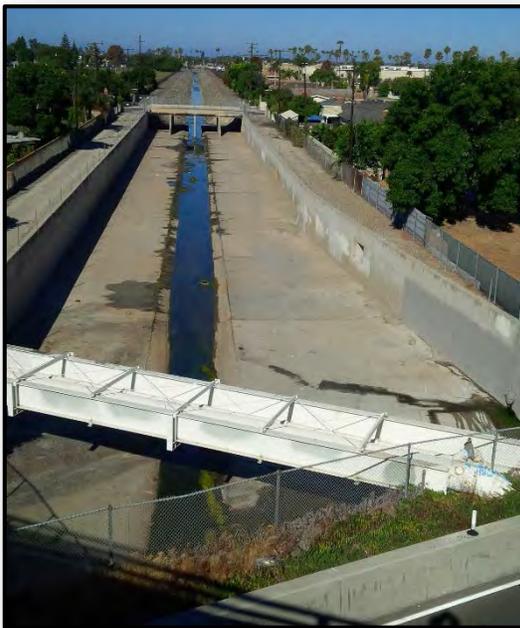

APPENDIX M – MITIGATION STRATEGY
For
WESTMINSTER, EAST GARDEN GROVE
FLOOD RISK MANAGEMENT STUDY



October 2018



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Appendix M – Mitigation Strategy

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APPENDIX M – MITIGATION STRATEGY

For

WESTMINSTER, EAST GARDEN GROVE

FLOOD RISK MANAGEMENT STUDY

1.0 Introduction

The Chicago District of the U.S. Army Corps of Engineers (USACE) is preparing a Draft Feasibility Report/Draft Environmental Impact Statement/Draft Environmental Impact Report (Draft IFR) for the Westminster East Garden Grove Orange County, California Flood Risk Management Study. Potential impacts to seasonal wetlands/soft bottom habitat, upland habitat and adjacent fringe wetland have been predicted to require mitigation. The purpose of this document is to describe the process used by the USACE to determine the acreage of mitigation that may be required for the proposed project.

1.1 Study Area

The study area is located entirely within the Westminster watershed in western Orange County, California, approximately 25 miles southeast of the City of Los Angeles (Figure 1). The watershed is approximately 87 square miles in area and lies on a flat coastal plain. The study area is almost entirely urbanized. Cities in the watershed include Anaheim, Stanton, Cypress, Garden Grove, Westminster, Fountain Valley, Los Alamitos, Seal Beach, and Huntington Beach.

The project area includes portions of four non-federal drainage channels within the watershed and the receiving waters of one of the channel systems in the Bolsa Chica Ecological Reserve (BCER). Drainage channels within the Westminster watershed that collect local storm water runoff and vary in size, geometry, and lining material.

C02 – Bolsa Chica Channel

This study includes the portion of C02 that extends from Huntington Harbour to the confluence with the C04 channel near Bolsa Chica Street. This channel segment is approximately 1.5 miles long and provides flood risk management for Huntington Beach, Huntington Harbour, and the Seal Beach Naval Weapons Station.

C04 – Westminster Channel

The C04 channel is approximately 7.8 miles and provides flood risk management for the cities of Garden Grove, Westminster, and Huntington Beach. The channel begins at Highway 22 and continues downstream past Westminster Memorial Park Cemetery, I-405, and the Westminster Mall, before joining with the C02.

C05 – East Garden Grove/Wintersburg Channel

The C05 channel is approximately 11.6 miles and provides flood risk management for the cities of Santa Ana, Garden Grove, Westminster, and Huntington Beach. The channel begins west of the intersection of Highway 5, Highway 57, and Highway 22 in the city of Santa Ana and flows southwest through Haster Basin, under I-405, and through the BCER before discharging into Outer Bolsa Bay and eventually the Pacific Ocean.

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C06 – Ocean View Channel

The C06 channel is approximately 4.1 miles in length and provides flood risk management for the cities of Fountain Valley and Huntington Beach. The channel begins in the City of Fountain Valley and flows westward through Mile Square Regional Park and under I-405, ultimately discharging into the C05 channel at the confluence near Gothard Street in Huntington Beach. Mile Square Regional Park is a 640-acre park and one of few open spaces or outdoor recreation resources in this densely developed watershed.



Figure 1: Westminster watershed and the study channels overlaid on the FEMA 1% ACE floodplain (Source: FEMA National Flood Hazard Layer (NFHL)).

1.2 Final Array of Alternative Plans

The final array of alternative plans includes five alternative plans including the No Action Plan.

No Action – Under the No Action Alternative, no management measures would be implemented to reduce the current risk of flood damage in the project area. Flooding will continue throughout the Westminster watershed due to the insufficient capacity of the existing channel systems. This will continue to cause damages to structures and road closures in the project area as a result of channel overtopping.

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Minimum Channel Modifications Plan – This alternative would reduce flood risk within the watershed by improving conveyance efficiency of existing channels. Trapezoidal channels within C02, C04, C05, and C06 that currently have an earthen bottom and either earthen or riprap banks would be lined with concrete. There would be no alteration to reaches that are rectangular in shape or lined with concrete, nor to reaches of in-channel box and pipe structures.

The leveed areas in the downstream reaches of C02 and C05 (reaches 23 and 1, respectively) would be improved to reduce the risk of levee failure. Modifications in these reaches would include installation of steel sheet pile channel walls and preservation of existing soft bottom, tidally-influenced habitat.

Additional downstream measures would be combined with the in-channel measures to address existing flooding in Outer Bolsa Bay and to account for increased flow volumes that result from increased conveyance capacity in the channels. The tide gates on C05 would be replaced in order to improve the flow conditions through the lower reaches of the C05 channel. The current tide gates leak and therefore allow saltwater to intrude upstream in C05. This saltwater influence extends upstream of Outer Bolsa Bay for approximately 2.7 miles. The replacement of the tide gates as part of this alternative would be configured to allow for continued tidal influence in the lower reaches of C05, thus lessening impacts to the existing ecological conditions.

This alternative also includes the widening of the Outer Bolsa Bay channel just upstream of the Warner Avenue Bridge. Widening of the channel would require that the Warner Avenue Bridge and the pedestrian bridge at the Bolsa Chica Conservancy be widened as well. Widening of the Outer Bolsa Bay channel would improve conveyance as well as they hydraulic efficiency of the lower reaches of C05.

An approximately 2,500 foot long and 3 foot tall floodwall would be built along PCH at Outer Bolsa Bay to reduce impacts from flooding on traffic.

Compatible nonstructural measures would be incorporated to lessen the life safety risk associated with flooding in the project area. Compatible nonstructural measures that were considered in the development of this alternative include the development of a flood warning system and removal of impediments to flow.

Moderate Channel Modifications Plan – Under the Moderate Channel Modifications Alternative, individual reaches of C02, C04, C05, and C06 would be given either the minimum or maximum channel modifications. The Moderate Channel Modifications Plan also includes increasing the span of Warner Avenue Bridge, replacing the tide gates on C05, and constructing a floodwall along the Pacific Coast Highway at Outer Bolsa Bay which are discussed in detail under the Minimum Channel Modifications Plan. Lastly, compatible nonstructural measures would be incorporated to lessen the life safety risk associated with flooding in the project area. Compatible nonstructural measures include development of a flood warning system and removal of impediments to flow.

Maximum Channel Modifications Plan – Under the Maximum Channel Modifications Alternative, trapezoidal channels within C02, C04, C05, and C06 will be replaced with rectangular concrete (or steel sheet pile) channels to contain a 0.01 annual chance of exceedance (ACE) storm event. Additionally, floodwalls would be constructed in the existing channel right-of-way where necessary. The Maximum Channel Modifications Plan also includes increasing the span of Warner Avenue Bridge, replacing the tide gates on C05, and constructing a floodwall along the Pacific Coast Highway at Outer Bolsa Bay which are discussed in detail under the Minimum Channel Modifications Plan. Lastly, compatible nonstructural measures would be incorporated to lessen the life safety risk associated with flooding in the project area. Compatible nonstructural measures include development of a flood warning system and removal of impediments to flow.

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1.3 Preliminary Recommendation

Based on the cost and benefit analysis of the final array of alternatives, the Tentatively Selected Plan (TSP) is the National Economic Development (NED) Plan, the Minimum Channel Modifications Plan. The non-federal sponsor has expressed an interest in pursuing a Locally Preferred Plan (LPP) from one of the final array of alternative plans, the Maximum Channel Modifications Plan.

1.3.1 Tentatively Selected Plan

Under the Minimum Channel Modifications Plan (Tables 1 and 2, and Figure 2), earthen or riprap lined channels would be lined with concrete to increase conveyance efficiency. This plan is expected to significantly reduce impacts up to approximately the 2% ACE event.

Table 1: Channel Modifications within C02/C04 under the Minimum Channel Modifications Plan.

C02/C04			
Channel	Reach	EXISTING CONDITIONS	MINIMUM CHANNEL MODIFICATIONS PLAN
C02	23	Earthen trapezoidal	Widened to 230' soft bottom with double sheet piles on both sides
C04	20	Riprap lined trapezoidal from C02 to Bolsa Chica St.; Earthen & riprap trapezoidal from Bolsa Chica St. to Graham St.; Earthen trapezoidal from Graham St. to McFadden Ave.; Riprap trapezoidal from McFadden Ave. to Bolsa Ave.; Earthen & riprap trapezoidal from Bolsa Ave. to Edwards St. Concrete lined rectangular from Edwards St. to I-405	Concrete lined trapezoidal from C02 to Edwards St.; Concrete lined rectangular from Edwards St. to I-405 (existing);
C04	21	Concrete lined rectangular	No change from existing condition
C04	22	Concrete lined compound from Beach Blvd. to Magnolia St.; Concrete rectangular with soft bottom from Magnolia St. to Brookhurst; Riprap trapezoidal from Brookhurst St. to Westminster Ave.; Concrete lined trapezoidal from Westminster Ave. to SR-22	Concrete lined compound from Beach Blvd. to Magnolia St.; Concrete rectangular from Magnolia St. to Brookhurst; Concrete lined trapezoidal from Brookhurst St. to SR-22

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Table 2: Channel Modifications within C05/C06 under the Minimum Channel Modifications Plan.

C05/C06			
Channel	Reach	EXISTING CONDITIONS	MINIMUM CHANNEL MODIFICATIONS PLAN
C05	1	Earthen levee from tide gates to Warner Ave. w/ some SSP on south bank near Graham St.; SSP rectangular from Graham St. to Warner Ave.; Earthen levees from Warner Ave. to 1,300 ft upstream of Edwards Ave.	Sheet pile/ soft bottom/ splash walls (various heights) from tide gates to existing rectangular channel west of Golden West St.
C05	2	Concrete lined rectangular	No change from existing condition
C05	3	Riprap lined trapezoidal from C05/C06 confluence to Woodruff St.; Concrete rectangular from Woodruff St. to I-405	Concrete lined trapezoidal from confluence with C06 to Beach Blvd.; Concrete lined rectangular from Beach Blvd. to I-405
C05	4	Concrete lined rectangular from I-405 to Quartz St.; Riprap lined trapezoidal from Quartz St. to Bushard St.	Concrete lined rectangular from I-405 to Magnolia St.; Concrete lined trapezoidal from Magnolia St. to Bushard St.
C05	5	Riprap lined trapezoidal from Bushard St. to Brookhurst St.; 1,300 ft of concrete lined trapezoidal upstream of Brookhurst St.; Riprap lined trapezoidal to 3rd St.	Concrete lined trapezoidal
C05	6	Concrete lined trapezoidal	No change from existing condition
C05	7	Covered concrete conduit	No change from existing condition
C05	8	Concrete lined trapezoidal	No change from existing condition
C05	9	Concrete lined trapezoidal	No change from existing condition
C05	10	Covered concrete conduit	No change from existing condition
C05	11	Covered concrete conduit	No change from existing condition
C05	12	Concrete lined trapezoidal (first 1400') and covered concrete conduit (next 1000')	No change from existing condition
C06	13	Earthen trapezoidal from C05/C06 confluence to Bolsa Ave./RT-39; Riprap lined trapezoidal from Bolsa Ave./RT-39 to Ross Lane	Concrete lined trapezoidal
C06	14	Concrete lined rectangular	No change from existing condition
C06	15	Covered concrete conduit	No change from existing condition
C06	16	Concrete lined rectangular	No change from existing condition
C06	17	Earthen and riprap lined trapezoidal	Concrete lined trapezoidal
C06	18	Mile Square Park-concrete low flow v-channel	No change from existing condition
C06	19	Riprap lined trapezoidal	Concrete lined trapezoidal

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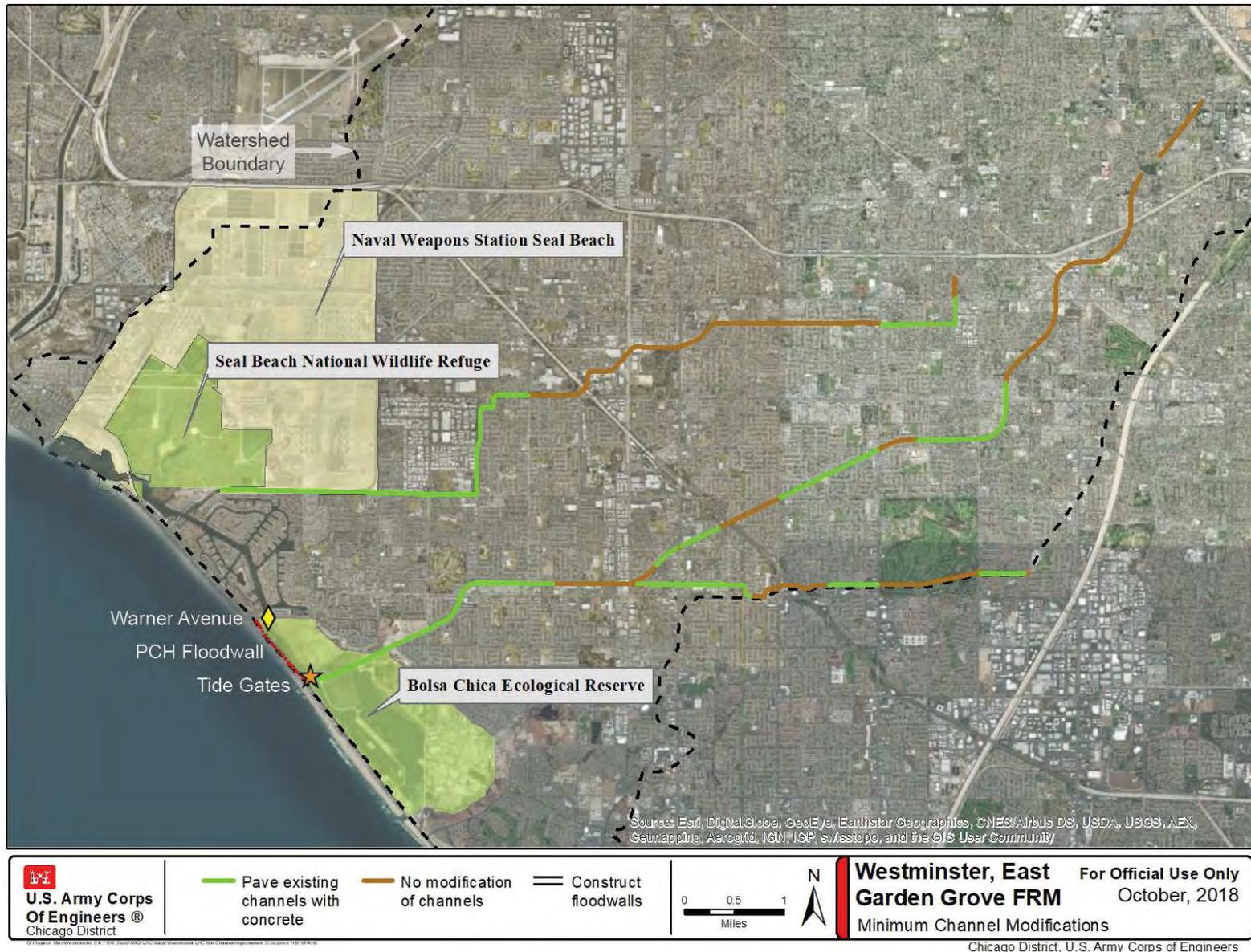


Figure 2: Minimum Channel Modifications Plan

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1.3.2 Locally Preferred Plan

The Locally Preferred Plan (LPP) is the Maximum Channel Modifications Plan. Under the Maximum Channel Modifications Plan (Tables 3 and 4, and Figure 3), trapezoidal channels would be reconfigured to have a rectangular cross sectional geometry. This would increase both conveyance efficiency and capacity. This alternative is designed to contain the 1% ACE storm event. For reaches that do not contain the 1% ACE event after conversion to a concrete rectangular channel, floodwalls would be added. As a potential LPP, this plan would require the NFS to provide 100% of the increased cost difference to go from minimum channel modifications to maximum channel modifications in the identified reaches.

Table 3: Channel Modifications within C02/C04 under the Maximum Channel Modifications Plan.

C02/C04			
Channel	Reach	EXISTING CONDITIONS	MAXIMUM CHANNEL MODIFICATIONS PLAN
C02	23	Earthen trapezoidal	Widened to 230' soft bottom with double sheet piles on both sides
C04	20	Riprap lined trapezoidal from C02 to Bolsa Chica St.; Earthen & riprap trapezoidal from Bolsa Chica St. to Graham St.; Earthen trapezoidal from Graham St. to McFadden Ave.; Riprap trapezoidal from McFadden Ave. to Bolsa Ave.; Earthen & riprap trapezoidal from Bolsa Ave. to Edwards St. Concrete lined rectangular from Edwards St. to I-405	80' Concrete rectangular with middle 48' left earthen from C02 to McFadden Ave.; 68' Concrete rectangular with middle 40' left earthen from McFadden Ave. to Bolsa Ave.; 55' Concrete rectangular from Bolsa Ave. to Edwards St.; 3 crossings replaced of different dimensions
C04	21	Concrete lined rectangular	Navy Railroad Reroute
C04	22	Concrete lined compound from Beach Blvd. to Magnolia St.; Concrete rectangular with soft bottom from Magnolia St. to Brookhurst; Riprap trapezoidal from Brookhurst St to Westminster Ave.; Concrete lined trapezoidal from Westminster Ave. to SR-22	Base of concrete lined channel increased to 35' from Beach Blvd. to Magnolia St.; Soft bottom channel from Magnolia St. to Brookhurst St. concrete lined; Concrete lined trapezoidal from Brookhurst Street to Westminster Ave.; 18' Concrete rectangular from Westminster Ave. to SR-22

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Table 4: Channel Modifications within C05/C06 under the Maximum Channel Modifications Plan.

C05/C06			
Channel	Reach	EXISTING CONDITIONS	MAXIMUM CHANNEL MODIFICATIONS PLAN
C05	1	Earthen levee from tide gates to Warner Ave. w/ some SSP on south bank near Graham St.; SSP rectangular from Graham St. to Warner Ave.; Earthen levees from Warner Ave. to 1,300 ft upstream of Edwards Ave.	Sheet pile/ soft bottom/ splash walls (various heights) from tide gates to existing rectangular channel west of Golden West St.
C05	2	Concrete lined rectangular	Concrete lined rectangular with 1' splash walls from Golden West St. to Gothard St.; Concrete lined rectangular from Gothard St. to C05/ C06 confluence
C05	3	Riprap lined trapezoidal from C05/ C06 confluence to Woodruff St.; Concrete rectangular from Woodruff St. to I-405	Concrete lined rectangular; Some sections of 1' splash wall between Beach Blvd. and Woodruff Rd.; 2 crossings replaced of different sizes
C05	4	Concrete lined rectangular from I-405 to Quartz St.; Riprap lined trapezoidal from Quartz St. to Bushard St.	Concrete lined rectangular with splash walls (various heights); 3 crossings replaced of different sizes
C05	5	Riprap lined trapezoidal from Bushard St. to Brookhurst St.; 1,300 ft of concrete lined trapezoidal upstream of Brookhurst St.; Riprap lined trapezoidal to 3rd St.	Concrete lined rectangular with splash walls (various heights); 5 crossings replaced of different dimensions
C05	6	Concrete lined trapezoidal	Concrete lined rectangular; 1 crossing replaced
C05	7	Covered concrete conduit	No change from existing condition
C05	8	Concrete lined trapezoidal	Concrete lined rectangular
C05	9	Concrete lined trapezoidal	Concrete lined rectangular
C05	10	Covered concrete conduit	Concrete lined rectangular
C05	11	Covered concrete conduit	No change from existing condition
C05	12	Concrete lined trapezoidal (first 1400') and covered concrete conduit (next 1000')	Concrete lined rectangular with splash walls (various heights); Haster Basin inlet culverts modified
C06	13	Earthen trapezoidal from C05/ C06 confluence to Bolsa Ave./ RT-39; Riprap lined trapezoidal from Bolsa Ave./ RT-39 to Ross Lane	Concrete lined rectangular at confluence; Concrete lined trapezoidal from confluence to Ross St.; 2 crossings replaced of different sizes
C06	14	Concrete lined rectangular	Concrete lined rectangular from Ross St. to Asari Lane; Concrete lined rectangular with splash walls (1.5-2') from Asari Lane to Riverbend Dr.
C06	15	Covered concrete conduit	Covered concrete conduit; 1 crossing replaced
C06	16	Concrete lined rectangular	No change from existing condition
C06	17	Earthen and riprap lined trapezoidal	Concrete lined trapezoidal

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C05/C06			
Channel	Reach	EXISTING CONDITIONS	MAXIMUM CHANNEL MODIFICATIONS PLAN
C06	18	Mile Square Park-concrete low flow v-channel	Mile Square Park-concrete low flow v-channel
C06	19	Riprap lined trapezoidal	Concrete lined trapezoidal

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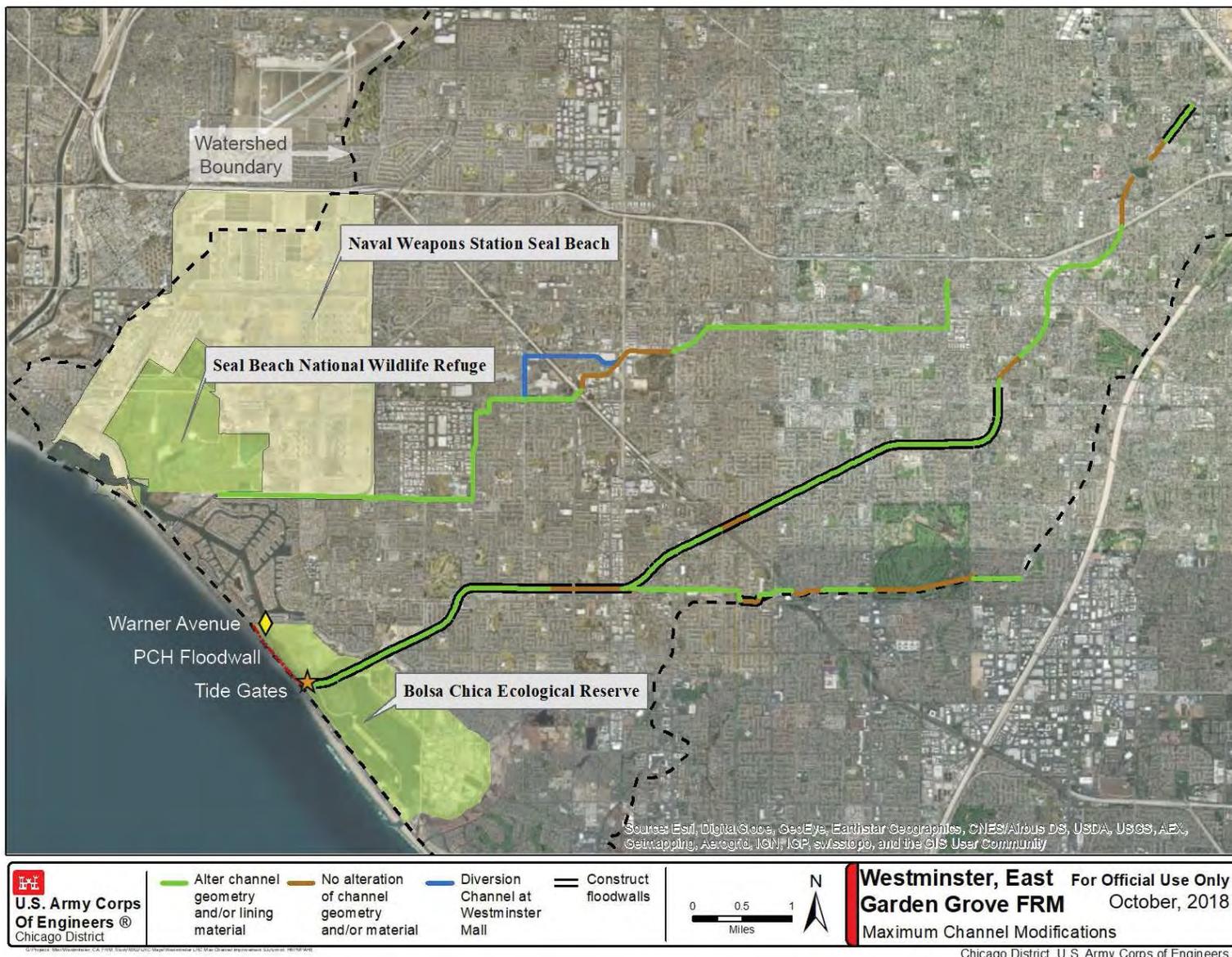


Figure 3: Maximum Channel Modifications Plan (LPP)

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1.4 Potentially Significant Impacts Requiring Mitigation

Implementation of either the TSP or LPP are expected to require mitigation for the loss of fish and wildlife habitat, although the amount of mitigation would vary between the two alternatives (Table 5). Potentially significant impacts requiring mitigation are the conversion of soft-bottom habitat to hard-bottom habitat within the flood conveyance channels, increasing the span of Warner Avenue Bridge which includes the removal of approximately 1 acre of upland and adjacent fringe wetland habitat upstream of the bridge in Outer Bolsa Bay, and construction of the floodwall along PCH which includes the loss of approximately 0.2 acres of adjacent upland and fringe wetland habitat. The amount of mitigable acreage for the TSP and LPP would be the same in regards to modifying Warner Avenue Bridge and constructing the floodwall along PCH; however, would vary in regards to channel modifications.

Table 5: Preliminary Estimate of Mitigable Acres for the TSP and LPP

Alternative	Potentially Mitigable Acres			
	Channels		Warner Avenue Bridge	PCH Floodwall
	C02/C04	C05/C06		
TSP	16.66	7.07	1.0	0.2
LPP	2.27	7.07	1.0	0.2

Total potential mitigable acres for the TSP is approximately 24.93 (23.73 acres of soft-bottom/seasonal wetland habitat and 1.2 acres of upland habitat with adjacent fringe wetland) and for the LPP is approximately 10.54 acres (9.34 acres of soft-bottom/seasonal wetland habitat and 1.2 acres of upland habitat with adjacent fringe wetland). The acreages above are acres that would be directly impacted by the proposed project. A ratio was not used at this time in determining mitigable acres, however, it may be necessary to ensure the appropriate level of mitigation is being provided.

1.5 Mitigation Goals and Objective

The goal of the mitigation strategy is to offset the increment of loss in fish and wildlife habitat resulting from the implementation of the TSP or the LPP. As discussed in *Section 1.4 Potentially Significant Impacts Requiring Mitigation*, if the TSP or the LPP are implemented there would be a loss of soft-bottom/wetland habitat within the channels and loss of upland habitat with adjacent fringe wetland in Outer Bolsa Bay. Therefore, the mitigation objective is to offset this loss of habitat.

1.6 Mitigation Considerations

USACE considered each of the following in the development of the TSP and LPP:

- Avoiding the impact altogether by not taking a certain action or part of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;
- Compensating for the impact by replacing or providing substitute resources or environments.

USACE considered the guidance in the following sections of the Planning Guidance Notebook (USACE 2000) in the development of this mitigation strategy:

- USACE must identify the least cost mitigation plan that provides full mitigation of losses specified in mitigation planning objectives [Paragraph C-3 e.(8)];

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- USACE must conduct incremental cost analyses to demonstrate that the most cost effective mitigation measure(s) has been selected [Paragraph C-3e. (2) and (8)];
- Habitat-based evaluation methodologies shall be used to the extent possible [Paragraph C-3 d.(6)];
- Mitigation planning shall address a range of alternatives up to the full compensation of significant ecological resource losses [Paragraph C-3 E (4)];
- The evaluation of effects is a comparison of the with-project and without project conditions for each alternative [Paragraph 2-3 d.(1)];
- Characterize the effects by magnitude, location, timing and duration [Paragraph 2-3 d.(2)];
- USACE must consider monitoring time and cost limits [Paragraphs C-3 e.(10); G-63 (b)];
- Fish and wildlife mitigation costs are subject to cost sharing to the same extent as other project costs [Paragraph C-3 e. (12)(c)].

1.7 Mitigation Opportunities

The majority of the proposed project area is built-out with only approximately 10 acres of vacant land; therefore, there are few mitigation opportunities available. Within the project area is the Bolsa Chica Ecological Reserve which may provide potential mitigation opportunities for project impacts.

1.7.1 Bolsa Chica Ecological Reserve

The Bolsa Chica Ecological Reserve is owned by the California State Lands Commission (SLC) and is managed by the California Department of Fish and Wildlife (CDFW). Three potential mitigation opportunities have been discussed by the SLC, CDFW, and the project team. Potential mitigation opportunities that were discussed include increasing the size/height of north and south tern islands to accommodate for projected sea level rise over the next 50 years, adding tide gates between C05 and the full tidal basin with the intent of flushing accumulated sand from the ocean outlet, and terracing/grading banks and creating habitat along the east bank upstream of Warner Avenue Bridge (Figure 4). At this time, these are just potential mitigation opportunities requiring further analysis and coordination.

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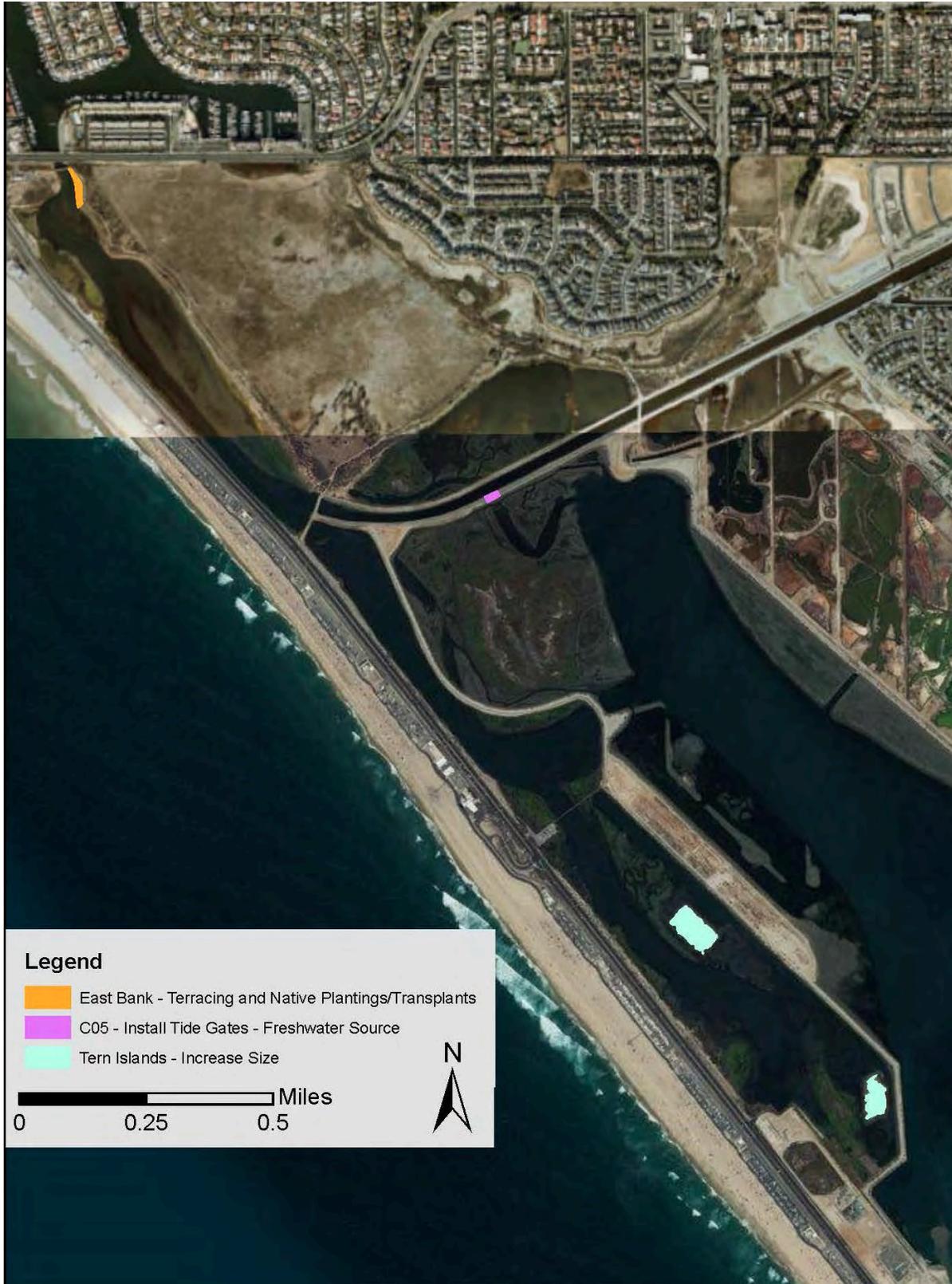


Figure 4: Potential Mitigation Opportunities at Bolsa Chica Ecological Reserve for Proposed Project Impacts.

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1.8 Functional Assessment

The Functional Assessment is used to provide a quantitative valuation of existing and mitigation features to support a mitigation functional equivalent to offset unavoidable losses to seasonal wetlands/soft bottom habitat, upland habitat, and adjacent fringe wetland habitat resulting from the proposed project.

USACE guidance for establishing mitigation requirements in the Civil Works Program is provided in ER 1105-2-100. USACE planning policy is clear on the use of functional habitat evaluation assessment or functional assessments: “Mitigation planning objectives are clearly written statements that prescribe specific actions to be taken to avoid and minimize adverse impacts, and identifies specific amounts (units of measurement, e.g., habitat units) of compensation required to replace or substitute for remaining, significant unavoidable losses” [ER 1105-2-100, App C, Paragraph C-3.b (13) 22 April 2000] and “habitat-based evaluation methodologies...shall be used to describe and evaluate ecological resources and impacts” [ER 1105-2-100, App C, Paragraph C-3.d (5)].

This guidance requires that USACE not use standardized ratios, but instead a scientific-based approach through the use of habitat evaluation through functional assessment (FA).

For the Draft IFR, a functional assessment has not been conducted on potential mitigation opportunities, but will be conducted prior to completion of the Final IFR. Potential models that are being considered, but not limited to, for use include the Southern California Coastal Bay Ecosystem Model, Least Tern Habitat Suitability Index, Osprey Habitat Suitability Index, and the California Habitat Assessment Procedure (CHAP). The potential mitigation opportunities listed in *Section 1.7* will be developed into mitigation alternatives that will be evaluated and compared to the future without project conditions.