Appendix I

Water Quality Technical Report

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LOMA ALTA SLOUGH ENHANCEMENT

Water Quality Technical Report

Prepared for
City of Oceanside

May 2020

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SECTION 1
Introduction and Background

This report summarizes the current water quality regulatory status of Loma Alta Slough and monitoring programs completed to date. Additionally, this report documents the preliminary assessment of potential benefits to water quality that could arise through the establishment of a wetland habitat along the creek banks as a result of the project. Although the proposed project is focused on habitat restoration a major goal of implementation is improvement to the ambient water quality within the wetland area. To assess the potential for future water quality improvement as a result of implementation, existing peer-reviewed literature and monitoring program data were examined. Based on the assessment, there would likely be simultaneous benefits to water quality that could also arise with the restoration and enhancement of the existing wetland fringe associated with the project alternatives.

1.1 Water Quality Issues in Loma Alta Slough

One of the major water quality problems in Loma Alta Slough is that of low and widely variable levels of dissolved oxygen (DO). Low and highly variable levels of DO are a common feature of eutrophic waterbodies (waterbodies high in nutrients) and in bar-built estuaries throughout California. The intermittent closure of the bar (sandy beach) creates conditions that are conducive for trapping oceanic saltwater and preventing mixing. When the mouth of the estuary is closed by wave action, tide water and wave overwash are essentially trapped in the lagoon behind the closed beach, and the salt water settles on the bottom, forming vertical stratification in the water column. Even in the absence of aquatic macroalgae at the surface, this situation can lead to declines in DO in the bottom layer for two reasons. First, the lower layer typically includes enough underlying biochemical oxygen demand (BOD) to generate the draw down over time of oxygen as micro-organisms metabolize detritus. Second, the difference in salinity between the two layers is usually sufficient to prevent vertical mixing between the two layers while the mouth is closed. So while the upper layer can be reoxygenated due to its exposure to the atmosphere, the lower layer becomes hypoxic over time. This pattern of vertical salt-stratification and the resulting hypoxia at depth has been documented at multiple lagoon systems along the California coast, including Devereux Slough, Mission Lagoon, Goleta Slough, Santa Clara River Estuary, Ormond Lagoon, and Aliso Creek.

The low and highly variable levels of DO are caused by excessive primary production caused by increased nutrient input through watershed runoff and groundwater seepage, nighttime respiration (when plants continue consuming oxygen, but are not releasing any back into the water as they do during the day), and the decomposition of elevated levels of organic matter such as leaves or dead macroalgae. In the Loma Alta Slough system, macroalgae have been identified as the dominant primary producer that responds to enhanced nutrient supply from the watershed. Eutrophication occurs primarily during the summer months when the mouth of the lagoon is closed to oceanic exchange and inflow is largely dry-weather runoff from the watershed. Previous work has identified phosphorus as the main cause of the very high macroalgal abundance (McLaughlin et al. 2010, CRWQCB 2014, Weston 2019).

1.2 Regulatory Framework

1.2.1 Federal – Clean Water Act

The Clean Water Act (CWA), also known as the Federal Water Pollution Control Act as amended by the Federal Water Pollution Control Act Amendments of 1972, (33 USC 1251–1376) is the major federal legislation governing water quality. The CWA sets water quality standards for all contaminants in surface waters. The CWA states that the discharge of pollutants to waters of the United States from any point source is unlawful, unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit.

Clean Water Act Section 303—Water Quality Criteria and Standards

CWA Section 303 requires states to adopt water quality standards for all surface waters of the United States. As defined by the CWA, water quality standards consist of two elements: identified designated beneficial uses of the water body in question and criteria that protect the designated uses. In California, the USEPA has granted the State Water Resources Control Board and its local Regional Water Quality Control Boards (RWQCB) the authority to identify beneficial uses and adopt applicable water quality objectives.

Clean Water Act Section 303(d)

CWA Section 303(d) requires that each state identify water bodies or segments of water bodies that are "impaired" (i.e., do not meet one or more of the water quality standards established by the state). These waters are identified in the Section 303(d) list as waters that are polluted and need further attention to support their beneficial uses. Once the water body or segment is listed, the state is required to establish a Total Maximum Daily Load (TMDL) for the pollutant.

A TMDL is a pollution budget, and includes a calculation of the maximum amount of a pollutant that can occur in a waterbody, and allocates the necessary reductions to one or more pollutant sources. A TMDL serves as a planning tool and potential starting point for restoration or protection activities with the ultimate goal of attaining or maintaining water quality standards.

Loma Alta Slough was placed on the 1996 CWA Section 303(d) list of impaired water bodies for excessive eutrophic conditions. Section 1.3 below describes the Loma Alta Slough TMDL

1.2.2 State – Porter Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (California Water Code Sections 13000–16104) (Porter-Cologne Act) provides the basis for water quality regulation within California and defines water quality objectives as the limits or levels of water constituents that are established for reasonable protection of beneficial uses. The SWRCB administers water rights, water pollution control, and water quality functions throughout the state, while the local water boards (in this case, San Diego RWQCB or SD-RWQCB) conducts planning, permitting, and enforcement activities.

1.2.3 State – Municipal Stormwater Permitting (MS4)

The state's Municipal Stormwater Permitting Program regulates stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s). MS4 Permits were issued in two phases. Phase I was initiated in 1990, under which the RWQCBs adopted NPDES stormwater permits for medium (serving between 100,000 and 250,000 people) and large (serving more than 250,000 people) municipalities. The regional water quality control boards, including SD-RWQCB, have adopted an MS4 Permit specific to their region. As part of the Phase II of the MS4 Permit, the SWRCB adopted a General Permit for small MS4s (serving less than 100,000 people) and non-traditional small MS4s including governmental facilities such as military bases, public campuses, and hospital complexes.

1.2.4 Regional – Municipal Separate Storm Sewer System Permit

On May 8, 2013, the SD-RWQCB approved a regional municipal separate storm sewer system (MS4) permit for San Diego, southern Orange, and southwestern Riverside counties (Order No. R9-2013-0001). The region-wide NPDES Permit (commonly referred to as the Regional MS4 Permit) sets the framework for municipalities, including the City of Oceanside, to implement a collaborative watershed-based approach to restore and maintain the health of surface waters. The Regional MS4 Permit requires development of a Water Quality Improvement Plan (WQIP) that will allow the City Oceanside (and other watershed stakeholders) to prioritize and address pollutants through an appropriate suite of best management practices in each watershed. The City of Oceanside lies within the Carlsbad Watershed Management Area and is one of the responsible municipalities for the watershed's WQIP.

1.2.5 Regional – Carlsbad Watershed Management Area Water Quality Improvement Plan

The Carlsbad Watershed Management Area WQIP was developed to demonstrate compliance with the Regional MS4 Permit (Order No. R9-2013-0001) discussed above. This watershed-specific plan was developed by the Copermittees of the Carlsbad Watershed Management Area (City of Oceanside, Carlsbad, Encinitas, Escondido, San Marcos, Solana Beach, Vista and the County of San Diego), and is intended to provide a process by which the Copermittees can select and address the highest priority water quality issues. The WQIP includes descriptions of the highest priority pollutants or conditions within the watershed as well as goals and strategies to address those pollutants or conditions, and time schedules associated with those goals and strategies.

1.3 Loma Alta Slough TMDL

In response to the very low levels of DO in the system and the Slough's status on the CWA 303(d) list, the SD-RWQCB developed a Total Maximum Daily Load (TMDL) for Loma Alta Slough (SD-RWQCB 2014). The TMDL calls for a target macroalgal abundance of 90 grams dry weight per cubic meter (g dw/m^3) or less, and macroalgae coverage of less than 50% of the surface of the Slough during the growing period of July through August. The TMDL target is to be met by the year 2023, with intermediate macroalgae abundance goals incorporated into the water quality monitoring plan. Intermediate goals for macroalgae are 530 g dw / m^3 with <74% coverage by 2018 and 350 g dw / m^3 with <65% coverage by 2021 (SD-RWQCB 2014). The City is tasked with monitoring progress to these targets consistent with a Resolution adopted by the SD-RWQCB (Order No. R9-2014-0020).

To achieve and sustain these lower macroalgal levels, the TMDL has a dry season (May to October) monthly phosphorous load target of 31.5 g Total Phosphorus (TP)/month for the combination of watershed runoff and groundwater loads. It was determined that groundwater contributions (19.7 g TP/month) were associated with TP concentrations that were sufficiently low that they were not considered to be problematic (SD-RWQCB 2014). As a result, the waste load allocation in the TMDL was set at 11.8 g TP/month. The TMDL assigned the waste load allocation to dry season watershed runoff from the Loma Alta Creek including non-stormwater discharges from the City of Oceanside's municipal storm drain system. The City is tasked with reducing unallowed discharge of TP from the public storm drain system through the Regional Municipal Stormwater Permit compliance program to meet the TMDL phosphorus target. The loading sources, maximum daily allowable loads, and load reductions outlined in the Loma Alta Slough TMDL are summarized in Table 1.

TABLE 1
PHOSPHORUS LOADS AND SOURCES, ALLOWABLE LOADS, AND PERCENT REDUCTIONS NEEDED TO MEET TMDL REQUIREMENTS FOR LOMA ALTA SLOUGH

Source	2008 load	Allowable load	Reduction required	
	g TP/month	g TP/month	g TP/month	(%)
Groundwater	19.7	19.7	0.0	0.0
WLA - NPDES & WDRs	787.8	11.8	776.0	98.5
MOS	n/a	n/a	implicit	implicit
Total	807.5	31.5	776.0	96.1

Values displayed are derived from Table 6 of CRWQCB (2014). WLA= Wasteload Allocation, NPDES = Non-point Discharge Elimination System, WDR = Waste Discharge Requirement, MOS = Margin of Safety, and n/a = not applicable.

The TMDL for Loma Alta Slough (SD-RWQCB 2014) determined that the much higher TP loads in the wet season (November to April) were not a primary stressor for the DO and macroalgal problems in the Slough. This finding was due to the following factors: 1) when wet season loads were occurring, the beach berm across the Slough mouth was typically not present, and tidal flushing reduced water quality problems in the Slough, and 2) there was no evidence that organic matter accumulated in any significant amount from the wet season loads that would cause issues with subsequent dry season conditions.

The findings of the TMDL are that dry season TP loads from the watershed were the primary pollutant loads of concern for the Slough. While McLaughlin et al. (2010) found that benthic processes were important for understanding the Slough's phosphorus budget, watershed runoff was the primary source of TP loads to the Slough. Further, it was determined that the groundwater contribution to dry season TP loads occurred at concentrations that were low enough to not be of concern. Instead, the primary focus of TMDL activities was identified as watershed runoff into the Slough during the dry season months. As noted above, these findings are consistent with the conclusions from McLaughlin et al. (2010) who stated "Terrestrial loads drive the Slough nutrients budgets year-round…" The TMDL (SD-RWQCB 2014a) further stated that much of the elevated TP loads from dry-weather runoff was due to a combination of residential and commercial land uses where the landscapes were over-irrigated.

1.4 TMDL Monitoring

In June 2014, Resolution R9-2014-0020 was adopted as an alternative to the TMDL. The Resolution of Commitment to an Alternative Process for Achieving Water Quality Objectives for Biostimulatory Substances in Loma Alta Slough proposes using the existing MS4 Permit (RWQCB 2013) and associated Water Quality Improvement Plans (WQIPs) to improve the eutrophic conditions of Loma Alta Slough (RWQCB 2014b). The Resolution indicates that implementation of the Carlsbad Watershed Management Area WQIP will result in the desired reductions of eutrophic conditions in the Slough. The Resolution also required the development of a monitoring program to track progress towards achieving the numeric targets listed in the Draft TMDL. Water quality monitoring began in 2016 and will continue through 2022.

The TMDL for the Slough is based on the year 2008, which represented a year with intensive data collection efforts. The average dry season (May to October) TP load in 2008 was recorded at 807.5 g TP/month. It is important to note that during the 2008 data collection effort, significant construction and sediment movement occurred in the Loma Alta Slough. During the summer of 2008, the North County Transit District oversaw removal and reconstruction of a new train trestle crossing the Slough. This operation required installations of temporary dikes and culverts in the wetland that may have altered typical hydrologic patterns. Thus data collected in 2008 for the development of the TMDL may not reflect usual summer conditions and macroalgae growth patterns. Water quality monitoring data for the Slough are sparse between 2008 and the beginning of the City's TMDL monitoring program in 2016 to comply with Resolution No. R9-2014-0020. Under this effort, Weston (2019) reported monthly average dry season TP loads to the Slough of 402, 263, and 608 g TP/month for the years 2016, 2017, and 2018, respectively; values lower than the 2008 TP load included in the TMDL (SD-RWQCB 2014a). However, each of the years of 2008, 2016, 2017, and 2018 had monthly TP loads far in excess of the TMDL target of 31.5 g TP/month.

SECTION 2
Water Quality Benefits due to Restoration

The primary purpose of the proposed Project is enhancement of biological function, restoration of historical coastal wetlands, and improvements for wildlife and recreational opportunities. However, water quality improvement is considered an ancillary benefit of restoration that is advantageous in achieving the Project's primary goals. Based on similar case studies and the peer-reviewed literature, wetlands have been shown to be able to improve water quality, particularly for phosphorus, which is the basis for the TMDL for the Slough.

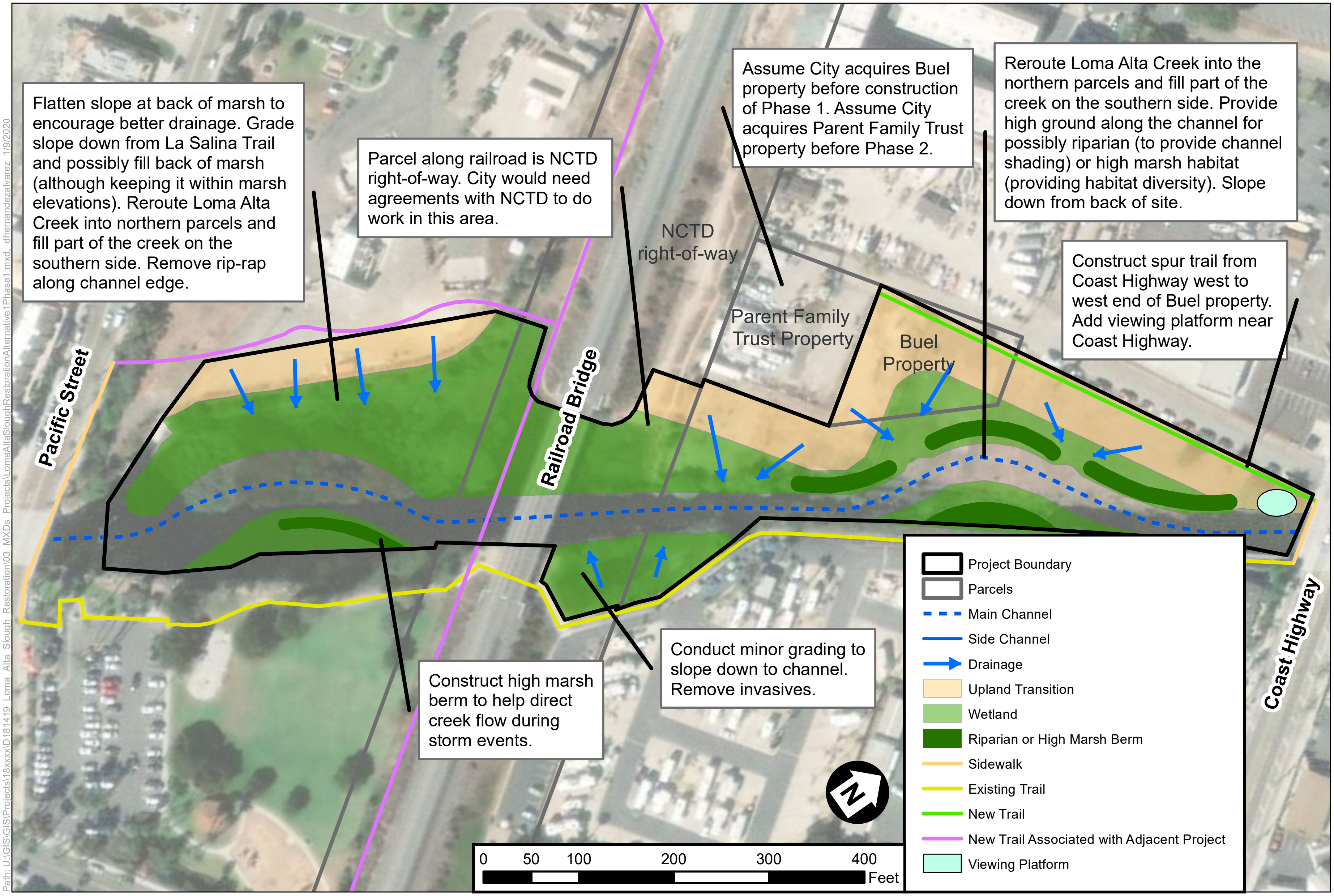
The project consists of expanding the wetland footprint through removal of historical infill, improving the ecological and hydrological conditions of the current wetlands and integrating the project with recreational features such as trails and bike paths. The wetland restoration alternatives being considered for Loma Alta Slough are not designed to be flow-through treatment wetland systems, where nutrient removal would occur as water is diverted into specially designed treatment wetlands. However, wetlands along the side of riverbanks (riverine wetlands) have been documented to remove phosphorus, although not at rates as high as those documented for specially-designed treatment wetlands (Land et al. 2013).

In a review of literature on the nutrient removal rates of created wetlands, Land et al. (2013) summarized results from a number of studies conducted across the globe. Hoffmann et al. (2009) found phosphorus retention varying from a rates as high as 1 g TP /m^2 /yr in flow-through systems to rates as low as 0.3 g TP/m^2/yr for fringing and/or floodplain wetlands. In contrast, Braskerud et al. (2005) found much higher rates, with a range of 27 to 156 g TP/m^2/yr phosphorus removal in Norwegian wetlands. The very high rates found by Braskerud et al. (2005) were attributed to the finding that much of the phosphorus in question was in the particulate form, and the primary phosphorus removal process was settling out of suspended particles. Busnardo et. al (1992) found rates between 25 to 79 g TP/m^2/yr for wetland mesocosms in the Tijuana River National Estuarine Research Reserve in San Diego County under different hydroperiod regimes.

Uptake rates may fluctuate based on hydrology changes (e.g., higher flows, low residence times). To err on the side of a conservative estimate, a phosphorus removal rate of 0.3 g TP/m^2/yr was used in this assessment of the ability of fringing wetlands to assimilate watershed phosphorus loads that contribute to dry season eutrophication in Loma Alta Slough. Since the TMDL for Loma Alta Slough (SD-RWQCB 2014a) focuses on monthly TP loads during the months of May to October, this low-end annual TP reduction rate was modified to become an assumed monthly phosphorus reduction capacity of 0.025 mg TP/m^2/month. Upon conversion to acres, this equates to an assumed phosphorus removal rate of 101 g TP/acre/month.

The proposed wetland restoration alternatives would increase the vegetated, jurisdictional wetland acreage (including salt marsh/upland ecotone, salt marsh, brackish/freshwater marsh, and existing disturbed marsh habitats) in Loma Alta Slough between the Coast Highway and Pacific Street from the existing 1.6 acres, up to 2.9 – 3.3 acres. The three potential alternatives are displayed in Figures 1 through 5.

Using the information outlined above, the TP load reduction potential of the existing conditions, and three different restoration alternatives was calculated. The results are presented in Table 2.

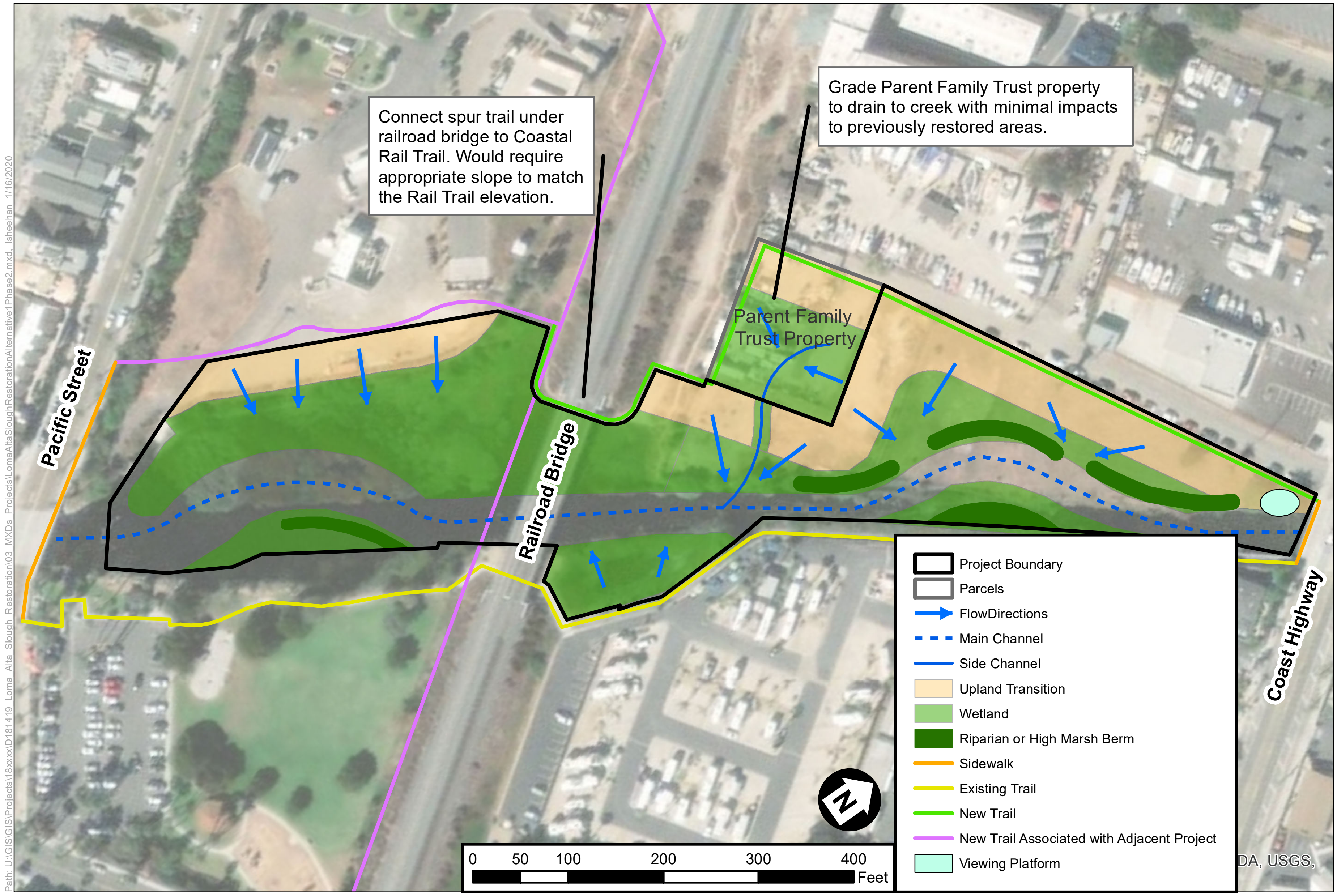


SOURCE:

Loma Alta Slough Restoration

Figure 1
Alternative 1, Phase 1

ESA

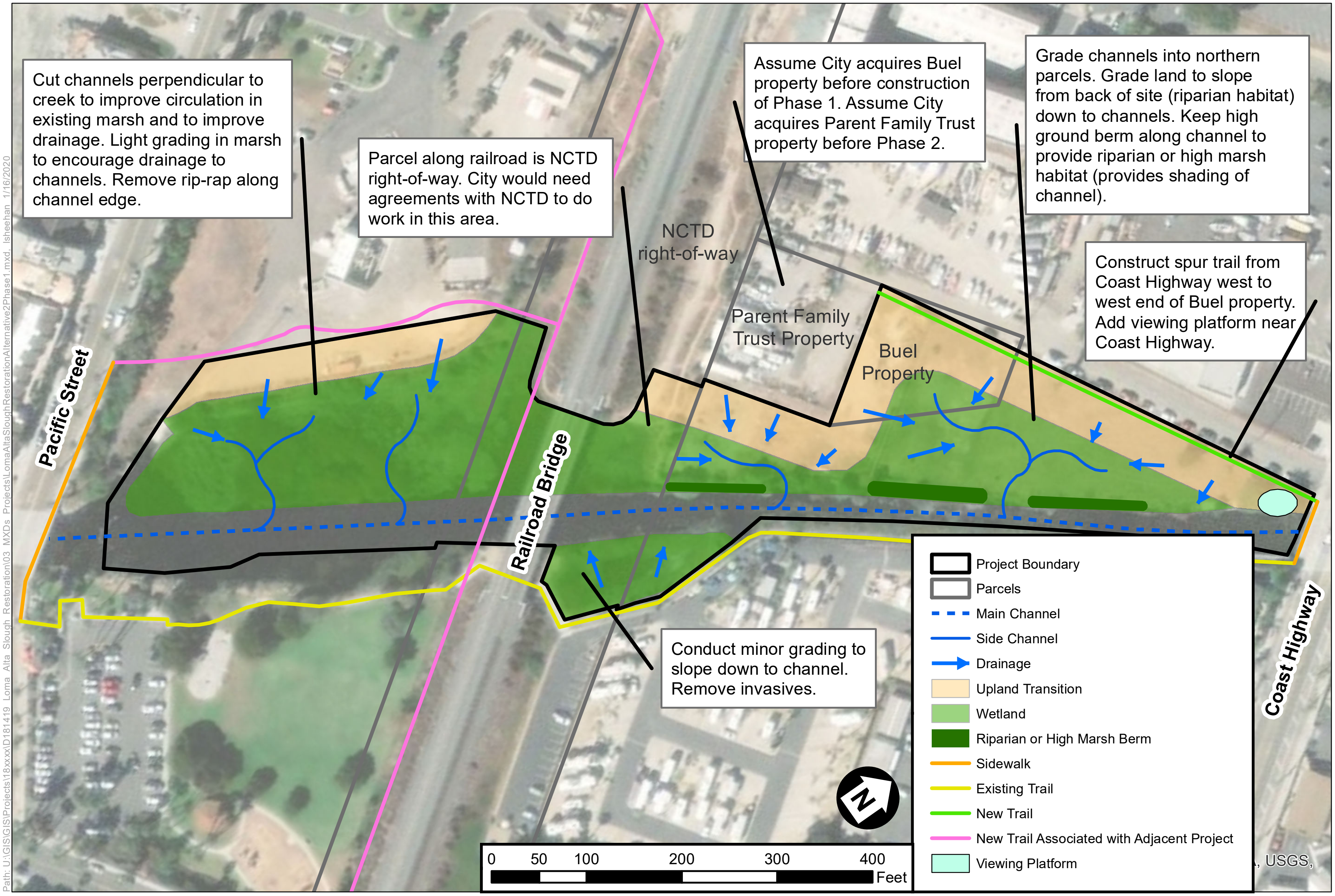


SOURCE:

Loma Alta Slough Restoration

Figure 2
Alternative 1, Phase 2

ESA

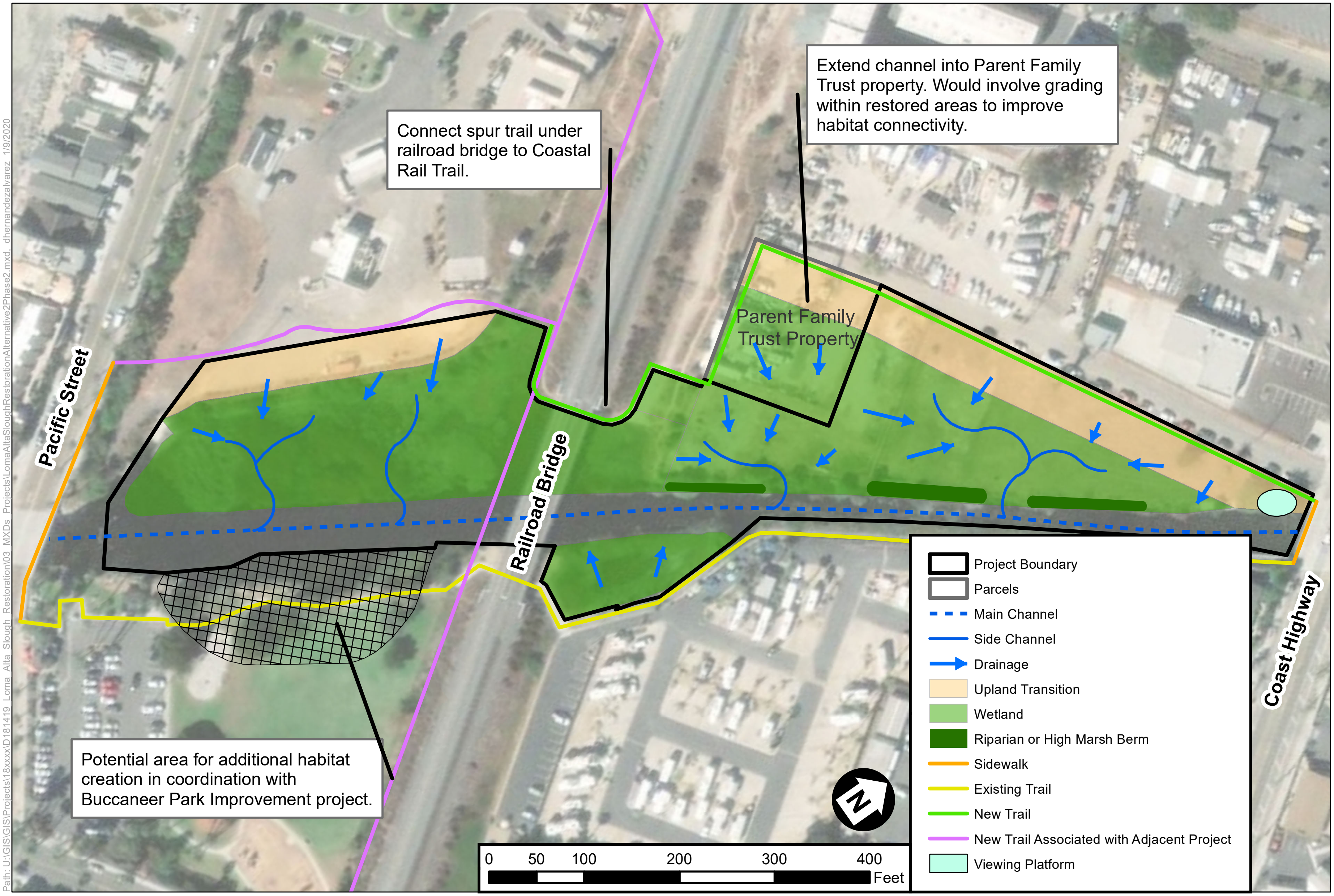


SOURCE:

Loma Alta Slough Restoration

Figure 3
Alternative 2, Phase 1

ESA

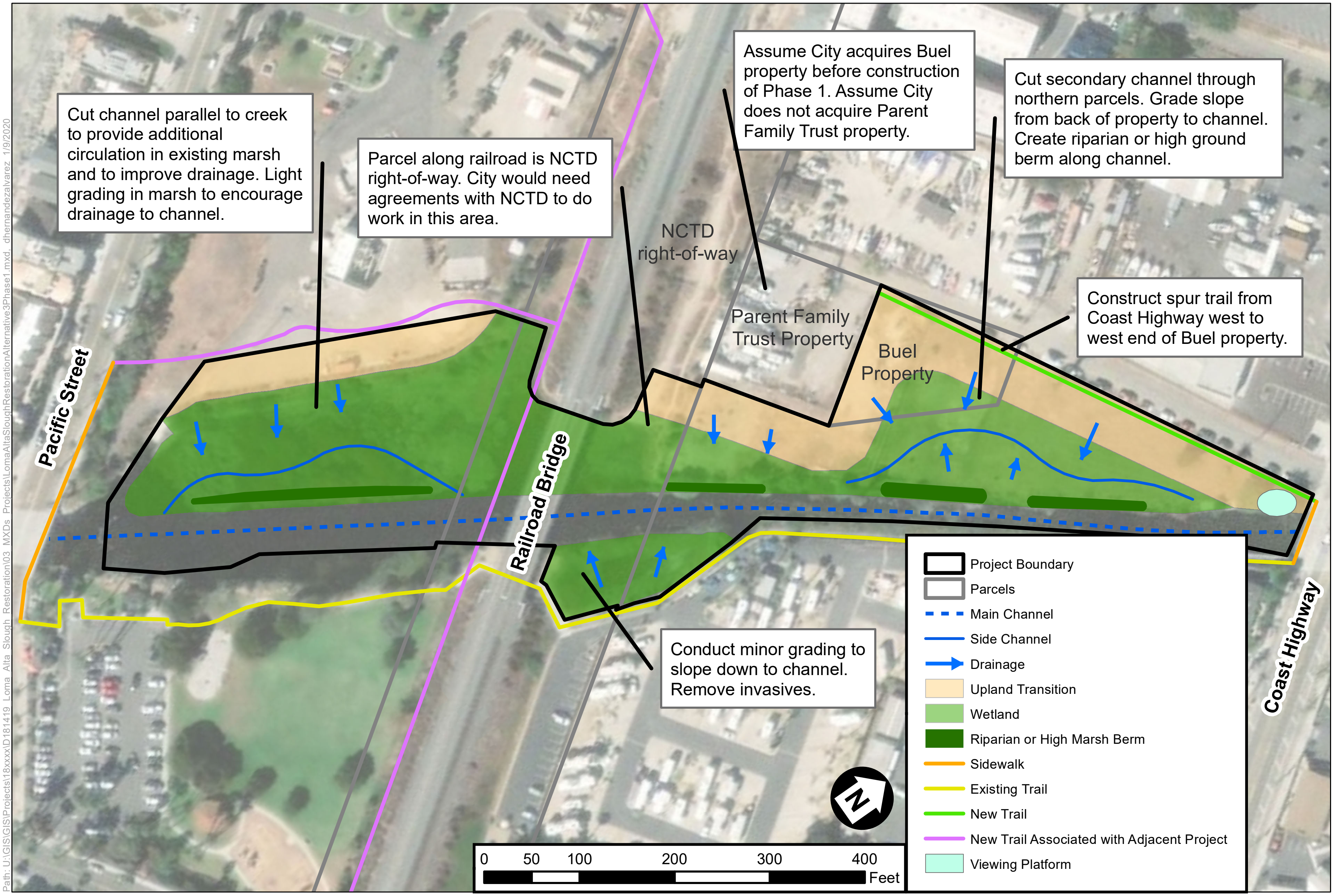


SOURCE:

Loma Alta Slough Restoration

Figure 4
Alternative 2, Phase 2

ESA



SOURCE:

Loma Alta Slough Restoration

Figure 5
Alternative 3

ESA

TABLE 2
PHOSPHORUS LOAD REDUCTION POTENTIALS FOR EXISTING CONDITIONS AND THE RESTORATION ALTERNATIVES

	Wetlands[1]		Assumed TP removal rate				TP load reduction	TMDL reduction achieved
Scenario	acres	m^2	g $TP/m^2/yr$	g $TP/m^2/month$	g TP/acre/month	g TP/month	g TP/month	(%)
Existing	1.6	6,470	0.300	0.025	101	162	n/a	n/a
Alternative 1 – Phase 1	2.8	11,330	0.300	0.025	101	283	121	16%
Alternative 1 – Phase 2	3.1	12,550	0.300	0.025	101	314	152	20%
Alternative 2 – Phase 1	2.8	11,330	0.300	0.025	101	283	121	16%
Alternative 2 – Phase 2	3.3	13,350	0.300	0.025	101	334	172	22%
Alternative 3	2.9	11,740	0.300	0.025	101	294	132	17%

1. Wetlands acreages determined based on jurisdictional wetlands (up to elevation 9.4 ft NAVD), which include salt marsh/upland ecotone, salt marsh, tule marsh, cattail marsh, and existing disturbed salt marsh).

The results shown in Table 2 should be viewed as potential phosphorus reduction rates. The ability of the wetlands to remove phosphorous would occur if currently untreated runoff from the watershed inundates the fringing wetlands proposed in the alternatives. Additional TP reductions could occur if water from within the creek filters into or flows across the newly constructed fringing wetlands (Conlen 2017).

The results shown in Table 2 suggest that three wetland restoration alternatives could help improve water quality within the Slough, by reducing TP loads by 17 to 22 percent of the load reductions listed in the TMDL (SD-RWQCB 2014a). While the wetland systems envisioned are not specifically designed for water quality improvements, wetlands have a long and well-documented ability to improve water quality by filtering out particulate forms of various contaminants, and by creating the conditions that allow for biogeochemical processes that reduce impact of anthropogenic contaminants. The results shown in Table 2 were derived by using a very conservative (i.e., very low) phosphorus removal rate for fringing and/or riparian wetlands. The project alternatives may be more efficient at phosphorus removal than the rates used here. A robust water quality monitoring program will be important in assessing this potential benefit following implementation of the project.

As with all wetland systems, the phosphorus removal rates of the potential wetlands may decline over time, in the absence of future management. In a summary of over 15 years of data, it was found that TP retention rates of constructed treatment wetlands declined from initial rates of 60% down to 10%, over the course of 15 years (Mitsch et al. 2012). If the desire is to maintain initial TP reduction rates of the restored wetlands, management actions such as sediment removal and/or replanting might be needed in later years.

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