Cost Effective Dredging in Mobile Bay: Possibilities for Sustainable Dredged Material Management

By:

Samantha Islam, PhD (Corresponding Author)
Assistant Professor
University of South Alabama
Mobile, AL 36688
Phone: (251) 460-6955
Email: sislam@usouthal.edu

Jacqueline Parks
Undergraduate Student
University of South Alabama
Mobile, AL 36688
Phone: (251) 460-6174
Email: jjp901@jagmail.southalabama.edu

Submitted in response to the Call for Papers on: “Environmental Sustainability” by AW010 the Committee on Ports and Channels

Number of Words: Abstract 233 + Body 4082 + 3 tables + 9 Figures = Total 7315

Key Words: Dredging, Sustainability, Coastal restoration, Hopper dredge, Pipeline dredge

Submitted to the Transportation Research Board for presentation and publication

Date of Submission: August 1, 2012
Revised: November 14, 2012
ABSTRACT

This paper describes a study performed at the University of South Alabama to determine the cost-effective method of dredging in Mobile Bay and to explore the possibility of utilizing the dredged materials in an environmentally sustainable way. Historical cost and working time data for hopper dredging and pipeline dredging for Mobile Bay in Alabama from 1991 to present were obtained from the Mobile District U.S. Army Corps of Engineers. For comparison, dredging data for Bayou Casotte in Mississippi were also obtained. An analysis of data showed that there was no significant difference in unit costs for pipeline and hopper dredging in Mobile Bay. However, further analysis showed that pipeline dredging was able to output more dredged material daily than hopper dredging. The disposal methods of dredging operations were taken into consideration while interpreting the results. Although the cost was similar, the extended distance that a hopper dredge has to travel to dispose of dredged sediment seems to make pipeline dredging more desirable for Mobile Bay and its channel maintenance needs. Moreover, if future shoreline restoration projects are initiated, pipeline dredging is expected to become the more desirable maintenance dredging method to keep up with the demand for material for shoreline re-nourishment activities. In addition to shoreline re-nourishment, the paper discusses several other possibilities of sustainable utilization of dredged materials, including using desalinated dredged sediments on agricultural lands in Alabama and elsewhere.
INTRODUCTION
Maritime transport plays a vital role in the economy of the region it serves. It is considered to be an economic, energy efficient and environmental friendly mode of transport for transporting mass quantities of commodities and containerized cargo (1,2). The role of maritime transport in the global economy is increasing and to meet the growing demand for an increase in shipping activities, larger and more efficient ships are introduced. The introduction of larger ships has resulted in the needs of deepening and/or widening the navigation channels to provide safe and adequate access to the ports and harbors (3). Maintenance activities of navigation channels through dredging can pose a major threat to the environment due to the environmental degradation it might cause and the disturbances it might create to marine life. Therefore, the disposal methods or use of the dredge material in a beneficial way is a major issue that should be addressed while selecting a particular method for dredging operations.

BACKGROUND
Year round maintenance dredging of Mobile Bay is required to keep the bay accessible to the ships that transport approximately 25 million tons of cargo to and from the Alabama State Port (4). As of 2010, Mobile, Alabama was ranked 8th among U.S. Ports for dry bulk vessel calls, 7th for general and 4th for combo vessel calls (5). Currently, the most common method of dredging in Mobile Bay and its shipping channel is with a hopper dredge. A self-propelled hopper dredge is a large ship that vacuums sediment from the floor of a body of water through a large mechanical drag arm and draws it into a hopper within the ship’s body. Most hopper dredges have large doors on the underside of their body which open to discharge the slurry (sediment mixed with water) once the vessel has travelled to its disposal site. The removed sediment from mobile bay by hopper dredging is disposed of in deepwater disposal sites in the Gulf of Mexico as mandated by the Water Resources Development Act (WRDA) of 1986 (6).

In the WRDA of 1996 (7), Congress modified the protocol for the disposal of dredged material from the Mobile Harbor to allow the U.S. Army Corps of Engineers (USACE) to consider other alternatives for disposing dredge material in the Gulf of Mexico. According to the WRDA of 1996, the possible alternatives for conducting the dredging operations must use the dredged material in an environmentally conscious and beneficial way and/or provide protection against shore erosion. One common method of using suitable dredged material in a beneficial way is to perform the dredging process with a pipeline dredge and discharge the sediment onto a shoreline for erosion control or to build up coastal areas that are subject to damage by hurricanes. A pipeline (also known as cutterhead) dredge is a semi-stationary vessel that removes sediment from an area by drawing it through a pipeline and discharging it onto a barge, a shoreline or an open water disposal site.

A hopper dredge is able to collect large quantities of material in a relatively short amount of time but must travel to and from its approved discharge locations. A pipeline dredge does not immediately remove the same cubic yardage as a hopper dredge but it is able to maintain continuous operations since it does not have to break work to dispose of the dredged material. The goal of this paper is to compare the costs associated with pipeline and hopper dredging in Mobile Bay, and to weigh in the benefits of sediment disposal methods associated with each type of dredging. This paper also discusses possible sustainable ways of utilizing the dredged material.

METHODOLOGY
The following sections describe the process that was followed in collecting and analyzing the cost data for hopper and pipeline dredging in Mobile Bay.
**Data Collection**

The data in the form of dredging contract history cards from 1991 to present for Mobile Bay were obtained from the Mobile District USACE via the Freedom of Information Act (FOIA). In total, sixty-two history cards for Mobile Bay were obtained. There were fifty-six history cards containing information on hopper dredging and six records for pipeline dredging.

There was not sufficient data on pipeline dredging for Mobile Bay. Therefore, additional dredging data in the form of history cards for Bayou Casotte, Mississippi were obtained from the Mobile District USACE. The reason for including Bayou Casotte data in the analysis was that the two areas have similar geographical features as far as dredging factors are concerned with the exception of the distance from their open ocean disposal areas. Pipeline dredging is primarily used for channel maintenance in Bayou Casotte, while hopper dredging is typically used in Mobile Bay. Eleven history cards were obtained for Bayou Casotte with seven of them being for pipeline dredging and four for hopper dredging. Mobile District USACE was contacted for background information and assistance in properly reading the cards and interpreting these results.

**Data Analysis**

The data consisted of history cards and operational logs for contracted hopper and pipeline work as well as dredge rental work done in Mobile Bay, Alabama and Bayou Casotte, Mississippi. These cards and logs were records of completed dredging operations. They included the contractor’s name, type of dredge, its capacity, the cubic yardage that was dredged and an itemized cost breakdown of the work performed to include mobilization fees, turtle observers etc. The data obtained from these records were reduced and compiled into a spreadsheet that included the working times, cubic yardage and costs for dredging operations performed from 1991 to present day for each location and for each year the data was available.

All the cost data from 1991 to present were adjusted to 2011 US Dollars using the yearly average Consumer Price Index (CPI) values as compiled by the Bureau of Labor and Statistics (8). The following formula was used to inflate the cost data to 2011 US dollar values:

\[
\text{Cost in 2011 US Dollars} = \text{Cost in US Dollars in year } \times \frac{\text{CPI for year 2011}}{\text{CPI for year } x}
\]

For each year, the total cost of dredging operation was tabulated in a spreadsheet and adjusted to 2011 US Dollars. The unit cost of dredging for each year was determined by dividing the total amount paid for a dredging operation by the total cubic yards of sediment dredged by the same dredging operation.

The dredging rate was calculated as the arithmetic mean of cubic yards of dredged material extracted per hour from each dredging operation obtained from the data cards. Similarly, average working hour per day was calculated as the arithmetic mean of the working hours per day for each dredging operation obtained from the data cards. Emergency dredging, atypical contracts and erratic data were not included in any of these calculations.

**RESULTS AND DISCUSSIONS**

The annual volume of dredged material and corresponding annual expenses for hopper and pipeline dredging from 1993 to 2010 for Mobile Bay are presented in Figures 1 and 2. As seen in Figure 1, the Mobile District USACE spent annually between $3.0 million and $14.0 million to dredge 1.6 to 5.3 million cubic yards of sediment from Mobile Bay between 1993 and 2010 using hopper dredging. On the other hand, they spent between $1.4 million and $9.8 million to
dredge 0.6 to 3.4 million cubic yards of sediment using pipeline dredging between 1991 and 2010. Hopper dredging was primarily used because the U.S. Congress mandated in the WRDA of 1986 that dredged material from Mobile Bay should be disposed of in the deep waters of the Gulf of Mexico. Pipeline dredging was performed in Mobile Bay only for special instances when a hopper dredger could not be brought in at the location due to space constraints.

![Amount of Dredging (in Million Cubic Yards) and Annual cost of Dredging (in Million Dollars adj. to 2011)](image)

**FIGURE 1** Annual cost and volume of dredged material produced using a hopper dredge in Mobile Bay.

To better understand the cost associated with each type of dredging, unit costs were calculated as the total cost of dredging in a year divided by the total volume of dredged material produced in that year. Table 1 shows the annual expenditure and the volume of dredging performed using hopper dredging and the corresponding average unit cost per cubic yard from 1993 to 2010 for Mobile Bay. The total cost and the average unit cost adjusted to 2011 dollar values are also shown in Table 1. In Mobile Bay, the unit cost to extract a cubic yard of dredged material using a hopper dredging varied from $1.37 to $4.51 (in 2011 US dollars). Table 2 shows the annual expenditure and the volume of dredging performed using pipeline dredging and the corresponding average unit cost for Mobile Bay. In Mobile Bay, the unit cost to extract a cubic yard of dredged material using pipeline dredging varied from $1.82 to $4.42 (in 2011 US dollars). Since there was not sufficient data on pipeline dredging for Mobile Bay, cost data for pipeline dredging in Bayou Casotte, Mississippi is also tabulated in Table 2 to investigate the possible trend in cost for pipeline dredging. In Bayou Casotte, the unit cost to extract a cubic yard of dredged material through a pipeline dredger varied from $1.30 to $6.25 (in 2011 US dollars).
FIGURE 2 Annual cost and volume of dredged material produced using a pipeline dredge in Mobile Bay.

Table 1 Cost Data for Hopper Dredging in Mobile Bay

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume in cubic yards</th>
<th>Total Cost</th>
<th>Total Cost adjusted in 2011 Dollars</th>
<th>Unit Cost</th>
<th>Unit Cost adjusted in 2011 Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>4066349</td>
<td>$11,781,935</td>
<td>$18,340,599</td>
<td>$2.90</td>
<td>$4.51</td>
</tr>
<tr>
<td>1995</td>
<td>4386544</td>
<td>$9,967,770</td>
<td>$14,712,207</td>
<td>$2.27</td>
<td>$3.35</td>
</tr>
<tr>
<td>1996</td>
<td>2696844</td>
<td>$7,046,096</td>
<td>$10,101,605</td>
<td>$2.61</td>
<td>$3.75</td>
</tr>
<tr>
<td>1997</td>
<td>4076835</td>
<td>$9,697,830</td>
<td>$13,591,403</td>
<td>$2.38</td>
<td>$3.33</td>
</tr>
<tr>
<td>1998</td>
<td>5297992</td>
<td>$13,544,004</td>
<td>$18,690,643</td>
<td>$2.56</td>
<td>$3.53</td>
</tr>
<tr>
<td>1999</td>
<td>3374671</td>
<td>$7,808,398</td>
<td>$10,542,697</td>
<td>$2.31</td>
<td>$3.12</td>
</tr>
<tr>
<td>2000</td>
<td>4551347</td>
<td>$8,733,788</td>
<td>$11,408,650</td>
<td>$1.92</td>
<td>$2.51</td>
</tr>
<tr>
<td>2001</td>
<td>2880055</td>
<td>$9,074,631</td>
<td>$11,525,908</td>
<td>$3.15</td>
<td>$4.00</td>
</tr>
<tr>
<td>2002</td>
<td>1823165</td>
<td>$3,296,527</td>
<td>$4,122,290</td>
<td>$1.81</td>
<td>$2.26</td>
</tr>
<tr>
<td>2003</td>
<td>4700316</td>
<td>$10,632,430</td>
<td>$13,000,914</td>
<td>$2.26</td>
<td>$2.77</td>
</tr>
<tr>
<td>2004</td>
<td>4603811</td>
<td>$5,473,573</td>
<td>$6,517,840</td>
<td>$1.19</td>
<td>$1.42</td>
</tr>
<tr>
<td>2005</td>
<td>2600342</td>
<td>$3,090,241</td>
<td>$3,559,220</td>
<td>$1.19</td>
<td>$1.37</td>
</tr>
<tr>
<td>2006</td>
<td>3255384</td>
<td>$8,268,103</td>
<td>$9,225,292</td>
<td>$2.54</td>
<td>$2.83</td>
</tr>
<tr>
<td>2007</td>
<td>2939664</td>
<td>$8,889,181</td>
<td>$9,643,601</td>
<td>$3.02</td>
<td>$3.28</td>
</tr>
<tr>
<td>2008</td>
<td>1699061</td>
<td>$6,005,000</td>
<td>$6,273,757</td>
<td>$3.53</td>
<td>$3.69</td>
</tr>
<tr>
<td>2009</td>
<td>3638909</td>
<td>$13,994,991</td>
<td>$14,673,549</td>
<td>$3.85</td>
<td>$4.03</td>
</tr>
<tr>
<td>2010</td>
<td>1973615</td>
<td>$5,999,980</td>
<td>$6,189,371</td>
<td>$3.04</td>
<td>$3.14</td>
</tr>
</tbody>
</table>
TABLE 2 Cost Data for Pipeline Dredging in Mobile Bay and Bayou Casotte

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume in cubic yards</th>
<th>Total Cost</th>
<th>Total Cost adjusted in 2011</th>
<th>Unit Cost</th>
<th>Unit Cost adjusted in 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Bay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>1229066</td>
<td>$1,444,691</td>
<td>$2,385,957</td>
<td>$1.18</td>
<td>$1.94</td>
</tr>
<tr>
<td>2002</td>
<td>560644</td>
<td>$1,980,371</td>
<td>$2,476,444</td>
<td>$3.53</td>
<td>$4.42</td>
</tr>
<tr>
<td>2006</td>
<td>3458489</td>
<td>$5,639,387</td>
<td>$6,292,252</td>
<td>$1.63</td>
<td>$1.82</td>
</tr>
<tr>
<td>2010</td>
<td>3315403</td>
<td>$9,862,183</td>
<td>$10,173,485</td>
<td>$2.97</td>
<td>$3.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bayou Casotte</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>1637118</td>
<td>$1,603,584</td>
<td>$1,846,946</td>
<td>$1.13</td>
<td>$1.30</td>
</tr>
<tr>
<td>2006</td>
<td>1350632</td>
<td>$2,671,935</td>
<td>$2,981,262</td>
<td>$2.21</td>
<td>$2.46</td>
</tr>
<tr>
<td>2007</td>
<td>1055936</td>
<td>$3,080,650</td>
<td>$3,342,103</td>
<td>$3.17</td>
<td>$3.43</td>
</tr>
<tr>
<td>2008</td>
<td>1074335</td>
<td>$6,147,659</td>
<td>$6,422,801</td>
<td>$5.98</td>
<td>$6.25</td>
</tr>
<tr>
<td>2009</td>
<td>1949733</td>
<td>$6,924,150</td>
<td>$7,259,873</td>
<td>$3.72</td>
<td>$3.90</td>
</tr>
<tr>
<td>2011</td>
<td>1912311</td>
<td>$6,259,680</td>
<td>$6,259,680</td>
<td>$3.27</td>
<td>$3.27</td>
</tr>
</tbody>
</table>

FIGURE 3 Unit costs of dredging using hopper dredging in Mobile Bay, Alabama.

To explore possible trends in the unit cost per cubic yards of dredged material produced by hopper and pipeline dredging, the unit costs are plotted in Figures 3 and 4. Figure 3 shows the unit costs of hopper dredging in Mobile Bay from 1993 to 2010. The unit costs in general demonstrated a non-linear decrease until 2005 and then demonstrated a non-linear increase until
2009. Figure 4 shows the unit costs of pipeline dredging in Mobile Bay from 1991 to 2010. As mentioned earlier, pipeline dredging is not typically used in Mobile Bay and consequently there is a shortage of data for pipeline dredging as demonstrated in Figure 4. As seen in Figure 4, there was a general increase in unit cost of pipeline dredging from 1991 to 2010. However, the figure shows that there was a significant jump in the unit cost of pipeline dredging in 2002. This significant increase occurred immediately after the change in WRDA legislation in 1996. As per the changed legislation, the hopper dredging was not the only dredging option for Mobile Bay anymore.

![Unit costs of pipeline dredging in Mobile Bay, Alabama.](image)

FIGURE 4 Unit costs of dredging using pipeline dredging in Mobile Bay, Alabama.

To further compare the unit cost of pipeline and hopper dredging, the unit cost data adjusted to 2011 values for both dredging methods are plotted in Figure 5. Since there is a shortage of pipeline dredging data for Mobile Bay, the unit cost of pipeline dredging in Bayou Casotte are also plotted in Figure 5. As it appears in Figure 5, there was no significant difference in unit cost between pipeline and hopper dredging except for the exceptional instance of pipeline dredging in Bayou Casotte in 2008. Though the trends in unit costs look similar, there was a 151.5% increase in unit cost of pipeline dredging in Bayou Casotte from 2005 to 2011. This rapid increase in unit cost might be due to the reason that pipeline contractors inflated their price as they were in demand for maintenance dredging in Bayou Casotte.
Dredging Rate and Work Output
The dredging rates and dredging outputs for both dredging methods for Mobile Bay and Bayou Casotte are presented in Table 3. The table shows that for hopper dredging in Mobile Bay, the dredging rate was 914 cubic yards per hour for approximately 20 working hours per day. For pipeline dredging in Mobile Bay, the dredging rate was 1610 cubic yards per hour for approximately 12 working hours per day. For Bayou Casotte, the dredging rate for hopper dredging was approximately 980 cubic yards per hour for 18 working hours per day. The dredging rate for pipeline dredging was approximately 1931 cubic yards per hour for 14 working hours per day. The comparison of dredging rate between pipeline and hopper dredging in cubic yards per hour for Mobile Bay and Bayou Casotte is shown in Figure 6. It is evident from the figure that the dredging rates were comparable between Mobile Bay and Bayou Casotte for both hopper and pipeline dredging.

Table 3 Dredging and Work Output from Hopper and Pipeline Dredging

<table>
<thead>
<tr>
<th>Dredging Type</th>
<th>Location</th>
<th>Dredging Rate (Cubic Yards per Hour)</th>
<th>Average Working Hours per Day</th>
<th>Dredging Output (Cubic Yards per Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hopper</td>
<td>Mobile</td>
<td>914</td>
<td>20</td>
<td>18280</td>
</tr>
<tr>
<td>Pipeline</td>
<td>Mobile</td>
<td>1610</td>
<td>12</td>
<td>19320</td>
</tr>
<tr>
<td>Hopper</td>
<td>Bayou Casotte</td>
<td>980</td>
<td>18</td>
<td>17640</td>
</tr>
<tr>
<td>Pipeline</td>
<td>Bayou Casotte</td>
<td>1931</td>
<td>14</td>
<td>27034</td>
</tr>
</tbody>
</table>
The daily work output achieved from each dredging method in terms of cubic yards of dredged material per day was calculated by multiplying the dredging rate (in cubic yards per hour) by the working hours per day. Figure 7 shows the daily work output using pipeline and hopper dredging for Mobile Bay and Bayou Casotte. As shown in Figure 7, pipeline dredging produced more dredged material per day than hopper dredging. The data from Bayou Casotte, where pipeline dredging was most commonly used, provides the strongest evidence in favor.

Dredging Contracts and Cost Issues

There are two types of contracts that are used to perform dredging operations, namely a rental contract and a unit price contract. In a rental agreement the contractor works on an hourly basis;
this allows the USACE to direct their work until their budget for that project is exhausted. In unit price contracts, in order for a contract to be established for dredging work, the required funds has to be allocated in full for the amount of the contract. Instances of cost fluctuations have influenced the Mobile District USACE to enter into more rental contracts in lieu of unit price contracts as rental contracts offer more flexibility in terms of funds allocation issues.

**DISPOSAL OF DREDGED MATERIAL**

The fine-grained sediment (also referred to as mud) dredged from Mobile Bay with a hopper is disposed of in deep offshore waters. On the other hand, much of the fine-grained sediment that is pipeline dredged from Mobile Bay is discharged onto Gaillard Island or other disposal sites which is beneficial for their maintenance. An aspect of the disposal process that warrants some attention is the impact that the Deep Water Horizon oil spill may have on the sediment quality of the dredged material. Prior to the oil spill, as shown in Figure 8, the sediment in Mobile Bay was rated fair by the Environmental Protection Agency (EPA) with only 9% of the monitored areas of the estuary containing poor sediment quality (9). This relative cleanliness allowed the sediment from Mobile Bay to be suitable for open sea disposal by hopper dredge. There are currently studies being conducted to investigate the quality of the sediment after the oil spill to determine its purity (10, 11, 12). If the sediment is found to contain contaminants, it may no longer be feasible or recommended to dispose of the dredged material in the open sea thereby negating the use of a hopper dredge and making any alternative dredging and disposal method like pipeline dredging more environmentally friendly and beneficial.

![Sediment Quality Index](image)

**FIGURE 8** Mobile Bay sediment quality (9).

**SUSTAINABLE USE OF DREDGED MATERIAL**

While the difference in cost between pipeline dredging and hopper dredging is not substantial, the disposal method and use of dredged material obtained from each dredging method holds a paramount importance in deciding for a particular method. The sediments from Mobile Bay and adjacent channels are a great asset to our coast. They have the potential to contribute greatly to the improvement of our shoreline and, with the proper treatment, our agricultural land. The
following paragraphs discuss several possible sustainable ways of utilizing dredged material obtained from Mobile Bay.

![Diagram of Mobile Bay and Sand Island](image)

**FIGURE 9** Location of the Bar Channel and Sand Island beneficial use area.

Mobile Bay has a unique environmental system and its suitably-grained sediment has the benefit of being suitable for beneficial uses such as berm establishment, barrier island build-up and non-recreational beach re-nourishment. Many States, such as Louisiana, have difficulty locating suitable material for their coastal improvement projects (13) and others, such as New York and New Jersey, have to decontaminate their materials through lengthy and expensive treatment procedures in order to even consider using them beneficially (14). Material that is produced as a result of maintenance dredging the Mobile Bay can be utilized in a sustainable way if proper initiative is taken. In one such initiative, a proposal was submitted to the Congress in 2010 for using dredged material from the Mobile Bar Channel to build an oil mitigation berm at the mouth of Mobile Bay and rebuild Sand Island to its original size (15). Figure 9 shows the location of the Bar Channel and Sand Island beneficial use area. The proposal has been accepted and this work has recently been contracted by the Mobile District USACE. In addition to the beneficial use of dredged material, this project could reduce the cost of maintenance dredging in the Bar Channel area since there will be virtually no distance to travel to a disposal site. Another good example of sustainable use of dredged material is the initiative taken by Mississippi Coastal Improvements Program (MCIP) to utilize dredged material from the widening of the Mississippi Bar Channel and other sites in order to restore coastal barrier islands (16). Similarly, in the future, suitably-grained dredged material from maintenance dredging of Mobile Bay may be considered for use in the restoration and protection of Alabama’s coast as well.

Another possibility of sustainable use of dredged material from Mobile Bay is using it on agricultural lands in Alabama or elsewhere. In 2004, the U.S. Department of Agriculture published the results of a study in which lake dredged material was used on pasture-lands in Sumter County, Florida (17). The study found that the lake-dredged material acted as a fertilizer for Bahia grass grown on the pasture-lands. The plots they experimented showed increased grass production and higher crude protein content than those without lake-dredged material. The fine
grained sediment that is found at the bottom of Mobile Bay is rich in nutrients and organic material that has washed down through the Mobile-Tombigbee-Alabama River system (18). In a way similar to the lake-dredged material used in the USDA research, dredged sediment from Mobile Bay could serve to enrich the agricultural lands in Alabama or elsewhere if it were desalinated. Although the current de-salination processes make this sediments’ immediate use for agricultural purposes impractical, a cost efficient method of salt extraction might expand the options for its beneficial use. If it has to be decontaminated due to the Deepwater Horizon oil spill, then the de-salination process may be more feasible since the material will already be undergoing some type of chemical treatment or processing.

SUMMARY AND CONCLUSIONS

In this paper, an attempt has been made to compare the cost of hopper and pipeline dredging, two alternative methods for maintenance dredging in Mobile bay. Cost data for both dredging methods were obtained from Mobile District USACE. USACE could not provide sufficient pipeline dredging data for Mobile Bay since pipeline dredging was performed in Mobile Bay only for special instances when a hopper dredge could not be brought in at the location due to space constraint. To account for this shortage, additional pipeline dredging data was obtained for Bayou Casotte in Mississippi. The reason for including Bayou Casotte data in the analysis was that the two areas have similar geographical features as far as dredging factors are concerned. Analysis of data showed that there was no significant difference in unit costs for pipeline and hopper dredging in Mobile Bay.

Although unit costs were similar for both methods of dredging, further analysis showed that pipeline dredging was able to produce more dredged material output (per day) than hopper dredging. This is due to the fact that a pipeline dredge can dredge continuously for longer hours than a hopper dredge since hopper dredge needs to stop dredging and travel to a disposal site to dispose of dredged sediment.

The extended distance that a hopper dredge must travel in order to dispose of dredged sediment from Mobile Bay makes pipeline dredging more desirable for Mobile Bay and its channel maintenance needs. As the cost of fuel increases the cost of hopper dredging is also expected to increase. Therefore, pipeline dredging should be made a natural choice for Mobile Bay as it is efficient and also offers sustainable alternates for utilizing the readily available dredged materials.

It is unknown at this time whether the Deepwater Horizon oil spill has contaminated the sediment in Mobile Bay area to levels exceeding the EPA regulations for deepwater ocean disposal. If Mobile Bay sediment quality is found to be negatively affected, it is expected to have vast implications on Mobile Bay dredging practices and disposal methods. In addition, if future shoreline restoration and beneficial use projects are initiated, it is possible that pipeline dredging may become the most desired maintenance dredging method to be used in Mobile Bay in order to keep up with the demand for material to supply future shoreline re-nourishment projects.

Finally, the paper provides several possibilities of sustainable utilization of dredged materials. The most innovative of them was to use the dredged materials on agricultural lands in Alabama or elsewhere since the fine grained sediment at the bottom of Mobile Bay is rich in nutrients and organic materials. However, these sediments must be desalinated before they can be used on the agricultural land. Development of a cost efficient method of salt extraction might expand the options for its beneficial use.
ACKNOWLEDGEMENTS

The authors would like to thank the Mobile District U.S. Army Corps of Engineers and the Mobile Office of the NOAA National Weather Service for their cooperation on this project. Carl Dyess, Mobile District’s Chief of Navigation and Herbert Bullock from the Irvington Site Office, were great technical resources for this research project and their assistance is greatly appreciated. Keith Williams, NOAA’s Mobile Office Hydrologic Programs Manager and Katherine Sanders, NOAA’s Mobile Office Administrative Support Assistant, also contributed to the success of this project through the provision of charts, graphs, maps and Mobile Bay historical information.

REFERENCES


15. **Sand Island 406 Oil Mitigation: Federally Authorized Re-Establishment of Sand Island.**

