WASTEWATER NEEDS ASSESSMENT

PHASE 1 REPORT 2025

CALIFORNIA Water Boards

CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

DEFINITION OF TERMS

At-Risk Wastewater Facility: Wastewater facility at-risk of inadequacy that may be confronting circumstances which threaten its ability to continue adequately treating and disposing of wastewater.

Cesspool: An excavation in the ground receiving domestic wastewater, designed to retain the organic matter and solids, while allowing the liquids to seep into the soil. Cesspools differ from seepage pits because cesspool systems do not have septic tanks and are not authorized under the OWTS Policy (OWTS Policy definitions). The term cesspool does not include pit-privies and out-houses, which are not regulated under the OWTS Policy.

Collection System (CS): A generic term for any system of pipes or sewer lines used to convey wastewater to a treatment facility.

Consolidation: Currently used within Senate Bill (SB) 1215 purview for projects that involve connecting communities relying on inadequate Onsite Sewage Treatment Systems (OSTS) to public sewer systems with the intent of improving wastewater management, protecting public health, and enhancing water quality.

Inadequate Wastewater Facility: Wastewater facility not effectively treating and disposing of wastewater, leading to environmental, health, and operational issues.

National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a permit is issued that complies with the Clean Water Act. The State and Regional Water Boards issue WDRs that serve as NPDES permits in California.

NPDES facilities: Wastewater treatment facilities permitted through the NPDES Program.

Onsite Sewage Treatment Systems (OSTS): Onsite sewage treatment system(s) (OSTS) include individual disposal systems, community collection and disposal systems, and alternative collection and disposal systems that use subsurface disposal (Water Code Section 13290(b)…and includes, but is not limited to, a septic tank, cesspool, leach field, and seepage pit." (Water Code Section 13288(2)).

Onsite Wastewater Treatment Systems (OWTS): Onsite wastewater treatment system – onsite systems specific to the OWTS policy.

OWTS Policy: The OWTS Policy sets statewide requirements for the siting, design, operation, and maintenance for qualifying wastewater and onsite treatment systems that use subsurface disposal primarily treating domestic wastewater, including septic tanks.

WWNA project team: WWNA project team (UCLA, OWP, UMass, UC ANR, Dania Jimmerson (State Water Board).

Regional Water Boards: California Regional Water Quality Control Boards

Regionalization: It typically refers to a broader, collaborative approach that connects multiple systems—usually more than two—without necessarily merging them physically.

Sanitary Sewer Overflow (SSO): Any overflow, spill, release, discharge, or diversion of untreated or partially treated wastewater from a sanitary sewer system.

Sanitary Sewer System: Any system of pipes, pump stations, sewer lines, or other conveyances, upstream of a wastewater treatment plant headworks and which is comprised of more than one mile of pipes and sewer lines, used to collect and convey wastewater to a publicly owned treatment facility.

Senate Bill No. 1215 (SB 1215): SB 1215 covers all treatment technologies under the OWTS Policy and others, including cesspools (a type of OSTS).

Septic System: An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a system of tile lines or a pit for disposal of the liquid effluent (sludge) that remains after decomposition of the solids by bacteria in the tank. Must be pumped out periodically.

Sewage: The waste and wastewater produced by residential and commercial sources and discharged into sewers.

SSSGO systems: Collection systems regulated under the Sanitary Sewer System General Order (Note that CIWQS uses the term SSO to refer to systems regulated by the SSSGO. The acronym “SSO” will be used consistently in the report to match CIWQS terminology, ensuring alignment for future iterations of the WWNA if parts of the study are replicated or recalculated.)

State Water Board: State Water Resources Control Board

UMass unsewered model: Machine learning model developed by University of Massachusetts Amherst (UMass) to assign properties as sewered, unsewered, or N/A

Waste Discharge Requirements (WDR): A water quality order adopted by Regional Water Boards to regulate discharges of waste to surface water and discharges of waste to land.

Wastewater Treatment Facilities (WWTFs): Facilities that treat or reclaim industrial or sewage waste.

Water Boards: Used to refer collectively to State Water Board and Regional Water Boards

WDR facilities: Wastewater treatment facilities subject to WDRs.

ACRONYMS

CIWQS: California Integrated Water Quality System Project

CIWR: California Institute for Water Resources

CS: Collection System

CWA: Clean Water Act

CWNS: Clean Watershed Needs Survey

CWSRF: Clean Water State Revolving Fund

DWR: Department of Water Resources

EPA: U.S. Environmental Protection Agency

LAMPs: Local Agency Management Programs

NPDES: National Pollutant Discharge Elimination System

OSTS: Onsite Sewage Treatment Systems

OWP: California State University Sacramento - Office of Water Programs

OWTS: Onsite Wastewater Treatment Systems

SCWW: Small Community Wastewater

SSO: Sanitary Sewer Overflow

SSSGO: Sanitary Sewer System General Order

UC ANR: University of California, Agriculture and Natural Resources

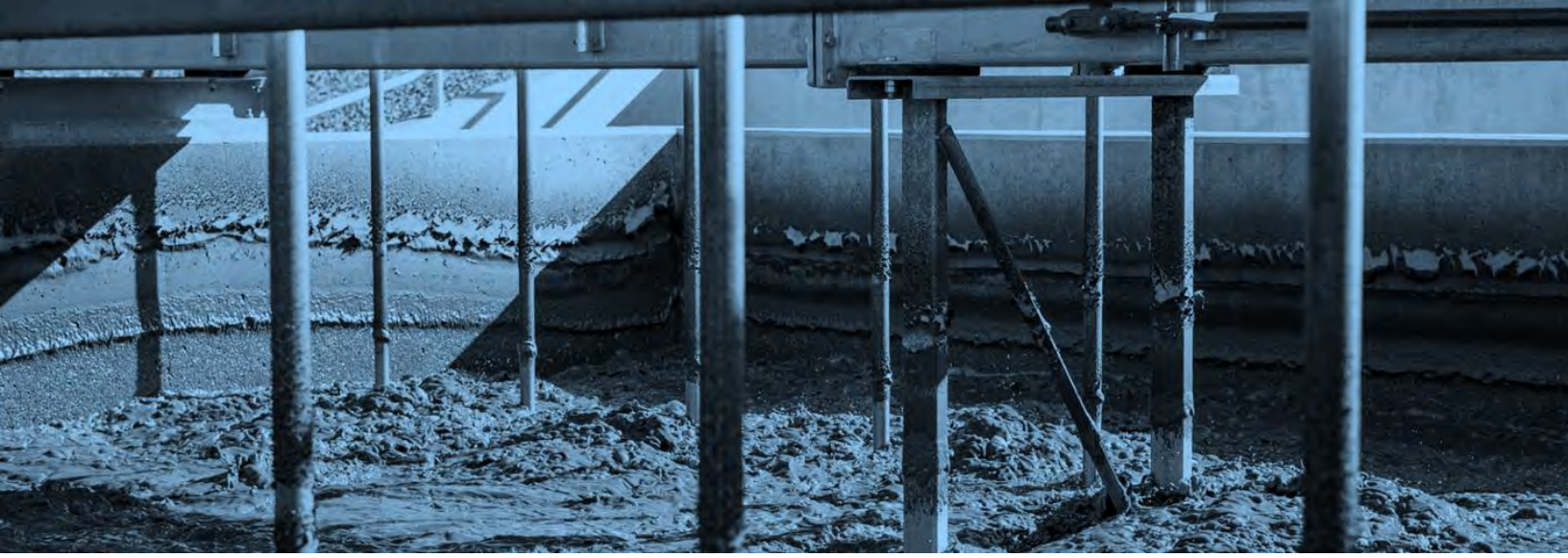
UCLA: University of California, Luskin Center for Innovation

UMass: University of Massachusetts - Amherst

WDR: Waste Discharge Requirements

WWNA: Wastewater Needs Assessment

WWTF: Wastewater Treatment Facility



EXECUTIVE SUMMARY

OCTOBER 2025

CALIFORNIA Water Boards | State Water Resources Control Board

Division of Water Quality, State Water Resources Control Board

UCLA Luskin Center for Innovation

Prepared by UCLA Luskin Center

EXECUTIVE SUMMARY

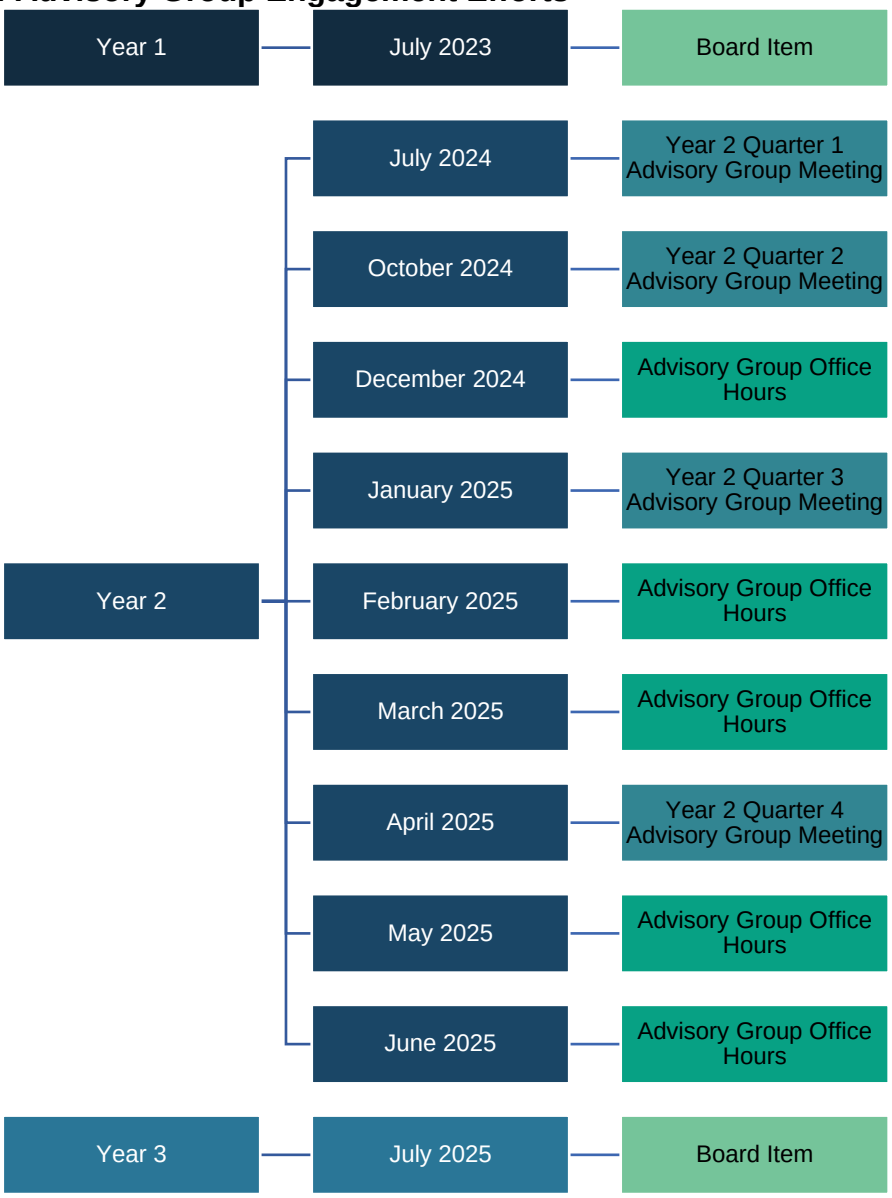
Safe management of wastewater is crucial for ensuring human and environmental health. The State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards' (Regional Water Boards) vision is "a sustainable California made possible by clean water and water availability for both human uses and environmental resource protection." Wastewater sanitation systems that are poorly designed, installed, or managed can contaminate drinking water supplies and release harmful pollutants into the environment.

In response to its overarching vision and several pieces of recent legislation, the State Water Board and the Regional Water Boards (collectively, Water Boards) developed the concept of conducting a "Wastewater Needs Assessment" (WWNA), as specified in State Water Board Resolution No. 2022-0019. The overarching goal of the WWNA is to provide information on sanitation needs across California and develop strategies to address the state's sanitation system needs. This effort aligns with the Water Boards' vision of clean, safe, and affordable water for human uses and environmental resource protection across California, with a particular focus on disadvantaged communities and decentralized systems. It is also aligned with the State Water Board's Racial Equity Action Plan and Climate Change Resolution.

A brief summary of the Phase 1 chapters is provided below (pg. 13). As described further in this report, the assessment involves developing a comprehensive analytical framework and tracking specific systems to prioritize infrastructure investments to promote equity in sanitation as part of achieving the Human Right to Water. This is a first-time effort for the state, and for that matter, for any state or territory in the U.S. Given the scale and novelty of this undertaking, the Water Boards are partnering with practitioners under contract to conduct the first WWNA from July 1, 2023, until June 30, 2027. The University of California, Los Angeles (UCLA) Luskin Center for Innovation is serving as the lead contractor for the WWNA. UCLA is working in close partnership with the Office of Water Programs (OWP) at California State University, Sacramento, the California Institute for Water Resources (CIWR) within the UC Agriculture and Natural Resources system (UC ANR), and the University of Massachusetts Amherst (UMass) on this effort.

Although it was not part of the contracted WWNA scope, UCLA recommended the formation of a WWNA Advisory Group to obtain diverse engagement outside of the WWNA project team and the Water Boards. The WWNA project team established a stakeholder advisory group of 30 members and has led the engagement of the group, initially quarterly but now monthly, with the WWNA project team and Water Boards (See Figure 1). The WWNA Advisory Group participants advise on project development and draft analyses, inform the WWNA team on wastewater data and information, and provide other key areas of expertise and perspectives.

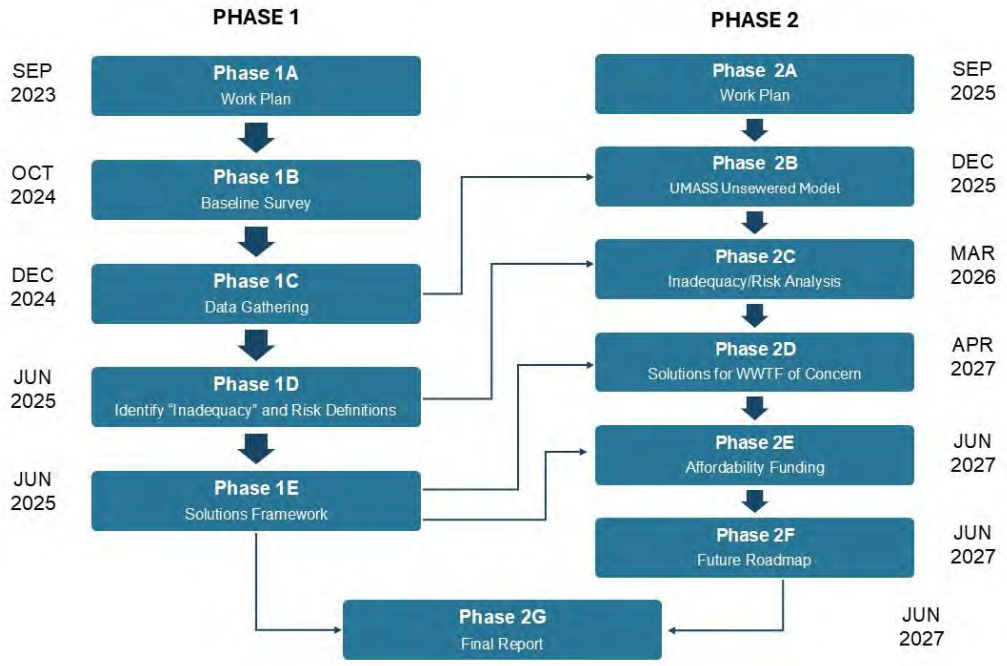
Figure 1: Advisory Group Engagement Efforts



PHASE 1 OF THE WWNA

The initial contracted WWNA lasts for four years and is conducted in sequential 2-year phases, which in turn are divided into discrete tasks (see Figure 2 below). Through the first phase of WWNA (July 2023-June 2025), the WWNA project team evaluated the baseline conditions of wastewater infrastructure services in California. This phase involves developing a process for collecting, compiling, and assessing data to inform the second phase of research, which will implement the process, including identification of wastewater systems of concern, potential solutions, and relevant costs and funding opportunities. A summary of the Phase 1 work was also presented at a State Water Board meeting on July 16, 2025.

Figure 2: WWNA Project Phases



At a high level, Phase 1 of the project established methodologies, developed a survey, collected initial data, assessed data gaps, and provided potential means for filling them. It also established key definitions of risk and inadequacy for sewage collection systems, sewage treatment plants, and onsite wastewater systems, as well as a set of methods for modeling potential solutions to challenges, and their associated costs and potential funding sources.[1] Phase 1A (Chapter A) laid out a work plan for the rest of Phase 1.

Phase 1B (Chapter B) sets a baseline of understanding for the rest of the WWNA project. This work enables the WWNA project team and the broader public to understand the landscape of wastewater needs and existing data sources and research efforts in California. It also aims to potentially motivate investment in the needs assessment process itself beyond the initial WWNA effort. This effort was two-fold. The first and larger portion was led by UC ANR. This effort consisted of a statewide survey of community needs (with 112 unique responses), mapping of potentially vulnerable housing types, and a field campaign, which remains ongoing. Although the Field Campaign was not part of the original contract scope, it was important to include it to ground-truth the information collected through the survey. It also provides valuable context by capturing photos and conversations that helped illustrate and humanize the data—essentially bringing the stories behind the survey results to life. The UCLA portion of the baseline study consists of a review of previously-published studies and data sources, most of them generated outside the State Water Board, potentially relevant to

[1] The chapters were originally designed as standalone sections to allow for easy access, reference, and sharing.

the WWNA. It reveals a relative dearth of foundational data and methodologies, underlining the WWNA's novelty.

Phase 1C (Chapter C) exhaustively surveys the breadth, depth, and quality of publicly available data for subsequent analysis in the WWNA. In this effort, led by OWP with support from UCLA, there is a special but not exclusive focus on Water Boards' datasets. Through a novel and iterative process using data from the State Water Boards' California Integrated Water Quality System (CIWQS) database, it identifies the three major facility and system types as well as the 2,657 specific systems to be included in various parts of the WWNA analysis (called "The Facilities and Systems List"). It also outlines several data gaps, some of which can be filled in during the WWNA, and others that serve as recommendations to be filled with future efforts by the State Board and its partners.

Phase 1D (Chapter D) then provides novel methodologies for defining and quantifying the inadequacy and the risk-of-becoming inadequate for all 2,657 wastewater facilities and systems identified in Phase 1C. Given the unique way in which the three major wastewater system types operate and are regulated, the methods for assessing inadequacy, and to some degree risk, are necessarily differentiated by facility and system type. This chapter identifies both the framework for defining inadequacy and risk, as well as specific factors to be included, while noting that some potentially useful indicators to characterize inadequacy and risk are excluded due to a lack of available data. This effort was led by UCLA and included consultation with the entire project team, as well as a designated working group of Water Boards staff focused on relevant regulation development and compliance aspects.

Phase 1E (Chapter E) builds on prior phases of the WWNA effort to develop methodologies for assigning potential technical solutions to the issues causing wastewater facilities and systems to be found as inadequate. These solutions include, but are not limited to, infrastructure repairs and replacement, operational and managerial oversight enhancements, and interconnection between systems. This chapter also develops methods to provide high-level estimates of the cost of these solutions, which can inform state and local community funding needs estimates and potential eligibility for funding programs. This effort was led by OWP, with support from the broader project team.

Finally, while the WWNA contract did not originally scope an advisory group component, the WWNA project team in consultation with the State Water Board integrated an Advisory Group (Phase 1F) into the work plan and broader effort based on its interest in expanding public engagement, incorporating the fullest range of expertise in this novel effort, and the expressed broader interest in the project. Phase 1F (Chapter F) outlines the formation of the WWNA Advisory Group, its quarterly meetings, and additional engagement opportunities throughout Phase 1. These efforts allowed the team to gather valuable feedback and suggestions from wastewater professionals and community representatives at key stages of the WWNA.

INTRODUCTION: PHASE 1 REPORT

OCTOBER 2025

CALIFORNIA Water Boards | State Water Resources Control Board

Division of Water Quality, State Water Resources Control Board

UCLA Luskin Center for Innovation

Prepared by UCLA Luskin Center

TABLE OF CONTENTS

TABLE OF FIGURES

INTRODUCTION

Safe management of wastewater is crucial for ensuring human and environmental health. The State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards' (Regional Water Boards) vision is "a sustainable California made possible by clean water and water availability for both human uses and environmental resource protection." Wastewater sanitation systems that are poorly designed, installed, or managed can contaminate drinking water supplies and release harmful pollutants into the environment.

In 2012, Assembly Bill 685 established the Human Right to Water and recognized the inherent importance of access to water for sanitary purposes: "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." Subsequently, in 2018, Governor Brown signed Senate Bill 1215 into law, sanctioning the California State Water Board to facilitate the consolidation of inadequate onsite sewage treatment systems with existing sewer systems. Senate Bill 1215 modifies the Porter-Cologne Water Quality Control Act (California Water Code Chapter 4.3, commencing with Section 13288) to authorize the Regional Water Boards to encourage, and if necessary, mandate the provision of sewer service to disadvantaged communities with inadequate onsite sewage treatment systems (OSTS).

In response to these statutes and other drivers, the State Water Board and Regional Water Boards (collectively, Water Boards) developed the concept of conducting a "Wastewater Needs Assessment" (WWNA), and on June 7, 2022, the State Water Board adopted Resolution No. 2022-0019, authorizing $4 million for a statewide WWNA contract. The overarching goal of the WWNA is to provide information on sanitation needs across California and develop strategies to address the state's sanitation system needs. This effort aligns with the Water Boards' vision of clean, safe, and affordable water for human uses and environmental resource protection across California, with a particular focus on disadvantaged communities and decentralized systems. As described further in this report, the assessment involves developing a comprehensive analytical framework and tracking specific systems to prioritize infrastructure investments to promote equity in sanitation as part of achieving the Human Right to Water. This is a first-time effort for California, and for any U.S. state or territory.

The Water Boards are partnering with practitioners who are under contract to conduct the first WWNA from July 1, 2023, to June 30, 2027. The University of California, Los Angeles (UCLA) Luskin Center for Innovation is serving as the lead contractor for the WWNA. UCLA is working in close partnership with the Office of Water Programs (OWP) at California State University, Sacramento, the California Institute for Water Resources (CIWR) within UC Agriculture and Natural Resources system (UC ANR), and the University of Massachusetts Amherst (UMass) on this effort (see Figure 3 below). These contracted organizations are working collaboratively with the Water Boards. Collectively, the group will be referred to as the "project team" throughout the WWNA effort and this document.

Figure 3: WWNA Team

While not part of the contracted WWNA scope, UCLA recommended the formation of a WWNA Advisory Group to obtain diverse engagement outside of the WWNA project team and the Water Boards. The WWNA project team established a stakeholder advisory group of 30 members and has led the engagement of the group with the WWNA project team and Water Boards. The WWNA Advisory Group participants advise on project development and draft analyses, inform the WWNA project team on wastewater data and information, and provide other areas of expertise or perspectives (see Figure 4 and Figure 5 below). The advisory group consists of local government agencies, state and federal agencies, California Native American tribes, and other tribal sovereignties, non-profits, consultants, and members of the public.

Figure 4: Advisory Group Members by Organizational Expertise

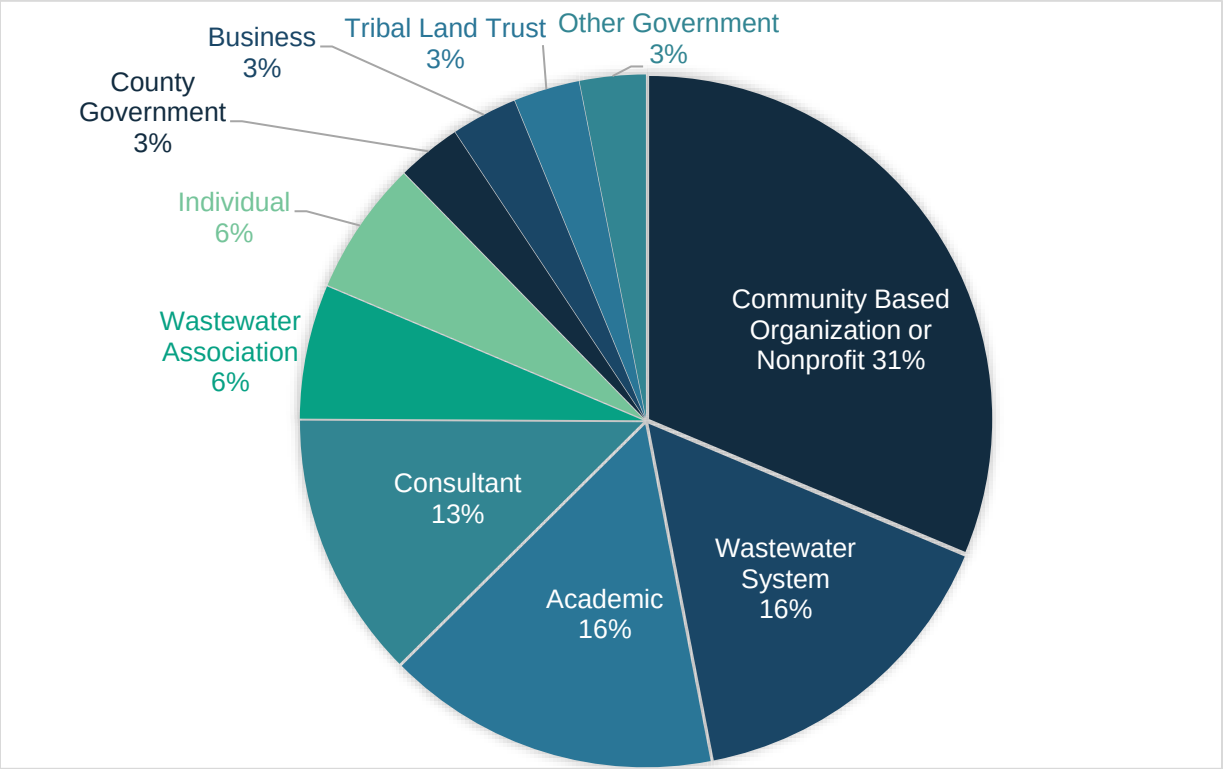
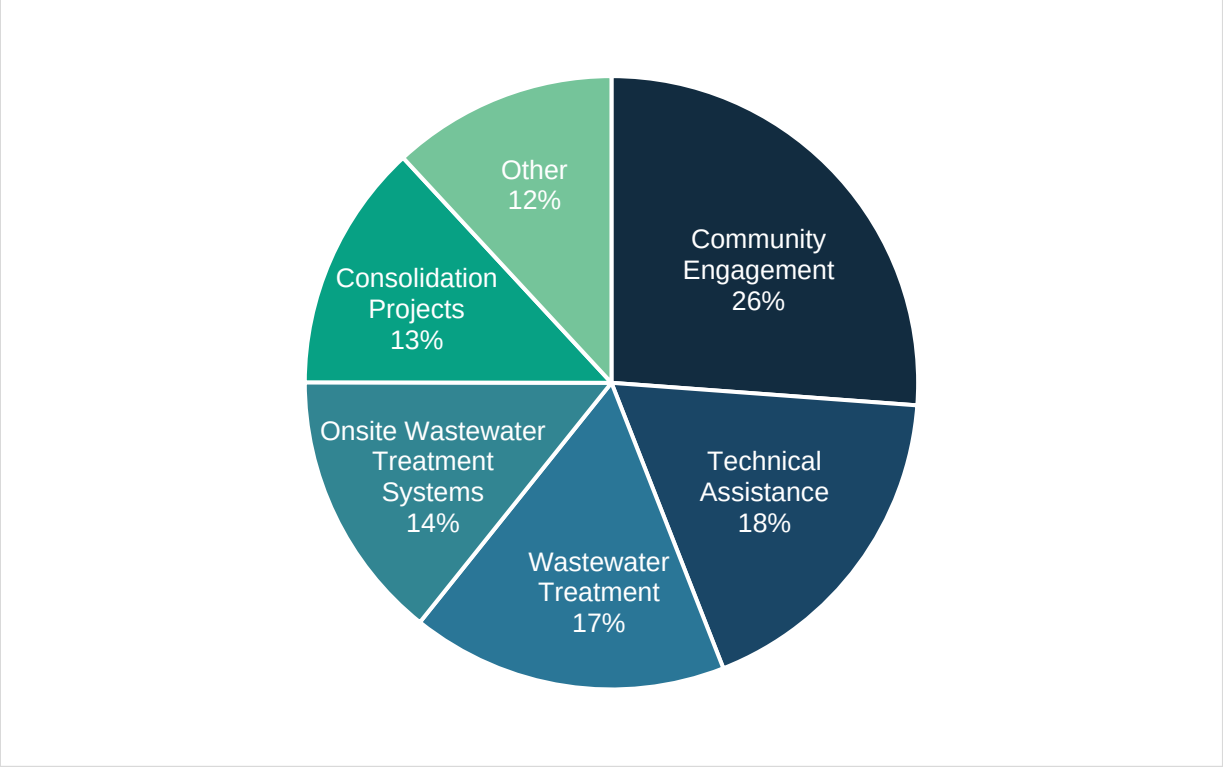


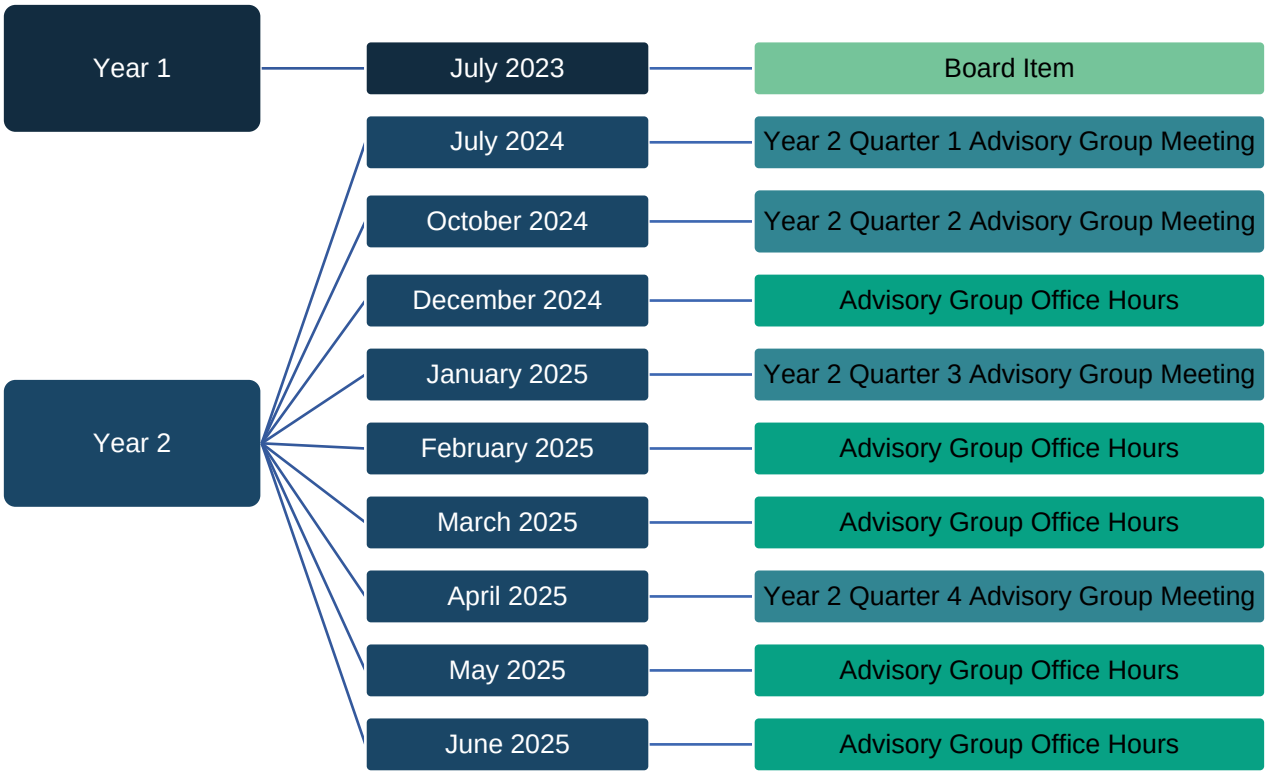
Figure 5: Advisory Group Members by Wastewater Area of Expertise



The WWNA effort has published significant information for the public and continues to conduct extensive engagement on both its intended and ongoing efforts. Designated State Water Board[2] and UCLA webpages[3] update information on progress periodically, especially with Executive Summaries released in conjunction with WWNA Advisory Group meetings' materials (described more fully below). Email addresses[4] for the public have been formed and are responded to as the WWNA project team receives incoming queries. Although not originally envisioned to be so, WWNA Advisory Group meetings are all made open to the public because of State Water Board members' interest in attendance. Further engagement and outreach have been conducted in other parts of the WWNA project, including UC ANR outreach efforts described more fully in Phase 1B of the report.

[2] See: https://www.waterboards.ca.gov/water_issues/programs/waste_discharge_requirements/wastewater_needs_assessment.html
[3] See: https://innovation.luskin.ucla.edu/assessing-californians-wastewater-needs/
[4] UCLA email address: wwna@luskin.ucla.edu and State Water Board email address: WWNA@waterboards.ca.gov

Figure 6: Phase 1 Public Engagement Opportunities



PHASES OF THE WWNA

The initial contracted WWNA lasts for 4 years and is conducted in sequential 2-year phases, which in turn are divided into discrete tasks (see Figure 7 below). Through the first phase of WWNA (July 2023-June 2025), the WWNA project team aims to evaluate baseline conditions of wastewater infrastructure services in California. This phase involves developing a process for collecting, compiling, and assessing data to inform the second phase of research, which will implement the process, including identification of wastewater systems of concern, potential solutions, and relevant costs and funding opportunities.

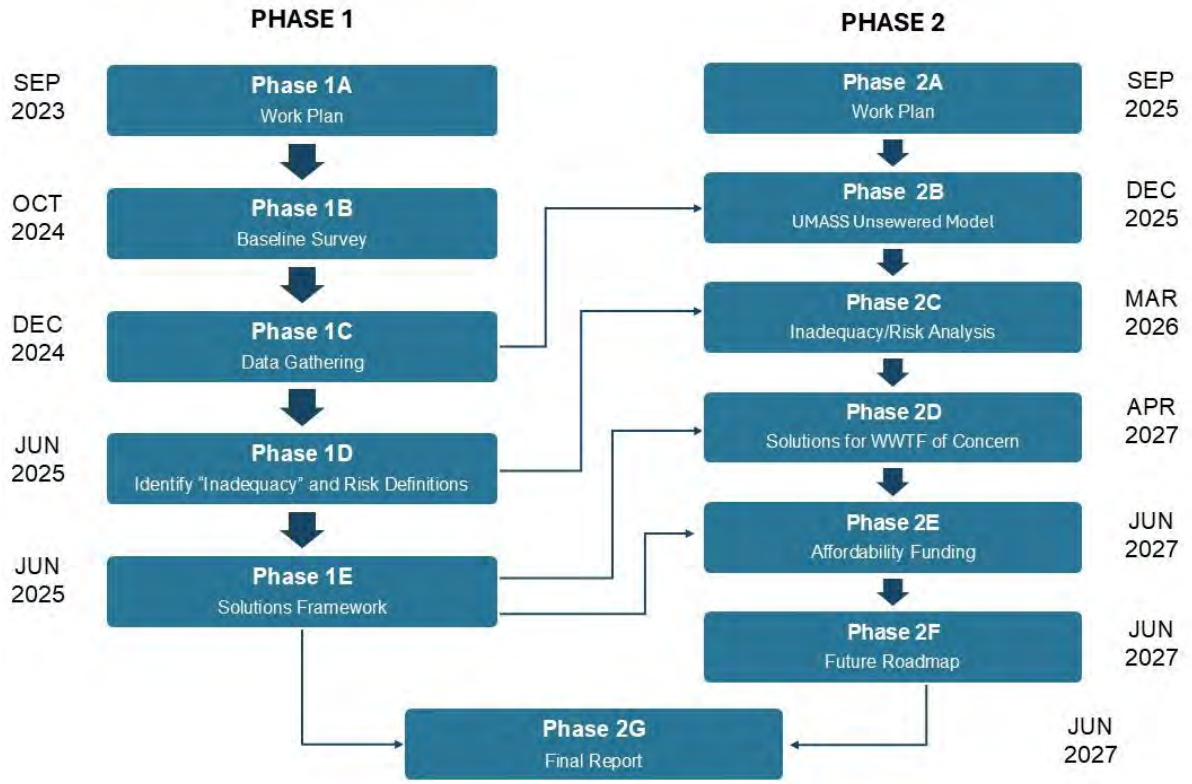
At a high level, Phase 1 of the project establishes methodologies, develops a survey, collects initial data, assesses data gaps, and provides potential means for filling them. It also establishes key definitions of risk and inadequacy for sewage collection systems, sewage treatment plants, and onsite wastewater systems, as well as a set of potential solutions for addressing them.

Phase 2 of the project (starting July 2025-June 2027) operationalizes these methodologies and definitions to empirically analyze system-wide needs and solution costs informed by the Phase 1 findings. It also provides a long-term pathway for the

provision of more equitable sanitation services in California and provides a roadmap for ongoing assessment beyond June 2027.

A final report with full WWNA results will be released by the end of 2027. This report presents detailed descriptions of the results, but with great emphasis on data sources and methods analyses, only for Phase 1. Please note that the evaluation of data sources and final methods deployed in Phase 2 is subject to change but will largely rely on the data and methods outlined here.

Figure 7: WWNA Project Phases



COHERENCE WITH THE STATE WATER BOARD'S RACIAL EQUITY ACTION PLAN

The Wastewater Needs Assessment helps support and is in part inspired by the State Water Board's Racial Equity Action Plan.[5] The Racial Equity Action Plan establishes three strategic steps the Water Boards will take to approach the work of advancing racial equity:

1. Integrating racial equity and measuring impact by infusing considerations throughout policies, programs, and practices; and monitoring progress.

[5] See: https://www.waterboards.ca.gov/racial_equity/ and https://waterboards.ca.gov/racial_equity/docs/racial-equity-action-plan-final-en.pdf

2. Creating and maintaining inclusive spaces by addressing representation within the Water Boards and elevating understanding of racial equity.
3. Activating community wisdom and sharing power by removing barriers for participation and incorporating input.

The WWNA effort advances these efforts in multiple ways. These include, but are not limited to, the project's risk methodology to prioritize underserved and DACs, the community-centered approach in the field campaign that developed through Phase 1B's baseline survey, the inadequacy and risk assessment, which will lead to equitable investment planning, and the WWNA's scientific approach, which will ensure data transparency and accountability. Additionally, the WWNA efforts support the Racial Equity Action Plan and the Climate Change Resolution,[6] in addressing how climate impacts have disproportionate impacts on Black, Indigenous, People of Color (BIPOC) and disadvantaged communities through the inadequacy and risk assessment.

PHASE 1 REPORT OUTLINE

The remainder of this Phase 1 report is organized into six core chapters, reflecting contractual WWNA tasks. These chapters are briefly described below. Supplemental supporting material for these chapters is provided in the Appendices to this report, as necessary.[7]

First, Phase 1A (Chapter A) lays out a work plan for the rest of Phase 1. The WWNA project team collaboratively developed a Phase 1 WWNA work plan. The work plan provided a summary of tasks to be completed during Phase 1, including who will be responsible for facilitating task completion, timelines, deliverables, and the necessary steps to complete each sub-task.

Phase 1B (Chapter B) sets a baseline of understanding for the rest of the WWNA project. This phase enables the WWNA project team and broader public to better understand wastewater needs in California, as well as to potentially motivate investment in the needs assessment process itself beyond the initial WWNA effort. This effort was two-fold and led by UC ANR (survey of community needs, mapping, and a field campaign) and UCLA (baseline review of previous studies and other data sources), respectively, with additional detailed components within each effort. Although the Field Campaign was not part of the original contract scope, it was important to include it to ground-truth the information collected through the survey. It also provided valuable context by capturing photos and conversations that helped illustrate and humanize the data—essentially bringing the stories behind the survey results to life.

Also, the Field Campaign aligns with the State Water Board Strategies for Racial Equity, particularly "Activating community wisdom and sharing power" by engaging directly with

[6] See: https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2017/rs2017_0012.pdf

[7] The chapters were originally designed as standalone sections to allow for easy access, reference, and sharing.

impacted communities to inform needs and solutions, and by incorporating local knowledge and priorities into the statewide assessment process.

Phase 1C (Chapter C) surveys the breadth, depth, and quality of publicly available data for subsequent analysis in the WWNA. There is a special but not exclusive focus on State Water Board datasets. It identifies the facility and system types to be included in various parts of the WWNA analysis (called “The Facilities List”). It also outlines several data gaps, some of which can be filled during the WWNA and others that serve as recommendations for future efforts by the State Water Board and its partners. This effort was led by OWP, with support from UCLA.

Phase 1D (Chapter D) then provides novel methodologies for defining and quantifying the inadequacy and the risk of becoming inadequate for all wastewater facility and system types identified in Phase 1C of this effort. Given the unique way in which different wastewater systems operate and are regulated, the methods for assessing inadequacy, and to some degree risk, are necessarily differentiated by facility and system type. Indicators to characterize inadequacy and risk are constrained by available data. This effort was led by UCLA and included consultation with the entire WWNA project team and a designated working group of Water Boards’ staff focused on relevant regulation development and compliance aspects.

Phase 1E (Chapter E) builds on prior phases of the WWNA effort to develop methodologies for assigning potential technical solutions to the issues causing wastewater facilities and systems to be found inadequate. It also develops methods to provide high-level estimates of the cost of these solutions, which can inform funding needs estimates and potential eligibility for funding programs. This effort was led by OWP, with support from the broader WWNA project team.

The WWNA contract did not originally scope an advisory group. However, the WWNA project team, in consultation with the State Water Board, integrated an Advisory Group (Phase 1F) into the work plan and broader effort. This change was based on interest in expanding public engagement, incorporating the full range of expertise in this novel effort, and a broader interest in the project. Phase 1F (Chapter F) outlines the formation of the WWNA Advisory Group, its quarterly meetings, and additional engagement opportunities throughout Phase 1. These efforts allowed the team to gather valuable feedback and suggestions from wastewater professionals and community representatives at key stages of the WWNA.

CHAPTER A: WORK PLAN DEVELOPMENT

OCTOBER 2025

CALIFORNIA Water Boards | State Water Resources Control Board

Division of Water Quality, State Water Resources Control Board

UCLA Luskin Center for Innovation

Prepared by UCLA Luskin Center

TABLE OF CONTENTS

TABLE OF FIGURES

WORK PLAN DEVELOPMENT

Over the first 3 months of the project, UCLA, OWP, and UC ANR collaboratively developed a Phase 1 WWNA work plan. The work plan provided a summary of tasks to be completed during Phase 1, including who was responsible for facilitating task completion, timelines, deliverables, and the necessary steps to complete each sub-task. The work plan was delivered to the State Water Board and finalized in agreement by all parties by the end of the initial 3-month period.

Figure 8: Phase 1 of WWNA

CHAPTER B: BASELINE STUDIES REPORTS

OCTOBER 2025

CALIFORNIA Water Boards | State Water Resources Control Board

Division of Water Quality, State Water Resources Control Board

UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources | California Institute for Water Resources

University of California Agriculture and Natural Resources

UCLA Luskin Center for Innovation

Prepared by UCLA Luskin Center

TABLE OF CONTENTS

TABLE OF FIGURES

INTRODUCTION

The initial empirical task of the WWNA, carried out in Phase 1B, sought a baseline of understanding for the rest of the project. This phase enabled the WWNA project team and broader public to better understand wastewater needs in California, as well as to potentially motivate investment in the needs assessment process itself beyond the initial WWNA effort. This effort was two-fold and led by UC ANR and UCLA, respectively, with additional detailed components within each effort. First, statewide survey, mapping, and field visiting campaign efforts were carried out by UC ANR to qualitatively illustrate the breadth, depth, geographic areas of concern, and geographic areas of concern of sanitation issues in California, with an ongoing fieldwork component. The survey also solicited input for definitions of key terms from respondents that included experts from government, non-profits, and academia. Second, UCLA rapidly reviewed existing readily available data sources and reports to provide a high-level summary of existing pre-WWNA statewide knowledge on sanitation needs and associated costs. Given that they were produced earlier in the project and were initially designed to be released in late 2024, these analyses were produced as separate reports in different formats than the rest of Phase 1 and can be found in full at UCLA's WWNA website.[8] Below is a brief summary of the content of these reports.

BASELINE SURVEY OF SANITATION ISSUES

The UC ANR baseline survey of sanitation issues provides an assessment that illustrates the scope of challenges faced by communities across the state.[9] The survey outreach was divided into three parts. First, a survey collected information on sanitation issues and needs in communities. UC ANR sought survey responses from government agencies, technical assistance providers, private sector companies, journalists, academics, university extension, non-governmental organizations, and community advocates. The WWNA project team sent the survey to 166 potential respondents and received 112 answers (response rate of 67%). Of the respondents, 71 offered information on specific communities where they know sanitation issues exist.

Survey results identified challenges faced by communities, including lack of access to functioning wastewater systems, exposure to raw sewage, the types with issues, and more. Generally, critical gaps in service are limited, with extremely severe issues reported by small percentages of expert respondents. The respondents also noted specific types of wastewater solutions that merit consideration and further work that could be done to characterize challenges as California seeks to meet to achieve goals related to the human right to sanitation, including California Water Code Section 106.3 (State Water Board Resolution 2016-0010) recognizing that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption,

[8] For the Baseline Survey Report, see: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/07/Phase-1B-Baseline-Survey.pdf
For the Baseline Studies Review, see: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/07/Phase-1B-Report-Baseline-Studies-Review.pdf

[9] See: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/07/Phase-1B-Baseline-Survey.pdf

cooking, and sanitary purposes" and State Water Board Resolution 2022-2019 that noted the need to prioritize needs and investments.

Second, UC ANR compiled a spatial database of communities with increased vulnerability to inadequate wastewater services based on survey results to locate potential communities. The database includes locations of mobile home and recreational vehicle (RV) parks, farmworker housing, federal and state campgrounds, disadvantaged communities, and tribal communities. Third, UC ANR is carrying out[10] a field visiting campaign, in partnership with Water Board staff as well as Advisory Group members and other community partners, to visit sites identified by the survey and surrounding areas to provide more context to survey results and document first-hand accounts of known issues. These efforts will be described in a follow-up report in Phase 2 of the WWNA.

BASELINE STUDIES REVIEW

Parallel to UC ANR's survey and field visit campaign, UCLA's effort provided a high-level summary of existing statewide knowledge on sanitation needs and associated costs (hereafter, the Baseline Studies Review report).[11] UCLA initiated the review to better understand wastewater needs and wastewater equity in California, as well as to differentiate the WWNA project from the many other current/recently conducted efforts.

This exercise enabled the WWNA project team to identify and characterize (1) previous system mapping efforts, (2) methodologies used to identify communities of wastewater concern, (3) definitions and criteria for failing/at-risk wastewater systems, (4) cost and affordability estimates to address inadequate wastewater systems, and (5) state-wide funding estimates to address needs (Figure 9). Broadly, the WWNA project team found that previous studies, while valuable, do not replace the need for the WWNA as they are limited in relevance, accuracy, and coverage. The WWNA process thus helps fill gaps in existing data sources and literature.

[10] At the time of this report, the field campaign is still ongoing.
[11] See: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/07/Phase-1B-Report-Baseline-Studies-Review.pdf

Figure 9: Phase 1B Baseline Studies Review Outline

CHAPTER C: DATA COLLECTION AND GAP ANALYSIS

OCTOBER 2025

Division of Water Quality, State Water Resources Control Board

UCLA Luskin Center for Innovation

UCLA Luskin Center

Prepared by Office of Water Programs | California State University, Sacramento

TABLE OF CONTENTS

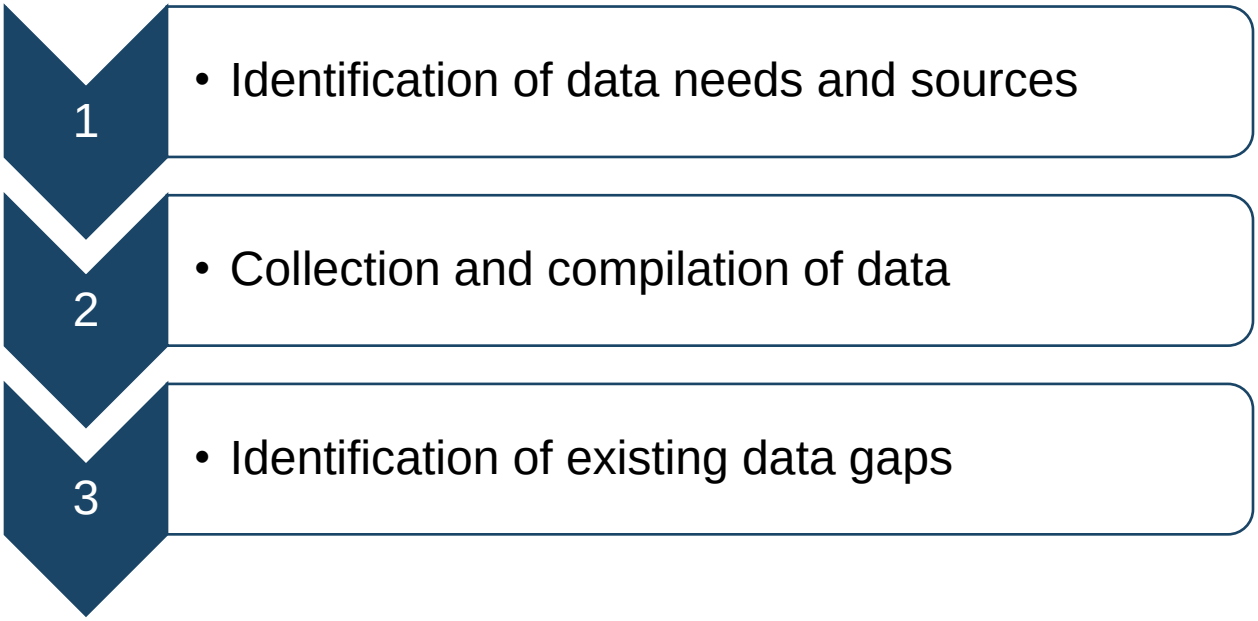
TABLE OF TABLES

TABLE OF FIGURES

INTRODUCTION

This chapter covers stepwise data collection and gap analysis activities in the Wastewater Needs Assessment (WWNA), including identification of data needs and sources, collection and compilation of data, and identification of existing data gaps, as shown in Figure 10.

Figure 10: The stepwise process followed in Phase 1C of the Wastewater Needs Assessment.



The remainder of this document is organized as follows:

- Background
- Data Needs and Sources
- Data Collection for Wastewater Treatment Facilities (WWTFs) and Collection Systems (CS)
- Data Processing for WWTFs and CS
- Data Collection for Onsite Sewage Treatment Systems (OSTS) Impacts on Groundwater
- Data Processing for OSTS Impacts on Groundwater
- Remaining Data Gaps
- Conclusions

BACKGROUND

Numerous efforts attempted to address California's sanitation needs prior to the initiation of the WWNA, some of which are summarized in the Phase 1B report.[12] These efforts occurred at various scales, such as on individual parcels, at permitted facilities

[12] See: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/07/Phase-1B-Baseline-Survey.pdf

and systems, and across regions. The WWNA intends to compile relevant, existing data for use in assessing sanitation services across the state. Prior to the WWNA, a multitude of entities including the State and Regional Water Boards, counties, technical assistance providers, sanitation agencies, and other wastewater discharge permittees, developed, maintained, and otherwise managed the various data. The WWNA represents a first attempt at compiling a statewide dataset of relevant information. Note that the WWNA is not intended to address the totality of wastewater needs in the state across all sectors, and the following qualifiers apply:

- The WWNA does not assess industrial wastewater. The focus is on domestic wastewater, wastewater that includes human waste from domestic activities (e.g., cooking, cleaning, and hygiene). This focus results from the sanitation-themed statutes in the Human Right to Water from which the WWNA originated.[13]
- The WWNA assesses facilities and systems that transport and process raw sewage as influent. Such facilities may or may not produce effluent that can be recycled and/or include sludge treatment processes. However, facilities that receive wastewater or sludge treated by other facilities (i.e., are not directly connected to human sanitary sources) are not included in the assessment.
- The WWNA focuses on the water quality aspects of sanitation services to protect public health and provide sanitation. This is in line with the Water Board's mission "to preserve, enhance, and restore the quality of California's water resources and drinking water for the protection of the environment, public health, and all beneficial uses, and to ensure proper water resource allocation and efficient use, for the benefit of present and future generations."
- The WWNA's primary focus is not safe and dignified surroundings and conditions when using sanitary facilities as interpreted from the Human Right to Water's reference to "safe, clean, affordable, and accessible water." The qualitative baseline assessment of sanitation conditions throughout the state addresses these issues, but the project's inadequacy/risk assessments or cost of solutions estimates do not.

[13] Assembly Bill 685 established the Human Right to Water. It recognized the importance of equitable access to water for sanitation services in its declaration that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." In 2018, Senate Bill 1215 (SB 1215) directed the Water Board to facilitate the consolidation of inadequate onsite sewage treatment systems with existing sewer systems. SB 1215 modified the Porter-Cologne Water Quality Control Act to authorize the Regional Water Quality Control Boards to encourage, and if necessary, mandate the provision of sewer service to disadvantaged communities with inadequate onsite sewage treatment systems.

TYPES OF WASTEWATER FACILITIES

The WWNA considers two major categories of wastewater facilities and systems:

- Wastewater Treatment Facilities and their associated collection systems
- Onsite Sewage Treatment Systems (OSTS)

The WWNA project team further categorized the wastewater treatment facilities and their associated collection systems into three types based on regulatory status: National Pollutant Discharge Elimination System (NPDES) permits, Waste Discharge Requirements (WDRs), and the Sanitary Sewer System General Order (SSSGO). In most urbanized areas, a subsurface piping network collects municipal wastewater from properties and carries it to a centralized location for treatment and eventual discharge into a receiving water body or to land. WWTFs that discharge to surface water bodies are regulated by NPDES permits, while those that discharge to land are governed by WDRs. WWTF permits or requirements may or may not include a conveyance system component (i.e., a collection system). If not, the associated collection systems are regulated by the SSSGO. WWTFs and collection systems can have several types of network relationships, listed in order of complexity: a single collection system delivers influent to a single WWTF, multiple collection systems deliver influent to a single WWTF, or multiple collection systems have overlapping service areas and deliver influent to multiple WWTFs.

Onsite Wastewater Systems (OWTS)

"…individual disposal systems, community collection and disposal systems, and alternative collection and disposal systems that use subsurface disposal."

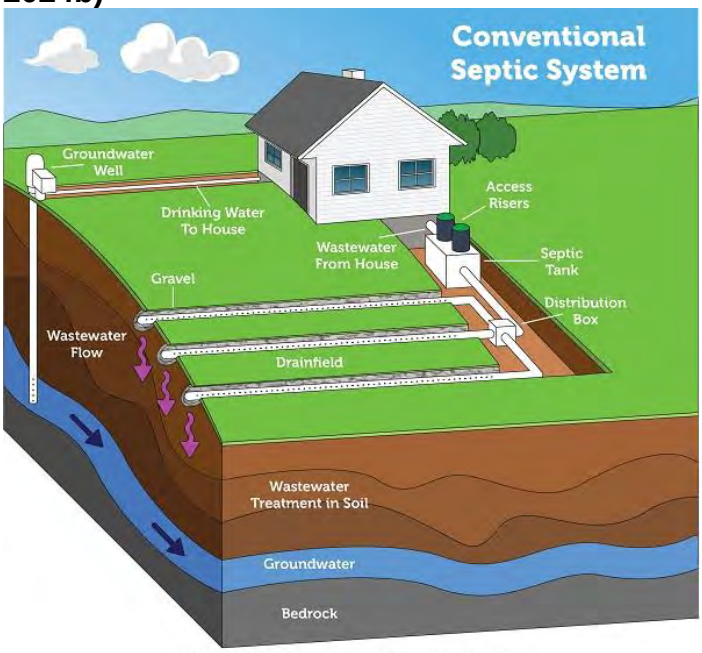
- State Water Board 2023

In rural settings and some pockets of urbanized areas, unsewered or decentralized systems are common. Unsewered areas include systems in which wastewater from a single dwelling or building is treated and dispersed onsite in subsurface facilities. Regional Water Boards regulate onsite wastewater treatment systems (OWTS, a subset of OSTS) under either individual WDRs or the State Water Board's OWTS Policy[14] or general orders; while county health departments regulate them through Local Agency Management Programs (LAMPs) established under the OWTS policy.[15] Figure 11 shows the differences between a conventional OSTS (i.e., an unsewered system) and a decentralized cluster system.

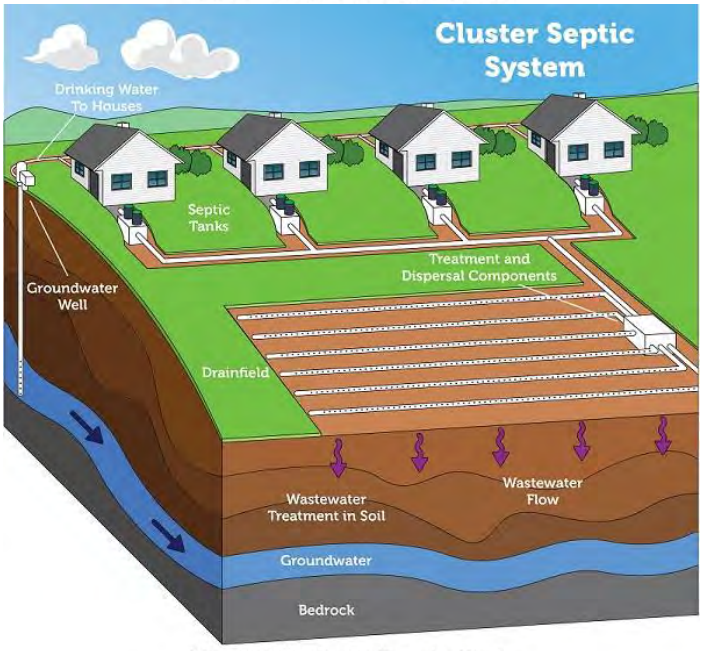
[14] State Water Board 2023. California State Water Resources Control Board. OWTS Policy, Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Systems. April 18, 2023.

[15] Other types of OSTS exist, such as cesspools, although they are not legal in California and must be removed.

Figure 11: Examples of Onsite Wastewater Systems (adapted from OWTS, USEPA 2024b)



Please note: Septic systems vary. Diagram is not to scale.



Please note: Septic systems vary. Diagram is not to scale.

Due to the differences in permitting and infrastructure between the two major types of systems, the WWNA includes two assessment pathways in parallel:

1. Inadequacy assessment of WWTFs and collection systems
2. Groundwater impact assessment of OSTS

The data collection and processing efforts for each pathway are somewhat different and thus are described separately in this report, though some aspects of data collection overlap.

DATA NEEDS

The basic data needed relevant to the WWNA includes facility and system names, types, and locations, as well as facility and system attributes necessary for assessing adequacy, evaluating solutions, and estimating costs of solutions. The tasks for which data are needed include:

- Assess Inadequacy/Risk
- Evaluate Solutions & Estimate Related Costs
- Assess Impacts of OSTS on Groundwater

Appendix A lists general data needs identified in the WWNA's Scope of Work and presents their current status. Appendix B lists specific data needs determined by professional engineering and economic judgement, then correlates them to the different facility types and WWNA tasks.

DATA SOURCES

The major data sources useful for the WWNA include:

- California Integrated Water Quality System (CIWQS)
- Regional Water Quality Control Boards
- California Association of Sanitation Agencies (CASA)
- County LAMPS
- State Water Board Division of Financial Assistance (DFA)
- State Water Board Division of Water Quality (DWQ)
- State Water Board Technical Assistance (TA) Providers

General descriptions of these data sources follow in the remainder of this section.

CIWQS

The Water Boards use a relational database called CIWQS[16] to track information about places of environmental interest, administer permits and other orders, track inspections, and manage violations and enforcement activities. CIWQS allows online submittal of information by NPDES, SSSGO, WDR, and other permittees and makes data available

[16] State Water Board 2023. California State Water Resources Control Board. California Integrated Water Quality System Project (CIWQS). Accessed December 2023. https://www.waterboards.ca.gov/ciwqs/

to the public through reports. CIWQS is unique among regulatory tracking databases in that it is intended for use by regulatory staff, regulated facility and system staff, and the public to access regulatory information about a variety of programs, including discharges to surface and groundwaters, landfills, irrigated lands, and water rights. As such, the WWNA project team identified CIWQS as one of the primary data sources that would provide particular attributes for wastewater treatment facilities and collection systems to be used for assessing inadequacy and risk, identifying solution sets, and estimating costs.

REGIONAL WATER BOARDS

Since Regional Water Boards administer individual NPDES and WDR permits, the WWNA project team identified Regional Water Board staff as key authorities regarding the accuracy, completeness, and nuances of data available from CIWQS. Staff members retain first-hand experience with the different facilities and systems, their operations, and permitted status. They have also developed methods for planning and implementing regionalization, septic-to-sewer, and capital improvements projects in which one or more smaller wastewater facilities merge together or merge with an existing larger system. The assessment of the feasibility of regionalization and design projects relies heavily on various data types, so the WWNA project team considers Regional Water Board staff members to be critical in identifying additional data attributes that would be necessary or otherwise valuable for the WWNA.

CASA

CASA, a non-governmental organization, represents more than 140 local public agencies engaged in the collection, treatment, and recycling of wastewater and biosolids to protect public health and the environment. Member agencies represent a variety of communities statewide, including large, urban agencies like East Bay Municipal Utility District and the Sanitation Districts of Los Angeles County, as well as smaller agencies like the Town of Paradise and Tahoe-Truckee Sanitation District. Its mission[17] is to provide trusted information and advocacy on behalf of California clean water agencies, and to be a leader in sustainability and utilization of renewable resources. CASA generously offered to assist in coordinating the collection of sewer system boundaries to be used in regionalization analyses. A representative from CASA also serves on the WWNA Advisory Group.

COUNTY LAMPS

Since the OWTS Policy allows local agencies to continue managing the installation of new and replacement OWTS, the WWNA project team regards these agencies as the primary source of information regarding the location, maintenance, and monitoring of OWTS. For most counties, the Department of Environmental Health is responsible for the management of OWTS.

DFA

[17] CASA 2024. California Association of Sanitation Agencies. About CASA. Accessed December 2024. https://casaweb.org/about-us/about-casa/

The WWNA project team identified the State Water Board's Division of Financial Assistance as a data source for developing solutions and cost estimates, particularly through its role in administering loan and grant funding for conveyance and treatment projects.

DWQ

The WWNA project team identified the State Water Board's Division of Water Quality as a data source for the collection of sewer system boundaries via the SSSGO[18] and interpretation of permit requirements, particularly through its role in enforcing the requirements of NPDES permits and WDRs.

TA PROVIDERS

The WWNA project team identified the State Water Board's contracted TA Providers as sources for identifying solutions sets and estimated costs due to their role in assisting municipal organizations navigate DFA's loan and grant funded projects, as well as other funding sources external to the State Water Board. TA providers tend to be non-profit organizations such as the Rural Community Assistance Corporation or Self-Help Enterprises.

DATA COLLECTION FOR WWTFS AND COLLECTION SYSTEMS

CIWQS

The WWNA project team queried publicly available CIWQS reports in December 2023 via the Regulated Facility Report tool to obtain a list of wastewater treatment facilities and collection systems, referred to hereinafter as facilities and systems, that are within the purview of the WWNA. To identify appropriate facilities, the programs listed in CIWQS were limited to those concerned with regulating municipal wastewater: NPDES Wastewater (NPDESWW), WDR, and Sanitary Sewer Overflow ("SSO").[19] Note that CIWQS uses the term SSO to refer to systems regulated by the SSSGO. CIWQS subdivides groupings of permittees according to physical characteristics. These subgroupings include domestic and commercial wastewater, and certain types of industrial wastewater. Although other programs may regulate wastewater in some fashion, these were not considered due to the WWNA's focus on domestic wastewater. Table 1 lists and defines program categories of interest.

[18] State Water Board 2022. California State Water Resources Control Board. Order No. 2022-0103-DWQ, Statewide Waste Discharge Requirements General Order for Sanitary Sewer Systems.

[19] Note that CIWQS uses the term SSO to refer to systems regulated by the SSSGO. However, SSO is commonly used to represent sanitary systems overflows, so SSSGO is used throughout this chapter for clarity.

Table 1: CIWQS Programs, Categories, and Definitions used in the WWNA

CIWQS Program Name	CIWQS Program Category	Definition
NPDESWW	NPDES, Municipal Large (NPDMUNILRG)	Municipal waste discharged to surface waters, individually regulated larger than 1 Million Gallons per Day (MGD)[1]
NPDESWW	NPDES, Municipal Other (NPDMUNIOTH)	Municipal waste discharged to surface waters, individually regulated less than 1 MGD[1]
SSO[4]	SSO, Municipal Large (SSOMUNILRG)[4]	Large municipal collection system serving a population of more than 50,000[2]
SSO[4]	SSO, Municipal Small (SSOMUNISML)[4]	Small municipal collection system serving a population of less than 50,000[2]
WDR	WDR, Municipal Large (WDRMUNILRG)	Municipal waste discharged to land, individually regulated larger than 0.1 MGD[1]
WDR	WDR, Municipal Other (WDRMUNIOTH)	Municipal waste discharged to land, individually regulated less than 0.1 MGD[1]
WDR	WDR, Municipal OWTS (WDRMUNIOWTS)	Municipal OWTS[1,3]
WDR	WDR, Municipal All Other Enrollees (WDRMUNIENROTH)	Municipal/domestic waste discharged to land and enrolled in a general order[1]

Notes:

1. The State Water Board created these definitions for use in CIWQS.
2. Definitions were not available for these categories and instead inferred from the Fee Structure outlined in the SSSGO.
3. This program category was included to identify OSTS tracked by CIWQS and then set aside for consideration for the Groundwater Impacts assessment, but the Inadequacy and Risk Assessments will not consider them.
4. “SSO" is the term used in CIWQS to represent systems regulated by the SSSGO.

To ensure that the most complete set of data was used, the WWNA project team accessed an exported spreadsheet, dated January 16, 2024, of the full CIWQS database available on California's Open Data Portal.[20] The WWNA project team filtered the spreadsheet by the program categories described in Table 1 to identify permittees that generate domestic wastewater. However, the program category does not sufficiently distinguish some permittees' discharges and thus are erroneously included in the first filter. The CIWQS attribute "Facility Place Subtype" provides further distinction between permittees that discharge waste generated through commercial, domestic, or industrial activity within the greater scope of municipally focused programs. Table 2 displays the Facility Place Subtypes deemed to be relevant to the WWNA, which were determined following extensive consideration and discussion by the WWNA project team and Water Boards staff in consultation with the Advisory Group.

Table 2: Facility Place Subtypes

Facility Place Subtype[1]	Definition
Wastewater Treatment Facilities	Location where sewage or industrial waste is treated and/or reclaimed. The facilities may be either publicly or privately owned. If it is privately owned, it must be regulated by the Public Utilities Commission or the Regional Water Board to be considered a wastewater treatment facility.
Collection System	Location where there is a network of pipes and pumping systems used to convey sewage and/or industrial wastewater to a wastewater treatment facility.
Mobile Home Parks	Location where there is a concentration of mobile homes and/or recreational vehicles from which domestic wastewater is collected and treated in an onsite wastewater treatment system. Wastewater from these sites is typically not industrial waste.
Prisons	Location comprised of a building or set of buildings used for the confinement of persons held while awaiting trial or persons sentenced after conviction

[20] GovOps 2024. California Government Operations Agency. Open Data Portal. Surface Water – Water Quality Regulated Facility Information. Accessed January 2024. https://data.ca.gov/dataset/surface-water-water-quality-regulated-facility-information

Facility Place Subtype[1]	Definition
Educational Facilities	Location comprised of a building or set of buildings used for educational purposes.
Domestic Site Not Elsewhere Categorized (NEC)	Location where a domestic activity (i.e., community-based, non-industrial) has or is creating a discharge regulated or potentially regulated by the Water Boards. This place type is appropriate for places such as highway rest stops, farm labor camps, or office buildings. If there is another place type that describes the activity at the place more specifically, use that place type instead.
Residences NEC	Location where people live. If there is another place type that describes the activity at the place more specifically, use that place type instead.
Campground	Location where campers and their equipment, including tents, tent trailers, travel trailers, and recreational vehicles are hosted. Access to facilities such as washrooms, laundry rooms, recreation halls and playgrounds, stores, and snack bars may also be present.

Notes:

1. Adapted from Water Board, CIWQS Place Type Definitions, 2025 https://www.waterboards.ca.gov/water_issues/programs/ciwqs/def_places.html

REGIONAL WATER BOARDS

The WWNA project team organized the resulting list of facilities initially filtered from CIWQS by permit type and region, then shared that list with Regional Water Board staff for their input on the accuracy and completeness of the data for their region. In addition to reviewing the data, the WWNA project team provided Regional Water Board staff members with a data request template that asked for available information on the location of OSTS within their jurisdiction, populations served by various facilities and systems, service boundaries of permitted facilities and systems, and other information that may be relevant to the goals of the WWNA. Appendix B shows an example of a data request submitted to the Regional Water Board that includes the aforementioned requested data fields separated by regulatory status. Beginning in January 2024, the

State Water Board's Division of Water Quality delivered the list of facilities and systems to Regional Water Board staff via e-mail and coordinated meetings between the WWNA project team and Regional Water Board staff. The WWNA project team successfully met with representatives of all nine Regional Water Boards by April 2024.

Regional Water Board staff provided feedback verbally during meetings, and over the following months, returned both the list of facilities and systems provided to the WWNA project team with suggested revisions and, when available, supplementary information. In some cases, Regional Water Board staff shared information about processes and procedures for how their region engages in wastewater regionalization efforts.

The WWNA project team had two key takeaways from these interactions. First, CIWQS attributes alone may not be ideal for identifying facilities and systems within the scope of the WWNA due to either incompleteness, inaccuracy, or lack of sufficient detail describing operations. Inaccurate attributes and the methods used to address the lack of detail are discussed in more detail in the next section of this report. Second, Regional Water Boards have discretion when assigning a formal Notice of Violation to a permittee and may opt to use an informal approach to solving a problem. For this reason, the violations shown in CIWQS may not present the complete story regarding a facility or system's operational history.

CASA

The WWNA project team coordinated with CASA leadership to request that member agencies provide their service area boundaries in a digital shapefile. The WWNA plans to use service area boundaries to inform the feasibility of regionalization as a possible solution for inadequate systems or OSTS. State Water Board staff provided a file-sharing repository for member agencies to upload their files and State Water Board staff exported the files to the WWNA project team as needed. This effort is ongoing as CASA member agencies complete the digitization of their service area boundaries.

DFA AND TA PROVIDERS

The WWNA project team worked with DFA staff to obtain a comprehensive list of projects funded through the Clean Water State Revolving Fund (CWSRF). The list of projects included information about project goals to inform available solutions, project costs to inform costing and affordability assessments, and TA providers involved with the project to inform future targeted outreach. The WWNA project team reviewed cases that were relevant to the WWNA and requested the engineering reports. When available, project engineering reports were provided.

DWQ

The WWNA project team communicated with DWQ staff to coordinate efforts and discuss data that will be made available as permittees comply with upcoming SSSGO requirements, but WWNA project deadlines did not align with the SSSGO timeline. Starting on July 1, 2025, and no later than December 31, 2025, the SSSGO requires each permitted facility to submit an up-to-date electronic spatial map of its sewer system

service area boundaries. The WWNA project team plans to coordinate with DWQ staff to obtain data once it is available.

DATA PROCESSING FOR WWTFS AND CS

CIWQS DATA

While processing the queried list of facilities and systems, the WWNA project team discovered inconsistencies in the data and attributed them to errors in transcription when Regional Water Board staff entered facility or system information into CIWQS. The WWNA project team corrected these errors as they were discovered throughout the project period. Errors included misattributed Regional Water Board or Program Category assignments. For example, certain permittees reported their Regional Water Board as "SB" or their permitted collection system as regulated by an NPDES permit. Such errors complicated the sorting of facilities and systems, thus preventing proper analysis. These errors needed to be corrected so that each permittee could be considered within the scope of their Regional Water Board providing oversight and Program Category. The WWNA project team corrected erroneous Regional Water Board assignments by geolocating each facility and system by latitude and longitude within the Regional Water Board shapefile[21] produced by the State Water Board. The WWNA project team corrected Program Type assignments by comparing the associated permit for the facility with its corresponding Program Type attribute in CIWQS.

After correcting the minor errors in the queried list, the WWNA project team removed duplicate entries for permittees. Duplicates existed for certain facilities and systems that were regulated by multiple programs, such as NPDES facilities that have a discharge-to-land component, or NPDES/WDR facilities that have a water recycling component. In some cases, a duplicate entry existed for a facility or system that had been issued a new permit. The queried list also contained entries for both historical and draft permits that were generally removed. However, since NPDES permits are renewed on a five-year basis, some permits labeled as historical in CIWQS did not necessarily indicate that the facility in question was no longer permitted or operational, as the permit reissuance had yet to be uploaded to CIWQS. The WWNA project team identified each historical NPDES entry and manually investigated them by reviewing existing permits, other regulatory documents available on CIWQS, and conducting web searches for explicit indications of decommissioning. The WWNA project team removed a facility or system entry only if it had been decommissioned and was not awaiting a permit reissuance.

After receiving feedback from the Regional Water Boards and discovering that CIWQS attributes like Program Category or Facility Place Subtype are sometimes too broad to determine whether analysis of a facility or system aligns with the WWNA's goals, the

[21] CDT 2024. California Department of Technology. California State GeoPortal. Regional Board Boundaries. Accessed January 2024. https://gis.data.ca.gov/datasets/waterboards::regional-board-boundaries/about

WWNA project team reviewed and further subdivided the list of facilities and systems to produce an Assessment Matrix to be used in subsequent project activities. The purpose of the matrix is to identify whether a given facility or system should be: 1) excluded from further analysis completely, 2) assessed for only impacts to groundwater, or 3) assessed for both impacts to groundwater and for risk and inadequacy.

The WWNA project team produced the matrix by investigating individual permits assigned to each facility and assigning them to one of 10 categories based on the nature of their wastewater and characteristics of the populations they serve. Development of these categories occurred over time through discussions with State and Regional Water Board staff and was finalized in February 2025. Table 3 displays these 10 categories and the nature of their assigned assessments. Appendix C presents more detailed category descriptions and contextual reasoning for including or excluding each category in the various assessments.

Table 3: Category Descriptions and Assessment Assignments

Categories	Included in Groundwater Impacts Assessment?[1]	Included in Risk/Inadequacy Assessment?
I – Included facilities. Includes domestic treatment facilities, mobile home parks and private community systems (i.e., HOAs), settlements serving migrant labor part of the year, schools (with and without overnight student housing), prisons and work camps, health care facilities.	Yes	Yes
AD – Administrative action rather than a physical facility. Examples include LAMPs, reclamation master permits, or local ordinances.	No	No
DC – Decommissioned facility that is no longer operating.	No	No
NS - Not treating sanitary waste directly. Reclamation facilities that do not treat raw sewage (i.e., there is no direct connection to a toilet).	No	No

Categories	Included in Groundwater Impacts Assessment?[1]	Included in Risk/Inadequacy Assessment?
RE – Campgrounds, other day use in recreational settings. Mobile homes and HOAs running community treatment facilities are not in this category.	Yes	No
RT – Residential-transient. Treatment of waste from short-term residents (hotels, motels, resorts, lodges).	Yes	Yes
RV - Recreational Vehicle facilities.	Yes	Yes
NR – Non-Residential. Treatment of waste from private sources such as stores, restaurants, churches, or other commercial/industrial locations that were assigned a Municipal tag in CIWQS.	No	No
DU - Day use. Facilities for incidental, non-overnight public use, or non-overnight publicly-owned work sites.	Yes	No
PR - Private residences. These facilities would be set aside for inclusion in the OWTS workflow.	Yes	No

Notes:

1. NPDES facilities are not recommended for inclusion in Groundwater Impacts Assessment since they discharge effluent to surface waters.

The resulting Assessment Matrix recommends whether each of the 272 NPDES-permitted facilities, 1372 WDR facilities, and 1013 SSSGO permitted systems should be assessed for inadequacy, impacts to groundwater, both, or neither. Appendix D displays the complete Assessment Matrix. Figure 12 summarizes the eight-step process followed to produce the Assessment Matrix, and Table 4 displays the counts of facilities per each Regional Water Board.[22]

[22] Facilities were organized by permit – WDR, NPDES, and SSSGO. In general, if a facility's treatment system and collection system are both regulated by the WDR, they are only counted in the WDR list since they do not report data according to SSSGO requirements. If the facility has both a WDR and an SSSGO, each permit is counted in its respective section and will be assessed separately.

Figure 12: A summary of the process followed resulting in the Assessment Matrix.

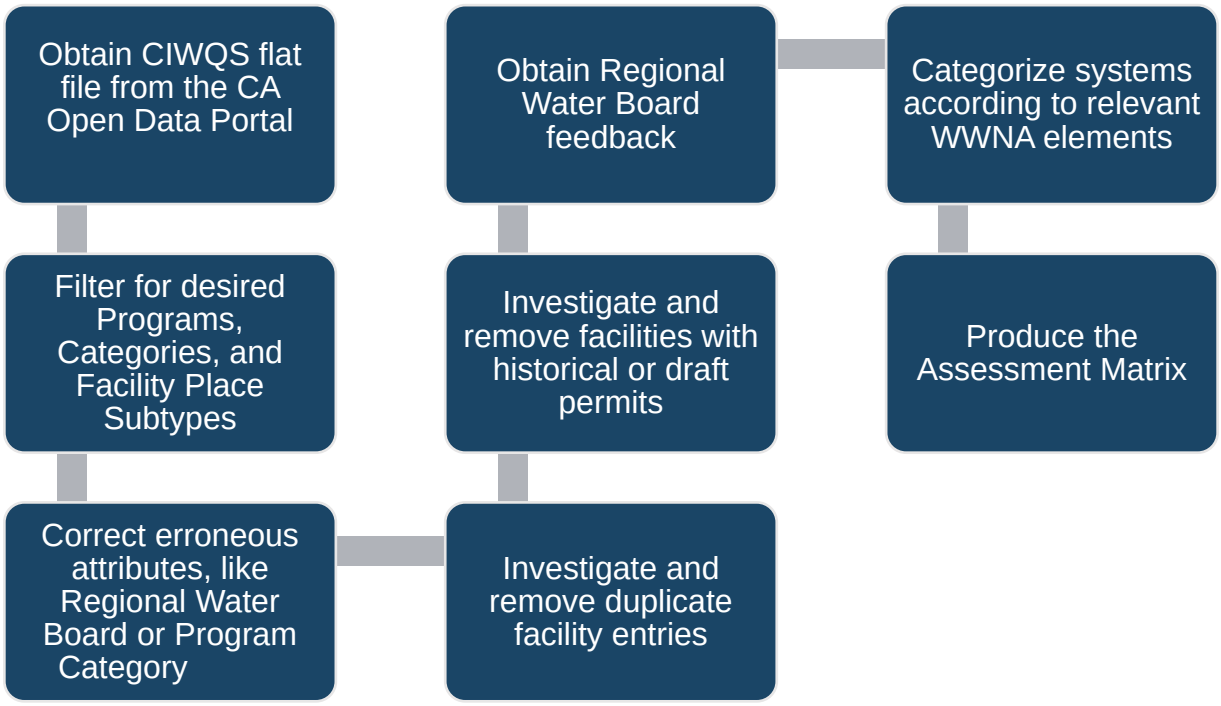


Table 4: A tabulated record of facility and system type counts per each Regional Water Board.

Regional Water Quality Control Board (RWQCB)	Count of NPDES	Count of SSSGO	Count of WDR	Total Facilities and Systems per RWQCB
1	27	67	127	221
2	51	147	51	249
3	26	95	172	293
4	26	122	108	256
5	80	338	614	1032
6	2	65	84	151
7	17	28	92	137
8	23	84	30	137
9	20	67	94	181
Grand Total	**272**	**1013**	**1372**	**2657**

SERVICE AREA BOUNDARIES

CASA member agencies submitted 151 service area boundaries in various formats. The WWNA project team categorized each submission into one of three types: 1) ready-to-use shapefiles, 2) non-digitized maps, and 3) incomplete data submissions. 132 of the 151 submitted boundaries were provided as well-structured and readily usable shapefiles. 15 of the submitted boundaries were submitted as non-digitized maps in PDF format that needed additional processing. These boundaries were georeferenced to align them with a spatial coordinate system and then manually digitized to create vector shapefiles in the same format as the ready-to-use shapefiles. The remaining four submissions were provided with incomplete spatial or attribute information and could not be effectively mapped and were therefore excluded from the dataset.

The WWNA project team consolidated the 147 usable shapefiles representing 132 unique service areas into a single shapefile for use. Spatial adjustment techniques resolved overlapping and duplicate boundaries to ensure seamless integration. The consolidated shapefile represents a unified geospatial dataset encompassing all mappable service area boundaries submitted to date. Appendix E tabulates a list of service areas included in the shapefile. The WWNA project team will consolidate additional service area boundaries into the shapefile as they are acquired.

DATA COLLECTION FOR OWTS IMPACTS ON GROUNDWATER

COUNTY LAMPS

The WWNA project team accessed each of the state's 58 County Health Department websites to download LAMP documents that have been approved by the corresponding Regional Water Board. Supplementary information, like LAMP Water Quality Reports, was downloaded when available. Regional Water Board staff provided LAMP Water Quality Reports for the Central Valley Water Board.

Additional outreach to County Health Departments is on-going to obtain inventories of OWTS locations where available.

OTHER DATA

The WWNA project team collected supplementary geospatial and groundwater quality data to be used in support of project activities, including: an assessment of the impact of WDR facilities and OSTS on groundwater, approximation of OSTS locations, and modeling of potential solutions. The State Water Board's Division of Information Technology (DIT) provided a statewide collection of parcel shapefiles. Nitrate concentrations in groundwater were obtained through the State Water Board's Groundwater Ambient Monitoring and Assessment (GAMA) Program[23]. Annual precipitation data were downloaded through Oregon State University's Parameter-elevation Regressions on Independent Slopes Model[24]. The Natural Resources Conservation Service's Gridded Soil Survey Geographic Database[25] was accessed to obtain a geodatabase of soil attributes across the state. Depth to groundwater measurements were obtained from Fan, Li, and Miguez-Macho's *Global patterns of groundwater table depth*[26].

DATA PROCESSING FOR OWTS IMPACTS ON GROUNDWATER

COUNTY LAMPS

The WWNA project team downloaded 47 of the 58 potential LAMPs from county websites. The remaining 11 LAMPs were not downloaded because the counties in question had not yet had their LAMPs approved by the Regional Water Board. The following information was extracted from the LAMPs when available:

[23]State Water Board 2025. California State Water Resources Control Board. "Groundwater Ambient Monitoring and Assessment (GAMA) Program." Sacramento, CA: California State Water Resources Control Board.
[24]PRISM 2025. PRISM Climate Group. "30-Year Normal Precipitation Data (1991–2020)." Oregon State University.
https://prism.oregonstate.edu
[25]NRCS 2025. Natural Resources Conservation Service. n.d. "Soil Drainage Class System." U.S. Department of Agriculture.
https://www.nrcs.usda.gov
[26]Fan, et al 2013. Fan, X., Y. Li, and G. Miguez-Macho. "Depth to Groundwater Data." Raster GIS file.
https://www.science.org/doi/10.1126/science.1229881

- Estimation of the number of OWTS
- Maps of Sewer Service Boundaries
- Maps of OWTS locations
- Estimation of cesspool counts and reporting requirements
- Local OWTS regulations differing from OWTS policy
- Areas of concern
- Nutrient management plan requirements
- Number of registered septage haulers and septage hauling locations

The WWNA project team tabulated the extracted information, included as Appendix F, and identified types of data valuable for a later phase of the project. That phase involves an ongoing effort to contribute data to a team at the University of Massachusetts, Amherst (UMass), developing a machine-learning model to predict the locations of otherwise unknown unsewered areas. A central motivation for reviewing the county LAMP data was to obtain inventories of known OWTS. The WWNA project team obtained inventories of OWTS governed by LAMPs from the Regional Water Boards of the following counties: Los Angeles, Ventura, Santa Barbara, Santa Cruz, and Monterey. While reviewing water quality reports, the WWNA project team found inventories of the locations of all newly permitted OWTS, repaired, or replaced OWTS, and OWTS failures for Placer and Sacramento County. Counties are required to track information about the locations of OWTS, so the WWNA project team planned to conduct outreach to county departments of environmental health to gather this data. Due to time constraints, the WWNA project team decided to perform targeted outreach to specific counties identified as most critical to training the UMass unsewered model.

REMAINING DATA GAPS

WWTFS AND CS

Data gaps remain for the WWNA list of facilities and systems, primarily due to the nature of CIWQS as a database. Facility and system data are updated frequently and iteratively. It is possible that since the flat file of CIWQS was accessed on a certain date, the status of a facility or system has since changed. For example, a draft permit as of 01/16/2024 may have been formally adopted in the time since. In some cases, the most recent permit attributed to a facility or system may not have yet been available for public access on CIWQS. Finally, it is possible that facilities that treat domestic wastewater within the purview of the WWNA are currently mislabeled under a Program or Facility Place Subtype not initially considered by the WWNA project team.

LAMPS

The primary data gap remaining for LAMPs is the acquisition of OWTS inventories from the appropriate County Agency. Of the 47 counties in California with an active LAMP, only seven OWTS inventories have been acquired. The WWNA project team expects that the availability and completeness of OWTS inventories will vary for the remaining counties. The WWNA project team attributes this in part to agency resource limitations, but primarily due to the OWTS policy and related LAMPs only having jurisdiction over new OWTS or OWTS in need of repair. Additionally, the 11 LAMPs that have not yet

been approved by their Regional Water Board should be included in future iterations of the WWNA if available.

SERVICE AREA BOUNDARIES

Approximately 870 service area boundaries remain to be obtained by the WWNA project team for use in the WWNA. The remaining boundaries are planned to be obtained through contributions from CASA member agencies and through requirements set by the State Water Board's SSSGO. DWQ staff have indicated that the WWNA project team will receive copies of these boundaries for use in the WWNA.

RECOMMENDATIONS

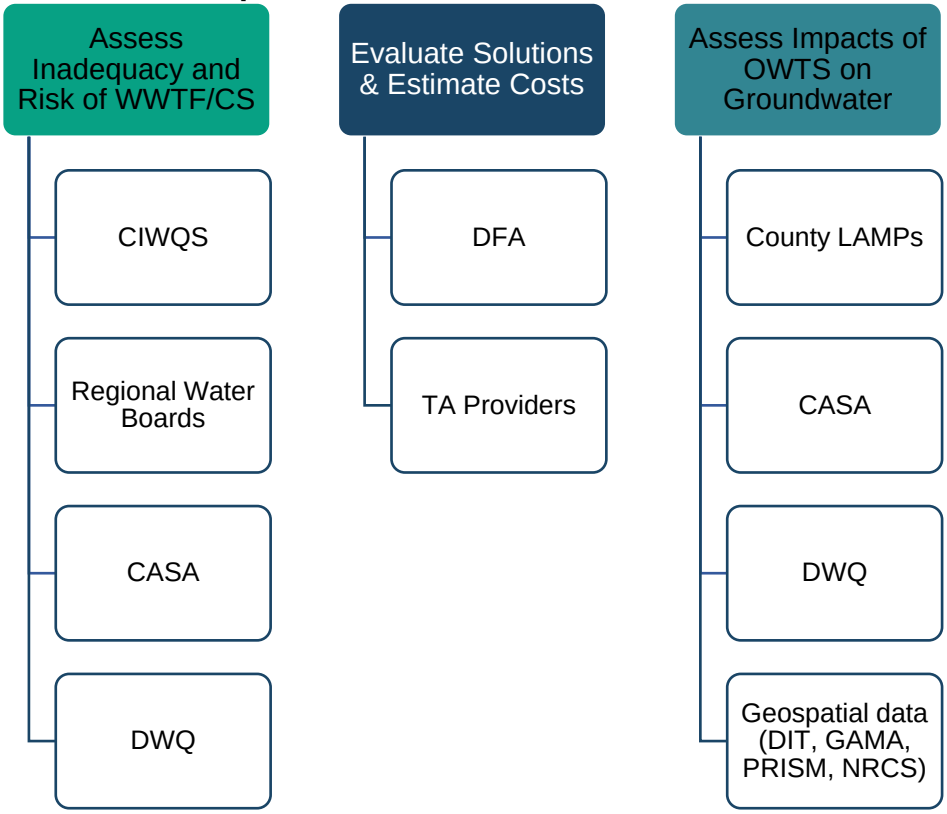
The WWNA project team believes that State Water Board staff should consider the following recommendations to improve the quality of data provided by CIWQS and to increase the efficiency of future activities related to the WWNA:

- To prevent facilities and systems from being mislabeled in the future, the State Water Board should consider instituting data validation procedures in CIWQS such that when permittees or Regional Water Board Staff are inputting information, certain Programs or Facility Place Subtypes are only able to be selected when the proper Program Category is assigned.
    - For example, a facility or system that is labeled within the WDR Program Category should have different valid Program assignments than would be allowed for a system that is labeled within the SSO Program Category so that a wastewater treatment facility is not grouped with SSOs (i.e., collection systems SSSGOs) or vice versa.
- The State Water Board should consider instituting data validation procedures in CIWQS such that when permittees or Regional Water Board Staff are inputting information, only reasonable values to denote a Regional Board are allowed.
- For example, the values 1, 2, or 3 are valid Regional Water Board assignments but the strings "SB" or "CV" are not.
- The State Water Board should consider developing another category for permit status for NPDES facilities that reflects the need for a permit reissuance so that facilities awaiting a new permit are not mischaracterized as historical or decommissioned.
- The State Water Board should consider expanding the CIWQS glossary of terms to define specific Programs, such as the several types of SSO Programs, as well as to define Facility Place Subtypes.
    - A glossary for Facility Place Subtypes does exist on its own as cited in Table 2, but it is not explicitly linked to any public-facing CIWQS webpage.
- Regional Water Board Staff should consider implementing the corrections to facility and system Program Categories that the WWNA project team has made during this activity. Appendix G lists the facilities and systems corrected by the WWNA project team, based on CIWQS data accessed in January 2024.

CONCLUSIONS

The WWNA represents California's first attempt to compile a statewide dataset of relevant information to assess sanitation services in terms of inadequacy and risk, as well as to consider solutions and estimate the costs of potential solutions. The WWNA project team collected data from myriad sources in various states of accuracy and completeness. In some cases, data collection is ongoing as project needs evolve. Figure 13 below summarizes the relationship between WWNA tasks and data sources.

Figure 13: Relationship between WWNA tasks and data sources.



The primary results of the data collection effort include:

- A one-of-its-kind methodology to determine whether a given facility treats domestic-sanitation related wastewater.
- A final list of facilities and systems to be assessed for inadequacy and risk of inadequacy for the initial WWNA.
- A collection of geospatial datasets used to assess potential impacts to groundwater from OSTS, to identify potential OSTS connection opportunities, and to evaluate the feasibility of potentially connecting inadequate facilities to existing collection systems.

- A set of state-funded projects and associated engineering reports used to identify potential solutions for inadequate facilities and systems and to estimate implementation costs.
- A set of data gaps to guide long-term improvements by the Water Boards, supporting multiple purposes including future WWNA efforts.

APPENDIX MATERIALS

APPENDIX C1: STATUS OF DATA NEEDS OUTLINED IN THE WWNA SCOPE OF WORK, CATEGORIZED BY FACILITY TYPE

Table C1. Collection System Data Needs and Status

Collection System Data Needs	Status
Geographic Service areas/location boundaries	In Progress
violations and compliance status	Obtained
Existing failure data (sanitary sewer order data, including overflows, root intrusions, in/exfiltration etc.),	Obtained
Current Design Parameters	Obtained
Current population	Obtained
Network connectivity: for existing collection systems, identify upstream (water suppliers) and downstream (wastewater treatment facilities)	Obtained
Climate, slope, and other characteristics	Climate data is readily available; slope (grade) was determined to be irrelevant to the Risk and Inadequacy Assessments.
Existing capital and operation and maintenance (O&M) investment levels	Not Available
Serving a disadvantaged community, severely disadvantaged community (collectively S/DAC), or area with historical lack of access to adequate sanitation/resources to support adequate sanitation (vulnerable or overburdened communities)	Obtained
Baseline changes in future operations (influent flow rates, populations, and effects on concentrations)	Not Available
Documented data gaps and areas for future data collection and analysis by the Water Boards	In Progress

Table C2. WWTF Data Needs and Status

WWTF Data Needs	Status
Upcoming renewals for discharge permits	Generally, Not Available for WDR, NPDES permits are renewed every 5 years.
Near-future WWTF Upgrades	Not Available
Design parameters, including influent flow (total and per capita) volume, level of treatment and treatment train, location, existing pretreatment programs, existing discharge requirements, influent water quality, and other operational parameters	Obtained
Serving a disadvantaged community, severely disadvantaged community (collectively S/DAC), and communities with historical lack of access to adequate sanitation/resources to support adequate sanitation (e.g., environmentally vulnerable, or overburdened communities that have experienced historic inequality like redlining)	Obtained
Baseline changes in future operations (influent flow rates, populations, and effects on concentrations)	Not Available
Discharge locations (surface water, land, ocean)	Obtained
Network connectivity: for existing treatment systems, identify upstream collection systems	Obtained
Documented data gaps and areas for future data collection and analysis by the Water Boards	In Progress

Table C3. OWTS Data needs and Status

OWTS Data Needs	Status
OWTS locations/boundaries and related data, critical missing data, propose methods to fill the gaps and data analysis processes	In Progress
Documentation from an assessment of OWTS regulatory requirements and reporting by local agencies, its potential integration in a statewide database, and a comparison to small area estimation methods similar to analysis conducted by the Groundwater Ambient Management and Assessment Program (GAMA) of domestic wells, and carefully planned machine learning techniques	In Progress
OWTS physical/chemical processes and assess local environmental systems or drinking water sources at risk from contamination	In Progress
Local environmental conditions (groundwater levels, soil type, proximity to surface water or drinking supply wells)	Obtained
Documented data gaps and areas for future data collection and analysis by the Water Boards	In Progress

APPENDIX C2: DESIRED DATA, FACILITY TYPE, AND WWNA ACTIVITY

Desired Data	Facility Type: WDR	Facility Type: NPDES	Facility Type: SSSGO Facility	WWNA Activity: Assess Inadequacy/Risk	WWNA Activity: Consider Solutions	WWNA Activity: Estimate Costs	WWNA Activity: Assess GW Impacts
Facility Name	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Permit (Hyperlink)	Yes	Yes	No	Yes	Yes	Yes	Yes
Facility Address	Yes	Yes	Yes	No	No	No	No
Facility Coordinates	Yes	Yes	No	No	Yes	Yes	Yes
City	Yes	Yes	Yes	No	No	No	No
County	Yes	Yes	Yes	No	No	No	No
Program	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Place/Project Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Population	Yes	Yes	No	No	Yes	Yes	Yes
# of Connections	Yes	No	No	No	Yes	Yes	Yes
Communities Served	Yes	Yes	No	Yes	Yes	Yes	Yes
MHI	Yes	Yes	No	No	Yes	Yes	Yes
DAC/SDAC	Yes	Yes	No	No	Yes	Yes	Yes
Permitted Flow	Yes	Yes	No	Yes	Yes	Yes	Yes
Design Flow	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Permits in Processing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average Flow	Yes	Yes	No	Yes	Yes	Yes	Yes
Level of Treatment	Yes	Yes	No	Yes	Yes	Yes	Yes

Desired Data	Facility Type: WDR	Facility Type: NPDES	Facility Type: SSSGO Facility	WWNA Activity: Assess Inadequacy/Risk	WWNA Activity: Consider Solutions	WWNA Activity: Estimate Costs	WWNA Activity: Assess GW Impacts
Treatment Train	No	Yes	No	No	No	No	No
Receiving Waters	Yes	Yes	No	Yes	Yes	Yes	Yes
Post-Onsite Treatment	Yes	No	No	Yes	Yes	Yes	Yes
# of Violations in Past 5 Years	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Enforcement Actions in Past 5 Years	Yes	Yes	No	Yes	Yes	Yes	Yes
Nutrient Violations (Yes/No)	Yes	Yes	No	Yes	Yes	Yes	Yes
TDS Violation (Yes/No)	Yes	Yes	No	Yes	Yes	Yes	Yes
Combined Storm Sewer (Yes/No)	No	No	Yes	No	No	No	No
Total Staff	No	No	Yes	No	No	No	No
Highest Operator Certification Level	No	No	Yes	No	No	No	No
# of SSO Violations In Past 5 years	No	No	Yes	No	No	No	No
Cause of SSO Violations (List 1-3 most common causes)	No	No	Yes	No	No	No	No
Design Flow	No	No	Yes	No	No	No	No
Average Dry Weather Flow	No	No	Yes	No	No	No	No
Peak Wet Weather Flow	No	No	Yes	No	No	No	No

Desired Data	Facility Type: WDR	Facility Type: NPDES	Facility Type: SSSGO Facility	WWNA Activity: Assess Inadequacy/Risk	WWNA Activity: Consider Solutions	WWNA Activity: Estimate Costs	WWNA Activity: Assess GW Impacts
Collection System Service Boundaries	No	No	Yes	No	No	No	No
Total Miles of Sewer	No	No	Yes	No	No	No	No
Miles Constructed Before 1900	No	No	Yes	No	No	No	No
Miles Constructed 1900 to 1919	No	No	Yes	No	No	No	No
Miles Constructed 1920 to 1939	No	No	Yes	No	No	No	No
Miles Constructed from 1940 to 1959	No	No	Yes	No	No	No	No
Miles Constructed 1960 to 1979	No	No	Yes	No	No	No	No
Miles Constructed 1980 to 1999	No	No	Yes	No	No	No	No
Miles Constructed After 2000	No	No	Yes	No	No	No	No
Number of Permits in Processing	No	No	Yes	No	No	No	No

APPENDIX C3: EXAMPLE DATA REQUEST TABLE SUBMITTED TO REGIONAL BOARDS

Requested Data: General Information	OWP Has Access[1]
Location of WDR Permitted OWTS	
Location of OWTS Under WDR Waiver	
Political Jurisdiction Boundaries	
Service Boundaries for Community Special Districts or Private Sanitary Districts	
Planned WWTP Upgrades	
Locations of Migrant/Refugee Communities	

Requested Data: NPDES/WDR Facilities	OWP Has Access[1]
Facility Name	X
NPDES/WDR Permit (Hyperlink)	X
Facility Address	X
Facility Coordinates	X
City	X
County	X
Program	X
Place/Project Type	X
Population	X
Communities Served	
MHI	
DAC/SDAC	
Permitted Flow	
Design Flow	X
Average Flow	
Post-Onsite Treatment	X

Requested Data: NPDES/WDR Facilities	OWP Has Access[1]
Treatment Train	
Total Staff	
Highest Operator Certification Level	
# of Violations in Past 5 Years	X
# of Enforcement Actions in Past 5 Years	X
Nutrient Violations (Yes/No)	X
TDS Violation (Yes/No)	X

Requested Data: SSO Facilities	OWP Has Access[1]
Facility Name	X
Facility Address	X
City	X
Place/Project Type	X
Combined Storm Sewer (Yes/No)	
Total Staff	X
Highest Operator Certification Level	X
# of SSO Violations In Past 5 years	X
Cause of SSO Violations (List 1-3 most common causes)	X
Design Flow	X
Average Dry Weather Flow	X
Peak Wet Weather Flow	X
Collection System Service Boundaries	
# of Service Connections	
Total Miles of Sewer	X
Miles Constructed Before 1900	X
Miles Constructed 1900 to 1919	X

Requested Data: SSO Facilities	OWP Has Access[1]
Miles Constructed 1920 to 1939	X
Miles Constructed from 1940 to 1959	X
Miles Constructed 1960 to 1979	X
Miles Constructed 1980 to 1999	X
Miles Constructed After 2000	X

Notes:

1. An ‘X’ in this column denotes that the WWNA project team had at least partial access to the corresponding data field, but Regional Water Boards were encouraged to submit any additional data to complete the dataset.

APPENDIX C4: TABULATED CATEGORIES USED TO INFORM ASSESSMENT TYPES

Categories[1] (General Facility Place Subtype associated with category; Beginning Initials (also shown in red font) are OWP Groupings used to identify facilities)	Characteristics/Search Criteria	Included in Impacts to Groundwater Assessment?[2]	Included in Risk/Inadequacy Assessment?
I - Included - Domestic treatment facilities. (Facility Place Subtype: Wastewater Treatment Facility)	• If the agency type is city agency, county agency, agency combination, municipal, or special district; then they **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. • In lieu of looking up every site's permit, if a facility is owned by a government agency and does not seem special from its description (i.e., an industrial park or similar), then they **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments.	Yes	Yes

I - Included - Mobile home parks and private community systems (i.e., HOAs).
 	
(Facility Place Subtype: Mobile Home Park)
	• All facilities listed in CIWQS as mobile home parks **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments.
	  o Also did search on strings "mobile" and "MH" (not all facilities properly described in CIWQS).
	• Privately-owned facilities serving dispersed individual private residences in a community (subdivision) **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments.
	  o E.g., owned by an HOA-like entity; determined by looking at individual permits
	• Must be some shared infrastructure to be included (collection system, treatment facility, community leach field). Organizations that provide maintenance services to privately-owned septic systems **are excluded** from consideration.
		Yes	Yes

I - Included - Settlements serving migrant labor part of the year. (Facility Place Subtype: Residence, NEC; Domestic NEC)	• All facilities described as worker housing; either public or private, and that house workers for all or part of the year **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. • Facilities serving employee housing explicitly (public or private) in residences (not overnight barracks) **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments.	Yes	Yes
I - Included - Schools (with and without overnight student housing). (Facility Place Subtype: Educational Facility)	• All facilities described as schools (all kinds of schools, public or private) **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. o Not all schools listed as educational facilities in CIWQS. • Education centers which are attached to parks, private retreat centers, visitor centers, outdoor education centers, nature centers, private conference centers, science centers (unless they have overnight facilities) **are excluded** from consideration.	Yes	Yes
I - Included - Prisons and work camps. (Facility Place Subtype: Prison; Domestic NEC; Residence, NEC)	• All facilities listed in CIWQS as prisons **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. • Conservation camps that employ inmates **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments.	Yes	Yes

Categories[1] (General Facility Place Subtype associated with category; Beginning Initials (also shown in red font) are OWP Groupings used to identify facilities)	Characteristics/Search Criteria	Included in Impacts to Groundwater Assessment?[2]	Included in Risk/Inadequacy Assessment?
I - Included - Health care facilities. (Facility Place Subtype: Wastewater Treatment Facility)	• All facilities described as hospitals, residential rehabilitation, or convalescent facilities **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. o Emphasis is on the residential nature of these facilities. • Outpatient facilities and clinics or wellness centers **are excluded** from consideration.	Yes	Yes
AD – Administrative action rather than a physical facility. Examples include LAMP, reclamation master permits, local ordinances.	• Sort for LAMP in facility name; these entries **are excluded** from consideration. • Look up permit for facility names that suggest planning or other administrative entries (e.g., master reclamation permit); these entries **are excluded** from consideration.	No	No
DC – Decommissioned facility that is no longer operating.	• Facilities fitting the criteria below **are excluded** from consideration: o The facility was completely dismantled. o A septic system had been connected to a sewer. o The project and facility were never built. o The permit had been issued for a short-term project (e.g., a construction site) that was finished. o The treatment facility had been so modified that regulators decided to write a new permit with a different name. After checking that the new facility was included in the facility list or otherwise classified, the historical CIWQS entry was reclassified as DC.	No	No
NS - Not treating sanitary waste directly. Reclamation facilities that do not treat raw sewage (i.e., there is no direct connection to a toilet).	• Check if facility type in CIWQS is one of the following: all other, unknown, industrial; these entries **are excluded** from consideration. • If the facilities are present in the Volumetric Annual Reporting (VAR) recycle list or are the recipient of effluent from another facility, then they **are excluded** from consideration. • Look for key words in facility name (e.g., biosolids, outfall, tertiary, recycle, intertie, pipeline, conveyance). These entries **are excluded** from consideration. • If the permits describe graywater, infiltration, and groundwater treatment discharge; they **are excluded** from consideration.	No	No
RE – Campgrounds, other day use in recreational settings. Mobile homes and HOAs running community treatment facilities are not in this category.	• Searched for string “park” and checked for permit language describing recreational facilities; these facilities **are considered** in the Threat to Groundwater Assessment but **are excluded** from consideration in the Risk/Inadequacy Assessments. • Category RE does include “Camps” owned by public entities like cities (e.g., San Jose, San Francisco). • Category RE does not include private camps (listed under NR.). • Category RE does include campgrounds that accommodate both tent-camping and Recreational Vehicles.	Yes	No

Categories[1] (General Facility Place Subtype associated with category; Beginning Initials (also shown in red font) are OWP Groupings used to identify facilities)	Characteristics/Search Criteria	Included in Impacts to Groundwater Assessment?[2]	Included in Risk/Inadequacy Assessment?
RT – Residential-transient. Treatment of waste from short-term residents (hotels, motels, resorts, lodges)	• Category RT generally includes mixed-use locations (e.g., truck stops with hotels, restaurants, gas stations, etc.) even if it could be argued that the bulk of the wastewater came from other facilities. These facilities **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. • Category RT facilities are generally open more than 6 months per year and open to the general public. • Category RT does not include facilities that serve restricted customer bases (e.g., club members) or are open primarily for programs (i.e., conference centers); these are classified as NR.	Yes	Yes
RV - Recreational Vehicle facilities. (Facility Place Subtype: Campground)	• Recreational Vehicle facilities sometimes function as short-or long-term worker housing, thus **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. • Campgrounds that accommodate both tent-camping and Recreational Vehicles are classified as RE. • Other short-term recreational facilities **are excluded** from consideration.	Yes	Yes
NR – Non-Residential. Treatment of waste from private sources such as stores, restaurants, churches, or other commercial/industrial locations that were assigned a Municipal tag in CIWQS.	• Sort for where the CIWQS agency type is “privately-owned business;” these **are excluded** from consideration. o For those above where the place type is “utility,” facilities **are considered** in the Threat to Groundwater Assessment but **are excluded** from consideration in the Risk/Inadequacy Assessments. • Category NR does include non-profit private facilities such as churches, and for-profit private facilities such as camps (e.g., summer camps), conference centers. • Category NR does include outpatient medical facilities. Senior residential (non-medical) facilities listed as PR. • Category NR does not include labor camps or health-related sites.	No	No
DU - Day use. Facilities for incidental, non-overnight public use, or non-overnight publicly-owned work sites	• Searched for key words in facility name (e.g., library, educational “center” (as opposed to school), highway rest stops, weighing stations, maintenance stations, visitor centers.) These **are considered** in the Threat to Groundwater Assessment but **are excluded** from consideration in the Risk/Inadequacy Assessments.	Yes	No
PR - Private residences. These facilities would be set aside for inclusion in the OWTS workflow.	• Sort for facilities where CIWQS Place type is Residence/Education, Place subtype is Residence NEC, and Agency type is Privately-Individual. These facilities **are considered** in the Threat to Groundwater Assessment but **are excluded** from consideration in the Risk/Inadequacy Assessments. o Program WDRMUNIOWTS used as check: Some facilities tagged as WDRMUNIOWTS serve Mobile Home Parks or similar communities – these **are considered** in the Threat to Groundwater Assessment and Risk/Inadequacy Assessments. • If the agency type is Privately owned business or something else, permit was checked and categorized as follows: o Category PR does include apartment and condominium complexes, senior residential complexes (non-medical) o Category PR does not include Mobile home parks, HOAs (same logic as exempting mobile home parks, i.e., private dwellings in a community setting with a private sewer and treatment system) o Category PR does not include Health-related facilities or labor housing	Yes	No

Notes:

1. Federal Facility Categorization: To provide some level of discrimination among federal facilities for the purpose of risk assessment. All the federal facility permits were reviewed. In some cases, Google maps were used to judge the characteristics of the sources. Facilities were classified as follows:
   a. Federal: Residential or Mixed – Many military bases contained a mix of sources like municipalities. If the contributing area contained permanent residences (base housing) serving stable populations, the facilities were placed in this class.

b. Federal: Transient Residential – Many military bases have housing for short-term stays (apartments or barracks). Recreation areas often contain hotels, motels, or lodges. Facilities were open >6 mo/yr but have a high turnover in occupants were placed in this class. Refers to buildings, not campgrounds or camps that are open only part of the year (e.g., high mountain summer camps).
c. Federal: Recreational – Campgrounds, days use areas, and similar sources. Where there was a mix of sources such as at national parks, a judgment was made as to which source contributed the most wastewater (e.g., a lodge or an adjacent campground).
d. Federal: Non-Residential – This class covers domestic wastewater sources that do not involve overnight stays such as offices, ranger stations, or entry points.
e. Federal: Collection System – This class covers Collection Systems for Federal Facilities that do not serve Recreational facilities as described above in Item 1c.

2. NPDES facilities are not recommended for inclusion in the Impacts to Groundwater Assessment since they necessarily discharge effluent to surface water

APPENDIX C5: ASSESSMENT MATRIX (ELECTRONIC ONLY)

APPENDIX C6: TABULATED RECORD OF 115 SERVICE AREA BOUNDARIES PROVIDED BY CASA

Service Area Boundaries Received as of 6/15/2025[27]
Airport Larkfield Wikiup Sanitation Zone
Almonte Sanitary District
Angel Island State Park
Bayshore Sanitary District
Bear City
Bear Valley
Big Bear Area Regional Wastewater Agency
Bolinas Community Public Utility District
Camarillo Sanitary District
Carpinteria Sanitary District
Central Contra Costa Sanitary District
Central Marin Sanitation Agency
Cities of San Jose & Santa Clara
City of Big Bear Lake
City of American Canyon
City of Beaumont
City of Benicia
City of Burlingame
City of Carlsbad
City of Corona
City of Encinitas
City of Folsom
City of Grass Valley Public Works
City of Hayward

[27] Numbers subject to change. Collection systems are required to submit boundary data to the State Water Board by December 31, 2025.

Service Area Boundaries Received as of 6/15/2025[27]
City of Jackson
City of Lancaster
City of Lathrop
City of Livermore
City of Manteca
City of Millbrae
City of Oceanside
City of Oxnard
City of Pacifica
City of Palo Alto
City of Petaluma
City of Pinole
City of Pleasanton
City of Richmond
City of Riverbank
City of Roseville
City of San Bernardino Municipal Water Department
City of San Diego
City of San Dimas
City of San Leandro
City of San Mateo
City of Santa Barbara Sewer Service Boundary
City of Santa Cruz
City of Santa Rosa
City of Simi Valley
City of Stockton Sanitary Collections
City of Sunnyvale

Service Area Boundaries Received as of 6/15/2025[27]
City of Thousand Oaks Wastewater
City of Tracy
City of Vista Sanitation District
Coachella Valley Water District
Crestline Sanitation District
Crockett Community Services District
Delta Diablo Sanitation District
Dublin San Ramon Services District
East Bay Municipal Utility District
East Orange County Water District
Eastern Municipal Water District
Elsinore Valley Municipal Water District
Encina Wastewater Authority
Fairfield Suisun Sewer District
Geyserville Sanitation Zone
Goleta Regional Sanitary Services
Granada Community Services District
Inland Empire Utilities Agency
Ironhouse Sanitary District
Lake Arrowhead CSD
Las Gallinas Valley Sanitary District
Las Virgenes Municipal Water District
Los Angeles County Sanitation Districts
Marconi Conference Center
Modesto Municipal Sanitary District No 1
Montecito Sanitary District
Monterey Regional County Sanitation District
Moulton Niguel Water District

Service Area Boundaries Received as of 6/15/2025[27]
Mountain View Sanitary District
Napa River Reclamation District
Napa Sanitation District
North San Mateo County Sanitation District
Novato Sanitary District
Occidental County Sanitation District
Orange County
Oro Loma Sanitary District
Padre Dam Municipal Water District
Penngrove Sanitation Zone
Rancho Cordova Water District
Riverside City
Riverside City Edgemont
Riverside City Jurupa
Riverside City Rubidoux
Rodeo Sanitary District
Rose Valley School District
Russian River County Sanitation District
Sacramento Area Sewer District
San Bernardino County
San Francisco International Airport
San Francisco Public Utilities Commission
San Luis Obispo
Sanitary District No 5 of Marin County
Santa Ana Watershed Project Authority
Santa Rosa Regional Resources Authority
Sausalito Marin City Sanitary District
Sea Ranch Sanitation District

Service Area Boundaries Received as of 6/15/2025[27]
Sewer Authority Mid Coastside
Sewerage Agency of Southern Marin
Silicon Valley Clean Water
Sonoma Valley County Sanitation District
South Coast Water District
South Orange County Wastewater Authority
South Placer Municipal Utility District
South San Francisco San Bruno
South Tahoe Public Utility District
Tahoe City Public Utility District
Tomales Village Community Services District
Town of Windsor
Town of Yountville
Truckee Sanitary District
Tuolumne Utilities District
UC Davis (2024)
Union Sanitary District
Vallecitos Water District
Vallejo Flood and Wastewater District
Valley Sanitary District
Victor Valley Wastewater Reclamation Authority
West Basin Municipal Water District
West County Wastewater District
West Valley Sanitation District
Yucaipa Valley Water District

APPENDIX C7: TABULATED RECORD OF COUNTY LAMP DOCUMENTS AND CONTENTS

County	LAMP downloaded? (Yes/No)	Maps of Sewered vs Unsewered Areas? (Yes/No)	Nutrient Management Plan (Yes/No)	Cesspool locations/Counts (Yes/No)
Alameda County	Yes	Yes	Yes	No
Alpine County	Yes	No	No	No
Amador County	Yes	No	No	No
Butte County	Yes	No	No	No
Calaveras County	No	n/a	n/a	n/a
Colusa County	Yes	Yes	Yes	No
Contra Costa County	No	n/a	n/a	n/a
Del Norte County	No	n/a	n/a	n/a
El Dorado County	Yes	No	No	No
Fresno County	Yes	No	No	No
Glenn County	Yes	Yes	Yes	No
Humboldt County	Yes	No	No	No
Imperial County	Yes	No	No	No
Inyo County	Yes	No	Yes	No
Kern County	Yes	Yes	Yes	No
Kings County	Yes	Yes	Yes	No
Lake County	No	n/a	n/a	n/a
Lassen County	Yes	No	Yes	No
Los Angeles County	Yes	Yes	Yes	Yes
Madera County	Yes	Yes	No	No
Marin County	Yes	Yes	No	No
Mariposa County	Yes	No	Yes	No
Mendocino County	Yes	No	No	No

County	LAMP downloaded? (Yes/No)	Maps of Sewered vs Unsewered Areas? (Yes/No)	Nutrient Management Plan (Yes/No)	Cesspool locations/Counts (Yes/No)
Merced County	Yes	Yes	Yes	No
Modoc County	Yes	No	Yes	No
Mono County	Yes	No	Yes	No
Monterey County	Yes	Yes	Yes	No
Napa County	Yes	No	No	No
Nevada County	Yes	Yes	No	No
Orange County	Yes	Yes	Yes	No
Placer County	Yes	Yes	No	No
Plumas County	Yes	No	Yes	No
Riverside County	Yes	Yes	Yes	No
Sacramento County	Yes	Yes	No	No
San Benito County	No	n/a	n/a	n/a
San Bernardino County	Yes	Yes	Yes	No
San Diego County	Yes	No	Yes	No
The City and County of San Francisco	No	n/a	n/a	n/a
San Joaquin County	Yes	Yes	No	No
San Luis Obispo County	Yes	Yes	Yes	No
San Mateo County	Yes	Yes	No	No
Santa Barbara County	Yes	n/a	n/a	n/a
Santa Clara County	Yes	Yes	Yes	No
Santa Cruz County	Yes	Yes	Yes	No
Shasta County	Yes	No	No	No
Sierra County	Yes	No	No	No

County	LAMP downloaded? (Yes/No)	Maps of Sewered vs Unsewered Areas? (Yes/No)	Nutrient Management Plan (Yes/No)	Cesspool locations/Counts (Yes/No)
Siskiyou County	Yes	No	No	No
Solano County	Yes	No	Yes	No
Sonoma County	No	n/a	n/a	n/a
Stanislaus County	Yes	Yes	Yes	No
Sutter County	No	n/a	n/a	n/a
Tehama County	Yes	No	No	No
Trinity County	No	n/a	n/a	n/a
Tulare County	Yes	No	No	No
Tuolumne County	Yes	No	Yes	No
Ventura County	Yes	No	Yes	Yes
Yolo County	No	n/a	n/a	n/a
Yuba County	No	n/a	n/a	n/a

Definitions:
n/a: Not Applicable

APPENDIX C8: TABULATED RECORD OF FACILITIES WITH ERRONEOUS PROGRAM ASSIGNMENTS

Facility Name	Erroneous Program	Corrected Program
Gualala WWTF	SSO	WDR
Manila CSD WWTP	SSO	WDR
Mobile Home Estates	SSO	WDR
Yreka City WWTP	SSO	WDR
California Utilities	SSO	WDR
Glenview Mobile Home Park	SSO	WDR
Amador County Regional Outfall	SSO	WDR
Biola WWTF	SSO	WDR
California Pines CSD	SSO	WDR
Clearlake Oaks Co WTR Dis WWTP	SSO	WDR
Groveland WWTF	SSO	WDR
Southeast Regional WW System	SSO	WDR
Adelanto WWTP	SSO	WDR
Barstow Wastewater Treatment Plant	SSO	WDR
Mammoth CWD STP	SSO	WDR
Arcata City WWTF	SSO	NPDES
Eureka City Elk River WWTP	SSO	NPDES
Fortuna City WWTP	SSO	NPDES
Healdsburg City WWTP	SSO	NPDES
Mendocino City CSD	SSO	NPDES
Redway POTW	SSO	NPDES
Ferndale City POTW	SSO	NPDES
Mendocino County WWD#2-Anchor Bay	SSO	NPDES
Graton CSD	SSO	NPDES

Facility Name	Erroneous Program	Corrected Program
EBMUD WPCP	SSO	NPDES
Paso Robles WWTP	SSO	NPDES
Watsonville WWTP	SSO	NPDES
Moorpark WRF - WRR	SSO	NPDES
Calipatria City WWTP	SSO	NPDES
SCWA Russian River CSD	SSO	NPDES
Ukiah City WWTP	SSO	NPDES
Sonoma Valley County SD WWTP	SSO	NPDES
South San Francisco-San Bruno WQCP	SSO	NPDES
California Men's Colony WWTP	SSO	NPDES
South San Luis Obispo SD WWTP	SSO	NPDES
American Valley WWTP	SSO	NPDES
City of Corning WWTP	SSO	NPDES
Discovery Bay WWTP	SSO	NPDES
Grass Valley City WWTP	SSO	NPDES
Dry Creek WWTP	SSO	NPDES
Lincoln City WWTF	SSO	NPDES
Sac City Combined WW Collection/TRT Sys	SSO	NPDES
Stillwater WWTF	SSO	NPDES
Victor Valley Wastewater Reclamation Authority WTP	SSO	NPDES
La Salina WWTP, Oceanside Ocean Outfall	SSO	NPDES
Point Loma WWTP & Ocean Outfall	SSO	NPDES
4-S Ranch CS	WDR	SSO
Alameda City CS	NPDES and WDR	SSO
Angel Island State Park CS	NPDES and WDR	SSO

Facility Name	Erroneous Program	Corrected Program
Angels Camp CS	WDR	SSO
Bear Creek Estates CS	WDR	SSO
Buena CS	WDR	SSO
Calera Crk Wtr Recycling Plant CS	NPDES and WDR	SSO
Carlsbad MWD CS	WDR	SSO
Central Contra Costa Sd CS	NPDES and WDR	SSO
City Of Bakersfield CS	WDR	SSO
City of Chula Vista CS	WDR	SSO
City of Coronado CS	WDR	SSO
City Of Del Mar CS	WDR	SSO
City of El Cajon CS	WDR	SSO
City of Encinitas CS	WDR	SSO
City of Imperial Beach CS	WDR	SSO
City of La Mesa CS	WDR	SSO
City of Laguna Beach CS	WDR	SSO
City of Lemon Grove CS	WDR	SSO
City of National City CS	WDR	SSO
City of Oceanside Collection System, La Salina WWTP	WDR	SSO
City of Poway CS	WDR	SSO
City of San Clemente CS	WDR	SSO
City Of Solana Beach CS	WDR	SSO
City of Vista CS	WDR	SSO
Collection System - Freedom (Ind WDR)	WDR	SSO
Collection System - Pajaro	WDR	SSO
Collection WDR Santa Cruz	WDR	SSO

Facility Name	Erroneous Program	Corrected Program
Contra Costa County SD 5 CS	WDR	SSO
Contra Costa County SD 6 CS	WDR	SSO
County Of San Diego CS - multiple facilities	WDR	SSO
Crescent City CS	NPDES and WDR	SSO
Crystal Springs CSD CS	NPDES and WDR	SSO
CSU San Francisco CS	WDR	SSO
Descanso Detention Facility CS	WDR	SSO
Discovery Bay CS	NPDES and WDR	SSO
Dublin San Ramon Serv Dst CS	NPDES and WDR	SSO
Eastern Municipal Water District CS	WDR	SSO
El Toro Water District R9 CS	WDR	SSO
Elsinore Valley (Southern) Sewage Collection System	WDR	SSO
Emerald Bay Service District CS	WDR	SSO
Fairbanks Ranch CS	WDR	SSO
Fallbrook PUD CS	WDR	SSO
Golden Gate National Rec Area CS	WDR	SSO
Graton CSD Graton CSA No. 2 CS	NPDES and WDR	SSO
Groveland CS	WDR	SSO
Gualala CS	WDR	SSO
HARRF Disch To San Elijo OO CS	NPDES and WDR	SSO
Hercules City CS	NPDES and WDR	SSO
Klamath CSD CS	WDR	SSO
Lake Arrowhead Community Services District Collection Sytem	WDR	SSO
Lake California CS	NPDES	SSO

Facility Name	Erroneous Program	Corrected Program
Lawrence Berkeley National Laboratory CS	WDR	SSO
Leucadia Wastewater District CS	WDR	SSO
Los Alisos WRP CS	WDR	SSO
Los Osos Water Recycling Facility CS	WDR	SSO
Lower Moosa Canyon Recl Facil CS	WDR	SSO
Meadowlark CS	WDR	SSO
Monterey One Water Reg Trtmt & Outfall Sys CS	NPDES	SSO
Moulton Niguel Water District CS	WDR	SSO
Mt. View SD CS	NPDES and WDR	SSO
Murrieta WMWD CS	WDR	SSO
Oakland City CS	NPDES and WDR	SSO
Otay Water District CS	WDR	SSO
Padre Dam CS	WDR	SSO
Pauma Valley Treatment Plant CS	WDR	SSO
Pine Valley San Diego Cnty CS	WDR	SSO
Rainbow Municipal Water Dist CS	WDR	SSO
Redding City CS	NPDES	SSO
Reedley, City Of CS	WDR	SSO
Richmond City CS	NPDES and WDR	SSO
Ridgecrest WWTF CS	WDR	SSO
Rodeo SD CS	NPDES and WDR	SSO
San Diego City CS (Wastewater Collection System)	WDR	SSO
San Mateo City CS	NPDES and WDR	SSO
San Mateo County CS	WDR	SSO
Santa Margarita Water District CS	WDR	SSO

Facility Name	Erroneous Program	Corrected Program
Santa Maria/San Vicente Treatment Plant CS	WDR	SSO
Santa Rosa WRF-Recycled Wtr CS	WDR	SSO
Santa Rosa WRF-Recycled Wtr/Santa Fe Valley CS	WDR	SSO
Sausalito CS	NPDES and WDR	SSO
SCWA Russian River CSD CS	NPDES	SSO
Sf- Oceanside CS	WDR	SSO
Sonoma Valley County S.D. CS	NPDES and WDR	SSO
South Coast Water District CS	WDR	SSO
South Park CSD CS	NPDES and WDR	SSO
South San Francisco City CS	NPDES and WDR	SSO
South San Luis Obispo Sd CS	NPDES	SSO
Temecula Valley RCS	WDR	SSO
Tomales Village CS	WDR	SSO
Town Of Hillsborough CS	NPDES and WDR	SSO
Trabuco Canyon Water District CS	WDR	SSO
Tuttletown Recreation Area CS	WDR	SSO
Ukiah Valley Sanitation District CS	NPDES	SSO
West County WW District CS	NPDES and WDR	SSO
Westwood CS	WDR	SSO
Whispering Palms CS	WDR	SSO
Windsor Town CS	NPDES	SSO

CHAPTER D: INADEQUACY & RISK ASSESSMENT METHODS AND CRITERIA

OCTOBER 2025

Division of Water Quality, State Water Resources Control Board

Office of Water Programs, Sacramento State University

Prepared by the Luskin Center for Innovation | University of California, Los Angeles

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

INTRODUCTION

One of the core tasks of the Wastewater Needs Assessment (WWNA) is to identify wastewater treatment facilities (WWTFs) and their associated collection systems currently or with near-term potential to inadequately treat and dispose of wastewater, degrading the environment, system, and public health. Standardized definitions of "Inadequate" and "At-Risk" facilities and systems do not currently exist in wastewater regulations. These definitions will help identify specific wastewater facilities and systems that need attention across California. Thus, the work in the Inadequacy and Risk Assessments (Phase 1D) of the WWNA proposes a methodology to define and identify Inadequate and At-Risk wastewater facilities and systems throughout California.

CONTRACTED SCOPE

The research team from the University of California, Los Angeles (UCLA) is the lead on the Inadequacy and Risk Assessments (Phase 1D) of the broader WWNA. These assessments attempt to provide definitions for Inadequate and At-Risk wastewater facilities and systems, while also achieving coherence with existing regulatory definitions, code, or law. The intent of these definitions is to identify wastewater facilities and systems in need of additional funding and support to improve wastewater services and compliance across California.

The Inadequacy and Risk (hereafter, "I&R," when discussed together) Assessments build upon the Data Collection and Gap Analysis (Phase 1C) completed by the Office of Water Programs (OWP) at Sacramento State University, which identifies the data sources available for analysis in the WWNA and defines which WWTFs and associated collection systems will be included in the I&R Assessments. The I&R Assessments also lead directly into later phases of the WWNA project, including the OWP's Cost of Solutions Assessment Approach (Phase 1E), which identifies a framework for modeling potential solutions and estimating costs for Inadequate WWTFs and collection systems. The WWNA follows a sequential, qualitative approach like that used in the State Water Resources Control Board's (State Water Board's) annual Drinking Water Needs Assessment to identify under-performing and at-risk drinking water systems, project high-level solutions to address these failings, and estimate the solutions' rough associated costs.

Overall, the contracted scope of the I&R Assessments consists of two core elements:

- Identification of currently Inadequate wastewater facilities and systems: developing and evaluating inadequacy criteria for wastewater facilities and systems regulated under a National Pollutant Discharge Elimination System (NPDES) permit, a Waste Discharge Requirement (WDR), or the Sanitary Sewer System General Order (SSSGO).
- Identification of currently At-Risk wastewater facilities and systems: developing and evaluating risk criteria for wastewater facilities and systems regulated under an NPDES permit, a WDR, or the SSSGO. These systems are at-risk of being identified as Inadequate in the future.

As noted above, the results of the entire WWNA, but especially the I&R Assessments, will be used to prioritize public wastewater facilities and systems for additional funding considerations, guide State Water Board technical assistance, and develop strategies for implementing interim and long-term solutions. In addition, this assessment will help the Regional Water Boards implementing SB 1215 evaluate which systems can immediately provide sewer service to unsewered disadvantaged communities, and which ones may need assistance themselves to do so.

INCLUDED FACILITY AND SYSTEM TYPES

All WWTFs and collection systems that meet the inclusion criteria[28] defined in OWP's Data Collection and Gap Analysis (Phase 1C) are included in the I&R Assessments. Different regulatory processes apply to WWTFs and collection systems because of their distinct roles in the wastewater management process and varying potential impacts on the environment and human health. The I&R Assessments include WWTFs regulated by a NPDES permit; WWTFs regulated by a WDR; and collection systems regulated by the SSSGO.

Throughout this chapter, these facilities and systems are referred to as NPDES, WDR, and SSSGO facilities and systems.

- **NPDES:** Wastewater facilities regulated by the US Clean Water Act that discharge into navigable surface waters such as rivers, lakes, and streams. These facilities must meet specific limits of pollutant levels in their discharges and require regular monitoring and reporting to ensure compliance with environmental standards.
- **WDR:** Wastewater facilitated regulated by the California Code of Regulations that discharge waste that can affect the quality of waters of the state including surface water and groundwater.
- **SSSGO:** Municipal wastewater collection systems that collect and transport wastewater to ensure it is safely managed and treated before being discharged into the environment. The goal of regulating and monitoring these systems is to prevent overflows and spills of untreated or partially treated sewage.

The quantitative I&R Assessments conducted in Phase 2 of the WWNA will be performed for 272 NPDES, 1,373 WDR, and 1,073 SSSGO facilities and systems included in the WWNA, as defined in OWP's Data Collection and Gap Analysis (Chapter C).

Table 5: Wastewater Facility Types Analyzed in the 2027 Inadequacy & Risk Assessments

Facility or System Type	Number Included in WWNA
NPDES	272

[28]System types included in the WWNA: Public treatment plants – cities and special districts; Private treatment plants serving rural residential settlements, mobile home parks, etc.; Migrant labor camps; RV Parks; Hotels; Prisons and Work/Conservation Camps; Schools and Hospitals.

Facility or System Type	Number Included in WWNA
WDR	1,372
SSSGO	1,013
TOTAL ANALYZED:	**2,657**

The I&R Assessments will not evaluate Onsite Sewage Treatment Systems (OSTS) or unsewered communities more broadly. However, an assessment of impacts to groundwater by OSTS and unsewered communities by WWNA project team members at the OWP, supported by analysis generated by UMass, will be included as a separate analysis in the Risk Assessment generated in Phase 2 of the WWNA. Appendix B presents the methodology for this proposed OSTS Groundwater Impacts Assessment (GIA).

INADEQUACY & RISK CRITERIA SELECTION

These assessments must provide a rigorous, data-driven evaluation of the performance and potential vulnerabilities of wastewater facilities and systems across California. This approach may limit the inclusion of some useful data points for several reasons: certain data may only be available for a subset of facilities and systems, may be computationally intensive to process, or may come from private or one-time sources, making them less accessible or consistent. The findings will be shared in a public-facing report; therefore, to ensure credibility and transparency, the underlying data should meet the following guidelines:

- **Relevance to I&R Assessments**: All data incorporated into the I&R Assessments should have a direct connection to the WWNA's definition of Inadequate and At-Risk facilities and systems. There is no unequivocal degree of relevance for inclusion, but this criterion largely relies on expert and professional judgment. Additionally, criteria included in the predictive Risk Assessment will be considered for their collinearity to interpret the relationship between each risk variable and their ability to predict At-Risk wastewater facilities and systems.
- **Publicly Available**: Data in the WWNA must be publicly available for the vast majority of facilities and systems under evaluation. This ensures accountability, allows for independent verification, and helps mitigate the omission of potential facilities or systems of concern due to data gaps. Some data will need to be requested directly from the State Water Board or the California Regional Water Quality Control Boards (Regional Water Boards), and not all data will be available for every system included in the assessments, although the WWNA project team aims to primarily use data that is available for all or most facilities and systems included in the assessments.
- **Computationally feasible**: The assessment will use simple, mostly quantitative inputs— such as discharge monitoring rates, infrastructure age, or missing required reports—rather than qualitative judgments, which are subject to discretion or are time intensive to compute. Quantitative data support the

development of measurable and comparable benchmarks for adequacy, given the considerable number of facilities and systems included in the assessments.

- **Reproducible and Temporally Available**: The data must be consistently reproducible and available over time, enabling the State Water Board and partners to potentially track improvements or deteriorations in system performance in potential future versions of the WWNA.

INTRODUCTION TO THE INADEQUACY ASSESSMENT

The assessment must remain focused on identifying facilities and systems most in need of investment or support and help prioritize actions that will reduce public health threats, environmental harm, and regulatory non-compliance. The Inadequacy Assessment aims to identify currently Inadequate NPDES, WDR, and SSSGO facilities and systems.

Based on State and Regional Water Boards' (collectively Water Boards) staff and WWNA project team input, Inadequate wastewater facilities and systems are defined as: **wastewater facilities and systems that do not effectively treat and dispose of wastewater, leading to environmental, health and operational issues**. This definition parallels the State Water Board's Drinking Water Needs Assessment definition of "Failing" drinking water systems. However, the WWNA project team proceeded with a different label ("Inadequate") based on the expressed preference and input from the Water Boards and other stakeholders.

Inadequate wastewater facilities and systems can have infrastructural and operational shortcomings, resulting in violations and enforcement orders. Violations are issued by the Water Boards and occur when the system fails to comply with state or federal wastewater regulations. Enforcement orders are issued by the Water Boards in response to unresolved violations that may require corrective measures.

The identification of Inadequate wastewater facilities and systems will help the Water Boards prioritize technical assistance and funding towards facilities and systems most in need of support. This will help facilities and systems return to compliance with regulations, preventing further degradation to the environment, system, and community, and, if needed, support the eventual extension of sewer services to communities lacking reliable access.

The WWNA's definition of Inadequate wastewater facilities and systems is not legally binding and differs from the definition of "Inadequate Sewer Service" in Assembly Bill (AB) 805[29]. Passed in 2024, AB 805 allows the State Water Board, until January 1, 2029, to appoint an administrator for sewer systems with a history of regulatory failures and serve disadvantaged communities. The goal is to provide technical, managerial, and financial support to improve service quality. AB 805 has a narrower scope and has been implemented to assist a small community in the Central Valley. The WWNA's definition of Inadequate wastewater facilities and systems is not limited to facilities or systems serving disadvantaged communities. Rather, its definition aims to identify

[29] Full bill text here: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240AB805

wastewater facilities and systems experiencing multiple types of wastewater treatment and disposal challenges.

Additionally, the WWNA definition of Inadequate wastewater facilities and systems is largely distinct from the regulatory framework developed by the passage of Senate Bill (SB) 1215[30] in 2018. This bill established a statewide program to facilitate the consolidation of inadequate onsite sewage treatment systems (OSTS) with existing sewer systems. As noted earlier, the I&R Assessments in this initial WWNA do not evaluate OSTS or unsewered communities, but such communities are considered in OWP's GIA (Phase 1D - Appendix D2) and Cost of Solutions Assessment Approach (Chapter E).

INTRODUCTION TO THE RISK ASSESSMENT

The Risk Assessment aims to identify currently "At-Risk" NPDES, WDR, and SSSGO facilities and systems. These are facilities and systems that are at-risk of becoming Inadequate in the future.

Based on Water Boards staff and WWNA project team input, At-Risk wastewater facilities and systems are defined as: **facilities and systems that may be confronting circumstances which threaten their ability to continue adequately treating and disposing of wastewater.** For example, wastewater facilities and systems serving disadvantaged or severely disadvantaged communities may face limited resources to fund the facility or system and have reduced opportunity for community engagement. Or the impacts of climate change, such as increasing heavy rain and flash floods, can overwhelm sewer systems, especially combined with aging infrastructure, leading to increased sanitary sewer overflows. On the other hand, reduced water availability from drought can affect influent flow volumes and dilution capacity, leading to more concentrated wastewater, straining treatment processes. All variables included in the Risk Assessment are expanded later in this report.

The goals of the Risk Assessment are:

1. Identify wastewater facilities and systems in need of potential assistance or support before they fail to provide adequate and safe sanitation services.
2. Help prioritize facilities and systems for targeted technical and financial assistance. This support will advance long-term solutions to prevent wastewater facilities and systems from inadequately treating or disposing wastewater and help provide reliable and safe wastewater services across California.

In other words, the risk assessment aims to preventatively identify and support wastewater facilities and systems, and the communities they serve, before conditions deteriorate to a state of acute concern.

[30] Full bill text here: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB1215

END-USE OF ASSESSMENTS

The identification of Inadequate and At-Risk Wastewater facilities and systems will help the Water Boards target technical assistance and funding towards facilities and systems most in need of support. For example, these assessments are crucial for the Regional Water Boards in implementing SB 1215 (septic-to-sewer projects) and assessing the condition of wastewater facilities and systems. Additionally, these assessments can benefit the State Water Board when evaluating wastewater projects, such as Capital Improvement or Wastewater Consolidation opportunities, submitted to various Division of Financial Assistance (DFA)-managed funding programs, or the Technical Assistance Program (see Phase 1B report for more detail on specific programs).[31] These assessments will assist Water Boards staff to help facilities and systems remain in, and return to, compliance with wastewater regulations, preventing further degradation to the environment, facility, and community.

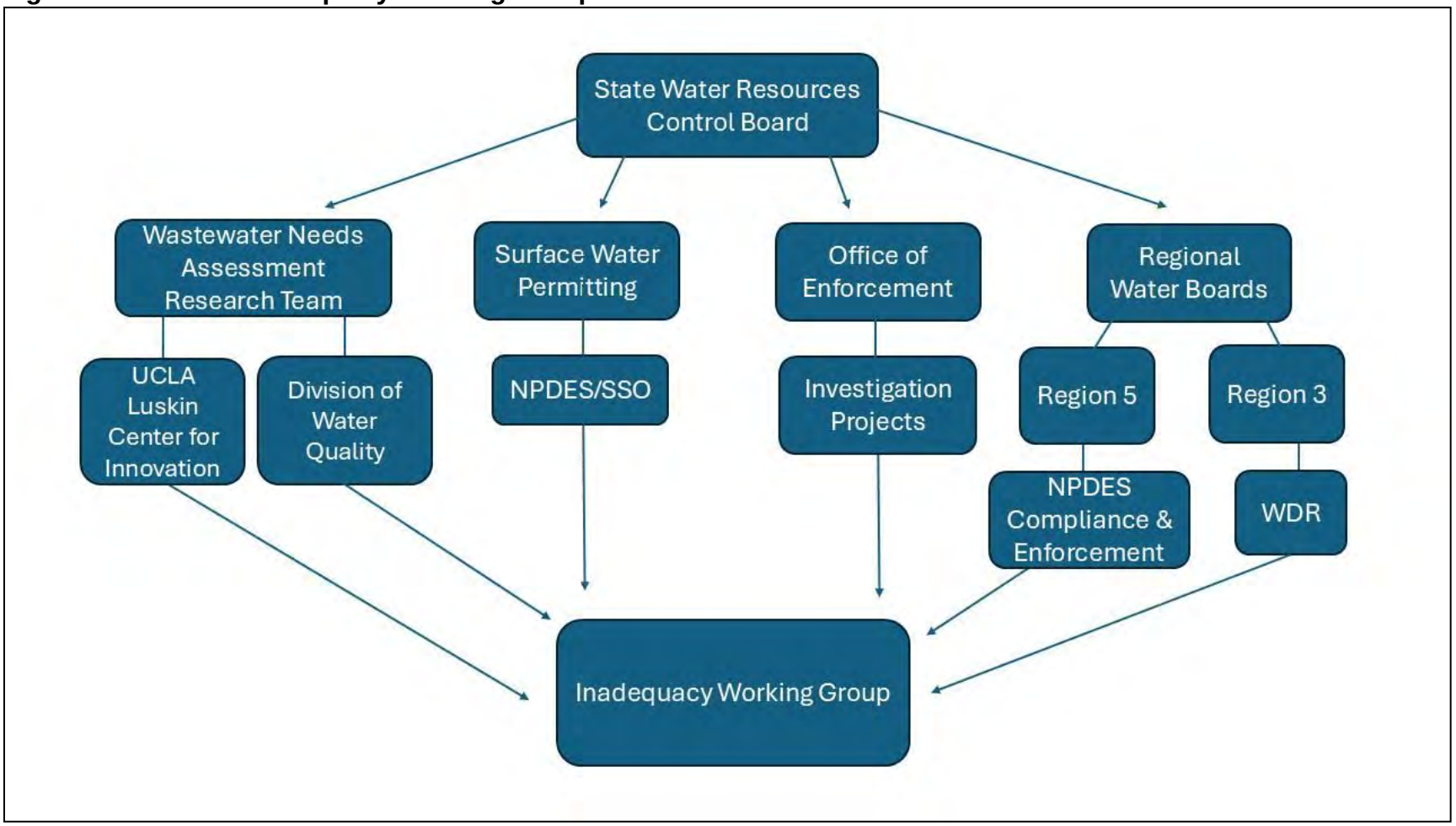
METHODS INTRODUCTION

INADEQUACY & RISK CRITERIA DEVELOPMENT

The WWNA project team began developing the Inadequacy Criteria in July 2024. Shortly after, the WWNA project team established an Internal Working Group of Water Boards staff experienced with compliance and enforcement reporting, tracking, and data for all three permit types. Through a series of monthly meetings and input forms, State and Regional Water Board staff helped us identify the most relevant violations and enforcement orders for each permit type. They also helped to explain why some of these factors should not be included in the Inadequacy Criteria. The WWNA project team will continue collaborating with this Internal Working Group through 2025 as the Inadequacy Criteria is finalized.

[31] See: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/07/Phase-1B-Report-Baseline-Studies-Review.pdf

Figure 14: Internal Inadequacy Working Group



The WWNA project team developed an initial list of Risk Criteria based on reviews of previously published literature, conversations with experts within the WWNA project team, and consultation with Water Boards staff serving on the Internal Inadequacy Working Group, all with experience in compliance and enforcement for facilities and systems regulated under an NPDES permit, WDR, or SSSGO. The WWNA project team presented its initial proposed list of I&R Criteria for each permit type at the January 2025 Advisory Group meeting to solicit live feedback on the proposed criteria from the meeting attendees. In addition, the WWNA project team hosted two office hour sessions where Advisory Group members could ask questions and provide additional feedback on both the I&R Criteria. The WWNA project team adjusted the criteria based on each round of feedback and shared these updates with the Internal Working Group and WWNA team. This report contains the most recent version of the I&R Criteria. At this time, given the project and contract specified timelines and deliverables, there may be limited opportunities to modify these criteria as additional feedback is received from Water Boards staff and Advisory Group members before final implementation of the I&R Assessments. However, the implementation stage of the WWNA (Phase 2) directly follows the publication of this report.

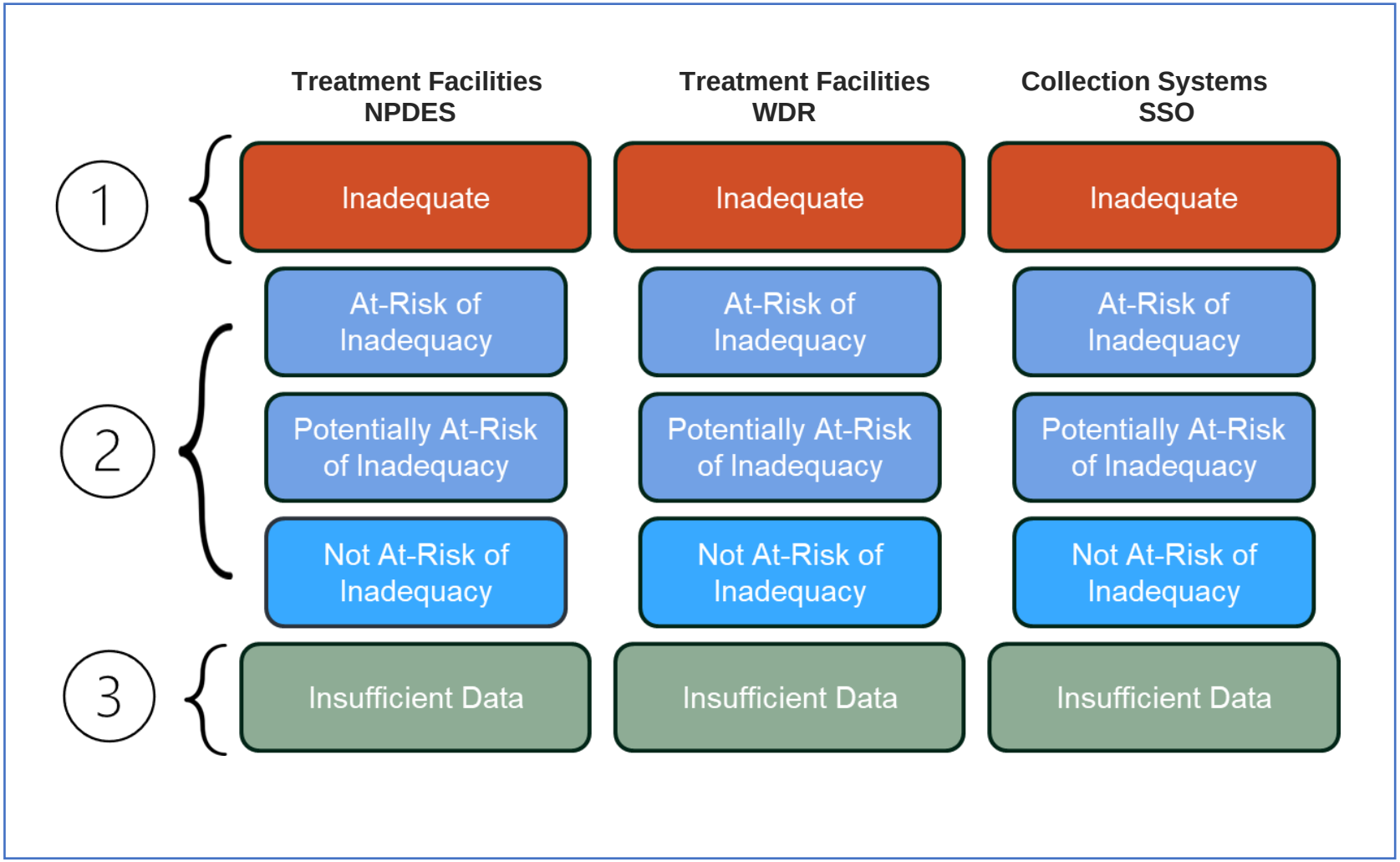
CRITERIA VARIATION ACROSS FACILITY AND SYSTEM TYPES

Wastewater facilities and systems regulated under an NPDES permit, a WDR, or the SSSGO serve nuanced purposes, can impact the environment and human health in distinct ways, and thus are regulated differently. Therefore, these facilities and systems require slightly different criteria to identify Inadequate and At-Risk facilities and systems within each type.

The criteria proposed in this report vary across the three facility and system types, NPDES, WDR, and SSSGO, although some criteria are shared. Figure 15. visualizes the six different assessments that will be completed for the WWNA. Distinct Inadequacy Assessments for NPDES, WDR, and SSSGO facilities and systems, and distinct Risk Assessments for NPDES, WDR, and SSSGO facilities and systems.

In some cases, the WWNA project team may have to exclude systems from the entire I&R analysis, as they may have wholly insufficient data in order to enable credible scoring and categorization. The WWNA project team will hesitate to use this option, as discussed at the end of this chapter.

Figure 15: Assessments by Facility and System Type



DATA SOURCES

As explained above, the data used in the WWNA must be publicly available or producible by the State Water Board for all or most wastewater facilities and systems across California, internally valid and reliable, and updated with some regularity.

For these reasons, the primary data source for the Inadequacy Assessment is the California Integrated Water Quality System (CIWQS). CIWQS is a database used by the Water Boards to manage wastewater facilities and systems permits, inspections, violations, and enforcement actions. Despite challenges with CIWQS's public-facing user-interface, such as limited search and filter options and manually input data, which can include entry errors, it is by far the most reliable source of publicly available water quality data for California wastewater facilities and systems. Additionally, in a review of other public state databases for wastewater facility and system performance and compliance data, CIWQS compares relatively well in terms of accessibility and data availability. Some CIWQS data is also available through California's Open Data Portal, which improves overall accessibility. The WWNA project team is using CIWQS and the CA Open Data portal to access data on wastewater facilities and systems included in the WWNA, with a specific focus on violation and enforcement action data to inform the Inadequacy Criteria.

Another key data source for NPDES facilities in the WWNA will be the Integrated Compliance Information System – National Pollutant Discharge Elimination System (ICIS-NPDES). This database is managed by US EPA and contains data from discharge monitoring reports (DMRs).

The WWNA project team is also receiving a limited amount of data from the State Water Board's DFA for the I&R Assessments. This data is focused on wastewater facilities and systems' treatment classes, and the presence of required certified operators. Specifically, the status of whether a certified operator(s) is qualified for that treatment class regularly serves or is present at that system or facility.

INADEQUACY ASSESSMENT

PROPOSED INADEQUACY CRITERIA

The proposed Inadequacy Criteria for wastewater facilities and systems regulated by an NPDES permit, a WDR, or the SSSGO are reported below based on research and input received from a variety of experts and stakeholders. Each table lists the Inadequacy Criteria intended for use in the initial WWNA to determine if a wastewater facility or system is significantly non-compliant with existing state and federal wastewater

regulations, reflecting infrastructural and operational shortcomings, resulting in violations and enforcement orders.[32]

SANITARY SEWER SYSTEM GENERAL ORDER (SSSGO)

A sanitary sewer system is broadly described as a network of pipes that collect and transport wastewater to treatment facilities. These systems are regulated under the Sanitary Sewer System General Order[33] (SSSGO) by the State Water Board to prevent contamination of water bodies and protect public health. The 2023 SSSGO states a sanitary sewer system "includes, but is not limited to, pipes, valves, pump stations, manholes, siphons, wet wells, diversion structures, and/or other pertinent infrastructure, upstream of a wastewater treatment plant headworks."

The SSSGO is largely focused on preventing sanitary sewer overflows, which can contaminate water, as well as harm aquatic and human health. Accordingly, the criteria the WWNA project team developed to identify Inadequate SSSGO systems share this focus on sanitary sewer overflow frequency, severity, recovery, and reporting.

FUTURE ADJUSTMENTS TO SSSGO INADEQUACY CRITERIA

The WWNA project team is considering several adjustments to the proposed SSSGO Inadequacy Criteria for Phase 2 of the WWNA.

First, using a more limited number of criteria to develop an initial list of potentially Inadequate SSSGO systems, followed by secondary criteria – such as presence of active enforcement actions including notices of violation (NOV) – to highlight systems of greatest concern. This approach helps mitigate sampling bias for systems that consistently report enforcement actions such as NOVs.

Second, to more accurately identify systems experiencing a serious number of sanitary sewer overflows, the WWNA project team is considering implementing performance bands based on 12-month and 5-year rolling averages of CA sanitary sewer overflows, rather than identifying systems with a greater number of spills/100mi than the CA state average every year for the past five years. These bands would establish thresholds to better identify systems of greatest concern. Additionally, grouping systems by size (large, medium, small, micro) would allow comparisons between systems of a comparable size. While the existing proposed criteria normalize the number of spills/100 miles, sized-based groups would better highlight systems of greatest concern in each group.

Finally, the WWNA project team may consolidate the three reporting-related criteria into one variable. This could be an option if the initial list of potentially Inadequate systems needs to be narrowed by flagging systems missing multiple types of reports.

[32] After the WWNA assessment study is complete, it will be up to the Water Boards staff to maintain and update the inadequacy and at-risk lists. Periodic evaluations—every few years—should determine whether systems remain classified as inadequate, at-risk, or should be footnoted to reflect that violations are being addressed.

[33] Program details here: https://www.waterboards.ca.gov/water_issues/programs/sso/

PROPOSED SSSGO INADEQUACY CRITERIA METHODS

The Inadequacy Criteria for SSSGO systems are still under active development as described above to ensure the WWNA project team generates a targeted list of systems for the Water Boards to assist. The WWNA project team emphasize that is an initial, proposed criteria to identify Inadequate SSSGO systems.

Currently, a SSSGO system would be identified as Inadequate if the system meets two or more of the criteria listed in the table below. The SSSGO Inadequacy criteria below are all weighted equally at this time.

Table 6: Inadequacy Criteria for SSSGO Systems

Indicator Type	Criteria Description
Sanitary Sewer Overflows	Greater number of (Category 1-3[34]) spills/100miles than the state average number of spills/100miles every year for the past 5 years.
Spill Recovery	75% of a Category 1 spill reached surface water in the last 5 years excluding those that occurred during exceptional circumstances (e.g., a 1-in-100-year storm, earthquake, fire).
Sewer System Management Plan Missing	No Sewer System Management Plan submitted in the last 6 years, or existing plan is more than 6 years old.
No-spill Certification	Missing "No Spill Certification" when 0 spills reported for 12/12 months the past year.
Annual Report Missing	No Annual Report submitted in the last year.
Notice of Violation	1+ active or historical Notice of Violation (NOV) in the last 5 years
Enforcement Order	1+ active Enforcement Order(s) in the last 5 years: - Administrative Civil Liability Order (ACLO) - Cleanup & Abatement Order (CAO) - Cease & Desist Order (CDO) - Time Schedule Order (TSO)

[34] Refer to the SSSGO program's spill categories table for definitions: https://www.waterboards.ca.gov/water_issues/programs/sso/

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

The National Pollutant Discharge Elimination System (NPDES) permit program was created in conjunction with the US Government's passage of the Clean Water Act[35] (CWA) in 1972 and remains a flagship initiative of CWA efforts nationally. Therefore, and distinct from WDR facilities or SSSGO systems, the US EPA authorizes the NPDES permit program to state, tribal, and territorial governments to implement the NPDES program locally. The NPDES permit program regulates the discharge of pollutants into waters of the United States. Therefore, an NPDES permit is typically a license for a facility to discharge a specified amount of pollution into receiving water under certain conditions.

The WWNA project team structured the Inadequacy Criteria for NPDES facilities to parallel US EPA's existing Significant Non-Compliance (SNC) criteria. As shown in Table 7, there are five individual criteria that are used by US EPA to calculate an overall SNC score. SNC refers to NPDES permits violating permit terms that are serious enough to warrant enforcement and compliance attention by US EPA. These violations can include exceedances of permitted discharge limits, failure to submit required reports, or other actions that negatively impact human health or the environment.

PROPOSED NPDES INADEQUACY CRITERIA METHODS

The Inadequacy Criteria for NPDES facilities are still in development, aimed at creating a targeted list of systems for the Water Boards to assist. These are an initial, proposed criteria to identify Inadequate NPDES facilities.

The current proposed Inadequacy Criteria primarily rely on the US EPA's Significant Non-Compliance (SNC)[36] designation. This designation is well understood and accepted in the wastewater community and minimizes the analytical effort required to create new Inadequacy Criteria for NPDES facilities. The only planned deviation from US EPA's SNC criteria is to incorporate enforcement order data from CIWQS, as recommended by the Internal Inadequacy Working Group. In short, a NPDES facility would be identified as Inadequate by either having one or more active enforcement order(s) in the last five years (see Table 7 for included enforcement orders), or, if the facility is included on EPA's list of SNC systems from the most recently available quarter because the system has met one or more of the SNC criteria listed in Table 7.

[35] The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Find more information here: https://www.epa.gov/laws-regulations/summary-clean-water-act

[36] Types of SNC violations range from significant exceedances of effluent limits, which can cause harm to human health and the environment to failure to submit reports that can mask serious deficiencies. Find more information here: https://www.epa.gov/enforcement/national-enforcement-and-compliance-initiative-reducing-significant-non-compliance

Table 7: Inadequacy Criteria for NPDES Facilities

Violation Type	Violation Description	Additional Details
Compliance/Permit Schedule - Violations	Facility has an enforcement action or permit compliance schedule event violation more than 90 days late.	No additional details
Effluent - Monthly Average Limit	Facility receives effluent violation(s) from exceeding **monthly** average Discharge Monitoring Report (DMR) limits (technical review criteria or chronic criteria) or a SNC-level single event violation.	**Monthly** exceedances are based upon a monthly average of readings submitted by the permittee. EPA generally believes that monthly averages are the most important, because the exceedance represents an average of many readings. **Technical Review Criteria (TRC)** establishes a threshold for effluent exceedance violations that equal or exceed the limit by 20 or 40 percent in any two or more months in a 6-month period at the same permitted feature, monitoring location, parameter, and statistical base type. - Group I[37] Pollutant TRC = 1.4 - Group II Pollutants TRC = 1.2 **Chronic** C**riteria** establishes a threshold for effluent exceedance violations that exceed the limit by any amount in any four or more months during a 6-month period at the same permitted feature, monitoring location, parameter, and statistical base type.

[37] Group 1 pollutants are typically considered more critical; however, Group 2 pollutants still indicate noncompliance with permit conditions, but are generally less critical. Review the specific contaminants in each Group in the Code of Federal Regulations: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-123/subpart-C/section-123.45

Violation Type	Violation Description	Additional Details
Effluent - Non-monthly Average Limit	Facility receives effluent violation(s) from exceeding **non-monthly** average DMR limits (technical review criteria or chronic).	**Non-monthly** exceedances are generally a "maximum" amount read during the reporting period (and could indicate a spike that is not continuous).
Compliance/Permit Schedule - Reporting	Facility has an enforcement action or permit compliance reporting violation more than 30 days late	No additional details
Failure to Report DMR - Not Received	Regulator does not receive a system's DMR in the required reporting timeframe.	No additional details
Open Enforcement Order in the last 5 years	1+ active enforcement order(s) in the last 5 years: - Administrative Civil Liability Order (ACLO) - Cleanup & Abatement Order (CAO) - Cease & Desist Order (CDO) - Time Schedule Order (TSO)	These data are not found within the ICIS-NPDES dataset. Reports about enforcement orders are found within the California Integrated Water Quality System (CIWQS).

WASTE DISCHARGE REQUIREMENT (WDR)

Finally, a Waste Discharge Requirement (WDR) is a type of permit issued by the Water Boards to regulate discharges of waste that can affect the quality of surface water or groundwater. Unlike NPDES facilities, WDR facilities are regulated exclusively by the Water Boards and not the Federal Government. Regulations within these permits largely focus on effluent discharge limits and monitoring and reporting requirements to ensure discharges do not negatively impact water quality, aquatic, and human health. The criteria developed to identify Inadequate WDR facilities shares this focus on impact to water quality as well as aquatic and human health.

PROPOSED WDR INADEQUACY CRITERIA METHODS

The Inadequacy Criteria for WDR facilities are still under active development as the WWNA project team wants to ensure the criteria are specific enough to generate a targeted list of systems for the Water Boards to assist. These are initial, proposed criteria to identify Inadequate WDR facilities.

As WDR facilities are not federally regulated, there is no shared definition or set of criteria, such as NPDES's SNC criteria, to define what an Inadequate WDR facility may look like. Therefore, the WWNA project team worked with the Internal Working Group to develop a set of Inadequacy Criteria for WDR facilities. The Internal Inadequacy Working Group helped us identify the most relevant violation types for WDR facilities and apply weights to those violations based on how well their presence may indicate if a system is functioning inadequately. The exact weighting and thresholds applied to these violation types are still being discussed, and those listed should be interpreted as proposed weights and thresholds.

Tables 8 and 9 include the Inadequacy Criteria for WDR facilities. Table 8 lists effluent violations and enforcement order types with specific limit exceedances or number of enforcement orders that would identify a WDR facility as Inadequate if one is surpassed. Table 9 lists monitoring & reporting (M&R) violations along with the violations proposed weights based on the level of concern. Rather than considering a facility as Inadequate if one of these M&R violations occurs, the WWNA project team is proposing setting an Inadequacy threshold that considers if multiple M&R violations have occurred over the last 5 years. This quantitative threshold has not been established and will be informed by the initial results of the WWNA project team's analysis.

For additional information about each violation type included in the tables below, please refer to the CIWQS glossary.[38]

[38] Link to CIWQS glossary: https://www.waterboards.ca.gov/water_issues/programs/ciwqs/glossary.html

Table 8: Inadequacy Criteria for WDR Facilities: Effluent Violations & Enforcement Orders

Violation Group	Violation Type	Inadequacy Criteria
Effluent Violation	Total Suspended Solids (TSS)	Exceed permit limit by 20% or more in any 2 months in a 6-month period the last 5 years.
	Total Kjeldahl Nitrogen (TKN) as (N)	Exceed permit limit by 20% or in any 2 months in a 6-month period the last 5 years.
	Settleable Solids	Exceed permit limit by 20% or more in any 2 months in a 6-month period the last 5 years.
	pH	Exceed permit limit by 20% or more in any 2 months in a 6-month period the last 5 years.
	Oil and Grease	Exceed permit limit by 60% or more in any 2 months in a 6-month period the last 5 years.
	Dissolved Oxygen	Exceed permit limit by 60% or more in any 2 months in a 6-month period the last 5 years.
	Surface Loading Rate	Exceed permit limit by 40% or more in any 2 months in a 6-month period the last 5 years.
	Nitrogen, Total (as N); Nitrite plus Nitrate (as N); Nitrate, Total (as NO3); Nitrate, Total (as N)	Exceed permit limit by 20% or more in any 2 months in a 6-month period the last 5 years.
	Carbonaceous Biochemical Oxygen Demand (CBOD), Percent Removal; Carbonaceous Biochemical Oxygen Demand (CBOD)	Exceed permit limit by 20% or more in any 2 months in a 6-month period the last 5 years.
	Biochemical Oxygen Demand (BOD)	Exceed permit limit by 40% or more in any 2 months in a 6-month period the last 5 years.
	Ammonia, Total (as N) violation; Ammonia, Unionized (as N)	Exceed permit limit by 20% or more in any 2 months in a 6-month period the last 5 years.
	E. coli; Fecal Coliform, Total Coliform, Enterococcus	Exceed permit limit by 20% or more in any 2 months in a 6-month period the last 5 years.

Violation Group	Violation Type	Inadequacy Criteria
Enforcement Order	Administrative Civil Liability Order (ACLO); Cleanup & Abatement Order (CAO); Cease & Desist Order (CDO)	1 or more ACLO, CAO, or CDO over the last 5 years
	Notice of Violation (NOV)	2 or more NOVs over the last 5 years.

Table 9: Inadequacy Criteria for WDR Facilities: Monitoring & Reporting Violations

Violation Group	Violation Type	Threshold	Weight
Monitoring & Reporting Violation	Unauthorized Discharge	1 or more Unauthorized Discharge violation(s) over the last 5 years	3
	Sanitary Sewer Overflow/Spill	1 or more Sanitary Sewer Overflow/Spill violation(s) over the last 5 years	2
	Failure to submit a monitoring report	1 or more missing monitoring report(s) over the last 5 years	3
	Late Report	1 or more Late Report violation(s) over the last 5 years	1
	Deficient Report	1 or more Deficient Report violation(s) over the last 5 years	2
	Receiving Water - Groundwater	1 or more Receiving Water - Groundwater violation(s) over the last 5 years	3
	Receiving Water - Surface Water	1 or more Receiving Water - Surface Water violation(s) over the last 5 years	3
	Enforcement Action	1 or more Enforcement Action violation(s) over the last 5 years	3
	Deficient Monitoring	1 or more Deficient Monitoring violation(s) over the last 5 years	1

Violation Group	Violation Type	Threshold	Weight
	Order Conditions	1 or more Order Conditions violation(s) over the last 5 years	2
	Flow	1 or more Flow violation(s) over the last 5 years	3

RISK ASSESSMENT

RISK ASSESSMENT COMPONENTS

The Risk Assessment's aim is to identify facilities and systems at-risk of becoming Inadequate in the future. These facilities and systems require some intervention, or else their concerns may become exacerbated, negatively impacting human and environmental health.

The Risk Assessment will evaluate the performance of wastewater treatment and collection systems across risk indicators within the following four categories: socioeconomic, operational, environmental, and public health. NPDES, WDR, SSSGO facilities and systems require both a set of core variables shared between all three, and an additional set of distinct Risk Criteria to capture their diverse characteristics accurately.

In calculating the risk assessment for each facility type, the WWNA project team must also consider not only the inclusion of risk indicators but also the thresholds of concern for each indicator and how the indicators are combined via weighting and scoring to contribute to the overall assessment.

- **Risk Indicators:** quantifiable measurements of key data points that allow the State Water Board to assess the near-term probability of a water system inadequately treating or disposing of wastewater. Risk indicators will be incorporated based on their criticality as it relates to a system's ability to remain in compliance with wastewater standards.
- **Risk Thresholds**: the levels, points, or values associated with a risk indicator that delineates when a water system is more or less at-risk of inadequacy.
- **Weighting and/or Scoring**: the application of a value or weight to each risk indicator – as certain risk indicators may be deemed more critical than others. The application of weights to risk indicators allows the State Water Board to assess all the risk indicators together with a combined Risk Assessment score.

As with the Inadequacy Assessment, the WWNA project team conducted an extensive evaluation of indicators recommended for inclusion in the Risk Assessment across facility and system types. Many potential risk indicators were excluded from the initial WWNA Risk Assessment due to limitations in the coverage, availability, and quality of the data necessary for calculating these indicators, as further discussed below in

Appendix A, Table 9. In particular, insufficient data is currently available to robustly assess the financial capacity of wastewater systems, such as their wastewater rates or days of cash on hand, as well as their capital asset conditions, such as equipment redundancies.

The State Water Board's primary violation, enforcement, and regulatory tracking database for wastewater facilities and systems, CIWQS, was designed for reporting compliance to the State Water Board and US EPA. The database was not designed for the type of complex risk assessments being done in California or tailored to California's specific water quality regulations or monitoring needs. CIWQS is further limited in its ability to store technical, managerial, and financial data and currently does not separate out other key system-level data components, such as facilities' asset conditions.

The Water Boards have made several efforts to augment this data collection and management through project-specific efforts, such as SSSGO system surveys and a previous DFA survey of rates and charges. The ideal solution would likely entail the creation of a comprehensive data management system to fully support the transparent and data-driven work required for the WWNA.

RISK INDICATOR CATEGORIES

The WWNA project team selected risk category names and variables to be included in the Risk Assessment based on reviews of previously published literature, conversations with experts within the project team, and consultation with the Internal Working Group. Additionally, the WWNA project team received feedback and input, incorporated from the Wastewater Needs Assessment Advisory Group.

Table 10: Number of Evaluated and Included Risk Variables

Category	Number of Variables Evaluated	Number of Variables Included
Socioeconomic	9	4
Operational	19	14
Environmental	10	8
Public Health	6	1
Total	**44**	**27**

There is no perfect way to construct comprehensive and non-overlapping risk categories. The WWNA project team selected four broad risk categories - socioeconomic, operational, environmental, and public health - to organize risk variables. Of forty-four evaluated variables, twenty-seven were included.

Table 11 lists the selected variables and the applicable facility or system types (NPDES, WDR, or SSSGO). Table 12 provides a detailed description of each included risk variable. Variables were excluded mainly due to a lack of relevant or up-to-date data sources (most common), composite measures that may be better represented by individual risk variables, or variables that are outside of the core scope of the WWNA.

The descriptions and specific reasons for exclusion can be found in Appendix D1, Table 13.

Table 11: Risk Indicators Included Across Facility and System Types[39]

Category	Risk Indicators*
Socioeconomic	Household Socioeconomic Burden
	Disadvantaged Community Status
	Severely Disadvantaged Community Status
	Race/Ethnicity
Operational	Relative Annual Capital Expenditures (SSSGO only)
	Relative Operation & Maintenance Budget (SSSGO only)
	<15% of system being cleaned annually (SSSGO only)
	<10% of system being inspected with closed-circuit television (CCTV) annually (SSSGO only)
	Relative system capacity (SSSGO only)
	Age of System
	System Governance
	Operator Certification
	Future Permit Limit Additions (NPDES only)
	Design Flow vs. Actual Flow
	Depopulation
	Population Growth
	Population Served by System
	Permit from before 2000 (WDR only)
Environmental	Wildfire
	Discharge to impaired water bodies
	Drought Indicator
	Flooding
	High Precipitation Events
	Sea Level Rise
	Extreme Heat

[39] Not all indicators listed may have a direct impact on the risk of wastewater system or facility inadequacy in the short-term but may potentially have more relevancy to risk over a longer time frame.

Category	Risk Indicators*
	Increasing Instances of Near- Discharge Exceedance (NPDES only)
Public Health	Constituents of Emerging Concern (NPDES only)

**Risk indicators without a specified system type are applicable to all systems*

Table 12 provides more detailed descriptions and the rationale behind the significance of the included risk variables, as well as their proposed data sources. Since not every variable is relevant for every system type, the variable column indicates whether the indicator is relevant for NPDES, WDR, and/or SSSGO facilities and systems. The thresholds listed in the following tables are initial approximations and will be updated for future versions.

Table 12: Included Risk Variables Details

Risk Category	Variable	Description	Potential Thresholds	Data Source
Socioeconomic	Household Socioeconomic Burden *(NPDES, WDR, SSSGO)*	Measures household poverty prevalence and housing burden using a composite score. Communities with prominent levels of poverty and high housing costs may struggle more to pay for the necessary upgrades, maintenance, and operation of wastewater facilities and systems.	>50% population with incomes <200% of federal poverty level combined with >50% households with incomes ≤ 80% of the HUD Area Median Family Income (HAMFI) and paying more than 50% of household income for housing,	Poverty Prevalence, 5-year ACS 2023 Housing Cost Burden, Comprehensive Housing Affordability Strategy 2017-2021
Socioeconomic	Disadvantaged Community Status (DAC) *(NPDES, WDR, SSSGO)*	Identifies when a community's median household income is at or below 80 percent of the statewide median household income (MHI).	MHI< 80% of Statewide MHI 80% of Statewide MHI = $77,067 based on 2023 ACS	Median Household Income, 5-year ACS 2023
Socioeconomic	Severely Disadvantaged Community Status (SDAC) *(NPDES, WDR, SSSGO)*	Identifies when a community's median household income is at or below 60 percent of the statewide MHI.	MHI< 60% of Statewide MHI 60% of Statewide MHI = $57,800 based on 2023 ACS	Median Household Income, 5-year ACS 2023

Risk Category	Variable	Description	Potential Thresholds	Data Source
Socioeconomic	Race/Ethnicity *(NPDES, WDR, SSSGO)*	The racial and ethnic makeup of the community served by a Wastewater System and Facility. Historically marginalized people and communities are disproportionately likely to be without access to safe water and sanitation.	> 50% population non-white	Race and Ethnicity, 5-year ACS 2023
Operational	Relative Annual Capital Expenditures *(SSSGO)*	Funds spent on acquiring, upgrading, or maintaining physical assets and infrastructure to build, expand, or upgrade wastewater facilities or systems relative to the size of the system.	To be determined	Only available in SSO Questionnaire (pre-June 2023)
Operational	Relative Operation & Maintenance Budget *(SSSGO)*	Self-reported budgets that cover the costs associated with operating, maintaining, and managing wastewater facilities or systems relative to the size of the system.	To be determined	Only available in SSO Questionnaire (pre-June 2023)
Operational	Percent of system cleaned annually *(SSSGO)*	Indicates insufficient system maintenance, increasing risk of system inefficiency or failure.	<15% of the system cleaned annually	SSO Annual Reports (post- June 2023) SSO Questionnaire (pre-June 2023)

Risk Category	Variable	Description	Potential Thresholds	Data Source
Operational	Percent of system inspected with closed-circuit television (CCTV) annually *(SSSGO)*	Indicates inadequate inspection practices, increasing the likelihood of undetected issues and reducing system reliability.	<10% of the system inspected with CCTV annually	SSO Annual Reports (post- June 2023) SSO Questionnaire (pre-June 2023)
Operational	Relative System Capacity *(SSSGO)*	The designed flow capacity of a system relative to the total number of people served by the system.	To be determined	SSO Annual Reports (post- June 2023) SSO Questionnaire (pre-June 2023)
Operational	Age of system *(SSSGO)*	System may be more likely to experience structural failures, capacity issues, and increased maintenance needs.	> 50% of system built before 1980	SSO Annual Reports (post- June 2023) SSO Questionnaire (pre-June 2023)
Operational	System Governance Type *(NPDES, WDR, SSSGO)*	The legal entity that manages a wastewater facility or system.	Privately managed, small (see below criteria), non-CPUC regulated systems,	Facility Details CIWQS File

Risk Category	Variable	Description	Potential Thresholds	Data Source
Operational	Operator Certification *(NPDES, WDR, SSSGO)*	Measures if a certified operator is present at a wastewater treatment facility and, if so, if the certification present is sufficient for the wastewater facility or system.	No certified operator present, or under-qualified operator present	DFA WWTP Classifications SSO Annual Report (post- June 2023) SSO Questionnaire (pre- June 2023)
Operational	Future Permit Limit Additions *(NPDES)*	NPDES-permitted wastewater facilities typically follow secondary treatment standards. However, facilities discharging into impaired or effluent-dominated waterbodies with beneficial uses must meet tertiary treatment standards and may face stricter limits in the future, which will be approximated here.	Tertiary treatment standards imposed	ICIS-NPDES Permit Limit and Discharge Monitoring Report (DMR) Datasets; 2024 303(d) list
Operational	Design Flow vs. Actual Flow *(NPDES, WDR, SSSGO)*	Measures the peak flow volume that a Wastewater System and Facility is designed to process compared to the amount the system is truly processing. Identifies overburdened systems.	To be determined	Volumetric Annual Report - design flow eSMR - actual flow (NPDES & WDR)

Risk Category	Variable	Description	Potential Thresholds	Data Source
Operational	Depopulation of System Service Area *(NPDES, WDR, SSSGO)*	Measures the population decline of areas served by a wastewater system and facility. A shrinking customer base can lead to difficulties covering fixed costs and necessary upgrades.	>15% population decline in the previous 5 years	Total Population, 5-year ACS: 2019,2020,2021, 2022,2023
Operational	Population Growth of System Service Area *(NPDES, WDR, SSSGO)*	The increase in the population served by a wastewater system and facility. Rapid population growth can lead to hydraulic overloading and operational constraints.	>15% population growth in the previous 5 years	Total Population, 5-year ACS: 2019,2020,2021, 2022,2023
Operational	Population Served by System *(NPDES, WDR, SSSGO)*	The total number of people served by a given wastewater treatment facility or collection system. Necessary volume and capacity estimates are a function of the population served by the system.	Small= Population served by system <3,000 .	SSO Annual Reports (post- June 2023) SSO Questionnaire (pre-June 2023)
Operational	Year Permit Issued (WDR)	Measures if wastewater facilities and systems have an up-to-date permit(s). Out-of-date permits may not have appropriate limits and systems may struggle to remain in compliance with General Order requirements.	Permit issued before 2000	Facility Details CIWQS File

Risk Category	Variable	Description	Potential Thresholds	Data Source
Environmental	Near-Discharge Exceedance (NPDES)	Wastewater facilities and systems that are nearing their limits for priority parameters like permitted flow, BOD and nutrient loading, and any local contaminants of concern.	≥ 2 quarters reporting < 10% difference from effluent discharge limit	US EPA Enforcement and Compliance History Online (ECHO) database
Environmental	Discharge to impaired water bodies *(NPDES, WDR, SSSGO)*	Identifies wastewater facilities and systems which may have increasingly stringent discharge requirements because they discharge to a 303(d) List impaired waterbody.	System discharges to impaired waterbodies	The California Water Boards 2020-2022 Integrated Report
Environmental	Drought *(NPDES, WDR, SSSGO)*	Drought impacts and associated conservation measures contribute to lower indoor water usage. Declining indoor water flows can pose risk to wastewater facilities and systems.	To be determined based on final data source used	Example: U.S. Drought Monitor, NDMC, USDA, and NOAA
Environmental	Flooding *(NPDES, WDR, SSSGO)*	Various metrics measure flood risk to wastewater facilities and systems. Flooding can lead to wastewater infrastructure damage and forced treatment bypass.	To be determined based on final data source used	Example: California DWR Flood maps

Risk Category	Variable	Description	Potential Thresholds	Data Source
Environmental	Precipitation Levels *(NPDES, WDR, SSSGO)*	Various metrics identify regions with historically high precipitation levels. Very high precipitation levels can increase influent levels past the acute or chronic capacity of a wastewater facility or system.	To be determined based on final data source used	Example: Western U.S. Climate Historical Summaries
Environmental	Sea Level Rise *(NPDES, WDR, SSSGO)*	Various metrics project sea level rise. For coastal wastewater facilities or systems, sea level rise can cause flooding or block system outflows, among other negative system impacts.	To be determined based on final data source used	Example: Sea Level Rise Viewer, NOAA
Environmental	Extreme Heat *(NPDES, WDR, SSSGO)*	Various metrics identify local areas with frequent and especially severe extreme heat days. Extreme heat events can impact wastewater facilities or systems' ability to remove contaminants effectively and efficiently.	To be determined based on final data source used	Example: National Environmental Public Health Tracking Network, CDC

Risk Category	Variable	Description	Potential Thresholds	Data Source
Environmental	Wildfire *(NPDES, WDR, SSSGO)*	Various metrics measure the projected fire hazard severity of an area where a Wastewater System and Facility is located. Wildfires can damage wastewater infrastructure and change flow levels.	To be determined based on final data source used	Example: Fire Hazard Severity Zones, Cal Fire
Public Health	Constituents of Emerging Concern (CEC) *(NPDES, WDR, SSSGO)*	CECs are substances or matter of concern in aquatic ecosystems for which there are not currently published enforceable health standards, the standard is being evaluated, or the toxicology and overall relative risk is not fully understood.	To be determined based on provisional or scientific-literature standards	CEC Dataset, State Water Resources Control Board

NEXT STEPS

The methodology and criteria developed over the past two years and laid out here for I&R assessments in the inaugural WWNA are subject to additional refinement, especially as they are operationalized with real data. Any changes to the criteria will be made in consultation with the broader WWNA project team, Water Boards staff and management, and the WWNA Advisory Group. Further details on implementation and any adjustments will be fully described in the 2027 final WWNA report.

However, as per the WWNA timeline, the WWNA project team must operationalize these criteria in the near term to produce lists of Inadequate and At-Risk Systems by early 2026. These lists will first be checked by the Regional Water Boards staff with knowledge of and experience with these systems before the list is finalized and the Inadequate systems are further assessed for solutions and associated cost estimates.

RISK THRESHOLDS AND WEIGHTS

The WWNA project team is still developing the risk thresholds, weights, and scores that will be applied to the risk variables to perform the risk assessment for each facility and system type. Like the process of selecting the included risk variables, the weights and thresholds will be informed by the WWNA project team in consultation with the Water Boards and the WWNA Advisory Group, as well as relevant case examples and literature. Once the risk thresholds and weights/scores are finalized and applied to the risk variables, the WWNA project team can conduct the full, quantitative risk assessment.

SYSTEMS WITH INSUFFICIENT DATA

When individual systems do not have sufficient data, the WWNA project team is ultimately unable to categorize them as Inadequate, At-Risk, or Not-at-Risk using the developed criteria. However, systems that are not reporting or have very incomplete data may be the most At-Risk or already Inadequate. This is especially a concern for WDR facilities because these systems are not federally regulated, generally have fewer staff assigned to their oversight, and therefore, have fewer resources to regularly report data. The WWNA project team is currently considering different strategies on how to minimize the number of systems excluded from the inaugural WWNA due to insufficient data, how to account for and characterize the systems that do not have enough data to evaluate and longer-term recommendations to ensure such systems and the populations they serve and ecosystems they affect are not effectively excluded from the due consideration and support they need.

APPENDIX MATERIALS

APPENDIX D1 – EXCLUDED RISK CRITERIA

Table 13: Excluded Risk Criteria

Risk Category	Variable	Description	Reason for exclusion
Socioeconomic	Incomplete Plumbing	Incomplete plumbing identifies the number of occupied housing units lacking complete plumbing.	There is no longer complete data for the incomplete plumbing variable. The U.S. Census Bureau removed the portion of the complete plumbing question that identified if there is a flush toilet in the house as of the 2016 ACS. As such, there is no longer relevant data after the 2012 - 2016 ACS.
Socioeconomic	CalEnviroScreen-determined Disadvantaged Community	CalEnviroScreen Disadvantaged Communities measures cumulative health burden through a composite score based on a combination of 21 indicators of pollution burden and population characteristics.	Several of the indicators included in the composite score are not relevant to wastewater facilities or systems. Moreover, the water sector in California traditionally uses income-based definitions of disadvantaged community status, as enshrined in the California Water Code.

Risk Category	Variable	Description	Reason for exclusion
Socioeconomic	Wastewater utility rates and charges	Wastewater rates and charges are set by wastewater utilities and paid for by customers to help cover the cost of operating and maintaining a wastewater facility or system.	Data for wastewater rates previously maintained by the Water Boards is incomplete and out of date (last version 2018).
Socioeconomic	Redlining	Redlining data was a discriminatory practice of denying or limiting financial services, such as loans or insurance, to certain communities based on their racial or ethnic composition. Redlining maps help identify areas with systematic and historic disinvestment and persisting housing and economic disparities.	Redlining data is mainly applicable for large urban centers. Data on this phenomenon does not apply to and is thus not available for all of California.
Operational	Operating ratio	Operating ratio measures the ratio of annual operating revenues to annual operating expenses.	Data is not collected at a statewide scale currently.

Risk Category	Variable	Description	Reason for exclusion
Operational	Days cash on hand	Days cash on hand measures the number of days the system can continue to operate using only the cash and cash equivalents it currently has available. It is the equivalent of a personal checking account balance for a utility.	Data is not collected at a statewide scale currently.
Operational	System Interconnections	Interconnections allow systems to move water from one section of the system to another when additional flow is needed, or when an overflow has occurred and excess flow must be moved. Interconnections can increase a system's overall resilience.	There is incomplete data for system interconnections via permits and facility details on CIWQS.
Operational	Equipment Backups	Measures if a wastewater facility or system has redundant systems in case of primary equipment failure.	The equipment backups variable may be difficult to measure as data about currently held; specific system infrastructure components are extremely limited.

Risk Category	Variable	Description	Reason for exclusion
Operational	Deferred Maintenance	Deferred maintenance is the delay of necessary repairs and upkeep for wastewater facilities and systems	Data on Deferred Maintenance is not available.
Environmental	Discharge to impaired water bodies	Discharges to impaired water bodies measure if wastewater facilities or systems discharges into an impaired waterbody and might indicate increased permitting requirements.	Waterbody impairment status is not necessarily a driver of permit limits. Additionally, this factor is partially covered in the included *Future Permit Limitations Additions* risk variable
Environmental	Climate Risk Composite	Climate Risk Composite is a composite climate risk indicator which includes multiple ecological risk factors.	It has been judged to be more effective to use individual climate risk variables that directly impact wastewater facilities and systems in diverse ways and to different degrees
Public Health	Incidence of Norovirus or Gastroenteritis	Incidence of norovirus or gastroenteritis measures confirmed norovirus outbreaks submitted by each State.	A quantitative public health risk assessment is outside the contracted scope of the WWNA.

Risk Category	Variable	Description	Reason for exclusion
Public Health	Quantitative Microbial Risk Assessment	Quantitative microbial risk assessment estimates the risk from exposure to microorganisms based on the measurement of pathogenic organisms and indicators.	A quantitative microbial risk assessment is outside the contracted scope of the WWNA.
Public Health	Mobile Toilet Prevalence	Mobile toilet prevalence measures the number of toilets in an area.	Data for this variable is incomplete. Additionally, the presence of mobile toilets does not have a direct impact on or reflect the functioning of a Wastewater Systems and Facility.
Public Health	Septic Hauling	Septic hauling measures the prevalence of septic hauling in an area.	Septic hauling does not directly impact or completely reflect the functioning of wastewater systems. Additionally, access to permit data for disposal is incomplete statewide.

APPENDIX D2 – GROUNDWATER IMPACTS ASSESSMENT

PREFACE

Although the assessment proposed below was not specifically included in the WWNA scope of work, the WWNA project team identified a simple means to assess potential impacts to groundwater quality from OSTS. Practitioners may use this additional assessment to inform where projects addressing potential groundwater impacts from OSTS might first be focused. The WWNA project team has included this proposed methodology as an appendix to the WWNA Inadequacy and Risk Assessment chapter, as it fits best here compared to other scope tasks.

INTRODUCTION

In addition to performing the Inadequacy and Risk Assessments on domestic wastewater facilities regulated by Nation Pollutant Discharge Elimination System (NPDES) permits, Waste Discharge Requirements (WDRs), and the Sanitary Sewer System General Order (SSSGO), the WWNA project team will assess statewide where onsite sewage treatment systems (OSTS)[40] might be impacting groundwater quality. This Groundwater Impacts Assessment (GIA)[41] will evaluate the potential for OSTS to contribute to nitrate contamination based on existing well data and modeled potential contamination concentrations from OSTS, as well as other site attributes that are likely to influence contamination.

Nitrate contamination is especially important to study because many California communities rely on groundwater as their primary source of drinking water. Elevated nitrate levels are associated with potential health risk, particularly in disadvantaged, rural communities. The WWNA project team acknowledges that other sources of nitrate contamination could be contributing to elevated nitrate[42] levels in groundwater (e.g., agriculture), but the proposed GIA will only be able to assess the likelihood of OSTS contributing to such contamination.[43]

The results can be used to inform decisions on where OSTS conversion projects (to existing sewer or to a community cluster) might be focused. The proposed GIA may help with the goals of the State Water Resource Control Board's (State Water Board's)

[40] OSTS refers to unsewered wastewater systems such as onsite wastewater treatment systems (OWTS) and cesspools.
[41] The GIA is not part of the original contract main tasks. The existing OSTS location data and their potential groundwater impacts are identified using nitrate information from the GAMMA database.
[42] The WWNA project team attempted to evaluate some of the annual WDR monitoring data, including bacteria data, as part of the GIA. However, the team determined that extracting the data would require substantial resources due to formatting and other accessibility issues. The team therefore discontinued pursuit of this data and continued the analysis using the available nitrate data from the Gamma database.
[43] If Water Board staff determine that multiple sources may be contributing multiple actions may be considered.

OWTS Policy[44] and relevant regional assessments[45] without overriding them. As a statewide assessment, the results of the GIA may be most useful for regions without planned or ongoing similar assessments.

The remainder of this appendix focuses on the GIA's application, use, and methodology.

APPLICATION AND USE

The GIA is intended to serve as a statewide screening methodology for identifying areas where OSTS may be contributing to elevated nitrate concentrations in groundwater. It is not intended to influence regulatory decisions but rather supports strategic planning, technical assistance targeting, and infrastructure investment, especially in the context of the WWNA.

The results of the GIA can be used to support the following:

- **Planning and Program Development:** Agencies and stakeholders can use the GIA classifications to identify areas were additional investigation, technical assistance, or infrastructure planning may be considered.
- **Gap Identification:** The GIA highlights areas where measured data is lacking and where modeling suggests potential vulnerability. These areas may benefit from further targeted groundwater monitoring or system performance assessments.
- **Recognizing Opportunities for OSTS Conversion or Sewer Connection:** The GIA outputs can inform efforts to identify unsewered communities or parcels where transitioning from OSTS to centralized sewer service may improve groundwater quality.

METHODOLOGY

The GIA applies a geospatial, rule-based screening approach to estimate the likelihood of OSTS contributing to nitrate contamination in groundwater across California. It uses both direct indicators (measured nitrate concentrations) and indirect indicators (modeled nitrogen concentrations and site attributes) to classify contamination likelihood.

A deliberately conservative approach was adopted to estimate nitrogen loading to groundwater for the GIA. It is assumed that a conventional OSTS provides essentially no nitrogen attenuation before recharge, so the nitrogen load to groundwater is equal to the typical per-capita load discharged to the OSTS. It is further assumed that all wastewater nitrogen is oxidized to nitrate during subsurface transport. Throughout this appendix, nitrate concentrations are reported as nitrate-nitrogen (NO_3-N) to allow direct comparison with total nitrogen (TN) loading and the nitrate maximum contaminant level (MCL).

[44] CA State Water Board OWTS Policy, 2023
[45] An example is the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) program.

The GIA is structured into three main components:

- **Assessment Applicability**: Defines where the GIA applies by identifying OSTS-dependent areas using proxy datasets and, later during the inaugural WWNA, a statewide sewered/unsewered parcel model.
- **Key Factor Selection**: Identifies key factors and underlying variables influencing the likelihood that OSTS may be contributing to nitrate contamination in groundwater.
- **Contamination Likelihood Classification**: Categorizes parcels into one of four likelihood classes (very high, high, moderate, and low) based on a three-tier decision framework as to how likely OSTS may be contributing to elevated nitrate concentrations.

Each component is further described below.

ASSESSMENT APPLICABILITY

The WWNA project team will apply the GIA only to OSTS-dependent unsewered areas, as approximated by a model being developed by the University of Massachusetts, Amherst (UMass), in the broader WWNA project. Until the UMass model is completed (estimated for December 2025), proxy datasets will be used to approximate unsewered parcels served by OSTS, with a focus on rural areas. The WWNA project team will use the following proxy datasets to construct a statewide screening layer identifying OSTS-dependent unsewered areas:

- **U.S. Census Bureau Urban and Rural Classification and Urban Area Criteria**[46]: Classifies the state into urban and rural areas based on 2020 census boundaries. The project team will apply the GIA to non-urban areas where OSTS are more likely.
- **U.S.G.S. National Land Cover Database (NLCD)**[47]: Provides detailed land cover classes, including levels of urban development. Parcels classified as "developed," specifically NLCD classes 21 (Developed, Open Space), 22 (Low Intensity), 23 (Medium Intensity), and 24 (High Intensity), are excluded from the GIA.
- **CA Office of Land Use and Climate Innovation Land Use Layers**[48]: Includes county-level general plan designations, zoning maps, and parcel land use codes that will be used in the GIA to remove areas designated as high-density or urban under local plans.

Only parcels in OSTS-dependent unsewered areas will be evaluated for the likelihood of contributing to nitrate contamination.

[46] U.S. Census Bureau. (2021). Urban and Rural Classification and Urban Area Criteria.
[47] U.S. Geological Survey (USGS). (2024). National Land Cover Database 2021 (NLCD 2021) – Land Cover.
[48] California Office of Land Use and Climate Innovation. (2020). California General Plan Land Use Layers.

KEY FACTOR SELECTION

The WWNA project team selected key factors to represent the core processes established in scientific studies to influence nitrate loading, transport, and attenuation from OSTS. Each key factor has one or more associated variables based on relevance to groundwater contamination pathways, availability at the parcel scale, and suitability for statewide analysis. These key factors and their associated variables, summarized in Table 10, are detailed in the following sections, including their descriptions, data sources, and processing methods.

Table 14: Key Factors and Associated Variables

Key Factors	Variable(s)
Measured Groundwater Nitrate Concentration	o Groundwater Nitrate Concentration Measurements
Modeled Nitrate Concentrations from OSTS	o Population o Per Capita Nitrogen Contribution o Parcel Area o Annual Precipitation
Site Attributes	o Depth to Groundwater o Soil Drainage

MEASURED GROUNDWATER NITRATE CONCENTRATION

1 associated variable: groundwater nitrate concentration measurements

- **Variable**: Groundwater Nitrate Concentration Measurements (mg/L)
  - **Description**: Measured concentrations of NO_3-N in groundwater, expressed in milligrams per liter (mg/L), based on data from monitoring wells across California compiled by the State Water Board's Groundwater Ambient Monitoring and Assessment (GAMA) Program.
  - **Justification**: This variable provides direct evidence of nitrate contamination in groundwater, based on observed concentrations. It serves as the most reliable indicator of OSTS-related impacts where monitoring data is available, anchoring the assessment in measured conditions. The influence of OSTS on measured concentrations depends on how close monitoring wells are to OSTS. Closer proximity increases the likelihood that observed nitrate levels reflect local OSTS impacts.
  - **Data Source**: GAMA Program[49]
  - **Processing Method**: No processing necessary; measured nitrate concentration values will be used directly as reported in the GAMA dataset.

[49] California State Water Resources Control Board. (2025). Groundwater Ambient Monitoring and Assessment (GAMA) Program. https://www.waterboards.ca.gov/gama/.

MODELED NITRATE CONCENTRATIONS FROM OSTS

4 associated variables: population, per capita nitrogen load, parcel area, and annual precipitation

- **Variable:** Population (estimated occupants per parcel)
  - **Description:** Estimated number of OSTS users per parcel, calculated using the number of bedrooms as a proxy for household population (1 bedroom = 1 person), used to model nitrogen concentrations.
  - **Justification:** Population is a primary driver of nitrogen input from OSTS, with more residents contributing to higher wastewater volumes and nutrient loading. Because parcel-level population data is limited, bedroom counts offer a consistent and scalable proxy to support statewide modeling.
  - **Data Source:** State Water Board Division of Information Technology (DIT, 2023)[50]
  - **Processing Method:** The WWNA project team will extract bedroom counts from the California Parcel Shapefile and apply a 1:1 ratio (one person per bedroom) to estimate parcel-level population, which will be used in the nitrogen loading calculation.
- **Variable:** Per Capita Nitrogen Loading (g/day/person)
  - **Description:** Standardized daily nitrogen discharge rate per person through OSTS, used to estimate the total nitrogen load from each parcel.
  - **Justification:** This rate converts the estimated population into nitrogen load using a standardized daily discharge rate. It enables consistent and transparent nitrogen loading estimates across parcels, even where site-specific data is unavailable.
  - **Data Source:** Tchobanoglous et al. (2013)[51]
  - **Processing Method:** No processing is required. The WWNA project team will use a fixed per capita nitrogen contribution value of 13.3 g/day/person in the loading calculations.
- **Variable:** Parcel Area (acres)
  - **Description:** Total parcel area over which modeled nitrogen loading is distributed, affecting dilution and attenuation capacity.
  - **Justification:** Parcel size influences the concentration and dilution of nitrogen in the subsurface. Larger parcels allow greater dispersal and attenuation of nitrogen, while smaller parcels concentrate loading and increase the likelihood of contributing to groundwater contamination.
  - **Data Source:** State Water Board DIT (2023)[52]
  - **Processing Method:** Parcel polygons were processed in ArcGIS Pro using the “Calculate Geometry” tool to determine parcel area in acres for each parcel.

[50]California State Water Resources Control Board, Division of Information Technology (SWRCB DIT). (2023). *California Parcel Shapefile.*

[51] Metcalf & Eddy, Tchobanoglous, G., Stensel, H., Tsuchihashi, R., & Burton, F. (2013). *Wastewater Engineering: Treatment and Resource Recovery* (5th ed.). McGraw-Hill.

[52] California State Water Resources Control Board, Division of Information Technology (State Water Board DIT). (2023). *California Parcel Shapefile.*

- **Variable:** Annual Precipitation (inches)
    - **Description**: Average annual precipitation at each parcel, used to estimate groundwater recharge and its influence on nitrate dilution.
    - **Justification:** Higher precipitation increases the volume of water entering the subsurface, which can dilute nitrate concentrations by dispersing the nitrogen load over a larger volume of recharged groundwater. This reduces the overall concentration of nitrate in groundwater, assuming infiltration occurs, and other attenuation processes are limited.
    - **Data Source:** PRISM Climate Group (2025)[53]
    - **Processing Method:** Annual precipitation values will be extracted in ArcGIS Pro using the "Extract Values to Points" tool. Parcel centroid points will be overlaid on the PRISM raster surface to assign precipitation values. If a centroid falls outside the raster extent, the nearest valid raster value will be assigned based on proximity to the parcel boundary.

SITE ATTRIBUTES

2 associated variables: depth to groundwater, soil classification

- **Variable:** Depth to Groundwater (feet)
    - **Description:** Modeled depth from the land surface to the water table, representing the thickness of the unsaturated zone available for attenuation of wastewater constituents.
    - **Justification:** Groundwater depth determines the thickness of the unsaturated zone available for nitrate attenuation (i.e., denitrification). Shallow water tables reduce the opportunity for attenuation, increasing the likelihood of nitrate reaching the aquifer.
    - **Data Source:** Fan, Li, and Miguez-Macho (2013)[54]
    - **Processing Method:** Groundwater depth values will be extracted in ArcGIS Pro using the "Extract Values to Points" tool. Parcel centroid points will be overlaid on the global depth to groundwater raster to assign precipitation values. If a centroid falls outside the raster extent, the nearest valid raster value will be assigned based on proximity to the parcel boundary.
- **Variable:** Soil Classification
    - **Description:** Natural Resources Conservation Service (NRCS)-defined Soil Drainage Classification, indicating how quickly water and nitrates move through the soil at each parcel.
    - **Justification:** Soil drainage controls the retention time of water in the unsaturated zone and time available for attenuation to take place. Well-drained soils promote rapid leaching with limited treatment, while poorly drained soils can increase retention time and enhance nitrate removals through denitrification.

[53] PRISM Climate Group. (2025). *30-Year Normal Annual Precipitation*. Oregon State University. https://prism.oregonstate.edu/normals/.
[54] Fan, Y., Li, H., & Miguez-Macho, G. (2013). *Global patterns of groundwater table depth*. Science, 339(6122), 940–943. https://doi.org/10.1126/science.1229881.

- **Data Source:** NRCS (2020)[55]
- **Processing Method:** Soil drainage classes will be assigned by spatially joining parcel centroid points to NRCS SSURGO soil polygons in ArcGIS Pro. Each parcel will inherit the drainage class of the intersecting polygon. If no intersection occurs, the classification from the nearest polygon will be assigned based on proximity.

CONTAMINATION LIKELIHOOD CLASSIFICATION

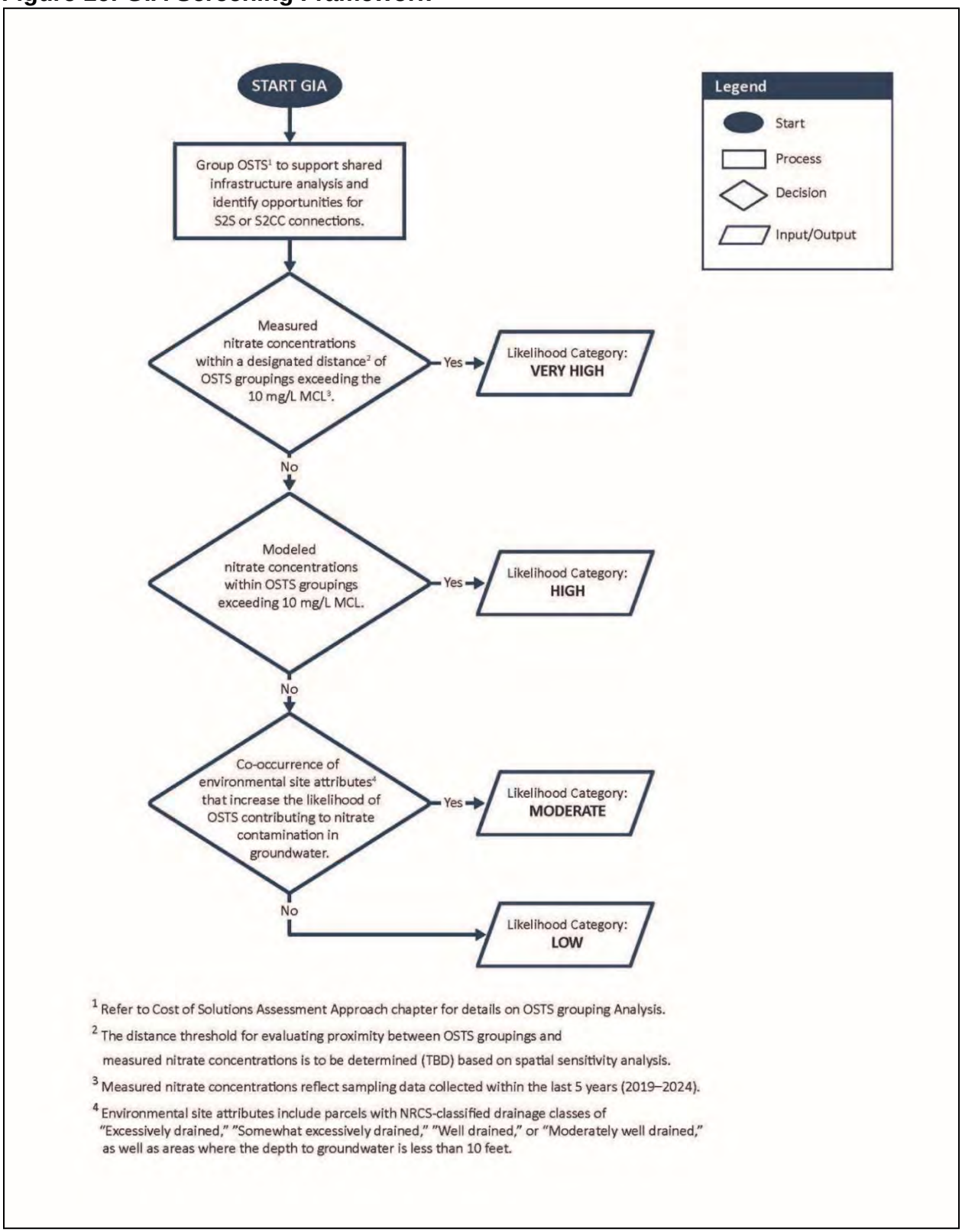
The WWNA project team will assign each parcel a Contamination Likelihood Classification using a three-tier screening framework, evaluating parcels sequentially, with each tier representing a different level of evidence. Once a parcel meets the criteria in a tier, it is assigned that classification and is not evaluated further.

This screening framework reflects the following structure, which is also depicted in Figure 16:

- **Tier 1– Measured Groundwater Nitrate Concentration Screening:** Measured data exceeds nitrate maximum contamination load (MCL) of 10 mg/L.
- **Tier 2– Modeled Nitrate Concentration Screening:** Modeled concentrations exceed nitrate MCL of 10 mg/L.
- **Tier 3–Site Attributes Screening:** Site conditions, such as shallow groundwater and well-drained soils, which can contribute to elevated nitrate concentrations. Shallow groundwater will be defined as having a depth to groundwater less than 10 feet. “Well-drained” soils will be defined as an NRCS classification of excessively drained, somewhat excessively drainage, well drained, or moderately well drained.[56]

[55] Natural Resources Conservation Service (NRCS). (2020). *Soil Survey Geographic (SSURGO) Database*. United States Department of Agriculture. https://www.nrcs.usda.gov/resources/data-and-reports/soil-survey-geographic-ssurgo-database.
[56] NRCS 2020

Figure 16: GIA Screening Framework



[1] Refer to Cost of Solutions Assessment Approach chapter for details on OSTS grouping Analysis.

[2] The distance threshold for evaluating proximity between OSTS groupings and measured nitrate concentrations is to be determined (TBD) based on spatial sensitivity analysis.

[3] Measured nitrate concentrations reflect sampling data collected within the last 5 years (2019–2024).

[4] Environmental site attributes include parcels with NRCS-classified drainage classes of "Excessively drained," "Somewhat excessively drained," "Well drained," or "Moderately well drained," as well as areas where the depth to groundwater is less than 10 feet.

TIER 1: MEASURED GROUNDWATER NITRATE CONCENTRATION

Overview: Identifies areas where nitrate MCL exceedances have been confirmed through measured groundwater data.

Screening Question: Does the parcel fall within a buffer zone around a groundwater sampling location with a nitrate exceedance (≥10 mg/L[57]) recorded within the last five years, and intersect an OSTS Grouping? (buffer zone distance to be determined)

Classification: Very High Likelihood of Contributing to Nitrate Contamination

Data: GAMA Nitrate Monitoring Well Data (SWRCB, 2025)[58].

Methodology:

- Retrieve nitrate concentration records from the GAMA dataset, limited to samples collected since January 1, 2019.
- Identify monitoring well locations where measured nitrate concentrations exceed the MCL of 10 mg/L.
- Create a buffer around each exceedance point to represent the potential zone of influence. The buffer distance will be determined during implementation through iterative testing and calibration.
- Determine and map OSTS groupings using density-based clustering of OSTS-dependent parcels (Refer to Cost of Solutions Assessment Approach (Phase 1E) of the main report for additional details on the OSTS grouping methodology.)
- Perform a spatial intersection to identify parcels located within both a nitrate exceedance buffer and an OSTS Grouping.
- If both conditions are met, classify the parcel as Very High Likelihood of Contributing to Nitrate Contamination.

TIER 2: MODELED NITRATE CONCENTRATIONS FROM OSTS

Overview: Estimates the likelihood of contributing to nitrate contamination using modeled concentration where measured data is unavailable.

Screening Question: Does the modeled nitrate concentration exceed 10 mg/L in an OSTS-dependent Community of Concern?

Classification: High Likelihood of Contributing to Nitrate Contamination

[57] The 10 mg/L threshold is the Primary Maximum Contaminant Level (MCL) for nitrate as nitrogen, set by both the U.S. EPA and the California State Water Resources Control Board.
[58] California State Water Resources Control Board. (2025). *Groundwater Ambient Monitoring and Assessment (GAMA) Program*. https://www.waterboards.ca.gov/gama/.

Data: California Parcel Shapefile (SWRCB DIT, 2023);[59] Annual Precipitation (PRISM Climate Group, 2025);[60] Per Capita Nitrogen Contribution (Tchobanoglous et al., 2013).[61]

Methodology:

- **Estimate Population per Parcel**
  - P = Estimated number of people on parcel
  - Assumption: 1 person per bedroom
  - Data Source: California Parcel Shapefile (bedroom count attribute)
- **Calculate Annual Nitrogen Load (N_T)**

Total nitrogen discharged from the septic system into the subsurface environment.

$$N_T = \frac{P \times L_N \times D}{1000}$$

Where:

  - NT = Annual Nitrogen load (kg/year)
  - P = Estimated number of people on parcel
  - L_N = Per capita nitrogen contribution (13.3 g/person/day)
  - D = Number of days per year (365)
  - 1000 = conversion from grams to kilograms

- **Estimate Groundwater Recharge Volume (V_R)**

Total available water for dilution by local groundwater recharge. It is assumed that 100% of precipitation is recharged.

$$V_R = A_{ft^2} \times \left(\frac{P_R}{12}\right) \times 7.48 \times 3.785$$

Where:

  - V_R = Groundwater recharge volume (Liters/year)
  - A_{ft^2} (A_{ft2}) = Parcel area (square feet)
  - P_R = Annual Precipitation (inches)
  - 12 = conversion from inches to feet
  - 7.48 = conversion from cubic feet to gallons
  - 3.785 = Conversion from gallons to liters

- **Calculate Modeled Nitrate Concentration (C_N)**

The nitrate concentration in the groundwater, assuming all nitrogen is converted to nitrate, 100% precipitation infiltration, and uniform groundwater mixing, but without accounting for denitrification (nitrate to nitrogen gas), soil absorption, or groundwater transport.

---

[59] California State Water Resources Control Board, Division of Information Technology (SWRCB DIT). (2023). *California Parcel Shapefile.*

[60] PRISM Climate Group. (2025). *30-Year Normal Annual Precipitation*. Oregon State University. https://prism.oregonstate.edu/normals/

[61] Metcalf & Eddy, Tchobanoglous, G., Stensel, H., Tsuchihashi, R., & Burton, F. (2013). *Wastewater Engineering: Treatment and Resource Recovery* (5th ed.). McGraw-Hill.

$$C_N = \frac{N_T}{V_R}$$

Where:

- C_N = *Modeled Nitrate Concentration in Groundwater (mg/L)*
- N_T = *Annual Nitrogen load (kg/year)*
- V_R = *Groundwater recharge volume (Liters/year)*

Parcels meeting the following two conditions – exceeding the nitrate MCL and intersecting OSTS groupings – are classified as having a High Likelihood of Contributing to Nitrate Contamination:

- $C_N > 10$ *mg/L MCL*
- *Intersect with OSTS groupings*

TIER 3: SITE ATTRIBUTES SCREENING

Overview: In the absence of measured or modeled exceedances, flags parcels with site characteristics that increase the likelihood of OSTS contributing to nitrate contamination

Screening Question: Does the parcel have well-draining or excessively draining soil and a groundwater depth of less than 10 feet?

Classifications: Moderate Likelihood of Contributing to Nitrate Contamination, Low Likelihood of Contributing to Nitrate Contamination

Data: Soil Drainage Class (NRCS, 2020)[62]; Depth to Groundwater (Fan et al., 2013)[63].

Methodology:

- Assign Soil Drainage Class to each parcel using the NRCS (2020) database.
- Identify parcels with well-draining or excessively draining soils based on NRCS drainage classes classified as “Excessively drained,” “Somewhat excessively drained,” “Well drained,” or “Moderately well drained.”[64]
- Assign depth to groundwater to each parcel using the Fan et al. (2013) dataset.
- Identify parcels where depth to groundwater is less than 10 feet.
- If parcel meets both conditions – well-drained or excessively drained soils and groundwater depth less than 10 feet – classify the parcel as having a Moderate Likelihood of Contributing to Nitrate Contamination.
- Parcels not meeting both conditions were classified as having a Low Likelihood of Contributing to Nitrate Contamination.

[62] Natural Resources Conservation Service (NRCS). (2020). *Soil Survey Geographic (SSURGO) Database*. United States Department of Agriculture. https://www.nrcs.usda.gov/resources/data-and-reports/soil-survey-geographic-ssurgo-database.
[63] Fan, Y., Li, H., & Miguez-Macho, G. (2013). *Global patterns of groundwater table depth*. Science, 339(6122), 940–943. https://doi.org/10.1126/science.1229881.
[64] NRCS 2020

CONCLUSION

The GIA offers a consistent, structured method for identifying areas where OSTS may be contributing to nitrate contamination in groundwater. By integrating measured nitrate data, modeled nitrogen loading, and site attributes, the GIA helps fill a key data gap in understanding water quality risks across unsewered areas of California.

While the GIA does not carry regulatory authority, it serves as a planning and decision-support tool for identifying areas that may benefit from technical assistance, infrastructure investment, or potential OSTS-to-centralized treatment conversions, especially in the context of the WWNA but also potentially beyond. By assigning parcels to one of four contamination likelihood categories, the methodology enables agencies to allocate resources more strategically and effectively.

CHAPTER E: COST OF SOLUTIONS ASSESSMENT APPROACH

OCTOBER 2025

State Water Resources Control Board

Division of Water Quality, State Water Resources Control Board

UCLA Luskin Center for Innovation

UCLA Luskin Center

OWP Sacramento State

Prepared by Office of Water Programs | California State University, Sacramento

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

INTRODUCTION

This chapter of the Phase 1 report presents approaches for:

- Modeling solutions for facilities and systems designated as inadequate by the WWNA's Inadequacy and Risk Assessment
- Modeling opportunities for connecting parcels with onsite sewage treatment systems (OSTS)[65] to an existing or new community system
- Estimating costs for facility and system solutions and OSTS connection opportunities
- Conducting a gap analysis comparing statewide costs to projected funding sources

The proposed approaches include decision criteria, cost assumptions, and calculation methods. The resulting cost estimates represent statewide needs to address domestic[66] sanitation conditions that inhibit the Water Board's vision of clean, safe, and affordable water for human uses and environmental resource protection across California.

The Cost Assessment does not provide a comprehensive assessment of statewide wastewater infrastructure needs. While all wastewater facilities, systems, and OSTS require routine maintenance and infrastructure replacement and enhancements, the Cost Assessment addresses only wastewater facilities and systems identified as currently inadequate, as defined in Chapter D of this report, as well as opportunities for OSTS replacements.

The Cost Assessment is a generalized statewide procedure; it is not designed to evaluate all possible interim and long-term solutions applicable to any specific site. Local solutions and actual costs will vary from system to system and depend on site-specific conditions and circumstances. To address facility inadequacies or potential OSTS connections, communities and practitioners will need to conduct detailed evaluations of their unique wastewater challenges and community needs and identify a range of solutions to select a path forward. Analysis at that level of detail is not possible within the constraints or goals of the WWNA.

[65] OSTS are unsewered wastewater systems such as OWTS (as defined in the State Water Board's 2023 OWTS Policy) and cesspools.

[66] The WWNA focuses on domestic wastewater—wastewater that includes human waste from domestic activities (e.g., cooking, cleaning, and hygiene). This focus derives from the sanitation-themed statutes in the Human Right to Water from which the WWNA originated. The WWNA does not evaluate industrial wastewater. Furthermore, facilities that receive wastewater or sludge treated by other facilities (i.e., are not directly connected to human sanitary sources) are not included in the assessment.

MODELING SOLUTIONS FOR INADEQUATE FACILITIES

Each wastewater treatment facility and collection system determined to be inadequate by the Inadequacy and Risk Assessment will be assigned a selected solution package corresponding to its specific inadequacy criteria. To develop a list of potential solutions, the WWNA project team examined the proposed inadequacy criteria and corresponding violations in both the California Integrated Water Quality System Project (CIWQS) and Sanitary Sewer System (SSS) databases.[67] Generally, the inadequacy criteria address one or more of the following deficiencies:

- **Treatment deficiency:** WWTF fails to achieve adequate removal of one or more constituents and is unable to meet discharge requirements
- **Infrastructure deficiency:** WWTF or collection system infrastructure capacity is insufficient to treat the volume of wastewater received, resulting in flow violations or sanitary sewer overflows
- **Operational deficiency:** collection system insufficient operation or maintenance of a collection system, leading to improper functioning
- **Administrative deficiency:** WWTF or collection system has deficient reporting, fails to respond to regulatory action, or lacks a sewer system management plan (SSMP)

The WWNA project team examined violation data from the CIWQS and SSS databases and identified common violation type combinations. While some facilities or systems only reported violations in a single deficiency category—treatment, operational, infrastructure, or administrative—facilities often reported violations in multiple or all categories. Consequently, the proposed solutions may consider a combination of remedial actions addressing specific inadequacy criteria. The following sections introduce the proposed treatment and infrastructure solutions for treatment facilities, infrastructure and operational solutions for inadequate collection systems, and administrative solutions for inadequate WWTFs and collection systems.

TREATMENT AND INFRASTRUCTURE SOLUTIONS FOR INADEQUATE NPDES AND WDR FACILITIES

Inadequacy criteria for facilities with National Pollutant Discharge Elimination System (NPDES) permits or Waste Discharge Requirements (WDRs) that are not considered OSTS (refer to Chapter C for further distinction) indicate treatment, infrastructure, or administrative deficiencies. This subsection describes the modeled solutions for addressing infrastructure and operational deficiencies of these facilities.

The modeled treatment and infrastructure solutions were designed to address inadequacy criteria related to effluent and receiving water violations. While violations may result from a wide range of water quality parameters and constituents, this study developed and categorized solutions only for those parameters and constituents most commonly addressed by

[67] The California Integrated Water Quality System (CIWQS) is a computer system used by the State and Regional Water Quality Control Boards to track information about places of environmental interest, manage permits and other orders; track inspections; and manage violations and enforcement activities. Public agencies that own or operate sanitary sewer systems must report all spills to CIWQS's Sanitary Sewer System Database.

wastewater treatment facilities. The parameters are listed in Table 5. Table 5 also combines violations associated with these parameters into categories in which violations are assumed to correspond with a similar deficiency in treatment or infrastructure. Each category is assigned a violation category label, which will be used to reference all relevant violations throughout the remainder of this chapter.

Table 15: Violation Categories Used to Develop Solutions

Violation Category	Category Description	Relevant Parameter(s) and Constituent(s)
Suspended Solids	Violations indicating inadequate solids removal	• TSS[1] • Settleable Solids • Turbidity
Flow	Violations for facilities exceeding their permitted flow	• Flow • Surface Loading Rate
pH	Violations for pH outside acceptable range	• pH
Biostimulatory Nitrogen	Violations for exceeding nitrate, nitrite, or total nitrogen discharge limits	• Nitrate, Total (as N) • Nitrate, Total (as NO_3) • Nitrite Plus Nitrate (as N) • Nitrite Plus Nitrate (as N) • Nitrogen, Total (as N) • Nitrogen, Total Organic (as N)
Oxygen-consuming Nitrogen	Violations for exceeding ammonia or total Kjeldahl nitrogen discharge limits	• Ammonia, Total (as N) • Ammonia, Unionized (as N) • Ammonia Impact Ratio • Total Kjeldahl Nitrogen (TKN)
Organics	Violations indicating inadequate removal of organic matter	• BOD (5-day at 20°C)[1] • CBOD (5-day at 20°C)[1]
Bacteria	Violations for inadequate pathogen removal	• E. coli • Enterococci • Fecal & Total Coliform
Disinfection	Violations for residual chlorine levels or disinfection byproducts	• Chlorine, Free Available & Total Residual • CT Value[68] • Dibromochloromethane • Dichlorobromomethane

[1] *Includes both concentration level and percent removal*

[68] CT is the product of the residual concentration of the disinfectant (C) measured in mg/L and the disinfectant contact time (T) measured in minutes. CT = C x T.

Note that Table 5 does not list all parameters for which violations may occur. Examples include total dissolved solids and metals. Such parameters are not typically targeted by treatment by WWTFs, and the violations result from the quality of the water prior to its use and disposal as wastewater. In such cases, source control, rather than treatment, is the preferred strategy for addressing these violations. To support source control solutions, facilities designated as inadequate with violations for parameters not listed in Table 5 will be assigned administrative solutions.

The assigned treatment and infrastructure solutions will depend on the type of violations, the combination of violations, and the facility type. All facilities will be classified by their wastewater treatment process in alignment with the State Water Resources Control Board's (State Water Board's) Wastewater Operator Certification Program (WWOCP) classification of treatment plants by treatment level and technology.[69] The classifications, referred to as facility type, are:

- Primary Treatment
- Conventional Treatment Pond (CTP)
- Modified Treatment Pond (MTP)
- Biofiltration
- Activated Sludge (AS)
- Tertiary Treatment
- Sequencing Batch Reactor (SBR)

The WWNA project team will use CIWQS violation data to identify common combinations of violation categories (Table 5). The team then used violation comments and corrective actions entries from the CIWQS violation data, as well as the State Water Board's Division of Financial Assistance (DFA) engineering reports (ERs) and the WWNA project team's engineering experience, to infer the underlying conditions leading to violations. These presumed conditions were then used to identify potential remedial actions.

The remedial actions are intended to represent common engineering solutions applicable to the respective facility types, not to reflect site-specific conditions. Table 6 lists the remedial actions and applicable facility types. Table 6 also presents scaling factors that the WWNA project team will use to develop associated unit costs.[70] As shown, most remedial actions will be scaled by design flow as a proxy for facility or infrastructure size.

Additionally, the WWNA project team proposes including factors for climate or facility age for some remedial actions. Climate factors impact the sizing of facility infrastructure. For example, a facility may need additional capacity to accommodate significant flow fluctuations associated with seasonal rainfall. Facility age is an indicator of the extent of repairs likely needed.

[69] Wastewater Operator Certification Program. Wastewater Plant Classification [Brochure]. State Water Resources Control Board. https://www.waterboards.ca.gov/water_issues/programs/operator_certification/docs/wwtp_classification_brochure.pdf

[70] The WWNA project team will develop a general unit cost for each remedial action using cost data collected from DFA engineering reports and other industry sources. See the Estimating Costs subsection for more details.

Table 16: Proposed Remedial Actions for Inadequate Treatment Facilities

Remedial Actions	Description	Applicable Facility Types[1]	Scaling Factor(s)[2]
Infiltration and Inflow (I&I) Repairs	Conduct I&I repairs on the collection system	All	Miles of Pipe
General Infrastructure and Equipment Rehabilitation	Conduct general repairs to structures and replace equipment (e.g., pumps, monitoring equipment)	All	Design Flow, Facility Age
Flow Recirculation	Install piping, pumps, and valves to allow operators to move wastewater to various parts of the treatment train to improve treatment efficiency	All	Design Flow
Storage Basin Installation	Construct additional upstream storage to accommodate periodic high flows	All	Design Flow, Climate Factor
Treatment Pond Rehabilitation	Remove accumulated sludge and regrade pond as needed to increase depth extending hydraulic retention time (HRT); install pond liner to prevent seepage leading to groundwater contamination	CTP, MTP	Design Flow
Shaded Zone or Wetlands Construction	Install shade structure or wetlands at pond outlet to discourage algal growth	CTP, MTP	Design Flow
Baffle or Flow Control Measure Installation	Install baffles to prevent short-circuiting within ponds and ensure that wastewater has proper contact with aeration system, or subdivide pond into smaller cells to improve treatment efficiency	MTP	Design Flow
Aeration Improvement	Rehabilitate existing aeration equipment, replace existing aeration system with a more efficient one, or enlarge aeration basin to prolong HRT	All	Design Flow
Biofiltration Improvement	Replace existing media with plastic media to increase surface area per unit volume, increasing treatment efficiency	Biofiltration	Design Flow

Remedial Actions	Description	Applicable Facility Types[1]	Scaling Factor(s)[2]
Clarifier Replacement or Rehabilitation	Replace clarifier or upgrade existing clarifier to improve efficiency (e.g., changing baffles or covering the clarifier to prevent excess algal growth)	AS, Tertiary	Design Flow
Flotation or Filtration System Installation	Install flotation or filtration system to remove excess algae	CTP, MTP	Design Flow
Effluent Filter Installation	Install or replace tertiary filtration system to remove excess TSS	AS, Tertiary, Biofiltration, SBR	Design Flow
Effluent Denitrification	Install denitrification system to treat effluent	All	Design Flow
Disinfection Improvement	Improve upstream filtration, replace chlorination equipment, and/or enlarge contact tank to increase contact time; if the facility has disinfection byproducts (DBPs), replace chlorination equipment with a UV disinfection system.	All	Design Flow
SBR Modification	Upgrade control mechanisms to use real-time sensor data so that various treatment stages have adequate durations or install additional unit	SBR	Design Flow

[1] "All" facility types include primary, CTP, MTP, biofiltration, AS, tertiary and SBR.
[2] Scaling factors will be used to develop unit costs for each remedial action.

A solution package of combined remedial actions will be created to address each facility's specific problem set scenario. The package will take into consideration the combination of violation categories, presumed underlying conditions, and facility type, as summarized in Table 7 and Table 8. Generally, remediation actions vary according to whether the facility types are treatment ponds (CPT or MTP) or mechanical treatment systems (AS, tertiary, biofiltration, and SBR).

Table 17: Common Inadequacy Scenarios and Remedial Actions for Treatment Ponds (CTPs & MTPs)

Violation Category[1]	Assumed Cause	Facility Type	I&I Repairs	Storage Basin Installation	Treatment Pond Rehab	Baffle or Flow Control Measure Install	Aeration Improvement	Flotation or Filtration System Installation	Flow Recirculation	Effluent Denitrification	Shaded Zone or Wetlands Construction	Disinfection Improvement
• Flow • Suspended Solids • Organics • Oxygen-consuming Nitrogen	Facility is periodically hydraulically overloaded, reducing HRT in treatment ponds, resulting in inadequate treatment.	**CTP and MTP**	x	x	x			x				
• Organics • Oxygen-consuming Nitrogen	Facility is chronically organically overloaded, resulting in ineffective treatment due to insufficient HRT or aeration.	**CTP and MTP**			x	x	x		x			
• Suspended Solids • Biostimulatory Nitrogen • pH	High algae concentrations and poor settling in treatment pond(s) causing TSS violations and high pH due to algae consumption of carbon dioxide (CO_2). The presence of nitrate indicates the aeration is adequate.	**CTP and MTP**			x	x		x			x	
• Biostimulatory Nitrogen	Facility has inadequate nitrate removal and is unable to meet discharge requirements.	**CTP and MTP**			x	x			x	x		
• Bacteria	Facility has insufficient disinfection. Violations for bacteria could indicate insufficient contact time or inadequate removal of solids or organics that interfere with disinfection. A related issue is the production of chlorine-related DBPs.	**CTP and MTP**				x		x				x

[1] *See Table 5 for parameters relevant to each category.*

Table 18: Common Inadequacy Scenarios and Remedial Actions for Mechanical Treatment Systems (AS, Tertiary, Biofiltration, and SBR)

Violation Category	Assumed Cause	Facility Type	I&I Repairs	Storage Basin Installation	Infrastructure and Equipment Rehabilitation	Aeration Improvement	Biofiltration Improvement	Clarifier Rehabilitation or Replacement	Effluent Filter Installation	Flow Recirculation	Effluent Denitrification	Disinfection Improvement	SBR Modification
• Flow • Suspended Solids • Organics • Oxygen-consuming Nitrogen	Facility is periodically hydraulically overloaded, reducing HRT in aeration basin and washing out biomass, resulting in inadequate treatment.	• AS • Tertiary	x	x	x								
• Organics • Oxygen-consuming Nitrogen	Facility is chronically organically overloaded with inadequate biological treatment, likely caused by insufficient HRT or aeration.	• AS • Tertiary			x	x							
• Suspended Solids • Organics	Facility has inadequate solids removal, likely caused by poorly settling sludge in the secondary clarifier.	• AS • Tertiary			x			x	x				
• Biostimulatory Nitrogen	Facility has inadequate nitrate removal.	• AS • Tertiary			x					x	x		
• Bacteria	Facility has insufficient disinfection due to insufficient contact time or chlorine dose control, or inadequate removal of interfering WQ parameters such as solids or organics prior to disinfection.	• AS • Tertiary			x				x			x	
• Flow • Suspended Solids • Organics • Oxygen-consuming Nitrogen	Facility is periodically hydraulically overloaded, reducing HRT, resulting in inadequate treatment.	• Biofiltration	x	x	x								
• Suspended Solids • Organics • Oxygen-consuming Nitrogen	Facility is chronically organically overloaded with inadequate biological treatment due to ineffective or insufficient filter media.	• Biofiltration			x			x	x				
• Biostimulatory Nitrogen	Facility has inadequate nitrate removal and cannot meet discharge requirements.	• Biofiltration			x					x	x		
• Bacteria	Facility has insufficient disinfection. Violations for bacteria could indicate insufficient contact time or chlorine dose control, or inadequate removal of interfering WQ parameters such as solids or organics prior to disinfection.	• Biofiltration			x				x			x	
• Flow • Suspended Solids • Organics • Oxygen-consuming Nitrogen	Facility is periodically hydraulically overloaded, reducing HRT in aeration phase, resulting in inadequate treatment.	• SBR	x	x	x								
• Organics • Oxygen-consuming Nitrogen	Facility is chronically organically overloaded with inadequate biological treatment, indicating too short of an aeration stage or problems with the aeration system.	• SBR			x	x							x
• Suspended Solids • Organics	Facility has inadequate solids removal, like due to poorly settling sludge, indicating the settling time is too short.	• SBR			x				x				x
• Biostimulatory Nitrogen	Facility has inadequate nitrate removal.	• SBR			x								x

For facilities with multiple violations, the cost of remedial actions may be comparable to a complete facility replacement. Facility replacement may be more appropriate than remediation if the facility is old, the violations are chronic, or the treatment technology being used is outdated. Consequently, the WWNA project team will consider facility replacement or facility to facility (F2F) connections as alternatives to the packages of remedial actions described previously (Table 6). Table 9 summarizes these alternatives.

Table 19: Facility Solution Alternatives to Remedial Action Solutions

Solution	Description	Scaling Factor[2]
Facility Replacement	Replace the entire facility with updated treatment technologies.[1]	Design Flow
F2F Connection	Construct a pipeline to divert flows to a nearby treatment facility with sufficient capacity.	Distance to Connecting Facility

[1] The WWNA project team will develop a general replacement package for various facility types.
[2] Scaling factors will be used to develop unit costs.

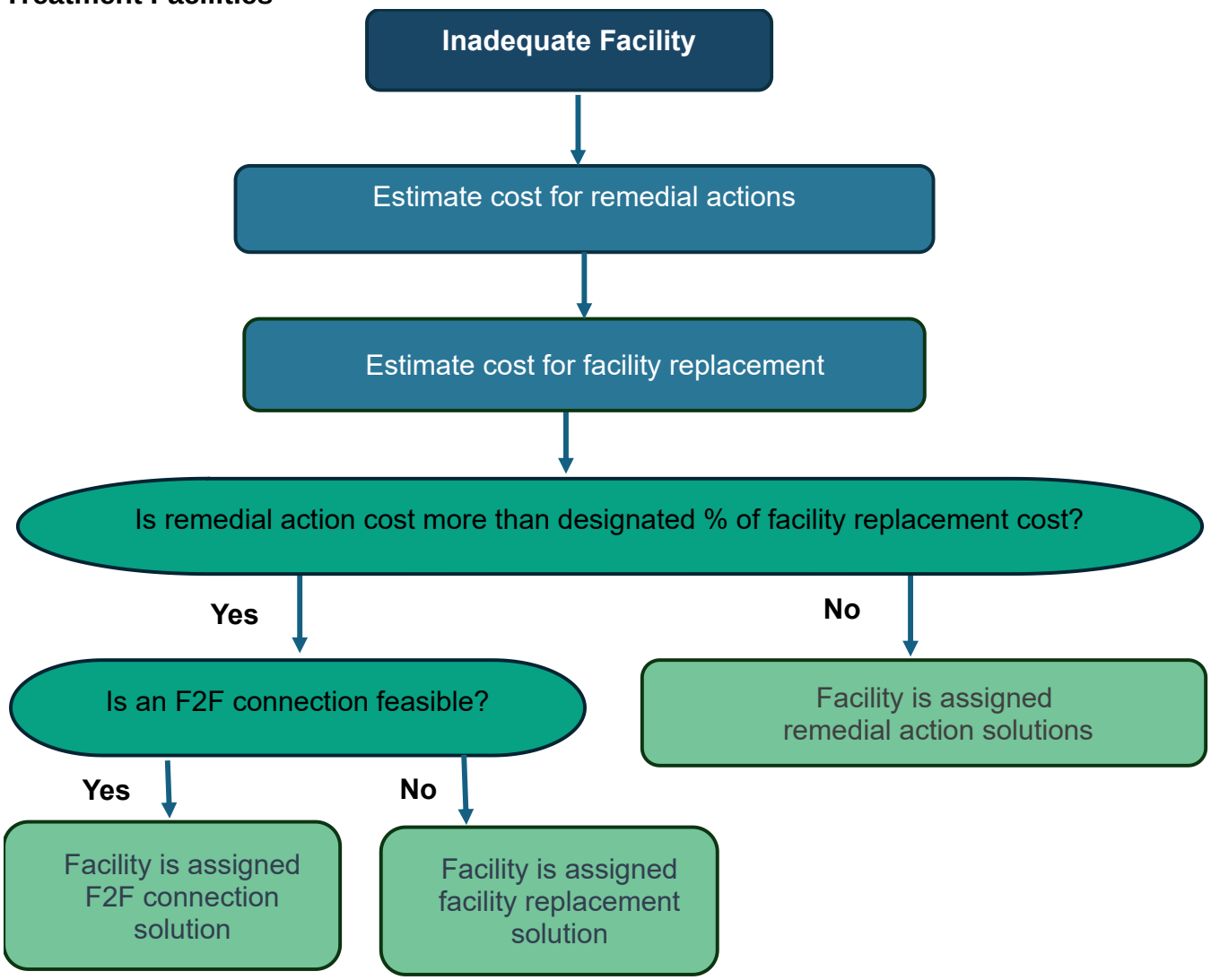
To evaluate the alternatives, the WWNA project team will develop a general unit cost for replacing each facility type using to-be-determined scaling factors (for cost estimating methodologies, see the subsection Estimating Costs). For each inadequate facility, the cost of facility replacement will be compared to the cost of remedial actions. If the package of remedial actions exceeds a certain percentage of the facility replacement cost, then an F2F connection will be considered. If an F2F connection is deemed feasible, the assigned facility solution will be an F2F connection. If an F2F connection is deemed infeasible, the assigned facility solution will be facility replacement. If the remedial action costs are below the established percentage of the facility replacement cost, the assigned facility solution will be the remedial actions plus any necessary administration solutions.

Figure 17 presents a flow chart for the solution selection process. The WWNA project team will coordinate with Water Board Staff, including those from DFA, to establish the threshold percentage[71]. F2F connection feasibility will be based on the inadequate facility's proximity to a facility not deemed as inadequate, along with that receiving facility's capacity to accept the inadequate facility's flow. The Drinking Water Needs Assessment (DWNA) uses a similar methodology for assessing the feasibility of consolidating drinking water systems with a three-mile distance threshold. The WWNA project team will coordinate with Water Board Staff to establish the distance threshold for this assessment.

Following Figure 17, is a case study to demonstrate the process of assigning a potential infrastructure and treatment solution to an inadequate facility.

[71] An alternative to using the threshold percentage to select between facility replacement, F2F connections, and remedial actions may be to compare costs against the project funding thresholds established in the current Clean Water State Revolving Fund Intended Use Plan (IUP).

Figure 17: Treatment and Infrastructure Solution Selection Process for Inadequate Treatment Facilities



CASE STUDY
Inadequate Pond Facility

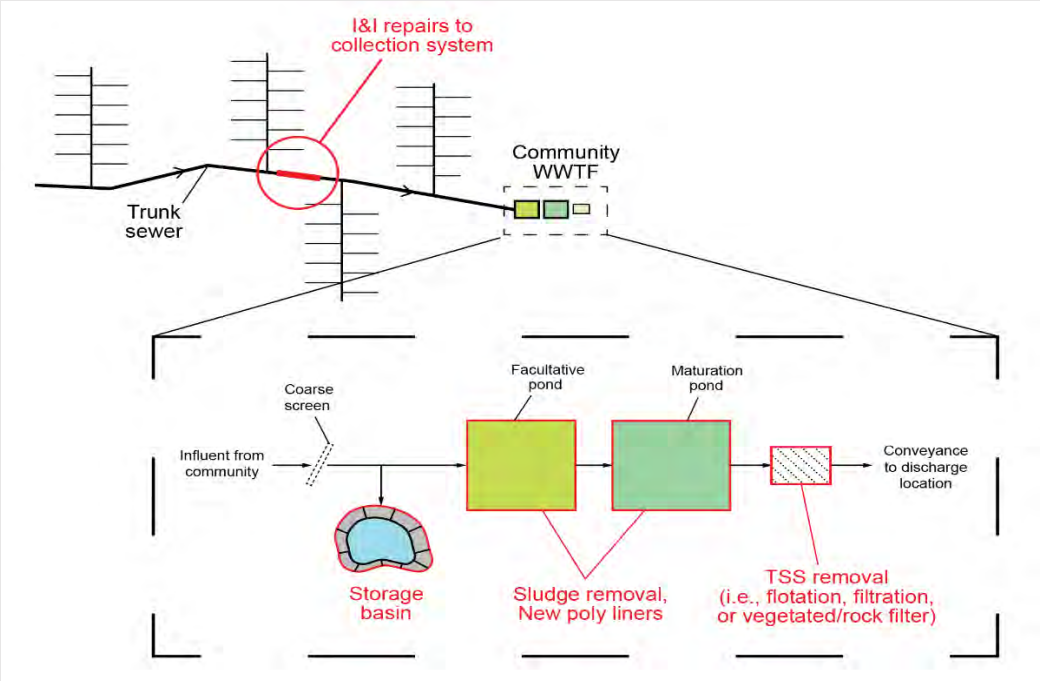
Facility Type: Conventional Treatment Pond

Violation Parameters: Flow, TSS, and BOD

Violation Categories (per Table 5): Flow, Suspended Solids, Organics

With reference to Table 7, these conditions indicate that the facility is likely periodically hydraulically overloaded, reducing the HRT in treatment ponds. The assigned remedial actions are:

- **I&I Repairs:** conducting I&I repairs to the collection system will reduce the fluctuations in flow the facility receives during storm events
- **Storage Basin Installation:** constructing a pretreatment storage basin will equalize flows and allow the facility to better handle periodic high flows
- **Treatment Pond Rehabilitation:** removing sludge and regrading the pond as needed will increase its volume and lengthen the HRT, allowing for more complete treatment of BOD; installing a liner will prevent leaching and protect groundwater
- **Install flotation or filtration system:** installing a filtration or flotation system following the treatment ponds will help remove TSS from the effluent



Note that the remedial actions are broad as per the high-level approach of the WWNA cost estimate. The remedial actions could change when applied to a specific site. For example, local sewer studies may show that I&I repair is not the proper solution to the flow variations and that adding a storage lagoon is an adequate solution. The WWNA cost assessments are not intended to substitute for local engineering investigations and analysis.

INFRASTRUCTURE AND OPERATIONAL SOLUTIONS FOR INADEQUATE COLLECTION SYSTEMS

Inadequacy criteria for collection systems relate to infrastructure, operational, or administrative deficiencies. This subsection describes the modeled solutions for addressing infrastructure and operational deficiencies. There is no treatment component for collection systems. Sanitary sewer overflow violations can indicate infrastructure deficiencies such as structural failures in pipes or pump stations, flows exceeding capacity, or root intrusions. Sanitary sewer overflow violations can also indicate operational deficiencies, such as incomplete spill cleanups or insufficient cleaning. To develop solutions for various deficiencies, the WWNA project team examined CIWQS and SSS database violations corresponding with the various inadequacy types, focusing on factors such as spill cause, response, and correlation with a storm event. Table 10 describes the proposed remedial actions for collection systems. To differentiate between focused or widespread pipe replacement or rehabilitation, the WWNA project team will coordinate with State Water Board staff to select specific numeric thresholds for the number of spills and the percentage of the system beyond its useful life.

Table 20: Remedial Actions for Inadequate Collection Systems

Remedial Action	Description	Scaling Factor[1]
Focused Pipe Replacement or Rehabilitation	Spot replace or line pipes exceeding their useful life	Miles of Pipe Beyond Predicted Useful Life
Widespread Pipe Replacement or Rehabilitation	Replace or line a portion or all of a collection system's pipes; include a monetary allowance for constructing new utility holes and other infrastructure	Miles of Pipe
Pump Station Replacement or Rehabilitation	Replace or rehabilitate pump equipment, install new monitoring, and control equipment, and repair or install a backup power supply	Number of Pump Stations, Average Pump Station Age
Operational Improvements	Replace or augment spill cleanup, maintenance, and inspection equipment; replace or upgrade Supervisory Control and Data Acquisition (SCADA) system	Miles of Pipe

[1] *Scaling factors will be used to develop unit costs.*

ADMINISTRATIVE SOLUTIONS

This subsection presents the proposed administrative solutions for addressing inadequacy criteria corresponding to deficient reporting, enforcement orders, or the lack of an SSMP. These solutions may be assigned to WWTFs and collection systems. The WWNA project team will further refine these through continued outreach to wastewater agencies and technical assistance providers regarding their prevalence, potential causes and fixes, and associated costs. Table E 7 presents the proposed administrative solutions.

Table 21: Proposed Administrative Solutions

Solution	Description	Scaling Factor[1]
Technical Assistance	Monetary allowance to obtain technical assistance to address monitoring and operational issues, conduct an I&I or source control study, or develop an SSMP	Facility Grade, Disadvantaged Community (DAC) Status
Administrative Assistance	Monetary allowance for better SCADA software and/or developing databases and reporting outlines; include allowance for training	Facility Grade
Administrator Appointment	Interim administrator appointed by the State Water Board[2]	Facility Grade
Operational Assistance	Monetary allowance to employ a contract operator, specifically in cases when a facility is upgraded to a higher grade	Facility Grade, Population Served (small systems only)

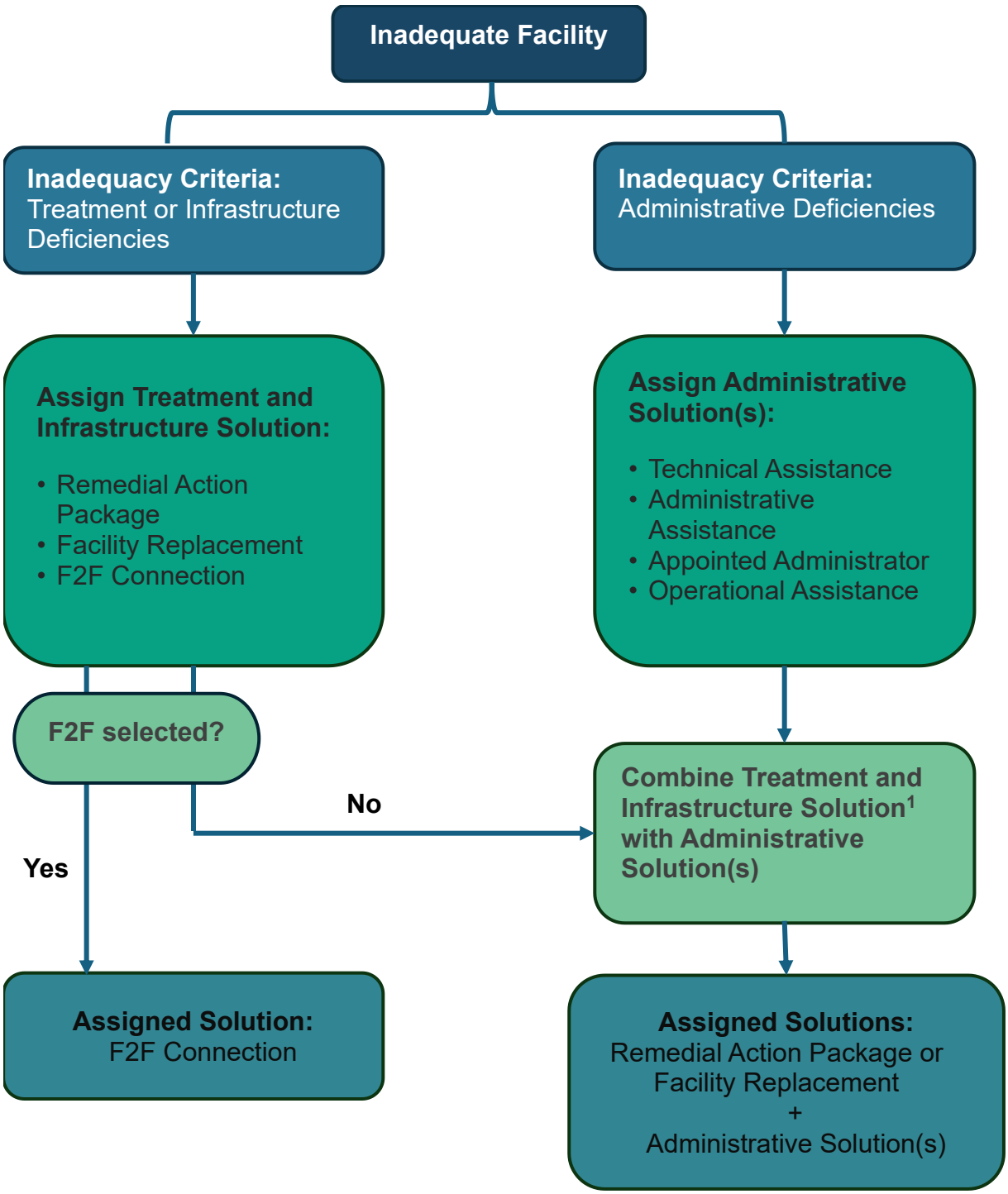
[1] *Scaling factors will be used to develop unit costs.*
[2] *Appointing an administrator may not be a feasible option due to the lack of a current funding mechanism.*

ASSIGNING SOLUTIONS

Solutions for inadequate WWTFs will be assigned by combining the selected treatment and infrastructure solution and administrative solution(s). In such cases where the selected treatment and infrastructure solution is an F2F connection, no administrative solutions will be assigned. Figure 18 shows a process diagram for potential solution selection for WWTFs.

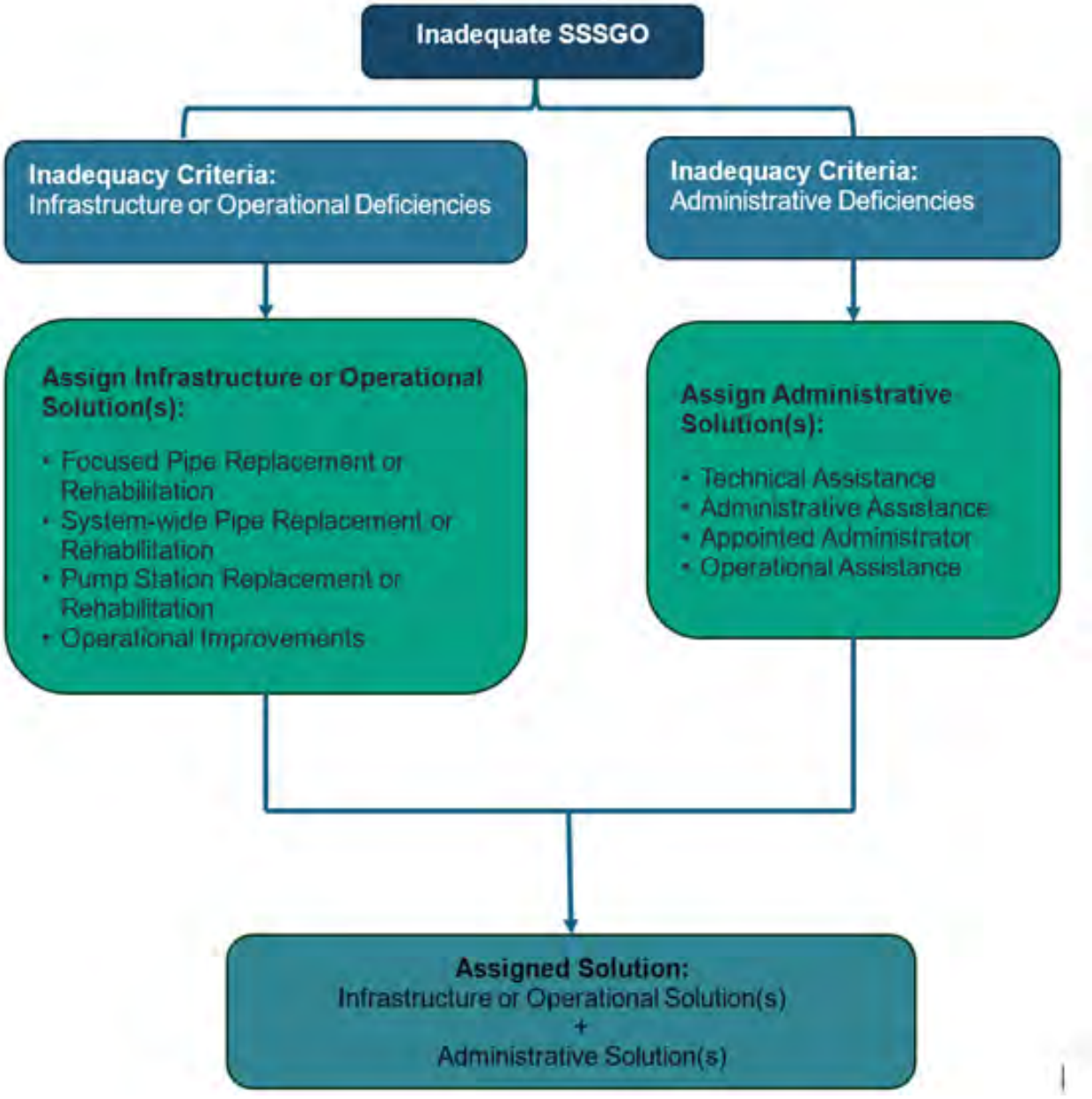
Figure 19 shows a process diagram for selecting solutions for collection systems. The applicable infrastructure or operational solutions and administrative solutions will be combined to form the solution package.

Figure 18: Solution Selection Process for Inadequate Treatment Facilities



[1] *In this case, the treatment and infrastructure solution could be a remedial actions package or facility replacement.*

Figure 19: Solution Selection Process for Inadequate SSSGOs



MODELING OSTS CONNECTION OPPORTUNITIES

This subsection describes a proposed method for identifying OSTS connection opportunities. Such opportunities include replacing OSTS on parcels in close proximity to each other with either:

- Connections to an existing system (septic to existing sewer, S2S)
- A new community cluster system (septic to community cluster, S2CC)

This subsection begins with background on the data compiled to develop the methodology followed by descriptions of how parcels with OSTS will be grouped and subsequently considered for S2S connections or S2CC systems.

OSTS DATA COMPILATION

This subsection outlines the process of collecting, processing, and preparing data to support analysis of potential OWTS connections.

DATA SOURCES

The WWNA project team used three primary data sources made available to us to develop the proposed methodology:

County LAMPs (Local Agency Management Programs): County LAMPs were reviewed to identify onsite wastewater treatment systems (OWTS), delineate existing sewer boundaries, and highlight areas of concern where OWTS may pose elevated risk to water quality. The data presented in the LAMPs were neither detailed enough nor properly formatted to support the spatial analysis below (refer to Chapter C of this report for details.).

Central Valley Water Board Annual OWTS Reports: annual OWTS reports submitted to the Central Valley Regional Water Quality Control Board (Central Valley Water Board) and provided to the WWNA project team by State Water Board staff offered more comprehensive and consistent data. These reports contained information on OWTS permit activity, OWTS complaints, septic tanks cleaning registrations, and monitoring wells. Reporting periods varied by county.[72] The Central Valley Water Board covers about 60% of California's 58 counties. Because of this, its annual reports are highly representative, as the region encompasses nearly two-thirds of the entire state.

California Parcel Shapefile: a statewide parcel shapefile provided a proxy for OSTS presence in unsewered, OSTS-dependent rural areas, especially where other datasets lacked sufficient spatial coverage. This shapefile supported the identification of developed parcels outside sewer service areas and enabled the estimation of likely OSTS locations. Appendix E1 provides further details on how this dataset was developed and used to support the identification of OSTS in these areas.

[72] Reports date from 2018 to 2025 and are available for 28 counties: Amador, Butte, Calaveras, Colusa, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Madera, Mariposa, Merced, Modoc, Nevada, Placer, Plumas, Sacramento, San Joaquin, Shasta, Sierra, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, and Yuba. Additional reports are submitted for the Cities of Clovis and Visalia, and the Town of Paradise.

DATA PROCESSING

The WWNA project team used the annual OWTS reports to compile a usable dataset of OWTS locations. Initial data processing was done in MS Excel, followed by geocoding and mapping in ArcGIS Pro.[73] The steps to process the data were as follows:

- **Organized and Categorized OWTS Data by County (Excel)**: combined permit, complaint, monitoring, and cleaning datasets for each county.
- **Standardized Fields (Excel):** ensured consistent formatting across all counties, including information on OWTS permits, locations, addresses, x/y coordinates, unique OWTS IDs, and other key attributes. Removed duplicate records and corrected common data entry issues.
- **Geocoded Locations (Excel):** for OWTS records without x/y coordinates, matched APNs to a parcel shapefile. Used the centroid of each matched parcel as the OWTS location.
- **Outputted Dataset (ArcGIS Pro):** generated geocoded OWTS point layer in geographic information system (GIS) for spatial analysis.

OWTS GROUPING METHODOLOGY

The spatial grouping of OSTS will identify areas where several properties served by OSTS may be grouped to assess OSTS connection opportunities (i.e., S2S and S2CC).

Grouping will involve selecting a grouping algorithm, defining relevant parameters, running the selected algorithm, and post-processing for group assembly. These procedures are described below.

GROUPING ALGORITHM SELECTION

The grouping process will use Hierarchical Density-Based Spatial Clustering of Applications with Noise (HDBSCAN).[74] This unsupervised[75] machine learning algorithm is suited for California's heterogeneous and fragmented OSTS landscape[76], due to its ability to:

- Adapt to irregular OSTS distribution patterns common in California's rural and urban areas.
- Detect groupings of varying size, shape, and density without requiring a predefined number of groupings.
- Identify outliers, allowing isolated or scattered OSTS to be excluded from inappropriate grouping.
- Manage spatial noise and fragmentation more effectively than traditional grouping methods.

[73] ArcGIS Pro is the premier desktop geographic information system (GIS) application.
[74] Esri. (n.d.). Density-based Clustering (Spatial Statistics). ArcGIS Pro Tool Reference. Retrieved from https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/densitybasedclustering.htm
[75]"Unsupervised" indicates the algorithm identifies patterns or groups in the data without being told what to look for.
[76] Campello, R. J. G. B., Moulavi, D., Zimek, A., & Sander, J. (2015). Hierarchical density estimates for data clustering, visualization, and outlier detection. ACM Transactions on Knowledge Discovery from Data (TKDD), 10(1), Article 5. https://doi.org/10.1145/2733381

PARAMETER DEFINITIONS

HDBSCAN's performance will depend on a few key parameters that will control how groupings will be identified and how noise (i.e., ungrouped points) will be managed. The following parameters will be set through iterative calibration and sensitivity analysis to ensure reliable and robust grouping outcomes:

- **Minimum Grouping Size:** will define the smallest number of OSTS points needed to form a grouping. This value will be calibrated through sensitivity analysis to balance the inclusion of rural groupings with avoidance of over-fragmentation.
- **Minimum Samples (optional):** will influence the moderation of grouping formation. Higher values will increase the likelihood of flagging loosely connected OSTS as noise.

California's diverse geography and development patterns will require region-specific adjustments to grouping parameters. For instance, mountainous regions may contain denser OSTS groupings, while the Central Valley may have less dense but spatially coherent groupings. A statewide baseline will also be evaluated to evaluate the feasibility of using consistent parameters across all regions.

RUNNING HDBSCAN IN ARCGIS PRO

The HDBSCAN algorithm will be implemented in ArcGIS Pro using the Density-Based Clustering tool located within the Spatial Statistics toolbox. This tool will be used to detect natural OSTS groupings based on proximity and density. Appendix E1 provides instructions.

POST-PROCESSING AND GROUPING PREPARATION

After running the HDBSCAN tool, additional steps will be required to refine the output and prepare it for infrastructure scenario modeling. Appendix E1 provides post-processing instructions.

IDENTIFY CONNECTION OPPORTUNITIES

Once OSTS groups are identified, each will be assessed for its potential to be connected to a common collection and treatment system. A rule-based, spatially informed model will determine the most feasible option. Groupings will first be checked for a connection to an existing centralized sewer. If that is not feasible, decentralized community systems will be evaluated instead.

SEPTIC TO EXISTING SEWER (S2S) CONNECTION

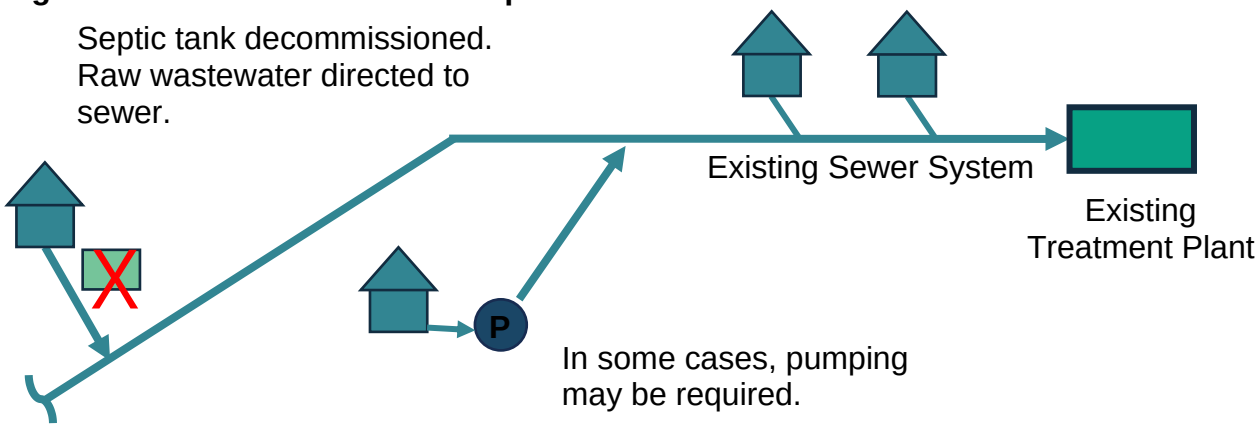
OSTS groupings will first be assessed for feasibility to connect to an existing centralized sewer service area (CSSA). A grouping will be considered feasible for S2S if both of the following apply:

- Its center is within a to be determined driving distance of a sewer service area boundary
- The route follows existing public roads that intersect the service area boundary.

This approach will ensure proposed connections are both geospatially feasible. The DWNA uses a similar methodology for assessing the feasibility of consolidating drinking water systems within a three-mile distance threshold. This approach is consistent with SB 1215, which states that "the regional board shall not require the provision of sewer service to a

disadvantaged community by a receiving sewer system if the service territory of the receiving sewer system is more than three miles away from the disadvantaged community. The WWNA project team will coordinate with State Water Board staff to establish the distance threshold for this assessment. In addition to geospatial feasibility, the WWNA approach will assess constructability based on existing road access and sewer infrastructure presence. The assessment will use ArcGIS Pro's Network Analyst tools to evaluate which OSTS groupings can be feasibly connected to existing CSSAs. Appendix E1 provides instructions for the assessment. Figure 20 shows an example of S2S connection.

Figure 20: S2S Connection Example

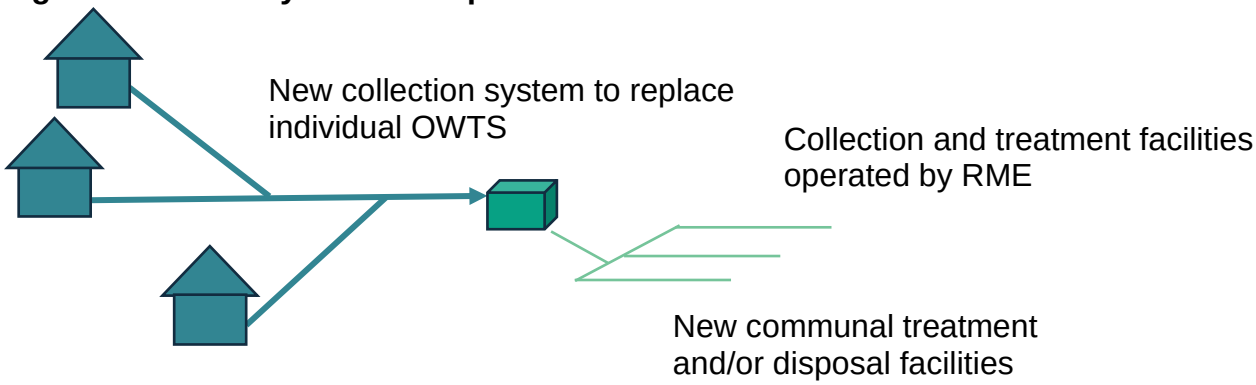


SEPTIC TO NEW COMMUNITY CLUSTER (S2CC) SYSTEM

If an OSTS grouping is not eligible for an S2S connection, the next alternative considered will be an S2CC. Figure 21 shows an S2CC example. In an S2CC configuration:

- Wastewater is collected from each property using individual septic tanks, pump stations, or small collection networks and conveyed to a shared treatment facility.
- Treatment systems may include an advanced communal septic tank, a small-scale package treatment plant, lagoon system with infiltration basin, or another modular community system appropriate for localized flows.
- Treated effluent is discharged either through subsurface leach fields or surface disposal, depending on site conditions and regulatory constraints.
- The system is operated and maintained by a responsible management entity such as a homeowners' association, community service district, public utility, or county agency.

Figure 21: S2CC System Example



ESTIMATING COSTS

The Cost Assessment Model will estimate costs for the solution packages selected for WWTFs and collection systems deemed inadequate by the Inadequacy and Risk Assessment, as well as costs for OSTS S2S and S2CC projects. To determine the methodology for this cost assessment, the WWNA project team relied extensively on the methodologies developed in the State Water Board's 2024 Drinking Water Needs Assessment,[77] internal outreach, and review of external literature and examples, including:

- Review of 2024 State of California DWNA
- Review of 2024 State of California DWNA Cost Assessment Methodology[78]
- Review of the State Water Board's DFA funding project engineering report files (ERs)
- Review of U.S. Environmental Protection Agency (EPA) Clean Watersheds Needs Survey (CWNS) – 2022 Report and Data[79]
- Review of U.S. EPA CWNS – 2022 Cost Estimation Tool Methods[80]
- Data collection from the DFA ERs, wastewater collection and treatment facilities, and the existing literature[81] to estimate and calibrate cost information and assumptions

[77] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html
[78] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-methodology.pdf
[79] https://www.epa.gov/cwns/clean-watersheds-needs-survey-cwns-2022-report-and-data
[80] https://www.epa.gov/system/files/documents/2024-05/2022-cwns-cost-estimation-tool-methods.pdf
[81] Including, but not limited to, Singh, Absar, and Starkl. "A review on full-scale decentralized wastewater treatment systems: techno-economical approach." Water Science and Technology 71, no. 4 (2015): 468-478; Plumlee et al. "Costs of advanced treatment in water reclamation." Ozone: Science & Engineering 36, no. 5 (2014): 485-495; Schimmoller, Larry. Fit for purpose water: The cost of overtreating reclaimed water. WaterReuse Research Foundation, 2014; Sharma, Jwala R., Mohammad Najafi, and Syed R. Qasim. "Preliminary cost estimation models for construction, operation, and maintenance of water treatment plants." Journal of Infrastructure Systems 19, no. 4 (2013): 451-464.

- Consultation with an internal workgroup of engineers, other researchers, State Water Board engineers and staff, and external advisory group members

COST ESTIMATE APPROACH

Following the assignment of a solutions package for an inadequate facility, the per unit capital cost for the individual elements of the package's remedial actions, the per unit net present value of the operating and maintenance (NPV O&M) costs, and the administrative solutions costs will be estimated. Given sufficient DFA ER data and common scaling factors, the WWNA project team will derive regression-based cost curves for the individual remedial action elements and any associated O&M and administrative solutions. The WWNA project team will then sum the capital costs, NPV O&M costs, and administrative solution costs to derive the total capital costs and total NPV O&M. More details on these costs are provided below.

Next, the total capital and NPV O&M costs will be adjusted for regional differences in construction costs as well as inflation if costs are to be incurred over time. In addition, there will be a set of capital cost multipliers added to the capital costs to account for non-infrastructure costs associated with capital elements of the solution package.

As in the DWNA, these additional capital costs may include, but not be limited to, electrical, planning and construction services, engineering and design, legal and administrative services, contingency, overhead, and environmental and permitting costs. These additional capital cost multipliers will be determined based on details in the DFA ERs and the existing literature. Figure 22 illustrates the general cost estimate approach.

REGIONAL AND INFLATION COST MULTIPLIERS

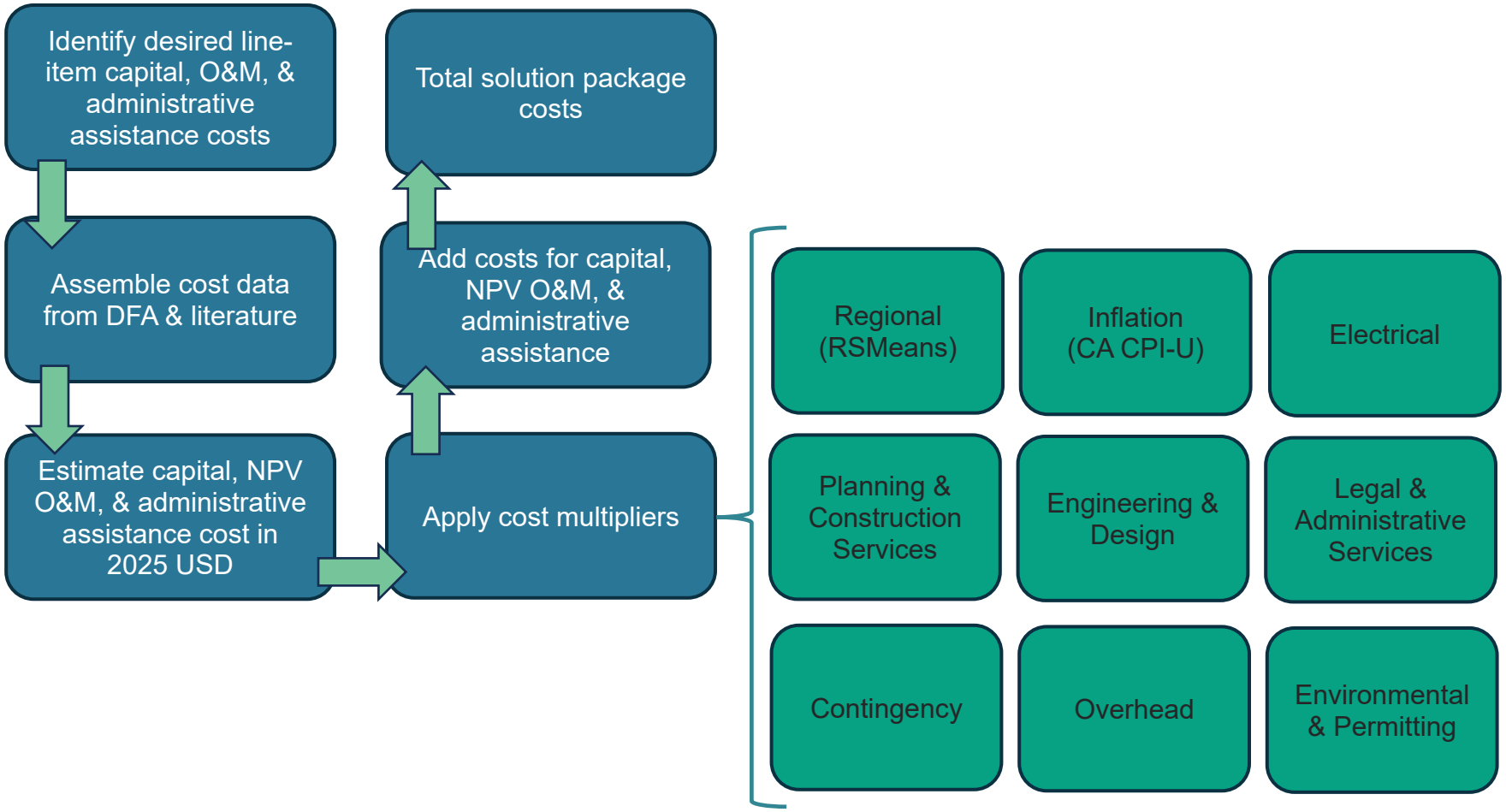
The Cost Assessment Model's capital cost, NPV O&M cost, and managerial assistance cost estimates will be adjusted for regional construction cost differences among rural, suburban, and urban communities using RSMeans City Cost Index (CCI) multiplier data,[82] as was done for the 2024 DWNA. All cost data will reflect 2026 market values. When cost data are gathered from DFA ERs and the literature, they will be adjusted to the value of the dollar in 2026 using the California Consumer Price Index for All Urban Consumers (CPI-U) obtained from the State of California Department of Industrial Relations.[83] Future capital and annual O&M costs will be adjusted for inflation using the California CPI-U as well.

CAPITAL COST MULTIPLIERS

The remaining capital cost multipliers will be determined using data gathered from the DFA ERs and the existing literature. The categories of multipliers will vary based on reviews of the information and may differ from those listed in Figure 22 (e.g., electrical, planning and construction services, engineering and design, legal and administrative services, contingency, overhead, and environmental and planning costs). These multipliers will be applied to the total capital cost when adjusting the total capital cost for regional differences, before adding the total capital cost to the total NPV O&M and total managerial assistance costs.

[82] https://www.rsmeans.com/rsmeans-city-cost-index
[83] https://www.dir.ca.gov/oprl/CPI/CPICalculator/CpiCalculator.aspx

Figure 22: Cost Estimate Approach for Inadequate Facilities and for OWTS



CAPITAL COST

The total capital cost will be the sum of the cost of the construction of wastewater collection and the wastewater treatment facility infrastructure needed for the solution package remedial treatments. These costs will be estimated based on available DFA ER data, cost curves found in the literature, and information gathered through outreach with the California wastewater community. The total capital cost for a solution package will be the sum of the capital costs for the assigned remedial actions. These total capital costs will then be modified using the various multipliers mentioned above. No financing of capital costs will be included.

OPERATING AND MAINTENANCE (O&M) COSTS

The Cost Assessment Model will estimate annual O&M expenses related to the modeled long-term treatment. Operational costs will generally reflect labor, materials, and other annual costs.

20-YEAR NET PRESENT WORTH OF CAPITAL AND O&M COSTS

As seen in many of the DFA ERs and the 2024 DWNA, the cost of capital and O&M will be evaluated over a life cycle of 20 years. Lifecycle costs for capital and O&M will be presented in terms of net present worth (NPW) and will be the sum of the region-adjusted, post-multiplier capital costs and the region-adjusted lifecycle NPV O&M cost estimate. The annual NPV O&M costs associated with remedial treatment elements of a solution package will be calculated as follows:

$$\text{NPV O\&M} = \sum_{t=1}^{20} \frac{\text{Annual O\&M Cost}_t}{(1+r)^t}$$

The NPW cost (capital and O&M) for an inadequate facility or OSTS connection, then, will be calculated as:

NPW = Region-and-capital-cost-multiplier-adjusted Capital Cost
+ Region-adjusted NPV O&M

All NPW costs will be developed using a 20-year period and a 4% annual discount rate, consistent with the 2024 DWNA, as well as the lifecycle NPV O&M estimate for each modeled remedial treatment when applicable.

ADMINISTRATIVE SOLUTION COSTS

Some of the solution packages will include administrative assistance, such as managerial and technical assistance. The costs associated with these managerial assistance elements of the solution package will be included in the total solution package cost. They will be regionally adjusted before being added to the NPW for the total solution package cost. As the solutions develop, so will the cost estimates, whether through examples in the DFA ERs, existing literature, or through outreach with information provided by the California wastewater community.

AGGREGATING COSTS

The cost estimate models above will result in a modeled cost for each facility identified as inadequate by the WWNA. Facility costs will be combined to calculate the funding needed to address inadequate wastewater facilities throughout the state, as well as cumulative costs per cost type. Types of costs to be aggregated include:

- Modeled long-term solution costs for inadequate WDR WWTFs
- Modeled long-term solution costs for inadequate NPDES WWTFs
- Modeled long-term solution costs for inadequate collection systems
- Modeled long-term solution costs for OSTS groupings

FUNDING GAP ANALYSIS

The State Water Board has several funding and financing programs that offer upfront grants, principal forgiveness loans (i.e., effectively grants), and low interest loans for wastewater projects in California. It is anticipated that some of the modeled solution costs estimated by the WWNA can be covered by these state programs. The objective of the Funding Gap Analysis, then, will be to estimate the amount of funding that will need to be covered through local cost share or other non-State Water Board principal forgiveness or grant mechanisms.

The proposed WWNA Funding Gap Analysis will be similar to that conducted for the DWNA, estimating the funding gap for a future five-year period.

The WWNA Funding Gap Analysis will be composed of four main steps:

- Project future funding availability
- Estimate costs for potential future facility inadequacies
- Categorize modeled funding needs
- Calculate the funding gap

These steps are further detailed below.

PROJECT FUTURE FUNDING AVAILABILITY

As done for the DWNA, the WWNA Funding Gap Analysis will compare modeled funding needs to relevant funding available from the State Water Board. The WWNA project team will therefore coordinate with DFA to identify funding programs (such as the Clean Water State Revolving Fund [CWSRF]) relevant to types of costs modeled by the WWNA. The WWNA project team will also coordinate with DFA to project funding availability from these programs for the next five years.

ESTIMATE COSTS FOR POTENTIAL FUTURE FACILITY INADEQUACIES

It is anticipated that some facilities relevant to the WWNA will become inadequate within a few years of the initial WWNA Inadequacy and Risk Assessment. To provide a more accurate representation of WWNA funding needs over the five-year Funding Gap Analysis period, the Funding Gap Analysis will need to include modeled costs to account for such occurrences.

Similar accounting projections were done for the DWNA, using historical records of the number of failing water systems added to the Human Right to Water (HR2W) list[84] over a period of years. The DWNA assumed an average annual number of systems added to the DWNA failing list over a future five-year period. Associated costs were then estimated based on DWNA cost results, proportional to the number of utility connections.

As this WWNA is the first of its kind, there is no historical record available for calculating an annual average of facilities becoming inadequate. The WWNA project team will therefore consult with State and Regional Water Board staff to develop a method for estimating future inadequacies. The WWNA project team will also consult with the DWNA team to learn the specific calculations used to estimate per-connection solution costs and then confer internally to develop a similar scheme specific to the WWNA.

CATEGORIZE MODELED FUNDING NEEDS

The Funding Gap Analysis will need to categorize modeled costs to compare costs to projected funding. Therefore, modeled costs will be categorized as follows:

- Modeled costs for inadequate facility solutions or OSTS projects that have existing funding agreements with the State Water Board
- Modeled costs that would need to be met by communities through local cost share
- Modeled costs that could be eligible for State Water Board grants
- Modeled costs that could be eligible for State Water Board loans

To categorize the costs, the WWNA project team will obtain information from DFA regarding CWSRF or other State Water Board-funded wastewater projects that have had funding agreements in the last five years or are expected to have agreements in the next few years. The WWNA project team will then compare the funded projects with the WWNA modeled inadequate facility solutions and OSTS projects to identify modeled costs that can be excluded from the WWNA Funding Gap Analysis. More high-level information for such programs and their history is found in the Baseline Studies Review[85] and will be detailed in the final WWNA report in 2027.

Finally, the WWNA project team will review the current CWSRF Intended Use Plan (IUP)[86] and other relevant funding program documentation to understand funding eligibility requirements. Several types of modeled costs, such as interest payments and O&M costs, are likely not eligible for current State Water Board funding. Such costs will be compiled and deemed necessary to be covered by non-State Water Board funding (e.g., other federal, state, local, or private sources). The WWNA project team will review the remaining modeled costs and categorize them as eligible for State Water Board

[84] HR2W list
[85] See: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/07/Phase-1B-Report-Baseline-Studies-Review.pdf
[86] The State Water Board issued a draft of the CWSRF IUP in June 2025. The WWNA project team will review the adopted final IUP.

grants or loans, or neither. It is anticipated that funding eligibility will be based on facility type, size, and DAC/SDAC status.

CALCULATE THE FUNDING GAP

Having projected future funding availability, estimated future inadequacy needs, and categorized modeled costs, the WWNA project team will calculate modeled costs that could be covered by projected State Water Board funding, and those that will require other funding mechanisms (e.g., other federal, state, local, or private sources). The modeled funding gap will be summarized as follows:

- Modeled costs for currently funded projects
- Modeled costs eligible for State Water Board grant/principal forgiveness funding
- Modeled costs eligible for State Water Board low interest loan funding
- Modeled costs requiring non-State Water Board funding

APPENDIX MATERIALS

APPENDIX E1- TECHNICAL INSTRUCTIONS FOR OSTS SPATIAL GROUPING AND S2S EVALUATION

OVERVIEW

This appendix provides technical instructions for spatially grouping onsite sewage treatment systems (OSTS)[87] as well as assessing opportunities for OSTS connections f using geographic information system (GIS) based methods. These procedures support the analysis described in Chapter E of the main body of the report and are used to identify areas where OSTS could be replaced with either septic to existing sewer (S2S) connections or septic to new community cluster (S2CC) systems.

The workflows outlined here are designed to:

- Group OSTS points into meaningful clusters based on proximity and density using a machine learning algorithm (HDBSCAN)
- Process grouped OSTS into polygon features for infrastructure modeling
- Assess the feasibility of connecting each OSTS group to a nearby service area using network analysis
- Prepare spatial outputs for use in cost modeling and infrastructure planning

TOOLS AND SOFTWARE USED

- Microsoft Excel: Used for initial OSTS data compilation, cleaning, and preparation prior to import into ArcGIS
- ArcGIS Pro: Core platform for all spatial analysis
- Spatial Statistics Toolbox (ArcGIS): Used to run the HDBSCAN algorithm via the Density-Based Clustering tool
- Network Analyst Toolbox (ArcGIS): Used for evaluating road-based driving distance to existing centralized sewer service areas

APPLICABLE DATA SOURCES

- Central Valley Regional Water Quality Control Board (Central Valley Water Boards) Annual Onsite Wastewater Treatment System (OWTS) Reports: Contain permit, complaint, and monitoring records used to geocode and map OWTS locations across 28 counties
- California Parcel Shapefile (SWRCB DIT, 2023): Used as a proxy to identify likely OSTS locations in unsewered rural areas by analyzing parcel attributes and centroid locations

[87] OSTS are unsewered wastewater systems such as OWTS (as defined in the State Water Board's 2023 OWTS Policy) and cesspools.

RUNNING HDBSCAN IN ARCGIS PRO

- Prepare Input Data
  - Ensure the OSTS point dataset is projected in a coordinate system with linear units (e.g., meters or feet). The OSTS point dataset refers to both parcel centroids used as proxy OSTS locations in unsewered areas and actual OSTS locations derived from the Central Valley Water Boards' Annual OWTS Reports where geocoded permit data are available.
  - Clean or filter the dataset to remove incomplete records before grouping. Incomplete records refer to OSTS entries that lack location data, such as missing addresses and latitude/longitude coordinates.
- Open the Tool
  - In ArcGIS Pro, navigate to: "Analysis" - "Tools" - "Spatial Statistics Tools" - "Modeling Spatial Relationships" - "Density-Based Clustering."
- Configure Tool Parameters
  - "Input Features": Select the OSTS point feature class (e.g., geocoded permit and complaint records).
  - "Output Features": Specify the name and location of the output feature class.
  - "Clustering Method": Select "HDBSCAN."
  - "Distance Method": Select "Euclidean."
  - "Minimum Cluster Size": Enter the desired minimum number of OSTS to form a valid grouping (e.g., 5 or 10). This is a key calibration parameter.
  - "Minimum Samples (optional)": Leave blank for a default value or set a value to control the conservativeness of the grouping.
  - "Search Distance (optional)": Leave blank unless manually controlling the maximum distance between points for grouping.
- Run the Tool
  - Click Run. The tool will generate: (1) A point feature class with fields for "CLUSTER_ID" (unique ID for each grouping) and "IS_NOISE" (1 = noise, 0 = part of a grouping).; (2) Optional summary statistics table if enabled.

POST-PROCESSING AND GROUPING PREPARATION

- **Assign "Cluster IDs":** Each OSTS point is assigned a unique "CLUSTER_ID" or flagged as noise (IS_NOISE = 1). These identifiers serve as the basis for grouping and analysis.
- **Generate Polygons:** Convert grouped points into polygon features using one of the following methods:
  - Parcel Dissolution – Merges parcels associated with grouped OSTS.
  - Convex/Concave Hulls – Creates generalized boundaries around groupings, especially useful when parcel data is incomplete or inconsistent.
- **Validate Geometry:** Review grouping geometries to ensure spatial coherence and check for alignment with jurisdictional boundaries, such as city limits or service areas.

- **Generate Grouping Attributes:** Calculate key statistics for each grouping, such as:
    - Total number of OSTS
    - OSTS density (e.g., per acre or per parcel)
    - Proximity to the nearest wastewater service area
- **Export for Modeling:** Export the finalized point and polygon layers for integration into S2S and S2CC scenario modeling workflows.

GIS WORKFLOW: EVALUATING S2S FEASIBILITY

- Identify Sewer-Accessible Roads
    - Use the “Select Layer by Location” tool to extract road segments that intersect with the boundaries of the Centralized Sewer Service Areas (CSSAs).
    - This step ensures that any connection path terminates at an accessible boundary of existing infrastructure.
- Generate Receiving Points of Interest (Rec_POIs)
    - Apply the “Feature Vertices To Points” tool to the selected road segments. Use the “MID” option to ensure each Rec_POI is placed in the center of a road segment intersecting a CSSA.
    - These points represent feasible, on-road tie-in locations where new sewer laterals or mainlines could physically connect to the existing system.
- Configure and Run Closest Facility Analysis
    - Open the “Closest Facility” tool under the “Network Analyst” toolbox.
    - Set input layers:
        - Incidents: OSTS Grouping centroids (representing the approximate center of each unsewered area).
        - Facilities: Rec_POI from the previous step.
    - Set travel mode to “Driving Distance” using routable street network dataset.
    - Apply a “3-mile cutoff.”
    - Solve the analysis to identify the shortest drivable path between each OSTS grouping and is nearest sewer-accessible road.
- Extract and Filter Eligible Routes
    - Export the output Routes and “Facility-to-Incident” tables.
    - Filter out any grouping-route pair where the travel distance exceeds 3 miles
    - Use spatial joins or table joins to link retained routes back to the original OSTS grouping layer.
- Classify S2S Candidates
    - Add a new field to the OSTS grouping layer (e.g., “S2S_Eligible”) and assign a value of “Yes” or “No” based on whether the grouping has a valid connection route within the 3-mile driving distance.
    - For each S2S-eligible grouping, perform a spatial join with the Centralized Sewer Service Area (CSSA) polygon layer using the identified Rec_POI location or the nearest intersected CSSA boundary.

- Extract and assign the corresponding “CSSA ID” (e.g., “SewerArea_ID” or “System_Name”) to a new field in the OSTS grouping layer.
- This ID links each eligible OSTS grouping to the sewer system it is most likely to connect to. It is essential for analyzing cost estimates.

CHAPTER F: ADVISORY GROUP ENGAGEMENT

OCTOBER 2025

CALIFORNIA Water Boards | State Water Resources Control Board

Division of Water Quality, State Water Resources Control Board

UCLA Luskin Center for Innovation

Prepared by UCLA Luskin Center

TABLE OF CONTENTS

TABLE OF FIGURES

INTRODUCTION

While it was not part of the contracted WWNA scope, the WWNA project team formed and leads engagement with an external stakeholder advisory group of thirty members. The WWNA Advisory Group voluntary participants advise the WWNA project team on project development and on wastewater data and information, draft analyses, effective outreach methods, and other areas of expertise or perspectives. The advisory group consists of representatives from local government agencies, state and federal agencies, California Native American tribes and other tribal sovereignties, non-profits, consultants, and other interested members of the general public.

ADVISORY GROUP FORMATION EFFORTS

PURPOSE

During the development of the Work Plan, the WWNA project team determined that it would be beneficial to create a stakeholder advisory group to provide insights to the WWNA. The WWNA project team and the State Water Resources Control Board (State Water Board) wanted to ensure that this advisory group contained representatives from various geographic locations throughout the state, from various levels of government (I.e., tribal sovereignties, state agencies, local agencies), who work in and/or live in S/DACs with a historic lack of access to water for sanitary purposes, and who can provide diverse perspectives on the issue of sanitation and wastewater management.

The WWNA project team envisioned that the WWNA Advisory Group participants would advise on the project development and the WWNA project team throughout the final three years (2024-2027) of the four-year contract on:

- Wastewater data and information,
- Draft analyses,
- Effective outreach methods, and
- Other areas of expertise or perspectives.

The Advisory Group does not have additional authorities or final decision-making power regarding the WWNA or other State Water Board activities.

ADVISORY GROUP APPLICATION AND SELECTION PROCESS

In January 2024, the WWNA project team developed a set of application questions.[88] The WWNA project team disseminated this application using Microsoft Forms and utilizing the State Water Board's WWNA listserv, contact information from the Department of Water Resources – Individual Needs Assessment Reports, and contact information of individuals that the WWNA project team identified as having wastewater expertise. The WWNA project team reached out to a diverse range of potential Advisory Group members in terms of geographical regional expertise (with a focus on

[88] See application questions here: https://www.waterboards.ca.gov/water_issues/programs/waste_discharge_requirements/docs/2024/eng-wwna-application.pdf

California but not limited to the state), wastewater area of expertise, and organization type. The WWNA project team identified individuals via professional networks as well as through internet searching. The WWNA project team and the State Water Board also publicly advertised the opportunity to apply.

The application notice specified that the Advisory Group was open, but not limited to:

- Members of the public,
- Advocacy groups,
- Community groups,
- Tribes and tribal organizations,
- Local representatives or government agencies,
- Regional or statewide regulatory agencies, or
- Federal organizations or agencies.

The WWNA Advisory Group application received forty-three applications. In consultation with the Board, the WWNA project team decided to accept thirty-two applicants into the Advisory Group. However, two applicants could not accept the Advisory Group member position, so the Advisory Group includes thirty members. Please see Figure 23, 24, and 25 for the general demographics of the selected applicants and Appendix A for the full list of the selected Advisory Group members.

Figure 23: Advisory Group Members by Organizational Expertise

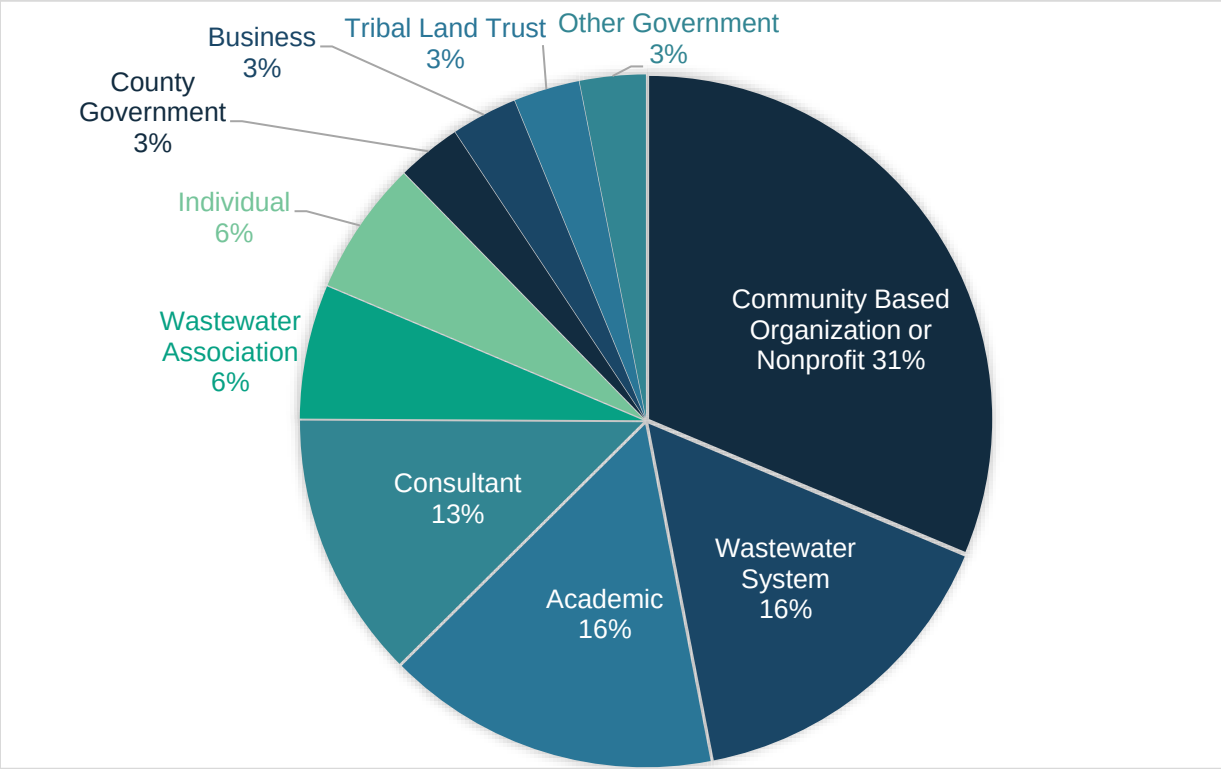


Figure 24: Advisory Group Members by Wastewater Area of Expertise

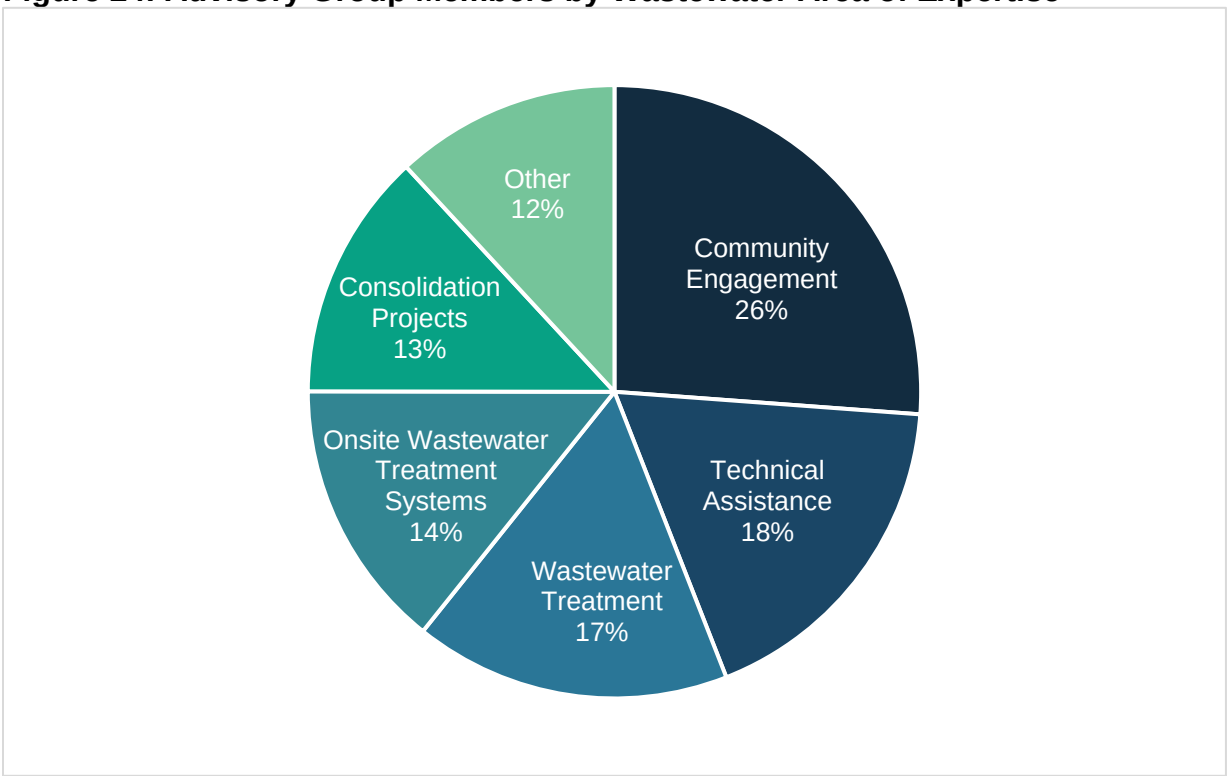
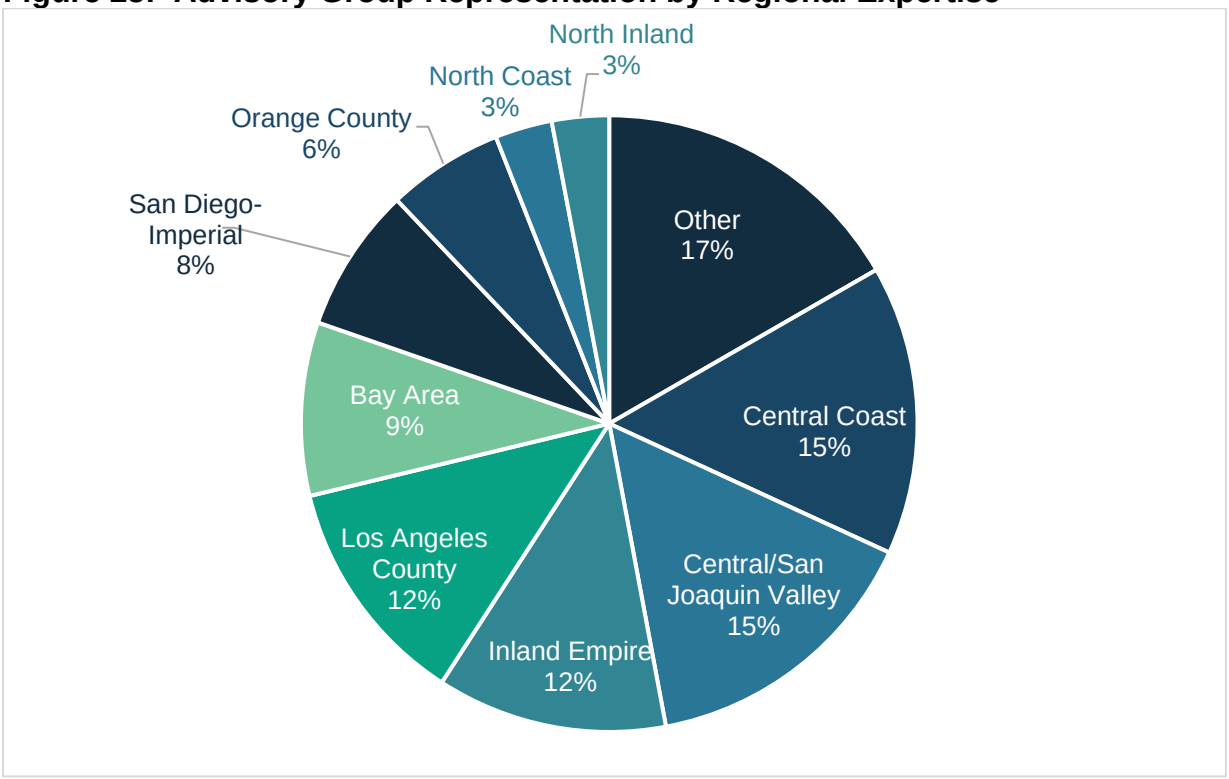


Figure 25: Advisory Group Representation by Regional Expertise



The UCLA team reviewed the applications first and made an initial screening of Advisory Group applicants. The UCLA team selected applicants based on relevant and unique experience and/or perspectives related to the Human Right to Sanitation, the diversity of regional expertise represented, including whether they had experience working with disadvantaged communities, and the organization that they represented. The WWNA project team aimed to ensure that there was an even distribution (where one group was not overwhelmingly larger than other groups) of perspectives related to regional expertise, wastewater area of expertise, and organization type.

The broader project team and Board staff provided input on the initial recommendations. Based on the WWNA project team's input, the UCLA team determined the final group of applicants. Below is an image of the members of the initial Advisory Group.

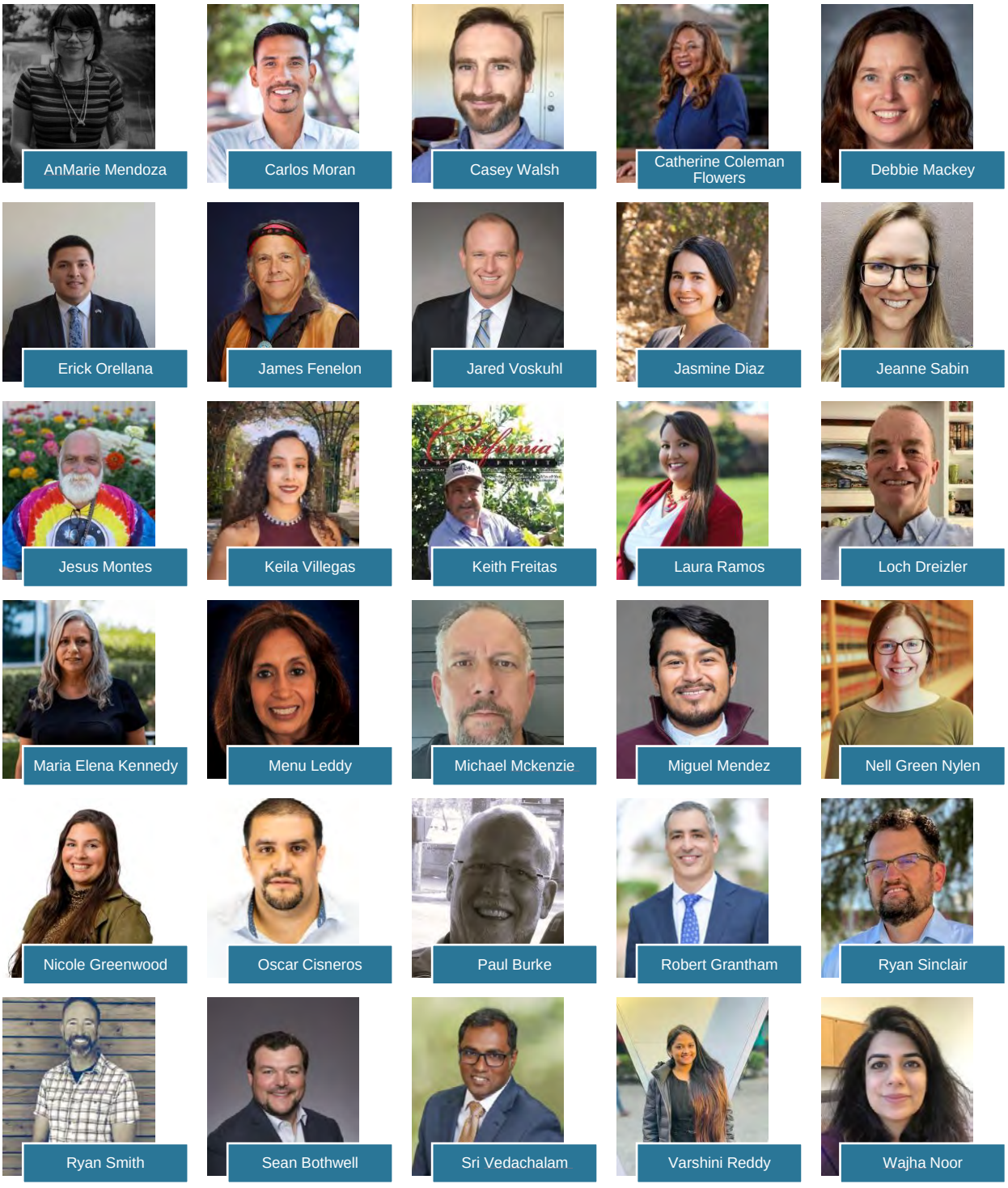
ADVISORY GROUP ENGAGEMENT

PURPOSE

The WWNA project team hosts quarterly Advisory Group meetings to update Advisory Group members on the status of the WWNA, provide an opportunity for feedback and questions from the Advisory Group, and for the WWNA project team to seek input on specific aspects of the WWNA. The first Advisory Group meeting was virtual with an in-person optional component (see photo below).

Image taken at the July 2024 WWNA Advisory Group meeting by Annalisa Kihara.

Figure 26: Advisory Group Members (July 2024)



The Advisory Group members provide constructive advice and feedback on the WWNA, and other key analyses and policies associated with the State Water Board's final determination. The Advisory Group does not develop consensus recommendations or majority opinions. Advisory Group comments are advisory to the WWNA, and the WWNA project team will provide the comments to the State Water Board for consideration.

These meetings are available to the public and allow for a public comment period at the end of each meeting.

In addition to the quarterly Advisory Group meetings, in December 2024, at the request of the Advisory Group, the WWNA project team began hosting monthly[89] "Office Hours" for the Advisory Group members. At the October 2024 Advisory Group meeting, Advisory Group members expressed interest in meeting more frequently. Based on this feedback, UCLA began hosting "Office Hours" so that Advisory Group members could have more opportunities to discuss questions or provide feedback on the WWNA to the team.

ADVISORY GROUP MEETINGS

FIRST ADVISORY GROUP MEETING (JULY 2024)

The Advisory Group began convening in Year 2 of the WWNA on July 26, 2024. The WWNA project team held the kickoff meeting via Zoom with an in-person component at the Central Valley Regional Water Quality Control Board Office in Rancho Cordova, CA.

PURPOSE:

The purpose of the first Advisory Group was to introduce the WWNA project team to the Advisory Group, for the WWNA project team to review the general expectations for the Advisory Group, for the WWNA project team to provide an overview of the project, and for the WWNA project team to provide a brief update of Year 1 (July 2023-June 2024) of the WWNA. Multiple State Water Board members and Executives were present to provide opening remarks and show their support for the project.[90]

OUTCOME/ADVISORY GROUP MEMBERS' FEEDBACK:

Advisory Group members requested that the WWNA project team send the meeting materials further in advance, provide Spanish translation (if possible), reduce highly technical details, spell out acronyms, and for more opportunities for the Advisory Group members to communicate with each other outside of Advisory Group meetings.

In response, the WWNA project team now sends the meeting materials ten business days in advance of the Advisory Group meetings (when possible) and translates the executive summary materials into Spanish. During the WWNA Advisory Group meetings, the WWNA project team attempts to reduce highly technical details and allow

[89] The Office Hours meetings do not take place in the same month as a regular Advisory Group meeting.
[90] See agenda here: https://innovation.luskin.ucla.edu/wp-content/uploads/2024/06/WWNA-AG-Agenda-7-26-24.pdf. See recording here: https://www.youtube.com/watch?v=z0aAtz8N66Y

adequate time for questions and avoids using acronyms or spelling them aloud or in the Zoom chat. After the first Advisory Group meeting, the WWNA project team send a contact list to the Advisory Group members with emails from the other members so that they may get into contact with one another outside of the Advisory Group meetings.

SECOND ADVISORY GROUP MEETING (OCTOBER 2024)

The WWNA project team virtually held the second Advisory Group meeting on October 25, 2024.

PURPOSE:

The purpose of the second Advisory Group meeting was to present, review, and seek input on the baseline, qualitative assessment of wastewater conditions in California (Phase 1B); data collection efforts that inform the quantitative assessment (Phase 1C); and potential definitions for decentralized or non-traditional treatment and/or collection systems.[91] This meeting had one breakout session with three breakout rooms to discuss the three meeting topics (1) data collection efforts that inform the quantitative assessment, (2) baseline, qualitative assessment of wastewater conditions in California, and (3) individual sewage system terminology. The WWNA project team asked the AG members to select which breakout room topic they would like to participate in. The WWNA project team placed those who did not select a topic into a breakout room.

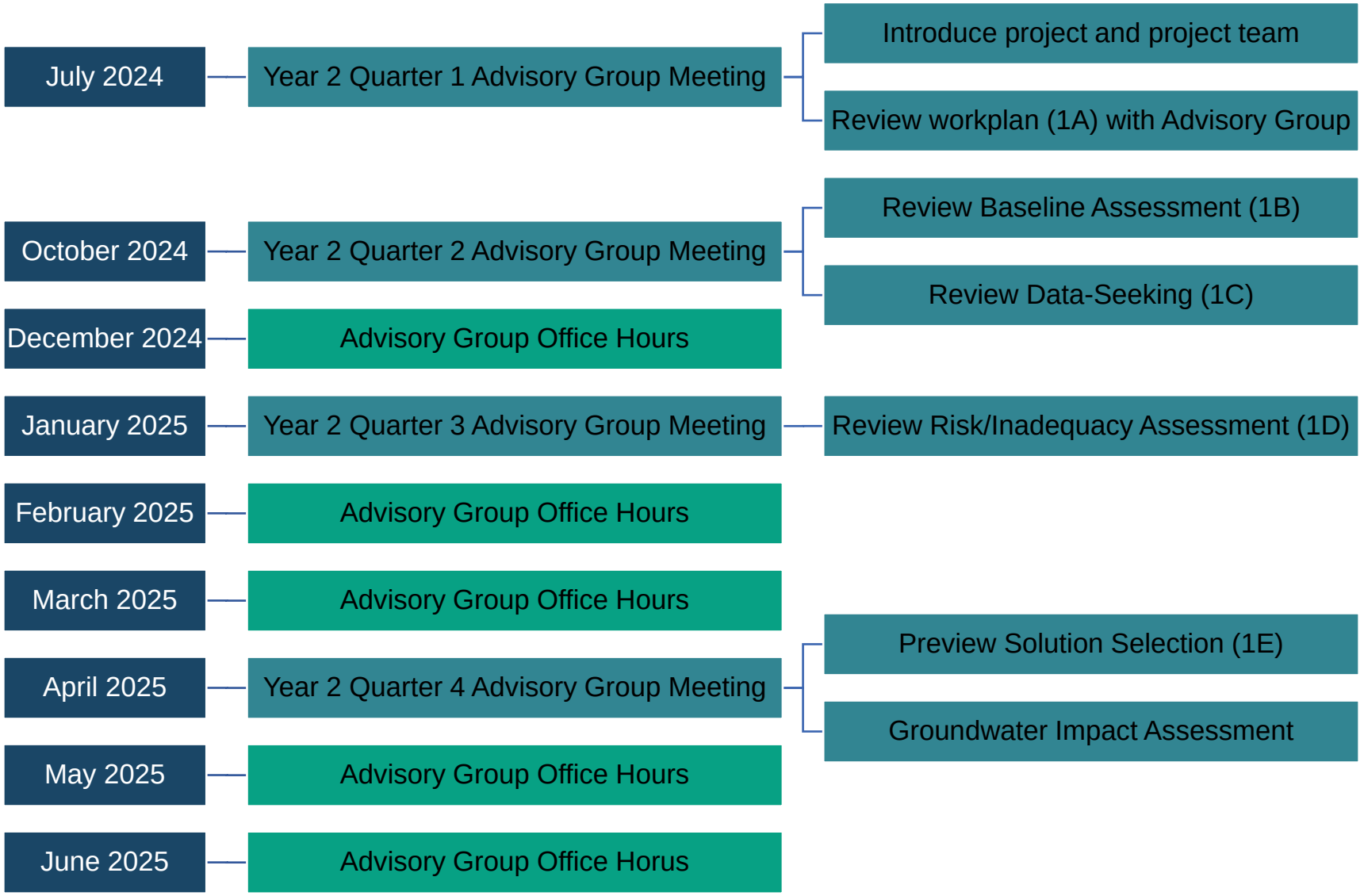
OUTCOME/ADVISORY GROUP MEMBERS' FEEDBACK:

A substantial comment that the AG members made to the WWNA project team was that they would appreciate more time to provide feedback on the materials provided and have more frequent meetings with the WWNA project team. They also requested to have breakout rooms with the same topics, as many Advisory Group members wanted to attend multiple breakout room sessions but were only able to join one breakout room.

These comments led to the formation of the monthly Office Hours and a restructuring of future Advisory Group meetings.

[91] See agenda here: https://innovation.luskin.ucla.edu/wp-content/uploads/2024/10/WWNA_AG_Agenda_10_25_PublicAnnouncement-1.pdf. See recording here: https://youtu.be/8sB3OTsvzAM

Figure 27: Advisory Group Engagement (July 2024-June 2025)



THIRD ADVISORY GROUP MEETING (JANUARY 2025)

PURPOSE:

The WWNA project team virtually held the third Advisory Group meeting on January 25, 2025. The purpose of this meeting was to present, review, and seek input on the Inadequacy and Risk Assessment (Phase 1D).[92]

OUTCOME/ADVISORY GROUP MEMBERS' FEEDBACK:

The Advisory Group commented on the inadequacy criteria and suggestions to refine the definition of inadequacy for wastewater systems. In response, the WWNA project team has held ad hoc meetings with Advisory Group members who have requested additional meetings as well as discussed updates to the inadequacy criteria at multiple Office Hour meetings following the Advisory Group meeting.

FOURTH ADVISORY GROUP MEETING (APRIL 2025)

PURPOSE:

The WWNA project team virtually held the fourth Advisory Group meeting on April 25, 2025. The purpose of this meeting was to present, review, and seek input on methodologies for (1) developing and selecting solutions for inadequate wastewater facilities and onsite wastewater treatment systems (OWTS) (Phase 1E) and (2) assessing groundwater impacts.[93]

OUTCOME/ADVISORY GROUP MEMBERS' FEEDBACK:

Advisory Group members mentioned concerns with only identifying solutions for systems that the WWNA deemed inadequate and not identifying solutions for systems that were at-risk of inadequacy. The WWNA project team is identifying systems at-risk of inadequacy but currently is not identifying solutions for those systems.

On the groundwater impacts assessment, the Advisory Group members mostly provided comments on additional data sources and areas for improving the methodology.

OFFICE HOURS

As noted above, based on feedback from the second Advisory Group meeting in October 2024, the WWNA project team decided that UCLA team will host additional monthly one-hour “Office Hours.” The Advisory Group members expressed that they would like to meet more frequently and voiced a desire for more engagement with the WWNA materials. These meetings are for Advisory Group members only and are not

[92] See agenda here: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/01/WWNA_AG_Jan2025_Agenda_PUBLIC.docx. See recording here: https://www.youtube.com/watch?v=2AZPCHgFuUc

[93] See agenda here: https://innovation.luskin.ucla.edu/wp-content/uploads/2025/04/2025_0424_WWNA_AG_Mtg_Agenda_Public.pdf. See recording here: https://youtu.be/63Aut-zX5HE

open to the public (unlike the quarterly Advisory Group meetings), and attendance is entirely voluntary.

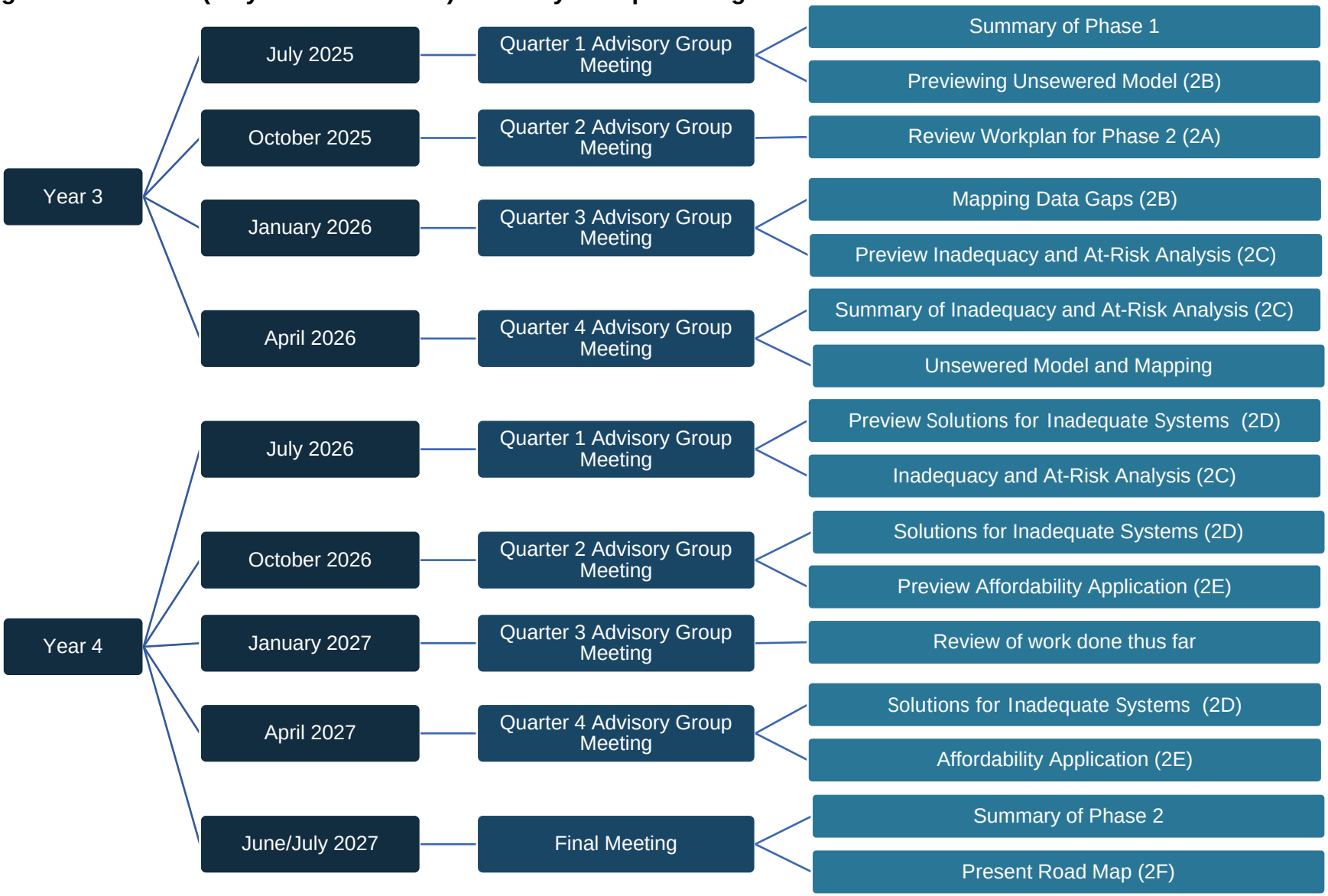
Due to the original intent and structure of the Advisory Group, as well as limitations in staffing and capacity, the WWNA project team was unable to plan additional Advisory Group meetings. However, these Office Hours provide Advisory Group members with additional opportunities to provide feedback and ask the WWNA project team questions. During these Office Hours, the WWNA project team—led primarily by —does not present or prepare new materials but is available via Zoom to receive feedback or questions from Advisory Group members. UCLA serves as the main host, with staff from the State Water Board also in attendance. Depending on availability, representatives from UC ANR, Sac State-OWP, and UMass may also join. UCLA records each session and shares the recordings with project team members and Advisory Group members who could not attend.

NEXT STEPS

The WWNA project team will first share the Phase 1 Report with the State Water Board Members for feedback and then with the Advisory Group members to gather their input and feedback.

In Phase 2, the WWNA project team plans to host nine Advisory Group meetings and up to sixteen office hours. The graphic below displays the Phase 2 Advisory Group meetings and their respective topics, subject to change based on project team capacity and workflow progress. The Advisory Group meetings will cover the workplan for Phase 2 (2A), mapping efforts (2B), application of risk/inadequacy assessment (2C), application of cost and solutions (2D), affordability application (2E), and the road map for future efforts beyond the WWNA (2F).

Figure 28: Phase 2 (July 2025-June 2027) Advisory Group Meetings



APPENDIX MATERIALS

APPENDIX F1. ADVISORY GROUP MEMBERSHIP AND AFFILIATION (JULY 2025)

Name	Affiliation
Ryan Smith	Water Pollution Control Operations Manager, City of Sunnyvale
Jasmine Diaz	Regional Field Manager Rural Community Assistance Corporation
Catherine Coleman Flowers	CEO and Founder, Center for Rural Enterprise, and Environmental Justice
Maria Elena Kennedy	President, Kennedy Communications, Inc
Paul Burke	Environment & Climate Justice Chair, NAACP of Ventura County
Sri Vedachalam	Senior Director, Water Equity and Climate Resilience at Corvias Infrastructure Solutions, LLC
Keila Villegas	Water Justice Director Orange County Environmental Justice
Ryan Sinclair	Associate Professor of Environmental Microbiology, Loma Linda University
Debbie Mackey	Executive Officer, Central Valley Clean Water Association
Laura Ramos	Director, California Water Institute- Fresno State
Jeanne Sabin	Water Compliance Program Manager, Ames Research Center, National Aeronautics and Space Administration

Name	Affiliation
James Fenelon	Professor of Sociology and Director of the Center for Indigenous Peoples Studies, Cal State San Bernadino
AnMarie Mendoza	Board member, Tongva Taraxat Paxaavxa Conservancy
Carlos Moran	Executive Director, North East Trees
Sean Bothwell	Executive Director, California Coastkeeper Alliance
Mikel Irigoyen	Community Solutions Manager, Community Water Center
Varshini Reddy	Project Engineer, EEC Environmental
Wajiha Noor	Government Affairs Analyst, Eastern Municipal Water District
Oscar Cisneros	Community Development Specialist, Self-Help Enterprises
Menu Leddy	Chief Scientific Officer Metro Builders and Engineering Group, Ltd.
Nell Green Nylen	Wheeler Water Institute, Center for Law, Energy & the Environment, UC Berkeley
Jared Voskuhl	Manager of Regulatory Affairs, California Association of Sanitation Agencies
Miguel Mendez	Associate Environmental Scientist, San Francisco Estuary Institute
Robert Grantham	General Manager, Santa Margarita Water District

Name	Affiliation
Loch Dreizler	General Manager, Santa Ynez Community Services District
Michael Mckenzie	Project Manager Veolia
Nicole Greenwood	Wastewater Resource Analyst City of Riverside
Keith Freitas	Retired Tend The Garden, Inc.
Casey Walsh	Professor of Anthropology UC Santa Barbara
Jesus Montes	Community service, El circulo de hombres

CONCLUSION

OCTOBER 2025

CALIFORNIA Water Boards | State Water Resources Control Board

Division of Water Quality, State Water Resources Control Board

UCLA Luskin Center for Innovation

Prepared by UCLA Luskin Center

TABLE OF CONTENTS

TABLE OF FIGURES

NEXT STEPS

The overarching goal of the WWNA is to provide information on sanitation needs across California and develop strategies to address the state's sanitation system needs. This effort aligns with the Water Boards' vision of clean, safe, and affordable water for human uses and environmental resource protection across California, with a particular focus on disadvantaged communities and decentralized systems.

During Phase 1, the WWNA project team established methodologies, developed a baseline assessment of existing sanitation conditions, and addressed data gaps. The WWNA project team developed key definitions of inadequacy and risk for sewage collection systems, sewage treatment plants, and decentralized systems, as well as potential solutions to address inadequate systems. Please note that the evaluation of data sources and final methods deployed in Phase 2 is subject to change but will rely on the data and methods outlined here.

In Phase 2, the WWNA project team will build off the inadequacy and risk definitions to empirically analyze system-wide needs and develop working public lists and mapping tools of systems of concern. The WWNA project team will then conduct a cost of solutions assessment across system types using methodologies identified in Phase 1. At the end of Phase 2, the WWNA project team will provide a final, public report to the State Water Board on the prevalence and geography of different system types, associated inadequacies, recommended solutions and associated costs, and funding gaps. In Phase 2, the WWNA project team will also provide a long-term pathway for the provision of more equitable sanitation services in California through a roadmap for ongoing assessment beyond June 2027.

Figure 29: WWNA Phase 2