided might be applied differently in support of environmental activities.

4:00 pm – 4:30 pm

Trends in infrastructure management and in environmental opportunities. A representative from South Pacific Division Office to present on changes and trends in infrastructure management within SPD and provide an overview of environmental opportunities from Division's perspective. What changes, actions, or opportunities do they see coming up in the next 5-10 years.

4:30 pm Wrap for day and details about tomorrow.

Thursday, November 2, 2023 – Tin Barn, Building 518

8:00 am - 8:15 am (start earlier)

Greeting and Revisit of Meeting Objectives. Session describes meeting goals and activities for the day.

8:15 am - 8:30 am

Review of Yesterday. Brief retrospective about yesterday's focus sessions for 1) environmental activities at water infrastructure projects and 2) project prioritizations.

8:30 am - 10:30 pm

Strategy Session to Integrate Information. Location-based teams reconvene to finalize thoughts and materials for report out and write up findings.

10:30 am - 11:00 am Break

11:00 pm - 12:00 pm

Reports from Location-based Teams. Teams will report to group on identified environmental opportunities and candidate infrastructure projects. Actionable ideas will be highlighted.

12:00 pm - 1:00 pm Working Lunch (at the venue)

1:00 pm - 1:30 pm

Group discussion. Open discussion about meeting products and actionable ideas. Follow-up tasks. Concluding thoughts.

1:30 pm - 2:00 pm

Review Regional Meeting Concept. This is the fifth regional meeting done via the Sustainable Rivers Program. Review overall agenda and revisit key components to discuss effectiveness and generate ideas for future meetings. Ideas about meeting goals, construct, and potential would be welcome. Discuss where the meetings outcomes can and should go and can these types of meetings be a platform for anything else.

2:00 pm Meeting Adjourned