Appendix F – Cost Engineering

Aquatic Ecosystem Restoration for Gulf Intracoastal Waterway (GIWW) – Beneficial Use of Dredged Material, Texas

Section 204

Draft Integrated Detailed Project Report and Environmental Assessment

November 2022

US Army Corps of Engineers
Galveston District

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List of Acronyms

ARA – Abbreviated Risk Analysis

CEDEP – Cost Engineering Dredge Estimating Program

MCACES – Micro-Computer Aided Cost Estimating System

PDT – Project Delivery Team

TPCS – Total Project Cost Summary

TSP – Tentatively Selected Plan

1 Cost Engineering

1.1 Cost Description

The cost estimate was prepared using the latest Unit Price Books and labor rates for fiscal year 2023 (October 2022) and in accordance with Engineering Regulation (ER) 1110-2-1302. This study focuses on beneficial use of dredged material for a saline marsh creation at Goose Island State Park. Five (5) alternative placement arrangements were considered:

- Alternative 3A: Saline Marsh in Existing Cells.
- Alternative 3B: Saline Marsh in Existing Cells and Living Shoreline.
- Alternative 3C: Saline Marsh and High Emergent Marsh in Existing Cells, Addition of New Low Emergent Marsh Cells.
- Alternative 3D: Saline Marsh in Existing Cells, Addition of New Low and High Emergent Marsh Cells.
- Alternative 3E: Saline Marsh in Existing Cells, Addition of New Low and High Emergent Marsh Cells, and Living Shoreline. Dropped from further consideration as it damages existing seagrass areas.

Alternative 3D was selected as the TSP. *Table 1* contains the costs of each alternative including the base plan/Federal Standard. Base plan cost varies per alternative, because base plan dredge quantities match dredge quantities needed per alternative. Each alternative requires a different quantity of dredged material.

The PDT developed, quality controlled, and verified quantities. The estimate was organized in accordance with the work breakdown structure using the following codes of account.

ACCOUNT CODE 01 - LANDS AND DAMAGES: The Galveston District Real Estate Division developed costs and contingency for Lands and Damages.

ACCOUNT CODE 06 – FISH AND WILDLIFE FACILITIES: Hydraulics & Hydrology Branch and Environmental developed quantities for Fish and Wildlife Facilities. The cost was based on similar work done by the Galveston District. This account consists of spartina planting and work related to the new low and high emergent marsh cells and a containment berm and includes the cost for all labor, equipment, and material.

ACCOUNT CODE 12 – NAVIGATION PORTS AND HARBORS: Hydraulics & Hydrology Branch developed quantities for Navigation Ports and Harbors. It was assumed a 24" pipeline dredge would dredge material from Gulf Intercoastal Waterway and place it into the marsh using traditional dredging methods for the area. The dredging cost was developed using CEDEP and based on standard operating practices for the Galveston District.

ACCOUNT CODE 30 – PLANNING, ENGINEERING, AND DESIGN: The cost for this account code was developed using a percentage of the construction work and in coordination with Project Manager and PDT

ACCOUNT CODE 31 - CONSTRUCTION MANAGEMENT: The cost for this account code was developed using a percentage of the construction work and in coordination with Project Manager and PDT.

Table 1: Alternatives cost summary includes total base plan cost, total alternative cost, and incremental cost.

Alternatives		*Alt 3A*		*Alt 3B*		*Alt 3C*		*Alt 3D*		*Alt 3E*
	Base Plan	Alternative	Base Plan	Alternative	Base Plan	Alternative	Base Plan	Alternative	Base Plan	Alternative
01 Real Estate		$1,915,675.92		$4,383,264.94		$1,509,220.12		$1,508,140.16		$2,543,532.46
06 Fish and Wildlife Facilities		$929,591.46		$1,123,719.66		$2,311,728.30		$2,311,728.30		$2,431,357.74
12 Navigation, ports & harbors	$2,755,714.50	$4,601,958.48	$2,927,799.00	$4,800,219.48	$3,167,980.20	$5,218,224.48	$3,168,074.70	$5,258,166.48	$3,340,916.46	$5,547,599.82
30 Planning, Eng & design	$275,562.00	$731,934.00	$292,824.00	$1,001,448.00	$316,764.00	$893,844.00	$316,764.00	$897,750.00	$334,152.00	$1,035,342.00
31 Construction Mngt	$220,500.00	$585,522.00	$234,234.00	$801,234.00	$253,386.00	$715,050.00	$253,386.00	$718,200.00	$267,246.00	$828,198.00
Total Project Cost	$3,251,800.00	$8,764,700.00	$3,454,900.00	$12,109,900.00	$3,738,200.00	$10,648,100.00	$3,738,300.00	$10,694,000.00	$3,942,400.00	$12,386,100.00
Incremental Project Cost		$5,512,900.00		$8,655,000.00		$6,909,900.00		$6,955,700.00		$8,443,700.00

Cost does not include escalation/inflation.

1.2 Construction Schedule

The construction schedule was estimated given CEDEP values for dredging time as well as prior projects of similar scope with regards to marsh and containment berm work. The resulting calendars (*Figure 1 and Figure 2*) show the resulting project (by contract) schedule and the construction schedule. Alternative 3D would have an estimated construction duration of 13 months. The duration includes all work related to alternative 3D.

Alternative	Description	Duration (month)	Design Midpoint	Start Date	Mid-Point	End Date
3D	Dredging/Containment Dike	11	Apr-24 2024Q3	1-Oct-24	**17-Mar-25** 2025Q2	31-Aug-25

Figure 1: Alternative Contract Schedule

ALT	Activity	DURATION (MONTHS)	FY 2025 YEAR 1											FY 2026 YEAR 2										
			OCT 1	NOV 2	DEC 3	JAN 4	FEB 5	MAR 6	APR 7	MAY 8	JUN 9	JUL 10	AUG 11	SEP 12	OCT 1	NOV 2	DEC 3	JAN 4	FEB 5	MAR 6	APR 7	MAY 8	JUN 9	JUL 10	AUG 11	SEP 12
3D	Dredging/Containment Dike	11.0																						

Figure 2: Alternative Construction Schedule.

1.3 Total Project Cost Summary

A Total Project Cost Summary was prepared for the TSP tentatively selected plan (Figure 3). The summary consists of estimated cost, project first cost and total project cost and includes contingency and escalation/inflation for the project. The total project cost (Fully Funded) for alternative 3D is $11,322,000. Subtracting the cost of the Federal Standard (Base Plan - $3,987,000), which will be funded by Operations and Maintenance funds, the final bottom line total for a fully funded project is **$7,336,000**.

Table 2: Total Project Cost Summary

****** TOTAL PROJECT COST SUMMARY ******

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PROJECT: **Beneficial Use of Dredged Material (CAP Sec 204)**
PROJECT N **455266**
LOCATION: **Gulf Intracoastal Waterway, Texas**

DISTRICT: **SWG - Galveston District** PREPARED: **11/1/2022**

POC: **CHIEF, COST ENGINEERING, Martin B. Regner, P.E.**

This Estimate reflects the scope and schedule in report; Draft Report

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2024									
						Effective Price Level Date: 1-Oct- 23									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 1-Oct-22 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
06	FISH & WILDLIFE FACILITIES	$1,835	$477	26%	$2,312	2.9%	$1,887	$491	$2,378		$2,378	3.9%	$1,962	$510	$2,472
12	NAVIGATION PORTS & HARBORS	$1,659	$431	26%	$2,090	2.9%	$1,706	$444	$2,150		$2,150	3.9%	$1,774	$461	$2,235
	CONSTRUCTION ESTIMATE TOTALS:	$3,494	$908		$4,402	2.9%	$3,593	$934	$4,528		$4,528	3.9%	$3,735	$971	$4,706
01	LANDS AND DAMAGES	$1,117	$391	35%	$1,508	2.9%	$1,149	$402	$1,551		$1,551	0.7%	$1,157	$405	$1,561
30	PLANNING, ENGINEERING & DESIGN	$521	$135	26%	$656	3.2%	$538	$140	$678		$678	2.5%	$551	$143	$695
31	CONSTRUCTION MANAGEMENT	$279	$73	26%	$352	2.8%	$287	$75	$361		$361	3.3%	$296	$77	$373
	PROJECT COST TOTALS:	$5,411	$1,507	28%	$6,918		$5,567	$1,551	$7,118		**$7,118**	3.1%	$5,739	$1,596	$7,336

ESTIMATED TOTAL PROJECT COST: $7,336

_____ CHIEF, COST ENGINEERING, Martin B. Regner, P.E.

_____ PROJECT MANAGER, Reuben Trevino

_____ CHIEF, REAL ESTATE, Timothy Nelson

_____ CHIEF, PLANNING, Andrea Cantanzaro

_____ CHIEF, ENGINEERING,Willie J. Honza, P.E.

_____ CHIEF, OPERATIONS, Chris Frabotta

_____ CHIEF, CONSTRUCTION, Don Carelock, P.E.

_____ CHIEF, CONTRACTING, Shamekia Chapman

_____ CHIEF, PM-PB, Tonya Lippe

_____ CHIEF, DPM, Byron Williams, PMP

Filename: CAP Example TPCS 30 Sep 2022.xlsx
TPCS

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Beneficial Use of Dredged Material (CAP Sec 204)
LOCATION: Gulf Intracoastal Waterway, Texas
This Estimate reflects the scope and schedule in report; Draft Report

DISTRICT: SWG - Galveston District
POC: CHIEF, COST ENGINEERING, Martin B. Regner, P.E.

PREPARED: 11/1/2022

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 1-Nov-22 Estimate Price Level: 1-Oct-22				Program Year (Budget EC): 2024 Effective Price Level Date: 1 -Oct-23								
				RISK BASED										
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	ESC (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
	Alternative 3D													
06	FISH & WILDLIFE FACILITIES	$1,835	$477	26.0%	$2,312	2.9%	$1,887	$491	$2,378	2025Q3	3.9%	$1,962	$510	$2,472
12	NAVIGATION PORTS & HARBORS	$4,173	$1,085	26.0%	$5,258	2.9%	$4,292	$1,116	$5,408	2025Q3	3.9%	$4,462	$1,160	$5,622
	CONSTRUCTION ESTIMATE TOTALS:	$6,008	$1,562	26.0%	$7,570		$6,180	$1,607	$7,786			$6,423	$1,670	$8,094
01	LANDS AND DAMAGES	$1,117	$391	35.0%	$1,508	2.9%	$1,149	$402	$1,551	2024Q2	0.7%	$1,157	$405	$1,561
30	PLANNING, ENGINEERING & DESIGN													
0.8%	Project Management	$48	$12	26.0%	$60	2.8%	$49	$13	$62	2024Q3	1.1%	$50	$13	$63
0.7%	Planning & Environmental Compliance	$42	$11	26.0%	$53	2.8%	$43	$11	$54	2024Q3	1.1%	$44	$11	$55
2.0%	Engineering & Design	$120	$31	26.0%	$151	2.8%	$123	$32	$155	2024Q3	1.1%	$125	$32	$157
0.8%	Reviews, ATRs, IEPRs, VE	$48	$12	26.0%	$60	2.8%	$49	$13	$62	2024Q3	1.1%	$50	$13	$63
0.5%	Life Cycle Updates (cost, schedule, risks)	$30	$8	26.0%	$38	2.8%	$31	$8	$39	2024Q3	1.1%	$31	$8	$39
0.5%	Contracting & Reprographics	$30	$8	26.0%	$38	2.8%	$31	$8	$39	2025Q3	3.3%	$32	$8	$40
1.0%	Engineering During Construction	$60	$16	26.0%	$76	2.8%	$62	$16	$78	2025Q3	3.3%	$64	$17	$80
0.5%	Planning During Construction	$30	$8	26.0%	$38	2.8%	$31	$8	$39	2024Q3	1.1%	$31	$8	$39
	Adaptive Management & Monitoring	$334	$87	26.0%	$421	2.8%	$344	$89	$433	2025Q3	3.3%	$355	$92	$448
0.5%	Project Operations	$30	$8	26.0%	$38	2.8%	$31	$8	$39	2025Q3	3.3%	$32	$8	$40
7.3%														
31	CONSTRUCTION MANAGEMENT													
6.0%	Construction Management	$360	$94	26.0%	$454	2.8%	$370	$96	$466	2025Q3	3.3%	$382	$99	$482
1.0%	Project Operation:	$60	$16	26.0%	$76	2.8%	$62	$16	$78	2025Q3	3.3%	$64	$17	$80
1.0%	Project Management	$60	$16	26.0%	$76	2.8%	$62	$16	$78	2025Q3	3.3%	$64	$17	$80
	CONTRACT COST TOTALS:	$8,377	$2,279		$10,656		$8,617	$2,344	**$10,960**			$8,903	$2,419	**$11,322**

Filename: CAP Example TPCS 30 Sep 2022.xlsx
TPCS

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Beneficial Use of Dredged Material (CAP Sec 204)
LOCATION: Gulf Intracoastal Waterway, Texas
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POC: CHIEF, COST ENGINEERING, Martin B. Regner, P.E.

PREPARED: 11/1/2022

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 1-Nov-22 Estimate Price Level: 1-Oct-22				Program Year (Budget EC): 2024 Effective Price Level Date: 1 -Oct-23								
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	Base Plan													
12	NAVIGATION PORTS & HARBORS	-$2,514	-$654	26.0%	-$3,168	2.9%	-$2,586	-$672	-$3,259	2025Q3	3.9%	-$2,688	-$699	-$3,387
	CONSTRUCTION ESTIMATE TOTALS:	-$2,514	-$654		-$3,168		-$2,586	-$672	-$3,259			-$2,688	-$699	-$3,387
30	PLANNING, ENGINEERING & DESIGN													
0.8%	Project Management	-$20	-$5	26.0%	-$25	2.8%	-$21	-$5	-$26	2024Q3	1.1%	-$21	-$5	-$26
0.7%	Planning & Environmental Compliance	-$18	-$5	26.0%	-$23	2.8%	-$19	-$5	-$23	2024Q3	1.1%	-$19	-$5	-$24
2.0%	Engineering & Design	-$50	-$13	26.0%	-$63	2.8%	-$51	-$13	-$65	2024Q3	1.1%	-$52	-$14	-$65
0.8%	Reviews, ATRs, IEPRs, VE	-$20	-$5	26.0%	-$25	2.8%	-$21	-$5	-$26	2024Q3	1.1%	-$21	-$5	-$26
0.5%	Life Cycle Updates (cost, schedule, risks)	-$13	-$3	26.0%	-$16	2.8%	-$13	-$3	-$17	2024Q3	1.1%	-$14	-$4	-$17
0.4%	Contracting & Reprographics	-$10	-$3	26.0%	-$13	2.8%	-$10	-$3	-$13	2025Q3	3.3%	-$11	-$3	-$13
1.0%	Engineering During Construction	-$25	-$7	26.0%	-$32	2.8%	-$26	-$7	-$32	2025Q3	3.3%	-$27	-$7	-$33
0.3%	Planning During Construction	-$8	-$2	26.0%	-$10	2.8%	-$8	-$2	-$10	2024Q3	1.1%	-$8	-$2	-$10
3.0%	Adaptive Management & Monitoring	-$75	-$20	26.0%	-$95		-$75	-$20	-$95	2025Q3	3.3%	-$77	-$20	-$98
0.5%	Project Operations	-$13	-$3	26.0%	-$16	2.8%	-$13	-$3	-$16	2025Q3	3.3%	-$13	-$3	-$17
31	CONSTRUCTION MANAGEMENT													
6.0%	Construction Management	-$151	-$39	26.0%	-$190	2.8%	-$155	-$40	-$196	2025Q3	3.3%	-$160	-$42	-$202
1.0%	Project Operation:	-$25	-$7	26.0%	-$32	2.8%	-$26	-$7	-$32	2025Q3	3.3%	-$27	-$7	-$33
1.0%	Project Management	-$25	-$7	26.0%	-$32	2.8%	-$26	-$7	-$32	2025Q3	3.3%	-$27	-$7	-$33
	CONTRACT COST TOTALS:	-$2,967	-$771		-$3,738		-$3,049	-$793	**-$3,842**			-$3,164	-$823	**-$3,987**

Filename: CAP Example TPCS 30 Sep 2022.xlsx
TPCS

1.4 Abbreviated Risk Analysis

An ARA was developed with the participation of the PDT. The results were used to develop the project contingences. The ARA resulted in a 26% contingency. This contingency is applied to all costs except Real Estate. Costs include a Base Plan/Federal Standard alternative to obtain the incremental costs.

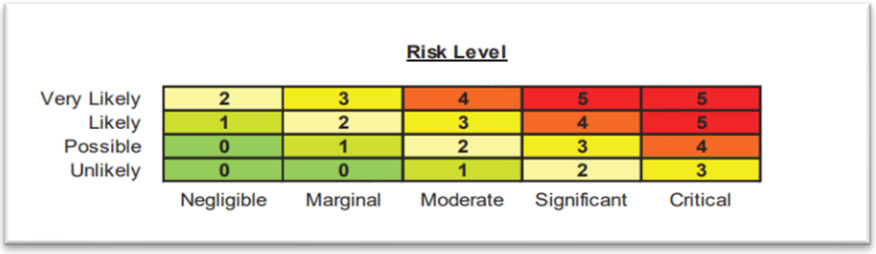

Figure 3: Risk Level

Meeting Date: 12-Sep-22

PDT Members

Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	Reuben Trevino
Planner:	Hana Schlang
Real Estate:	Britney Nealon/Micaela
Technical Lead:	Brenda Hayden
H&H	Frederick Fenner
Cost Engineering:	Stephanie Nieves-Perez
Environmental:	Raven Blakeway
Archeologist	John Campbell
Participant	Martin Regner

Figure 4: ARA Attendance

Table 3: Abbreviated Risk Analysis

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**40%**
PS-1	Marsh creation	* Potential for scope growth, added features?	No concerns anticipated. There is an adjacent private channel that will be (to be confirmed by HH) modeled and surveyed during PED – GOV due diligence to confirm no impact. However, no impact to project or channel anticipated.	Negligible	Unlikely	0
PS-2	Dredging	* Potential for scope, growth, added features? Funding difficulties?	No concerns anticipated.	Negligible	Unlikely	0
Acquisition Strategy				**Maximum Project Growth**		**30%**
AS-1	Marsh creation	* 8a or small business likely?	Dredge assumed to be large business. Historically, we have seen large business dredges subcontract placement area (marsh) work to small businesses, which results in a markup on a markup. Current marsh estimate is based on a large business. It is possible to see a large business subcontract this work, resulting in a markup on markup with marginal cost increase.	Marginal	Possible	1
AS-2	Dredging	* Contracting plan firmly established?	Dredging work will be by a large business, i.e. it will be combined with our maintenance program/project. Dredging rates should be historically reasonable. There is a risk that we create a standalone contract for this work. It is possible it could go small business with marginal cost increases. Assumed conventional contracting practices of IFB.	Marginal	Possible	1
Construction Elements				**Maximum Project Growth**		**15%**
CON-1	Marsh creation	• subcontractors needed? Material Settlement?	Need soil borings to cross-check settlement of riprap. Riprap (armoring) is a minor feature. Results of borings (during PED) could possibly require more rirap, creating a marginal cost increase. Marsh work may be perform by a subcontractor.	Marginal	Possible	1

CE-2	Dredging	• construction methods? Placement?	Assumes placing material in an existing, confined area. While alternatives include creating a new containment berm (mechanically placed) and armoring it, there is no concern with placing material.	Negligible	Unlikely	0
Technical Design & Quantities					**Maximum Project Growth**	**20%**
T-1	Marsh creation	Possibility for increased quantities due to loss, waste,subsidence, other? Sufficient investigations to develop quantities?	No new bathymetry and topography. Survey data used based on NOAA charts and Ducks Unlimited data. Ducks Unlimited data based on survey/quantity. HH analysis of NOAA data vs. Ducks data shows they align. However, new bathymetry would improve quantity confidence. There is a possible risk for quantity overruns. Additional investigations will be conducted during PED	Marginal	Possible	1
T-2	Dredging	Possibility for increased quantities due to loss, waste, subsidence,other? Sufficient investigations to develop quantities?	Dredge quantity subject to change. For example, OM could dredge GIWW before this is built, reducing the available material for use. Or a storm could hit and create shoaling with extra material. There is a possible risk for quantity overruns. Additional investigations will be conducted during PED.	Moderate	Possible	2
Cost Estimate Assumptions					**Maximum Project Growth**	**25%**
EST-1	Marsh creation	• Site accessibility, transport delays, congestion?	Current assumption is that access will be by boat.	Negligible	Possible	0
EST-2	Dredging	Assumptions regarding crew, productivity, overtime? *fuel fluctuations can impact dredging costs	Cost estimate was consistent with level of design performed. Use of historical data & parametric estimating is acceptable for early study milestones, but costs could increase with later refinement. However, use of CEDEP for dredging helps to reduce impact of under estimating costs. Fuel fluctuation was taken into consideration.	Negligible	Possible	0
External Project Risks					**Maximum Project Growth**	**20%**
EX-1	Marsh creation	• Funding Constraints • Potential for severe adverse weather?	There is potential for weatehr damages and delays, e.g. tropical depressions or hurricanes, should project construction occur during hurricane seaons, which is anticipated. There is more certainty that the district will get the funding.	Significant	Possible	3
EX-2	Dredging	• Funding Constraints • Potential for severe adverse weather?	There is potential for weatehr damages and delays, e.g. tropical depressions or hurricanes, should project construction occur during hurricane seaons, which is anticipated. It is uncertain on when and if funding for dreding will be appropriated.	Significant	Possible	3

Estimated by USACE SWG ECE-P
Designed by USACE SWG EC
Prepared by Stephanie Nieves-Perez
Preparation Date 11/1/2022
Effective Date of Pricing 10/1/2022
Estimated Construction Time Days

Figure 5: MCACES Report

Description	Quantity	UOM	DirectCost	ContractCost	ProjectCost
Project Cost Summary Report			8,851,253	9,639,339	12,246,110
Base Plan	1.00	JOB	2,514,345	2,514,345	3,168,075
Alt 3D	1.00	JOB	2,514,345	2,514,345	3,168,075
12 Navigation, Ports & Harbors	1.00	JOB	2,514,345	2,514,345	3,168,075
Alternatives	1.00	JOB	6,336,908	7,124,994	9,078,036
Alt 3D	1.00	JOB	6,336,908	7,124,994	9,078,036
01 Land and Damages	1.00	JOB	1,117,141	1,117,141	1,508,140
06 Fish and Wildlife Facilities	1.00	JOB	1,226,969	1,834,705	2,311,729
12 Navigation, Ports & Harbors	1.00	JOB	3,992,798	4,173,148	5,258,167