

# City of Palo Alto

## Palo Alto Horizontal Levee Pilot Project

### Location

Palo Alto, CA

### Project Budget

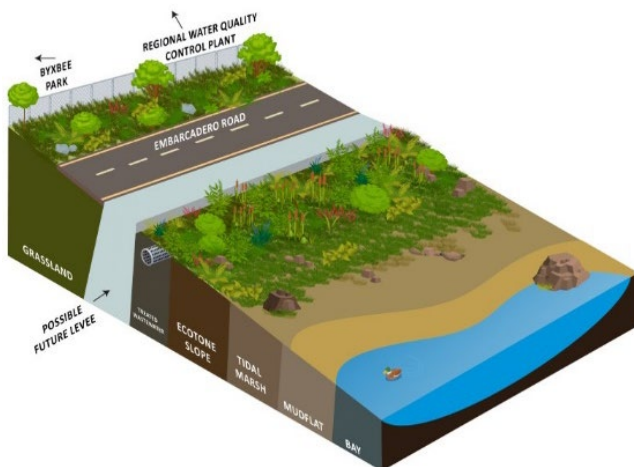
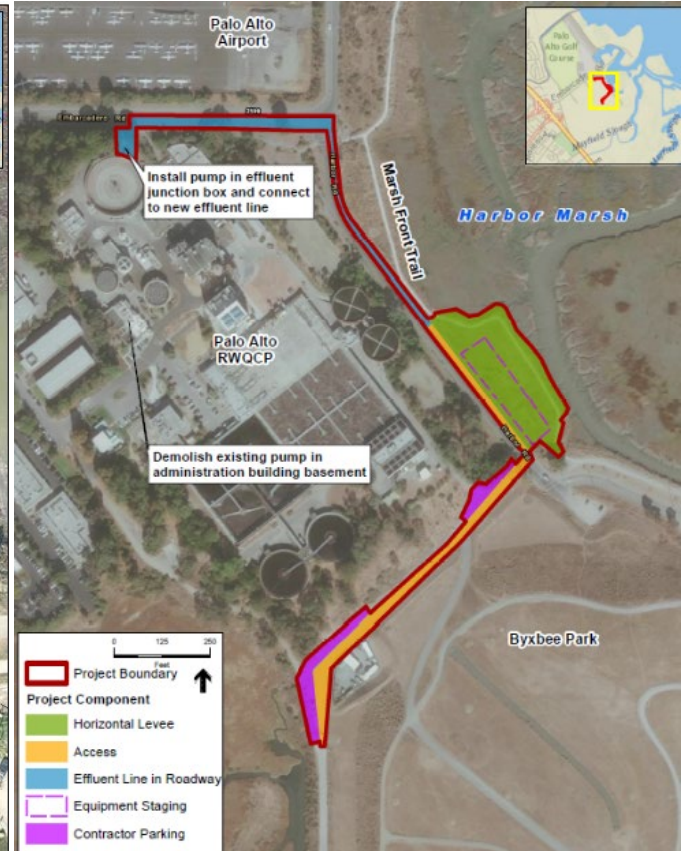
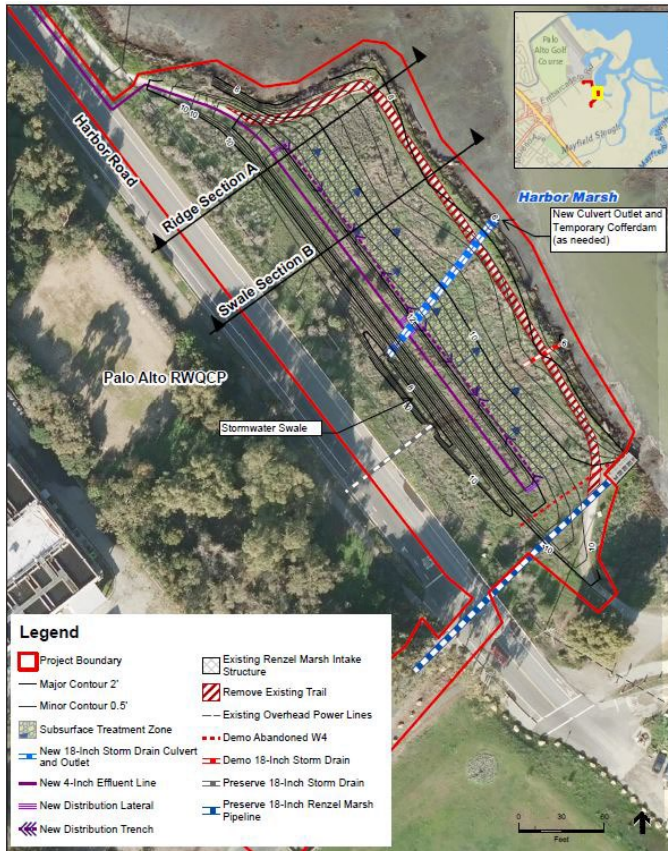
Approximately \$5,000,000

### Schedule

- Conceptual Design: 2017
- Preliminary Design: 2020
- Final Design: 2023
- Permitting/CEQA: 2023-2024
- Construction: 2024-2025

### Sponsors

- City of Palo Alto
- San Francisco Estuary Partnership
- U.S. Environmental Protection Agency
- California State Coastal Conservancy



## **Project Objectives**

- Engage communities and technical experts to design and permit a multi-benefit horizontal levee adjacent to the Regional Water Quality Control Plant
- Restore and enhance critical habitat, support sea level rise resiliency, and improve water quality

## **Project Goals**

- Restore and enhance rare and historic transitional habitat along the Bay's shoreline for special status species.
- Adapt to sea level rise by providing a vegetated slope that will support freshwater plants and build organic soils to keep pace with, and allow wetland habitat to migrate up-slope with, rising water levels.
- Provide polishing treatment of tertiary-treated wastewater.
- Engage diverse populations of residents and interested stakeholders in sea level rise adaptation, habitat restoration, and shoreline planning activities.

## **Project Overview**

The Palo Alto Horizontal Levee Pilot Project is a multi-benefit project designed to improve and expand shoreline habitat along the perimeter of Harbor Marsh. The project will create a broad horizontal levee that is adaptable to sea level rise and provides polishing treatment to treated wastewater from the City's Regional Water Quality Control Plant (RWQCP) before it enters the San Francisco Bay. The horizontal levee will include grassy wet meadow, freshwater/tidal brackish marsh, and riparian scrub – historical transitional habitat between uplands and tidal marshes which has been decimated by development along the Bay shoreline, contributing to the regional decline in sensitive marsh species, and is therefore a high restoration priority for resource agencies.

The project involves excavating the existing berm, constructing a new 500-linear-foot levee berm and ecotone slope, installing a new pump at the RWQCP, trenching and installation of a buried pipeline along Harbor Road and Embarcadero Road, and installation of a treated wastewater subsurface irrigation system at the newly created horizontal levee that is vegetated with freshwater native species. The project is designed as a permanent pilot study that would collect information on horizontal levees to inform larger-scale flood protection projects in the future. As such, the project is designed to accommodate future construction of a regional flood protection levee between the horizontal levee and Embarcadero Road.

The project received permits in late 2023/early 2024 and will break ground on construction in Summer 2024.

## **Anticipated Project Benefits**

This multi-benefit pilot project will create and expand aquatic tidal marsh habitat (jurisdictional waters) and rare transitional habitat types between upland and tidal salt marsh communities. The horizontal levee design provides an upland transition zone for marsh vegetation communities and sensitive species to adapt to predicted sea level rise while maintaining flood protection integrity for the City's vital RWQCP infrastructure, as well as supporting future integration into a regional flood protection solution.

The horizontal levee pilot project allows design standards, planting assemblages, irrigation source water application and approach, and maintenance practices to be tested and refined to inform larger-scale implementation of similar horizontal levee designs along the South Bay shoreline.

## **Regulatory Permitting Considerations**

To avoid potential significant conflicts related to the proposed siting of the project on City airport land, and the inherent conflict between airport operations and wetland habitats (per Federal Aviation Administration [FAA] guidance on the topic of wetland birds and aircraft strikes), as well as to avoid the potential requirement of the U.S. Army Corps of Engineers to process an Individual Permit based on these potential conflicts, an alternative site was selected for the project and design was re-initiated for the new site. In addition, in order to meet most permitting agencies' requirements, the project must demonstrate that aquatic and wildlife impacts have been

avoided and minimized to the maximum extent feasible. The following efforts were taken to demonstrate compliance with these requirements, while meeting project goals:

- With the selection of the alternative site for the project, impacts to existing wetlands were reduced (<0.1 ac perm.) and most work will be conducted in less sensitive upland habitats compared to the original project site.
- A project commitment to limited change to wetland habitats (i.e., ‘type conversion,’ of tidal salt marsh to tidal brackish marsh) from treated wastewater (freshwater) irrigation, via careful monitoring and adherence to an agency-approved Monitoring and Adaptive Management Plan (MAMP).
- To minimize construction-related adverse effects to federal- and state-listed and fully-protected species, costly avoidance and minimization measures will be implemented, many of which could be argued are not warranted for the low quality of existing habitat (see more on this below). Example impact avoidance/minimization measures required of the project include the use of qualified biological monitors during construction activities, seasonal and tidal cycle work limitations, predominantly non-mechanized vegetation removal methods, installation of acoustic barriers, and installation of predator perching deterrents.
- Avoidance of all adverse effects to in-water aquatic species will occur, via installation of an integrated silt/wildlife exclusion fence along the interface of the toe of slope and the adjacent tidal marsh channel. Finally, to meet most permitting agencies’ requirements to qualify for coverage under programmatic permits for restoration projects, the project expended significant time and effort to demonstrate that type conversion would be minimized, and that the project would result in a net increase in functions and services for aquatic habitats and associated aquatic species, both post-project and with projected sea level rise. In addition, the project was required to make numerous costly post-project commitments, via the MAMP, for extensive performance monitoring for a minimum of 5 years.

Discharge of treated wastewater into waters of the U.S. requires a National Pollutant Discharge Elimination System (NPDES) permit under CWA Section 402. The proposed horizontal levee polishing treatment of tertiary-treated wastewater from the City’s RWQCP therefore requires authorization from the San Francisco Bay RWQCB which has delegated authority to implement CWA Section 402. The City RWQCP’s existing NPDES permit covers shallow water discharges, and is being modified to add the project’s horizontal levee treatment zone as an additional discharge location and receiving water. Aside from having to

Per Sam Engelage, City of Palo Alto: *The NPDES permit was one of the easiest permits to obtain. As part of the wastewater treatment plant’s permit reissuance we’ve applied for adding this site as an additional discharge location and received water. For that we had to conduct a dilution and mixing zone study to support that effort. But with that and early coordination with our NPDES permit writer, there has been very little back and forth and a very clear path forward for that permit.*

conduct a dilution and mixing zone study to support this effort, and some early coordination with the NPDES permit preparer, the process has been relatively straightforward. In 2022, the San Francisco Bay RWQCB developed the “NPDES Permitting for Nature-Based Solutions” Fact Sheet <sup>1</sup>, which provides useful regulatory permitting context for nature based solutions including treatment wetlands and horizontal levees. This fact sheet is not yet [posted online](#) but is appended for reference. One key takeaway from this process is that, for proposed horizontal levee projects with a treated wastewater component, timing for horizontal levee construction should be coordinated with the scheduled reissuance of the wastewater treatment facility’s NPDES permit, as the RWQCBs prefer not having to modify an existing NPDES permit mid-way through its current term.

To achieve the project goals and obtain approval from the San Francisco Bay Conservation and Development Commission (BCDC), which regulates activities in the Bay and within 100 feet of the Bay shoreline, public access elements are incorporated into the project. Public access goals, requirements from BCDC (e.g., recreational trail and overlook amenities), and ADA compliance requirements often conflicted with wildlife protection objectives and other project goals (such as allowing for efficient City operations and maintenance, as well as

<sup>1</sup> San Francisco Bay Regional Water Quality Control Board. 2022. NPDES Permitting for Nature-based Solutions Fact Sheet. Attached.

supporting future integration into a regional flood protection solution); these conflicts required early and frequent stakeholder outreach and collaboration to resolve.

With respect to the extensive and costly avoidance and minimization measures currently being required by permitting/wildlife agencies to minimize construction-related adverse effects to federal- and state-listed and fully-protected species, it should be noted that most nature-based solutions (NbS) shoreline adaptation projects inherently must occur in or adjacent to suitable habitat for such species. Because of this, adverse construction-related effects to sensitive species from NbS shoreline adaptation projects are in essence unavoidable. However, these projects are inherently aimed at creating, restoring, enhancing, and/or preserving<sup>2</sup> such habitats for sensitive species, and therefore will result in long term benefits to these same species. As such, we highly encourage the environmental/permitting community to acknowledge and accept a low level of initial incidental take, in exchange for the long term benefits to these species and their ecosystems, rather than spending inordinate amounts of time, effort, and money to reduce or avoid such incidental take. Stated in another way, the magnitude of added costs and effort being expended on construction-related avoidance and minimization measures for sensitive species is not commensurate with the short-term benefits or protections being afforded by the measures, in light of the long-term benefits that restoration projects are delivering to sensitive species and their habitats.

Once the project is constructed, monitoring and adaptive management actions will be needed to maintain project goals and maximize successes over time, and have been required as conditions of regulatory agency permits and approvals. Post-construction actions will require a financial commitment by the project sponsors for many years following construction. Further, some adaptive management plan actions may disturb sensitive species or habitats and need additional permitting support. For example, if the levee slope needed to be regraded to improve habitat establishment and wastewater treatment polishing, that action may require regulatory agency approval due to the potential for harm to protected species or work in regulated aquatic habitats during the process. These sorts of actions may be deemed necessary and occur after the initial project construction permits have expired, and therefore may require a new suite of regulatory agency approvals (but because they are not currently anticipated, they were not analyzed or requested in this project's current permits). As an important note, for projects that can anticipate future adaptive management actions that will trigger impacts and require permits over the post-construction life of the project, these actions can be analyzed and included in the project's initial permit request to minimize future regulatory analysis.

## Successes and Wins

Building on the success of the Oro Loma Horizontal Levee Demonstration Project, this will be the first horizontal levee project constructed with a wastewater treatment zone discharging directly to the Bay<sup>3</sup>. Furthermore, the City of Palo Alto successfully leveraged collaboration to secure grant funding and advance this innovative project type from concept to construction, in a situation where, like most local jurisdictions, the City would have been stretched too thin to accomplish this kind of innovative pilot project on its own.

To advance the permitting process, the project team heavily engaged with the San Francisco Bay Restoration and Regulatory Integration Team (BRRIT) prior to submitting permitting applications. Early and frequent engagement included four pre-application meetings starting at the concept inception stage in 2019, and a site tour; the site tour proved to be a highly successful way to help agency staff appreciate the project's constraints and vision, by providing a firsthand understanding of site and surrounding conditions. This early regulatory agency engagement resulted in project design refinements that were satisfactory to the BRRIT such that permitting could be advanced.

Furthermore, during the period of this project's active BRRIT engagement and permit application process, BCDC's Bay Plan Amendment, which revised their policies surrounding the placement of in-Bay fill for the purposes of habitat restoration (to allow fill in the minimum amount necessary, as well as to allow some 'type conversion'), was adopted. This Amendment was a benefit to the project's permitting process and will continue to be for other horizontal levee projects. In addition, during the period of this project's active BRRIT engagement and permit application process, the U.S. Army Corps of Engineers' position with respect to permitting a

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<sup>2</sup> Such as under future sea level rise scenarios.

<sup>3</sup> The Oro Loma Horizontal Levee Demonstration Project discharges are contained within a 'closed system' not connected the Bay.

horizontal levee that supports vegetation whose hydrology is dependent upon on-going wastewater inputs (versus natural hydrologic sources) evolved, such that they concluded this project could be authorized under a Clean Water Act Section 404 Nationwide Permit Program Number 27 (Restoration) rather than a more involved Individual Permit.

Applying statewide programmatic permits for restoration projects, including California's Cutting the Green Tape (CGT) restoration permit pathways, reduced the project's CEQA compliance and permitting costs to some degree. The project utilized the CEQA categorical exemption for Small Habitat Restoration Projects (Categorical Exemption Sec. 15333) which reduced the effort and time to prepare CEQA compliance documentation in comparison to the typical CEQA compliance pathway (i.e., IS/MND). For permitting, the project qualified for and obtained coverage under the following programmatic restoration permits: SWRCB Clean Water Act Section 401 General Water Quality Certification for Small Habitat Restoration Projects (File No. SB12006GN) , USFWS California Statewide Restoration Programmatic Biological Opinion (FWS: 2022-0005149-S7) for federal species take coverage, and a CDFW Restoration Management Permit (RMP No. 2023-0008-R3) for state species take coverage. The typical benefits of using these statewide programmatic permits for restoration projects include: relatively standardized permit requirements (i.e., construction and post-construction conditions), faster internal agency processing time, substantially reduced or waived application fees, and others yet to be observed. However, for this project in particular and due to the relatively new status of statewide programmatic restoration permits (many of which were being crafted and newly made available during the project's design development and permit processing), the agency processing times were not perceptibly faster, and may in fact have been slower, due to the learning curve involved with not having used them (much) before. That said, this situation is expected to improve dramatically over the next several years, as applicants and agencies get more comfortable with the programmatic restoration permits, and their benefits become increasingly realized. And in the end, the project team concluded that 'early regulatory agency and community engagement always pays off.'

Lastly, while the effort to demonstrate the project's net benefit to aquatic resources and minimization of habitat 'type conversion' was substantial, the project successfully avoided the need for costly compensatory mitigation.

# NPDES PERMITTING FOR NATURE-BASED SOLUTIONS

The Clean Water Act requires a National Pollutant Discharge Elimination System (NPDES) permit to discharge treated wastewater to waters of the United States. Various strategies exist for crafting NPDES permits for nature-based solutions, such as treatment wetlands and horizontal levees. Many of these strategies are comparable to those for gray infrastructure. Some key NPDES permitting concepts and how they apply to nature-based solutions are presented below.

## Discharge points

“Discharge points” are locations where treated wastewater enters waters of the United States. Water quality standards apply within waters of the United States. Although these waters may naturally assimilate some pollutants, they cannot be used to treat wastewater. “Treatment” refers to pollutant removal prior to discharge; thus, treatment always occurs upstream of discharge points. Discharge points may be traditional outfall pipes, but they do not have to be. For horizontal levees, they may be lines that run parallel along the levees. The shape is typically not very important. Whether considering treatment wetlands, horizontal levees, or gray infrastructure, compliance with permit requirements is rarely evaluated at discharge points.

## Exceptions to discharge prohibitions

The *Water Quality Control Plan for the San Francisco Bay Region* (Basin Plan) prohibits certain discharges, including many discharges into shallow nearshore waters. Because the Basin Plan provides for exceptions, this is rarely a problem for municipal wastewater discharges if they receive treatment above and beyond U.S. EPA’s Secondary Treatment Standards (e.g., if filtration is used to remove more suspended sediment and biochemical oxygen demand, or nitrification and denitrification processes remove ammonia and nitrogen).

The Basin Plan contains the following discharge prohibitions, among others:

1. Any wastewater (e.g., treated sewage) that has particular characteristics of concern to beneficial uses at any point at which the wastewater does not receive a minimum initial dilution of at least 10:1, or into any nontidal water, dead-end slough, or similar confined waters.
2. Any wastewater that has particular characteristics of concern to beneficial uses to San Francisco Bay south of the Dumbarton Bridge.
3. Any wastewater that has particular characteristics of concern to beneficial uses to Suisun Marsh during the dry weather period of the year.

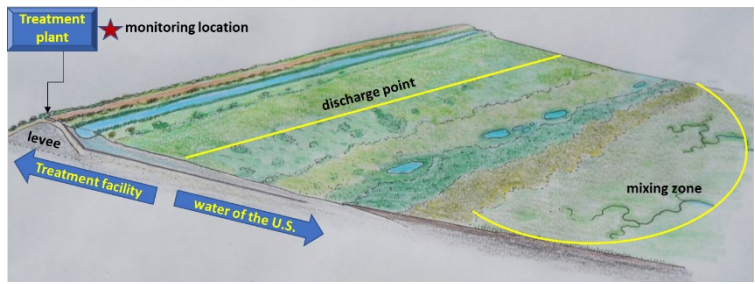
On a case-by-case basis, the Basin Plan allows for exceptions if one of the following conditions is met:

- An inordinate burden would be placed on the discharger relative to the beneficial uses protected and an equivalent level of environmental protection will be achieved by alternate means, such as an alternative discharge site, a higher level of treatment, or improved treatment reliability;
- The discharge is approved as part of a reclamation project;
- Net environmental benefits will be derived as a result of the discharge; or
- The discharge is approved as part of a groundwater clean-up project.

Most nature-based solutions qualify for the first exception (“equivalent protection”) because those wastewater discharges receive treatment above and beyond Secondary Treatment Standards. If nature-based solutions are paired with reclamation projects, they may qualify for the second exception too. If nature-based solutions create new waters of the United States that could not exist without the wastewater discharges, the third exception (“net environmental benefits”) may apply.

To demonstrate net environmental benefits, Water Board Resolution 94-086 (“Policy on the Use of

**Conceptual Horizontal Levee.**  
 The discharge point is a line running parallel along the levee. Effluent limits ensure that water quality standards are maintained beyond the discharge point (or mixing zones, if any). Compliance monitoring occurs at the treatment plant.  
*Base drawing courtesy of Peter Baye.*



Wastewater to Create, Restore, and/or Enhance Wetlands”) says, “...it will be necessary for the applicant to demonstrate that (1) full and uninterrupted protection will be given to all beneficial uses which could be made of the receiving water...in the absence of wastewater discharges and (2) that new beneficial uses will result from wetland creation, or, in rare cases, fuller realization of existing or potential uses will result from wetland restoration or enhancement beyond that which would occur in the absence of point source discharges.” Wetlands used to demonstrate net environmental benefits may not be used to satisfy mitigation requirements pursuant to Clean Water Act sections 401 and 404.

## Effluent limitations

NPDES permits contain technology-based and water quality-based requirements. Technology-based requirements ensure treatment performance. U.S. EPA’s Secondary Treatment Standards (40 C.F.R. Part 133) are the minimum technology-based requirements for municipal wastewater. However, if better treatment performance is used to justify an exception to a discharge prohibition based on equivalent protection, a permit may contain more stringent technology-based requirements to ensure that the exception remains justified.

Water quality-based requirements ensure that water quality standards are maintained within waters of the United States (i.e., beyond discharge points). Regulations may be very specific or more flexible, depending on the pollutant considered. For example, water quality-based effluent limitations for most “priority pollutants” must be expressed in terms of concentrations. In contrast, water quality-based effluent limitations for other pollutants, such as nutrients, may be expressed in terms of concentrations or loads.

The Water Board may authorize one or more pollutant-specific mixing zones within waters of the

United States. Inside the mixing zones, ambient water mixes with treated effluent and dilutes pollutant concentrations. In these cases, concentration-based effluent limitations may be calculated to achieve water quality standards beyond the mixing zones. Since mixing zones and dilution do not affect pollutant loading, however, they have no bearing on load-based effluent limitations. Nevertheless, the Water Board may consider pollutant uptake, assimilation, or removal within waters of the United States when developing load-based effluent limitations, provided available information supports doing so.

## Facility operations and maintenance

Permits require treatment facilities, whether they be gray infrastructure, treatment wetlands, or horizontal levees, to be operated and maintained to ensure continued treatment performance. Permits may also require levee maintenance or other receiving water management provisions to ensure water quality.

## Compliance evaluation

To evaluate compliance with permit requirements, NPDES permits define “monitoring locations” where treated effluent samples are collected. For both gray infrastructure and nature-based solutions, monitoring locations are commonly placed at or near treatment plants because sampling at discharge points or at the edges of mixing zones is often infeasible, or at least very inconvenient. The Water Board may establish monitoring locations at the outfalls from treatment wetlands if there are good reasons to do so. Alternatively, the Water Board may evaluate compliance at monitoring locations at or near treatment plants, but adjust the effluent limitations to reflect demonstrated treatment downstream of the monitoring locations.

## Available exceptions to Basin Plan discharge prohibitions for generic nature-based solutions

	Equivalent Protection	Reclamation Project	Net Environmental Benefits	Groundwater Cleanup Project
<b>Treatment Wetland Constructed Upland</b>	<b>Yes</b> Discharges receive treatment above and beyond Secondary Treatment Standards upstream of discharge point.	<b>Maybe</b> Exception may apply when nature-based solutions are paired with reclamation projects.	<b>No</b> No new waters of United States created.	<b>No</b> Exception does not apply.
<b>Horizontal Levee Constructed Upland</b>	<b>Yes</b> Discharges receive treatment above and beyond Secondary Treatment Standards upstream of discharge point.	<b>Maybe</b> Exception may apply when nature-based solutions are paired with reclamation projects.	<b>Maybe</b> New waters of United States may be created. Water Board Resolution 94-086 applies.	<b>No</b> Exception does not apply.
<b>Horizontal Levee Constructed in Waters of United States</b>	<b>Yes</b> Discharges receive treatment above and beyond Secondary Treatment Standards upstream of levee.	<b>Maybe</b> Exception may apply when nature-based solutions are paired with reclamation projects.	<b>No</b> No new waters of United States created.	<b>No</b> Exception does not apply.

## Application of key concepts to generic nature-based solutions

	Treatment Wetland Constructed Upland	Horizontal Levee Constructed Upland	Horizontal Levee Constructed in Waters of United States
<b>Discharge points</b>	Discharge point is outfall from treatment wetland to waters of United States.	Discharge point may be line parallel to, and probably through, levee, distinguishing treatment facility from waters of United States.	Discharge point may be line parallel to, and probably through, levee, distinguishing treatment facility from waters of United States. Portion of levee constructed in water of United States is subject to Clean Water Act sections 401 and 404 permitting and mitigation.
<b>Exceptions to discharge prohibitions</b>	Higher level of treatment justifies exception based on equivalent protection. Treatment could be filtration or nitrification prior to treatment wetland, or treatment within wetland (e.g., removal of nutrients or contaminants of emerging concern).	Wastewater must be nitrified prior to discharge through horizontal levee. This treatment justifies exception based on equivalent protection. Treatment within levee (e.g., removal of nutrients or contaminants of emerging concern) also justifies exception based on equivalent protection.	Wastewater must be nitrified prior to discharge through horizontal levee. This treatment justifies exception based on equivalent protection. Treatment within portion of levee considered part of treatment facility (e.g., removal of nutrients or contaminants of emerging concern) may also justify exception based on equivalent protection.
<b>Effluent limitations</b>	Technology-based effluent limitations are more stringent than Secondary Treatment Standards to ensure higher level of treatment. Water quality-	Technology-based effluent limitations are more stringent than Secondary Treatment Standards to ensure higher level of treatment (e.g., to ensure	Technology-based effluent limitations are more stringent than Secondary Treatment Standards to ensure higher level of treatment (e.g., to ensure



	based effluent limitations are concentration-based when necessary (mixing zones may be established) or load-based if appropriate.	effective nitrification). Water quality-based effluent limitations are concentration-based when necessary (mixing zones may be established) or load-based if appropriate. Load-based effluent limitations may account for pollutant uptake within levee.	effective nitrification). Water quality-based effluent limitations are concentration-based when necessary (mixing zones may be established) or load-based if appropriate. Load-based effluent limitations may account for pollutant uptake within levee.
<b>Facility operations and maintenance</b>	Maintenance requirements ensure wetland treatment performance.	Maintenance requirements ensure levee performance.	Maintenance requirements ensure levee performance.
<b>Compliance evaluation</b>	Compliance is evaluated at monitoring location at or near treatment plant (or at outfall from treatment wetland if warranted).	Compliance is evaluated at monitoring location at or near treatment plant.	Compliance is evaluated at monitoring location at or near treatment plant.

### Specific examples of NPDES permits for nature-based solutions

Permit Number	Order Number	Discharger	Facility	Discharge Prohibition Exception Based on Equivalent Protection	Discharge Prohibition Exception Based on Net Environmental Benefits
CA0038881	R2-2022-0006	City of San Leandro	City of San Leandro Water Pollution Control Plant – Treatment Wetland	X	
CA0037770	R2-2021-0026	Mt. View Sanitary District	Mt. View Sanitary District Wastewater Treatment Plant	X	
CA0037810	R2-2021-0008	City of Petaluma	Ellis Creek Water Recycling Facility	X	
CA0110116	R2-2020-0020	U.S. Department of Navy	Treasure Island Wastewater Treatment Plant	X	
CA0037958	R2-2020-0019	Novato Sanitary District	Novato Sanitary District Wastewater Treatment Plant	X	*
CA0037800	R2-2019-0019	Sonoma Valley County Sanitation District	Sonoma Valley County Sanitation District Wastewater Treatment Plant	X	
CA0037834	R2-2019-0015	City of Palo Alto	Palo Alto Regional Water Quality Control Plant	X	
CA0038776	R2-2017-0013	City of Pacifica	Calera Creek Water Recycling Plant	X	X
CA0038768	R2-2017-0008	City of American Canyon	American Canyon Water Reclamation Facility	X	X
CA0038636	R2-2011-0058	East Bay Regional Park District, Union Sanitary District, and East Bay Dischargers Authority	Hayward Marsh		X

\* The Novato Sanitary District is planning to move its discharge inland to provide secondary-treated effluent as a freshwater source to a proposed new marsh. The discharge will create and sustain new brackish marsh habitat for fish, plant, and wildlife. The wetlands will provide storm and flood protection against rising sea levels and provide recreational, scenic, and education benefits. The discharge may qualify for an exception based on net environmental benefits.