2023 DRAFT COASTAL MASTER PLAN

PROJECT COSTING TOOL VALIDATION STUDY

SUPPLEMENTAL MATERIAL F7.6

REPORT: VERSION 01

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COASTAL PROTECTION AND RESTORATION AUTHORITY

This document was developed in support of the 2023 Coastal Master Plan being prepared by the Coastal Protection and Restoration Authority (CPRA). CPRA was established by the Louisiana Legislature in response to Hurricanes Katrina and Rita through Act 8 of the First Extraordinary Session of 2005. Act 8 of the First Extraordinary Session of 2005 expanded the membership, duties, and responsibilities of CPRA and charged the new authority to develop and implement a comprehensive coastal protection plan, consisting of a master plan (revised every six years) and annual plans. CPRA's mandate is to develop, implement, and enforce a comprehensive coastal protection and restoration master plan.

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LIST OF ABBREVIATIONS

CAD	COMPUTER-AIDED DESIGN
CF	CUT-TO-FILL
CL	GAP CLOSURES
CM	CONSTRUCTION MANAGEMENT
CPRA	COASTAL PROTECTION AND RESTORATION AUTHORITY
CWPPRA	COASTAL WETLANDS PLANNING, PROTECTION AND RESTORATION ACT
GIS	GEOGRAPHIC INFORMATION SYSTEM
MC	MARSH CREATION
O&M	OPERATION AND MAINTENANCE
PCT	PROJECT COSTING TOOL
PDD	PROJECT DEVELOPMENT DATABASE
PE&D	LANNING/ENGINEERING AND DESIGN
PL	PROPOSED LEVEE
RR	RIDGE RESTORATION
SR	STRUCTURAL RISK REDUCTION
SP	SHORELINE PROTECTION
SWPPPS	STORMWATER POLLUTION PREVENTION PLANS
USACE	U.S. ARMY CORP OF ENGINEERS
USD	U.S. DOLLARS

1.0 INTRODUCTION

This technical memorandum serves to summarize the results of the validation pilot study conducted to compare costs produced by the 2023 Coastal Master Plan Project Costing Tool (PCT) with costs reported for projects at 95% design. This qualitative and quantitative analysis aims to address the following questions:

- Are the components driving costs in design reports appropriately represented in the PCT?
- How do specific quantification methodologies or assumptions differ between design reports and the PCT, and what is the relative importance of those differences?
- Does the PCT predict costs at the same order-of-magnitude as design-level reports?
- What additional research is needed to improve the accuracy of the PCT?

To do so, this analysis evaluates two Ridge Restoration (RR) projects, two Marsh Creation (MC) projects, and one Structural Risk Reduction (SR) project, with the intent to capture a wide range of complexity for some of the most prevalent project types in the 2023 Coastal Master Plan. Projects were chosen by CPRA based on availability of supporting data and documentation. Because the best available RR reports were for projects that also included MC features, the analysis of MC cost methodologies includes comparisons from all four relevant reports. Additionally, some projects included features representative of additional master plan Element types, such as Shoreline Protection (SP) and Gap Closures (CL), that were evaluated qualitatively, but specific costs for those additional Element types were not evaluated. Though a single SR project (Morganza to the Gulf) was chosen, costs for two individual proposed Levee (PL) reaches were evaluated.

The six chosen designed projects and their source documentation are listed below described in detail in later in this section:

- Bayou La Loutre Ridge Restoration and Marsh Creation Project (PO-0178), 95% Design Report (2020)
- Grand Liard Marsh and Ridge Restoration (BA-68) Final Design Report (2011)
- Lake Hermitage Marsh Creation Project (BA-42) Final (95%) Design Report (2008) and Monitoring Plan (2016)
- Oyster Bayou Marsh Restoration Project (CS-59) 95% Design Report (2014), Monitoring Plan for 95% Design Plan (2014), and Project Completion Report (2019)
- Morganza to the Gulf - Hurricane Protection Interim Flood Risk Reduction Project Reach F Levee Alignment (2010)
- Morganza to the Gulf - Hurricane Protection Interim Flood Risk Reduction Project Reach H, Segment 2 Levee Alignment (2009)

BAYOU LA LOUTRE

The Bayou La Loutre Ridge Restoration and Marsh Creation Project (Bayou La Loutre) is an integrated project funded for engineering and design as project PO-178 under Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Priority Project List 26 in 2017. The project lies within St. Bernard Parish in the Lake Pontchartrain Basin and includes a 5.25-mile, 32-acre ridge along Bayou La Loutre, as well as 420 acres of marsh creation near Lena Lagoon (Figure 1). Additionally, sheetpile gap closure features are included at tidal channels to restrict flow. Ridge creation sediment is borrowed from Bayou La Loutre using bucket dredges and placed using marsh buggies. Marsh creation activities use interior borrow sources in Lake Borgne. The project had the most detailed available cost data (in the form of an Excel workbook) across all chosen projects in this study.

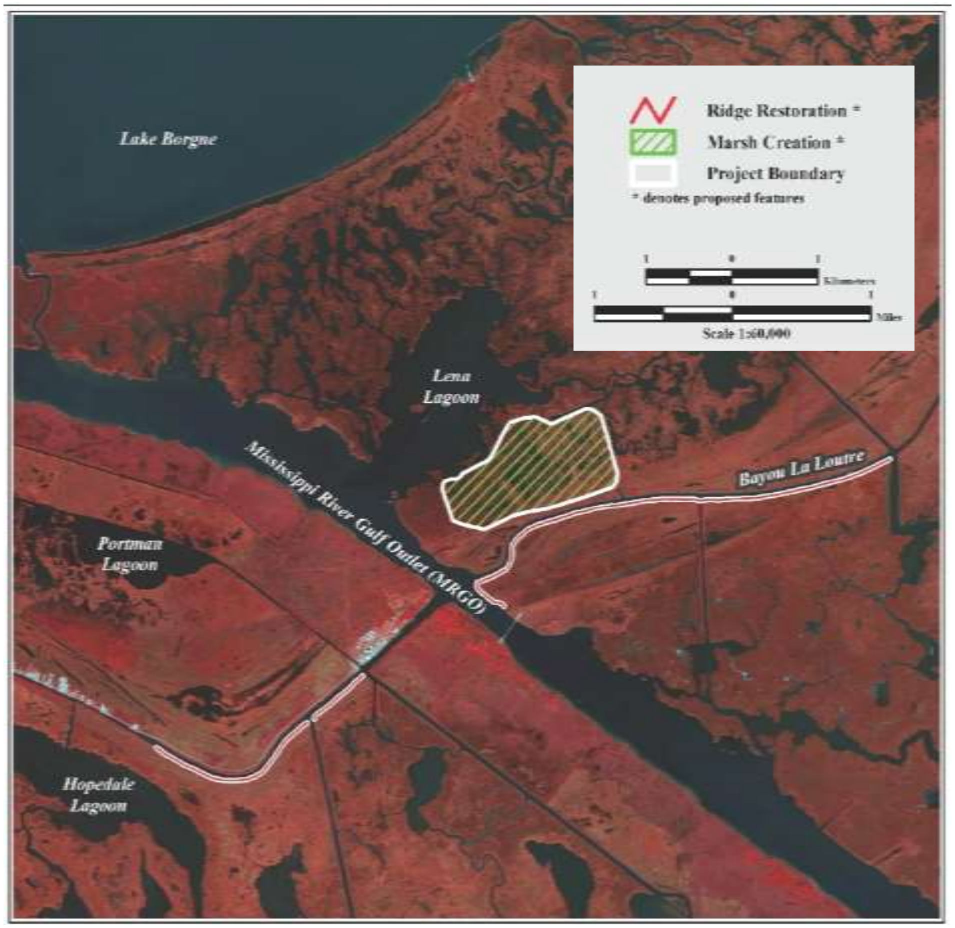

Figure 1. Bayou La Loutre Ridge Restoration and Marsh Creation.
Source: Bayou La Loutre Ridge Restoration and Marsh Creation Project (PO-0178) – 95% Design Report (2020)

GRAND LIARD

The Grand Liard Marsh and Ridge Restoration Project (Grand Liard) is an integrated project funded for engineering and design as project BA-68 under CWPPRA Priority Project List 18 in January 2009. Construction began in July 2014 and was completed in August 2015. The project lies within Plaquemines Parish in Barataria Basin and includes 468 acres of marsh creation and approximately 3.15 miles of ridge restoration (Figure 2). Additionally, sheetpile gap closure features were included at tidal channels to restrict flow. Ridge creation sediment was borrowed from Bayou Grand Liard and placed using marsh buggies. Marsh creation activities used an offshore borrow source. A final design report and 95% design cost spreadsheet were available for use in this validation.

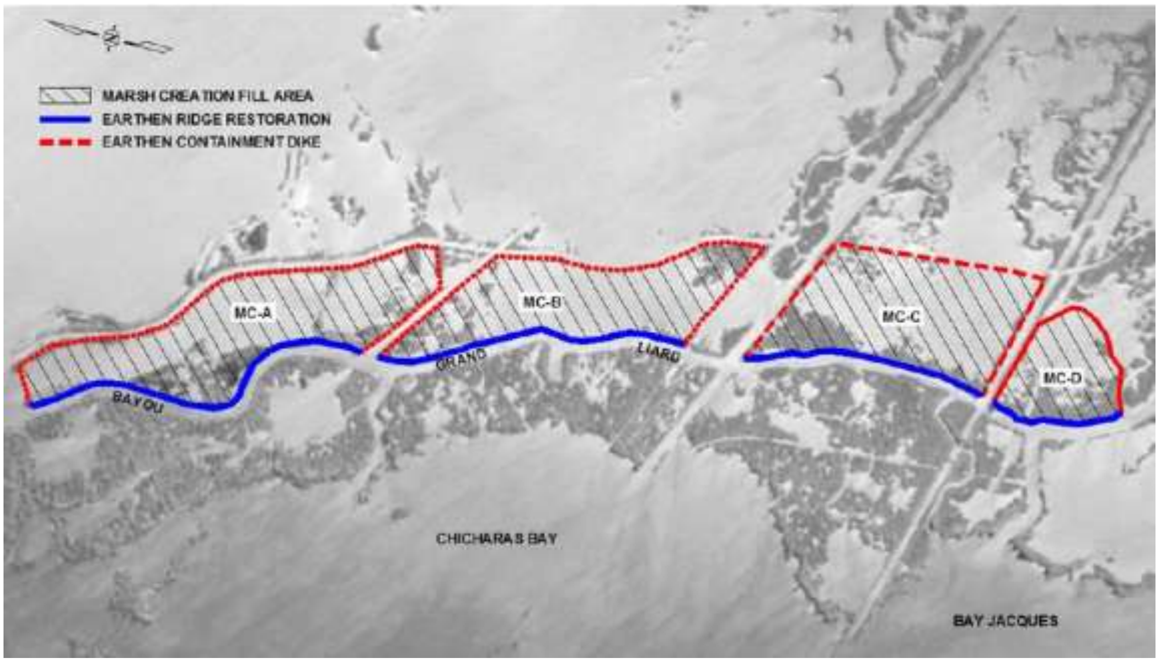

Figure 2. Grand Liard Marsh and Ridge Restoration.
Source: Grand Liard Marsh and Ridge Restoration (BA-68) Final Design Report (2011)

LAKE HERMITAGE

The Lake Hermitage Marsh Creation Project (Lake Hermitage) is a marsh creation, shoreline protection, and terracing project funded for engineering and design as project BA-42 under CWPPRA Priority Project List 15 in February 2006. Construction began February 2012 and was completed in May 2015. The project lies within Plaquemines Parish in Barataria Basin and includes 549 acres of marsh creation built from sediment dredged from the Mississippi River, 6,300 feet of shoreline restoration, and 7,300 feet of terrace construction (Figure 3). An additional 246 acres of marsh creation was added to the project following completion of the 95% design report; however, for the purpose of this validation, only costs associated with the original 549-acre footprint were assessed. Because documents for this project lacked detail in specific quantification of budget line items, the analysis for Lake Hermitage is less quantitative and more qualitative than that of Bayou La Loutre or Grand Liard.

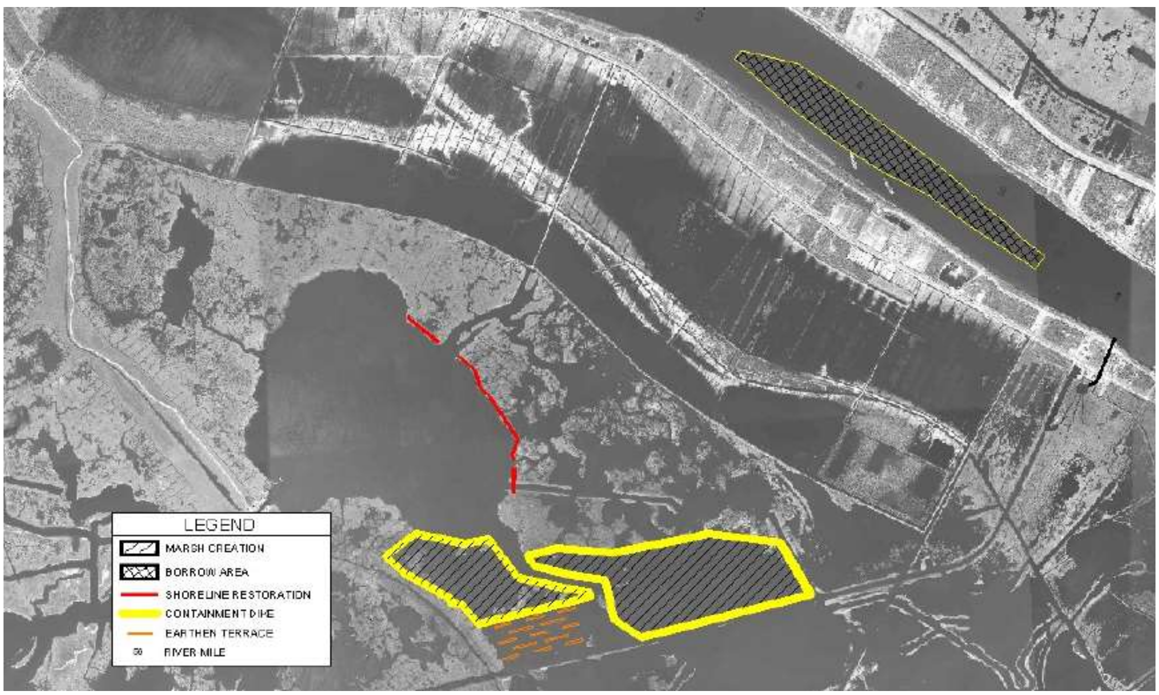

Figure 3. Lake Hermitage Marsh Creation Project.
Source: Lake Hermitage Marsh Creation Project (BA-42) Final (95%) Design Report (2008)

OYSTER BAYOU

The Oyster Bayou Marsh Creation Project (Oyster Bayou) is a marsh creation and terracing project funded for engineering and design as project CS-59 under CWPPRA Priority Project List 21 in 2012. Construction began December 2016 and was completed January 2019.The project lies within Cameron Parish in the Calcasieu-Sabine Basin and includes approximately 500 acres of marsh creation and 14,140 feet of terraces (Figure 4). For this validation study, only the marsh creation component was analyzed. As with Lake Hermitage, design documentation did not thoroughly detail quantification of budget line items, and the validation analysis is less quantitative and more qualitative than that of Bayou La Loutre or Grand Liard.

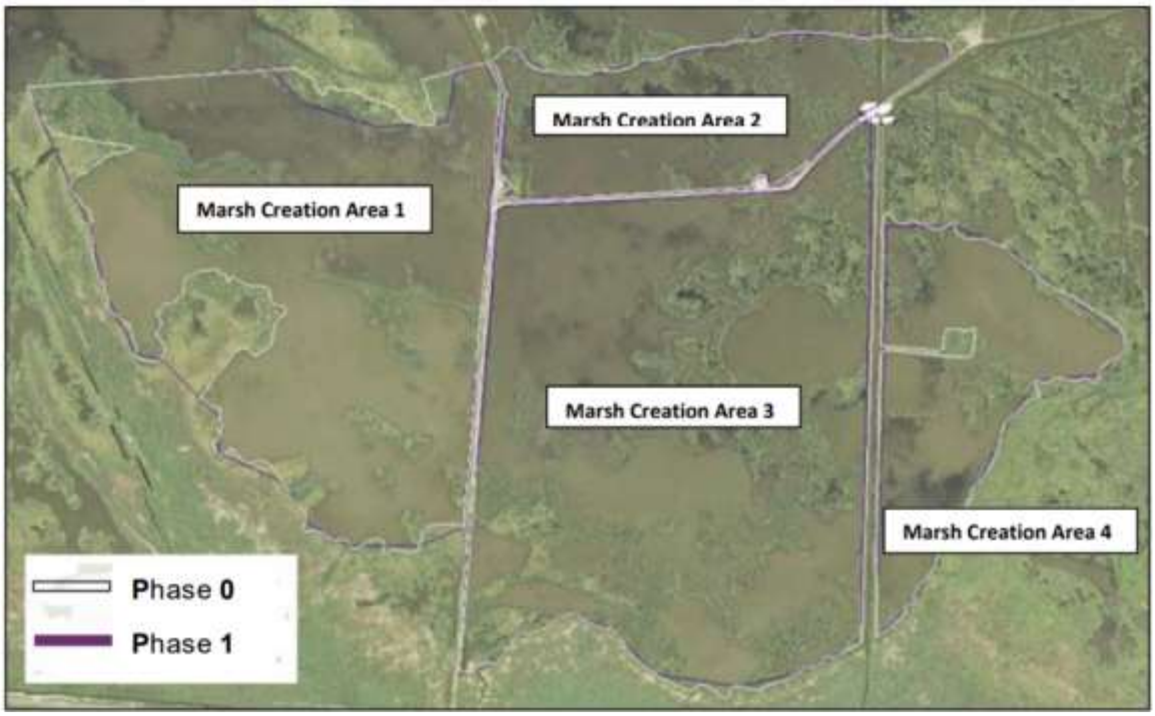

Figure 4. Oyster Bayou Marsh Creation Project.
Source: Oyster Bayou Marsh Restoration Project (CS-59) 95% Design Report (2014)

MORGANZA TO THE GULF

The Morganza to the Gulf Protection Project (Morganza to the Gulf) is a structural risk reduction project intended to provide protection to the residents of Terrebonne and Lafourche Parishes. The project (as described in the 95% design report) includes 98 miles of levee, 12 floodgates, 12 environmental control structures, and a lock complex. The project was authorized in the Water Resources Development Act of 2007. Several reaches of the overall project have been constructed as an interim flood risk reduction. This validation memo analyzes the levee components of Reaches F and H-2, shown in Figure 5, as these two reaches have the best available survey and cost data in the final design reports.

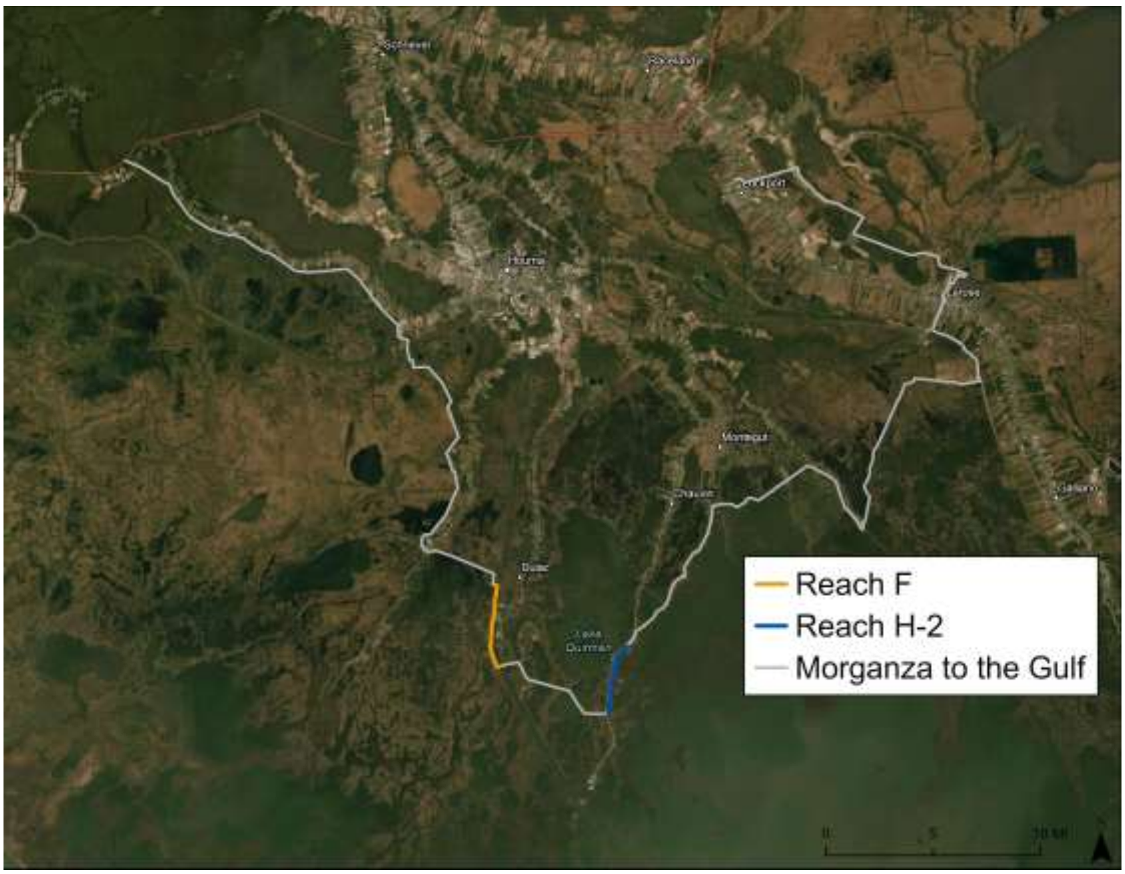

Figure 5. Morganza to the Gulf Protection Project – Reach F and Reach H-2.

2.0 METHODOLOGY

This validation pilot study focuses on four main aspects of comparison between the design reports and the PCT: identification of components included in cost estimation, accuracy of quantification of said components, general assumptions made, and order of magnitude of project-level costs.

For each project, relevant project attribute data (including input attributes and component quantities) were mined from the design reports and recorded into a spreadsheet template structured after the Project Development Database (PDD) to be read by the PCT. (Specific attribute data for each project is reported in the Assumptions section of this memo.) Geographic Information System (GIS) features for ridges, marshes, and levees were then developed for each project, and relevant GIS tools, such as the dredge mobilization pipeline pathway tool (dredge mob tool) and access channels tools, were used to generate additional attributes not explicitly available in the design reports. Additionally, a sensitivity analysis was performed to assess the ability of the GIS dredge mob tool to predict designed dredge pathways.

After running the PCT, quantities of individual components produced by the PCT were compared to quantities presented in the design reports. This analysis ultimately resulted in the investigation of fifteen unique component types including three component types from RR elements, six from MC elements, and six from PL elements (Table 1). As quantities were compared, specific PCT assumptions, such as cut-to-fill (CF) ratios, were evaluated against design assumptions and differences were recorded along with an assessment of the relative importance of each difference.

Table 1. Components Analyzed by Element Type

Element Type	Component
Ridge Restoration	Ridge Volume
	Ridge Plantings
	Access Channels
Marsh Creation	Marsh Volume
	Marsh Plantings
	Containment Dikes
	Settlement Plates
	Grade Stakes
	Sheetpile Gap Closures
Proposed Levee	Levee Volume
	Turf
	Clearing and Grubbing
	Stormwater Pollution Prevention Plan
	Permanent Ramps
	Borrow Canal Stabilization

Project-level costs were also mined from the design reports and escalated to 2023 U.S. Dollars (USD) using the U.S. Army Corp of Engineers (USACE) Civil Works Construction Cost Index System (USACE 2019). Project-level costs include:

- Component costs, or the sum of the costs of all individual components comprising an element
- Construction surveys (or simply, survey)
- Mobilization and demobilization (or simply, mobilization)
- Construction costs, or the sum of component, mobilization, and survey costs,
- Contingency
- Planning/engineering and design (PE&D)
- Construction management (CM)
- Operation and maintenance (O&M) costs

These project-level costs were compared to outputs from the PCT for each project to determine if the PCT produces costs at the same order of magnitude as the design reports. A cost from the PCT was deemed “the same order of magnitude” if it fell between half of and double the corresponding cost from the design report.

For each level of comparison, conclusions were drawn based on the relative importance and scale of the differences with the aim to identify any portions of the PCT methodology that may need to be updated or at least investigated further. Assumptions, Results, and Conclusions are described in the subsequent sections of this memo.

3.0 ASSUMPTIONS

This section details the assumptions made to compare design report and PCT results, including any modifications to the typical PCT, commentary on how specific methodologies were implemented in the analysis, and a summary of attributes used in the PCT for each project.

The 95% design reports were the primary source of attribute and cost data for each project; however, the report for Oyster Bayou did not include a cost estimate, so approximate costs were taken from the project completion report, despite changes to the general project scope between design and completion.

Costs and quantities for features outside of the typical RR, MC, or PL element templates were typically not compared in a quantitative fashion but were addressed qualitatively when deemed that the feature could potentially be considered as a part of the generic element template in future PCT iterations. Such features included gap closures, pipeline crossings, and bank stabilization along borrow canals. Other features that were deemed more project-specific, such as shoreline protection, terracing, or highway relocations, were not assessed in this analysis.

When running the PCT for Master Plan cost estimates, length attributes are typically pulled directly from the GIS representation of each element. To focus validation efforts on the quantification of ridge volumes, the PCT used the design report length values instead of GIS lengths for modeled ridge features. Levee reaches, however, used GIS values because lengths reported in the design reports were inconsistent and/or not precise. For MC elements, containment dike lengths were based on polygon perimeters in GIS even if containment dike lengths were provided in design reports, again due to inconsistencies in reporting across all evaluated design reports.

In general, this study did not evaluate MC viable marsh area or required sediment volume calculations. Typically, the PCT gets these values from the ICM, which calculates the difference between the target marsh elevation and existing elevation on a coastwide depth raster. Since some of the projects considered in this study were already present on the depth raster, marsh areas for this analysis were assumed to be 90% of the MC polygon extent based on the average relationship between marsh area and footprint present in existing master plan projects. Sediment volumes from the design report were utilized unless otherwise described. Additionally, this analysis included saline marsh plantings on all MC elements, even if they weren't specified design reports.

MC elements costed by the PCT for the master plan are typically divided into cells with approximately 2,000-acre footprints. Projects considered in this validation are significantly smaller (between 350 and 550 acres) and are broken up into even smaller cells. Typically, the dredge mob tool draws a dredge pipeline from a borrow source to each individual cell within an MC element; however, for this analysis, to capture containment dike lengths most accurately without overestimating mobilization costs, cells were grouped together as single multi-part polygon features and treated as a single unit in the dredge mob tool.

To capture the uncertainty of each unit cost, the PCT provides a range of cost estimates using the minimum expected unit costs (cost scenario 1), most likely unit costs (cost scenario 2), and maximum expected unit costs (cost scenario 3). Unless specified or provided as a range, PCT costs are represented using the tool's cost scenario 2. Additionally, because cost estimates from design reports do not always consider or detail unit cost source years, all costs from design reports are escalated using the year the report was released and the CWCCIS's annual composite index.

This validation generally doesn't evaluate specific unit costs for line items except in situations where design reports do not report the quantities of components driving a lump-sum cost. Variance in unit costs across projects is inevitable for the master plan's statewide planning effort given the variety of sources, regions, and time frames considered.

P/E&D, CM, and O&M costs were not included in any of the 95% design reports, however, available cost estimate worksheets for Bayou La Loutre and Grand Liard included detailed, itemized breakdowns for each of these parameters. Specifically, these worksheets identified itemized "Phase I" and 'Phase II" activities, which represented features typically represented in the PCT as P/E&D and CM costs, respectively, and were assigned as such in project-level cost comparisons. Additionally, O&M costs for Oyster Bayou and Lake Hermitage were available in a separate monitoring plan. The Lake Hermitage monitoring plan was published 8 years after 95% design report was released and includes a larger marsh creation extent than identified in the design report. As a result, reported O&M costs may be overestimated. The Oyster Bayou monitoring plan relates to the 95% design, and as discussed above, costs for this project are generally compared at the project completion level. As a result, O&M applies to a smaller area of marsh and may be underrepresented.

Tables 2 through 4 summarize the attributes used in the PCT for MC, RR, and PL elements, respectively.

Table 2. MC Attributes Modeled in PCT

Parameter	Bayou La Loutre	Grand Liard	Lake Hermitage	Oyster Bayou
Marsh Area (Acres)	378	405	494	530
Marsh Volume (CY)	999,990	2,667,377	3,725,784	2,205,000
Dike Length (FT)	18,801	46,243	34,373	44,489
Borrow Source	Lake Borgne, From Report	Offshore, Deltaic Plain	Mississippi River - 17	Offshore, Chenier Plain

Parameter	**Bayou La Loutre**	**Grand Liard**	**Lake Hermitage**	**Oyster Bayou**
Sediment Type	Interior Mixed Fines	Offshore Mixed Fines	Mississippi River Sand	Offshore Mixed Fines
Shoreline Pickup (FT)	7,107	649	10,552	878
Shoreline Prelay (FT)	12,019	17,657	23,612	9,996
Subline Prelay (FT)	14,061	30,381	6,603	22,203
Fill-to-Borrow (FT)	26,080	48,038	30,215	32,198

Table 3. RR Attributes modeled in PCT.

Parameter	Bayou La Loutre					Grand Liard
	Reach 1	**Reach 2**	**Reach 3**	**Reach 4**	**Reach 5**	
Length (FT)	7,010	2,525	2,550	8,252	7,404	15,446
Base Elevation (FT NAVD88)	1.83	2.20	1.01	1.36	1.36	-0.11
Crest Width (FT)	15	15	15	15	15	20
Slope	5	5	5	5	5	7
Access Existing Elevation (FT NAVD88)	N/A	N/A	N/A	N/A	N/A	-3.94
Access Length (FT)	N/A	N/A	N/A	N/A	N/A	26,774

Table 4. PL Attributes modeled in PCT.

Parameter	Morganza Reach F	Morganza Reach H2
Base Elevation (FT)	1.18	1.62
Crest Elevation (FT)	12	12
Length (FT)	20,409	17,609
Crest Width (FT)	10	10
Top Slope Protected	3	4
Top Slope Flooded	3	4
Berm Slope Protected	12.5	10
Berm Slope Flooded	12.5	10
Berm Top Elevation	7	3
Inspection Width Protected	125	140
Inspection Width Flooded	15	60

4.0 RESULTS

This section details the results from the component-level quantity, project-level cost, and order-of-magnitude overall cost comparisons.

4.1 RIDGE RESTORATION COMPONENTS

RIDGE VOLUME

The Bayou La Loutre report used computer-aided design (CAD) software to estimate volumes from the ridge template superimposed over survey data from transects spaced roughly every 250 feet. Grand Liard employed a similar method using survey data spaced every 500 feet. The PCT in general applies a single trapezoidal template to the entire length of the reach. For this analysis, the average elevation from the survey transects for each reach was inputted into the PCT. Additionally, the PCT methodology employs a 25% overbuild factor applied to the height of the ridge to account for settlement and offset future O&M costs of ridge lifts; however, these factors are not considered in either design report analyzed. As shown in Table 5, this methodology ultimately results in a volume that is 30% higher than the design volume, which is a significant impact, since sediment is the largest contributor to cost. When compared without the overbuild, PCT volumes using the average elevation were within 10% of the design fill volumes.

Though the PCT prices ridge volume based on cut volume, Table 5 summarizes results of the analysis in terms of fill volume to reconcile differences between design report methodologies. For all RR elements, the PCT assumes a C:F ratio of 1.5:1; however, Bayou La Loutre estimates costs based on cut volume with a 1.5:1 C:F ratio and the Grand Liard report estimates costs based on fill volume but reports a C:F ratio of 2:1. It is recommended that the C:F assumption is evaluated across additional ridge projects, and that the state-wide C:F ratio assumption is reviewed to determine if regional-specific ratios should be employed.

Table 5. Fill Volume Comparison for Ridge Elements

Project	Design Report Fill Volume (CY)	PCT Fill Volume		Difference from Design	
		With Overbuild (CY)	***No Overbuild (CY)***	***With Overbuild***	***No Overbuild***
Bayou La Loutre	126,569	164,861	116,228	30%	-8%
Grand Liard	174,449	236,475	163,038	36%	-7%

The Grand Liard design report assumes two different methods of applying material – the majority excavated via a bucket dredge from Bayou Grand Liard, and the remaining using a more expensive marsh buggy directly from the marsh fill site. The PCT, however, assumed that a bucket dredge would be used to build the entirely of the ridge feature. This assumption did not impact the order-of-magnitude of the overall project cost estimate, and it is not recommended that any change to the PCT should occur to accommodate this level of detail in the design report. If required, one could split a reach built from two borrow sources into two elements to accommodate the increased cost of building using a marsh buggy.

Both ridge projects considered in this analysis were significantly narrower than the standard PCT template; the Bayou La Loutre and Grand Liard design reports specify crest widths of 15 and 20 feet, respectively, while the default crest width for master plan ridges is 50 feet. Future analysis should investigate design reports for larger ridges to determine if there are any additional components or other assumptions to be considered in the PCT for larger-scale ridge features.

PLANTINGS (RIDGE)

Both the Bayou La Loutre and Grand Liard design reports separated ridge plantings from the rest of the construction costs with the assumption that plantings would occur on a separate vegetation contract apart from the primary construction bid. However, itemized planting components were detailed in each report's corresponding cost calculation Excel workbook. The Bayou La Loutre report recommended planting smooth cordgrass and seashore paspalum with a specified spacing along the ridge crest, along with an additional generalized temporary grass seeding along the entire surface area of the ridge. The Grand Liard design recommended specific spacings of a handful of grasses across 24 acres of the ridge, including smooth cordgrass, paspalum, marsh-hay cordgrass, and switch grass, along with matrimony vine and Baccharis shrub species. The Grand Liard project also accounts for tallow control across 24 acres. The full surface area of the Grand Liard ridge is 32 acres, and the crest is 7 acres, but it is unclear exactly what portion of the designed ridge is represented by the 24-

acre assumption.

The PCT estimates costs for ridge plantings using a per-acre cost for a more generalized variety of saline plants and hardwood tree species rather than any specific grasses or shrubs. Saline plantings are assumed to be planted across 60% of the surface area of the ridge that is above 1.5' NAVD88., and hardwood species are planted only along the crest of the ridge.

Because of the differing methodologies utilized between the PCT and design reports, a direct comparison of planting quantities was not performed; instead, the relative contribution of plantings to total ridge components was assessed. For Grand Liard, the design report estimated that plantings would contribute 17% to the cost of ridge components, while the PCT estimated a 3% contribution. For the Bayou La Loutre project, the design report estimated an 11% contribution, while the PCT estimated an 8 % contribution. These results indicate that more design reports should be analyzed to get a better understanding of the PCT's ability to accurately predict planting costs, however, because ridge costs are driven by sediment requirement, this may not be a high priority for PCT development.

ACCESS DREDGING

The Grand Liard design report estimated 80,000 cubic yards of material would be required to be dredged to access the project site along specific locations in the path shown in Figure 6. The access dredging tool used to create access paths used in the PCT estimated of 285,167 cubic yards of material – over 3.5 times that estimated in the design report. This discrepancy in quantity can be attributed to the resolution of the DEM that the access tool uses to estimate access channel volumes. While the general path between the Grand Liard project site and the area of navigable water was the same between the PCT and the design report, the design report's survey was able to identify more specific, smaller areas of dredging needs while the PCT assumed the entire length of the access channel required dredging. For this validation assessment, the access channel cost is overestimated, contributing to 43% of the ridge components in the PCT compared to the 15% contribution to ridge components reported in the Grand Liard design report. However, master plan projects in general see access channels typically represent only 6% of ridge component costs. It is recommended that a review of coastal navigable waters is performed to identify navigation channels not resolved by the DEM, however, it is believed that the present methodology likely represents the best available science for estimating projects at a coastwide scale in the absence of design-level survey data.

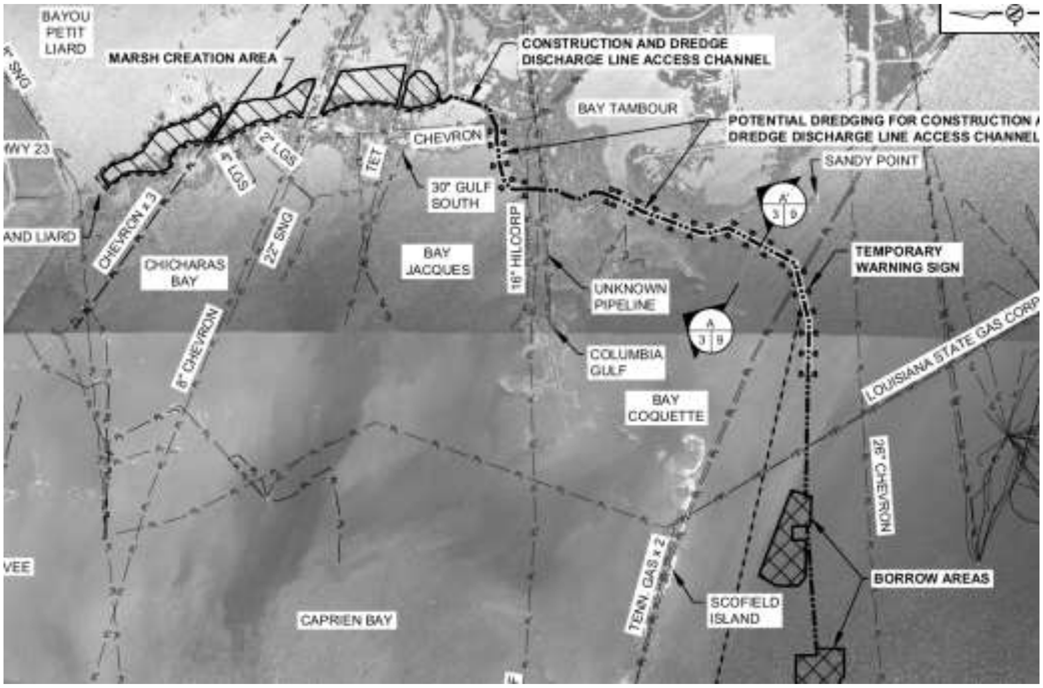

Figure 6. Access path to Grand Liard project site.

4.2 MARSH CREATION COMPONENTS

MARSH VOLUME

The cost of sediment accounts for most of the component costs across all MC projects currently in the master plan. As stated in the Assumptions section, validation efforts used design report marsh volumes and considered dredge pathways from both design reports and the outputs of the dredge mob tools. Pipeline paths derived from design reports were used to determine the unit cost of sediment. Since report marsh volumes were utilized, the marsh component comparison focuses on impacts to escalated unit costs rather than the sediment itself (Table 6). Bayou La Loutre uses a similar approach to the PCT to scale unit costs based on pipeline length, but Grand Liard, Oyster Bayou, and Lake Hermitage do not indicate how unit costs were derived, though it is assumed that pipeline length would be a factor. For inland and river borrow sources, the PCT predicted similar unit costs to design reports, but underestimated unit costs for longer offshore sources. Since unit costs are known to vary across time, this may not have a significant impact on the PCT, but further research into more recent projects obtaining sediment from offshore sources could influence the curve used to determine sediment unit costs.

Table 6. MC Sediment Unit Cost Summary

Project	Sediment Source	Fill to Borrow Distance (miles)	Sediment Unit Cost (per CY)	
			Report	***PCT***
Bayou La Loutre	Lake Borgne, From Report	4.9	$5.67	$5.31
Grand Liard	Offshore, Deltaic Plain	9.1	$7.16	$9.03
Lake Hermitage	Mississippi River - 17	5.7	$8.41	$8.56
Oyster Bayou	Offshore, Chenier Plain	6.1	$5.07	$8.20

MARSH PLANTINGS

Marsh plantings account for about 9% of component costs across all current MC projects in the master plan. The PCT assumes that 60% of created marsh is planted with some form of marsh vegetation. None of the four projects analyzed included marsh plantings in design reports or O&M plans. While these projects do include plantings on ridges, terraces, and shoreline restoration reaches, they are excluded from marsh creation; however, it is known that separate contracts are often created to manage project vegetation. Future work should include research as to how the cost of vegetation is addressed in other design projects before changes are made to the PCT.

CONTAINMENT DIKES

The PCT costs containment dikes per linear foot based on the perimeter of the MC cell as drawn in GIS. Like ridge sediment estimates, Bayou La Loutre calculated dike fill volumetrically based on survey data spaced roughly every 900 feet and a C:F ratio of 1.5. Grand Liard uses a similar approach, with survey data spaced roughly every 500 feet and a C:F ratio of 2. Lake Hermitage and Oyster Bayou, however, both estimate costs based on length, as done in the PCT. Across all four projects, report containment dike costs account for approximately 7% of component costs. The PCT estimated that dikes contribute around 12% for these projects, which is high compared to the typical master plan average of 6% contribution. As noted in the Assumptions section, MC projects considered in this analysis are significantly smaller than those typically evaluated in the master plan, and as such, the relative contribution of dikes to sediment volume is expected to be high. In general, due to the relatively low impact of containment dikes on final project costs, no further research is recommended to refine this component in the PCT at this time.

SETTLEMENT PLATES

Settlement plates account for less than 0.5% of component costs across all current MC projects in the master plan. The PCT currently includes one settlement plate per 50 acres of marsh creation. Settlement plates specified in design reports varied (see Table 7), and quantification methods were not always apparent. Additionally, Bayou La Loutre includes 3 instrumented plates rather than standard non-instrumented plates, each roughly 10 times the cost of a traditional plate. Given the inconsistency across design reports and the relatively low contribution to costs, no change to the PCT assumptions for settlement plates is recommended at this time.

Table 7. Summary of Settlement Plate Quantities.

Project	**Count of Settlement Plates**	
	Design	***PCT***
Bayou La Loutre	17	8
Grand Liard	8	9
Lake Hermitage	4	10
Oyster Bayou	7	12

GRADE STAKES

Grade stakes are included as line items in the Bayou La Loutre and Lake Hermitage design reports. La Loutre includes 40 units, and Lake Hermitage includes 84. It is not apparent how these values were assigned, and grade stakes were not specifically mentioned in the Grand Liard or Oyster Bayou projects. The PCT does not currently consider grade stakes, and no changes are recommended since they do not significantly contribute to construction costs. It is generally assumed that this item may be absorbed by surveying costs.

SHEETPILE GAP CLOSURES

The PCT has a gap closure module that estimate costs for restrictions in tidal channels using sheetpile walls; however, this module is currently only used for large land bridge integrated projects. Sheetpile gap closures were identified in the Bayou La Loutre and Grand Liard design reports and provide a significant contribution (~10%) to component costs. However, neither Lake Hermitage nor Oyster Bayou accounted for these features. It is recommended that further research is performed to assess whether closures would be an appropriate addition to the typical MC project template.

4.3 PROPOSED LEVEE COMPONENTS

LEVEE VOLUME

The PCT calculates levee fill volumes by first calculating the height of the feature (equal to the crest elevation minus the base elevation) and increasing the height by a 25% overbuild factor. Then, the fill volume is determined by finding the cross-sectional area of a typical section and multiplying it by the length of the feature. An additional quantity of compacted sediment is included to account for the volume of land lost once clearing and grubbing activities have occurred, equal to the footprint area of the levee and the right-of-way multiplied by a standard depth of 0.5 feet.

The design reports for the Morganza to the Gulf estimate the required fill volume at a much higher resolution, using CAD software to apply the design template to transects along the reach spaced every 200 feet. Costs are based on cut volumes, so cut-to-fill (C:F) ratios (equal to 2.25 and 1.75 for Reaches F and H2, respectively) are applied to the calculated fill volumes to produce costs. However, no specific volume is added to account for clearing-and-grubbing activities. A summary of calculated fill volumes from the PCT and the Design reports is shown in Table 8.

Table 8: Comparison of Levee Fill Volumes

Reach	Design Report Fill Volume (CY)	PCT Fill Volume		Difference from Design	
		Levee Only (CY)	*With Clearing and Grubbing (CY)*	*Levee Only*	*With Clearing and Grubbing*
Reach F	848,889	760,278	836,520	-10%	-1%
Reach H2	414,983	531,266	573,776	+28%	+38%

For both reaches, the PCT produced volumes at the same order of magnitude as the detailed design reports, however, the added resolution provided using CAD software clearly influences the estimated volume of sediment. Splitting each reach into many smaller Elements before modeling in the PCT may improve the accuracy of the volume estimation, but additional analyses of other levee reaches is recommended to better understand the magnitude of differences between design and PCT methodologies. Furthermore, assumptions regarding the volume of additional sediment from clearing and grubbing activities should be reviewed. Because levee material generally comprises the largest portion of PL element costs (roughly 80% for Reaches F and H2 modeled in the PCT), improving the accuracy of volume calculations could significantly impact project-level costs.

TURF

Planting turf along the surface area of the levee accounts for the second-highest portion of PL element costs. The PCT calculates cost based on the surface area of the levee and right-of-way. The design report estimates include 160 acres of seeding, fertilization, and mulching for Reach H2 and 130 acres for Reach F, resulting in component costs for turf of $320,000 and $325,000, respectively. The PCT calculates 135 acres for Reach H2 and 162 acres for Reach F, totaling $1.5 million and $1.8 million, respectively.

Since calculated acreages are similar (+1% for H2 and +4% for F), the difference in component costs is mainly due to the significantly higher unit cost used in the PCT. Design reports use unit costs of $2,000 and $2,500 per acre, and the PCT uses $8,805 per acre. Though it is known that unit costs are subject to large variations over time, further research into turf quantification and unit costs is recommended to determine if the PCT is overestimating this component cost.

CLEARING AND GRUBBING

In addition to the volume of sediment discussed above, clearing and grubbing quantities in the PCT are also reported as a per-acre cost for the impacted footprint of the levee (including the levee feature and the associated right-of-way). Clearing and grubbing in the Morganza to the Gulf design reports, however, is reported as a simple lump sum cost, equal to $1.1 million for Reach H2 and $1.4 million for Reach F, escalated to 2023 USD. The PCT estimates that 160 acres of clearing and grubbing for Reach F would cost between $850,000 and $1 million, while 134 acres for Reach H2 would fall somewhere between $710,000 and $850,000. Because these costs represent a relatively small portion (3-4%) of PL element costs produced by the PCT and are on the same order of magnitude of costs in the design reports, no further investigation of clearing and grubbing methodology is recommended.

STORMWATER POLLUTION PREVENTION PLAN

In general, Stormwater Pollution Prevention Plans (SWPPPs) comprise less than 1% of a typical PL element in the master plan. The design report for Reach H2 has 35,000 linear feet of silt fence as the SWPPP, while Reach F reports 43,000 linear feet. The PCT calculated 35,000 linear feet for Reach H2 and 41,000 linear feet for Reach F. Though it is not explicit in the design reports, both methodologies seem to place SWPPP components along each side of the proposed levee. No further investigation into this component is recommended.

PERMANENT RAMPS

The design report includes line items for sand and crushed limestone for permanent access ramps on the ends of levees, however permanent ramps are not generally included in the PCT. Access roads running parallel to the levee are sometimes considered for master plan projects, and typically cost about 7% of the cost of sediment but were not included in the design reports for Reach H2 or F, so were not evaluated in this assessment. Adding permanent ramps would represent a 1-3% increase in comparable Component costs to the PCT and is considered a negligible addition, especially when access roads could provide a similar function.

BORROW CANAL STABILIZATION

Design of the Morganza to the Gulf Hurricane Protection reaches includes a borrow canal with bankline armoring. For reaches F and H2, the borrow canal is located along the levee on the protected side. The bankline armoring is a feature similar to Shoreline Protection (riprap + geotextile) located along the borrow canal bank. Borrow canal stabilization is not included in PCT design. This bankline armoring (borrow canal stabilization) contributes 20-30% of the overall cost for the selected reaches. It might be worthwhile to consider adding borrow canal stabilization as a bank stabilization element for levee projects in the PCT; however, more research is required to determine if this is a standard feature among other designed levee reaches.

4.4 PROJECT-LEVEL COSTS

SURVEY PERCENTAGES

The PCT estimates survey costs as a flat 2.5% of overall component costs for all projects, while the restoration design projects varied in their assumptions for assessing survey costs. Bayou La Loutre similarly used a 2.5% assumption (excluding plantings, since they are considered under a separate contract), while Grand Liard and Lake Hermitage estimated surveys as lump sum costs equal to $300,000 (not escalated to 2023 USD). The Oyster Bayou Project Completion document reported a $360,000 total lump sum cost for pre-construction and as-built surveys (also not scaled to 2023 USD). Survey cost estimates for Morganza to the Gulf were not included in the design reports. Overall, survey costs fall between 1% and 2.5% of component costs for each project. It is assumed that the PCT's assumption of 2.5% is a generally a fair representation of estimated survey costs for restoration projects, though more research is needed to determine if this assumption is also valid for risk reduction projects.

MOBILIZATION

In general, the PCT calculates mobilization costs for all element types other than marsh creation as a flat 5% of the sum of component and survey costs. Mobilization for Bayou La Loutre and Grand Liard ridges were rolled into the mobilization costs for their respective marsh components in design reports, so specific ridge mobilization comparisons were not possible. The Morganza to the Gulf Reaches H2 and F reported lump sum mobilization costs equivalent to 11% and 3% of component costs, respectively, though there was no indication of how the lump sum values were assigned.

For marsh creation projects, the PCT estimates mobilization costs by first using a GIS tool to draw the least-cost path from the project site to the nearest available borrow source. The tool analyzes how much of the path is over water and how much is over land to determine specific component costs related to pick-up and prelay of subline and shoreline pipe placement. This methodology was based on the Dredge Mob Estimator used in the 2017 Coastal Master Plan cost spreadsheets and used frequently for restoration design at CPRA; however, a recent sensitivity test of the spreadsheet model found a lack of sensitivity toward over-land and over-water inputs, indicating that there is room for streamlining the methodology utilized in the PCT.

The Grand Liard project used the same CPRA Dredge Mob Estimator spreadsheet used in the 2017 Coastal Master Plan, and attributes produced by the GIS tool for the same pathway were similar to those in the design report, as shown in Table 9. The Bayou La Loutre project, however, estimated mobilization based on averages from past projects in Coles Bayou, Bayou Bonfouca, and Lost Lake. This approach used a per-linear-foot cost applied to the required dredge pipe length along with the average cost of mobilization of a 22-inch to 24-inch hydraulic dredge and an additional “general mobilization and demobilization +1% bid bond” average cost. The methodology for determining the values driving the lump sum costs for mobilization in the Lake Hermitage and Oyster Bayou design reports was not reported, but as shown in Tables 12 to 14 later in this memo, the PCT did well in predicting the design-level estimate for mobilization when using dredge paths defined in the design reports.

Table 9. Dredge Mobilization Attributes for Grand Liard MC

Attribute	Design Report	PCT	Percent Difference
Subline Prelay (FT)	31,700	30,381	-4%
Shoreline Prelay (FT)	18,700	17,657	-6%
Shoreline Pickup (FT)	1,000	649	-35%
Fill to Borrow Distance (FT)	49,400	48,023	-3%

A sensitivity test was performed to assess the differences between dredge pathways produced by the GIS tool and those found in the design reports. The GIS tool was run as it would if each project were a master plan project, producing multiple possible paths to nearby borrow sources for the Planning Tool to choose MC projects based on sediment availability. A summary of results is shown in Table 10.

For Bayou La Loutre, the closest master plan borrow source is much further than the borrow source provided in the design report, indicating that borrow option limitations in the master plan could result in vastly over-estimating projects that would otherwise be built using closer materials. However, the two cheapest paths produced for the Grand Liard and Oyster Bayou projects produced overall costs that were lower than those associated with paths reported in the respective design reports. Though the costs tend to be on the same order of magnitude as the preferred path in the design, these results indicate that the cheapest option with respect to mobilization and sediment volume costs is not necessarily the preferred option for final design, and that other factors (such as land use permitting or dredge access) may be useful to consider in planning a dredge pipeline route.

Table 10. Results of Dredge Mobilization Sensitivity Test

Project	Borrow Source	Mobilization	Marsh Cost	Construction
Bayou La Loutre	**Lake Borgne, From Report**	**$4,000,000**	**$5,300,000**	**$12,000,000**
	Lake Borgne, Master Plan Site	$13,000,000	$10,000,000	$26,000,000
Grand Liard	**Offshore, From Report**	**$6,300,000**	**$24,000,000**	**$36,000,000**
	Offshore, Deltaic Plain	$5,600,000	$23,000,000	$34,000,000
	Mississippi River - 6 & 7	$3,900,000	$23,000,000	$32,000,000
Lake Hermitage	**Mississippi River - 17**	**$4,100,000**	**$32,000,000**	**$41,000,000**
	Offshore, Deltaic Plain	$15,000,000	$46,000,000	$66,000,000
Oyster Bayou	**Offshore, From Report**	**$4,500,000**	**$18,000,000**	**$28,000,000**
	Calcasieu Lower Lake	$5,700,000	$12,000,000	$23,000,000
	Offshore, Chenier Plain	$3,100,000	$17,000,000	$25,000,000

CONTINGENCY

Restoration projects followed CPRA guidance in Marsh Creation Design Guidelines (CPRA, 2017) of employing a 15% contingency for the final design estimates, while the USACE applied 10% of the construction costs as contingency for the Morganza to the Gulf reaches. The PCT uses a default value of 20% of the construction cost, which falls within the “Preliminary Design” range based on CPRA guidance (CPRA, 2017). Therefore, no changes are recommended to PCT calculations of contingency.

PLANNING/ENGINEERING AND DESIGN

Bayou La Loutre and Grand Liard design costs included detailed estimates for specific PE&D items at both State and Federal levels (such as geotechnical investigation, land rights, project management etc.) that were difficult to break out by specific RR or MC components. For these two projects, PE&D costs were equivalent to 20% of the construction cost for Bayou La Loutre and 10% for Grand Liard. The PCT’s default percentage for PE&D is 10% of construction costs, indicating that there is a potential that the PCT under-values the PE&D costs, though it would be worth researching more projects before making changes to the methodology. Neither Lake Hermitage, Oyster Bayou or Morganza to the Gulf included discernable costs for PE&D and were not evaluated, further suggesting more information be gathered prior to updating the PCT.

CONSTRUCTION MANAGEMENT

Similarly, there is a potential that the PCT under-values CM costs. Bayou La Loutre and Grand Liard, again, include detailed estimates for construction management at state and federal levels (including USACE administration, supervision and inspection, oyster activities, etc.) for the combined MC and RR features. CM costs were equivalent to 15% and 9% of the overall construction costs for Bayou La Loutre and Grand Liard, respectively. In the PCT, construction management is estimated as only 5% of the construction costs. Lake Hermitage, Oyster Bayou and Morganza to the Gulf again did not include a specific cost item for construction management. With the lack of information from four of the selected projects and potential undervaluing of the CM costs by the PCT for the remaining two, it is recommended more projects design costs be evaluated to determine if CM costs should be increased in the PCT.

OPERATIONS AND MAINTENANCE

As discussed in the Assumptions section, only Bayou La Loutre and Grand Liard had O&M costs associated with the 95% design reports. While Oyster Bayou had O&M costs associated with the 95% design Monitoring Report, other costs were extracted from the Project Completion report; each report referenced versions of the project with unique geographic footprints. Similarly, Lake Hermitage's monitoring plan includes O&M for an additional phase of the project and may generally overestimate O&M costs in relation to construction costs. In general, detailed O&M costs for all restoration projects included line items such as surveys, inspections, gapping containment dikes and additional vegetative plantings, identified for both state and federal funding sources.

To facilitate comparison to the PCT's standard O&M assumption of 5% of construction costs over 50 years, total O&M costs in each report were divided by the O&M time frame (typically between 15-20 years) to produce annual O&M costs. These annual values were then extended to a 50-year timeframe and reported as a percentage of construction costs, as shown in Table 11. Results from Bayou La Loutre and Grand Liard indicate that the PCT may be significantly underestimating O&M costs, though the Grand Liard and Oyster Bayou projects show comparable values. Further research is recommended to confirm whether this apparent undervaluation is a common issue among RR projects, since much of the O&M for Bayou La Loutre and Grand Liard was derived from ridge plantings.

Table 11. O&M as a Percentage of Construction Costs

Project	O&M Timeframe (years)	50-year O&M
Bayou La Loutre	20	55%
Grand Liard	15	11%
Lake Hermitage	20	4%
Oyster Bayou	20	4%

4.5 ORDER-OF-MAGNITUDE COMPARISON

Tables 12 through 17 compare the escalated costs from each design report to the range of costs produced by the PCT to glean a high-level understanding of where the PCT may be overestimating (producing most-likely costs that are more than twice that in a design report) or underestimating (producing costs less than half of the corresponding value from a design report) project-level costs. PCT costs are deemed acceptable (OK) if they do not meet either threshold. Survey costs and contingency costs are not included in the comparison below because their values are directly linked to construction costs.

Though results described earlier in this section identify some features worth investigating for further improvement (e.g., marsh plantings, mobilization/demobilization, ridge overbuild and sheetpile), overall, this analysis showed that the present methodology of the PCT results in construction costs that are generally in the same ballpark as values reported in the design reports. Only Reach H2 from Morganza to the Gulf (Table 16) showed the PCT significantly overestimating Construction Costs, but that difference can be traced back to a significant difference in the unit cost for the levee construction. However, as mentioned earlier in this section, the PCT may significantly be underestimating PE&D, CM and O&M costs.

Table 12. Bayou La Loutre Cost Item Comparison

Cost Item	**Design Value**	**PCT**			**PCT Note**
		Low	**Medium**	**High**	
Construction	$15,000,000	$13,000,000	$14,000,000	$15,000,000	OK
Components	$11,000,000	$9,000,000	$9,900,000	$11,000,000	OK
Comparable	$11,000,000	$9,000,000	$9,900,000	$11,000,000	OK
Mobilization	$3,000,000	$3,800,000	$4,100,000	$4,400,000	OK
PE&D	$3,000,000	$1,300,000	$1,400,000	$1,500,000	Under
CM	$2,200,000	$650,000	$710,000	$770,000	Under
O&M	$160,000	$13,000	$14,000	$15,000	Under

Table 13. Grand Liard Cost Item Comparison

Cost Item	**Design Value**	**PCT**			**PCT Note**
		Low	Medium	High	
Construction	$38,000,000	$37,000,000	$41,000,000	$44,000,000	OK
Components	$31,000,000	$30,000,000	$33,000,000	$36,000,000	OK
Comparable	$28,000,000	$30,000,000	$33,000,000	$36,000,000	OK
Mobilization	$6,900,000	$6,100,000	$6,500,000	$7,000,000	OK
PE&D	$4,200,000	$3,700,000	$4,100,000	$4,400,000	OK

Cost Item	Design Value	PCT			PCT Note
		Low	Medium	High	
CM	$3,500,000	$1,800,000	$2,000,000	$2,200,000	OK
O&M	$81,000	$37,000	$41,000	$44,000	Under

Table 14. Lake Hermitage Cost Item Comparison

Cost Item	Design Value	PCT			PCT Note
		Low	**Medium**	**High**	
Construction	$40,000,000	$37,000,000	$41,000,000	$45,000,000	OK
Components	$36,000,000	$32,000,000	$36,000,000	$40,000,000	OK
Comparable	$33,000,000	$32,000,000	$36,000,000	$40,000,000	OK
Mobilization	$3,800,000	$3,800,000	$4,100,000	$4,400,000	OK
PE&D	N/A	$3,700,000	$4,100,000	$4,500,000	N/A
CM	N/A	$1,900,000	$2,100,000	$2,200,000	N/A
O&M	$30,000	$37,000	$41,000	$45,000	OK

Table 15. Oyster Bayou Cost Item Comparison

Cost Item	Design Value	PCT			PCT Note
		Low	**Medium**	**High**	
Construction	$23,000,000	$25,000,000	$28,000,000	$31,000,000	OK
Components	$19,000,000	$21,000,000	$23,000,000	$25,000,000	OK
Comparable	$18,000,000	$21,000,000	$23,000,000	$25,000,000	OK
Mobilization	$3,800,000	$4,200,000	$4,500,000	$4,800,000	OK
PE&D	N/A	$2,500,000	$2,800,000	$3,100,000	N/A
CM	N/A	$1,300,000	$1,400,000	$1,500,000	N/A
O&M	$19,000	$25,000	$28,000	$31,000	OK

Table 16. Morganza to the Gulf Reach H2 Cost Item Comparison

Cost Item	Design Value	PCT			PCT Note
		Low	**Medium**	**High**	
Construction	$9,800,000	$20,000,000	$22,000,000	$24,000,000	Over
Components	$8,900,000	$18,000,000	$20,000,000	$22,000,000	Over
Comparable	$6,800,000	$18,000,000	$20,000,000	$22,000,000	Over
Mobilization	$970,000	$940,000	$1,000,000	$1,100,000	OK
PE&D	N/A	$2,000,000	$2,200,000	$2,400,000	N/A
CM	N/A	$980,000	$1,100,000	$1,200,000	N/A

Cost Item	Design Value	PCT			PCT Note
		Low	Medium	High	
O&M	N/A	$28,000	$31,000	$34,000	N/A

Table 17. Morganza to the Gulf Reach F Cost Item Comparison

Cost Item	Design Value	PCT			PCT Note
		Low	Medium	High	
Construction	$32,000,000	$28,000,000	$31,000,000	$34,000,000	OK
Components	$31,000,000	$26,000,000	$29,000,000	$31,000,000	OK
Comparable	$21,000,000	$26,000,000	$29,000,000	$31,000,000	OK
Mobilization	$810,000	$1,300,000	$1,500,000	$1,600,000	OK
PE&D	N/A	$2,800,000	$3,100,000	$3,400,000	N/A
CM	N/A	$1,400,000	$1,500,000	$1,700,000	N/A
O&M	N/A	$33,000	$37,000	$41,000	N/A

5.0 CONCLUSIONS AND NEXT STEPS

In general, the PCT tends to produce costs that are on the same order of magnitude as design-level costs for the six projects considered. Table 18 summarizes the results for each other item of comparison, providing next steps and a hierarchy of priorities based on the likely impact each item may have on overall PCT performance. In general, the highest priority items were those that had the largest impact on project-level costs, including ridge and levee sediment volume quantification (specifically regarding the overbuild assumptions), marsh vegetation costs, and O&M related to RR elements. Investigation of more projects with detailed cost estimates (such as were obtained for Bayou La Loutre) is recommended before any specific changes to the PCT are made.

Table 18. Analysis Summary

TYPE	COMPARISON ITEM	CONCLUSION	NEXT STEP	PRIORITY
RIDGE RESTORATION	GENERAL COMPONENT LIST	APPROPRIATELY ASSESSED	INVESTIGATE LARGER RR PROJECTS	LOW
	RIDGE VOLUME	POTENTIALLY OVERESTIMATED	RESEARCH OVERBUILD METHODOLOGY	HIGH
	RIDGE PLANTINGS	POTENTIALLY UNDERESTIMATED	RESEARCH VEGETATION COSTS	LOW
	ACCESS CHANNELS	POTENTIALLY OVERESTIMATED	RESEARCH NAVIGABLE CHANNELS	LOW
	CONTINGENCY	APPROPRIATELY ASSESSED	NO ACTION RECOMMENDED	-
	MOBILIZATION	NOT EXPLICITLY INCLUDED IN DESIGN REPORTS	RESEARCH MOBILIZATION COSTS	LOW
	P/E&D	POTENTIALLY UNDERESTIMATED	INVESTIGATE ADDITIONAL PROJECTS	MEDIUM
	CM	POTENTIALLY UNDERESTIMATED	INVESTIGATE ADDITIONAL PROJECTS	MEDIUM
	O&M	POTENTIALLY UNDERESTIMATED	INVESTIGATE ADDITIONAL PROJECTS	HIGH
MARSH CREATION	GENERAL COMPONENT LIST	MISSING SOME DESIGN COMPONENTS	RESEARCH INCLUSION OF CL ELEMENTS INVESTIGATE LARGER MC PROJECTS	MEDIUM
	MARSH VOLUME	APPROPRIATELY ASSESSED	RESEARCH OFFSHORE SEDIMENT UNIT COSTS	LOW
	MARSH PLANTINGS	NOT INCLUDED IN DESIGN REPORTS	RESEARCH VEGETATION COSTS	HIGH
	CONTAINMENT DIKES	APPROPRIATELY ASSESSED	NO ACTION RECOMMENDED	-

TYPE	COMPARISON ITEM	**CONCLUSION**	**NEXT STEP**	PRIORITY
	SETTLEMENT PLATES	APPROPRIATELY ASSESSED	NO ACTION RECOMMENDED	-
	GRADE STAKES	NOT INCLUDED IN PCT	NO ACTION RECOMMENDED	-
	SHEETPILE GAP CLOSURES	NOT INCLUDED IN PCT	INVESTIGATE ADDITIONAL PROJECTS	MEDIUM
	CONTINGENCY	APPROPRIATELY ASSESSED	NO ACTION RECOMMENDED	-
	MOBILIZATION	APPROPRIATELY ASSESSED	COULD SIMPLIFY METHODOLOGY	MEDIUM
	P/E&D, CM	NOT INCLUDED IN DESIGN REPORTS	INVESTIGATE ADDITIONAL PROJECTS	MEDIUM
	O&M	POTENTIALLY UNDERESTIMATED	INVESTIGATE ADDITIONAL PROJECTS	MEDIUM
PROPOSED LEVEE	GENERAL COMPONENT LIST	MISSING SOME DESIGN COMPONENTS	RESEARCH INCLUSION OF BORROW CANAL STABILIZATION	MEDIUM
	LEVEE VOLUME	INCONSISTENT PCT COMPARISON	INVESTIGATE ADDITIONAL PROJECTS	MEDIUM
	TURF	POTENTIALLY OVERESTIMATED	INVESTIGATE QUANTIFICATION AND UNIT COSTS	MEDIUM
	CLEARING AND GRUBBING	APPROPRIATELY ASSESSED	NO ACTION RECOMMENDED	-
	SWPPP	APPROPRIATELY ASSESSED	NO ACTION RECOMMENDED	-
	PERMANENT RAMPS	NOT INCLUDED IN PCT	NO ACTION RECOMMENDED	-
	BORROW CANAL STABILIZATION	NOT INCLUDED IN PCT	INVESTIGATE ADDITIONAL PROJECTS	MEDIUM
	CONTINGENCY	APPROPRIATELY ASSESSED	NO ACTION RECOMMENDED	-
	MOBILIZATION	POTENTIALLY UNDERESTIMATED	RESEARCH MOBILIZATION COSTS	LOW
	P/E&D, CM, O&M	NOT INCLUDED IN DESIGN REPORTS	INVESTIGATE ADDITIONAL PROJECTS	HIGH

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