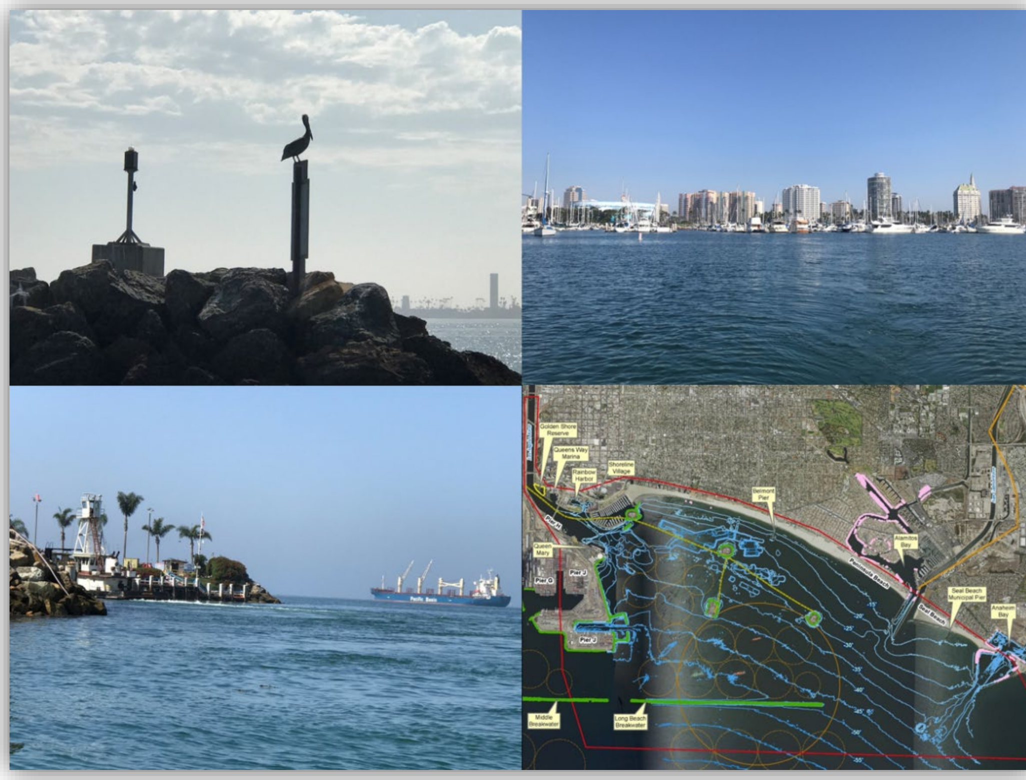
DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT / ENVIRONMENTAL IMPACT REPORT (EIS/EIR)

APPENDIX B: COST ENGINEERING

EAST SAN PEDRO BAY
ECOSYSTEM RESTORATION STUDY
Long Beach, California

November 2019



US Army Corps of Engineers ®

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November 2019

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1.0 OVERVIEW

The study investigates potential alternatives to restore within East San Pedro Bay (ESPB) the complex aquatic ecosystem that was historically present in the region but has been degraded by port construction, river channelization, construction of the Middle and Long Beach federal breakwaters, and other contributors to current conditions.

The purpose of this study is to evaluate opportunities for ecosystem restoration within San Pedro Bay, with a focus on the nearshore area off the City of Long Beach, within East San Pedro Bay.

Figure 1-1 – Study Area

The study area was divided into five zones during plan formulation:

Zone 1: Nearshore Zone	Includes the shallow waters <-20' MLLW off of the recreational beaches in Long Beach and Seal Beach, starting at Alamitos Beach by the Long Beach Shoreline Marina, includes Peninsula Beach, the Alamitos Bay Jetties and Seal Beach, up to but not including the Anaheim Bay jetties.
Zone 2: Open Water Zone	Includes all of the open water areas adjacent to the other zones that are >-20' MLLW and includes 3 oil islands.
Zone 3: LA River Mouth Zone	Extends from West Anaheim Street bridge crossing down 1 mile to the river mouth and includes the Queen Mary, Rainbow Harbor, Long Beach Shoreline Marina and Grissom Oil Island.
Zone 4: Port Zone	Includes the Carnival Cruise Pier, the "Cove" (rectangular inset along Pier G/J), Pier J, and out approximately 3,000' out from the port shoreline to Queens Gate's
Zone 5: Breakwater Zone	A buffer zone approximately 1,500' on either side and ends of the breakwater, including the Queens Gate navigation opening between the Long Beach and Middle Breakwaters.

Each opportunity zone is outlined in Figure 1-2.

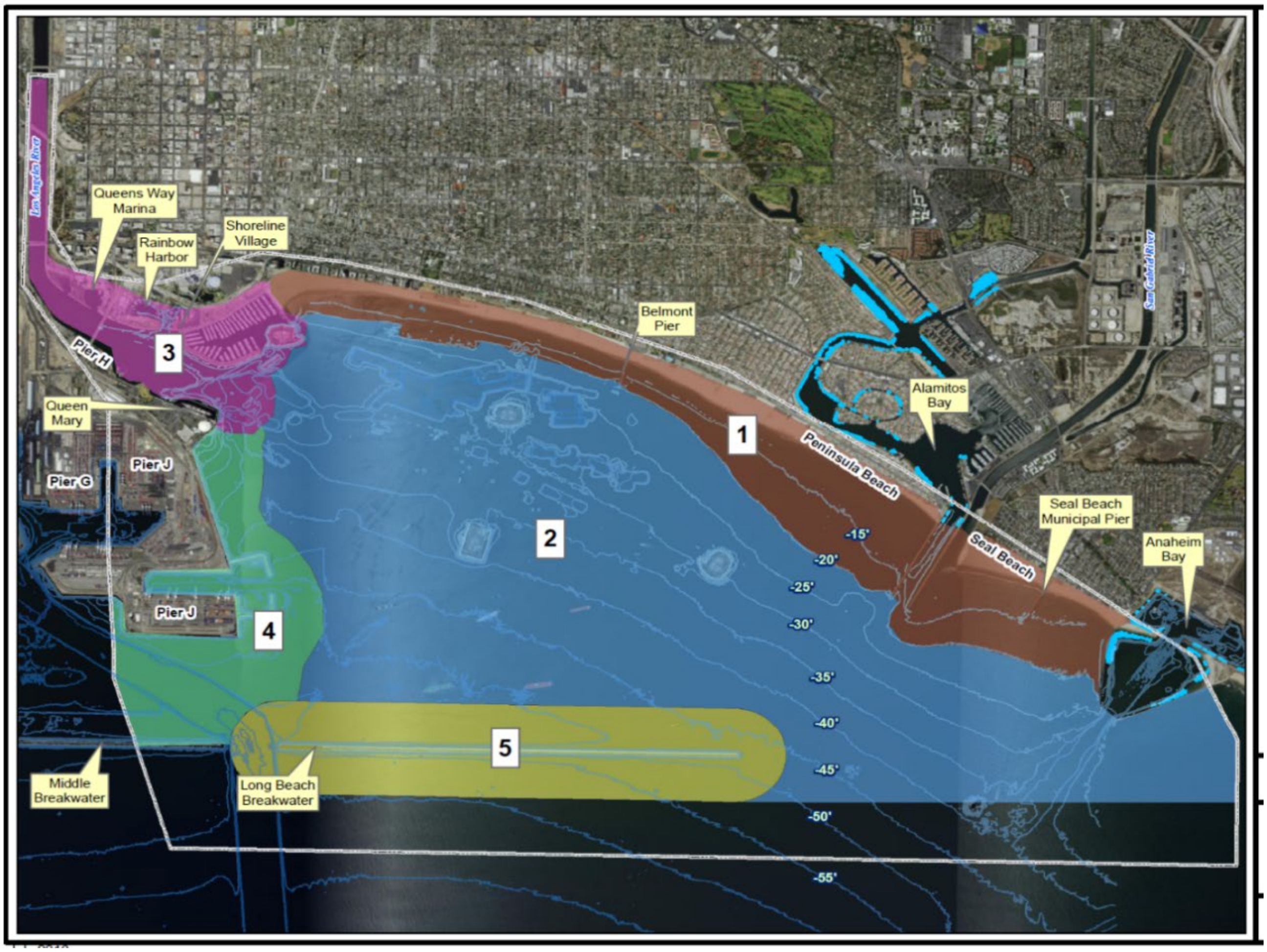


Figure 1-2 – Project Opportunity Zones

Separate measures for each zone were developed by the PDT to address both aquatic ecosystem restoration and improved water circulation. Various Habitat Measures, such as Eelgrass Planting, Kelp Reefs, Rocky Reefs, Coastal Wetlands, Emergent Islands, and Oyster beds construction were examined. A brief description of each of the identified measures can be found in Attachment 1 – Measure Data Summary. Detailed figures and design information can be found in the main body of the Integrated Feasibility Report.

Construction costs, adaptive management costs, and operation and maintenance costs were developed separately for each measure and are presented in Attachment 2 – Detailed Measure Cost Data.

Construction costs include the work required to initially install or construct a feature while adaptive management costs include additional labor and work to monitor and modify the feature as necessary to ensure it will fulfill the environmental restoration objective. Operation and maintenances costs include costs incurred after the measure is constructed or installed and the measure is established to where it addresses the ecosystem restoration objective as intended.

The output and costs of the measures comprising the preliminary conceptual alternatives were broken out to aid in conducting a Cost Effectiveness and Incremental Cost Analysis (CEICA) to determine the most cost effective and efficient plan combinations. The CEICA analysis identified two best buy and one cost effective alternatives – Plan 2, Plan 4A, and Plan 8, which were determined the be the Final Array of Alternatives. Additionally, at the request of the Local Sponsor, two Alternatives involving modifications to the breakwater were examined, however those were removed from consideration as they did not meet the Corps screening criteria. The measures in each of the three alternatives in the final array are summarized in the table below. An overview of each measure can be found in Attachment 1 – Alternative Summary by Measure.

Opportunity Zone 1: Nearshore	
NB	**Add (5) Rocky Reef Shoals (East) + Eelgrass**
N2	**(1) Large Sandy Island**
N4	**Small Oyster Reef (EJ)**
N5b	**Add (1) Rocky Reef Shoals (East) + Eelgrass**
Opportunity Zone 2: Open Water	
OB	**Kelp Reefs**
O1b	**(2) Rocky Reef Complex (Island A)**
O1e	**(5) Rocky Reef Complex (Island B)**
O2d	**Kelp Reefs (Scale 4)**
Opportunity Zone 3: LA River Mouth	
L1	**Small Coastal Wetland**
Opportunity Zone 4: Port	
P1c	**Large Coastal Wetland**
Opportunity Zone 5: Breakwater	
B2d	**Kelp Reefs (Scale 4)**

Table 1-1: Measure Summary

1.1 DESCRIPTION OF FINAL ARRAY OF ALTERNATIVES

1.1.1 ALTERNATIVE 2 (BEST BUY PLAN 2) - KELP RESTORATION PLAN

Alternative 2 is the least-cost best buy action plan and minimally meets the planning objectives. Open water kelp, shown as blue circles, provides high habitat output at a relatively low cost. This plan introduces three habitat types including eelgrass, (nearshore) rocky reef, and kelp reef, creating a horseshoe shaped benefit area. The most prevalent habitat type in this plan are 60+ acres of kelp beds in open water and off of the breakwater. The kelp bed placement takes advantage of beneficial open ocean currents. The yellow patches placed at differing intervals along the breakwater not only expands existing rocky reef habitat, but greatly increases the complexity and value through the undulating edges layout. Nearshore rocky reef in shallow ~15' depth provides habitat for intertidal zone kelp/algae and provides the conditions needed (calm, shallow waters) for eelgrass establishment. This serves to extend existing eelgrass beds west of Belmont Pier.

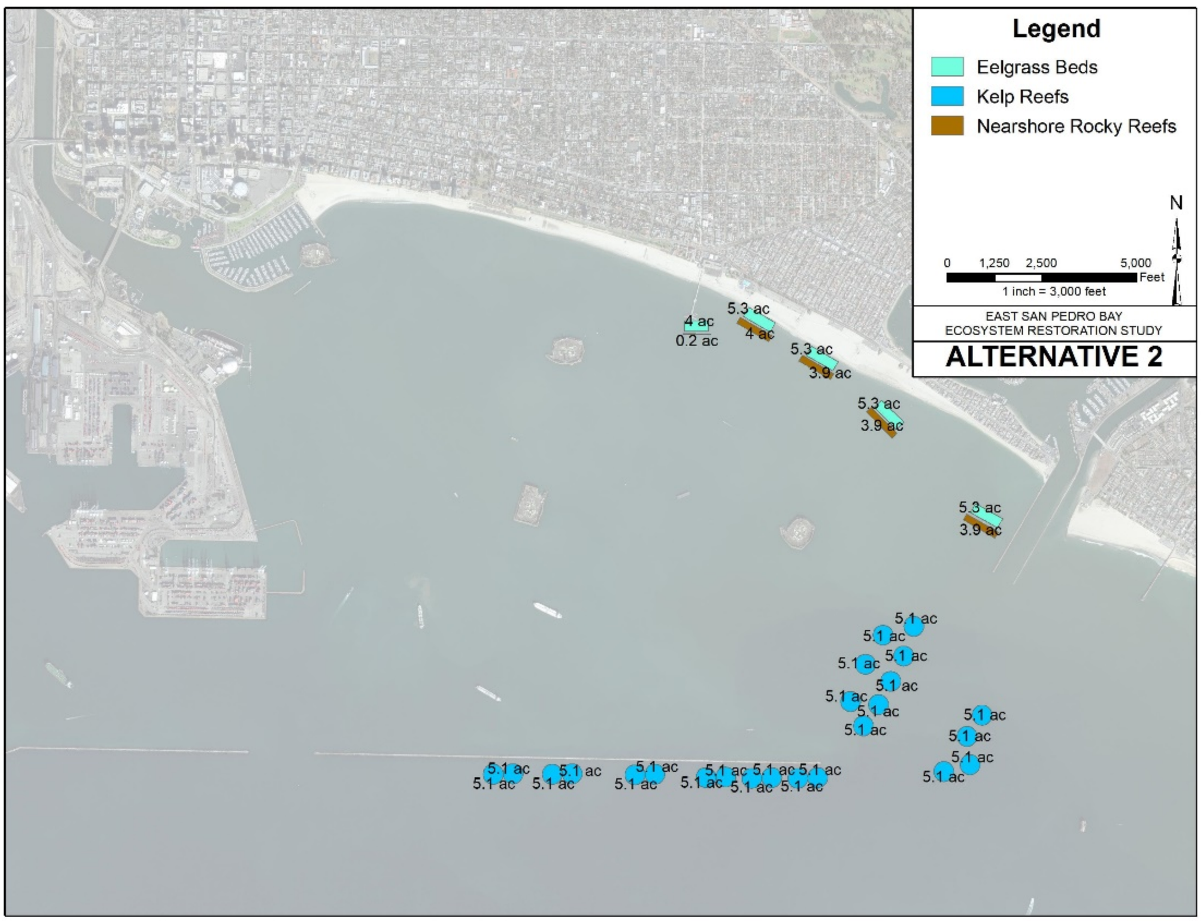


Figure 1-3 – Alternative 2

1.1.2 ALTERNATIVE 4A (TENTATIVELY SELECTED PLAN 4A) - REEF RESTORATION PLAN

Alternative 4A introduces a productive new habitat type with two 15 acre rocky reef patches placed along oil island (Island Chaffee) in the center of the open water zone. This placement augments existing rocky reef habitat at the oil island. Rocky reef provides high habitat value due to the ability to support of a wide variety of aquatic species, and have vertical as well as horizontal habitat benefits. Placing two rocky reef patches adjacent to each other promotes synergies between the patches, augmenting habitat value. Alternative 4A has increased habitat connectivity among and between zones, creating a benefit area that is more triangular and larger than Alternative 2. Alternative 4A also includes an additional nearshore rocky reef and eelgrass complex west of Belmont Pier.

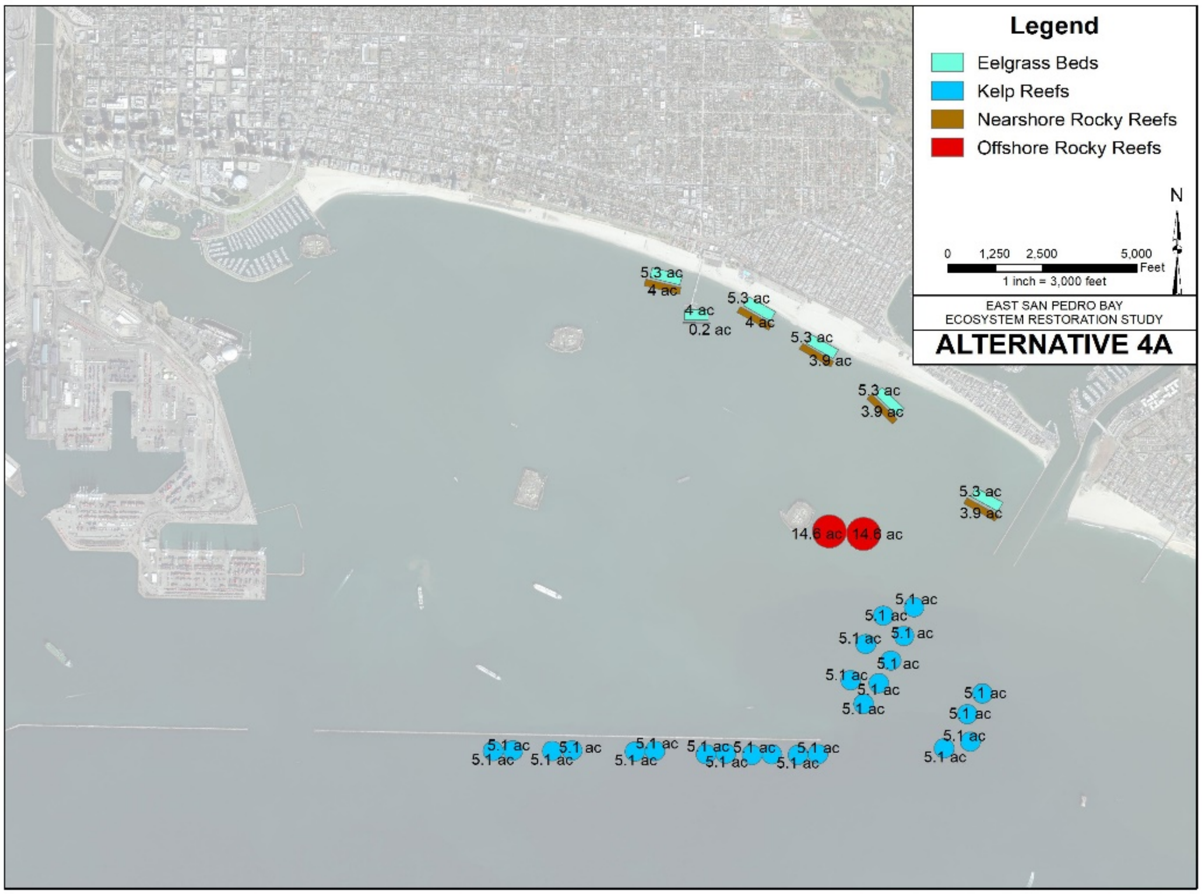


Figure 1-4 – Alternative 4A

1.1.3 ALTERNATIVE 8 (BEST BUY PLAN 8) - SCARCE HABITAT RESTORATION PLAN

Alternative 8 includes, sandy islands, coastal wetlands, and oyster beds, in addition to the features in Alternative 4A. This alternative places restoration features in all five zones within the bay, expanding the benefit area to include the entire project area. The proposed 24-acre sandy island provides much needed habitat for threatened and endangered shorebirds which are subject to disturbance from people and predators. Two tidal salt marsh wetlands are proposed, totaling 52 acres, providing transitional habitat to support aquatic species, amphibians (land and water), shorebirds, and terrestrial species.

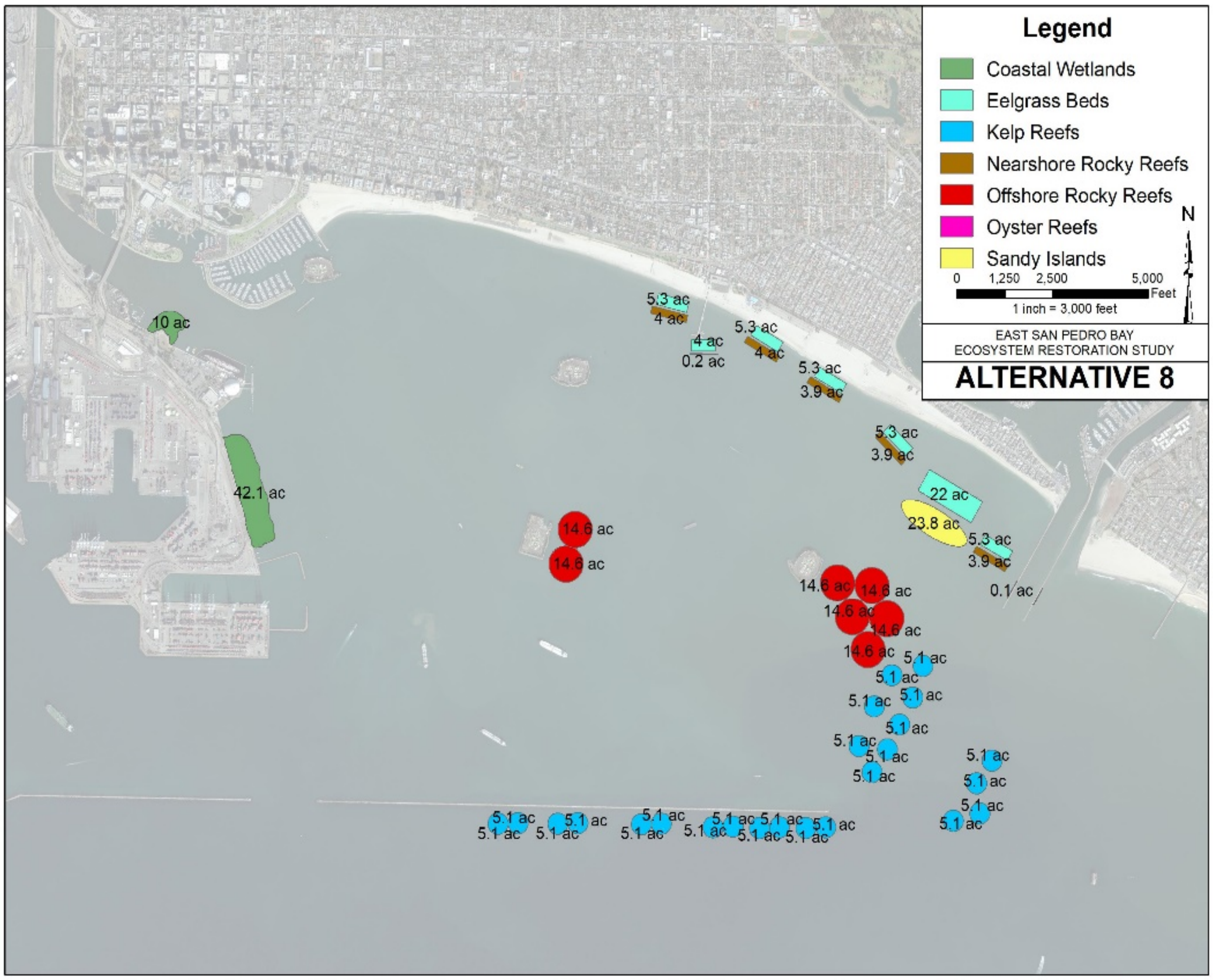


Figure 1-5 – Alternative 8

An Abbreviated Cost Risk Analysis (ACRA) was completed for each of the measures which comprise the three best-buy alternatives and a Total Project Cost Summary (TPCS) was developed for each of the three alternatives.

All cost products went through District Quality Control (DQC) review by the Los Angeles District (SPL) Cost Engineering Subject Matter Expert, as well as Agency Technical Review (ATR) by the Cost Engineering Center of Expertise (MCX) in Walla Walla District (NWW).

The Tentatively Selected Plan (TSP) has been determined to be plan 4A.

This cost engineering assessment is compliant with ER 1110-2-1302 - Civil Works Cost Engineering dated 30 June 2016.

2.0 SUMMARY

The following sections apply to the costs developed for each of the measures, which were eventually combined to identify cost effective and best buy plans through CEICA analysis and comprise the three alternatives carried forward, including the TSP.

2.1 UNIT COST BASIS

2.1.1 DIRECT COSTS

Costs for each measure were determined using a combination of parametric data, and development of labor, equipment and material costs utilizing cost book information where historical pricing was limited. Each measure was divided into separate major components and unit prices were developed based on the work necessary to construct each component. A single unit price (i.e. core stone) was used for similar components found in multiple measures. A detailed breakdown of the components in each measure and a summary of all unit costs used to develop the costs for each measure can be found in Attachment 2 – Detailed Measure Cost Data.

Unit costs developed using parametric data relied on data from past USACE projects within The Ports of Los Angeles and Long Beach, and within the Southern California area. These projects included the following:

1. San Pedro Breakwater Repairs (2016)
2. Los Angeles – Long Beach Harbor Breakwater Repair (2015)
3. Jetty Repairs for Naval Weapons Station Seal Beach (2015)
4. Upper Newport Bay Ecosystem Restoration (2005)
5. Port of Long Beach & Other Long Beach Projects (2009)
6. Port of Los Angeles and LA River Estuary Maintenance Dredging (2014)

Labor rates used to develop the estimate were provided from Davis-Bacon Wage Rates.

Equipment rates are based on the Department of the Army EP 1110-1-8 “Construction Equipment Ownership and Expense Schedule”, Volume 7, November 2016.

2.1.2 EQUIPMENT SELECTION

Equipment selection and sizing were developed using the cost estimator’s experience and technical input from other PDT members. The majority of the work involves placement of large armor stone, and core stone, which will utilize a barge mounted crane. This equipment is present in Southern California, and is regularly used to repair USACE coastal structures such as Jetties and Breakwaters. However, the quantity of equipment with sufficient boom reach and lift capacity for larger stone placement, as well as the amount of quarried rock available is limited.

2.1.3 SALES TAX

Los Angeles county sales tax is 9.5%

2.2 INDIRECT COSTS

1. Pre-construction, Engineering, and Design (PED) – 10%
2. Supervision and Administration during Construction (S&A) – 5%

Given the relatively high prices of the measures proposed in each Alternative, the cost of PED and S&A was lowered from typical values used. This is because most of the cost of the measures is in material price, and the design and contract administration efforts relative to the cost of the contract are lower than most Civil Works projects. Additionally, caps of $2.5M for PED and $1M for S&A per measure, to avoid overestimating indirect costs where there is a large discrepancy between the contract costs / material prices, and the relative indirect costs required to design and administer the proposed measures.

2.3 CONTRACTOR MARKUPS

Contractor markups were only applied to unit costs that were based on developed crews and cost book items. Sub-contractor markups were included on a limited number of items of work. Markups include: Job Office Overhead, Home Office Overhead, Profit, and Bond. Fully developed costs were largely used to verify the reasonableness of the parametric data.

All markups assume all work is being performed using the “Invitation for Bid” contract mechanism. For unit prices that utilized parametric data, the indirect costs were already built into those unit prices. Additional potential costs, if Best Value or Request for Proposal Contract is used are captured in the Abbreviated Cost Risk Analysis under the “Acquisition Strategy” risk element.

2.4 FEDERAL AND NON-FEDERAL PERCENT BREAKDOWN

The Federal Government is responsible for 65% of the total project cost, with the Non-Federal Sponsor responsible for the remaining 35% of the total project cost. Additionally, the Non-Federal sponsor is responsible for all Lands Easements, Right of Way, Relocations and Disposal (LERRD), the value of which may be credited towards the local sponsor contribution of project costs.

2.5 ABBREVIATED COST RISK ANALYSES

An Abbreviated Cost Risk Analyses was completed in accordance with ER 1110-2-1302 for each of the measures considered, including those that comprise the three alternatives. Common project risks for each measure are categorized and analyzed by Risk Element. Risk elements, show below, are assigned a risk level rating (0 through 5) based on the likelihood and potential impact determined by the Project Delivery Team. The Analyses, and collective risk ratings, provide a risk based contingency for each measure, which is then applied to the total project cost. Collective alternative contingencies ranged from 41 to 60%.

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Typical Risk Elements

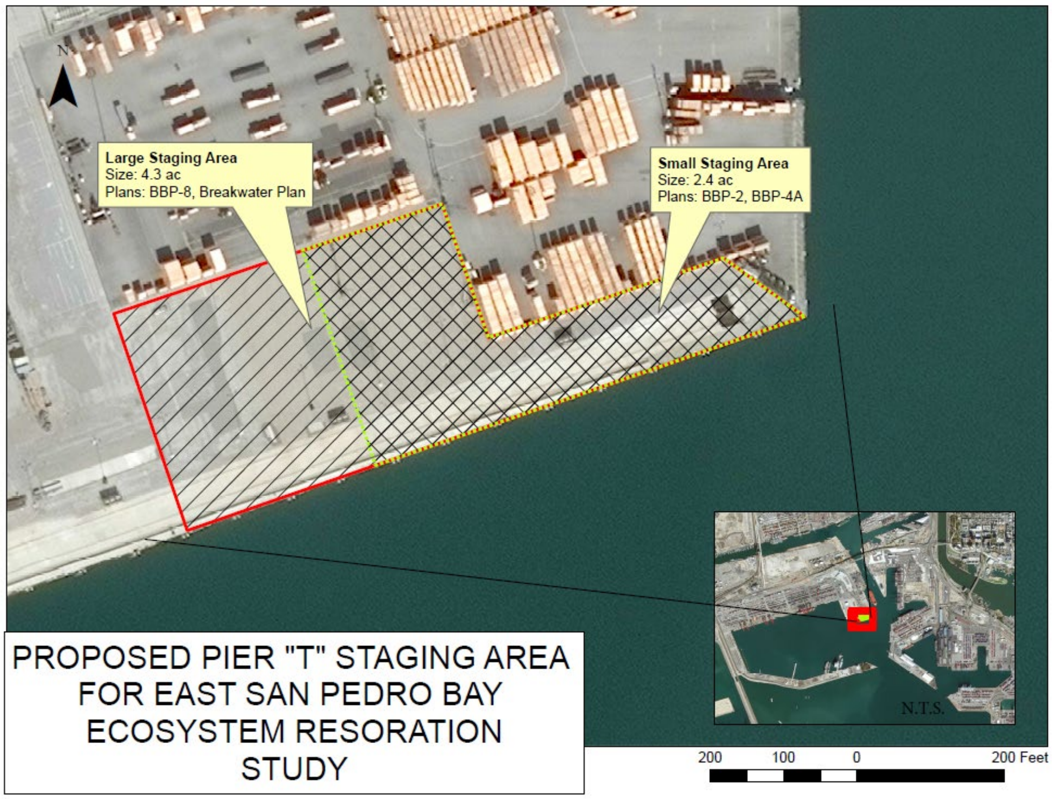
Risk Element	Typical Concerns	Max Potential Cost Growth
Project Management & Scope Growth	• Potential for scope growth, added features? • Project accomplishes intent? • Funding Difficulties? • Sufficent Staffing/Support?	75%
Acquisition Strategy	• Contracting plan firmly established? • 8a or small business likely? • Requirement for subcontracting? • Accelerated schedule or harsh weather schedule? • High-risk acquisition limits competition, design/build? • Limited bid competition anticipated? • Bid schedule developed to reduce quantity risks?	30%
Construction Elements	• Accelerated schedule or harsh weather schedule? • High risk or complex construction elements, site access, in-water? • Water care and diversion plan? • Unique construction methods? • Special mobilization? • Special equipment or subcontractors needed? • Potential for construction modification and claims?	25%
Specialty Construction or Fabrication	• Atypical construction elements, unusual material or equipment manufactured or installed? • Confidence in constructibility or methodology? • One of a kind and confidence in fabrication and installation? • Ability to reasonably transport? • Risk of specialty equipment functioning first time? Testing?	65%
Technical Design & Quantities	• Level of confidence based on design and assumptions? • Possibility for increased quantities due to loss, waste, or subsidence? • Appropriate methods applied to calculate quantities? • Sufficient investigations to develop quantities? • Quality control check applied?	30%
Cost Estimate Assumptions	• Reliability and number of key quotes? • Assumptions related to prime and subcontractor markups/assignments? • Assumptions regarding crew, productivity, overtime? • Site accessibility, transport delays, congestion? • Overuse of Cost Book, lump sum, allowances? • Lack confidence on critical cost items?	35%
External Project Risks	• Potential for severe adverse weather? • Political influences, lack of support, obstacles? • Unanticipated inflations in fuel, key materials? • Potential for market volatility impacting competition, pricing?	40%

The results of the risk analysis can be found in Attachment 3 – Abbreviated Cost Risk Analysis.

2.6 ASSUMPTIONS

2.6.1 SITE ACCESS

Site access is readily available and no special accommodations are required throughout the project area. Land access and mooring would be provided at Pier T. Marine Construction regularly occurs within the Ports of Los Angeles and Long Beach, including USACE projects for maintenance dredging and breakwater repairs. The existing breakwaters on site, provide protection from wave action under most swell directions and conditions for work within the Breakwater.



2.6.2 MATERIAL PRODUCTION

Rock material, which makes up a significant portion of contract costs, is assumed to come from Catalina Island's Pebble Beach Quarry, as it is the closest quarry and is able to provide aquatic delivery of the material without double handling. While inland sources, such as the Corona area would be suitable, the cost to truck and double handle the material for aquatic placement is prohibitive. For alternatives that require significant amounts of armor stone, advanced notice would be needed for the quarry to produce Armor Stone (10-15 Ton) in larger quantities. Armor stone is not a commercial product, and is largely used for USACE coastal structures, therefore production is largely based on the amount of USACE projects requiring stone, and advanced stockpiling of material is limited by storage area at the quarry. Typically only 2-5% of quarry production yields Armor stone due to the large size required. The availability and production of this stone can have a large effect on price and timeline for construction, depending on the amount of armor stone required for an alternative. For smaller sized core stone and quarry run, material is more readily available. A significant portion of the measures include placement of stone. Although the size of stone, elevations and configurations vary by measure, material price of stone contributes significantly to the overall cost of those measures. Therefore, using relevant parametric data for stone pricing was an important in determining a reasonable cost estimate. Additionally, the historical pricing was compared to quotes obtained from local quarries to ensure reasonableness.

2.6.3 MATERIAL REUSE

For measures involving removal of breakwater Armor and Core stone, it is assumed that this material would be reused for Nearshore Rocky Reef Placement, and the material cost for the quantity of stone that is able to be reused was omitted under those scenarios. These measures were not carried forward in the final array of alternatives.

2.6.4 CONSTRUCTION PERIOD

No environmental or construction windows prohibit work and any work within ESPB would remain mainly protected by the breakwaters present in the area. However any extensive modification work to the middle breakwater would likely need to be done during the summer, when ocean conditions are calmer. For alternatives involving a greater number of measures, it is likely that the work would need to be split into multiple Contract based on funding and material and equipment availability.

2.6.5 SCHEDULE OF WORK

Assume work schedule: 5 days per week, 10 hours per day, for all rockwork and habitat creation. For any potential dredging activities, work hours are limited to daylight hours when visual monitoring of marine mammals and sea turtles can be conducted.

2.6.6 CONSTRUCTION METHODOLOGY

Construction Equipment – For Armor and Core stone operations a barge, derrick crane, and support vessels would be required. For any fill operations a dredge plant, support vessels, earth moving equipment would be required. Depending on the quantity and location of fill, either a clamshell or cutterhead / pipeline dredge would be utilized.

Kelp Reef – Stone would be pushed off directly from a barge to achieve a roughly circular shape, at the required density, with and one layer of stone thickness. In this method, a derrick barge, held in place by anchor locations, is tethered to a flat-deck barge. The barge will be positioned directly over the proposed kelp reef location and the front loader or bulldozer will push off the material to achieve the required density of stone. Equipment used during construction would most likely consist of; one derrick barge, two tugboats, three flat-deck supply barges, and two front-end track loaders. No maintenance costs are expected for this measure.

Nearshore Rocky Reef - Rocky reef shoals would be placed in shallow waters, but wave conditions are not anticipated to hinder construction operations. Prior to construction, surveys for eelgrass and invasive alga would be conducted in the nearshore placement area. The placement of material would be conducted to avoid or minimize any direct or indirect impacts to existing eelgrass or other resources within the limits of the nearshore placement area. The construction of the nearshore rocky reefs will be accomplished by a barge and crane with appropriate support vessels. Fill material may be dumped from a barge using a front loader or bulldozer. Armor stones must be specially placed by a crane to obtain the specific armor layer thickness. The design for these submerged reefs involves constructing sufficient voids for provision of refuges for smaller juvenile and adult fish and invertebrates. A verification survey by full bottom coverage multibeam methods, will be required.

Based on experience with other rubble-mound structures, it is estimated that 0.5% of the total cost per year would be required to maintain the structure. Typically, maintenance activities would be conducted every 10 years or after a strong storm event that has displaced enough stones to justify the cost of mobilization.

Open Water Rocky Reef

The open water rocky reefs are individual modules that vary in height between 3 feet to 12 feet above the seabed and are grouped into a reef complex, and will be placed at lower elevations than the nearshore rocky reefs. Interlocking for this type of reef is not needed due the level of submergence. All stone can be placed in a random manner to achieve the required relief and depth. Construction of the offshore reefs require more complex placement techniques. For this measure, stone cannot be dumped from a barge and must be specially placed in order to obtain the required void spaces. A verification survey by full bottom coverage multibeam methods, will be required.

The deeply submerged open water reefs will not experience any maintenance cost due to the large armor stone size required for sufficient large void spaces and stability. Since the placement will be entirely submerged in at least 15 ft. of water, maintenance after a failure will be nearly impossible as limited visibility would hinder such a repair and impact existing habitats.

Eelgrass Beds - Eelgrass habitat would be established in the nearshore zone, co-located with the nearshore rocky reefs described above. Additional sediment would also be placed leeward of the rocky shoal to optimize ideal conditions and depth. For the eelgrass beds, up to 100,000 cubic yards of dredged sand material obtained from the Surfside/Sunset borrow area would be dumped on the leeward side of the nearshore rocky reefs with the use of a split-haul scow. Dredging equipment for eelgrass bed sand placement would most likely consist of 1 hydraulic or mechanical dredge, 1 tug and 2 scows. Donor eelgrass for transplanting would be derived from pre-approved eelgrass donor beds. Anchored, bare-root transplant units would be the principal transplant technique used, although other methods may be investigated. Planting would be conducted using divers working on a defined planting grid with temporary bounding lines to control planting areas. No maintenance costs are expected for this measure.

Sandy Island – Lifts of silt or sand would be dredged until the desired elevation is reached (fill material). A cover of design material (white sand) would be placed on top of the fill material. Clean sand would be excavated from the Surfside/Sunset borrow area, located approximately 3 nautical miles from the proposed project area. Slopes would consist of two layers of riveted rock with a portion of a constructed beach with a natural profile. Sandy island construction would require a dredge plant and additional earth moving equipment. Fill material would be placed in lifts with a scow or hopper dredge (if scow is used, then a mechanical dredge required) until unfeasible to bottom dump (~ 10 ft. depth). Then fill material would be pumped out to obtain required elevation. Clean sand is then pumped out to obtain the required elevation. The sandy beach would be built with a 10H:1V slope and would be distributed to achieve a more natural profile over time. A single scrapper and front-loader would be sufficient able to move the sand around between scow/hopper transits.

Yearly maintenance will be required to clean and groom the sand along with weeding and grubbing to limit the vegetative cover and invasive species. The sand cap is expected to be lost over time through natural processes and replaced with clean sediment would at least every 5 years to maintain the required elevation and beach shape. The revetted slope should be maintained on a 10 year cycle, or as needed to justify the cost of mobilization. It is estimated that 50% of the sand material will need to be added every 10 years. Maintenance of the armored slope will occur approximately every 10 years or when needed.

Coastal Wetland - The perimeter of the wetland would be a stone foundation of quarry run material with pre-cast concrete segments filled with ballast (rock). The interior would be sand or silt (fill material) covered with clean sand to reach required elevation. Most likely a cofferdam dam would be needed. Caisson perforations would be included to absorb wave energy. Wetlands construction would require a dredge plant and additional earth moving equipment. To construct the wetlands, the foundation would be placed by barge dump in random manner and leveled. Pre-cast concrete sections would be constructed off-site, floated into position then sunk by ballast stone. Fill material would be placed hydraulically until required elevation is obtained. Finally the wetland would be capped with clean sand and contoured to achieve required elevation and interior channeling with earth moving equipment. Earthwork equipment would involve 2 scrappers and 2 front loaders. Planting of natural wetland flora will take place soon after construction.

Maintenance would be required both for the tidal salt marsh interior and structural components. Maintenance of the hard structural components (caisson and foundation) will consist of repairing damages caused by large waves; such as replacing stone scoured out at the toe of the caisson or replacing individual caisson units that may have shifted during a storm event. Interior maintenance consists of monthly landscaping, cleaning and removal of unwanted species as well as replacement of the sediment lost from the system by tidal currents. For a conservative estimate, it is assumed that 25% of the sandy material will be lost and need to be replenished every 10 years to return the wetland to the design elevation.

Oyster Beds – If needed, bathymetry of the oyster bed areas would be raised by placing appropriate substrate stone. A base layer of shell-hash (typical material used for oyster bed establishment) would be required. Once the shell-hash is placed, active “seeding” of the bed with juvenile oysters would be conducted. Shell hash will be distributed within the elevation bounds along the placement areas shown using an excavator mounted on a barge. An oyster platform can also be utilized. These floating platforms are submerged to the required depth and attached to the seabed using an anchor and cable system. Seeding of juveniles will be required directly after construction of the substrate and no maintenance is expected to be performed on the oyster reefs after the adaptive management period.

Environmental Monitoring – Monitoring requirements for NEPA compliance, such as water quality, air, noise and vibration monitoring are included within the scope of each measure and have been accounted for in the cost estimate for each measure.

3.0 SYNOPSIS

In Summary, the Current Working Estimates (CWE) for Final Array Plans 2, 4, and 8, in 2018 price levels are presented in Attachment 4 – Alternative Total Project Cost Summary and are summarized in the table below. These cost include: construction cost, monitoring and adaptive management costs, planning engineering and design, supervision and administration, and contingency. Real Estate costs of ranging from $1.3-3.4M and Operation and maintenance costs are not provided in the costs below but are provided in Attachment 2 – Detailed Measure Cost Data.

Plan 2	**$ 82,482,000**
Plan 4A (TSP)	**$ 139,552,000**
Plan 8	**$ 557,240,000**

Table 3-1 Alternative Costs

Final Array of Alternatives:

Alternative 1 (No Action Plan)
Alternative 2 (Best Buy Plan 2)
Alternative 4A (Cost Effective Variation of Best Buy Plan 4)
Alternative 8 (Best Buy Plan 8)

Plans of Local Interest (screened out):

Alternative BW1 *(Breakwater Western Notching Plan)*
Alternative BW2 *(Breakwater Eastern Removal Plan)*

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Attachment 1 – Alternative Summary by Measure

Opportunity Zone 1. Nearshore				
NB	Add (5) Rocky Reef Shoals (East) + Eelgrass	INCLUDED IN ALTERNATIVE 1	INCLUDED IN ALTERNATIVE 2	INCLUDED IN ALTERNATIVE 3
N2	(1) Large Sandy Island			INCLUDED IN ALTERNATIVE 3
N3a	Small Oyster Reef (WJ)			INCLUDED IN ALTERNATIVE 3
N4	Small Oyster Reef (EJ)			INCLUDED IN ALTERNATIVE 3
N5b	Add (1) Rocky Reef Shoals (East) + Eelgrass		INCLUDED IN ALTERNATIVE 2	INCLUDED IN ALTERNATIVE 3
Opportunity Zone 2. Open Water				
OB	Kelp Reefs	INCLUDED IN ALTERNATIVE 1	INCLUDED IN ALTERNATIVE 2	INCLUDED IN ALTERNATIVE 3
O1b	(2) Rocky Reef Complex (Island A)		INCLUDED IN ALTERNATIVE 2	
O1e	(5) Rocky Reef Complex (Island B)			INCLUDED IN ALTERNATIVE 3
O2d	Kelp Reefs (Scale 4)	INCLUDED IN ALTERNATIVE 1	INCLUDED IN ALTERNATIVE 2	INCLUDED IN ALTERNATIVE 3
Opportunity Zone 3. LA River Mouth				
L1	Small Coastal Wetland			INCLUDED IN ALTERNATIVE 3
Opportunity Zone 4. Port				
P1c	Large Coastal Wetland			INCLUDED IN ALTERNATIVE 3
Opportunity Zone 5. Breakwater				
B2d	Kelp Reefs (Scale 4)	INCLUDED IN ALTERNATIVE 1	INCLUDED IN ALTERNATIVE 2	INCLUDED IN ALTERNATIVE 3

Attachment 2 – Detailed Measure Cost Data

		Construction Cost	Monitoring & Adaptive Management Costs	PED	S&A	Cont (%)	Contingency ($)	TOTAL PROJECT COST (Inc. monitoring, PED, S&A, Contingency)	O&M Total Project Costs (50 yrs)
Opportunity Zone 1: Nearshore				10%	5%				
NB	Add (5) Rocky Reef Shoals (East) + Eelgrass	$ 33,722,000	$ 1,047,978	$ 2,500,000	$ 1,000,000	45%	$ 16,136,100	$ 54,406,078	$ 10,369,500
N2	(1) Large Sandy Island	$ 65,068,000	$ 773,068	$ 2,500,000	$ 1,000,000	50%	$ 34,703,000	$ 104,044,068	$ 124,912,500
N4	Small Oyster Reef (EJ)	$ 326,000	$ 184,503	$ 32,600	$ 16,300	100%	$ 574,900	$ 1,134,303	$ -
N5b	Add (1) Rocky Reef Shoals (East) + Eelgrass	$ 7,081,000	$ 306,275	$ 708,100	$ 354,050	45%	$ 3,555,068	$ 12,004,493	$ 2,186,000
Opportunity Zone 2: Open Water									
OB	Kelp Reefs	$ 2,275,000	$ 184,503	$ 227,500	$ 113,750	40%	$ 1,126,500	$ 3,927,253	$ -
O1b	(2) Rocky Reef Complex (Island A)	$ 27,390,000	$ 184,503	$ 2,500,000	$ 1,000,000	45%	$ 13,990,500	$ 45,065,003	$ -
O1e	(5) Rocky Reef Complex (Island B)	$ 96,365,000	$ 184,503	$ 2,500,000	$ 1,000,000	45%	$ 45,029,250	$ 145,078,753	$ -
O2d	Kelp Reefs (Scale 4)	$ 3,025,000	$ 184,503	$ 302,500	$ 151,250	40%	$ 1,471,500	$ 5,134,753	$ -
Opportunity Zone 3: LA River Mouth									
L1	Small Coastal Wetland	$ 11,371,000	$ 64,576	$ 1,137,100	$ 568,550	90%	$ 11,831,985	$ 24,973,211	$ 31,188,500
Opportunity Zone 4: Port									
P1c	Large Coastal Wetland	$ 92,379,000	$ 64,576	$ 3,750,000	$ 2,500,000	90%	$ 88,829,100	$ 187,522,676	$ 123,974,750
Opportunity Zone 5: Breakwater									
B2d	Kelp Reefs (Scale 4)	$ 11,810,000	$ -	$ 1,181,000	$ 590,500	40%	$ 5,432,600	$ 19,014,100	$ -
	Alternative 1 - BBP2	$ 50,832,000	$ 1,416,984	$ 4,211,000	$ 1,855,500	41%	$ 24,166,700	**$ 82,482,184**	**$ 10,369,500**
	Alternative 2 - BBP4A	$ 85,303,000	$ 1,907,762	$ 7,419,100	$ 3,209,550	43%	$ 41,712,268	**$ 139,551,680**	**$ 12,555,500**
	Alternative 3 - BBP8	$ 323,422,000	$ 2,994,485	$ 14,838,800	$ 7,294,400	60%	$ 208,690,003	**$ 557,239,688**	**$ 292,631,250**

Attachment 3 – Abbreviated Cost Risk Analysis

Abbreviated Risk Analysis

Risk Evaluation

	WBS	**Potential Risk Areas**	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks
	01 LANDS AND DAMAGES	Real Estate							
	10 BREAKWATERS AND SEAWALLS	Rock Reef Shoals	2	2	2	1	3	2	3
	10 BREAKWATERS AND SEAWALLS	Emergent Islands	2	2	2	2	3	2	3
	06 FISH AND WILDLIFE FACILITIES	Oyster Reefs	4	3	2	3	4	3	3
	10 BREAKWATERS AND SEAWALLS	Kelp Forest / Scattered Rock	2	2	2	1	3	2	2
	10 BREAKWATERS AND SEAWALLS	Rock Reef Complex	2	2	2	2	3	2	2
	06 FISH AND WILDLIFE FACILITIES	Wetland	3	3	3	4	3	3	3
	12 NAVIGATION, PORTS AND HARBORS	0	2	2	2	1	2	2	2
1	10 BREAKWATERS AND SEAWALLS	Add rock to Breakwater	2	2	2	2	2	2	1
	All Other	Remaining Construction Items	2	2	0	1	0	2	2
	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	3	1	1	1	0	2	2
2	31 CONSTRUCTION MANAGEMENT	Construction Management	1	2	1	1	0	2	2

Terminology

Term	**Definition**
Risk Analysis ER 1110-2-1302, 15 Sep 08, page 19	a. Cost risk analysis is the process of identifying and measuring the cost impact of project uncertainties on the estimated TPC. It shall be accomplished as a joint analysis between the cost engineer and the designers or appropriate PDT members that have specific knowledge and expertise on all possible project risks. (1) PDTs are required to prepare a formal cost risk analysis for all decision documents requiring Congressional authorization for projects exceeding $40 million (TPC)(see appendix B). Where cost risk analysis is required, it is anticipated that the cost risk analysis will be performed once the recommended plan is identified prior to the alternative formulation briefing milestone.
Typical Risk Elements	Factors that can introduce risk to items listed in the Selected Work Breakdown Structure Items. The ones listed are the most typical for Civil Works Projects. These Risk Elements should be reviewed and established for each project.
Potential Risk Areas	These are items from the estimate's Work Breakdown Structure, either broad or detailed, that are believed to contain some risk. The cost estimator defines the Work Breakdown Structure. It is recommended that the PDT select the appropriate Selected Work Breakdown Structure Items and considers all Features. Focus should be placed on the items with the significant risks. Appropriately identifying the Selected Work Breakdown Structure Items will lead to a more confident development of contingency.

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Attachment 4 – Alternatives Total Project Cost Summary

		Alternative 1 TPC	Alternative 2 TPC	Alternative 3 TPC	Alternative 1 O&M	Alternative 2 O&M	Alternative 3 O&M
Opportunity Zone 1: Nearshore							
NB	Add (5) Rocky Reef Shoals (East) + Eelgrass	$ 54,406,078	$ 54,406,078	$ 54,406,078	$ 10,369,500	$ 10,369,500	$ 10,369,500
N2	(1) Large Sandy Island			$ 104,044,068			$ 124,912,500
N4	Small Oyster Reef (EJ)			$ 1,134,303			$ -
N5b	Add (1) Rocky Reef Shoals (East) + Eelgrass		$ 12,004,493	$ 12,004,493		$ 2,186,000	$ 2,186,000
Opportunity Zone 2: Open Water							
OB	Kelp Reefs	$ 3,927,253	$ 3,927,253	$ 3,927,253	$ -	$ -	$ -
O1b	(2) Rocky Reef Complex (Island A)		$ 45,065,003			$ -	
O1e	(5) Rocky Reef Complex (Island B)			$ 145,078,753			$ -
O2d	Kelp Reefs (Scale 4)	$ 5,134,753	$ 5,134,753	$ 5,134,753	$ -	$ -	$ -
Opportunity Zone 3: LA River Mouth							
L1	Small Coastal Wetland			$ 24,973,211			$ 31,188,500
Opportunity Zone 4: Port							
P1c	Large Coastal Wetland			$ 187,522,676			$ 123,974,750
Opportunity Zone 5: Breakwater							
B2d	Kelp Reefs (Scale 4)	$ 19,014,100	$ 19,014,100	$ 19,014,100	$ -	$ -	$ -
TOTAL PROJECT COST		$ 82,482,000	$ 139,552,000	$ 557,240,000	$ 10,369,500	$ 12,555,500	$ 292,631,250
Real Estate Costs		$ 1,105,000	$ 1,356,000	$ 3,441,000			
Duration (MO)		30	37	53			