Applicability of Regional Monitoring for Agencies: Guidelines for Incorporating the WRP Regional Monitoring Program into Agency Programs

Product of
The Wetland Recovery Project Scientific Advisory Panel

December 2025
Technical Report #1393.C

SOUTHERN CALIFORNIA WETLANDS RECOVERY PROJECT

Executive Summary

The Wetland Recovery Project Regional Monitoring Program (WRP RMP) consists of coordinated approaches for coastal wetland monitoring to track progress toward achieving objectives of the WRP's Regional Strategy and to assist interested landowners/managers, agencies and implementing organizations in incorporating these approaches into site-specific permit- and funding-required monitoring programs. Implementation of the WRP RMP is centered on three primary elements: core monitoring of sentinel sites at defined intervals, project monitoring through grant and permit programs, and special studies. This document supports the project monitoring element of the WRP RMP by providing mechanisms for agencies to use the WRP RMP tools and approaches to support monitoring and assessment of grant funded and/or permit required restoration projects, some of which may be required by agencies as compensatory mitigation. Incorporating existing tools and protocols can increase effectiveness and efficiency of performance monitoring, reduce costs to agencies and permittees/grantees, and improve overall decision making by leveraging project data with past and ongoing site-specific and regional monitoring. Incorporation of standardized approaches can also reduce costs for landowners and natural resource managers and allow them to take advantage of state and regional data sets. Aligning permit and grant-based monitoring with state and regional programs will help support and sustain these larger, ongoing programs.

The WRP RMP tools and approaches can be applied to support the following aspects of the regulatory and grant funded mitigation/restoration process (as shown in Figure ES-1):

A. Provide comparator sites to help gauge project success through comparison to existing sentinel sites: Comparator sites can help measure project success by providing context to other relevant sites and can help improve the ability to interpret patterns and trends at restoration or mitigation sites. The term "comparator" site is similar to the more commonly used "reference" site, but can include sites that are less than pristine, but still serve as a good basis of comparison to gauge mitigation/restoration success given their similarity in estuary type and geomorphic setting. Comparator sites will be a subset of sites from the regional sentinel site network (Southern California Wetlands Recovery Project 2024) that are most relevant for evaluating performance of the restoration or mitigation site of interest

B. Inform development and assessment of performance standards/success criteria: Performance standards allow objective evaluation of the condition or function of a restoration site relative to agreed upon targets. Ideally, performance standards should be related to design parameters, targeted ecological or physical functions, and restoration goals and objectives, based on the same indicators used for monitoring, and should provide both interim and ultimate measures of success relative to objectives/targets. The WRP RMP indicators, protocols, and data interpretation tools can support the development of performance standards and allow those standards to be contextualized against other WRP RMP sites.

C. Provide a general approach for developing a mitigation or restoration performance monitoring plan or other compliance monitoring plans: Project specific monitoring plans can support and align with the WRP RMP by prioritizing core indicators and monitoring frequencies, using the sampling design and SOPs indicated in the WRP RMP, and taking advantage of the data templates

and associated quality control features. This will reduce costs and increase efficiency of project specific monitoring, improve consistency, and allow projects to take advantage of the data collected through the WRP RMP. This will also allow data from numerous projects to be synthesized to evaluate restoration performance across the region and progress toward achieving the WRP's stated regional goals and objectives.

D. Provide consistent data structures and quality assurance tools (including metadata) and a data portal that provides a mechanism for managing and accessing monitoring data by agencies and the public: Ideally, agencies may start to align data management and submittal requirements based on the WRP RMP data management plan. In addition, projects should utilize the WRP RMP data management plan to increase data accessibility, consistency, and quality.

<table>
<tr><th>Grant Phase</th><th colspan="5">RMP Element Implementation</th></tr>
<tr><td>Application Evaluation & Permit/Grant Issuance</td><td>Comparator site selection</td><td>Monitoring plan development</td><td>Development of performance standards</td><td></td><td></td></tr>
<tr><td>Implementation, Monitoring, and Adaptive Management</td><td></td><td>Monitoring plan implementation</td><td>Performance monitoring</td><td rowspan="2">Data management</td><td></td></tr>
<tr><td>Long-term Stewardship (may be done by different entity than the permittee/grantee</td><td></td><td></td><td></td><td>Long-term monitoring via incorporation of restoration site into the sentinel site network</td></tr>
</table>

Figure ES-1: Relationship between permit and grant phase and when various WRP RMP elements should be applied/implemented

These guidelines are not intended to be prescriptive and do not supplant or replace existing agency requirements, nor are they intended to establish policies or procedures for any agency. Rather, they are intended to serve as a technical foundation to help agencies consider how to integrate elements of the WRP RMP into project evaluation and permit or grant requirements, at their discretion and to support long-term monitoring by landowners and resource managers. The expectation is that each agency will determine the most appropriate mechanism to use these guidelines and will develop its own processes and procedures to incorporate elements of the WRP RMP into their programs. Over time, implementation approaches should be revisited and revised as necessary based on lessons learned and evolving agency mandates and priorities. These lessons should be shared with the WRP partner agencies and other WRP RMP participants to allow the program to grow, evolve, and improve over time.

Acknowledgements

Prepared for: The U.S. Environmental Protection Agency (EPA)

As a Deliverable for the EPA Wetland Program Development Grant: Building Capacity for Assessing Wetland Recovery Efforts in Supporting Regional Wetland Health and Resiliency

EPA grant # 98T31101

This report should be cited as: Southern California Wetlands Recovery Project. 2025. Applicability of Regional Monitoring for Agencies: Guidelines for Incorporating the WRP Regional Monitoring Program into Agency Programs. Prepared by the Wetland Recovery Project Science Advisory Panel.

Foreword

This document is intended to assist individual agencies in determining how to support the Wetland Recovery Project Regional Monitoring Program (WRP RMP). It includes several elements that can be implemented individually or in total and can be adjusted to the needs of specific projects. Importantly, these guidelines are not prescriptive and do not supplant or replace existing agency guidelines, nor are they intended to establish policies or procedures for any agency. Rather, they are intended to serve as a technical foundation to help agencies consider how to integrate elements of the WRP RMP into project evaluation and permit or grant requirements, at their discretion. The expectation is that each agency will determine the most appropriate mechanism to use or implement these guidelines.

The WRP RMP is critical to evaluating progress toward achieving the WRP's regional goals, assessing overall program effectiveness, informing adaptive management decisions, and supporting project specific assessment and decision making. The guidelines were developed based on the assumption that long-term implementation of the WRP RMP is only possible through collective action of the WRP partner agencies. Incorporation of elements of the WRP RMP, such as standard protocols and use of sentinel sites, into grant and permit program implementation will be necessary to achieve the WRP goals. It also provides an opportunity for agencies to leverage the investment made in developing regional monitoring tools. This will reduce cost and effort for agencies and project proponents, improve consistency, and promote data sharing and integration.

The WRP RMP was developed by the Science Advisory Panel with support from a Project Technical Team (Table FW-1). This document, which focuses on the applicability of the WRP RMP for agencies, was written by the Project Technical Team with input from the WRP Science Advisory Panel.

Table FW- 1. The WRP RMP was developed by both the Project Technical Team and Science Advisory Panel.

Name	Affiliation	Role
Jan Walker	Southern California Coastal Water Research Project	Project Technical Team
Eric Stein	Southern California Coastal Water Research Project	Project Technical Team
Katie Nichols	State Coastal Conservancy	Project Technical Team
Kevin O'Connor	Central Coast Wetlands Group, Moss Landing Marine Labs	Project Technical Team
Megan Hall	California Coastal Commission	Project Technical Team
Corey Clatterbuck	California Coastal Commission	Project Technical Team
Rich Ambrose	University of California, Los Angeles	Science Advisory Panel
Kat Beheshti	SONGS Mitigation Program, University of California, Santa Barbara	Science Advisory Panel
Caitlin Crain	San Francisco Estuary Institute	Science Advisory Panel
Jeff Crooks	Tijuana River National Estuarine Research Reserve	Science Advisory Panel
Karina Johnston	University of California Santa Barbara	Science Advisory Panel
Kerstin Wasson	Elkhorn Slough, National Estuarine Research Reserve	Science Advisory Panel
Christine Whitcraft	California State University, Long Beach	Science Advisory Panel

Glossary of Terms

ACOE or USACE	US Army Corps of Engineers
Bight RMP	Southern California Bight Regional Monitoring Program
CARI	California Aquatic Resources Inventory
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
DiG	WRP Directors Group
EMPA	Estuary Marine Protected Area Monitoring Program
EPA	US Environmental Protection Agency
IM Plan	Information Management Plan
NERR	National Estuarine Research Reserve
OPC	Ocean Protection Council
PTT	Project Technical Team
SAP	Science Advisory Panel
SAV	Submerged aquatic vegetation
SCB	Southern California Bight
SCC	State Coastal Conservancy
SCWRP or WRP	Southern California Wetlands Recovery Project
SDTF	Standardized data transfer formats
SONGS MMP	San Onofre Nuclear Generating Station Mitigation Monitoring Program
SOP	Standard Operating Procedure
WAG	Wetland Advisory Group
WMG	Wetland Managers Group
WRAMP	Wetland and Riparian Area Monitoring Plan
WRMP	San Francisco Wetland Regional Monitoring Program
WRP RMP	Wetland Recovery Project Regional Monitoring Program

Table of Contents

Table of Figures

Table of Tables

1. Context: The Southern California Wetlands Recovery Project Regional Monitoring Program

The Wetland Recovery Project[1] Regional Monitoring Program (WRP RMP) consists of coordinated approaches for coastal wetland monitoring to track progress toward achieving objectives of the WRP's Regional Strategy and to assist interested agencies and implementing organizations, alone with landowners and natural resource managers in incorporating these approaches into general, site-specific permit- and funding-required monitoring programs. The WRP RMP provides a mechanism to collect regional scientific information to evaluate project performance, improve regional assessment, enhance data consistency, and provide efficiency for individual restoration projects.

WRP Regional Monitoring Program goals include:

- Track the collective condition of coastal wetlands in the region and how they are responding to climate change stressors and other stressors
- Help agencies assess coastal wetland resilience to address climate change effects and develop adaptation strategies
- Provide landowners/resource managers, regulatory and funding agencies with an opportunity to monitor wetlands in a comparable way, improve access to data, and better leverage efforts across programs to improve regional wetland inventories and condition assessments
- Utilize improved information on wetland condition, resilience, and performance in southern California to help state and federal regulatory programs more effectively manage, preserve, and restore wetlands in southern California.
- Assess progress towards reaching the WRP's regional goals for coastal wetland restoration, under the WRP Regional Strategy 2018

The development and formation of the WRP Regional Monitoring Program includes elements focused on a process for establishing a sentinel site network[2], a monitoring strategy, and an implementation strategy for coastal wetlands in southern California. These elements of the monitoring program are described in the following four documents:

1. Development of a Coastal Wetland Sentinel Site Network. Summarizes recommendations for the development and maintenance of a statewide sentinel site network and provides recommendations for southern California sentinel sites (Southern California Wetlands Recovery Project 2024, Walker et al. 2025).

[1] The Southern California Wetlands Recovery Project (WRP) is a partnership of 18 State and Federal agencies that was formed in 1997 to serve as a regional voice for the valuable yet diminishing coastal wetlands of southern California and to cooperate on effort to promote their recovery.

[2] Sentinel sites are coastal wetlands that are designated for long-term monitoring to track ecological condition through time, evaluate the effect of regional trends in external conditions/stressors, and track progress towards regional objectives, strategies, or plans.

2. Monitoring for management: A monitoring strategy for southern California wetlands. Provides an overview of the monitoring strategy, monitoring questions, and priority indicators necessary to develop the WRP Regional Monitoring Program.
3. **Applicability of Regional Monitoring for Agencies: Guidelines for Incorporating the WRP Regional Monitoring Program into Agency Programs. Provides agency-specific guidelines for applying the regional monitoring approach to permitted and funded projects.**
4. Implementation strategy for the WRP Regional Monitoring Program. Outlines a plan to guide the rollout and coordination of a collaborative coastal wetland monitoring effort across wetlands in southern California.

This document provides guidelines for how state and federal agencies can incorporate elements of the WRP RMP into their agency-specific programs. (Document #3).

2. Introduction and Objectives

Implementation of the WRP RMP is centered on three primary elements: core monitoring of sentinel sites at defined intervals, project monitoring through grant and permit programs, and special studies. This document supports the project monitoring element of the WRP RMP by providing mechanisms for agencies to use the WRP RMP tools and approaches to support monitoring and assessment of permit required and/or grant funded restoration projects, some of which may be required by agencies as compensatory mitigation, and by landowners and resource managers. Incorporating existing tools and protocols can increase effectiveness and efficiency of performance monitoring, reduce costs to agencies and permittees/grantees, and improve overall decision making by leveraging project data with past and ongoing site-specific and regional monitoring. In turn, aligning permit and grant-based monitoring with regional and state programs will help support and sustain these larger, ongoing programs.

While the WRP RMP can improve regional understanding of drivers and performance of projects, it may not include all regulatory requirements, especially those addressing threats to sensitive species and loss of critical habitat. As a result, the monitoring requirements of individual restoration projects should be customized or supplemented, based on the resources affected by the project, for example, when listed species occupy a project site. Recommendations are not intended to be overly prescriptive as some projects may have limited funding. Site-specific variability may also affect the selection of monitoring components.

These guidelines are intended to support the implementation of agency programs related to evaluation, restoration, and monitoring of coastal wetlands (i.e., estuaries and coastal lagoons) through the following objectives and expectations:

- Provide suggestions for how to incorporate monitoring approaches and tools of the WRP RMP into wetland regulatory and grant programs
    - Habitats include subtidal, intertidal and marsh plain habitats in coastal wetlands including perennial estuaries, bar-built estuaries, and coastal lakes and lagoons.
- Provide non-prescriptive recommendations that do not seek to contradict any existing agency policies or guidelines
- Encourage project proponents to incorporate monitoring approaches and tools of the WRP RMP into their project plans
- Encourage agency staff to include requirements or incentives to permittees and grantees to use the WRP RMP estuary monitoring tools, standard procedures, and data management systems as the core of their project monitoring and assessment
- Provide a mechanism to contextualize and better interpret project performance
- Improve the ability to answer regional questions about estuary health, stress, and progress toward meeting the WRP regional objectives
- Help document decision making, improve transparency and enhance future replicability.

The general concepts could be expanded to other coastal and inland aquatic resources and transitional habitats, but would require development of additional tools, protocols, and implementation capacity. Specific permit or grant requirements will be determined at the discretion of each agency.

These guidelines are intended to further support existing agency and organizational guidelines and frameworks including but not limited to:

- California Coastal Commission (CCC) - *Suggestions for the Development of Habitat Mitigation and Monitoring Plans for the CA Coastal Commission*- provides general guidance for habitat (terrestrial, wetland, marine) mitigation designs, monitoring programs, reporting, and adaptive management actions.
- United States Army Corps of Engineers (USACE) – *South Pacific Division Mitigation and Monitoring Guidelines* – provides more specificity in protocols for indicators included in performance indicator tables.
- The Wetland and Riparian Area Monitoring Plan (WRAMP) - provides for comprehensive monitoring and assessment of aquatic resources using a watershed or landscape context based on U.S. Environmental Protection Agency's three-tier monitoring and assessment framework.
- State of California Water Quality Control Plans -, including, but not limited to the *Enclosed Bays and Estuaries Plan*, the *Thermal Plan* and various regional basin plans.

Application

Existing WRP RMP tools and approaches can be applied to support the following aspects of the grant funded restoration process (which is usually voluntary) and the permit required compensatory mitigation process (which is usually compulsory):

A. Provide comparator sites to help gauge project success through comparison to existing sentinel sites: Comparator sites are sites that can help measure project success by providing context and can help improve the ability to interpret patterns and trends at restoration or mitigation sites. The term “comparator” site is similar to the more commonly used “reference” site, but can include sites that are less than pristine, but still serve as a good basis of comparison to gauge mitigation/restoration success given their similarity in type and setting. Comparator sites should be comprised of a subset of the regional sentinel sites and can include non-sentinel sites selected at the discretion of agency staff. Sentinel sites are coastal wetlands that are designated for long-term monitoring to track ecological condition through time, evaluate the effect of regional trends in external conditions/stressors, and track progress towards regional objectives, strategies, or plans (Southern California Wetlands Recovery Project 2024).

B. Inform development and assessment of performance standards/success criteria: Performance standards allow for objective evaluation of the condition or function of a restoration site relative to agreed upon targets. Ideally, performance standards should be related to project objectives and design parameters, based on the same indicators used for monitoring, and should provide both interim and ultimate measures of success relative to objectives/targets. The WRP RMP indicators, protocols, and data interpretation tools can support the development of performance standards and allow those standards to be contextualized against other WRP RMP sites.

E. Provide a general approach for developing a mitigation or restoration performance monitoring plan or other compliance monitoring plans: Project specific monitoring plans can support and align with the WRP RMP by prioritizing core indicators and monitoring frequencies, using the sampling design and SOPs indicated in the WRP RMP, and taking advantage of the data templates and associated quality control features. This will reduce costs and increase efficiency of project specific monitoring, improve consistency, and allow projects to take advantage of the data collected through the WRP RMP. This will also allow data from numerous projects to be synthesized to evaluate restoration performance across the region and progress toward achieving the WRP's stated regional goals and objectives.

C. Provide consistent data structures and quality assurance tools (including metadata) and a data portal that provides a mechanism for managing and accessing monitoring data by agencies and the public: Ideally, agencies may start to align data management and submittal requirements based on the WRP RMP data management plan. In addition, projects should utilize the WRP RMP data management plan to increase data accessibility, consistency, and quality.

This document contains recommendations for how to incorporate different elements of the WRP RMP into agency actions, which are summarized in Table 1 and discussed in more detail in subsequent sections of the document.

Table 1. Summary of recommendations for how to incorporate RMP elements into agency actions

RMP Elements	Recommended Agency Action	Document Section
Sentinel Site Network	Select reference/comparator sites from the sentinel site network	3
Monitoring Plan	Apply sampling design and SOPs from the RMP	4
Monitoring Plan	Align frequency of long-term monitoring with RMP 5-year cycle	4
Monitoring Indicators	Include relevant core indicators in the project's monitoring plan and performance criteria	4 & 5
Data Management	Use RMP data templates and upload data to the data portal	6

Successful incorporation of these tools and resources should occur early in the mitigation/ restoration planning process and should be refined over time throughout the process. They can also be applied as part of long-term monitoring and stewardship by landowners and natural resource managers. The general relationship between the permit/grant application phase and when various WRP RMP elements should be applied is shown in Figure 1.

<table>
<tr><th>Grant Phase</th><th colspan="5">RMP Element Implementation</th></tr>
<tr><td>Application Evaluation & Permit/Grant Issuance</td><td>Comparator site selection</td><td>Monitoring plan development</td><td>Development of performance standards</td><td></td><td></td></tr>
<tr><td>Implementation, Monitoring, and Adaptive Management</td><td></td><td>Monitoring plan implementation</td><td>Performance monitoring</td><td rowspan="2">Data management</td><td></td></tr>
<tr><td>Long-term Stewardship (may be done by different entity than the permittee/grantee</td><td></td><td></td><td></td><td>Long-term monitoring via incorporation of restoration site into the sentinel site network</td></tr>
</table>

Figure 1. Relationship between permit and grant phase and when various WRP RMP elements should be applied/implemented

Comparator Site Selection

A common way to measure project success is to compare project (restoration or mitigation) sites to comparator sites (defined above) to provide context and improve the ability to interpret patterns and trends at restoration or mitigation sites. The term “comparator” site is similar to the more commonly used “reference” site but can include sites that are less than pristine but still serve as a good basis of comparison to gauge mitigation/restoration success given their similarity in type and setting. This may be especially relevant in urbanized or heavily impacted regions.

Are Comparator Sites Necessary?

The decision as to whether comparator site(s) are necessary will depend on the size and complexity of the restoration. Restoration types, such as minor recontouring, restoring temporary impacts, invasive species removal, or some voluntary restoration projects may not require monitoring of comparator sites. More complex or larger restoration efforts will often require one or more comparator sites to help evaluate restoration success, especially mitigation projects. The number and type of comparator sites should encompass the target (intended) habitat types of the restoration. In some cases, data from existing sentinel site monitoring may be sufficient to meet this requirement, but in other cases additional comparator site data may be warranted.

Utility of the Sentinel Site Network

Projects should use the *WRP Regional Monitoring Program Sentinel Site Network* (Southern California Wetlands Recovery Project 2024) to the extent practical to select comparator sites. Sentinel sites are coastal wetlands that are designated for long-term monitoring to track ecological condition through time, evaluate the effect of regional trends in external conditions/stressors, and track progress towards regional objectives, strategies, or plans. They can be useful for evaluating long term efficacy of site-specific and regional restoration and management actions and informing adaptive management programs for coastal wetlands. Sentinel sites are typically defined as encompassing the entire wetland; in contrast, comparator sites may either be an entire wetland or a portion of the wetland that provides appropriate context for the habitat being restored.

The WRP sentinel site network has three categories of sites: Reference, Restoration, and Other Sites of Interest. Reference sites reflect the least degree of alterations, impacts, or stressors in the landscape, and are often the sites used for comparison when assessing restoration or impacted sites. When selecting comparator sites, project proponents should consider selecting sites from the sentinel site network. The network is beneficial because 1) it has pre-identified reference sites in the region, 2) it includes regional monitoring on a consistent basis, and 3) it provides an opportunity to collate the data into an accessible dashboard. There may be some instances where project proponents decide to select non-sentinel sites.

To select sites, projects should walk through the provided workbook exercise to select comparator sites. The goal of this exercise is for project proponents and agency staff to document their rationale for selection of comparator sites as part of the development of permit or grant funded monitoring programs. The selection process should be clearly documented and justified, particularly when best professional judgement is used.

Workbook Exercise for Selecting Comparator Sites

As noted above, not every restoration project requires comparator sites. However, if comparator sites are desired, it is important to have an explicit, structured process for choosing the comparator sites. The selection of comparator sites can be documented by using the provided excel workbook (Appendix A. Comparator Site Worksheet). Sites are scored based on five categories: Archetype, Sentinel Type, Proximity, Monitoring, and Project Similarity. Descriptions of each category and workbook directions are described below. In addition to the selection criteria below, projects should also consider restoration/mitigation goals when selecting sites. For example, if a project is prioritizing the restoration of hydrologic processes, then projects should consider sites that have similar processes to the restoration site's hydrologic objective. Selecting sites with the desired restored ecological functions (e.g., primary production, nekton habitat provisioning, and nutrient cycling) will strengthen the comparisons post-restoration and allow projects to better quantify whether function was restored.

Step 1: Fill out the restoration or mitigation site information.

At the bottom of the workbook, projects should first fill out the site information. This information can help both project proponents and agency staff distill the relevant information that might help them select comparator sites. Projects should fill out the site name, restoration goal, potential monitoring indicators, and the desired restored functions or processes. By documenting both the monitoring indicators and

desired restored processes, projects can select comparator sites that potentially already monitor these indicators and select sites that have similar functions and processes.

Step 2: Score each site based on the four criteria categories

Projects should walk through the comparator site workbook to score each and ultimately help make a final comparator site selection. For each selection category, we provide a description of the category, considerations when scoring, a scoring step, and the associated criteria. Following each category, we provide an overall workbook action (e.g., filter out all sites with a score of 0). The criteria should be evaluated in the defined sequence as the result of each scoring will help reduce the number of sites as projects move through the categories. Therefore, as projects progress through the workbook, sites will drop off and be removed from further scoring and the ultimate list will be narrowed to the most appropriate comparator sites.

1. Archetype
    a. Description: Coastal wetlands are complex and highly variable ecosystems. As defined in the WRP Regional Strategy for southern California, archetypes are representations of a group or class of coastal wetlands similar in form and structure. Grouping wetlands into archetypes is useful because it provides a general conceptual model that can be used to explain how a specific group of wetlands function and how they may respond to external pressures or drivers. The project site should have a known targeted archetype post-restoration. A restored archetype may be different than the current or historic archetype. Therefore, when selecting a comparator site, a site should be selected with the same or similar archetype to the targeted post-restoration archetype.
    b. Considerations: Selecting a site with the exact same targeted archetype may not be possible and may be overly limited. Therefore, we provide a table that crosswalks each archetype (Table 2). Each archetype pair is evaluated for its appropriateness for comparison (High [H], Moderate [M], and Low [L).
    c. Action: Score each sentinel site based on its archetype appropriateness for comparison to the restoration/mitigation site.
        i. 2 – Same archetype (H)
        ii. 1 – Similar archetype (M)
        iii. 0 – Different archetype (L)

Table 2. Archetype comparisons scored by the appropriateness for comparison to the restoration or mitigation site. Each archetype pair is evaluated for its appropriateness for comparison (High [H], Moderate [M], and Low [L].

	Small Creek or Lagoon	River Valley Estuary	Large Lagoon	Intermediate Estuary	Bay Estuary
Small Creek or Lagoon	H				
River Valley Estuary	L	H			
Large Lagoon	L	M	H		
Intermediate Estuary	L	M	M	H	
Bay Estuary	L	L*	M	M	H

* Bay estuaries and river valley estuaries could have moderate appropriateness depending on the site; therefore, this could be scored higher based on best professional judgement.

Remove the sites that scored 0, then proceed with the remaining exercise.

2. Sentinel site type

    a. Description: Sentinel sites are categorized into three categories: Reference, Restoration, and Other Sites of Interest. Reference sites reflect the least degree of alterations, impacts, or stressors in the landscape, and are often the best sites for comparison when assessing restoration or impacted sites. The WRP Reference sites were designated based on the following criteria: mouth/inlet state, buffer condition, watershed stressors, California Rapid Assessment Method, invasive species, and habitat stability (Southern California Wetlands Recovery Project 2024). When possible, reference sites should be prioritized as comparator sites due to their extensive vetting and "less-altered" states.

    b. Considerations: The use of reference sites may not always be possible or necessary when selecting comparator sites. Depending on the size of the restoration, projects could consider using a portion of an estuary when selecting a comparator site. For example, some sites may have areas that retain the desired functions and attributes that are ideal for comparison. When scoring, project proponents or agency staff can make decisions that differ from the scoring criteria (e.g., based on project size, complexity or whether the site is compensatory mitigation or voluntary restoration). However, all decisions should be justified and documented in the comments. Additionally, data could be used to further justify making non-reference site selections.

    c. Action: Score each sentinel site based on the sentinel site type.
        i. 2 – Reference site
        ii. 1 – Restoration sites that could be comparator sites
        iii. 0 – Unlikely comparator sites (most likely Other Sites of Interest)

Remove the sites that scored 0, then proceed with the remaining exercise.

3. Proximity to project site

    a. Description: Typically, sites that are closer together are going to function more similarly and be exposed to similar stressors. They may also function to support metapopulations of organisms that can move between nearby systems. Therefore, comparator sites that are closer to project sites should be preferred and scored higher.

    b. Considerations: The scoring criteria was selected as a starting point (50-mile increments). The underlying assumption is that the more proximate systems may make better comparator sites. As more projects utilize the comparator site selection criteria, the WRP can re-evaluate the 50-mile scoring criteria.

    c. Action: Calculate the proximity of the sentinel sites to the project site using the provided latitude and longitude, then score the site based on proximity.
        i. 2 - <50 miles or same subregion
        ii. 1 – 50-100 miles or adjacent subregion
        iii. 0 - >100 miles

Continue scoring process without removing sites that score 0.

4. Monitoring Data Availability

    a. Description: Comparable and available monitoring information for comparator sites is extremely useful in understanding the performance and trends of comparator sites. Comparator sites that have both been monitored recently and will continue to be monitored will help project proponents better understand the overarching health of the comparator sites. Sites that have existing and continuing monitoring should be prioritized.

    b. Considerations: Although some sites may have existing monitoring programs and data, project proponents should make sure the data is relevant to the project-specific restoration objectives. Monitored indicators at the potential comparator site(s) should align with the project restoration/mitigation project objectives to ensure comparability with chosen comparator sites.

    c. Action: Determine if relevant monitoring data is available and if monitoring will occur into the near future. Relevant monitoring data is defined as the data that is relevant to the restoration objectives. Score the sites based on the criteria below.
        i. 2 – Routine monitoring in the last 10 years that is part of an established, ongoing program with quality control criteria and publicly accessible data
        ii. 1 – Any monitoring data that is available in the last 10 years (e.g., single time point monitoring data)
        iii. 0 – Limited or difficult to access data

Tally the scores from #1-4 together to get a site score for each site.

Step 3: Add an optional bonus score based on an additional criteria category

Project proponents or agency staff can add an additional bonus score to weight sites that have previously been used as comparator sites.

5. Similar projects
    a. Description: There are many ongoing and past mitigation and restoration projects, all which had to select comparator sites. Projects should identify if there are similar projects to their own and then determine if previously used comparator sites are suitable.
    b. Considerations: Whether a site was a previous comparator site may not be useful or relevant for all projects. Therefore, project proponents can decide to skip this category.
    c. Action: Identify similar mitigation or restoration projects and determine if their comparator sites are suitable
        i. 1 – Past comparator site
        ii. 0 – No record of being a comparator site

Step 4: Add an optional weighting factor or considerations

Specific criterium can be weighted more than other criterium to allow project proponents or agency staff discretion to prioritize specific criterion based on the needs of an individual project. For example, reference sites could be weighted more heavily than non-reference sentinel sites, or sites that support specific habitats or species could be weighted more heavily. A weighting factor between 0 and 1 can be added to one or more of the criteria to reflect agency priorities, permit or grant requirements, or to account for uncertainty in scoring of some of the criteria (i.e., assign a higher weight to criterium with higher confidence).

Step 5: Select comparator sites and provide justification

Once the workbook exercise is complete, there will be a final list of sites with high scores. Agency staff and/or project proponents can then select the final comparator sites. It is not necessary to choose only comparator sites with the highest scores, rather project proponents and/or agency staff should utilize their best professional judgement with the workbook results as a guide. All selections should be justified and explained at the bottom of the workbook.

Example Comparator Site Selection

The WRP Scientific Advisory Panel (SAP) tested and validated the workbook exercise by completing the exercise for two sites: San Dieguito Lagoon and Huntington Beach Wetlands.

San Dieguito Lagoon

San Dieguito Lagoon (SDL) is a River Valley Estuary and designated as a restoration site in the Sentinel Site Network. In 2010, SDL underwent restoration to preserve, improve, and create a variety of habitats to increase and maintain fish, invertebrate and bird habitat, ensure the protection of endangered species, and ensure adequate tidal flushing and circulation to support a diversity of biological resources while maintaining the functions typical of a natural wetland ecosystem. To date, the mitigation project (San Onofre Nuclear Generating Station (SONGS) Mitigation Monitoring Program) has not met its performance

standards and continues to be monitored and assessed by a team of California Coastal Commission staff, contract scientists at UC Santa Barbara, and a Science Advisory Panel.

SDL was scored following the above criteria (Table 3). The SAP weighted Proximity and Monitoring less than Archetype and Sentinel categories to align the current exercise with the original SDL selection criteria. They also decided not to add a bonus score for similar projects, as this was also not done in the original selections.

Using the comparator site selection process, 11 sites scored higher than a 4, and 5 sites scored higher than a 4.5. It's worth noting that comparator sites were chosen for SONGS prior to the completion of restoration construction in 2011, well ahead of the development of the WRP RMP comparator site selection process. The SONGS coastal development permit specified criteria for comparator site selection ("relatively undisturbed, natural tidal within the Southern California Bight"). The requirement that comparator sites be "natural" precluded sites that have undergone large-scale restoration, which disqualified a subset of the high scoring comparator sites (e.g., San Elijo Lagoon, Batiquitos Lagoon, Bolsa Chica, Huntington Beach Wetlands). Of the top 5 qualifying sites (Los Penasquitos Lagoon, Santa Margarita Estuary, Seal Beach National Wildlife Refuge and Mugu Lagoon, and Carpinteria Salt Marsh), all three of the current (2024-present) comparator sites (Los Penasquitos Lagoon, Mugu Lagoon, and Carpinteria Salt Marsh) for SDL scored high, particularly when incorporating project specific considerations (e.g., permit criteria).

Table 3. Abbreviated workbook for San Dieguito Lagoon.

Name	Archetype Score	Archetype Weight	Sentinel Score	Sentinel Weight	Proximity score	Proximity Weight	Monitoring Score	Monitoring Weight	Total
Los Penasquitos Lagoon	2	1	2	1	2	0.5	2	0.5	6
San Elijo Lagoon	2	1	1	1	2	0.5	2	0.5	5
Santa Margarita Estuary	2	1	2	1	2	0.5	0	0.5	5
Seal Beach National Wildlife Refuge	1	1	2	1	2	0.5	2	0.5	5
Mugu Lagoon	1	1	2	1	1	0.5	2	0.5	4.5
Batiquitos Lagoon	1	1	1	1	2	0.5	2	0.5	4
Bolsa Chica Lagoon	1	1	1	1	2	0.5	2	0.5	4
Carpinteria Salt Marsh	1	1	2	1	0	0.5	2	0.5	4
Huntington Beach Wetlands	1	1	1	1	2	0.5	2	0.5	4
San Mateo Lagoon	1	1	2	1	2	0.5	0	0.5	4
Santa Ana Wetlands	2	1	1	1	2	0.5	0	0.5	4

Huntington Beach Wetlands

Huntington Beach Wetlands (HBW) is a Large Lagoon and designated as a restoration site in the sentinel site network. Huntington Beach Wetlands were historically a large lagoon system, and while a large amount of intertidal marsh has been restored, it is now decoupled from the neighboring river system (Santa Ana River). It was restored in several pieces (1989, 2008, 2009) as voluntary restoration, and extensive data exist about those monitoring years as well as about current conditions. HBW restoration was restored with a focus on birds in Talbert and Brookhurst Marshes and for fish in Magnolia Marsh. No official scoring process for comparator sites was followed at the time of restoration in 2008-2009; however, Talbert Marsh was used as a comparison for the subsequent restoration of both Brookhurst Marsh and Magnolia Marsh, explicitly weighting proximity over restoration status.

HBW was scored following the criteria above (Table 4). The SAP decided to not weight any categories. They also decided not to add a bonus score for similar projects, since HBW is such a unique system and there may not be many relevant existing comparator sites.

Nine sites scored higher than 4. The top three sites (list) are the sites that make the most sense for HBW, as they are all similar archetypes and have extensive fish and bird habitat.

Table 4. Abbreviated workbook output for Huntington Beach Wetlands.

Name	Archetype Score	Archetype Weight	Sentinel Score	Sentinel Weight	Proximity score	Proximity Weight	Monitoring Score	Monitoring Weight	Total
Bolsa Chica Lagoon	2	1	1	1	2	1	2	1	**7**
Seal Beach National Wildlife Refuge	2	1	2	1	2	1	1	1	**7**
Batiquitos Lagoon	2	1	1	1	1	1	2	1	**6**
Las Flores Creek	1	1	2	1	2	1	0	1	5
Cockleburr Canyon	1	1	2	1	1	1	0	1	4
Devereux Lagoon	2	1	1	1	0	1	1	1	4
Arroyo de las Aguas	1	1	2	1	0	1	0	1	3
Damsite Canyon	1	1	2	1	0	1	0	1	3
El Capitan	1	1	2	1	0	1	0	1	3

3. Monitoring Plan Development

Project specific monitoring plans could support and align with the WRP RMP by:

- Prioritizing the core indicators and recommended monitoring frequencies
- Applying the sampling design and SOPs indicated in the WRP RMP
- Taking advantage of the data templates and associated quality control features

This will reduce costs and increase efficiency of project specific monitoring, improve consistency, and allow projects to take advantage of the data collected through the WRP RMP.

Integration of permit and grant required monitoring with core regional monitoring of sentinel and non-sentinel sites supports overall implementation of the WRP RMP. The spatial and temporal frequency of monitoring may need to be adjusted relative to what is done at sentinel sites based on the size and nature of the mitigation/restoration project and based on project specific needs or funding availability.

Regular mapping of wetland extent is a foundational element of the WRP RMP and is critical to evaluating both project-specific condition/performance and progress toward meeting regional goals and objectives. Individual projects should conduct regular habitat mapping consistent with the California Aquatic Resources Inventory (CARI) approach and classification system to allow project-based mapping to contribute to regional (and statewide) assessment of habitat status and trends.

Core Indicators

Prioritize WRP RMP core indicators

The WRP RMP includes two classes of indicators, core and supplemental. The WRP RMP provides Standard Operating Procedures/Protocols (SOPs) that should be adhered to in order to ensure comparability between project-specific monitoring and other monitoring elements of the WRP RMP[3]. Core indicators should be monitored across all sites (Table 5). These indicators were recommended by the WRP Science Advisory Panel (see Appendix D of the WRP RMP document) as the minimum indicators necessary to evaluate ecosystem condition; they can be augmented or enhanced based on individual agency needs and discretion. They are intended to provide base information on wetland condition that are generally important across all wetland types. The process for selecting these indicators is described in detail in the WRP Regional Monitoring Plan. Second are supplemental indicators that provide more specific or detailed information on condition or that may be more relevant for specific wetland types. The WRP RMP core indicators should be incorporated into monitoring requirements using the WRP RMP SOPs (as possible given the type of site being restored). Supplemental indicators (or additional indicators not included in the WRP RMP core monitoring) may be included based on the target functions of the mitigation/restoration and the project goals. Indicators can be used to estimate ecosystem functions (over time) using Estuary Marine Protected Area (EMPA) Monitoring Program function-based assessment framework and evaluation methods.

[3] SOPs can be intensified or augment (e.g., additional plant transects, additional indicators), but should not be modified or reduced

Table 5. Final list of core and supplemental indicators for inclusion in the WRP RMP.

Core Indicators	Supplemental Indicators
Habitat and Elevation	Sediment Dynamics
Marsh Vegetation	Mouth Dynamics
Water Quality: Temp., DO, Salinity	Water Quality: Parameters of Concern
Hydrology	Submerged Aquatic Vegetation
Rapid Assessment	Birds
Fish: Minimum sampling	Fish: Extensive sampling
Invertebrates: Macrofauna (> 3 mm)	Invertebrates: Infauna (< 500 um)
Eutrophication: sediment nutrients	Eutrophication: algae

Station (Sampling Area) Monitoring Design

Focus station selection and sampling design on clustering indicators within key habitat types

Estuaries are composed of a diversity of habitats or landscape features from salt marsh platforms to intertidal and subtidal channels to seagrass beds. WRP RMP monitoring is based on establishing sampling stations that encompass a variety of habitat types and functions. Within these sampling stations, users can concentrate multiple sampling methods (i.e., cluster sampling) within a given area and can resample areas more frequently based on project-specific needs (Figure 2).

The selection of sampling stations within each estuary or restoration site is critical to increase the comparability of the assessment framework and interpretability of the data across estuaries. The overarching goal of this process is to develop a standardized process for the placement of sampling stations, which will allow users to identify and prioritize the main landscape features that will allow them to assess ecological functions, given their specific estuary. The degree of replication needed to accurately capture these processes will vary with the size of the estuary, but also the diversity of habitats contained within it. The purpose of these sampling stations is to pre-determine the areas for focused or concentrated sampling and return to them over time. Depending on the size of the estuary, two to three sampling stations are selected for focused monitoring efforts within each estuary. The precise location, density and number of sample stations will be based on habitat complexity, configuration and size of project site. Individual project monitoring may require additional stations or spatial intensification in areas of interest depending on the goals and objectives of the project. For more details on the process, see the Estuary MPA Monitoring Protocol (Walker et al. 2023).

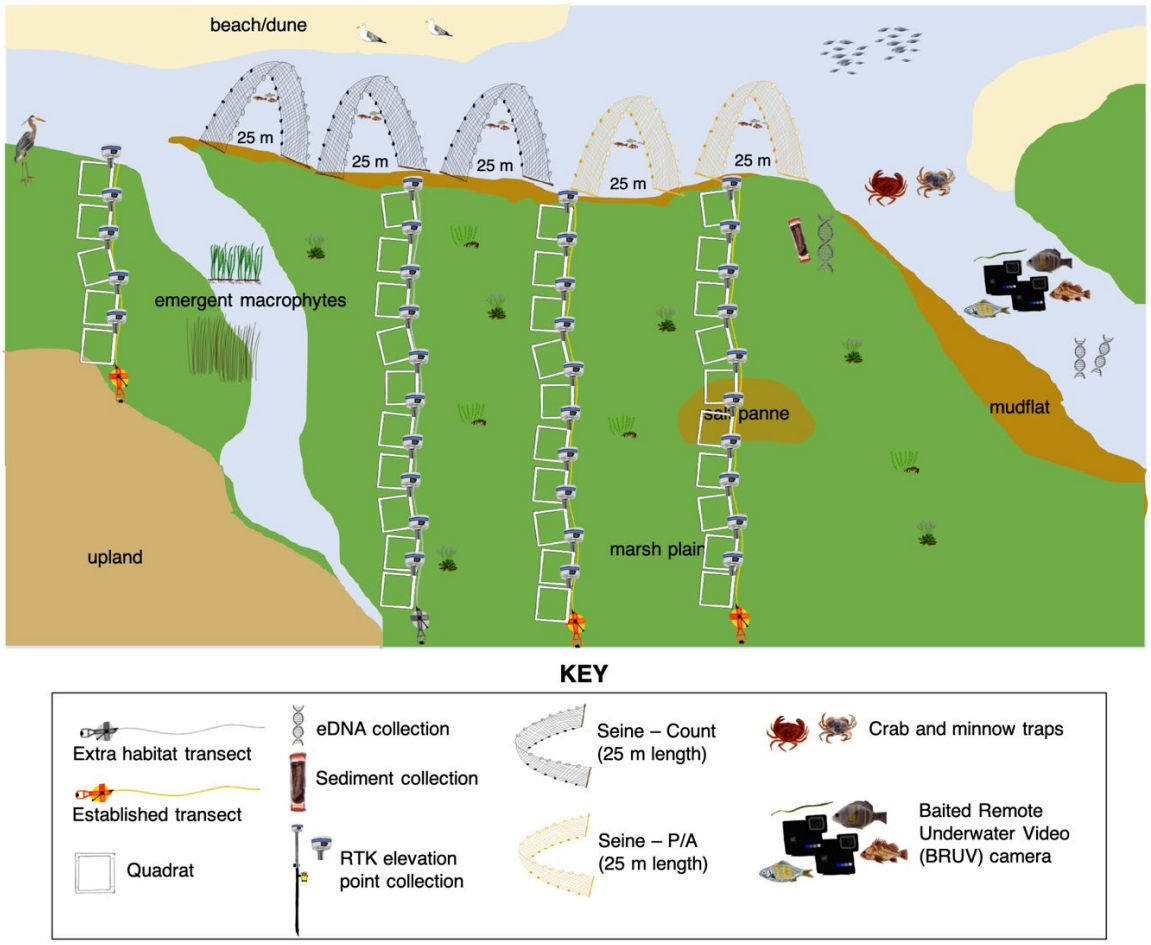

Figure 2. Example of EMPA cluster sampling at a single station. Methods and indicators would vary based on RMP selections.

Monitoring Duration and Frequency

Monitoring should be timed to coincide with core monitoring of sentinel sites to leverage effort and minimize potential confounding effects of different sampling periods

Within the WRP RMP plan, the core monitoring of the sentinel sites occurs on a five-year cycle. Within the monitoring year, the frequency of monitoring will depend on the individual indicator and method (e.g., whether the indicator should be monitored seasonally or at a single time point within the monitoring year). Some indicators should be monitored seasonally (e.g., spring and fall), while other indicators should be monitored based on events (e.g., mouth open and closure). All recommendations with the WRP RMP monitoring plan are within a single year.

For permit and grant monitoring, at a minimum, monitoring should occur in spring and fall for at least the first 5 years following management action(s). However, this may depend on the specific indicator. For example, macroalgae cover may be better monitored in the summer. The majority of WRP RMP indicators

are recommended to be monitored in the spring and fall, however the duration of monitoring may be increased at the agency's discretion, and the frequency and intensity of monitoring may be adjusted over time based on proximity to performance targets or the need to implement adaptive measures (see below). For intermittently opening and closing estuaries, monitoring may be tied to events that trigger mouth opening to capture conditions associated with different phases of the estuary (i.e., open vs. closed).

Upon the conclusion of the permit or grant required monitoring, grant funded (voluntary) mitigation sites that have met all their success criteria may be added to the sentinel site network for periodic longer-term monitoring under the WRP RMP. Compensatory mitigation sites (particularly those associated with mitigation banks) often include long-term monitoring requirements. These should be coordinated to coincide with the 5-year monitoring cycle of the WRP RMP. If/when long-term monitoring of mitigation sites is no longer required, these sites may also be added to the sentinel site network.

4. Performance Standard Criteria

Performance standards allow objective evaluation of the condition or function of a mitigation/ restoration site relative to agreed upon targets. Ideally, performance standards should be related to design parameters and restoration project goals and objectives, based on the same indicators used for monitoring, and should provide both interim and ultimate measures of success relative to objectives/targets, consistent with guidelines provided by both the CCC *HMMP Suggestions* and the USACE *Uniform Performance Standards for Compensatory Mitigation Requirements* documents. The WRP RMP indicators, protocols, and data interpretation tools can support the development of performance standards and allow those standards to be contextualized against other WRP RMP sites.

Performance standards should evaluate the trajectory of a site toward achieving the desired functions and expected timeframe for achieving those functions. Functions may take 5-10 years to mature, and the functional trajectory may be extended by stochastic events (e.g., extended droughts or ENSO events).

The development of performance standards should generally take the following approach:

- Select appropriate WRP RMP indicators that align with target functions
- Develop measurable standards (see recommendations below)
    - Standards may be evaluated relative to desired endpoint at the project site (absolute standard) or based on comparison to comparator (e.g., reference) sites or change over time (relative standard). Absolute standards are appropriate when comparing to an established target, such as desired habitat area or a known ecological temperature threshold. Relative standards can be appropriate when evaluating general function or condition over time.
- Compare ecosystem functions over time at the restoration/mitigation site to those at comparator sentinel sites (relative standard)
    - Differences or similarities at indicator and function level should be compared to comparator sites and over time restoration/mitigation sites should follow similar trajectories to comparator sites, particularly following natural disturbances.
- Define adaptive management triggers and decision process for triggering remedial measures

The following general recommendations regarding the structure of effective performance standards can serve as a guide, or template, for development of program or project specific standards. Because specific performance standards are necessarily project and agency specific, here we provide only general recommendations. Effective performance standards generally address “what to measure,” “how to measure,” and “when to gauge success,” and have the following attributes (for additional details for development of performance indicators see the EPA guidance document).

1) Measures a single aspect of condition/function - Each standard should attempt to isolate one aspect/indicator or function, such as recruitment of native plant communities or appropriate hydrology during the growing season. Although compensatory mitigation should strive to restore fully integrated functional ecosystems, measuring specific indicators is often more practical and enforceable, and can be more easily tied to adaptive management.

2) Can be measured objectively and in a repeatable manner – To the extent possible, standard acceptable protocols should be used so that independent practitioners are producing data in a consistent, repeatable manner. This allows for comparison of data over time at a given site or between sites within a region.

3) Quantifiable targets with known certainty – Standard protocols are typically associated with specific error rates that provide known levels of confidence. These error rates may result from variability during data collection or analysis (e.g., inherent errors in species identification or instrument measurements) and should be accounted for during data interpretation. Data from the WRP RMP can be used to estimate natural variability between aquatic resources and help bound the ranges of expectations for performance standards. Performance standards should account for such measurement uncertainty.

4) Clear target or benchmark anchored to reference – Performance should be assessed relative to a defined target and should include an expected timeframe to meet that target (e.g., at year 5 following construction, 3 years after the first 5-year storm event). Data from other WRP RMP sites can provide context for evaluating benchmarks in several ways (Figure 3). The target can be absolute (i.e., based on a specific target), or relative to conditions at sentinel sites. Performance trajectories can also support the development of interim performance standards that assess progress toward ultimate targets and can inform adaptive management decisions.

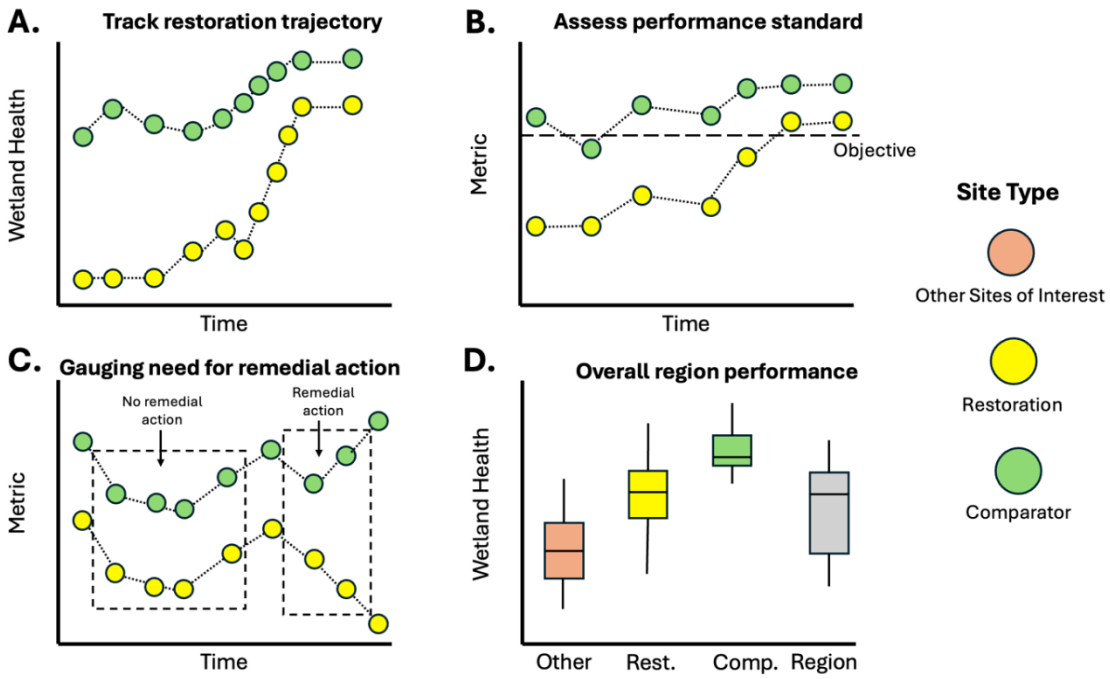

Figure 3. Conceptual ways that data from the WRP RMP can help contextualize performance at mitigation/restoration sites, adapted from Walker et al. 2025.

5) Clear and concise wording - The period of performance evaluation often exceeds the tenure of an individual permit manager or may involve staff who were not involved in writing the performance standards. The language of each standard should be written so that an uninitiated staff person can readily interpret the intent of the standard and reach a clear determination of compliance and/or success. Clear and unambiguous standards can also reduce disagreements between project proponents and agency staff as to whether the standard has been achieved. An example standard is provided in Table 6.

Table 6. Sample performance standard (adapted from Stein et al. 2022).

Sample Performance Standard/Success Criteria
At the end of year 3, at least 80% of Area A shall have a benthic invertebrate index score within 10% of the median reference population score.
If this standard is not met, the site will be re-evaluated within 120 days of the original field assessment.
If the standard is still not met, metric level analysis and/or casual assessment shall be conducted to identify likely reasons for failure

6) Scientifically defensible – Standards should be grounded in sound scientific principles and preferably supported by peer-reviewed studies. Technical studies and data used to support the development of state water quality standards can be used to help inform performance standards. Analysis of data from past restoration and mitigation projects and/or sentinel sites can also provide scientific rationale and support for development and ongoing refinement of performance standards, which should not be static, but evolve over time as lessons are learned from past practices.

7) Phased - Performance standards can be phased over time with performance of the physical aspects of the wetland being evaluated earlier in the restoration process and obtainment of the biological aspects occurring later, once the physical and hydrologic elements are well established (Figure 4). Such a phased approach may be more conducive to development of interim performance targets and to earlier identification of problems that require remedial action or adaptive management.

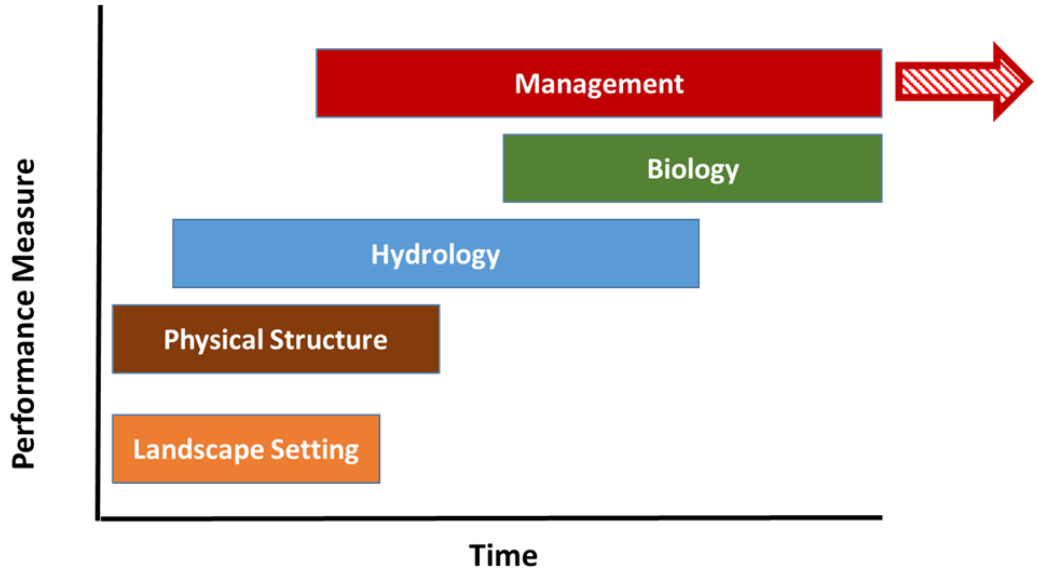

Figure 4. Phased implementation of performance standards can facilitate early intervention and adaptive management, which may in turn promote increased likelihood of mitigation success (from Stein et al. 2022).

Performance standards should account for the inherent non-stationarity of most landscapes. Conditions will inevitably change over the period in which restoration/mitigation sites are maturing, and standards used during the monitoring period and especially those employed after the required monitoring period should account for this variation. Natural events such as droughts or fires may change physical or biological conditions. New invasive species or threatened/endangered species may inhabit the site. Long-term climate change may alter hydrologic and temperature regimes over the decades in which sites are developing. Additional restoration sites may be implemented that change connectivity etc. Finally, other management programs, such as stormwater runoff control or groundwater infiltration, may fundamentally alter catchment water balances and affect the amount and timing of water available to support restoration sites.

Standards should attempt to accommodate such changes to the extent that they can be identified from existing conditions or reasonable future projections. This will support a determination of whether partial success (or failure) is due to site conditions or a landscape-level shift across the range of conditions that could inform adaptive management actions or trigger changes in the evaluation approach. Development of function-based standards and coupling of performance standards to reference conditions can help improve their longevity and continued relevance.

5. Data Management

Projects should fulfill all relevant agency-specific data management and submittal requirements. Ideally, agencies may start to align data management and submittal requirements based on the WRP RMP data management plan. The WRP RMP data management plan calls for project proponents and resource managers to integrate their data with existing data portals, such as the EMPA Monitoring Program. The EMPA Monitoring Program is a cooperative, integrated state and regional monitoring program with many participating agencies. The EMPA program utilizes standardized data transfer formats (SDTF) to upload data to a common database using the EMPA data portal. The EMPA data portal is currently maintained by SCCWRP, who manage data quality and consistency and ensure that submitted data are publicly accessible and available for download. The EMPA portal can also by linked to other data systems through web services to promote data interoperability and to support wider use of the monitoring data.

Project proponents and resource managers should use WRP RMP SOPs and data templates and upload all data to the designated WRP RMP portal at least annually. Data uploads should incorporate all relevant metadata and be uploaded following each monitoring cycle. Future efforts could include development of data visualization tools and automatic reporting, based on agency needs and funding availability for development and ongoing maintenance. Additional information on data management needs is provided in the Implementation Strategy.

6. Example of Agency Use Case

We demonstrate how the WRP RMP can be applied to a specific project through the San Elijo Lagoon restoration/mitigation project (see Appendix B. San Elijo Case Study). The case study illustrates the following benefits of integration with the WRP RMP and how project specific monitoring and regional monitoring can work together:

- Reduced effort in selecting (and sampling) comparator sites (called reference sites for this project)
- Availability of SOPs for agreed upon indicators
- Improved data access and possibly data sharing
- Ability to take advantage of regional and statewide data sets
- Partnership on data analysis and interpretation

The case study showed that for new projects, the application of the WRP RMP tools is generally consistent with existing regulatory agency requirements. There may be advantages to incorporation of the WRP RMP in terms of increased transparency, replicability, and comparability between projects. Further, there is sufficient flexibility to augment the WRP RMP tools with additional project specific requirements based on the needs and objectives of an individual project. For existing projects, it may be difficult or undesirable to retrofit the project, but in most cases, it would be possible to crosswalk the WRP RMP and project indicators to increase leverage opportunities between project needs and WRP RMP needs. The case study produced the following conclusions:

- The WRP RMP aligns well with existing wetland restoration projects in that it provides tools, approaches, and potential datasets to inform wetland monitoring requirements that are already considered within the permit process at regulatory agencies. These include a comparator site selection worksheet for selecting potential reference sites, suggestions for core and supplemental monitoring indicators, and SOPs for monitoring each indicator.
- No changes would be necessary for the comparator site selection process or the selection of monitored indicators to be applied to specific projects. Changing data collection protocols is not advisable for existing restoration projects that are still subject to performance criteria in their regulatory permits. However, many of the protocol changes that would be necessary are minor changes to protocols to ensure comparability with data collected at other WRP RMP sites. Similarly, the WRP RMP monitoring SOPs would need to be examined prior to application to specific projects to ensure the performance criteria can still be appropriately assessed.
- Some flexibility in monitoring protocol selection will be necessary from the agency perspective to ensure efficient and comprehensive monitoring of project success, particularly for compensatory mitigation projects. However, the WRP RMP SOPs typically measure the same metrics as are often used in project-specific monitoring programs.
- Full adoption of the WRP RMP SOPs is feasible after regulatory monitoring requirements have been met, especially where they are included in a site's long-term monitoring plan.

7. Conclusion

Incorporation of these agency guidelines into grant and permit programs will support one of the three main elements of the WRP RMP (along with core sentinel site monitoring and special studies). In turn, use of the guidelines will support agency programs by reducing effort and improving transparency in selecting comparator sites, providing accepted indicators and SOPs, supporting development of performance standards, improving access to data by agencies and the public, and leveraging efforts to support addressing local and regional management questions.

To fully implement the guidelines, each agency will ideally develop its own processes and procedures to incorporate elements of the WRP RMP into their programs. Over time, implementation approaches should be revisited and revised as necessary based on lessons learned and evolving agency mandates and priorities. These lessons should be shared with the WRP partner agencies and other WRP RMP participants to allow the program to grow, evolve, and improve over time. Specific actions that should occur on a recurring basis include:

- ✓ Revisit implementation after each five-year monitoring cycle
- ✓ Incorporate feedback from use-cases for potential updates and refinements
- ✓ Develop sample monitoring outputs as examples of the products of this effort
- ✓ Incorporate new or modified indicators/SOPs
- ✓ Use data management and visualization tools as they are developed
- ✓ Incorporate results and products from special studies

The long-term sustainability will also depend on the ability to develop and support structures and processes for ongoing interagency coordination and shared governance of the WRP RMP. This includes strategies for joint and shared funding of the program through agency funds and grantee and permittee support. This can be augmented by development of low-cost monitoring approaches that can be readily implemented by community-based organizations over extended periods of time. These issues are explored more fully in the WRP RMP Implementation Strategy.

8. References

Southern California Wetlands Recovery Project. 2024. Assessing Wetland Recovery: Building Capacity for Assessing Wetland Recovery Efforts in Supporting Regional Wetland Health and Resiliency - Development of a Coastal Wetland Sentinel Site Setwork. Prepared by the Wetland Recovery Project Scientific Advisory Panel.

Walker, J., Stein, E.B., O'Connor, K., Clark, R., Whitcraft, C., Garcia, S., Hughes, B., Cooper, A., Jacobs, D., Abrecht, M., Largier, J., Roettger, R., Christina, T. 2023. Estuary Marine Protected Area Monitoring Protocol. A report prepared for the California Ocean Protection Council and the California Department of Fish and Wildlife. 29pp.

Walker, J. B., O'Connor, K., Wasson, K., Crain, C., Johnston, K. K., Ambrose, R. F., ... & Stein, E. D. (2025). Sentinel site networks as a mechanism to evaluate progress toward meeting restoration goals in altered and unaltered landscapes. *Restoration Ecology*, e70062.

Appendix A. Comparator Site Worksheet

The selection of comparator sites can be documented by using the provided excel workbook (linked below). Sites are scored based on five categories: Archetype, Sentinel Type, Proximity, Monitoring, and Project Similarity. Descriptions of each category and workbook directions are described in the main body (see Comparator Site Selection). In addition to the selection criteria, projects should also consider restoration/mitigation goals when selecting sites. For example, if a project is prioritizing the restoration of hydrologic processes, then projects should consider sites that have similar processes to the restoration's hydrologic objective. Selecting sites with the desired restored ecological functions (e.g., primary production, nekton habitat provisioning, and nutrient cycling) will strengthen the comparisons post-restoration and allow projects to better quantify whether function was restored.

https://sccwrp.sharepoint.com/:x:/s/Projectteam-WRPRegionalMonitoring/ET7GN_BotwtBlVcPYa1e1KsBemR1f2FAMWpSZIvZwF3lhQ?e=77IBhz

Appendix B. San Elijo Case Study

Purpose

Regulatory agencies play a core role in permitting wetland restoration projects, whether through voluntary restoration or mitigation (in-kind or out of kind) to compensate for the habitat or other environmental loss from other development projects. These same agencies would benefit from ongoing regional monitoring data and synthesis of restoration success that the WRP RMP can provide. One barrier to agency incorporation of the WRP RMP is the potential lift required to adapt current agency monitoring requirements to align with the WRP RMP. Identifying whether and to what degree monitoring designs and conditions that are typically required by agencies align with the WRP RMP, as well as the feasibility of any necessary regulatory adaptations to use the program, could encourage regulatory staff to explore and use the WRP RMP.

The purpose of this case study is to examine whether and how an existing restoration monitoring plan would need to be adapted to use the WRP RMP. Specifically, we asked:

1. To what extent do the WRP RMP tools, designs, and monitoring SOPs already align with an existing wetland restoration project?
2. What would need to change about the project in order to fit the WRP RMP?
3. Are those changes feasible?

Case Study Project Selection and Limitations

Core team members identified the San Elijo Lagoon Restoration Project (SELRP) as an appropriate restoration project to use in the case study. San Elijo Lagoon lies within the San Elijo Ecological Reserve in the City of Encinitas in San Diego County, California. The lagoon drains the Escondido Creek watershed, which encompasses 200 square kilometers, and has a narrow connection to the Pacific Ocean. Multiple structures and surrounding developments restrict freshwater flows and tidal exchange, which has in turn degraded the lagoon's water quality and converted habitats from saltwater marsh to freshwater marsh and low to high marsh. The proposed restoration improves ecological conditions throughout 960 acres of the lagoon through many restoration actions, including recontouring lagoon elevations via grading and dredging to support a more stable mix of habitat types, reconfiguring channels to increase hydraulic flow, and commensurate marsh habitat restoration.

The project was authorized to meet permitting requirements of multiple regulatory agencies, including the California Coastal Commission (CCC), San Diego Regional Water Quality Control Board (RWQCB), Army Corps of Engineers (Corps), and the United States Fish and Wildlife Service (USFWS). The project received a Coastal Development Permit (#6-16-0275) from the CCC in 2016, which required a Lagoon-wide monitoring plan and authorized the project to serve as mitigation for impacts resulting from implementation of the highway, rail, and community enhancement projects in the North Coast Corridor Public Works Plan and Transportation Resource Enhancement Program (NCC PWP/TREP) funded by

Caltrans and the San Diego Association of Governments (SANDAG). The final monitoring plan was published in 2020 and incorporated permitting conditions from the above agencies.

The SELRP represents a recent, large scale wetland restoration project that incorporates the permitting requirements of multiple agencies. Further, it is a mitigation project required to demonstrate restoration performance to mitigate for the loss of wetland habitats elsewhere in coastal San Diego County. As a result, the final restoration plan includes elements similar to the WRP RMP like reference site selection, monitoring indicator selection and assessment methodology, and performance criteria and analysis, all supported by rationale in the restoration plan. All of these features of the SELRP make it ideal for comparison to the WRP RMP.

Because the SELRP is a large, whole-system restoration project, the SELRP has a more robust monitoring plan than other restoration projects permitted by the Commission. While this allows for a comprehensive review for this case study, we acknowledge that it may not be representative of approaches for every or most wetland projects reviewed for the Commission and similarly unsure how this falls for other regulatory agencies. Other restoration projects, especially ones that restore smaller parts of wetland systems, may not be able to monitor every WRP RMP core indicator. However, agencies can still use the WRP RMP for their restoration projects, including comparator site selection, monitoring plan and success criteria development, and data consistency and sharing to submit a smaller subset of monitoring data. Additionally, this project only covers monitoring within the 5-10 years post-project or until all performance criteria are met. It does not cover construction compliance or adaptive management monitoring related to a long-term management plan.

Comparator Site Selection

The comparator site selection process described in the Agency Guidelines is analogous to the reference site selection process implemented for SELRP, as is standard in many wetland mitigation permits. Reference site selection for the SELRP was required based on the CCC's Coastal Development Permit authorizing the restoration. The permit required that the wetlands chosen for reference be relatively undisturbed, natural tidal wetlands within the Southern California Bight. These wetlands have minimal human disturbance to habitats, are not constructed or substantially restored, and receive regular tidal inundation. The SELRP monitoring plan states that UCSB biologists, as part of the SONGS Marine Mitigation Program, evaluated over 40 wetlands within the region for reference site suitability based on these specific permit requirements and selected three reference wetlands for the monitoring plan: Tijuana River Estuary, Mugu Lagoon, and Carpinteria Salt Marsh. However, the SELRP monitoring plan provides little detail on the characteristics of the considered sites and limited rationale or process for reference site selection.

To assess whether the comparator site selection process would yield similar reference sites as the expert opinion consulted as a part of the SELRP monitoring plan, we put San Elijo Lagoon through the comparator site selection process (Table B-1). San Elijo Lagoon is considered a River Valley Estuary, and multiple functions are expected as a part of the SELRP. No other weighting occurred.

Table B-1. Abbreviated comparator site selection workbook for San Elijo Lagoon. Selected reference sites for the SELRP are in bold.

Name	Archetype Score	Archetype Weight	Sentinel Score	Sentinel Weight	Proximity score	Proximity Weight	Monitoring Score	Monitoring Weight	Total
Los Penasquitos Lagoon	2	1	2	1	2	1	2	1	8
Tijuana River Estuary	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**7**
San Dieguito Lagoon	2	1	1	1	2	1	2	1	7
Batiquitos Lagoon	1	1	1	1	2	1	2	1	6
Seal Beach National Wildlife Refuge	1	1	2	1	1	1	2	1	6
Mugu Lagoon	**1**	**1**	**2**	**1**	**0**	**1**	**2**	**1**	**5**
Carpinteria Salt Marsh	**1**	**1**	**2**	**1**	**0**	**1**	**2**	**1**	**5**
Santa Margarita Estuary	2	1	2	1	2	1	0	1	6
San Mateo Lagoon	1	1	2	1	2	1	0	1	5
Canada del la Gaviota Creek	1	1	2	1	0	1	0	1	3

The comparator site selection process identified the three wetlands the UCSB biologists selected as reference sites as a part of the SELRP, but also seven other wetlands that may have been suitable. This suggests that the process aligns with expert opinion consulted as a part of the SELRP regarding the health and function of tidal wetlands in Southern California. Further, there are multiple advantages to using the sentinel site network as described in the *WRP Regional Monitoring Program Sentinel Site Network* (Southern California Wetlands Recovery Project 2024) as part of the comparator site selection for restoration practitioners and regulatory agencies. For example, the process provides a common, transparent beginning to the reference (or comparator) site selection. The selection process is science-based, but also integrates restoration and agency expertise and permitting requirements during the selection process to emphasize particular characteristics or eliminate potential comparator sites. For example, following the permit requirements that the reference wetlands must be relatively undisturbed and the SELRP site selection description that the reference wetlands are not constructed or substantially restored, the SELRP permittees and the CCC could choose to eliminate any site with a Sentinel score lower than 2 (i.e., any site that is not a reference site). This could result in Tijuana River Estuary, San Dieguito Lagoon, and Batiquitos Lagoon being dropped from the site selection process. Seal Beach National Wildlife Refuge has logistical barriers to regular monitoring and sampling. Los Penasquitos Lagoon was the highest scoring wetland in the comparator site exercise, but was not selected as a reference site at the time the monitoring plan was drafted. However, Tijuana River Estuary's site condition changed over time likely due to cross-border pollution and was replaced with Los Penasquitos

Lagoon (lower lagoon; not the planned restoration in the upper part of the lagoon pursuant to the Los Penasquitos Lagoon TMDL adopted into the Region 9 Water Board's Basin Plan in 2014) as a reference site. Permitting agencies scrutinize changes to reference sites, but this exercise demonstrates the strength of the comparator site selection process as unpredictable events occur and reference sites may need to be changed. The reference site selection process, discussion, and outcomes can be memorialized into future wetland monitoring plans and could be referred to when assessing potential adaptive management actions.

Comparing Indicators

WRP RMP indicators are analogous to the required monitoring variables at SELRP. There are 16 WRP RMP indicators, 8 considered core indicators and 8 considered secondary indicators. There are 13 SELRP variables. A crosswalk between the indicators and variables is provided in the table below (Table B-2) based on the descriptions of the collected data for each indicator or variable, as applicable. The crosswalk does not indicate that the data collected using WRP RMP and SELRP protocols are comparable – this information is discussed in the following section.

Table B-2: Crosswalk of WRP RMP indicators and SELRP variables.

WRP RMP Indicator	WRP RMP Indicator Class	SELRP Variable
Habitat and elevation	Core	Topography
		Habitat areas
Marsh vegetation	Core	Habitat areas
		Vegetation
Water quality: Temp, DO, Salinity	Core	Water quality
Hydrology	Core	Tidal elevation
Rapid assessment	Core	Wetland function (CRAM)
Fish: Minimum sampling	Core	Fish
Fish: Extensive sampling	Supplemental	
Invertebrates: Macrofauna (> 3 mm)	Core	Benthic invertebrates
Invertebrates: Infauna (< 500 um)	Supplemental	
Eutrophication: sediment nutrients	Core	Sediments
Sediment dynamics	Supplemental	
Mouth dynamics	Supplemental	Bathymetry
Water quality: Parameters of concern	Supplemental	--
Submerged Aquatic Vegetation	Supplemental	Eelgrass
Birds	Supplemental	Birds
Eutrophication: algae	Supplemental	Caulerpa

Comparing Protocols

One goal of the WRP RMP is to encourage restoration efforts to use common monitoring protocols to assess project progress towards desired habitat forms and functions and ensure that data collected across a wide range of restoration and monitoring efforts is comparable. Different monitoring protocols may use methods that inherently create data that may not be comparable, either within the same project or among different restoration projects. Encouraging use of the same or similar protocols, where feasible and reasonable, will enable comparisons of restoration progress within and among restoration projects across the Southern California region and enhance agency decision making and evaluations of wetland restoration. At the same time, agencies may require a protocol that differs from the WRP RMP either to assess a particular performance criterion or to maintain consistency with other projects in the agency's jurisdiction.

To this end, this section assesses whether the standard operating procedures employed as a part of the WRP RMP (WRP RMP SOPs) create data that is comparable with data created by the SELRP protocols. Specifically, we examined each protocol that had a common indicator in both the WRP RMP SOPs and the SELRP for differences regarding the metric collected, the resolution of the data, and protocol methodology. We also discuss the significance of the observed differences in interpreting restoration success within the San Elijo Lagoon Restoration from the regulatory agency perspective.

Of the 13 SELRP variables and the WRP RMP indicators that were compared, 6 had differences in monitoring protocols. These included: SELRP Topography and WRP RMP Habitat and elevation mapping; SELRP Habitat areas and WRP RMP Habitat and elevation mapping; SELRP Vegetation and RMP Vegetation; SELRP Fish and WRP RMP Fish: extensive sampling; SELRP benthic invertebrates and WRP RMP Invertebrates: Macrofauna; and SELRP Caulerpa and WRP RMP Eutrophication: algae. Four variables used methods that produced data with high comparability: Hydrology, Water Quality, Wetland Function (CRAM), and Sediments. Three variables did not have an associated WRP RMP protocol, so a comparison could not be made. Protocols for bird surveys were not developed as the wildlife agencies frequently provide SOPs for surveying targeted bird species. The WRP RMP does not provide a protocol to assess submerged aquatic vegetation or mouth dynamics and will rely on other protocols to obtain data on submerged aquatic vegetation density and distribution as well as imagery or sondes to assess how often a tidal mouth is open. Given the frequency of Clean Water Act 404 permits in wetland restoration, protocols that include surveying for eelgrass habitat (which is based on eelgrass density and distribution) are likely to be included with the WRP RMP, but had not yet been prepared at the time of this case study.

The observed differences in monitoring protocols were primarily minor, but some involved different methods of measuring the same metric which ultimately had implications for data comparability. For example, SELRP methods for measuring percent cover used point-intercept transects parallel to shore at 0.5m distances between points, while the WRP RMP suggests using $1m^2$ quadrats spaced dependent on wetland size along transects perpendicular to shore. Both are valid methods for measuring vegetation cover, but the data collected in each may not be comparable. Similarly, the fish protocols employ block netting (SELRP) and beach seining (WRP RMP) sampling methods which do not create comparable catch per unit effort (CPUE) and are therefore not interchangeable. However, the fish species richness created by each method may be comparable. Both block netting and beach seining are included in the WRP RMP protocol for minimum sampling, so SOP selection should consider the benefits and drawbacks of each

method. For extensive or targeted fish sampling, enclosure traps (SELRP) and minnow traps (WRP RMP) do not create comparable data on the density and richness of benthic fishes (e.g., Gobiidae) or mobile macroinvertebrate community (e.g., crabs), but both are reasonable methods to use to measure community density and species richness.

Some of the observed differences were based on the amount or resolution of data collected. For example, the SELRP evaluates topography and habitat areas based on aerial imagery (e.g., NDVI) measured biannually. This approach makes sense for a 960-acre wetland restoration effort that also has issues with site access. Meanwhile, the equivalent WRP RMP indicators are measured using an RTK GPS with transects placed at important topographic features. For wetland restoration projects that are accessible by foot and are restored at smaller scales, the WRP RMP's approach is a practical, lower-resolution solution to ensure the site develops functioning wetland habitats as planned.

Finally, we found one WRP RMP SOP that would not be appropriate to include in the SELRP based on the desired performance criteria for SELRP as distinct from the goals of the WRP RMP. The SELRP's Corps Clean Water Act Section 404 Permit and the USFWS Biological Opinion conditions required that the invasive algae *Caulerpa sp*. not be observed in the system in either pre- or post-restoration. A Caulerpa Control Protocol must be employed in order to fulfill those permit conditions. The WRP RMP's Eutrophication: algae protocol is designed to assess wetland production and eutrophication. While the WRP RMP surveys in some areas are appropriate for Caulerpa (intertidal bottom and surface water of subtidal habitats), the WRP RMP protocol does not assess the bottom of subtidal habitats and also not at the approved survey intensity levels required by the Caulerpa Control Protocol.

In summary, our analysis found some differences in sampling protocols between the WRP RMP and the SELRP. These differences were significant enough that data collected through RMP SOPs would not be directly comparable with data collected to comply with agency monitoring requirements (at least for this particular project). However, the RMP SOPs likely would be adequate to include in a newly developed restoration project or monitored wetland. Accordingly, the majority of WRP RMP SOPs could be used to address the same performance criteria in the SELRP. This is because the methods in the SELRP and WRP RMP generally assess the same metrics using different, but highly tested, methodologies. It is understandable that the SELRP uses some methods that are generally more comprehensive and expensive than ones provided in the WRP RMP given the size and compliance requirements of the restoration. Other differences are based on specific regulatory agency needs reflected in the SELRP's performance criteria. Adopting the SOPs provided as a part of the WRP RMP is a critical step towards developing regional assessments of coastal wetlands, and aligning with the provided SOPs is feasible and largely non-disruptive to current restoration monitoring practices.

A Note on Sampling Design and Effort

During our analysis of indicator protocols, we noted that the sampling effort associated with some WRP RMP indicators and SELRP variables differed. This is a critical difference for indicators that use relative performance criteria and data collected at the reference site to aid in evaluating restoration success. The SELRP has relative performance criteria for four variables that the metric measured at the restoration site must, "Not (be) significantly worse than the mean value at the lowest performing reference wetland within 5 years (in one case, 10 years) of monitoring following construction." These criteria can only be

met if the restoration project also lays out a quantitative plan for determining similarity, which should include but is not limited to the sampling effort required at the reference and restoration sites. As a result, during regulatory review of projects that use comparator sites in the WRP RMP, it is critical to consider how performance criteria may influence the monitoring design of your selected WRP RMP indicator. For example, if the current sampling effort at a selected comparator site is not adequate to assess performance at the restoration site, the restoration effort might need to increase sampling effort (and commensurately, the monitoring budget) at the selected comparator sites while the site is under regulatory monitoring requirements to ensure that the data is comparable. Anticipating these needs during the monitoring plan development will help avoid issues with performance assessment years after the restoration is installed.

Summary

How much of the WRP RMP already aligns with existing wetland restoration projects?

- The WRP RMP provides tools, approaches, and potential datasets to inform wetland monitoring requirements that are already considered within the permit process at regulatory agencies. These include a comparator site selection worksheet for selecting potential reference sites, suggestions for core and supplemental monitoring indicators, and SOPs for monitoring each indicator.
- The comparator site selection process identified the three wetland reference sites that the SELRP adopted, in addition to six other potential wetland reference sites in the region.
- When one of the initially selected reference sites for the SELRP degraded, another reference site was selected based on expert guidance. This reference site, Los Penasquitos Lagoon, was also the highest-ranking comparator site in the worksheet, indicating the preciseness of this approach for choosing reference sites in alignment with best professional judgment of experts in the field.
- All 13 SELRP monitoring variables aligned with the core and supplemental indicators in the WRP RMP. One supplemental indicator was not included in the SELRP.
- Of the aligned monitoring indicators between the SELRP and WRP RMP, only four indicator monitoring SOPs would provide comparable data between the SELRP and RMP.

How much would the published SELRP need to change to use the WRP RMP?

- No changes would be necessary for the comparator site selection process or the selection of monitored indicators.
- The SELRP would need to switch seven of the current monitoring protocols to use the similar WRP RMP protocols. Changing data collection protocols is not advisable for existing restoration projects that are still subject to meeting performance criteria in their regulatory permits. However, many of the protocol changes are minor changes to protocols to ensure comparability with data collected at other WRP RMP sites. Comparability is of primary concern for indicators that use relative performance criteria for evaluation.

- Similarly, the SELRP would need to re-examine the WRP RMP monitoring SOPs with provided performance criteria for any necessary changes to monitoring and sampling design to ensure the performance criteria can still be appropriately assessed.

Are those changes feasible?

- Yes, with some guidelines. The decision to use those protocols would need to take place before pre-construction surveys to ensure the same protocol is used pre- and post-construction.
- Some flexibility in monitoring indicator and protocol selection is necessary from the agency perspective to ensure efficient and comprehensive restoration, particularly for compensatory mitigation projects. However, the WRP RMP SOPs typically measure the same metrics as the monitoring methods in the SELRP.
- Due to the differences in goals between the Caulerpa performance criteria and the eutrophication: algae WRP RMP indicator, it is unlikely that regulatory agencies would adopt the related WRP RMP SOP and instead continue to use the Caulerpa Control Protocol to address Caulerpa detection.

Based on review of the SELRP case study, we conclude that application of the WRP RMP tools is generally consistent with existing Commission permit conditions, and potentially for other regulatory agency requirements. There may be advantages to incorporation of the WRP RMP in terms of increased transparency, replicability, and comparability between projects. Further, there is sufficient flexibility to augment the WRP RMP tools with additional project specific requirements based on the needs and objectives of an individual project. For existing projects, it may be difficult or undesirable to retrofit the project, but in some cases it would be possible to crosswalk the WRP RMP indicators with existing project indicators to further align opportunities between existing project needs and WRP RMP needs.