Sand, Silt, and Strategy: Restoring Beaches and Beyond in Mississippi

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Life is indeed a beach…until it is not. This speaks to the starring role of sand in coastal management and the critical supporting role played by silts and clays. Mississippi has famous examples of both. Its 26-mile man-made sand beach beckons tourists, while Mississippi is nationally known for its nearly 20-year-old beneficial use of dredged material program which strives to apply all dredged materials to an environmental benefit.

Beneficial use (BU) is an essential step in addressing coastal land loss which normally replaces the lost land with new material. Historically, materials were replaced by active means such as pumping or machine placement. Passive measures such as living shorelines, which build land by trapping material from natural sediment transport systems, are becoming more common but are left to another discussion (See, *Living Shorelines, How to Keep the Coast the "Coast"* by Eric Sparks). Instead of these practices, BU uses dredged materials to replace eroded land.

Importance of Beneficial Use Practices

Coastal erosion drives the application and importance of BU in Mississippi. Coastal erosion occurs through sea level rise and land subsidence, leading to land loss such as the conversion of marsh to open-water or erosional shoreline retreat. Mississippi has lost approximately 15,000 acres of land over the last 70 years. BU is used to replace the lost land or to slow the loss.

Overall subsidence rates in Mississippi are lower than in Louisiana, which has suffered significant loss. Mississippi marshes have maintained accretion sufficient to avoid severe fragmentation. However, marshes compose a large percentage of Mississippi's 200-acre plus annual land loss because they are stripped away daily, as well as by storm-driven wind and waves. This scenario known as shoreline retreat is expressed particularly in the natural shores of Hancock and Jackson Counties which can crumble inland 30 feet or more annually.

In Mississippi, primary losses are along eroding shorelines which are more exposed than interior open water areas. This edge erosion typically appears as a vertical face, or scarp, that often grades to significant depths of five feet or more immediately adjacent to the shore. This scenario generally requires a protective structure such as a breakwater or sand berm in order to place silt/clays thickly enough to form new marsh base. Accommodating this type of structure adds complexity and cost to a project.

How Beneficial Use Works

The first rule of fixing something is to quit breaking it. Sand, silts, and clay are, respectively, coarse grained to fine grained geologic materials, attributes that strongly define how they behave in the environment. Dredging is a common method of removing unwanted materials from navigation channels, marinas, and other areas. However, dredging also transports sediment which historically has increased coastal erosion by removing geologic material from its natural transport system and disposing it into a landfill or offshore ocean disposal area. Beneficial use completely flips this equation by reapplying dredged materials within the natural sediment transport system such as a bay, sound, or other aquatic area. Specifically, BU recycles materials that have been dredged for navigation or other reasons and uses them for filling eroded areas instead of discarding them. This reduces environmental impacts that would occur for projects that initiated new dredging to supply material. It can also be cheaper. In fact, for Mississippi, BU has often proven to cost less than disposal.

However, there are creative challenges to applying BU in Mississippi. Due to our geology and coastal dynamics most dredged materials in Mississippi are not pure sands containing less than 5% fines (silt/clay). Typically, silt/clay

materials are not appealing for beach applications, and using them involves more administrative and technical challenges than when working with pure sand. For example, sand settles (consolidates) rapidly while silt/clays can take days or months to solidify. This complicates both the permitting process and the physical application of these materials. A permit must regulate turbidity, and suspended silt/clays may require control measures in the permit to prevent unwanted impacts to the environment. Application of silt/clay is challenging because protective or containment structures are required to be built until the material settles. However, tidal marsh, which has a silt/clay substrate, is highly receptive of our typical BU materials.

Background of Beneficial Use in Mississippi

Beneficial Use in Mississippi accelerated in 2001 with publication of the *Beneficial Use of Dredged Material and Concrete Rubble Plan*,[1] along with significant leadership from the US Army Corps of Engineers (USACE) Mobile District, and Mississippi congressman Gene Taylor.[2] This included a national mandate regarding regional sediment management and BU. An initial project by the Corps in 2001 with MDMR as state sponsor was proposed on the east end of Deer Island near Biloxi.

Mississippi began working more programmatically in 2008, with the development of the Mississippi Beneficial Use Group (BUG) modeled after a similar group established at the Port of Houston. The BUG brought local, state, federal, private, and NGO stakeholders together to conceive, permit, and implement BU-based restoration projects in a more efficient and timely manner. By 2010 the BUG successfully pursued an amendment to legislation requiring dredging activities of over 2,500 cubic yards to demonstrate suitable materials and beneficial site.[3] Although Mississippi's ability to permit and build BU sites limited the effectiveness of this amendment, it helped to emphasize BU as a priority for the state and has anecdotally improved interest and participation in BU. In 2011, the original 2002 BU planning documents were updated into a Master and Implementation Plan.[4]

Suitability Determinations

Another key issue under BUG consideration was the suitability determination for dredged materials. The goal was to develop cost-effective, accurate, and efficient means of assessing contaminants before dredging to determine if they are clean for restoration purposes. Concern over potential contaminants is an issue for BU programs owing to problems from industrial areas such as the Midwest and Northeast. However, Mississippi has comparatively little history of heavy industry. This explains why, after a decade of testing, a distinct majority of dredged materials in the state are deemed suitable, whereas unsuitable materials appear to be localized to relatively well-defined areas.

Suitability determinations need some work, such as more efficient screening. Typical sampling and testing costs thousands of dollars. This makes it cost prohibitive for smaller dredging projects (less than 2,500 cubic yards) in residential or non-industrial areas where materials could easily be used for restoration projects in some of Mississippi's smaller, confined waterways. Suitability determination testing methods need improvement, as some methods such as bioassays, which were designed for sediments normally containing significant amounts of organic carbon, are applied to geologic material from the sub-surface that does not contain sufficient carbon to support an accurate test. For example, a failed bioassay for the Port of Gulfport required testing to be rerun at a cost of about $700,000. Upon retesting, the materials were confirmed to be suitable without any significant reservations. A revision to suitability determinations could exclude such virgin materials from analysis.

Figure 1.
Round Island 2013 - Phase #1 – Looking northwest (training dike and initial island habitat)

Round Island

Round Island, about 2 miles offshore of Pascagoula, emphasizes the importance of BU in coastal restoration. It is the largest state-initiated BU restoration project in Mississippi. The project was to restore relict eroded portions of Round Island which had shrunk from about 700 acres to approximately 30 acres over 300 years.

Extensive shallow (1-3 ft.) sand shoals remained as vestiges of the island. Meanwhile, a dredging operation was underway in the Port of Pascagoula which could supply several million cubic yards of material for the restoration. However, during that process, the economic circumstances of the state changed, and the project was scaled back significantly. At that point, the project's 220-acre perimeter had already been established with a preliminary sand "training" dike several feet high dug from the interior of the sandy shoal. But the reduced dredged material yielded only about 20 acres of fill for the interior (Figure 1).

In 2016 a USACE project to widen and deepen the Pascagoula Ship Channel would yield 5 million cubic yards (MCY) of dredged material (enough to fill the Superdome to the roof) slated for offshore disposal. The majority of this material would be "new cut" virgin geologic material particularly valuable for restoration use as it is denser and more structurally resilient than "maintenance" material that, for example, has floated into a navigation channel. Using money from the 2010 Gulf Oil Spill, the National Fish and Wildlife Foundation (NFWF), Mississippi Department of Environmental Quality (MDEQ), MDMR, USACE, and the Port of Pascagoula coordinated to build out the entire 220-acre permitted footprint on Round Island. NFWF began aligning $10 million to fund construction of the full design sand berm – approximately 4,500 yards long, 100 yards wide, and 3 yards high. The berm was constructed by dredging the existing shoal down to a depth of about 12 ft. and pumping it along the existing training dike.

The project was essentially completed by early 2017. USACE pumped about 3.3 MCY directly through 5 miles of 30-inch diameter steel pipe into the new berm enclosure on Round Island, leaving a breach on the north end of the project to allow for tidal exchange. The end result is over 4,500 yards of new native sand beach enclosing about 150 acres of fine silt/clay pumped to elevations mimicking local elevations for natural marsh (Figure 2).

The Round Island restoration is a sterling example of the alignment of critical resources: a permitted project, a material source, a diverse group of agencies willing to work to a common goal, and finally, funding. However, Round Island is not a laurel on which we should rest. At 220 acres, this project theoretically only replaced one year of habitat loss which continues unabated with no comparable projects permitted.

Figure 2.
Round Island 2020 – Looking southeast
(original remaining island with trees to the right)

The BU materials regularly laid at our feet in Mississippi can be used to best advantage if we prioritize comprehensive science and planning to guide restoration using system-wide goals. This process will likely include efforts to expand acquisition of existing and new monitoring data and link hydrodynamic models. This will enable us to understand the estuary system centered by the Mississippi Sound, known as the Louisiana, Mississippi, Alabama Coastal System or LMACS. Understanding LMACS and the eroding barrier islands and marshes that regulate salinities, wind/wave energies, and other key factors from the Gulf of Mexico is critical. Concurrently, understanding natural riverine inflows and possibly more urgently, anthropogenic inflows from the Bonnet Carré Spillway (which disrupt estuary function) is also vital. Understanding the history and potential future function of the system will allow us to restore not just expanses of habitat but simultaneously address the erosion and forms that regulate primary estuary function in the LMACS.

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Endnotes

1. *See also*, Lynn R. Martin, *Authorities and Policies Supporting Implementation of Regional Sediment Management*, U.S. Army Corps of Engineers (ERDC/CHL CHETN-XIV-8 2002).
2. Rep. Taylor led efforts in Mississippi to reuse concrete rubble to environmental advantage creating nearshore artificial reefs such as Taylor Key near Pass Christian.
3. 2010 Miss. Laws Ch. 412, H.B. No. 1440, amending Miss. Code Ann. § 49-27-61(2).
4. Gulf of Mexico Alliance, Habitat Conservation and Restoration Team, *Master Plan for the Beneficial Use of Dredged Material for Coastal Mississippi* (2011).