CHANNEL MAINTENANCE AND COASTAL RESTORATION IN LOUISIANA

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ABSTRACT

Coastal Louisiana is rich in water resources projects, which have a diversity of purposes. Two of these, navigation and ecosystem restoration, have major roles in the region, and present a formidable challenge to strike a balance for their achievement during project planning and execution. Channel maintenance in coastal Louisiana produces a significant volume of dredged material, requiring sizeable placement areas. Coastal land loss systematically impacts south Louisiana, where vertical sediment accretion is a prominent need. The U.S. Army Corps of Engineers (USACE) Project Management Business Process (PMBP) is used to advance channel maintenance project planning and execution, in connection with opportunistic beneficial use of dredged materials, to address coastal land loss problems. The USACE Environmental Operating Principles guide plan formulation, evaluation, and selection, with a view towards ecosystem sustainability. Resulting for each waterway is a Dredged Materials Management Plan (DMMP), which serves as a life cycle guide to conducting annual project Operations and Maintenance (O&M). The effort requires use of a Project Delivery Team (PDT) concept, where USACE professionals interact with customers, partners, and stakeholders, to solicit their views of project conditions and needs. Produced is a set of sustainable plans for prioritized execution within budget constraints to provide the levels of navigation service required. A survey of projects located in southeast Louisiana characterizes the effectiveness of this approach.

Key Words: Water resources planning and management; channel maintenance; coastal restoration; dredging.

INTRODUCTION

Setting

The Mississippi River drains about 41% of the continental United States and two Canadian provinces. Approximately 40% of America's coastal wetlands reside at the lower end if the Mississippi River's drainage basin where it meets the Gulf of Mexico. This estuary experiences about 80% of coastal wetland loss nationwide, which equates to a loss rate of about 25 square miles (64.7 square kilometers) per year, (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998). Causes of this land loss stem from both natural and anthropogenic factors, which include: relative sea level rise; normal tidal interaction and high energy storm events; development and usage of waterways and wetlands for flood damage reduction, navigation, agriculture, and for other human needs; and minerals extraction. Significant effects resulting from these causes are subsidence and erosion; saltwater intrusion; and loss of hydrological structure and function of the estuary. In some cases, these causes and effects interact to result in a greater cumulative impact than where occurring as independently acting events. The Louisiana Coastal Area (LCA) has lost about 1,500 (3,885 square kilometers) square miles since the 1930s, and is poised to lose another 1,000 square miles (2,590 square kilometers) by the year 2050, with no action beyond currently authorized programs and projects (Dunbar, Britsch, L.D., and Kemp, III, E.B., 1992).

Governmental agencies and the public worked cooperatively to produce the 1998 Coast 2050 Plan – a compendium that characterizes Louisiana's coastal land loss problems and potential protection and restoration strategies. The Coast 2050 Plan identifies three main categories of coastal processes, functions, and values, that are required to sustain Louisiana's coast: (1) sediment input and accretion for maintenance of emergent vertical elevation, which is necessary to provide the right conditions for habitation by coastal flora and fauna; (2) freshwater and nutrient input for establishment of an estuarine gradient, which provides conditions for ecosystem biodiversity; and (3) hydrologic basin interconnectivity for exchange of energy and organisms within the wetland interior as well as with open

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waters, for increased wildlife productivity (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998).

The LCA Program was initiated in 1999 as a multi-agency and stakeholder effort. A 2004 Chief of Engineer's Report (USACE, 2004) identified a wide range of projects for implementation to address coastal land loss in Louisiana. Many are complex projects of considerable scope, which will require a sustained effort and considerable cost-shared funding in the billions of dollars to develop and implement. The LCA Program classified beneficial use of channel maintenance dredged materials as a best practice effective for addressing coastal land loss opportunistically in the near term. Successfully achieving beneficial use involves many different parties, dynamic planning and execution processes, and well-established lines of communication. The district's O&M Program has made significant strides in the last 10 to 20 years using this approach – making continual improvements along the way. It will serve as a pattern for a cooperative effort between the O&M and LCA Programs to synergistically attain restoration goals for coastal Louisiana.

Program Authorities and Project Development Criteria

The USACE, New Orleans District, actively performs O&M on twelve shallow and deep draft channels, moving significant volumes of dredged materials annually. Figure 1 presents an overview of the most active channel maintenance projects in the district. Some of these projects are maintained periodically. Many of the projects require annual maintenance, with a few under nearly continuous dredging year round. The 1999-2004 average annual quantities dredged by the district is 59 million cubic yards (MCY) (45.1 million cubic meters – million CM, or MCM), at an average annual cost of about $72 M (IWR, 2005).

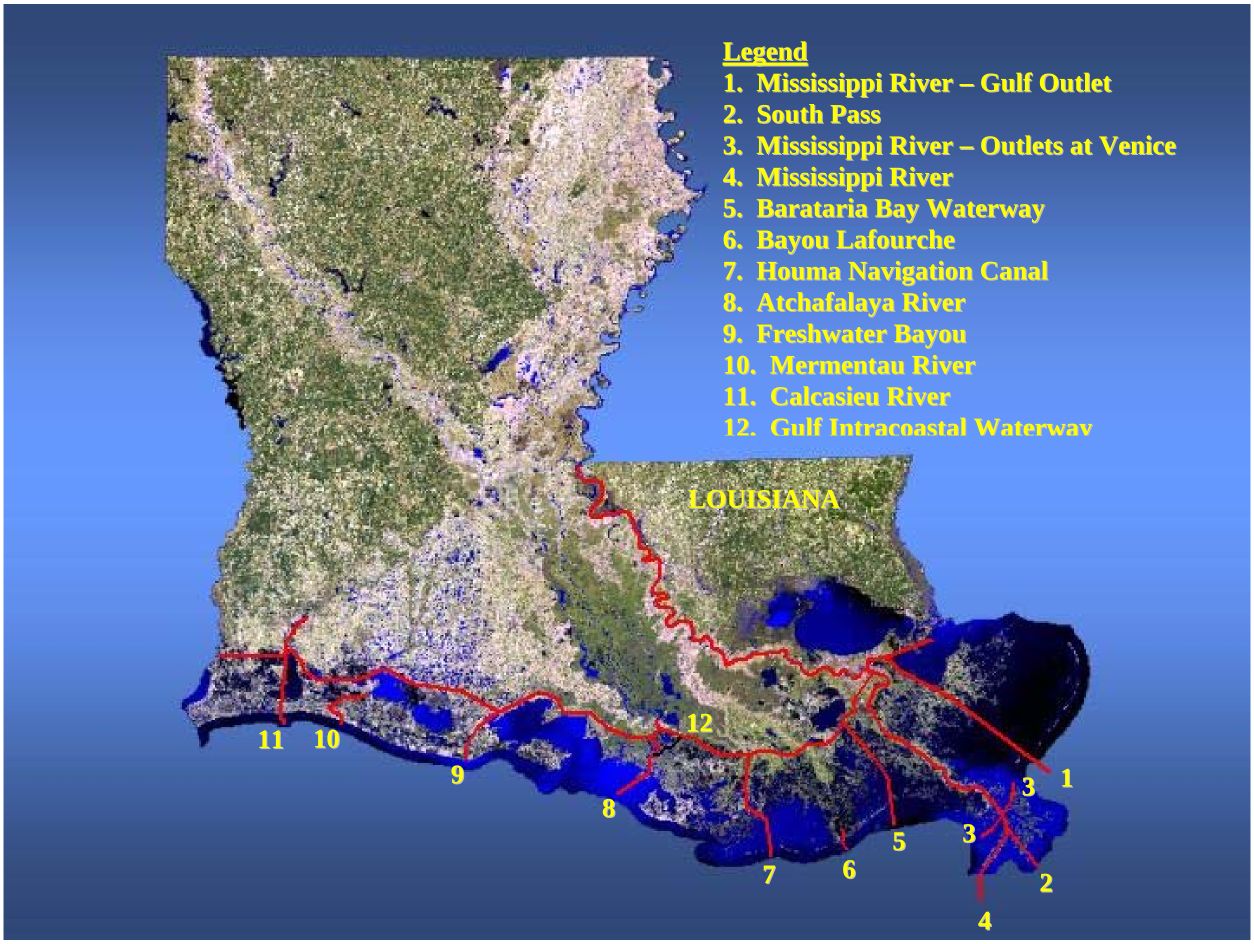

Figure 1. Active Channel Maintenance Projects in the New Orleans District.

Dredged materials placement performed during channel maintenance dredging must be conducted according to prescribed criteria, when funded and executed under the Corps' O&M General Appropriation. Under the O&M Program, dredged materials placement plans must be formulated according to the Federal Standard. The Federal Standard, or Base Plan, requires that dredged material placement alternatives be identified at least cost, consistent with sound engineering practices and meet environmental standards established by the Section 404 (b)(1) evaluation process or ocean dumping criteria (33 CFR 335-338).

The Section 204 Program may be employed to perform beneficial use of dredged materials in cases where it is beyond the scope of the O&M Program. The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) presents similar opportunities in coastal Louisiana for beneficial use. A third venue, the LCA Program, may also provide for beneficial use above that possible in the O&M Program in the future. These latter three programs have been traditionally sponsored by the State of Louisiana's Department of Natural Resources for beneficial use projects conducted in the New Orleans District.

MANAGEMENT STRATEGY

Project Management Business Process (PMBP)

USACE (2001) describes the Corps' PMBP, which is the basis for performing channel maintenance and dredged materials placement. Paramount to successfully conducting beneficial use of dredged materials is having the leadership of an Operations Manager (OM), who engages the customers, partners, stakeholders, and technical team involved with each channel maintenance project, from the beginning of project planning through its execution. The customers in this case are the navigation interests, which include, for example: port authorities, shipping interests, pilots, and the U.S. Coast Guard. Partners for beneficial use are those entities that are non-federal sponsors for cost sharing and/or acquisition of Lands, Easements, Rights-of-Way, and Relocations (LEER). Stakeholders include local, state, and federal natural resource/regulatory agencies, elected officials, special interest groups, and the general public. The technical team includes those members of the Corps' engineering, environmental, economics, real estate, contracting, construction, operations, and maintenance staff. These professionals reside at the district, as well as in the vertical team, and at the Engineer Research and Development Center (ERDC). The vertical team includes Headquarters USACE, as well as the District Support Team (DST) located at the New Orleans District's Major Subordinate Command, the Mississippi Valley Division. Collectively, these groups form the PDT.

Environmental Operating Principles (EOPs)

The EOPs (USACE, 2002) serve as the basis for planning and executing channel maintenance. The strategy is to reduce channel sedimentation in synergy with implementation of management and structural measures that promote ecosystem sustainability while simultaneously reducing life cycle costs. Beneficial use of dredged materials is a key component in this strategy, where dredged materials are considered a resource, not a waste material. Related measures include providing bank/shoreline protection to abate erosion of adjacent emergent features, which if not implemented, lead to continued erosion-related channel shoaling and subsequent cyclic channel maintenance needs.

Dredged Materials Management Plan (DMMP)

Engineer Regulation (ER) 1105-2-100 (USACE, 2000a), Appendix E, describes DMMPs. Federally operated and maintained navigation channels are required to have sufficient capacity for placement of dredged materials for a minimum life cycle of 20 years. If there is insufficient capacity, a DMMP must be developed, identifying the Federal Standard/Base Plan. A preliminary assessment must show that the economic benefits outweigh the channel maintenance costs over the life cycle under consideration for justification of continued channel O&M. An Environmental Impact Statement (EIS) must be conducted in conjunction with DMMP development to meet environmental compliance requirements. Operations Management is responsible for advancing a DMMP where required, using existing authorities, with the support of the PDT using the PMBP. The completed DMMP is submitted for consideration of approval by higher authority.

PLANNING AND EXECUTION PROCESS

Channel maintenance is managed in phases, which include: (1) DMMP development, (2) Pre-Construction, Engineering, and Design (PED), and (3) construction. Figures 2, 4, and 5 present flow charts for each phase, which fit successively in series. Each task of these flow charts is identified with numbering shown at the lower right of each task block. This system of reference is used in the following elaboration of each management phase.

DMMP Development Phase

T.1-T.3. Management Initiation of Project; Lead Teams, Coordinate Funding; Conduct/Attend Regular PDTs. A Project Management Plan is developed to outline the project tasks, timelines, involved parties, costs, and expected outcome. Pursuant to this, the OM: announces start of the project to the PDT, soliciting time and cost estimate input; establishes resources, tasks, and schedules, for the PDT to conduct work; and sets up regular meetings of the PDT. Prior to the first meeting, the OM requests that the PDT assembles existing technical information of the project area for integration and group consideration. The OM tracks PDT progress, identifies/resolves problems, and reports on project accomplishments. Meeting minutes for each event are composed and distributed to the PDT to document progress and list outstanding issues.

T.4. Obtain Channel Surveys. The OM schedules hydrographic surveys of the channel, referenced to the appropriate datum controls. The surveys are processed to characterize shoaling rates and patterns for PDT consideration.

T.5. Draft Scope and Plan. The PDT convenes on multiple occasions to review the existing conditions map, which has overlays of features critical to identifying a draft scope and plan. Key features for preliminary analysis include: aerial photography; real property lines; channel geometry and existing dredged materials placement areas; as well as existing features that may impact the project, such as cultural resource sites, buried utility lines, and oyster leases. Experience and judgment are heavily relied upon in this early stage. There are dynamic interactions of customers, partners, stakeholders, and interdisciplinary staff, to define the problems, needs, opportunities, and constraints. The object at this stage is to decide dredging requirement frequency and quantity by reach, as well as several proposed dredged materials placement sites for investigation. It is a consensus-based approach, where members of the PDT strive to collectively shape the scope and plan in a series of meetings.

T.6. Obtain ROE for Field Investigations. Rights-of-Entry (ROE) to conduct field investigations are secured for areas that the PDT identifies as areas having reasonable potential for dredged materials placement. ROE is normally secured through the acquisition agency for the channel maintenance project.

T.7. Obtain Field Surveys. Topographic and bathymetric surveys are acquired and plotted for the sites identified by the PDT for investigation. This data is normally used to determine site capacity for dredged materials placement, considering diking, ditching, and effluent return requirements. Surveys will also provide input for determining the ability to construct dikes at the site.

T.8. Obtain Subsurface Information. Acquisition of geotechnical information at sites being investigated is necessary to determine bearing capacity, slope stability, and settlement of dikes that would be constructed, as well as for defining borrow sources for dike building. Subsurface information of site water bottoms is also important for estimating displacement of very soft and/or unconsolidated soils at the water bottom during dredged materials placement, if any, as well as subsidence of the dredged materials placement substrate.

T.9. Obtain Hydraulics Input. Information on waves and currents are estimated to gain an understanding of hydraulic forces that must be designed for during the project, which affects the type, size, and strength of structures used.

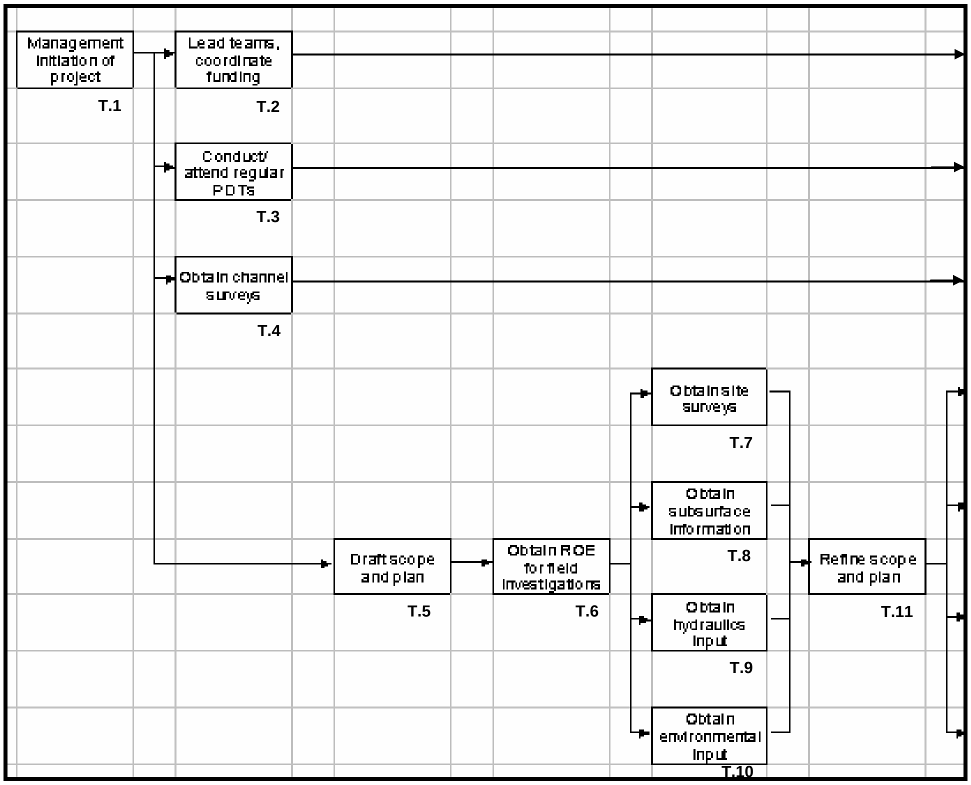

Figure 2. DMMP Development Phase.

T.10. Obtain Environmental Input. A determination of habitat types is made for areas to be investigated, as well as a delineation of cultural resources that may be in the area. Recommendations are made to avoid and minimize adverse environmental impact, and ways are offered on how dredged materials could be used for beneficial use to restore/protect the environment.

T.11. Refine Scope and Plan. Several scales of preliminary engineering designs are formulated using environmental and real estate input. PDT members review and comment on the preliminary engineering designs for refinement of the scope and plan. The scope and plan must go through several iterations of revision before prospective sites for materials placement have enough details to be considered technically complete as alternatives. Public input is solicited for consideration in shaping the scope and plan. Once the PDT has agreement on the shape of the scope and plan, there are a number of placement sites designed to a level of detail of sufficient technical adequacy so that cost estimating can be conducted to determine the life cycle cost of using each for dredging a specified channel reach or reaches.

Combinations of dredging reaches and alternative dredged material placement sites can be evaluated using Cost Effectiveness/Incremental Cost Analysis (CE-ICA) to identify the Base Plan. This approach is qualitatively shown in Figure 3. If there is a relatively small incremental cost above the Base Plan where beneficial use would be conducted in lieu of upland and/or open water disposal, the OM has discretion in the DMMP guidance to select the beneficial use alternative. If there is an alternative above the Base Plan that is significantly beyond the Base Plan/Federal Standard, where beneficial use would be had in lieu of disposal, an ecosystem restoration authority may be sought to cost share that increment above the Base Plan/Federal Standard. Once the alternatives have been identified for dredging by reach, for either beneficial use and/or disposal, conducted under one or more authorities, they may be described in the DMMP and addressed in the accompanying EIS. Also, a preliminary economic analysis is performed to indicate whether or not continued project O&M is justified according to the developed DMMP.

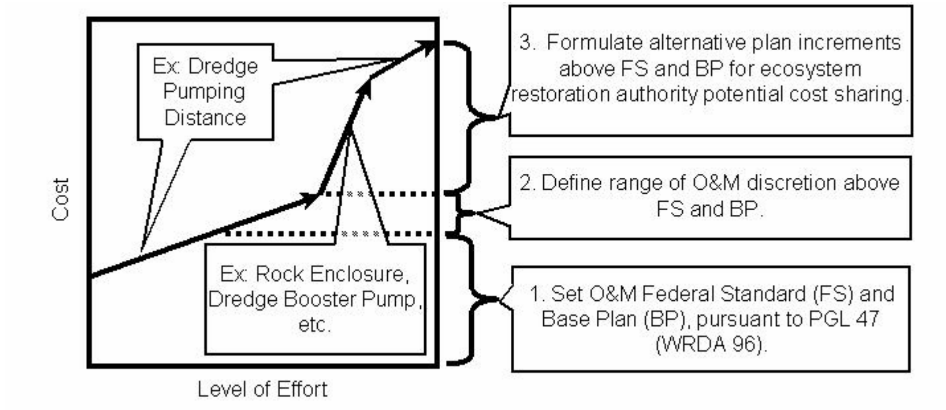

Figure 3. Cost Effectiveness/Incremental Cost Analysis (CE/ICA) of Alternative Plans.

PED Phase

T.12. Develop Draft P&S. Based on the DMMP, draft Plans and Specifications (P&S) are developed by the PDT, considering specific details for the upcoming life cycle, such as dredging template, dredging limits, and quantity to be removed.

T.13. Obtain Water Quality Input. Information is obtained on the specific dredging and materials placement scenario that will be conducted in the dredging event for acquisition of Water Quality Certification.

T.14. Conduct Environmental Compliance. If there are any deviations from the DMMP/EIS in the draft P&S for the specific event under consideration, additional environmental compliance is secured to address those details.

T.15. Conduct O&M Environmental Compliance. A Federal consistency determination is provided to the Louisiana Department of Natural Resources and concurrence is obtained for the specific dredging event to be conducted.

T.16. Obtain ROE/ROW for Construction. ROE and Rights-of-Way (ROW) for construction are secured through the acquisition agency for the specific dredging event that will occur.

T.17. Conduct BCOE Review. The PDT reviews and comments on the draft P&S.

T.18. Resolve Comments and Finalize P&S. PDT comments are used to revise and finalize the P&S.

T.19. Provide BCOE Certification. The finalized P&S are checked for resolution of all comments and certified as complete.

T.20. Provide Legal Certification. The finalized P&S are reviewed for legal sufficiency.

T.21. Format, EBS, P&S; Initiate Contracting. The P&S are next formatted and converted into an Electronic Bid Set (EBS) for the initiation of contracting.

T.22. Synopsize and Advertise Solicitation. The PDT supplies all necessary information for solicitation advanced notice and solicitation advertisement on the internet. The solicitation may be advertised with or without a bid opening date set.

T.23. Develop Amendments. As an optional step, amendments are developed as necessary to make adjustments to the solicitation.

T.24. Develop Engineering Cost Estimate. Just prior to the bid opening date, a market survey is conducted and engineering cost estimate developed.

T.25. Amend Solicitation. If a bid opening is established upon advertisement, this step is omitted. If the solicitation was advertised with bid opening by amendment, the bid opening date is set by amendment in this step.

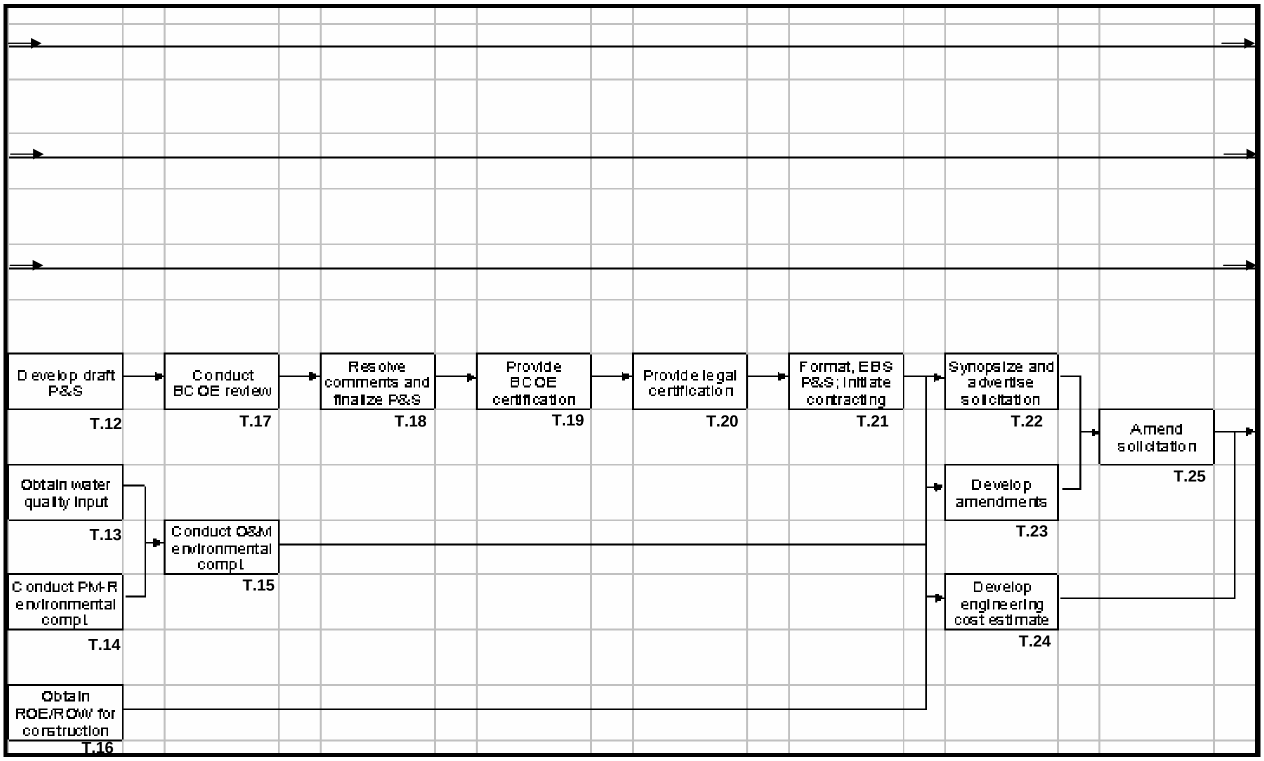

Figure 4. PED Phase.

Construction Phase

T.26. Conduct/Attend Bid Opening. The OM and PDT often attend the bid opening to obtain the results as they become available.

T.27. Conduct Contract Award. Pending a successful bid opening for sealed bidding formatted contracting actions, the contract is awarded to the apparent low bidder meeting the requirements for award.

T.28. Issue NTP. After contract award, the government issues the Notice to Proceed (NTP) to the contractor for the initiation of work. This is the start day under the maximum days of contract duration allowed to complete work.

T.29. Conduct/Attend Precon Meeting. The "Precon," or Pre-Construction meeting, is held with the contractor by the government to review the work requirements set forth in the contract and obtain the contractor's plan of work to address these requirements.

T.30. Administer Contract. The government administers the contract to track progress, quantify completed work, and disburse monthly payments.

T.31. Conduct/Attend Site Visit. The OM and PDT often make site visits to inspect the work, identify if there are any problems for resolution, and determine what improvements may be made for the next cycle of work.

T.32. Handle Mods/Claims. If there are changes that must be made during the course of work that were unforeseen during solicitation advertisement, they must be quantified and negotiated with the contractor for equitable compensation. This is handled via "mod," i.e., contract modification, or a contractor claim.

T.33. Complete NCR; Close Out Contract. The Narrative Completion Report (NCR) and "As-Built" drawings are developed to document the physically completed contract actions, and the contract is closed out as financially complete.

T. 34. Management Close Out of Project. The OM closes out the project by obtaining post-dredging hydrographic surveys for reporting, and concludes document and financial management of the initiative.

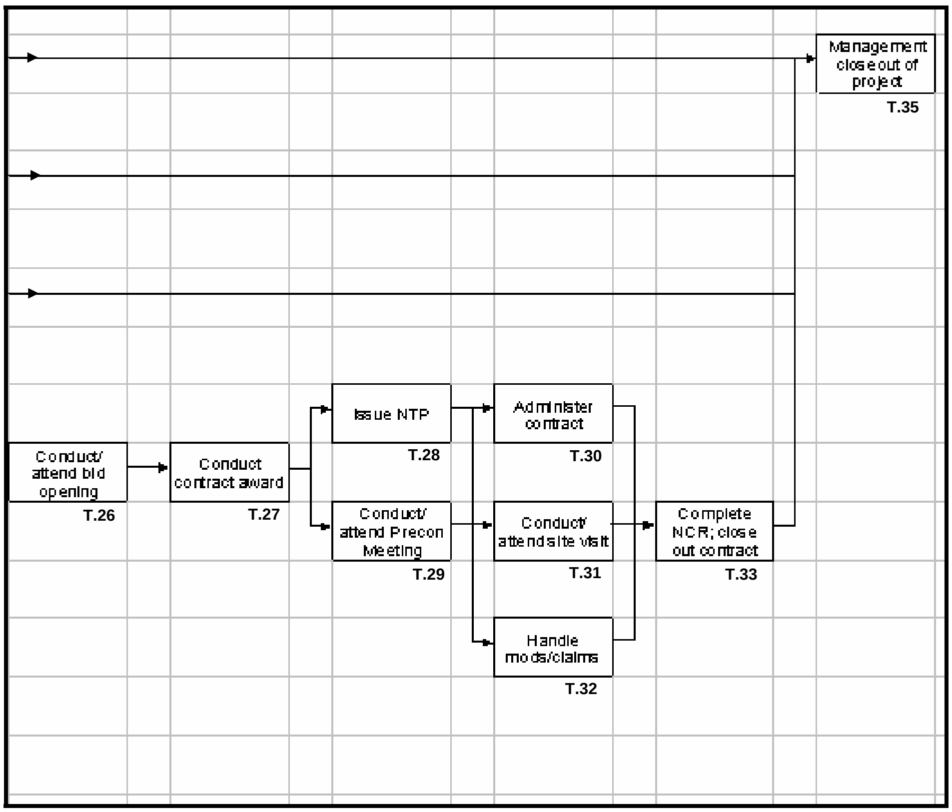

Figure 5. Construction Phase.

Beneficial Use Monitoring Program (BUMP)

The New Orleans District contracted with the University of New Orleans' Department of Geology and Geophysics for development and implementation of a large-scale monitoring program to quantify the amount of new habitat created and to improve dredge materials placement techniques for continual process improvement to maximize beneficial use into the future. Each year, vertical photography is acquired and digital mosaics are produced for each of the study sites shown in Figure 6. Geospatial Information System (GIS) habitat analysis and field surveys are conducted on only those sites specified by the district. The work products for the sites selected for full monitoring include dredging history maps, habitat maps for the base year, habitat maps for the selected monitoring years, and habitat change maps. From this analysis, coastal change data quantifies the creation of new coastal lands and other habitats at selected navigation channel locations. The field program includes information about vegetation, disposal elevations, and placement practices that maximize beneficial use (USACE, 1998).

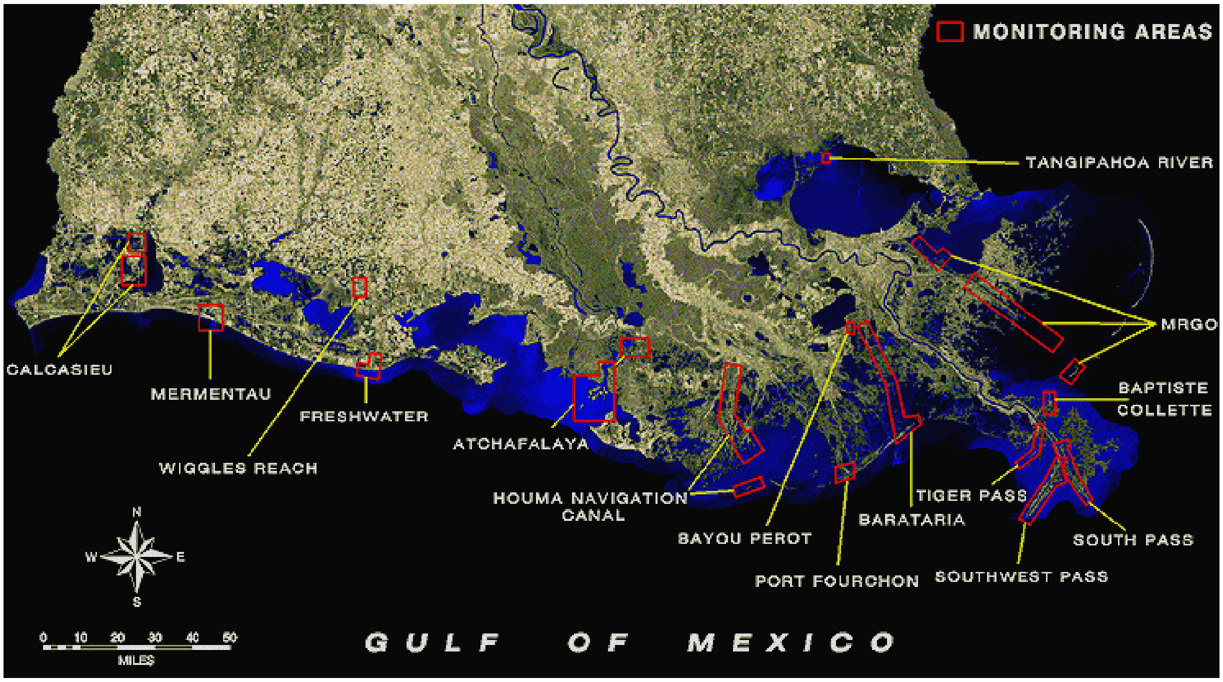

Figure 6. BUMP Regions of Monitoring and Analysis.

SELECTED CASE PROFILES

Planning Scenario

Dredged material placement planning is portrayed in the following, where the PDT considered beneficial use in comparison to a non-beneficial use alternative. The purpose was to understand whether or not costs were competitive enough to execute the beneficial use plan in lieu of upland disposal for dredged material from Mi. 50.0 to 47.6 of the Mississippi River – Gulf Outlet (MRGO), Louisiana. About 395,000 CY (301,988 CM) would be dredged and placed. Figure 7 illustrates the beneficial use placement site, which is labeled "DA F". The site labeled "DA 51," is the upland disposal site for comparison in cost for dredging the prescribed reach. Materials placement for beneficial use would involve constructing small, sacrificial earthen dikes to guide the dredged materials, which would be placed in a semi-confined manner into shallow open water pockets residing within deteriorating wetlands. The non-beneficial use alternative would involve re-constructing large Confined Disposal Facility (CDF) dikes of an existing CDF to engineered cross sections and alignments, for sufficiency in containing the dredged materials. For the beneficial use alternative, about 7,500 linear feet (LF) (2,286 meters – M) of sacrificial earthen guide dikes would be constructed/re-built. Silt curtains also would be used to direct dredged materials flow in the beneficial use plan. The upland disposal (i.e., non-beneficial use) plan would involve constructing and maintaining about 15,000 LF (4,572 M) of CDF-caliber dikes. The dredging and materials conveyance costs would be about the same for each alternative. However, the CDF diking/management costs are about 100% more costly than construction of sacrificial earthen guide dikes for beneficial use. In this case the beneficial use alternative is about 8% less expensive than that for non-beneficial use. Approximately 82 acres (0.332 square kilometers) of wetlands would be created in the former, whereas disposal within the CDF would produce upland habitat with relatively lower ecosystem benefit.

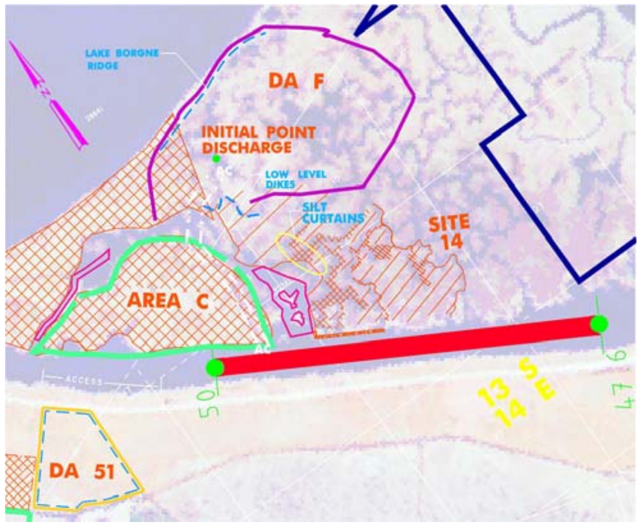

Figure 7. Comparison of Beneficial Use and Non-Beneficial Use Alternatives.

Construction Scenario

Two beneficial and two non-beneficial use placement sites were constructed in 2004 during dredging of MRGO, Mi. 56.7 to 49.9 reach. An example of each is illustrated in the following. These examples indicate the potential outcomes of the planning scenario previously discussed.

Figure 8. Beneficial Use Site Area "B".

Areas "B" and "D" were used for beneficial use in this construction scenario, where 25.7 and 235.5 acres (0.104 and 0.953 square kilometers, respectively) of wetlands were created, respectively. A total of about 348 acres (1.41 square kilometers) of existing wetlands were nourished during the materials placement process at these two sites. While Site "B" seems relatively small in size, it has significance as a coastal land bridge, separating the MRGO from Lake Borgne. Figure 8 presents a low aerial view of Site "B" after construction. Site "D" (not shown) performs a similar function, but in an area less vulnerable at present. Figure 9 is a close-up view of a small, sacrificial earthen guide dike at Site "B," taken mid-way along the MRGO side of the site. It stood about 5 feet (1.52 meters) tall during construction.

Figure 9. Sacrificial Earthen Guide Dike – Area “B”.

CDF Sites SB-S and SB-N were used for upland disposal during this maintenance event. Figure 10 is a low aerial image of Site SB-S. Images of Site SB-N are not shown. Figure 11 is an image of the CDF dike and weir structure at Site SB-S, which stands about 10 feet (3.05 meters) tall.

Figure 10. Upland Disposal Area SB-S.

Figure 11. CDF Area SB-S –CDF Dike and Weir Structure.

SUMMARY OF COMPLETED WORK

Approximately 25% of the channel maintenance materials dredged in the New Orleans District are used beneficially. Figure 12 presents a summary of the cumulative landscape change history that occurred as a result of beneficial use activities conducted from 1985 to 2000.

Site	Acres	Square Kilometers
Atchafalaya River-Avoca Island	1065.6	4.312
Atchafalaya River-Delta	2924.4	11.835
Atchafalaya River-Horseshoe	1255.5	5.081
Baptiste Collette Bayou	6238.9	25.248
BBWW - Bay Reach	59.8	0.242
BBWW - Grand Terre Island	121.4	0.491
BBWW - Inland Reach	141.0	0.571
Calcasieu River - Brown Lake	194.9	0.789
Calcasieu River - SNWR	745.1	3.015
Freshwater Bayou	20.6	0.083
HNC - Bay Chaland	13.3	0.054
HNC - Wine Island	48.1	0.195
Mermentau River	62.9	0.255
MRGO - Inland	288.7	1.168
MRGO - Jetties	319.3	1.292
MRGO - Breton Island		0.000
Mississippi River, South Pass	396.4	1.604
Mississippi River, Southwest Pass	2574.2	10.418
Tiger Pass	346.6	1.403
Total =	16816.7	68.1

Figure 12. Cumulative Landscape History – 1985-2000 (USACE, 2000).

CONCLUSIONS

Beneficial use can be identified as the selected alternative during the O&M dredge planning process when sustainable concepts are employed during plan formulation/evaluation and such plans are cost competitive to non-beneficial use placement options. A community effort by those involved with the channel maintenance-dredging program is required for maximizing beneficial use within authority and budget constraints. In this way, the O&M Program has played a valuable part in addressing coastal land loss in south Louisiana. The planning and execution approach used in the O&M Program serves as a template for successfully coupling the navigation and ecosystem restoration missions of the Corps. Leveraging of multiple program authorities in ways that work synergistically with each other, is a strategic means to enhance the potential for conducting beneficial use within the O&M Program and beyond, for reaching restoration and protection goals in coastal Louisiana.

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