

LOWER WALNUT CREEK RESTORATION PROJECT

Monitoring and Adaptive Management Plan

Prepared for
Contra Costa County Flood Control &
Water Conservation District

August 2020



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A Salt Marsh Harvest Mouse Monitoring PlanA-1

SECTION 1

Introduction

Purpose

This Monitoring and Adaptive Management Plan (MAMP) for the Lower Walnut Creek Restoration Project (Project) describes monitoring actions that will be conducted to evaluate progress toward desired outcomes and ongoing and long-term management actions to ensure sustainable outcomes. Monitoring will serve multiple purposes:

- Assess physical conditions to verify that the Project was constructed as designed and meets permit requirements (compliance monitoring)
- Measure physical outputs and ecological outcomes to track progress towards Project objectives (effectiveness monitoring)
- Inform corrective actions if success criteria are not met. Monitoring results will be used to reduce uncertainties and improve management and future planning (adaptive management).
- Meet regulatory requirements for evaluating and documenting performance. This plan conforms with the requirements of the U.S. Army Corps of Engineers (USACE) Final Compensatory Mitigation and Monitoring Guidelines for the South Pacific Division (USACE, 2015).

Monitoring will document conditions and improve understanding of how proposed manipulations associated with restoration actions can lead to support for target ecosystems and functions. This MAMP is a living document that may be amended from time to time to address changing conditions and new monitoring techniques and technologies.

In addition to monitoring and management actions, the MAMP identifies Project success criteria, responsible parties for execution of this plan and reporting requirements. Monitoring and maintenance specific to levee performance for flood protection will follow existing Contra Costa County Flood Control and Water Conservation District (District) guidance and are not described in detail here.

Project Summary

The Lower Walnut Creek Restoration Project (Project), led by the District, in conjunction with partner John Muir Land Trust, will restore and enhance coastal wetlands and adjacent habitats at the mouth of Walnut Creek and its tributary Pacheco Creek, improving habitat quality, diversity, and connectivity along four miles of creek channel, over approximately 296 acres in total. The Project is located along the southern shoreline of Suisun Bay (**Figure 1**).



SOURCE: ESA, 2019; Digital Globe, 2017

Lower Walnut Creek Restoration . D170378

Figure 1
Project Location

The Project will enhance and restore estuarine wetlands and associated wetland-upland transitional habitats that have suffered large historic losses, eliminate expensive and environmentally destructive flood-related dredging, and remedy limited public access. The Project has been designed to provide sustainable benefits in consideration of future environmental changes, particularly sea level rise. The Project will enhance the over-all resilience of wetland habitats within the Project area by providing space for tidal marsh migration with rising sea levels, increasing tidal connectivity, reconnecting sediment flow pathways to promote healthy marsh accretion, and reducing the fragmentation of existing wetlands habitats in the region.

The restoration approach capitalizes on large areas of supratidal elevation lands and existing (degraded) landscape features to restore tidal marsh intergraded with a matrix of lowland terrestrial ecotone habitats (**Figure 2**). Regional ecosystem goals (Goals Project 2016) call for restoration of this type of habitat matrix and note that opportunities for its creation are rare around San Francisco Bay's mostly-developed shoreline. These habitats will provide diversity and enhanced ecosystem functions under present day conditions and sustainably evolve with sea-level rise. The connectivity of wetland and lowland terrestrial habitats is important to support contemporary ecosystem functions, including wildlife habitat and biogeochemical functions such as nutrient exchange. In addition, by restoring the conditions that support sustained wetland functions and enhanced upland vegetation, the Project will reduce greenhouse gas emissions, incorporating climate change mitigation with flood and habitat management and restoration. Restoration will be accomplished by breaching and lowering levees and berms to reintroduce the tides to diked former baylands, constructing new setback levees for flood protection, and grading filled areas to create new tidal channels, tidal wetland, ecotonal lowland terrestrial areas, and adjacent upland scrub habitat. The Project includes interim management of non-native invasive plant species that would be selected based upon population size, location relative to restoration design elements, and on feasibility of elimination/control within the available timeframe. Plant material for revegetation of the restored site will be sourced from a combination of onsite collection/propagation/salvage, contract collection and growing of genotypically appropriate native plants at offsite location(s), and purchase of genotypically appropriate seed and of nursery plant stock if needed for replacement plantings during the establishment period. The Project anticipates gradual estuarine transgression, and is designed to provide high ecological value and function through the 21st century. Additional information about the Project is available at www.lowerwalnutcreek.org.

Project Goals and Objectives

The District developed Project goals and objectives, which were refined with input from the community-based planning process.

The Project goal is to:

Restore and enhance wetlands and associated habitats in Lower Walnut Creek and to provide sustainable flood management, while allowing opportunities for public access and recreation.

Additional information on the District's vision for a restored Lower Walnut Creek can be found in the "Resilient Landscape Vision for Lower Walnut Creek" report (SFEI, 2017).

Project objectives are to:

1. *Restore wetlands to improve ecological function and habitat quantity, quality, and connectivity (including upland transition zones) in the Lower Walnut Creek area for native, resident plant and animal species including special status species.*

Special status species known to occur in the area include the salt marsh harvest mouse, California black rail, Ridgway's rail, Suisun marsh aster, Delta tule pea, and Mason's lilaeopsis. Chinook salmon, steelhead, and green sturgeon are special-status fish species known to occur in the general vicinity of the project area and delta smelt, longfin smelt, and soft bird's beak could occur in the general vicinity of the project area.

2. *Maintain appropriate levels of flood protection along Lower Walnut and Pacheco creeks, as warranted by the land use.*

This includes protecting the services provided by existing infrastructure (e.g., power lines, railroads, water lines) and maintaining access to infrastructure and adjacent private property. Open space areas may not require maintenance or improvement of flood protection levels.

3. *Allow for future public access, education, and recreational opportunities.*

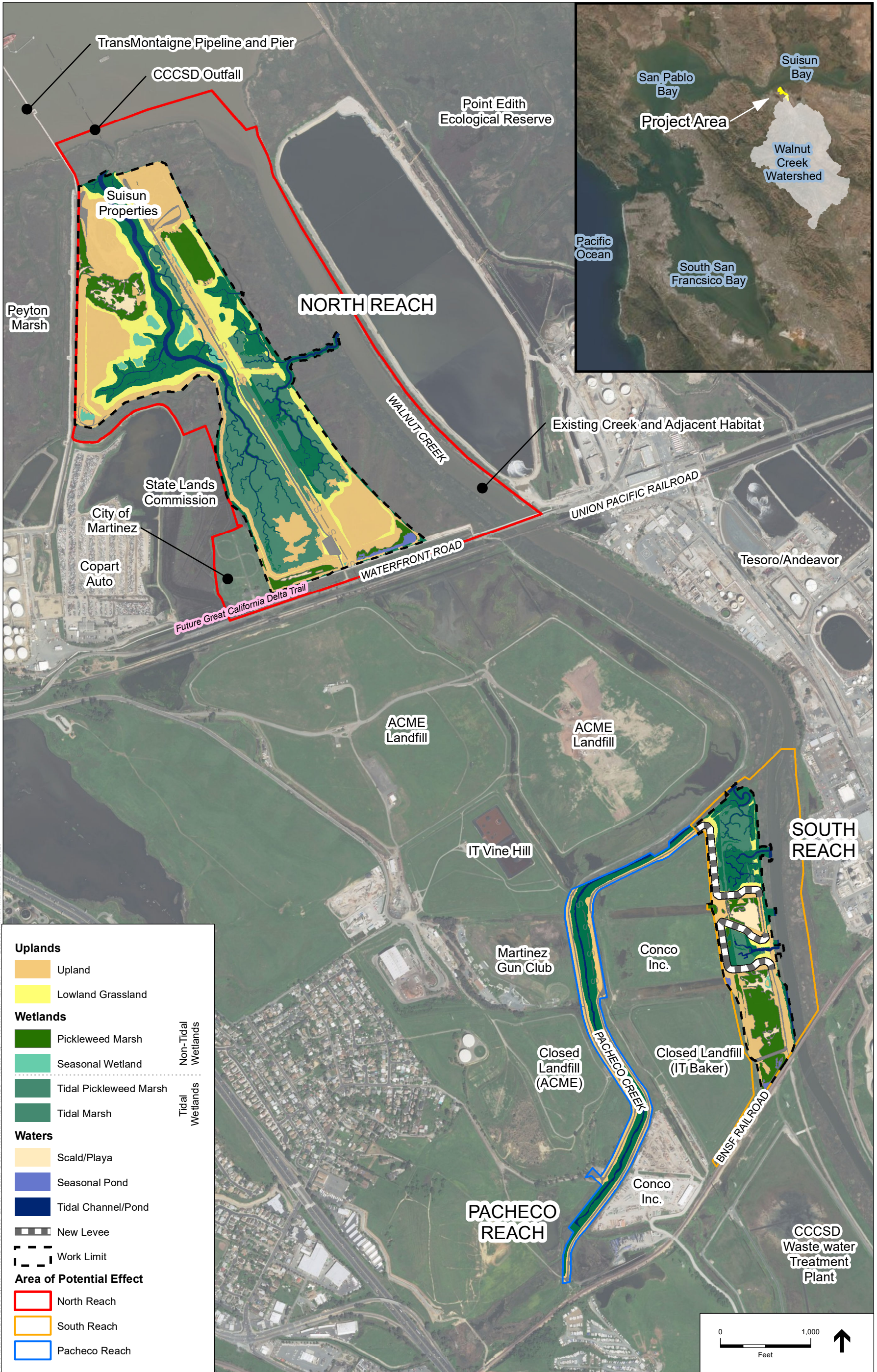
The District is committed to developing a project that is compatible with regional goals for public access through the Project area, such as a trail segment connecting two regionally-significant trails – the Ironhorse and Bay trails. The District's charter, however, limits the ability of the District to directly fund the creation and maintenance of public access and recreation facilities.

While the District is not in a position to directly implement public access and recreational facilities, the District will provide opportunities for partners such as the East Bay Regional Park District (EBRPD) and John Muir Land Trust to pursue future public access and recreation projects within the Lower Walnut Creek Project area.

4. *Create sustainable benefits that consider future environmental changes such as sea level rise and sedimentation.*

A guiding principle in planning the Lower Walnut Creek Restoration Project is to design a system that works with nature, not against it. This means anticipating changes associated with estuarine and fluvial sediment deposition and increases in flooding anticipated to result from future sea level rise, and designing a system that is resilient to these changes without expensive and environmentally disruptive management actions.

The District is committed to developing a project that will be resilient to future sea level rise through the year 2050, and adaptable to anticipated changes through 2100. For planning purposes, the Project has adopted a sea level rise projection of 2 feet by 2050 and considers a range of sea level rise extending up to 5 feet by 2100. These values are consistent with the upper range of projected sea level rise indicated in the National Research Council's 2012 report "Sea level Rise for the Coasts of California, Oregon and Washington" (NRC, 2012) and BCDC's Adapting to Rising Tides regional sea level rise planning program (AECOM 2016).



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Uplands	
[Orange Box]	Upland
[Yellow Box]	Lowland Grassland

Wetlands	
[Dark Green Box]	Pickleweed Marsh
[Light Green Box]	Seasonal Wetland
[Medium Green Box]	Tidal Pickleweed Marsh
[Dark Teal Box]	Tidal Marsh

Waters	
[Light Yellow Box]	Scald/Playa
[Blue Box]	Seasonal Pond
[Dark Blue Box]	Tidal Channel/Pond

Area of Potential Effect	
[Red Outline]	North Reach
[Orange Outline]	South Reach
[Blue Outline]	Pacheco Reach

Other Features	
[Dashed Line]	New Levee
[Dotted Line]	Work Limit

SOURCE: ESA, 2020

Lower Walnut Creek Restoration D170378.00
Figure 2
 Project Restoration Plan

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Plan Implementation Strategy

The Plan implementation strategy relies on the following concepts to guide the implementation and development of the site:

1. Utilize natural processes for habitat establishment, as possible.
2. Utilize best available science to manage the site.
3. Practice adaptive management of the site utilizing input from monitoring data in conjunction with adaptive review of restoration goals and objectives.
4. Review monitoring reports to identify any additional management actions needed to promote achievement of restoration goals and objectives.
5. To the extent practicable, minimize effects that would lead to improved conditions for nonnative invasive species such as perennial pepperweed (*Lepidium latifolium*), and stinkwort (*Dittrichia graveolens*), or non-native predators of special status wildlife species.

Responsible Parties

The Project site is owned by the Contra Costa County Flood Control and Water Conservation District. After construction is complete, the District will retain responsibility for all management and maintenance activities described in this plan, including reporting. In the North Reach, the District may share some of this responsibility with John Muir Land Trust. Management responsibilities will include:

- Executing the management, monitoring, maintenance, and reporting responsibilities as described in this Plan, including data collection, storage, and transmittal.
- Performing general inspections to ensure restored habitat values are protected and maintained.
- Analyzing portions of the monitoring data resulting from the monitoring activities and implementing any remedial or adaptive management actions as required by regulatory permit conditions.
- Filing reports (annual or as required by regulatory permit and grant conditions) describing the status and evolution of the restored habitats, general plant and tidal area health, presence and abundance of invasive flora and fauna, hydrologic conditions, wildlife utilization, and other management, maintenance, monitoring and reporting activities that have a bearing on successfully meeting regulatory permit requirements.
- Maintaining a file on the Project detailing management, maintenance, monitoring, and reporting activities, correspondence, and determinations.

Qualified Personnel

The District will retain professional biologists, botanists, restoration ecologists, or other specialists (“Qualified Personnel”) as necessary to conduct tasks and monitoring as described in this Plan. Duties of the Qualified Personnel may include, but are not limited to:

- Monitoring erosion and slope stability
- Identifying and evaluating the presence of invasive species and developing management recommendations
- Conducting surveys that are required by this Plan and/or the biological opinion(s)/permits
- Evaluating site conditions and recommending remedial actions or adaptive management actions to the District
- Assisting in the review or planning of any additional restoration actions following initial construction
- Preparing monitoring reports associated with each monitoring year

SECTION 2

Success Criteria

The success criteria identified below will provide a basis for determining the need for remedial (corrective) measures and adaptive management. Variable environmental conditions beyond the control of the Project, such as extreme weather patterns, trespassers, and vandalism, may contribute to one or more of the success criteria not being attained in a specific year, but will not necessarily imply that the restoration has failed. The project is designed to be successful and eventually self-sustaining under a normal range of interannual variability in weather. The entire set of monitoring results will provide a basis for discussion with regulatory agencies as to whether remedial actions are warranted. Despite failure to attain one or more specific success criteria, monitoring results may suggest that the restoration areas are developing properly, overall performance goals are being met, and that no remedial intervention would be warranted. Most importantly the success criteria are intended to be used and interpreted based on professional judgment of the Qualified Personnel monitoring the Project site as well as the professional judgement of regulatory agency staff.

The success criteria by which the Project will be evaluated are described below.

Hydrology

Within 10-years post-breach, full tidal inundation will be achieved in the restored tidal marsh areas, with tide range comparable to natural marshes in Suisun Bay. Once achieved, the site is expected to maintain full tidal inundation long-term.

Water Quality

For the first 5-years post-breach, water quality conditions (temperature, dissolved oxygen (DO), and electrical conductivity (EC)) will be monitored within the North Reach. Within the site, the minimum water quality conditions required to support aquatic life will be maintained over the course of the monitoring program. Once achieved, the North Reach is expected to maintain water quality conditions suitable for aquatic species long-term.

Geomorphology

The total constructed and length of tidal channels per area of restored marsh (channel density) will be at least 100 feet per acre as-built. This is within the range observed in reference brackish and freshwater tidal wetlands within San Francisco Estuary (Grossinger 1995; WWR 2006, Orr and Olson 2014). The constructed channel cross sectional geometry will be similar to that of natural reference marsh channels (e.g. Williams et al. 2002; Orr and Olson 2014).

Vegetation

The Project will restore and enhance a mosaic of native wetland, transitional, and upland habitats across the Project site that will provide valuable ecosystem functions. Desired native plant species will populate the restoration site through planting and natural recruitment. Plug and container plantings will occur in all habitat types within the project area including upland scrub, lowland grassland, tidal marsh benches, marsh ponds, seasonal wetlands, and sandy alkali playa flat. All upland and lowland grassland areas will also be seeded with a native seed mix. The complex of tidal marsh (intertidal marsh, low tidal marsh, high tidal marsh, and marsh pond), lowland terrestrial (sandy alkali playa flats, lowland grassland, and seasonal wetlands) and upland (grassland and scrub) will represent a diversity of native species.

Vegetation Establishment

Vegetation establishment will be monitored over the 10-year monitoring term by monitoring percent cover by remote sensing and a qualitative reconnaissance survey to generally observe vegetation health, colonization, and species diversity. Limited photo documentation (one photo per habitat type) would be included in this monitoring to document general conditions within the different habitat types. The reconnaissance survey would take place by biologists at the same time as completing the weed surveys in Years 1, 2, 3, 5, 7 and 10. If additional representations of vegetation expansion can be observed through aerial imagery, that will be analyzed and noted in the monitoring reports. Rate of colonization and spread could provide useful information, especially in the first few years post-restoration, on whether desirable plant populations are progressing well, albeit slowly, or whether there are underlying issues inhibiting successful native plant establishment.

Success criteria for percent cover for the target habitats for each monitoring year are presented in **Table 1**. Criteria are expressed as ranges based on knowledge of the site design, reference site habitats, and existing conditions at the site. On lands at elevations transitional between tidal wetlands and uplands, a mosaic of interdigitated habitats will be created within a wide ecotonal zone. Boundaries between these habitats are anticipated to shift due to weather patterns (variable year to year), possible settlement or erosion/sedimentation, unanticipated site conditions, and eventually sea level rise. Vegetation distribution and species composition may vary year to year and across habitat “edges”. Maintaining consistent discrete lines around as-built habitat types could significantly alter percent cover measurements within specific habitats and between monitoring years. Such shifts should not necessarily be construed as indications of success or failure.

TABLE 1
VEGETATION PERCENT COVER SUCCESS CRITERIA

	Year 1	Year 2	Year 3	Year 5	Year 7	Year 10
Tidal Wetlands						
% Total cover	5-40	10-50	15-70	25-85	30-90	40-90
Seasonal Wetlands						
% Total cover (variable by season)	5-40	10-40	10-40	15-50	15-50	15-50
Lowland Grassland, Upland Grassland, and Scrub						
% Total cover	25-60	30-75	35-85	45-90	55-90	65-95

NOTE: Sandy alkali playa flats is not included in the percent cover success criteria due to its expected low and variable cover.

Qualified personnel performing vegetation monitoring should consider site conditions and anticipated natural variations and trajectories and apply their professional judgement in determining the relative success for each habitat type during each monitoring year.

If vegetation cover is within the lower half of the proposed range of success criteria during monitoring Years 1, 2, 3, 5, 7, and 10, the District will consult with the agencies to determine whether adaptive management is needed. For example, if the success criteria for total vegetation cover ranges from 15-70 percent, then the District will consult with the agencies if vegetation cover is less than 43 percent. Consultation will include phone or email notification to RWQCB, USFWS, USACE, CDFW, and BCDC staff and if necessary, one meeting to discuss vegetation results and recommendations.

Regardless of whether the Project has met performance criteria for Years 1-5, the Project will meet with the San Francisco Bay Restoration Regulatory Integration Team (BRRIT) to discuss vegetation monitoring data collected through Year 5 to evaluate site conditions and adjust vegetation success criteria as needed.

Tidal Wetlands: Within tidal marsh habitats vegetative cover is expected to become established relatively rapidly. Native high marsh plant species assemblages are expected to increase in extent and diversity in a 5 to 10-foot zone (or wider) around banks of extended, deepened tidal channel networks, continually increasing over the 10-year monitoring period. Within five years, the marsh plain is expected to develop a nearly continuous fringe of native brackish marsh plants along the higher-elevation wetland margins, with intermittent patches of the same species scattered throughout the interior of the site. Within 10 years the vegetation is expected to expand into larger patches within the interior parts of the marsh. Tidal marsh reference sites include some existing tidal marshes around Lower Walnut Creek and Point Edith Wildlife Area. Anticipated ranges for cover success criteria are shown in Table 1.

Seasonal Wetlands: The created and enhanced seasonal wetlands are expected to support native seasonal wetland plants. The amount of vegetation cover is anticipated to be slightly higher than

that of the alkali playa flats, however depending on the location of each seasonal wetland the percent cover may vary depending on elevation, drainage, and adjacent habitats (see Table 1). The seasonal wetlands are expected to vary in species composition, distribution and overall vegetative cover by season and by year, as driven by weather patterns. Reference sites include seasonal wetlands found in Rush Ranch and Suisun Marsh (Orr et al. 2017).

Lowland Grassland: Lowland grassland habitats are also anticipated to vary in rate of establishment depending on timing and amount of rainfall in the months after planting. Native perennial wet meadow (lowland grassland) vegetation is expected to develop initially as discrete patches (clonal colonies) within a matrix of native annual cover crops and grasses, gradually spreading into consolidated stands of dominant native perennial vegetation within 5-7 years, but up to 10 years for full establishment if multi-year droughts set back survivorship and growth.

Upland Grassland and Scrub: Upland grassland and scrub habitats will support a mix of ruderal and native perennial grassland and native scrub species. These areas are expected to support fairly robust vegetative cover relatively quickly compared to the other habitat types found at the site due to ruderal vegetation filling in gaps where native vegetation doesn't exist.

For the purposes of monitoring vegetation establishment and percent cover, lowland grassland, upland grassland, and scrub are lumped due to the similar general cover expectations and interdigitated nature of the habitats making it difficult to parse out these habitats within the aerial imagery (see Table 1).

Total cover by this vegetation is expected to progressively increase during the first five-year period. Table 1 shows the performance criteria for vegetation establishment with a cover range for of native and naturalized species in restored and enhanced habitats at the site (based on interpretation of aerial imagery).

In order for accurate evaluation of vegetation establishment over time the imagery used to evaluate percent cover will be captured during the same season each monitoring year to the extent feasible.

Sandy Alkali Playa Flats: Sandy alkali playa flats are expected to remain relatively bare or sparsely vegetated, as in such naturally occurring habitats, and are expected to develop a highly dynamic, variable vegetation pattern and species composition. The sandy alkali playa flats are expected to support native alkali vernal pool flora and a diversity of other native annual and perennial species. The sandy alkali playa flats are anticipated to have similar (sparse) cover to what currently exists at the site in the sandy scald areas, but with predominantly native plant species rather than the existing non-native cover. These habitats are expected to develop highly dynamic, variable (unstable) vegetation patterns and species composition of local assemblages, including increased diversity of native species introduced with restoration. Reference sites with similar habitats include portions of Whittell Marsh, Point Pinole, Upper Hill Slough, and Suisun Marsh (Orr et al. 2017). Over decades, the alkali playa habitats will become increasingly modified by episodic extreme high tidal flooding and debris deposition, forming high tidal marsh-terrestrial ecotones incorporating the native alkali pool flora.

Because sandy alkali flats naturally have low cover and/or bare patches and can vary in species composition and distribution from year to year it is difficult to anticipate cover targets that would indicate that such habitat is on a trajectory to successful establishment in each monitoring year. Therefore, instead of this habitat type being monitored for percent cover, a ground reconnaissance survey to observe the general health, diversity, and distribution of vegetation will occur during weed surveys. Spring annuals will be observed and health of plantings will be noted within the alkali playa flats. Photo documentation of the alkali playa flats will occur to document noted conditions.

Invasive Plants

In the lowland terrestrial and upland habitat there is a potential for rapid colonization by naturalized ruderal plants, some of which are acceptable with respect to project goals (e.g. most non-native grasses and forbs), and some of which are not (e.g. highly invasive grasses, forbs, shrubs, and trees). Control of plants that have potential to become highly invasive at the site (high priority weeds), which may include plants rated as High or Moderate by California Invasive Plant Council (Cal-IPC), will be implemented.

High priority weeds include perennial pepperweed (*Lepidium latifolium*), stinkwort (*Dittrichia graveolens*), and other species that will be identified by a Qualified botanist or restoration ecologist prior to and during monitoring events. High priority weeds will be monitored twice a year, or as needed, throughout the 10-year monitoring period. The acceptable cover of high priority weeds will be less than 5% within the work limit within the restoration site (areas shown in Figure 2). Identification of high priority weeds will trigger eradication measures. Some invasive plants are established within existing tidal marshes along Lower Walnut Creek and Pacheco Creek, but areas outside of the Project work limit will not be managed as a part of this Project. This management trigger should be actively tracked over the first three years of monitoring and as needed (annually or every other year) throughout the rest of the 10-year monitoring period. Invasive plant eradication measures will be conducted at the proper time of year, using appropriate control measures. Examples of such measures and schedule are shown in Table 3. Prior to commencement of work, the contractor will be required to prepare for approval a weed management plan to provide specific methods for control of specific target species, and employ a certified pest control applicator to implement the approved weed control plan.

Timing of weed control efforts in highly sensitive habitats may need to be modified due to other restrictions, such as during the nesting season of birds or special status species, or may not be attempted at all where accessing infestations would result in significant disturbance to endangered species habitats. Control of weeds (by either mechanical means or by herbicide application) will not occur within 300 feet of current year rail detections during rail breeding season (Feb 1-Aug 31), however limited hand-removal or herbicide application could occur in locations where there is a substantial non-habitat barrier (i.e. open water from major slough channels, berms, or roads) in between the weed management area and the rail detection location. Due to weed management restrictions within a 300-ft buffer around a rail nest, these rail nest buffer zones will not be considered as part of the <5% cover requirement for invasive target weeds.

Wetlands

A re-delineation of jurisdictional wetlands will be performed in Year 10 of the monitoring period to verify the amount of wetland acreage that has been attained. The District will consult with the agencies and discuss the results, as well as the overall site function and conditions and determine if any remedial actions should be taken.

Public Access Accommodation Space

The current restoration is being implemented consistent with construction of public access as a future Project phase. For the current restoration phase, the Project will grade accommodation space for future trails and public access facilities consistent with public access plans developed by John Muir Land Trust (North Reach) and East Bay Regional Park District (South Reach) in coordination with the Project.

SECTION 3

Monitoring

Pre-Project Conditions

Pre-project conditions are documented in the Lower Walnut Creek Restoration Project Study Report (ESA 2017) and permit applications. The documents provide information on hydrology, geomorphology, wetland and upland habitat types and public access existing prior to project construction.

In addition, aerial photography using an Unmanned Aircraft System (UAS, or drone) or airplane will be acquired prior to construction to provide a visual document of pre-project existing conditions.

A baseline wetland assessment utilizing the California Rapid Assessment Method (CRAM) will also be completed within the year prior to the beginning of project construction. The CRAM assessment will be completed by a certified CRAM practitioner and the data will be uploaded at <http://www.cramwetlands.org/>.

As-Built Conditions

Aerial photography will be acquired immediately following completion of construction to document the as-built conditions. The baseline imagery will also inform assessment of the rate of change within the restored area, and the effectiveness of restoration and subsequent management actions.

A topographic survey of the restoration site will be acquired immediately following the completion of construction to document as-built ground elevations. The construction contractor will apply appropriate survey methods to characterize site conditions, and may use ground based and/or aerial survey techniques.

Monitoring

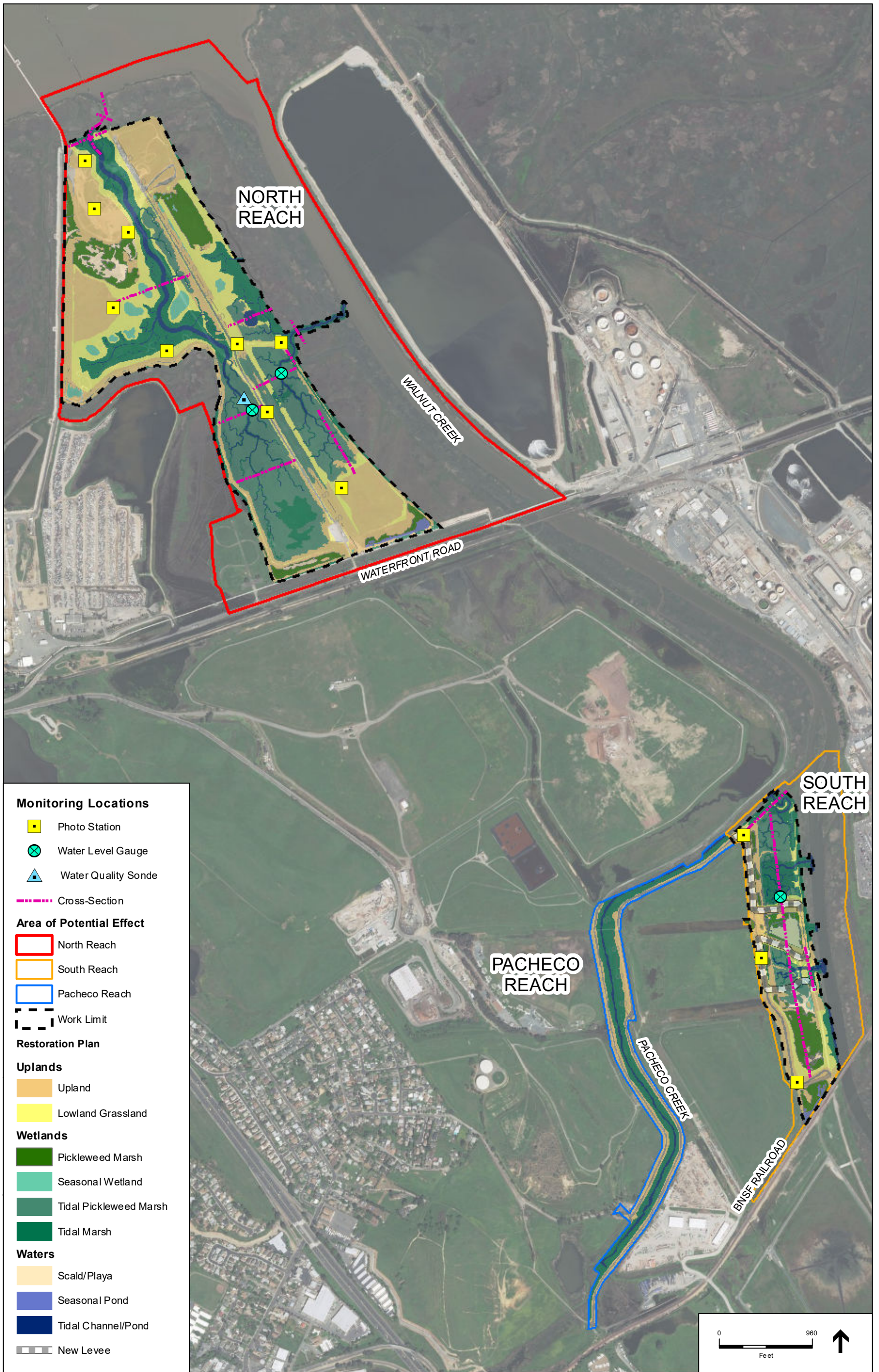
Table 2 provides a summary of the monitoring activities and schedule planned for the Project site. The monitoring schedule described will be adaptable based upon implementation of adaptive management measures. **Figure 3** shows preliminary monitoring locations at the site.

Additional monitoring requirements for salt marsh harvest mouse will be implemented in accordance to the Memorandum of Understanding (MOU) issued by CDFW. The salt marsh harvest monitoring plan is included in **Attachment A**.

**TABLE 2
SUMMARY OF MONITORING SCHEDULE**

Category	Aspect	Location	Monitoring Parameter	Time of Year	Monitoring Years
Hydrology	Water levels	Install pressure transducer: <ul style="list-style-type: none"> • Representative channel network in North and South Reaches 	Water level	Deployed for a minimum of 30 days, April - October	As built, Years 1, 2, 3, 5, 7, and 10, as needed
Water Quality	Aquatic habitat suitability	Install continuous data sonde: <ul style="list-style-type: none"> • North Reach: Interior site adjacent to water level gauge • North Reach Optional: additional sonde installed at breach location 	Temperature, DO, EC	All year, automatic measurements (may focus on spring-fall period)	Years 1, 3, and 5
Geomorphology	Channel development – planform	<ul style="list-style-type: none"> • North and South Reaches 	Channel length	Late summer	Pre-construction, As-built, Years 1, 2, 3, 5, 7, and 10
	Channel development – cross-sections	<ul style="list-style-type: none"> • North and South Reaches: cross-sections of channels and adjacent marshplain, thalweg profile of North Reach outboard channel to Suisun Bay 	Elevation	Summer	As-built, Years 1, 2, 3, 5, 7, and 10
Vegetation	Vegetation establishment	<ul style="list-style-type: none"> • North and South Reaches 	Vegetative cover	Late summer	Years 1, 2, 3, 5, 7, and 10
	Weed survey	<ul style="list-style-type: none"> • North, South, and Pacheco Reaches 	Invasive plants	Late spring and/or late summer	Years 1, 2, 3, 5, 7, and 10
	Photo-documentation	<ul style="list-style-type: none"> • North and South Reaches 	Site development	Late summer	Years 1, 2, 3, 5, 7, and 10
Wetlands	Wetland extent	<ul style="list-style-type: none"> • North and South Reaches 	USACE jurisdictional wetlands	Any season	Year 10
	Wetland condition	<ul style="list-style-type: none"> • North Reach 	Wetland condition	Between spring and late summer	Pre-construction and Year 5
Public Access	Accommodation space for future trail and access facilities	<ul style="list-style-type: none"> • South Reach 	Area Length of levee	Any season	As-built
	Accommodation space for future trail and access facilities	<ul style="list-style-type: none"> • North Reach 	Area Length	Any season	As-built
Sustainable Benefits	Habitat resilience, accommodation space	<ul style="list-style-type: none"> • North and South Reaches 	Area	Any season	As-built
	Levee	<ul style="list-style-type: none"> • South Reach 	Length	Any season	As-built

NOTE: Monitoring and maintenance specific to levee performance for flood protection will follow existing Contract Costa County Flood Control District (District) guidance and are not presented in detail here.



SOURCE: ESA, 2020

Lower Walnut Creek Restoration . D170378.00

Figure 3
Preliminary Monitoring Locations

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Hydrology

Measurements of tidal water elevations within the Project will be made to assess hydrologic functions and to document the depth and duration of tidal inundation over the marshplain surface.

Water levels will be measured and recorded at two locations in the North Reach and one location in the South Reach using continuous water level recorders. Preliminary gauge locations are shown in Figure 3. The exact locations of gauges will be determined in the field, with consideration given to access for downloading data and protection from vandalism. Water levels within the Project site will be compared to the NOAA Port Chicago Tide Gage, which prior ESA monitoring (ESA 2017) has established to be representative of tidal water levels along Suisun Bay outboard of the Project site. Hydrology monitoring will take place for as-built conditions and during monitoring years 1, 2, 3, 5, 7 and 10. Sensors will be deployed for a minimum of 30 days (to record two neap-spring cycles) between April and October. Monitoring will be discontinued once the success criteria have been met.

Water Quality

For the first 5-years post-breach, water quality conditions will be monitored within the North Reach. Basic metrics (temperature, dissolved oxygen, and EC) will be measured in years 1, 3 and 5 using water quality measurement data sondes (e.g., YSI 6600 V2-4 Sondes) installed with data logger at up to two locations within the North Reach. First priority for the sonde install location will be within the North Reach adjacent to an interior water level gauge. The preliminary sonde location is shown in Figure 3. The District may have the option to install a second water quality monitoring sonde at a North Reach tidal channel breach location. Data will be collected continuously during each of the three monitoring years, however, special attention will be given to the spring to fall period when water quality issues are most likely to arise.

Where possible, sampling and analysis for the Project will be coordinated with existing programs such as the Department of Water Resources discrete water quality monitoring program, the UC Davis Suisun Marsh study, Interagency Ecological Program (IEP) Tidal Wetlands Monitoring Project Work Team for restoration sites, and/or regional methyl mercury studies by the US Geological Survey or San Francisco Estuary Institute.

Geomorphology

Tidal Wetland Development – Planform

Aerial photographs will be taken of the site at a scale from which the development of the channel networks, and the distribution of marsh and mudflat areas is distinguishable. During monitoring years 0 (as-built condition), 1, 2, 3, 5, 7, and 10, aerial photographs will be taken and changes in wetland development will be compared to the previous aerial photographs. Free satellite photos will also be used when possible. Newly-formed channels and significant changes to the channel layout will be noted in each monitoring year. Aerial photographs will be taken in the late summer and during a tide no greater than +2.0 feet MLLW so that channels are clearly visible and marsh/mudflat areas can be viewed. Mapping will be performed at a minimum scale of 1:2400. The images will be obtained in a digital rectified format to allow use in a GIS system.

At years 1, 2, 3, 5, 7 and 10, aerial photography will be used to show site development, habitat evolution, and settlement of site features. Aerial photographs taken to evaluate channel development and marsh/mudflat layout will also support the vegetation establishment monitoring.

Tidal Wetland Development – Cross-Sectional

The cross-sectional geometry of the channels and marsh plain will be monitored using ground-surveyed transects and augmented with aerial photographs (described above). Transects will be established at key locations across slough channels, mudflat, and marsh. Preliminary cross-section locations are shown in Figure 3. All transects will be surveyed upon completion of construction (as-built condition) to provide baseline data on the channel and marsh elevations prior to tidal inundation. Transect starting and ending points will be permanently monumented in the field to facilitate reoccupation in subsequent monitoring years. Transects will be resurveyed at years 1, 2, 3, 5, 7 and 10.

Transect data will indicate channel erosion or shoaling and whether or not marsh/mudflat areas are accreting at the expected rates. In particular, the existing outboard channel connecting the North Reach directly to Suisun Bay is undersized and is expected to erode in response to restored tidal flows. While the restoration Project is not reliant on accretion in order to support tidal marsh vegetation in the near term, sediment accretion will help the restored marshes persist in the future with rising sea-levels. Vegetation cover will also be recorded in the elevation transect surveys to document patterns of vegetation establishment relative to elevation (as an indicator or hydroperiod).

Access within the site may be difficult in some areas due to the soft ground surface, deep channels, and the need to minimize disturbance to the site. Transect elevations will be surveyed during high tides by boat if it is not possible to accomplish the surveys on foot.

Vegetation

Vegetation Establishment

Aerial photographs will be used to monitor vegetation establishment with limited ground-truthing. Limited ground-truthing will include a site visit to take GPS points of algae, mudflat, and different dominant vegetation communities to refine the remote sensing results.

A map of the colonizing and expanding patches of native and non-native vegetation will be produced from the analysis of the aerial images. False color infra-red photography may be used in the identification of plant species that have become established throughout the site. Aerial image interpretation to determine vegetation types and cover will be completed in Years 1, 2, 3, 5, 7, and 10.

Weed Survey

Locations of perennial pepperweed (*Lepidium latifolium*), stinkwort (*Dittrichia graveolens*), and other highly invasive plants that negatively affect tidal marsh and transition zone habitats will be recorded. Populations of non-native and non-naturalized species that are rated High or Moderate according to the Cal IPCs California Invasive Plant Inventory, Online Database (Cal-IPC 2017),

as well as other target species identified by a Qualified botanist or restoration ecologist, will be documented and recommended for treatment or other management actions, with an emphasis on controlling weeds that threaten the ability to meet performance criteria specified in the regulatory permits¹. The initial list of potential target weeds and management methods for those weeds is shown in **Table 3**. A list of invasive species targeted for management will be developed and updated during each monitoring cycle. Stands of target invasive plants will be mapped using GPS to monitor invasive plant colonization and establishment at the site.

¹ Naturalized weeds that are part of the surrounding landscape and do not present an impediment to meeting the performance criteria will not be included in the weed survey. Examples include many non-native annual grasses or offsite populations of stinkwort or perennial pepperweed.

**TABLE 3
POTENTIAL TARGET WEEDS AND MANAGEMENT METHODS**

Species	Common Name	Life Form	Cal-IPC Rating	Mgmt. Methods	Priority for Control	Notes	Schedule			
							Spring	Summer	Fall	Winter
<i>Arundo donax</i>	giant reed	P	High	CES	High	Excavate where feasible or cut near ground and immediately spray cut ends	C/E	S		MONITOR, NO VEGETATION MANAGEMENT TO BE PERFORMED
<i>Brassica nigra</i>	black mustard	A	Mod	CMS	Moderate	Cut/mow in spring before seed set, spray regrowth	C/M	S		
<i>Carduus pycnocephalus</i>	Italian thistle	A	Mod	CMS	High	Cut/mow in spring before seed set, spray regrowth	C/M	S		
<i>Carpobrotus edulis</i>	ice plant	P	High	ES	Moderate	Excavate, place in piles to decompose, spray seedlings		ES		
<i>Centaurea solstitialis</i>	yellow starthistle	A	High	CMS	High	Cut/mow in spring before seed set, spray regrowth	C/M	S	S	
<i>Cirsium vulgare</i>	bull thistle	A	Mod	CMS	Moderate	Cut/mow in spring before seed set, spray regrowth	C/M	S		
<i>Cortaderia selloana</i>	pampas grass	P	High	BES	High	Excavate, pull/spray seedlings, bag seed heads	BES	S		
<i>Dittrichia graveolens</i>	stinkwort	A	Mod - Alert	EMS	High	Excavate, pull/spray seedlings before seed set (in early fall ~1 st weeks of Sept)			ES	
<i>Lepidium latifolium</i>	perennial pepperweed	P	High	CMS	High	Cut/mow in spring before seed set, spray regrowth	C/M	S	S	
<i>Rubus armeniacus</i>	Himalayan blackberry	P	High	CS	Moderate	Cut and spray in spring, spray resprouts	CS	S	S	
<i>Tamarix ramosissima</i>	saltcedar	P	High	CS	High	Cut near ground and spray stump immediately, spray resprouts	CS	S		

NOTES:

- A = Annual plant, includes biennial plants
- B = Bag seed heads
- C = Cut with line trimmer, blade or chain saw
- E = Excavate by soil knife, shovel or backhoe bucket
- M = Mow with high clearance mower set to 6"
- P = Perennial plant
- S = Spray with herbicide (Herbicides to be applied under the direction of a licensed pest control applicator)

Cal-IPC High = On a state-wide basis have severe ecological impacts on physical processes, plant and animal communities and vegetation structure

Cal-IPC Moderate (Mod) = On a state-wide basis have substantial ecological impacts on physical processes, plant and animal communities and vegetation structure.

For the first three years, mapping will occur at least twice a year (likely in late spring and late summer) to capture invasive plants species with different growth periods at the site. After three years, it may be determined that more or fewer weed surveys are necessary, or, depending on what invasive species are present, biennial monitoring may continue to be required. Weed surveys and mapping will occur in Years 1, 2, 3, 5, 7, and 10, unless it is determined after three years that the monitoring should continue annually in order to inform annual maintenance and invasive plant control work at the site.

Photo-Documentation

Twelve permanent photo-documentation stations will be established at the site prior to commencement of construction. Preliminary photo-documentation stations are shown in Figure 3. Photographs will be taken to document pre-project conditions and, following construction in monitoring years will provide documentation of vegetation establishment and evolution of marsh, transitional, and upland habitat areas throughout the site. To the extent possible, photopoints will be located in areas that provide good vantage points of the site, representative of site conditions, good distribution around the site, and that can be reoccupied in subsequent years. The location of photopoints will be recorded with GPS and the direction (aspect) and other relevant relocation information will be recorded. A map of photopoint locations and exposure directions as well as a photo appendix with all photos will be included in each monitoring report.

Wetlands

A re-delineation of jurisdictional wetlands will be performed 10 years following construction. The delineation may revisit any data points that have not been altered by construction and are accessible, and will also rely on new data points to identify wetland boundaries. Only the minimum number of sample points necessary to establish the extent of jurisdictional wetlands will be employed. Results of the re-delineation will be summarized in a wetland delineation technical memorandum with maps and data sheets, and will be provided to the USACE for verification.

A post-project CRAM assessment following construction of the project will be completed in order to document the change in wetland condition at the project site. The CRAM assessment should be completed once the site is mostly recovered from temporary impacts from construction and the vegetation has had time to develop, which likely will be around 5 years following construction.

Public Access Accommodation Space

The Project will grade accommodation space for future trails and public access facilities as documented in Project as-built topographic surveys. Length of levee or other area set aside for future trails and area set aside for facilities will be measured from the as-built surveys.

Sustainable Benefits

The area of potential future transitional ecotone and uplands habitats based on elevation will be surveyed and reported as part of the Project as-built plans. This data will be used in coordination

with data collected under vegetation succession and wetland extent to monitor the migration of wetlands and transitional habitats within the potential habitat areas.

The length and height of levee constructed will be surveyed and reported as part of the Project as-built construction plans.

SECTION 4

Reporting

Monitoring reports will be submitted to USACE, USFWS, NMFS, RWQCB, CDFW, and BCDC, by January 31 following each monitoring year. Monitoring years include Year 1, 2, 3, 5, 7, and 10. Monitoring reports will include, at the minimum, the following information:

- Summary description of the monitoring methods, including data collection and analysis;
- An overview of the restoration project progression, including a general discussion of site conditions and changes in conditions since the previous report; quantitative and qualitative comparisons of vegetation establishment, marsh conditions, and geomorphic evolution/stability between previous monitoring years;
- Analysis of performance in relation to success criteria;
- Discussion of maintenance actions undertaken that are directly relevant to restoration of wetlands;
- Color photographs taken from the photo-monitoring point locations; and
- A discussion of any corrective measures needed or undertaken (including weed control, replanting or reseeded, regrading for tidal circulation, or erosion control measures).
- The 10-year wetland delineation will be provided with the year 10 monitoring report.

Wetland restoration data will also be uploaded to the EcoAtlas Project Tracker and applicable incidental species observations will be reported to the California Natural Diversity Database. The District will consult with the agencies to determine if adaptive management actions are needed based on monitoring results after Years 1, 2, 3, 5, and 7. This consultation will consist of providing the monitoring report to the agencies and allowing the agencies to respond if they don't agree with the discussion or conclusions, or don't think the proposed corrective measures or adaptive management actions, if any, are appropriate.

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SECTION 5

Maintenance and Adaptive Management

Adaptive management is defined as "a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives."² An adaptive management approach provides a structured process that allows for taking action under uncertain conditions based on the best available science, closely monitoring and evaluating outcomes, and re-evaluating and adjusting decisions as more information is learned.³

Maintenance activities, on the other hand, are those readily anticipated to be needed to sustain the as-built functioning of the site. Maintenance activities can be described as routine, predictable, and would be expected to occur on a regular schedule.

The overall goal of maintenance and adaptive management of the site is to promote the long-term trajectory of the site in providing the desired functions and services associated with the restored habitats while preventing any negative unintended consequences. A large part of any successful Maintenance and Adaptive Management Plan is thorough planning using the best available information to develop appropriate and achievable objectives.

The approach to adaptive management of the Project will be to conduct regular site visits and monitor selected characteristics to determine the stability of the site and ongoing trends in physical and biological processes related to the project goals and objectives. Unexpected trends in the biological or morphological characteristics of the site will require examination to determine if they are compromising the goals and objectives of the restoration Project or may cause undesired effects.

To evaluate whether project objectives are being met, it is necessary to compare the monitoring data from the current and previous years with the success criteria, and interpret the trends based on professional judgment. The District, in consultation with Qualified Personnel⁴, will assess monitoring results and, if necessary, evaluate potential adaptive management approaches. Possible adaptive management actions could include additional studies or monitoring and/or corrective on-the-ground actions. Adaptive management actions will be discussed with agency personnel to the extent potential actions may affect permit conditions. For example, routine activities outlined herein would be documented to the agencies in the monitoring reports. For routine maintenance activities, the District currently provides a list of anticipated upcoming work,

² 2011 California Water Code, Division 35. Sacramento-San Joaquin Delta Reform Act of 2009, Chapter 4, Section 85052.

³ California Department of Fish and Wildlife, Adaptive Management. Available online at https://www.dfg.ca.gov/erp/adaptive_management.asp. Accessed on August 6, 2019.

⁴ Qualified Personnel include professional biologists, botanists, restoration ecologists, or other specialists

and then a quarterly report on what was accomplished. Common measures may include additional or specific weed control measures, trash and litter control, repair or installation of erosion/sediment controls, and/or supplemental seeding or planting. If general site assessments or monitoring indicate that additional site maintenance is needed or success criteria are not being met, corrective measures will be implemented. Corrective measures will be directed by the District in consultation with the agencies. Any activities not anticipated by this document will be discussed via a phone call to the agencies prior to taking action, and then documented in the monitoring reports. Some of these actions may require additional authorization from the agencies, but the intent of this document is to get clearance for the District to take swift action on smaller items to prevent them from becoming more serious, thereby minimizing the disturbance. Permit amendments therefore are reserved specifically for larger activities that fall outside the scope of this agreement.

To ensure that objectives are attainable, a project should begin with clearly defined, measureable targets and triggers that are linked to those objectives. Targets are typically defined as the quantitative goals or outcomes to meet project objectives (success criteria), while triggers are thresholds at which adaptive management interventions need to be considered. Triggers should be established in a manner that precedes undesirable outcomes, unintended consequences, or negative impacts so that corrective measures can be taken to re-direct the trajectory of the project before such results would occur. **Table 4** includes a list of likely adaptive management actions, triggers, and estimated maximum limits on the actions, based on the knowledge of this project site and experience at other similar projects.

Maximum limits have been estimated given our knowledge of expected site conditions and the experience of other similar projects in the region. These limits are estimates of very conservative assessments of likely scenarios based on District knowledge of the site, and the team's experience with other similar restoration projects around the Bay Area. However, if the limits are anticipated to be exceeded, the agencies will be contacted for concurrence on the path forward. Larger or more impactful measures that are not reflected in the Maintenance and Adaptive Management Plan may result in the need for permit revisions and/or new authorizations. All applicable permit conditions and avoidance and minimization measures identified in the final permits would be applied to Adaptive Management and Maintenance Activities identified in Tables 4 and 5.

Note that these adaptive management actions specifically omit future public use and trail-specific activities, such as converting trails to boardwalks, or addressing erosion around pedestrian bridges. Public use management actions will be handled by the John Muir Land Trust and their regulatory permits and approvals for public access elements.

Any adaptive management actions involving fill or excavation in jurisdictional areas, such as sediment or debris removal in channels, will require phone or email notification to the USACE, BCDC, and RWQCB, and written concurrence from the RWQCB. Some adaptive management actions involving fill or regrading/reconfiguring of the site may also require a BCDC permit amendment or plan review approval depending upon the scope of work.

**TABLE 4
SUMMARY OF ADAPTIVE MANAGEMENT OBJECTIVES, MONITORING, TRIGGERS, ACTIONS, AND LIMITS**

Objective	Monitoring Parameter	Management Trigger	Time Scale for Decision-Making	As Needed Applied Studies	Potential Management Action¹	Maximum Limits
Restore wetlands to improve ecological function and habitat quantity, quality, and connectivity (including upland transition zones) in the Lower Walnut Creek area for native, resident plant and animal species including special status species.	Water Levels	The site does not appear to be on the trajectory to be fully tidal after 10 years and causing reduced ecological function or habitat quality	Years 2-10	Determine (field observations, examine other success criteria, etc.) if tidal dampening is providing reduced ecological function or habitat quality; perform formal surveys or studies only if required.	Potential management actions may include excavation of sediment or debris from tidal channels.	Not to exceed clearing of 1 channel per year. Not to exceed 5,000 cubic yards in any given year, not to occur more than twice in 10 years. Not to exceed 1,000 linear feet., per event.
	Water Quality	Temperature, DO, and EC drop below a threshold required to support aquatic life. DO at sonde install location falls below the temperature-dependent threshold for aquatic life for 24 continuous hours.	Years 1-5	Collect continuous water quality data (temperature, DO, EC) with sonde.	Excavation of sediment or debris from tidal channels to facilitate tidal flushing. Continue to monitor water quality beyond year 5. Close off selected tidal channels or accept the reduced accommodation space if suitable water quality levels cannot be maintained (would require agency consultation).	Not to exceed clearing of 1 channel per year. Not to exceed 5,000 cubic yards in any given year, not to occur more than twice in 10 years. Not to exceed 1,000 linear feet per event.
	Channel Development	The breach or channel configuration is not properly sized and is limiting planned tidal exchange or is failing to provide the expected ecological functions.	Years 1-10	Study if channel development is reducing ecological function.	Continue to monitor channel development. Excavate and/or regrade breaches or channels.	Not to exceed clearing of 1 channel per year. Not to exceed 5,000 cubic yards in any given year, not to occur more than twice in 10 years. Not to exceed 1,000 linear feet per event.

Objective	Monitoring Parameter	Management Trigger	Time Scale for Decision-Making	As Needed Applied Studies	Potential Management Action ¹	Maximum Limits
	Vegetation Establishment	Not meeting success criteria because rates of vegetation establishment are slower than predicted and/or plants are not appropriate for the ecotone.	Years 2-7	Study the causes of slow vegetation establishment. Have qualified personnel and agencies review the findings and assess whether observed trajectories require intervention.	Replanting of specified plant species, or if unanticipated conditions in ecotone indicate changes to plant palette is warranted.	50% replanting of original planting amount, exact location of the plantings may vary based on site conditions A new planting palette would not exceed 25% of the original planting plan in quantity or extent Native revegetation in areas not originally planted to help meet ecological goals
	Invasive Plants	Not meeting success criteria – unable to control target weeds	Years 0-10	If target weed species cannot be properly controlled, study the biotic response to specific invasive species that are particularly detrimental to the site.	Potential management actions may include increasing non-native invasive species control frequency or methods.	Increase treatment frequency up to 4 treatments per year (over the currently anticipated 2 treatments per year).
	Wetland Extent	If target wetland acreage is not obtained Sediment from upland areas is deposited over and smothers wetlands, reducing habitat quality	Year 10 Years 1 - 10	Investigate sources of sedimentation	Debris or sediment removal in channels to ensure full tidal exchange Implement sediment control measures	Not to exceed clearing more than 1 channel of 500 linear feet per year. Install additional sediment control measures (coir rolls, silt fence, etc.) at no more than 10 discrete upland locations to prevent deleterious sediment delivery.
Allow for future public access, education, and recreational opportunities.	Successful opening of the site to the public via public access partner, JMLT	Not applicable (JMLT)	TBD	Not applicable (JMLT)	Not applicable (JMLT)	Not applicable (JMLT)

Objective	Monitoring Parameter	Management Trigger	Time Scale for Decision-Making	As Needed Applied Studies	Potential Management Action ¹	Maximum Limits
Create sustainable benefits that consider future environmental changes such as sea level rise and sedimentation.	Distribution and evolution of habitats over the site.	If tidal system has eroded into other valuable habitat areas, such as seasonal ponds quicker than expected. Regional and significant sea level rise effects are observed more rapidly than anticipated.	Years 5 - 10	Assess whether observed changes are due to restoration actions or system-wide change.	Close off selected tidal channels or accept the reduced accommodation space (would require agency consultation).	Closing off a maximum of 1 tidal channel.

NOTES:

- ¹ All applicable permit conditions and avoidance and minimization measures identified in the permits would be applied to Adaptive Management Activities. If working within the permitted work windows is not feasible, then the District would notify and discuss with the agencies prior to conducting the activities to ensure that impacts are being minimized.

In addition to the possible adaptive management activities outlined in Table 4, other less quantitative measures might also be required. We anticipate the following additional possible adaptive management considerations:

- Adaptive management activities related to public access project objectives will be provided by JMLT as a part of their permit process.
- Sea level rise has the potential to change the level of flood protection needed to maintain appropriate levels of flood protection along Lower Walnut and Pacheco creeks. This will be monitored and may trigger or expedite maintenance actions as outlined in **Table 5**.
- Other (yet to be defined) minor habitat adjustments as needed
 - Qualitative Trigger: triggers vary, but larger remedial actions such as sediment augmentation (e.g., import of dredged material to raise elevations) to the habitats would require subsequent regulatory clearances/permits
- Revise the type/frequency of monitoring being performed
 - Qualitative Trigger: if available data does not lend itself to determining appropriate adaptive measures
- In consultation with the regulatory agencies, adjust project goals and objectives
 - Qualitative Trigger: used as a last resort if project is consistently not meeting success criteria and other adaptive measures are not proving useful

Routine Maintenance Activities

In addition to possible adaptive management actions, the Project has been designed to minimize the need for both active operations (there are no operable facilities within the proposed Project area) and ongoing maintenance. The District recognizes that even the minimum level of ongoing maintenance has the potential for impacts. As such, the section below provides an overview of expected routine maintenance tasks. Potential maintenance actions are also shown in Table 5 below. To the extent feasible, all maintenance activities will be conducted outside of rail and salt marsh harvest mouse habitat and appropriate buffer areas and seasonal restrictions. The Management and Maintenance Activities permitted in Table 5 are all subject to the same permit conditions and avoidance and minimization measures identified in the overall project permits.

The District, in conjunction with its primary partner the John Muir Land Trust, will conduct ongoing, or routine, maintenance of the Project site, consisting of trash collection, security, trail inspection, vandalism damage repair, homeless encampment clean-up, fencing repair and cross culvert cleaning (including headwalls and flapgates, South Reach only) to ensure proper long term functioning of all parts of the Project. This would require the use of trucks and all terrain utility vehicles on roads and possibly levees.

**TABLE 5
SUMMARY OF ROUTINE MAINTENANCE OBJECTIVES, MONITORING, TRIGGERS, ACTIONS, AND LIMITS**

Objective	Monitoring Parameter	Maintenance Trigger	As Needed Applied Studies	Potential Maintenance Action ¹	Maximum Limits
Maintain appropriate levels of flood protection along Lower Walnut and Pacheco creeks, as warranted by the land use.	Proper functioning and condition of levee, culvert, flapgate and headwall.	Cracking along the crown, settlement or sloughing of the levee top or side slopes, rodent burrows that may cause seepage pathways. Erosion or wasting of the levee slope, boils or other evidence of through or under seepage.	Evaluate conditions contributing to levee degradation. Evaluations may include topographic surveys, or geotechnical analyses.	Install erosion control measures along the levee toe. Repair boils or seepage issue.	No more than 10 discrete locations (up to 100 linear feet each) of coir rolls, fabric placement, or minor regrading (not to exceed 5,000 sq ft)
		Encroachments or unauthorized excavation into the levee prism that could compromise the levee's integrity.		Remove encroachments, and restore levee or other damaged areas.	No more than 5 locations (up to 500 linear feet in length) and maximum input of 10,000 cubic yards of imported soil.
		Levee foundation consolidation is greater than expected and reduces level of protection		Raise levee crown to restore design level of protection (i.e., original constructed elevation).	No more than 10% of the total levee length would be repaired in any given year.
		Interior drainage culvert / headwalls / flapgate no longer functioning as designed.		Remove debris, replace culvert./ headwall / flapgate to restore functionality.	Temporary disturbance not to exceed 5,000 sq ft in the vicinity of the culvert / headwall / flapgate being serviced. Minor debris removal (by hand) may occur annually. Anticipated timing of larger disturbance not to exceed once every 5 years.
	Proper functioning and condition of access road	Levee surface rutted and/or causing standing water on top of levee. Levee surface worn and muddy in inclement weather.	Visual inspection of road conditions	Regrade or renew gravel surface on top of levee	
Restore wetlands to improve ecological function and habitat quantity, quality, and connectivity (including upland transition zones) in the Lower Walnut Creek area for native, resident plant and animal species including special status species.	Proper functioning of restored lands	Presence of litter, vandalism damage, homeless encampments, fencing damage, or other trespassing.	Not Applicable	Trash collection, vandalism damage repair (including replacing vegetation), homeless encampment clean-up, fencing repair, install additional security measures (gates, bollards, etc. consistent with original design), general site cleanup. Modifications not consistent with original design would be discussed with BCDC)	Not Applicable.

NOTES:
¹ All applicable permit conditions and avoidance and minimization measures identified in the permits would be applied to Routine Maintenance Activities. If working within the permitted work windows is not feasible, then the District would notify and discuss with the agencies prior to conducting the activities to ensure that impacts are being minimized.

Vegetation maintenance will be focused on routine mowing for fire suppression and general maintenance, but restricting the spread of target invasive exotic species as outline in the adaptive management section is linked to these activities and may include mechanical treatment (mowing, manual pull, mechanical scrape) and/or herbicide application, as determined by a qualified biologist/botanist in response to particular site conditions. Other vegetation work may include propagation, replanting and augmentation of appropriate native species, led either by the District or by our partners and volunteers.

Additional likely long-term maintenance activities based on the experience of similar projects in the region include levee maintenance such as use of standard erosion control measures, light regrading of levee surface and/or side slopes, augmentation of levee surfacing (gravel), possible import and placement of fill material (e.g. dirt, rip-rap, etc.) under scenarios of unexpected levee erosion or rodent burrows.

Levees, such as those constructed as part of the Project's South Reach, are designed to lower flood risk for parcels on the land side of the levee, and require careful inspection and maintenance to ensure they can continue this important role. With proper maintenance, earthen levees can last indefinitely. Without maintenance, levees can catastrophically fail, release floodwaters and cause great damage. Inspections will be conducted from light vehicles or on foot.

Levees on the Project site will be inspected annually and after significant storm events. Issues that may arise after a routine levee inspection may include cracking along the crown, settlement or sloughing of the levee top or side slopes, rodent burrows that may cause seepage pathways, erosion or wasting of the waterside slope, boils or other evidence of through or underseepage, or encroachments or unauthorized excavation into the levee prism that could compromise the levee's integrity. Fill would be placed by excavators working from existing levees and/or roads. Identified deficiencies are classified by severity and ranked for remediation. Issues that could cause imminent failure of the levee are typically handled under an emergency authorization (such emergency activities are not covered by this plan and may require other authorizations). Other critical issues (high risk but low frequency events that do not yet rise to the level of emergency) would be remediated using the same construction techniques, equipment and mitigation measures used to construct the levee as part of the Project (excavators and heavy equipment working from roads and levees to the extent feasible).

Standard levee maintenance activities include:

- Exploratory borings from top of levee road.
- Removal of sloughed material using excavator from top of levee road.
- Addition and compaction of levee material in discrete locations using equipment from top of levee road.
- Removal, replacement, and compaction of material on top of levee road using small excavators, compactors.
- Filling of rodent burrows and compacting of surrounding material for a smooth finish.
- Installation of appropriate stormwater BMPs, including wattles, coir rolls, hydroseeding, etc.

- Although not anticipated, heavy equipment may need to travel below the levee road for access to damaged levee areas.

SECTION 6

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Attachment A

Salt Marsh Harvest Mouse Monitoring Plan