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SAN MATEO CREEK WATERSHED MANAGEMENT PLAN – FINAL

Prepared for:
State Water Resources Control Board
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ACRONYMS

319 grant	Clean Water Act section 319 grant
ASCI	Algal Stream Condition Index
Basin Plan	Water Quality Control Plan for the San Diego Basin
BIOL	Preservation of Biological Habitats of Special Significance
BMI	Benthic Macroinvertebrate
BMP	Best Management Practice
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CFP	California Fully Protected
CMP	California Coastal Monitoring Plan
CNDDDB	California Natural Diversity Database
CNF	Cleveland National Forest
CNPS	California Native Plant Society
COLD	Cold Freshwater Habitat
CP	California Protected
CPUE	catch per unit effort
CRAM	California Rapid Assessment Method
CSCI	California Stream Condition Index
CSSC	California Species of Special Concern
CSP	California State Parks
CWA	Clean Water Act
DPS	Distinct Population Segment
eDNA	Environmental DNA
ESA	Endangered Species Act
FE	Federally Endangered
FEMA	Federal Emergency Management Agency
ft/sec	feet per second
HPWQC	High Priority Water Quality Concern
INRMP	Integrated Natural Resources Management Plan
LMP	Land Management Plan
LTMP	Long-Term Monitoring Plan
MAR	Marine Habitat
MCBCP	Marine Corps Base Camp Pendleton
mg/L	milligram(s) per liter
MIGR	Migration of Aquatic Organisms
MS4	Municipal Separate Storm Sewer System
MSCP	Multiple Species Conservation Program (North San Diego)
MSHCP	Multiple Species Habitat Conservation Plan (Western Riverside County)
NAVD88	North American Vertical Datum of 1988
NCCP	Natural Community Conservation Plan
NEPA	National Environmental Policy Act
NMFS	National Marine and Fisheries Service
OC	Orange County
PAO	Proportion of Area Occupied
RARE	Rare, Threatened, or Endangered Species
RCD	Resource Conservation District

RCTLMA	Riverside County Transportation and Land Management Agency
REC-1	Contact Water Recreation
REC-2	Non-Contact Water Recreation
SAMP	Special Area Management Plan
SC	State Candidate
SD	State Delisted
SDCWA	San Diego County Water Authority
SDRWQCB	San Diego Regional Water Quality Control Board
SE	State Endangered
SMC	San Mateo Creek
SMCC	San Mateo Creek Conservancy
SOP	standard operating procedure
SP	Special Vascular Plants
SPWN	Spawning, Reproduction, and/or Early Development
SSHCP	Natural Community Conservation Plan/Habitat Conservation Plan (Southern Subregion)
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TEAM RCD	Temecula-Elsinore-Anza-Murrieta Resource Conservation District
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USMC	United States Marine Corps
VSP	Viable Salmonid Population
WARM	Warm Freshwater Habitat
WILD	Wildlife Habitat
WMP	Watershed Management Plan
WQIP	Water Quality Improvement Plan
WRCC	Western Regional Climate Center

EXECUTIVE SUMMARY

The San Mateo Creek (SMC) Watershed is a substantially important watershed in Southern California. It is one of the few remaining undammed watersheds in the region and contains over 200 miles of stream habitat. Despite being located near densely populated urban areas, over 90% of the watershed is located on public lands and is largely undeveloped. The watershed spans three counties (Riverside, San Diego, and Orange), a portion of the Cleveland National Forest (CNF), Marine Corps Base Camp Pendleton (MCBCP), and San Onofre State Park. The SMC terminates at the Pacific Ocean near the world-famous surfing destination, Trestles Beach.

The SMC Watershed contains habitat for numerous threatened and endangered species, including designated critical habitat in the upper SMC for the arroyo toad (*Anaxyrus californicus*). San Mateo Creek contains critical habitat designation for federally and state endangered Southern California steelhead (*Oncorhynchus mykiss*) outside of MCBCP. San Mateo Creek supports other state and federal sensitive native species such as the tidewater goby (*Eucyclogobius Newberry*), California newt (*Taricha torosa*), and southwestern pond turtle (*Emys pallida*). Historically, arroyo chub (*Gila orcutti*) also inhabited the watershed. The SMC Watershed exhibits high California Stream Condition Index (CSCI) scores for benthic macroinvertebrates, habitat quality, and benthic algae. With additional management actions and intervention, the SMC Watershed provides an excellent opportunity for reestablishing local Southern California steelhead populations while concurrently benefitting arroyo toad, tidewater goby, California newt, and arroyo toad populations.

There are, however, considerable threats to ecosystem health in the SMC Watershed that resulted in its Clean Water Act (CWA) 303(d) listing as impaired for three beneficial uses (migration of aquatic organisms; spawning, reproduction, and/or early development; and rare, threatened, or endangered species) in the 2014-16 California Integrated Report. Impairment is primarily related to the release of aquatic invasive species from private ponds (source populations) located in the upper reaches of the SMC Watershed on the remaining 10% of private land. Their proliferation (present populations) has led to competition with and predation of Southern California steelhead and other sensitive native species.

In recognition of this, SDRWQCB issued a final invasive species total maximum daily load (TMDL) in November 2023 that set numeric targets for the Southern California steelhead, seven aquatic invasive species, as well as water quality monitoring indicators for dissolved oxygen and temperature to remediate invasive species and meet desired conditions within the SMC Watershed. The SDRWQCB certified that implementation actions taken, consistent with the TMDL, are expected to resolve the impairment.

This San Mateo Creek Watershed Plan presents a cohesive framework for implementing the SDRWQCB (2023) TMDL for Invasive Species as a Nonpoint Source Pollutant. Generated through collaborative work among multiple stakeholders and consistent with the EPA's Nine Key Elements, the Plan contains a Land Management Plan (Section 1), Long-term Monitoring Plan (Section 2), Aquatic Invasive Species Work Plan (Section 3) with Implementation Strategy and Adaptive Management sections, and Public Outreach Plan (Section 4) that outlines strategies to control source populations of invasive species in San Mateo Creek headwaters.

1. LAND MANAGEMENT PLAN

1.1. Introduction

The San Mateo Creek (SMC) Watershed consists of approximately 114,000 acres (178 square miles) and 200 total stream miles spread across northern San Diego County, southern Orange County, and western Riverside County in Southern California (San Diego Region Water Quality Control Board [SDRWQCB] 2023) (Figure 1).

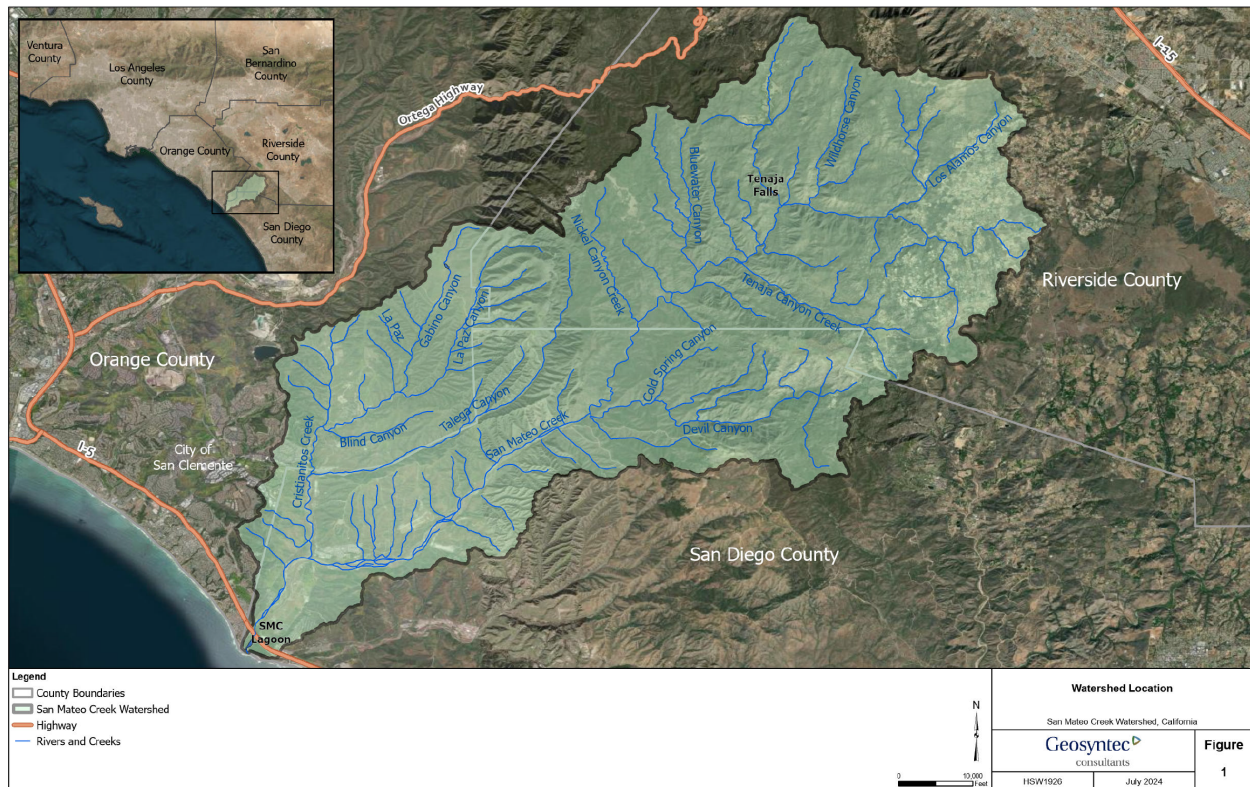


Figure 1: Watershed Location

The headwaters of SMC originate in Cleveland National Forest (CNF) and flow southwest to the Pacific Ocean, crossing across multiple landownership boundaries, ecosystem types, and stakeholder jurisdictions. The SMC Watershed is an important resource for both people and wildlife, as it is one of the last undammed watersheds in Southern California and is largely undeveloped despite its close proximity to dense urban population centers (San Mateo Creek Conservancy [SMCC] 2023). The SMC Watershed exhibits intermittent flow and contains deep pools, spawning and rearing habitat, and high-quality aquatic and terrestrial habitat. The SMC Watershed is used as a reference watershed for numerous regional biomonitoring initiatives (Mazor et al. 2007); however, the SMC Watershed is vulnerable to environmental stressors that threaten its uniqueness, such as invasive species, land development, and climate change. These threats impact its ability to support wildlife and meet its designated uses (California Trout 2024a).

SDRWQCB's Water Quality Control Plan for the San Diego Basin (Basin Plan; 1994) designated a total of 10 beneficial uses for various reaches of the SMC Watershed, including its mouth (coastal water), main stem, and tributaries (inland surface waters):

- Contact Water Recreation (REC-1) (*mouth only*)
- Non-Contact Water Recreation (REC-2)
- Preservation of Biological Habitats of Special Significance (BIOL) (*mouth only*)
- Warm Freshwater Habitat (WARM)
- Cold Freshwater Habitat (COLD)
- Wildlife Habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)
- Marine Habitat (MAR) (*mouth only*)
- Migration of Aquatic Organisms (MIGR)
- Spawning, Reproduction, and/or Early Development (SPWN)

In addition to its beneficial uses, other species of concern also inhabit the SMC Watershed, including the California newt (*Taricha torosa*), arroyo toad (*Anaxyrus californicus*), arroyo chub (*Gila orcuttii*), southwestern pond turtle (*Actinemys pallida*), and tidewater goby (*Eucyclogobius newberryi*). The existence and proliferation of these species, and the federally and state endangered Southern California steelhead (*O. mykiss*), is directly threatened by the presence of aquatic invasive species that outcompete native species for resources, modify habitat conditions, predate upon native species, and spread disease (Moyle et al. 2013). The presence and general negative effects of aquatic invasive species led to the Clean Water Act (CWA) 303(d) listing of SMC as a 5A impaired water body for the RARE, MIGR, and SPWN beneficial uses described in the 2014-2016 California Integrated Report, (SDRWQCB 2018). In response to the 2016 CWA 303(d) listing of SMC as impaired for invasive species, SDRWQCB approved a total maximum daily load (TMDL) that lists numeric targets for aquatic invasive species and steelhead, as well as water quality monitoring indicators (SDRWQCB 2023) that represent alternative numeric targets to Basin Plan water quality objectives. Furthermore, the approved TMDL also includes secondary considerations for the tidewater goby and arroyo toad.

1.1.1. Purpose of Land Management Plan

The purpose of this Land Management Plan (LMP) is to holistically inform and designate land management strategies within the SMC Watershed that promote water quality improvement and the remediation of aquatic invasive species. A specific emphasis is placed on managing the land for the expansion of *O. mykiss* and other sensitive native species to align with the approved TMDL and its numeric targets. Additionally, this LMP seeks to consolidate existing information and priorities from the various landowners, agencies, and stakeholders involved across jurisdictional boundaries, effectively manage financial and human resources, and create a comprehensive overarching framework for managing land in the SMC Watershed.

1.1.2. Goals and Objectives

To help meet the numeric targets designated in the approved TMDL, as well as improve water quality and promote healthy habitats for sensitive native species in the SMC Watershed, this LMP will do the following:

- Identify responsibilities of various stakeholders throughout the watershed.
- Describe critical characteristics of the watershed and their relationship to native species.
- Synthesize and prioritize land management goals and strategies throughout the watershed.
- Describe appropriate data collection and monitoring approaches.
- Determine universal metrics for measuring success in land management strategies.
- Establish data management and interagency reporting guidelines.
- Designate a framework and triggers for adaptive management and LMP updates.
- Three management goals have been established that contain three supporting objectives and 15 subsequent actions to meet the TMDL numeric targets (Table 1-1).

Table 1-1: Management Goals 1-3

Management Goals 1–3: Remediation of Aquatic Invasive Species, Recovery of Southern Steelhead, Water Quality Improvements	Status
Objective #1 – Remediation and mitigation of ponds that hold aquatic invasive species	
Action 1.1 – Mapping and assessment of loading sources	In Progress
Action 1.2 – Public outreach and communication with private property owners	In Progress
Action 1.3 – Evaluation of priority remediation and mitigation areas	Not Started
Action 1.4 – Evaluation of mitigation measure feasibility for ponds	Not Started
Action 1.5 – Implementation of practices for on-site source control	Not Started
Action 1.6 – Monitoring and reporting of remediation and mitigation efforts	Not Started
Objective #2 – Removal of aquatic invasive species from San Mateo Creek	
Action 2.1 – Mapping and assessment of present sources	In Progress
Action 2.2 – Evaluation of priority management areas	Not Started
Action 2.3 – Evaluation of removal feasibility	In Progress
Action 2.4 – Implementation of practices for San Mateo Creek source control	In Progress
Action 2.5 – Monitoring and reporting of source control in designated management areas	In Progress
Objective #3 – Monitoring and assessment of TMDL implementation	
Action 3.1 – Identify responsibilities of various stakeholders throughout the watershed	Completed
Action 3.2 – Describe appropriate data collection and monitoring approaches	Completed
Action 3.3 – Determine universal metrics for measuring success	Completed
Action 3.4 – Data management and interagency reporting on TMDL monitoring and implementation	In Progress

Stakeholders the SMC Watershed have been identified and assigned roles and responsibilities related to this LMP and the SMC Watershed Management Plan (WMP; Table 1-2).

Table 1-2: Stakeholder Roles and Responsibilities

Stakeholder	TAC Representation	Field Work Obligation*	Data Reporting Obligation
California Trout (current 319 grant recipient)	X	X	X
California State Parks	X	X	X
USMC Camp Pendleton	X	X	X
United States Forest Service	X	X	X
California Department of Fish and Wildlife	X	X	X
Acjachemen Tribe	X		
TEAM RCD	X		
The Nature Conservancy	X		

*TAC: Technical Advisory Committee

*TEAM RCD: Temecula-Elsinore-Anza-Murrieta Resource Conservation District

Implementing this LMP is meant to be an iterative process that utilizes adaptive management and collaboration across the watershed. As needed, this LMP can be updated to maintain accuracy and alignment with the most current project goals, objectives, and actions, as well as to capture any new information, and incorporate any changes to the TMDL and SDRWQCB Certification. A general implementation schedule was established for all stakeholders to work from (Table 1-3).

Table 1-3: General Implementation Schedule

Implementation Action	Start Date	End Date
Steelhead Population Estimation Survey	2024	Ongoing
Invasive Species Surveys in the SMC Watershed	2024	2025
Monitoring for Numeric Targets	2026	2037
Attainment of Final Numeric Targets	2037	2037
Continued Monitoring of Steelhead Populations	2037	Ongoing
Continued Monitoring of Aquatic Invasive Species	2037	Ongoing

1.1.3. Existing Land Management Plans Within San Mateo Creek Watershed

The SMC Watershed spans three county lines that include numerous privately owned lands, the CNF, MCBCP, and San Onofre State Park. In addition to falling within the jurisdiction of multiple regulatory agencies, the SMC Watershed has historically been managed in an unconsolidated manner resulting from each party’s own management goals and objectives. Management activities to date do exhibit some similar approaches for monitoring terrestrial and aquatic habitats, as well as general consistency in guidance for invasive species removals, but do not always have aligning goals/visions, monitoring methods, or data management and reporting obligations. Major plans and documents that include a land management component relevant for

aquatic invasive species remediation and the proliferation of *O. mykiss* and other sensitive native species in the SMC Watershed are summarized below and in Table 1-4.

1.1.3.1. Camp Pendleton Integrated Natural Resources Management Plan

The Draft Final Integrated Natural Resources Management Plan (INRMP) for United States Marine Corps (USMC) Base Camp Pendleton was most recently updated in June of 2023 and includes extensive information regarding operations and existing infrastructure on the base, ecosystem composition and species distributions, and mapping and monitoring approaches for state/federally listed species and invasive/nonnative species. MCBCP cooperates with federal and nonfederal agencies for the management of ecosystems and species and is currently aware of the presence of 19 federally listed species on the base, including the Southern California steelhead, tidewater goby, and arroyo toad.

The Southern California steelhead is monitored through environmental DNA (eDNA) techniques and visual observations in the field. Results indicated the presence of two individuals confirmed in SMC in 2017, and several eDNA detections in 2020 and 2021 (USMC 2023). The tidewater goby is monitored by seining at least every 3 years (but generally annually) throughout the eight lagoons on MCBCP, and, while detections vary each year, the tidewater goby has been detected in all eight lagoons on base with 150 individuals identified since 2002. Translocation of individuals to suitable off-site habitat is currently being considered. The management of a stable arroyo toad population in SMC has been conducted through an analysis of trend data every five years, using Proportion of Area Occupied (PAO) monitoring methods conducted annually (USMC 2023). USMC also monitors the southwestern pond turtle and has conducted surveys in 2008, 2010, 2022, and 2023 to assess their distribution, abundance, and general health on MCBCP. Monitoring and management for the arroyo chub and California newt is not discussed in the INRMP.

Base Training Regulations for MCBCP advise military training units to generally prohibit unauthorized foot and vehicle traffic around streams, lagoons, and estuaries to limit impacts to ecosystems and species. From spring to fall annually, non-native aquatic species are removed from water bodies as observed.

1.1.3.2. Cleveland National Forest Land and Resource Management Plan

The United States Forest Service (USFS) Pacific Southwest Region published the CNF LMP in September of 2005. This plan establishes the vision, strategy, and resource management strategy for CNF (USFS 2005). Subsequently, the USFS has also produced LMP monitoring and evaluation reports every year since 2006 (through 2022) that track progress toward meeting the designated vision and goals. While the greater CNF extends beyond the boundaries of SMC, the San Mateo Canyon Wilderness unit within the Trabuco Ranger District of the CNF includes the SMC Watershed.

USFS currently monitors for Southern California steelhead and the arroyo toad in their annual LMP efforts in accordance with a United States Fish and Wildlife Service (USFWS) biological opinion. In 2022 there were no roadkill of arroyo toad in the San Mateo Canyon Wilderness reported (USFS 2022). USFS also employs invasive species prevention and control measures that include physically removing aquatic invasive species where encountered, monitoring noxious weeds, and setting priorities for invasive species treatment (USFS 2005). High-quality habitat for the southwestern pond turtle has been acknowledged in the CNF; however, specific

monitoring and management for the southwestern pond turtle, arroyo chub, and California newt are not discussed in the CNF LMP.

1.1.3.3. Western Riverside County Multiple Species Habitat Conservation Plan

The Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) was developed by the Riverside County Transportation and Land Management Agency (RCTLMA) in 2004 for the conservation of multiple species and their habitats across nearly 1.26 million acres (1,968 square miles) and multiple bioregions (RCTLMA 2004), including the northeastern-most region of the SMC Watershed. The MSHCP includes provisions for monitoring and managing 146 total species, including the arroyo toad, arroyo chub, and southwestern pond turtle as well as invasive species (both terrestrial and aquatic).

Monitoring the arroyo toad under the MSHCP includes a baseline survey, distribution monitoring every eight years, and reproduction monitoring every one to five years. Breeding populations of arroyo toad will be maintained through managing hydrology and flood control, non-native plant species, farming, mining, grazing, recreation, and predation (RCTLMA 2004). Specifically, suitable habitat will undergo enhancement measures such as creating stream meanders and pool-riffle complexes, as well as reestablishing native riparian vegetation. Aquatic invasive species will be remediated through mechanical removal and the development of fish barriers at known source populations.

1.1.3.4. North San Diego County Multiple Species Conservation Program

The North San Diego County Multiple Species Conservation Program (MSCP), jointly prepared by the County of San Diego and Technology Associates International Corporation in February of 2009, covers approximately 313,000 acres (489 square miles) and 63 species, including the arroyo toad, California Newt, and southwestern pond turtle. The northernmost section of the MSCP is within the SMC Watershed boundary. The County of San Diego has also prepared a Framework Resource Management Plan that provides specific direction for management and biological monitoring of preserves, as well as adaptive management and landowner responsibilities.

To conserve arroyo toad populations within the MSCP jurisdiction, a predicted species distribution model and habitat evaluation model were created to understand where the species may occur and the quality of their habitat throughout northern San Diego County. Additional best management practices (BMPs) for arroyo toad habitats are identified in the MSCP with specific emphasis on agricultural lands.

1.1.3.5. Southern Subregion Habitat Conservation Plan

The Southern Subregion Natural Community Conservation Plan/Habitat Conservation Plan (SSHCP) was approved in 2007 and covers 132,000 acres and 32 species across southern Orange County, including the arroyo toad, arroyo chub, and southwestern pond turtle in the western portion of the SMC Watershed (National Community Conservation Plan [NCCP] /Special Area Management Plan [SAMP] Working Group 2004; USFWS 2007). The SSHCP includes extensive information regarding the arroyo toad, which has “major” and “important” populations in Talega Canyon and Cristianitos Creek of the SMC Watershed (USFWS 2007). Monitoring of the arroyo toad is conducted at both the species-specific and habitat levels. Methods have included radio telemetry on toads between 2009 and 2013 and periodic monitoring (every 3 years) through 2031. Breeding and foraging habitat is protected along Talega Canyon and Cristianitos Creek. Furthermore, the management of non-native plants and aquatic predators is

conducted through an Invasive Species Control Plan that calls for mechanical removal of non-native species, with specific provisions for bullfrog and crayfish removal.

1.1.3.6. San Diego Regional Water Quality Control Board Basin Plan

SDRWQCB published the Water Quality Control Plan for the San Diego Basin (Basin Plan) originally in 1975, with major updates and rewriting in September of 1994 and the most recent minor update in September of 2021 (SDRWQCB 1994). The Basin Plan is intended to be a dynamic document that describes how the regional board will manage water and water quality in the San Diego Region and designates beneficial uses for water bodies. On July 3, 2024, SDRWQCB released a notice of public meeting to be held on September 18, 2024, to consider approval of the biological objectives amendment to the Basin Plan. These biological amendments include monitoring guidance and goals for bioassessment to meet designated uses and would generally be beneficial in the SMC Watershed (SDRWQCB 2020).

1.1.3.7. South Orange County Water Quality Improvement Plan

The Copermittees of Orange County (OC) submitted the South Orange County Watershed Management Area Water Quality Improvement Plan (WQIP) to the SDRWQCB in 2018 for compliance with the San Diego Regional Municipal Separate Storm Sewer System (MS4) Permit (OCC 2018). The South OC WQIP jurisdiction includes the SMC Watershed and discusses water quality improvement goals, strategies, and schedules, in addition to geomorphic concerns, water balance and streamflow, and adaptive management. While no specific guidance is given regarding steelhead, arroyo toad, or tidewater goby monitoring, the South OC WQIP does describe watershed remediation actions, including erosion abatement and stream rehabilitation, that are supplemented with other data collection efforts such as bioassessment to improve steelhead populations.

Table 1-4: Summary of Existing Land Management Plan Components Related to the SDRWQCB Approved TMDL

LMP	Southern California Steelhead	Arroyo Toad	Tidewater Goby	Arroyo Chub	Southwestern Pond Turtle	California Newt	Aquatic Invasive Species
INRMP	X	X	X		X		X
CNF LMP	X	X					X
MSHCP		X		X	X		X
MSCP		X			X	X	
SSHCP		X		X	X		X
Basin Plan	X						
South OC WQIP	X						

1.2. Watershed description

1.2.1. General Setting

The SMC Watershed consists of approximately 114,000 acres (178 square miles) and 200 total river miles within western Riverside County, northwestern San Diego County, and southeastern Orange County (Figure 1). Over 90% of the watershed is classified as public land and is owned by both federal and state governments, and is managed by numerous agencies including USFS, the California Department of Parks and Recreation (California State Parks [CSP]), and USMC (Figure 2). The main stem of SMC largely flows through MCBCP and CNF. It is important to note that CSP managed land in the SMC watershed is leased from MCBCP.

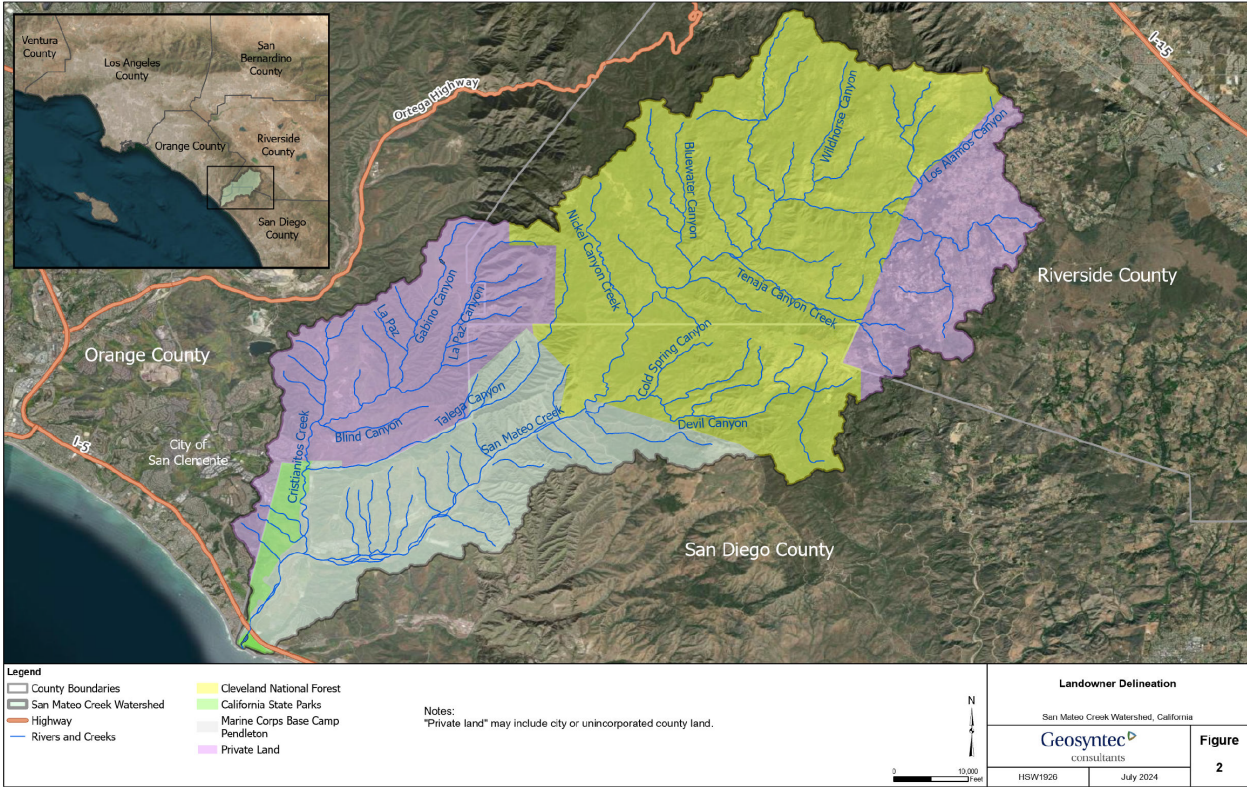


Figure 2: Landowner Delineation

1.2.2. Environmental Conditions

The SMC Watershed has a Mediterranean climate in which rainfall patterns can be inconsistent, causing discrete wet and dry periods (SWRCB 2005). The watershed is located on the western slopes of the Santa Ana Mountains and is composed of metasedimentary, metavolcanic, and igneous rocks of the Jurassic age or younger (SWRCB 2005). The three main soils found in the watershed are sandy and silty-sandy, crystalline, and clayey, and all soils display rapid runoff. The SMC Watershed consists of two main drainage systems that join in the lower stream valley, forming broad alluvial plains as they approach the Pacific Ocean (SWRCB 2005; USMC 2023). During the Rancho period, rancheros cleared underbrush using fire to improve livestock

foraging. Pioneer settlers in the late 1860s used fires to clear great expanses of brush to make way for mineral exploration, leaving a much larger impact on the watershed (SMCC 2023).

1.2.2.1. Climate

The Mediterranean climate in Southern California is distinguished by brief, intense storms that occur between November and March, with extended dry periods lasting from April to October. The mean annual precipitation ranges from 10 inches per year in the coastal plain area to 22 inches per year in the mountains, with substantial year-to-year variation (SMCC 2023; USMC 2023). Mean annual temperatures are mild around 65°F (18°C), with generally higher temperatures experienced further inland from the Pacific Ocean. A monthly climate summary for Laguna Beach, California, (north of the SMC Watershed) is provided in Table 1-5 below.

Recently, Southern California has been experiencing prolonged periods of heat and drought, leading to an increase in wildfire frequency and severity and extreme wet weather events (SDRWQCB 2023). During dry seasons, it is not uncommon for many intermittent streams of the SMC Watershed to be without water and for perennial pools to be hydrologically disconnected (SDRWQCB 2023); during wet seasons, SMC and its tributaries can exhibit continuous flow conditions and connectivity into the late spring and early summer months, but connectivity typically ceases during the late summer dry months.

Table 1-5: Climate Summary from 1948 to 2016 for Laguna Beach, California WRCC Station #044647

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Maximum Temperature (°F)	65.1	66.1	67.1	69.0	70.9	73.1	76.5	78.1	77.5	74.5	70.4	66.1	71.2
Average Minimum Temperature (°F)	43.0	44.1	45.8	48.4	53.0	56.1	59.3	59.6	58.2	53.7	47.5	43.4	51.0
Average Total Precipitation (inches)	2.43	2.77	2.01	0.98	0.25	0.10	0.03	0.07	0.26	0.47	1.24	1.92	12.52

Source: Western Regional Climate Center (WRCC) for a Period of Record between March 1, 1928, to April 24, 2016.

1.2.2.2. Topography and Geology

The SMC Watershed is located on the western slopes of the Santa Ana Mountains (part of the Peninsular Range) and is composed of metavolcanic, metasedimentary, and igneous rocks of Jurassic age and younger that have been formed by sediment deposition, mass wasting, and alternating periods of depression and uplift (SMCC 2023; SWRCB 2005). Elevations of the watershed range from approximately 3,500 feet above sea level in the northern region of the watershed, to sea level at the mouth of SMC (Figure 3).

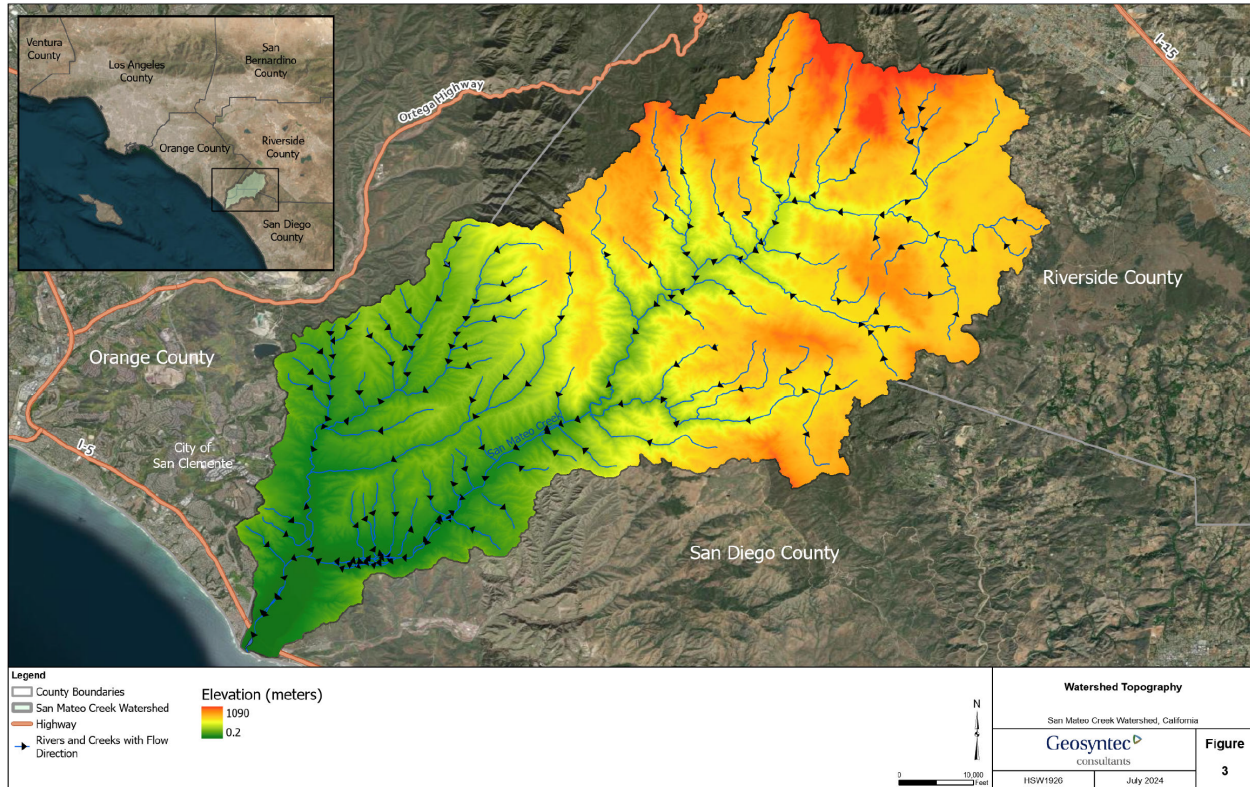


Figure 3: Watershed Topography

The exposed rock in the Santa Ana Mountains is slightly metamorphosed volcanic rock that contain several thousand feet of younger conglomerates, with overlain siltstones and sandstones. The area between the Santa Ana Mountains and the Pacific Ocean is composed of a younger sedimentary bedrock, including siltstones, mudstones, conglomerates, limestones, shales, and marine and nonmarine sandstones, overlaid by Holocene stream channel deposits and Quaternary stream terrace deposits (SMCC 2023). There are three processes that have fundamentally affected the structure of the watershed during the past two million years:

- Soils historically formed under vastly different climate conditions, which promoted the development of hardpan mesas that now channel water flow into headwater streams of SMC (SWRCB 2005).
- Continuing uplift of usually 400 feet or more created four major stream terrace levels along the major streams of the SMC Watershed (SWRCB 2005).

- Downcutting of the main canyons to sea levels with young, soft materials prone to incision (SWRCB 2005).

1.2.2.3. Soils

Over 200 soil series are found in the SMC Watershed (Figure 4), and soil textures vary widely from loamy sands to sands in the mountains, to sandy and silty loams in the foothills, and sandy clays in the coastal plain (Soil Survey Staff 2024; SMCC 2023).

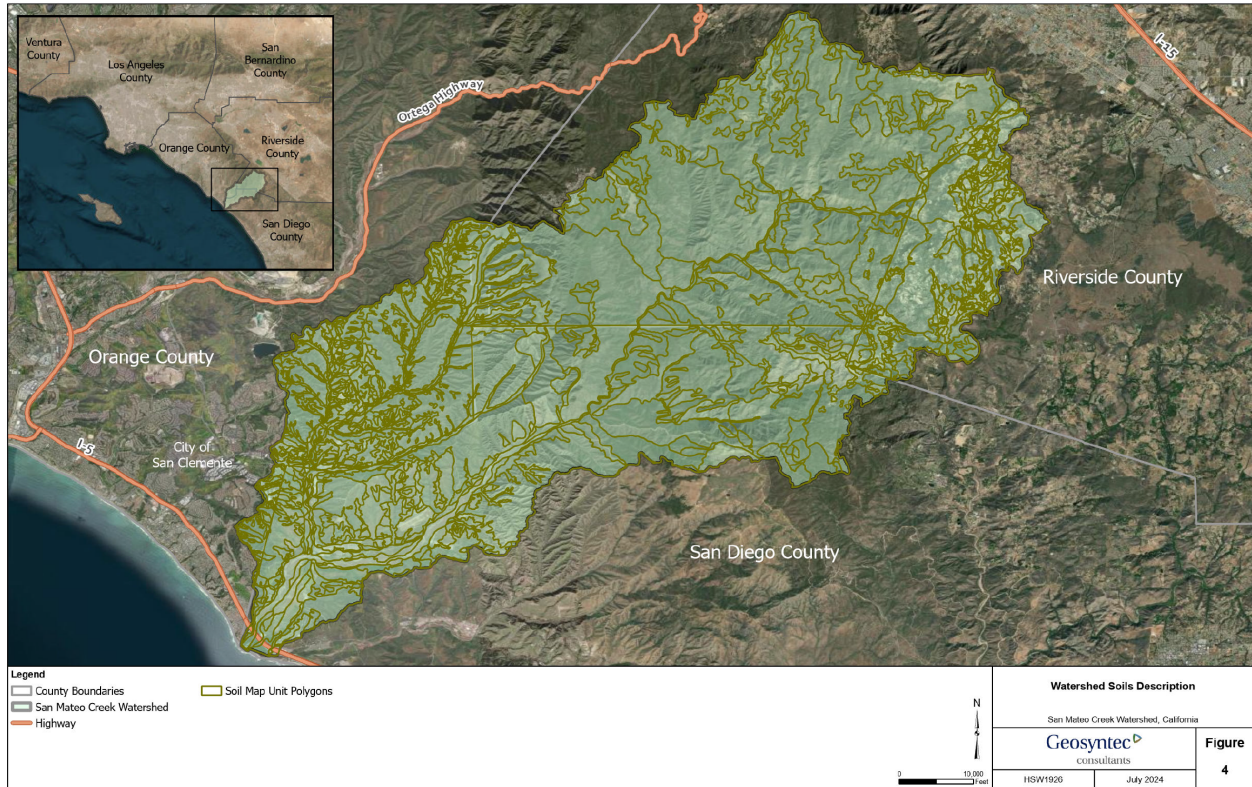


Figure 4: Watershed Soils Description

The coarser textures in the headwaters of the watershed play an important hydrologic regulation role by infiltrating stormwater and recharging groundwater. Rock outcrops, boulders, and shallow depths to confining layers are common throughout the upper portion of the watershed (SMCC 2023). Soils are generally classified as hydrologic soil types C and D for poorly infiltrating soils (SWRCB 2005).

1.2.2.4. Hydrology

The SMC Watershed is in the SDRWQCB San Juan Hydrologic Unit (HUC-10: 1807030102). Two main drainage systems join in the lower stream valley to form broad alluvial plains as they approach the Pacific Ocean (SWRCB 2005; USMC 2023). Major tributaries to the SMC include Cristianitos Creek, Gabino Creek, La Paz Creek, Talega Creek, Cold Spring Creek, and Devils Canyon Creek, with other named creeks/canyons including Bluewater, Tenaja, Wildhorse, and Los Alamos (SMCC 2023) (Figure 1). As the streams meet the Pacific Ocean, narrow tidal barriers and sand bars form estuarine lagoons that are breached during storm event high flows, creating a passage for anadromous species to enter the watershed (USMC 2023). Due to the

Mediterranean climate, the SMC exhibits wide seasonal and annual variation, and it is common for the SMC to experience extremely low flows or be dry from July to October (SMCC 2023).

The main channel of SMC flows across a sandy flat floodplain near the mouth of the creek. There are three main types of flow in the floodplains in the watershed: flood flow over open floodplains; groundwater discharge to springs and seeps; and precipitation combined with overbank flooding (Lichvar et al. 2000; SMCC 2023). The United States Geological Survey (USGS) maintains two flow monitoring gauges in the SMC Watershed (station numbers 11046360 and 11046300). Most mapped wetlands and the 1% annual Federal Emergency Management Agency (FEMA) floodplain occur within MCBCP and San Onofre State Beach (Figure 5).

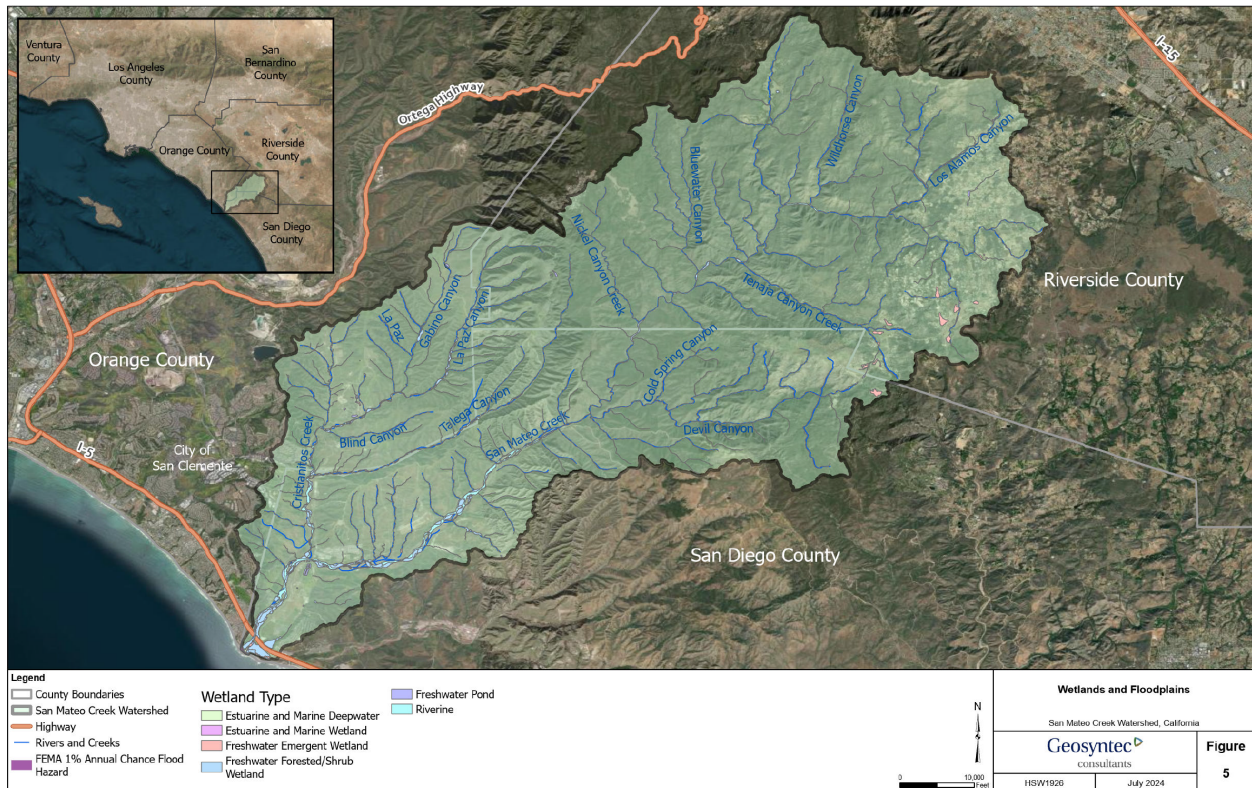


Figure 5: Wetlands and Floodplains

1.2.3. Cultural History and Resources

The Acjachemen (Juaneño) People are the original inhabitants of lands that have become OC, as well as parts of San Diego, Los Angeles, and Riverside Counties (Juaneño Band of Mission Indians 2022), though there was some overlap with the Kumeyaay, Luiseños, Cahuilla, and Cupeño tribes who also inhabited lands in the watershed (SMCC 2023). The total tribe population exceeded 3,900 people before European expansion and spread across over 20 distinct village locations (O’Neil 2014). Each village had its own characteristic resources and were politically independent from one another. Ties to other villages were kept through religious, economic, and social networks (Juaneño Band of Mission Indians 2022). Diets of each village were unique depending on their relative location to the ocean. Villages close to the coast would survive off aquatic animals (including Southern steelhead, shellfish, and marine mammals),

while villages farther inland relied on rabbits and antelope deer for their food. Both territories were rich in edible roots, leaves, berries, and seeds (O’Neil 2014).

Historians and anthropologists have characterized the historical inhabitation of Southern California into several periods, which include the Mission Period (1769–1820), Rancho Period (1821–1846), Pioneer Period (1846–1890), and the Contemporary Period (1891–current) (SMCC 2023). The Mission Period began in 1769, when Junipero Serra and Gaspar de Portolá led Spanish mission expeditions that founded settlements from San Diego to Monterey. The Spanish had expertise in aqueducts, and they constructed a large network of them throughout California. They drew from surface water sources to water extensive gardens, orchards, and vineyards. In 1775, Spanish colonists built a cross on an Acjachemen religious site and then returned in 1776 to begin converting the Acjachemen population (Juaneño Band of Mission Indians 2022). The Acjachemen people resisted assimilation by practicing their religious and cultural ceremonies, and, although the Spanish retaliated by taking Acjachemen children away from their families and placing them into dormitories in the missions, the Spanish’s attempts to convert the Acjachemen people were largely unsuccessful (Juaneño Band of Mission Indians 2022). The missions thrived until Mexico became independent from Spain in 1821. The Mission San Juan Capistrano was the focus of the European settlement of the SMC Watershed (SMCC 2023).

The Mission Period ended in 1833 with the passing of the Secularization Act, which substantially reduced mission-owned lands. This allowed private ranchers to settle on large areas of land that were previously part of the mission system and marked the beginning of the Rancho Period. During this period, land within the watershed was divided into large Mexican land grants called "ranchos," which provided grazing for cattle and sheep. Ranching became the main activity in the watershed. Rancheros cleared trees and brush for fences and burned underbrush to improve grazing conditions. Ranching remained the dominant land use activity in the area until the early 20th century (SMCC 2023).

1.2.3.1. Fire History

During the Rancho period, rancheros cleared underbrush with fires to improve foraging conditions. Pioneer settlers in the late 1860s used fires to clear larger expanses of brush to make way for mineral exploration (SMCC 2023). Economic priorities shifted to mining and logging, leading to fire being overused and uncontrollable fires that burned for weeks at a time. Fires in the 1870s and 1880s were so severe that the California Forestry Commission requested special protection of the SMC Watershed and its resources (SMCC 2023).

In 1948, the Stuart Fire burned much of the watershed, and steelhead were not reportedly observed again until 1950 by the California Department of Fish and Wildlife (CDFW) (USFWS 1998). More recently, wildfires started from anthropogenic influence (camping, arson, roadways, etc.) occur frequently in the SMC Watershed (SWRCB 2005). On MCBCP, an average of 12,000 acres per year were burned from 1973 to 2022 (USMC 2023). Most of the fires on MCBCP were related to missions (e.g., caused by explosions and firing weapons), while the rest were caused by ignitions and utilities (USMC 2023).

1.2.4. Land Use and Existing Structures

The current land use within the watershed was largely shaped by the Forest Reserve Act of 1891 that established the boundaries of the CNF and eliminated illegal timber cutting and mining (SMCC 2023). Additional alterations to the watershed began in the 1930's, and USMC currently maintains housing, warehousing, and training grounds across lower portions of the watershed. In 1984, portions of the upper watershed were designated as the San Mateo Canyon Wilderness, which prohibited the construction of roads and structures and limited vehicle access in favor of public recreation such as camping, hiking, and hunting (SMCC 2023).

Today, approximately 90% of the SMC Watershed is undeveloped and situated on public land (California Trout 2024a). The remaining 10% of private lands span the upper watershed in western Riverside County and the southeastern watershed across southern Orange County and the City of San Clemente (Figure 2). Much of the private land in Orange County is medium-density suburban housing and includes developments such as golf courses and city parks. Private land in Riverside County consists of primarily low-density rural residential housing and agriculture. Reviews of satellite imagery have identified 92 individual properties with private ponds within the SMC Watershed, located primarily in the developed Riverside County area, though there may be additional unreported ponds (Figure 6). Many of these private ponds are stocked with exotic aquatic species intended for private recreational use, though their unsuccessful containment has led to their proliferation throughout the watershed (California Trout 2024a).

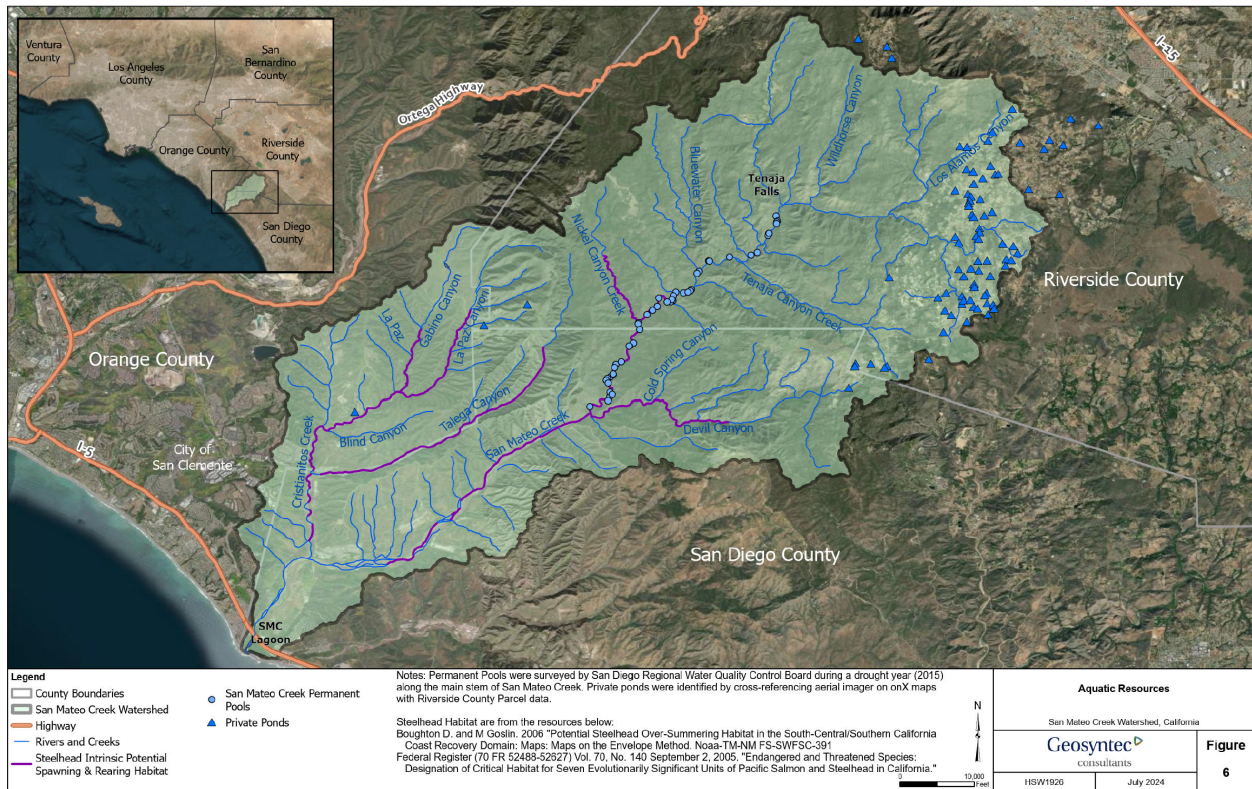


Figure 6: Aquatic Resources

Several major roads cross over SMC, including Interstate-5, San Mateo Drive, and Talega Road, as well as a few smaller access roads and unpaved roads used by USMC on MCBCP. Road crossing structures may be barriers to both adult and juvenile southern California steelhead (Wilcox 2012). Camping and hiking are allowed in San Onofre State Park, San Mateo Campground, and the CNF, and some hiking trails are present in parts of the City of San Clemente.

MCBCP operates groundwater wells on the lower portion of SMC to supply water to several military camps (USMC 2023). Groundwater use and over-pumping throughout the watershed could pose a problem for steelhead populations during times of drought, as steelhead rely on groundwater-supplied perennial pools for spawning and rearing habitat (National Marine and Fisheries Service [NMFS] 2022) (Figure 6).

1.3. Existing Ecological Conditions

1.3.1. Habitat and Species Distributions

Five main vegetative communities within the SMC Watershed include mixed chaparral, oak woodland, annual grassland, coastal sage scrub, and riparian (SMCC 2023). Their general description and distributions are summarized below in Table 1-6.

Table 1-6: Main Habitat Types in the San Mateo Creek Watershed

Habitat Type	Distribution
Mixed Chaparral	Upper SMC; Canyons of the CNF
Oak Woodland	Cristianitos Creek; MCBCP
Annual Grassland	Cristianitos Creek
Coastal Sage Scrub	Coastal hills throughout
Riparian	Lower SMC; Canyon bottoms and creek channels

Source: SMCC 2023

Other important habitat types and land cover include cliff/rock, open water, marsh, and non-natural land cover such as agriculture, disturbed habitat, and developed habitat (SWRCB 2005). While comprehensive plant and animal species inventories of the entire watershed have not been conducted, 1,015 plant species and 559 animal species have been documented on MCBCP alone, including numerous federal- and state-listed threatened and endangered species (USMC 2023; SMCC 2023). Tabulated records of habitat found in MCBCP can be found in Appendix D of the 2023 INRMP (USMC 2023).

1.3.1.1. Vegetation

Detailed floristic surveys have been conducted in MCBCP and parts of the San Mateo Canyon Wilderness inside the CNF. For MCBCP, 1,015 plant species were identified, including state-listed species, and are documented in Appendices E and K of the MCBCP INRMP, with non-native plant species described in Appendix L (USMC 2023). In 1995, Boyd et al. identified 626 vascular plant species in the San Mateo County Wilderness, and a focused survey in the central portion of Lucas Canyon conducted in 2014, expanding on the 1995 efforts, identified 206 individual plant taxa, with 81% (185) considered native and the remaining 19% (40) considered

non-native (Vanderhoff et al. 2014). A summary of common vegetative species found in various habitats of the SMC Watershed is summarized in Table 1-7.

Table 1-7: Common Vegetative Species in the San Mateo Creek Watershed

Habitat Type	Common Plants
Mixed Chaparral	<ul style="list-style-type: none"> - Chamise (<i>Adenostoma fasciculatum</i>) - Scrub Oak (<i>Quercus berberidifolia</i>) - Foothill Ash (<i>Fraxinus dipetala</i>) - Manzanita (<i>Arctostaphylos spp.</i>) - California Lilac (<i>Ceanothus spp.</i>) - California Coffeeberry (<i>Frangula californica</i>) - Birchleaf Mountain Mahogany (<i>Cercocarpus montanus</i>) - Toyon (<i>Heteromeles arbutifolia</i>)
Oak Woodland	<ul style="list-style-type: none"> - Coastal Live Oak (<i>Quercus agrifolia</i>) - Interior Live Oak (<i>Quercus wislizeni</i>) - California Walnut (<i>Juglans californica</i>) - Engelmann Oak (<i>Quercus engelmannii</i>)
Annual Grassland	<ul style="list-style-type: none"> - Non-Native Grasses - Wild Oats (<i>Avena fatua</i>) - Wild Barley (<i>Hordeum murinum ssp. leporinum</i>) - Valley Needlegrass (<i>Nassella spp.</i>)
Coastal Sage Scrub	<ul style="list-style-type: none"> - California Buckwheat (<i>Eriogonum fasciculatum</i>) - California Sagebrush (<i>Artemisia californica</i>) - Black Sage (<i>Salvia mellifera</i>) - Prickly Pear Cactus (<i>Opuntia spp.</i>) - Our Lord’s Candle (<i>Hesperoyucca whipplei</i>) - California Brittlebush (<i>Encelia californica</i>) - Lemonade-Berry (<i>Rhus integrifolia</i>)
Riparian	<ul style="list-style-type: none"> - Western Sycamore (<i>Platanus racemora</i>) - White Alder (<i>Alnus rhombifolia</i>) - Canyon Live Oak (<i>Quercys chrysolepis</i>) - Big Leaf Maple (<i>Acer macrophyllum</i>) - Foothill Ash (<i>Fraxinus dipetala</i>) - Willows (<i>Salix spp.</i>) - Pacific Poison Oak (<i>Toxicodendron diversilobum</i>) - Wild Rose (<i>Rosa californica</i>) - California Blackberry (<i>Rubus ursinus</i>) - California Wild Grape (<i>Vitis californica</i>) - Tamarisk (<i>Tamarisk spp.</i>) - Cottonwood (<i>Populus fremontii</i>)
Cliff/Rock	<ul style="list-style-type: none"> - Desert Thorn (<i>Lycium californicum</i>)

Habitat Type	Common Plants
	<ul style="list-style-type: none"> - Big Saltbush (<i>Atriplex lentiformis</i>) - Bluff Buckwheat (<i>Eriogonum parvifolium</i>) - California Goldenbush (<i>Isocoma menziesii</i>) - Bladderpod (<i>Peritoma arborea</i>) - Sticky Dudleya (<i>Dudleya viscida</i>) - California Brickellbush (<i>Brickellia californica</i>) - Laurel Sumac (<i>Malosma laurina</i>)
Wetlands/Marsh	<ul style="list-style-type: none"> - Cattail (<i>Typha spp.</i>) - Bulrush (<i>Schoenoplectus spp.</i>) - Sedges (<i>Carex spp.</i>) - Salt Marsh Fleabane (<i>Pluchea odorata</i>) - Alkali Heath (<i>Frankenia salina</i>) - Pacific Pickleweed (<i>Sarcocornia pacifica</i>) - Alkali Weed (<i>Cressa truxillensis</i>)

Sources: Boyd et al. 1995; ICF 2016; SMCC 2023; USMC 2023

Monitoring of wetland vegetative community health via the California Rapid Assessment Method (CRAM) has been done throughout the SMC Watershed since 2009 at approximately 10 unique monitoring sites (Figure 7; Table 1-8). It is common for the SMC Watershed to outperform regional reference sites in the CRAM Index score.

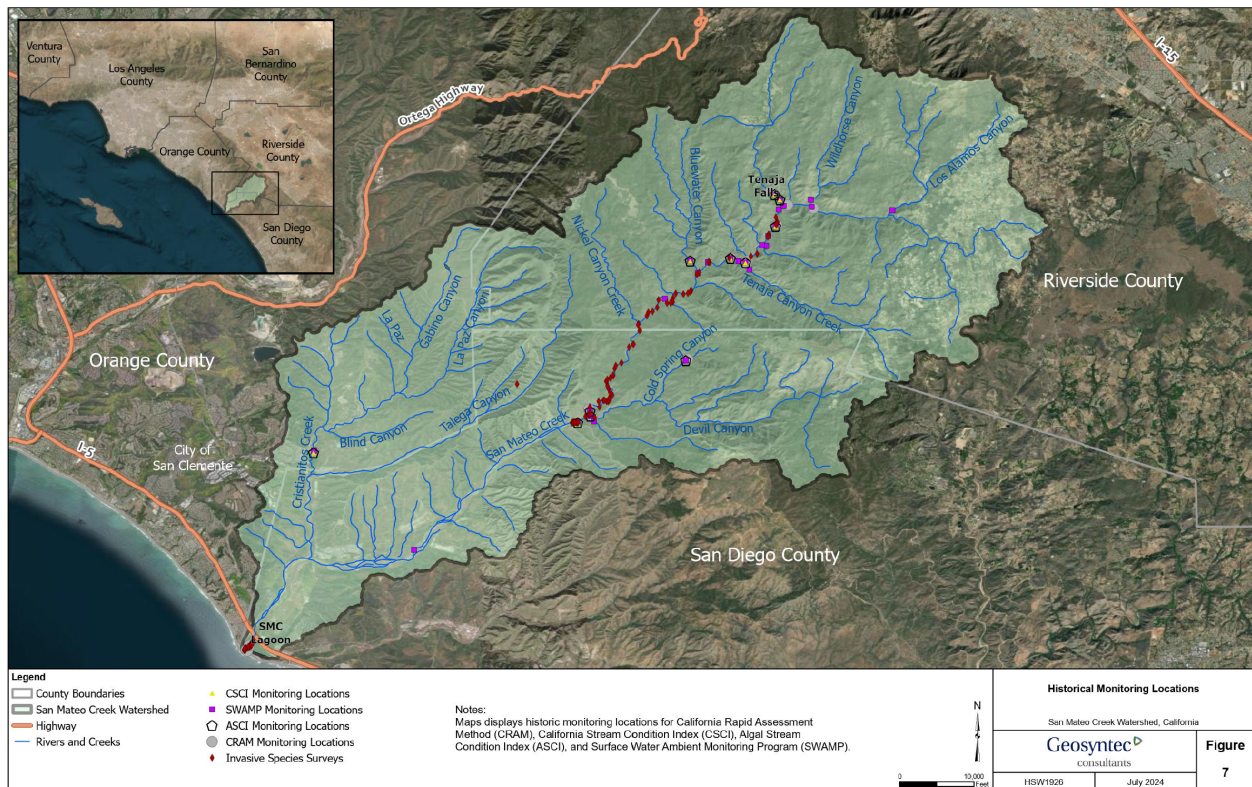


Figure 7: Historical Monitoring Locations

Table 1-8: Location of CRAM Monitoring Sites in the San Mateo Creek Watershed

CRAM Location	Longitude	Latitude	Index Score	Sample Date
San Mateo (Trestles)	-117.59371	33.38617	76	5-31-2012
San Mateo Lagoon #1	-117.59325	33.38587	72	10-6-2015
San Mateo Lagoon #2	-117.59195	33.38852	70	10-6-2015
San Mateo #2 (Upstream)	-117.5925	33.38792	70	10-6-2015
San Mateo Canyon Creek	-117.46644	33.47564	92	5-16-2011
Devils Canyon Creek	-117.46526	33.47269	84	5-16-2011
Cold Spring Canyon Creek	-117.42993	33.49422	87	6-1-2011
San Mateo Canyon Creek	-117.40846	33.52998	93	5-9-2017
San Mateo Canyon Creek	-117.40774	33.53064	88	6-3-2009
San Mateo Canyon Creek	-117.41377	33.53167	98	5-31-2011
San Mateo Creek 0469	-117.40813	33.52982	92	4-6-2021
San Mateo Creek 2873	-117.39722	33.54377	90	4-7-2021
San Mateo Creek 2873	-117.39688	33.54389	93	6-10-2010
San Mateo Creek 6969	-117.39286	33.55135	90	6-20-2012
San Mateo Creek 1849	-117.39919	33.55652	95	6-10-2010
Los Alamos Creek	-117.3833	33.55022	88	4-6-2021

Source: San Francisco Estuary Institute 2024

Special Status Plant Species

Due to the largely undeveloped nature of the SMC Watershed, it is home to a large variety of special status species. While comprehensive plant species inventories of the entire watershed have not been conducted, known species with federal, state, and California Native Plant Society (CNPS) special status listings have been documented in the MCBCP 2023 INRMP and by SMCC (SMCC 2023; USMC 2023). These species are summarized below in Table 1-9, and known special status plant species distributions in MCBCP are shown in **Figure 3-13** of the 2023 INRMP (USMC 2023).

Table 1-9: Special Status Plant Species in the San Mateo Creek Watershed

Scientific Name	Common Name	Federal Status	State Status	CNPS
<i>Abronia maritima</i>	red sand-verbena		SP	4.2
<i>Abronia villosa var. aurita</i>	chaparral sand-verbena		SP	1B.1
<i>Acemison prostratus</i>	Nuttall's acemison		SP	1B.1
<i>Aphanisma blitoides</i>	Aphanisma		SP	1B.2
<i>Arctostaphylos rainbowensis</i>	Rainbow manzanita		SP	1B.1
<i>Artemisia palmeri</i>	San Diego sagewort		SP	4.2
<i>Asplenium vespertinum</i>	western spleenwort		SP	4.2

Scientific Name	Common Name	Federal Status	State Status	CNPS
<i>Atriplex coulteri</i>	Coulter's saltbush		SP	1B.2
<i>Atriplex pacifica</i>	South Coast saltscale		SP	1B.2
<i>Baccharis vanessae</i>	Encinitas baccharis	FT	SE	1B.1
<i>Bahiopsis laciniata</i>	San Diego County viguiera		SP	4.2
<i>Brodiaea filifolia</i>	thread-leaved brodiaea	FT	SE	1B.1
<i>Brodiaea orcuttii</i>	Orcutt's brodiaea		SP	1B.1
<i>Calandrinia breweri</i>	Brewer's calandrinia		SP	4.2
<i>Calandrinia maritime</i>	Seaside calandrinia			4
<i>Calochortus catalinae</i>	Catalina mariposa lily		SP	4.2
<i>Calochortus weedii var. intermedius</i>	Intermediate mariposa lily			1B
<i>Calystegia soldanella</i>	beach morning-glory			CBR
<i>Camissoniopsis lewisii</i>	Lewis' evening-primrose		SP	3
<i>Caulanthus simulans</i>	Payson's jewel-flower		SP	4.2
<i>Centromadia parryi ssp. australis</i>	southern tarplant		SP	1B.1
<i>Centromadia pungens ssp. laevis</i>	smooth tarplant		SP	1B.1
<i>Chamaebatia australis</i>	southern mountain misery		SP	4.2
<i>Chorizanthe polygonoides var. longispina</i>	knotweed spineflower		SP	1B.2
<i>Cistanthe maritima</i>	seaside cistanthe		SP	4.2
<i>Comarostaphylis diversifolia ssp. diversifolia</i>	summer-holly		SP	1B.2
<i>Convolvulus simulans</i>	small-flowered morning-glory		SP	4.2
<i>Deinandra paniculata</i>	paniculate tarplant		SP	4.2
<i>Dichondra occidentalis</i>	western dichondra		SP	4.2
<i>Dudleya blochmaniae ssp. blochmaniae</i>	Blochman's dudleya		SP	1B.1
<i>Dudleya multicaulis</i>	many-stemmed dudleya		SP	1B.2
<i>Dudleya variegata</i>	variegated dudleya		SP	1B.2
<i>Dudleya viscida</i>	sticky dudleya		SP	1B.2
<i>Eriogonum giganteum var. giganteum</i>	Santa Catalina Island buckwheat		SP	4.3
<i>Eryngium aristulatum var. parishii</i>	San Diego button-celery	FE	SE	1B.1
<i>Eryngium pendletonense</i>	Pendleton button-celery		SP	1B.1
<i>Erysimum aff. ammophilum</i>	sand-loving wallflower		SP	1B.2
<i>Euphorbia misera</i>	Cliff spurge			2
<i>Harpagonella palmeri</i>	Palmer's grapplinghook		SP	4.2
<i>Holocarpha virgata ssp. elongata</i>	graceful tarplant		SP	4.2
<i>Hordeum intercedens</i>	vernal barley		SP	3.2

Scientific Name	Common Name	Federal Status	State Status	CNPS
<i>Horkelia cuneata ssp. puberula</i>	mesa horkelia		SP	1B.1
<i>Horkelia truncata</i>	Ramona horkelia		SP	1B.3
<i>Isocoma menziesii var. decumbens</i>	decumbent goldenbush		SP	1B.2
<i>Iva hayesiana</i>	San Diego marsh-elder		SP	2B.2
<i>Juncus acutus ssp. leopoldii</i>	southwestern spiny rush		SP	4.2
<i>Lasthenia glabrata ssp. coulteri</i>	Coulter's goldfields		SP	1B.1
<i>Lepidium virginicum var. robinsonii</i>	Robinson's pepper-grass		SP	4.3
<i>Leptosyne maritima</i>	sea dahlia		SP	2B.2
<i>Lilium humboldtii ssp. ocellatum</i>	ocellated Humboldt lily		SP	4.2
<i>Lotus nuttallianus</i>	Nuttal's lotus			1B
<i>Lycium californicum</i>	California box-thorn		SP	4.2
<i>Microseris douglasii ssp. platycarpha</i>	small-flowered microseris		SP	4.2
<i>Monardella hypoleuca ssp. intermedia</i>	intermediate monardella		SP	1B.3
<i>Myosurus minimus ssp. apus</i>	little mousetail		SP	3.1
<i>Nama stenocarpa</i>	Mud nama			2
<i>Navarretia fossalis</i>	spreading navarretia	FT	SP	1B.1
<i>Navarretia prostrata</i>	prostrate vernal pool navarretia		SP	1B.1
<i>Nemacaulis denudata var. denudata</i>	coast woolly-heads		SP	1B.2
<i>Nolina cismontana</i>	chaparral nolina		SP	1B.2
<i>Ophioglossum californicum</i>	California adder's-tongue		SP	4.2
<i>Orcuttia californica</i>	California Orcutt grass	FE	SE	
<i>Orobanche parishii ssp. brachyloba</i>	short-lobed broomrape		SP	4.2
<i>Pentachaeta aurea ssp. aurea</i>	golden-rayed pentachaeta		SP	4.2
<i>Phacelia stellaris</i>	Brand's phacelia		SP	1B.1
<i>Pickeringia montana var. tomentosa</i>	woolly chaparral-pea		SP	4.3
<i>Pinus torreyana</i>	Torrey pine		SP	1B.2
<i>Piperia cooperi</i>	chaparral rein orchid		SP	4.2
<i>Polygala cornuta var. fishiae</i>	Fish's milkwort			4
<i>Pseudognaphalium leucocephalum</i>	white rabbit-tobacco		SP	2B.2
<i>Quercus dumosa</i>	Nuttall's scrub oak		SP	1B.1
<i>Quercus engelmannii</i>	Engelmann oak		SP	4.2
<i>Rhinotropis cornuta var. fishiae (=Polygala cornuta var. fishiae)</i>	Fish's milkwort		SP	4.3
<i>Romneya coulteri</i>	Coulter's matilija poppy		SP	4.2
<i>Saltugilia caruifolia</i>	caraway-leaved woodland-gilia		SP	4.3
<i>Salvia munzii</i>	Munz's Sage		SP	2B.2

Scientific Name	Common Name	Federal Status	State Status	CNPS
<i>Selaginella cinerascens</i>	ashy spike-moss		SP	4.1
<i>Senecio aphanactis</i>	california groundsel; chaparral ragwort		SP	2B.2
<i>Suaeda esteroa</i>	estuary seablite		SP	1B.2
<i>Suaeda taxifolia</i>	woolly seablite		SP	4.2
<i>Viguiera lanciniata</i>	San Diego County viguiera			4
<i>Viguiera purisimae</i>	La Purisima viguiera		SP	2B.3

Source: California Natural Diversity Database (CNDDDB) 2024; SMCC 2023; USMC 2023

FC (Federal Candidate); FE (Federally Endangered); FT (Federally Threatened); SC (State Candidate); SD (State Delisted); SE (State Endangered); ST (State Threatened); CP (California Protected); CFP (California Fully Protected); CSSC (California Species of Special Concern); SP (Special Vascular Plants)

California Rare Plant Ranks: 1A (plants presumed extirpated in California and either rare or extinct elsewhere); 1B (plants rare, threatened, or endangered in California and elsewhere); 2A (plants presumed extirpated in California but common elsewhere); 2B (plants rare, threatened, or endangered in California but more common elsewhere); 3 (plants about which more information is needed), 4 (Plants of limited distribution)

1.3.1.2. Animals

Detailed animal species surveys have been conducted in MCBCP and parts of the San Mateo Canyon Wilderness inside the CNF. Results for MCBCP indicate there are 559 unique animal species, including state-listed species. These species are documented in Appendices F and K of the MCBCP INRMP (USMC 2023). The Wilderness Institute at the University of Montana estimates that over 229 unique animal species inhabit the San Mateo Canyon Wilderness, including 139 bird species, 37 mammal species, 46 reptile and amphibian species, and 7 species of fish (University of Montana 2024).

Special Status Animal Species

The SMC Watershed provides refuge for at least seven federally threatened and endangered animal species, as well as numerous other special status species. The California newt, arroyo chub, southwestern pond turtle, and the Southern California steelhead have all been observed in the watershed and would benefit from the removal of non-native aquatic species (SDRWQCB 2023). The arroyo toad has been observed in the main stem as well as some of the intermittent tributaries of SMC, and the tidewater goby has been documented inhabiting the San Mateo Lagoon at the mouth of the creek (SDRWQCB 2023). The habitat for the tidewater goby is located within MCBCP and encompasses approximately 4 to 6 hectares in the San Mateo Lagoon (USFWS 2005). The arroyo toad has been observed commonly inhabiting the upper areas of SMC and in the sandy regions of the SMC tributaries, and, as such, the upper SMC has been designated as critical habitat (USFWS 1998).

While comprehensive animal species inventories of the entire watershed have not been conducted, known species with federal, state, and other special status listings have been documented in the MCBCP 2023 INRMP and by SMCC (SMCC 2023; USMC 2023). These are summarized below in Table 1-10, and known special status animal species distributions in MCBCP are shown in **Figures 3-6 to 3-12** of the 2023 INRMP (USMC 2023).

Table 1-10: Special Status Animal Species in the San Mateo Creek Watershed

Common Name	Scientific Name	Federal Status	State Status
Riverside Fairy Shrimp	<i>Streptocephalus woottoni</i>	FE	
San Diego Fairy Shrimp	<i>Branchinecta sandiegonensis</i>	FE	
Arroyo Chub	<i>Gila orcutti</i>		CSSC
Pacific Lamprey	<i>Entosphenus tridentatus</i>		CSSC
Southern California Steelhead	<i>Oncorhynchus mykiss irideus</i>	FE	SE
Southern Tidewater Goby	<i>Eucyclogobius kristinae</i>	FE	
Arroyo Toad	<i>Anaxyrus californicus</i>	FE	
California Newt	<i>Taricha torosa</i>		CSSC
Coast Range Newt	<i>Taricha torosa torosa</i>		CSSC
Western Spadefoot	<i>Spea hammondi</i>	FC	CSSC
Belding's Orange-throated Whiptail	<i>Aspidoscelis hyperythra beldingi</i>		
Blainville's Horned Lizard	<i>Phrynosoma blainvillii</i>		CP, CSSC
California Glossy Snake	<i>Arizona elegans occidentalis</i>		CP, CSSC
Coast Patch-nosed Snake	<i>Salvadora hexalepis virgultea</i>		CSSC
Southwestern Pond Turtle	<i>Actinemys pallida</i>	FC	CSSC
Red Diamond Rattlesnake	<i>Crotalus ruber</i>		CSSC
Rosy Boa	<i>Lichanura orcutti</i>		
San Diegan Legless Lizard	<i>Anniella stebbinsi</i>		CSSC
San Diego Banded Gecko	<i>Coleonyx variegatus abbotti</i>		CCSC
San Diego Ring-necked Snake	<i>Diadophis punctatus similis</i>		
South Coast Garter Snake	<i>Thamnophis sirtalis ssp.nov.</i>		CSSC
Two-striped Garter Snake	<i>Thamnophis hammondi</i>		CSSC
American Peregrine Falcon	<i>Falco peregrinus anatum</i>		
American White Pelican	<i>Pelecanus erythrorhynchos</i>		CSSC
Baird's Sandpiper	<i>Calidris bairdii</i>		CSSC
Bald Eagle	<i>Haliaeetus leucocephalus</i>		SE, CFP
Bank Swallow	<i>Riparia riparia</i>		ST
Bell's Sage Sparrow	<i>Amphispiza belli belli</i>		CSSC
Belding's Savannah Sparrow	<i>Passerculus sandwichensis beldingi</i>		SE
Black Skimmer	<i>Rynchops nigra</i>		CSSC
Black Tern	<i>Chlidonias niger</i>		CSSC
Burrowing Owl	<i>Athene cunicularia</i>		CSSC
California Brown Pelican	<i>Pelecanus occidentalis californicus</i>		SD
California Horned Lark	<i>Eremophila alpestris actia</i>		CSSC

Common Name	Scientific Name	Federal Status	State Status
California Gull	<i>Larus californicus</i>		CSSC
California Least Tern	<i>Sternula antillarum browni</i>	FE	SE
Coastal Cactus Wren	<i>Campylorhynchus brunneicapillus sandiegoense</i>		CSSC
Coastal California Gnatcatcher	<i>Polioptila californica californica</i>	FT	CSSC
Common Loon	<i>Gavia immer</i>		CSSC
Cooper's Hawk	<i>Accipiter cooperii</i>		CSSC
Double-crested Cormorant	<i>Phalacrocorax auritus</i>		CSSC
Elegant Tern	<i>Sterna elegans</i>		CSSC
Ferruginous Hawk	<i>Buteo regalis</i>		CSSC
Golden Eagle	<i>Aquila chrysaetos</i>		CFP, CSSC
Hooded Oriole	<i>Icterus cucullatus</i>		CSSC
Least Bell's Vireo	<i>Vireo bellii pusillus</i>	FE	SE
Least Bittern	<i>Ixobrychus exilis</i>		CSSC
Light-footed Ridgway's Rail	<i>Rallus obsoletus levipes</i>	FE	SE
Loggerhead Shrike	<i>Lanius ludovicianus</i>		CSSC
Long-billed Curlew	<i>Numenius americanus</i>		CSSC
Long-eared Owl	<i>Asio otus</i>		CSSC
Merlin	<i>Falco columbarius</i>		CSSC
Northern Harrier	<i>Circus cyaneus</i>		CSSC
Osprey	<i>Pandion haliaetus</i>		CSSC
Prairie Falcon	<i>Falco mexicanus</i>		CSSC
Purple Martin	<i>Progne subis</i>		CSSC
Sharp-shinned Hawk	<i>Accipiter striatus</i>		CSSC
Short-eared Owl	<i>Asio flammeus</i>		CSSC
Southern California Rufous-crowned Sparrow	<i>Aimophila ruficeps canescens</i>		CSSC
Southwestern Willow Flycatcher	<i>Empidonax traillii extimus</i>	FE	SE
Swainson's Hawk	<i>Buteo swainsoni</i>		ST
Tricolored Blackbird	<i>Agelaius tricolor</i>		ST
Vaux's Swift	<i>Chaetura vauxi</i>		CSSC
Western Snowy Plover	<i>Charadrius alexandrinus nivosus</i>	FT	CSSC
White-faced Ibis	<i>Plegadis chihi</i>		CSSC
White-tailed Kite	<i>Elanus leucurus</i>		CFP
Wood Stork	<i>Mycteria americana</i>		CSSC

Common Name	Scientific Name	Federal Status	State Status
Yellow-billed Cuckoo Western DPS	<i>Coccyzus americanus</i>	FT	SE
Yellow Warbler	<i>Dendroica petechia</i>		CSSC
American Badger	<i>Taxidea taxus</i>		CSSC
California Sea Lion	<i>Zalophus californianus</i>		CP
Dulzura (California) Pocket Mouse	<i>Chaetodipus californicus femoralis</i>		CSSC
Mountain Lion	<i>Puma concolor</i>		SC
Northern Elephant Seal	<i>Mirounga angustirostris</i>		CP, CFP
Pallid Bat	<i>Antrozous pallidus</i>		CSSC
Pacific Pocket Mouse	<i>Perognathus longimembris pacificus</i>	FE	
San Diego Black-tailed Jackrabbit	<i>Lepus californicus bennettii</i>		CSSC
Bryant's Woodrat	<i>Neotoma bryanti intermedia</i>		CSSC
Stephens' Kangaroo Rat	<i>Dipodomys stephensi</i>	FT	ST
Western Mastiff Bat	<i>Eumops perotis californicus</i>		CSSC
Western Red Bat	<i>Lasiurus blossewillii</i>		CSSC
Yuma Myotis	<i>Myotis yumanensis</i>		CSSC

Source: CNDDB 2024; SMCC, 2023; USMC 2023.

1.3.1.3. Habitat Connectivity

The connectivity of the watershed is disrupted by a variety of factors, primarily consisting of anthropogenic forces such as roads, residential home development, and military operations, as well as hydrologic factors, including groundwater pumping and low flow conditions (SDRWQCB; SMCC 2023).

Interstate 5 runs through the lower portion of the watershed and has constricted and isolated the historical oxbow geomorphic features and floodplain of the SMC's drainage system, as well as impacted coastal valley hydrologic dynamics (SMCC 2023). Additional roads throughout the SMC Watershed include those named roads on MCBCP (Cristianitos Road, Talega Ridge Road, San Mateo Drive, San Mateo Canyon Road) and those located in the private communities of Riverside County and residential/commercial developments of the City of San Clemente. Military operations within MCBCP are carefully planned, though cantonments, military housing, hazardous waste storage, artillery firing, live firing and maneuvering, and general training all occur within the SMC portion of MCBCP that may lead to disruption of wildlife and habitat through noise or physical disturbance (USMC 2023). MCBCP does maintain Range Standard Operating Procedures including training restrictions based on proximity to sensitive habitat and designated stream crossing locations to minimize adverse impacts to wildlife and habitat.

The hydrology of SMC Watershed plays a critical role in the connectivity of habitat for native species, particularly the southern steelhead. During the summer and early fall dry season in the SMC Watershed, there are no continuous surface flows in the creek, but perennial pools supported by subsurface springs and flows are present, providing some habitat for steelhead (SDRWQCB 2023). Drought conditions reduce the amount of water in the stream and its

tributaries, limiting the steelhead to small, disconnected perennial pools largely in the middle to upper reaches of the creek (Figure 6). These pools may exhibit increases in temperature and decreases in dissolved oxygen due to low water levels and limited turbulence (SDRWQCB 2023). Becoming isolated in these perennial pools during extended droughts can often be fatal for steelhead.

USMC started pumping groundwater from the area for use at the base after 1942. This groundwater pumping resulted in a lowered water table below the creek channel and created dry reaches of SMC that historically had flow for longer periods of the year (SMCC 2023), which has eliminated or hindered steelhead migrations, trapping steelhead in pools and preventing their return to sea (SMCC 2023). The rapid lowering of groundwater has also led to increased erosion of the creek bank, reduced the depth of the stream channel, and further altered physical habitat and connectivity (SMCC 2023).

1.3.1.4. Water Quality

The water quality of SMC has been assessed by the Surface Water Ambient Monitoring Program (SWAMP) during baseflow conditions, and all the resulting CSCI scores have been above the 0.79 threshold for determining impairment in SMC, except for one result taken in 2009 (SWRCB 2021) (Figure 7, Table 1-11). The San Mateo Canyon above Tenaja Canyon Creek station had a CSCI score of 0.78 in May 2009, but then improved drastically by May 2011 when it received a CSCI score of 1.17. The other CSCI scores for SMC ranged from 0.82 to 1.24, sampled from 2001 to 2012 (SWRCB 2021). In addition to CSCI scores, the main stem of SMC and its tributaries have also been assessed through other bioassessment methods such as the algal stream condition index (ASCI), both of which have returned positive results indicative of a high degree of biological integrity (SDRWQCB 2023).

Table 1-11: Location of CSCI Monitoring Sites in the San Mateo Creek Watershed

CSCI Location	Longitude	Latitude
901CSCADC	-117.431	33.49366
901DCCDCx	-117.465	33.47108
901DCCSMC	-117.466	33.47303
901NP9BWR	-117.429	33.53063
901NP9LAC	-117.384	33.5507
901NP9LAN	-117.354	33.5494
901NP9TNC	-117.407	33.5274
901S00469	-117.409	33.52999
901S01849	-117.398	33.55524
901S04309	-117.466	33.47486
901S04565	-117.414	33.5316
901S06969	-117.396	33.55334
901SJSMT2	-117.396	33.5497
901SJSMT3	-117.471	33.47056
901SMCSMR	-117.531	33.42339

CSCI Location	Longitude	Latitude
901SMCWHC	-117.384	33.55338
CC-CR	-117.568	33.46019
SMC02873	-117.397	33.54344
901USMFCP	-117.401	33.5362

Source: Personal Communication with Chad Loflen of SDRWQCB

While impaired for multiple pollutants (indicator bacteria, dissolved oxygen, invasive species), the presence and proliferation of invasive species in SMC is the primary reason for impairing the RARE, SPWN, and MIGR beneficial uses for southern steelhead and is the main driver for the approved TMDL (SDRWQCB 2023). The presence of aquatic invasive species is due to periodic releases from upstream private ponds (sources) and their instream reproduction and recruitment throughout the SMC Watershed. The TMDL will be implemented through nonregulatory programs by other entities and enforcement of existing regulations using Nonpoint Source Pollution Control Program funding and under direction of the SMC Watershed Management Plan being written by California Trout (SDRWQCB 2023). A summary of the approved TMDL requirements is listed in Table 1-12.

Table 1-12: Main Requirements of the 2024 Approved TMDL for Invasive Species

TMDL Element	Description
Water Body	San Mateo Creek
Impaired Uses	RARE, SPAWN, MIGR
CWA 303(d) Listing	Invasive Species
Causative Pollutant	Invasive Species
Sources	Private ponds Instream reproduction and recruitment
Total Maximum Daily Load	0 invasive aquatic species
Numeric Targets (Summer Dry Season)	0 invasive aquatic species 70 adult steelhead Presence of juvenile steelhead
Load Allocation	0 invasive aquatic species
Waste Load Allocation	Implicit
Implementation Mechanisms	NPS funding Nonregulatory programs by other entities Enforcement of existing regulations
Estimated Attainment Date	2037

Source: SDRWQCB 2023

The instream habitat requirements for steelhead generally include cool temperatures and well oxygenated water for survival, though the Southern California Distinct Population Segment does have some unique adaptations that allow for slightly higher temperature and lower dissolved oxygen levels than other steelhead (SDRWQCB 2023; Boughton et al. 2007; Sloat and

Osterback 2012). Existing data collected in SMC perennial pools suggest that summer water temperatures are sufficient to sustain steelhead (Hovey 2004; Wilcox 2012), though dissolved oxygen levels are unknown.

1.3.1.5. Historical and Existing Management Activities

Some of the earliest documented fish population and aquatic invasive species removal efforts were done in 2003 and 2004 by Trout Unlimited (California Coastal Commission [CCC] 2011). This work included testing removal techniques such as electrofishing, electrofishing with seining, and minnow trapping. A total of 29,310 individuals of various aquatic invasive species were removed from the main stem of SMC in the CNF in 2003 and another 17,089 in 2004.

USMC maintains their own invasive species removal program for MCBCP and contracts with consulting firms to perform field work on their behalf. Invasive species removal techniques employed by Trout Unlimited, USMC, CDFW, and USGS throughout the watershed include bullfrog gigging, seining, dip-netting, electrofishing, fyke nets, and minnow trapping. Data from efforts between 2010 to 2022 are provided below in Table 1-13. Nearly 150,000 individuals have been removed from SMC by Trout Unlimited, USMC, CDFW, and USGS since 2003. Known historical locations of invasive species removals are indicated on Figure 6 and largely overlap with mapped permanent pools (Figure 7).

Table 1-13: Summary of Invasive Species Removal in San Mateo Creek

Agency/Party	Year	SMC Reach	Species	# Removed
Trout Unlimited	2003	CNF	Bullfrog, black bullhead, bluegill, mosquitofish, red swamp crayfish	29,310
	2004			17,089
USMC/ECORP	2010	Lagoon/Lower	Common carp, fathead minnow, mosquitofish, golden shiner, goldfish, green sunfish, bluegill, largemouth bass, black bullhead, brown bullhead, yellow bullhead, yellowfin goby, red swamp crayfish, American bullfrog	877
		Upper		2,465
	2011	Lagoon/Lower	16,979	
		Upper	502	
	2013	Lagoon	235	
		Lower	5,534	
		Middle	11	
	2015	Upper	1,326	
		Lagoon	6,903	
	2016	Upper	111	
		Lagoon	6,418	
	2018	Lagoon	789	
		Upper	288	
	2017	Lagoon	93	
	2019	Lagoon	1,932	
		Middle	744	
	2021a	Upper	2,698	
		Lagoon	1,995	
	2021b	Upper	768	
		Lagoon	1,976	
	2021c	Middle	10	
		Upper	1,045	
		Lagoon	1,726	
2022	Middle	6,026		
	Upper	314		
2023	Lagoon	23,866		
	Upper	920		
USGS	2022	Upper	Common carp, fathead minnow, mosquitofish, golden shiner, goldfish, green sunfish, bluegill, largemouth bass, black bullhead, brown bullhead, yellow bullhead, yellowfin goby, red swamp crayfish, American bullfrog	2
		Tributary		14
	2023	Lagoon		685
		Upper		0
		Tributary		62
CDFW	2015	Deville Canyon	Green sunfish, golden shiner,	12,729
	2016*	Deville Canyon	mosquitofish, red swamp crayfish,	0
	2017*	Upper	black bullhead, bullfrogs	0
	2018*	Upper		4
	2019*	Upper		4

Sources: CCC 2011; CDFW Reports 2024; Unpublished USMC and USGS Data 2024

*Primary purpose of these surveys were for steelhead and habitat observations, not invasive species removals.

1.4. Conservation Threats

The SMC Watershed is unique for a variety of reasons discussed in earlier sections of this report. Its ability to support wildlife and meet its designated beneficial uses depends heavily on the reduction and elimination of conservation threats throughout the watershed, including the introduction of invasive aquatic species, development within the watershed, and climate change. The specific threats described below inhibit the restoration and persistence of steelhead and other sensitive species in the SMC Watershed.

1.4.1. Exotic/Invasive Species

The presence of aquatic invasive species in the SMC Watershed is the most pressing issue affecting steelhead and the causative pollutant for the 2014/2016 CWA 303(d) listing (SDRWQCB 2018). Source populations of aquatic invasive species in the upper watershed, primarily from private stock ponds used for recreation, are introduced to middle and lower reaches of the watershed because of flooding during wet weather events when source populations can traverse downstream (SDRWQCB 2023).

The presence and proliferation of aquatic invasive species result in the competitive exclusion of steelhead through both direct competition for resources, as well as through predation upon juvenile steelhead and preventing recruitment (Hovey 2004). Aquatic invasive species can also lead to the degradation of habitat and water quality through the production of higher water temperatures, lower dissolved oxygen content, higher biological oxygen demand, and excessive algal growth (SDRWQCB 2023).

Common invasive species found in the SMC Watershed are listed in Table 1-14 and include the bullfrog (*Lithobates catesbeianus*), which typically inhabit creeks and the upstream section of the lagoon. Bullfrogs prey on the larvae of arroyo toads, steelhead eggs and juveniles, and southwestern pond turtle hatchlings (SDRWQCB 2023; SMCC 2023). Crayfish also consume arroyo toad larvae. Green sunfish (*Lepomis cyanellus*) can survive in the small pools during the summer and will outcompete young steelhead, tidewater goby, and arroyo chub for resources (SMCC 2023). Invasive giant reed (*Arundo donax*) has the potential to decrease baseflow via transpirational fluxes that can further exacerbate flow conditions for steelhead and other sensitive species (Dudley and Cole 2018).

Table 1-14: Aquatic Invasive Species Found in the San Mateo Creek Watershed

Common Name	Scientific Name
Green Sunfish	<i>Lepomis cyanellus</i>
Golden Shiner	<i>Notemigonus crysoleucas</i>
Bluegill	<i>Lepomis macrochirus</i>
Largemouth Bass	<i>Micropterus salmoides</i>
Bullhead (black & brown)	<i>Ameiurus melas & Ameiurus nebulosus</i>
Bullfrog	<i>Lithobates catesbeianus</i>
Crayfish	<i>Procambarus clarkii</i>

Source: SDRWQCB 2023

1.4.2. Wildlife Diseases

Warm water temperatures and intermittent/stagnant flows, especially during the dry season when steelhead are restricted to disconnected perennial pools, can reduce steelhead fitness and health, making them more susceptible to diseases (Wilcox 2012). The introduction of exotic species and other parasites such as the New Zealand mud snail (*Potamopyrgus antipodarum*) and *Myxobolus cerebralis* into streams of the western United States poses a great disease threat (CCC 2007). There is potential for fisherman to unknowingly spread whirling disease from parasites attached to waders, boots, or other fishing gear that have not been properly disinfected (Montana State University 2024). Whirling disease is often fatal to trout and other salmonoids by damaging fish cartilage or causing infected fish to swim in an uncontrollable manner, as well as by direct mortality of juveniles (CDFW 2011).

1.4.3. Habitat Fragmentation and Degradation

The fragmentation and degradation of habitat within the SMC Watershed are due primarily to development within parts of the watershed for human use that have introduced physical barriers, increased sediment loading in streams, or otherwise altered surface and groundwater hydrology. Historic grazing operations that have diverting stream flows, as well as groundwater pumping, have dropped instream flows and the water table; altered historic migration corridors, flow timing, duration, and magnitude; or completely dewatered stream segments (USMC 1993). Decreased water levels have led to increased bank erosion and the fragmentation of pool habitats that were previously connected and have also trapped steelhead in pools, sometimes with aquatic invasive species who further degrade habitat and water quality (SDRWQCB 2023; SMCC 2023).

Road construction has affected steelhead and other sensitive species through sediment discharges into streams during storms and through erosion from road surfaces and drainage ditch construction (CCC 2007). Additionally, road construction can result in the placement of culverts that physically block steelhead migration, resulting in population isolation.

While baseflow in SMC can persist into late spring and summer, during late summer and the early fall dry season, there are typically no continuous surface flows in the creek, but perennial pools supported by subsurface springs and flows provide some habitat for steelhead (SDRWQCB 2023). This alternating seasonal hydrologic connectivity is common throughout Southern California and is known as an interrupted flow regime. Drought conditions reduce the amount of water in the stream and its tributaries, limiting the steelhead to the small, disconnected perennial pools that can increase in temperature due to the shallowness of the water and hinder steelheads' ability to return to the sea (SDRWQCB 2023).

1.4.4. Climate Considerations

Southern California is expected to experience the effects of climate change through multiple pathways, including altered frequency and intensity of precipitation events, sea level rise, and extended periods of drought and excessive heat (San Diego County 2023). Altered precipitation patterns that bring less frequent, more intense storms are projected to impact the SMC Watershed by changing the frequency and duration of hydrologic connectivity throughout the watershed (Kalansky et al. 2018; Dong et al. 2019; Huang et al. 2020), increasing streambank erosion and sediment yield from developed surfaces (SDRWQCB 2023), destroying spawning habitat for steelhead (Wilcox 2012), and increasing other pollutant loading to receiving waterbodies.

Furthermore, prolonged periods of drought and increasing air temperature are anticipated to reduce instream flows and increase the temperature of water in intermittent pools, potentially harming southern steelhead (SDRWQCB 2023), making the removal of aquatic invasive species more critical (Moyle et al. 2013). Wildfire frequency and extreme weather events are predicted to increase (San Diego County 2023), which further exacerbate habitat degradation and the viability of the SMC Watershed for native species. The sea-level rise caused by climate change has also been inundating coastal lagoons and eroding beaches, impacting the habitat of the tidewater goby (SDRWQCB 2023; San Diego County 2023).

1.5. Management Goals and Tasks

1.5.1. Key Elements of the Land Management Plan

The impairment of SMC by aquatic invasive species is due to the proliferation and recruitment of source populations throughout the watershed. Therefore, a watershed planning approach is appropriate to reduce and eliminate invasive species and promote the recovery of southern steelhead and other sensitive species (SDRWQCB 2023). Key elements to the successful implementation of this LMP include the following:

- setting explicit goals, objectives, and management actions
- defining measurement criteria and metrics for success
- understanding available resources and tools
- properly executing management actions
- monitoring, reporting, and adapting the LMP approach
- effectively communicating with appropriate stakeholders, including regulatory agencies and landowners

Each key element is discussed in detail further below and align with and complement the San Mateo Creek Long-Term Monitoring Plan (LTMP) and other documentation within the greater SMC WMP.

1.5.2. Management of Conservation Threats

To holistically inform and designate land management strategies within the SMC Watershed, explicit goals, objectives, and management actions must be designated. Goal, objective, and management action are defined as follows:

- *Goal*: a broad outcome to accomplish, qualitative in nature
- *Objective*: a measurable step taken to achieve a goal, quantitative in nature
- *Management action*: a specific activity that will be conducted to meet objectives

These may be guided by a unifying purpose that ties actions to objectives and objectives to goals. The purpose of this LMP and the greater SMC WMP is to attain the numeric targets and designated beneficial uses of SMC in accordance with the 2024 approved TMDL for aquatic invasive species.

1.5.2.1. Goals and Objectives

Attaining the approved TMDL will occur when three primary goals are met:

1. Remediation of aquatic invasive species
2. Recovery of southern steelhead
3. Improvement of instream temperature and dissolved oxygen

The 2024 approved TMDL set numeric targets for each goal, which are included below for invasive species (Table 1-15), steelhead (Table 1-16), and monitoring indicators (Table 1-17).

Table 1-15: Numeric Targets for Aquatic Invasive Species in San Mateo Creek

Common Name	Scientific Name	Numeric Target	Interim CPUE Target*
Green Sunfish	<i>Lepomis cyanellus</i>	0	0
Golden Shiner	<i>Notemigonus crysoleucas</i>	0	0
Bluegill	<i>Lepomis macrochirus</i>	0	0
Largemouth Bass	<i>Micropterus salmoides</i>	0	0
Bullhead (black)	<i>Ameiurus melas</i>	0	0
Bullhead (brown)	<i>Ameiurus nebulosus</i>	0	0
Bullfrog	<i>Lithobates catesbeianus</i>	0	0
Crayfish	<i>Procambarus clarkii</i>	0	0

Source: SDRWQCB 2023

*Catch Per Unit Effort (CPUE) using standardized methods in areas with perennial surface water.

Table 1-16: Numeric Targets for Steelhead Presence in San Mateo Creek

Class	Number
Adults	Interim: 70 Final: 70 until or unless an alternative self-sustaining, viable Core 1 Population number is determined in consultation with NMFS
Juvenile	Present

Source: SDRWQCB 2023

Table 1-17: Water Quality Criteria for Monitoring Indicators

Water Quality Parameter	Monitoring Indicator (Summer Dry)
Dissolved Oxygen	Temperature- and time-dependent*
Temperature	Instantaneous maximum surface: <28°C 7-day mean: <24°C

Source: SDRWQCB 2023

NMFS: National Marine and Fisheries Service

*See Table 2 in Matthews and Berg 1997

To meet these goals, the 2024-approved TMDL has designated three objectives:

1. Remediating and mitigating ponds that hold aquatic invasive species
2. Removing aquatic invasive species from SMC
3. Monitoring and assessing TMDL implementation

The first goal of remediating and mitigating source populations of aquatic invasive species in upstream private stock ponds must be prioritized and achieved before the second and third goals can be met. It is paramount that public outreach to private landowners and successful implementation of mitigation measures on private ponds occurs before in-stream removal efforts, as only then can in-stream removal efforts become effective in reducing the invasive species population in the watershed (SDRWQCB 2023). Furthermore, monitoring and assessing TMDL implementation will only be helpful in informing adaptive management strategies if aquatic invasive species have been successfully removed from both source and present populations.

1.5.2.2. Management Actions

Implementing numerous and simultaneous specific management actions is likely to contribute to the success of each objective and associated goals.

Actions to Meet Objective #1

To effectively halt source populations of aquatic invasive species and address the nonpoint source for the TMDL, on-site source control measures and practices to prevent future reseeding downstream will need to occur. These will occur through sequentially executing six actions, including mapping loading sources, prioritizing remediation and mitigation efforts, evaluating feasibility, conducting public outreach, implementing practices for on-site source control, and monitoring and reporting remediation and mitigation efforts.

Action 1.1: Mapping and assessment of loading sources

Some effort has already gone into identifying and mapping loading sources throughout the watershed (CCC 2011), particularly the upper reaches on private stock ponds of Riverside County (Figure 6). A directory of known landowners and their contact information has been created by California Trout; however, the relative stocking rates, BMPs, and source population inventories for each pond are currently unknown. This information may be obtained through additional outreach to landowners and can help inform subsequent actions in this LMP.

Action 1.2: Public outreach and communication with private property owners

Some historical efforts have been made to educate and coordinate with the general public and private landowners in the upper reaches of SMC, which have included developing a brochure on invasive species impacts to SMC, conducting public workshops in the upper watershed directed towards landowners, and publishing newspaper articles (CCC 2011). The majority of this outreach was conducted in 2006 and, while received favorably, was not comprehensive or iterative in nature and was ultimately ineffective.

California Trout developed a Public Outreach Plan for the SMC WMP in 2024 that includes the following five main components, as well as supplemental materials:

1. Establish Public Outreach Partnerships with Key Stakeholders and Geographical Areas of Expertise

2. Identify Target Communities
3. Proposed Outreach Methods/Materials
4. Public Outreach Timeline
5. Data/Reporting

This Public Outreach Plan implementation will prioritize outreach to private landowners with potential invasive species “source” ponds; and emphasize education on the issue of invasives, their impact to the ecosystem, and mitigation measures that can be implemented to control the source of invasive species. Implementation will also be tailored to persuade and incentivize the adoption of proposed mitigation measures (California Trout 2024b).

Action 1.3: Evaluation of priority remediation and mitigation areas

Upon completing the loading sources mapping and assessment, ponds with the highest abundance of aquatic invasive species, as well as those with the lowest degree of functional BMPs, shall be considered to have the highest loading potential for SMC, and remediation and mitigation should be prioritized in these areas.

Action 1.4: Evaluation of mitigation measure feasibility for ponds

A variety of mitigation measures and practices are available that have the potential to control source populations of aquatic invasive species (SDRWQCB 2023), but to responsibly use human and capital resources, the feasibility of each measure/practice should be evaluated for each mitigation area. Potential measures/practices may include, but are not limited to, the following:

- pond removal and stream restoration
- pond hydromodification and isolation from SMC stream flows
- installation of pond outflow mitigation measures
- physical removal of aquatic invasive species:
 - electrofishing
 - seining
 - gigging
 - dip-netting
 - minnow trapping
 - fyke netting

Action 1.5: Implementation of practices for on-site source control

Once mitigation areas have been identified and prioritized and an appropriate mitigation measure/practice has been selected, on-site source control can occur. These efforts will be multifaceted and may include multiple measures/practices to achieve Objective #1. It is anticipated that field work will be necessary across multiple seasons.

Action 1.6: Monitoring and reporting of remediation and mitigation efforts

Concurrently with Action 1.5, monitoring and reporting of remediation and mitigation efforts should be conducted using a universal approach across all stakeholder groups to maintain data quality and resolution. An independent 3rd party agreed upon by the TAC will be the primary stakeholder responsible for data management. It is anticipated that the timeframe to meet Objective #1 is unknown and will be influenced by climatic factors but will have a TMDL target attainment date of 2037 or sooner (SDRWQCB 2023).

Actions to Meet Objective #2

To effectively remediate all present populations of aquatic invasive species from SMC and address the secondary nonpoint source, field efforts from all stakeholders will be necessary, and a unified removal approach should be established. This will occur through the sequential execution of five actions, including mapping and estimating present populations, prioritizing removal efforts, evaluating feasibility, implementing practices for SMC source control, and monitoring and reporting source control measures.

Action 2.1: Mapping and assessment of present sources

While invasive species removal has been conducted throughout the watershed since at least 2003 by various parties (USMC, USGS, CDFW, Trout Unlimited), minimal attention has been given to mapping the spatial extent of invasive species loading throughout the watershed. Some locations and general reaches of historical work are known (Figure 7, Table 3-8), but present population estimates have not been conducted, and habitat characteristics for each location are known for only some of the historical locations. This information will be useful to inform Action 2.2 and will help with tracking progress of source control efforts.

Action 2.2: Evaluation of priority management areas

Upon completing present sources mapping and assessment, management areas with the highest abundance of aquatic invasive species, as well as those with the best spawning and over-summering habitat for southern steelhead proliferation, will be prioritized for removal efforts. To meet the numeric target for the approved TMDL, all aquatic invasive species in the watershed will need to be remediated, but prioritization and systematic removal in management areas will help reduce duplicating efforts in the long term.

Action 2.3: Evaluation of removal feasibility

In-stream removal efforts have been ongoing for approximately 20 years throughout the watershed (Figure 7, Table 3-8) and are considered feasible, but their success is limited due to the continued recruitment of aquatic invasive species from upstream source populations. This action should occur simultaneously or after Actions 1.5 and 1.6 for the greatest chance of success.

Action 2.4: Implementation of practices for San Mateo Creek source control

Once present populations have been identified and management areas have been prioritized, management area source control can occur. These efforts will be multifaceted and may include multiple removal methods to achieve Goal #2. Typical methods used by stakeholders for invasive species removals are listed in Action 1.4. It is anticipated that field work will be necessary across multiple seasons. It is possible that field work may be timed to take advantage of natural or coincidental contraction of invasive species populations (e.g. due to drought, wildfire).

Action 2.5: Monitoring and reporting of source control in designated management areas

Concurrently with Action 2.4, monitoring and reporting source control efforts should be conducted using a universal approach across all stakeholder groups to maintain data quality and resolution. An independent 3rd party agreed upon by the TAC will be the primary stakeholder responsible for data management. It is anticipated that the timeframe to meet Objective #2 is unknown and will be influenced by climatic factors but will have a TMDL attainment date of 2037 or sooner (SDRWQCB 2023).

Actions to Meet Objective #3

Monitoring is a critical component of every TMDL and is needed to assess progress toward achieving TMDL implementation and TMDL numeric targets (SDRWQCB 2023). Multiple stakeholders conduct steelhead and non-native species monitoring in the SMC Watershed (USMC, USFS, CDFW, USGS, California Trout). It is important that monitoring methods be compatible and complimentary not only to each other, but also to other larger data needs and monitoring efforts that are used to track species recovery (Boughton et al. 2022).

The SMC LTMP outlines in detail the multiple agencies and entities who conduct steelhead, invasive species, water quality, and other relevant monitoring in the SMC Watershed. Thus, monitoring will be briefly summarized here and focuses on core assessment elements of the following:

- steelhead habitat suitability
- invasive species populations
- steelhead populations
- hydrologic connectivity information

Action 3.1: Identify responsibilities of various stakeholders throughout the watershed

In drafting their public outreach plan, California Trout identified key stakeholders throughout the watershed and acknowledged their respective geographical areas of expertise (California Trout 2024b).

Action 3.2: Describe appropriate data collection and monitoring approaches

Detailed data collection and monitoring approaches are based on site-specific conditions provided in the SMC LTMP and are provided in summary here. Steelhead habitat suitability will be assessed by monitoring water temperature and dissolved oxygen levels in permanent pools throughout the SMC Watershed while considering the hydrologic connectivity. Hydrologic

connectivity data will include presence/absence surveys for water in pool habitat, flow measurements (cubic feet per second), and water levels (meters) where water is present. Monitoring for invasive species can use a variety of standard techniques to determine their presence/absence, as well as distribution and density over time (Wallace and Bargeron 2014; Oswalt et al. 2021). Steelhead population estimate methods would be developed in consultation with NMFS for consistency with the California Coastal Monitoring Plan and the Fish Bulletin 182 “Integration of Steelhead Viability Monitoring, Recovery Plans, and Fisheries Management in the Southern Coastal Area” (Boughton et al. 2022). A summary of monitoring approaches and data collection methods is provided in Table 1-18.

Table 1-18: Summary of Data Collection and Monitoring Approaches*

Monitoring Approach	Frequency	Metric
Steelhead Habitat Suitability	Continuous	Temperature, Dissolved Oxygen
Steelhead Population Survey	Annual	Counts
Aquatic Invasive Species Population Survey	Annual	Counts, CPUE, Population Estimates
Hydrologic Connectivity Survey	Continuous	Flow, Water Level, Presence/Absence

* Detailed monitoring approaches and methods are provided in the SMC LTMP and may include more metrics than described here.

Action 3.3: Determine universal metrics for measuring success

Monitoring approaches for the SMC Watershed should generally follow Table 1-19 and align with the SMC WMP; additionally, monitoring efforts should all be compared against universal benchmarks or metrics to determine success. For steelhead habitat suitability, Matthews and Berg (1997) describe the importance of temperature and dissolved oxygen dynamics in permanent pools for the proliferation of steelhead, noting that there are complex interactions between the two, as well as other biological, chemical, and physical components that may determine habitat suitability for steelhead. The 2024-approved TMDL sets monitoring indicator levels for both temperature and dissolved oxygen and sets numeric targets for steelhead populations and aquatic invasive species (SDRWQCB 2023). Benchmark standards for hydrologic connectivity are relatively less explored in the literature due to the site-specific conditions that drive connectivity, but generally the presence of flowing water at adequate depths, potentially supplemented by springs or seeps, is necessary for steelhead proliferation. Matthews and Berg (1997) observed steelhead proliferation in a pool that was 1.42 meters at its deepest, suggesting that steelhead may survive at least temporarily in water levels lower than that. Other research has suggested that successful migration of adult steelhead can occur in water depths as little as 7 inches and with flows up to 10 ft/sec (Bovee 1978; Barnhardt 1986; CDFW 2021)

Table 1-19: Summary of Data Collection and Monitoring Approach Metrics for Success*

Monitoring Approach	Metric	Goal
Steelhead Habitat Suitability	Temperature	<28°C (Instantaneous) <24°C 7-day mean
	Dissolved Oxygen	>5.0 mg/L [†]
Steelhead Population Survey	Counts	70 Adults; Presence of Juveniles
Aquatic Invasive Species Population Survey	Counts	0
	CPUE	0
	Population Estimates	0
Hydrologic Connectivity Survey	Presence/Absence	Presence
	Flow	Surface flow or groundwater seep present; <10 ft/sec
	Water Level	>7 inches

*Detailed monitoring approaches and methods are provided in the SMC LTMP and may include more metrics than described here.

Time and temperature dependent.

mg/L: milligram(s) per liter

ft/sec: feet per second

Action 3.4: Data management and interagency reporting on TMDL monitoring and implementation

An independently funded 3rd party agreed upon by the TAC will be the primary stakeholder responsible for interagency reporting and data management regarding TMDL monitoring and implementation. It is anticipated that the timeframe to meet Objective #3 is unknown and will be influenced by climatic factors but will have a TMDL attainment date of 2037 or sooner (SDRWQCB 2023).

A summary of management goals, objectives, and actions is provided in Table 1-20.

Table 1-20: Summary of Management Goals, Objectives, and Actions

Management Goals 1–3: Remediation of aquatic invasive species, recovery of southern steelhead, and water quality improvements		Status
Objective #1: Remediation and mitigation of ponds that hold aquatic invasive species		
Action 1.1 – Mapping and assessment of loading sources		In-Progress
Action 1.2 – Public outreach and communication with private property owners		In-Progress
Action 1.3 – Evaluation of priority remediation and mitigation areas		Not Started
Action 1.4 – Evaluation of mitigation measure feasibility for ponds		Not Started
Action 1.5 – Implementation of practices for on-site source control		Not Started
Action 1.6 – Monitoring and reporting of remediation and mitigation efforts		Not Started
Objective #2: Removal of aquatic invasive species from San Mateo Creek		
Action 2.1 – Mapping and assessment of present sources		In-Progress
Action 2.2 – Evaluation of priority management areas		Not Started
Action 2.3 – Evaluation of removal feasibility		Completed
Action 2.4 – Implementation of practices for San Mateo Creek source control		In-Progress
Action 2.5 – Monitoring and reporting of source control in designated management areas		In-Progress
Objective #3: Monitoring and assessment of TMDL implementation		
Action 3.1 – Identify responsibilities of various stakeholders throughout the watershed		Completed
Action 3.2 – Describe appropriate data collection and monitoring approaches		Completed
Action 3.3 – Determine universal metrics for measuring success		Completed
Action 3.4 – Data management and interagency reporting on TMDL monitoring and implementation		In-Progress

1.5.2.3. Management Areas

The monitoring program for the LMP, LTMP, and greater SMC WMP was designed to meet the minimum monitoring metrics found in the approved TMDL (SDRWQCB 2023) while considering effectiveness, efficiency, cost, and a strategy for meeting multiple objectives simultaneously. Monitoring methods and locations reflect the monitoring protocols established by Boughton et al. (2022); recommendations of the SMC TAC made up of individuals from various federal, state, and regional stakeholder and regulatory groups; and other available research for monitoring steelhead habitat suitability and populations, aquatic invasive species populations, and hydrologic connectivity.

1.5.2.4. Monitoring Locations, Methods, and Metrics

A matrix of proposed monitoring methods by monitoring location is provided in Table 1-21, which generally consists of riffle/run strategies, pool strategies, and methods that are appropriate for both habitat types. Proposed monitoring locations are based on diversity of habitat, likelihood that they are suitable for southern steelhead at various life stages, and likelihood that invasive aquatic species are present. The appropriate methods used to adequately capture representative data should be based on observed conditions in the field and adjusted as appropriate. Additional monitoring details can be found in the LTMP document. Monitoring for species with secondary considerations in the TMDL (arroyo toad, tidewater goby) and of other species of special concern (arroyo chub, southwestern pond turtle, California newt) should occur simultaneously as appropriate.

Table 1-21: Summary of Monitoring Method by Monitoring Location

Watershed Reach	Location Description	Seining	Electrofishing	Snorkel Survey	eDNA Sampling	BMI Sampling	Water Quality Meter	Flow Meter	Bullfrog Giggling	Dip Netting	Fyke Nets	Minnow Trapping
SMC Lagoon	Longitudinal 1	X		X	X		X		X			X
	Longitudinal 2	X		X	X		X		X			X
	Longitudinal 3	X		X	X		X		X			X
Main Stem (Upper Lagoon to Tenaja Falls)	Upstream 1-5 Bridge	X	X		X	X	X	X	X	X	X	
	San Mateo Campground	X	X		X	X	X	X	X	X	X	
	Upstream of San Mateo Campground	X	X		X	X	X	X	X	X	X	
	Upstream San Mateo Drive	X	X		X	X	X	X	X	X	X	
	Permanent Pool 1	X		X	X		X		X			X
	Permanent Pool 2	X		X	X		X		X			X
	Permanent Pool 3	X		X	X		X		X			X
	Permanent Pool 4	X		X	X		X		X			X
Permanent Pool 5	X		X	X		X		X			X	
Tributaries	Cold Spring Canyon	X	X		X	X	X	X	X	X	X	
	Cristiantos Creek	X	X		X	X	X	X	X	X	X	
	Devils Canyon	X	X		X	X	X	X	X	X	X	
	Los Alamos Canyon	X	X		X	X	X	X	X	X	X	
	Bluewater Canyon	X	X		X	X	X	X	X	X	X	
	Tenaja Canyon	X	X		X	X	X	X	X	X	X	
	Wildhorse Canyon	X	X		X	X		X	X	X	X	
Upper Watershed (Above Tenaja Falls)	Permanent Pool 6*	X		X	X				X			X
	Permanent Pool 7*	X		X	X		X		X			X
	Permanent Pool 8*	X		X	X		X		X			X
	Upstream of Tenaja Falls*	X	X	X	X	X	X	X	X	X		X

*Locations not surveyed in any previous monitoring effort.

1.6. Land Management Plan Implementation

1.6.1. Monitoring and Reporting

To effectively implement the LMP and track progress toward attaining TMDL numeric targets, monitoring protocols and schedules will need to be developed and standardized for use by all stakeholders across the watershed, in addition to training and quality assurance plans. Many threatened and endangered species have existing survey guidance from USFWS or CDFW, and these monitoring efforts are currently employed on MCBCP and in the CNF; however, standardized reporting protocols and monitoring schedules are necessary. A general proposed implementation schedule is given in Table 1-22.

Table 1-22: Proposed Implementation Monitoring Schedule

Implementation Action	Start Date	End Date
Steelhead Population Estimation Survey	2024	Ongoing
Invasive Species Surveys in the SMC Watershed	2024	2025
Monitoring for Numeric Targets	2026	2037
Attainment of Final Numeric Targets	2037	2037
Continued Monitoring of Steelhead Populations	2037	Ongoing
Continued Monitoring of Aquatic Invasive Species	2037	Ongoing

Source: SDRWQCB 2023

Furthermore, incremental targets and measures to track progress during LMP implementation will need to be established and should consider the findings of Actions 1.1, 1.3, 2.1, and 2.2 to inform appropriate incremental targets.

Reporting from stakeholder monitoring events should follow a standardized format, including tables, figures, statistics, and field observations. The CWA section 319 grant (319 grant) recipient will be responsible for creating standardized reporting documentation (data templates, metadata standards, data quality objectives) that will be distributed for use by the stakeholders performing field work. Additional details for monitoring and reporting can be found in the SMC LTMP.

1.6.1.1. Interagency Reporting Requirements

A variety of environmental permits will be needed to implement this LMP and the greater SMC WMP to meet numeric targets of the TMDL, which inherently comes with reporting obligations to federal, state, and local agencies issuing permits. Examples of agencies who might need to be consulted to be issued a permit include SDRWQCB, CDFW, United States Army Corps of Engineers (USACE), and the United States Environmental Protection Agency (USEPA) for compliance with the CWA, Endangered Species Act (ESA), National Environmental Policy Act (NEPA), and other regulations. A matrix of potential necessary permits is provided in the greater SMC WMP, along with potential pathways, estimated maximum fees for each permit, and estimated timelines for issuance by regulatory agencies. However, early consultation (even informally) with regulatory agencies can substantially increase the speed at which permits are attained and decrease the cost of attainment. The Cutting the Green Tape program by the state of California also encourages expedited permitting pathways for the issuance of multiple permits through one permit package submittal, and potential expedited pathways are also outlined in the greater SMC WMP (**Appendices A-B**).

1.6.1.2. Data Management

An independently funded 3rd party agreed upon by the TAC will be responsible for compiling, processing, and uploading data into a central state or federal data repository and for retaining monitoring and implementation data related to attaining the TMDL. All stakeholders will provide the independently funded 3rd party with relevant data within an appropriate timeframe after its collection, specific to the nature of data collected. Types of data may include preliminary

field data, final field data, final field reports, public outreach engagement surveys, etc. The independently funded 3rd party will retain all data for the SMC WMP through 2042, or for five years after TMDL numeric targets are met if before 2037. For holistic watershed collaboration and the transfer of knowledge, inter-stakeholder data sharing is also encouraged.

1.6.1.3. Land Management Parties and Funding

The roles of stakeholders identified by California Trout (2024b) with respect to this LMP are identified below in Table 1-23 and generally include technical council and advisory roles for the LMP and greater SMC WMP field work roles that include habitat and species surveys and data reporting roles for field work efforts.

Table 1-23: Responsibilities of Stakeholders in the San Mateo Creek Watershed

Stakeholder	TAC Representation	Field Work Obligation*	Data Reporting Obligation	Data Management & Retention Obligation
California Trout (current 319 grant recipient)	X	X	X	
California State Parks	X	X	X	
USMC Camp Pendleton	X	X	X	
United States Forest Service	X	X	X	
California Department of Fish and Wildlife	X	X	X	
Acjachemen Tribe	X			
TEAM RCD	X			
The Nature Conservancy	X			
Independently Funded 3 rd Party Data Manager				X

*Field work may include removals of invasive species, steelhead population and habitat surveys, or other surveys.

TAC: Technical Advisory Committee

TEAM RCD: Temecula-Elsinore-Anza-Murrieta Resource Conservation District

1.6.2. Adaptive Management

Adaptive management is the practice of making decisions through continuous learning and iterative assessment. The TAC and other stakeholders within the SMC watershed will utilize an adaptive management approach to periodically reevaluate priorities, goals, actions, schedules, and project status with available tools to improve the effectiveness of the LMP and the greater SMC WMP. Due to the long-term implementation schedule of this LMP and the inherent variability of climate in the future, considerations for changing environmental conditions such as temperature and precipitation, anthropogenic influence, and natural disasters, including but not limited to floods, fire, and drought, are needed to successfully implement this LMP and the greater SMC WMP.

Potential triggers and/or evaluation criteria that could indicate an update to this LMP is needed might include:

- Progress is not being made towards numeric targets and project goals.
 - Aquatic invasive species populations are not trending downwards towards zero.

- Southern steelhead populations are not trending upwards towards at least 70 adults.
- Instream temperatures are not stable or are increasing.
- Instream dissolved oxygen is not stable or is decreasing.
- New data or reports become available that impact goals and priorities.
- The TMDL is amended.
- Unintended consequences to non-target species or habitat are being observed.

Where the primary goals of this LMP are not being achieved, adaptive management measures should be employed to course correct as appropriate to meet project goals. Adaptive management measures considered for this LMP include the following:

1. Modify pond remediation and mitigation activities (schedule and/or method)
2. Modify aquatic invasive species removal activities (schedule and/or method)
3. Modify management areas and steelhead monitoring (schedule and/or method)
4. Modify metrics for success

Modifications to pond remediation and mitigation activities may include altering the designated duration for remediation in specific ponds, combining multiple removal techniques for maximum removal efficacy, targeting specific landowners with public outreach techniques, or shifting priorities when new information is available. Additionally, loss of access to ponds through change in landownership and landowner cooperation, wildfire, flooding, or mudslides is possible and would warrant a change in pond remediation and mitigation activities.

Modifications to aquatic invasive species removal activities in SMC may include changing the timing and duration of remediation at specific locations, combining multiple removal techniques for maximum removal efficacy, adding or removing monitoring and removal locations, or altering the priority of monitoring and removal locations based on project implementation. Due to the remote location of many mapped permanent pools, it is possible that access will change throughout project implementation due to a variety of reasons, including but not limited to wildfire, flooding, mudslides, and other unforeseen natural barriers.

Modifications to management areas and steelhead monitoring in SMC may include changing the timing and duration of activities at specific locations, adding or removing locations, altering the priority of locations based on project implementation, and changing monitoring strategies based on observed field conditions. Alterations to the access of permanent pool habitats for invasive species removal also applies to steelhead monitoring. It is likely that pool habitats and the availability of cool oxygenated water will be different in the future in comparison to current conditions, so this adaptive management measure should be used for climate considerations as well.

Lastly, with change in climate and the likelihood of extreme weather events and natural disasters, metrics that define success and suitable habitat for steelhead may change as new research is published and as the TMDL is reviewed and potentially amended.

Decision trees for each of the three management objectives, using adaptive management measures above, are provided as Figures 8 through 12.

Figure 8: Adaptive Management Decision Tree – Goal #1

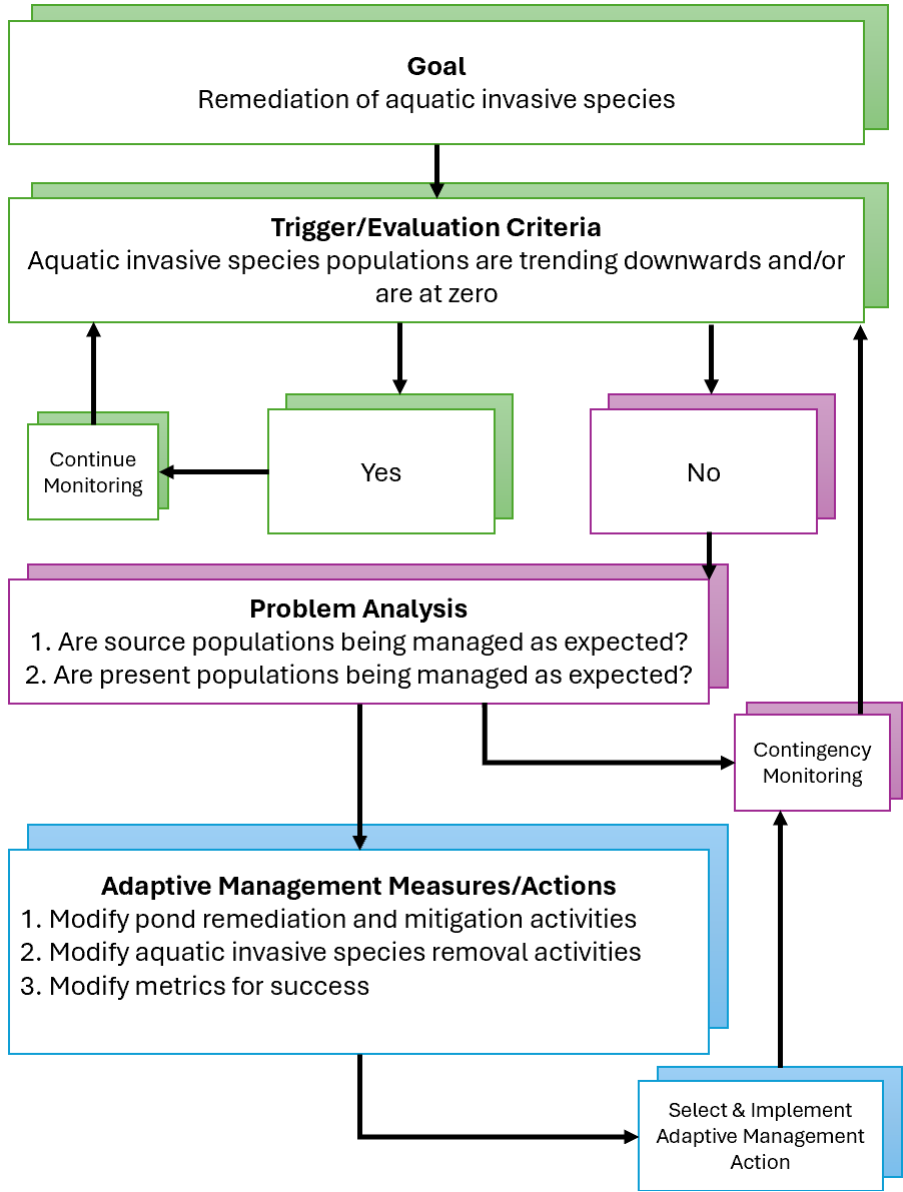


Figure 9: Adaptive Management Decision Tree – Goal #2

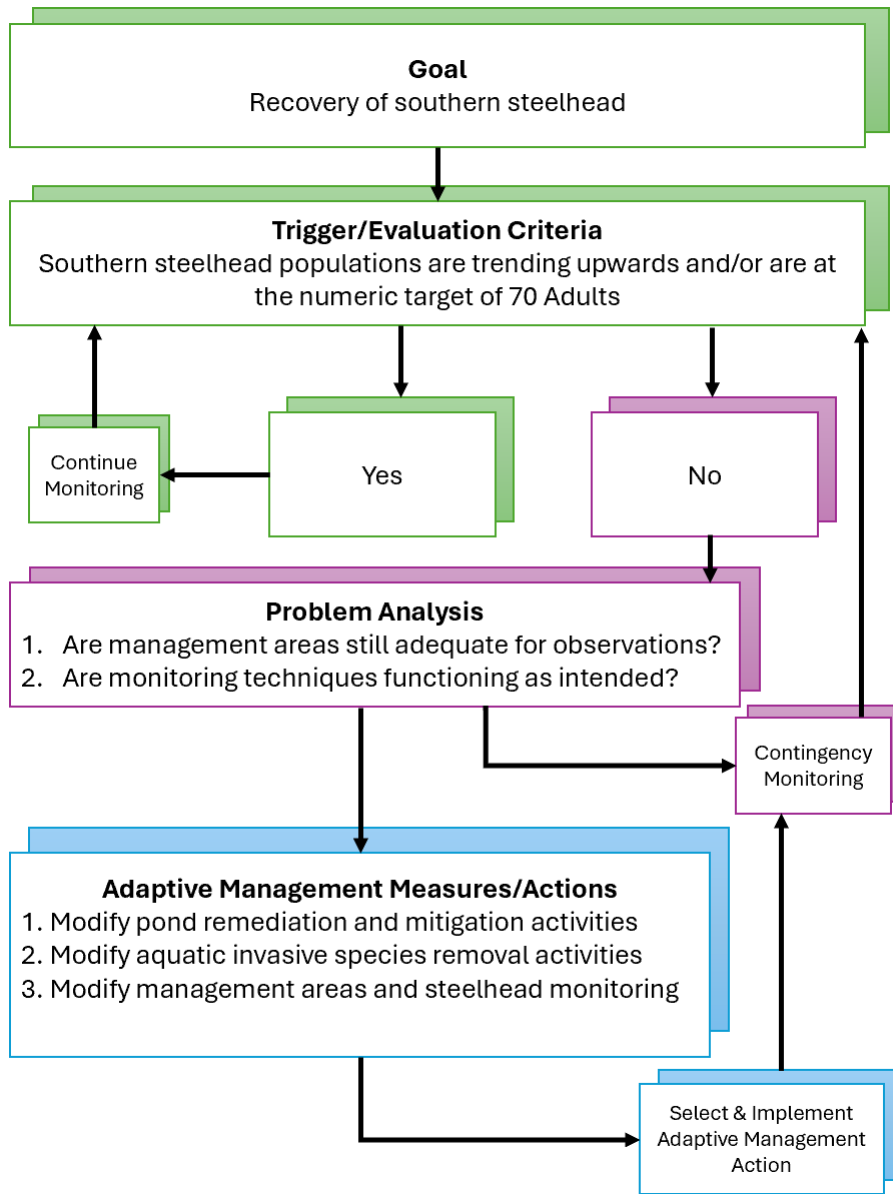


Figure 10: Adaptive Management Decision Tree – Goal #3

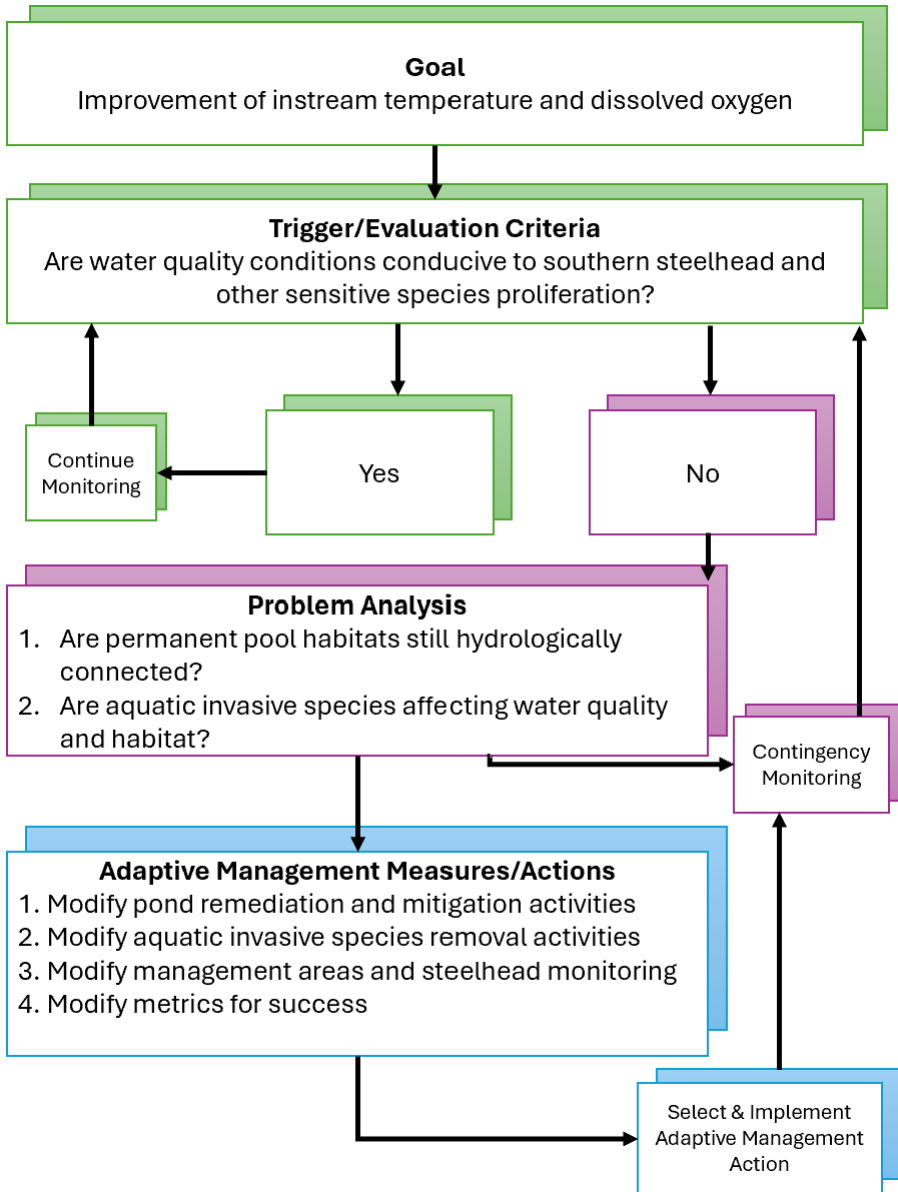


Figure 11: Adaptive Management Decision Tree – New Information

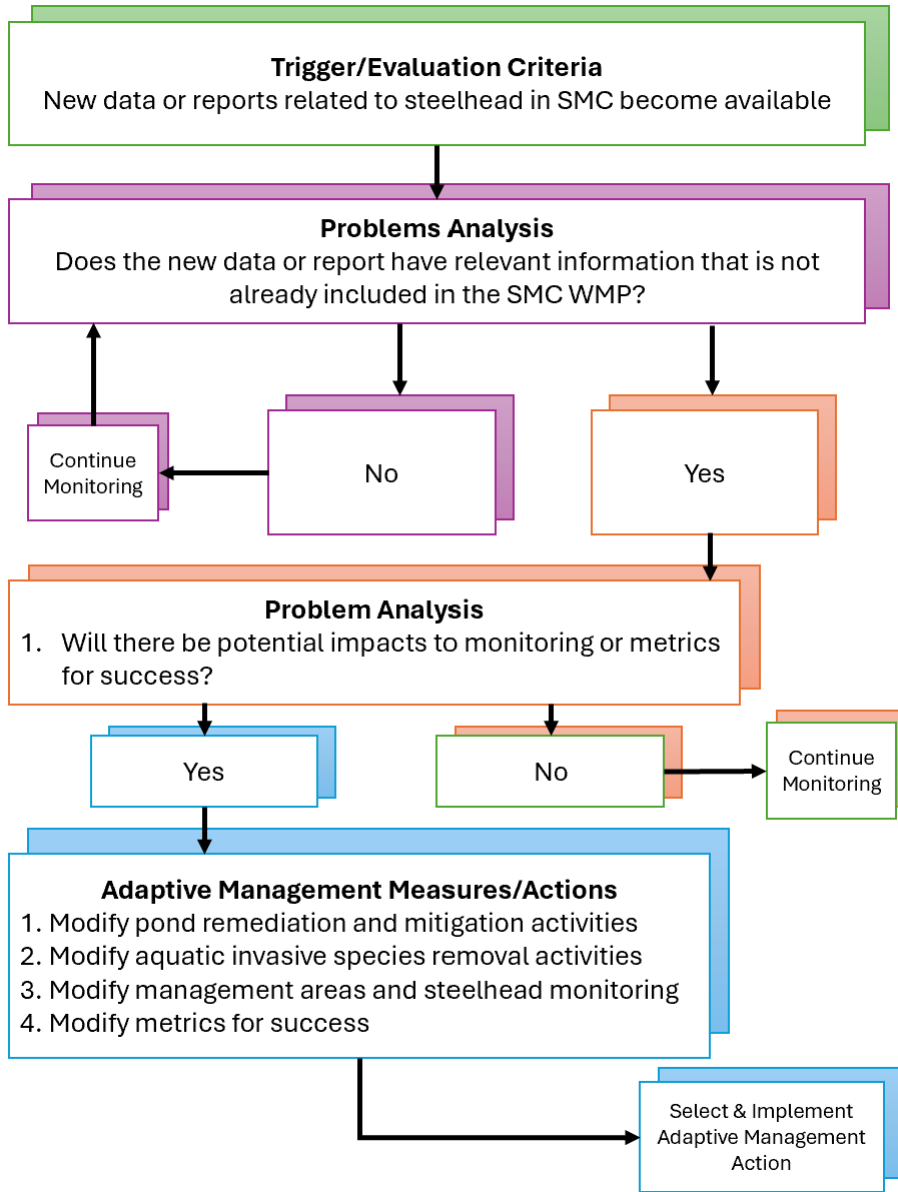
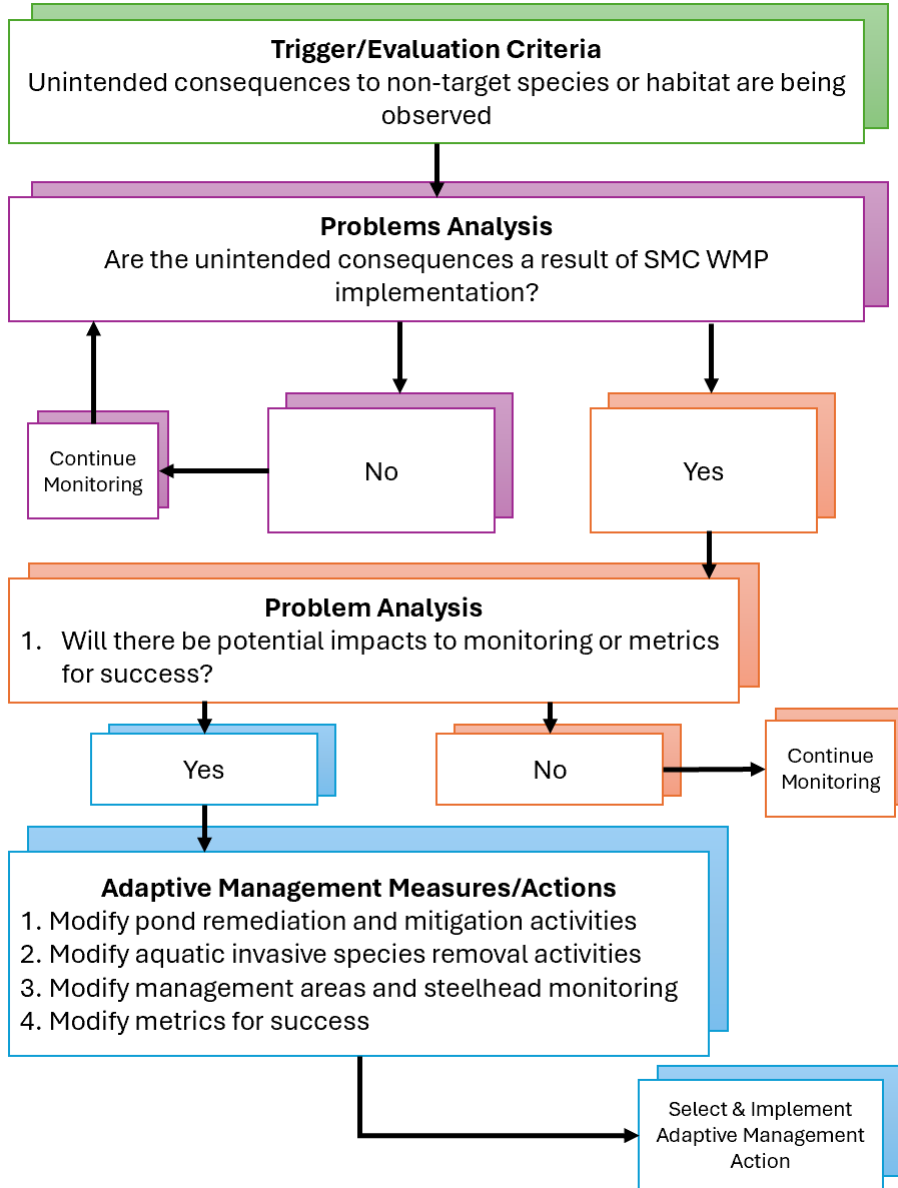


Figure 12: Adaptive Management Decision Tree – Unintended Consequences



1.6.3. Land Management Plan Updates

It is anticipated that this LMP will periodically need updates to text, figures, tables, and appendices as the LMP and greater SMC WMP are implemented, new information is obtained, and if the TMDL is amended. Example scenarios that would warrant an update of the LMP include the following:

- changes in prioritization or implementation schedule
- changes in monitoring approach or strategy
- new 319 grant recipient is awarded
- changes to data management or reporting requirements
- TMDL is amended

At least every two years, the content of this LMP should be reviewed for accuracy and alignment with project goals, objectives, and actions. However, if the adaptive management process identifies the need for an update at any time this LMP should be updated within 60 days of a known trigger, to the extent feasible. Additionally, this LMP should be considered a “living” document, and updates can be made at any time as deemed appropriate by the TAC, 319 grant recipient, or any individual stakeholder.

2. LONG-TERM MONITORING PLAN

2.1. Introduction

The San Mateo Creek (SMC) Watershed consists of approximately 114,000 acres (178 square miles) and 200 total stream miles spread across northern San Diego, southern Orange, and western Riverside Counties in Southern California (San Diego Regional Water Quality Control Board [SDRWQCB] 2023) (Figure 1). The headwaters of SMC originate in the Cleveland National Forest (CNF) and flow southwest to the Pacific Ocean through multiple landownership boundaries, ecosystem types, and stakeholder jurisdictions. The SMC Watershed is an important resource for both people and wildlife, as it is one of the last undammed watersheds in Southern California and is largely undeveloped, despite its close proximity to dense urban population centers (San Mateo Creek Conservancy [SMCC] 2023). The SMC Watershed exhibits intermittent flow and contains deep pools, spawning and rearing habitat, and high-quality aquatic and terrestrial habitat and is used as a reference watershed for numerous regional biomonitoring initiatives (Mazor et al. 2007); however, the SMC Watershed is vulnerable to environmental stressors that threaten its unique character and quality, such as invasive species, land development, and climate change. These threats impact its ability to support wildlife and meet its designated uses (California Trout 2023).

SDRWQCB's Water Quality Control Plan for the San Diego Basin (Basin Plan) (1994) designated a total of 10 beneficial uses for various reaches of the SMC Watershed, and, in addition to its beneficial uses, other species of concern also inhabit the SMC Watershed, including the California newt (*Taricha torosa*), the arroyo toad (*Anaxyrus californicus*), arroyo chub (*Gila orcuttii*), southwestern pond turtle (*Actinemys pallida*), and the tidewater goby (*Eucyclogobius newberryi*). The existence and proliferation of these species, including *O. mykiss*, is directly threatened by the presence of aquatic invasive species that outcompete native species for resources, modify habitat conditions, predate upon native species, and spread disease (Moyle et al. 2013). The presence and general negative effects of aquatic invasive species led to the Clean Water Act (CWA) 303(d) listing of SMC as impaired for the Rare, Threatened, or Endangered Species (RARE), Migration of Aquatic Organisms (MIGR), and Spawning, Reproduction, and/or Early Development (SPWN) beneficial uses described in the 2014-2016 California Integrated Report, meaning SMC is a 5A waterbody (SDRWQCB 2018). In response to the 2016 CWA 303(d) listing of SMC as impaired for invasive species, SDRWQCB approved a total maximum daily load (TMDL) that lists numeric targets for aquatic invasive species and steelhead, as well as water quality monitoring indicators (SDRWQCB 2023) that represent alternative numeric targets to Basin Plan water quality objectives. Furthermore, the approved TMDL also includes secondary considerations for the tidewater goby and arroyo toad.

2.1.1. Purpose of Long-Term Monitoring Plan

The purpose of this Long-Term Monitoring Plan (LTMP) is to holistically inform and designate long-term monitoring strategies within the SMC Watershed that provide insights for water quality improvement, proliferation of Southern California steelhead (*O. mykiss*), and the remediation of aquatic invasive species in the SMC watershed in accordance with the 2024 approved TMDL. Additionally, this LTMP seeks to consolidate existing information and priorities from the various landowners, agencies, and stakeholders involved across jurisdictional

boundaries, effectively manage financial and human resources, and create a comprehensive overarching framework for species, habitat, and water quality monitoring in the SMC Watershed.

The LTMP will coordinate monitoring between the multiple entities who currently conduct steelhead and non-native species monitoring in the SMC Watershed, consistent with the monitoring schedules and techniques developed in Fish Bulletin 182 “Integration of Steelhead Viability Monitoring, Recovery Plans, and Fisheries Management in the Southern Coastal Area” to meet larger data needs in evaluating steelhead recovery across the Southern California distinct population segment (DPS) (Boughton et al. 2022).

2.1.1.1. San Diego Regional Water Quality Control Board Aquatic Invasive Species Total Maximum Daily Load

Impaired Uses

The Basin Plan (1994) designated a total of 10 beneficial uses for various reaches of the SMC Watershed, including its mouth (coastal water), main stem, and tributaries (inland surface waters), which include the following:

- Contact Water Recreation (REC-1) (*mouth only*)
- Non-Contact Water Recreation (REC-2)
- Preservation of Biological Habitats of Special Significance (BIOL) (*mouth only*)
- Warm Freshwater Habitat (WARM)
- Cold Freshwater Habitat (COLD)
- Wildlife Habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)
- Marine Habitat (MAR) (*mouth only*)
- Migration of Aquatic Organisms (MIGR)
- Spawning, Reproduction, and/or Early Development (SPWN)

Of these beneficial uses, the presence and proliferation of aquatic invasive species specifically prevent the SMC Watershed from meeting three: MIGR, SPWN, and RARE. These beneficial uses are described further below:

- MIGR: Support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.
- SPWN: Support high-quality habitats suitable for reproduction, early development, and sustenance of marine fish and/or cold freshwater fish.
- RARE: Support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal laws as rare, threatened, or endangered.

MIGR, SPWN, and RARE impairments of SMC for the Southern California steelhead are a direct result of the continued recruitment and proliferation of aquatic invasive species in the

SMC Watershed (SDRWQCB 2023). Invasive species impair steelhead viability through direct competition for food and other resources, predation of juveniles, disease transmission, and water quality degradation, particularly during the summer-fall dry season (Fresh 1997; Stouder et al. 1997; Hovey 2004; National Marine and Fisheries Service [NMFS] 2016). The invasive species specifically associated with the impairment of SMC are provided in Table 2-1.

Table 2-1: Aquatic Invasive Species found in the San Mateo Creek Watershed

Common Name	Scientific Name
Green Sunfish	<i>Lepomis cyanellus</i>
Golden Shiner	<i>Notemigonus crysoleucas</i>
Bluegill	<i>Lepomis macrochirus</i>
Largemouth Bass	<i>Micropterus salmoides</i>
Bullhead (black)	<i>Ameiurus melas</i>
Bullhead (brown)	<i>Ameiurus nebulosus</i>
Bullfrog	<i>Lithobates catesbeianus</i>
Crayfish	<i>Procambarus clarkii</i>

Source: SDRWQCB 2023

Numeric Targets

Numeric targets for SMC were selected based on invasive species impacts to the Southern California steelhead and two other federally endangered species: the tidewater goby and arroyo toad, which inhabit the SMC watershed and are threatened by invasive species. The TMDL numeric target for invasive species in SMC is based off of an assimilative capacity of zero individuals per month, while the numeric target for steelhead is based on the original survey from 1999, which estimated approximately 70 steelhead in the watershed (SDRWQCB 2023). Steelhead and non-native species numeric targets are a valid interpretation of the Basin Plan’s water quality standards, as they are directly linked to beneficial use attainment and impairment. The meeting of both the numeric target for invasives and for steelhead presence simultaneously is expected to promote a self-sustaining, viable Core 1 population over time. These numeric targets are provided in Table 2-2 and Table 2-3 below.

Table 2-2: Numeric Targets for Aquatic Invasive Species in San Mateo Creek

Species	Numeric Target	Interim CPUE Target*
Green Sunfish	0	0
Golden Shiner	0	0
Bluegill	0	0
Largemouth Bass	0	0
Bullhead (black)	0	0
Bullhead (brown)	0	0
Bullfrog	0	0
Crayfish	0	0

Source: SDRWQCB 2023

*Catch Per Unit Effort (CPUE) using standardized methods in areas with perennial surface water

Table 2-3: Numeric Targets for Steelhead Presence in San Mateo Creek

Class	Number
Adults	Interim: 70 Final: 70 until or unless an alternative self-sustaining, viable Core 1 Population number is determined in consultation with NMFS
Juvenile	Present

Source: SDRWQCB 2023

Monitoring Indicators and Minimum Monitoring

In addition to the primary numeric targets, the SMC TMDL also outlines secondary monitoring indicators (Table 2-4) and minimum monitoring metrics (Table 2-5). Secondary monitoring indicators are water quality parameters that may be impacted by invasive species and can therefore be indicative of the presence of invasives in the watershed. There are two secondary water quality monitoring indicators for SMC that include dissolved oxygen and temperature.

Table 2-4: Water Quality Criteria for Monitoring Indicators

Water Quality Parameter	Monitoring Indicator (Summer Dry)
Dissolved Oxygen	Temperature and Time Dependent*
Temperature	Instantaneous Maximum Surface: <28°C 7-Day Mean: <24°C

Source: SDRWQCB 2023

*See Table 2 in Matthews and Berg 1997

Minimum monitoring metrics are intended to assess steelhead habitat suitability, invasive species population, steelhead population, and hydrologic connectivity. Assessment of steelhead population and habitat suitability should include water quality monitoring for perennial pools and spawning habitat, population estimates, and age class and evidence of reproduction. Assessment of invasive species populations should include population estimates, age class and evidence of reproduction, and source tributary flow monitoring. Hydrologic connectivity studies should assess tributary flow data.

Table 2-5: Minimum Monitoring for the Invasive Species TMDL in San Mateo Creek

Monitoring Approach	Frequency	Metric
Steelhead Habitat Suitability	Continuous	Temperature, Dissolved Oxygen
Steelhead Population Survey	Annual	Counts
Aquatic Invasive Species Population Survey	Annual	Counts, CPUE, Population Estimates
Hydrologic Connectivity Survey	Continuous	Flow, Water Level, Presence/Absence

Source: SDRWQCB 2023

2.1.2. Existing Monitoring Plans Within San Mateo Creek Watershed

The SMC Watershed is subject to existing federal, state, and regional monitoring plans that may impact monitoring conducted under this LTMP. Existing monitoring plans are further described in the sections below.

2.1.2.1. South Orange County Water Quality Improvement Plan

The South Orange County Water Quality Improvement Plan (WQIP) was written in accordance with Provision B of the San Diego Regional Municipal Separate Storm Sewer Systems (MS4) Permit (Order R9-2013-001 as amended by Order No. R9-2015-001 and Order No. R9-2015-0100) and applies to the South Orange County Watershed Management Area, including the SMC Watershed (Orange County Copermittees 2018). The WQIP identifies Highest Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions, and the associated adaptive goals, strategies, and schedules for the overall purpose of managing water quality.

The SMC Watershed is subject to the following HPWQCs set forth in the WQIP:

- Pathogen Health Risk at Beaches (Coastal Waters)
- Channel Erosion and Associated Geomorphic Impacts (Inland Receiving Waters)
- Unnatural Water Balance/Flow Regime (Inland Receiving Waters)

The WQIP puts forth procedures, including monitoring and assessment programs, to minimize human waste and other sources of indicator bacteria, restore inland receiving water channels, and eliminate dry weather MS4 flows. Specific remediation actions include erosion abatement, stream rehabilitation, and implementing bacterial source control best management practices (BMPs).

The monitoring program includes human waste investigations, structural BMP performance evaluations, stream restoration and aerial surveys, dry weather outfall inspections, receiving water investigations (including visual observations, field measurements, analytical monitoring, toxicity monitoring, bioassessment, hydromodification, beach monitoring, sediment quality studies, and biological surveys), bacterial monitoring, and evaluation of in-stream flow conditions.

2.1.2.2. Fish Bulletin 182

The Fish Bulletin 182 “Integration of Steelhead Viability Monitoring, Recovery Plans, and Fisheries Management in the Southern Coastal Area” (Boughton et al. 2022) combines multiple approaches for coastal salmonid monitoring in Southern California through an update of the California Coastal Monitoring Plan (CMP) that includes a detailed strategy, design, and methodology for the Southern Coastal Area. The objectives of Fish Bulletin 182 are:

1. Promote integration of the CMP with recovery plan targets and metrics
2. Facilitate methodological flexibility
3. Integrate viability monitoring to facilitate recovery and eventual delisting

Boughton et al (2022) propose viable salmonoid population (VSP) parameters of abundance, productivity, spatial structure, and diversity that can be utilized at multiple hierarchy levels and present a monitoring plan organization that includes these VSP characteristics in addition to life

cycle monitoring and adaptive management for the highest probability of success at steelhead recovery in the Southern Coastal Region. Furthermore, specific guidance and best practices for field monitoring methods like electrofishing, snorkel surveys, redd counts, and life cycle monitoring stations are provided. For SMC specifically, counting stations are recommended for every four years in rotation, and redd counts are generally not recommended.

2.1.2.3. Camp Pendleton Integrated Natural Resources Management Plan

The Camp Pendleton Integrated Natural Resources Management Plan (INRMP) (USMC 2023) coordinates an adaptive approach to conserving habitat and rehabilitating threatened and endangered species, including the Southern California steelhead, which occur within the boundaries of MCBCP.

At MCBCP, the Southern California steelhead is managed through monitoring, habitat conservation, and adaptive management of water resources, including the following:

- Providing annual briefs to military units training in the vicinity of estuaries, lagoons, and streams to deter unauthorized vehicle and foot traffic
- Conducting presence surveys using environmental DNA (eDNA), as funding allows, at designated sampling stations in the Santa Margarita River and SMC
- Removing aquatic exotic species from streams, ponded water, and lagoons annually, from spring to fall
- Coordinating with facilities staff on the Santa Margarita River Conjunctive Use Project adaptive management plan to determine whether water management activities have positive or negative impacts on steelhead presence and persistence

The management season for the Southern California steelhead runs from December 1 to May 31. Steelhead, along with southern tidewater goby, are monitored annually or as funding allows. Monitoring efforts include presence/absence surveys and assessment of habitat suitability. Southern California steelhead have been surveyed through collection of environmental DNA (eDNA), and secondary visual surveys following a positive detection. This survey methodology can be updated each year within a reasonable scope of work and costs. Implementation is annual or as funding allows. A separate contract has been written to use standard electrofishing techniques to collect a freshwater fish inventory in NMFS core streams for steelhead including San Mateo Creek. A section 10 a1A research permit has been secured for this effort which will be implemented as soon as funding allows.

One of the objectives of the INRMP is to “obtain reasonable control (distribution and abundance) of exotic wildlife species to benefit listed and non-listed species through annual removal efforts.” Invasive removal is conducted within the SMC Watershed, including estuaries and lagoons, and counts of each species removed are maintained by MCBCP staff and their consultants.

The INRMP also includes land management and population rehabilitation efforts for threatened and endangered species that may be impacted specifically in response to climate change. Specific actions include species relocation and habitat restoration.

2.1.2.4. Cleveland National Forest Land and Resource Management Plan

The Cleveland National Forest Strategy (Forest Plan) is Part 2 of the broader Southern California National Forest Land Management Plan (LMP) (United States Department of Agriculture

[USDA] 2005). The CNF Forest Plan outlines various tools that the national forest may implement to achieve the goals discussed in Part 1 of the LMP. These goals include removing threats from wildland fires, invasive species, loss of open space, and unmanaged recreation.

Actions that the United States Forest Service (USFS) may perform in CNF that may directly or indirectly impact southern California steelhead, invasive species, or overall watershed health include the following:

- Conduct surveys within suitable habitat to determine the presence of threatened and endangered species.
- Survey wetlands, vernal pools, meadows, springs, and stringer meadows for plant and wildlife species (e.g., spring snails).
- Complete invasive nonnative plant and animal inventories based on regional protocol methods.
- Assess the effects of nonnative species and the effects of management activities on threatened, endangered, proposed, candidate, and sensitive habitat.
- Identify best methods for removal of exotic species.
- Work with the United States Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Association fisheries to develop recovery plans for federally listed species.
- Coordinate with California Department of Fish and Wildlife (CDFW) regarding fish stocking and nonnative fisheries management to implement measures to resolve conflicts with threatened, endangered, proposed, candidate, and sensitive species and habitats.
- Manage State of California designated Wild Trout Streams to maintain high quality habitat for wild trout populations.
- Monitor management indicator species.
- Monitor habitat for ecological health indicators.

In 2011, the CNF was ordered by the United States District Court (Order No. C 08-01278 EMC) to conduct steelhead viability surveys to determine the effect of the Forest Plan on steelhead populations within the CNF. The CNF is also ordered to conduct surveys whenever the SMC sandbar is breached, providing anadromous access to upstream areas of the watershed. Surveys are initiated based on flow data from the United States Geological Survey (USGS) stream gauge station 1146300 and include snorkel surveys, seine and hand-netting, electrofishing, and temperature monitoring dependent on conditions (Wilcox 2012).

2.1.2.5. San Diego Region Water Quality Control Board Regional Basin Plan

The SDRWQCB Basin Plan is designed to “preserve and enhance water quality and protect the beneficial uses of all regional waters. Specifically, the Basin Plan:

- Designates beneficial uses for surface and ground waters;
- Sets narratives and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the state’s antidegradation policy;

- Describes implementation programs to protect the beneficial uses of all waters in the Region; and
- Describes surveillance and monitoring activities to evaluate the effectiveness of the Basin Plan.”

The Basin Plan identifies 10 beneficial uses for the SMC Watershed and, in response to the approved invasive species TMDL, resolution No. R9-2024-0012, certified that nonregulatory action should restore the RARE beneficial use of SMC in lieu of adopting a Basin Plan Amendment (SDRWQCB 2024).

2.2. Current Watershed Conditions

The SMC Watershed is within the SDRWQCB designated San Juan Hydrologic Unit and flows from the Santa Ana Mountains in the CNF to the Pacific Ocean at Trestles Beach in northern San Diego County. The SMC Watershed encompasses approximately 178 square miles and 200 miles of stream habitat throughout western Riverside County, northwestern San Diego County, and southeastern Orange County.

2.2.1. Hydrology and Connectivity

SMC Watershed consists of two main drainage systems that converge to create broad alluvial plains in the lower valley (State Water Resources Control Board [SWRCB] 2005; USMC 2023). The watershed is intermittent, and flows vary seasonally in direct relation to precipitation (SMCC 2023).

2.2.1.1. San Mateo Creek and Tributaries

The main stem of SMC is approximately 29 miles in length, and its watershed includes an additional 171 miles of tributary waters. Major tributaries to SMC include Cristianitos Creek, Gabino Creek, La Paz Creek, Talega Creek, Cold Spring Creek, and Devil Canyon Creek, with other named creeks/canyons, including Bluewater, Tenaja, Wildhorse, and Los Alamos (SMCC 2023) (Figure 1). Most mapped wetlands and the 1% annual Federal Emergency Management Agency (FEMA) floodplain occur within MCBCP and San Onofre State Beach (Figure 5). Due to the mediterranean climate, the watershed is intermittent and flows seasonally in response to precipitation. During the dry season, typically May to September, periods of no-flow are frequent, and it is common for the streambed upstream of the Interstate-5 intersection to be dry. During the rainy season, typically October to April, streamflow increases (SMCC 2023).

During periods of continuous surface flow, SMC exhibits good biological integrity and provides suitable connected habitat from the Pacific Ocean to the upper portions of the watershed for anadromous use. During the dry season, surface water is restricted to a series of groundwater-supplied perennial pools. Perennial pools provide some habitat for juvenile steelhead and other listed species during periods of drought; however, extremely high temperatures may cause pools to become too hot or low in oxygen (Boughton et al 2022). The locations of 58 permanent pools mapped during the 2013-2016 drought (Barabe and Nickerson 2015) are depicted on Figure 6.

2.2.1.2. San Mateo Lagoon

The San Mateo Lagoon is part of the SMC Watershed and lies in northern San Diego County on the southern boundary of MCBCP. The San Mateo Lagoon is a naturally bar-built estuary. Sand bars typically separate the lagoon from the Pacific Ocean, but during periods of high rainfall,

these bars can be breached. Tidal influence is low due to the usual separation of San Mateo Lagoon from the ocean, but salt intrusion does occur from subsurface flow (USMC 2023). The San Mateo Lagoon exhibits suitable habitat for Southern California steelhead and the federally endangered tidewater goby (USFWS 2005). The San Mateo Lagoon is typically disconnected from the ocean during a large portion of the year and only breaches naturally during high precipitation years (e.g. 2023, 2024). The lagoon may go unbreached during dry years or for multiple years during drought (e.g. 2014-2016).

2.2.2. Land Development and Management

SMC is largely undeveloped and one of the last remaining undammed streams in Southern California. Ninety-five percent of the watershed is designated open space, and only 6.6% of the watershed is developed (SDRWQCB 2023). Approximately 48% of the watershed is publicly owned. Most private development consists of low-density rural housing in Riverside County.

2.2.2.1. Land Managers

The lower reaches of the SMC Watershed are managed by MCBCP and California State Parks (CSP) including the mouth of SMC, the San Mateo Lagoon, San Mateo Campground, and up until the CNF designation just past the Talega Road intersection. It is important to note that CSP managed land in the SMC watershed is leased from MCBCP. Most of the upper reach of SMC is within the CNF San Mateo Canyon Wilderness Area and is managed by USFS. Portions of the watershed are privately owned, including areas in Riverside County and southern Orange County. A delineation of landownership is shown on Figure 2.

Segmented jurisdiction throughout the watershed presents unique opportunities and challenges for monitoring. Monitoring access to the lower watershed requires coordination and permissions from MCBCP and/or CSP, while monitoring access to the middle watershed is largely limited to nonvehicular means due to the wilderness designation. Within the middle watershed access is largely available on the southern boundary. Coordinates for known access locations in the middle and upper watershed are provided in Table 2-6.

Table 2-6: Monitoring Access Points in the Middle/Upper SMC Watershed

Access Location	Latitude	Longitude
Tenaja Trailhead	33.51048	-117.36866
Fisherman’s Camp	33.53226	-117.39299
Tenaja Falls	33.54905	-117.39454
Cold Spring Trailhead	33.49492	-117.41969
Morgan Trailhead	33.63563	-117.38626
Bear Canyon Trailhead	33.61262	-117.42681
Forest Road 6S07 ¹	--	--

1. Multiple access points are available off Forest Road 6S07.

2.2.2.2. Existing Structures

Development in the SMC Watershed is largely limited to the southwestern edge in Orange County and the northeastern portion of the watershed within Riverside County. This area consists primarily of low-density rural residential housing. Approximately 74 private ponds are located

within the SMC Watershed (Figure 6), located primarily in the developed Riverside County area, although there may be additional unreported ponds. Privately owned and stocked ponds are a documented source population of aquatic invasive species and are considered the primary nonpoint source contributing to the watershed's impairment.

The upstream portions of SMC lie within the San Mateo Wilderness area of the CNF and are largely undeveloped and used exclusively for recreational purposes. Prescribed burns and stream channel remediation may take place in accordance with the CNF Forest Plan outlined in Section 1.2.4 (USDA 2005).

Several major roads cross over SMC, including Interstate-5, San Mateo Drive, and Talega Road, as well as a few smaller access roads. Road crossing structures may be barriers to both adult and juvenile Southern California steelhead (Wilcox 2012). Expansion of the Foothill-South Toll Road is under consideration, which would require constructing an overpass across SMC, creating additional risk for steelhead migration and introducing additional sediment and pollution into the watershed (SMCC 2023).

MCBCP operates groundwater wells on the lower portion of SMC to supply water to several military camps (USMC 2023). Groundwater use may be a problem for Southern California steelhead populations during times of drought, where steelhead rely on groundwater-supplied permanent pools for spawning and rearing habitat (NMFS 2022) (Figure 6). Pumping of groundwater lowers the water table, creating migration blockades in the form of dry reaches or isolated pools (SMCC 2023). Military operations at MCBCP also create potential fire hazards, which burn riparian vegetation and cause high levels of sediment to enter the stream

2.2.3. Habitat and Population Estimates

The Southern California DPS includes all naturally spawned anadromous *O. mykiss* originating below natural and manmade impassible barriers. The range for the Southern California steelhead DPS extends from the Santa Maria River to the Tijuana River (Boughton et al. 2022). As of 2009, there were an estimated 500 adult steelhead in the entire Southern California DPS (NMFS 2007).

2.2.3.1. Southern California Steelhead Populations

Surveys conducted by California Department of Fish and Wildlife (CDFW) (formerly California Department of Fish and Game) in the spring of 1999 identified the presence of a small population of fewer than 70 individuals of Southern California steelhead in SMC and Devil Canyon Creek, a tributary to SMC (Hovey 2004). This was the first account of steelhead in the SMC Watershed in nearly 50 years, and no population as large has been documented in the SMC Watershed since. CDFW conducted a four-year monitoring program immediately following the 1999 discovery, which confirmed an additional population of approximately eight steelhead in Devil Canyon Creek. Recent surveys of the upper SMC watershed have resulted in no steelhead detected above MCBCP (Hovey 2004; Wilcox 2012; Barabe and Nickerson 2015; Boughton et al. 2022).

The lower portions of the watershed are managed by MCBCP and are subject to monitoring through the Camp Pendleton INRMP. During aquatic exotic removal surveys conducted in accordance with the INRMP, one steelhead individual was observed in 2017 in SMC (USMC 2023).

Population Estimates

Current data on southern California steelhead populations are limited. The population of fewer than 70 individuals that was discovered in 1999 by CDFW was the first multiple record account of trout in SMC in nearly 50 years, and no population as large has been identified since (Hovey 2004). The decline in steelhead correlates with the increased development, use of groundwater, and recruitment and proliferation of aquatic invasive species, which limits viable steelhead habitat through depletion of refuge pools and competition for food sources. Only a few individuals have been reported in the lower portion of the watershed in the past two decades (USMC 2023). USFS conducted a biological presence/absence survey of the CNF for *O. mykiss* using bankside observation, snorkel surveys, seine and hand-netting, and electroshocking on the main stems of Trabuco Creek, San Juan Creek, and SMC in the summer of 2012 (Wilcox 2012). Water temperature monitoring was also conducted using Onset Corp. Hobos© sensors. No steelhead were observed during this survey, but over 24 rainbow trout were observed in Trabuco Creek, along with the California newt, arroyo chub, and southwestern pond turtle in Trabuco and San Juan Creeks.

Age Class and Evidence of Reproduction

Tissue collected during the 1999 CDFW survey confirmed that the observed population of steelhead was likely the offspring of adult anadromous wild steelhead; however, there was no evidence at that time that supported a reproducing resident trout population (Hovey 2004). Continued monitoring and genetic analysis from 1999–2003 identified the presence of a second and third generation of trout, proving that F1 and F2 reproduction could be successful in the SMC Watershed. However, the positive identification of direct descendants from the limited number of previously sampled trout indicated that the resident population of steelhead was extremely small.

2.2.3.2. Southern California Steelhead Habitat Suitability

Historically, SMC exhibits high biological integrity and suitability for steelhead use and reproduction. However, increased water use, climate change, and the introduction of aquatic invasive species into the watershed has caused steelhead populations to decline. The surveys conducted between 1999–2003 describe individuals that are emaciated and areas of high water temperatures (Hovey 2004). The total potential spawning area of the SMC Watershed is greater than 25 miles (Becker et al. 2010). The lower portions of SMC that lie within MCBCP are thought to serve as migration corridors, typically from December to March, to spawning habitat off base. Limited potential for rearing in the estuaries is expected (USMC 2023).

2.2.3.3. Invasive Species Populations

The presence of aquatic invasive species in the SMC Watershed is causing severe impairment in the watershed and is the primary causative pollutant that resulted in its 303(d) listing in 2016 (SDRWQCB 2018). Aquatic invasives are introduced into the watershed when extreme rain events cause flooding of privately stocked ponds in the upper reaches of the watershed, resulting in an influx of invasives into the middle and lower reaches of the SMC watershed (SDRWQCB 2023).

Population Estimates

Some of the earliest documented fish population and aquatic invasive species removal efforts were done in 2003 and 2004 by Trout Unlimited (California Coastal Conservancy [CCC] 2011). This work included testing removal techniques such as electrofishing, electrofishing with seining, and minnow trapping. A total of 29,310 individuals were removed from the main stem of SMC in CNF in 2003, and another 17,089 in 2004.

USMC maintains their own invasive species removal program for MCBCP, and contracts with qualified consultants to perform field work on their behalf. Though actual population sizes are largely unknown, recent years have shown as high as 23,866 total invasive individuals, primarily American bullfrog tadpoles, removed from the San Mateo Lagoon in a 250-hour removal effort.

Invasive species removal techniques employed by Trout Unlimited, USMC, CDFW, and USGS throughout the watershed include bullfrog gigging, seining, dip-netting, electrofishing, fyke nets, and minnow trapping. Data from efforts between 2010 to 2022 are provided below in Table 2-7. Nearly 150,000 individuals have been removed from SMC by Trout Unlimited, USMC, CDFW, and USGS since 2003. Known historical locations of invasive species removals are indicated on Figure 7 and largely overlap with mapped permanent pools (Figure 6).

Table 2-7: Summary of Invasive Species Removal in San Mateo Creek

Agency/Party	Year	SMC Reach	Species	# Removed
Trout Unlimited	2003	CNF	Bullfrog, black bullhead, bluegill, mosquitofish, red swamp crayfish	29,310
	2004			17,089
USMC/ECORP	2010	Lagoon/Lower	Common carp, fathead minnow, mosquitofish, golden shiner, goldfish, green sunfish, bluegill, largemouth bass, black bullhead, brown bullhead, yellow bullhead, yellowfin goby, red swamp crayfish, American bullfrog	877
		Upper		2,465
	2011	Lagoon/Lower		16,979
		Upper		502
	2013	Lagoon		235
		Lower		5,534
		Middle		11
	2015	Upper		1,326
		Lagoon		6,903
	2016	Upper		111
		Lagoon		6,418
	2018	Lagoon		789
		Upper		288
	2017	Lagoon		93
		Lagoon		1,932
	2019	Middle		744
		Upper		2,698
		Lagoon		1,995
	2021a	Upper		768
		Lagoon		1,976
	2021b	Middle		10
		Upper		1,045
		Lagoon		1,726
2021c	Middle	6,026		
	Upper	314		
	Lagoon	23,866		
2022	Upper	3,461		
	Upper	2		
USGS	2022	Lagoon	Common carp, fathead minnow, mosquitofish, golden shiner, goldfish, green sunfish, bluegill, largemouth bass, black bullhead, brown bullhead, yellow bullhead, yellowfin goby, red swamp crayfish, American bullfrog	14
		Upper		685
		Tributary		0
	2023	Lagoon		62
		Upper		493
2023	Tributary	0		
CDFW	2015	Devils Canyon	Green sunfish, golden shiner, mosquitofish, red swamp crayfish, black bullhead, bullfrogs	12,729
	2016*	Devils Canyon		0
	2017*	Upper		0
	2018*	Upper		4
	2019*	Upper		4

Sources: CCC 2011; CDFW Reports 2024; Unpublished USMC and USGS Data 2024.

*Primary purpose of these surveys was for steelhead and habitat observations, not invasive species removals.

Age Class and Evidence of Reproduction

Little published data exists that quantifies invasive populations by age class, but high population numbers and presence of juveniles indicate successful reproduction in the SMC Watershed.

San Mateo Source Tributary Flow Monitoring

There is one flow monitoring gauge (USGS Station #11046300) located on SMC at the boundary between MCBCP and the San Mateo Canyon Wilderness Area, just downstream of where Devils Canyon Creek meets SMC. Discharge is highest during the wet season (typically June through November), and discharge slows or stops altogether during the dry season (typically December through May). Severe storm events during the 2023 and 2024 wet season caused discharges

around and exceeding 2,000 cubic feet per second. Typical stream water elevation levels above North American Vertical Datum of 1988 (NAVD88) from 2020–2024 were around 404 feet during dry conditions and anywhere from 405 to 411 feet during wet conditions (USGS Water Data for the Nation). A secondary flow monitoring station (USGS Station #11046360) is located on Cristianitos Creek.

2.2.3.4. Other Sensitive Native Species Populations

The SMC Watershed provides refuge for numerous federally threatened and endangered species. California Species of Special Concern, the California newt, arroyo chub, and southwestern pond turtle have been observed in the watershed and would also benefit from the control and removal of aquatic invasives (SDRWQCB 2023). The federally endangered arroyo toad has been observed in some of the intermittent tributaries of SMC, and the tidewater goby has been documented inhabiting the San Mateo Lagoon at the mouth of the creek (SDRWQCB 2023). Tidewater goby is endemic to MCBCP and its habitat encompasses approximately 4 to 6 hectares in the San Mateo Lagoon (USFWS 2005). The arroyo toad has been observed commonly inhabiting the upper areas of SMC and in the sandy regions of the SMC tributaries, and as such, the upper SMC has been designated as critical habitat (USFWS 1998).

The following table provides a list of special status species that may be present in the SMC Watershed.

Table 2-8: Other Aquatic Native Species of Concern in the San Mateo Creek Watershed

Common Name	Scientific Name	Status	Included in TMDL?
Southern California Steelhead	<i>Oncorhynchus mykiss</i>	FE, SE	Primary
California Newt	<i>Taricha torosa</i>	CSSC	No
Southwestern Pond Turtle	<i>Emys pallida</i>	CSSC	No
Tidewater Goby	<i>Eucyclogobius newberryi</i>	FE	Secondary
Arroyo Chub	<i>Gila orcuttii</i>	CSSC	No
Arroyo Toad	<i>Anaxyrus californicus</i>	FE	Secondary

Source: California Natural Diversity Database [CNDDDB] 2024; SMCC 2023; USMC 2023.

FE: Federally Endangered; SE: CA State Endangered

CSSC: California Species of Special Concern

Population Estimates

Monitoring conducted since 2010 by MCBCP in SMC and the San Mateo Lagoon have identified small populations of tidewater goby, southwestern pond turtle, and arroyo toad, although total population estimates are largely unknown. Detections of tidewater goby in the lower reaches of SMC have fluctuated since 2007, with absence documented in 2007–2009, 2013, and 2016. Tidewater goby presence/absence surveys continue to be conducted by MCBCP. Populations of southwestern pond turtle have been declining on MCBCP lands since the late 1990s. Surveys conducted in 2008 and 2010 identified a breeding population of southwestern pond turtles in the upper portions of SMC, and more recent monitoring has continued to document southwestern pond turtle presence. Arroyo toad surveys conducted from 2003–2021 by MCBCP reported no evidence of breeding in six of the 19 survey years and very limited

breeding in 2009, 2012-2014, and 2016 (USMC 2023). The California newt, arroyo chub, and southwestern pond turtle have been observed in Trabuco and San Juan Creeks in CNF as recently as 2012 (Wilcox 2012).

2.3. Monitoring Approaches and Schedule

This LTMP was designed to meet the minimum monitoring metrics while considering effectiveness, efficiency, cost, and a strategy for meeting multiple objectives simultaneously. Monitoring methods and locations were integrated into and reflect the monitoring protocols established by Fish Bulletin 182 “Integration of Steelhead Viability Monitoring, Recovery Plans, and Fisheries Management in the Southern Coastal Area” (Boughton et al. 2022) and recommendations of the SMC Technical Advisory Committee (TAC) made up of individuals from various federal, state, and regional stakeholder and regulatory groups. Available methods and locations for each component of the monitoring plan (steelhead, aquatic invasive species, habitat) are presented, along with an overall summary of methods, locations, metrics, schedules, and responsibilities of associated parties (Table 2-9).

Monitoring approaches are determined based on their ability to satisfy the necessary viability indicators, Viable Salmonid Population (VSP) parameters, and the ability to implement the approach at the chosen monitoring locations. Monitoring locations have been selected to include a diversity of habitats that encompass potential steelhead spawning habitat, juvenile rearing habitat, and drought refugia habitat, in addition to known locations of monitoring by United States Marine Corps (USMC) and United States Forest Service (USFS), and those of other regional monitoring programs.

Table 2-9: Summary of Monitoring Method by Monitoring Location.

Watershed Reach	Location Description	Seining	Electrofishing	Snorkel Survey	eDNA Sampling	BMI Sampling	Water Quality Meter	Flow Meter	Bullfrog Giggling	Dip Netting	Fyke Nets	Minnow Trapping
SMC Lagoon	Longitudinal 1	X		X	X		X		X			X
	Longitudinal 2	X		X	X		X		X			X
	Longitudinal 3	X		X	X		X		X			X
Main Stem (Upper Lagoon to Tenaja Falls)	Upstream 1-5 Bridge	X	X		X	X	X	X	X	X	X	
	San Mateo Campground	X	X		X	X	X	X	X	X	X	
	Upstream of San Mateo Campground	X	X		X	X	X	X	X	X	X	
	Upstream San Mateo Drive	X	X		X	X	X	X	X	X	X	
	Permanent Pool 1	X		X	X		X		X			X
	Permanent Pool 2	X		X	X		X		X			X
	Permanent Pool 3	X		X	X		X		X			X
	Permanent Pool 4	X		X	X		X		X			X
Permanent Pool 5	X		X	X		X		X			X	
Tributaries	Cold Spring Canyon	X	X		X	X	X	X	X	X	X	
	Cristianitos Creek	X	X		X	X	X	X	X	X	X	
	Devils Canyon	X	X		X	X	X	X	X	X	X	
	Los Alamos Canyon	X	X		X	X	X	X	X	X	X	
	Bluewater Canyon	X	X		X	X	X	X	X	X	X	
	Tenaja Canyon	X	X		X	X	X	X	X	X	X	
Upper Watershed (Above Tenaja Falls)	Wildhorse Canyon	X	X		X	X		X	X	X	X	
	Permanent Pool 6*	X		X	X				X			X
	Permanent Pool 7*	X		X	X		X		X			X
	Permanent Pool 8*	X		X	X		X		X			X
	Upstream of Tenaja Falls*	X	X	X	X	X	X	X	X	X		X

BMI: benthic macroinvertebrate

eDNA: environmental DNA

It is expected that the multiple parties responsible for monitoring will work collaboratively and openly with one another to successfully achieve attainment with the TMDL and accomplish the goals of the greater Watershed Management Plan (WMP). For effective implementation of the LTMP and to track progress towards attaining TMDL numeric targets, monitoring standard operating procedures (SOPs) and schedules will need to be developed and standardized for use by all stakeholders across the watershed.

Implementation of the LTMP will require a variety of environmental permits. Permit reporting obligations will be met by the Clean Water Act (CWA) section 319 grant (319 grant) recipient with assistance from project partners. The TAC will appoint an independently funded 3rd party to act as a central data repository for retaining monitoring and implementation data related to attaining the TMDL, with all stakeholders assisting by providing relevant data within an appropriate timeframe following collection. The LTMP will follow an adaptive management framework and will be updated as necessary as additional information is obtained or as conditional changes dictate.

2.3.1. Steelhead Population Surveys

Steelhead population survey methods and locations incorporate and build upon existing monitoring currently being conducted by MCBCP and the USFS in the SMC Watershed. In accordance with the TMDL, steelhead population counts shall be conducted annually at minimum.

2.3.1.1. Monitoring Approach

Monitoring approaches are determined based on their ability to satisfy the necessary viability indicators, VSP parameters, and the ability to implement the approach at the chosen monitoring locations. Table 2-10 below designates the available methods for the monitoring of steelhead and steelhead habitat, including viability indicators and VSP parameters.

Table 2-10: Available Monitoring Methods, Viability Indicators, and VSP Parameters

Monitoring Method	Viability Indicators	VSP Parameter
Seining	<ul style="list-style-type: none"> - Adult Abundance - Population Density - Juvenile Distribution - Life-History Diversity - Drought Refugia 	<ul style="list-style-type: none"> - Abundance - Productivity - Diversity - Spatial Structure
Electrofishing	<ul style="list-style-type: none"> - Adult Abundance - Population Density - Juvenile Distribution - Life-History Diversity - Drought Refugia 	<ul style="list-style-type: none"> - Abundance - Productivity - Diversity - Spatial Structure
Snorkel Survey	<ul style="list-style-type: none"> - Adult Abundance - Population Density - Juvenile Distribution - Life-History Diversity - Drought Refugia 	<ul style="list-style-type: none"> - Abundance - Productivity - Diversity - Spatial Structure
Redd Counts	<ul style="list-style-type: none"> - Productivity 	<ul style="list-style-type: none"> - Abundance - Productivity - Spatial Structure
eDNA Sampling (Metabarcoding)	<ul style="list-style-type: none"> - Life-History Diversity - Spatial Structure 	<ul style="list-style-type: none"> - Diversity - Spatial Structure

However, not every method is appropriate for all cases of monitoring, and cost and site-specific conditions should be considered for monitoring programs (Table 2-11).

Table 2-11: Advantages and Disadvantages of Steelhead Monitoring Methods

Monitoring Method	Advantages	Disadvantages	Unit Cost*
Seining	<ul style="list-style-type: none"> - Allows for direct handling of fish - Opportunity to collect additional fish data - Simultaneously remove invasive species 	<ul style="list-style-type: none"> - Physically intensive - Smaller/quicker fish may not be captured 	\$250 per seine net
Electrofishing	<ul style="list-style-type: none"> - Allows for direct handling of fish - Opportunity to collect additional fish data - Simultaneously remove invasive species 	<ul style="list-style-type: none"> - Stresses fish - Not recommended for water >18°C - Not recommended in water deeper than 1.2 m 	\$25,000 purchase or \$1,500 per week rental
Snorkel Survey	<ul style="list-style-type: none"> - Can be used in deep water - Minimal equipment - Low stress to fish 	<ul style="list-style-type: none"> - Less effective in high turbidity - Difficult to count and ID individuals 	\$300 (snorkel and wetsuit)
Redd Counts	<ul style="list-style-type: none"> - Confirms presence and reproduction - Suitable spawning gravel 	<ul style="list-style-type: none"> - Not recommended for SMC by Wilcox, 2012 	\$0
eDNA Sampling	<ul style="list-style-type: none"> - Low cost and time efficient - Useful for presence screening of low abundance species - Metabarcoding option 	<ul style="list-style-type: none"> - Does not provide population estimates - Not all species can be detected via eDNA techniques 	\$180 (per single filter and analysis); controls add cost

*Unit costs may vary by vendor and by supply and include cost of equipment acquisition but not labor in the field.

2.3.1.2. Monitoring Locations

Monitoring locations have been selected for diversity of habitats and encompass potential steelhead spawning habitat, juvenile rearing habitat, and drought refugia habitat, in addition to known locations of monitoring by USMC and USFS, as well as locations of other regional monitoring programs through Surface Water Ambient Monitoring Program (SWAMP) that include California Stream Condition Index (CSCI), algal stream condition index (ASCI), or California Rapid Assessment Method (CRAM). In addition, locations consider ease of access, particularly for sites whose sampling methods require equipment. Proposed monitoring locations are further described below and can be found in Table 2-12 and on Figure 13.

Table 2-12: Steelhead Population Monitoring Locations

Watershed Reach	Location Description	Latitude	Longitude
SMC Lagoon	Longitudinal 1	33.386319	-117.594231
	Longitudinal 2	33.387286	-117.593094
	Longitudinal 3	33.389014	-117.591228
Main Stem (Upper Lagoon to Tenaja Falls)	Upstream 1-5 Bridge	33.392344	-117.590233
	San Mateo Campground	33.404514	-117.580739
	Upstream of San Mateo Campground	33.417917	-117.576761
	Upstream San Mateo Drive	33.4206	-117.53315
	Permanent Pool 1	33.480431	-117.457842
	Permanent Pool 2	33.492733	-117.454508
	Permanent Pool 3	33.514994	-117.436447
	Permanent Pool 4	33.520358	-117.427969
	Permanent Pool 5	33.545275	-117.396842
Tributaries	Cold Spring Canyon	33.493328	-117.431719
	Cristianitos Creek	33.460825	-117.568492
	Devils Canyon	33.473531	-117.43705
	Los Alamos Canyon	33.550542	-117.351183
	Nickel Canyon	33.508321	-117.448350
	Bluewater Canyon	33.530881	-117.429503
	Tenaja Canyon	33.529917	-117.410103
	Wildhorse Canyon	33.550942	-117.384225
Upper Watershed (Above Tenaja Falls)	Permanent Pool 6*	33.5564	-117.398667
	Permanent Pool 7*	33.557025	-117.399839
	Permanent Pool 8*	33.569989	-117.404681
	Upstream of Tenaja Falls*	33.558461	-117.401767

Note: Coordinates provided for approximate locations of monitoring. Actual locations of monitoring will be based on field conditions and stream levels observed during monitoring events.

*Locations not surveyed in any previous monitoring effort.

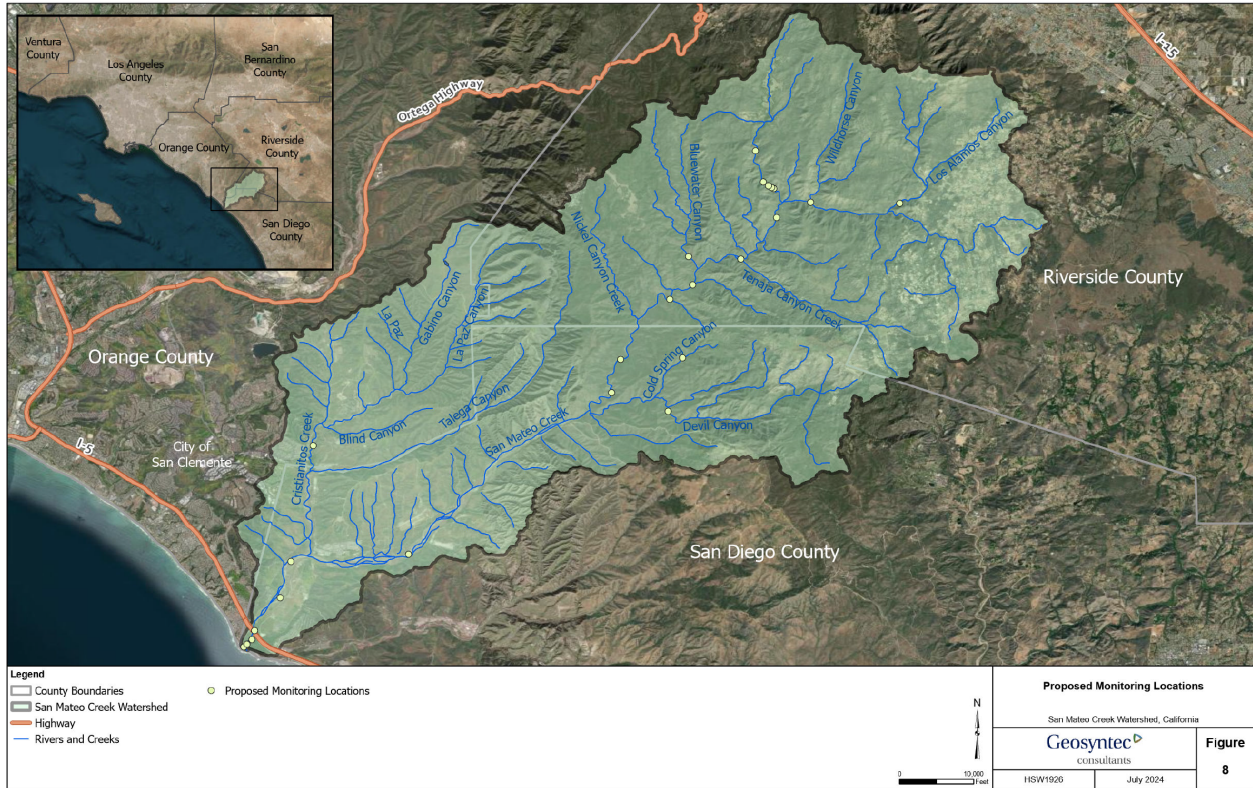


Figure 13: Proposed Monitoring Locations

The selected monitoring locations were generally based on representative sampling of the SMC lagoon (three longitudinal sections and possibly multiple depths) and major tributaries, as well as the main stem of SMC above Tenaja Falls (riffle/runs and pools). It is important to note that ecological conditions such as drought, fire, severe storms, and geologic changes may prevent certain proposed locations from being suitable for monitoring. During dry periods, situations may arise where a proposed monitoring location is entirely dry. To avoid negative bias, monitoring location suitability should be assessed and reevaluated if necessary.

2.3.2. Aquatic Invasive Species Surveys

Aquatic invasive species surveys shall be conducted simultaneously with steelhead population surveys. In accordance with the TMDL, nonnative population estimates shall, at a minimum, consist of annual dry season counts, population estimates, and catch per unit effort.

2.3.2.1. Monitoring Approach

Since 2003, invasive species removal techniques employed by Trout Unlimited, USMC, CDFW, and USGS throughout the watershed have included bullfrog gigging, seining, dip-netting, electrofishing, fyke nets, and minnow trapping. However, not every method is appropriate for all cases of monitoring, and cost and site-specific conditions should be considered for the most efficient use of resources and time (Table 2-13).

Table 2-13: Advantages and Disadvantages of Steelhead Monitoring Methods

Monitoring Method	Advantages	Disadvantages	Unit Cost*
Bullfrog Gigging	<ul style="list-style-type: none"> - Targeted control method with minimal bycatch - Effective extermination method 	<ul style="list-style-type: none"> - Manual and not practical for large numbers 	\$20 per gig
Seining	<ul style="list-style-type: none"> - Allows for direct handling of large numbers of fish - Opportunity to collect additional fish data 	<ul style="list-style-type: none"> - Physically intensive - Smaller/quicker fish may not be captured 	\$250 per seine net
Dip Netting	<ul style="list-style-type: none"> - Targeted control method with minimal bycatch 	<ul style="list-style-type: none"> - Manual and not practical for large numbers - Smaller/quicker fish may not be captured 	\$100 per dip net
Electrofishing	<ul style="list-style-type: none"> - Allows for direct handling of large numbers of fish - Opportunity to collect additional fish data 	<ul style="list-style-type: none"> - Stresses non-target fish - Not recommended for water >18°C - Not recommended in water deeper than 1.2 m 	\$25,000 purchase or \$1,500 per week rental
Fyke Nets	<ul style="list-style-type: none"> - Can be deployed and left unattended for short durations - Can capture large amounts of fish - Does not harm fish 	<ul style="list-style-type: none"> - Limited utility depending on depths - Small errors in installation can result in large losses of data 	\$1,000 per fyke net
Minnow Trapping	<ul style="list-style-type: none"> - Can be deployed and left unattended for short durations - Can capture large amounts of fish - Does not harm fish 	<ul style="list-style-type: none"> - Not suitable for larger fish or large numbers of fish 	\$15 per minnow trap

*Unit costs may vary by vendor and by supply and include cost of equipment acquisition but not labor in the field.

2.3.2.2. Monitoring Locations

Monitoring for aquatic invasive species will occur at the same locations as monitoring for steelhead and as feasible, simultaneously in the field during monitoring events.

2.3.3. Water Quality, Habitat Suitability, and Hydrologic Connectivity

In accordance with the TMDL, hydrologic connectivity of tributaries shall be monitored continuously (flow, water level, presence/absence), and water quality measurements should also

be taken during steelhead and aquatic invasive species survey efforts. Water quality parameters of interest include temperature and dissolved oxygen in accordance with the TMDL, as well as pH, conductivity, and dissolved solids to supplement findings and further inform habitat suitability. Furthermore, the collection of benthic macroinvertebrate (BMI) samples is recommended as a surrogate for water quality, as well as a VSP parameter for abundance and productivity. While it is recommended that BMI samples be collected during the same field effort as steelhead monitoring, aquatic invasive species monitoring, and water quality/habitat suitability, it is understood that the proper collection of representative BMI samples can be time-intensive, and efforts may need to be segregated from other scopes of work.

2.3.3.1. Monitoring Approach

The viability indicators and VSP parameters for BMI, water quality meters, and flow meters are provided in Table 2-14, and their relative advantages and disadvantages are discussed in Table 2-15.

Table 2-14: Available Monitoring Methods, Viability Indicators, and VSP Parameters

Monitoring Method	Viability Indicators	VSP Parameter
Benthic Macroinvertebrate Sampling	<ul style="list-style-type: none"> - Population Density - Drought Refugia 	<ul style="list-style-type: none"> - Abundance - Productivity
Water Quality Meter*	<ul style="list-style-type: none"> - Freshwater Conditions 	<ul style="list-style-type: none"> - Productivity
Flow Meter	<ul style="list-style-type: none"> - Freshwater Conditions - Drought Refugia 	<ul style="list-style-type: none"> - Productivity - Spatial Structure

*Water quality parameters include temperature, dissolved oxygen, pH, conductivity, and dissolved solids

Table 2-15: Advantages and Disadvantages of Steelhead Monitoring Methods

Monitoring Method	Advantages	Disadvantages	Unit Cost*
Benthic Macroinvertebrate Sampling	<ul style="list-style-type: none"> - Relatively simple and cost-effective method for monitoring water quality and fish food source 	<ul style="list-style-type: none"> - Does not quantify fish populations - Can be affected by large precipitation events 	\$700 (per sample kit and analysis)
Water Quality Meter	<ul style="list-style-type: none"> - Relatively simple and cost-effective method for monitoring water quality - Data is available in real time 	<ul style="list-style-type: none"> - Not spatially explicit - Can be easily skewed by microhabitat conditions - Requires careful calibration 	\$7,500 purchase or \$50/day rental
Flow Meter	<ul style="list-style-type: none"> - Relatively simple and cost-effective method for monitoring habitat 	<ul style="list-style-type: none"> - Not spatially explicit 	\$1,500 purchase or \$40/day rental

Monitoring Method	Advantages	Disadvantages	Unit Cost*
	<ul style="list-style-type: none"> - Data is available in real time 	<ul style="list-style-type: none"> - Can be easily skewed by microhabitat conditions - Requires careful calibration - Not recommended for pools 	

*Unit costs may vary by vendor and by supply and include cost of equipment acquisition but not labor in the field.

2.3.3.2. Monitoring Locations

Monitoring for BMIs and water quality parameters will occur at the same locations as monitoring for steelhead and aquatic invasive species and as feasible simultaneously in the field during monitoring events (Table 3-3). There are two USGS flow monitoring gauges (USGS Station #11046300 and USGS Station #11046360) that will be monitored throughout the project, and data can be accessed at any time from the USGS database. For riffle/run habitat, additional flow readings can be taken to supplement the USGS station readings, as feasible in the field. Additionally, water quality measurements using a multiparameter meter or equivalent shall be taken at each monitoring location proposed in Table 3-3 during monitoring events.

2.3.4. Summary of Long-Term Monitoring

2.3.4.1. Monitoring Locations, Methods, and Metrics

A matrix of proposed monitoring method by monitoring location is provided in Table 2-9 which generally consists of riffle/run strategies, pool strategies, and methods that are appropriate for both habitat types. It should be noted that proposed monitoring locations are based on diversity of habitat, likelihood that they are suitable for southern steelhead at various life stages, and likelihood that invasive aquatic species are present. The appropriate methods used to adequately capture representative data should be based on observed conditions in the field and adjusted as appropriate. Monitoring for species with secondary considerations in the TMDL (arroyo toad, tidewater goby) and of other species of special concern (arroyo chub, southwestern pond turtle, California newt) should occur simultaneously as appropriate. Specific metrics for defining success with attainment of the TMDL are described in Table 2-16.

Table 2-16: Summary of Data Collection and Monitoring Approach Metrics for Success

Monitoring Approach	Metric	Goal
Steelhead Habitat Suitability	Temperature	<28°C (Instantaneous); <24°C 7-day mean
	Dissolved Oxygen	>5.0 mg/l†
Steelhead Population Survey	Counts	70 Adults; Presence of Juveniles
Aquatic Invasive Species Population Survey	Counts	0
	CPUE	0
	Population Estimates	0
Hydrologic Connectivity Survey	Presence/Absence	Presence
	Flow	Surface flow or groundwater seep present; <10 ft/sec
	Water Level	>7 inches

Time- and temperature-dependent
mg/L: milligram(s) per liter

2.3.4.2. Stakeholder Responsibilities

It is expected that the multiple parties responsible for monitoring (Table 2-17) will work collaboratively and openly with one another to successfully achieve attainment with the TMDL numeric targets and to accomplish the goals of the greater Watershed Management Plan (WMP) (described in the SMC LMP). However, specific reaches of the SMC watershed are primarily managed by different stakeholders (Figure 4), and the respective parties who should conduct monitoring within these jurisdictions at designated monitoring locations are described in Table 2-18.

Table 2-17: Responsibilities of Stakeholders in the San Mateo Creek Watershed

Stakeholder	TAC Representation	Field Work Obligation*	Data Reporting Obligation	Data Management & Retention Obligation
California Trout (current 319 grant recipient)	X	X	X	
California State Parks	X	X	X	
USMC Camp Pendleton	X	X	X	
United States Forest Service	X	X	X	
California Department of Fish and Wildlife	X	X	X	
Acjachemen Tribe	X			
TEAM RCD	X			
The Nature Conservancy	X			
Independently Funded 3 rd Party Data Manager				X

*Field work may include removals of invasive species, steelhead population and habitat surveys, or other surveys.

319 grant: CWA Section 319 grant

TEAM RCD: Temecula-Elsinore-Anza-Murrieta Resource Conservation District

Table 2-18: Summary of Responsible Parties and Frequency by Monitoring Location

Watershed Reach	Location Description	Monitoring Frequency	Responsible Party			
			Grant Applicant Lead**	CSP	USMC	USFS
SMC Lagoon	Longitudinal 1	Annually	X	X	X	
	Longitudinal 2		X	X	X	
	Longitudinal 3		X	X	X	
Main Stem (Upper Lagoon to Tenaja Falls)	Upstream 1-5 Bridge		X		X	
	San Mateo Campground		X		X	
	Upstream of San Mateo Campground		X		X	
	Upstream San Mateo Drive		X		X	
	Permanent Pool 1		X		X	X
	Permanent Pool 2		X		X	X
	Permanent Pool 3		X		X	X
	Permanent Pool 4		X			X
	Permanent Pool 5		X			X
Tributaries	Cold Spring Canyon		X			X
	Cristianitos Creek		X			X
	Devils Canyon		X			X
	Los Alamos Canyon		X			X
	Nickel Canyon		X			X
	Bluewater Canyon		X			X
	Tenaja Canyon		X			X
	Wildhorse Canyon		X			X
Upper Watershed (Above Tenaja Falls)	Permanent Pool 6*	X			X	
	Permanent Pool 7*	X			X	
	Permanent Pool 8*	X			X	
	Upstream of Tenaja Falls*	X			X	

*Locations not surveyed in previous monitoring effort.** CalTrout intends to lead first grant proposal application but does not have jurisdictional responsibility for monitoring.

2.3.4.3. Monitoring Schedule

To effectively implement the LTMP and to track progress towards attaining TMDL numeric targets, monitoring standard operating procedures (SOPs) and schedules will need to be developed and standardized for use by all stakeholders across the watershed. Many threatened and endangered species have existing survey guidance from USFWS or CDFW, and these monitoring efforts are currently employed on MCBCP and in the CNF; however, standardized reporting protocols and monitoring schedules are necessary. A general proposed implementation schedule is given in Table 2-19.

Table 2-19: Proposed Implementation Monitoring Schedule

Implementation Action	Start Date	End Date
Steelhead Population Estimation Survey	2024	Ongoing
Invasive Species Surveys in the SMC Watershed	2024	2025
Monitoring for Numeric Targets	2026	2037
Attainment of Final Numeric Targets	2037	2037
Continued Monitoring of Steelhead Populations	2037	Ongoing
Continued Monitoring of Aquatic Invasive Species	2037	Ongoing

Source: SDRWQCB 2023

Furthermore, incremental targets and measures to track progress during LTMP implementation will need to be established and should align with the goals, objectives, and actions in the LMP.

2.4. Long-Term Monitoring Plan Implementation

2.4.1. Interagency Reporting Requirements

A variety of environmental permits will be needed to implement this LTMP and the greater SMC WMP to meet numeric targets of the TMDL, and this inherently comes with reporting obligations by the CWA 319 grant recipient to federal, state, and local agencies issuing permits. Examples of agencies who might need consultation for issuance of permits includes the SDRWQCB, CDFW, United States Army Corps of Engineers (USACE), and United States Environmental Protection Agency (USEPA) for compliance with the CWA, Endangered Species Act (ESA), National Environmental Policy Act (NEPA), and other regulations. A matrix of potential necessary permits is provided within the greater WMP (Appendices A and B), along with potential pathways, estimated maximum fees for each permit, and estimated timelines for issuance by regulatory agencies. However, early consultation (even informally) with regulatory agencies can substantially increase the speed at which permits are attained and decrease the cost of attainment. The “Cutting the Green Tape” program by the State of California also encourages expedited permitting pathways for the issuance of multiple permits through one permit package submittal, and potential expedited pathways are also outlined in the greater SMC WMP.

2.4.2. Data Management

An independently funded 3rd party agreed upon by the TAC will be responsible for compiling, processing, and uploading data into a central state or federal data repository and for retaining monitoring and implementation data related to attaining the TMDL. All stakeholders will provide the independently funded 3rd party with relevant data within an appropriate timeframe after its collection, specifically to the nature of data collected. Types of data may include preliminary field data, final field data, final field reports, public outreach engagement surveys, etc. The independently funded 3rd party will retain all data for the SMC WMP through 2042, or for five years after TMDL numeric targets are met if before 2037. For holistic watershed collaboration and the transfer of knowledge, inter-stakeholder data sharing is encouraged as well.

2.4.2.1. Quality Assurance/Quality Control

Data collection and fieldwork efforts should follow SOPs designated by the 319 grant recipient, in accordance with existing SWAMP protocols and USFS and USMC protocols, and should consider guidance from Boughton et al. (2022). Furthermore, many threatened and endangered species have existing survey guidance from USFWS or CDFW, and these should additionally be consulted and referenced to create a comprehensive set of SOPs for the SMC WMP.

Reporting from stakeholder monitoring events should follow a standardized format, including tables, figures, statistics, and field observations. The 319 grant recipient will be responsible for creating standardized reporting documentation that will be distributed for use by the stakeholders performing field work.

2.4.3. Adaptive Management

Adaptive management is the practice of decision-making through continuous learning and iterative assessment of project goals and project status with available tools. Considerations for changing environmental conditions, anthropogenic influence, and natural disaster—including but not limited to floods, fire, and drought—is needed to successfully implement this LTMP and the greater SMC WMP.

Adaptive management measures considered for this LTMP include the following:

5. Modify aquatic invasive species removal activities (schedule and/or method)
6. Modify management areas and steelhead monitoring (schedule and/or method)
7. Modify monitoring location
8. Modify monitoring method

To avoid negative bias, monitoring location suitability should be assessed and reevaluated as necessary according to Figure 7. Additional details discussing adaptive management for other components of the SMC WMP are discussed in the LMP.

2.4.4. Long-Term Monitoring Plan Updates

It is anticipated that this LTMP will periodically need updates to text, figures, tables, and appendices as the LTMP and greater SMC WMP are implemented and new information is obtained, as well as to incorporate any changes to the TMDL and SDRWQCB Certification. Example scenarios that would warrant an update of the LTMP include the following:

- Changes in prioritization or implementation schedule
- Changes in monitoring methods or locations
- A new 319 grant recipient is awarded
- Changes to data management or reporting requirements
- The TMDL is amended

At least every two years, the content of this LTMP should be reviewed for accuracy and alignment with stakeholder consensus, as well as the project goals, objectives, and actions outlined in the LMP. This LTMP should be considered a “living” document, and updates can be

made at any time as deemed appropriate by the TAC, 319 grant recipient, or any individual stakeholder. Updates should be made promptly within 60 days of known trigger, or if routine reevaluation necessitates updates to content.

3. AQUATIC INVASIVE SPECIES WORK PLAN

3.1. Introduction

The San Mateo Creek (SMC) Watershed consists of approximately 114,000 acres (178 square miles) and 200 total stream miles spread across northern San Diego, southern Orange, and western Riverside Counties in Southern California (San Diego Regional Water Quality Control Board [SDRWQCB] 2023) (Figure 1). The headwaters of SMC originate in both the Cleveland National Forest (CNF) and private property, flowing southwest to the Pacific Ocean through multiple landownership boundaries, ecosystem types, and stakeholder jurisdictions. The SMC Watershed is an important resource for both people and wildlife, as it is one of the last undammed watersheds in Southern California and is largely undeveloped, despite its close proximity to dense urban population centers (San Mateo Creek Conservancy [SMCC] 2023). The SMC Watershed exhibits intermittent flow and contains deep pools, spawning and rearing habitat, and high-quality aquatic and terrestrial habitat and is used as a reference watershed for numerous regional biomonitoring initiatives (Mazor et al. 2007); however, the SMC Watershed is vulnerable to environmental stressors that threaten its unique character and quality, such as invasive species, land development, fire, and climate change. These threats impact its ability to support wildlife and meet its designated uses (California Trout 2023).

SDRWQCB's Water Quality Control Plan for the San Diego Basin (Basin Plan) (1994) designated a total of 10 beneficial uses for various reaches of the SMC Watershed, and, in addition to its beneficial uses, other species of concern also inhabit the SMC Watershed, including the California newt (*Taricha torosa*), the arroyo toad (*Anaxyrus californicus*), arroyo chub (*Gila orcuttii*), southwestern pond turtle (*Actinemys pallida*), and the tidewater goby (*Eucyclogobius newberryi*). The existence and proliferation of these species, including *O. mykiss*, is directly threatened by the presence of aquatic invasive species that outcompete native species for resources, modify habitat conditions, predate upon native species, and spread disease (Moyle et al. 2013). The presence and general negative effects of aquatic invasive species led to the Clean Water Act (CWA) 303(d) listing of SMC as impaired for the Rare, Threatened, or Endangered Species (RARE), Migration of Aquatic Organisms (MIGR), and Spawning, Reproduction, and/or Early Development (SPWN) beneficial uses described in the 2014-2016 California Integrated Report (SDRWQCB 2018). In response to the 2016 CWA 303(d) listing of SMC as impaired for invasive species, SDRWQCB approved a total maximum daily load (TMDL) that lists numeric targets for aquatic invasive species and steelhead, as well as water quality monitoring indicators (SDRWQCB 2023) that represent alternative numeric

targets to Basin Plan water quality objectives. Furthermore, the approved TMDL also includes secondary considerations for the tidewater goby and arroyo toad.

3.1.1. Purpose of Aquatic Invasive Species Work Plan

The purpose of this Aquatic Invasive Species Work Plan (AISWP) is to prioritize and designate long-term aquatic invasive species remediation strategies within the SMC Watershed. The AISWP aims to inform implementation planning and execution through a phased approach to maximize efficiency and achievement of desired goals and objectives, including the proliferation of Southern California steelhead (*O. mykiss*), the remediation of aquatic invasive species, improvement in key indicators of water quality, consideration of in-stream flow requirements where applicable, and minimizing adverse impacts to other sensitive native species populations within the watershed. Aquatic invasive species remediation strategies are designed in accordance with the 2024 TMDL and will function in conjunction with the Land Management Plan and Long-term Monitoring Plan, specifically in the areas of water quality monitoring, in-stream flow analysis, and aquatic species monitoring.

The AISWP will coordinate remediation efforts between the entities who currently engage in land management and aquatic species monitoring in the watershed. The AISWP also outlines anticipated material and labor costs for the designated aquatic invasive species remediation methods as well as essential permitting pathways and costs facilitating year-to-year budget planning, funding analysis, and legal compliance.

3.1.2. Plan Development Process and Participation

In 2016, SDRWQCB determined that presence of aquatic invasive species in San Mateo Creek restricts the ability of its waters to support the Beneficial Uses of RARE (Rare, Threatened, or Endangered Species), MIGR (Migration of Aquatic Organisms), and SPWN (Spawning, Reproduction, and/or Early Development) for southern steelhead as designated in the Water Quality Control Plan for the San Diego Basin (SDRWQCB 2106a). Due to these impairments, San Mateo Creek was placed on the 2014/16 CWA section 303(d) list of impaired water bodies (SDRWQCB 2016b). The listing on the CWA 303(d) list of impaired water bodies provided the pathway for SDRWQCB to develop a strategy to address these impairments, and SDRWQCB subsequently published the Nonpoint Source Invasive Species Total Maximum Daily Load for San Mateo Creek. The TMDL defines numeric targets for the removal of aquatic invasive species, the re-establishment of adult and juvenile southern steelhead populations, and water quality standards to support the southern steelhead population.

The TMDL was not adopted as a Basin Plan amendment but was approved by the San Diego Water Board to be implemented through actions taken by other entities. The approval of the TMDL necessitated the creation of a watershed-scale management plan that incorporates the TMDL's numeric targets along with a land management plan, long-term monitoring plan,

invasive species work plan, a public outreach plan, and an implementation strategy that addresses stakeholder responsibility, working timelines, data management, and permitting. SDRWQCB contracted California Trout to draft the San Mateo Creek Watershed Management Plan. California Trout convened a Technical Advisory Committee consisting of the following members with expertise on San Mateo Creek and/or invasive species management:

- San Diego Regional Water Quality Control Board
- California Department of Fish and Wildlife
- U.S. Forest Service
- U.S. Geological Survey
- U.S. Marine Corps Base Camp Pendleton
- NOAA - National Marine Fisheries Service
- California State Parks
- U.S. Fish and Wildlife Service
- Juaneño Band of Mission Indians Acjachemen Nation
- Temecula, Elsinore, Anza, Murrieta Resource Conservation District
- Southern California Coastal Water Research Project

California Trout also subcontracted Geosyntec Consultants, Inc to assist in the creation of the Land Management Plan and Long-term Monitoring Plan sections of the Plan as well as a permitting matrix detailing the necessary regulatory permits required for Plan implementation.

3.1.3. Existing Authorities and Programs

3.1.3.1. Applicable Federal Aquatic Invasive Species Laws, Regulations, & Authorities

1990 – Nonindigenous Aquatic Nuisance Prevention and Control Act

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) established a federal program tasked with preventing the introduction of and controlling the spread of introduced aquatic nuisance species (ANS). The act created a framework that prioritizes research, applies prevention and control strategies, designates national priorities, provides citizen education and outreach, and coordinates public programs. The act also calls on states to develop their own state management plans to prevent the introduction and spread of ANS. Section 1201 of the act established the national Aquatic Nuisance Species Task Force (ANSTF). The Task Force, co-chaired by USFWS and NOAA, is responsible for coordinating governmental efforts related to ANS prevention and control. Section 1002 of NANPCA lists five objectives of the act, as follows:

1. Prevent further unintentional introductions of nonindigenous aquatic species;
2. Coordinate federally funded research, control efforts, and information dissemination;
3. Develop and carry out environmentally sound control methods to prevent, monitor, and control unintentional introductions;
4. Understand and minimize economic and ecological damage; and
5. Establish a program of research and technology development to assist state governments.

1999 – Executive Order 13112

Executive Order 13112 was signed on February 3, 1999 by President William J. Clinton. The order called newly established National Invasive Species Council (NISC) to create a National Invasive Species Management Plan that aimed to prevent the introduction of invasive species, provide for their control, and minimize their impacts through improved coordination of federal agency efforts. The order directs all federal agencies to address invasive species concerns and refrain from actions likely to increase invasive species problems. The order also established the Invasive Species Advisory Committee (ISAC) which is composed of stakeholder representatives from state governments, industry, conservation groups, academia, and other interests. ISAC's role is to work with NISC and advise the federal government on concerns related to invasive species. NISC's role is similar to that of ANSTF, but it differs in that it addresses all invasive species while ANSTF only addresses aquatic invasive species.

Endangered Species Act of 1973

The ESA seeks to protect endangered and threatened species. This act can be applied as the basis for invasive species control or eradication efforts by USFWS or NOAA – National Marine Fisheries Service (NMFS) when non-native invasive species threaten endangered species. The potential to harm a federally listed species and the need to obtain the proper permits from USFWS or NMFS should be considered when selecting aquatic invasive species management methods.

Lacey Act (1900; amended 1998)

The Lacey Act was the first federal act attempting to control migrations and importations of nonindigenous species. The act prohibits the importation of a list of designated species that are “injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States.” The act makes it unlawful to import, export, sell, acquire, or purchase fish, wildlife, or plants taken, possessed, transported or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken, possessed, or sold in violation of State or foreign law. USFWS is the lead agency tasked with enforcing the act's prohibition of fish and wildlife imports.

National Environmental Policy Act of 1970

NEPA requires the assessment of environmental impacts for any federal action, including direct federal activities, permitting, and federal funding of activities by another entity. NEPA environmental documents may include a “finding of no significant impact (FONSI),” and “environmental assessment (EA),” or a full “environmental impact statement (EIS).” The potential impact of invasive species, whether direct or indirect, are among the issues that should be considered under NEPA.

3.1.3.2. Applicable Federal Agencies

National Oceanic and Atmospheric Administration (NOAA) & National Marine Fisheries Service (NMFS)

NOAA is the primary federal agency tasked with the management of marine resources. The agency is the co-chair of the ANSTF as well as the NISC. Within NOAA, additional national, state, and regional agencies and programs work to address aquatic invasive species issues. One of these agencies is the National Marine Fisheries Service.

NMFS is an agency within NOAA that is charged with sustaining the nation’s fisheries, including the assessment and management of impacts to fisheries from aquatic invasive species. NMFS is heavily involved in aquatic invasive species risk evaluation and research and participates in several aquatic invasive species advisory and coordinating committees including the Pacific Ballast Water Group, Non-Native Invasive Species Advisory Council, and the West Coast Ballast Outreach Project Advisory Team.

U.S. Army Corps of Engineers (USACE)

The USACE supports the military and local governments with engineering, construction, and environmental project services. The USACE will also support local governments with water resource development needs including flood control, navigation, ecosystem restoration, and watershed planning. The USACE will conduct research on invasive species when assisting with ecosystem restoration.

U.S. Environmental Protection Agency (USEPA)

USEPA is responsible for leading the nation’s environmental science, research, education, and assessment efforts. The agency develops and enforces regulations, offers financial assistance, performs environmental research, sponsors voluntary partnerships and programs, furthers environmental education, and publishes environmental information. In addition to enforcing the Clean Water Act, the agency is also responsible for CWA permitting.

U.S. Fish and Wildlife Service (USFWS)

USFWS serves as co-chair of the Federal ANSTF and provides technical assistance to states regarding aquatic invasive species management. The agency is also responsible for the administration of the Lacey Act.

U.S. Geological Survey (USGS)

USGS developed a White Paper on invasive species stressing the development of new strategies for the prevention, early detection, and prompt eradication of new invasive species. The USGS plays a key role in information management and documentation of invasions and maintains an extensive, geographic database of non-native species.

3.1.3.3. Applicable State Aquatic Invasive Species Laws, Regulations, & Authorities *California Environmental Quality Act (CEQA)*

CEQA requires public disclosure of all significant environmental effects of proposed discretionary projects. Final documents in the CEQA process must show: 1) what mitigation measures will be required to reduce particular effects to a less significant level; and 2) provide justifications for the approval of the project with particular significant effects left unmitigated.

California Porter-Cologne Water Quality Control Act

California's Porter-Cologne Water Quality Control Act states, "any person discharging waste, or proposing to discharge waste, within any region that could affect the quality of the waters of the state" must file a report of the discharge with the appropriate Regional Water Quality Control Board. The act defines "waste" broadly, and the term has been applied to a variety of materials. Section 13050 of the act specifically details the regulation of "biological" pollutants. Aquatic invasive species are an example of "biological" pollutants if they are discharged to receiving waters.

Fish and Game Code and Title 14 of the California Code of Regulations

Fish and Game Code designated the California Fish and Game Commission as the entity responsible for adopting regulations that provide details on how certain Fish and Game laws are to be applied and implemented. These regulations are published in Title 14 of the California Code of Regulations. The Codes below pertain to invasive species and control actions:

Fish and Game Code 2080-2089: DFG regulates the take of species listed under the California Endangered Species Act. These statutes and regulations should be consulted if aquatic invasive species control measures could potentially impact State-listed species.

Fish and Game Code 2118, 2270-2300: DFG is responsible for the enforcement of importation, transportation, and sheltering of restricted live wild animals.

Fish and Game Code 6400-6403: It is unlawful to place live fish, fresh or saltwater animals, or aquatic plants in any waters of the state without a permit from DFG.

3.1.3.4. Applicable State Agencies *California Coastal Commission (CCC)*

The CCC protects and enhances public access, recreation, wetlands, visual resources, agriculture, commercial activity, industrial activity, and environmentally sensitive habitats within the coastal zone by reviewing and issuing coastal development permits, implementing coastal programs, and applying federal consistency review. The CCC is responsible for protecting the biology of aquatic ecosystems as well as the special uses associated with the marine environment including commercial fishing and recreation.

California Department of Fish and Wildlife (CDFW)

CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, plants, and habitat necessary for biologically sustainable populations of those species. CDFW is the lead agency in developing the statewide aquatic invasive species management plan as well as a rapid response plan for invasions. The agency is also tasked with conducting biological surveys to assess the types and extent of aquatic invasive species present in state waters.

California Department of Parks and Recreation (PARKS)

PARKS is responsible for the management of areas designated as California state parks. Management of these areas can differ based on the site and environment and can range from management that prioritizes preservation to management that prioritizes recreation. Management does include the control and removal of exotic species.

State Water Resources Control Board (SWRCB) & San Diego Regional Water Quality Control Board (SDRWQCB)

The SWRCB strives to preserve, enhance, and restore the quality of California's water resources. The agency also ensures the proper allocation and efficient use of water resources for the benefit of present and future generations. Under the State Board, nine Regional Water Quality Control Boards support the goals and initiatives of the State Board at a local level, including work on the management of aquatic invasive species.

The SDRWQCB oversees the water resources of San Mateo Creek in Orange, San Diego, and Riverside counties. SDRWQCB is responsible for enforcing the Clean Water Act and implementing programs to address water resources on the CWA's 303 (d) list of impaired bodies of water. Due to San Mateo Creek's status on the 303 (d) list, SDRWQCB issued the state's first non-point source TMDL for aquatic invasive species to address the issue. The TMDL, along with the USEPA's Nine Key Elements for a Watershed Management Plan serve as the basis for this Plan.

3.2. Aquatic Invasive Species Impairment

3.2.1. Description of Problem

The presence and proliferation of aquatic invasive species in the SMC Watershed is the most consequential issue impacting steelhead and other native aquatic species in the watershed. Aquatic invasive species are the impairment cited for the 2014/2016 CWA 303(d) listing as well as the pollutant contributing to SDRWQCB's Nonpoint Source TMDL for aquatic invasive species in San Mateo Creek. Aquatic invasive species are introduced to the watershed from private stock ponds used for recreation in the upper watershed. During wet weather events, the stock ponds can flood, discharging the aquatic invasive species into natural drainage channels, providing access to the middle and lower reaches of the watershed.

Once introduced, aquatic invasive species proliferate throughout the watershed leading to competitive exclusion of steelhead via direct competition for resources and via predation upon juvenile steelhead preventing new recruitment (Hovey 2004). The presence of aquatic invasive species can also contribute to habitat degradation and decreased water quality from higher water temperatures, lower dissolved oxygen content, higher biological oxygen demand, and increased algal growth (SDRWQCB 2023). The most common aquatic invasive species in SMC Watershed are green sunfish (*Lepomis cyanellus*), golden shiner (*Notemigonus crysoleucas*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), bullhead (*Ameiurus ferus*), bullfrog (*Lithobates catesbeianus*), and crayfish (*Procambarus clarkii*).

Bullfrogs are known to prey on steelhead juveniles and eggs, and they will predate on other native aquatic species in the watershed including the larvae of arroyo toads and southwestern pond turtle hatchlings (SDRWQCB 2023; SMCC 2023). Crayfish will also consume arroyo toad larvae, while green sunfish, golden shiner, bluegill, largemouth bass, and bullhead can survive in small, intermittent pools during the dry summer months, and they are able to outcompete young steelhead and other native species such as tidewater goby and arroyo chub for resources (SMCC 2023). Other aquatic invasive species have been observed in the watershed sporadically, but these species remain the most prevalent and impactful on the steelhead population. This Plan is designed to address all aquatic invasive species and not just the most prevalent ones mentioned here.

3.2.2. Impacts

The presence and proliferation of aquatic invasive species in SMC Watershed restricts the ability of its waters to support the Beneficial Uses of RARE (Rare, Threatened, or Endangered Species), MIGR (Migration of Aquatic Organisms), and SPWN (Spawning, Reproduction, and/or Early Development) for southern steelhead as designated in the Water Quality Control Plan for the San Diego Basin (SDRWQCB 2016a). Historically, steelhead have been monitored in the watershed via visual observations in the field. More recently, eDNA sampling has been incorporated into monitoring efforts. Despite the capabilities of eDNA to detect the presence of steelhead that may

not have been otherwise observed, steelhead are still only intermittently detected in SMC Watershed. Two individual steelhead were observed in 2017, and eDNA analysis confirmed detections in 2019, 2020, and 2021 (San Diego Water Board 2019, USMC 2023). However, multiple years can pass with no visual observations or eDNA detections.

The existence and re-establishment of a viable southern steelhead in SMC is directly threatened by the presence of aquatic invasive species that outcompete native species for resources, modify habitat conditions, predate upon native species, and spread disease (Moyle et al. 2013). Even if steelhead successfully spawn in the watershed, the proliferation of aquatic invasive species results in the competitive exclusion of juvenile steelhead through both direct competition for resources, as well as through predation and preventing recruitment (Hovey 2004). Aquatic invasive species may also lead to habitat degradation and decreased water quality by contributing to higher water temperatures, lower dissolved oxygen content, higher biological oxygen demand, and excessive algal growth (SDRWQCB 2023). Invasive giant reed (*Arundo donax*), a water-intensive plant species, also has the potential to decrease baseflow via transpirational fluxes that can further exacerbate flow conditions for steelhead and other sensitive species (Dudley and Cole 2018).

Baseflow in SMC can persist into late summer, but during late summer and early fall dry season, there are typically no continuous surface flows in the creek except during high precipitation years. Habitat for steelhead and other aquatic species is restricted to disconnected perennial pools supported by subsurface springs and flows (SDRWQCB 2023). Drought conditions can further reduce perennial pool size and depth. The disconnected nature of the pools and limited influx of cooler, subsurface flows contribute to warmer temperatures which can reduce steelhead fitness and health making them more susceptible to disease (Wilcox 2012). This reduction in available habitat compounds competition for resources, potential for predation, dissolved oxygen content, and biological oxygen demand by corralling aquatic fish species into small, isolated areas and no opportunity to move throughout the watershed until surface flow returns.

3.2.3. Pathways/Vector

Multiple nonpoint source pathways contribute to the impairments caused by aquatic invasive species in San Mateo Creek Watershed. The primary pathway results from the existence of historic stock and recreational ponds in the upper watershed. Ponds are located primarily on private inholdings in the Cleveland National Forest and on private land in the Los Alamos Canyon tributary and Devil Canyon tributary watersheds (SDRWQCB 2023). Historically, the ponds have been stocked with invasive species for recreational fishing opportunities as well as insect control. They serve as a refuge and loading source for areas in lower portions of the watershed (MRCO 2006; Hovey 2017). Many of the ponds have been constructed in-line with natural drainage channels that lead to San Mateo Creek tributaries. During heavy precipitation events, these ponds can overflow, resulting in the downstream transport of aquatic invasive species. Ponds with hydrologic connectivity to downstream surface waters are considered the

primary nonpoint source (SDRWQCB 2023). In the future, the watershed may be subject to more frequent flooding resulting from increased precipitation intensity and frequency driven by climate change (Kalansky et al. 2018; Dong et al. 2019; Huang et al. 2020).

A secondary pathway occurs once invasives are incorporated into San Mateo Creek and its tributaries. Species counts and class sizes in multi-year surveys indicate invasives can support self-sustaining populations and proliferation via reproduction and dispersal (SDRWQCB 2023). Invasives in San Mateo Creek have also been able to sustain populations during drought years (Barabe 2018). The sustained presence of aquatic invasive species and their successful proliferation prevents steelhead recovery due to predation of juveniles and direct competition for resources. Prior sporadic and non-coordinated invasive species removal efforts have been performed in the watershed, but these efforts were discontinued. Mitigation of discharge from the upper watershed stock ponds was not addressed as a part of these efforts, and reintroductions of invasive species continue to occur (SDRWQCB 2023).

3.2.4. Categorization of Key Aquatic Species

San Mateo Creek Watershed is home to an array of species. The implementation of this WMP is expected to primarily impact aquatic species. Table 3-1 categorizes key aquatic invasive species known to be present in the watershed as well as sensitive native aquatic species with state or federal protection statuses.

Table 3-1: Categorization of Species in San Mateo Creek Watershed

Species Name	Species Description	Species Status	Preferred Habitat
Aquatic Invasive Animal Species			
Green Sunfish (<i>Lepomis cyanellus</i>)	Fish	Invasive	Pools, runs
Golden Shiner (<i>Notemigonus crysoleucas</i>)	Fish	Invasive	Pools, runs
Bluegill (<i>Lepomis macrochirus</i>)	Fish	Invasive	Pools, runs
Largemouth Bass (<i>Micropterus salmoides</i>)	Fish	Invasive	Pools, runs
Bullhead (black and brown) (<i>Ameiurus melas</i> and <i>Ameiurus nebulosus</i>)	Fish	Invasive	Pools, runs
Bullfrog (<i>Lithobates catesbeianus</i>)	Amphibian	Invasive	Pools, runs, riparian
Crayfish (<i>Procambarus clarkii</i>)	Crustacean	Invasive	Pools, runs, riffles
Invasive Plant Species Impacting Water Quality/Availability			
Arundo (<i>Arundo donax</i>)	Vegetation	Invasive	Riparian
Native Aquatic Animal Species			
Southern Steelhead (<i>Oncorhynchus mykiss irideus</i>)	Fish	FE, SE	Lagoon, pools, runs, riffles
Arroyo Chub (<i>Gila arcuati</i>)	Fish	CSSC	Pools, runs (Possibly extirpated)
Southern Tidewater Goby (<i>Eucyclogobius kristinae</i>)	Fish	FE	Lagoon
Southwestern Pond Turtle (<i>Actinemys pallida</i>)	Reptile	FC, CSSC	Lagoon, pools
Pacific Lamprey (<i>Entosphenus tridentatus</i>)	Fish	CSSC	Runs, riffles (Possibly extirpated)
California Newt (<i>Taricha torosa</i>)	Amphibian	CSSC	Riparian, Runs, Glides
Arroyo Toad (<i>Anaxyrus californicus</i>)	Amphibian	FE	Riparian, Stream Margins along Runs and Glides
Western Spadefoot (<i>Spea hammondi</i>)	Amphibian	FC, CSSC	Riparian

3.3. Implementation Strategy

3.3.1. Implementation Goals

The goals and objectives of the Invasive Species Work Plan are consistent with the goals defined by SDRWQCB’s TMDL. Achieving the approved TMDL will require the successful attainment of three primary goals:

1. Remediation of aquatic invasive species
2. Recovery of southern steelhead
3. Improvement of instream temperature and dissolved oxygen

Numeric targets for these goals are summarized in Table 3-2, Table 3-3, and Table 3-4.

Table 3-2: Numeric Targets for the Remediation of Aquatic Invasive Species

Common Name	Scientific Name	Numeric Target	Interim CPUE Target*
Green Sunfish	<i>Lepomis cyanellus</i>	0	0
Golden Shiner	<i>Notemigonus crysoleucas</i>	0	0
Bluegill	<i>Lepomis macrochirus</i>	0	0
Largemouth Bass	<i>Micropterus salmoides</i>	0	0
Bullhead (black)	<i>Ameiurus melas</i>	0	0
Bullhead (brown)	<i>Ameiurus nebulosus</i>	0	0
Bullfrog	<i>Lithobates catesbeianus</i>	0	0
Crayfish	<i>Procambarus clarkii</i>	0	0

Source: SDRWQCB 2023

*Catch Per Unit Effort (CPUE) using standardized methods in areas with perennial surface water.

Table 3-3: Numeric Targets for the Recovery of Southern Steelhead

Class	Number
Adults	Interim: 70

Class	Number
	Final: 70 until or unless an alternative self-sustaining, viable Core 1 Population number is determined in consultation with NMFS
Juvenile	Present

Source: SDRWQCB 2023

Table 3-4: Numeric Targets for the Improvement of Instream Temperature and Dissolved Oxygen

Water Quality Parameter	Monitoring Indicator (Summer Dry)
Dissolved Oxygen	Temperature- and time-dependent*
Temperature	Instantaneous maximum surface: <28°C 7-day mean: <24°C

Source: SDRWQCB 2023

3.3.2. Implementation Objectives

The TMDL also established three objectives to meet the defined goals:

1. Remediating and mitigating ponds that hold aquatic invasive species
2. Removing aquatic invasive species from SMC
3. Monitoring and assessing TMDL implementation

The realization of these objectives will require a systematic, phased approach to maximize results and efficiency. The remediation and mitigation of private ponds that hold aquatic invasive species will be prioritized. Achievement of this objective increases efficiency when dedicating resources towards the achievement of the remaining two objectives. Otherwise, aquatic invasive species will continue to be discharged from the stock ponds and incorporated into the natural watershed, erasing any instream eradication measures that have already been performed. The Public Outreach section of this WMP details the methods and strategy essential to educating private landowners and successfully implementing mitigation measures. Once adopted and mitigated, instream removal efforts can be effective in reducing the invasive species population in the watershed (SDRWQCB 2023). Finally, continuous monitoring and assessment of Plan implementation will be essential to track progress towards goal and objective achievement, realization of desired outcomes, and inform adaptive management strategies.

3.3.2.1. Remediating and Mitigating Ponds That Hold Aquatic Invasive Species

The remediation and mitigation of private stock ponds that hold aquatic invasive species in SMC Watershed is the critical first phase towards achieving the numeric targets established by the approved TMDL. Initial efforts under this objective will prioritize public outreach and landowner engagement. It is essential to provide public education regarding the impacts of aquatic invasive species on the natural ecosystem and the role that private stock ponds can play in contributing to those impacts. Effective engagement and the establishment of partnerships with landowners will

facilitate the adoption of necessary pond management best practices to prevent the discharge of aquatic invasive species and recruitment of new invasive individuals into the natural watershed. California Trout will coordinate with nonprofit organizations, government agencies, NGO's, and other stakeholders in the watershed to engage in public speaking opportunities, attend public events, plan landowner-specific events and education opportunities, and develop educational outreach materials for wider dispersion. Full public outreach priorities, details, and strategies can be referenced in the Public Outreach Plan section of the SMC WMP.

Effective remediation and mitigation of private stock ponds will require the cooperation of landowners and their adoption of pond management best practices and mitigation measures. Best practices and necessary mitigation measures may vary based on the specific characteristics and locations of individual ponds. To achieve the desired results, multiple mitigation measures may need to be implemented.

Aquatic invasive species mitigation measures for private stock ponds include:

1. Direct removal of aquatic invasive species or dewatering of the pond
2. Introduction of odanates for mosquito control
3. Installation and management of drainage pathways and sedimentation
4. Off-channel relocation of pond site
5. Installation of downstream aquatic species discharge barriers (catch nets/weirs)

Mitigation Measure #1:

Landowners may opt to mechanically or chemically remove aquatic invasive species from their pond. Instream removal efforts will also rely on mechanical removal strategies, and they are summarized in detail in the subsequent section of the AISWP. At their discretion, landowners may cull the captured invasives or relocate them, where legally able to do so, outside of the watershed or to another pond with adequate mitigation measures that would prevent their discharge into SMC. Dewatering or chemically treating the pond would also be effective in culling invasives and removing them from that particular pond on the property. Removal efforts should be repeated annually until two consecutive years yield zero aquatic invasive species.

Mitigation Measure #2:

In addition to private, recreational fishing opportunities, some landowners stock their ponds with aquatic invasive species for the purpose of mosquito control. In the absence of aquatic invasive species, landowners can still effectively control mosquito populations via the introduction of odanates such as dragonflies. Dragonflies are highly predatory in both their naiad and adult life stages. During their naiad, or aquatic nymph, life stage, dragonflies are predators of mosquito

larvae. A single dragonfly in its naiad stage will consume an average of 40 mosquito larvae per day (Priyadarshana 2023). Controlling mosquito populations at their larval stage is highly effective since the mosquitoes do not have an opportunity to mature and reproduce.

Mitigation Measure #3:

Private ponds that are situated in-line with natural drainage channels are most likely to discharge aquatic invasive species into the natural watershed during significant wet weather events. A primary spillway constructed downstream of the pond that directs water flow off-line of the natural drainage channel would mitigate the potential for invasive species to be discharged into the natural watershed. Directing flow off-line of natural drainage channels may not be possible in some situations, and a second emergency spillway or catch basin may be necessary to adequately prevent flows and discharges from reaching the natural watershed. These secondary spillways and basins may also be necessary to accommodate particularly severe wet weather events.

Upstream mitigation measures can also be considered. Recontouring of the land upstream of the pond can be performed to direct water runoff away from the pond, preventing the pond from discharging during wet weather events. Sediment pits may also be constructed upstream from the pond to allow for the accumulation of sediment from upstream erosion in the pit rather than in the pond itself. Without an upstream sediment pit, surface water runoff flowing directly into the pond may deposit and accumulate sediment over time reducing the depth of the pond and its maximum water storage capacity. Upstream sediment pits may also dissipate flow energy and reduce erosion of the pond itself.

The measures discussed under Mitigation Measure #2 will be altered over time via natural erosion and sedimentation processes. Landowners will need to continuously maintain these measures over time to ensure that they continue to adequately prevent the discharge of invasives. Any modifications to natural drainage channels may require streambed alteration permitting to ensure legal compliance. Landowners should consult the proper regulatory authorities before engaging in construction.

Mitigation Measure #4:

Based on the location, orientation, and surrounding topography of a pond, modification to drainage pathways and sedimentation may not be feasible or effective in preventing the discharge of invasives. If the landowner desires to still have a pond on the property with aquatic invasive species, it may be necessary to relocate the pond entirely to a different location on the property that is off-line of natural drainage channels. This mitigation measure allows the landowner to maintain a pond on the property, but when properly sited, the new pond will not discharge invasives into the natural watershed. Any modifications to natural drainage channels may require streambed alteration permitting to ensure legal compliance. Landowners should consult the proper regulatory authorities before engaging in construction.

Mitigation Measure #5:

Downstream discharge and catch barrier systems will not prevent the initial overflow of ponds, but they can assist in catching discharged invasives and preventing them from accessing the natural watershed. When properly installed and oriented, netting systems and catch weirs can effectively block aquatic invasive species from being discharged further downstream. Screens installed on defined drainage outlets can also prevent aquatic invasive species from escaping the confines of the pond. These systems should be considered supplementary to other mitigation measures as they are not likely to be 100% effective in preventing discharges, and smaller invasives may still be able to pass through the system. Continual maintenance would also be required to ensure that these systems continue to work as designed over time.

Permitting Compliance:

In addition to mitigation measures, permitting compliance can be reviewed to ensure private ponds, and the aquatic species stocked in them, have been properly sited and approved by the appropriate authorities. California state law may require permitting when constructing, modifying, or relocating ponds on private property depending on their orientation with and proximity to natural drainage channels and streambeds. Additionally, the state has specific laws regarding the stocking of aquatic plants and animals on private property including specific permit requirements for certain aquatic species and requirements that certain aquatic species must be obtained from a registered aquaculturist. Landowners with private stock ponds should review these regulatory requirements with appropriate local authorities and ensure that they are currently in compliance, and they should seek the proper permits before stocking any additional aquatic species. Failure to do so could result in legal action against the landowner.

3.3.2.2. Aquatic Invasive Species Removal Methods

Instream aquatic invasive species removal efforts can be implemented concurrently with private stock pond mitigation measures to resolve the impairments caused by the presence and proliferation of aquatic invasive species in SMC Watershed. This AISWP will implement and execute mechanical and chemical aquatic invasive species removal methods prioritized to maximize efficacy and minimize adverse impacts to sensitive, threatened, and endangered native aquatic species in the watershed. Aquatic invasive species removal methods appropriate for San Mateo Creek Watershed are summarized in

Table 3-5 along with anticipated equipment requirements, recommended habitat types, and costs per unit effort. Entities performing aquatic invasive species removal will select the appropriate method based on the habitat type and their experience and expertise in removing invasives in similar watersheds.

Table 3-5: Summary of AIS Removal Methods, Equipment Requirements, and Habitat Type

AIS Removal Method	Equipment Requirements	Recommended Habitat Type
Electrofishing	<ul style="list-style-type: none"> • Battery-powered backpack shocking unit with safety kill switch, anode ring, rat tail cathode • Elbow-length rubber lineman’s gloves 	Riffles, runs
Seining	<ul style="list-style-type: none"> • 20ft x 6ft seine with maximum 1/8” mesh (size needed may vary based on individual pools) • 6ft support poles x 2 	Lagoon, pools, riffles, runs
Gigging	<ul style="list-style-type: none"> • 6ft gigging pole • 6000K rated LED gigging light • 2000K rated LED gigging light 	Lagoon, pools, riffles, runs
Dip-netting	<ul style="list-style-type: none"> • Dip nets of various sizes/length with maximum 1/8” mesh 	Riffles, runs
Aquatic Species Trapping	<ul style="list-style-type: none"> • Minnow traps with clips • Line/Rope to secure trap to shore • Bait 	Lagoon, pools
Fyke Netting	<ul style="list-style-type: none"> • Fyke nets with maximum 1/8” mesh 	Riffles, runs
pH Treatment		Pools, runs
Dewatering	<ul style="list-style-type: none"> • 3” Pump x 2 • 2” Pump x 3 • 1” Pump x 1 • Electrofishing equipment as specified above • Shovel • Rebar • Paracord and NRS straps • Haul packs x 3 • Hose clamps (1 per inlet) • Fuel cans (1-gallon x 2; 5-gallon x 2) • Conduit for unrolling pipe x 2 • Pipe (8”, 10”, 12”, 16”, and 18”) 	Pools, runs

<p>Additional Equipment Required for All Removal Methods</p>	<ul style="list-style-type: none"> • Chest waders • Polarized sunglasses • Dip nets of various sizes • Aquarium nets • Holding bucket/livewell • Aerator • Large holding bin • Data collection materials • Meter board/tape measure • Scale • GPS/Satellite phone 	
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Initial removal efforts will prioritize locations along the main stem of SMC and tributaries with the highest intrinsic spawning and rearing habitat (e.g. Devil and Nickel Canyons). Removal efforts will be scheduled to occur during spring and fall. Annual removal efforts will be scheduled to be executed during the month of May to correspond with largemouth bass spawning season and prevent further proliferation. Subsequent removal efforts may be necessary to effectively reduce the instream aquatic invasive species population, and these efforts will be scheduled annually to begin during the month of September and may extend into late fall and early winter, depending on rainfall. During the late summer and early fall months, surface flows along the main stem typically cease, and the available aquatic habitat is restricted to a series of disconnected perennial pools. Previous mapping efforts conducted during extreme drought cycles confirmed the presence and resilience of these pools from year-to-year. The restriction of available habitat congregates aquatic invasive species into concise locations allowing for increased efficiency of removal efforts. The Long-Term Monitoring Plan for the SMC WMP stipulates continuous eDNA monitoring at strategic locations throughout the watershed. Detections of invasives in tributaries to SMC may require additional removal efforts at expanded locations which can be targeted based on confirmed detections at specific locations.

3.3.2.3. Regulatory Compliance

San Mateo Creek Watershed is host to multiple native aquatic species with federal and/or state protection status. Implementation project managers and entities performing aquatic invasive species removal will need to ensure that removal efforts minimize adverse impacts to these native species and that the proper permits for the work being performed are in place to ensure regulatory compliance, including acquiring and maintaining the proper permits required to conduct electrofishing. Multiple permitting pathways exist to satisfy regulatory requirements, and they are summarized in the permitting matrices provided within the SMC WMP (Appendices A-B).

3.3.3. Aquatic Invasive Species Removal Strategies

3.3.3.1. Aquatic Invasive Species Removal Strategy for San Mateo Lagoon

San Mateo Lagoon is the portion of the watershed that is furthest downstream from the private stock ponds in the upper portion of the watershed. The lagoon is a naturally bar-built estuary separated from the Pacific Ocean by sand bars. During significant wet weather events, the sand bars breach making anadromy possible for southern steelhead. However, during particularly dry years or sustained drought, the lagoon may go un-breached for multiple years.

Aquatic invasive species persist in the lagoon and directly compete with native aquatic species. Southern steelhead use the lagoon for juvenile rearing and as a staging area for adults prior to anadromy. This is also the only portion of the watershed where tidewater goby encounter conditions suitable for their survival. Arroyo toad and southwestern pond turtle can also be found in low abundances.

Due to the size, complexity, and depth of the lagoon, multi-pass seining will be the primary aquatic invasive species removal strategy. Native species collected alive will be staged and returned to the lagoon upon completion of that day’s seining efforts. Supplemental gigging will be performed on bullfrogs, and minnow trapping may also be implemented. Table 3-6 describes the geographic coordinates and aquatic invasive removal methods applicable to San Mateo Lagoon.

Table 3-6: AIS Removal Sites for San Mateo Lagoon

Watershed Reach	Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
SMC Lagoon	Longitudinal 1	33.386319	-117.594231	Seining, Gigging, AIS Trapping	USMC, CSP
	Longitudinal 2	33.387286	-117.593094	Seining, Gigging, AIS Trapping	USMC, CSP
	Longitudinal 3	33.389014	-117.591228	Seining, Gigging, AIS Trapping	USMC, CSP

**Listed sites correspond to the accompanying Long-term Monitoring Plan. Lead agencies are tasked to address all sites capable of hosting aquatic invasive species in this portion of the watershed.*

3.3.3.2. Aquatic Invasive Species Removal Strategy for San Mateo Creek on USMC Base Camp Pendleton

As San Mateo Creek exits Cleveland National Forest, the hydrology of the creek changes. Defined by narrow canyons and moderate elevation loss in Cleveland National Forest, the creek emerges from the forest to broad, gently sloping alluvial plains. As the creek loses elevation, vegetation and creek cover becomes sparse, and the creek is increasingly exposed to direct

sunlight and higher ambient temperatures. Deep pools that offer refuge habitat for aquatic species also become increasingly sparse, and the habitat becomes defined by shallow riffles and runs. It is not uncommon for the stretch of San Mateo Creek that runs through MCBCP to become completely dry during the late summer and fall months.

MCBCP has a history of conducting invasive species surveys and removals on base stretching from the lagoon upstream to the base's northeastern border where it meets Cleveland National Forest. Past efforts utilized seining, bullfrog giggering, dip-netting, electrofishing, fyke nets, and minnow trapping methods to remove aquatic invasive species. Since 2003, USMC along with Trout Unlimited, CDFW, and USGS have removed nearly 150,000 aquatic invasive individuals from the watershed. These efforts reduced aquatic invasive species in the watershed on a temporary basis, but invasive populations were reestablished since measures to control the source populations emanating from the private stock ponds in the upper watershed had not been implemented.

Based on the available habitat and hydrology of San Mateo Creek on MCBCP, this Plan proposes using similar removal strategies to those that have been practiced historically. However, with private stock pond populations mitigated as outlined in this Plan, in-stream removal efforts are expected to be more successful in continuously reducing in-stream aquatic invasive species populations. Electrofishing and seining will be prioritized for the removal of invasive fish species, while bullfrog giggering will be necessary to mitigate bullfrog populations. Supplemental dip-netting and the use of fyke nets may be incorporated as determined by USMC and the entities performing the surveys.

Removal efforts will be scheduled to occur during spring and fall. Removal surveys will occur annually in the month of May to correspond with largemouth bass spawning season. Performing removal efforts during the month of May is critical to slowing and stopping the proliferation of these species before they have successfully spawned. Secondary removal efforts will occur from September through December, depending on early season rainfall and stream flows. Available habitat should be drastically reduced via drying during the late summer months allowing for greater efficiency with focused efforts on small, precise habitats. It is possible that available aquatic habitat on MCBCP will completely dry during certain years, and September/October removal efforts will not be necessary.

Table 3-7 identifies monitoring locations for San Mateo Creek on MCBCP. Precise locations for invasive species removal will be determined by MCBCP and participating agencies based on the variable conditions and flow characteristics experienced on base during a given year. While precise locations for removal on MCBCP cannot be identified, it is expected that agencies participating in removal surveys will treat all aquatic habitats capable of supporting aquatic invasive species during both the spring and fall removal efforts.

Table 3-7: AIS Removal Sites for San Mateo Creek on USMC Base Camp Pendleton

Watershed Reach	Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
USMC Base Camp Pendleton	Upstream I-5 Bridge	33.392344	-117.590233	Electrofishing, Seining, Gigging, Dip Netting, Fyke Nets	USMC
	San Mateo Campground	33.404514	-117.580739	Electrofishing, Seining, Gigging, Dip Netting, Fyke Nets	USMC
	Upstream San Mateo Campground	33.417917	-117.576761	Electrofishing, Seining, Gigging, Dip Netting, Fyke Nets	USMC
	Upstream San Mateo Drive	33.420600	-117.533150	Electrofishing, Seining, Gigging, Dip Netting, Fyke Nets	USMC

**Listed sites correspond to the accompanying Long-term Monitoring Plan. Lead agencies are tasked to address all sites capable of hosting aquatic invasive species in this portion of the watershed unless otherwise restricted.*

3.3.3.3. Aquatic Invasive Species Removal Strategy for Pool Habitat Along Main-Stem San Mateo Creek

Historical surveys in the watershed have identified a series of at least 59 pool habitats along the main stem of San Mateo Creek. The identified pools are confined to the stretch of San Mateo Creek between the MCBCP/Cleveland National Forest border and Tenaja Falls, which is a natural barrier to the anadromy of southern steelhead. Many of the pools were surveyed during sustained drought cycles and are considered permanent as they have adequate ground water exfiltration to sustain the aquatic habitat even during extreme and extended dry periods. While these pools offer refuge habitat for adult and juvenile southern steelhead, they also congregate aquatic invasives when surface flows between the pools cease during the late summer months. Because the available habitat for aquatic species becomes constrained during the late summer months due to lack of precipitation, it is recommended that aquatic invasive species removal efforts be conducted annually between the months of September and December to maximize efficacy.

Mechanical and chemical aquatic invasive species removal strategies will be implemented to treat pool habitats with the primary methods being seining and chemical pH treatment. Multi-pass seining efforts will be conducted at each pool. When consecutive seining passes fail to

collect aquatic species, supplemental chemical treatment may be applied. When possible, native species captured alive via seining will be collected and translocated to the nearest available suitable habitat where chemical treatment has not been applied. Chemical pH treatment may be considered when seining is not possible based on a specific pool’s conditions and characteristics. Any pools receiving pH treatment will require water quality testing in the pools and immediately downstream of the pool, where surface water is present, 14-21 days after treatment to ensure that water quality has returned to suitable pH levels for native aquatic life. Supplemental mechanical removal methods may also be implemented including gigging and trapping. Gigging will be the primary strategy when adult bullfrogs are observed on-site, and trapping may be required to preserve southwestern pond turtles. Turtle traps should be set 7-14 days prior to removal treatment with sufficient bait to sustain turtles over that time.

Table 3-8 identifies the geographic coordinates of the 59 surveyed pools along main-stem San Mateo Creek as well as the recommended removal methods and agencies responsible for leading the removal efforts. The total number of pools identified once on-site may vary based on yearly fluctuations in precipitation, and the lead agency will need to adapt the plan in real-time to ensure that all refuge areas for aquatic species are adequately treated.

Table 3-8: AIS Removal Sites for Pool Habitat Along Main-Stem San Mateo Creek

Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
Pool 1	33.470477	-117.470804	Seining, pH, Gigging, AIS Trapping	USMC, USFS
Pool 2	33.473019	-117.468194	Seining, pH, Gigging, AIS Trapping	USMC, USFS
Pool 3	33.473915	-117.466119	Seining, pH, Gigging, AIS Trapping	USMC, USFS
Pool 4	33.477578	-117.46189	Seining, pH, Gigging, AIS Trapping	USFS
Pool 5	33.478038	-117.462449	Seining, pH, Gigging, AIS Trapping	USFS
Pool 6	33.478662	-117.462904	Seining, pH, Gigging, AIS Trapping	USFS
Pool 7	33.479039	-117.46123	Seining, pH, Gigging, AIS Trapping	USFS
Pool 8	33.478463	-117.459769	Seining, pH, Gigging, AIS Trapping	USFS
Pool 9	33.479035	-117.45871	Seining, pH, Gigging, AIS Trapping	USFS
Pool 10	33.480094	-117.4587	Seining, pH, Gigging, AIS Trapping	USFS

Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
Pool 11	33.480825	-117.457728	Seining, pH, Giggling, AIS Trapping	USFS
Pool 12	33.481328	-117.457377	Seining, pH, Giggling, AIS Trapping	USFS
Pool 13	33.481483	-117.458783	Seining, pH, Giggling, AIS Trapping	USFS
Pool 14	33.483444	-117.459259	Seining, pH, Giggling, AIS Trapping	USFS
Pool 15	33.484411	-117.459443	Seining, pH, Giggling, AIS Trapping	USFS
Pool 16	33.484895	-117.459288	Seining, pH, Giggling, AIS Trapping	USFS
Pool 17	33.486791	-117.459249	Seining, pH, Giggling, AIS Trapping	USFS
Pool 18	33.48812	-117.457497	Seining, pH, Giggling, AIS Trapping	USFS
Pool 19	33.488334	-117.457534	Seining, pH, Giggling, AIS Trapping	USFS
Pool 20	33.490488	-117.45701	Seining, pH, Giggling, AIS Trapping	USFS
Pool 21	33.491788	-117.456518	Seining, pH, Giggling, AIS Trapping	USFS
Pool 22	33.492585	-117.454878	Seining, pH, Giggling, AIS Trapping	USFS
Pool 23	33.498627	-117.451497	Seining, pH, Giggling, AIS Trapping	USFS
Pool 24	33.499722	-117.450055	Seining, pH, Giggling, AIS Trapping	USFS
Pool 25	33.501544	-117.450895	Seining, pH, Giggling, AIS Trapping	USFS
Pool 26	33.503217	-117.449526	Seining, pH, Giggling, AIS Trapping	USFS
Pool 27	33.504626	-117.447893	Seining, pH, Giggling, AIS Trapping	USFS
Pool 28	33.506792	-117.448451	Seining, pH, Giggling, AIS Trapping	USFS
Pool 29	33.507235	-117.448356	Seining, pH, Giggling, AIS Trapping	USFS
Pool 30	33.510181	-117.445204	Seining, pH, Giggling, AIS Trapping	USFS

Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
Pool 31	33.511559	-117.444674	Seining, pH, Giggling, AIS Trapping	USFS
Pool 32	33.511907	-117.443015	Seining, pH, Giggling, AIS Trapping	USFS
Pool 33	33.513291	-117.441313	Seining, pH, Giggling, AIS Trapping	USFS
Pool 34	33.51631	-117.440762	Seining, pH, Giggling, AIS Trapping	USFS
Pool 35	33.517326	-117.439072	Seining, pH, Giggling, AIS Trapping	USFS
Pool 36	33.514991	-117.43774	Seining, pH, Giggling, AIS Trapping	USFS
Pool 37	33.515676	-117.435712	Seining, pH, Giggling, AIS Trapping	USFS
Pool 38	33.517121	-117.435362	Seining, pH, Giggling, AIS Trapping	USFS
Pool 39	33.518721	-117.43468	Seining, pH, Giggling, AIS Trapping	USFS
Pool 40	33.526341	-117.425738	Seining, pH, Giggling, AIS Trapping	USFS
Pool 41	33.52736	-117.424518	Seining, pH, Giggling, AIS Trapping	USFS
Pool 42	33.529966	-117.42253	Seining, pH, Giggling, AIS Trapping	USFS
Pool 43	33.529129	-117.419937	Seining, pH, Giggling, AIS Trapping	USFS
Pool 44	33.531466	-117.412843	Seining, pH, Giggling, AIS Trapping	USFS
Pool 45	33.530674	-117.411497	Seining, pH, Giggling, AIS Trapping	USFS
Pool 46	33.531917	-117.407281	Seining, pH, Giggling, AIS Trapping	USFS
Pool 47	33.533088	-117.404979	Seining, pH, Giggling, AIS Trapping	USFS
Pool 48	33.533178	-117.404146	Seining, pH, Giggling, AIS Trapping	USFS
Pool 49	33.534127	-117.403857	Seining, pH, Giggling, AIS Trapping	USFS
Pool 50	33.5347	-117.404254	Seining, pH, Giggling, AIS Trapping	USFS

Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
Pool 51	33.535433	-117.404101	Seining, pH, Giggling, AIS Trapping	USFS
Pool 52	33.539041	-117.400317	Seining, pH, Giggling, AIS Trapping	USFS
Pool 53	33.540405	-117.399698	Seining, pH, Giggling, AIS Trapping	USFS
Pool 54	33.540763	-117.399499	Seining, pH, Giggling, AIS Trapping	USFS
Pool 55	33.544883	-117.396971	Seining, pH, Giggling, AIS Trapping	USFS
Pool 56	33.545257	-117.396791	Seining, pH, Giggling, AIS Trapping	USFS
Pool 57	33.545563	-117.396805	Seining, pH, Giggling, AIS Trapping	USFS
Pool 58	33.547005	-117.397401	Seining, pH, Giggling, AIS Trapping	USFS
Pool 59	33.550035	-117.395666	Seining, pH, Giggling, AIS Trapping	USFS

**Listed sites correspond to the accompanying Long-term Monitoring Plan. Lead agencies are tasked to address all sites capable of hosting aquatic invasive species in this portion of the watershed, even if GPS coordinates for those sites are not explicitly listed here.*

3.3.3.4. Aquatic Invasive Species Removal Strategy for San Mateo Creek Above Tenaja Falls

Tenaja Falls in upper San Mateo Creek Watershed is an abrupt change in elevation of the creek bed that prevents southern steelhead from passing further upstream. This geological feature represents the limit of anadromy to southern steelhead along main-stem San Mateo Creek. Though steelhead are unable to navigate beyond this natural barrier, aquatic invasive species from a few discrete upstream sources could wash downstream over this barrier during wet weather events and higher flows. To prevent transport of aquatic invasive species and further proliferation downstream, surveys will need to be conducted directly upstream of Tenaja Falls.

A series of three permanent pools directly above Tenaja Falls was identified in previous surveys. These pools are considered permanent based on their ability to hold water even during excessive drought conditions which persisted from 2014 through 2016. Removal strategies for these pools are consistent with those used to address pool habitats below Tenaja Falls. Multi-pass seining will be conducted in each pool with a subsequent application of pH treatment if deemed necessary by USFS or other participating agencies. If pH treatment is planned, turtle traps must be installed 7-14 days prior to treatment to attempt to capture and preserve southwestern pond turtles. Post pH treatment, water quality testing will be required in the pool and immediately

downstream of the pool, where surface water is present, 14-21 days after treatment to ensure that water quality has returned to suitable levels for native aquatic life. Electrofishing may also be implemented to treat intervening stretches between pools and riffle/run habitat upstream of Tenaja Falls as surface flow conditions permit. Bullfrog gigging will also be required.

Aquatic invasive species removal strategies will be implemented in coordination with California Trout, USFS, and other potential third-party agencies/organizations. Because of the limited upstream sources compared to other tributaries (see below), eDNA sampling may be implemented prior to or during removal surveys to better assess presence and sources. Removal surveys will be conducted annually during the month of May to correspond with largemouth bass spawning season in an effort to minimize in-stream invasive fish proliferation. These removal surveys must be duplicated in September/October each year as refuge habitat available to aquatic species will be most constrained during these months. It is possible that sections treated during the May surveys will be completely dry, and it is the responsibility of the lead and participating agencies to adapt plans on-site to effectively treat all available aquatic invasive species habitats. Table 3-9 identifies the geographic location for the pools and describes the removal strategies to be implemented.

Table 3-9: AIS Removal Sites for San Mateo Creek Above Tenaja Falls

Watershed Reach	Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
Main Stem SMC (Above Tenaja Falls)	Tenaja Falls Pool 1	33.556400	-117.398667	Seining, pH, Gigging, AIS Trapping	USFS
	Tenaja Falls Pool 2	33.557025	-117.399839	Seining, pH, Gigging, AIS Trapping	USFS
	Tenaja Falls Pool 3	33.569989	-117.404681	Seining, pH, Gigging, AIS Trapping	USFS
	Upstream Tenaja Falls	33.558461	-117.401767	Electrofishing, Seining, pH, Gigging, Dip Netting, AIS Trapping	USFS

**Listed sites correspond to the accompanying Long-term Monitoring Plan. Lead agencies are tasked to address all sites capable of hosting aquatic invasive species in this portion of the watershed.*

3.3.3.5. Aquatic Invasive Species Removal Strategy for San Mateo Creek Tributaries

San Mateo Creek Watershed contains tributaries that provide pathways for aquatic invasive species to migrate downstream from the private stock ponds in the upper watershed to main-stem San Mateo Creek. These also may provide adequate habitat for spawning and rearing. The key

tributaries feeding into San Mateo Creek are Cristianitos Creek, partially in MCBCP and Cold Spring Canyon Creek, Devils Canyon Creek, Los Alamos Canyon Creek, Bluewater Canyon Creek, Tenaja Canyon Creek, and Wildhorse Canyon Creek, all partially or wholly within Cleveland National Forest. Aquatic invasive species surveys will be required in all of these tributaries. If aquatic invasive species are observed or detected in tributaries during these surveys, subsequent removal efforts will need to be implemented to ensure that transport pathways are mitigated and cease to harbor aquatic invasive species.

Aquatic habitats in these smaller tributaries are variable, and the aquatic invasive species removal methods implemented reflect that variability. While riffles and runs will be the dominant aquatic habitat, it is likely that isolated, small pools will also be encountered depending on the time of year. In consultation with California Trout, USMC in Cristianitos Creek, USFS in all other tributaries, and other potential third-party agencies/organizations, electrofishing and seining will be implemented to address aquatic invasive species impairments. Bullfrog gigning will also be required to effectively mitigate bullfrog populations. Supplementary removal methods such as dip-netting and fyke nets may be implemented as deemed necessary by the agencies and organizations participating in the removal efforts. pH treatment may also be implemented at the discretion of the groups conducting removal. Should pH treatment be used, the previously described rotenone protocols should be followed including the setting of turtle traps 7-14 days prior to treatment and subsequent water quality monitoring 14-21 days after treatment. The timing of removal efforts in the tributaries will coincide with the previously described efforts in other portions of the watershed. Surveys will be conducted annually in May and repeated in September.

Table 3-10 provides geographic coordinates identifying the locations of the tributaries. However, aquatic invasive species removal surveys will need to be conducted throughout the reaches of these tributaries to fully mitigate invasive species populations already established in the natural watershed.

Table 3-10: AIS Removal Sites for San Mateo Creek Tributaries

Watershed Reach	Location Description	Latitude	Longitude	Recommended AIS Removal Methods (Bi-Annually, Spring & Fall)	Expected Lead Agency
Tributaries	Cold Spring Canyon*	33.493328	-117.431719	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS
	Cristianitos Creek	33.460825	-117.568492	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS
	Devils Canyon*	33.473531	-117.437050	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS
	Los Alamos Canyon	33.550542	-117.351183	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS
	Nickel Canyon*	33.508321	-117.448350	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS
	Bluewater Canyon*	33.530881	-117.429503	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS
	Tenaja Canyon*	33.529917	-117.410103	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS
	Wildhorse Canyon*	33.550942	-117.384225	Electrofishing, Seining, pH, Giggling, Dip Netting, Fyke Nets	USFS

Listed sites correspond to the accompanying Long-term Monitoring Plan. Lead agencies are tasked to address all sites capable of hosting aquatic invasive species in this portion of the watershed.

**Because of the limited upstream invasive species sources, eDNA sampling should be implemented prior to or during removal surveys to better assess presence and sources.*

3.4. Adaptive Management

Continuous reassessment of AISWP strategies should be performed while considering changes in environmental conditions, anthropogenic influences, climate change, and natural disasters, including but not limited to floods, fire, and drought. Re-evaluation should also incorporate lessons learned from implementation experience and data collected. Adaptive management

measures may be necessary to achieve numeric targets, satisfy budget requirements, preserve native species, maintain legal compliance, and/or prepare or respond to a natural disaster.

Adaptive management measures considered for this AISWP may include the following:

1. Modify aquatic invasive species source control measures
2. Modify aquatic invasive species removal activities (schedule and/or method)
3. Modify removal locations

Invasive species removal location and method should be assessed and re-evaluated as necessary and may require adjustments made in real time based on the observations of field staff.

Additional details discussing adaptive management for other components of the SMC WMP are discussed in the LMP and LTMP as well as **Appendices C-G**.

3.5. Future Updates

This AISWP is considered a roadmap for addressing the sources of impairment for SMC for both private ponds and in-stream invasive species. Implementation of the SMC watershed management plan is expected to result in improved conditions and understanding of invasive species for SMC. As a result, this document may be updated in the future to incorporate lessons learned, advances in technologies, and new relevant information.

4. PUBLIC OUTREACH PLAN

4.1. Introduction

Engaging with key factions of the public community in and surrounding San Mateo Creek Watershed will be critical to the long-term success of the WMP. Though the 90% of the watershed is situated on public lands, portions of the watershed are situated in the densely populated Southern California counties of Orange, Riverside, and San Diego, providing a variety of recreational opportunities to these communities. The remaining 10% of the watershed is owned by private interests, with the majority of that 10% being the La Cresta community in the northeast corner of the watershed. The vast majority of the private stock ponds in the watershed are located in this community, and these stock ponds are directly contributing to the impairment of aquatic invasive species in San Mateo Creek (SDRWQCB 2023). This Public Outreach Plan emphasizes education and engagement with these landowners, the recreational community, and the general public, and it outlines the efforts and strategies intended to garner support for and participation in the mitigation strategies that will remediate the impairment of aquatic invasive species.

4.2. Goals and Objectives

To help meet the numeric targets designated in the approved TMDL, as well as improve water quality and promote healthy habitats for sensitive native species in the SMC Watershed, this Public Outreach Plan will do the following:

- Identify public outreach education and engagement opportunities;
- Educate private landowners with stock ponds regarding the impairment of aquatic invasive species in San Mateo Creek;
- Educate San Mateo Creek Watershed’s recreational community regarding planned monitoring and aquatic invasive species removal work; AND
- Educate the general public and provide citizen science volunteer opportunities regarding the removal of aquatic invasive species and the re-establishment of sustainable native steelhead populations

4.3. Target Audiences

4.3.1. Internal Stakeholder Engagement

In developing the 2024 San Mateo Creek Watershed Management Plan, California Trout had the opportunity to convene key stakeholders and agencies within the watershed to participate on a Technical Advisory Committee (TAC). Members of the TAC were purposefully selected based on their experience and expertise related to aquatic invasive species management in the watershed and their historical relationships with key landowner communities as well as the local

recreational community. The TAC was tasked with providing resources and informing the Plan to create a long-term strategy that remediates aquatic invasive species populations and satisfies the numeric targets established in SDRWQCB's TMDL. The following agencies, organizations, and communities were included in the San Mateo Creek Watershed Management Plan TAC:

- California Trout
- San Diego Regional Water Quality Control Board
- Acjachemen Nation
- California Department of Fish and Wildlife
- United States Forest Service
- United States Geological Survey
- United States Marine Corps Base Camp Pendleton
- National Marine Fisheries Service
- California State Parks
- United States Fish and Wildlife Service
- Temecula-Elsinore-Anza-Murrieta Resource Conservation District
- Southern California Coastal Water Research Project

Many members of the TAC have explicit responsibilities outlined in the Plan regarding the implementation and execution of Plan strategies. The TAC will continue to meet and consult based on findings and lessons learned from the implementation of the Plan and will adapt the Plan as needed to promote progress towards the achievement of the Plan's numeric targets.

4.3.2. Private Landowners with Stock Ponds

The La Cresta community is a private community with private homes, equestrian states, and small-scale agricultural ranches and vineyards (La Cresta POA 2024). It is located in Riverside County approximately two miles west of the city of Murrieta. Each parcel in this private community is situated on a minimum of five acres, and the community hosts 887 individual parcels encompassing a total area of 5,878 acres. 60% of the parcels have single family homes (La Cresta POA 2024). Reviews of aerial and satellite imagery have identified 92 individual parcels with at least one private pond on the property. Due to limitations in the resolution of satellite imagery, it is possible that additional ponds may exist in the community. Additionally, the presence of aquatic invasive species in individual ponds is unknown at this time.

Identifying all private ponds stocked with aquatic invasive species is paramount to the remediation of these source populations which will stop the flow of invasives from the stock ponds to main-stem San Mateo Creek. Outreach efforts to these landowners will prioritize establishing relationships and gaining access to properties so the presence of invasives can be confirmed at individual properties. Outreach will also emphasize educating landowners on how stocking ponds with aquatic invasive species contributes to the water quality impairments in San

Mateo Creek as well as encouraging landowners to adopt mitigation measures that remove invasives from their property or properly contain invasives within their property.

4.3.3. Recreational Community

Cleveland National Forest in the upper watershed offers recreational opportunities including hiking, mountain biking, dispersed camping and off-roading. Due to the area's topography and remote setting, access points for these recreational activities are largely restricted to predefined trailheads including Tenaja Trailhead, Fisherman's Camp Trailhead, Tenaja Falls Trailhead, Cold Spring Trailhead, Morgan Trailhead, and Bear Canyon Trailhead. There are also several smaller-scale access points along Forest Road 6S07. These established trailheads provide opportunities to educate and engage with recreators via the installation of signage that showcases the watershed's native biodiversity, the WMP's objectives, native steelhead, and stewardship of natural resources.

MCBCP encompasses a large portion of the lower watershed, and access to this area is limited to authorized personnel only. Hiking and biking opportunities in the lower watershed are restricted to Panhe Nature Trail and Trestles Beach Trail on the west bank of San Mateo Creek. San Mateo Campground is also situated along the west bank of San Mateo Creek and offers tent and RV camping. The most popular recreational location in the lower watershed is Trestles Beach where San Mateo Creek meets the Pacific Ocean. Trestles Beach is a favorite among local beachgoers, and it is recognized as one of the best surfing locations in all of California. This popular beach offers additional opportunities to educate and engage with the public through tabling events and increased signage detailing the significance of the lagoon habitat to sensitive native species.

4.3.4. General Public

Providing outreach to the general public in local communities surrounding San Mateo Creek Watershed will be crucial to garnering public support of the WMP, promoting stewardship and protection of our native natural resources, and developing a citizen science community of volunteers. Opportunities to engage with the public are available through the attendance of community events and events hosted by conservation organizations and foundations. Public speaking opportunities are also available at events including but not limited to Marine Corps Community Services' Nature Talk Series and Orange County Public Works' San Onofre Lecture Series. In addition to these public speaking opportunities, additional opportunities to present exist through clubs with shared interests such as Fly Fishers Club of Orange County and San Diego Fly Fishers Club.

California Trout has a history of recruiting conservation-minded volunteers and performing citizen science in other Southern California watersheds. Past citizen science activities include steelhead observation surveys after precipitation events breach sand berms, reconnecting coastal watersheds to the Pacific Ocean allowing anadromy for native steelhead. Additionally, citizen

science volunteers have been trained to conduct eDNA sampling expanding the capability to detect the presence and map the location of native and invasive aquatic species. Throughout 2024, California Trout has recruited 26 volunteers interested in supporting citizen science in San Mateo Creek and will engage these volunteers in activities that support the goals and objectives of the San Mateo Creek WMP.

4.4. Executed and Proposed Public Outreach

Throughout the creation of this WMP, California Trout has engaged in designing public outreach materials and has attended events intended to raise awareness surrounding the Plan’s goals and objectives. The WMP details long-term strategies to address aquatic invasive species remediation in the watershed with numeric targets expected to be achieved in 2037. Continuous strategic public outreach will be necessary throughout the implementation of the WMP to ensure that the public is aware of the issues being addressed in San Mateo Creek and private landowners are informed and willing to adopt mitigation measures to control aquatic invasive species on their properties. Each year, internal stakeholders will continue to seek new methods and opportunities to inform and engage the public as they are available and applicable. Table 4-1 describes public outreach measures that have already been taken in 2024 and are proposed for 2025.

Table 4-1: Executed and Proposed Public Outreach

Outreach Task	Goal	Target Audience	Date Completed / Proposed	Outreach Metric	Metric Achieved
Form a Technical Advisory Committee	Secure representation from stakeholder agencies and organizations with AIS removal expertise	Internal Stakeholders	December, 2023	Participation	Secured representation from SDRWQCB, CDFW, USFS, USGS, MCBCP, NMFS, CA State Parks, USFWS, TEAM RCD, SCCWRP, and Acjachemen Nation
Identify private landowners with potential source ponds	Develop a directory of private landowners with potential source ponds and map their location	Private Landowners	April, 2024	Research	92 individual landowners identified with mapped GPS location of potential source ponds

Outreach Task	Goal	Target Audience	Date Completed / Proposed	Outreach Metric	Metric Achieved
Develop outreach posters for tabling events	Create visual aids to be displayed at tabling events	Recreation / General Public	July, 2024	Supplemental materials for display / distribution	300 SMC Watershed brochures; 300 "Pond Problems" brochures; Tabling poster
Nature Education Resource Forum (Event)	Host a table and distribute project information to local educators	General Public	September, 2024	Booth attendance	40 booth visitors
Panhe 2024: A Celebration of Protection & Preservation (Event)	Host a table and distribute project information to the local community	General Public	October, 2024	Booth attendance	40 booth visitors
Scripps Institution of Oceanography Marine Biodiversity & Conservation Panel Discussion (Event)	Serve on panel discussion to inform graduate students of WMP goals and objectives	General Public / Higher Education Community	October, 2024	Discussion Attendance	34 attendees
Family Wildlife Day (Event)	Host a table and distribute project information to the local community	Recreation / General Public	November, 2024	Booth attendance	83 booth visitors
Distribute SMC Watershed & "Pond Problems" Brochures to Private Landowners	Mail informational brochures to all identified private landowners with potential source ponds	Private Landowners	December, 2024	Supplemental materials for display / distribution	92 brochure packets mailed
Host BBQ Event in La Cresta to Meet Target Private Landowners	Establish relationship with private landowners, secure contact information and permission to access property,	Private Landowners	Spring, 2025	Event Attendance	

Outreach Task	Goal	Target Audience	Date Completed / Proposed	Outreach Metric	Metric Achieved
	and educate on WMP goals and objectives				
Door-to-Door Canvassing in La Cresta	Establish relationship with private landowners, secure contact information and permission to access property, and educate on WMP goals and objectives	Private Landowners	Spring, 2025	Number of landowners willing to exchange contact information and provide access to property	
Marine Corps Community Services Nature Talk Series (Lecture)	Present WMP goals and objectives to event attendees	General Public	Summer, 2025	Lecture Attendance	
Orange County Public Works San Onofre Lecture Series (Lecture)	Present WMP goals and objectives to event attendees	General Public	Summer, 2025	Lecture Attendance	
Fly Fishers Club of Orange County (Lecture)	Present WMP goals and objectives to event attendees	Recreation / General Public	Summer, 2025	Lecture Attendance	
San Diego Fly Fishers Club (Lecture)	Present WMP goals and objectives to event attendees	Recreation / General Public	Summer, 2025	Lecture Attendance	
Develop project signage to be implemented at trailheads and recreation access points	Raise project awareness among the recreational community that visits San Mateo Creek Watershed	Recreation / General Public	Fall, 2025	Number of signs installed	

4.5. Future Updates

This Public Outreach Plan is designed to educate private landowners, the recreational community, and the general public regarding the impairment of aquatic invasive species in San Mateo Creek. Implementation of the Public Outreach Plan is expected to raise awareness around the WMP's goals and objectives and secure support from the local community. The Public Outreach Plan is also intended to encourage citizen science volunteers to play an active role in performing monitoring and eDNA collection to further aid and inform the future of the WMP.

Achievement of the WMP's long-term numeric targets established in the TMDL hinges on the Public Outreach Plan's ability to educate and persuade private landowners to implement mitigation measures that remove or contain aquatic invasive species on their property. The strategies described in the WMP are expected to meet these numeric targets by 2037. Continuous reassessment of Public Outreach Plan strategies should be performed while considering changes in environmental conditions, political climate, new development in the watershed, technological advancements, and population changes in the La Cresta community. Re-evaluation should also incorporate lessons learned from implementation experience and data collected. As a result, this document may be updated in the future to incorporate lessons learned, new relevant information, and modified outreach strategies to ensure adoption of mitigation measures from private landowners.

5. REFERENCES

- Barabe, R. and D. Nickerson. 2015. San Mateo Creek Refuge Pool Mapping and Invasive Species Removal Summer 2015. State of California Department of Fish and Game.
- Barabe, R. 2018. San Mateo Creek Steelhead Surveys. State of California Department of Fish and Wildlife.
- Barnhart, R. 1986. Species profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest) Steelhead. U.S. Fish and Wildlife Service Biological Report No. 82. U.S. Army Corps of Engineers Technical Report. EL-82- 421.
- Becker, G.S., Smetak, K.M. and D.A. Asbury. 2010. Southern Steelhead Resources Evaluation: Identifying Promising Locations for Steelhead Restoration in Watersheds South of the Golden Gate. Center for Ecosystem Management and Restoration. Oakland, CA.
- Boughton, D. A., M. Gibson, R. Yedor, and E. Kelley. 2007. “Stream temperature and the potential growth and survival of juvenile *Oncorhynchus mykiss* in a southern California creek.” *Freshwater Biology* (2007): 52:1353-1364.
- Boughton, D. A., Nelson, J. and M. K. Lacey. 2022. Integration of Steelhead Viability Monitoring, Recovery Plans and Fisheries Management in the Southern Coastal Area. Fish Bulletin 182. State of California
- Bovee KD. 1978. Probability-of-use criteria for the family Salmonidae. Instream flow information paper 4. US Fish and Wildlife Service, FWS/OBS-78/07. 79 p.
- Boyd, S., T.S. Ross, O. Mistretta, and D. Bramlet. 1995. Vascular Flora of the San Mateo Canyon Wilderness Area, Cleveland National Forest, California. Rancho Santa Ana Botanic Garden, Claremont, California. *Aliso* 14(2):109-139.
- California Coastal Conservancy. 2007. *San Mateo Creek Steelhead Recovery Project Phase IV, Staff Recommendation*. California State Coastal Conservancy. March 8.
- California Natural Diversity Database (CNDDDB). 2024. Available online at <https://wildlife.ca.gov/Data/CNDDDB/News/rarethreatenedendangered-species-and-special-plants-and-animals-lists-quarterly-update-january-2024>.
- California Trout. 2024a. *Water Quality Improvement in San Mateo Creek*. Technical Memo – Literature Review. January.
- California Trout. 2024b. *Public Outreach Plan*. Nonpoint Source Pollution Control Program Grant – Agreement No. D2213901.
- CCC. 2011. Staff Recommendation Report Regarding Consideration and possible authorization to seek reallocation of Proposition 12 funds appropriated to the Conservancy for restoration of arroyo chub, partially armored stickleback, and southern steelhead fisheries in San Mateo Creek and San Onofre Creek in San Diego County. January.
- CDFW. 2011. *Yellow Creek 2011 Summary Report*. State of California Natural Resources Agency Heritage and Wild Trout Program. October 18-21.

- CDFW. 2021. *Notice of Petition: Southern California Steelhead (Oncorhynchus mykiss)*. June.
- CNDDDB. 2024. California Natural Diversity Database Management Framework. California Department of Fish and Wildlife. Sacramento, CA.
- County of San Diego and Technology Associates International Corporation . 2009. *Multiple Species Conservation Program, North County Plan, Volume I*. County of San Diego. Technology Associates International Corporation. February.
- Dong, L., Leung, L.R., Lu, J. and Y. Gao. 2019. Contributions of Extreme and Non-Extreme Precipitation to California Precipitation Seasonality Changes Under Warming. *Geophysical Research Letters* 46 <https://doi.org/10.1029/2019GL084225>
- Dudley, T. and Cole. 2018. Preliminary Comparison of Transpirational Water Use by *Arundo donax* and Replacement Riparian Vegetation Types in California. Report for Madero County Resource Conservation District.
- ECORP. 2023. Marine Corps Base, Camp Pendleton Aquatic Species Removal Project. ECORP Consulting, Inc. West Hills Web, Inc. Available online at: <https://www.ecorpconsulting.com/projects/camp-pendleton/>.
- Fresh, K.L. 1997. The Role of Competition and Predation in the Decline of Pacific Salmon and Steelhead. *The Role of Competition and Predation in the Decline of Pacific Salmon and Steelhead*: 245-275.
- Hovey, T. 2004. Current Status of Southern Steelhead/Rainbow Trout in San Mateo Creek, California. *California Fish and Game* 90(3):140-154.
- Hovey, T. 2017. Saving What's left of SoCal Steelhead Runs. In: *California Sportsmen Magazine*, February 2017 Issue.
- Huang, X., Swain, D.L. and A.D. Hall. 2020. "Future precipitation increase from very high resolution ensemble downscaling of extreme atmospheric river storms in California." *Science Advances* 29:1-12.
- ICF. 2016. *Orange County Transportation Authority M2 Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP)*. Final. ICF. ICF 00536.10. November.
- Juaneño Band of Mission Indians. 2022. Acjachemen History. Available online at: <https://www.jbmian.com/history.html#/>
- Kalansky, J., Cayan, D., Barba, K., Walsh, L., Brouwer, K. and D. Boudreau. 2018. San Diego Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-009.
- La Cresta Property Owners Association. 2024. Welcome to your La Cresta Property Owners Association. Available online at: <https://lacrestapoa.com/community/home>
- Lichvar, R., Gustina, G., MacDonald, D., Ericsson, M. 2000. "Planning Level Wetland Delineation and Geospatial Characterization of San Juan and Portions of San Mateo Watersheds, Orange County, California" *United States Corps of Engineers, Engineering and Research Development Center, Cold Regions Research and Engineering Laboratory*.

- Matthews, K.R. and N.H. Berg. 1997. Rainbow trout responses to water temperature and dissolved oxygen stress in two southern California stream pools. *Journal of Fish Biology* 50: 50–67
- Mazor, R., Schiff, K. 2007. *Surface Water Ambient Monitoring Program (SWAMP) Report on the San Juan Hydrologic Unit*. Technical Report 527. Southern California Coastal Water Research Project. Prepared for the California Regional Water Quality Control Board, San Diego Region. July.
- Mission Resource Conservation District. 2006. Interview in San Diego Union Tribune Article “The San Mateo Creek invasion: Ponds in Riverside County called source of nonnative fish.”
- Montana State University. 2024. *Whirling Disease: What You Need to Know*. Whirling Disease Initiative, Montana Water Center. Available online at <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=100977>. Accessed on July 5, 2024.
- Moyle, P.B., J. D. Kiernan, P. K. Crain, and R. M. Quiones. 2013. “Climate change vulnerability of native and alien freshwater fishes of California: a systematic assessment approach.” *PLoS One*. <http://dx.plos.org/10.1371/journal.pone.0063883>
- National Community Conservation Plan (NCCP)/Special Area Management Plan (SAMP) Working Group. 2004. *Draft Southern NCCP/HCP Planning Guidelines*. Southern Subregion Orange County, California. May.
- NMFS. 2007. Federal Recovery Outline for the Distinct Population Segment of Southern California Coast Steelhead. Southwest Regional Office.
- NMFS. 2016. 5-Year Review: Summary and Evaluation of Southern California Coast Steelhead Distinct Population Segment. West Coast Region, California Coastal Office, Long Beach, California.
- NMFS. 2022. 5-Year Review: Summary and Evaluation of Southern California Steelhead Distinct Population Segment. West Coast Region, California Coastal Office, Long Beach, California.
- O’Neil, S. 2014. *The Acjachemen (Juaneño) Indians of Coastal Southern California*. Malki-Ballena Press.
- Orange County Copermittees (OCC). 2018. *South Orange County Watershed Management Plan Area Water Quality Improvement Plan*. Final Certified Plan (Version 1.0), Minor Revision January 2022 (Version 1.4). June.
- Oswalt, S. C. Oswalt, A. Crall, R. Rabglia, M. K. Schwartz, and B. K. Kerns. 2021. Inventory and Monitoring Invasive Species. In: T. M. Poland et al. (eds). *Invasive Species in Forests and Rangelands of the United States*.
- Priyadarshana, T.S., Slade, E.M. 2023. “A meta-analysis reveals that dragonflies and damselflies can provide effective biological control of mosquitoes.” *The Journal of American Ecology* 92(8): 1589-1600.
- Riverside County Transportation and Land Management Agency (RCTLMA). 2004. *Multiple*

Species Habitat Conservation Plan. Volume 1. Riverside County, Transportation and Land Management Agency. June.

San Diego County. 2023. *Draft 2024 Climate Action Plan*. October, 2023.

San Francisco Estuary Institute. 2024. California Rapid Assessment Method Data Viewer. Available online at <https://www.cramwetlands.org/>. Accessed on July 5, 2024.

San Mateo Creek Conservancy. 2023. San Mateo Creek Watershed Profile. Available online at: <http://sanmateocc.org/files/sanmateocreekwatershedprofile.pdf>.

SDCWA. 1997. *Groundwater Report*.

SDRWQCB. 1994. *The Water Quality Control Plan for the San Diego Basin (Basin Plan)*. California Water Boards, San Diego, Region 9. September.

SDRWQCB. 2018. 2014 and 2016 California Integrated Report (Clean Water Act Section 303(d) List and 305(b) Report). April 6th.

SDRWQCB. 2020. *San Diego Regional Water Quality Control Board Biological Objectives for the San Diego Region*. Final Staff Report. November 18.

SDRWQCB. 2023. *Invasive Species Total Maximum Daily Load for San Mateo Creek*. Final Staff Report. California Environmental Protection Agency, Regional Water Quality Control Board, San Diego Region. November.

SDRWQCB. 2024. *Resolution No. R9-2024-0012*.

Sloat, M. R. and A-M. K. Osterback. 2012. Maximum stream temperature and the occurrence, abundance, and behavior of steelhead trout (*Oncorhynchus mykiss*) in a southern California stream. *Canadian Journal of Aquatic Sciences* (2013) 760:64-73.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online. Accessed July 9, 2024.

Stouder, D.J., Bisson, P.A. and R.J. Naiman. 1997. "Where Are We? Resources at the Brink." *Pacific Salmon & their Ecosystems*: 1-10.

SWRCB. 2005. *San Juan Creek and San Mateo Creek Watershed Special Area Management Plan*. Draft Environmental Impact Statement. California State Water Resources Control Board. November.

SWRCB. 2021. Surface Water Ambient Monitoring Program, Bioassessment Scores Map. Available online at: https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/csci_scores_map.html

United States Geological Survey, National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), San Mateo C NR San Clemente CA – 11046300, accessed July 1, 2024 at <https://waterdata.usgs.gov/monitoring-location/11046300/-parameterCode=63160&showMedian=false&startDT=2020-01-01&endDT=2024-07-01>

- University of Montana, 2024. San Mateo Canyon Wilderness. Available online at <https://wilderness.net/visit-wilderness/?ID=524#:~:text=Keep%20an%20eye%20open%20for,mountain%20lion%20is%20rarely%20seen>. Accessed on July 5, 2024.
- USDA. 2005. *Land Management Plan, Part 2 Cleveland National Forest Strategy*. United States Department of Agriculture, Forest Service, Pacific Southwest Region. September.
- USFS. 2005. *Land Management Plan, Part 2 Cleveland National Forest Strategy*. United States Department of Agriculture, Forest Service, Pacific Southwest Region. September.
- USFS. 2022. *Land Management Plan Monitoring Report for the Angeles, Cleveland, and San Bernardino National Forests*. United States Department of Agriculture, Forest Service.
- USFWS. 1998. *Southern Steelhead *Oncorhynchus mykiss* Habitat Suitability Survey of the Santa Margarita River, San Mateo, and San Onofre Creeks of Marine Corps Base Camp Pendleton, California*. United States Fish and Wildlife Service, Department of the Interior Coastal California Fish and Wildlife Office Arcata, California.
- USFWS. 2005. Recovery Plan for the Tidewater Goby (*Eucyclogobius newberryi*). U.S. Fish and Wildlife Service, Portland, Oregon.
- USFWS. 2007. *Intra-Service Formal Section 7 Consultation/Conference for Issuance of an Endangered Species Act Section 10(a)(1)(B) Permit (TE144113-0, TE144140-0, and TE144105-0) for The Southern Orange Natural Community Conservation Plan/ Master Streambed Alteration Agreement/ Habitat Conservation Plan, Orange County, California*. Biological Opinion 1-6-07-f-812.8. Carlsbad Fish and Wildlife Office. January 10.
- USMC. 1993. Stream flow and precipitation records for San Mateo Creek. Camp Pendleton files.
- USMC. 2023. *Integrated Natural Resources Management Plan for Marine Corps Base Camp Pendleton, California*. Draft Final. United States Marine Corps, Environmental Security Department, Resource Management Branch. June.
- Vanderhoff, R., Davey, K., Larson, K., Sisson, S., Tringle, S. 2014. *Floristic Survey of Lucas Canyon San Mateo Canyon Wilderness*. April 27.
- Wallace, R. D., C. T. Barger. 2014. Identifying invasive species in real time: early detection and distribution mapping system (EDDMapsS) and other mapping tools. In: L. Ziska and J.S. Dukes (eds.) *Invasive Species and Global Climate Change*. Western Riverside County Regional Conservation Authority. 2018. Western Riverside County Multiple Species Habitat Conservation Plan Biological Monitoring Program 2017 Arroyo Toad Survey Report. July 24, 2018.
- Western Regional Climate Center. Cooperative Climatological Data Summaries Laguna Beach Station #044647. Available online at https://wrcc.dri.edu/Climate/west_coop_summaries.php. Accessed on July 5, 2024.
- Wilcox, J.M. 2012. Assessment of Southern California Steelhead Trout on the Cleveland National Forest. United States Forest Service, September 21, 2012.

6. APPENDICES

6.1. Appendix A: Potential Expedited Permitting Pathways for Watershed Plan Implementation

Permit #	Law/Regulation	Permit	Covers or Has Consistency With	Fees	Preparation Time	Approval Time
1	Clean Water Act	SWRCB Statewide Restoration General Order (SRGO)	CWA 401 Certification, USFWS & NMFS PBO, CEQA SERP	\$1,200	1 Day	30 Days
2	California Endangered Species Act	CDFW Restoration Consistency Determination (CD)	Incidental Take Permit, USFWS & NMFS PBO	Up to \$46,000	1 Day	30 Days
3	Federal Endangered Species Act	USFWS Statewide Restoration Programmatic Biological Opinion (PBO)	Section 7 Consultation, NMFS PBO	N/A	3 Days	90 Days
4	Federal Coastal Zone Management Act	NOAA South Coast Federal Consistency Determination (CD)	Coastal Development Permit, NMFS PBO	\$0	1 Day	90 Days
5	Magnuson-Stevens Act	NMFS South Coast Programmatic Biological Opinion (PBO)	Fisheries Management Plan, USFWS PBO	\$0	1 Day	90 Days
6	California Environmental Quality Act	CEQA Statutory Exemption for Restoration Projects (SERP)	CEQA Compliance, SWRCB SRGO	N/A	3 Days	60 Days

Notes:

Caltrans - California Department of Transportation

CC - Consistency Certificate

CCC - California Coastal Commission

CD - Consistency Determination

CDFW - California Department of Fish and Wildlife

CE - Categorical Exclusion

EPA - Environmental Protection Agency

N/A - Not Applicable (Cost not confirmed to be \$0, but no confirmed fee or rate identified)

NMFS - National Marine & Fisheries Service

NOAA - National Oceanic and Atmospheric Administration

NPDES - National Pollutant Discharge Elimination System

NWP - Nationwide Permit

PBO - Programmatic Biological Opinion

RGP - Regional General Permit

RWQCB - Regional Water Quality Control Board

SERP - Statutory Exemption for Restoration Projects

SHPO - State Historic Preservation Officer

SLC - State Lands Commission

SRGO - Statewide Restoration General Order

SWRCB - State Water Resources Control Board

USACE - United States Army Corps of Engineers

USFWS - United States Fish and Wildlife Service

* - This table presents expedited pathways for some necessary permits applicable to the San Mateo Creek Watershed Plan, but additional permits under routine conditions may also be needed (i.e. cultural resources, local county permits, etc.).

† - Does not include time to prepare attachments to permits such as monitoring plans, field reports, or other supporting information.

Permit approval times by regulatory agencies include maximum time after a received application is considered complete.

Helpful Links:

<https://wildlife.ca.gov/Conservation/Cutting-Green-Tape>

<https://acceleratingrestoration.org/find-permits/by-agency/>

6.2. Appendix B: Environmental Permits That May Be Required for Watershed Plan Implementation

Environmental Resource	Law/Regulation	Permit Type	Specific Permit	Regulatory Agency	Fees	Preparation Time	Approval Time
Wetlands/Water	Rivers & Harbors Act	Section 10 Individual or General Permit	RGP41 or RGP78	USACE	\$10	1 Day†	30 Days
	Clean Water Act	Section 401 Water Quality Certification/Waste Discharge Requirement	NWP27	SWRCB/RWQCB	Up to \$259,000	1 Day†	30 Days
		Section 402 NPDES Individual or General Permit	CGP	SWRCB/RWQCB	Up to \$11,000	90 Days	15 Days
		Section 404 Discharge of Dredge/Fill Material Individual or Regional Permit	RGP41 or RGP78	USACE	\$200	1 Day†	30 Days
	California Fish and Game Code	Sections 1600-1607 Lake and Streambed Alteration Agreement	1602 or 1652/1653	CDFW	Up to \$15,000	1 Day†	90 Days
	Porter Cologne Act	Waste Discharge Requirement	--	SWRCB/RWQCB	Up to \$196,000	1 Day†	30 Days
Habitat/Species*	Endangered Species Act	Section 7 Consultation	--	USFWS/NMFS	N/A	1 Day†	135 Days
	Magnuson-Stevens Act	Fisheries Management Plan	--	NMFS	N/A	180 Days	210 Days
	Fish & Wildlife Coordination Act	Report	--	USFWS	N/A	90 Days	Unknown
	California Endangered Species Act	Incidental Take Permit	--	CDFW	Up to \$46,000	1 Day†	180 Days
	Habitat Restoration & Enhancement Act	Small Habitat Restoration Projects	1652/1653	CDFW	Up to \$15,000	1 Day†	60 Days
Cultural	National Historic Preservation Act	Section 106 Consultation	--	SHPO	N/A	60 Days	30 Days
Land/Coast	Federal Coastal Zone Management Act	Subparts C-F	CC/CDP or NWP27	CCC	N/A	3 Days†	240 Days
	California Coastal Act	Section 30601.3	--	CCC	Up to \$20,000	3 Days†	240 Days
	Land Use Lease	Application for Use of State Lands	--	SLC	\$25	3 Days†	240 Days
Multiple	National Environmental Policy Act	Categorical Exclusion or Environmental Assessment	--	Multiple	N/A	90 Days	720 Days
	California Environmental Quality Act	Statutory Exemption or Environmental Impact Report	--	Multiple	N/A	90 Days	720 Days
Utilities/Other	California Streets & Highway Code	Encroachment Permit	--	Caltrans	\$300	1 Day†	240 Days
	Local Grading Ordinances	Grading Permit	--	County Departments	Up to \$6,000	1 Day†	240 Days

Notes:

Caltrans - California Department of Transportation

CC - Consistency Certificate

CCC - California Coastal Commission

CDFW - California Department of Fish and Wildlife

CDP - Coastal Development Permit

CE - Categorical Exclusion

EPA - Environmental Protection Agency

N/A - Not Applicable (Cost not confirmed to be \$0, but no confirmed fee or rate identified)

NMFS - National Marine & Fisheries Service

NOAA - National Oceanic and Atmospheric Administration

NPDES - National Pollutant Discharge Elimination System

NWP - Nationwide Permit

RGP - Regional General Permit

RWQCB - Regional Water Quality Control Board

SERP - Statutory Exemption for Restoration Projects

SHPO - State Historic Preservation Officer

SLC - State Lands Commission

SWRCB - State Water Resources Control Board

USACE - United States Army Corps of Engineers

USFWS - United States Fish and Wildlife Service

† - Does not include time to prepare attachments to permits such as monitoring plans, field reports, or other supporting information.

Permit approval times by regulatory agencies include maximum time after a received application is considered complete.

* - May also require individuals to carry a recovery permit and/or scientific collection permit to work with special status species.

6.3. Appendix C: Adaptive Management for AIS Removal in Pool Habitat

Habitat	Baseline	Action 1	Action 2	Monitoring 1	Monitoring 2
Pool (Mainstem SMC and Tribs)	<p><u>Single-Pass Seining</u> Establish baseline from single pass. This is Pass 1. Record number and species. Set baseline for catch per unit time and volume;</p>	<p><u>Multi-Pass Seining</u> Target depletion percentage in each pool is 99.9% achieved through sequential passes of 90% depletion. Pass 1 establishes baseline. Pass 2: Conduct seining and calculate depletion percentage via regression analysis and record species/size class from catch, If 90% of baseline then target depletion percentage from a single pass met. Perform Pass 3 and Pass 4 until catch is zero or one individual. E.g. Baseline = 1000 individuals; Pass 2 catch 900 (90%) and 100 remaining. Pass 3 catch 90 (90%) and 10 remaining. Pass 4 catch 9 (90%) and 1 remaining. Thus total depletion = $999/1000 = 99.9\%$. If certain species or size classes are not subject to 99.9% depletion, move to Action 2. Captured native species must be relocated to nearest suitable habitat prior to pH treatment.</p>	<p><u>pH Treatment</u> Conduct pH treatment via CaOH or similar (Abdel-Fattadh 2011) to cull remaining population in bulk within one day. Follow Monitoring 2 Protocol to determine percent depletion.</p>	<p><u>Within 7 Days of Treatment</u> Conduct single-pass seining to determine number of individuals. If greater than 1 individual captured, then repeat original protocol, If no connectivity between pools exists, then increase in # individuals after 7 days in a pool is likely from reproduction (seasonal) or catch of those that evaded earlier removal effort. If connectivity between pools exists, it is likely that upstream invasives have colonized the treated pool. If connectivity and >100 individuals, go directly to pH treatment. If no connectivity and <10 conduct 2-pass seining. If pH treatment implemented, conduct pH monitoring within 24 hrs to confirm restored water quality.</p>	<p><u>Within 6 Months of Treatment</u> Conduct single-pass seining; If greater than 10 individuals are captured, then repeat original multi-pass seining protocol.</p>

6.4. Appendix D: Adaptive Management for AIS Removal in Riffle/Run Habitat

Habitat	Baseline	Action 1	Action 2	Monitoring 1
<p>Riffle/Run (Main-stem SMC and Tribs) <i>*Block nets must be installed on upstream and downstream border of treatment area while performing eFishing or rewatering after dewatering treatment</i></p>	<p><u>Single-Pass eFishing</u> Establish baseline from single pass electrofishing. This is Pass 1. Record number and species. Set baseline for catch per unit time and volume;</p>	<p><u>Multi-Pass eFishing</u> Target depletion percentage in each 0.1 mi stretch is 99.9% achieved through sequential passes of 90% depletion. Pass 1 establishes baseline. Pass 2: Conduct e-fishing and calculate depletion percentage via regression analysis and record species/size class from catch, if 90% of baseline then target depletion percentage from a single pass met. Perform Pass 3 and Pass 4 until catch is zero or one individual. 2. If 90% of individuals not captured, adjust e-fishing equipment and methods for salinity, volume, water temperature, conduct one pass to determine if increased catch rate. 2. If 90% catch target not achieved after three consecutive passes, implement Action 2. Captured native species must be relocated to nearest suitable habitat prior to dewatering.</p>	<p><u>Dewatering</u> Conduct dewatering to cull remaining population; Follow Monitoring 1 Protocol (Captured native species must be returned to treated habitat or relocated to nearest suitable habitat if adequate water depth not available post-dewatering)</p>	<p><u>Within 7 Days of Treatment</u> Conduct single-pass eFishing of treated habitat; If greater than 10 individuals are captured, then repeat original protocol.</p>

6.5. Appendix E: Adaptive Management for AIS Removal in SMC Lagoon

Habitat	Baseline	Action 1
SMC Lagoon	<u>Single-Pass Seining</u> Expected catch rate = 90%; remaining population estimated based on 90% catch rate assumption	<u>Multi-Pass Seining</u> Based on habitat size and type, multi-pass seining is the only feasible strategy for the lagoon; seining passes should be continued until passes repeatedly capture less than 10 invasive individuals; seining passes should be repeatedly daily for 5 days

6.6. Appendix F: Adaptive Management for AIS Removal in Private Stock Ponds

Population Control Strategy	Action 1	Action 2	Action 3
<p><u>Strategy 1</u> Removal of in-pond invasive population</p>	<p><u>pH Treatment</u> Expected 100% efficacy; Conduct monitoring 7 days after treatment to confirm - if invasives persist, implement Action 2</p>	<p><u>Dewatering</u> Expected 100% efficacy; maintain dry pond for minimum 7 days; amphibian invasives may persist - if observed, implement Action 3</p>	<p><u>Bullfrog Gigging</u> Bullfrog gigging must be performed in conjunction with pH treatment to prevent repopulating. If the property owner plans to refill the pond within 30 days, bullfrog gigging must be performed weekly prior to refill.</p>
<p><u>Strategy 2</u> Management of drainage pathways on private property</p>	<p><u>Relocate Pond</u> Relocate the pond to a portion of the property that is outside of natural drainage channels; If not possible or desired as a means of mitigation, implement Action 2 <i>*Consult relevant authorities regarding need for streambed alteration permit</i></p>	<p><u>Recontouring of Upstream Land</u> Recontour upstream land to divert surface runoff around the pond; If not possible or desired as a means of mitigation, implement Action 3 <i>*Consult relevant authorities regarding need for streambed alteration permit</i></p>	<p><u>Downstream Spillway/Catchment Basin</u> Construct downstream spillway/catchment basin that directs discharged invasives outside of natural drainage channels or congregates them in another basin resistant to flooding/discharge; If not possible or desired as a means of mitigation, Strategy 1 or 3 must be implemented <i>*Consult relevant authorities regarding need for streambed alteration permit</i></p>

Population Control Strategy	Action 1	Action 2	Action 3
<u>Strategy 3</u> Regulatory Compliance	If a property owner with a pond stocked with aquatic invasive species refuses mitigation, regulatory enforcement should be pursued to ensure proper streambed alteration permitting, stocking permitting, and CESA compliance.		

Population Control Strategy	Action 1	Action 2	Action 3
<p><u>Supplemental Mitigation</u> <i>*Measures are considered supplemental as they are not expected to be 100% effective during particularly severe precipitation events or cannot be monitored to confirm 100% efficacy</i></p>	<p><u>Option 1: Installation of Discharge Barriers</u> Install a catch weir downstream of the pond to capture discharged invasive species</p>	<p><u>Option 2: Install Screens on Defined Drainage Outlets</u> Install screens on defined drainage outlets to prevent discharge of invasives downstream</p>	<p><u>Option 3: Introduction of Odonates</u> If ponds were previously stocked for mosquito control, introducing odonates such as dragonflies and damselflies will help control the mosquito population in the pond</p>

6.7. Appendix G: Adaptive Management for AIS Removal in Response to Environmental Hazards

Hazard	Trigger	Action 1	Action 2	Action 3	Action 4
Fire (Native Species)*	<ol style="list-style-type: none"> Brush fire starts within borders of SMC Watershed Brush fire outside of SMC Watershed borders is predicted to enter SMC Watershed 	<ol style="list-style-type: none"> Alert CDFW, NMFS, State Parks, USGS, USFWS and USFS. Conduct monitoring in prioritized areas where native species are known to reside. Identify translocation area: <ol style="list-style-type: none"> within stream; within SMC watershed; and within nearest watershed with suitable habitat 	Perform native species collection utilizing collection methods specified in this Plan or based on agency-approved protocols, based on habitat type and transport to selected translocation site based on predicted fire severity and path	<u>Monthly After Fire Threat Extinguished</u> Conduct water quality monitoring for alkalinity, pH, turbidity, sedimentation, organics, copper, temperature, and dissolved oxygen	<u>Return Translocated Individuals to SMC Watershed</u> Once two consecutive months of monitoring confirm suitable water quality conditions, return translocated individuals to suitable habitat in SMC Watershed as possible
Fire (Invasive Species)*	<ol style="list-style-type: none"> Brush fire starts within borders of SMC Watershed Brush fire outside of SMC Watershed borders is predicted to enter SMC Watershed 	<ol style="list-style-type: none"> Alert CDFW, NMFS, State Parks, USGS, USFWS and USFS. After the rainy season following the fire: Conduct monitoring in prioritized areas where invasive species are known to reside to document sediment impacts and resulting removal opportunities (e.g. pools filled with sediment allow for method change). Identify areas where invasive removals should be prioritized due to sedimentation conditions and presence/absence of native species. 	Perform invasive species removals using methods specified in this plan		

Hazard	Trigger	Action 1	Action 2	Action 3	Action 4
High Flow (2 Year)	SMC CFS at USGS Gage 11046300 > 2,980cfs < 13,155cfs	<u>Within 30 Days</u> Perform eDNA monitoring at 3 SMC Lagoon sites and 10 individual SMC main-stem pools to document recruitment of new invasives and/or southern steelhead			
High Flow (10 Year)	SMC CFS at USGS Gage 11046300 > 13,155cfs < 33,228cfs	<u>Within 30 Days</u> Perform eDNA monitoring at 3 SMC Lagoon sites and 10 individual SMC main-stem pools to document recruitment of new invasives and/or southern steelhead	<u>Within 30 Days</u> Perform 3-pass seining at same eDNA monitoring sites to document species and count of invasives and/or southern steelhead post 10-year flow event		
High Flow (100 Year)	SMC CFS at USGS Gage 11046300 > 33,228cfs	<u>Within 30 Days</u> Perform eDNA monitoring at 3 SMC Lagoon sites and 10 individual SMC main-stem pools to document recruitment of new invasives and/or southern steelhead	<u>Within 30 Days</u> Perform AIS Removal protocol as specified in Plan to capitalize on likelihood that AIS were flushed from watershed and further reduce instream invasive population		

Hazard	Trigger	Action 1	Action 2	Action 3	Action 4
Drought (SMC Main-Stem Pools, Native Species)	1. Annual Plan monitoring reveals individual pool depth < 36in or predetermined percentage WSE decrease; AND 2. Confirmed southern steelhead capture, observation, or eDNA detection in individual pool	1. Alert CDFW 2. Conduct pre-monitoring 3. Identify translocation area: a. within stream; b. within SMC watershed; and c. within nearest watershed with suitable habitat	Perform native species collection utilizing collection methods specified in this Plan based on habitat type and transport to selected translocation site based on habitat and water quality suitability	<u>Month of April Following Translocation</u> Conduct daily water quality monitoring for 7 days confirming: 1. mean surface water temperature <24C; AND 2. dissolved oxygen > 5mg/l AND 3. maximum pool depth greater than 48in	<u>Return Translocated Individuals to SMC Watershed</u> Once Action 3 criteria met consecutively for 7 days, return translocated individuals to suitable habitat in SMC Watershed as possible
Drought (SMC Main-Stem Pools, Invasive Species)	1. Annual Plan monitoring reveals individual pool depth < 36in or predetermined percentage WSE decrease;	1. Alert CDFW 2. Conduct pre-monitoring 3. Identify invasive species presence and native species presence/absence	Perform invasive species removals using methods specified in this plan		

Hazard	Trigger	Action 1	Action 2	Action 3	Action 4
Water Quality in SMC Main-Stem Pools	1. Instantaneous maximum surface temperature >29C; OR 2. Dissolved Oxygen < 5mg/l or % saturation?	1. Alert CDFW 2. Conduct pre-monitoring 3. Identify translocation area: a. within stream; b. within SMC watershed; AND c. within nearest watershed with suitable habitat	Perform native species collection utilizing collection methods specified in this Plan based on habitat type and transport to selected translocation site based on habitat and water quality suitability	<u>Monthly After Translocation</u> Conduct water temperature and dissolved oxygen monitoring	<u>Return Translocated Individuals to SMC Watershed</u> Once two consecutive months of monitoring confirm suitable water quality conditions, return translocated individuals to suitable habitat in SMC Watershed as possible
Artificial Lagoon Breach	Unscheduled, man-made breach of SMC Lagoon sand berm allowing connectivity between SMC and Pacific Ocean	1. Alert CSP and USMC to restore the sand berm 2. Alert CDFW and NMFS to conduct legal investigation	<u>Weekly</u> Conduct water quality morning until two consecutive weeks reveal suitable water quality conditions	<u>Within 30 Days of Sand Berm Restoration</u> Follow SMC Lagoon AIS removal protocol to capitalize on likelihood of reduced AIS population due to lagoon flush	

** United States Marine Corps Base Camp Pendleton may experience multiple fires of varying severity on base during any given year. MCBCP will follow their established CPEN Wildfire Protocol per the ES Consultation Handbook for all fires on base. Should MCBCP observe or presume that a species with listed protection status has been or will be directly or indirectly impacted by a fire event, then this observation or presumption of impact shall serve as the trigger for MCBCP to initiate the adaptive management measures as outlined in **Appendix G**.*