CA Wastewater Needs Assessment
Solutions and Cost Assessment
Advisory Group Summary for October 2026 Meeting

Solutions and Cost Assessment

Overview

Following the Inadequacy and Risk Assessment, the Wastewater Needs Assessment (WWNA) is developing a framework to model high-level solutions and estimate associated solution costs for facilities designated as Inadequate[1]. The Solutions and Cost Assessment also considers opportunities for onsite sewage treatment system (OSTS) conversions. The methodology will be used to estimate statewide costs to address Inadequate wastewater facilities and OSTS conversion opportunities. As in the Drinking Water Needs Assessment (DWNA), the framework is not designed to be used to determine community- or site-level decisions and does not replace feasibility study or preliminary engineering report processes. As such, the term "modeled solutions" is used throughout the WWNA to emphasize this intent.

This Advisory Group (AG) Summary focuses on:

- The types of modeled solutions being considered for Inadequate facilities and systems, as well as OSTS conversion
- The methods for selecting modeled solutions for Inadequate Waste Discharge Requirement (WDR) facilities, National Pollutant Discharge Elimination System (NPDES) facilities, and Sanitary Sewer System General Order (SSSGO) systems
- The method for mapping OSTS conversion opportunities

Future AG presentations will focus on the final modeled solution methodologies, the proposed cost assumptions, and the funding gap analysis.

Types of Potential Modeled Solutions

Potential modeled solutions will be considered only for facilities determined to be Inadequate by the WWNA methodology. A facilities and systems list was developed in previous phases of the WWNA and includes facilities and systems with NPDES permits, WDRs, or enrollment in the Statewide General Waste Discharge Requirements for SSSGO that primarily treat or convey domestic wastewater. The WWNA project team examined the Inadequacy criteria and the associated California Integrated Water Quality System (CIWQS) Project violations to identify the common causes and corrective actions correlated with each. Generally, it is assumed that each Inadequacy criterion can be attributed to one or more operational, infrastructure, or administrative deficiencies. The WWNA project team examined the inadequacy criteria and the associated California Integrated Water Quality System (CIWQS) Project violations to identify the common causes and corrective actions correlated with each. Generally, it is assumed that each Inadequacy criterion can be attributed to one or more operational, infrastructure, or administrative deficiencies.

Based on assumed deficiencies, the WWNA project team is developing modeled solutions for the treatment systems (NPDES & WDR permitted facilities) and the collection systems (facilities enrolled in the SSSGO) determined to be Inadequate. To inform choices of modeled solutions, the WWNA project team applied common wastewater treatment strategies and engineering judgment informed by its experience. The team is now seeking input on the modeled solutions approach from AG members and State and Regional Water Board staff.

The following types of modeled solutions are being considered:

[1] Based on list finalized on June 1, 2026.

- Modeled Solutions for Inadequate NDPES & WDR Facilities
  - Remedial actions
  - Facility replacement
  - Facility-to-system connection
  - Technical assistance
- Modeled Solutions for Inadequate SSSGO Collection Systems
  - Pipe repair or replacement
  - Technical assistance
- Opportunities for OSTS Conversions
  - Septic to sewer conversions

Potential modeled solution types are defined as follows:

- Remedial Actions (RA): remedial actions represent common infrastructure improvements related to wastewater treatment operations and processes applicable to the respective facility types and parameter inadequacies; they do not reflect any further site-specific conditions.
- Facility Replacement (FR): replacement of the entire facility with a new package plant.
- Facility-to-System Connection (F2S): connection of an Inadequate facility with an existing sewer system, with decommissioning of the original facility.
- Technical Assistance (TA): support by an experienced entity contracted to work with the Inadequate facility or system to improve its technical, managerial, and financial capacity. This may include reviewing and advising on operational or administrative practices, or assisting with capital infrastructure planning, design, and funding applications.
- Pipe Repair or Replacement (PRR): repair or replacement of sewer pipelines.
- Septic to Sewer Conversions (S2S): connection of a group of unsewered parcels (assuming they have septic or other OSTS) with an existing sewer system and decommissioning of the septic or OSTS.

Note that the WWNA approach for selecting technical assistance as a modeled solution differs from that used in the Drinking Water Needs Assessment (DWNA). The DWNA selects technical assistance as a modeled solution for small (fewer than 3,300 service connections), failing public systems, and for at-risk systems serving disadvantaged and severely disadvantaged communities. The WWNA selects technical assistance as a modeled solution for facilities and systems with monitoring, reporting, and/or general operational inadequacies, regardless of size or disadvantaged community status. Nonetheless, a few Inadequate WWNA facilities and systems are fairly large, having design flows between 10 and 20 MGD. While the Water Board may consider assessing its enforcement program to better support these facilities in identifying and promptly addressing violations, technical assistance can be provided in the interim to begin managerial and operational improvements.

Summary of WDR Modeled Solutions Approach

The project team presented proposed modeled solutions for Inadequate WDR facilities during the July 2026 AG meeting and requested comments by August 11, 2026. No comments were received. Attachment A presents the final approach for selecting modeled solutions for Inadequate WDR facilities.

The number of facilities for each modeled solution type, along with the associated inadequacies, is shown in Table 1. Remedial action, facility replacement, technical assistance, or some combination of these is the selected modeled solution for all 139 Inadequate WDR facilities. Some remedial action modeled solutions may be replaced with facility replacements or facility-to-system connections. The approach is presented in Attachment A.

Table 1. Count of Solution Types for Inadequate WDR Facilities (139 Facilities Total)

Remedial Action Modeled Solutions Only: 35 Facilities
• 35 due to effluent inadequacies
Technical Assistance Modeled Solutions Only: 59 Facilities
• 36 due to deficient monitoring, deficient reporting, late report, or failure to submit monitoring report inadequacies • 4 due to receiving water inadequacies • 15 due to enforcement order inadequacies • 4 due to order condition inadequacies
Remedial Action (or Facility Replacement[1]) & Technical Assistance Modeled Solutions: 45 Facilities
• 21 due to effluent inadequacies & deficient monitoring, deficient reporting, late report, or failure to submit monitoring report inadequacies • 7 due to enforcement order inadequacies • 13 due to effluent inadequacies & enforcement order inadequacies • 4 due to enforcement order inadequacies & deficient monitoring, deficient reporting, late report, or failure to submit monitoring report inadequacies

[1] *Facility replacement was selected for one facility in lieu of remedial actions, as it is classified as a subsurface OSTS.*

Summary of NPDES Modeled Solutions Approach

The NPDES Inadequacy Assessment considered criteria related to two general types of violations: 1) effluent violations and 2) scheduling or reporting violations. Technical assistance alone or remedial actions with technical assistance are the selected modeled solutions for these facilities. Attachment B includes a detailed approach for selecting the modeled solutions. The number of facilities for each modeled solution, along with the associated inadequacies, is included in Table 2. Some remedial action modeled solutions may be replaced with facility replacements or facility-to-system connections.

Table 2. Count of Modeled Solution Types for Inadequate NPDES Facilities (20 Facilities Total)

Technical Assistance Modeled Solutions Only: 5 Facilities
• 5 due to scheduling/reporting non-compliance
Remedial Action & Technical Assistance Modeled Solutions: 15 Facilities
• 11 due to effluent & scheduling/reporting non-compliance • 4 due to effluent non-compliance associated with particular parameters (see Attachment B, Table B-2)

Modeled Solutions for Inadequate SSSGO Systems

The SSSGO Inadequacy assessment criteria related to spill or reporting violations. Several systems met the Inadequacy criteria for poor spill performance. It is assumed that these spills result from old, cracked infrastructure, leading to inflow and infiltration that cause flows within the sewer lines to exceed their capacity. Pipe repair or replacement will be the modeled solution. The WWNA project team devised an approach to estimate the amount of pipe that would need repair or replacement, and the detailed approach is provided in Attachment C of this AG Summary. The number of systems for each modeled solution type, along with the associated inadequacies, is included in Table 3.

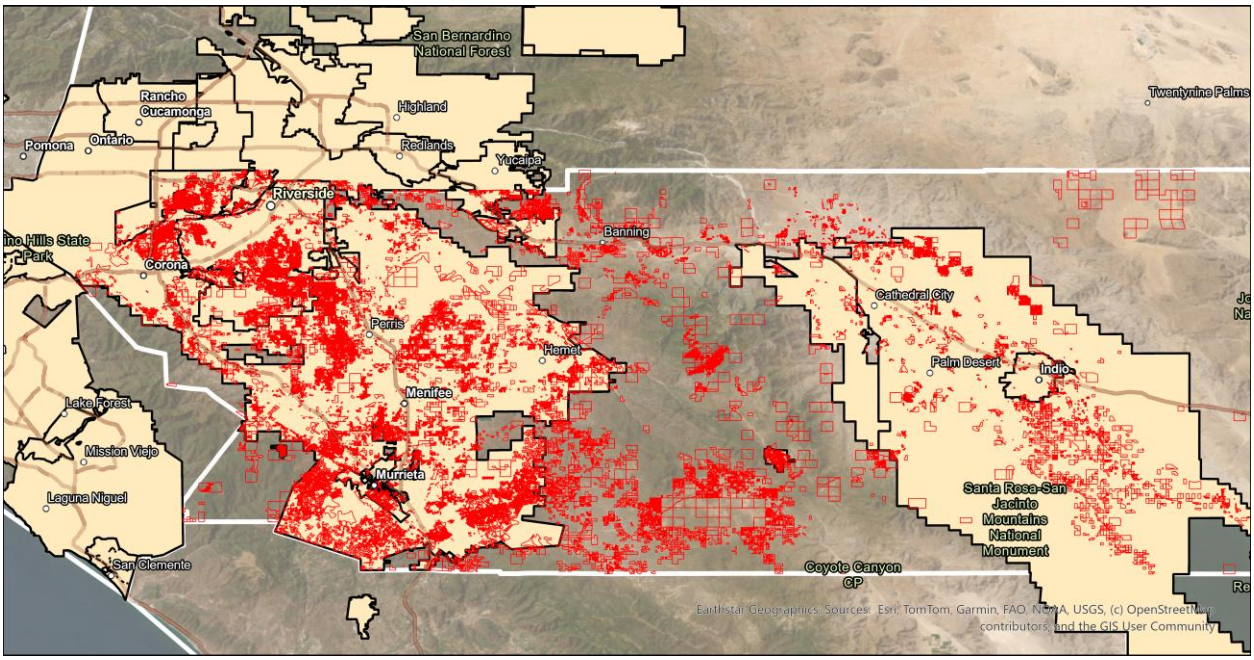
Table 3. Count of Modeled Solution Types for Inadequate SSSGO Systems (70 Facilities Total)

Pipe Repair or Replacement Modeled Solutions: 30 Systems
• 30 due to effluent inadequacies
Technical Assistance Modeled Solutions: 40 Facilities
• 40 due to scheduling/reporting inadequacies

OSTS Conversion Opportunities

The assessment for OSTS conversion opportunities will be similar to that presented in the Phase 1 report, with a few exceptions. The assessment is being scaled down from a statewide scope to approximately 6 case study counties due to methodological considerations and time and budget constraints. More effort is needed to refine the modeled solutions and cost assessment for Inadequate systems than initially anticipated due to the complexity of the Inadequacy criteria. The scope is also reduced to exclude the assessment of connecting a group of septic-system parcels to a new community cluster system (S2CC), due to the large number of unsewered parcels with no clear clusters. Figure 1 demonstrates the complexity, using Riverside County as an example. There is a high density of the unsewered parcels (small red polygons) between the two large sewershed areas (yellow polygons) in the western part of the county. In the east, there appear to be some clusters consisting of a handful of unsewered parcels, but likely not enough to make a community cluster wastewater system (package plant) affordable. Whether these parcels require wastewater treatment within the scope of the WWNA is also questionable, given the lack of visible infrastructure in satellite imagery. Regional Board feedback has also raised concerns about the accuracy of the modeled unsewered results, which are limited by the small number of field-confirmed OSTS and unsewered parcel locations statewide. The decision was therefore made to discontinue this cluster analysis.

Figure 1. Map of Sewersheds (large yellow polygons) and Unsewered Parcels (small red polygons, based on UMASS modeling) in Riverside County, Demonstrating the Complexity of Identifying Clusters of Unsewered Parcels to Convert to Package Plants.



Although the scale and scope have been reduced, the ultimate intent is to provide the State and Regional Water Boards with a methodology for identifying potential OSTS conversion opportunities, which can be improved upon as more data on OSTS locations is collected. The OSTS conversion opportunities assessment will identify opportunities to connect groups of septic system parcels to existing sewer systems (S2S) using UMASS unsewered mapping results. Unsewered parcels located within existing sewersheds will be defined, and the sewershed boundaries will be extended 1 mile and 3 miles to locate unsewered parcels within those distances. The assessment will be conducted for six counties based on extensive WWNA project team and Board input, especially from UCANR's field investigations:

- Fresno County
- Humbolt County
- Monterey County
- Riverside County
- San Bernadino County
- Tulare County

Conclusion and Next Steps

The WWNA-modeled solutions and cost assessment are intended to approximate solutions and costs for Inadequate facilities and systems as determined by the project's Inadequacy assessment. Maps for potential opportunities to connect OSTS to existing sewer (S2S) will also be included. The results will provide high-level insights to support the Water Boards' statewide planning efforts, particularly related to funding needs. No modeled solution selected for any particular facility or system should be assumed to determine or replace site-specific planning efforts, such as project feasibility studies and engineering reports that consider all aspects of the system or the community it serves.

Attachments A, B, and C provide detailed summaries of the approach for selecting modeled solutions for Inadequate WDR facilities, NPDES facilities, and SSSGO systems, respectively. The project team is seeking feedback on these approaches as well as the OSTS conversion assessment approach**. Please send written comments by November 13, 2026, to: OWP-WWNA@owp.csus.edu.** Upon addressing comments and conferring with the State Water Board, the project team will finalize and implement the modeled solution approaches for the inadequate facility and system, as well as the OSTS conversion approach.

Future efforts for the modeled solutions and cost components of the WWNA include continuing previous work to compile cost curves and link costs to solutions for the various inadequate systems. Approaches for these remaining activities will be presented at future AG meetings in January 2027, along with a revisit of the funding gap analysis approach. AG members will be given approximately three weeks (one week prior to quarterly AG meetings and two weeks after) to review AG summaries and presentations on each topic and provide comments. After that, the project team will confer with State Water Board staff and finalize each approach. Cost estimate results will be presented to the AG members at the April 2027 AG meeting.

Attachment A – Modeled Solutions Approach for Inadequate WDR Facilities

Inadequacy Results and Modeled Solution Types

The WDR Inadequacy assessment considered criteria related to three violation groups: effluent violations, enforcement actions, and monitoring and reporting violations. Table A-1 lists the number of Inadequate WDR facilities that met the criteria within each violation group, along with the potential modeled solution types.

Table A-1. Count of WDR Facilities Deemed Inadequate each Inadequacy Type and their Potential Modeled Solution Type

Violation Group (Inadequacy~~Inadequacy~~ Type)	Count of Inadequate WDR Facilities Meeting Violation Criteria	Potential Modeled Solution Type
Effluent	69	Remedial Action (RA) or Facility Replacement (FR)
Monitoring & Reporting – Failure to submit a monitoring report, Late Report, Deficient Report, or Deficient Monitoring	61	Technical Assistance (TA)
Monitoring & Reporting – Receiving Water (Groundwater)	8	RA or TA
Enforcement Order	41	RA or TA
Monitoring & Reporting – Order Conditions	50	TA or FR
Monitoring & Reporting – Unauthorized Discharge	5	TA
Monitoring & Reporting – Sanitary Sewer Overflow	1	TA
Monitoring & Reporting – Flow	0	TA
Monitoring & Reporting – Enforcement Action	0	TA

Process for Selecting Modeled Solutions

The WWNA project team developed the following steps to select modeled solutions for Inadequate WDR facilities:

1. If effluent Inadequacy, select remedial actions as a solution, unless facility type is on-site wastewater treatment system (OWTS[2]), for which facility replacement is the selected solution.
2. If failure to submit a monitoring report, late report, deficient report, or deficient monitoring Inadequacy, select technical assistance as a solution.
3. If receiving water Inadequacy, review CIWQS flat file violation descriptions

[2] *On-site wastewater treatment system (OWTS) is a type of on-site sewage treatment system (OSTS). California defines OWST as "… individual disposal systems, community collection and disposal systems, and alternative collection and disposal systems that use subsurface disposal. The short form of the term may be singular or plural. OWTS do not include "graywater" systems pursuant to Health and Safety Code Section 17922.12." (State Water Board 2023)*

   a. If fairly old or infrequent (one or two occurrences), assume already addressed (no remedial action needed).
   b. If receiving water Inadequacy associated with parameter for which no effluent Inadequacy occurred, assume no remedial action needed. TA will be a selected solution to look into possible causes.
4. If enforcement order Inadequacy, review Regional Board-provided summary
   a. If associated with monitoring, reporting, or operational issues or effluent violation for "source control parameters[3]", select technical assistance as a solution (if not previously selected)
   b. If associated with effluent Inadequacy parameter for which no effluent Inadequacy occurred, select technical assistance as a solution, if not previously addressed.
   c. If associated with parameter that can be addressed through infrastructure improvements, select remedial action as a solution.
5. If order condition Inadequacy, review CIWQS flat file violation descriptions
   a. If system has many operational and effluent violations, as well as effluent inadequacies, replace remedial actions with facility replacement and technical assistance as selected solutions.
   b. Otherwise select technical assistance as a solution, if not already selected.
6. If unauthorized discharge Inadequacy, select technical assistance as a solution, if not already selected.
7. If sanitary sewer overflow Inadequacy, select technical assistance as a solution, if not already selected.
8. If flow Inadequacy, select technical assistance as a solution, if not already selected.
9. If enforcement action Inadequacy, select technical assistance as a solution, if not already selected.

The above process results in the following solution counts. Table 1 (main body of this AG summary) provides a detailed list of the Inadequacy causes.

- Remedial Actions Only: 35 Facilities
- Technical Assistance Only: 59 Facilities
- Remedial Action (or Facility Replacement) & Technical Assistance: 45 Facilities

[3] *No reasonable remedial action could be applied at the treatment facility to address violations for some parameter types (e.g., salts, salt indicators, and metals. Instead, a source-control effort involving large-scale engineering studies and collaboration with water distribution utilities to identify and remedy the causes would be warranted, as some of the Regional Water Quality Control Boards are already doing (CV-SALTS, Central Valley Regional Water Quality Control Board). The WWNA selects technical assistance as the modeled solution to serve as an interim/starting point solutions for these types of violations/inadequacies, if not previously selected.*

Remedial actions may be replaced with facility-to-system connections or facility replacements as a selected solution. These alternatives will be considered for facilities with design flows equal to or less than 1 million gallons per day (MGD). To evaluate these alternatives, the WWNA project team will first assess the feasibility of connecting the Inadequate facility to another facility based on a 3-mile road distance threshold. No cost comparison for assessing facility-to-facility connections will be made[4]. If facility connections are deemed feasible using this distance criterion, facility connections will be the selected modeled solution in lieu of remedial actions. If the facility connection is deemed infeasible based on the distance threshold, facility replacement will be considered. If the cost of implementing remedial actions exceeds 60% percent of the facility replacement cost, facility replacement will be selected as the modeled solution in lieu of remedial actions.

Effluent Inadequacies

Sixty-nine (69) facilities met effluent violation Inadequacy criteria. The WWNA Project Team developed and categorized remedial actions for parameters assessed under the effluent violation Inadequacy criteria. Table A-3 lists the parameters and indicates whether each parameter resulted in WDR effluent violation inadequacies.

Table A-3. Parameters Triggering WDR Effluent Violation Inadequacy Criteria

Parameters Considered in the WDR Effluent Violation Inadequacy Assessment	Was Parameter a Cause of WDR Effluent Violation Inadequacies?
Biochemical Oxygen Demand (BOD)	Y
Nitrate, Total (as N)	Y
Nitrite plus Nitrate (as N)	Y
Nitrogen, Total (as N)	Y
Settleable Solids	Y
Total Coliform	Y
Total Kjeldahl Nitrogen (TKN) as (N)	Y
Total Suspended Solids (TSS)	Y
Ammonia, Total (as N) violation; Ammonia, Unionized (as N)	N
Carbonaceous Biochemical Oxygen Demand (CBOD), Percent Removal; Carbonaceous Biochemical Oxygen Demand (CBOD)	N
Dissolved Oxygen	N
E. coli; Fecal Coliform; Enterococcus	N
Nitrate, Total (as NO3)	N
Oil and Grease	N
pH	N
Surface Loading Rate	N

The selected remedial actions will depend on the parameters in violation, the combination of violating parameters, and the facility type. The WWNA project team classified all facilities by their wastewater treatment process in alignment with the State Water Resources Control Board's (State Water Board's)

[4] The WWNA team conferred with the State Water Board's Division of Financial Assistance (DFA) and concluded that data to assess cost feasibility is not readily available. In addition, DFA noted that current cost thresholds used for facility-to-facility projects in the Clean Water State Revolving Fund Intended Use Plan (CWSRF IUP) are based solely on funding availability for recent years, and not a proper costs assessment feasibility study.

Wastewater Operator Certification Program (WWOCP) classification of treatment plants by treatment level and technology. The facility type classifications are:

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

The WWNA project team then used its engineering experience to infer the underlying conditions that led to violations, which in turn were 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. Of the 69 facilities with effluent inadequacies, 68 fall into one of the facility classifications above, with about 36 distinct scenarios of facility-type-parameter violation combinations. Tables A-4 through A-10 contain the remedial actions for each scenario. The 69th facility is classified as OWTS, and a full facility replacement (package plant) is the selected solution.

Receiving Water Inadequacies

Eight (8) facilities met the receiving water Inadequacy criteria. Four (4) of these facilities had fairly old or infrequent violations (one or two occurrences), and it is assumed these issues have since been addressed. Some of the remaining four (4) facilities either had violations related to parameters for which there were no effluent inadequacies (nitrate, total nitrogen, total coliform, TKN, and pH) or violations related to salts. Technical assistance is selected as a solution for these facilities

Deficient Monitoring, Deficient Reporting, Late Reports, Failure to Submit a Monitoring Report Inadequacies

Sixty-one (61) WDR facilities met Inadequacy criteria for deficient monitoring, deficient reporting, late reports, or failure to submit a monitoring report. Technical assistance is selected as a solution for these facilities to help assess and improve their administrative practices.

Enforcement Order Inadequacies

Forty-one (41) WDR facilities met Inadequacy criteria for enforcement orders. There does not appear to be a repository that summarizes the details behind the orders; the details on enforcement orders exist within dozens of PDF documents accessed by download through CIWQS. The WWNA project team, therefore, obtained summary information from Regional Board staff. Enforcement orders were generally issued due to effluent violations, monitoring or reporting issues, or operational issues such as non-descript discharges, animal burrowing, or odor complaints.

Twenty-six (26) facilities were Inadequate due to enforcement orders for effluent violations, although fifteen (15) of these also met effluent Inadequacy criteria. In a few cases, the enforcement orders were associated with additional constituents that did not meet effluent Inadequacy criteria. Regardless, additional remedial actions were not included as solutions for these facilities. For the eleven (11) facilities that did not meet effluent Inadequacy criteria but did meet enforcement order Inadequacy criteria, and the orders were associated with effluent violations, remedial actions are the selected solution following the solution matrices provided in Tables A-4 through A-10.

All forty-one (41) facilities were Inadequate due to enforcement orders for monitoring, reporting, or operational issues or for effluent violations associated with "source control[5]" parameters. Six (6) of these also met the Inadequacy criteria for deficient monitoring, deficient reporting, late reports, or failure to submit a monitoring report; therefore, technical assistance was selected as the solution for these facilities. Technical assistance will be a selected solution for the additional thirty-five (35) WDRs facilities with enforcement orders due to monitoring, reporting, or operational issues.

Order Condition Inadequacies

Fifty (50) facilities met order condition inadequacies. Such conditions span causes including:

- Parameter exceedances for pH, biological oxygen demand, dissolved oxygen, total suspended solids, turbidity, electrical conductivity, total dissolved solids, boron, sodium, and total coliform
- Incomplete, missing, or deficient reporting
- Deficient monitoring
- Animal burrows in pond levees/banks
- Non-operative equipment (such as aerators)
- Spills, unauthorized discharges, and free board exceedances

There are approximately 800 unique violation-description line items to review across the fifty (50) facilities with order condition inadequacies. Only four (4) of these facilities did not have remedial actions, technical assistance, or facility replacement (or some combination) as selected solutions based on other Inadequacy criteria. Technical assistance is the selected solution for these four (4) facilities, as all order conditions relate to operational issues. While the project team did not review all 800 violation description line items in detail, a value-added approach was used to simplify the solution selection approach, assuming the most concerning issues faced by a facility would already have been addressed following solutions selected for other inadequacies.

Unauthorized Discharge Inadequacies

Five (5) facilities were deemed Inadequate due to unauthorized discharge violations. However, all facilities already had technical assistance selected as a solution for other inadequacies, and it is assumed that technical assistance will support the facilities in addressing their unauthorized discharge inadequacies. Therefore, no solutions are proposed.

Sanitary Sewer Overflow Inadequacies

One (1) facility met sanitary sewer overflow Inadequacy criteria. Technical assistance is already a selected solution for this facility due to meeting Inadequacy criteria for deficient monitoring, deficient reporting, late reports, or failure to submit a monitoring report. It is assumed that technical assistance will also support issues associated with this Inadequacy.

Flow and Enforcement Action Inadequacies

No facilities met flow or enforcement action Inadequacy criteria.

[5] No reasonable remedial action can be applied at the treatment facility to address violations for some parameter types (e.g., salt indicators, and metals). Instead, a source-control effort involving large-scale engineering studies and collaboration with water distribution utilities to identify and remedy the causes would be warranted, as some of the Regional Water Quality Control Boards are already doing (CV-SALTS, Central Valley Regional Water Quality Control Board). The WWNA selects technical assistance as the modeled solution to serve as an interim/starting point solutions for these types of violations/inadequacies, if not previously selected.

Table A-4. Remedial Actions for Activated Sludge Facility Types

Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install New or Rehab/Replace Existing Clarifier	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C)	X					X	Elevated BOD indicates insufficient BOD removal. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading and Inadequate aeration.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Improve aeration system to increase dissolved oxygen and support BOD removal.
BOD (5-day @ 20 Deg. C) Nitrogen, Total (as N)	X	X	X			X	Elevated BOD and total nitrogen indicate insufficient BOD removal and insufficient nitrogen removal/denitrification. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient nitrification, limited anoxic treatment capacity, and particulate organic nitrogen carryover.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal through nitrification and denitrification. Install effluent filter or flotation to improve solids separation and reduce particulate BOD and organic nitrogen carryover. Improve aeration system to increase dissolved oxygen and support BOD removal and nitrification.
BOD (5-day @ 20 Deg. C) Total Kjeldahl Nitrogen (TKN) (as N)	X					X	Elevated BOD and TKN indicate insufficient BOD removal and insufficient nitrification. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, Inadequate aeration, and excessive organic or nitrogen loading.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Improve aeration system to increase dissolved oxygen and support BOD removal and nitrification.
BOD (5-day @ 20 Deg. C) TSS	X		X	X		X	Elevated BOD and TSS indicate insufficient BOD removal and insufficient clarification and solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, solids carryover, and Inadequate aeration.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter or flotation to improve solids separation and reduce TSS and associated particulate BOD. Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover. Improve aeration system to increase dissolved oxygen and support BOD removal.
BOD (5-day @ 20 Deg. C) Nitrate, Total (as N) TSS	X	X	X	X		X	Elevated BOD, nitrate, and TSS indicate insufficient BOD removal, insufficient nitrogen removal/denitrification, and insufficient clarification and solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, limited anoxic treatment capacity, and solids carryover.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install/upgrade for BNR to improve denitrification and nitrogen removal. Install effluent filter or flotation to improve solids separation and reduce TSS and associated particulate BOD. Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover. Improve aeration system to support BOD removal and upstream nitrification.

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Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install New or Rehab/Replace Existing Clarifier	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C) Nitrogen, Total (as N) TSS	X	X	X	X		X	Elevated BOD, total nitrogen, and TSS indicate insufficient BOD removal, insufficient nitrogen removal/denitrification, and insufficient clarification and solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient nitrification, limited anoxic treatment capacity, and solids carryover.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal through nitrification and denitrification. Install effluent filter or flotation to improve solids separation and reduce TSS, particulate BOD, and particulate organic nitrogen. Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover. Improve aeration system to support BOD removal and nitrification.
Nitrogen, Total (as N)	X	X	X			X	Elevated total nitrogen indicates insufficient nitrogen removal/denitrification. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, limited anoxic treatment capacity, and particulate organic nitrogen carryover.	Install new earthen storage basin to provide flow equalization and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal through nitrification and denitrification. Install effluent filter or flotation to reduce particulate organic nitrogen. Improve aeration system to support nitrification.
Nitrogen, Total (as N) TSS	X	X	X	X			Elevated total nitrogen and TSS indicate insufficient nitrogen removal/denitrification and insufficient clarification and solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, limited anoxic treatment capacity, and particulate organic nitrogen carryover.	Install new earthen storage basin to provide flow equalization and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal through nitrification and denitrification. Install effluent filter or flotation to reduce TSS and particulate organic nitrogen. Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover.
BOD (5-day @ 20 Deg. C) Settleable Solids TSS	X		X	X		X	Elevated BOD, settleable solids, and TSS indicate insufficient BOD removal and insufficient clarification and solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, poor solids settleability, and solids carryover.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter or flotation to improve solids separation and reduce settleable solids, TSS, and associated particulate BOD. Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover. Improve aeration system to support BOD removal.
Settleable Solids Total Coliform				X	X		Elevated settleable solids and total coliform indicate insufficient clarification and solids separation and insufficient disinfection. Solids carryover may also interfere with effective disinfection.	Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover. Install UV disinfection to improve disinfection and reduce coliform concentrations.
TSS	X		X	X			Elevated TSS indicates insufficient clarification and solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, poor settleability, and solids carryover.	Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Install effluent filter or flotation to improve solids separation and reduce TSS. Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover.

Table A-5. Remedial Actions for Biofiltration Facility Types

Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C) TSS	X		X	X	Elevated BOD and TSS indicate insufficient BOD removal and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, biofilm sloughing, solids carryover, and Inadequate aeration.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter or flotation to improve solids separation and reduce TSS and associated particulate BOD. Improve aeration system to increase dissolved oxygen and support BOD removal.
Nitrate, Total (as N)	X	X			Elevated nitrate indicates insufficient nitrogen removal/denitrification. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, limited anoxic treatment capacity, limited recycle capacity, or insufficient available carbon.	Install new earthen storage basin to provide flow equalization and improve treatment stability. Install/upgrade for BNR to increase anoxic treatment capacity and improve denitrification.

Table A-6. Remedial Actions for Conventional Treatment Pond Facility Types

Combination of Specific Parameter Violations	Add New Treatment Pond Capacity (New Ponds)	Desludge Pond and Install New Liner	Install New Earthen Storage Basin (Flow EQ)	Install Effluent Filter or Flotation	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C)	X	X	X			X	Elevated BOD indicates insufficient BOD removal. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient solids management and reduced effective treatment volume, insufficient detention time, and Inadequate aeration.	Add new treatment pond capacity (new ponds) to increase treatment capacity and detention time and reduce hydraulic and organic loading rates. Desludge pond and install new liner to restore effective treatment volume, improve solids management, and restore pond integrity. Install new earthen storage basin to provide flow equalization and reduce peak hydraulic and organic loading. Improve aeration system to support BOD removal.
BOD (5-day @ 20 Deg. C) Settleable Solids	X	X	X	X		X	Elevated BOD and settleable solids indicate insufficient BOD removal and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading and insufficient solids management and reduced effective treatment volume.	Add new treatment pond capacity (new ponds) to increase treatment capacity and detention time. Desludge pond and install new liner to restore effective treatment volume, improve solids management, and restore pond integrity. Install new earthen storage basin to provide flow equalization and reduce peak loading. Install effluent filter or flotation to improve solids separation and reduce settleable solids and associated particulate BOD. Improve aeration system to support BOD removal.

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Combination of Specific Parameter Violations	Add New Treatment Pond Capacity (New Ponds)	Desludge Pond and Install New Liner	Install New Earthen Storage Basin (Flow EQ)	Install Effluent Filter or Flotation	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C) TSS	X	X	X	X		X	Elevated BOD and TSS indicate insufficient BOD removal and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient solids management and reduced effective treatment volume, and algae or biomass carryover.	Add new treatment pond capacity (new ponds) to increase treatment capacity and detention time. Desludge pond and install new liner to restore effective treatment volume and improve solids management. Install new earthen storage basin to provide flow equalization and reduce peak loading. Install effluent filter or flotation to reduce TSS, algae, and associated particulate BOD. Improve aeration system to support BOD removal.
BOD (5-day @ 20 Deg. C) Settleable Solids TSS	X	X	X	X		X	Elevated BOD, settleable solids, and TSS indicate insufficient BOD removal and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient solids management and reduced effective treatment volume, and algae or biomass carryover.	Add new treatment pond capacity (new ponds) to increase treatment capacity and detention time. Desludge pond and install new liner to restore effective treatment volume and improve solids management. Install new earthen storage basin to provide flow equalization and reduce peak loading. Install effluent filter or flotation to reduce settleable solids, TSS, algae, and associated particulate BOD. Improve aeration system to support BOD removal.
Nitrogen, Total (as N)		X	X	X		X	Elevated total nitrogen indicates insufficient nitrogen removal/denitrification. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient solids management and reduced effective treatment volume, insufficient nitrification, algal and other particulate organic nitrogen carryover.	Desludge pond and install new liner to restore effective treatment volume and improve solids management. Install new earthen storage basin to provide flow equalization and improve treatment stability. Install effluent filter or flotation to reduce particulate organic nitrogen carryover. Improve aeration system to support nitrification.
Total Coliform		X	X	X	X		Elevated total coliform indicates insufficient disinfection. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, insufficient solids management and reduced effective treatment volume, short-circuiting, and algae or suspended solids that interfere with disinfection.	Desludge pond and install new liner to restore effective treatment volume and improve solids management. Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Install effluent filter or flotation to reduce algae and suspended solids that can interfere with disinfection. Install UV disinfection to improve disinfection and reduce coliform concentrations.
TSS		X	X	X			Elevated TSS indicates insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, insufficient solids management and reduced effective treatment volume, and algae or biomass carryover.	Desludge pond and install new liner to restore effective treatment volume and improve solids management. Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Install effluent filter or flotation to improve solids separation and reduce TSS and algae carryover.

Table A-7. Remedial Actions for Modified Treatment Pond Facility Types

Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Desludge Pond and Install New Liner	Install Effluent Filter or Flotation	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C)	X	X			X	Elevated BOD indicates insufficient BOD removal. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient solids management and reduced effective treatment volume, Inadequate aeration, and seepage or liner deficiencies that reduce effective pond performance.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Remove accumulated sludge to restore effective treatment volume and improve solids management. Repair or replace deficient pond liner areas to reduce seepage and restore pond integrity. Improve aeration system to increase dissolved oxygen and support BOD removal.
BOD (5-day @ 20 Deg. C) Settleable Solids TSS	X	X	X			Elevated BOD, settleable solids, and TSS indicate insufficient BOD removal and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient solids management and reduced effective treatment volume, algae or biomass carryover, and seepage or liner deficiencies.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Remove accumulated sludge to restore effective treatment volume and improve solids management. Repair or replace deficient pond liner areas to reduce seepage and restore pond integrity. Install effluent filter or flotation to improve solids separation and reduce settleable solids, TSS, algae, and associated particulate BOD.
Total Coliform	X	X	X	X		Elevated total coliform indicates insufficient disinfection. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, insufficient solids management and reduced effective treatment volume, short-circuiting, algae or suspended solids that interfere with disinfection, and seepage or liner deficiencies.	Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Remove accumulated sludge to restore effective treatment volume and improve hydraulic performance. Repair or replace deficient pond liner areas to reduce seepage and restore pond integrity. Install effluent filter or flotation to reduce algae and suspended solids that can interfere with disinfection. Install UV disinfection for pathogen inactivation to improve disinfection and reduce coliform concentrations.
TSS	X	X	X			Elevated TSS indicates insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, insufficient solids management and reduced effective treatment volume, algae or biomass carryover, and seepage or liner deficiencies.	Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Remove accumulated sludge to restore effective treatment volume and improve solids management. Repair or replace deficient pond liner areas to reduce seepage and restore pond integrity. Install effluent filter or flotation to improve solids separation and reduce TSS and algae carryover.

Table A-8. Remedial Actions for Primary Facility Types

Combination of Specific Parameter Violations	Add New Treatment Capacity	Desludge Pond and Install New Liner	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C)	X	X	Elevated BOD indicates insufficient BOD removal in the conventional pond system. Potential contributing conditions include insufficient treatment capacity or detention time, insufficient solids management and reduced effective treatment volume, excessive organic loading, and seepage or liner deficiencies.	Add new treatment pond capacity (new ponds) to increase treatment capacity and detention time and reduce organic loading rates. Desludge pond and install new liner to restore effective treatment volume, improve solids management, reduce seepage, and restore pond integrity.

Table A-9. Remedial Actions for Sequencing Batch Reactor Facility Types

Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install Polymer Feed System to Improve Flotation and Filtration (w/Filter Upgrade)	Improve Aeration System	Modify SBR System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C) Nitrogen, Total (as N) TSS	X	X	X	X	Elevated BOD, total nitrogen, and TSS indicate insufficient BOD removal, insufficient nitrogen removal/denitrification, and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient nitrification, Inadequate aerobic/anoxic cycle sequencing, Inadequate solids retention, poor settling, and limited carbon for denitrification.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install polymer feed system to improve flotation/filtration (w/filter upgrade) to improve solids separation and reduce TSS and associated particulate BOD and nitrogen. Improve aeration system to increase dissolved oxygen and support BOD removal and nitrification. Modify SBR system to optimize BOD and nitrogen removal, including supplemental carbon addition where needed to support denitrification.

Table A-10. Remedial Actions for Tertiary Facility Types

Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install New or Rehab/Replace Existing Clarifier	Install Polymer Feed System to Improve Flotation and Filtration (w/Filter Upgrade)	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
BOD (5-day @ 20 Deg. C)	X			X		X	Elevated BOD indicates insufficient BOD removal. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, upstream BOD carryover, and insufficient tertiary removal of particulate BOD.	Install new earthen storage basin to provide flow equalization and stabilize BOD loading. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to improve removal of particulate BOD. Improve aeration system to improve upstream BOD removal.
BOD (5-day @ 20 Deg. C TSS	X			X		X	Elevated BOD and TSS indicate insufficient BOD removal and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, upstream solids carryover, and Inadequate tertiary filtration performance.	Install new earthen storage basin to provide flow equalization and stabilize BOD and TSS loading. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to improve solids separation and reduce TSS and associated particulate BOD. Improve aeration system to improve upstream BOD removal.
Nitrate, Total (as N) Total Coliform	X	X		X	X		Elevated nitrate and total coliform indicate insufficient nitrogen removal/denitrification and insufficient disinfection. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, limited anoxic treatment capacity or carbon availability, and solids or turbidity that interfere with disinfection.	Install new earthen storage basin to provide flow equalization and improve treatment stability. Install/upgrade for biological nutrient removal (BNR) to increase anoxic treatment capacity and improve denitrification, including supplemental carbon addition where needed. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to improve solids removal and reduce interference with disinfection. Install UV disinfection for pathogen inactivation to improve disinfection and reduce coliform concentrations.
Nitrite Plus Nitrate (as N)	X	X					Elevated nitrite and nitrate indicate insufficient nitrogen removal/denitrification. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, Inadequate anoxic conditions, limited recycle capacity, or insufficient carbon availability.	Install new earthen storage basin to provide flow equalization and improve treatment stability. Install/upgrade for biological nutrient removal (BNR) to increase anoxic treatment capacity and improve denitrification, including optimization of recycle rates and supplemental carbon addition where needed.

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Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install New or Rehab/Replace Existing Clarifier	Install Polymer Feed System to Improve Flotation and Filtration (w/Filter Upgrade)	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Nitrogen, Total (as N)	X	X		X		X	Elevated total nitrogen indicates insufficient nitrogen removal/denitrification. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient nitrification, limited anoxic treatment capacity or carbon availability, and particulate organic nitrogen carryover.	Install new earthen storage basin to provide flow equalization and improve treatment stability. Install/upgrade for biological nutrient removal (BNR) to improve nitrogen removal through nitrification and denitrification, including supplemental carbon addition where needed. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to reduce particulate organic nitrogen carryover. Improve aeration system to support nitrification.
Nitrogen, Total (as N) Total Coliform	X	X		X	X	X	Elevated total nitrogen and total coliform indicate insufficient nitrogen removal/denitrification and insufficient disinfection. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading, insufficient nitrification, limited anoxic treatment capacity or carbon availability, solids carryover, and insufficient disinfection performance.	Install new earthen storage basin to provide flow equalization and improve treatment stability. Install/upgrade for biological nutrient removal (BNR) to improve nitrogen removal through nitrification and denitrification, including supplemental carbon addition where needed. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to improve solids removal and reduce particulate nitrogen and interference with disinfection. Install UV disinfection for pathogen inactivation to improve disinfection and reduce coliform concentrations. Improve aeration system to support nitrification.
Settleable Solids	X		X	X			Elevated settleable solids indicate insufficient clarification and solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, insufficient upstream clarification, and Inadequate tertiary filtration performance.	Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Install new or rehab/replace existing clarifier to improve clarification and reduce solids carryover. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to improve tertiary solids separation and reduce settleable solids.
Total Coliform	X				X		Elevated total coliform indicates insufficient disinfection. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, insufficient UV intensity or disinfectant contact time, and interference from suspended solids or turbidity.	Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Install UV disinfection to improve disinfection and reduce coliform concentrations.

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Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install New or Rehab/Replace Existing Clarifier	Install Polymer Feed System to Improve Flotation and Filtration (w/Filter Upgrade)	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Total Coliform TSS	X			X	X		Elevated total coliform and TSS indicate insufficient disinfection and insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading and suspended solids or turbidity that interfere with disinfection.	Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to improve solids separation and reduce TSS and interference with disinfection. Install UV disinfection to improve disinfection and reduce coliform concentrations.
TSS	X			X			Elevated TSS indicates insufficient solids separation. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading, filter breakthrough, Inadequate coagulation, or solids loading that exceeds tertiary filtration capacity.	Install new earthen storage basin to provide flow equalization and reduce hydraulic loading variability. Install polymer feed system to improve flotation and filtration (w/filter upgrade) to improve tertiary solids separation and reduce TSS.

Attachment B - Proposed Solutions Approach for Inadequate NPDES Facilities

Eleven (11) NPDES facilities met Inadequacy criteria associated with a compliance schedule, compliance reporting, or failure to submit a discharge monitoring report. Technical assistance is the selected model solutions for these facilities.

Fifteen (15) Inadequate NPDES facilities met criteria for effluent violations and were thus assumed to be associated with a treatment or infrastructure deficiency. While the NPDES effluent violation Inadequacy criteria included a large set of parameters, the WWNA project team developed and categorized remedial actions only for parameters that could be addressed through remedial action infrastructure improvements. Table B-1 lists the parameters for which inadequacies occurred.

Table B-1. Parameters Triggering NPDES Effluent Violation Inadequacy with Remedial Actions as a Modeled Solutions

Parameter Violation Category	Specific Parameter Violations
Ammonia/TKN	Ammonia Impact Ratio Ammonia, Total (as N) Ammonia, Unionized (as N)
Bacteria	E.coli Total Coliform UV Transmittance
Chlorine	Chlorine, Free Available Chlorine, Total Residual
Disinfection Byproducts	Dibromochloromethane Dibromodichloromethane Dibromomethane Dichlorobromomethane
Flow	Flow
Nitrogen/Nitrate/Nitrite	Nitrate, Total (as N) Nitrite Plus Nitrate (as N) Nitrogen, Total (as N)
Oil & Grease	Oil & Grease
Organic Matter	Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) BOD5 @ 20 Deg. C, Percent Removal Carbonaceous Biochemical Oxygen Demand (CBOD) (5-day @ 20 Deg. C) Carbonaceous Biochemical Oxygen Demand (CBOD) (5-day @ 20 Deg. C), Percent Removal
pH	pH
Solids	Settleable Solids Total Solids (TS) Total Suspended Solids (TSS) Total Suspended Solids (TSS), Percent Removal Turbidity
Temperature	Temperature
Phosphorous	Phosphorus, Total (as P)

Table B-2 lists the parameters assessed for which no reasonable remedial action could be applied at the treatment facility. Instead, a source control effort involving large-scale engineering studies and collaboration with water distribution utilities to identify and remedy the causes would be warranted, as some Regional Water Quality Control Boards are already doing (e.g., CV-SALTS, Central Valley Regional Water Quality Control Board). For Inadequate facilities with these types of violations, the WWNA selects technical assistance as the modeled solution to serve as an interim/starting point solution, if not previously selected. Note that all 15 facilities with meeting effluent Inadequacy criteria had violations associated with such "source control" parameters.

Table B-2. Violation Parameters Assumed to Require Source Control Solutions for Inadequate NPDES Facilities

Parameter Violation Category	Specific Parameter Violations
Metals	Aluminum, Total Recoverable Copper, Total & Total Recoverable Zinc, Total & Total Recoverable
Organic Chemicals & Industrial Pollutants	Bis (2-Ethylhexyl) Phthalate Carbon disulfide Phthalate Esters Plastics TCDD Equivalents
Salts	Chloride Electrical Conductivity @ 25 Deg. C Sodium, Total & Total Recoverable Sulfate, Total (as SO4) Total Dissolved Solids (TDS)
Toxicity	Acute Toxicity, including Fathead Minnow-survival Chronic Toxicity, including Species 3; C.dubia-Reproduction; & Green Alga-Growth Cyanide, Free Available & Total (as CN)
UV Banks in Operation	UV Banks in Operation

To address inadequacies associated with parameters for which remedial action may be applied, the selected remedial actions will depend on the parameters in violation, the combination of violating parameters, and the facility type. The WWNA project team classified all facilities 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. The facility type classifications are:

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

The WWNA team then used its engineering experience to infer the underlying conditions that led to violations, which in turn were 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. Of the 15 facilities with effluent inadequacies, there are 14 distinct scenarios of facility-type-parameter violation combinations. Tables B-3 through B-8 list the remedial actions for each scenario. No NPDES SBR facilities met Inadequacy criteria for effluent violations, so no solutions were developed for SBR facilities.

Table B-3. Remedial Actions for Activated Sludge Facility Types

Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install Alkalinity/Chemical Feed	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Ammonia/TKN Bacteria Chlorine Disinfection Byproducts pH Nitrogen/Nitrate/Nitrite Organic Matter Solids	Ammonia Impact Ratio E.coli Total Coliform Chlorine (Free Available) Chlorine (Total Residual) Dibromochloromethane, Dibromodichloromethane, Dibromomethane, Dichlorobromomethane pH Nitrate (Total as N) BOD5 @ 20 Deg. C Percent Removal Settleable Solids Total Suspended Solids (TSS) Total Suspended Solids (TSS) Percent Removal	X	X	X	X	X	X	Elevated concentrations of ammonia, bacteria, chlorine residual, nitrate, organic matter, and solids, and abnormal pH indicate multiple activated sludge process deficiencies. Potential contributing conditions include variable hydraulic or organic loading; insufficient nitrification and nitrogen removal; insufficient aeration; insufficient solids separation/polishing; insufficient disinfection; Inadequate chlorine residual control; and Inadequate pH/alkalinity control.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal. Install effluent filter/flotation to reduce settleable solids and TSS in the effluent. Install alkalinity/chemical feed to provide pH and alkalinity control and support nitrification. Install UV disinfection to improve coliform removal and reduce chlorine-based disinfection. Improve the aeration system to increase dissolved oxygen and support nitrification and BOD removal.

Table B-4. Remedial Actions for Biofiltration Facility Types

Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install Alkalinity/ Chemical Feed	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Bacteria Organic Matter Solids	Total Coliform Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) BOD5 @ 20 Deg. C, Percent Removal Total Suspended Solids (TSS) Total Suspended Solids (TSS) Percent Removal Turbidity	X		X		X	X	Elevated concentrations of bacteria, organic matter, and solids indicate multiple treatment deficiencies. Potential contributing conditions include variable hydraulic or organic loading; insufficient BOD removal; insufficient solids separation/polishing; and insufficient disinfection.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter flotation to improve solids separation and reduce TSS and turbidity in the effluent. Install UV disinfection to reduce coliform concentrations. Improve aeration system to increase dissolved oxygen and support BOD removal.
Ammonia/TKN Bacteria Chlorine Disinfection Byproducts pH Nitrogen/Nitrate/Nitrite Solids	Ammonia (Total as N) Total Coliform Chlorine (Total Residual) Dichlorobromomethane pH Nitrate (Total as N) Settleable Solids	X	X	X	X	X	X	Elevated concentrations of ammonia, bacteria, chlorine residual, nitrate, and solids, and abnormal pH indicate multiple treatment deficiencies. Potential contributing conditions include variable hydraulic loading; insufficient nitrification and nitrogen removal; insufficient solids separation/polishing; insufficient disinfection; Inadequate chlorine residual control; and Inadequate pH/alkalinity control.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic loading, and improve treatment stability. Install/upgrade BNR to improve nitrogen removal. Install effluent filter/flotation to improve solids separation and reduce settleable solids in the effluent. Install alkalinity/chemical feed to provide pH and alkalinity control and support nitrification and ammonia removal. Install UV disinfection to reduce coliform concentrations and reduce chlorine-based disinfection. Improve aeration system to increase dissolved oxygen and support nitrification.

Table B-5. Remedial Actions for Conventional Treatment Pond Facility Types

Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Desludge Pond and Install New Liner	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter And/or Flotation	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Bacteria Nitrogen/Nitrate/Nitrite Organic Matter Solids	Total Coliform Nitrate (Total as N) Nitrite Plus Nitrate (as N) Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Settleable Solids Total Suspended Solids (TSS)	X	X	X	X	X	X	Elevated concentrations of bacteria, nitrate/nitrite, organic matter, and solids indicate multiple treatment pond deficiencies. Potential contributing conditions include variable hydraulic or organic loading; insufficient nitrogen removal; insufficient BOD removal; insufficient algal solids management, separation, and polishing; and insufficient disinfection.	Desludge pond and install new liner to restore effective pond volume, improve solids management, and restore pond integrity. Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal. Install effluent filter/flotation to improve algal solids separation and TSS in the effluent. Install UV disinfection to reduce coliform concentrations. Improve aeration system to increase dissolved oxygen and support BOD removal and nitrification.

Table B-6. Remedial Actions for Modified Treatment Pond Facility Types

Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Add New Treatment Pond Capacity (New Pond)	Desludge Pond and Install New Liner	Install New Earthen Storage Basin (Flow EQ)	Install Effluent Filter or Flotation	Install Alkalinity/ Chemical Feed	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Ammonia/TKN Bacteria Chlorine pH Organic Matter Solids	Ammonia (Total as N) Total Coliform Chlorine (Total Residual) pH BOD5 @ 20 Deg. Percent Removal Total Suspended Solids (TSS) Total Suspended Solids (TSS) Percent Removal	X	X	X	X	X	X	X	Elevated concentrations of ammonia, bacteria, chlorine residual, organic matter, and solids, and abnormal pH indicate multiple treatment pond deficiencies. Potential contributing conditions include insufficient treatment capacity and detention time; variable hydraulic or organic loading; insufficient nitrification; insufficient BOD removal; insufficient solids management, separation, and polishing; insufficient disinfection; Inadequate chlorine residual control; and Inadequate pH/alkalinity control.	Add new treatment pond capacity to increase treatment capacity and detention time and reduce hydraulic and organic loading rates. Desludge pond and install new liner to restore effective pond volume, improve solids management, and restore pond integrity. Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter/flotation to improve solids separation and reduce TSS in the effluent. Install alkalinity/chemical feed to provide pH and alkalinity control and support nitrification. Install UV disinfection to improve pathogen inactivation and reduce chlorine-based disinfection. Improve the aeration system to increase dissolved oxygen to support nitrification and BOD removal.

Table B-7. Remedial Actions for Primary Facility Types

Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Desludge Pond and Install New Liner	Install New Earthen Storage Basin (Flow EQ)	Install Effluent Filter or Flotation	Install UV Disinfection for Pathogen Inactivation	Add/Improve Aeration System	Inadequacies Assumption	remedial actions assumption
Chlorine Organic Matter Solids	Chlorine (Free Available) Chlorine (Total Residual) Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) BOD @ 20 Deg. C (Percent Removal) Settleable Solids Total Suspended Solids (TSS)	X	X	X	X	X	Elevated concentrations of chlorine residuals, organic matter, and solids indicate multiple primary treatment deficiencies. Potential contributing conditions include variable hydraulic or organic loading; insufficient biological organic matter removal; insufficient solids management, separation, and polishing; and Inadequate disinfection and chlorine residual control.	Desludge pond and install new liner to restore effective treatment volume, improve solids management, and restore pond integrity. Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter/flotation to reduce settleable solids and TSS in the effluent. Install UV disinfection to reduce chlorine-based disinfection. Add an aeration system to increase dissolved oxygen to support BOD removal.

Table B-8. Remedial Actions for Tertiary Facility Types

Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install Alkalinity/ Chemical Feed	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Ammonia/TKN Bacteria Chlorine Organic Matter Solids	Ammonia (Total as N) Total Coliform Chlorine (Total Residual) Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) BOD5 @ 20 Deg. C (Percent Removal) Total Suspended Solids (TSS) Total Suspended Solids (TSS) Percent Removal	X		X	X	X	X	Elevated concentrations of ammonia, bacteria, chlorine residual, organic matter, and solids indicate multiple treatment deficiencies. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading; insufficient nitrification and ammonia removal; insufficient BOD removal; insufficient solids separation/polishing; insufficient disinfection chlorine residual control.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. install effluent filter/flotation to improve solids separation and reduce TSS in the effluent. Install alkalinity/chemical feed to support nitrification. Install UV disinfection to reduce coliform concentrations and chlorine-based disinfection. Improve aeration system to increase dissolved oxygen to support nitrification and BOD removal.

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Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install Alkalinity/ Chemical Feed	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Bacteria Disinfection Byproducts pH Nitrogen/Nitrate/Nitrite Solids	Total Coliform Dichlorobromomethane, Dibromochloromethane pH Nitrogen (Total as N) Settleable Solids Total Suspended Solids (TSS)	X	X	X	X	X	X	Elevated concentrations of bacteria, nitrogen, and solids, and abnormal pH indicate multiple treatment deficiencies. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading; insufficient nitrogen removal; insufficient solids separation; insufficient disinfection; and Inadequate pH/alkalinity control.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic loading, and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal. Install effluent filter/flotation to reduce settleable solids and TSS in the effluent. Install alkalinity/chemical feed to provide pH and alkalinity control and support nitrification. Install UV disinfection to reduce coliform concentrations. Improve aeration system to increase dissolved oxygen for nitrification and nitrogen removal.
Ammonia/TKN Organic Matter Temperature	Ammonia (Unionized as N) Biochemical Oxygen Demand (BOD) (50day @ 20 Deg. C) Temperature	X			X		X	Elevated concentrations of ammonia and organic matter and abnormal effluent temperature indicate multiple treatment deficiencies. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading; insufficient nitrification; insufficient BOD removal; Inadequate dissolved oxygen; and elevated influent or process temperatures.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, improve treatment stability, and dampen short-term temperature fluctuations associated with influent flow variability. Install alkalinity/chemical feed to support nitrification. Improve aeration system to increase dissolved oxygen for nitrification and BOD removal.
Nitrogen/Nitrate/Nitrite	Nitrogen (Total as N)	X	X				X	Elevated total nitrogen indicates insufficient biological nitrogen removal. Potential contributing conditions include insufficient flow equalization and variable hydraulic loading; insufficient nitrification and denitrification; and Inadequate dissolved oxygen to support nitrification.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic loading, and improve treatment stability. Install/upgrade for BNR to improve nitrogen removal through nitrification and denitrification. Improve aeration system to increase dissolved oxygen to support nitrification.

CA Wastewater Needs Assessment
Solutions and Cost Assessment
Advisory Group Summary for October 2026 Meeting

Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install Alkalinity/ Chemical Feed	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Ammonia/TKN Bacteria Flow pH Organic Matter Solids	Ammonia (Unionized as N) Total Coliform Flow pH Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Total Suspended Solids (TSS)	X		X	X	X	X	Elevated concentrations of ammonia/TKN, bacteria, organic matter, and solids, abnormal pH, and elevated flow indicate multiple tertiary treatment deficiencies. Potential contributing conditions include insufficient flow equalization and excessive hydraulic or organic loading; insufficient nitrification and ammonia removal; insufficient biological organic matter removal; insufficient solids separation and polishing; insufficient disinfection and pathogen inactivation; Inadequate dissolved oxygen; and Inadequate pH/alkalinity control.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter/flotation to reduce TSS in the effluent. Install alkalinity/chemical feed to provide pH and alkalinity control and support nitrification. Install UV disinfection to reduce coliform concentrations. Improve aeration system to increase dissolved oxygen to support nitrification and BOD removal.
Bacteria	Total Coliform	X				X		Elevated concentrations of bacteria indicate insufficient disinfection and pathogen inactivation. Potential contributing conditions include insufficient flow equalization and hydraulic loading variability that may reduce disinfection performance.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic loading, and improve treatment stability. Install UV disinfection to reduce coliform concentrations.
Flow Organic Matter Solids	Flow Carbonaceous Biochemical Oxygen Demand (CBOD) (5-day @ 20 Deg. C) Carbonaceous Biochemical Oxygen (CBOD) (5-day @ 20 Deg. C) Percent Removal Settleable Solids Total Solids (TS) Total Suspended Solids (TSS) Total Suspended Solids (TSS) Percent Removal Turbidity	X		X			X	Elevated flow and concentrations of organic matter and solids indicate multiple treatment deficiencies. Potential contributing conditions include insufficient flow equalization and excessive hydraulic or organic loading; insufficient BOD removal; and insufficient solids separation.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, and improve treatment stability. Install effluent filter/flotation to improve solids separation and reduce settleable solids, total solids, TSS, and turbidity in the effluent. Improve aeration system to increase dissolved oxygen to support BOD removal.

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Combination of Parameter Violation Categories	Combination of Specific Parameter Violations	Install New Earthen Storage Basin (Flow EQ)	Install/Upgrade for BNR	Install Effluent Filter or Flotation	Install Alkalinity/ Chemical Feed	Install UV Disinfection for Pathogen Inactivation	Improve Aeration System	Inadequacies Assumption	Remedial Actions Assumption
Ammonia/TKN Bacteria Chlorine Nitrogen/Nitrate/Nitrite Oil & Grease Organic Matter Phosphorous Solids Temperature	Ammonia (Total as N) Total Coliform Chlorine (Total Residual) Nitrate (Total as N) Nitrite Plus Nitrate (as N) Oil & Grease Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Phosphorous (Total as P) Total Suspended Solids (TSS) Turbidity Temperature	X	X	X	X	X	X	Elevated concentrations of ammonia, bacteria, chlorine residual, nitrate/nitrite, oil & grease, organics, phosphorus, and solids, and abnormal effluent temperature indicate multiple treatment deficiencies. Potential contributing conditions include insufficient flow equalization and variable hydraulic or organic loading; insufficient nitrification and biological nutrient removal; insufficient biological treatment; insufficient solids separation and polishing; insufficient disinfection; Inadequate chlorine residual control; Inadequate dissolved oxygen; insufficient phosphorus removal; and elevated influent or process temperatures.	Install new earthen storage basin to provide flow equalization, reduce peak hydraulic and organic loading, improve treatment stability, and dampen short-term temperature fluctuations associated with influent flow variability. Install/upgrade BNR to improve nitrogen and phosphorous removal. Install effluent filter/flotation to reduce TSS, turbidity, and oil & grease in the effluent. Install alkalinity/chemical feed to provide alkalinity needed to support nitrification and provide chemical phosphorus removal, as applicable. Install UV disinfection to reduce coliform concentrations and reduce chlorine-based disinfection. Improve aeration system to increase dissolved oxygen to support nitrification and BOD removal.

Attachment C – SSSGO Pipe Repair/Replacement Approach

Several SSSGO systems met Inadequacy criteria for poor spill performance. It is assumed that these spills result from aging, cracked infrastructure with subsequent inflow and infiltration, causing flows within the sewer lines to exceed their capacity. Pipe repair or replacement will be the selected solution. The amount of pipe that would need repair or replacement will be based on each system pipe length .

As part of the Inadequacy assessment, the WWNA project team sorted SSSGO systems by system length, resulting in four system length size categories: large, medium, small, and micro. The project team calculated the average pipe length for all Inadequate facilities in each size category, applied a percentage to each category to determine the length to be repaired/replaced, and developed a correlation across all Inadequate SSSGO systems. Table C-1 lists each system length size category, the relevant number of Inadequate systems, average pipe length for each category, and the assumed percentage for repair/replacement. Figure C-1 displays the plot of the average pipe length and resulting pipe length to be repaired/replaced for each size category, as well as the estimated regression line. The project team plans to apply this correlation for each Inadequate SSSGO system to estimate the length of pipe to be repaired/replaced. The regression equation is:

$$PLRR = 0.1SPL + 6.7$$

Where PLRR is the pipe length to be repaired/replaced and SPL is the system pipe length.

Table C-1. Number of Inadequate Systems, Average Pipe Length, and Assumed Pipe Repair/Replacement for each System Length Size Category

System Length Size Category	# of Inadequate SSSGO Systems	Average Pipe Length (mi)	Assumed Percentage to be Repaired/Replaced	Length of Pipe to be Repaired/Replaced
Large	1	933	10%	93.3
Medium	12	165	15%	24.7
Small	11	44	25%	11.1
Micro	6	10	50%	5.2

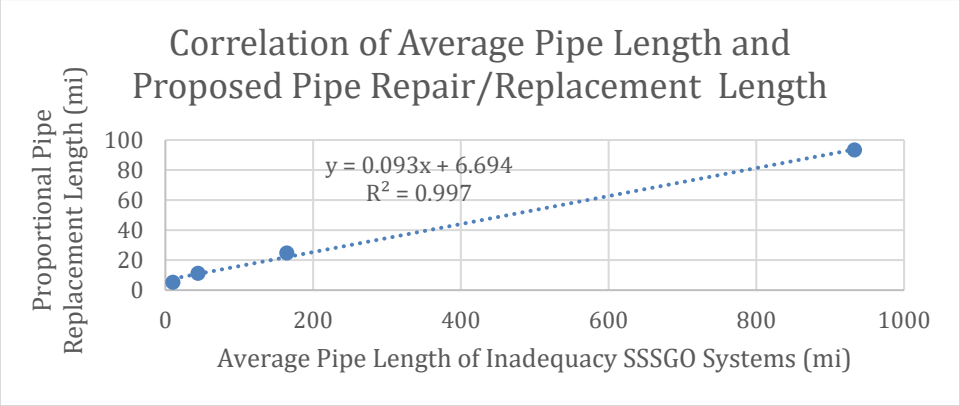


Figure C-1. Plot of Average Pipe Length and Proposed Pipe Repair/Replacement Length for Inadequate SSSGO Systems.