TAYLOR ENGINEERING, INC.

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

September 2018

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Review of Dredging Program Efficiencies

Prepared for

FLORIDA INLAND NAVIGATION DISTRICT

by

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1.0 INTRODUCTION

Since its formation in 1927, the Florida Inland Navigation District (FIND or District) has served as the State local sponsor for the federal Atlantic Intracoastal Waterway (AIWW), Intracoastal Waterway (ICWW) and a portion of the Okeechobee Waterway (OWW). Collectively known as the "Waterway", the AIWW/ICWW channel extends 377-miles along Florida's east coast from the Florida-Georgia state line south to the Miami Harbor Project (MHP) in Miami-Dade County. The OWW channel — extending from its intersection with the ICWW (on the east coast) to the Palm Beach/Hendry County line (in Lake Okeechobee) — is not explicitly addressed in this report; however, it is included in FIND's overall responsibility for the Waterway. As the projects' local sponsor, the FIND provides the U.S. Army Corps of Engineers (USACE), Jacksonville District with sites suitable for placing material dredged from the authorized navigation channels. The federal government — through the USACE — is responsible for maintaining the navigation channels to their authorized dimensions. However, due to federal funding limitations, FIND has increasingly supplemented the USACE dredging budget or independently contracted its own dredging projects to maintain navigability.

The Waterway does not compete well in the federal navigation budget process for the limited available federal funding for channel operation and maintenance. This is primarily due to the lack of commercial cargo transiting the Waterway and policy restrictions that prevent the USACE from considering recreational benefits in economic analyses. As a result, FIND spends approximately $20 million of its budget each year on dredging and dredged material management. These funds are normally split between supplementing the USACE budget for dredging and independently funding FIND-contracted dredging projects. To support its channel maintenance efforts, FIND contracted Taylor Engineering to investigate if a better, more efficient process may exist that will continue to accomplish the mission of keeping the Waterway open for both commercial and recreational navigation.

This report provides an initial review of possibilities — use of modified dredging technology, better planning of dredging projects, use of alternative contractual methods, and FIND dredge ownership — that may improve Waterway dredging efficiencies. **Chapter 2.0**, *Documentation*, summarizes interviews with and documentation received from industry leaders within the dredging community. Information received during the documentation phase fed into the development of the remaining report chapters. **Chapter 3.0,** *Dredge Fleet and Technology* provides a breakdown of the international dredge fleet compared to the United States fleet and dredges strictly based in Florida. The chapter includes a discussion on upcoming technology in the dredging industry. **Chapter 4.0**, *Florida East Coast Dredging and Management History* tabulates the Waterway dredging history from the 1940's and provides further insight into Florida's eastern navigation channel and port dredging patterns and history. This information will provide FIND potential opportunities to better plan and contract maintenance projects, as discussed in **Chapter 5.0**, *Modification of Current Contracting and Dredging Procedures*. **Chapter 6.0**, *Conclusions and Recommendations* summarizes the findings and provides recommendations for FIND's involvement with Waterway maintenance dredging. Finally, **Chapter 7.0**, *References* provides the sources for all cited materials.

2.0 DOCUMENTATION

Taylor Engineering interviewed and obtained documentation from twenty-seven leaders within the dredging community. Targeted interaction and information requests — focusing on available and upcoming dredging technology, dredged material placement methods, and contracting methods — included the professional associations, federal and state agencies, universities, dredging contractors, and manufacturers listed in **Table 2.1**. **Attachment A** provides a copy of the individual interview forms and, when applicable, supporting information supplied by the organization. Understandably, responses varied depending on each person's perspective and affiliation. The information received was, as applicable, incorporated into the remaining sections of the report.

Table 2.1 Summary of Documentation Contacts

Contact	Organization	Contact Name
Professional Associations	American Society of Civil Engineers - Coasts, Oceans, Ports, River, and Waterway Institute	Tom Chase
	Atlantic Intracoastal Waterway Association	Brad Pickel
	Western Dredging Association	Thomas Cappellino
Federal Agencies	USACE, Engineering Research and Development Center (ERDC)	Kenneth (Ned) Mitchell
	USACE, Dredging Operations Technical Support (DOTS), Dredged Material Management	Tim Welp
	USACE, DOTS, Sediment and Dredging Processes	Joe Gailiani
	USACE, DOTS, Environmental Resources Management	Todd Swannack
	USACE, Regional Sediment Management Regional Center of Expertise	Jackie Keiser
State Agencies	Hillsboro Inlet District	Jack Holland
	Jupiter Inlet District	Michael J. Grella
	St. Augustine Port, Waterway & Beach District	Carl Blow
	State of Delaware	Charles Williams
Universities	Stevens Institute	Thomas Wakeman
	Texas A&M University, College Station	Robert Randall
	University of Nevada, Las Vegas	Donald Hayes
Dredging Contractors	Cashman Dredging & Marine Contracting Co., LLC	Bill Hussin
	Cavache, Inc.	Anthony Cavo
	Great Lakes Dredge & Dock Company, LLC	William Hanson
	Manson Construction Co.	Dan Hussin
	Orion Marine Group Holdings, Inc.	John Vannoy
	Southwind Construction Corp.	Darrell Stewart
	Weeks Marine, Inc.	Ross Lowry
Dredge Manufacturers/ Technical Suppliers	Anvil Attachments	Nick Seghers
	Cable Arm	Darrell Nicholas
	DHI Group	Jacob Jenson
	Dredge Supply Co.	Charles Johnson
	Ellicott Dredges	Steve Miller

3.0 DREDGE FLEET AND TECHNOLOGY

Building on our experience and documentation collected (**Chapter 2.0**), Taylor Engineering researched available dredge types — along with available technologies — and their applicability to dredging requirements specific to the Waterway. Industry leaders provided useful insight into emerging dredging technology; however, they cautioned against investigation of dredging technologies outside the United States as the 1920 Merchant Marine Act (Jones Act), the Foreign Dredge Act of 1906, and the Shipping Act of 1916 require that all dredging inside the United States must be solely executed by United States (non-foreign) dredging companies. Therefore, bringing any new technology from outside the United States requires that it be solely implemented and sought after from United States documented firms and vessels. With that consideration, the following sections provide a general overview of the different dredge types, a summary of the currently available and market-driven international-, United States-, and Florida-based dredging fleets, and current and upcoming technology.

3.1 Dredge Types

Review of the current dredging fleet identified technology available for consideration for Waterway dredging projects. According to the International Association of Dredging Companies (https://www2.iadc-dredging.com/subject/equipment), dredge types are grouped into three major categories — mechanical, hydraulic, and hydrodynamic. Selection of a specific dredge type is based on a combination of factors such as material (depth, volume, and location), sediment characteristics (grain size, compactness), environmental issues (turbidity, contaminated sediments, permitting constraints), and cost considerations. Because the mobilization and capital costs of a dredge plant are significant, choosing the wrong vessel and methods can have significant economic consequences. No matter what dredge is selected, sediment resuspension (i.e., turbidity) and final disposal are issues that will typically have associated permitting and operational constraints.

3.1.1 Mechanical Dredges

Mechanical dredges work by digging sediment from a floating or fixed platform and placing the sediment into a holding area on the dredge or adjacent barge. These types of dredges comprise roughly 19% and 30% of the international and United States dredge fleet, respectively, and largely include clamshells, backhoes, and bucket ladders. Mechanical dredges are most commonly applied for (1) small volume dredging jobs, (2) sediment that is spread out over a larger horizontal distance, (3) when hydraulic or hydrodynamic dredges cannot overcome material hardness and compaction to be efficiently dredged, (4) small confined areas that would be too restrictive to operate a hydraulic dredge (e.g., marinas) or (5) when a nearby (< 5-10 miles) dredged material management area (DMMA) does not exist. Once dredged, material is generally either deposited offshore into an approved Ocean Dredged Material Disposal Site (ODMDS) or nearshore placement area. The material may also be mechanically transferred to an upland DMMA for dewatering, processing, and depending on sediment characteristics, including the presence of contaminants in the material, beneficially used in residential, commercial, or landfill applications.

Photograph 3.1 shows the mechanical dredge employed for the FIND ICWW Broward project that deepened the ICWW from -10 to -15 ft mean lower low water (MLLW). The contractor removed material from the bottom of the ICWW with a conventional open bucket (10 cubic yards, cy) excavator and placed it into hopper barges. The 164 ft x 49 ft x 10 ft mechanical dredge — a Liebherr 994 excavator — provided a shallow draft and was powerful enough to break through the weathered limestone material in the project area. When filled to capacity, the 2,430-ton capacity hopper barges (230 ft x 43 ft x 11.8 ft) transported the material from the dredging site to a temporary DMMA located on Port Everglades property approximately three miles south of the southerly project limit. On average, the dredging contractor achieved a production rate of approximately 1,300 cy/day over the course of the 160-day working or 870 cy/day over the 232-day total dredging period. With exception of one turbidity exceedance early in the construction period, the project resulted in no environmental permit violations.

Photograph 3.1 Mechanical Dredge and Hopper Barge in the ICWW, Broward County

Table 3.1 provides a cost summary for three recent (within the last 10 years) FIND dredging jobs using a mechanical dredge. Unit costs for dredged material removal ranged from $18 to $46/cy. The Lake Okeechobee project, at $46/cy, involved a much higher unit cost due to the incorporation of material handling costs (offloading, dewatering, maintenance of the DMMA) into the bid item, the fine-grained nature of the material, and the distance to which it needed to be barged and offloaded. Conversely, dredged material transport for the offloading of the dewatered dredged sediment ranged between $4 and $43/cy and, for the deepening projects, the unit costs included the material handling into the dewatered dredged sediment unit costs. Unit costs for the three separate projects also varied significantly due to the distance traveled to the final placement sites.

Table 3.1 Mechanical Dredging Costs for Recent FIND Projects

YEAR	PROJECT	DMMA	CONTRACTOR	TOTAL PROJECT COST	DREDGED MATERIAL REMOVED (CY)	MOB/DEMOB ($)	CONTRACTED UNIT COST FOR DREDGED MATERIAL REMOVED ($/CY)	DEWATERED DREDGED MATERIAL OFF-SITE TRANSPORT ($/CY)
2012	Lake Okeechobee, Routes 1 and 2	Lake Point Restoration Offload Area	Ferreira Construction	$479,000	7,600	$35,000	$46.28	$4.24
2012	Dania Cutoff Canal	Port Everglades	Lucas Marine Acquisition Company	$7,154,659	90,974	$1,132,000	$18.00	$13.45
2016	Broward Deepening	Port Everglades	Cashman Dredging & Marine Contracting	$19,342,844	182,893	$2,300,000	$19.30	$42.70

3.1.2 Hydraulic Dredges

Hydraulic dredges work by excavating and pumping a mixture of sediment and water (i.e., slurry) through a pipeline to a different location. These types of dredges comprise roughly 45% and 60% of the international and United States based dredge fleet, respectively, and predominantly include cutterheads, plain suction, trailing suction hopper, chain ladder, and bucketwheel/cutting wheel. Hydraulic dredges are preferred to produce the lowest resuspension rates (i.e., lowest turbidity) and can achieve the greatest efficiency in non-compacted (maintenance) vs. compacted (deepening) sediment with relatively low cost. For hydraulic dredging applications an effective means — i.e., upland dredged material management area, nearshore placement area, beach placement area, ODMDS — to manage the slurry discharge is required.

Photograph 3.2 shows the hydraulic dredge employed for the FIND ICWW Palm Beach project that deepened the ICWW from -10 ft to -15 ft MLLW. The contractor hydraulically removed material with a 68-ft x 28-ft 16-in. Ellicott 1170 conventional dredge. The dredge was configured with the dredging ladder attached to the forward end of the center hull section. The cutter drive system was mounted on the toe of the dredging ladder and a ladder A-frame was pin connected to the forward end of the two side floatation pontoons. The contractor selected 18-in. black high-density polyethylene (HDPE) pipe to convey the slurry material from the dredge to the FIND-owned Peanut Island DMMA. Since the total project area was approximately 3,600 ft and immediately adjacent to the DMMA, the use of a booster pump was not required. However, varying material types (sand and rock) throughout the ICWW cross-section made the hydraulic removal of 101,000 cy extremely taxing on the contractor's equipment and anticipated production. The contractor operated 5 days/week during daylight hours only. Production rates, due to encountering larger quantities of rock than expected, averaged 765 cy/day over the 132-day dredging period. No turbidity exceedances occurred.

Photograph 3.2 Hydraulic Dredge in the ICWW, Palm Beach County

Photograph 3.3 shows another hydraulic dredge working on a maintenance dredging project in AIWW in Nassau County. The contractor removed approximately 180,000 cy of material to -12 ft MLLW with an Ellicott 890, 18-in. cutter suction dredge and pumped the material to, depending on distance to the DMMA, to either NA-1 or DU-2, via up to 30,000 ft of 18- and 20-in. HDPE pipeline and two 18-in. booster pumps. The contractor elected to operate 24 hours per day for 7 days per week with production rates averaging 450 cy/hour or 10,800 cy/24-hrs. The contractor completed the job within 3 months, far below the allowable contract time of 180 days. No turbidity exceedances occurred.

Table 3.2 provides a cost summary for five recent FIND dredging jobs using a hydraulic dredge. Unit costs for dredged material removal ranged between \$6 and \$10/cy for unconsolidated (maintenance) dredged material. However, higher costs occurred for rock removal (\$19 and \$27/cy) and beach placement (\$34/cy). The ICWW St. Lucie Reach I Beach placement job was a very high risk, short-timeframe driven project (due to environmental restrictions related to the sea turtle nesting season) that included a 6.5-mile total pumping distance and the use of two booster pumps.

Photograph 3.3 Hydraulic Dredge in the AIWW, Nassau County

Table 3.2 Hydraulic Dredge Costs for Recent FIND Projects

YEAR	PROJECT	DMMA	CONTRACTOR	TOTAL PROJECT COST	MOB/DEMOB	DREDGED MATERIAL REMOVED (CY)	CONTRACTED UNIT COST FOR DREDGED MATERIAL REMOVED ($/CY)
2013	ICWW Volusia	MSA 434/434S	Cavache	$2,318,0356	$576,782	259,682	$6.89
2016	ICWW Palm Beach Deepening North	Peanut Island	Cavache	$2,078,370	$232,035	103,528	$9.10 – Sand $19.84 – Rock to -15 ft MLLW $26.78 – Rock between -15 and -17 ft MLLW
2017	ICWW St. Lucie	Beach	Cavache	$3,046,147	$1,845,000	98,192	$33.97
2017	ICWW Nassau Reach I	DMMA NA-1 and DU-2	Southwind Construction	$2,823,686	$1,116,145	197,714	$9.89 – Northern Area $8.45 – Southern Area
2017	ICWW Jupiter	Beach	Cavache	$715,800	$291,627	102,068	$7.00

3.1.3 Hydrodynamic Dredges

Hydrodynamic dredges comprise less than 1% of the international and United States dredging fleet. These dredges operate by resuspending bed sediments which then remain close to the channel bottom and flow to deeper areas within the channel. These types of dredges generally include agitation and ploughing and can include a variety of equipment such as a water injection dredge (WID), hopper dredge agitation, prop-wash, and rakes or drag beams. WID, considered the most specialized hydrodynamic dredge type, involves the fluidization of bed sediments to overcome cohesion in fine grained (cohesive) soils (silts and clays) or the internal friction of coarse grained (granular) soils. Coarser grained material (sands) having higher settling velocity than finer-grained material will likely settle out too quickly and will only flow over short distances. Fluidization of finer-grained sediments may be reduced as cohesion and consolidation increase. Hydrodynamic dredges are typically employed because of the apparent low cost and operational flexibility and have found success in areas that have a strong unidirectional current and involve small volume, routine maintenance where environmental and sediment characteristics are fully understood (e.g., smaller harbors). Site specific limitations (conditions often found repeatedly in a smaller maintenance project areas) — optimal soil and hydrodynamic conditions, compatible bathymetric conditions (vicinity, downstream deeper areas able to hold the fluidized sediment), acceptable transport distances, and operating depths — will restrict areas for which this type of dredging method could be applicable. In his review of WID, Wilson (2007) noted that WID does not remove sediment from a channel; it only redistributes sediment within the channel. However, he concluded that WID may be viable under these conditions:

1. *Long, straight channel reaches provide the best WID environment allowing WID operators to maintain a downward slope and density current. Typically, 1.62 km (1 mi) sections present the most conducive opportunity for WID capability.*
2. *Small sediment grain sizes much less than 0.2 mm (0.079 in) mean much more effective use of WID. Median grain sizes of 0.05-0.06 mm (0.0020-0.0024 in) produced the highest production rates known.*
3. *Smaller volumes than usual for a given dredge area produced the most cost effective WID operations…WID, therefore, serves as a viable emergency dredging option.*
4. *Extensive Field data collection always helps analyze the WID process. Density profile data, for example, always provide invaluable data on how effective WID works in a given environment…*

Weeks Marine currently owns and operates the only WID in the United States (Wilson, 2007). The USACE has contracted Weeks Marine for WID in the New Orleans and Houston areas. Typical production rates have ranged between 182 and 3,645 cy/hr with a median of 790 cy/hr for the 14 projects totaling 3.95 million cubic yards (mcy) performed between 1992 and 2005. Should FIND wish to purse WID for routine maintenance dredging, Taylor Engineering recommends limiting the method to those sections of the Waterway that meet the viable conditions outlined above.

3.2 Dredge Fleet Statistics

World Dredging Mining & Construction provides an annual update of the international dredging fleet. **Figures 3.1** and **3.2** provide graphical representations of the international and United States-based dredging fleets as of August 2017. **Attachment B** provides a detailed breakdown of all the dredge type categories by world region and country. The cutter suction dredge is the predominant dredge type both internationally (41%) and within the United States (54%). The trailing suction hopper (21%) and clamshell (19%) dredge follow in international dredge fleet statistics; however, the clamshell dredge (29%) is the second most abundant dredge in the United States. Remaining dredge types — suction dredge, bucket wheel suction dredge, bucket ladder dredge, bucket backhoe, and other (e.g., suction dustpan, water injection, agitation plough) — round up the remaining 19% and 17% of the total international and United States-based dredge fleet.

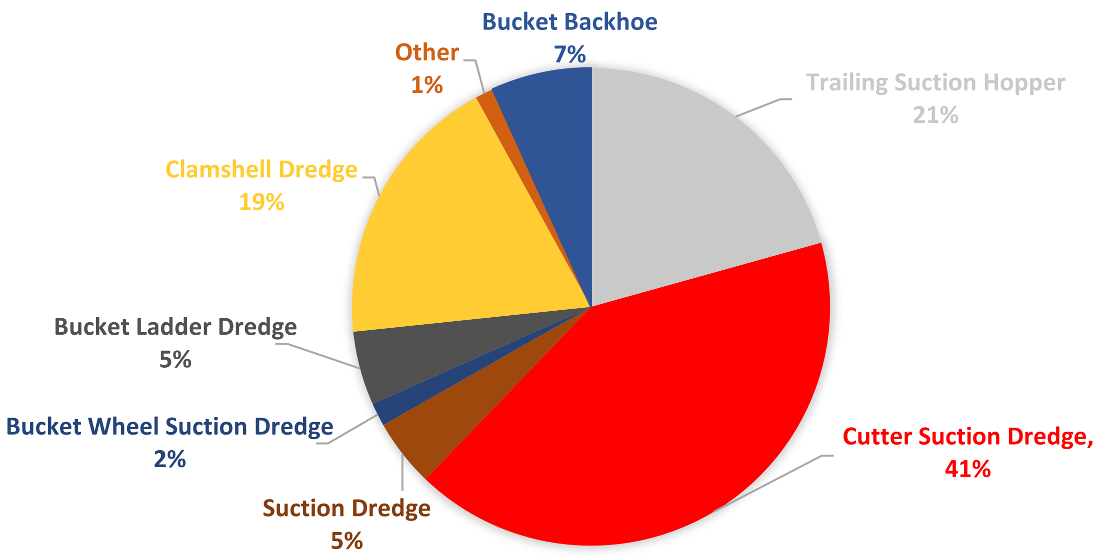

Figure 3.1 International Dredging Fleet, World Dredging Mining and Construction, 2017

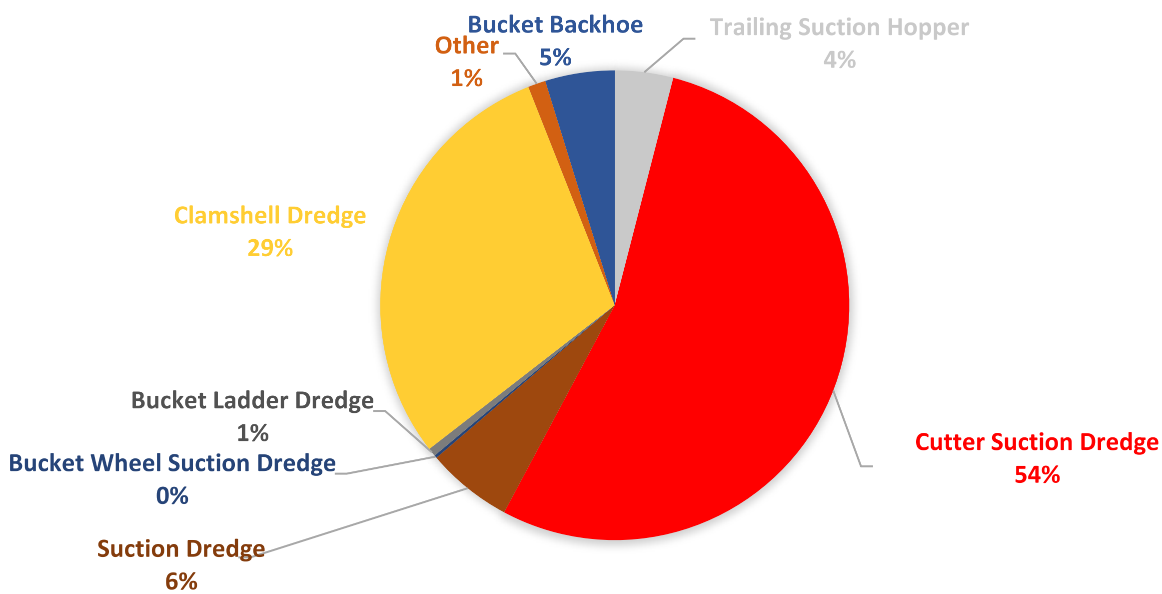

Figure 3.2 United States-Based Dredging Fleet, World Dredging, Mining, & Construction, 2017

The USACE Navigation Data Center (https://www.iwr.usace.army.mil/About/Technical-Centers/NDC-Navigation-and-Civil-Works-Decision-Support/) provides dredging data to support planning and program management decisions pertaining to the USACE dredging program. **Table 3.3** provides a summary of contracts awarded by dredge type and dredge quantity between 2012 and 2017. Of the 834 total contracts awarded during this period, 381 (46%) contracts were for hydraulic dredging via cutter suction dredge and pipeline, 242 (29%) employed mechanical bucket dredges, and 132 (16%) were for hydraulic hopper dredges. The remaining 79 (9%) contracts involved nonconventional, sidecaster, or a combination of the prevalent dredge types. The United States-based dredge type distribution (**Figure 3.2**) closely coincides with the type of contracts awarded and, likely, the prevalent types of market-driven dredging work.

Table 3.3 Contracts Awarded by Dredge Type, USACE Navigation Data Center, 2012–2017

DREDGE TYPE	2012	2013	2014	2015	2016	2017	2012-2017
BUCKET							
CONTRACT	34	40	48	55	40	25	**242**
CY	16,500,577	14,080,193	11,843,055	13,590,755	16,432,095	6,578,340	**79,025,015**
$	$182,620,109	$260,679,158	$144,495,990	$275,910,225	$199,337,551	$93,239,078	**$1,156,282,111**
HOPPER							
CONTRACT	24	28	30	17	21	12	**132**
CY	45,305,452	33,598,346	48,748,429	33,631,959	54,434,285	30,020,709	**245,739,180**
$	$199,628,956	$277,578,343	$562,836,051	$194,583,377	$342,064,345	$111,568,266	**$1,688,259,338**
NONCONVENTIONAL TYPE							
CONTRACT	--	--	1	--	1	--	**2**
CY	--	--	7,000	--	--	--	**7,000**
$	--	--	$351,031	--	$5,207,400	--	**$5,558,431**
PIPELINE							
CONTRACT	81	65	75	62	57	41	**381**
CY	79,759,104	65,423,809	79,818,557	60,403,896	80,623,393	56,630,950	**422,659,709**
$	$511,424,975	$647,219,087	$387,739,748	$363,026,198	$429,468,409	$287,258,548	**$2,626,136,965**
SIDECASTER							
CONTRACT	--	--	--	1	--	--	**1**
CY	--	--	--	1,372,500	--	--	**1,372,500**
$	--	--	--	$5,553,500	--	--	**$5,553,500**
UNKNOWN							
CONTRACT	--	1	8	6	3	2	**20**
CY	--	70,000	2,213,602	4,574,933	1,641,800	74,200	**8,574,535**
$	--	$0	$80,069,726	$133,946,038	$15,289,677	$10	**$229,305,451**
COMBO-ALL TYPE							
CONTRACT	--	1	1	1	--	2	**5**
CY	--	31,000	54,000	35,000	--	2,938,000	**3,058,000**
$	--	$0	$0	$5	--	$50,420,400	**$50,420,405**
PIPELINE & BUCKET							
CONTRACT	5	8	5	2	3	6	**29**
CY	1,072,500	1,557,860	582,000	1,057,500	796,000	1,614,856	**6,680,716**
$	$12,165,808	$13,041,117	$0	$39,520,505	$16,622,641	$14,752,312	**$96,102,383**
PIPELINE & HOPPER							
CONTRACT	4	3	--	5	2	--	**14**
CY	10,050,000	5,432,000	--	21,950,000	1,081,000	--	**38,513,000**
$	$24,396,563	$51,872,225	--	$278,236,200	$31,863,362	--	**$386,368,350**
HOPPER & BUCKET							
CONTRACT	--	1	1	--	5	1	**8**
CY	--	1,340,000	--	--	3,417,300	1,505,000	**6,721,300**
$	--	$7,140,000	$10,146,750	--	$41,691,034	$9,474,000	**$68,451,784**
TOTAL CONTRACT	**148**	**147**	**169**	**149**	**132**	**89**	**834**
TOTAL CY	**152,687,633**	**120,652,208**	**144,606,643**	**136,616,543**	**158,425,873**	**99,362,055**	**812,350,955**
TOTAL $	**$930,236,412**	**$1,257,529,929**	**$1,185,639,296**	**$1,290,776,047**	**$1,081,544,420**	**$566,712,615**	**$6,312,438,719**

International Dredging Review also provides an annual update of the United States-based dredging fleet with some additional detail for each state. Since potential cost savings could be achieved by using Florida-based firms (through reduced mobilization/demobilization costs), Figure 3.3 and Table 3.4 provide the dredging fleet breakdown of the 74 dredges and associated twenty-seven companies with headquarters or offices in Florida. The cutter suction (61%) and clamshell dredges (23%) are the predominant hydraulic and mechanical dredge types in Florida.

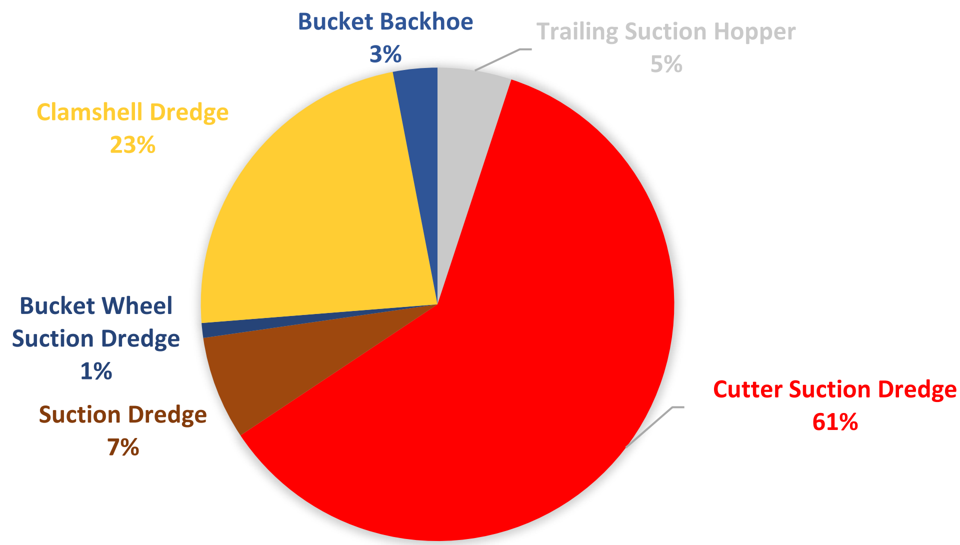

Figure 3.3 Florida-Based Dredging Fleet, International Dredging Review, 2018

Table 3.4 Florida Based Dredging Fleet, International Dredging Review, 2018

	COMPANY / EQUIPMENT	SIZE (IN OR CY)	HORSEPOWER (HP)	TYPE[1]
1	**AshBritt, Inc. - Deerfield**			
	Equipment list not provided.	--	--	--
2	**Aztec Development, Co. - Orlando**			
	General	14	1,000	CH
	Swinger	14	1,000	CH
	Dixie	12	1,200	CH
	Mini-Swinger	8	220	CH
	Jet-Spray	8	450	CH
	Jet-Spray II	8	220	CH
	Water-Vac	8	220	CH
	Water-Vac	8	220	CH
	Water-Vac	8	220	CH
3	**Bull Dredging, Inc. - Neptune Beach**			
	El Roro IV	8	260	CH
	SP-815	6	160	CH
4	**Cavache, Inc. - Pompano Beach**			
	Maya Caelyn	18	3,500	CH
	Michelle	16	1,800	CH
	Georgia	16	1,300	CH
	Lil Monica	12	750	CH
5	**Cemex - Davenport**			
	Kracken	16	2,850	PS
6	**Central Construction Corp. - Panama City**			
	Dredge 1	12	560	CH
	Dredge 2	8	350	CH
	Dredge 3	8	225	CH
	Dredge 4	8	220	CH
7	**Doctor Dredge, LLC - St. Augustine**			
	--	12	75	CH
8	**Duncan Seawall, Dock, and Boat Lift, LLC - Sarasota**			
	Equipment list not provided.	--	--	--
9	**E I Dupont De Nemours - Starke**			
	Sandpiper	--	3,750	CH
	Ridge Runner	--	1,250	CH
10	**Energy Resources Inc. - Jacksonville Beach**			
	Moray	8	--	CH
	Barracuda	10	--	CH
	Barracuda	10	--	CH

Table 3.4 Florida Based Dredging Fleet, International Dredging Review, 2018 (Continued)

	COMPANY / EQUIPMENT	SIZE (IN OR CY)	HORSEPOWER (HP)	TYPE[1]
11	**F&A Marine Construction, Inc. - St. Augustine**			
	Mechanical dredging equipment	--	--	CL
12	**Ferreira Construction Co., Inc. - Stuart**			
	Lady Mimi	14	1,145	CH
	Lori Hill	18	1,000	CH
13	**Florida Dredge & Dock, Inc. - Tarpon Springs**			
	Hooker Point	14	700	PS
	Cedar Point	20	2,000	CH
	Gator Point	14	1,100	CH
	Sand Point Dredge	20	1,200	CH
	Rock Point	10	450	CH
14	**Gator Dredging, Inc. - Clearwater**			
	Ellicot - 670	14	670	CH
	Ellicot - 370	14	370	CH
	Ellicot Swing Dragon	8	370	CH
	Versi	8	360	CH
	2 - Custom Hydraulic Dredges	6	--	CH
	Hopper Barge - 30 x 16	--	--	H
15	**Goodloe Marine - Wimauma**			
	Bettie	20	--	CH
	Diligence	18	--	CH
	Perseverance	18	--	CH
	Tenacious	16	--	CH
	Reliable	14	--	CH
16	**Grady Marine Construction - Fort Lauderdale**			
	Graymar	1 CY	--	CL
17	**Henry Fischer & Sons, Inc. - Sebastian**			
	Maddox	12	500	CH
	Shark	12	650	CH
	Fisher / Compton	12	1,350	CH
	Fisher / Compton	18	2,100	CH
	Fisher / Compton	8	605	CH
18	**J L Spangle Marine Construction Co. - New Port Richey**			
	Dredge Lynn	1.5 CY	--	CL
19	**Jahna Dredging, Inc. - Lake Wales**			
	DG-429	12	500	CH
	DG-1072	10	470	CH
	DG-925	10	470	CH
	DG-1008	8	5,012	CH

Table 3.4 Florida Based Dredging Fleet, International Dredging Review, 2018 (Continued)

	COMPANY / EQUIPMENT	SIZE (IN OR CY)	HORSEPOWER (HP)	TYPE[1]
20	**Lake Michigan Contractors, Inc. - Indiantown**			
	Hydraulic Dredging Equipment	16	--	CH
21	**Manson Construction Co, Jacksonville**			
	Clamshell Dredges (20)	--	--	CL
	Hopper Dredges (4)	--	--	H
	Cutter Suction (3)	--	--	CH
22	**Marine Contracting Group, Inc. - Punta Gorda**			
	DB-60	30 CY	140	BH
	DB-40	20 CY	200	BH
	DB-45	10 CY	200	BH
23	**Millmac Corporation - Coral Springs**			
	Margaret Jean	10	800	PS
	Bette Jean	8	250	BW
24	**Orion Marine Construction - Tampa**			
	Curtis K Huggins	24	6,150	CH
	Jeri B	14	2,600	CH
	Mr. O	14	2,300	CH
	C-Way	14	1,900	CH
	Amber Waves	14	3,200	CH
	Wildcat	10	800	CH
25	**Prosperity Dredging Co, Inc./DL Milling Family, LLC - Stuart**			
	Equipment list not provided.		--	--
26	**Puentes Y Dragados De Mexico - Miami**			
	Leases all equipment specific to job need.		--	--
27	**Standard Sand & Silica Co. - Miami**			
	Ivey #1	8	300	PS
	Ivey #2	8	300	PS
	Ocala	6	200	PS
	Ramrod	10	700	PS
			TOTAL BACKHOE (BH)	**3**
			TOTAL BUCKET WHEEL (BW)	**1**
			TOTAL CUTTERHEAD (CH)	**58**
			TOTAL CLAMSHELL (CL)	**4**
			TOTAL HOPPER (H)	**2**
			TOTAL PLAIN SUCTION (PS)	**6**
			ALL TOTAL	**74**

[1]BH = Backhoe; BW = Bucket Wheel; CH= Cutterhead; CL = Clamshell; H = Hopper; PS = Plain Suction

3.3 Dredge Technology

During our documentation efforts (**Chapter 2.0**), we also out reached to several United States-based dredge manufacturers and technical suppliers to gain insight into current and emerging technology that may benefit the Waterway. **Attachment A** provides a copy of the individual interview forms and, when applicable, supporting information supplied by the company.

3.3.1 Mechanical Dredge Manufacturers

Cable Arm, Inc. (Trenton, Michigan) and Anvil Attachments (Slaughter, Louisiana) are two of the leading cable- and hydraulic-clamshell bucket manufactures in the United States. Clamshell buckets are typically required for dredging contaminated sediment or where there is an overwhelming turbidity concern. The Cable Arm environmental clamshell buckets, updated in 2016, are designed to (1) seal in dredged material and contaminated sediment; (2) minimize lateral movement of material within the bucket; (3) remove material at nearly the same water content and volume as the in-situ material; and (4) create a nearly flat rectangular cut for even removal of sediment (http://www.cablearm.com/System.html). Anvil Attachments manufacturers six types of clamshell buckets (hydraulic, single-, double-, triple-, and quadruple-cable, electro-hydraulic, and diesel) that can be custom designed for any crane configuration and application. Several other United States-based companies — Caterpillar, Deere & Company, and Terex — manufacture traditional excavators and construction support equipment. Because these are not specialty dredging equipment manufacturers, we did not contact them.

3.3.2 Hydraulic Dredge Manufacturers

Ellicot Dredge (Baltimore, Maryland) and DSC Dredge (Reserve, Louisiana) are two of the predominant hydraulic dredge manufacturers in the United States. Ellicot Dredge — a 125-year old company that has sold over 2,000 dredges for 100 countries — manufactures portable cutterhead, swinging ladder, large cutterhead, and custom dredges, pump barges, and booster pumps (http://www.dredge.com/). DSC Dredge (http://www.dscdredge.com/) — formed with the consolidation of the merged Dredging Supply Company (1989) and Kenner Marine (1971) in 2010 — manufactures conventional, swinging ladder, and customized dredge types, support equipment (work boats, boosters), and automated interface solutions for the dredge operation (control, management, maintenance). Charles Johnson, DSC Dredge, indicated that they have been actively researching dredging efficiency for aggregate and navigational dredging. DSC has recently patented a new dredge design that dredges as wide as a conventional dredge with a swinging ladder and does not require the use of swing wires and anchors. The dredge swings side-to-side as it advances through the channel on spuds and is specifically designed to increase dredging efficiency in both operation and mechanics. **Attachment A** contains additional information on Ellicot and DSC Dredge.

3.3.3 Dredge-Specific Positioning Software

HYPACK® and ClamVision® provide the dredge captain a fully integrated, Windows-based software that provides navigational and dredging support with digging efficiency and precise positioning. HYPACK® (http://www.hypack.com/), serving both the surveying and dredging industry, has packaged several software programs specifically for acquisition and processing of sub-bottom profiling data (HYPACK® Sub-Bottom), calibrating, collecting and processing multibeam survey data (HYSWEEP®), collection and processing hydrographic data collection (HYPACK® Max), and dredging control for cutter suction, hopper, excavators, and bucket dredges (DREDGEPACK®). Cable Arm developed a similar, dredge positioning system — marketed as ClamVision® — that provides crane operators a real time view of the barge and clamshell bucket positions (http://www.cablearm.com/ClamVision.html). Listed features include tide gauge adjustments, fully wireless data and video communications, and bucket depth. As witnessed in several FIND dredging projects, when HYPACK® and ClamVision® are appropriately calibrated and used by dredge captains, efficiency (and cost) of dredging applications is significantly improved.

4.0 FLORIDA EAST COAST DREDGING AND MANAGEMENT HISTORY

A comprehensive understanding of dredged material management along the east coast of Florida is important to further developing dredging efficiencies (best management practices) for the FIND and USACE. Building on the historical information collected for FIND's DMMP and availability of information from FIND and the USACE, Taylor Engineering summarized the waterway (since the 1940's) and Florida's east coast harbors (since 2002) dredging projects. Consolidation of this information — authorized depths, dredging frequencies, typical unit costs, material placement, and dredge types — allowed Taylor Engineering to identify potential opportunities to improve dredging efficiencies. Current Florida Department of Environmental Protection (FDEP) and Department of Army (DOA) environmental regulations also influence dredge types used for Waterway dredging and affect dredging efficiency. Organized by the AIWW/ICWW and east coast harbors and inlets, a discussion of historic and future of dredged material management follows below.

4.1 Atlantic Intracoastal and Intracoastal Waterways

The Waterway comprises two authorized project depths: (1) 12 ft below MLLW from the state line to the Ft. Pierce Harbor Project (FPHP) and (2) 10 ft below MLLW from the FPHP southward to the Miami Harbor Project (MHP) in Biscayne Bay. An additional 75-ft wide, 63-mile segment of the ICWW authorized and constructed to seven feet below MLLW from the MHP to Cross Bank, Florida Bay is also considered part of the ICWW[1]. The 26-mile Florida section of the AIWW comprises that portion of the federal navigation project that extends northward from the Jacksonville Harbor Project (JHP) at the St. Johns River to the state line, while the 351-mile ICWW extends southward from the JHP to the MHP. Together, the AIWW and ICWW intersect each of Florida's 12 east coast (Nassau to Miami-Dade) counties.

4.1.1 Dredged Material Management

Before the increased environmental awareness of the 1970s and the recognition by various federal and state regulatory agencies of the value of estuarine wetlands, a short-term economic approach guided management of dredged material. Engineering/operational and cost considerations determined the design and execution of channel maintenance projects. The Trustees of the Internal Improvement Trust Fund granted to the FIND perpetual easements — typically named and identified by a maintenance spoil area (MSA) and number designation — of significant acreage along the waterways. Most of these easements, located entirely within the sovereign waters of the state, included open water areas as well as expanses of pristine salt marsh in the more northern counties and mangrove wetlands in the more southern counties. Additionally, many landowners with holdings adjoining the waterways sought to improve the development potential of wetlands by granting disposal easements and allowing the unconfined placement of maintenance material. This approach, combined with the desire of dredging contractors to maximize operational efficiency, resulted in open-water and wetland placement of channel construction and maintenance material. These activities resulted in a loss of wetlands and the proliferation of numerous small spoil mounds and islands lining the Waterway.

To secure its ability to maintain the waterways within the existing framework of engineering/operational and added environmental and socioeconomic/cultural considerations, the FIND initiated preparation of a long-range dredged material management plan (DMMP). Beginning in 1986, the

[1] Rivers and Harbors Act of 1945 authorized an expansion of this southern segment that would have widened the channel from 75 ft to 90 ft from Miami to Cross Bank and extended the 90-ft wide channel to Key West, FL; however, construction funds were never received, and the channel remains unconstructed.

two-phased plan implemented, on a county by county basis, planning and site acquisition activities to accommodate all maintenance material dredged from the Waterway for the next 50 years. In general accordance with the USACE Engineer Regulation 1105-2-100 guidance document, the FIND originally completed — on a county by county basis — Phase I of the long range dredged material plans between 1986 (Nassau and Duval Counties) and 2002 (Miami-Dade). The development of the original Phase I reports consisted of six primary components:

1. Establishment of the 50-year material storage requirement based on historic maintenance dredging volumes and subsequent examination surveys
2. Evaluation of remaining or potential storage capacity of existing easements and the FIND-owned tracts within the project area
3. Development of a management concept or strategy — ocean disposal, open water placement, beach/nearshore placement, centralized upland storage — appropriate to specific engineering/operational, environmental, and socioeconomic/cultural considerations
4. Identification of additional candidate sites consistent with the management concept
5. Evaluation of all candidate sites based on a standard set of criteria that reflects specific engineering/operational, environmental, and socioeconomic/cultural considerations
6. Selection of a set of primary (first-choice) and secondary (second-choice) dredged material management sites that best meet projected requirements consistent with the established management concept

Phase II involved field data collection, site acquisition, preliminary site design, permitting and construction. Due to this comprehensive and long-range effort, FIND has successfully secured 57 upland DMMA's and identified 9 beach placement areas for the management of the Waterway sediment.

An alternative and beneficial approach to traditional dredged material management methods — not originally considered in the original DMMP effort — includes regional sediment management (RSM), also known as engineering with nature and spoil site rejuvenation. RSM is a management method, with implications for all dredging projects, that (1) includes consideration of the environment; (2) accounts for the effect of human activities on sediment erosion; and (3) protects and enhances natural resources while balancing economic needs. RSM should be considered for long-term maintenance of the ICWW; however, RSM should be paired, with adjacent public agency projects (to share with environmental data collection costs) and, if possible, to secure future mitigation credits. From a cost perspective, applying RSM principles could be especially beneficial to the long-term maintenance of the Waterway by combining funds designated for Flood Risk Management projects (beaches) with dedicated navigation funding to achieve mutual goals of channel maintenance and shore protection (i.e., beach nourishment). In 2018, FIND initiated — in accordance with Section 253.03(10)(d), Florida Statutes — a programmatic "Spoil Site Rejuvenation Plan" to enable FIND to more efficiently offload ("rejuvenate") its DMMAs to maximize their storage capacity for immediate and long-term maintenance needs. Via the preparation and submittal of a comprehensive plan to the Board of Trustees of the Internal Improvement Trust Fund (BTIITF), this plan, when approved, will enable FIND (without charge or public notice) to remove dredged material and place it on public or private lands. The plan is currently in draft format and will be submitted to BTIITF for consideration in the fall of 2018. Combined, both RSM and the Spoil Site Rejuvenation Plan serve to further FIND's overall mission and improve overall dredging and dredged material management efficiencies.

4.1.2 Maintenance Dredging History

Both the historic and recent Waterway maintenance dredging history are provided in **Table 4.1**. Organized by county, this table provides a summary of 2014 shoal volumes for the Waterway (from FIND's most recent comprehensive bathymetric condition survey), location of the historical dredging projects by cut and station, dredging length, year, design and pay volumes, total pay volume by mile, total number of dredging events by reach, and the highest shoaling rate reaches. The location of the harbors (indicated in green and discussed further in **Section 4.2**) and reference to the tax-based inlet districts — St. Augustine Port, Waterway, & Beach District, Ponce de Leon Inlet Port Authority, Sebastian Inlet District, Jupiter Inlet District, and Hillsboro Inlet District — are organized in the table by reach. As shown and based on available data, a total of 22.6 mcy in the Waterway have been dredged since the 1940's. **Attachment C** provides a detailed breakdown by county of the summarized information contained in **Table 4.1**.

The six highest shoaling rate areas — Sawpit, Matanzas, Ponce de Leon Inlet, Crossroads, Jupiter, and Bakers Haulover — require frequent dredging to maintain safe, navigable depth. Each of these areas are near tidal inlets where shoals form primarily by sand transported through the inlet by waves and tides. Therefore, most of this material contained in these shoals likely consist of beach-quality sand. As shown in **Table 4.2,** these six areas account for more than 60% of the maintenance volume and 50% of the total number of dredging events required for the entire Waterway. Two potential opportunities to increase dredging efficiencies for these six areas are (1) analysis of the coastal conditions to see if the construction of advanced maintenance areas (deepening or settling basins) could decrease the dredging frequency and (2) construction of the two remaining DMMA's (DU-3&4, MSA 434/434N) for Reaches NA-II/DU-III and V-IV to increase available storage capacity and allow for multiple maintenance events into vicinity DMMAs.

For both the Matanzas and Crossroads areas, Taylor Engineering previously completed a detailed coastal analysis to investigate project modifications with the goal of increasing dredging efficiencies. For both areas, Taylor Engineering developed and applied a MIKE21 integrated hydrodynamic, wave, and sediment transport numerical model to identify, quantify, and analyze the wave climate, hydrodynamics, and sediment transport characteristics. The studies considered various alternatives seeking to reduce sediment inflow into the ICWW channel and other adjacent waterways. The 2007 Matanzas study evaluated a no-action alternative and three alternatives to reduce sediment deposition in Cuts SJ 59–61.

Table 4.1 AIWW/ICWW Historical Maintenance Dredging Summary, Nassau County to Miami-Dade, 1943-2017

Reach		DMMA		Volume			CY/Mile	CY/Year/Mile	50-Year Dredging Require-ment (CY)	50-Year Storage Require-ment (CY)	No. of Dredging Events	High Shoaling Rate Reaches
Name	Length (MI)	Name	Con-structed	Main-tenance (CY)	2014 Shoals (CY)	Total (CY)						
Kings Bay Entrance Channel & Fernandina Harbor[1]												
N-FHP	3.74	Undefined		18,392	11,354	29,746	407	109	20,374	43,804	1	
NA-1	10.20	NA-1	X	377,580	23,763	401,343	5,498	539	274,892	591,019	5	
NA-II	1.65	Amelia Island State Park (NA-AMI)		812,588	2,619	815,207	11,167	6,768	558,361	1,200,476	7	
Nassau Total	**15.59**	**DMMA: 1; Beach: 1**		**1,208,560**	**37,736**	**1,246,296**	**17,073**	**1,095**	**853,627**	**1,835,299**	**13**	Sawpit
DU-III	6.19	DU-2	X	1,107,043	45,342	1,152,385	16,005	2,577	800,267	1,720,575	9	
		DU-3&4										
DU-IV	4.24	DU-6A & 6B	X	265,756	77,938	343,694	4,774	1,128	238,676	513,154	6	
Mayport, Marine Corps Terminal – Blount Island, Jacksonville Harbor												
DU-V	3.93	DU-7		34,529	13,571	48,100	763	194	38,175	82,076	2	
DU-VI	3.88	DU-8	X	105,830	5,351	111,181	1,765	455	88,239	189,714	9	
DU-VII	4.00	DU-9	X	790,012	29,237	819,249	13,004	3,251	650,198	1,397,926	9	
Duval Total	**22.24**	**DMMA: 6; Beach: 0**		**2,303,170**	**171,439**	**2,474,609**	**36,311**	**1,633**	**1,815,555**	**3,903,443**	**35**	
SJ-I	6.29	SJ-14	X	1,149,140	79,144	1,228,284	19,811	3,155	990,552	2,129,686	4	
SJ-II	7.86			507,089	61,518	568,607	9,171	1,167	458,554	985,891	3	
SJ-III	11.86	SJ-29		123,345	6,223	129,568	1,993	168	99,667	214,285	1	
		St. Augustine Inlet Beach Placement Area (SJ-SAI)										
St. Augustine Inlet & St. Augustine, Port, Waterway, & Beach District												
SJ-IV	10.90	SJ-20A	-	18,600	18,600	300	28	15,000	32,251	0	0	
SJ-V	7.81	SJ-1	X	3,963,829	55,418	4,019,247	61,835	7,917	3,091,728	6,647,216	21	Matanzas
St Johns Total	**44.72**	**DMMA: 4; Beach: 2**		**5,743,403**	**220,902**	**5,964,305**	**93,110**	**2,082**	**4,655,501**	**10,009,328**	**29**	

Table 4.1 AIWW/ICWW Historical Maintenance Dredging Summary, Nassau County to Miami-Dade, 1943-2017 (Continued)

Reach		DMMA		Volume								
Name	Length (mi)	Name	Con-structed	Main-tenance (cy)	2014 Shoals (cy)	Total (cy)	cy/mile	cy/year/mile	50-Year Dredging Require-ment (cy)	50-Year Storage Require-ment (cy)	No. of Dredging Events	High Shoaling Rate Reaches
FL-I	4.44	FL-3	X	262,390	47,491	309,881	4,998	1,131	249,904	537,293	4	
FL-II	3.80	FL-8		588,120	14,185	602,305	9,715	2,563	485,730	1,044,320	3	
FL-III	5.84	FL-12		-	23,936	23,936	386	66	19,303	41,502	0	
FL-IV	4.06			-	20,947	20,947	338	83	16,892	36,319	0	
FLAGLER TOTAL	**18.14**	**DMMA: 3; BEACH: 0**		**850,510**	**106,559**	**957,069**	**15,437**	**851**	**771,830**	**1,659,434**	**7**	
V-I	10.16	MSA 410 V-6 (MSA 426/428)		57,406	195,902	253,308	4,691	462	234,544	504,270	1	
V-II	5.82	V-25		-	14,435	14,435	267	46	13,366	28,736	0	
V-III	4.85	V-29	X	60,835	11,351	72,186	1,337	276	66,838	143,703	1	
V-IV	10.98	MSA 434/434N MSA 434/434S Ponce de Leon Inlet Beach Placement Area (V-PDI)	 X 	5,442,527	64,320	5,506,847	101,979	9,288	5,098,933	10,962,706	16	Ponce de Leon Inlet
Ponce de Leon Inlet & Volusia County Ponce de Leon Inlet Port Authority												
V-V	10.58	V-26 V-21	X 	523,876	61,286	585,162	10,836	1,024	541,817	1,164,906	5	
V-VI	10.09	V-22A		-	115,666	115,666	2,142	212	107,098	230,261	-	
VOLUSIA TOTAL	**52.48**	**DMMA: 9; BEACH: 1**		**6,084,644**	**462,960**	**6,547,604**	**121,252**	**2,310**	**6,062,596**	**13,034,582**	**23**	
BV-I	7.74	BV-2C	X	1,483,778	152,640	1,636,418	30,304	3,915	1,515,202	3,257,684	5	
BV-II	11.94	BV-4B BV-NASA	 X	101,111	127,578	228,689	4,235	355	211,749	455,261	1	
BV-III	11.06	BV-11		42,980	55,008	97,988	1,815	164	90,730	195,069	1	
BV-IV	11.11	BV-R		-	24,250	24,250	449	40	22,454	48,275	0	
BV-V	12.69	BV-40 BV-52	 X	-	6,498	6,498	120	9	6,017	12,936	0	
BV-VI	13.47	BV-24A		-	128,816	128,816	2,385	177	119,274	256,439	0	
BREVARD TOTAL	**68.01**	**DMMA: 8; BEACH: 0**		**1,627,869**	**494,790**	**2,122,659**	**39,309**	**578**	**1,965,425**	**4,225,664**	**7**	

Table 4.1 AIWW/ICWW Historical Maintenance Dredging Summary, Nassau County to Miami-Dade, 1943-2017 (Continued)

Reach		DMMA		Volume			cy/mile	cy/year/mile	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Dredging Events	High Shoaling Rate Reaches
Name	Length (mi)	Name	Constructed	Maintenance (cy)	2014 Shoals (cy)	Total (cy)						
Sebastian Inlet & Sebastian Inlet District												
IR-I	8.09	IR-2	X	276,311	-	276,311	4,848	599	242,378	521,113	1	
IR-II	6.96	IR-7A		-	10,845	10,845	190	27	9,513	20,453	0	
Canaveral Harbor												
IR-III	8.27	IR-14		-	22,956	22,956	403	49	20,137	43,294	0	
INDIAN RIVER TOTAL	**23.32**	**DMMA:3; BEACH: 0**		**276,311**	**33,801**	**310,112**	**5,441**	**233**	**272,028**	**584,860**	**1**	
SL-I	8.81	SL-2	X	2,381	6,259	8,640	157	18	7,855	16,887	1	
FT. PIERCE HARBOR												
SL-II	12.91	M-8		73,777	8,878	82,655	1,425	110	71,254	153,197	3	
ST LUCIE TOTAL	**21.72**	**DMMA:2; BEACH: 0**		**76,158**	**15,137**	**91,295**	**1,582**	**73**	**79,109**	**170,084**	**4**	
M-I	4.34	M-12		-	1,727	1,727	34	8	1,693	3,640	0	
M-II	4.07	M-5	X	615,183	28,428	643,611	12,620	3,101	630,991	1,356,631	10	Crossroads
St. Lucie Inlet												
M-III	6.00	MSA 504B/E		19,286	15,039	34,325	673	112	33,652	72,352	1	
M-IV	7.84	MSA 524B		-	3,426	3,426	67	9	3,359	7,221	0	
MARTIN TOTAL	**22.25**	**DMMA: 4; BEACH: 1**		**634,469**	**48,620**	**683,089**	**12,650**	**569**	**669,695**	**1,439,844**	**11**	
Jupiter Inlet & Jupiter Inlet District												
PB-I	3.65	Jupiter Inlet Beach Disposal Area (PB-JB)		1,428,972	6,752	1,435,724	27,089	7,401	1,354,457	2,912,082	17	Jupiter
PB-II	7.52	MSA 610/611 MSA FO-617C		847,756	13,237	860,993	16,245	2,160	812,258	1,746,354	2	
PB-III	17.12	Peanut Island	X	233,277	14,886	248,163	4,682	332	234,116	503,349	4	

Table 4.1 AIWW/ICWW Historical Maintenance Dredging Summary, Nassau County to Miami-Dade, 1943-2017 (Continued)

Reach Name	Reach Length (mi)	DMMA Name	DMMA Constructed	Volume: Maintenance (cy)	Volume: 2014 Shoals (cy)	Volume: Total (cy)	cy/mile	cy/year/mile	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Dredging Events	High Shoaling Rate Reaches
PALM BEACH HARBOR/LAKE WORTH INLET												
PB-IV	18.50	Boynton Inlet Beach Disposal Area (PB-BB)		687,582	13,759	701,341	13,233	715	661,642	1,422,531	2	
		MSA 640/640A										
		MSA 641	X									
		MSA 684A										
PALM BEACH TOTAL	**46.79**	**DMMA: 6; BEACH: 2**		**3,197,587**	**48,634**	**3,246,221**	**61,249**	**1,309**	**3,062,473**	**6,584,316**	**25**	
HILLSBORO INLET & HILLSBORO INLET DISTRICT												
BW-I	4.74	MSA 726, 726B, 726C		-	9,781	9,781	192	40	9,589	20,617	0	
		Hillsboro Inlet Beach Placement Area (BW-HI)										
BW-II	7.05	MSA FO-727B		-	2,119	2,119	42	6	2,077	4,467	0	
PORT EVERGLADES												
BW-III	13.20	Port Everglades (MSA 783)		179,743	197	179,940	3,528	267	176,412	379,285	1	
BROWARD TOTAL	**24.99**	**DMMA: 3; BEACH: 1**		**179,743**	**12,097**	**191,840**	**3,762**	**151**	**188,078**	**404,369**	**1**	
DA-I	3.99	D-29		-	13	13	-	-	14	31	7	Bakers Haulover
DA-II	3.99	Bakers Haulover Inlet Beach Placement Area (D-BHI)		418,102	108	418,210	9,294	2,052	464,678	999,057	0	
DA-III	8.89	D-29		-	26	26	1	-	29	62	0	
END OF FEDERAL ICWW PROJECT - MIAMI HARBOR AND RIVER												
DA-IV	15.75	D-45		-	-	-	-	-	-	-	0	
DA-V	15.29	D-45		-	1,574	1,574	35	2	1,749	3,760	0	
MIAMI-DADE	**47.91**	**DMMA: 3; BEACH: 1**		**418,102**	**1,721**	**419,823**	**9,329**	**288**	**466,470**	**1,002,910**	**7**	
KEY WEST HARBOR												
TOTAL	**408.16[2]**	**DMMA: 52[3]; BEACH: 9**		**22,600,526**	**1,654,396**	**24,254,923**	**416,504**	**1,020**	**20,862,388**	**44,854,134**	**163**	

[1]Ocean harbors and inlets indicated in green; [2]377.12 miles = Total project length from Nassau to end of Federal project at Miami Harbor; [3]Five additional FIND-owned DMMA's (O-23, O-35, O-7, LT-4A, and LT-13A) and four material transfer sites (HD-1, HD-2, HD-3, and HD-4) serve the maintenance needs of the OWW. See **Attachment C**.

The alternatives included (1) constructing a sediment trap in the north arm of Matanzas River, (2) constructing a spur dike off the northern tip of Rattlesnake Island, and (3) extending the existing settling basin in the ICWW. Model results indicated that a sediment basin in the north arm of Matanzas River could provide an annual saving of $18,000 relative to the no action alternative. However, after the completion of the study, the Summer Haven River immediately south of Matanzas Inlet filled with beach sand that passed through an adjacent dune breach. The filling and subsequent, recent dredging of the Summer Haven River and resulting, large changes in bed elevations along the north arm of Matanzas River could have changed the area's hydrodynamics and rendered the results of the 2007 study invalid. Considering these changes, a re-evaluation of the area's hydrodynamics and potential sediment transport could provide new insights to better ways to reduce maintenance dredging in the ICWW near Matanzas Inlet.

Table 4.2 AIWW/ICWW Highest Shoaling Rate Reaches

REACH	DREDGED MATERIAL MANAGEMENT AREA	MAINTENANCE VOLUME (CY)	50-YEAR DREDGING REQUIREMENT (CY)	50-YEAR STORAGE REQUIREMENT (CY)	NUMBER OF DREDGING EVENTS	HIGH SHOALING RATE REACH
NA-II	Amelia Island State Park (NA-AMI)	812,588	558,361	1,200,476	7	Sawpit
DU-III	DU-2	1,107,043	800,267	1,720,575	9	
	DU-3&4					
SJ-V	SJ-1	3,963,829	3,091,728	6,647,216	21	Matanzas
	Matanzas Beach Placement Area (SJ-MB)					
V-IV	MSA 434/434N	5,442,527	5,098,933	10,962,706	16	Ponce de Leon Inlet
	MSA 434/434S					
	Volusia Ponce de Leon Inlet Beach Placement Area (V-PDI)					
M-II	M-5	615,183	630,991	1,356,631	10	Crossroads
	St. Lucie Inlet Beach Placement Area (M-SLI)					
PB-I	Jupiter Inlet Beach Disposal Area (PB-JB)	1,428,972	1,354,457	2,912,082	17	Jupiter
DA-II	Bakers Haulover Beach Placement Area (D-BHI)	418,102	464,678	999,057	7	Bakers Haulover
HIGHEST SHOALING RATE REACHES TOTAL		**13,788,244**	**11,999,415**	**25,798,742**	**87**	--
AIWW/ICWW TOTAL (TABLE 4.1)		**22,600,526**	**20,865,292**	**44,860,379**	**163**	--
PERCENT OF TOTAL (HIGHEST SHOALING RATE REACHES / [AIWW/ICWW TOTAL])		**61%**	**58%**	**58%**	**53%**	--

Similarly, the 2013-2015 Crossroads modeling study provided understanding of the forcing mechanisms of sediment transport in the waterways near OWW Cut 1. The study supported additional partial dredging of nearby shoals immediately north and south of OWW Cut 1 (wideners) to reduce the dredging frequency from every three years to every five years with an estimated annual savings of $200,000. The USACE expects to complete the project construction in 2018. Based on Taylor Engineering's analysis, the USACE has also completed and obtained approval of an advance maintenance report, which makes the wideners a part of the federal navigation project and eligible for federal funding for future maintenance. A recent (2017) ICWW Crossroads permit modification has also allowed increased flexibility for placement of dredged material into DMMA M-5, St. Lucie Inlet Impoundment Basin, or Martin County Borrow Area B. This modification provides FIND with increased flexibility to manage dredged sediment, the ability to reduce costs associated with offloading DMMA M-5 on a less frequent basis and helps Martin County receive sand on its beach in a more efficient manner.

The USACE provided documentation (**Attachment D**) for USACE-led advance maintenance projects at Sawpit, Jupiter, and Bakers Haulover; however, it is unknown to what extent the projects have undergone a detailed coastal analysis to determine optimal efficiencies. To our knowledge, Ponce de Leon has not been similarly investigated.

Reorganizing and expanding on the information previously presented in **Table 3.1** and **Table 3.2**, **Table 4.3** provides further detail on the design depth, effective unit cost (entire project cost and divided by the total project volume), and dredge type applied for FIND projects between 2012 and 2017. As shown, the effective unit cost is typically much higher — since it takes into consideration all other project costs such as mobilization/demobilization, insurance, environmental protection — than the contracted unit cost for dredged material removed. In all instances, dredging occurred with either a conventional bucket excavator or cutter-suction dredge.

Table 4.3 AIWW/ICWW Recent Maintenance Dredging History, 2012–2017

PROJECT AREA	DESIGN DEPTH	YEAR	TOTAL PROJECT COST ($)	MOB/ DEMOB ($)	DREDGED MATERIAL REMOVED (CY)	CONTRACTED UNIT COST FOR DREDGED MATERIAL REMOVED ($/CY)	EFFECTIVE UNIT COST OF DREDGED MATERIAL REMOVED ($/CY)	DREDGE TYPE
AIWW NASSAU REACH I	-12 ft MLLW	2017	2,823,686	1,116,145	197,714	9.89 – North 8.45 – South	14.28	Cutter-Suction
ICWW VOLUSIA	-12 ft MLLW	2013	2,318,036	576,782	259,682	6.89	8.92	Cutter-Suction
ICWW ST. LUCIE	-12 and -10 ft MLLW	2017	3,046,147	1,845,000	98,192	33.97 – included beach placement	31.02	Cutter-Suction
LAKE OKEECHOBEE, ROUTES 1 AND 2	-8 ft (Route 1) and -6 ft (Route 2) Lake Okeechobee Datum	2012	479,000	35,000	7,600	46.28	63.02	Bucket
ICWW JUPITER	-10 ft MLLW	2017	715,801	291,627	102,068	7.00	7.01	Cutter-Suction
ICWW PALM BEACH DEEPENING NORTH	-15 ft MLLW	2016	2,078,370	232,035	103,528	9.10 – Sand 19.84 – Rock to -15 ft MLLW 26.78 – Rock between -15 and -17 ft MLLW	20.07	Cutter-Suction
BROWARD DEEPENING	-15 ft MLLW	2016	19,342,844	2,300,000	182,893	19.30	105.76	Bucket
DANIA CUTOFF CANAL	-15 ft MLLW	2012	7,154,659	1,132,000	90,974	18.00	78.64	Bucket

4.2 Florida East Coast Harbors and Inlets

The east coast of Florida offers numerous passageways (i.e., harbors, inlets) connecting the Atlantic Ocean to the Waterway. The USACE Jacksonville District is responsible for seven deep draft and four shallow draft harbors or inlets on the east coast of Florida. Deep draft harbors generally achieve a high benefit-cost ratio due to calculated annual tonnage and cargo value; therefore, these projects compete well for federal navigation funding and are routinely scheduled in the USACE Operation and Maintenance budget. Maintenance projects that receive a low benefit-cost ratio (e.g., low use, shallow draft harbors, Waterway, inlets) must be funded through work plans or mini-pots which supplement the President's budget or through special taxing districts (e.g., Ponce Inlet Port Authority, Sebastian Inlet District, Jupiter Inlet District, Hillsboro Inlet District). Regardless, opportunities may exist where a combination of inlet and harbor project maintenance needs may overlap with the Waterway.

Table 4.4 summarizes pertinent information — design depth, typical dredging frequency, total number of dredging events, DMMA, total project volume, total project cost, effective unit cost, and typical dredge types — for each of the USACE-managed harbors between 2002 and 2017. Similar to each reach of the Waterway, each harbor project area has one or more designated DMMAs that may include beach, nearshore, ODMDS, and landfill (in the case of Miami River sediment) placement. The authorized design depth of the harbors varies from -12 to -50 ft MLLW. The 15-year maintenance history for the deep and shallow draft harbors managed by the USACE totals nearly $950 million dollars to dredge 65,640,000 cy. The effective median unit cost per cubic yard of dredged material removed varies with dredge type and placement area and ranges from $3 to $43. Given the large scale of most of the harbor projects, the most common dredge types employed were the hopper, cutter-suction, and conventional bucket excavator. **Attachment E** provides a detailed breakdown by harbor of the information summarized in **Table 4.4**.

Comparing the effective unit cost of the Waterway (**Table 4.3**) and harbors (**Table 4.4**) dredging, the unit costs for five of the eight FIND projects are not that substantially different. The three outliers include the two deepening (Dania Cutoff Canal and Broward Deepening) and the Lake Okeechobee muck dredging projects. The remaining five projects — ICWW Volusia, ICWW Palm Beach Deepening, ICWW St. Lucie Reach I, AIWW Nassau Reach I, and ICWW Jupiter — fall roughly in line with USACE projects occurring during the same year (**Figure 4.1**).

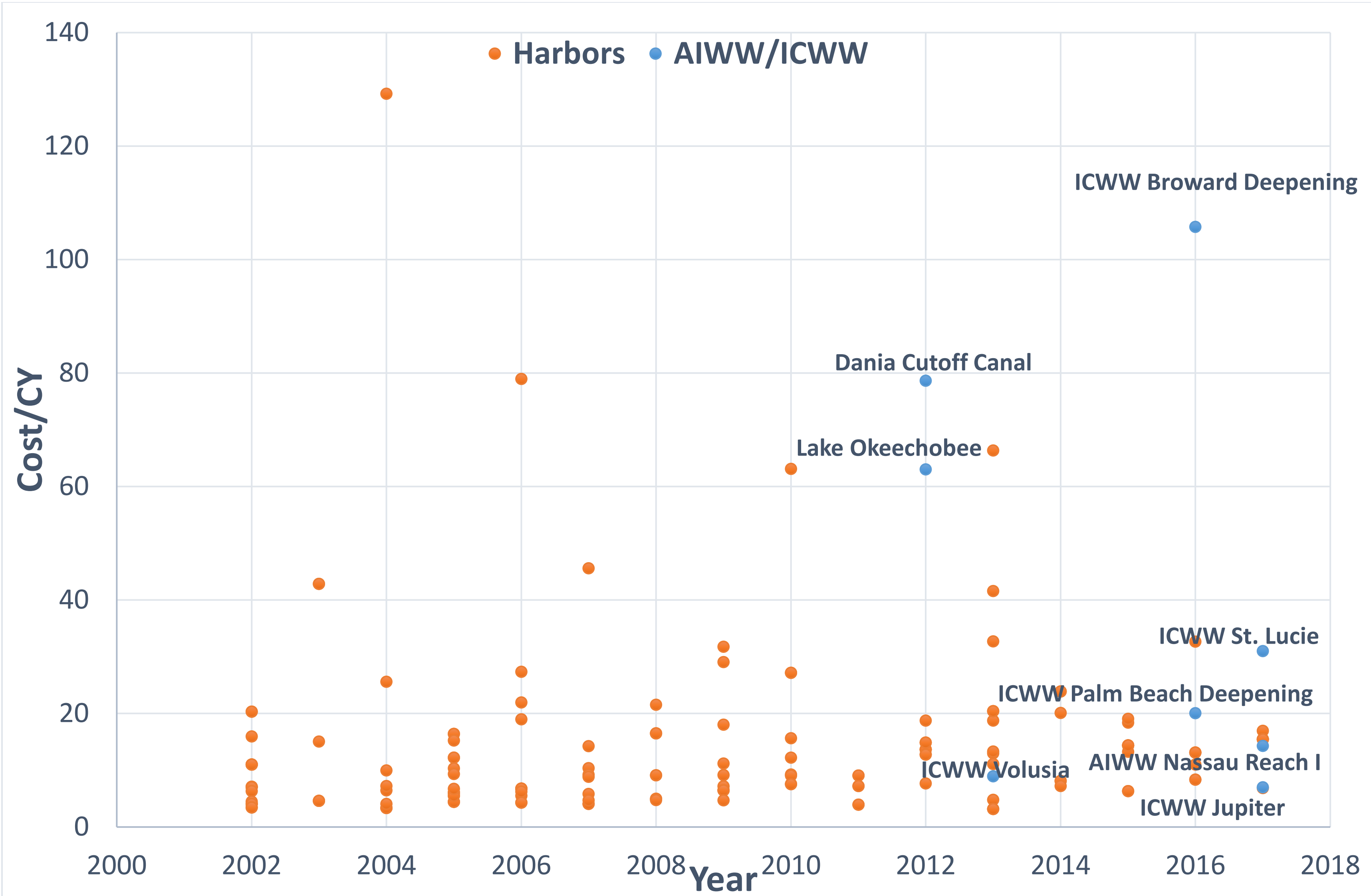

Figure 4.1 Comparison of FIND AIWW/ICWW vs. USACE Harbor Unit Dredging Costs

Table 4.4 Florida's East Coast Harbor Maintenance Dredging History, 2002–2017

PROJECT AREA	DESIGN DEPTH	TYPICAL DREDGING FREQUENCY	YEAR(S)	NO. OF DREDGING EVENTS	DMMA PLACEMENT AREA(S)	TOTAL VOLUME (CY)	TOTAL PROJECT COST ($)	EFFECTIVE MEDIAN UNIT COST ($/CY)	TYPICAL DREDGE TYPE
KINGS BAY ENTRANCE CHANNEL	-50 ft MLLW	Annually	2002, 2003, 2005, 2006, 2007, 2008, 2009, 2011, 2012, 2013, 2014, 2015, 2016 2017	14	Amelia Island North Beach Amelia Island Nearshore Ft. Clinch Fernandina ODMDS	13,026,851	128,230,991	6.97	Hopper
KINGS BAY INNER CHANNEL		Annually	2006, 2007, 2008, 2009, 2010, 2011, 2013, 2015, 2016, 2017	10	KBIC Upland DMMA Dayson Island	9,685,061	51,522,942	4.72	Cutter-suction
FERNANDINA HARBOR	-29 ft MLLW	Not dredged since 2004	2004	1	Amelia Island North Beach Amelia Island Nearshore Fernandina ODMDS	1,225,354	4,104,894	3.35	Hopper
MAYPORT	-50 ft MLLW	Every 2-3 years	2002, 2005, 2008, 2010 2013, 2014, 2017	7	Mayport Disposal Area Jacksonville ODMDS	11,332,320	87,175,185	7.23	Cutter Suction & Bucket, Hopper & Bucket, Bucket
MARINE CORPS TERMINAL – BLOUNT ISLAND	-40 FT MLLW	Every 2 years	2005, 2007, 2009, 2010	4	Dayson Island	688,581	5,684,295	8.87	Cutter-Suction
JACKSONVILLE HARBOR	-40 FT MLLW: Constructed; -47 FT MLLW: Authorized	Annually, split between three separate sections of the harbor	2002, 2004, 2005, 2006, 2007, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017	14	Bartram Island Buck Island Jacksonville ODMDS Mayport Beach	10,335,490	162,451,777	11.02	Hopper & Cutter-Suction Cutter-Suction
ST. AUGUSTINE INLET	-12 ft MLLW	Infrequent	2013	1	St Augustine Beach	182,998	2,439,010	13.33	Cutter-Suction
PONCE DE LEON INLET	-12 FT MLLW	Every 5 years	2005, 2009	2	Ponce Inlet Beach	249,829	2,586,013	10.28	Cutter-Suction
CANAVERAL HARBOR	-46 FT MLLW	Annually	2002, 2004, 2005, 2006, 2007, 2008, 2010, 2012, 2015,	9	Canaveral Disposal Ares A, C Canaveral ODMDS Canaveral nearshore Canaveral beach	6,376,796	53,342,332	7.33	Bucket, Cutter-Suction & Bucket Cutter-Suction

Table 4.4 Florida's East Coast Harbor Maintenance Dredging History, 2002 – 2017 (Continued)

PROJECT AREA	DESIGN DEPTH	TYPICAL DREDGING FREQUENCY	YEAR(S)	NO. OF DREDGING EVENTS	DMMA PLACEMENT AREA(S)	TOTAL VOLUME (CY)	TOTAL PROJECT COST ($)	EFFECTIVE MEDIAN UNIT COST ($/CY)	TYPICAL DREDGE TYPE
FT. PIERCE HARBOR	-28 ft MLLW	Every 10 years	2002, 2013, 2014	3	Ft. Pierce ODMDS Ft. Pierce Beach	399,118	6,571,472	18.74	Bucket, Hopper, Cutter-Suction
ST. LUCIE INLET	-10 ft MLLW	Every 5 to 10 years	2002, 2006, 2013, 2017	4	Jupiter Island Nearshore Donaldson Artificial Reef Area St. Lucie Inlet Beach	1,404,689	30,228,914	20.34	Cutter-Suction Bucket
PALM BEACH HARBOR	-33 ft MLLW: Constructed; -39 ft MLLW: Authorized	Every 2 years	2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2012, 2015, 2016, 2017	13	Palm Beach Harbor Beach In Channel Placement Palm Beach Harbor Nearshore Palm Beach Harbor Beach	2,059,611	34,067,224	15.32	Hopper Bucket Cutter-Suction & Bucket, Cutter-Suction
PORT EVERGLADES	-47 ft MLLW: Authorized; -42 ft MLLW: Constructed	Infrequent	2005, 2013	2	Port Everglades ODMDS Port Everglades Beach	465,360	9,032,846	20.42	Hopper, Hopper & Bucket
MIAMI HARBOR AND RIVER	-50 ft MLLW (Harbor) -15 ft MLLW (River)	Infrequent	2004, 2013	2	Miami ODMDS Miami Landfill	7,169,248	322,558,050	41.59	Cutter Suction Hopper, Cutter Suction & Bucket Bucket
			2004	1					
DEEPENING PROJECT FOR U.S. NAVY IN 2003	-30 ft MLLW: Authorized; -50 ft MLLW: Constructed	Infrequent	2003, 2006	2	Key West Single Use ODMDS Fleming Key	1,036,891	42,996,623	42.84	Hopper, Hopper & Bucket
		TOTAL		**93**	--	**65,638,197**	**942,992,551**	--	--

Five special taxing districts along the east coast of Florida support the development and improvement — through investigations, studies, surveys, plans, drawings, geotechnical borings, project construction etc. — of St. Augustine Inlet, Ponce Inlet, Sebastian Inlet, Jupiter Inlet, and Hillsboro Inlet. Jupiter Inlet District (JID) annually maintains the sand trap and every other year FIND partners with JID to share mobilization/demobilization costs to dredge the Waterway in conjunction with sand trap dredging. Of the five districts, only Hillsboro Inlet District (HID) operates and maintains its own dredge — an Ellicott Dragon Series 1070 14/12 Dredge. HID's dredge operation and maintenance annual budget totals approximately $1 million. To date, HID has not entertained (nor is it interested in pursuing) projects outside its jurisdiction. **Attachment A** contains documentation and interviews from four of the five Districts.

4.3 Maintenance Dredging Permitting

For maintenance dredging projects, FIND prepares and submits — to the FDEP and Department of the Army (DOA) — preliminary design drawings showing the proposed dredging locations, offloading area, and an abbreviated description of the dredged material handling methods and final placement (if not at an already permitted DMMA). The FDEP process generally involves verification of the maintenance dredging exemption under Chapter 403.813(3), Florida Statutes. If dredging restores the channel to original design specifications, previously undisturbed natural areas are not significantly impacted, and the work does not violate the manatee protection statute, Chapter 403.813(3) allows inland navigation districts to conduct maintenance dredging without a permit. Additional requirements to qualify for the exemption include compliance with a 150-meter turbidity mixing zone, material deposition into an upland DMMA existing before 2011 or permitted and constructed after 2011, notification to FDEP no less than 30 days before dredging, and more.

The DOA permitting requires verification of the maintenance dredging authorization under the Regional General Permit (RGP) SAJ-93. The RGP, effective through April 26, 2021, authorizes FIND maintenance dredging of the AIWW, ICWW, OWW in accordance with the Federal authorization (plus an allowable 2-ft overdredge) and has no limitations of the volume of material dredged. RGP SAJ-93 requires dredging by hydraulic pipeline cutterhead suction or mechanical clamshell. However, it also allows limited use of hydrodynamic dredges (WID, agitation, drag bar, etc.) to smooth high spots and fill in low areas. **Attachment F** provides copies of the Chapter 403.813(3), Florida Statutes and RGP SAJ-93.

5.0 MODIFICATION OF CURRENT CONTRACTING AND DREDGING PROCEDURES

Building on information presented in **Chapters 1.0–4.0**, Taylor Engineering provides an overview of current Waterway contracting and dredging procedures and modifications that would likely improve dredging efficiencies for the overall programmatic effort. One potential and significant modification that Taylor Engineering was asked to consider was FIND's acquisition, operation, and maintenance of a dredge. Both contractual and dredge-ownership considerations are discussed in the sections below.

5.1 Contracting Considerations

The FIND and USACE typically use conventional "design-bid-build" contracting procedures that involve solicitation of competitive bids from dredging contractors and selection of the least cost, technically acceptable bid. This is done on a project specific basis as the dredging need arises and usually involves one specific reach of the Waterway that requires maintenance. The USACE — to meet internal requirements and contracting goals — further refines its qualified bidder criteria by requiring that all Waterway dredging projects be performed by small businesses. Occasionally, the USACE will use one of its small hopper dredges (e.g., CURRITUCK or MURDEN) from the Wilmington District, on a daily rental basis, to accomplish smaller dredging jobs where the material can be placed in a nearshore disposal area. Outside the current FIND open-bid process, five contractual modifications we considered included: (1) removal/reduction of the USACE small business criteria on Waterway projects, (2) combination of maintenance projects, (3) multi-year contracts, (4) rental contracts, and, (5) implementation of Request for Qualifications (RFQ) procedures. Discussions of each of the five considerations follows:

Removal/Reduction of USACE Small Business Criteria and **Combination of Project Maintenance Needs.** While these two potential contractual modifications are different, removal of the USACE small business criteria could help to serve the combination of certain project maintenance needs. As presented in **Chapter 4.0**, dredging volumes for the 15-year history of the harbors amounts to 65.6 mcy versus the nearly 75-year dredging history of the Waterway of 22.6 mcy. Waterway project volumes are notably smaller and the controlling depths (-12 ft and -10 ft MLLW) place significant limits on a bigger dredge's ability to safely navigate; therefore, in most cases, the use of most deep-harbor dredging equipment will not be a viable choice for the Waterway. However, for certain projects — particularly for the six highest shoaling rate reaches (**Table 4.2**) — additional contractual opportunities (outside the typical FIND-JID for the ICWW Jupiter project) may exist between Waterway and harbor and inlet projects. Large dredging companies typically have shallow draft dredging equipment that could be mobilized with their larger plants when the need arises. For example, the Sawpit project could serve as an alternate bid item on the annual Jacksonville Harbor project, allowing larger dredging contractors to mobilize smaller dredging equipment — at a significantly reduced cost — to maintenance dredge the Waterway in vicinity of Sawpit. Similarly, ICWW maintenance in Reach PB-III near Peanut Island, though not frequently occurring, could be bid as an alternate with maintenance of the Palm Beach Harbor project. Outside the Waterway/harbor project opportunities, combination of Waterway project needs (e.g., Sawpit-Matanzas, Matanzas-Ponce de Leon Inlet, Ponce de Leon Inlet-Crossroads, Jupiter-Bakers Haulover) would be ideal for combining proximity, high-maintenance project needs to save on bidding and mobilization/demobilization costs.

Separate from these six highest shoaling rate reaches, increase in competition (via the removal or reduction of the USACE small business criteria) and combination of maintenance projects could increase contractor competition and drive down mobilization/demobilization costs. Waterway reaches requiring maintenance do not necessarily need to be near one another to capture the benefits. More competitive bids may be obtained from a larger quantity of material and an overall "bigger project". The USACE has previously combined two different and distinct authorized projects (such as Fort Pierce Harbor and Palm

Beach Harbor) into one maintenance dredging contract to reduce mobilization/demobilization, design, and construction administration costs. Recently, the USACE has also experimented with regional contracts, where projects in different USACE Districts are combined into a single contract. The concept could easily be applied to the Waterway whereby reaches in need of dredging throughout the Waterway are combined into a single contract.

Multi-Year Contracts. Multi-year contracts have also proven to increase competition (by drawing greater interest from contractors) and reducing overall costs of design and bid administration. Cashman Dredging & Marine Contracting currently holds a multi-year contract with the New York and New Jersey Port Authority. When contacted, Cashman has 30 days to respond to the initial dredging request. In addition to a <u>guarantee of a minimum level of work per year</u>, Cashman receives payment for each mobilization/demobilization and by unit cost of volume dredged. The USACE has also applied multi-year contracts whereby projects maintained on an annual basis are advertised for a base year and two option years. A contractor thus selected can dredge the project for three years straight without the USACE having to advertise and award of a new contract each year. Although this works for projects that required dredging on an annual basis, application of this method to a single project on the Waterway would be difficult, since the dredging frequency for the highest shoaling rate area on the Waterway is approximately every three years. However, a combination of projects by region (such as Sawpit-Matanzas, Ponce de Leon Inlet, Crossroads, Jupiter, and Bakers Haulover) and multi-year contracts may have great advantages.

Rental Contracts. This method entails solicitation of a daily dredge and crew rental for use on an on-call basis. Rental contracts are used extensively by USACE Districts responsible for the Mississippi River where dredging locations and needs vary as shoals tend to develop over short periods of time. Since the contractor is paid by the day (and not by the quantity dredged), this type of contract requires more proactive contract supervision. This scenario is used by the USACE Jacksonville District when it contracts the USACE Wilmington dredges (at a daily rate of $22,000/day) for Waterway projects. As an example of this type of contract, a solicitation from the USACE New Orleans District follows:

> *"**Synopsis:** The work consists of furnishing one fully crewed and equipped self-propelled trailing suction type hopper dredge on a rental basis. Work will be performed at the Mississippi River SWP Area, and possibly in other areas of the New Orleans District and in areas of both the Galveston and Mobile Districts. The estimated value of this work is between $5,000,000.00 and $10,000,000.00. The solicitation will issue on or about 14 November 2012, and a bid opening date will be established in a future amendment. This is an UNRESTRICTED procurement."*

Implementation of RFQ Procedures. Due to the uniqueness of the projects, FIND implemented two contracts — Dania Cutoff Canal and Broward ICWW Deepening — via the RFQ process. The RFQ evaluation committee consisted of the Executive Director, the District Engineer or his designee, and the District Commissioner for the county in which the project was located in. Specific proposal response requirements included a cover letter, proposer's technical profile, staff credentials and project team, quality control, listing of similar projects, project-specific technical approach for dredging and disposal of dredged material, and references. The evaluation committee members reviewed and rated each proposal, assigning points to several criteria based on the above topics. Combining the individual reviews, the committee ranked the contractors and asked the top three firms to provide a bid. The resulting, qualified low-bidder was awarded the contract. If FIND desires, this same RFQ process could be used for all projects, requiring contractors' proposals to address any number of general and project-specific topics (e.g., a specific dredge type, advanced technology, specific software for monitoring of dredge equipment). However, more stringent technical specifications will often drive project costs upwards. Nonetheless, the dredging industry is very competitive and, given enough flexibility in the means and methods to accomplish the overall project goal, dredging contractors can and will employ innovative approaches to reduce cost and, as a result, ultimately win more projects.

5.2 Dredge Ownership

In addition to contractual modifications, FIND has expressed some interest — mostly due to inadequate federal funding — in the acquisition, operation, and maintenance of a dredge for Waterway maintenance. While immediate and direct control of dredging appears appealing, the overall advantages and disadvantages of dredge ownership, including expected costs, must be considered before moving forward.

5.2.1 Advantages and Disadvantages

In general, the primary advantages of FIND dredge ownership include increased flexibility to schedule dredging on an as-needed basis, ability to purchase the best dredge for the specific needs of the Waterway, ability to manage project construction and safety, and, depending on where the dredge(s) are based, reduction or elimination of mobilization/demobilization costs. Conversely, primary disadvantages include increased liability; increased cost, time, and staff for dredging program administration; and possible decrease or elimination of federal funding for Waterway maintenance — both of which are not inconsequential. Liability considerations include worker safety, potential damages resulting from dredging operations (e.g., cut utility lines, improperly placed sediment, turbidity, impacts to recreational/commercial vessels) and strict compliance with the Longshoreman & Harbor Workers Compensation Act and other federal law related to dredging and marine operations.

5.2.2 Qualitative Opinion of Probable Program Costs

This section qualitatively discusses capital, fixed, and variable costs FIND would likely incur with purchasing a dredge and associated supporting equipment (e.g., tenders, pipeline, booster pumps, vehicles). Capital costs, costs associated with purchasing a dredge and dredging equipment would vary significantly depending on the type and the size of the dredge. The dredge would need to comply with the 1920 Merchant Marine Act (Jones Act), the Foreign Dredge Act of 1906, and the Shipping Act of 1916. FIND may also consider looking into purchasing a used dredge. Although this would reduce the initial capital cost of purchasing the dredge, the downside would be a shorter service life and possibly higher maintenance costs.

Fixed costs are incurred over the life cycle of a dredge, regardless of whether the dredge is operating. These costs include but are not limited to:

1. regular annual maintenance of the dredge, such as dry docking, regular painting to prevent corrosion due to extreme corrosive environment, pump overhauls, and servicing electric and hydraulic systems
2. dockage, to store and maintain dredge and supporting equipment when not in use
3. depreciation, i.e., the value of the dredge will be reduced over the passage of time, due to wear and tear
4. certifications, the dredge will need to be certified and inspected by a qualified person on a periodic basis to ensure the dredge conforms with all applicable regulations

5. permanent staff, due to the size and type of dredge a full-time crew will be required as they will need to be familiar with the operation of the dredge and supervise temporary staff during project operations
6. insurance, a typical insurance program for a dredging operation would include commercial or marine general liability, workers compensation, contractor's pollution liability, protection and indemnity, vessel pollution and Maritime Employer's Liability (MEL).

Variable costs are incurred with operation of a dredge on a project by project basis. These costs include, but are not limited to:

1. mobilization/demobilization, costs to transfer the dredge and supporting equipment from storage location to dredge location
2. fuel, consumption of fuel is directly proportional to the installed horsepower of the dredge and the number of production hours
3. oils/lubricants/grease required due to the mechanical nature of the equipment
4. temporary crew, the size of the crew is adjusted on a project by project basis, further costs include overtime, per diem and travel costs
5. leasing and contracting costs for tenders
6. pipeline and booster pumps, these major costs are based on the distance the material must be transported from the cut to the disposal location
7. earthmoving equipment required for reworking material placed in upland disposal areas
8. surveyors, required to conduct before and after dredge surveys for payment purposes
9. environmental monitoring, this could comprise sea turtle, bird and turbidity monitoring as required by regulatory agencies.

A considerable proportion of these costs are time-based unit costs. Therefore, a more cost-effective dredging program occurs with a 24-hour, 7-day a week production schedule to achieve the greatest production value relative to the fixed costs of ownership. To make a well-informed decision about dredge ownership, a thorough quantitative economic analysis — one that considers the total costs of acquisition, operation, and maintenance and an estimated production rate (cy/day) — should be directly compared to previous FIND jobs to see if a cost savings could be achieved.

5.2.3 Dredge Recommendation

If FIND decides to move forward with the purchase, operation, and maintenance of a dredge, FIND would need to select a dredge suitable for handling a typical range of Waterway dredging conditions. Identification of typical dredging requirements would include consideration of dredging depth, sediment type and grain size, pumping distance, and terminal elevation at the dredged slurry discharge. Taylor Engineering contacted two dredge manufacturers — Ellicot and DSC Dredge — to discuss potential dredge purchase options. Both companies indicated that they are available to assist FIND select the right size and model dredge for the specific project requirements and budget; however, since dredging conditions vary along the ICWW (e.g., material types, pumping distances, dredging volume), more than one dredge type may be necessary to meet the overall program needs.

6.0 CONCLUSIONS AND RECOMMENDATIONS

With limited federal navigation funding available for operation and maintenance, the Waterway does not compete well in the federal navigation budget process. FIND spends approximately $20 million each year on dredging and dredged material management. To investigate if a better, more efficient process exists, Taylor Engineering interviewed and obtained documentation from leaders within the dredging community, researched available dredge types and technologies and their applicability to dredging requirements specific to the Waterway, reviewed historical dredging patterns in the Waterway (since the 1940's) and Florida's east coast harbors (since 2002), and evaluated current contracting and dredging procedures. The following section summarizes our findings and provides recommendations for modifications that would likely improve dredging efficiencies for the overall programmatic effort.

6.1 Conclusions

Dredge types are grouped into three major categories — mechanical, hydraulic, and hydrodynamic. The hydraulic, cutter suction (54%) and mechanical, clamshell (29%) dredge are the predominant dredge types in the United States and this fleet breakdown closely aligns with the statistics of the international dredge fleet. Weeks Marine, Inc. currently owns and operates the only WID in the United States and has performed work for the USACE in the New Orleans and Houston areas since 1992. Site specific limitations (conditions often found repeatedly in smaller maintenance project areas) and environmental concerns restrict areas for which this type of dredging method is applicable. Unless solely implemented and sought after from United States owned firms, technology from outside the United States is strictly prohibited by the 1920 Merchant Marine Act (Jones Act), the Foreign Dredge Act of 1906, and the Shipping Act of 1916; however, United States companies are making technological advances in dredges, components, and software that are positively impacting dredging efficiencies. Maintaining the Waterway is more efficient because of the permitting allowances made by Chapter 403.813(3), Florida Statutes and the USACE Jacksonville District RGP SAJ-93.

Building on the historical information collected for FIND's DMMP and availability of information from FIND and the USACE, Taylor Engineering summarized Waterway (since the 1940's) and Florida's east coast harbors (since 2002) dredging projects. Dredging volume for the 15-year history of the harbors amounts to 65.6 mcy; in contrast, AIWW/ICWW dredging totals 22.6 mcy for the nearly 75-year dredging history of the Waterway. The six highest shoaling rate areas of the Waterway — Sawpit, Matanzas, Ponce de Leon Inlet, Crossroads, Jupiter, and Bakers Haulover — account for more than 60% of the maintenance volume and 50% of the total number of dredging events required for the entire Waterway. For the Crossroads area, Taylor Engineering simulated water surface elevation, flow velocity, bed and suspended sand transport, erosion, and deposition at the area of Crossroads. The 2013-2015 modeling effort resulted in channel modifications to reduce the dredging frequency from every three years to every five years with an estimated annual savings of $200,000. Recent (2017) permit modifications also allow increased flexibility for placement of Crossroads dredged material into DMMA M-5, St. Lucie Inlet Impoundment Basin, or Martin County Borrow Area B which may decrease double handling of material. To our knowledge, Ponce de Leon Inlet and Bakers Haulover have not been similarly investigated to determine whether similar improvements to dredging efficiency can be made.

The partnership agreement FIND and JID entered into for responsibility over the Jupiter section of the ICWW and sand trap has benefited both entities. There are other potential modifications to present contractual approaches — (1) removal/reduction of the USACE small business criteria on FIND projects, (2) combination of maintenance project needs, (3) multi-year contracts, (4) rental contracts and, (5) implementation of Request for Qualifications (RFQ) procedures — that should be pursued to increase dredging efficiencies along the Waterway, particularly in those six areas that consume more than 50% of the operation and maintenance budget. In addition to contractual modifications, FIND can pursue the acquisition, operation, and maintenance of a dredge to have immediate and direct control over dredging operations. However, to make a well-informed decision about dredge ownership, a thorough quantitative economic analysis — one that considers the total costs of acquisition, operation, and maintenance and an estimated production rate (cy/day) — could be directly compared to previous FIND dredging projects to see if cost savings could be achieved.

6.2 Recommendations

While FIND's programmatic effort is one of the most successful in the United States, continued programmatic greatness is achieved by looking forward. To continue to accomplish the overall mission of keeping the Waterway in a safe, navigable condition for commercial and recreational vessels, we recommend, in order of priority, the following:

1. Aside from Crossroads, analyze the remaining high shoaling rate areas to determine whether the reconfiguration of construction of advanced maintenance areas (deepening or settling basins) could decrease the overall dredging frequency. The current condition of the five remaining shoaling areas follow:
   a. Ponce de Leon Inlet has never been evaluated.
   b. Matanzas should be revaluated (from the previous 2007 effort), and the study area expanded to determine how the Summer Haven River filling and subsequent restoration has impacted the overall area.
   c. Sawpit, Jupiter, and Bakers Haulover should be reevaluated to determine if additional improvements can be made.
2. Obtain BTIITF approval for FIND Programmatic Spoil Site Rejuvenation plan.
3. Continue to consider and coordinate with USACE about potential RSM strategies.
4. In addition to open advertisement, send bid solicitations to Florida-based dredging companies to increase awareness and local competition.
5. Investigate contractual modifications:
   a. Discuss with USACE about decreasing or eliminating the small business set aside for all Waterway projects
   b. Partner with adjacent high maintenance harbor projects (e.g., Jacksonville Harbor, Canaveral Harbor, Palm Beach Harbor) and local tax-based inlet districts (St. Augustine Port, Waterway, & Beach District, Ponce de Leon Inlet Port Authority, Sebastian Inlet District, Jupiter Inlet District, and Hillsboro Inlet District) to dredge the Waterway.
   c. Consider combination of project needs, multi-year and rental contracts for Sawpit, Matanzas, Ponce de Leon Inlet, Crossroads, Jupiter, and Bakers Haulover to save on design and bid process fees.
   d. Require the use of integrated software (HYPACK® and ClamVision®) that supports digging efficiency and positioning.
6. If No. (1) does not achieve a significant reduction in shoaling rates, permit, design, and construct DMMA DU-3&4 and MSA 434/434 N for Reach NA-II/DU-III and V-IV to increase available storage capacity.
7. Complete a quantitative economic analysis of a FIND-owned dredge to see if a cost savings could be achieved.

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Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT A
DOCUMENTATION INTERVIEW FORMS

PROFESSIONAL ASSOCIATIONS
FEDERAL AGENCIES
STATE AGENCIES
UNIVERSITIES
DREDGING CONTRACTORS
DREDGE MANUFACTURERS/TECHNICAL SUPPLIERS

	Documentation Contacts	Name	Phone	E-mail	Interview Date	Website
PROFESSIONAL ASSOCIATIONS	American Society of Civil Engineers Coasts, Oceans, Ports, River, and Waterway Institute (ASCE COPRI)	Tom Chase	843-379-1151	tchase@asce.org	2/1/2018	http://www.asce.org/coasts-oceans-ports-and-rivers-engineering/coasts,-oceans,-ports-and-rivers-institute/
	Atlantic International Waterway Association (AIWA)	Brad Pickel	843-379-1151	bpickel@seahavenconsulting.com	1/29/2018	https://atlanticintracoastal.org/
	Western Dredging Association (WEDA)	Thomas Cappellino	949-422-8231	tcappellino@westerndredging.org	1/23/2018	https://westerndredging.org/index.php/
FEDERAL AGENCIES	Engineer Research and Development Center (ERDC)	Kenneth Ned Mitchell	601-634-2022	Kenneth.n.mitchell@usace.army.mil	3/9/2018	http://www.erdc.usace.army.mil/
	ERDC Dredging Operations Technical Support Program, Dredged Material Management	Tim Welp	601-634-2349	Timothy.L.Welp@usace.army.mil	2/20/2018	https://dots.el.erdc.dren.mil/
	ERDC Dredging Operations Technical Support Program, Sediment and Dredging Processes	Joe Gailiani	601-634-4851	joe.z.gailani@usace.army.mil	2/21/2018	https://dots.el.erdc.dren.mil/
	ERDC Dredging Operations Technical Support Program, Environmental Resources Management	Todd Swannack	601-636-3111	todd.m.swannack@usace.army.mil	2/2/2018	https://dots.el.erdc.dren.mil/
	Regional Sediment Management	Jackie Keiser	904-232-2042	Jacqueline.J.Keiser@usace.army.mil>	1/26/2018	http://rsm.usace.army.mil/
STATE AGENCIES	Hillsboro Inlet District (HID)	Jack Holland	561-479-5627	pajackbc@gmail.com	1/23/2018	http://www.hillsboroinletdistrict.org/
	Jupiter Inlet District (JID)	Michael J. Grella	561-746-2223	mgrella@jupiterinletdistrict.org	1/23/2018	http://jupiterinletdistrict.org/
	St. Augustine Port, Waterway & Beach District (SAPWBD)	Carl Blow	904-829-9277	jcblow@aicw.org	2/16/2018	http://staugustineport.com/
	State of Delaware (DNREC)	Charles Williams	302-739-9283	charles.williams@state.de.us	3/14/2018	https://dnrec.alpha.delaware.gov/coastal-programs/
UNIVERSITIES	Stevens Institute	Thomas Wakeman	201-216-5669	twakeman@stevens.edu	1/23/2018	https://web.stevens.edu/facultyprofile/?id=969
	Texas A&M University, College Station	Robert Randall	979-845-4568	r-randall@tamu.edu	1/26/2018	https://engineering.tamu.edu/ocean/people/randall-robert
	University of Nevada, Las Vegas	Donald Hayes	702.895.4723	donald.hayes@unlv.edu	1/26/2018	https://www.unlv.edu/people/donald-hayes
DREDGING CONTRACTORS	Cashman Dredging & Marine Contracting Co., LLC	Bill Hussin	617-890-0600	bhussin@jaycashman.com	2/7/2018	https://www.jaycashman.com/
	Cavache	Anthony Cavo	954-347-8788	anthony@cavache.com	1/31/2018	http://cavache.com/
	Great Lakes Dredge & Dock	William Hanson	630-699-0896	whhanson@gldd.com	2/1/2018	http://www.gldd.com/
	Manson	Dan Hussin	904-821-0211	dhussin@mansonconstruction.com	1/18/2018	http://www.mansonconstruction.com/
	Orion	John Vannoy	813-839-8441	jvannoy@orionmarinegroup.com	1/24/2018	http://www.orionmarinegroup.com/
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	Weeks Marine	Ross Lowry	908-956-6714	rjlowry@weeksmarine.com.	2/8/2018	http://www.weeksmarine.com/
DREDGE MANUFACTURERS / TECHNICAL SUPPLIERS	Anvil Attachments	Nick Seghers	225-654-8223	nseghers@anvilattachments.com	2/9/2018	http://www.anvilattachments.com/
	Cable Arm	Darrell Nicholas	734-676-6222	info@cablearm.com	1/23/2018	http://www.cablearm.com/
	DHI Group	Jacob Jensen	+45-4516-9218	Jhj@dhigroup.com	2/25/2018	https://www.dhigroup.com/
	DSC Dredge	Charles Johnson	985-479-8042	chjohnson@dscdredge.com	2/23/2018	http://www.dscdredge.com/
	Ellicott Dredges	Steve Miller	410-302-4348	smiller@dredge.com	2/28/2018	http://www.dredge.com/

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT A
DOCUMENTATION INTERVIEW FORMS

PROFESSIONAL ASSOCIATIONS

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/1/2018	**CONTACT**	Tom Chase
TIME	7:15 PM	**REPRESENTING**	American Society of Civil Engineers, Coasts, Oceans, Ports, and River Institute (COPRI)

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: The U.S. Army Corps currently maintains an active dredging fleet of nine dredges: (1) Currituck, (2) Essayons, (3) Goetz, (4) Hurley, (5) McFarland, (6) Merritt, (7) Murden, (8) Wheeler, and (9) Yaquina.

   The U.S. Navigation Data Center (http://www.navigationdatacenter.us/dredge/dredge.htm) maintains a database of the dredge fleet status (updated weekly), advertising schedule for the fiscal year, and dredging contracts awarded.

   As far as bringing newer technology (from outside the United States), the 1920 Merchant Marine Act (Jones Act), the Foreign Dredge Act of 1906), and the Shipping Act of 1916 states that all dredging inside the United States must be solely executed by United States dredging companies, not by foreign companies. Therefore, bringing any new technology (from outside United States) would need to be implemented and sought after solely from the United States based firms.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: No comment.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: No comment.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: Will follow up with the U.S. Navigation Center and obtain a copy of the 1920 Merchant Marine Act.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/29/2018	**CONTACT**	Brad Pickel
TIME	11:00 AM	**REPRESENTING**	Atlantic Intracoastal Waterway Association

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: No documents. Admitted not much experience in this arena but does work the waterway and always looking for ways to get dredging accomplished. Mentioned upcoming USACE Jekyll Creek thin-layer placement project.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Mentioned that USACE Charleston District recently had seven shoals throughout a stretch of about 60 miles and lumped together in one contract. Said we could talk to Wes Wilson in Charleston for more info.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Didn't think FIND buying a dredge was a viable alternative.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: The North Carolina Beach Inlet & Waterway Association has an upcoming meeting in April 2018 that will discuss, among many other topics, dredged material management, easement issues, funding, economic impacts of shallow draft waterways including the advantages/disadvantages of a State-owned dredge approach, the USACE federal fleet, and the current dredge industry.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/23/2018	**CONTACT**	Thomas Cappellino
TIME	12:15 PM	**REPRESENTING**	Western Dredging Association

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Mr. Cappellino indicated that he would look through the 2012-2016 conference proceedings to determine if he has any applicable documents relevant to the proposed project.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: No comment.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Mr. Cappellino indicated that he would look through the 2012-2016 conference proceedings to determine if he has any applicable documents relevant to the proposed project.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT A
DOCUMENTATION INTERVIEW FORMS

FEDERAL AGENCIES

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	3/9/2018	**CONTACT**	Kenneth Ned Mitchell
TIME	5:00 PM	**REPRESENTING**	ERDC

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Ned has been involved in developing a queuing program whereby available dredges can be scheduled compared to dredging needs across the country. The numbers of available dredges are limited, and Corps Districts compete with one another for equipment needs. This program may make for a more efficient process for planning and completing dredging jobs.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Not applicable.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Not applicable.

4. **QUESTION (CONTRACTORS ONLY):** As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/20/2018	**CONTACT**	Tim Welp
TIME	11:00 AM	**REPRESENTING**	ERDC

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Has done a lot of research on Water Injection Dredging. Copy of presentation is attached. Also suggested looking at the DOTS (Dredging Operations Technical Support website. Suggested thin layer placement techniques be further investigated. They are researching bedload collector technology (report provided in file) that may be of interest. He also mentioned “Fluidized Rock System”.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: USACE is moving toward longer duration contracts.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

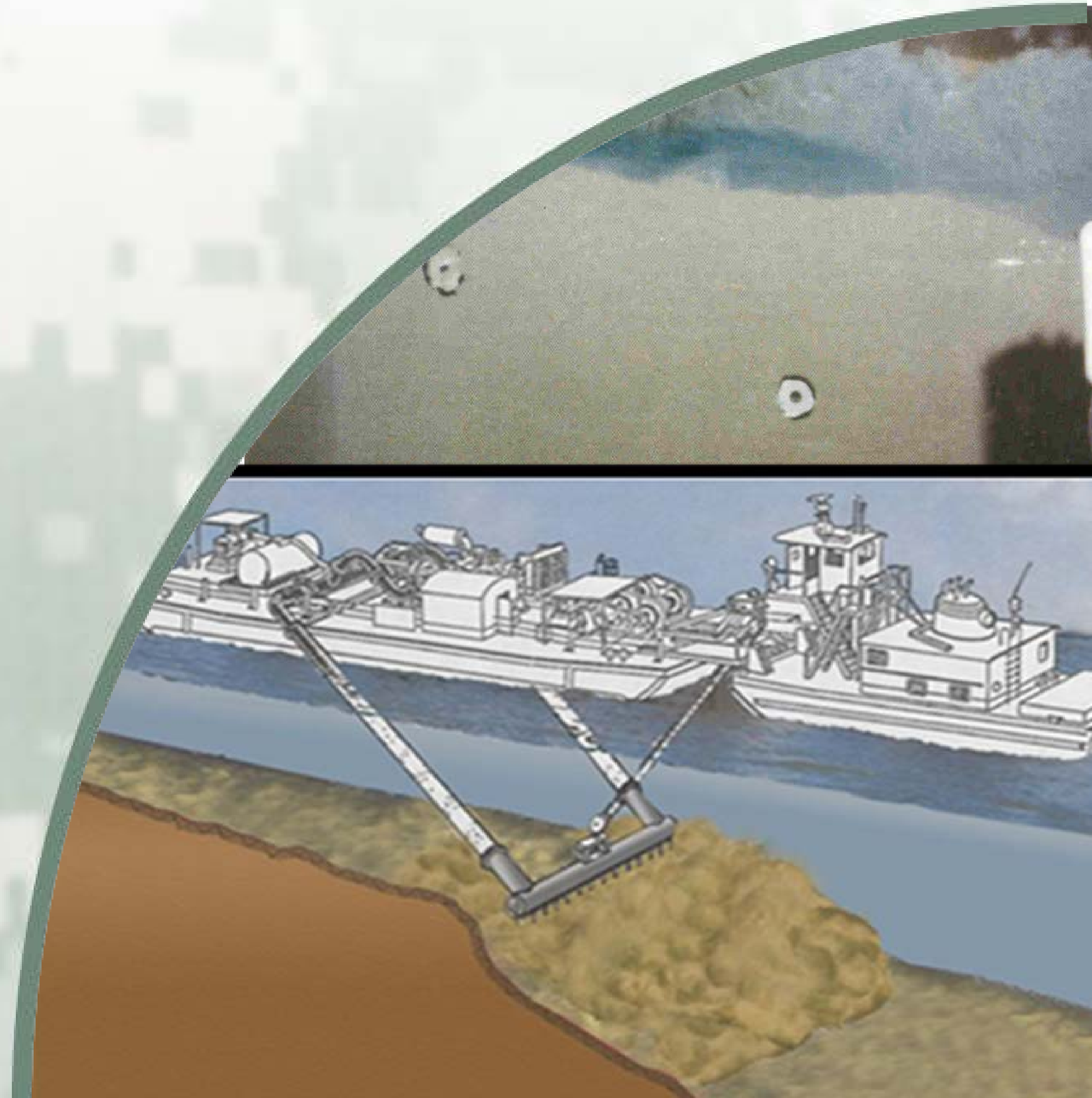
   RESPONSE: Not applicable.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida’s Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

Overview of Water Injection Dredging (WID) and the SedCon Turbo System



Timothy L. Welp

Research Hydraulic Engineer
USACE Engineer Research and Development Center,
Coastal Hydraulic Laboratory,
Vicksburg MS

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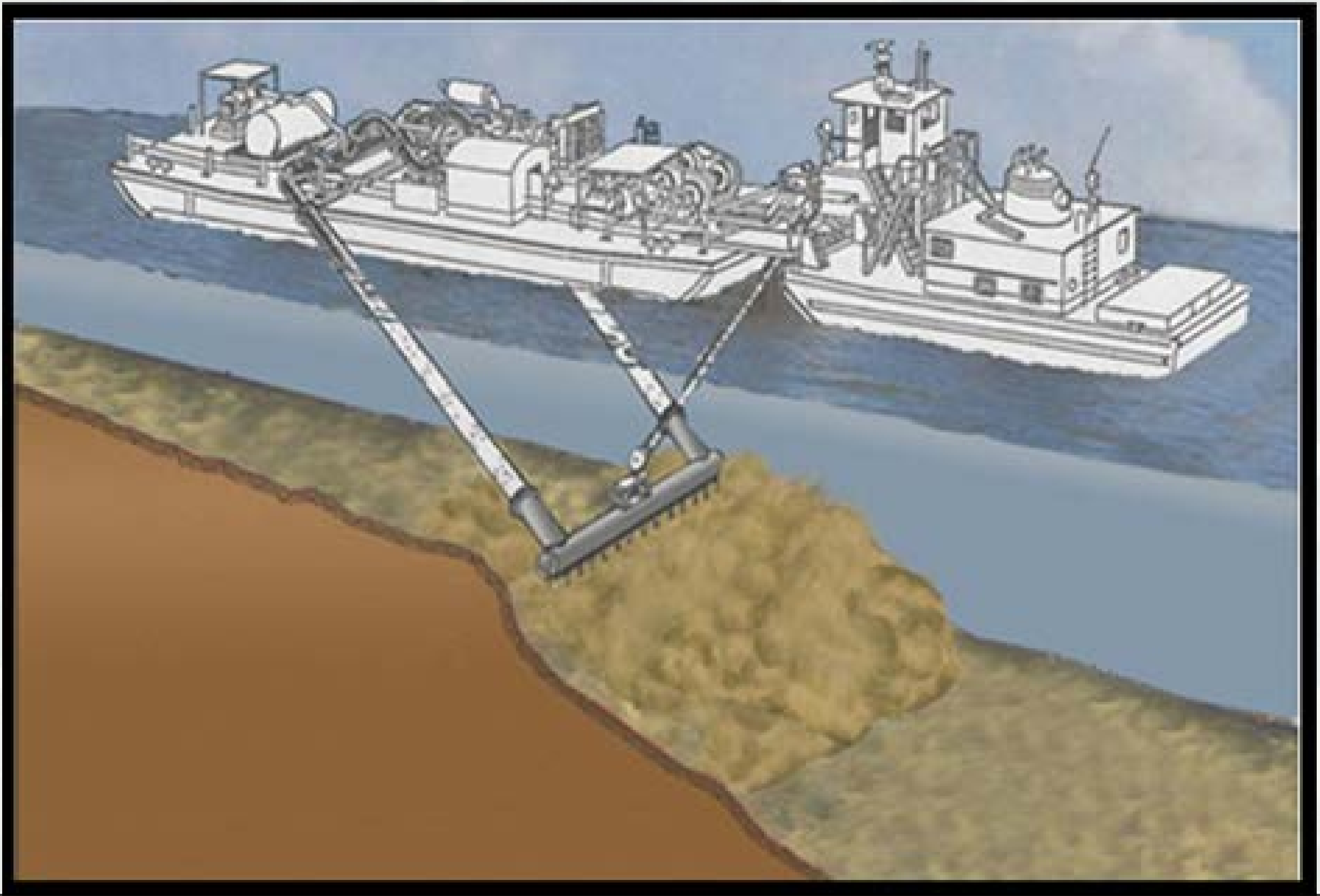
Timothy.L.Welp@usace.army.mil

Outline

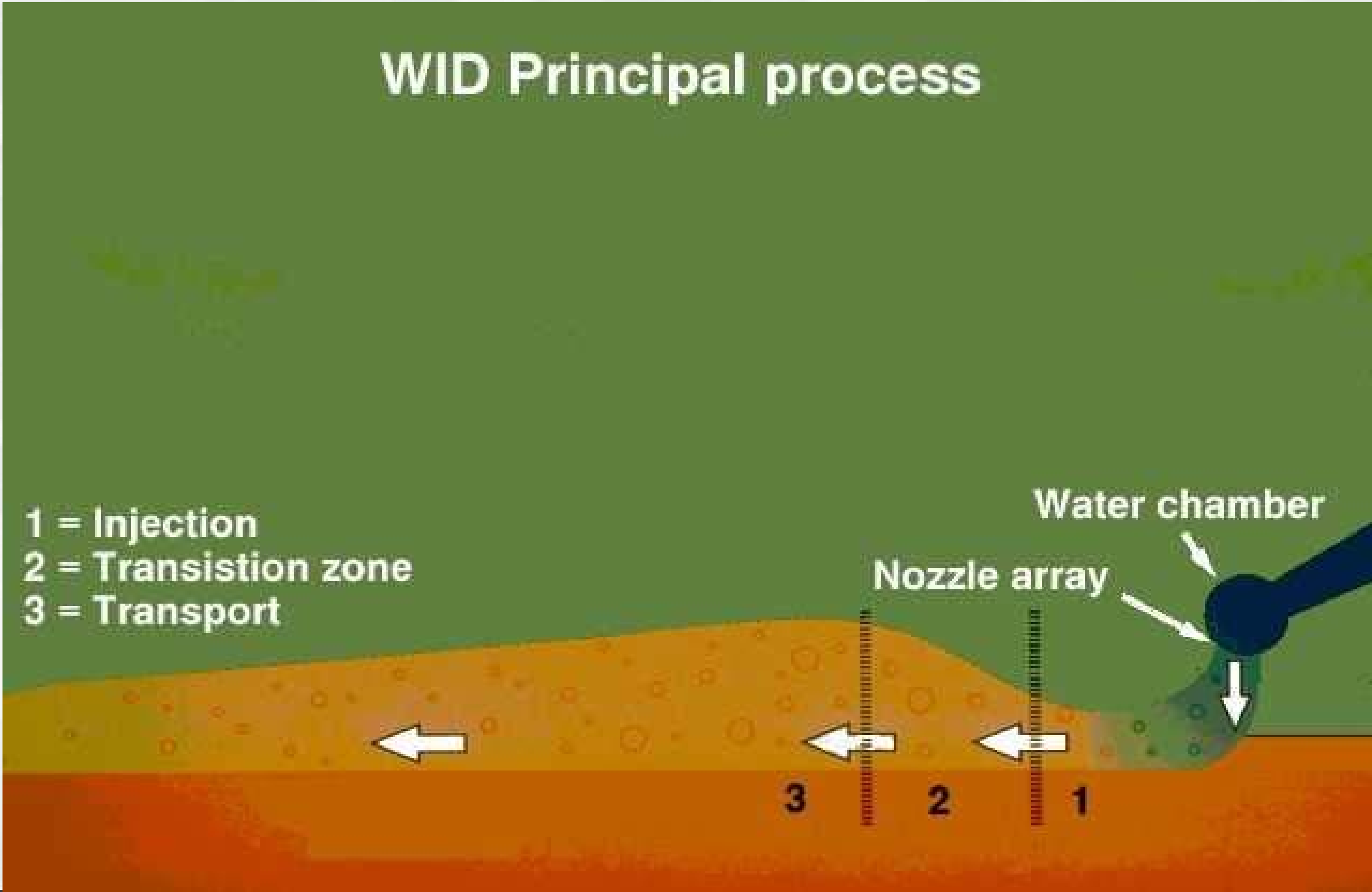
- Water Injection Dredge
- SedCon Turbo System

Water Injection Dredge (WID)



Density Current

Source: PIANC



Source: PIANC/Deltares

Worldwide WID

r world

Water Injection Dredge (WID)

Water Injection Dredge (WID)


WEEKS MARINE
Barge BT 773
Length:120’
Breadth:32’
Draft:8’
Injection Pipe:30” dia. w/23 –2.4” nozzles
Pump Size:24” x 30” (Goulds Pump 3420)
Engine:CAT 398 (825 HP)
Pump Capacity:23,000 GPM
Max. Dredging Depth:70’
Min. Dredging Depth:5’
Towing Vessel:1,200 HP minimum
CAUTION

WID Applicability

- Could be a very cost effective way of removing sediment from unwanted locations.
- Has the ecological advantage that it does not disturb the sediment balance of the watercourse.
- **However, the technique requires very specific site conditions**

Parameters That Influence WID Production

- Soil characteristics
- Site bathymetry and geometry
- Hydrodynamic conditions
- Geographic location (accessibility, proximity to structures, etc.)
- Type and level of contamination

US WID Dredging Projects

Traditional Operations
Private Dock Work
Mississippi River
- Grain Dock –Convent, LA
- Refinery –Baton Rouge, LA
- Refinery –Sunshine, LA
- Grain Dock –Destrehan, LA
- Chemical –Plaquemines, LA
- Refinery –St. James, LA
- Barge Dock -Jefferson, LA
- Refinery –St. James, LA
- Refinery –Jefferson, LA
- Refining Facility –Baton Rouge, LA
- Agricultural –Jefferson, LA

Atchafalaya River
- Refinery –Krotz Springs, LA

Federal Navigation
New Orleans District
- New Orleans Harbor
- Michoud Canal
- Miss. River Gulf Outlet
- E & W Calumet Floodgates
- Tiger Pass Channel

Galveston District
- Houston Ship Channel
- Bayport Ship Channel

Mobile District
- Horn Island

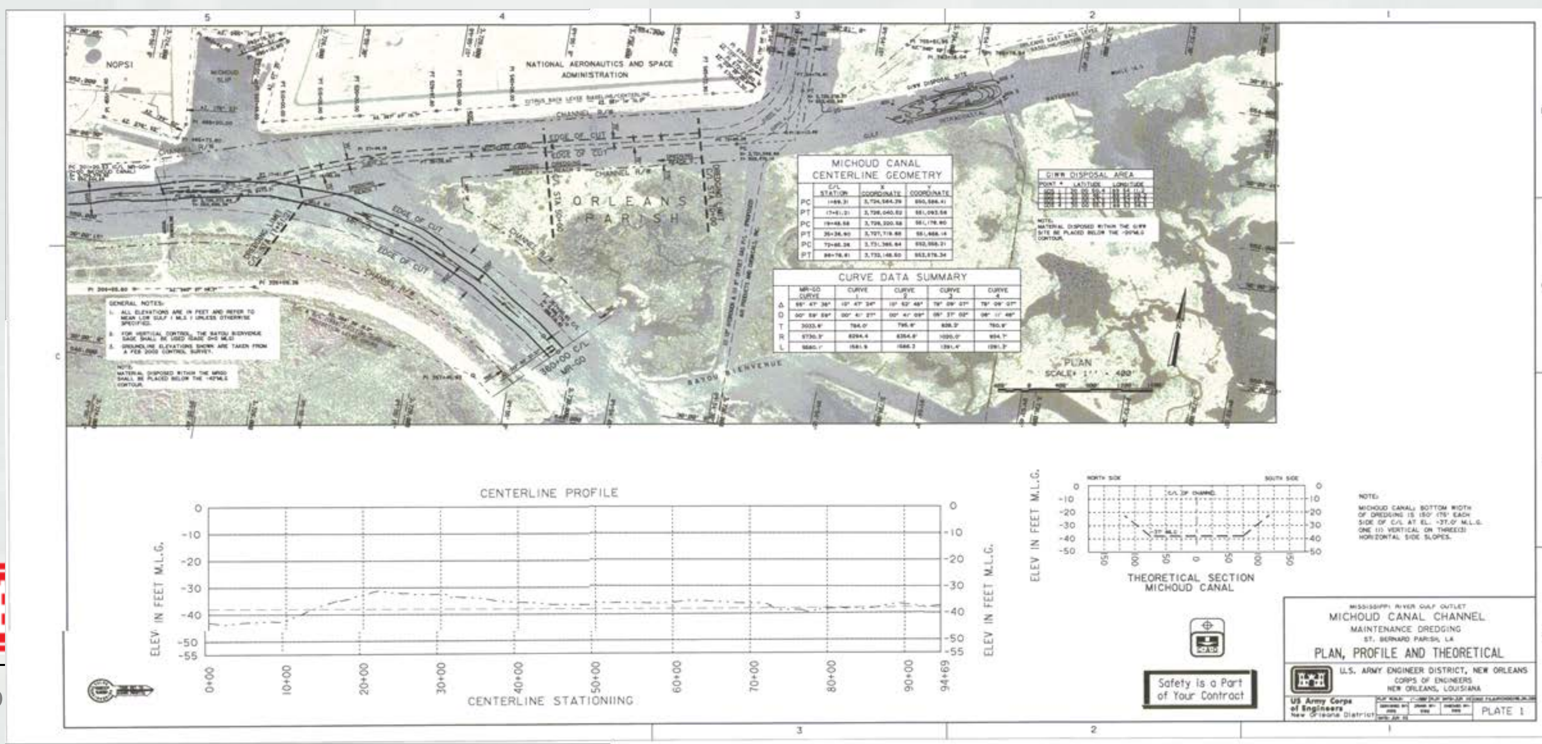
Source: WEEKS MARINE

Project Name	Project Site	Cost ($)	Volume (yd^3)	Duration (days)	Production Rate (yd^3/hr)
Upper Mississippi River 1992	Minn. & Ill.	NA	8,000	4	182
Calumet 1994	LA	41,438	15,644	1	652
New Orleans Harbor 1998	LA	731,975	650,482	57	476
New Orleans Harbor 2001	LA	794,260	334,530	46	394
Houston Ship Channel Emergency 2001	TX	335,810	113,200	4	1,179
Houston Ship Channel Bayport Flare 2001	TX	NA	116,671	2	2,431
Houston Ship Channel Carpenters to Green Bayou 2001	TX	NA	26,259	4	274
Houston Ship Channel Bayport Flare 2001	TX	NA	97,900	3	1,360
New Orleans Harbor 2002	LA	1,619,968	888,406	40	925
Michoud Canal 2002	LA	79,264	232,235	4	2,419
MRGO* 2003	LA	98,900	350,000	4	3,645
Houston Ship Channel Mid Bay 2004	TX	1,183,014	566,507	89	265
New Orleans Harbor 2005	TX	2,339,686	531,046	28	790
Calumet 2010	LA	260,436	22,406	1	934

Source: Wilson 2007

WID Monitoring
Michoud Canal

- WID worked 6-10 August 2002
- ERDC monitored 7 August 2002
- Focused on near and intermediate field sediment plume characteristics



WID Michoud Canal
Data Collected

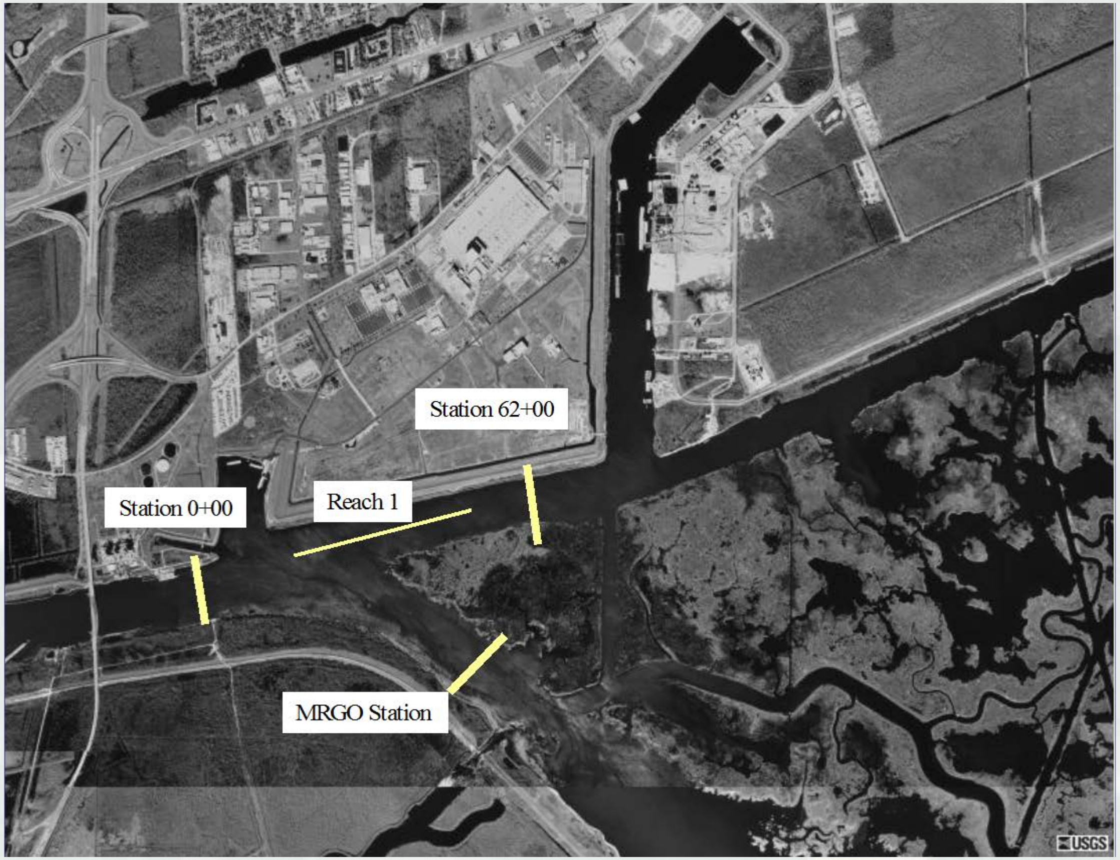
Data collected (ERDC)

- current velocities (ADCP)
- backscatter (ADCP)
- suspended sediment samples (Niskin tube)
- near bed samples (ball valve sampler).
- bottom samples,

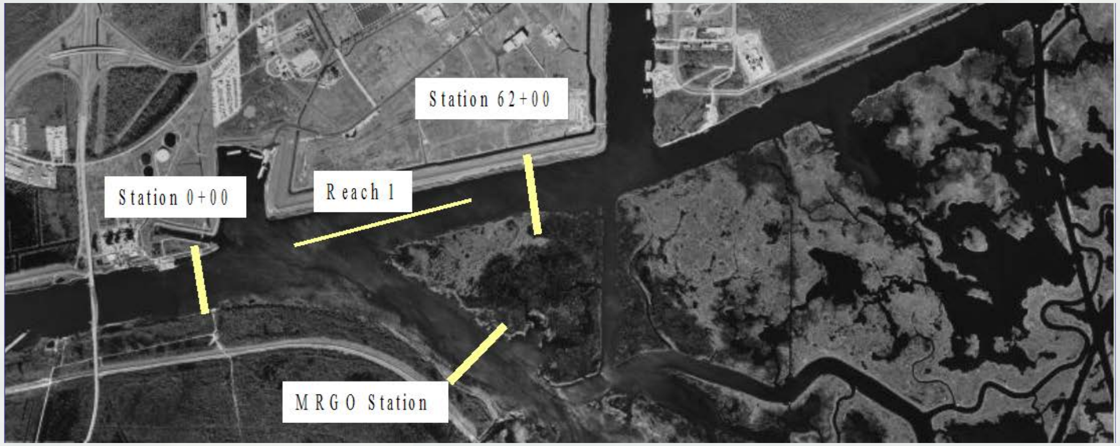
Data Collected MVN and Weeks
Before and After Dredge (BD &AD)Surveys

- bottom samples

Michoud Canal



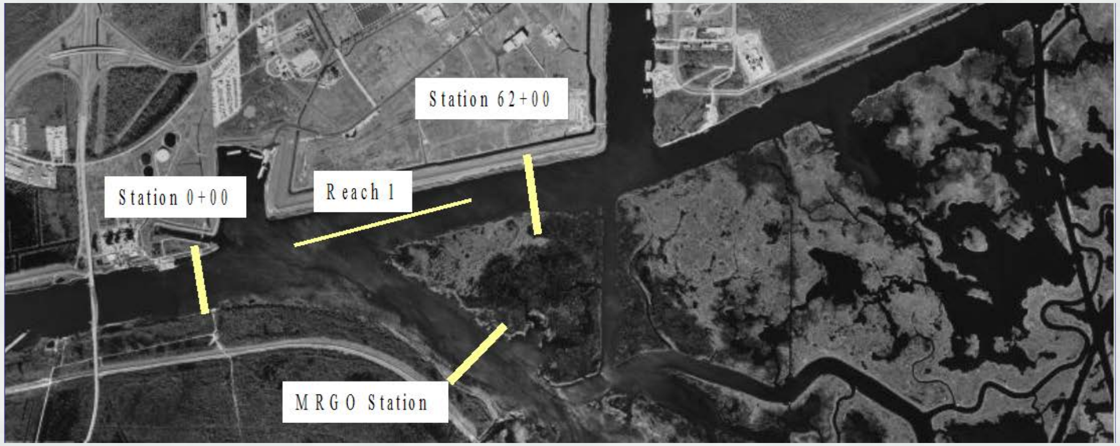
Background Water Samples



Total Suspended Solids (TSS) – mg/l

Station 0+00	MR-GO Station	Station 62+00
3 ft - 3	3 ft - 11	3 ft - 14
11 ft - 12	11 ft - 13	9 ft - 14
22 ft - 18	22 ft - 17	18 ft - 16
33 ft - 25	33 ft - 25	27 ft - 24
44 ft - 51	44 ft - 46	36 ft - 28

Dredge-Plume Water Samples

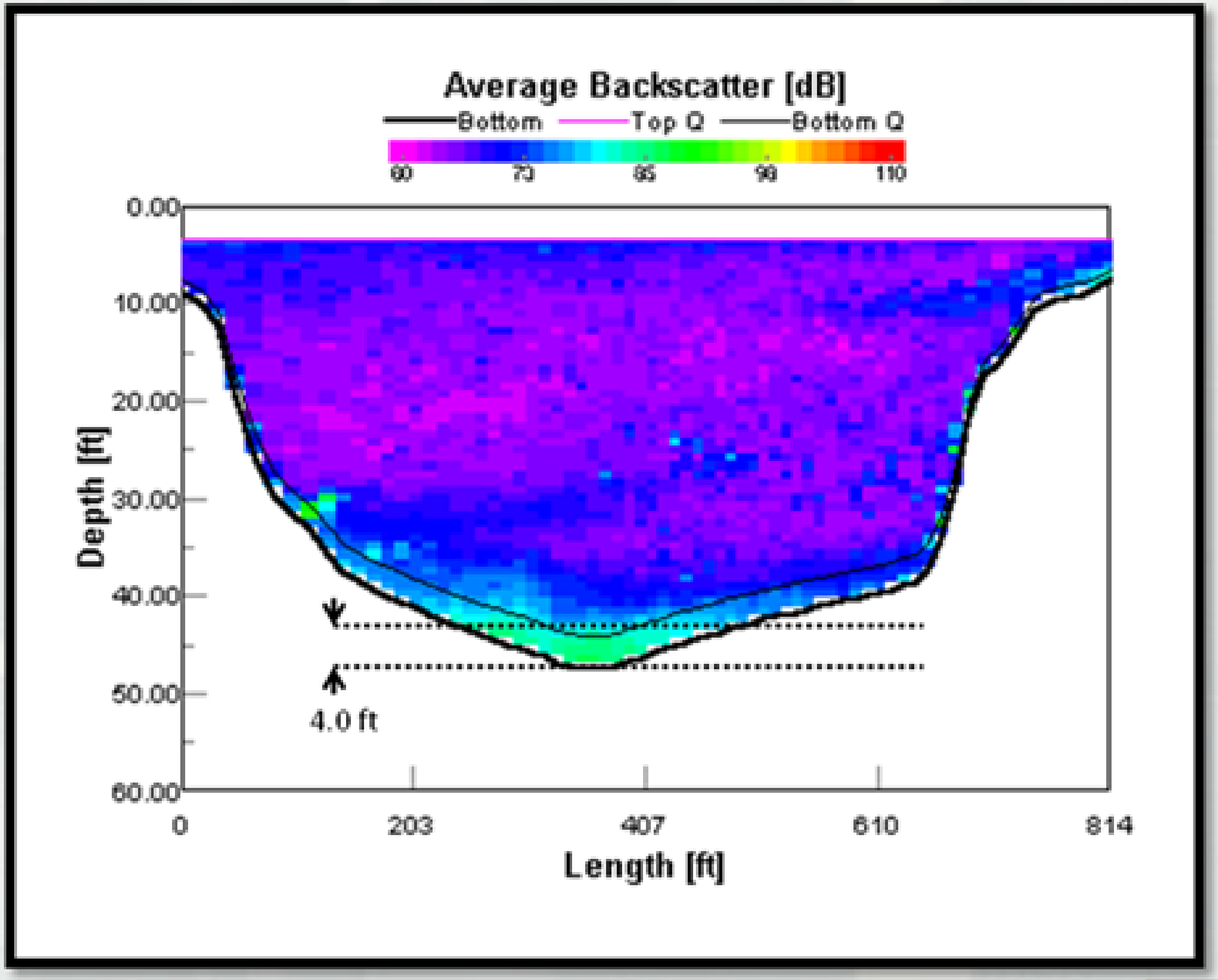


Total Suspended Solids (TSS) – mg/l

3 ft - 7
10 ft - 17
21 ft - 31
32 ft - 313
37 ft - 162641

3 ft - 24
10 ft - 17
21 ft - 36
33 ft - 193
38 ft - 219134

Acoustic Backscatter




MRGO
8-7-02
A
1655
MRGO
8-7-02
B
1655
MRGO
8-7-02
C
1655
MRGO
8-7-02
D
1655

Michoud Canal
Monitoring Conclusions

- .Background TSS values ranged

- from about10 mg/l near the surface,

- to about 20 mg/l at mid depth (say 20 ft)

- to 30 to 50 mg/l near the bottom (in fluid mud) (36 to 44 ft).

- During dredging in the immediate vicinity of the dredge head

- near bottom TSS values would rise dramatically, exceeding 100,000 mg/l within a ft of the bottom.

- sharp gradient in the TSS near the dredge, dropped to about 5,000 mg/l within 3 ft of the bottom.

Michoud Canal Monitoring Conclusions

- Elevated TSS levels stayed in the lower 5 to 6 ft of the water column. Above about 33 ft, essentially no difference in TSS levels between the area in the vicinity of the dredge and background could be measured.
- Some distance away from the dredge head, all the resuspended sediments appeared to stay within about 3 ft of the bottom.

Michoud Canal Monitoring Conclusions

- Where it could be detected, the density current flows under the influence of gravity and underwater slopes toward the deeper laying parts.

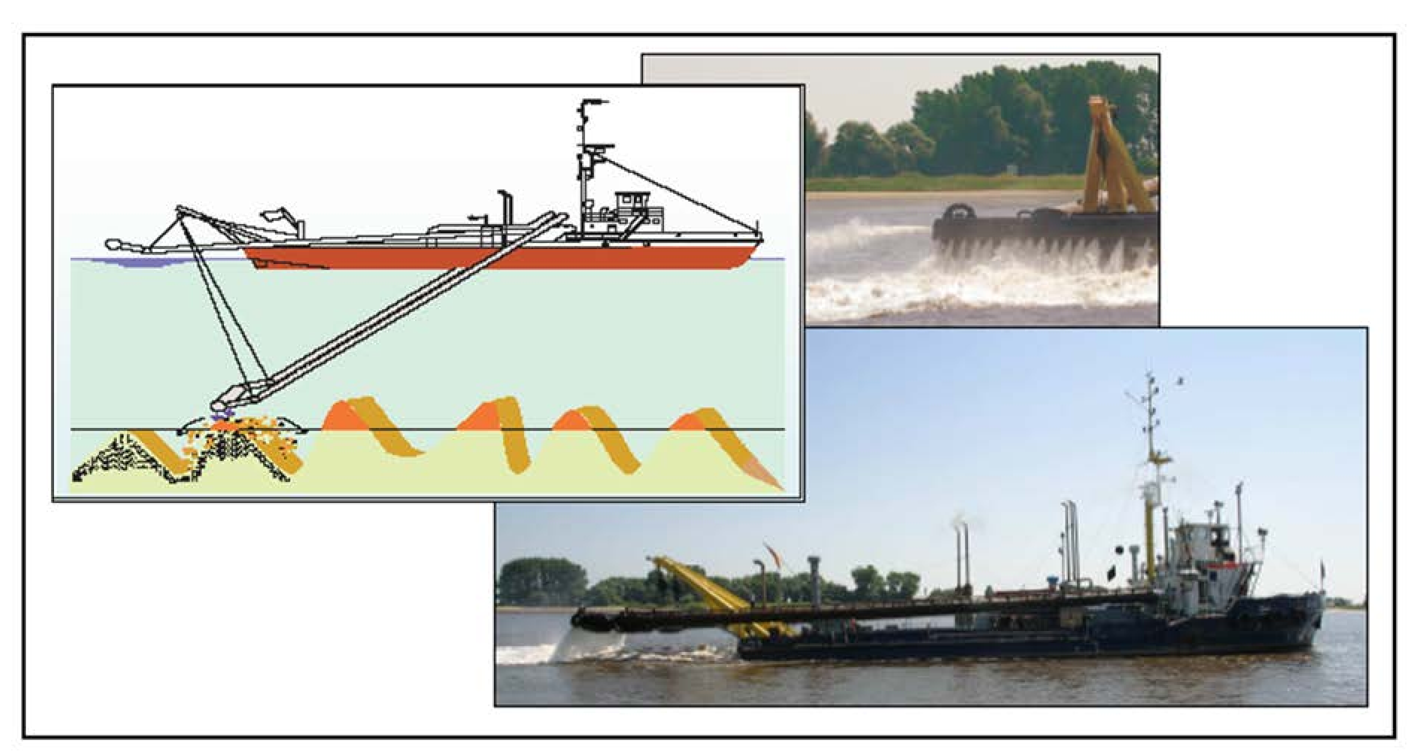
Similar results when monitoring the Mississippi River Gulf Outlet project.

WID Classification

In appropriate site specific conditions where density current is maintained WID is not agitation dredging that:

- Relies on water currents to move sediment out of channel
- Disperses sediment throughout the entire water column

WID Used to "Dredge" Sand Wave Crests



Source PIANC

WID Advantages

For appropriate locations where favorable bottom material and bathymetry exist, WID can offer several advantages:

- In optimum conditions WID is capable of very high production rates.
- WID can rapidly move from one project location to another on short notice and can immediately go to work once at the site.
- Because WID does not require pipelines, etc., the reduction directly translates into a reduction of required manpower and attendant operating costs.

WID Advantages

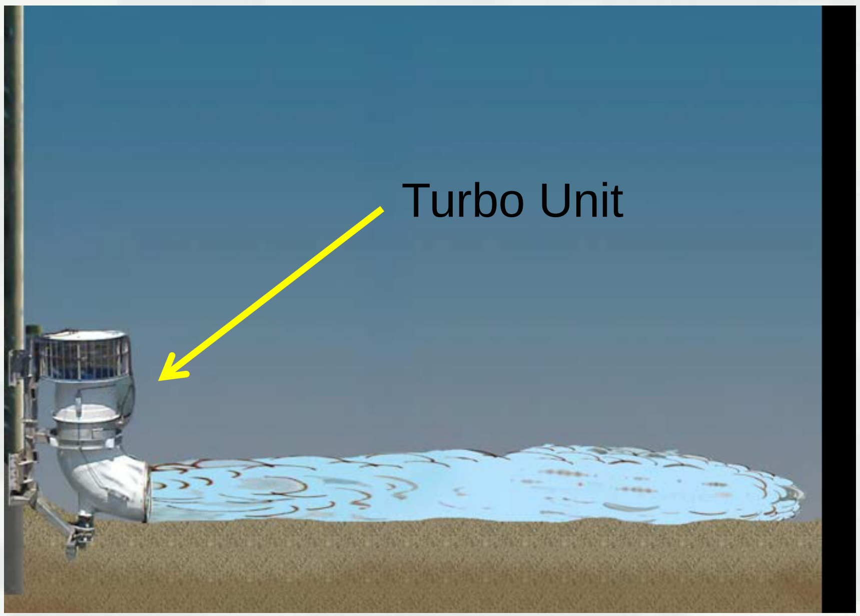
- WID provides fewer impediments to navigation, can quickly avoid vessels and resume dredging can result in substantially greater operating hours.
- Injection head merely rides on the surface of the sediment as opposed to actively digging into so allows safer operations with reduced chance of damage to submerged structures, pipelines, utility cables, etc.
- Keeps sediment in the “system.”

WID Limitations

- It can be used only where in-water placement of dredged material is allowed.
- WID can effectively operate only where favorable conditions exist.
- WID cannot be used where unacceptable environmental impacts occur (contaminant resuspension, unacceptable suspended solids impacts, etc.).
- Destination of dredged material more difficult to predict.

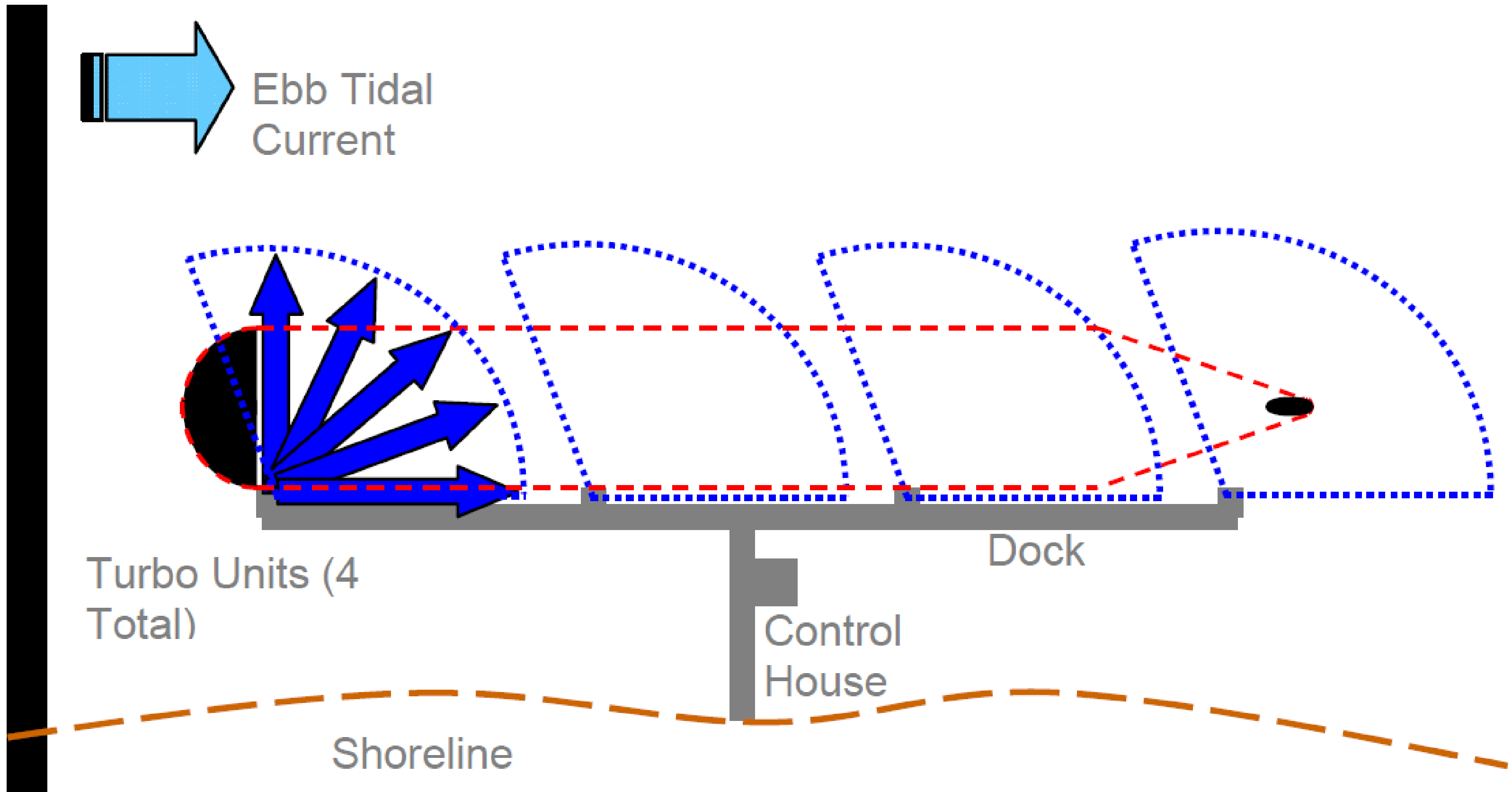
SedCon Turbo System

US Navy developed system in 1980s.
Commercially installed Port of Gray's Harbor in 1987.



Source: Bryant 2007

SedCon Operation



System operation is synchronized with the tides

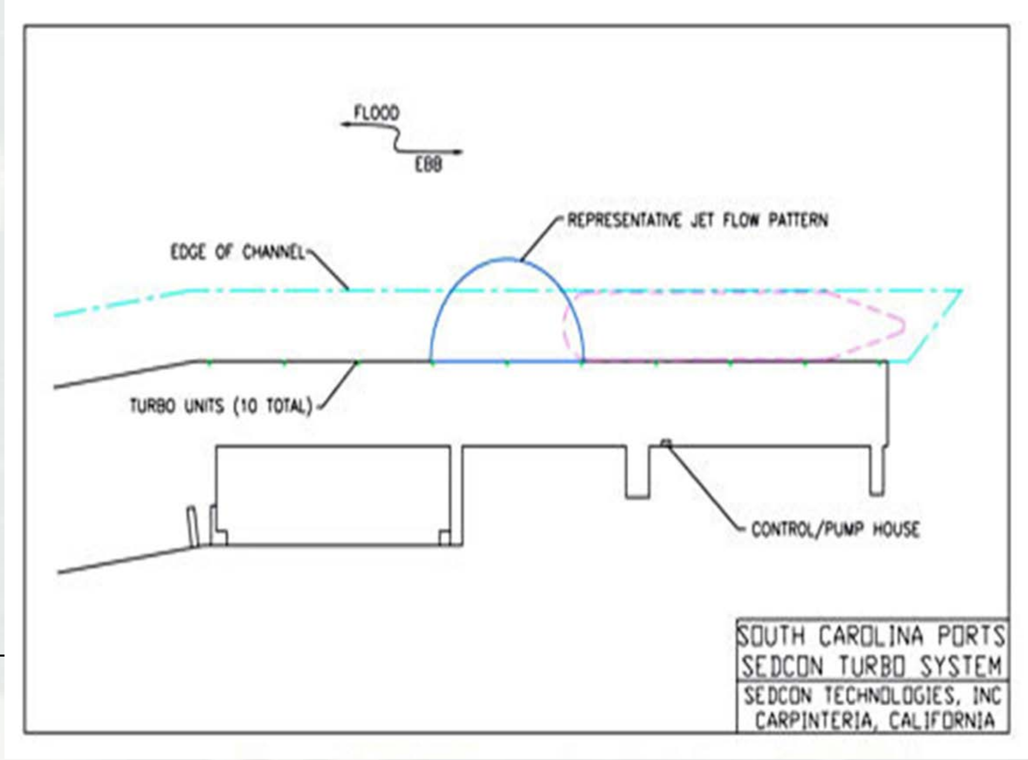
Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

Dredging cost \$1M/year 4x 80,000 yd^3 and dredged material placed in confined disposal facility.

2 complete systems - 5 turbo units each.

Source: Bryant 2007



Source: SedCon

Example: SedCon Installation Charleston, SC.

5 turbo units powered by common hydraulic pumping unit (150 gal oil reservoir, filtration, oil heating/cooling system, pressure control/relief (125 hp pump– uses vegetable oil. Energy consumption est 90 HP each

Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

- Water jests 36 inch diameter, approx 15 ft tall
- 180 degree sweep
- Suction screen approx 3 inch opening
- 2 shoes mount on frame & slid on H piling so can be slid up and down
- 10 jests space 175 ft apart on 1,640 ft wharf

Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

- Systems are controlled by software run on a PC.
- Operations may be remotely monitored and adjusted.
- Parameters that can be computer adjusted include:
  - Initial and final sweep position
  - System initiation relative to tidal conditions
  - Duration of operation of individual units and the total system

Source: Bryant 2007

Source: SedCon

Example: SedCon Installation Charleston, SC.

- Total installed cost approx $4.2M
- Annual maintenance approx $25,000
- Electrical power costs $25,000
- Assume 10 year before major maintenance
- Return on investment is expected to approach 20% with the payout slightly over four years.

Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

- U.S. Army Corps of Engineers Regulatory Division basically looked to the State for the section 401 water quality certification.
- Corps dredging group expressed concerns that the system would simply move the dredging burden from the berth into the Federal channel, Corps regulators pointed out that this situation had never materialized in other locations where systems have been installed.

Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

- The State's concerns were fourfold:
  - Ultimate disposition of the materials
  - Potential for scouring and increasing entrained solids
  - Impacts on water quality
  - Impacts on fish

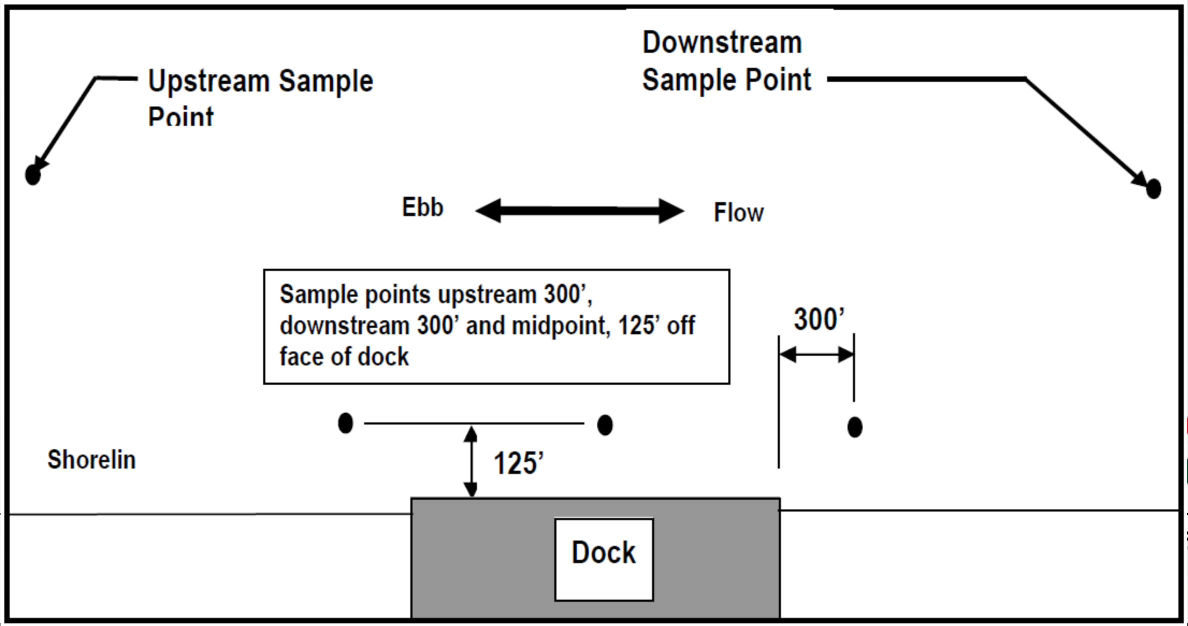
Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

Agreement on testing protocol:

Sampling stations – (see below) plus up and down stream ambient stations “well away” plus another at a marina.

Dissolved oxygen, total suspended solids, and turbidity 1 ft below surface and 4 ft off bottom (plus TSS 20 ft below surface)



Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

- Bathymetric sounding 28 KHz echosounder.
- Semi-continuous monitoring defined as every five minutes for 25 hours (constituted a “sampling event”).
- Sampling event conducted during a typical dredging process (dredging event) and 48 hours after the conclusion of dredging (post-dredging event).
- Sampling events were to be conducted during weeks one, three, five, fourteen, twenty seven, forty, fifty three, and sixty six.
- Sample results from these events were to be compared to sample results from the dredging and post-dredging sampling events.

Source: Bryant 2007

Example: SedCon Installation Charleston, SC.

- Bathymetric surveys made before system operation and after six months and one year of operation.
- The purpose of the surveys was to verify system operation and to look for evidence of scouring.
- Observations were also to be made around the units during testing for impacts on fish.
- If sampling events or bathymetric surveys gave indication of adverse impacts to the water quality or evidence of scouring system would be "de-tuned" by regulating the sweep times and duration or by slowing the impellers on the water jets.
- This would effectively reduce the energy being placed into the water column and reduce the impact on entrained sediments.
- If impacts on fish were observed, the openings on the water intake screen were to be lessened.

Source: Bryant 2007

Example: SedCon Installation Charleston, SC. Results

- During testing there were elevated levels of turbidity at various times and locations, but this information is all relative to ship activity as well as sampling depth and station.
- Sampling event #3 was conducted while the sediment suspension system was idle in order to mimic the conditions before the jet system but post dredging. During this event only 2 bottom water samples exceeded 25 Nephelometric Turbidity Units (NTU), which is the water quality criteria standard for turbidity.
- This shows that the turbidity during operation is somewhat higher than idle periods, but the effects on water quality caused by the sediment suspension system are minimal compared to those caused by dredging.

Source: Bryant 2007

Example: SedCon Installation Charleston, SC. Results

- First sampling event was performed during active dredging operations.
- All bottom water samples exceeded 25 NTU during sampling event #1, and two of the middle water column stations exceeded 25 NTU.
- In sampling event #2, only 2 bottom water samples exceeded the 25 NTU criteria, and one middle water column sample exceeded 25 NTU.
- Event #2 was conducted during the first week of the system's operation. The fourth sampling event showed similar results.
- The fifth sampling event showed one extremely elevated level of turbidity as well as other stations with elevated levels of turbidity. This may have been caused by recent ship activity.
- All samples taken in each event met the water quality standards for dissolved oxygen that cannot fall below 4 mg/L.

Source: Bryant 2007

Example: SedCon Installation Charleston, SC. Results

- Various locations of the sampling points support the data that shows shoaling is not caused at other locations as a result of the system. This was a voiced concern by some, but there are no test results that support this theory.
- 3 hydrographic surveys were conducted during the course of initial testing just before dredging, immediately following dredging, and six months after dredging indicate that after some initial post-dredging shoaling, the system has maintained the targeted project depth of 45 feet below mean low water (MLW).

Source: Bryant 2007

SedCon Installation Sites

Facility	Location	Installed	Dimensions (L x D)	Units
INVISTA	Wilmington, NC	1997	700ft x 40ft	8
NuStar Asphalt	Savannah, GA	1998	675ft x 40ft	3
CITGO Petroleum	Linden, NJ	2002	800ft x 36ft	4
Georgia Ports Authority 6 & 7	Savannah, GA	2003	1600ft x 42ft	8
Naval Submarine Base Kings Bay	Kings Bay, GA	2006	700ft x 42ft	7
South Carolina State Ports Authority (2 systems)	Charleston, SC	2006	2000ft x 45ft	10
Georgia Ports of Authority 8 & 9	Savannah, GA	2008	1400ft x 42ft	7

Source: SedCon

Influence of Site Specific Conditions

Site Geometry

Hydrodynamics

Sediment Characteristics

Socio/Political/Economics

Traffic draft relative to berth depth

QUESTIONS?

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April 2017

Sediment Management Methods to Reduce Dredging: Part 2, Sediment Collector Technology

by Robert Thomas, John McArthur, Dave Braatz, and Tim Welp

PURPOSE: This Dredging Operations and Environmental Research (DOER) Program technical note (TN) is the second in a series evaluating sediment management methods to reduce dredging through a research task (RT) in the DOER Program.[1] This TN presents an evaluation of sediment collector technology, one promising new device that may help better manage sediments to reduce traditional dredging requirements.

INTRODUCTION: The first of two technologies being evaluated under this RT is a sediment collector currently installed in Fountain Creek, Pueblo, CO, (location shown in Figure 1) intended to demonstrate technology to alleviate the need for dredging by lowering the downstream grade to reduce flooding and ultimately reduce sediment deposition as far downstream as John Martin Reservoir, a U.S. Army Corps of Engineers (USACE)-managed lake. The system operates on the principle that sediment in bedload can be trapped by gravity and removed at the natural rate of transport, instead of episodically. This DOER TN describes the technology and installation at Fountain Creek, other possible applications, lessons learned, cost, and provides some general guidance for applying collector technology at other sites.

Figure 1. Location of sediment collector.

COLLECTOR INSTALLATION IN FOUNTAIN CREEK: A 30 ft wide, high-capacity sediment collector was installed in Fountain Creek, Pueblo, CO, upstream of the confluence with the Arkansas River in July 2011 (Figures 1, 2, 3, and 4) to demonstrate the viability of this new technology.

[1] Thomas, R. C., and T. Welp. In preparation. Sediment management methods to reduce dredging: Part 1, sediment minimization concept and demonstration project introduction and overview. DOER Technical Notes Collection. Vicksburg, MS: U.S. Army Engineer Research and Development Center. www.wes.army.mil/el/dots/doer

Figure 2. Sediment collector installed in Fountain Creek.

Figure 3. Archimedes screw separator (left) and stacker (right).

Figure 4. Electronic control panel and Archimedes screw separator.

The sediment collector system, as installed in Fountain Creek, consists of six main parts:

1. collector: 30 ft wide bedload collector
2. pump: 50 HP, submersible variable frequency drive (VFD) pump
3. controller: electronic controls with internet access and remote interface
4. 6 in. discharge and 8 in. water return DR 11 (160 pounds per square inch [psi]) high-density polyethylene (HDPE) pipelines
5. sediment separator: 100 tons/hour (hr)
6. stacker: capable of storing approximately 1,000 cubic yards (yd^3).

The primary component of the collector is a steel hopper (Figures 2 and 5) placed on the bottom along a sediment transport pathway. A manifold system inside the hopper focuses flow across a small region within the hopper, providing high velocities needed to entrain sediment. A dredge pump housed in the hull with the hopper pumps water and sediment through the manifold to the placement area. The pump can also be mounted remotely on land, the preferred configuration for maintenance. Booster pumps can be added to increase the pumping distance, as required.

Figure 5. Installation of 30 ft long collector.

The system can be operated in an open or closed cycle. In the open cycle, water is drawn into the collector manifold from across the screen. Since the area of the screen openings is much greater than the area of the manifold orifices, velocity across the screen is very small (<1 feet per second [ft/sec]), even though velocity at the manifold is large enough to transport sediment. In the closed cycle, the slurry is discharged into a holding tank and separated from the water, and then the water is returned to the opposite side of the manifold so that water is drawn from the holding tank instead of across the screen. Advantages of the closed cycle include minimal impingement velocity (reducing potential for clogging) on the hopper screen, reduced risk of entrainment of aquatic organisms, and greatly reduced consumptive water loss. Sediment is discharged into a bin at the base of the screw separator (Figures 3 and 4), which separates and drops the coarse sediment onto the stacker (Figure 3). Sediment is stockpiled at the stacker until it can be trucked away.

Electronic controls enable automatic or remote operation, reducing or eliminating the cost of labor to supervise operation. The system can be set to run at specified times, as a function of stream gage data or as a function of hopper capacity (still in development). Dredge pumps, piping, separators, and stackers are off-the-shelf technology used in dredging and other industries with documented performance metrics.

OTHER POTENTIAL APPLICATIONS: Collector technology adds two key improvements over other installed dredging systems:

Selective capture. Both the size and quantity of sediment removed can be selected. Since the system operates with very low or no head across the screen into the hopper, only sediments coarse enough to be transported in bedload are trapped (fine sands to gravels), while finer sediments (silts and clays) remain in suspension. The top size of the sediment is limited by screen opening size. The total volume captured can be modified by controlling the duration of system operation and by varying the width of the collector installed.

Removal at the natural transport rate. At maximum production, the system is only capable of removing sediment at the total maximum natural transport rate. The collector is only capable of trapping sediments when they are supplied by natural forcing (currents or waves). Therefore, the system (when installed at grade) can never exceed natural transport processes. Removing sediment at the natural rate more closely mimics nature, reducing known and potential unforeseen environmental impacts. A permanent collector serves as a grade-control structure. When installed above grade on a complete cross section, the collector will cause aggradation upstream to the desired new elevation. When installed below grade, the collector will initiate a controlled-depth headcut upstream.

The selective capture of bed load at the natural transport rate leads to some specific new capabilities. Although not exhaustive, some potential applications for collector technology are discussed below:

- **Watershed management.** By actively managing sediments at the watershed level, it is possible to drastically reduce sediment load to the area or channel of interest. Managing sediments at many locations throughout the watershed may optimize habitat restoration and protection and also be more cost effective and environmentally friendly than the traditional practice of dredging at the problem site. This also presents an opportunity to take advantage of flexibility in siting, by helping to address issues with property ownership, road access, material handling and transportation, power availability, etc. Collectors are scalable to any stream width and can be readily retrofitted to existing cross-vane or other structures. They also allow users to actively manage grades in the vicinity of the collector.

- **Reduce quantity of contaminated sediment dredging.** Coarse sediments can be removed before being deposited in an area known to be contaminated, by reducing the total volume of sediment that must be dredged and placed under more stringent requirements typical for removing contaminated sediments.

- **Sediment bypassing.** At inlets in tidal systems, or other locations where there is a clearly defined sediment pathway crossing a navigation channel, a collector could be installed as a sediment bypassing system, allowing sediment to be removed and pumped past the navigation channel, and preventing deposition. The system would be installed at reaches where deposition is typical and the discharge located in an area with potential for scour or transport away from the channel.

  Reservoir sedimentation can be reduced by capturing and removing bedload at tributary mouths and either removing the material or reintroducing the sediment below the dam (at the natural transport rate, to offset channel and habitat degradation due to a sediment deficit caused by reservoir trap efficiency). Using collectors to design or retrofit sustainable reservoirs will not only reduce dredging requirements but will help maintain reservoir storage capacity and related hydroelectric generating capacity and reduce flood risks that would otherwise increase with a loss of storage.

- **Sediment backpassing.** On beach locations that experience accretion, the collector could be installed as a sediment backpassing system, allowing sediment to be removed from the accretion area and pumped back to beach erosional *hotspots* within practical pumping distance.

- **Application in remote locations.** Since a collector system can be installed with standard truckable equipment, it offers the potential for application in remote locations where there is a need to control grade in streams, to prevent downstream migration of excess or contaminated sediments, to maintain a navigable channel, or to supply coarse sediment with lower impact than traditional mining practices. In many headwater locations (e.g., first- or second-order streams impacted by logging, agriculture, or road construction), stream gradient may allow for collector clearing on a siphon basis for continuous operation with no pump or power requirement.

In addition to the potential applications listed above, implementation of this new technology could result in other benefits not yet fully investigated. Since there is essentially no flow into the hopper (with a closed water cycle), there is little risk of ingesting wildlife or foreign material that might clog the pump. This may help to meet permit requirements or avoid the need for some permits. Closed-cycle operations may also be used to address water rights issues by returning water to the hopper. Aesthetic impacts of dredging and operational limits (e.g., due to Threatened and Endangered species (T&E) or spawning seasons) could be avoided since there is very low or no flow into the system.

DEMONSTRATION PROJECT COST: Component, installation, and total cost of the system installed at Fountain Creek are listed in Table 1. The project was championed by the City of Pueblo and funded through the U.S. Environmental Protection Agency; Colorado Department of Public Health and Environment, Non-Point Source Office; Pueblo County; U.S. Department of Agriculture, Natural Resources Conservation Service; and Colorado Water Conservation Board (CWCB) in collaboration with the equipment developer Streamside Systems, LLC. Since the initiation of the project, the Fountain Creek Watershed, Flood Control, and Greenway District was created.

Costs shown in Table 1 approximate the actual system cost. Others have reported the cost to range from $500,000 to $1,000,000, although details associated with the higher estimates of cost are unavailable.

Table 1. Sediment collector cost.	
Collector (pumps, controllers, pipe, etc.)	$419,000.00
Sediment Stacker	$39,000.00
Installation	$110,000.00
Approximate Cost of Contract Documents	$50,000.00
Upgrades/Repairs	$10,000.00
Total	**$628,000.00**

Cost of operating the system has been minimal since it has been operated for short periods of time only and because Streamside Systems personnel donated time to operate the system to collect needed data. The system is capable of being operated remotely; however, because of potential risk to human safety associated with the separator and stacker, the system was only operated under direct supervision. The system uses approximately 1,000 Watts per hour (1kWh) per minute of operation. If the system were run continuously for 1 year, electricity cost would be approximately $52,560 (based on cost of $0.10/kWh).

Minor repairs were required after the flood of September 2011. Record-breaking rainfall resulted in extreme flooding and record creek flows but did not damage the collector. Damage to an exposed junction box required repairs totaling $1,765. The remaining cost for upgrades/repairs included a return flow pump and minor modification to the initial layout of the piping. An 1,800 gallon (gal) tank was added at the separator along with a pneumatically actuated valve that provides return prime water for the dredge pump at startup to ensure that the specific gravity of the slurry is managed.

PERFORMANCE: Monitoring of the demonstration project has been underway since installation. Parameters that were planned for measurement included stream bed elevation within one-half mile of the collector, water level, sediment removed, electricity usage, maintenance required, and hours in operation. Specific performance data were collected at various flow rates over approximately 500 hrs. Since the system was not operated continuously over many months and with the bedload transport continuing when the system was not in operation, short term stream bed elevation and coarsening impacts were overwhelmed. Therefore, stream bed elevation was not resurveyed at the end of the project.

Record breaking rainfall in September 2011 resulted in extreme flooding and record creek flows of 13,800 cubic feet per second (ft^3/sec). High water damaged the junction box, causing total down time of approximately 2.5 months while the City of Pueblo worked to get a repair contract executed. This flood demonstrated survivability of the system in an extreme event. Repair time was less than 1 day, once the repair contract was executed. Winterization (heat tracing and freeze protection) was not specified, and the system was not operated for approximately 2 months during the winter season.

Production rate was the key performance parameter measured. Prior to installation of the 30 ft bedload collector, a 2 ft bedload collector (Figure 6) was temporarily installed in Fountain Creek to estimate bedload transport extraction rates and assess optimal elevation for collector operation. The 2 ft collector pumped sediment into a drop box (Figure 6) that, in turn, allowed a 3 ft^3 container to be filled with the subsequent fill time noted to calculate a production rate. Sediment was collected over a 3-day duration with extraction rates at respective stream flows listed in Table 2. Assuming a linear extraction rate function for a longer collector, respective production rates were estimated for a 30 ft long collector and listed in Table 2 as well.

Figure 6. 2 ft collector and drop box used to estimate production rates.

Table 2. Measured 2 ft collector and estimated 30 ft collector extraction rates.

Stream Flow (ft^3/sec)	2 ft Collector Bedload Extraction Rates	Estimated 30 ft Collector Bedload Extraction Rate (yd^3/hr)
100	3 ft^3/26 min	2.6
120	3 ft^3/38 min	3.8
600	3 ft^3/6 min	16.7

Figure 7 plots maximum production rate vs. creek discharge for all data collected, with a second-order polynomial trend line fit to the data. These production rate values were not independently verified by the USACE. Excluding the September 2011 flood, the range of discharge rates captured represents the typical range expected at this site during any year. The figure shows the dependence of bed load on discharge. The estimated production rates in Table 2 (based on the 2 ft collector extraction rates) agree well with the production curve in Figure 7 at the lower flow rates of 100 and 120 ft^3/sec, but less so for the 600 ft^3/sec flow rate condition. Peak measured production rate for the 30 ft collector was 100 yd^3/hour. At this rate, if sufficient bed load were available, the single 30 ft collector would move 876,000 yd^3/year. The high capacity of a single unit makes it possible to use structures in conjunction with collectors to maximize total capture with fewer collectors.

Visual inspection of the hopper and other system components were made at least monthly over the course of the year. No significant wear or corrosion was shown on any parts although the urethane coating on the mild steel hull did sustain scouring and erosion. No repairs have been required other than those associated with initial system configuration as a result of the flood in

September 2011 and vandalism that damaged the power and control conduit leading to the dredge pump. Additional automation and instrumentation was added with the return water tank that included a variable level control and high-level switch that assists with balancing the system.

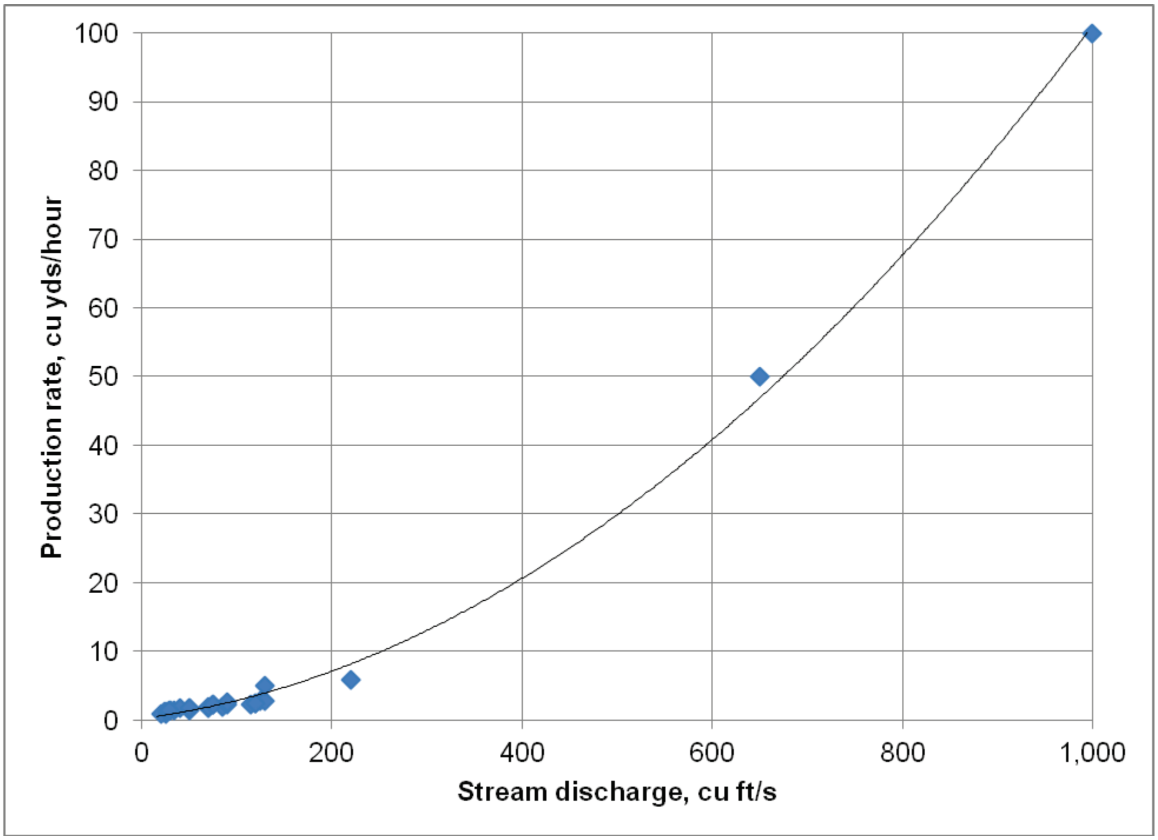


Figure 7. Sediment collector production curve.

LESSONS LEARNED: Initial deployment of new systems is an opportunity to inform design and improve installation procedures. The following list describes lessons learned during the demonstration project:

- All electrical components should be well above potential flood water levels.
- Pipelines should be as straight as possible, with no sharp turns, limiting the potential for air to be trapped in the lines.
- When operating the system with return flow, a sufficiently large water storage container should be available at the discharge point to prevent air intrusion during pump start-up and to ensure that an acceptable slurry specific gravity is maintained.
- Experience at Fountain Creek suggests that the return flow pump is a worthwhile investment, reducing risk associated with grade control, and that the return flow also prevented the collector from being clogged from surges of sediment that accumulated in the hopper (i.e., the return flow refluidizes these sediment *slugs* in the hopper and meters it into the suction ports).
- Accurate survey for grade control during installation is essential both at the discharge point and hopper.

  - Elevation of the hopper directly controls elevation of the bed during operation.
  - Elevation of the pipeline discharge point (relative to the hopper) controls the size of the return flow pump, or required head difference if attempting to run without a return flow pump.

- As with any industrial operation, measures must be taken to ensure that unauthorized personnel do not gain access to the material management equipment (separator and stacker). The 6 ft tall fence around the demonstration project site was insufficient to prevent the curious from gaining access to the dangerous electrical and mechanical equipment. Yard lighting is recommended for night operations.
- Screen configuration and size should be based on the aggregate particle sizes in bedload. This demonstration project selected the standard coarse sand, stainless steel, round bar stock with a 3/8 in. spacing in lieu of recommended vibratory screens. During periods of low flow, larger aggregate can align in the screen apertures, resulting in bridging. Vibrating screens or jet systems could be added to offset this requirement.
- To ensure that stream flow and bedload are delivered across the collector screens, appropriate permanent or temporary cross-vane structures are recommended. Tangential interception of the stream flow by the collector screens can exacerbate the aforementioned screen-bridging issues that were identified.
- Careful collaboration between the technology vendor (or other expert), engineer responsible for system/site design, and construction contractor is essential to avoid additional cost associated with field modifications during installation and initial testing. Design-build may be the best procurement mechanism for initial full-scale applications.

RECOMMENDED GENERAL APPROACH FOR COLLECTOR PROJECTS: Sediment collector technology should be considered when substantial quantities of sediment selected for removal are being transported as bedload. Recommended key steps in scoping, design, construction, and operation of a sediment collector project are identified below:

Predesign analysis. Appropriate analyses should be conducted to determine sediment transport processes, and expert advice should be solicited to determine if a collector is feasible for each site. Key parameters that should be investigated to determine if a collector project is feasible include the following:

- Sediment transport (size and rate): Typically measured through deployment of a 2 to 6 ft collector emplaced and operated during varying stream flow conditions (Lipscomb et al. 2005).
- Transport processes and pathways: Typically assessed through combination of expertise, field data and inspection, and application of numerical models.
- Sediment management: Identify potential placement locations and methods of conveyance.
- Operations plan: Identify who will be responsible for operating and maintaining the system after construction.
- Benefits analysis: Compare cost, both financial and environmental, to alternative methods to identify the least-cost method of removal.

Design. After the decision to install a collector has been made, design of the plant should be conducted by an experienced engineer consulting with the system developer or other expert in collector installation. Major components of design analyses include the following:

- Collector design: Based on data collected and analyses conducted in the predesign phase, consult with the system developer to determine the appropriate configuration of the full-scale collector system.
- Placement area design/plan: Design the placement area and plan operations to manage the sediment load anticipated. Contingencies for minimal oversight should be considered.
    - If not conducted during the redesign phase, it may be necessary to collect more data or conduct additional analyses to determine the rate of sediment that must be handled.
    - Placement area options range from direct discharge to a complete mechanical separation plant like the one used at Fountain Creek.
- Pump and pipeline design: Pipeline layout should minimize head loss, prevent air from being trapped, and follow the shortest possible route. Pump size will be a function of sediments, collector size and configuration, placement area design, and pipeline configuration.
- Electronic control and electrical design: Electronic controls and electrical wiring for the collector system must be designed. The control system should be designed with the collaboration of the system vendor.
- Final site design: Other design features typical of a civil project such as grading, drainage, roads, utilities, lighting, site safety, etc. should be considered.

Construction. The system should be installed by a qualified construction contractor with an expert in collector installation on staff. The demonstration project identified some issues to consider during construction, listed below:

- Construction quality control (QC): Lessons learned during the pilot highlighted the importance of QC during construction. Elevation tolerances, pipeline layout, and electrical wiring all had issues at Fountain Creek that could have been eliminated through QC during construction.
- Initial testing: Like any new system, initial testing should be conducted to determine if the system is operating as intended.

Operations and maintenance. After construction, the system should be monitored to ensure that it is functioning as designed. Some topics for consideration after construction include the following:

- Monitoring: System components (collectors, pumps, electronics, etc.) and environmental factors (sediment size and transport rate, flow rate, etc.) should be monitored to assess performance and to inform system maintenance or tuning.
- System tuning: Because of the uncertainty associated with modeling and measuring sediment transport, it is likely that actual production will be different than predicted. It may be possible to modify system configuration to optimize performance. Plan to re-evaluate system layout after monitoring data have been gathered and analyzed.

Length of monitoring duration necessary to make system tuning decisions will, of course, depend on which system design aspects are being evaluated. The decision to relocate certain Fountain Creek electrical components well above potential flood water levels happened immediately after the components were flooded. Something like a system reconfiguration may take longer to more accurately reassess site specific conditions (e.g., optimum sediment transport volumes and patterns).

CONCLUSIONS: This DOER TN is Part 2 of a series demonstrating innovative methods to enable sustainable sediment management to reduce dredging requirements. This TN presents application of sediment collector technology in Fountain Creek, Pueblo, CO, and discusses how it might be applied to reduce USACE navigation dredging. The installation successfully demonstrated the technology, specifically that collector technology

- works with coarse sediments in a shallow unidirectional flow environment
- has minimal maintenance costs over a 1 yr deployment
- survives record floods with minimal damage
- is capable of producing up to 100 yd^3 per hour with a single 30 ft collector
- is relatively inexpensive and easy to deploy without specialized equipment.

Further investigation of collector technology through a larger-scale demonstration at a navigation project is recommended. Future demonstrations should consider testing application in areas with wave dominated transport, application with finer sediments, application in deeper water, and different placement options.

POINTS OF CONTACT: For additional information on sediment minimization to reduce dredging, contact Robert Thomas (409-766-3179), *Robert.C.Thomas@usace.army.mil;* Timothy Welp (601-634-2083), *Timothy.L.Welp@usace.army.mil*; and/or the DOER Program Manager, Dr. Todd Bridges (601-634-3626), *Todd.S.Bridges@usace.army.mil* . This technical note should be cited as follows:

> Thomas, R., J. McArthur, D. Braatz, and T. Welp. 2017. *Sediment management methods to reduce dredging: Part 2, sediment collector technology.* DOER Technical Notes Collection. ERDC TN-DOER-T13. Vicksburg, MS: U.S. Army Engineer Research and Development Center. *www.wes.army.mil/el/dots/doer*

REFERENCES

Lipscomb, C. M., A. Darrow, and C. I. Thornton. 2005. *Removal efficiency testing of streamside systems bedload monitoring collector.* Ft. Collins, CO: Colorado State University Engineering Research Center.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/21/2018	**CONTACT**	Joseph Z Gailani
TIME	11:00 AM	**REPRESENTING**	ERDC/USACE

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: The Jones Act limits dredging equipment to United States based and owned equipment; therefore, United States dredging contractors have limited incentive to develop new technology. Regional Sediment Management is providing an innovative approach to efficiently manage sediment distribution. Advance maintenance dredging, if proposed, would require appropriate hydrodynamic model (predictive tools) to review how to best balance increased depth with risk (decreased velocity, modifications to sediment management (channel infilling, redistribution), impacts to surrounding sensitive environmental resources).

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Not applicable.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Contact Ned Mitchell, ERDC at 601.529-9005 or Kenneth.N.Mitchell@USACE.Army.mil. He will likely have additional information regarding cost efficiency and dredge optimization.

4. **QUESTION (CONTRACTORS ONLY):** As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?

   RESPONSE: Not applicable.

MILESTONE: Follow-up with Ned Mitchell, ERDC.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/2/2018	**CONTACT**	Todd Swannack
TIME	11:00 AM	**REPRESENTING**	ERDC/USACE

1. **QUESTION:** The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?

   RESPONSE: No documents. He said he really had no information on this subject and would think about it and call back if he thought of anything.

2. **QUESTION:** The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?

   RESPONSE: No comment.

3. **QUESTION:** Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?

   RESPONSE: Not applicable.

4. **QUESTION (CONTRACTORS ONLY):** As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/26/2018	**CONTACT**	Jackie Keiser
TIME	10:00 AM	**REPRESENTING**	USACE RSM Regional CX

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: The Jacksonville District is working with the Savannah District and are about to advertise a contract for Jekyll Creek where thin layer placement will be used as a disposal method. This RSM concept could be applied to the IWW in Florida; however, following this thin layer placement project may give good insight as to costs and future applications.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: The USACE is moving toward utilization of Regional contracts. Did a big one in 2017 where Charleston, Wilmington and Savannah had dredging requirements and these Districts combined the effort under one contract and was administered by Wilmington. The current MATOC is going away and this process may take its place, somewhat.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: No response.

4. **QUESTION (CONTRACTORS ONLY):** As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

Pilot Projects

Georgia AIWW: Jekyll Creek

Two Placement Strategies

- Thin Layer Placement
- Open Water Placement

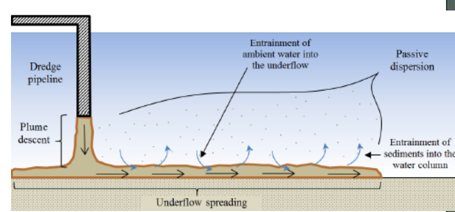
Multi-Agency and Stakeholder Collaboration

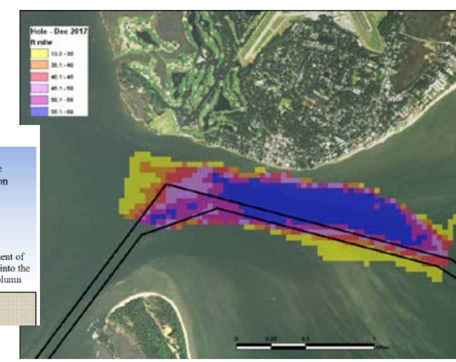
- USACE, GA DNR, USFWS, NOAA NMFS, JIA, TNC

2 Years Biological/Physical Monitoring

- USACE (SAS, RCX), GA DNR, academia

P&S Complete, Dredging begins Fall 2018





US Army Corps of Engineers

U.S.ARMY

Pilot Projects

NE Florida/SE Georgia:

Blount Island (USMC), NSB Kings Bay (NAVY)

TLP Proposal with USMC, NOAA

- Solutions for long term capacity issues
- Elevation capital, coastal resilience, combat SLR
- 5 Years Biological/Physical Monitoring

US Army Corps of Engineers

U.S. ARMY

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT A
DOCUMENTATION INTERVIEW FORMS

STATE AGENCIES

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/23/2018	**CONTACT**	Jack Holland
TIME	3:10 PM	**REPRESENTING**	Hillsboro Inlet District (HID)

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: No comment.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: No comment.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: The HID is a special state taxing district and they have an annual budget of approximately $1,00,000/year; all of which is spent entirely to maintain Hillsboro Inlet. They have owned and operated their own dredge since the 1960’s and currently have a five (5) man crew for their operation and maintenance needs. Their boatyard is located on the U.S. Coast Guard (USCG) property where they have free space in exchange for maintaining the USCG beach adjacent to the lighthouse. To date, they have owned three separate dredges — 8-in dredge, an Ellicot, and, at present, a 1412 suction dredge with two work boats — and average a production rate of approximately 100,000 cy/year. In 2002 the HID deepened and widened the design of their entrance channel from 9 to 20 feet MLLW. Their most active time is during winter (due to increased littoral drift) and shoaling rates tend to lessen during the summer. HID indicated that they had purchased a dredge specific for their needs and didn’t see how that would correlate to the ICWW; since the ICWW varies in sediment type, disposal area, dredged volume requirements, etc. HID indicated they would route a white paper, ppt, and budget for review.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida’s Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

Hillsboro Inlet District Operations - January 2016
Jack Holland, Chairman

Background
In 1957 the Florida Legislature created the Hillsboro Inlet District. This is a special independent district that can levy taxes to finance the maintenance and improvements to the Inlet. The taxing District runs from Dixie highway to the Ocean and from the Broward/Palm Beach county line to Lauderdale by the Sea. The District has eight commissioners from: Pompano Beach, Lighthouse Point, Deerfield Beach, Hillsboro Beach, Lauderdale-by-the-Sea, Sea Ranch Lakes, Ft. Lauderdale and Broward County.

Based on a physical model in 1964 at the University of Florida, the current configuration of the inlet was created by cutting the rock reef between the channel markers to10 feet deep, adding the 400 foot South jetty and a 200 foot north jetty. In heavy northeast storms the spillway between the north jetty and the lighthouse allows waves to carry sand from the littoral drift into a sand trap inside the inlet. With the outside channel rock at 10 feet, the sand dredging could only maintain a depth of 8 to 9 feet.

Financials
The District's source of revenue is predominately ad valorem taxes levied on real property within the District. The District's budget consists of two major components the recurring expenses and funding for special projects.

Recurring expenses are the day to day expenses to operate and maintain the dredging equipment to dredge the channel and bypass sand to the South.
These expenses are labor cost for crew of five, fuel, supplies, insurance, legal, accounting, etc. The day by day operation of the crew is supervised by the Dredge Captain and the Assistant Captain. The overall management strategy of the operation is provided by the District's eight commissioners that are volunteers with no direct compensation.

Special projects are mainly capital equipment purchases and improvements to the inlet. Channel improvements were cost shared with FDEP and FIND.

For these special projects a reserve is set up and funds are accrued (mostly over several years) before committing to the project. The District's special project outlay occurs in the year of the construction and/or the purchase of the capital equipment. The District does not carry any debt.

The District's dredging equipment consists of a hydraulic sand pumping dredge, two support workboats, an elbow barge and a yard crane.
A reserve to replace the dredging equipment had been established in the early 1980's.

Hillsboro Inlet District Operations - January 2016
Jack Holland, Chairman

Inlet Improvement Project

As part of a State required Inlet Management Plan, the District created a design to deepen and widen the outer channel. The plan was to remove the rock down to 20 feet and widen the channel by removing a small portion of the submerged reef on the south side of the channel. This reduces the danger of boats going onto the reef and gives the ever increasing number of boats more room to maneuver safely. A fan shaped channel design for these improvements was completed in 1995.

When the District was getting ready to implement the plan, the Army Corps of Engineers wanted to help the District using Federal funds. If they were to supply funding, they had to redesign the project. They spent several years studying and redesigning the project but no Federal Funds were available.

In 2002, an opportunity to economically have a rock cutting dredge complete the project for far less than the ACOE estimates occurred. It was decided to use the dredging equipment reserve to implement the channel improvement project.
This project was completed with financial support from FDEP and FIND with permitting from ACOE, FDEP and Broward County.

Project Costs:

Rock dredging:	$3,250,000
Engineering, Misc. Expenses*:	$250,000
Artificial Reef mitigation:	$500,000
Total Cost:	$4,000,000

Project Funding:

Florida DEP:	$1,600,000
FIND:	$927,000
Hillsboro Inlet District**:	$1,473,000
Total Funds:	$4,000,000

*Includes removal of navigation aids, project monitoring, etc.
** Mostly from reserve funds built up over the last 10 years for possible dredge replacement.

Construction of an artificial Reef was required as mitigation for removing a small portion of the hardbottom/reef south of the channel during the inlet improvement construction. The artificial reef was permitted by ACOE, FDEP and Broward County and was completed in April 2009 at a total cost of $1.3M with FDEP providing $550K and Hillsboro Inlet District providing $750K.

Hillsboro Inlet District Operations - January 2016
Jack Holland, Chairman

Taxes
In 2003 to 2005 the Special Project portion of the budget was increased temporarily to replenish the dredging equipment reserve.

Year	Millage	Taxes on $500,000	% Increase Since 2000	Revenue
2000	0.1036	51.80	0%	714,852
2001	0.0951	47.55	-8%	714,519
2002	0.1170	58.50	13%	994,390
2003	0.2490	124.50	140%	2,389,878
2004	0.1845	92.25	78%	2,016,626
2005	0.1845	92.25	78%	2,344,637
2006	0.1170	58.50	13%	1,802,521
2007	0.0860	43.00	-17%	1,432,315
2008	0.0860	43.00	-17%	1,338,686
2009	0.0860	43.00	-17%	1,201,233
2010	0.0860	43.00	-17%	1,047,195
2011	0.0860	43.00	-17%	1,021,118
2012	0.0860	43.00	-17%	1,031,819
2013	0.0860	43.00	-17%	1,068,167
2014	0.0860	43.00	-17%	1,134,761

Dredge Replacement
The District's equipment operates in very harsh environmental conditions with constant salt spray and wave action

The District's dredge was an Ellicott Dredge built in 1971. The District purchased it from Hanson Dredging in 1982.

For several years it required extensive repairs with excessive down time. Many of repair parts had to be custom fabricated by the crew and/or the original manufacturer.

In 2008, the District replaced the dredge with a new dredge built to better withstand the harsh salt environment.

The new dredge was an Ellicott Dragon Series 1070 14/12 Dredge purchased at a cost of $1.8 M. With an expected life of at least 30 years, the amortized cost of the dredge is about $60K a year which is 6% of our annual operating budget.

Some key dredge features include:

Large pontoons to give more freeboard to handle waves from ocean and wakes from boat traffic rushing for the bridge and/or ignoring no wake signs

Heavier spuds for better penetration and stability.

Stainless steel fittings on all hydraulic lines

All raw water piping is of stainless steel.

Fresh water tanks on dredge to facilitate fresh water wash down at the end of work day
New low pollution turbo-charged diesel engines-800HP for Pump and 350 HP for Auxiliary-using low sulfur fuel for reduced emissions.
Oil separator for bilge pump to guarantee no oil discharge
Coast guard approved biodegradable hydraulic fluids which were used on the old dredge for several years.
Gantry lift for ladder to not bang ladder into bottom as with the old dredge hydraulic ladder control
New dredge started pumping sand in May 2008.

Workboats Replacement
The inlet operates two work boats to support the dredging operation. The dredge has no means of moving on its own other than using winches to control its position. The work boats set anchors on steel cables that facilitate the winching operations. We commonly called the old boats the Steel workboat and the Aluminum workboat.

The steel work boat was purchased in Oct 1994. At that time the purchasing process that we have in place today had not yet been implemented and the quality of the boat was very poor. The company that supplied the boat was having financial problems and even though we were buying a new boat they resorted to using used parts in several key areas. Over the years this boat has required extensive repairs and has been unreliable when needed to perform its tasks.

The aluminum work boat purchased Nov 1995 had jet drive propulsion. Again this was purchased without the purchase process that we have in place today.
This boat has proven very unreliable because of sea grass, seaweed and other flotsam in the inlet clogging the jet drive intake. Bottom-line, a jet boat is not a practical application at the inlet. When setting anchors if it loses propulsion the whole dredging operation is impacted. In addition, the crew is put in jeopardy with the boat essentially adrift in the strong currents of the inlet.
An additional concern is that The District's new maintenance dredging permit is very specific about not disturbing any sea crass in The District's permitted operation area. Although unlikely that we would suck any growing grass into the boat, the possibility still exists.
In 2010 the District replaced the older work boats with two new identical custom steel workboats. All spare parts and maintenance techniques will be the same for both boats.

Yard Crane
A used yard crane was purchased in September 1999.
Again this was purchased without the purchase process that we have in place today. This crane was too large for The District's operation and could not be stored at The District's property at the inlet. It was stored at the Hillsboro Beach City water works

on Sample road. This crane has been a problem ever since we've had it with leaking hydraulic fluid, engine problems and safety issues with the outriggers failing endangering the crew. When we had a warrantee problem with the gearbox on the new dredge, the removal of the box was delayed over a week repairing the crane to remove the gearbox and facilitate loading in a crate for shipping.
A new yard crane small enough to be stored at the inlet yet with lifting capacity consistent with the District's operational requirements has been purchased and is now in service at the Inlet.

Distict Location at the Inlet.
The District has leased land from the US Coast Guard at the Inlet. The lease is a no-cost agreement with the Coast Guard. A portable office building and work shed is at the location. The district has done two major improvements: seawall replacement and workboat dock replacement. Both of these projects were funded by the District and gifted to the coast guard because it is not our property. The District is the main user of these improvements.

Sea Wall Replacement
The original seawall in our work area was made from piled bags of concrete. With the wave action at the inlet, the wall became undermined and unstable. This presented an unsafe environment to operate heavy equipment to remove equipment and/or service the dredging equipment. A new concrete piling-and-panel seawall with solid concrete cap was built in October 2004.

Workboat Dock Replacement
The dock for our workboats has been deteriorating for many years and had become unsafe even though being repaired several times. The district built a new dock in August 2008. It was built to withstand the constant wave action and current at the inlet. The dock is also used by the Hillsboro Inlet Lighthouse Preservation Society to bring visitors for lighthouse tours.

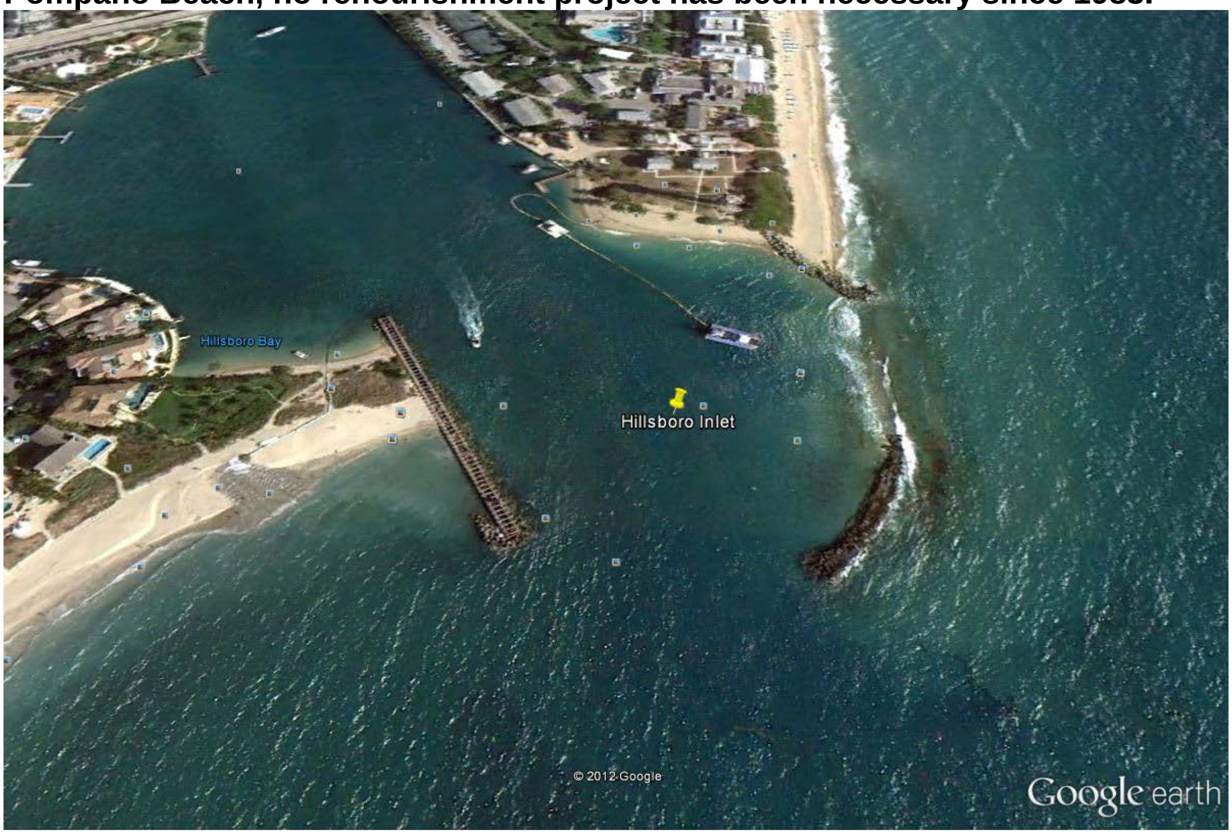
Dredging Volumes
See attached chart showing monthly volumes from 1991 to the present.

On Nov 19, 2008 a blockage developed in the submerged line under the inlet. The submerged line is made up of many sections of 12" rubber hose covered with sand. While removing the sand over the line, the dredge had a failure in the lubrication of the main reduction gear on December 8th.

Working with engineers and technicians from the gear box manufacturer, it was determined that the gear box would be repaired under warrantee but could not be repaired on site and would have to be shipped back to the factory in New York. The gear box was removed from the dredge (delayed by old yard crane problems) and shipped it to their factory on December 23rd. The repaired gear box was returned and installed with the dredge being operational February 23, 2009. To prevent future problems, a special alarm was added to the dredge operator's control room to monitor lubrication of the gear box.

The blockage was two steel belted tires from the old tire artificial reef off of Deerfield Beach. The tires with the steel wires were so tightly impaled into our rubber hose that the section of hose had to be replaced. To prevent any future blockages, we have added hardware to the input of the dredge cutter head to prevent large objects from being sucked up with the sand

Amount of sand by-passed is solely dependent on sand arriving at the inlet from Hillsboro Beach to the north by the littoral drift. With the District's deeper channel providing an expanded sand trap no sand is bypassing naturally around the inlet. **All sand arriving at Hillsboro is placed on the North end of Pompano Beach with no loss to near shore bars. With continued bypassing of sand to northern Pompano Beach, no renourishment project has been necessary since 1983.**



Hillsboro Inlet District

Jack Holland
Chairman
September 2015

Hillsboro Inlet District

- **What is HID?**
- Hillsboro Inlet District is a special independent district that can levy taxes to finance the maintenance and improvements for Hillsboro Inlet.
- **Where is HID?**
- Hillsboro Inlet is located in Northern Broward County. The taxing District runs from Dixie highway to the Ocean, and from the Broward/Palm Beach county line to Lauderdale-by-the-Sea.
- Taxes: $8.60 per $100k of taxable value

Hillsboro Inlet District

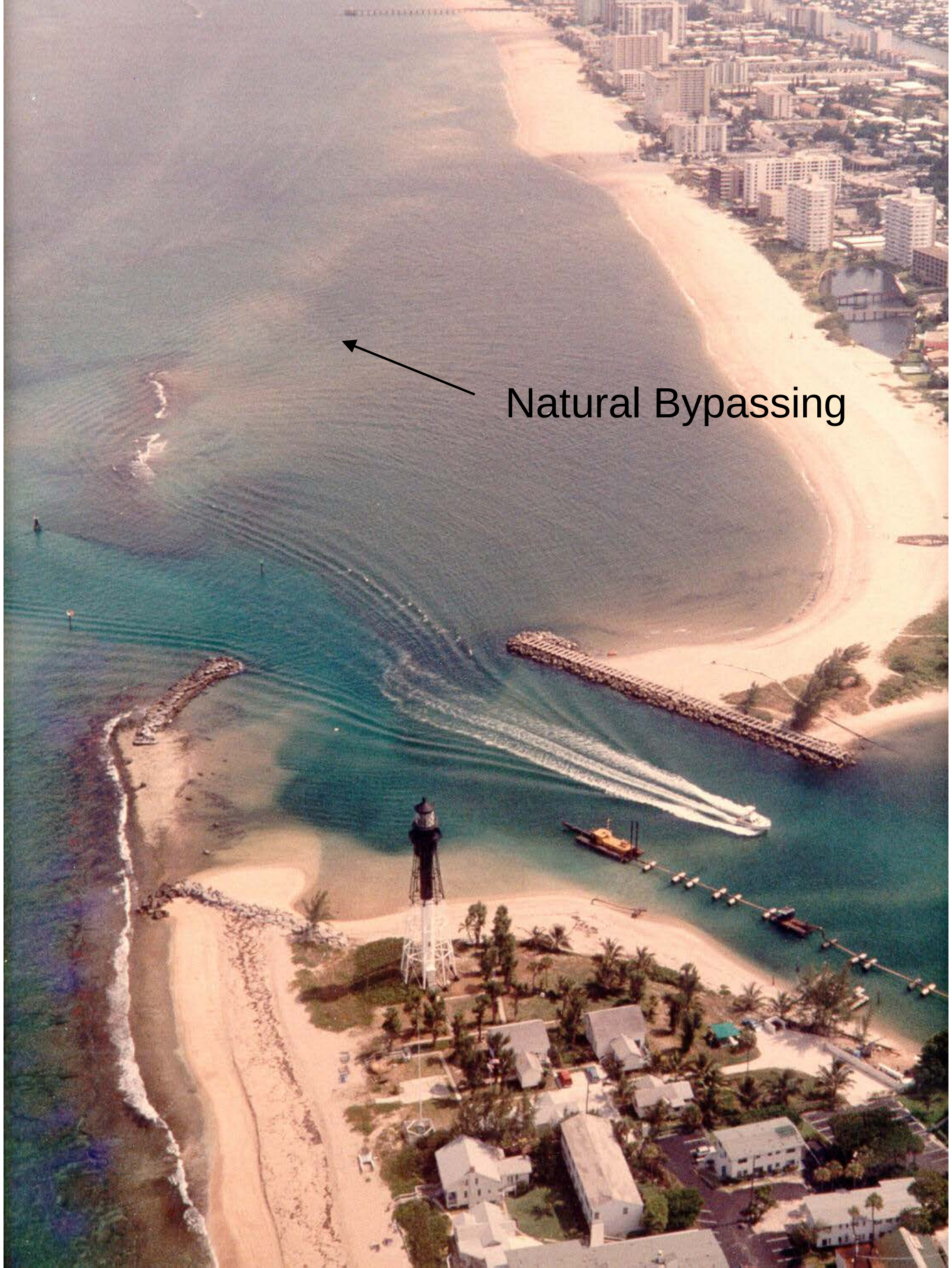
- **Who controls HID?**
- The District has eight commissioners:
- Jack Holland: Chairman Pompano Beach
- Larry Gore: Vice Chair Fort Lauderdale
- Hank Sarkis: Lighthouse Point
- Scott Loesel: Deerfield Beach
- Jim Lambert: Hillsboro Beach
- Stuart Dodd: Lauderdale-by-the-Sea
- Denise Bryan: Sea Ranch Lakes
- Tyler Chappel: Broward County.

Hillsboro Inlet District

- **What does HID do?**
- The District operates a sand pumping dredge:
- 1. To provide a safe navigable channel for both commercial and pleasure boating interests.
- 2. To bypass south flowing sand past the Inlet onto Pompano Beach shoreline south of the Inlet. If the sand was not pumped onto the beach, significant erosion would occur for the beaches south of the Inlet
- 3. To provide drainage for northern Broward County. During a major rain storm severe damage would occur in the District if the Inlet could not provide the proper drainage of water from the Intracoastal

Hillsboro Inlet District

- 1957 Inlet district was created by Florida Legislature
- 1963 An outdoor physical model of inlet was created at the University of Florida in Gainesville
- 1964 Based on the physical model, the current configuration of the inlet was created by cutting the rock reef between the channel markers to10 feet deep, adding the 400 foot South jetty and a 200 foot north jetty. In heavy northeast storms the spillway between the north jetty and the lighthouse allows waves to carry sand from the littoral drift into a sand trap inside the inlet.


Natural Bypassing

Five Year Plan – Navigation Issues

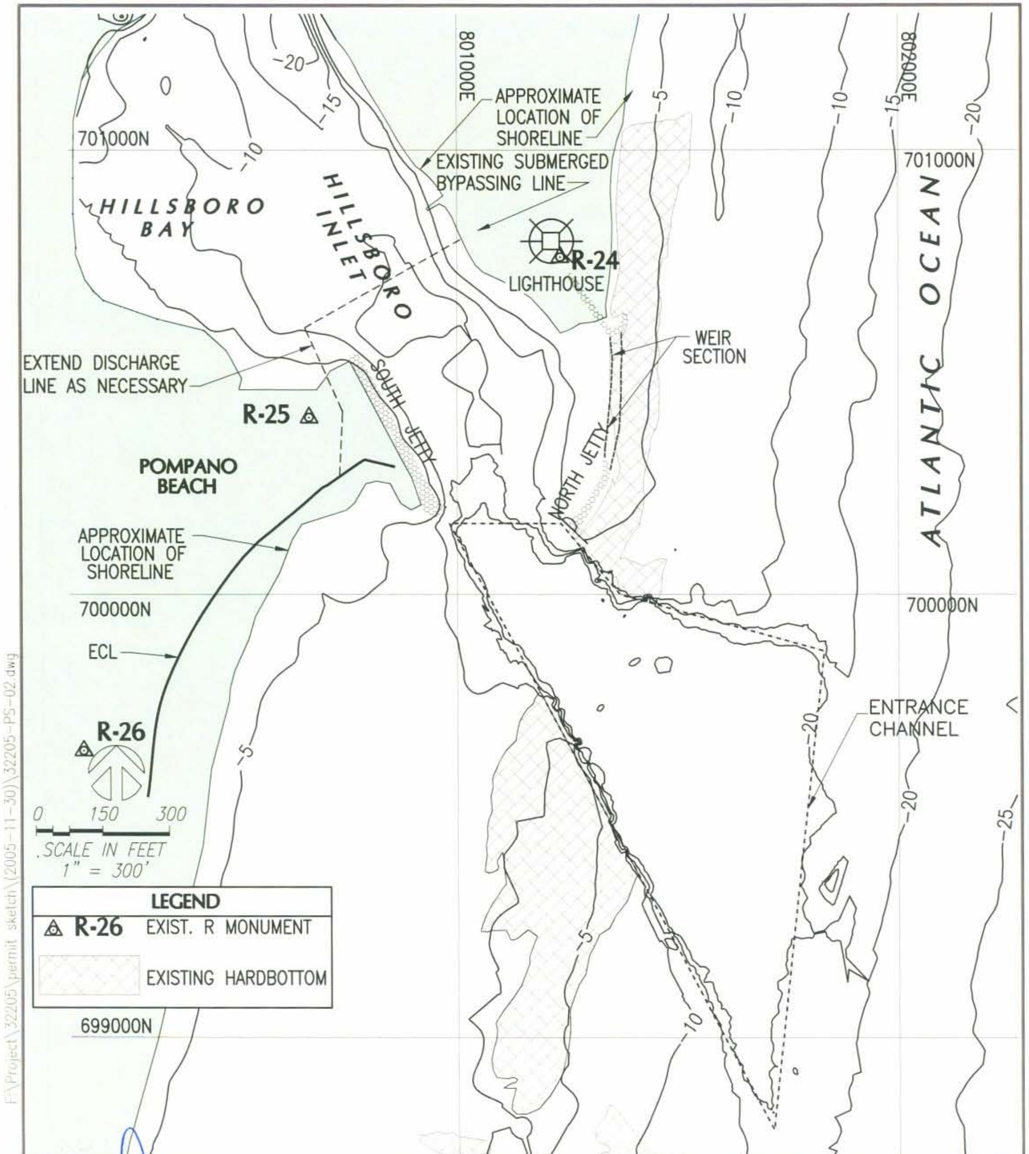
- Difficult inlet with dogleg channel
- Out going current sets boats onto reef to the south
- If weir is blocked, sand ends up in channel
- With 9’ max depth 4 feet of sand makes channel dangerous in any sea conditions

Five Year Plan – Sand Bypassing Issues

- With a major storm if sand trap fills up, sand flows into outer channel
- With the 9' channel essentially full, natural bypassing occurred towards pier – this sand is lost and of no use to anyone

Five Year Plan - Recommendation

- Cut outer rock to 20’
- Straighten channel in fan shape
- Deeper channel reduces standing waves and reduces current
- Fan shape reduces risk of being forced onto reef
- The deeper and wider channel provides a large reservoir for sand deposition to prevent natural bypassing and to reduce urgency of dredging after major storms.



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BLANKENSHIP
RE 55910

JUL 23 2007

HILLSBORO INLET DISTRICT
2861 NE 22nd COURT
POMPANO BEACH, FL 33062

COASTAL SYSTEMS INTERNATIONAL

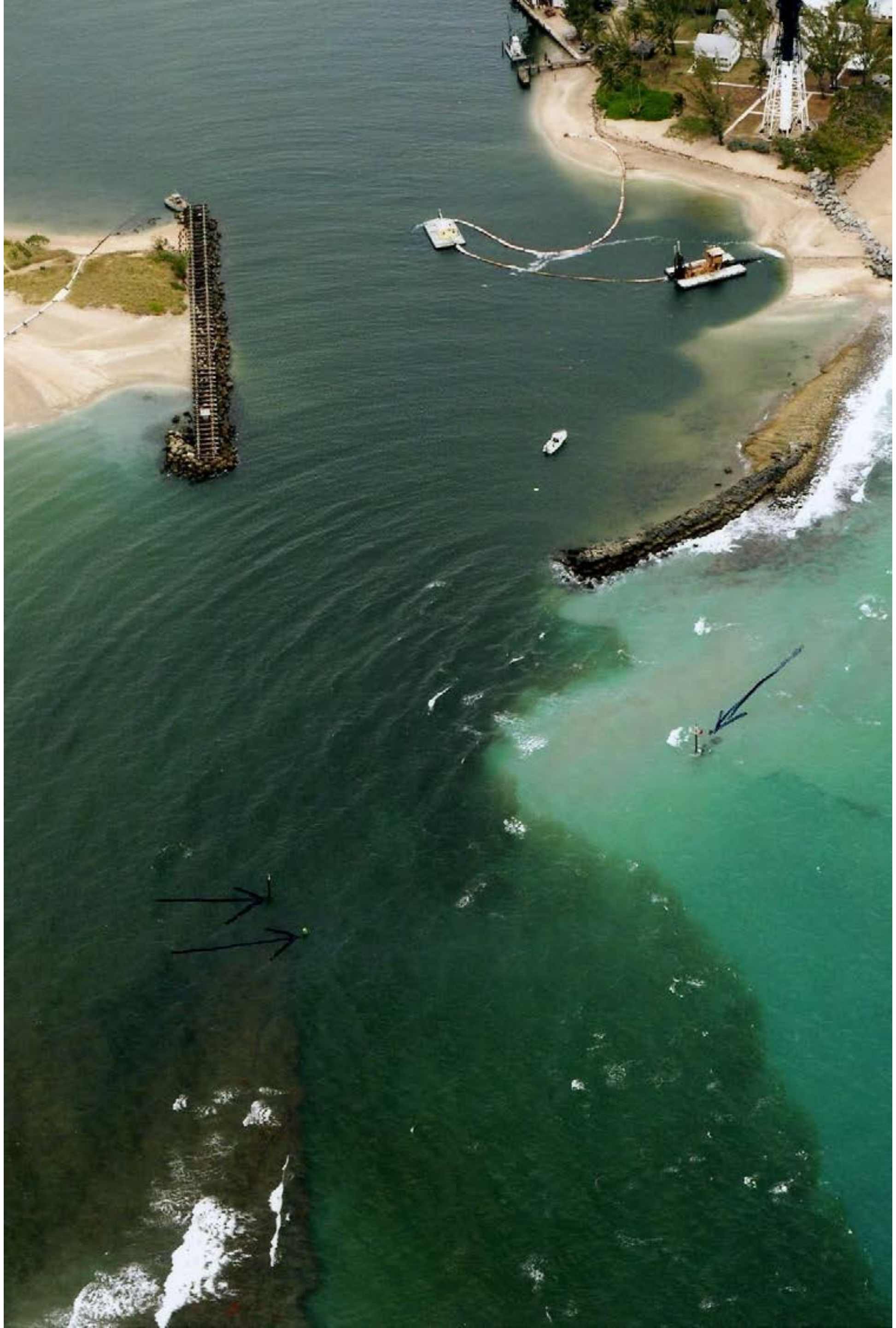
COASTAL SYSTEMS INTERNATIONAL, INC.
464 South Dixie Highway, Coral Gables, Florida 33146
Tel: 305/661-3655 Fax: 305/661-1914 www.CoastalSystemsInt.com
STATE OF FLORIDA EB #7087
Coastal, Environmental, Civil Engineering and Management

HILLSBORO INLET MAINTENANCE DREDGE AND BYPASSING	
EXISTING CONDITIONS	
JOB: 32205	DATE: 11/30/05
BY: MJP/VC	SHEET 2 OF 9

PERMIT # 229394001

Inlet Improvement Project

- 2002 The channel improvement project was implemented by Weeks Dredging for $4 million
- Funding
  - FDEP $1.6 million
  - FIND $1.0 million
  - HID $1.4 million



Hillsboro Inlet District

- 2008 New Ellicott Dragon Series 1070 14/12 Dredge was acquired.
- 2009 An 1.6 acre artificial reef of boulders was constructed south of the inlet as mitigation for removing a portion of the natural reef during channel deepening and widening.
- 2010 The workboats were replaced with two identical custom designed steel boats.

2008 Ellicott Dragon Series 1070 Dredge
76’ x 30’ Pump Eng 800HP Aux Eng 480HP
“Hillsboro Inlet”

2010 Work Boats: “Inlet I & Inlet II”
30’ x 20’ Dual 300HP

Hillsboro inlet District

- Dredging Operation: Captain plus 4 crew
- Dredge has no propulsion: 800 HP Pump and 480 HP for hydraulics
- Work boats either push dredge or set anchors and dredge pulls itself
- Spud down and use swing anchors (set by workboats) to make circular cuts
- Changes spuds to advance to new cut

Hillsboro Inlet District

- With the new 20’ depth and expanded channel we have the capacity to prevent any natural bypassing
- We can have 100% CONTROLLED bypassing
- All sand arriving at inlet is bypassed as soon as possible

Dredging Timing

- There is no scheduled dredging
- All dredging is on-demand as needed
- Can only dredge when sand comes into sand trap and/or channel
- Need to be able to completely remove sand from all areas permitted when ever needed


Hillsboro Bay
Hillsboro Inlet
© 2012 Google

Financials

- HID budget $1 million a year
- All raised from Ad Valorem taxes on real property within our taxing district
- No cost to State or County for 100K cu yds per year being bypassed

Hillsboro Inlet District

- Bypassing Big Picture
  - Natural delivery of sand to bypassing equipment – sand trap or channel
  - 100% bypassing of sand to placement area
  - Natural movement of sand south from placement area.


Hillsboro Bay
Hillsboro Inlet
© 2012 Google

Sandy Aftermath

- When Sandy was off the New Jersey coast, we experienced days of large NE swells
- With the tides higher than we have seen in 20+ years, waves came over the weir and lighthouse jetty

Verification of Bypass System

- Sandy aftermath filled sand trap, covered weir and deposited sand in outer channel
- So far 175k cubic yards have been placed on Pompano Beach
  - 146k from sand trap
  - 29k from outside channel
- No sand was lost to an ebb shoal

Inlet Comparisons

- Hillsboro Inlet
  - Large primary sand trap with deep channel backup
  - No natural bypassing
  - 100% controlled bypassing
  - No contract dredging
  - Natural movement from placement area

- Boca Inlet
  - No sand trap for dredge access
  - Mostly natural bypassing to ebb shoal
  - 40% controlled bypassing by dredge in channel
  - Contract dredging from ebb shoal as needed
  - Ebb shoal placement area partly protected by remaining ebb shoal

Hillsboro Inlet District
September 2017 Budget

	A	B	G
1	**Account #**	**Description**	**Sep-17**
2			**Budget**
3	4010	Estimate to be raised by taxes (DR-420)	**1,412,496**
4	4610	Interest on savings	1,000
5		**Total Income**	1,413,496
6	4970	Commissions - Tax Collector	28,250
7	4980	Discounts - Early tax payment	49,437
8		**Net Total Deductions**	77,687
9	4995	Gain/Loss on Investments	0
10	4990	**NET FUNDS AVAILABLE**	**1,335,809**
11			
12		**Expenses**	
13	5010	Elbow Barge Expenses (Reserves)	0
14	5020	Dredge Hauling (Reserves)	0
15	5030	Dredge Hose & Mooring	25,000
16	5040	Workboat Hauling (Reserves)	0
17	5050	Electric	2,000
18	5055	Engineering Services	70,000
19	5060	Fuel and lubricants	37,000
20	5065	Hospitalization Insurance	233,200
21	5069	Liability Insurance	30,000
22	5080	Miscellaneous Expenses	20,000
23	5085	Payroll - Labor	462,000
24	5087	Rent - Storage	9,000
25	5090	Repairs & Materials - Dredge	15,000
26	5110	Repairs & Materials - Workboats	5,000
27	5118	Retirement Plan	34,000
28	5120	Supplies	60,000
29	5125	Taxes - Payroll	38,695
30	5130	Telephone	1,500
31	5137	Project Reserves	95,759
32	5150	Workman's Comp Insurance	38,000
33	5389	**Total Operating Expenses**	**1,176,154**
34			
35			
36	6000	Accounting & Audit	25,000
37	6010	Bank Charges	4,800
38	6030	Commissioners' bonds	450
39	6050	Environmental Compliance	3,000
40	6070	Hull & equipment insurance	40,000
41	6080	Insurance	6,000
42	6100	Legal expenses	50,000
43	6110	Legal notices & advertising	6,000
44	6115	Misc. Administrative Expenses & Dues	2,000
45	6120	Office supplies & postage	2,000
46	6140	Property Appraiser's Budget Share	12,205
47	6600	Travel expenses	4,000
48	6690	Secretarial services	4,200
49	6788	**Total Administrative Expenses**	**159,655**
50		**TOTAL EXPENSES**	**1,335,809**

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/23/2018	**CONTACT**	Mike Grella
TIME	2:40 PM	**REPRESENTING**	Jupiter Inlet District (JID)

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: No comment.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: JID would consider a multi-year contract; however, are uncertain of the associated legal requirements, if any. In terms of efficiency and mobilization/demobilization cost savings, JID and FIND have worked well together on previous joint JID sand trap and FIND ICWW maintenance dredging jobs. Cost and efficiency considerations that needed attention included both the limitations associated with the turtle nesting constraints and the variance (associated with payment volume) between the pre- and post-construction bathymetric surveys.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: In 2004 and 2011, Taylor Engineering evaluated JID's ability to attract additional bids and evaluated the increase in recent dredging costs as it related to the sand trap maintenance needs (both documents are attached). JID did not move forward with a dredge acquisition due to the expenses associated with insurance, maintenance, operation, staff requirements, etc.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

Memo

Date: 3/23/2004

To: Mike Grella

Cc: Ken Craig

From: Edward Albada

RE: Attracting Dredging Contractors to JID Projects

Mike

We have spoken at length with Bill McFetridge, Taylor Engineering's key contact with FIND, and several dredging contractors, regarding various ways to make the JID's contracts more attractive to dredgers. The following are points of their suggestions:

1) The contract should state the owners have secured funding in advance.

2) Unit price contacts are typically more favorable for both the client and the dredging contractor than lump sum contracts. Typically, with a unit price contract the dredging contractor can submit a bid with more confidence that he will receive fair compensation for his work, and the client typically receives a higher quality project. With lump sum contracts, the dredgers do not know how much to bid, as they only have an estimate on the amount targeted for dredging. Their willingness to perform the work would increase if they know that they would receive payment for the amount dredged. As a side note, dredgers with unit price contracts tend to pay more attention to the dredge template. This attention to detail results from language common to unit price contracts — most contracts offer intermittent payment on the volume removed to date and no payment for material removed from outside the design template. The dredgers must make regular intermittent surveys to keep track of the volume removed. This gives both the dredger and the engineer a chance to monitor the dredging process, and to make minor modifications as necessary (i.e., to steer away from seagrasses, etc.) to ensure the dredger follows the template. With lump sum contracts, however, the dredgers tend to dredge everything within limits without performing regular survey checks, because they are more concerned at finishing the work quickly by dredging to the specified depth than in the volume dredged.

3) Dredgers should receive a pre-construction survey conducted as close to the dredging start date as possible. The survey should be detailed enough to provide an accurate dredge volume. The survey should include a zone outside the dredge template. The Contractor must be required to clear the required template, but should also be compensated for additional material removed

(provided the additional material is inside the established dredging limits) to fairly account for slumping and normal sediment redistribution during the course of dredging.

4) Advertising for dredging projects in the Dodge Report or DemandStar may result in more bids. Publishers of these reports secure a copy of drawings and specifications at “reading rooms” throughout the country. Contractors can review the plans, along with all other dredging projects, at their leisure. The common reading room allows contractors to schedule their dredgers for various projects in the same location and reduce mobilization/demobilization costs. The Dodge Report will also digitize the plans and specifications and send them to interested companies. In addition, Taylor Engineering can notify in advance specific dredging companies that we know can perform the work to attract their attention. A list of possible dredging companies that may be interested in the project are:

    i. Lake Michigan Contractors, Holland, MI
    ii. McGraw-Hill Construction Dodge, Jacksonville, FL
    iii. Great Lakes Dredge & Dock Company, Oak Brook, IL
    iv. Weeks Marine, Covington, LA
    v. Southern Dredging Company, Johns Island, SC
    vi. Southwind Construction, Evansville, IN
    vii. Shoreline Foundation, Pembroke Park, FL
    viii. Dredge America, Kansas City, MO
    ix. Norfolk Dredging, Chesapeake, VI

5) Most dredgers we talked to were not in favor of a multi-year contract. The dredging work is scattered around the eastern seaboard, and dredgers are unwilling to commit to a relatively small job at a fixed location that may require substantial mobilization costs. It is very unlikely that the JID receive reasonable bid estimates for a multi-year contract, as dredgers would tend to bid conservatively to account for indeterminate mobilization costs.

6) Advance preparation will maximize the project’s bidding time. A longer bidding time will allow dredgers more flexibility to consider the job to fit their schedules. Typically, bidding times have run for at least a month. The following 2004/2005 Sand Trap schedule (in reverse chronological order) will ensure at least two months (68 days) bidding times:

Date	Action	Time Interval
End of Year	Annual Report to FDEP (FDEP p11 #8j, p12 #8l, p12 #8m, p13 #8n)	
End day + 90	Engineer Report to FDEP (FDEP p16 #2c, p7 #5)	
End day + 60	Report of action implemented to South Florida Ecological Services Field Office (F&W, p.23, #10)	
End day + 30	Statement of Completion to FDEP (FDEP p4 #11)	
04/30/05	Last day of turtle-restricted dredging	
04/01/05	Last day of turtle-restriction free dredging	
02/20/05	Start dredging	40 days to dredge
02/18/05	Statement of Construction Commencement to FDEP (FDEP p4 #9)	2 days to start dredging
02/06/05	Pre-construction conference (FDEP p8 #4)	14 days to start dredging
01/30/05	Schedule Pre-construction conference (FDEP p8 #4)	7 days to pre-con conference

01/21/05	Meeting with Fish & Wildlife (F&W, p23 #7)	30 days to start dredging
01/11/05	Schedule Meeting with Fish & Wildlife (F&W, p23 #7)	10 days to Fish & Wildlife meeting
01/16/05	Bid review and bid award	7 days after bid opening
01/09/05	Bid Opening	28 days to Pre-con conference
11/08/04	Submit permit review request to FDEP (FDEP p5 #2)	90 days to Pre-con conference
	Advertise for Job	68 days to bid opening
10/25/04	Start preparation of project documents	14 days to submit permit review request, advertise
10/11/04	Notify Lidberg to survey trap	14 days to start project docs

Given the above, the JID can do little to attract more bids for a variety of reasons:

- First, for the sand trap dredging, few dredgers left in the business can do the work specified. The smaller dredgers lack the equipment, and the larger dredgers show little interest in such a small job. The sand trap project attracted eleven companies to request project packages, but only two submitted bids. This compares to the smaller Loxahatchee dredging project, where four out of ten companies submitted bids.

- Second, insurance costs and a lack of experienced personnel have resulted in a decline in the number of active dredging companies.

- Third, although the remaining dredgers compete, they communicate with each other, so they know which dredge is in the area at which time. Having the advantage of a dredge in the area significantly reduces the mob/demob costs and ultimately the final bid cost. Given a dredge in the area, the competition may not waste time preparing a bid that would probably not compete with the company with a local presence.

  As a word of note, Lake Michigan Contractors reports that had their dredge not been in the area, the bid may have been for as much as $500,000. Southwind stated the last time they were awarded the job, they had also been awarded the FIND Intracoastal maintenance-dredging project that Lake Michigan is performing now. Preliminary research into other South Florida regional dredging projects may allow the JID to take advantage of dredgers in the area to schedule projects at a more opportune time.

Typical unit cost for a project the size of the sand trap excluding mobilization/demobilization ranges from $3.50 to $5.00 per cubic yard. Total project costs range from $5.00 to $6.50 per cubic yard. A total cost above $8.00 per cubic yard should be questioned. Lake Michigan Contractors dredged 66,000 cubic yards and were awarded $328,000, for a unit cost of $4.97. Had their bid been $500,000, their unit costs rises to $7.58. Southwind Construction Corp. bid $1,099,470 for a unit cost of $16.66. Of course, verbiage in the bid documents states that the JID can refuse all bids due to high costs, and re-advertise the job stating extraordinary bid submittals. This may interest some companies to reconsider the job and submit a bid.

Many of the points addressed above are already in practice. The JID already ensures adequate funding and conducts a survey as close as possible to the project start date. Taylor Engineering ensures the advertising agencies such as the Dodge Report are aware of upcoming projects for bid. Taylor Engineering's recommendation to attract more bids is to switch from a lump sum to a unit cost contract and to assure advance notice directly to specific dredge companies.

Taylor Engineering also researched the economic feasibility of dredge purchase and maintenance for sand trap and Loxahatchee dredging projects. Advantages of dredge ownership include immediate dredge operation at the JID's disposal (without having to follow a bid process), and the possibility of extra revenue made by leasing the dredge out when not in use. Additionally, an operating staff familiar with both the dredge and dredge footprint will limit the potential for accidental dredging (i.e. seagrasses). Disadvantages include the additional liability normally absorbed by private dredgers, and high cost of operation, maintenance, insurance, and staffing.

Based on the assumptions listed below, the twenty-year equivalent annualized unit cost of owning and operating a dredge is slightly higher ($685,000) than the present JID' arrangement of bidding the dredging work to private contractors ($648,000). The assumptions made in this analysis include:

Outsource Dredging Operations:

1 - Inflation is 5% throughout the projection period.
2 - The JID Sand Trap will be dredged annually. The cubic yardage dredged each year will be 65,948 (the average from 1985 to 2002).
3 - The cost of Sand Trap dredging will be estimated at $6.50 per cubic yard. The cost will increase with inflation each year.
4 - River Maintenance dredging will occur every 5 years and will continue at the level dredged in 2003.
5 - The cost of River Maintenance dredging will increase with inflation throughout the projection period and is based on the actual 2003 cost of $136,585.
6 - Net Present Value (NPV) and Equivalent Uniform Annual Cost (EUAC) were calculated using a 10% rate of return.

Owning Dredge:

1 - Inflation is 5% throughout the projection period.
2 - Cost of the dredge is similar to that of the City of Boca Raton.
3 - Life of the dredge is 20 years.
4 - Sand Trap dredging will occur annually. The cubic yardage dredged will be 65,948 and will take 8 weeks to dredge.
5 - River Maintenance dredging will occur annually and will take 6 weeks to dredge.
7 - 2004 dredge maintenance and operating costs are similar to the City of Boca Raton's 2004 operating budget.
8 - Personnel costs, supplies, professional services & other operating expenses will increase with inflation.
9 - Maintenance costs will increase at 5% per year.
10 - The dredge's unutilized time may be contracted out, but no estimate of offsetting revenues is included in this analysis.
11 - Net Present Value (NPV) and Equivalent Uniform Annual Cost (EUAC) were calculated using a 10% rate of return.

Other considerations not included in the analysis are: 1) the possibility of earning extra revenue by leasing the dredge out when inactive, and 2) a contribution from FIND to the purchase of the dredge.

FIND contributed $100,000, or half of the dredge cost to the City of Boca Raton. Including these two considerations, the EUAC shows dredge ownership is slightly more economically attractive than yearly contract bidding. The following table demonstrates this comparison:

	EUAC for Dredge Ownership	EUAC for Outsource Dredging
Without FIND compensation	$685,000	$648,000
With $100,000 FIND compensation	$674,000	$648,000
With $100,000 FIND compensation and $50,000 per year additional revenue	$602,000	$648,000

Finally, Taylor Engineering contacted both the City of Boca Raton and the Hillsboro Inlet District to inquire about a lease agreement to perform the work. Neither party was interested. The chief concern of the proposed work was the time required to mobilize, perform the work, and demobilize back to the corresponding inlet. This may take an excess of a month. As the dredges are paid for and supported by their taxpayers, the districts feel that should anything happen to the dredge or the inlet in the absence of the dredge it would be doing the taxpayers a huge disservice. Other reasons given include the lack of downtime and additional equipment (e.g. dredge pipes) needed for the job.

EA

Increases in Dredging Costs **November 14, 2011**

Through our work with several clients, we have noticed significant increases in dredging costs. Our 10-year review of dredging history for the Intracoastal Waterway, Jupiter Inlet, and Palm Beach Inlet show that these cost have basically doubled. In view of this cost increase, we questioned several dredging companies to help identify causes for this occurrence. Input from these companies, as well as our perception of why these costs have increased, shaped the summary below.

Increased costs associated with environmental compliance, risk avoidance, and equipment (including labor) have had the greatest effect on overall dredging costs.

Environmental:

Environmental compliance costs associated with contracts has increased significantly over the past 10 years. Federal, state, and local permits have placed increasingly stringent environmental conditions on dredging projects.

Permits now require protected species monitors-observers for all in-water and beach work. Labor costs, when added to costs for plant mobilization and demobilization, can total close to $40,000 per month per project.

Additional costs ensue due to requirements to maintain an updated tracking system for dredge location, cutterhead-bucket location, anchor positioning, and seagrass delineation and turbidity monitoring. Further, these requirements slow production, increase labor requirements, and add tremendous inefficiency to dredging operations. Inefficiency leads to increases in downtime and thus increases overall dredging costs.

Risk avoidance:

Risks associated with environmental issues have increased the cost of insurance necessary to cover a dredging company's liability.

The dredging industry has experienced an increase in fines, litigation, and personal injury lawsuits. Insurance costs have increased in step with these actions.

Marine insurance has increased significantly over the past several years. This increase results from the risk associated with environmental issues and the inefficient use of new technologies that currently remain in their development phase.

Clients/owners have placed more risk on dredging companies but have not shared the cost of risk.

Some environmental requirements restrict projects to specific windows of time. As an example, the agencies' preferred time for placing sand on beaches in southeast Florida is November 1st to March 1st. These requirements have placed projects in a riskier period of performance for both operational efficiency and personal safety.

Restricting work to windows of time has also reduced the number of dredging companies that can sustain themselves over longer periods. This reduction has limited the competition for projects and consolidation of some companies. For example, Orion has purchased several smaller companies, and Bean has closed its hopper business.

Equipment:

Fuel costs have increased — anywhere from 70% in the past 2 years to 300% in the past 10 years.

Installing and implementing new technologies has increased requirements for expensive equipment overhauls and training for personnel who will use the new equipment.

Anticipating the improper use of a new technology, as part of the learning curve, dredgers have added expensive contingencies added to the dredging contracts.

Supplies such as wire rope, nuts, bolts, steel products have increased over 100% in the past 10 years.

Cost have increased with the increase in pumping and hauling distances for disposal of dredged material

Repair costs have risen at least 50% over the past 10 years.

Wages and health insurance have increased — anywhere from 30% increase in the past 3 years to 70% in the past 10 years.

Inflation: The decreased value of the dollar over the past 10 years has raised costs.

John F. Adams, P.E.
Senior Advisor
Taylor Engineering, Inc.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/16/2018	**CONTACT**	Carl Blow
TIME	7:00 PM	**REPRESENTING**	On behalf of: St Augustine Port, Waterway, & Beach District

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: No documents.

2. **QUESTION:** The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?

   RESPONSE: St. Augustine Port, Waterway, & Beach District do very small dredging operations which typically includes a small mechanical dredge. They rent a barge and build a box on the barge to dump into. They then offload onto trucks and haul material to fill pits around the county. Brance Diversified does a lot of their work. They have filled geotubes on occasion with the material but not typical.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Not applicable.

4. **QUESTION (CONTRACTORS ONLY):** As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	3/2/2018	**CONTACT**	Chuck Williams
TIME	3:00 PM	**REPRESENTING**	State of Delaware

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: No response.

   QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?

   RESPONSE: No response.

2. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Mr. Williams provided his own notes on his experience as a project manager for the State of Delaware (DNREC). State dredging began in the 1970's with three dredges and a 16-man crew. In the early 1990's things were great; the dredge operated in three shifts from 6 a.m. to 4 p.m. Then, constraints were implemented. The dredge could only operate six months out of the year due to fisheries (summer months). Therefore, we only dredged in winter months. This was difficult due to weather and the safety of our crew. In the late 1990's, the state owned two dredges and personnel issues started (staff retiring, budget cuts) then resulting in a six-man crew. Leading into the early 2000's, more issues with staff due to cooperation efforts. The staff were provided state vehicles to drive to the dredge and did not meet at the dredge at the specified time to start the operation. The staff made it difficult to successfully operate. At present, the State of Delaware has a 10-in Ellicot 370 conventional dredge and an Ellicot Dragon swinging ladder. Overally, Mr. stated the state-owned dredge program is a bad idea – unless you are planning on operation 24/7 – from a personnel and equipment standpoint. In the last 5 years the State of Delaware has contracted Manson and Southwind to dredge.

3. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT A
DOCUMENTATION INTERVIEW FORMS

UNIVERSITIES

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/23/2018	**CONTACT**	Dr. Thomas Wakeman III
TIME	11:40 AM	**REPRESENTING**	Stevens Institute of Technology

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Dr. Wakeman indicated that we should be seeking case studies to better document previous investigations on a similar topic. He recommended that we contact (1) the USACE San Francisco District (Tom Kendall [415-503-6822, Thomas.R.Kendall@usace.army.mil]) for his experience regarding the Santa Cove Harbor project and the USACE New York District (Joe Seebode, 917-790-8209, joseph.j.seebode@usace.army.mil) regarding an unsuccessful bid (due to permitting setbacks) that they had regarding an agitation dredging project.

   Dr. Wakeman indicated that the concern with agitation dredging stems from mobilization of contaminated sediments (if any) and recipients of material downstream. He was aware of an air-bubbler system that was used to keep sediments in suspension at a local area boatyard; however, this type of system would not work on a large-scale basis.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: No comment.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: The USACE San Francisco District should be able to provide comments relevant to this question.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: Will follow up with the USACE San Francisco and New York Districts as necessary.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/26/2018	**CONTACT**	Dr. Robert Randall
TIME	11:30 AM	**REPRESENTING**	Texas A&M University, Ocean Engineering

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: For the expected ICWW conditions, the U.S. Army Corps of Engineers Murden dredge provides the most recent hopper dredge technology in the United States. The shallow draft hopper dredge has a 512-cy capacity and was designed by the U.S. Army Corps of Engineers Marine Design Center in Philadelphia and is based out of Wilmington, North Carolina. The hull depth is 10 ft 9-in and has a draft of around 4 ft 7-in at the stern. In 2000 Dr. Randall completed a study for the Texas Transportation Institute that reviewed alternative dredging and disposal methods for the Gulf Intracoastal Waterway (GIWW). Dr. Randall will provide a copy of the paper (received and attached on 1/29/2018*). Other alternative dredging technologies include agitation dredging and regional sediment management (or Engineering with Nature). Agitation dredging uses equipment (hopper dredge, water injection, vertical mixers, prop-wash, and rakes/drag beams) to disturb the sediment into the upper water column to allow currents to transport the material out of the channel; however, the concern with this approach is where is the sediment going, who else are you impacting. Contacts for additional information on agitation dredging include Rob Thomas (operations) and Edmond Russo (Engineering) at the U. S. Army Corps of Engineers Galveston District. Regional Sediment Management (or Engineering with Nature) involves having a comprehensive understanding of source recognition, sedimentation, high-shoaling rate areas/patterns and applying beneficial use practices such as wetland creation, beach nourishment, etc. Both Todd Bridges and Burton Suedl with U.S. Army Corps of Engineers, Engineering Research and Development Center would be good contacts for additional information on this topic. *Due to the report length, only a small portion of the final report is attached.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Perform a comprehensive study on source recognition and improve Regional Sediment Management approach.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: No comment.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: Follow up with suggested contacts as necessary.

Technical Report Documentation Page

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4. Title and Subtitle
TEXAS GULF INTRACOASTAL WATERWAY (GIWW) DREDGED MATERIAL: BENEFICIAL USES, ESTIMATING COSTS, DISPOSAL ANALYSIS ALTERNATIVES, AND SEPARATION TECHNIQUES

5. Report Date
September 2000

6. Performing Organization Code

7. Author(s)
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Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843-3135

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Research Project Title: Alternative Dredging and Disposal Methods for the Texas Gulf Intracoastal Waterway (GIWW)

16. Abstract
A two-year project, Alternative Dredging and Disposal Methods for the Texas Gulf Intracoastal Waterway, investigates the cost and engineering of long distance pumping, beneficial uses of GIWW-dredged material for the Texas coastal zone, separation techniques for GIWW-dredged material, optimum slurry flow, and alternatives for analyzing dredged material disposal. A cost-estimating program incorporates fuel costs, dredge crew labor costs, routine maintenance and repairs, major repairs, overhead costs, depreciation, profit, mobilization and demobilization, and capital investment cost for a cutter suction dredge. The Cutter Suction Dredge Cost Estimation Program (CSDCEP) estimates the production rate and cost of dredging projects. Comparisons with actual production rate and costs show CSDCEP is accurate. An attractive beneficial use of dredged material from the GIWW is manufactured soil, which can be manufactured using dredged material, recyclable organic waste materials (sewage sludge), and bio-mass (cellulose or saw dust). Researchers estimate the manufacturing and transportation costs at $13 to $20 per cubic yard depending on the blending method, mode of transportation, and ease of excavation. Another beneficial use is thin-layer disposal, spraying dredged material on adjacent wetlands. A geotube filled with dredged material placed along the Texas GIWW could provide a beneficial use while preventing further inundation of wetlands due to erosion. Dewatering wheels and hydrocyclones have been identified as two potential separation techniques. Results from the CD-CORMIX software show that the reduced flow from smaller dredges can reduce turbidity during the dredging process.

17. Key Words
Beneficial Uses of GIWW-Dredged Material, Cost Estimating, Manufactured Soil, Geotube, Thin-Layer Placement, Separation Techniques, Dewatering Wheel, Hydrocyclone, Cutter Suction Dredge, Turbidity Reduction

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TEXAS GULF INTRACOASTAL WATERWAY (GIWW) DREDGED MATERIAL: BENEEFICIAL USES, ESTIMATING COSTS, DISPOSAL ANALYSIS ALTERNATIVES, AND SEPARATION TECHNIQUES

by

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Report 1733-S
Project Number 0-1733
Research Project Title: Alternative Dredging and Disposal Methods for the Texas Gulf Intracoastal Waterway (GIWW)

Sponsored by the
Texas Department of Transportation
In cooperation with the
U.S. Department of Transportation
Federal Highway Administration

September 2000

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation (TxDOT), or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation. The engineer in charge of the project was Dr. Billy L. Edge, P.E., Virginia 21484.

The United States Government and the state of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

ACKNOWLEDGMENTS

This project was funded by TxDOT as project 0-1733 through the Texas Transportation Institute (TTI) at Texas A&M University in College Station, Texas. The TTI project number is 417337. The project director was Mr. Raul Cantu of the Multimodal Operations Division of TxDOT, and his assistance and guidance during the two-year project is very much appreciated. The Federal Highway Administration (FHWA) was also a sponsor of the project. The data provided by Mr. Tim Baumer and Captain Truesdale of the Galveston District and from the Detroit District was invaluable for the completion of the project. Ms. Joyce Hyden and Christa Keiper, Technical Secretaries, in the Ocean Engineering Program of the Civil Engineering Department assisted in the final report preparation. The editing by Ms. Dolores Hott and her staff with the Texas Transportation Institute at Texas A&M University is appreciated.

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation/Symbol	**Definition**
AASHTO	American Association of State Highway and Transportation Officials
ADDAMS	Automated Dredging Disposal Alternatives Management System
AOS	Apparent size opening
ASTM	American Society for Testing and Materials
B	Buoyancy flux
B	$[(\gamma_s / \gamma - 1)\ g\ d^3_{50} / \nu^2]$
B	Horizontal width
b	Geotube flat base length
b_4	Empirical constant = 9.1
BHP	Brake horsepower
BM	Bio-mass
BS	Bio-solids
b_v	Value of x at which V reduces to some specified fraction of V_m
C	Tracer concentration
C	Sediment concentration by volume
C	Sediment concentration by weight
C'_T	Suspended solids concentration at the surface
C_d	Drag coefficient
CDF	Confined disposal facility
CDF	Cumulative distribution function
CDFATE (CD-CORMIX	Model for predicting the dilution and mixing zone of a typical continuous dredge discharge operation
C_m	Tracer concentration on the jet axis (centerline)
CPAR	Construction productivity advancement research program
CRDA	Cooperative research and development agreement
CSDCEP	Cutter suction dredge cost estimating program
C_T	Suspended solids concentration
C_v	Concentration of solids by volume
CZMP	Coastal zone management program
d	Median particle diameter
D	Pipe inside diameter
D	Pump impeller diameter
D	Diameter of a round discharge pipe
D	Pipe diameter
D	Depth from water surface
D	Distance
d_{50}	Grain diameter in mm
DE	Dredge efficiency
Dim	Indicates dimensionless quantity
DM	Dredged material
E	Excavation costs
EPA	Environmental Protection Agency
h	Pump efficiency
f	Friction factor
F_{excav}	Excavation factor
F_L	Coefficient based on the grain size and sediment concentration
$F_{s\text{-}bd}$	Factor of safety for biological degradation
$F_{s\text{-}cd}$	Factor of safety for chemical degradation
$F_{s\text{-}cr}$	Factor of safety for creep

$F_{s\text{-}id}$	Factor of safety for installation damage (1.3)
$F_{s\text{-}ss}$	Factor of safety for seam strength
g	Acceleration due to gravity (32.2 ft/s^2 or 9.81 m/s^2)
gpm, GPM	Gallons per minute
γ	Specific weight of fluid, specific weight of the slurry
γ_s	Specific gravity of the solid
GIWW	Gulf Intracoastal Waterway
H	Total pump head
H	Ambient water depth
h	Height of geotube
H_d	Discharge head
h_m	Minor head losses in pipe
h_o	Depth of discharge pipe below the water surface
H_s	Suction head
Hs	Significant wave height
i	Hydraulic gradient of water
i	Number of times each material is transported
i_f	Hydraulic gradient of the fluid
i_m	Hydraulic gradient of mixture (meters of water per unit of length)
K	Minor loss coefficient
L	Inlet/outlet spacing
L	Geotube circumference
LTFATE	Long-term fate
M	Momentum flux
MS	Manufactured soil
μ	Dynamic viscosity of fluid
n	Fluid kinematic viscosity
NWR	National Wildlife Refuge
ω	Pump speed (radians/s)
P	Pressure
P	Horsepower
P	Dredge production (cy/hr)
p(x)	Hydrostatic pressure at x
PF	Production factor
p_o	Pumping pressure
Q	Volumetric flowrate, discharge, flow rate of slurry
R	Transportation cost in dollars per m^3-km
r(x)	Radius of curvature at x
R_{excav}	Unit excavation cost
ρ_f	Density of fluid
ρ	Density of water
ρ_o	Clear water density
ρ_s	Density of solids
SETTLE	Computer program for design and operation of confined disposal facility
SG_f	Specific gravity of fluid
SG_s	Specific gravity of sediment particle
S_m	Specific gravity of mixture
S_s	Specific gravity of solids
T	Time since disposal in days
T	Total transportation cost
T	Tensile force
q	Angle of discharge pipe with respect to the vertical
TNRCC	Texas Natural Resources and Conservation Commission

T_{ult}	Geotube ultimate tensile strength
TxDOT	Texas Department of Transportation
U, V	Tide velocity
U_a	Uniform ambient current
USACE	U.S. Army Corps of Engineers
UV	Ultraviolet rays
V	Average velocity, mean velocity
V	Volume of material
V_{50}	Mean mixture velocity at which half of the mass of the solids is suspended by the fluid and half by contact with other particles
V_c	Transition velocity
V_f	Fall velocity of soil sediments
V_i	Volume of material
V_m	Mean velocity on the jet centerline
V_{sm}	Maximum velocity at limit of stationary deposition
V_t	Particle settling velocity, terminal velocity
V_{th}	Transition velocity
WES	Waterways Experiment Station
x	Transverse (radial) distance from jet centerline
Y	Mass flux of sediment
z	Elevation
z	Vertical distance along the jet centerline

IMPLEMENTATION RECOMMENDATIONS

1. The newly developed Cutter Suction Dredge Cost Estimating Program (CSDCEP) estimates the dredge production rate and subsequently uses the estimated production rate to evaluate the dredging cost. CSDCEP is capable of determining when booster pumps are needed for long distance pumping and includes the associated costs in its final cost estimate. The CSDCEP is a generalized program that gives an accurate cost estimate as demonstrated by comparison to actual project costs along the GIWW.

2. Converting dredged material to a manufactured soil is technically feasible. Researchers need to perform individual feasibility studies for each site to determine if the dredged material has the properties necessary for producing a high quality manufactured soil. Site selection is paramount in selecting a disposal area where excavation equipment can work. Many disposal areas are located along the coastline, and the Texas Gulf Intracoastal Waterway in particular. Most sites are remote with limited land access.

3. The main issues affecting the feasibility of manufacturing soil include finding a market or use for the converted topsoil, determining the optimum site for the project, deciding which bio-mass should be used and from where it will come, and acquiring the bio-solid or reconditioned sewage sludge. A methodology exists for determining the costs associated with converting dredged material to topsoil. The new methodology and cost analysis has been applied to two potential pilot sites along the Texas GIWW to demonstrate the methodology. The two sites, Matagorda Bay and the Bolivar Peninsula near Galveston Bay, show that manufactured soil for use in construction and landfill projects is feasible with prices ranging from \$17 to \$26 per m^3 (\$13 to \$19.9 per cy) of manufactured soil.

4. Manufactured soil cost of \$17 to \$26 per m^3 (\$13 to \$19.9 per cy) is a function of the blending method, mode of transportation, and ease of excavation. This price is also based on the bio-solid being reconditioned to a Class B level for restricted uses and donated by a sewage treatment facility. A higher cost of \$28 to \$32 per m^3 (\$21.4 to \$24.5 per cy) is necessary if the bio-solids are reconditioned to an unrestricted Class A level. Although manufactured soil is more expensive than typical landfill cover and construction materials, it must be emphasized that the purpose of converting dredged material to topsoil is to reduce the volume of dredged material placed into a disposal area. In addition, the use of dredged material from the disposal site will save costs associated with the purchase of land for new disposal areas.

5. It is recommended that plant-screening tests be performed on the dredged material to evaluate its suitability as a manufactured soil and potential growing capacity. These tests determine the percentages of each material, dredged material, bio-solid, and bio-mass, for optimal plant growth. In addition, the effects of salinity on selected plant types are also determined from the screening test. A small or medium size scale (800 to 8,000 m^3 or 1,046 to 10,464 cy of dredged material) pilot study is recommended to demonstrate viability of the concept.

6. There are several dredging sites along the Texas GIWW where the thin-layer disposal method can be applied. Initial reviews identified Galveston Causeway to Bastrop Bayou, Freeport Harbor to Caney Creek, and San Bernard River to Matagorda Bay as possible dredging locations for thin-layer disposal. For the specific dredging site, the thin-layer disposal width and thickness can be predicted by knowledge of the dredging volume, disposal thickness, and disposal width versus thickness curves.

7. When the thin-layer disposal thickness exceeds the desired thickness limit (currently 15 to 25 cm) for a specific dredging site, then increasing the dredging frequency and changing the dredging time schedule should be considered in order to apply the thin-layer disposal at this location. Current equipment can spray approximately 76.2 m (250 ft) inland and retractable reels and the associated pipe can be used to spray the dredged material further inland. Another possibility is to augment the thin layer disposal with excess dredged material being discharged into the current confined disposal facilities.

8. Experiences with thin-layer disposal have been documented at many sites outside of Texas. Many thin-layer beneficial use projects have been successful and it appears there are opportunities for this relatively new technique to be used for the benefit of the operation of the Texas GIWW. Additional physical and biological investigations are needed to further evaluate the acceptability of thin-layer disposal for the Texas GIWW.

9. It is recommended that researchers conduct pilot studies to determine the effectiveness of long-term dredge material management using geotubes that are filled with dredged material. These pilot studies should be conducted simultaneously with a dredging project and monitored to report the condition of the geotubes and their effectiveness in preventing further erosion along the GIWW. The geotubes for these studies are recommended to be approximately 9.14 m (30 ft) circumference, 152 to 305 m (500 to 1,000 ft) in length, filled directly from a small dredge or branch pipe, and have a minimum scour apron width of 9.14 m (30 ft). It is also recommended that further studies be conducted regarding scour and the width of the scour aprons to maximize the structure's effectiveness against erosion and undercutting.

10. The separation of sands and silts and the dewatering of dredged material can extend the life of a confined disposal facility (CDF) by reducing the volume of disposed material. In addition, separated material like sand can be used for beneficial purposes such as beach renourishment. While many separation techniques are not applicable to the high volumes associated with dredging operations, the dewatering wheel and hydrocyclone have been identified as the most promising dewatering mechanisms for use in conjunction with the disposal of dredged material resulting from maintenance dredging in the Texas GIWW.

11. Recommendations for the optimum discharge operation that reduces turbidity, mixing zone size, and deposits more of the discharged sediment on the bottom are:

    a) The ambient current velocity has an important influence on the dilution process. The smaller the ambient current, the faster the sediment is deposited. So, the disposal site should be chosen in a small ambient current field.

b) The angle between the ambient current direction and the slurry discharge direction must not be greater than 90 degrees. If the angle is greater than 90 degrees, then the jet produces a large tubulence within the ambient water body. The sediment is suspended for a long time in the turbulence, and the diffusion region is much wider.

c) In the same ambient conditions and the same discharge operations, the large dredge always produces higher turbidity (concentration) and a larger mixing zone region than the small size dredge for the same discharge velocity, mean grain size, and slurry concentration.

d) The plume of an above-water surface discharge is always larger than that of a submerged discharge as a result of the influence of turbulence.

e) For the same ambient conditions and the same discharge operations, the plume sizes of slower discharge velocity are always smaller than that of a higher discharge velocity for a specific dredge. Discharging at a velocity just above the critical velocity for heterogeneous flow is the recommended operational procedure for the purpose of reducing mixing region size.

f) The lowest centerline concentration of suspended sediment occurs at the lowest discharge velocity, so a small dredge is more desirable in the same dredging condition for small plume size and lowest concentration.

g) The plume size of a more submerged vertical downward discharge is always smaller than that of above water disharge, 45 degree downward submerged discharge, and submerged horizontal discharge.

12. The numerical model LTFATE is used for estimating the long-term response of a dredged material disposal site to local environmental forces such as waves, currents, and tides over a period of time on the order of months to years. A database of environmental forces is required to provide a means of defining realistic boundary conditions at a proposed or existing disposal site. Additional work is needed to get the database of environmental forces (tides, waves, and currents) for a specific disposal site in the vicinity of the GIWW. It is recommended that a first time user obtain assistance from the Corps of Engineers or the authors of this report.

13. SETTLE is another numerical model that facilitates proper dredged material management by providing an effective and efficient means of performing CDF design calculations. SETTLE is relatively easy to use and encourages the evaluation of an array of design alternatives. It does not, however, preclude the need for laboratory settling tests on the dredged material to be placed in the CDF.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/26/2018	**CONTACT**	Dr. Donald Hays
TIME	12:00 PM	**REPRESENTING**	University of Nevada, Las Vegas

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: There have been many new ideas and testing of advances in hydraulic and mechanical dredging equipment with no remarkable advantages. The dredging business is extremely competitive, and contractors are always looking to get the leading edge. Wide-spread change is not likely. Specific to agitation dredging, conditions (high flow, deep channel) need to be just right to work most efficiently and this type of dredging is not supported on a broad basis.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Multi-year contracts could work very successfully with qualifications-based contractors. Could consider providing contract for a fixed volume and/or multi-year level. However, beneficial use — combining dredging and sediment management — may be the best scenario to match beneficial use project to achieve maximum environmental credit and save on mobilization/demobilization costs. Match dredging effort with maintenance / perform advance maintenance dredging / deepen areas with higher dredging frequency.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Advantages: managing own equipment, increased number of projects; Disadvantages: decreased flexibility. Recommended documenting historical dredging history and sending to a dredge manufacturer (Ellicot and/or Dredge & Supply) to get a recommendation on the type and size of dredge for the ICWW.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: Complete dredging history and follow up with Ellicot and/or Dredge & Supply to obtain dredge recommendation specific to ICWW needs.

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT A
DOCUMENTATION INTERVIEW FORMS

DREDGING CONTRACTORS

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/7/2018	**CONTACT**	Bill Hussin, Stephen Tobin, Frank Belesimo
TIME	11:00 AM	**REPRESENTING**	Jay Cashman

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: The dredging industry is very competitive and, given enough flexibility in the contract and permit documents, dredging contractors are employing innovative technologies to reduce cost and ultimately win the job.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Increased permitting flexibility (do not include specific dredge types) would drive contractor innovations and lower costs. Recommended alternative bidding to achieve the lowest price that is technically feasible. Low turnaround time for selection preferred – so contractors can know the result to better gauge other/future work. Request for Qualifications for Broward ICWW project worked fine and is very common in the industry. Cashman currently has a multi-year contract with the New York and New Jersey Port Authority. They have 30 days to respond to the initial request and are guaranteed a minimum level of work per year. They are paid by volume and for each mob/demob.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: No comment.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Increased permitting flexibility, equipment availability (Cashman does not own a hydraulic dredge), project size (must be of sufficient size and complexity),

---

MILESTONE: Follow up with New York/New Jersey Port Authority (Omar Choukeir, P.E.; 212-435-4269; ochoukeir@panynj.gov) for additional contract details on multi-year contract.

FLORIDA INLAND NAVIGATION DISTRICT
DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DATE	2/1/2018	**CONTACT**	Anthony Cavo
TIME	3:30 PM	**REPRESENTING**	Cavache

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Mr. Cavo indicated that there are no new technologies he is aware of. For hydraulic pumping, the technology is the same. The types of methods used to dredge can increase the efficiency of your dredging job. With that said, since dredging technology has reached a plateau, the methods incorporated within the job can increase dredging efficiency. These methods vary due to the project. He stated the best way to ask this question is based on scenarios.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Mr. Cavo stated FIND does not need to change their bidding process. He said Taylor Engineering makes the job easier.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Mr. Cavo indicated that the type of dredge you purchase should be based off the type of projects that will be worked on. The dredge needs to be versatile among each project to be most cost-effective and efficient. For a depth of 12-15 ft deep, a conventional dredge with good floatation from boat wakes and small waves would serve well.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Mr. Cavo stated he is inspired by difficult jobs. He said Cavache enjoys challenging jobs because it makes life exciting.

MILESTONE: Taylor Engineering staff will follow up with Anthony Cavo if a detailed equipment list for FIND's evaluation for a state-owned dredge. If Taylor Engineering staff provides criteria of types of dredging jobs, water depths, and pumping distance, Mr. Cavo will provide an equipment list, personnel, and maintenance information.

CAVACHE Inc.

January 8, 2018

Morgan Smith
Taylor Engineering, Inc.
10151 Deerwood Park Blvd
Bldg 300 Suite 300
Jacksonville, FL 32256
904-731-7040

Subject: Cavache Partial Equipment List

Attn: Morgan Smith

Please see attached partial list for Cavache Dredging Equipment.

Boosters

		Pump Size	Total HP	Impeller Size	Impeller Vane
BP1	C32	16 X 16	1100 HP	40”	4 vane
BP2	Pearce	16 X 16	1000 HP	40 “	4 vane
BP3	ELLICOTT	18 X 18	1000 HP	40”	4 vane
BP4	GIW	16 X 16	1000 HP	40”	3 vane
BP5	Maddox	16 X 16	950 HP	40”	3 Vane
BP6	3512	18 X 18	1800 HP	52”	4 Vane

Dredges

Maya Caelyn	**198’**	**3500 hp**	18” x 16”
Michelle	**114.5’**	**1800 hp**	16” x 16”
Georgia	**90’**	**1300 hp**	16” x 16”
Lil Monica	**58’**	**750 hp**	12” x 12”

Barges
Tender Barge 45
Supply Barge 130
Supply Barge 90
Supply Barge 55

2125 E. Atlantic Blvd. Pompano Beach, FL 33062
Phone: 954-568-0007 Fax: 954-943-8550 Email: info@cavache.com
Website: www.cavache.com

CAVACHE Inc.

Work Boats

Mrs. Stacey	**25.5'**	**950 hp**	Twin
Mrs. Ryanne	**25'**	**350 hp**	Twin
Candice/Lola	**25.5'**	**950 hp**	Twin
Big John	**58.8'**	**2200 hp**	Twin
Florence	**21**	**175 hp**	Single
Skiff	**17'**	**90 hp**	Single
Lil Wes	**21'**	**115 hp**	Single

Land Support Equipment

Cat D-8 Crawler Tractor Dozer
Cat D-6H xl Crawler Tractor Dozer
Cat D-6H LGP Crawler Tractor Dozer
Excavators 345 (1)
Excavators 345 (2)
Excavators 345(3)
Kolbeco 110
LinkBelt 65' reach 240
JD 744 Loader
Komatsu WA 200 Loader
Caterpillar 980H Loader
Fusing Machines 618
Trac star fusing machine 2018
Barge mount Fusing 620

Pipeline

18" SDR 17 HDPE Dredge pipe 24,500 linear foot
20" SDR 13.5 HDPE Dredge Pipe 6,000 linear foot
12" SDR 17 HDPE Dredge Pipe 7,500 linear Foot

Miscellaneous

(3) Hypack/ Dredge Pack Real time positioning systems
(5) Doppler Flow and Velocity Meters

2125 E. Atlantic Blvd. Pompano Beach, FL 33062
Phone: 954-568-0007 Fax: 954-943-8550 Email: info@cavache.com
Website: www.cavache.com

CAVACHE Inc.

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FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/1/2018	**CONTACT**	Bill Hanson, Russ Zimmerman, Stan Ekren
TIME	3:00 PM	**REPRESENTING**	Great Lakes Dredge and Dock

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: No documents. Doesn’t think current dredging technology is an issue since they incorporate state of the art equipment. FIND should consider public/private partnerships. Agitation dredging only good if have deep-water and a good current.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Great Lakes Dredge and Dock mentioned combining or bundling projects together as a way to save on mobilization costs. Suggested holding an industry day, much like the USACE does before projects are advertised, to obtain contractor input that may save time and money and result in a better project.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Thought FIND buying a dredge was a terrible idea. No “one-size fits all” scenario. Different size dredge and different type needed dependent on where you are on the waterway. Have experience with locals buying a dredge thinking they are getting a good deal and results was a maintenance nightmare.

4. **QUESTION (CONTRACTORS ONLY):** As it specifically relates to work in Florida’s Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?

   RESPONSE: Believe they have problems competing with smaller, local companies who are right there and can offer lower mob costs. They do have small cutter suction dredges and provided information on their inland waterway staff and fleet.

MILESTONE: No follow-up required at this time.

DREDGING SERVICES

RIVERS & LAKES DIVISION

GREAT LAKES DREDGE
& DOCK COMPANY, LLC

INTRODUCTION

DREDGING WORLDWIDE

Great Lakes Dredge & Dock Company, LLC (GLDD), is the largest dredging contractor in the United States and a major international competitor. With its foremost commitment being to the safety of its workers, GLDD operates on every domestic coastline and in many foreign countries.

Bringing innovation and high-quality workmanship to its projects, and guarding its reputation for safety consciousness, GLDD serves its customers by studying and anticipating their needs and then responding with appropriate equipment and the finest, best-trained dredging talent in the business.

Dredging generally addresses the creation or restoration of navigable waterways, the construction of maritime infrastructure for international commerce, or the protection, restoration, or reclamation of shoreline land masses through the removal or placement of soil, sand, or rock. The U.S. dredging market generally consists of three types of work: capital projects, beach nourishment and restoration, and maintenance dredging. Since its founding in 1890, GLDD has been a leader and innovator in these markets, with many patents and new technologies to its credit. GLDD is the only U.S. dredging contractor with significant operations overseas.

RIVERS & LAKES DIVISION

The GLDD RIVERS & LAKES DIVISION serves four primary inland dredging markets in the United States:

- Lake & Reservoir Dredging
- Navigation Dredging
- Environmental & Habitat Restoration
- Levee Construction

Details regarding our unique capabilities and project experience can be found on the following pages.

COMPETITIVE STRENGTHS

INNOVATION, ENGINEERING, & EXECUTION

A number of competitive strengths have allowed GLDD to develop and maintain leadership of the industry.

PUBLICLY TRADED COMPANY

NASDAQ-GS: GLDD — with a market cap of $257M and 2016 annual revenue of $768M

VIRTUALLY UNLIMITED BONDING CAPACITY

HIGH-INTENSITY SAFETY PROGRAM

GLDD has adopted a high-intensity approach to safety which promotes and sustains a company-wide culture of Incident and Injury-Free (IIF) job safety performance. Our influence in this area has been felt throughout the industry.

QUALITY & EXPERIENCE

From our beginning in 1890, GLDD has built an outstanding reputation for high-quality project performance and client satisfaction, and we have never failed to complete a project.

UNSURPASSED DREDGING FLEET

Our fleet of over 200 vessels includes the largest hydraulic dredges in the United States. The size, versatility and technical capabilities of our fleet affords GLDD both the flexibility to select the most efficient equipment for a particular job, and the capacity to perform multiple projects simultaneously. To maintain the value and effectiveness of this fleet, GLDD emphasizes preventive maintenance which minimizes downtime, increases reliability and profitability, extends vessel life, and reduces replacement costs.

The GLDD fleet is valued at more than $1 billion. The Rivers & Lakes fleet consists of:

- Seven dredges
- Twelve tugboats
- Seventeen barges
- Twenty pieces of earth moving equipment
- Other support equipment

CUTTING EDGE TECHNOLOGY

GLDD has aggressively introduced new technologies to the dredging business, from bucket and cutter design to hydrographic survey and positioning technologies, and continues to do so.

SPECIALIZED CAPABILITY IN CAPITAL PROJECTS

GLDD is a leader in U.S. capital dredging, a focus that generally requires specialized engineering expertise — unique combinations of equipment and experience — to execute and complete complex projects. GLDD's extensive experience enhances its ability to win and complete these contracts profitably.

PROVEN, EXPERIENCED MANAGEMENT TEAM

Individuals who comprise GLDD's management team have an average of thirty years of experience in the dredging industry. This deep knowledge base provides the company with a significant advantage over the competition.

RIVERS & LAKES CAPABILITIES

GLDD has been in the dredging industry since 1890, and has removed millions of cubic yards of material from lakes and waterways, while creating fish and waterfowl/wildlife habitats throughout the United States. Rivers & Lakes' experienced personnel, and a large and diversified fleet of equipment, makes it an industry leader in the inland waterway market. R&L serves four primary inland dredging markets in the U.S. including:

- Lake & Reservoir Dredging
- Navigation Dredging
- Environmental & Habitat Restoration
- Levee Construction

R&L also boasts state-of-the-art dredging equipment that can operate in shallow drafts making it possible to tackle the most challenging projects.

In 2006, GLDD adopted the Incident- and Injury-Free (IIF) ethic and practice for all of its operations, on all its vessels, at all of its installations, and in all offices. We expect those who work at GLDD to govern their behavior first and foremost for safety. *Personal safety is always the first priority.*

In addition, GLDD takes every opportunity to advocate for safety in our relations with other organizations. We require our subcontractor and vendor personnel to participate in the spirit and specifics of IIF when engaged on projects with us. We are committed to spreading safety consciousness within our industry and throughout the maritime community, raising the spirit of IIF in meetings and making our safety materials freely available.

GREAT LAKES DREDGE & DOCK COMPANY, LLC SAFETY COMMITMENT STATEMENT

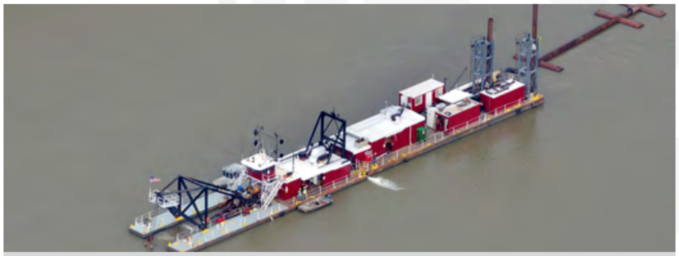
All GLDD employees are committed to an Incident- and Injury-Free (IIF) work environment, in which we return safely to our families every day. In this work environment:

- We care for each other and treat each other with respect and dignity through open and honest communication.
- We work safely because we want to, rather than because we feel we have to.
- We always seek out a safe course in performing our daily operations.
- We take visible and proactive responsibility for our safety and our coworkers' safety, and we will not accept unsafe actions from ourselves or others.
- We stop unsafe actions without fear of repercussion.
- We elevate safety issues that cannot be resolved on our own or with our immediate supervisor to a member of the Safety Leadership Team.
- We continuously develop, improve, and use tools and resources to keep ourselves and one another safe.
- We require all vendors and subcontractors to participate in GLDD's IIF work environment.
- We raise safety awareness as a part of our everyday life at work and at home.

RIVERS & LAKES EQUIPMENT

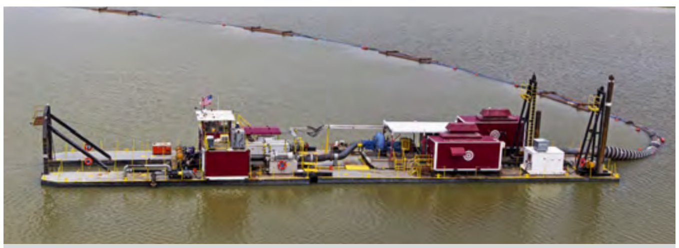
A large portion of the Rivers & Lakes equipment fleet is designed to operate in challenging, shallow draft environments and is portable, allowing it to be deployed into lakes, reservoirs, and non-navigable pools or waterways.

RIVERS & LAKES DREDGING FLEET



DREDGE IOWA
Discharge Diameter: 24 in

DREDGE LW
Discharge Diameter: 20 in



DREDGE LP
Discharge Diameter: 22 in

DREDGE SANDPIPER
Discharge Diameter: 20 in

DREDGE COMMODORE
Discharge Diameter: 16 in

DREDGE CHRIS L
Discharge Diameter: 12 in

DREDGE LAKE LADY
Discharge Diameter:10-12 in

RIVERS & LAKES PROJECT EXPERIENCE

LAKE DECATUR: PHASE II

This project involves the removal of 11 million cubic yards of sediment from Lake Decatur using the 20" Electric CSD "LW", pumping through 50,000 lf of discharge pipeline with 5 boosters to the CDF. In addition, the existing CDF was rebuilt to meet the dredging volumes. Site Construction started June 2014 and completion is anticipated December 2018, a full year ahead of schedule. This project will provide the City of Decatur with an increase of water supply for consumers and will improve recreational opportunities for lake users.

Quantity: 11 million cubic yards

JOHN REDMOND RESERVOIR SEDIMENT REMOVAL

Design Dredge Contract for the State of Kansas Water Office to remove sediment from a federally owned reservoir. Contract included design and construction of confined placement areas, over 30,000 lf of dredge discharge pipeline, and 6,000 lf of effluent discharge pipeline. Dredging started May 2016 and was completed in October 2016.

Quantity: 3 million cubic yards

MISSISSIPPI, ILLINOIS, KASKASKIA, OHIO, & RED RIVERS

Annual contract for maintenance dredging of sediments from the Mississippi, Illinois, Kaskaskia and Ohio Rivers for the Corps of Engineers, St. Louis District. The cutter suction dredge *America* has performed this annual contract during August-December since the late 1980s. The contract is challenging due to the high marine traffic specifically near Lock and Dam 27 (Chain of Rocks Canal) and St. Louis Harbor.

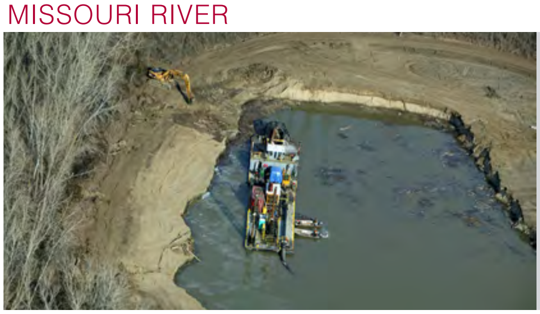
Approximate Annual Quantity: 2 to 3 million cubic yards

DEER ISLAND

This project consisted of excavating material from a two-mile-long stretch of the Missouri River located along the Deer Island State Game Management Area in Iowa. The Rivers and Lakes team executed dredging efforts with the cutter suction dredge *Sandpiper* over a four-year, two-phase construction period. With a projected completion set for mid-summer 2014, this project focuses on creating shallow water habitats along the main channel border of the river.

Quantity: 2.6 million cubic yards

MISSOURI RIVER



The Rivers & Lakes Division acted as a subcontractor and pumped 500,000 cubic yards of sand fill to create a large bird nesting habitat within the Missouri River. The creation of this island at river mile 777 and the accompanying backwater fish habitat was the latest in a series of habitat creation projects on the Missouri River.

Quantity: 500,000 cubic yards

RIVERS & LAKES PROJECT EXPERIENCE

LEWIS & CLARK LAKE

The 20-inch dredge *LW* completed a project for the U.S. Army Corps of Engineers, Omaha District which involved dredging sand from the Missouri River in Springfield, South Dakota and constructing a bird habitat island with the dredged material.
Quantity: 1.1 million cubic yards

CRYSTAL LAKE

The Rivers & Lakes team dredged 1.3 million cubic yards from Crystal Lake, located in Hancock County, IA. This project also included removal, replacement and extension of an existing aeration system and incidental work.
Quantity: 1.4 million cubic yards

LAKE TRAFFORD RESTORATION

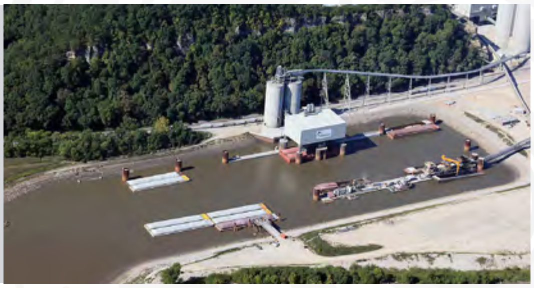
The Rivers & Lakes team dredged approximately 4 million cubic yards of sediment from Lake Trafford located in Immokalee, Florida using the 20-inch dredge *LW.* The project required the dredge material to be pumped 16,000 feet to a confined disposal area.
Quantity: 4 million cubic yards

LAKE WORTH

This project entailed removing approximately 2.2 million cubic yards of material from Lake Worth — located in Fort Worth, Texas — for the purpose of deepening the silted areas of the 100-year old lake to 584 feet above sea level, or a depth of 6 feet when at its lowest level.
Quantity: 2.2 million cubic yards

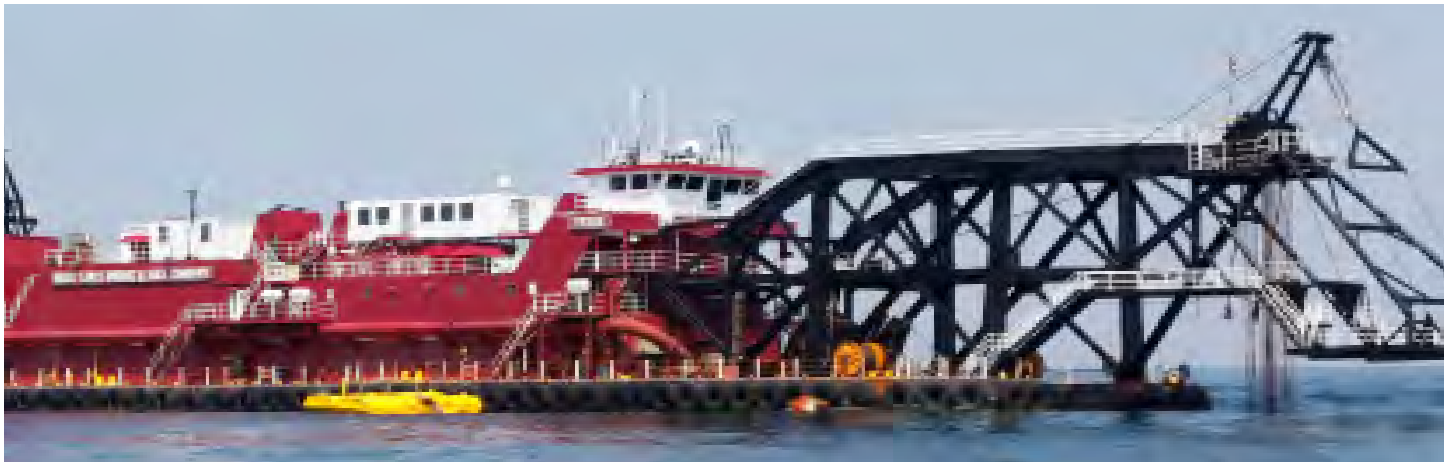
HOLCIM HARBOR CONSTRUCTION DREDGING

The dredge *Sandpiper* excavated 1 million cubic yards of sand and clay used to construct a new barge terminal for Holcim US plant in Bloomsdale, MO. Material removed from the site was pumped 8,000 feet to a man-made containment area located behind a 130-foot-high dam. A 2,000-hp booster was located at the edge of the excavation to pump sand and gravel 5,000 feet south, and then straight up into the confined disposal area. The effluent from the discharge was pumped back to the excavation to help keep the water elevation constant for the dredge.
Quantity: 1 million cubic yards



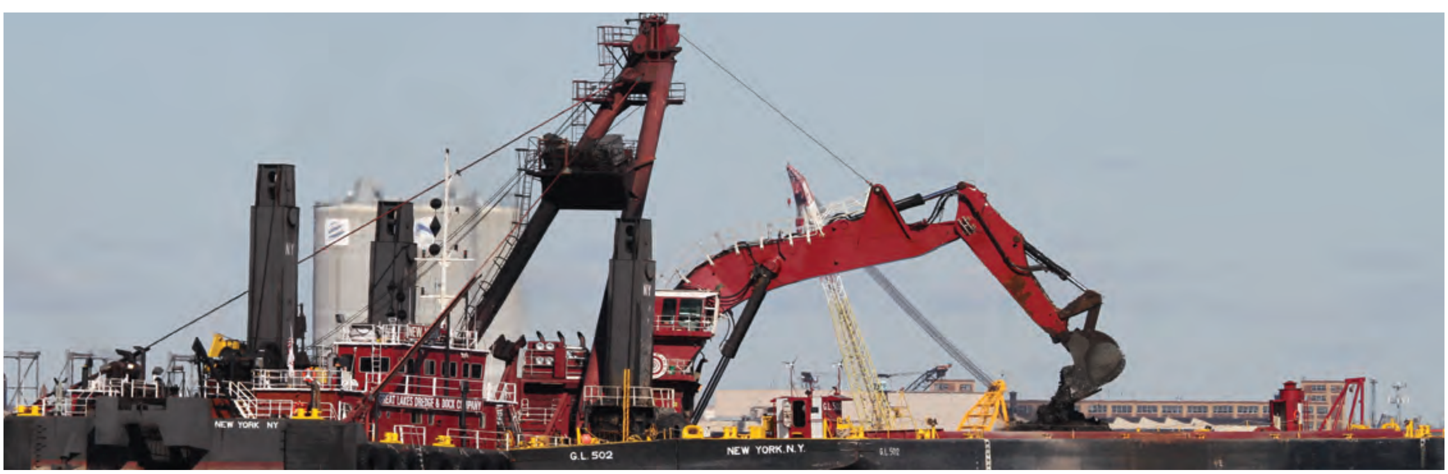
GLDD FLEET & EQUIPMENT

There are three primary types of dredging equipment in the GLDD fleet: cutter suction, trailing suction hopper, and mechanical dredges. These are supported by auxiliary vessels and equipment to prepare material for excavation, transport dredged material, and power the material through hydraulic pipelines.



CUTTER SUCTION DREDGE

TRAILING SUCTION HOPPER DREDGE



MECHANICAL DREDGE

GLDD DREDGING FLEET

TRAILING SUCTION HOPPER DREDGES (6 TOTAL)

Typically self-propelled and having the general appearance of an ocean-going vessel, trailing suction hopper dredges move through the water trailing a long suction arm to the ocean floor. At the end of these arms are dragheads through which material is suctioned from the ocean floor to the vessel above.

CUTTER SUCTION DREDGES (18 TOTAL)

Cutter suction dredges remove material using a revolving cutterhead which gouges into and loosens material on the ocean floor. The loosened material is pumped by the dredge first to the surface, and then through a pipeline to a remote disposal location. These dredges are very powerful and excavate a broad range of materials up to, and including, certain types of rock.

CLAMSHELL (GRAB) DREDGES (4 TOTAL)

A clamshell dredge uses buckets to remove material from the ocean floor. The dredged material is placed by the bucket into material barges for transport to designated disposal areas. Mechanical dredges are capable of removing hard-packed sediments and debris and can work in tight areas, such as along docks or in terminals.

BACKHOE EXCAVATOR DREDGE (1 TOTAL)

Mechanical backhoe dredges are floating platforms that house a heavy duty cycle crane that uses a wire rope suspended bucket to excavate the sea bottom. The dredge locates itself in position during dredging operations by lowering retractable spud poles to the sea bottom. Excavated material is loaded into barges (scows) for transportation by tugs to a disposal area.

DRILLBOATS (2 TOTAL)

Drillboats fragment rock with explosives prior to removal by bucket or cutter suction dredge. GLDD has two state-of-the-art drillboats.

MATERIAL BARGES (19 TOTAL)

GLDD has the largest fleet of material barges in the industry which provides cost advantages when project specifications require disposal of dredged material far offshore, or when controlled disposal is needed.

GLDD PROJECT TYPES

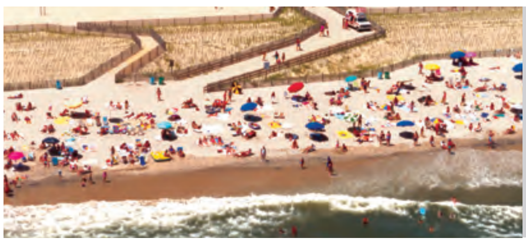
SHORE PROTECTION & BEACH NOURISHMENT

This nourishment project involved placing approximately 4,600,000 cubic yards of sand on a 10-mile stretch of Nags Head beach on the Outer Banks of North Carolina. The Nags Head beachfront was widened by 50 feet to 150 feet with a berm elevation of +6 feet at peak height.
4.6 MILLION CY | TSHD CSD | North Carolina

NAGS HEAD, NC

This nourishment project entailed protecting the Bay Joe Wise shoreline from coastal storms. At project completion, GLDD had increased the width of the barrier shoreline, built-up the back-barrier by about 220 acres, and created an emergent marsh suitable for tidal aquatic habitats.

PASS CHALAND, LA



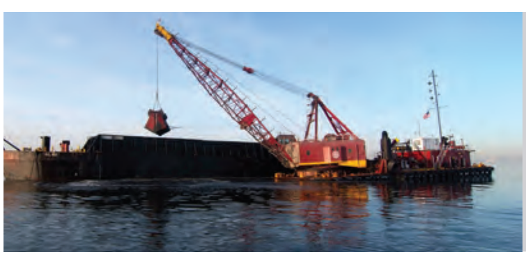
This project entailed renourishment of a 200-ft-wide beach over an 8.3-mile stretch of shoreline in Ocean City, Maryland. Additional operations included construction of a hurricane protection bund complete with pedestrian crossovers and grass plantings to stabilize the dune system.
6 MILLION CY | CSD | Maryland

OCEAN CITY, MD

The GLDD project team dredged approximately 2,000,000 cubic yards of sand and placed the material at 12 discrete locations, nourishing about 40 miles of coastline in San Diego, California. Dredged material was excavated from six separate borrow areas.
2 MILLION CY | TSHD | California

SAN DIEGO COUNTY, CA

MAINTENANCE DREDGING



This project entailed maintenance dredging within the Craighill Angle and the Brewerton Channel Eastern Extension of the Chesapeake Bay. The dredged material was placed in the Sarbanes Ecosystem Restoration Project on Poplar Island in Talbot County, Maryland.
3 MILLION CY | Clamshell | Maryland

BALTIMORE

Maintenance dredging within the channels leading into the Port of New York/New Jersey was executed over eight contracts and multiple phases. Operations required deepening the channels from an original depth of 35 feet to 40 feet, then to 45 feet, and eventually to 50 feet.

PORT OF NEW YORK / NEW JERSEY

GLDD PROJECT TYPES

FOREIGN CAPITAL PROJECTS

Performed over two phases, this project involved the construction of Diyar al Muharraq, an island system located in the Kingdom of Bahrain. GLDD excavated and placed 80,000,000 cubic meters of material to build this island system, which included almost 3,000 acres of reclaimed land.
80 MILLION CY | TSHD CSD | BAHRAIN

DIYAR AL MUHARRAQ

Øresund Fixed Link is a road/railway between Copenhagen, Denmark and Malmö, Sweden. GLDD performed design, dredging and construction works on the tunnel trench, work harbors, navigation and construction channels, compensation areas, and an artificial peninsula and island.
19.5 MILLION CM | DIPPER CLAMSHELL | DENMARK

ØRESUND FIXED LINK

This project was performed to protect and stabilize the shoreline from Keta to Hlorve in the Republic of Ghana, West Africa. Project operations involved creating a much-widened stretch of reclaimed land and constructing a protective revetment and groyne system.
15 MILLION CM | CSD | Republic of Ghana

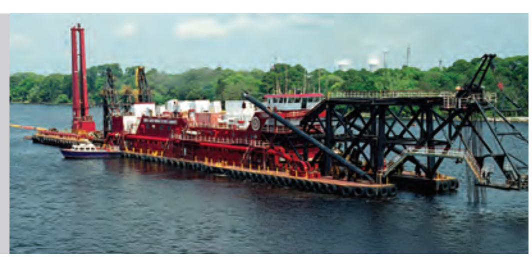
KETA SEA DEFENSE

DOMESTIC CAPITAL PROJECTS

The construction of Pier 400 in Los Angeles Harbor entailed the letting of two contracts, and stretched over a period of five and a half years. In addition to the key factor of partnering, the success of the Pier 400 contract was made possible by the substantial investment made by Great Lakes in rebuilding the cutter suction dredge Florida before putting the dredge to work on the project.
52.5 MILLION CY | TSHD CSD Clamshell | LOS ANGELES

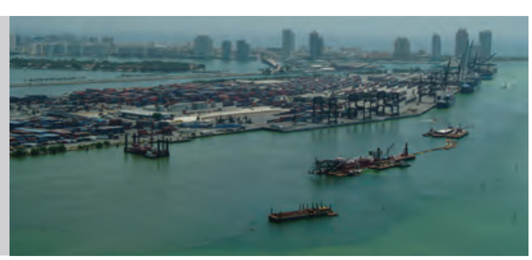
PIER 400

Dredging efforts included deepening the west channel of JAXPORT's Blount Island Marine Terminal from -30 feet to -38 feet. This was the third time in the decade that Great Lakes was awarded the contract for the dredging and expansion of Jacksonville Harbor.
4 MILLION CY | CSD | Florida



JACKSONVILLE HARBOR DEEPENING

Project operations involved removing approximately 1,120,000 cubic yards of material from Fisherman Channel through the Lummus Turning Basin, creating a depth of 42 feet. GLDD employed a wide variety of equipment to successfully complete this project.
1.1 MILLION CY | TSHD CSD CLAMSHELL | Florida



MIAMI HARBOR DEEPENING

A HISTORY OF EXCELLENCE

For over 125 years, Great Lakes Dredge & Dock Company's (GLDD) operations have helped shape the living environment and transportation resources of communities across the world, including the largest cities and ports of the United States. GLDD has played a major role in creating shorelines and waterways through both its dredging and construction activities. Throughout its history, GLDD has grown to be the largest dredging contractor in the United States, and a major international competitor.

EARLY DAYS

Founded in 1890 as the partnership of William A. Lydon and Fred C. Drews, Lydon & Drews' first project was construction of an off-shore tunnel to extend the water intake at Chicago Avenue to a new intake farther out in Lake Michigan. The company experienced tremendous expansion in the 1890s, growing in Chicago and opening satellite operations in virtually every major city on the Great Lakes. Projects at the time included the shoreline structures for Chicago's Columbian Exposition in 1892, including the foundations for what later came to be known as Navy Pier.

In 1905, the company changed its name to Great Lakes Dredge & Dock Company. The company's assets had expanded to include thirteen dredges and ten tugboats. Projects involving dredging, pile-driving, construction of foundations, bridges, breakwaters and lighthouses were completed in Chicago, as well as in such cities as Toledo, Indiana Harbor, and Waukegan, (Illinois). By 1920, Great Lakes was operating in Albany, New York City, Philadelphia, Boston, and other east coast locations. Accordingly, an Atlantic Division was established in the Whitehall Building in downtown Manhattan.

1900 – 1950

Between 1900 and 1950, the company completed a number of significant projects, including:

- A massive water intake tunnel for U.S. Steel's then new Gary (Indiana) works.
- Construction of the Sabin Lock at Sault Ste. Marie.
- Straightening the South Branch of the Chicago River in sections of the city west of the Loop.
- Construction of the Outer Drive Bridge on Lake Shore Drive, the LaSalle Street tunnel, the lower level of Wacker Drive, and the foundations and approaches to the Michigan Avenue Bridge in Chicago.
- Landfill and reclamation in Chicago where the Adler Planetarium, Soldier's Field, Meigs Field and the Field Museum of Natural History stand today, as well as landfill for Lincoln Park, Jackson Park and Chicago's nine-mile shoreline.
- Harbor and breakwater work at Great Lakes Naval Training Station in Waukegan (Illinois).

During World War II, GLDD was awarded the coveted Naval E-Flag for its superior work in construction of the large MacArthur Lock, a facility still in use (and named by the Corps of Engineers as the most reliable lock on the Great Lakes). This vital project, needed to keep iron ore moving freely on the Great Lakes to steel mills for munitions manufacturing, was completed a full year ahead of schedule.

POST- WWII

After the war, GLDD participated in extensive oil-related dredging in the Gulf of Mexico, as well as numerous bridge and other marine construction projects across the country. In the 1970s, the dredging industry experienced a fundamental change, as the Corps' fleet was reduced to a size and configuration considered necessary only for emergencies and national defense, and a robust private dredging sector took its place. GLDD's president at the time, John A. Downs, was instrumental in promoting legislation which ultimately mandated the reduction of the Corps fleet. In 1976, the company began to build its hopper dredge fleet to replace the reduced capacity of the Corps of Engineers. The company expanded its operations into the Middle East, South America, and Africa, and added restoration of storm-eroded beaches to its project resume while continuing with traditional work. This work to protect coastal assets has become a major activity for GLDD.

The Water Resources Development Act of 1986 (the so-called "Deep Ports" legislation) authorized deepening projects in major U.S. ports. This increased activity required GLDD to focus on deploying its equipment in the U.S. market from 1986 to 1992.

INTERNATIONAL EXPANSION

By 1990, it was apparent that the newly authorized projects were not delivering the volume of work proposed, and that contracts would be spread over a longer period of time. This, coupled with a weakening dollar, prompted GLDD to launch a renewed international marketing effort. In 1993, this marketing effort resulted in the award of a $115-million project at Doha, Qatar, followed in succeeding years by other successful projects in the Middle East, Denmark, Spain, Ghana, Egypt, India, Canada, Mexico, Chile, Argentina, Brazil, and the Caribbean. Revenue from the company's worldwide work has approximated twenty percent per annum since 1993.

The domestic market also produced major opportunities during this period, including major port expansions in Los Angeles/Long Beach Harbors and the Port of New York/New Jersey.

OVER 125 YEARS OF EXPERIENCE

GLDD has been involved in a number of unique projects, not only in the United States, but also internationally. We have completed more than seven massive land reclamation projects in the country of Bahrain in the last decade alone, with other notable projects completed in Diyar Al Muharraq (80 million cubic meters), Durrat Al Bahrain (35 million cubic meters), and the construction of the Hidd Construction Terminal (25 million cubic meters).

CORPORATE OWNERSHIP HISTORY

In 1979, Great Lakes International, Inc. (GLI), was incorporated as a holding company for GLDD and other subsidiaries. In November 1985, Itel Corporation purchased GLI through a friendly stock tender offer. Previously, GLI had been traded on the New York Stock Exchange. In October 1991, the company was purchased by Blackstone Dredging Partners LP, an affiliate of Blackstone Capital Partners, and in 1998, Vectura Holding Company, LLC, an affiliate of CitiCorp Venture Capital, purchased the company. In December of 2003, Citicorp sold the company to Madison-Dearborn Partners, a Chicago-based private equity firm. In December 2006, the company merged with a publicly traded subsidiary of Aldabra Acquisitions Corp., thus becoming a new holding company in the name of Great Lakes Dredge & Dock Corporation, traded on the NASDAQ Stock Exchange.

GREAT LAKES DREDGE & DOCK CORPORATION

GREAT LAKES DREDGE & DOCK COMPANY, LLC
WWW.GLDD.COM

GREAT LAKES ENVIRONMENTAL & INFRASTRUCTURE
FOCUSED ON ONE SOLUTION. YOURS.
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INFRASTRUCTURE
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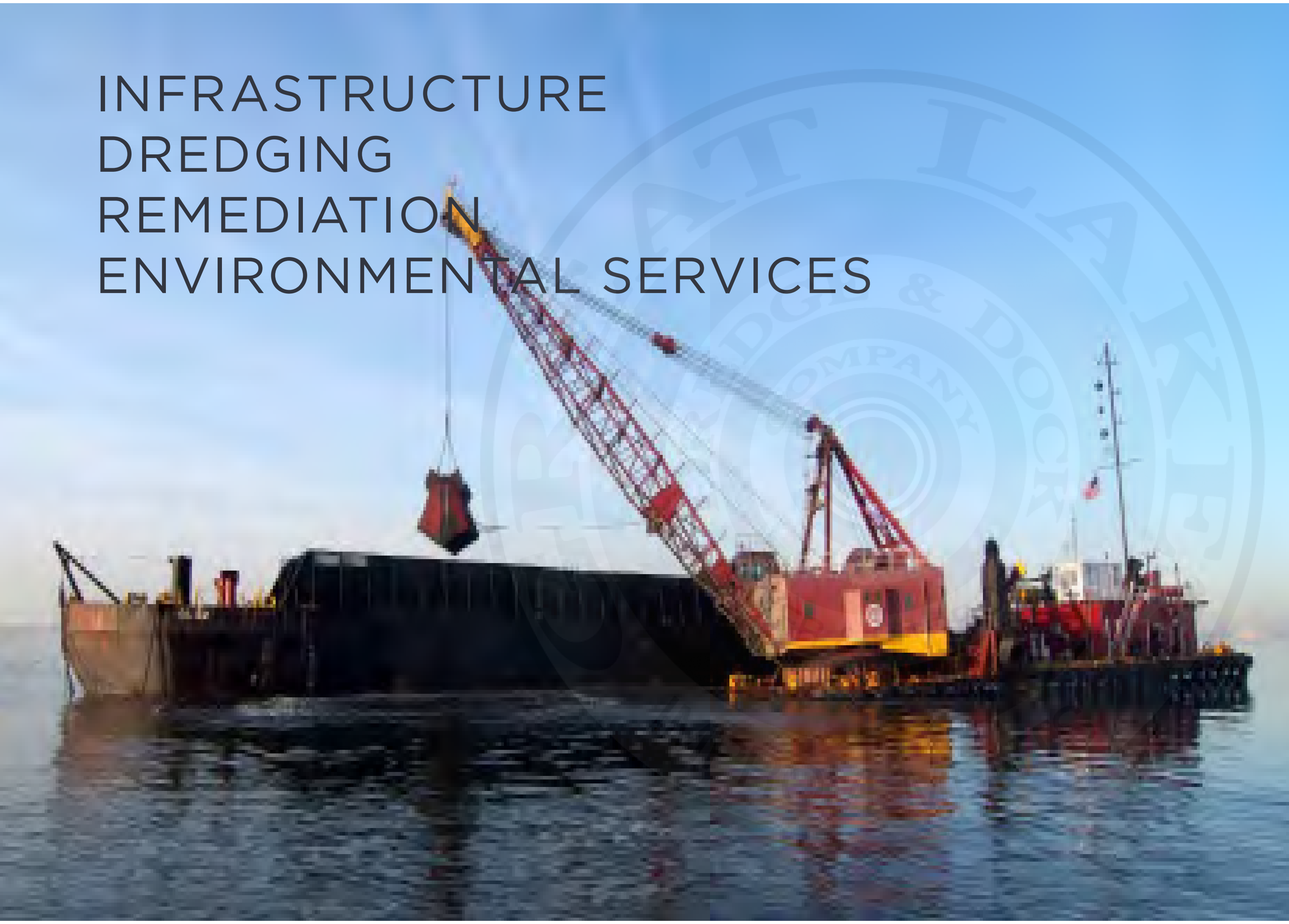


2122 YORK ROAD, OAK BROOK, IL 60523   630.574.3000

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/18/2018	**CONTACT**	Dan Hussin
TIME	11:30 AM	**REPRESENTING**	Manson Dredging

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: No documents. Mr. Hussin requested a follow-up with multiple people from his staff that may have more technical involvement.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Combining or bundling several contracts together as a way to save on mobilization costs.

3. **QUESTION:** Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?

   RESPONSE: Not applicable.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Mr. Hussin was under the belief that all contracts on the ICWW were small business set-asides. He found it very interesting and helpful to know that when FIND contracts on its own, there are no restrictions. Small Business only applies to USACE contracts.

MILESTONE: No follow-up required at this time.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/24/2018	**CONTACT**	John Vannoy
TIME	3:00 PM	**REPRESENTING**	Orion Marine Construction

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Mr. Vannoy suggested that he has no knowledge of anything new and innovative upcoming on dredging technology. The only new technology associated with dredging is the means of treating organics coming out of dredged material.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Mr. Vannoy did not recommend any alternative bid or contract methods.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Mr. Vannoy indicated owning your own dredge will have to be looked at as an "as needed basis". For all the construction to function with maintenance, you are creating more salary and administrative management costs which must be dedicated to a specific resource if the dredge is not on a project. He suggested considering a variety of equipment because all projects will not be a "one and done".

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Mr. Vannoy stated that his interest/lack of interest depends on the project. He indicated that FIND provides their DMMA's as a disposal area which makes it easier on the contractor, but sometimes getting to those disposal sites is cumbersome with proper equipment not on hand.

MILESTONE: No follow-up required at this time.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/23/2018	**CONTACT**	Darrell Stewart, Don Siebert
TIME	2:30 PM	**REPRESENTING**	Southwind Co.

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Mr. Stewart is not aware of any new alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. They do not attend the world dredging conferences.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Southwind Co. is satisfied with the procedure that FIND uses now. Mr. Stewart indicated that the bidding method would be more competitive if FIND put a series of contracts out at a time. They are comfortable with the contract methods.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Mr. Siebert stated Southwind Co. uses internal methods to track their costs. He suggested FIND should consider shipyard costs to maintain dredges. Also, other equipment not used on the dredge will need to be accounted for and maintained frequently due to the Intracoastal Waterway being very corrosive. Mr. Steward mentioned utilizations costs need to be analyzed in detail. He said when the dredge is busy, the cost to repair goes up astronomically due to replacing parts. Mr. Siebert indicated once you own your own dredge, you can’t just park it anywhere. Also, you must keep people on it when it is staged in the water. Mr. Siebert recommended investing in a facility if FIND decides to operate their own dredge. He said it is very hard to find employees that are experienced in the dredging industry.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida’s Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Mr. Stewart said Southwind Co. is interested in all work their company can handle. They do not have a lack of interest unless the design is difficult, or the environment isn’t suitable to a certain degree. Southwind has two dredges that can perform work for FIND.

MILESTONE: No follow-up required at this time.

FLORIDA INLAND NAVIGATION DISTRICT
DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DATE	2/8/18	**CONTACT**	Keith Lindsay
TIME	10:00 PM	**REPRESENTING**	Weeks Marine

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Mr. Lindsay indicated there is always innovation methods with in dredging due to competition. As far as actually dredging, he is not aware of anything specific.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Mr. Lindsay stated competitive bids processes work the best for Weeks Marine. He stated the best bid method for the contractor does not constrain or limit the contractor.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: No response.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Mr. Lindsay indicated the question needed to be asked as a job specific question; every job is different.

MILESTONE: No follow-up required at this time.

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT A
DOCUMENTATION INTERVIEW FORMS

DREDGE MANUFACTURERS/TECHNICAL SUPPLIERS

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/9/2018	**CONTACT**	Nick Seghers
TIME	3:00 PM	**REPRESENTING**	Anvil Attachments

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**
   RESPONSE: Mr. Seghers indicated Anvil Attachments was researching the efficiency of greaseless bearings and bushing by using finite element analysis.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**
   RESPONSE: Not applicable.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**
   RESPONSE: Mr. Seghers suggested the question is to broad. He stated that equipment, operation, and maintenance is all dependent on the types of soils being dredged, the dredge capacity, and the size of the bucket.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**
   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	1/23/2018	**CONTACT**	Raymond Bergeron
TIME	10:30 AM	**REPRESENTING**	Cable Arm

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Mr. Bergeron indicated he was not aware of any upcoming research on dredging technologies. He stated dredging efficiency all depends on what project/site you're dredging. Also, he said the most efficient way to dredge mud is to make the bucket width wider than the open length.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Not applicable.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Mr. Bergeron stated multiple dredges would need to be owned because one dredge could not complete all the areas in the Florida Intracoastal Waterway. The advantages would be the flexibility of owning a dredge and the cost of the project would be controlled.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: No follow-up required at this time.

ENVIRONMENTAL CLAMSHELL

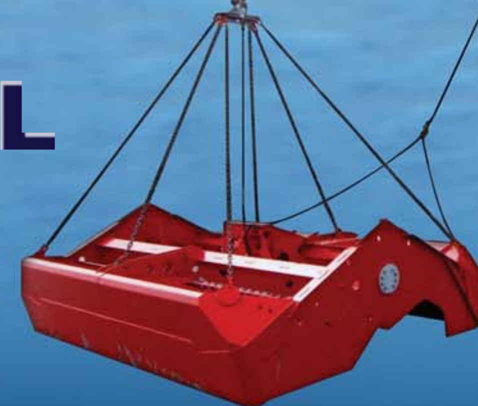
Sloping Profile

Allows for angled, lateral movement along an inclined bottom. Previously, over dredging in "steps" were required. These steps are then often filled in with capping material.

Oversized, Over-Square Footprint

Width greater than opened length minimizes outward windrowing flow of material during bucket closure. Footprint determines size of cut. A larger footprint size is designed for shallow face dredging.

(up to 100 m²)



Lightweight

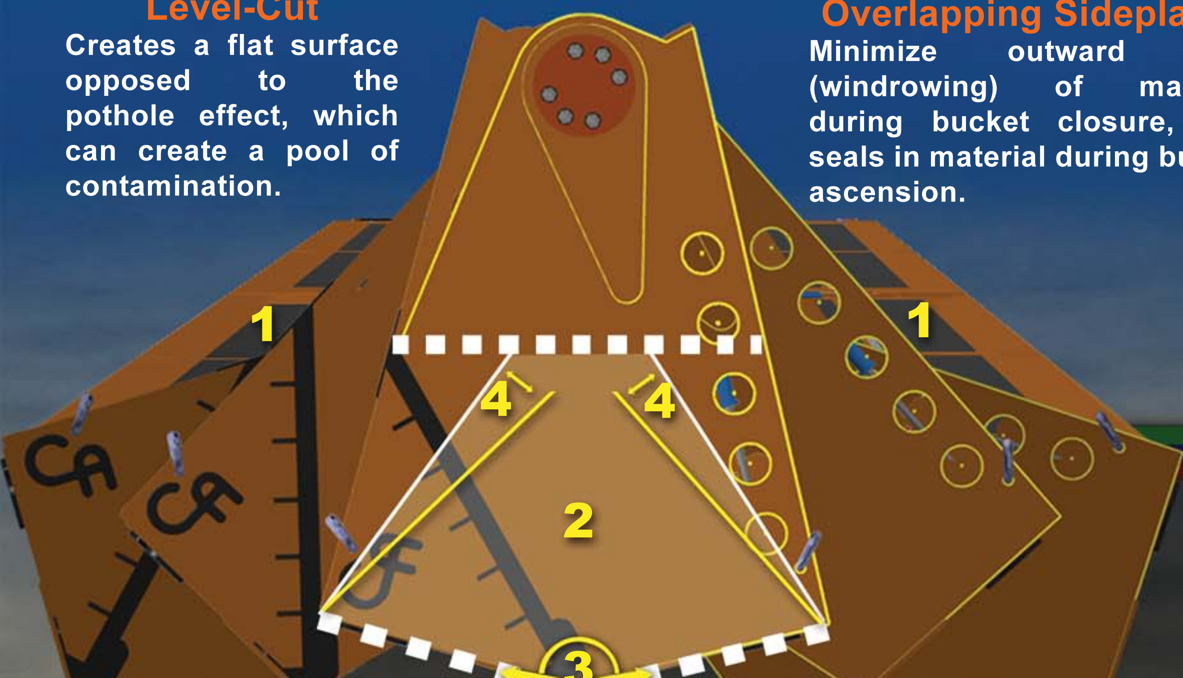
Eliminates the processing of hard, uncontaminated sediment.

Level-Cut

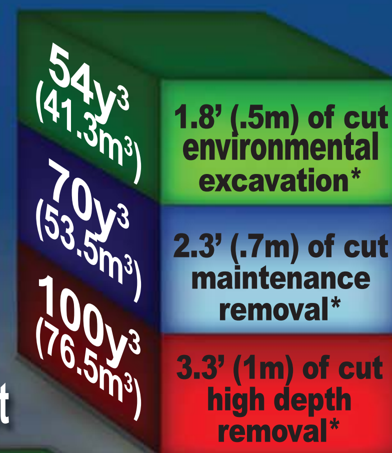
Creates a flat surface opposed to the pothole effect, which can create a pool of contamination.

Overlapping Sideplates

Minimize outward flow (windrowing) of material during bucket closure, and seals in material during bucket ascension.



Depth of cut
& adjustable
top screen plate
changes volume
to reduce free water content



*dredging operation examples

816 ft² (75m²) footprint

1 Venting System with open center decreases downward pressure during bucket descension, and seals in material during bucket ascension.

2 Center of Mass of material is located below the center of the bucket's containment area, minimizing material washout during bucket closing and ascension.

3 150° Cutting Edge allows the bucket to "scoop" material, which lowers the material's center of mass within the containment area.

4 Adjustable side screen plate determines depth of cut.

Environmental Precision Level-Cut Profiling Hydraulic Clamshell with T-LINK Closing Mechanism

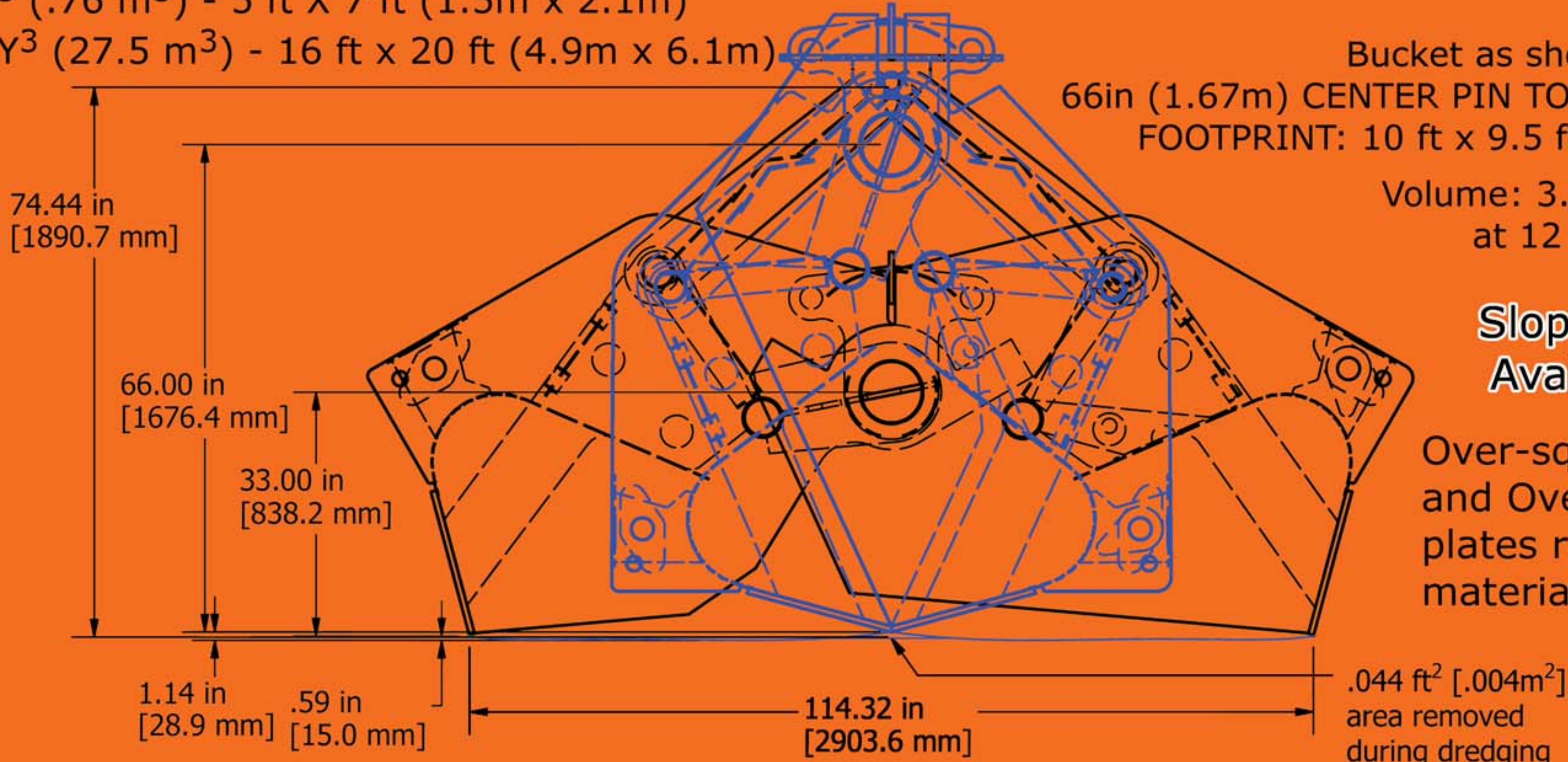
Available sizes:

1 Y^3 (.76 m^3) - 5 ft X 7 ft (1.5m x 2.1m)

36 Y^3 (27.5 m^3) - 16 ft x 20 ft (4.9m x 6.1m)

Bucket as shown: open/close
66in (1.67m) CENTER PIN TO CUTTING EDGE
FOOTPRINT: 10 ft x 9.5 ft (3.1m x 2.9m)

Volume: 3.5 Y^3 (2.67 m^3)
at 12 in (0.3m) of cut

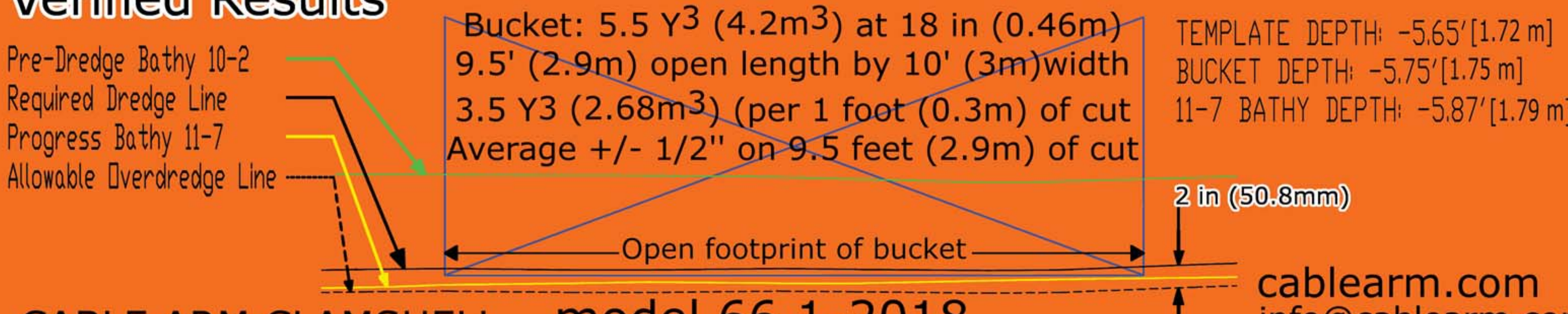


Sloping Profile Available

Over-square footprint and Overlapping side plates reduce dredge material windrowing

PATENTED
PATENT PENDING

Verified Results



CABLE ARM CLAMSHELL model 66 1-2018

cablearm.com
info@cablearm.com

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	3/2/2018	**CONTACT**	Jacob H. Jensen
TIME	7:00 AM	**REPRESENTING**	DHI Group

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: DHI provided a list of studies regarding the optimization and efficiency increase for dumping and hydraulic or mechanical dredging.

   - Ship-induced Channel Agitation and Resuspension. One completed project and one project which is ongoing and requiring a pilot project partner to test the idea.
   - Pre-design of Agitation dredging program for a big navigation channel using rakes pulled by tugs.
   - Jensen, J.H. and Saremi, S., 2014. Overflow concentration and sedimentation in hoppers. *Journal of Waterway, Port, Coastal, and Ocean Engineering*, *140*(6), p.04014023. Analytical model developed for calculation of the sedimentation and overflow in the hoppers, based on the dredged material type, dredging rate and the hopper dimensions. It can be used as an optimization tool for reduction of sediment losses during dredging, and sorting of dredged sediments.
   - Self-closing sheet for encapsulating and dumping a bulk of material. (Patented innovation at DTU by Jacob, J.H). For dumping of sediment spoils: A sheet to be placed in relation to a split barge for encapsulating a bulk of material to be dumped. It increases the efficiency of sediment dumping in terms of location, time and reduction of sediment loss dispersion.
   - GUIDE BLADE FOR AN OVERFLOW STRUCTURE TO BE PLACED ON A VESSEL. (Patented innovation at DTU by Jacob, J.H). The invention relates to an overflow system comprising one or more guide blades and an overflow structure.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Not applicable.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Not applicable.

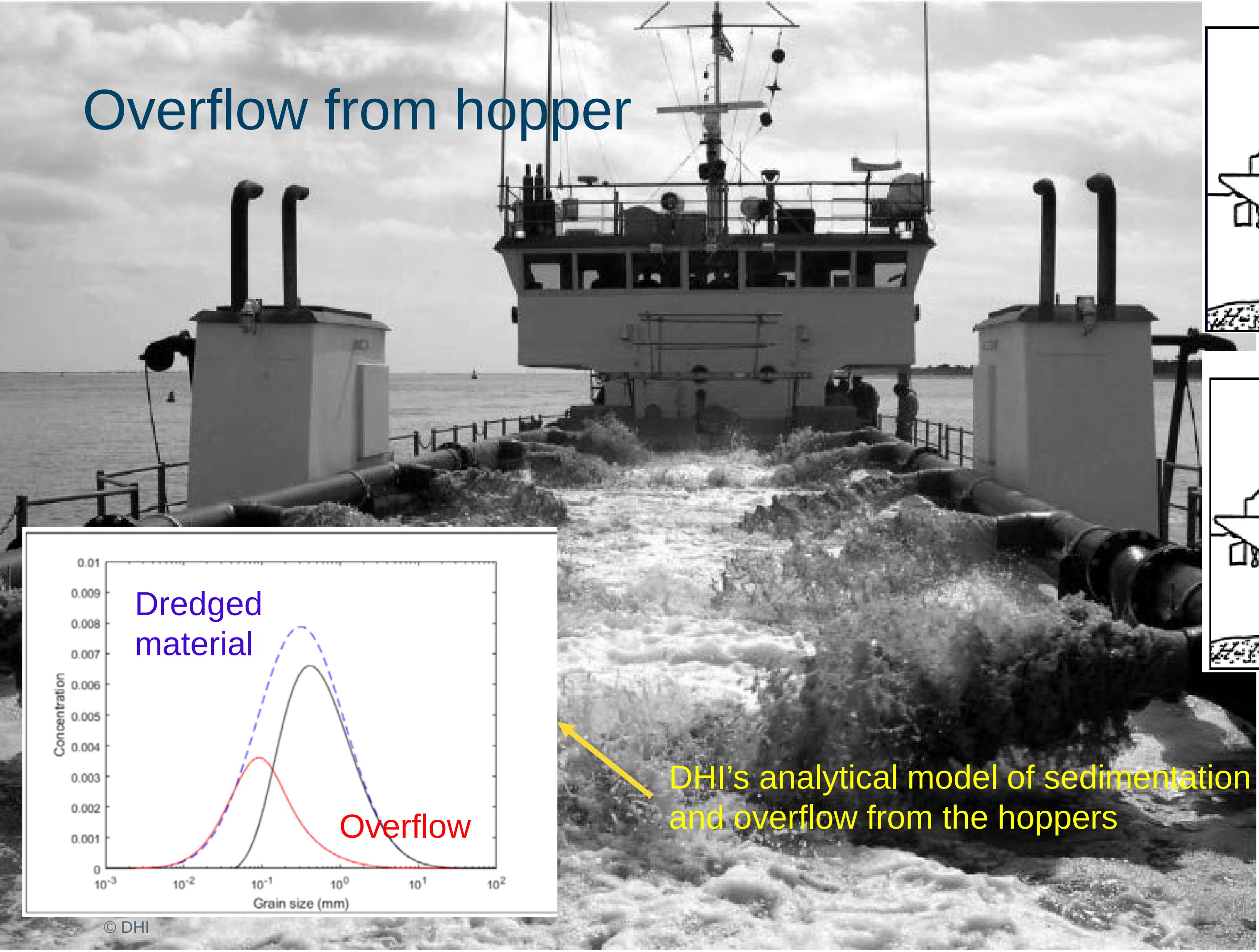
4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

MILESTONE: Mr. Henson will provide a presentation on dredging and sediment spill modeling.

Dredging and sediment spill modelling

Overflow from hopper



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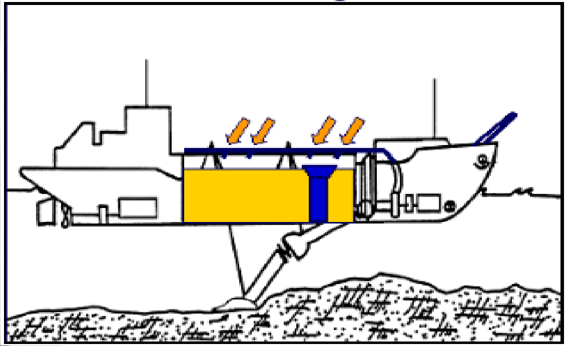
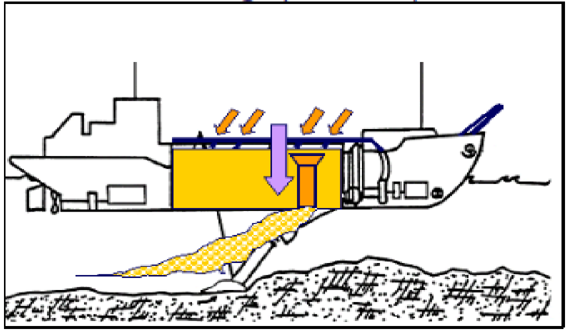
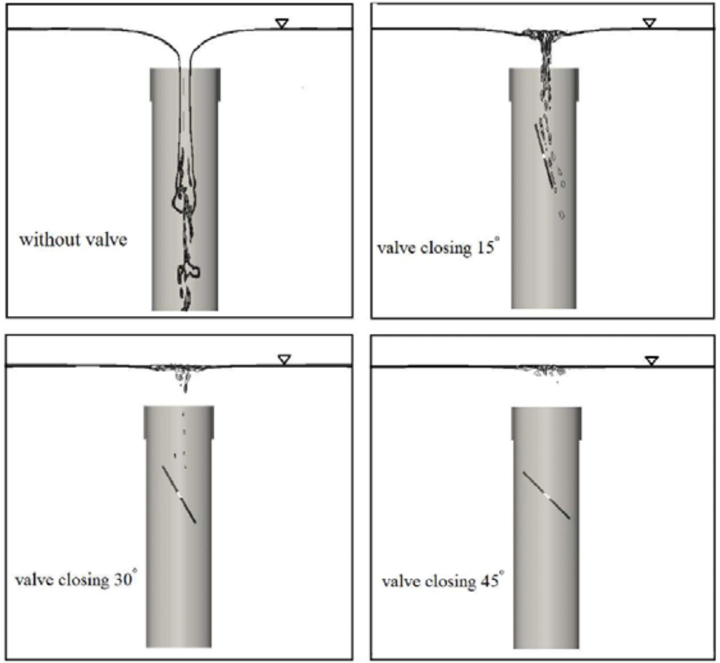


Loading (overflow)

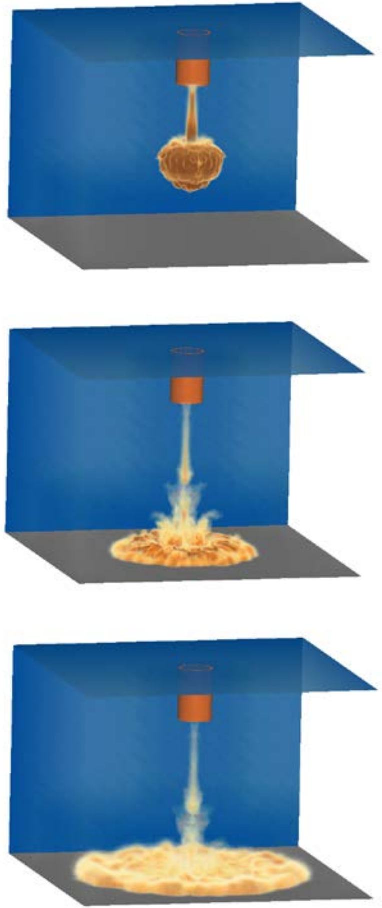


Design of overflow to minimize air entrainment



DHI's CFD modelling on studying air entrainment into the overflow shafts and the impact of Environmental Valves

Overflow meets ambient water – nearfield plume!

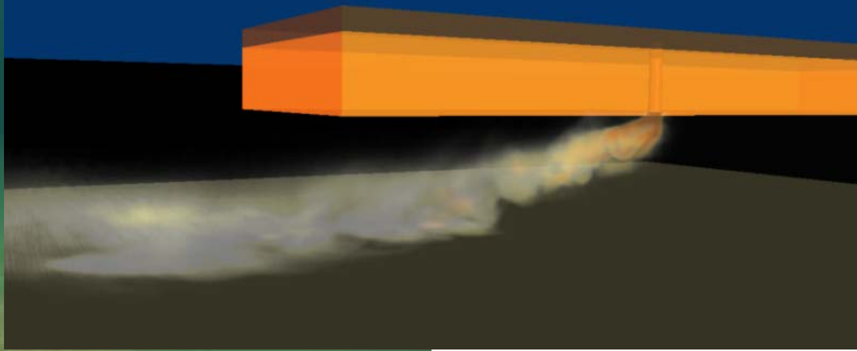


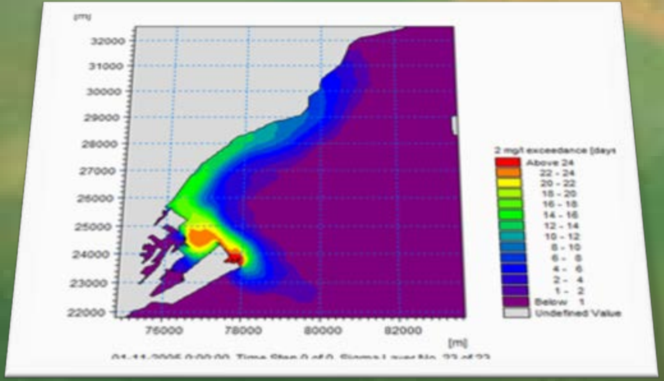
DHI’s CFD modelling on sediment plumes from disposal operations

Dredge plume
Transition from the Nearfield overflow to the Farfield plume dispersion

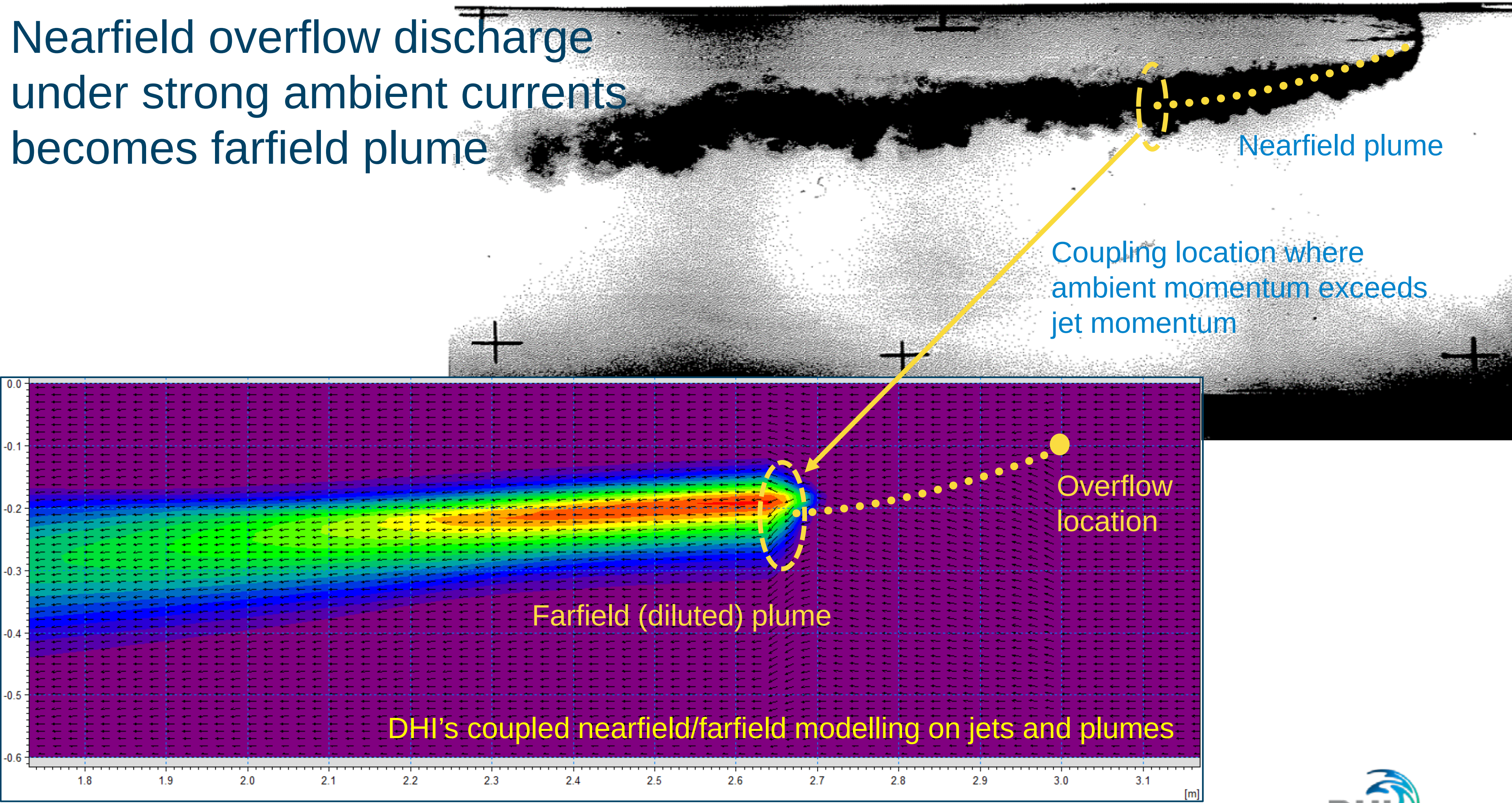
Release from vessel not moving and no current

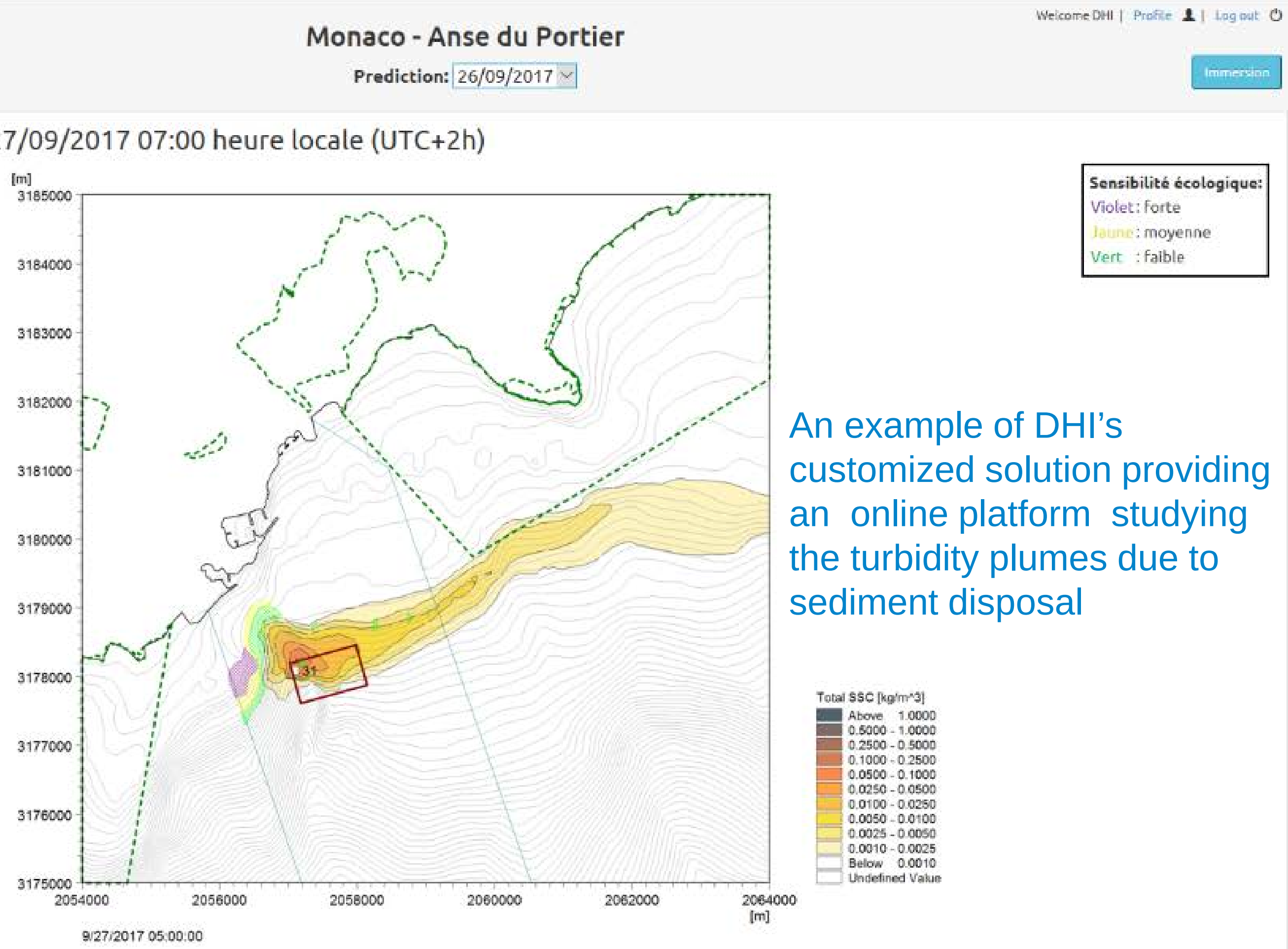
Release from vessel moving and/or with current





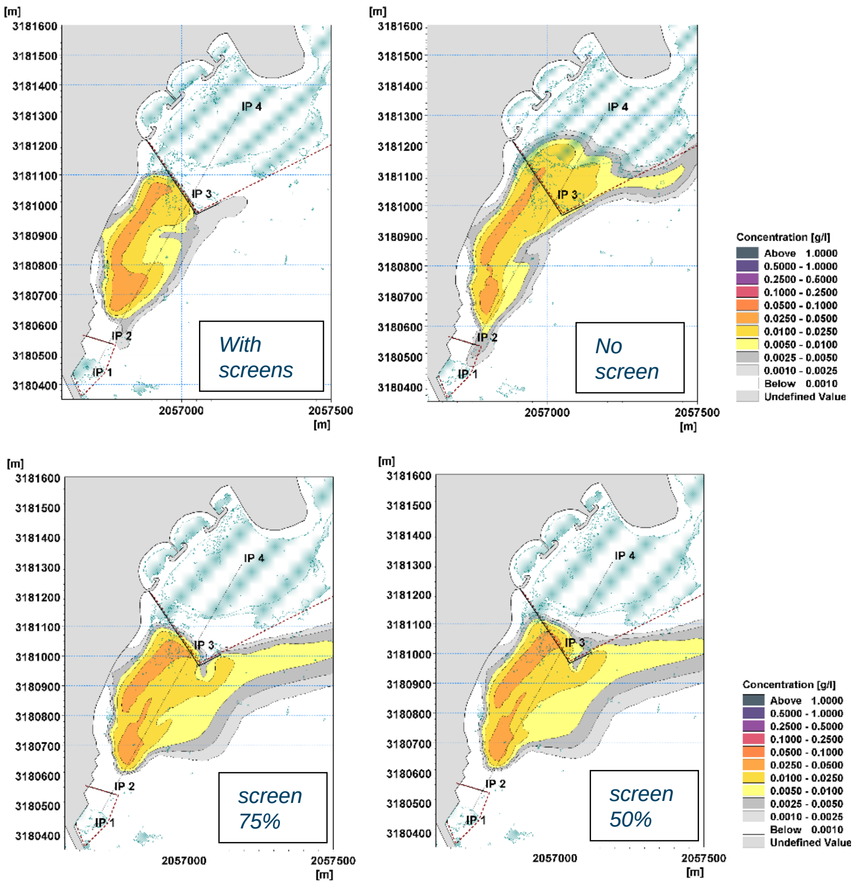
Nearfield overflow discharge under strong ambient currents becomes farfield plume





An example of DHI's customized solution providing an online platform studying the turbidity plumes due to sediment disposal

Design and optimization of silt screen layout



- Simulation of the efficiency of turbidity-blocking screens located at the border of the nature reserves
- Optimization of the turbidity screens designs (height and length) based on numerical modelling
- Assessment of the impact of potential temporary permeability of the screens on sediment plume evolution

Examples of mean concentration near the bottom layer during dredging operations with SHB and TSHD

Modelling the performance of silt-screens as a mitigation measure

Silt screens dynamics and impacts

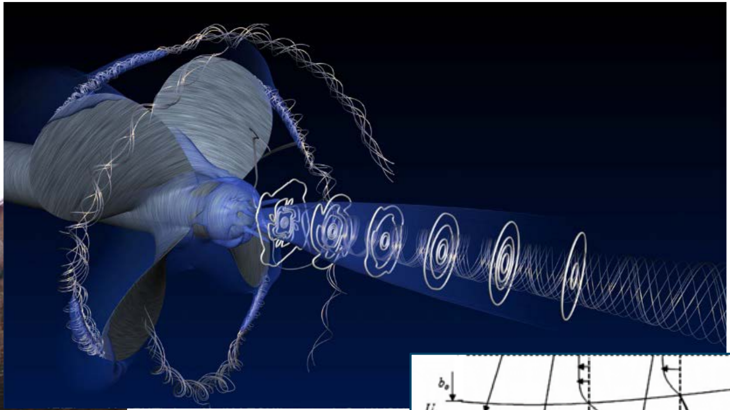
Detailed simulations and studying the flow and transport beneath the floating silt screens

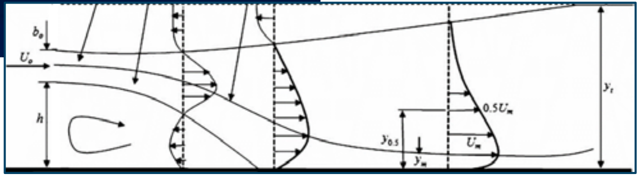
Disturbance of water by moving ship

Turbulence and rotational water flow is induced by the propellor

Magnitude and nature of disturbance depends on rotation and propellor settings. The propellor can be adjusted to create little thrust but rather maximum turbulence/stirring.

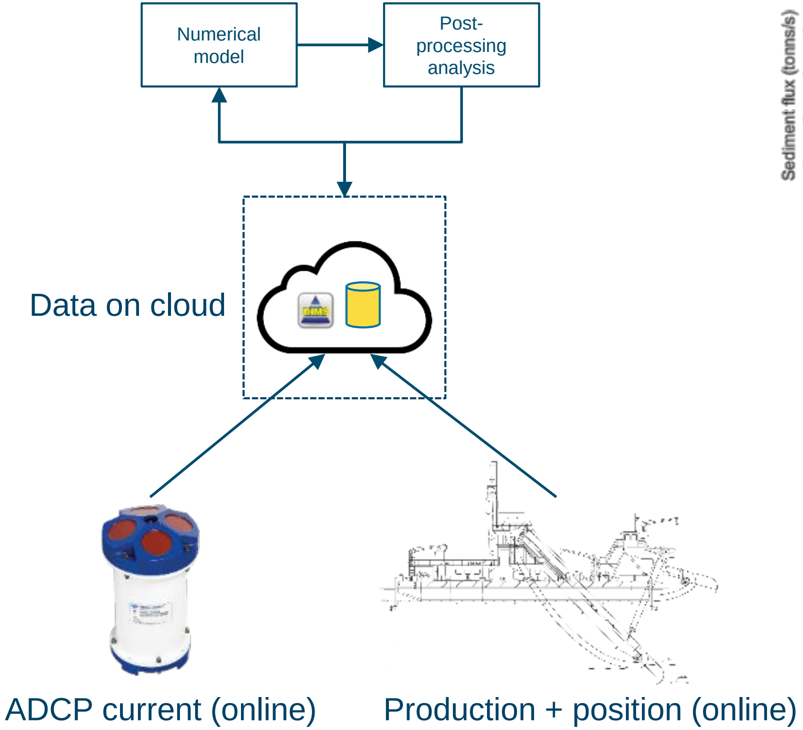
DHI has models for this (MIKE 3, CFD etc.)



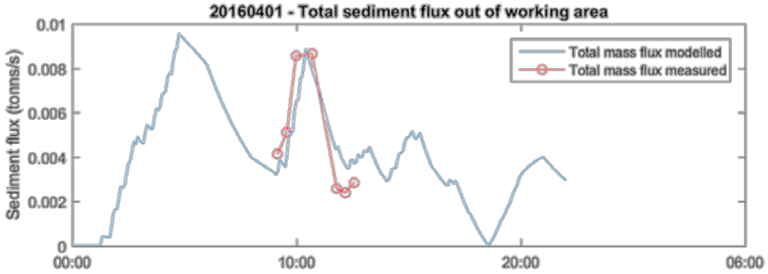


In particular, the combined effect of the hull and propellor-induced flow (**enhanced**) can provide signifcant stirring and destabilisation of sea bed ... Notedly: A stirring potential not utilized!

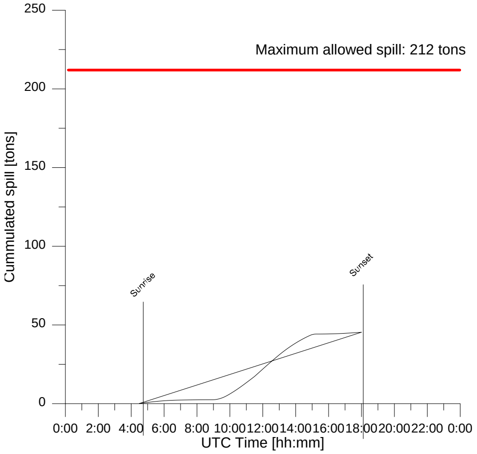
Operational Spill Monitoring



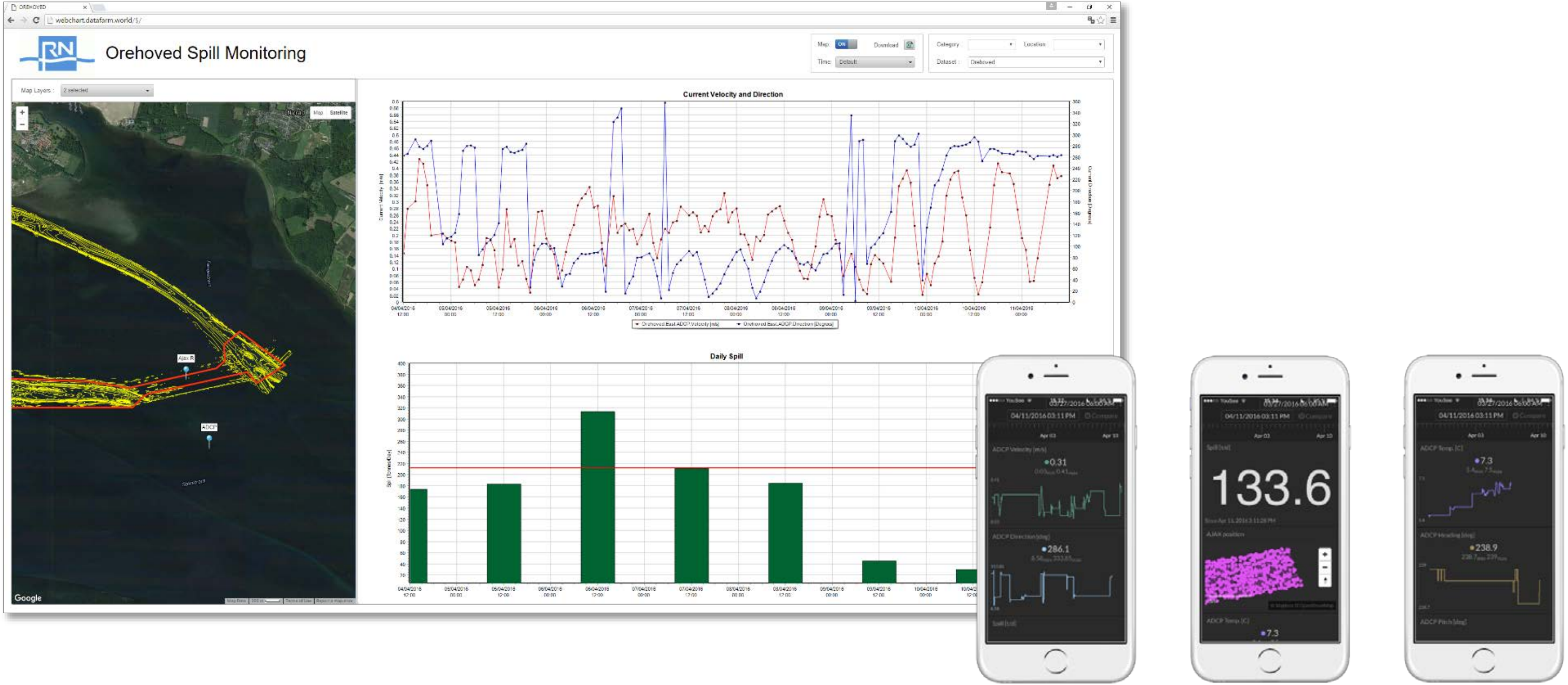
Calibrating the numerical model



Daily reporting from the numerical model



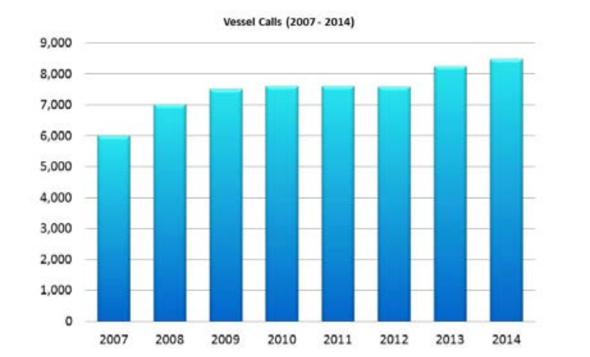
Outreach: Spill management through online services



Ex. B: Access Channel Maintenance Dredging Requirements Revisited

Port Settings

- Yearly: 9,000 vessel calls and cargo throughput of 45 mill tonnes
- Located on open coast facing SCS
- Access channel cut through wide-shallow muddy foreshore



Key Problem (of 2007)

- Port incurring excessive maintenance dredging costs with 6 million m3 of fines being dredged annually

Solution

Based on survey campaign (bed samples, acoustic sounding), observations of dredging, old hydraulic reports and MIKE 21 modelling, we agreed to a one-year trail test in which i) TSHD dredging contracts where terminated, ii) the use of propellers were boosted upon vessel departure to stir loose seabed sediments, and iii) a realistic definition of nautical depth adopted

Results and Main Benefits

- Environmental impacts eliminated (as a result of method & reduced siltation)
- Dredging was avoided the following year
- Downtime and nuisance reduced
- Cost savings and staff bonus …

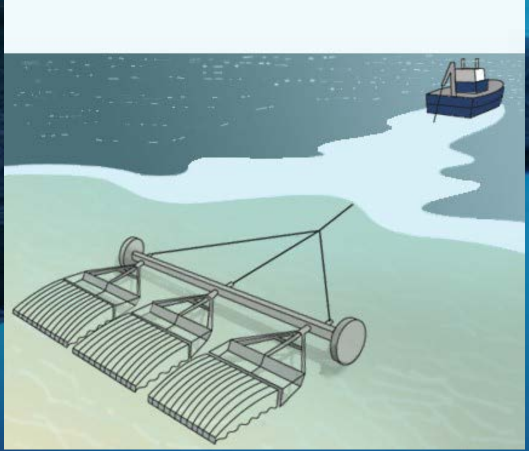
DHI

Ex. C: Redesign of Maintenance Dredging Program

Ports Settings
- Yearly: 16,000 vessel calls and cargo throughput of 220 mill tonnes
- Ports are located inside large estuary of the Malacca Strait
- 45 km of navigation channel and open berths are maintained

YEAR	DRY BULK	LIQUID BULK	GENERAL	CONTAINER	PASSENGER	OTHER	TOTAL
2005	353	1,317	2,482	10,266	632	45	**15,050**
2006	392	1,331	1,758	11,543	1,380	19	**16,404**
2007	424	1,455	1,698	12,019	1,553	23	**17,149**
2008	442	1,463	1,531	11,675	1,753	4	**16,864**
2009	286	1,683	1,499	11,080	1,568	18	**16,116**
2010	380	2,100	1,586	12,332	1,504	8	**17,910**
2011	411	2,216	1,690	12,387	1,408	5	**18,117**
2012	413	2,018	1,676	11,241	2,373	-	**17,721**
2013	457	1,676	1,788	10,933	1,849	-	**16,703**
2014	452	1,435	1,536	10,551	1,188	136	**15,298**
2015	446	1,265	1,539	11,944	1,325	24	**16,543**

Key Problem (now)
- Ports incurring excessive maintenance dredging costs and downtime with no room for expansion. Demand for channel deepening (17m CD) and unrestricted access. Relocation of operations is considered!



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One of the Solutions
Studying 35 years of dredge records, the role of ship-induced turbulence is obvious (Siltation 30% higher than dredge volumes). We are testing the potential of systematic agitation using small tugs in the framework of MIKE 21: i) Scheduled sectional dredging in tidal windows ii) Number of tugs and iii) Optimized to resuspend

Main Benefits:
- Frequency of TSHD (sub-contracted) significantly reduced (from 8 mnths to 3 yrs)
- Dredging operation can be controlled in-house (low-tech)
- Downtime reduced and tug-based maintenance can co-exist with port operations
- Cost savings and allowance for growth to potential
- Environmental impacts reduced

DHI

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/23/2018	**CONTACT**	Charles Johnson
TIME	10:30 AM	**REPRESENTING**	DSC Dredge

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**

   RESPONSE: Mr. Johnson indicated DSC Dredge has been researching dredging efficiency for aggregate and navigational dredging. DSC Dredge just patented a "swinging ladder shark combination". This new design dredges as wide as a conventional dredge, but with a swinging ladder. This concept does not use anchors; the dredge walks seamlessly on carriages. As the dredge is swinging side to side it is also advancing through the channel.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**

   RESPONSE: Not applicable.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**

   RESPONSE: Mr. Johnson stated the client needs to come up a criterion to judge variables involved (dredge efficiency, safety, etc.). Required list of factors to effectively select and price a dredge: (1) dredging depth; (2) average face of material; (3) material type (i.e., D_{50}, D_{85}); (4) discharge distance; (5) terminal elevation; and (6) cut width

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**

   RESPONSE: Not applicable.

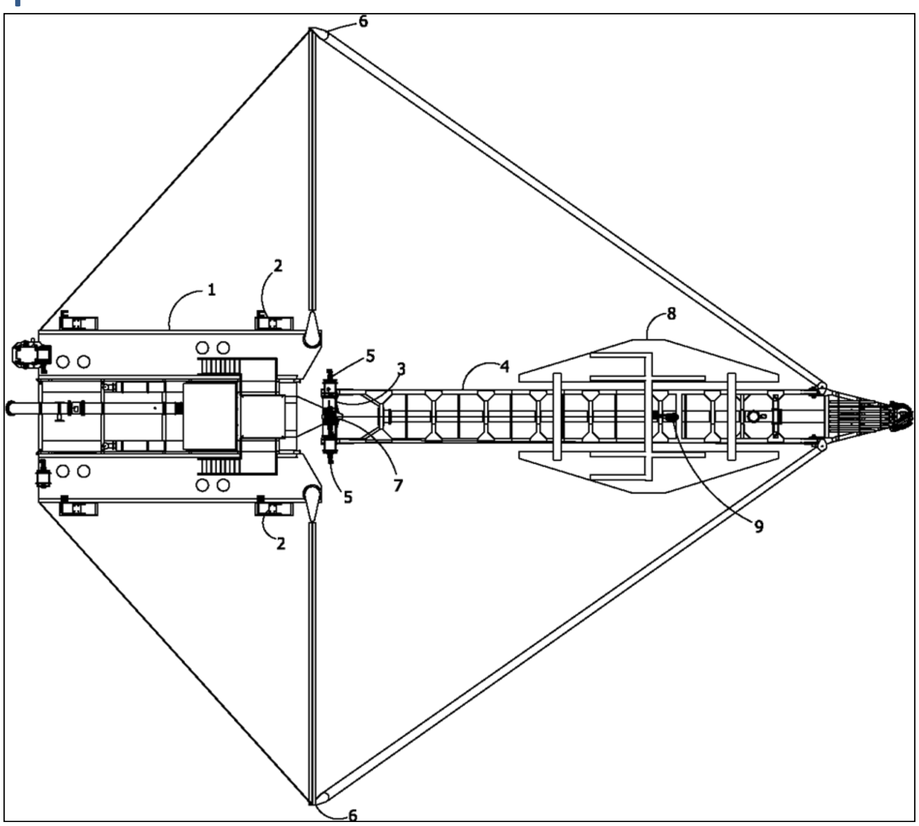
MILESTONE: Taylor Engineering staff noted Mr. Johnson will be teaching a dredging class on March 28th, 2018 in New Orleans, LA. Also, Mr. Johnson provided drawings and information on their new patented design and ways to drawings of using an idler barge to increase the efficiency of dredging the Intracoastal Waterway.

Wide-Format Swinging Ladder Dredge

General Description

DSC's patent pending wide-format swinging ladder dredge incorporates ideas and concepts not found on any other dredge manufactured today. Swinging ladder dredges use cylinders or winches to swing a short boom containing the slurry entrance (ladder) from side to side; the length of the ladder is constrained by the required excavation force and/or the ladder weight. DSC has devised a design that allows the use of a long boom to provide wide swings and deeper digging depths without loss in dredge stability or cutting forces. DSC's design employs a set of swing booms to provide better swing cable geometry and additional transverse stability (flotation); the booms allow sufficient swing forces, through a series of sheaves, to be applied to maximize the available cutter force. To negate the healing and trimming moment generated by the longer ladder (flotation instability), the design incorporates a traveling flotation tank that is connected to the dredge ladder; this tank pivots with the ladder and moves axially as the ladder is lowered and raised through a series of lift sheaves. The movement of the traveling tank is a function of geometry and not an automated control system.

System Components



The DSC wide-format swinging ladder dredge consists of a floating equipment platform (1) that includes foundations or attachments for most components, A system of spuds or cables to hold this platform from translating or rotating while dredging (2), a dredge ladder pivot called a gimbal (3), a swinging dredge ladder containing the piping to transport slurry with or without an excavation device and additional pumping devices (4), Swing winches, cables, and sheaves with or without swing cylinders to swing the ladder from side to side (5), foldable swing booms with or without sheaves to stabilize the dredge and allow for proper swing forces (6), ladder lift winch(s) and cylinder(s) to lift the ladder and/or hold it at the proper depth (7), traveling floatation tank with lift frame to support ladder weight (8), ladder lift rigging including lift cable(s), sheaves, and chains to properly position traveling tank and lift the ladder (9).

Method of Operation

Figure 1 shows a plan view of the wide---format swinging ladder dredge in a non--- dredging position with the ladder raised and centered; this is the normal position to begin dredging operation.

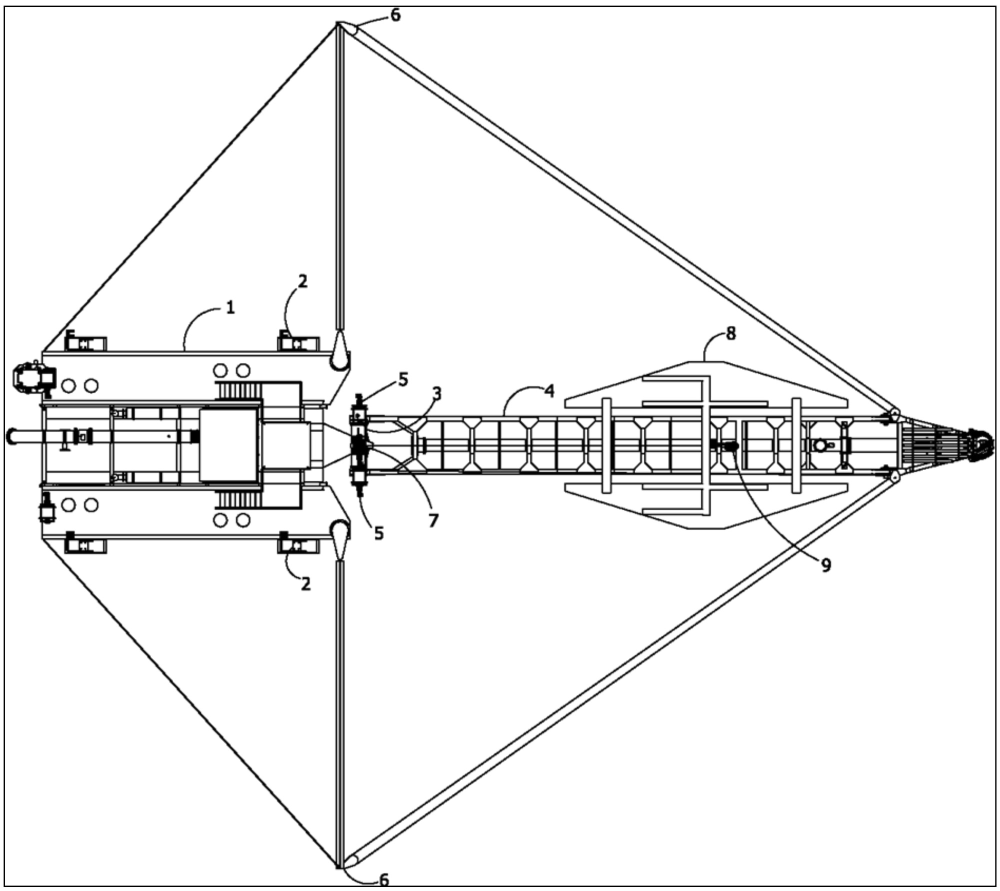


Figure 1

Figure 2 shows the outboard profile of the dredge in the same position.

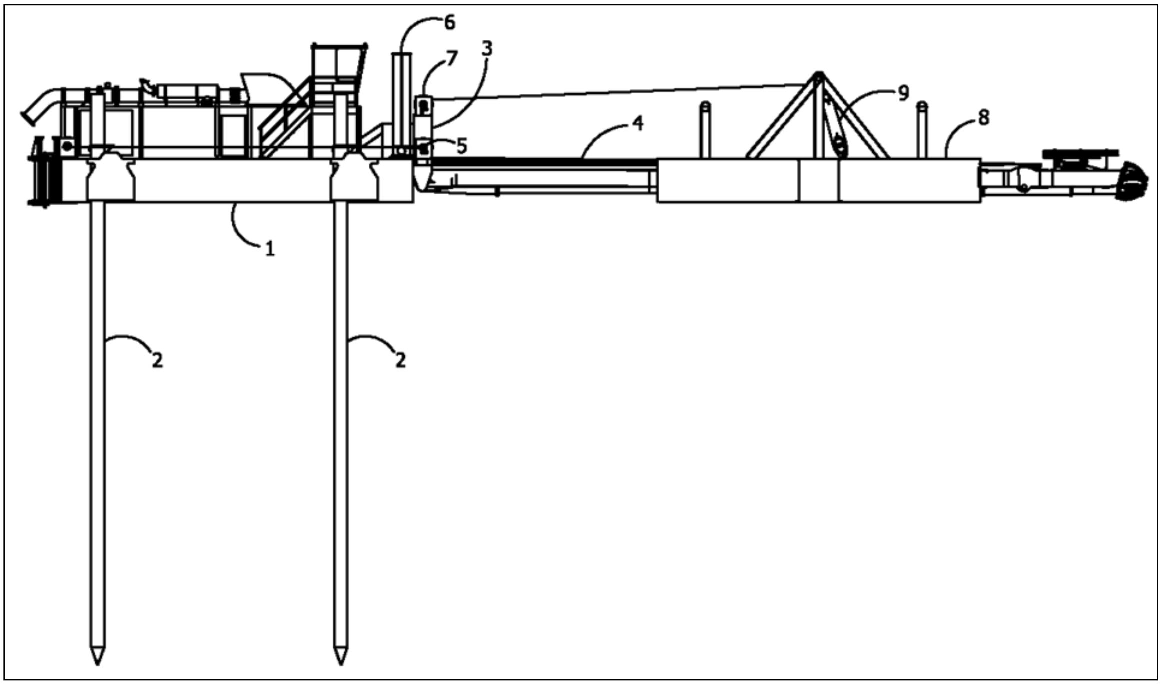


Figure 2

Figure 1 and 2 show the dredge flotation tank held in position by four spuds; a minimum of two spuds or three cables is required to keep the dredge in the proper position. Additional spuds or cables may be used to enhance or automate the dredge tank movement.

Using the swing winches and or swing cylinders, the dredge ladder is swung to one side to begin the dredging process as shown in plan view in Figure 3.

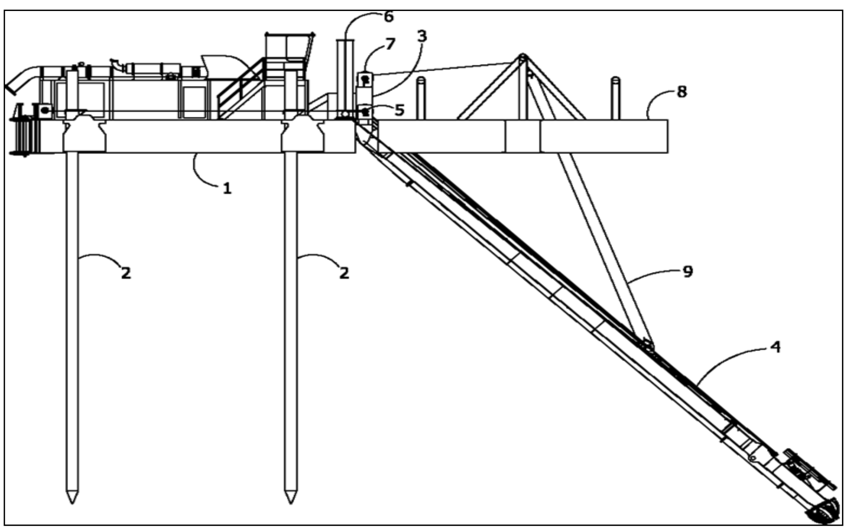


Figure 3

The ladder is lowered to the bottom by the ladder lift winch(s) and cylinder(s) as shown in the plan view shown above. With the ladder slurry pipe near the bottom, the dredge swing winches rotate the dredge ladder through an arc of up to ninety degrees to the desired position on the opposite side. One swing winch pulls the dredge ladder across the bottom as the other winch releases cable as needed. This operation is repeated with the ladder being lowered until the desired depth is achieved; once the depth is reached, the dredge can be repositioned forward by the spud or cable system to remove more sediment.

Dredge Hull

Watertight bulkheads have water stops to prevent flooding from tank to tank. This design allows the dredge to remain afloat with one flooded tank compartment. All void tanks have flush mounted watertight manholes for access and service. The side tank assemblies and the center section assembly are bolted together to form the complete hull.

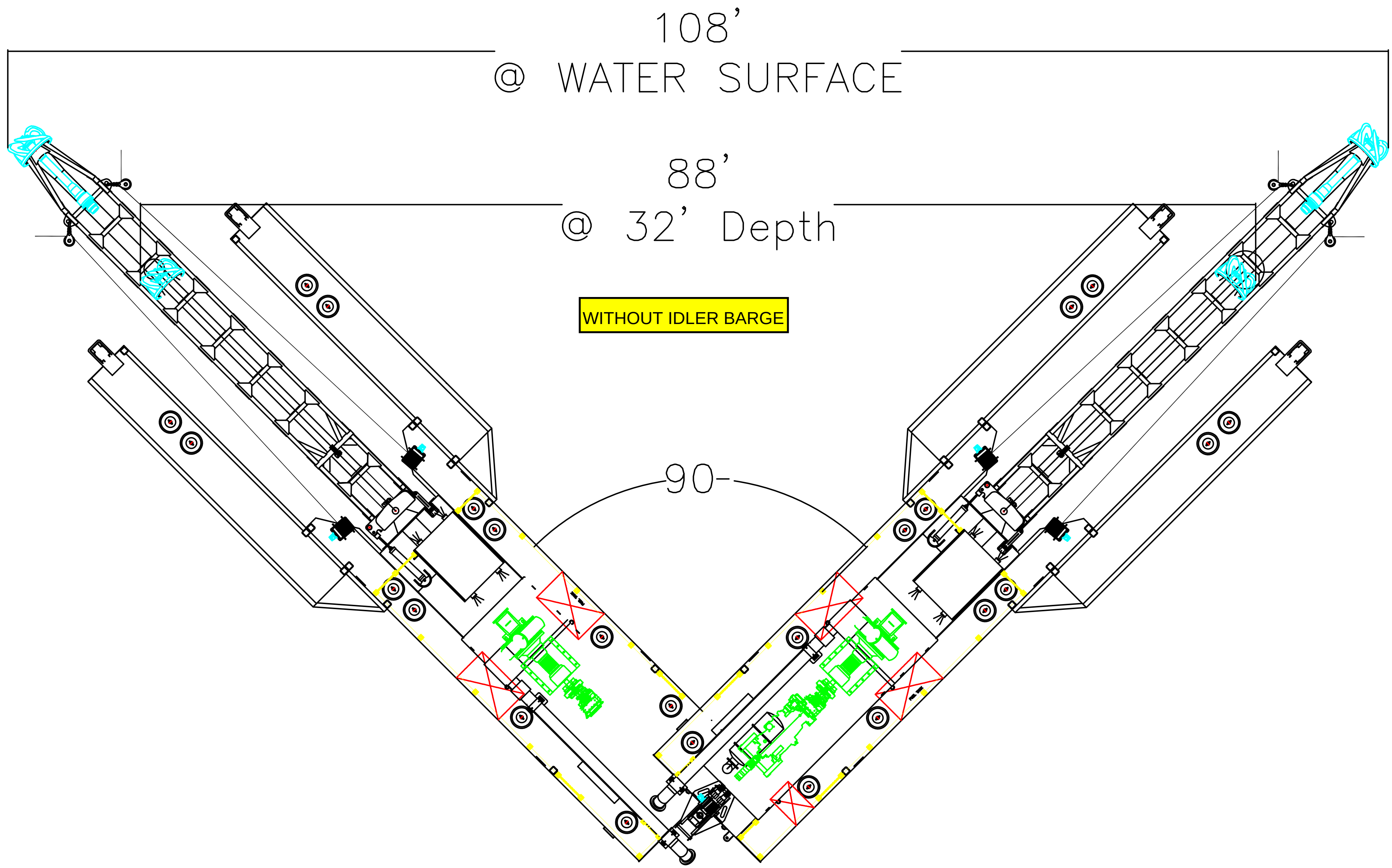
Flotation/Hull

Each side tank assembly will be 40' long x 4' deep (12.2m x 1.2m) and integral with the machinery center section to form a single piece hull configuration. The side tanks are of a rectangular cross-section and are constructed of minimum ¼" (6.35mm) steel plating for the sides, bottom and top sections. These plates are formed to eliminate any corner welding. The side tanks are transversely framed with channel frames or bulkheads. The side tanks also have longitudinal framing. Additional foundations and bracing assemblies are also found in the sections of the side tanks that experience loading. Each side tank incorporates one of the dredge's fuel tanks. The dredge center section assembly will be approximately 37' in length x 4' deep (10m x 1.2m). The center tank is of a rectangular cross-section and is constructed of minimum 1/4" (6mm) steel plating. These plates are formed to eliminate any corner welding. The assembled hull dimensions are approximately 40' long x 24' wide x 4' deep (12.2m x 7.3m x 1.2m).

Dredge Ladder

The ladder is mounted on a structural steel gimbal assembly that is mounted at the front of the center section. The gimbal assembly is designed with ample strength to support the ladder. The dredge ladder is of the most robust design for dredging applications. Structural heavy-duty beams provide side structures and are connected together by cross members for strength. The ladder has been designed to meet the demands of rugged river dredging conditions and is both reliable and durable. The ladder has been designed to accept the loading of the cutterhead and swing mechanisms. Safety chains are provided to secure the ladder when the dredge is not operating. A suction inlet or mouthpiece is installed in the forward most section of the ladder assembly. The mouthpiece is so designed to provide an increased suction diameter over the inlet suction piping so the dredge can effectively pull an abundance of material into the suction. The mouthpiece is attached to the head plate located at the forward end of the ladder structure. The dredge ladder will include the following components:

- Cutter module
- Swing sheaves
- Hydraulic piping
- Suction transition hose
- Suction piping



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

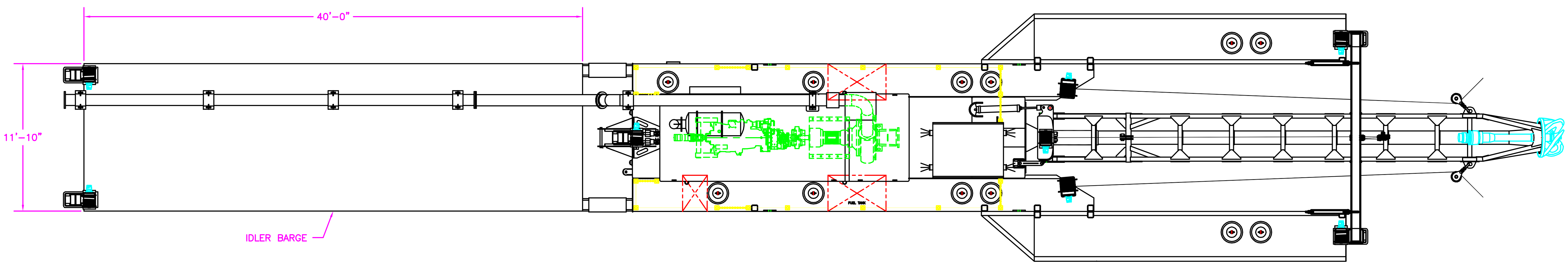
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

DSC 10” BARRACUDA DREDGE

DICKERSON
CONVENTIONAL SWING WIDTH

ENGR/DESNR: DJG	
DRAWN: WJB	
CHK:	APP BY:
SCALE: N/S	DATE: 11/28/06
PROJECT: 206180/ 190	
DWG NO#: 206180M003	REV



GENERAL ARRANGEMENT WITH IDLER BARGE

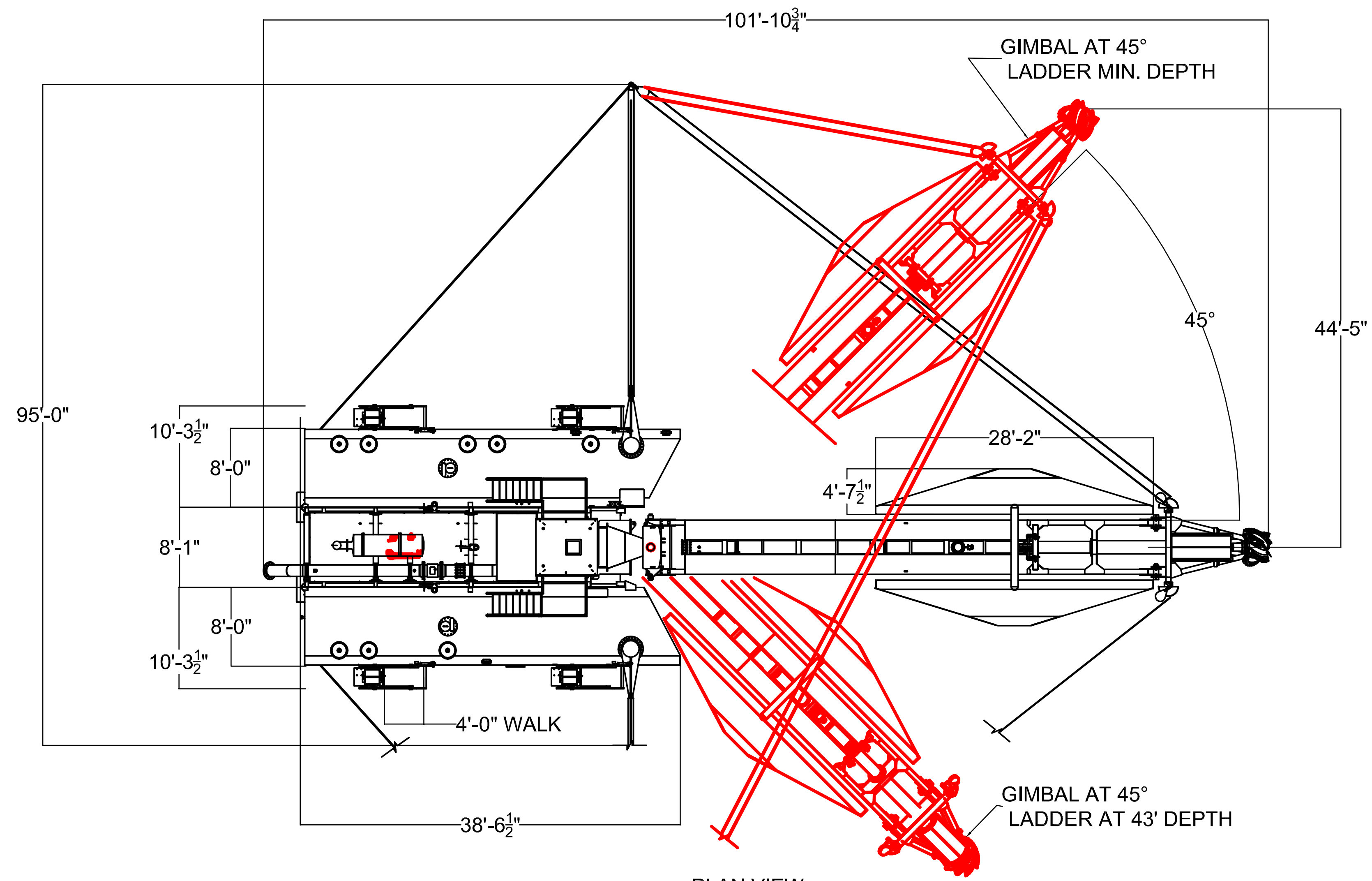
NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.

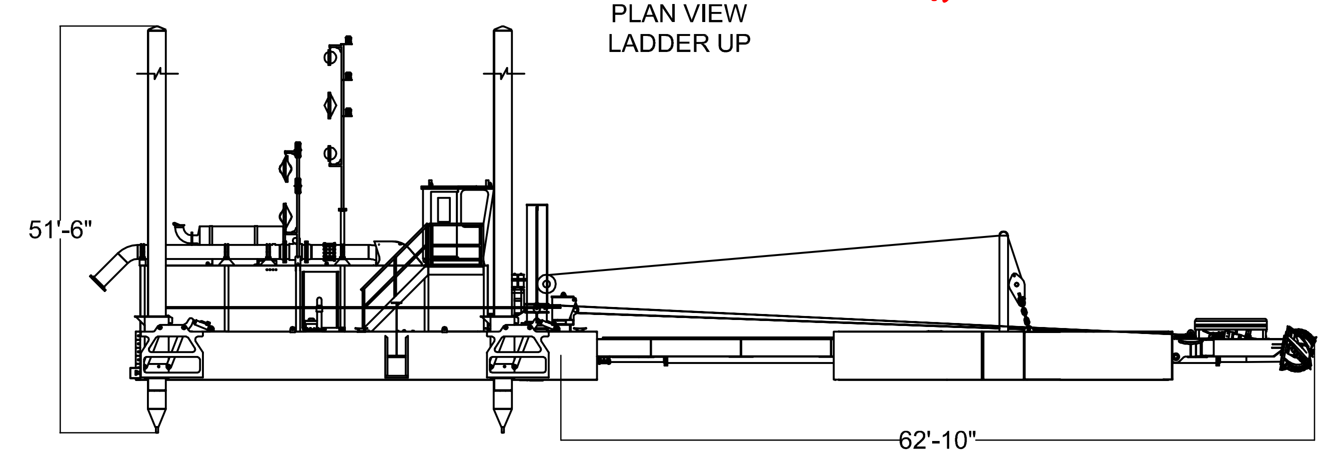
DSC 10" BARRACUDA DREDGE

DICKERSON
PRELIMINARY GA W/ IDLER BARGE

ENGR/DESNR: JPS	
DRAWN: JPS	
CHK:	APP BY:
SCALE: 1/4"=1'-0"	DATE: 01/13/10
PROJECT: ___	
DWG NO#: ___	REV



PLAN VIEW
LADDER UP



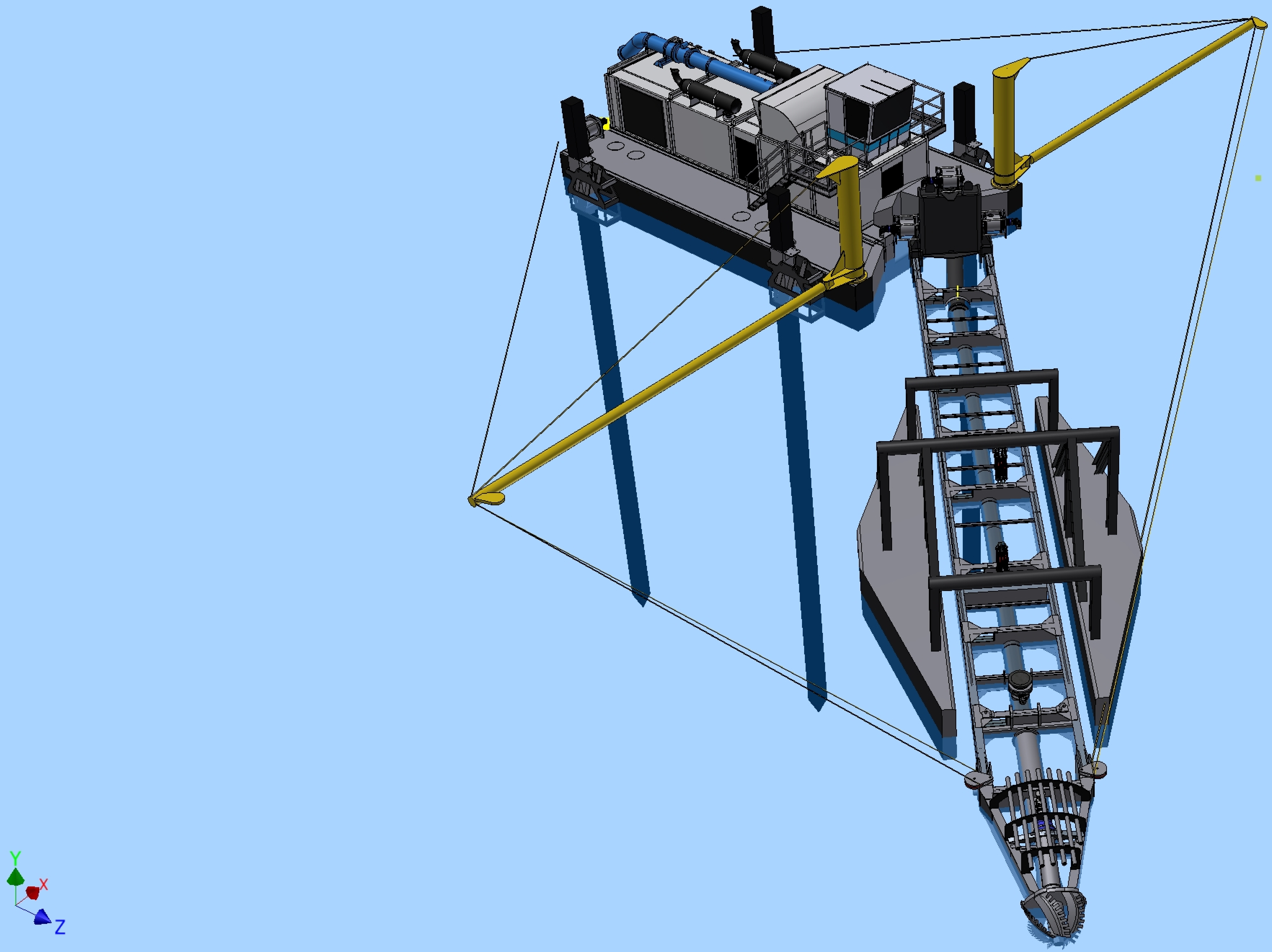
PROFILE VIEW
LADDER UP

THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREON IS THE PROPERTY OF DSC DREDGE, LLC, AND MUST NOT BE MADE PUBLIC, DUPLICATED, OR USED IN ANY WAY DETRIMENTAL TO OUR INTEREST. IT IS FURNISHED SUBJECT TO RETURN ON DEMAND UNLESS FURNISHED UNDER CONTRACT PROVISIONS.

DSC Dredge LLC

DESIGNER BJF	**DSC Dredge, LLC**	
CHECKED	KEYNOUN SHARK	DESCRIPTION SH-5450-43D-SP
ENGINEER WJW	SIZE B	ITEM NO **4800061718** REV
APPROVED	SCALE	ISSUE DATE 11-9-15 SHEET 1 OF 1


Y
X
Z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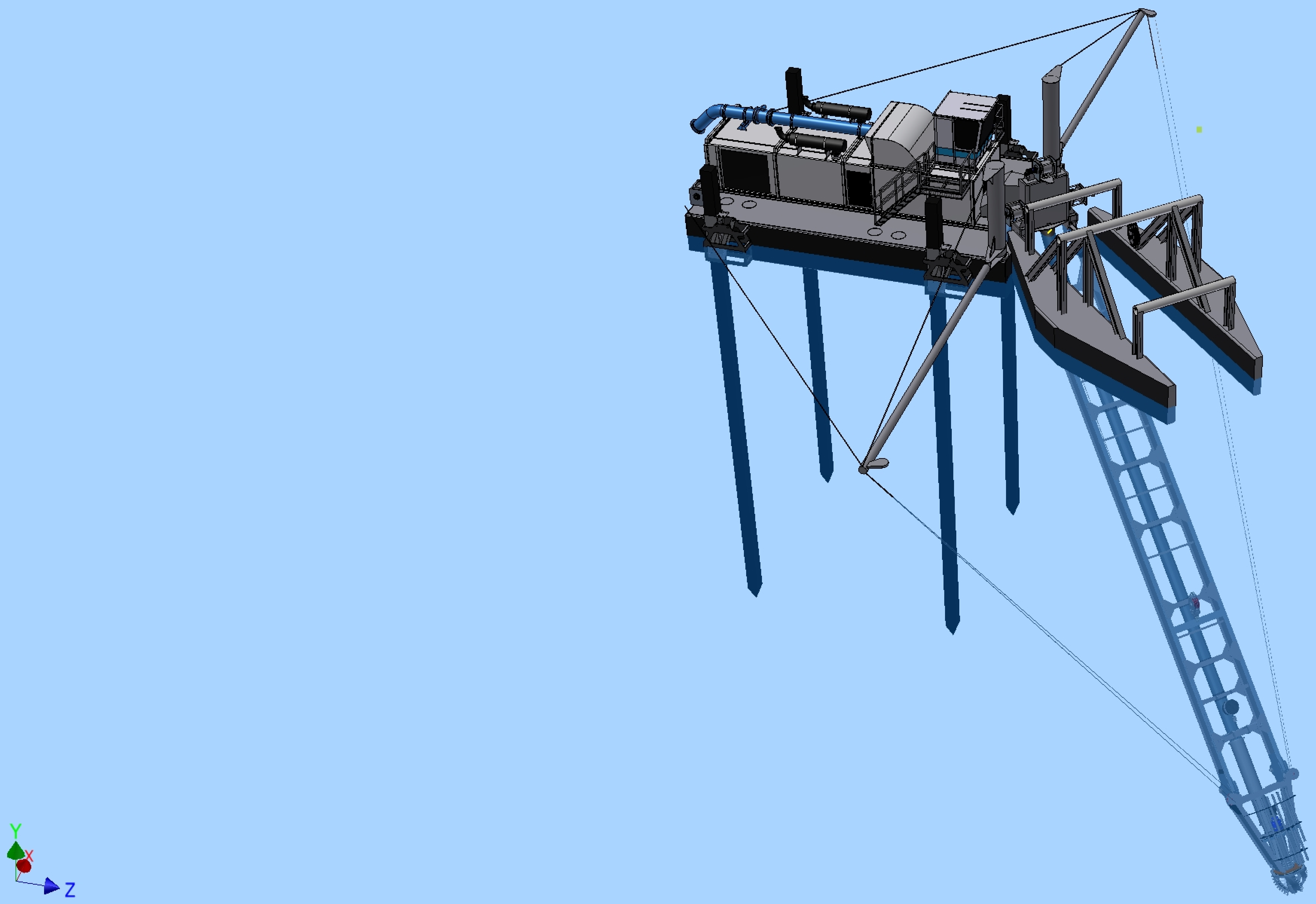
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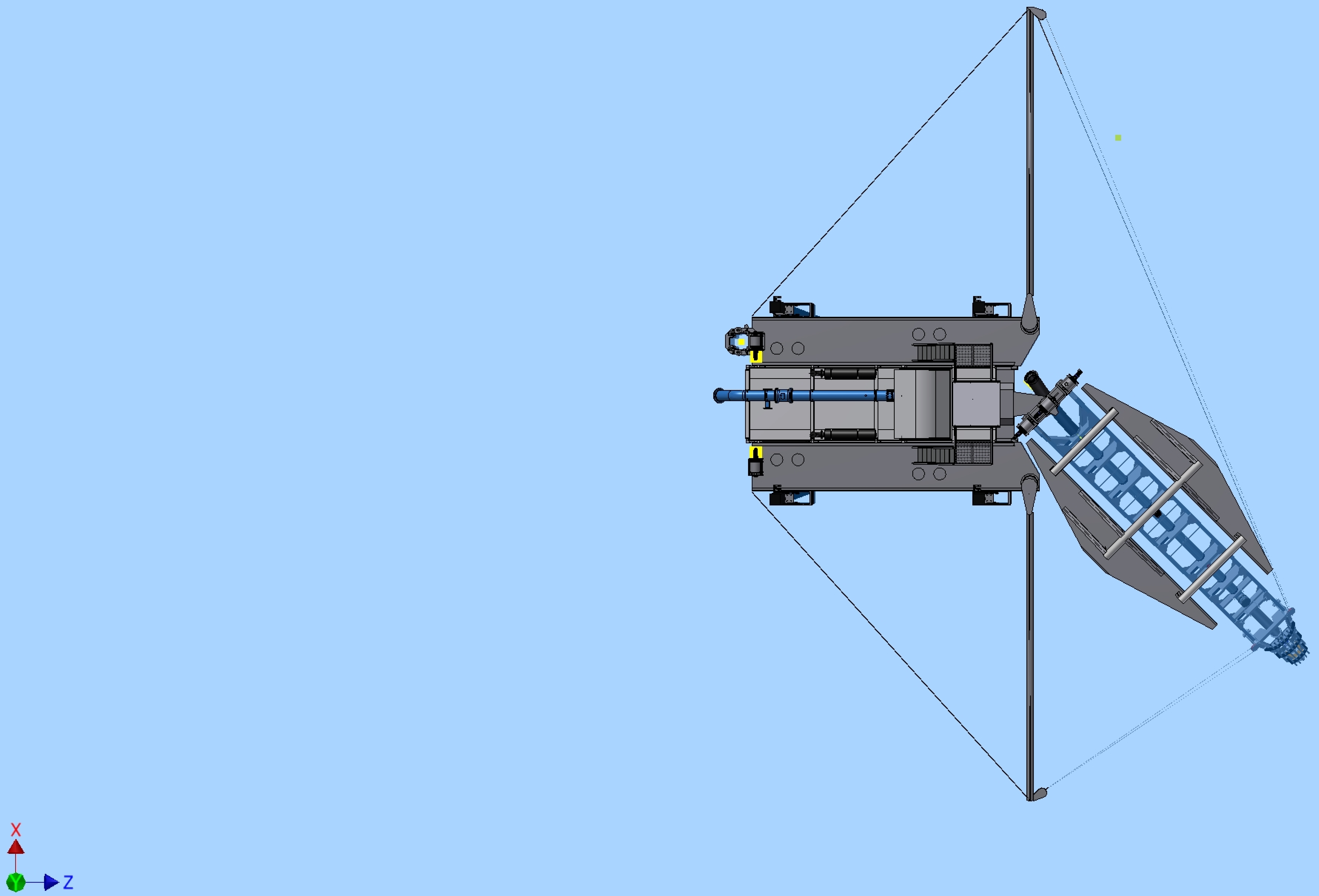
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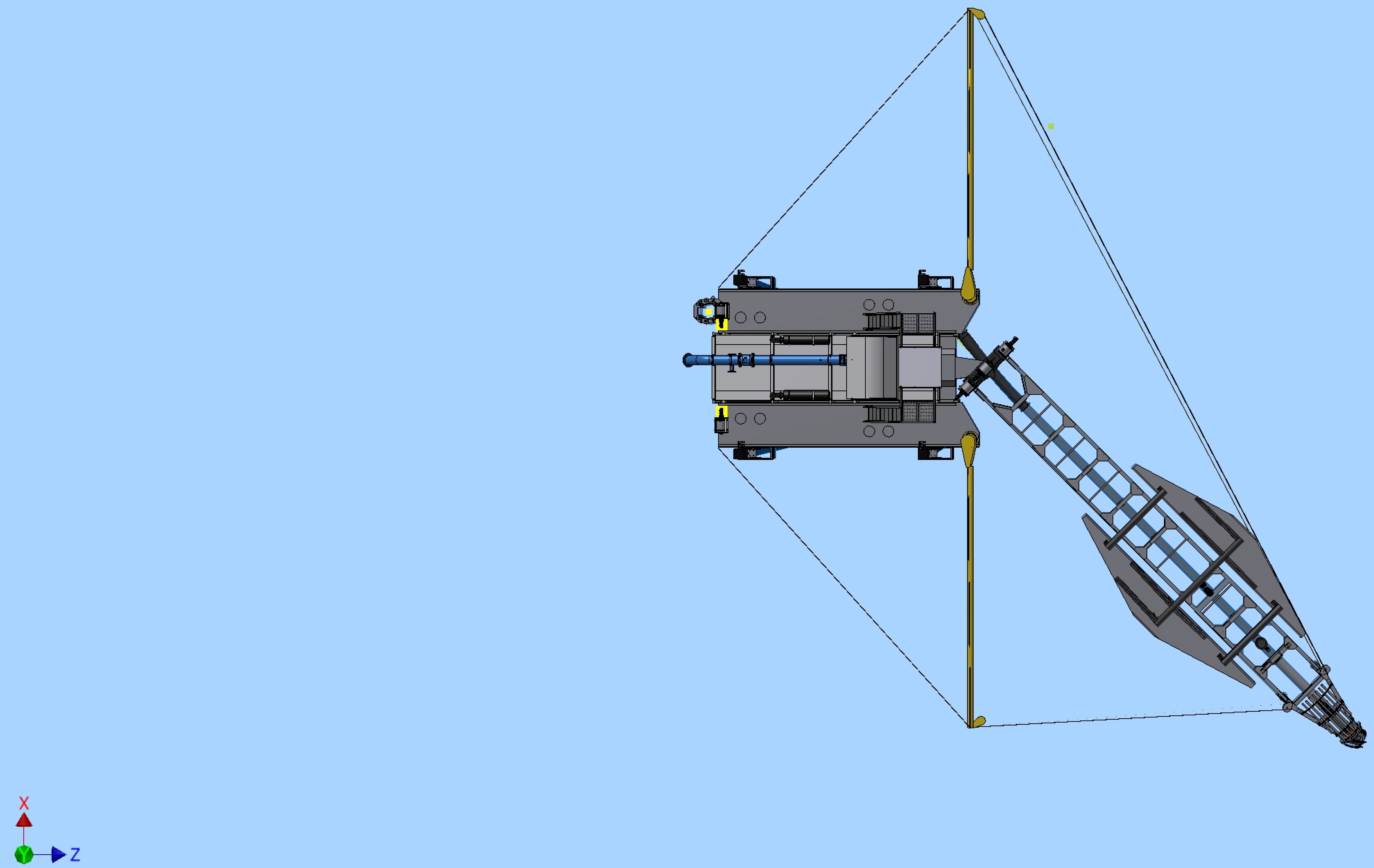
X
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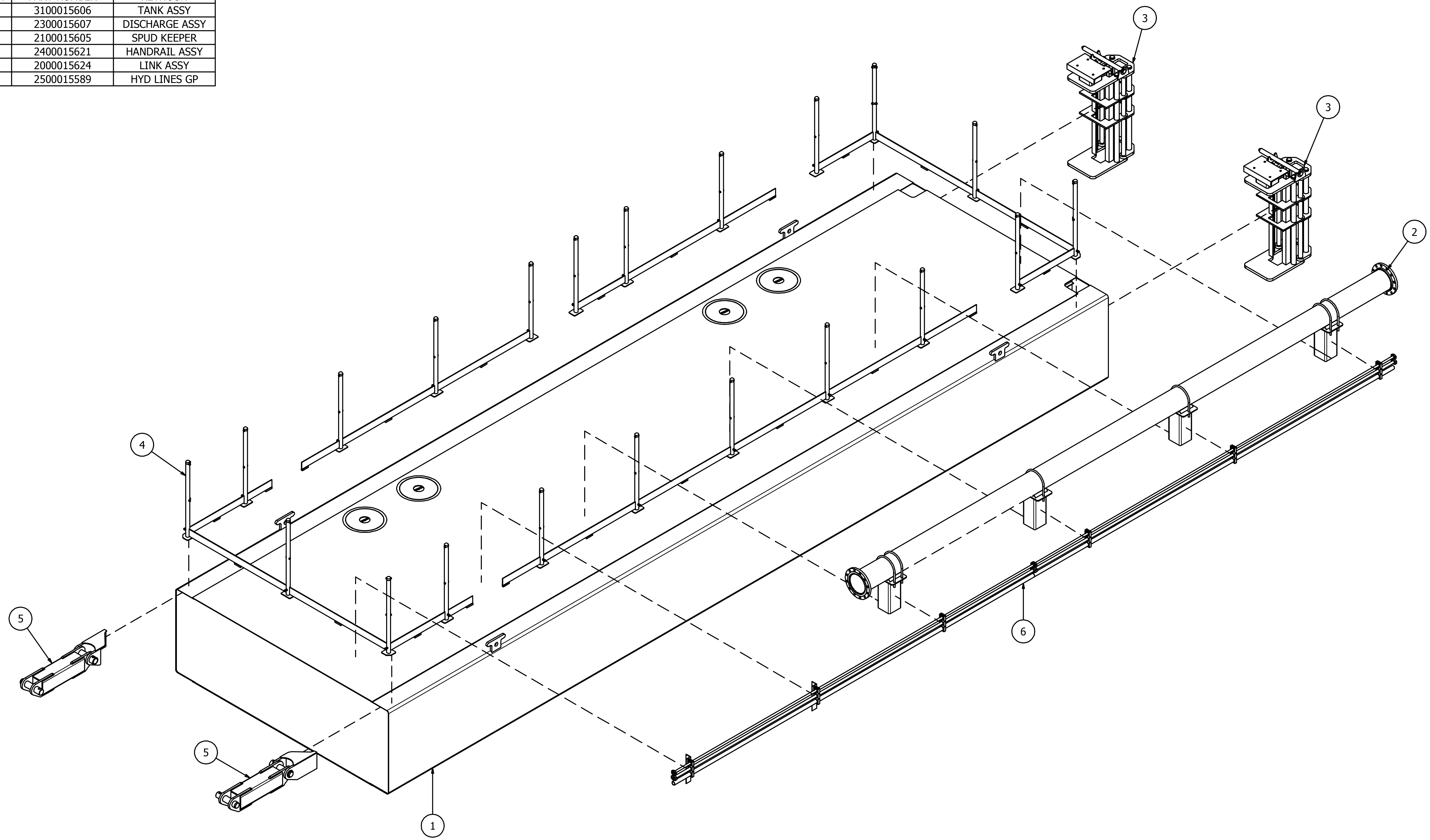
PARTS LIST			
ITEM	QTY	PART NUMBER	KEYNOUN
1	1	3100015606	TANK ASSY
2	1	2300015607	DISCHARGE ASSY
3	2	2100015605	SPUD KEEPER
4	1	2400015621	HANDRAIL ASSY
5	1	2000015624	LINK ASSY
6	1	2500015589	HYD LINES GP



DESIGNER SBS	DREDGING SUPPLY COMPANY, Inc.		
CHECKED RMM	KEYNOUN IDLER BARGE	DESCRIPTION 40.0 X 11-10	
ENGINEER MWW	SIZE B	ITEM NO 2000015617	REV 0
APPROVED DJG	SCALE NTS	ISSUE DATE 3/11/2010	SHEET 1 OF 4

DICKERSON BARRACUDA SWING WIDTH WITH IDLER BARGE DETAILS								
Overall Length of Dredge (feet)	**Length of Ladder (feet)**	**Trunnion Height above Water (feet)**	**Max. Ladder Down Angle (degrees)**	**Maximum Swing Angle off Center Line (degrees)**	**Dredging Depth (feet)**	**Distance from Spud to Cutter (feet)**	**Cutter Outside Diameter (inches)**	**Channel Width (feet)**
125	41.75	0	6.9	45	5.0	124.7	44.00	180.0
125	41.75	0	50	45	32.0	110.1	44.00	159.4

FLORIDA INLAND NAVIGATION DISTRICT
INTRACOASTAL WATERWAY DREDGING EFFICIENCIES

DOCUMENTATION INTERVIEWS AND DATA COLLECTION RECORD

DATE	2/26/2018	**CONTACT**	Steve Miller
TIME	3:00 PM	**REPRESENTING**	Ellicott Dredges

1. **QUESTION: The Florida Inland Navigation District is researching alternative dredging techniques to increase dredging efficiency in the Intracoastal Waterway. Given this, can you provide or are you aware of any specific studies/documents related to current and upcoming hydraulic and mechanical dredging technology?**
   RESPONSE: Traditional contracting subjects the end user to number of unpredictable variables, beginning with availability of qualified companies and equipment capacity. FIND sponsored projects will be subject to whatever equipment the contractor has available and not necessarily the most suitable for the specific project. A self-managed dredging program allows the end user to select from variety of standard model dredges and outfit to meet the project needs. Self-managed programs can accurately control project cost while having total control of the availability, scheduling and planning of the equipment. Purchasing new equipment allows the end users to take advantage of manufactures in house dredge training simulators, Hands on training both at manufacturing plant and onsite on delivery and on demand. New equipment will fully meet EPA engine regulations, USACE & CG requirements. The equipment will be covered under the manufacture warranty program and engine warranties can be extended through program offered by manufactures. New electronic control and monitoring systems can be accessed remotely by the manufacture upon request to trouble shoot or access maintenance records. This is also true for the GPS based positioning system which can be remotely accessed through a Team Viewer program. The manufacturer will assist the end user to select the right size and model dredge that meets project requirements and budget. Ellicott will provide delivery, onsite support for the set-up, start-up and training of customer operational staff. The equipment can be upgraded to add booster pump stations as needed and controlled/monitored by the dredge operator. Automation features will self-adjust pump speed to meet demand and therefore reduce fuel consumption and wear. Specialized dredges like our 360, 460 and 860SL models operate in both conventional mode (wide swings) and swinging ladder (no cabling or anchors) which provides user versatility.

2. **QUESTION: The Florida Inland Navigation District is researching alternative bid and contract methods to streamline dredging needs. Based on your experience, do you have any recommended alternatives processes?**
   RESPONSE: Not applicable.

3. **QUESTION: Do you have any evaluation criteria, including cost, for potential State-owned dredge equipment, operation, and maintenance?**
   RESPONSE: See attached document.

4. **QUESTION (CONTRACTORS ONLY): As it specifically relates to work in Florida's Intracoastal Waterway, what are the factors driving your interest/lack of interest in performing work for the Florida Inland Navigation District?**
   RESPONSE: Not applicable.

MILESTONE: Mr. Miller will provide a client list and various information about Ellicott Dredges.Taylor Engineering staff will follow up with Steve Miller if a technical presentation is requested.


Ellicott
DREDGES


VALDEZ


VALDEZ

Swinging Ladder Dredges

360 SL Swinging Dragon® Dredge

- 8” pumping system and 15’ digging depth
- Economical and highly transportable
- Optional swing winches for conventional operation

460 SL Swinging Dragon® Dredge

- 10” pumping system and 20’ digging depth
- Rugged heavy-duty construction
- Can be oufitted with swing winches for conventional operation

860 SL Swinging Dragon® Dredge

- 12” or 14” pumping system and 30’ digging depth
- Swing winches are standard for dual mode operation
- Integral spud carriage

Dredge Model	360 SL	460 SL	860 SL
Discharge Diameter	8” (200 mm)	10” (250 mm)	14” (350 mm)
Max. Digging Depth	15’ (4.6 m)	20’ (6.1 m)	30’ (9 m)
Total Power	375 HP (280 kW)	440 HP (330 kW)	800 HP (600 kW)
Pump Power	290 HP (215 kW)	320 HP (240 kW)	625 HP (470 kW)
Cutter Power	40 HP (30 kW)	40 HP (30 kW)	80 HP (60 kW)

Portable Cutterhead Dredges

370 HP Dragon® Dredge


- Designed for easy transport, handling and set-up
- Heavy-duty construction and components
- Versatile usage for a wide variety of applications

670 Dragon® Dredge


- Similar great features as the 370 but in larger size with higher production rates
- Simple and fast assembly with minimal effort
- Full length side tanks provide stability and added deck space

870 JD Jet Dragon® Dredge


- Digging depth to 60 ft. (18 m)
- Unique Jet Suction Assist allows for high production at any digging depth
- No submerged ladder pump—keeps maintenance simple

Dredge Model	370 HP	670	870 JD
Discharge Diameter	10” (250 mm)	14” (350 mm)	14” (350 mm)
Max. Digging Depth	20-42’ (6-13 m)	33-42’ (10-13 m)	50’ (15.2 m)
Total Power	440 HP (330 kW)	800 HP (600 kW)	960 HP (715 kW)
Pump Power	320 HP (240 kW)	560 HP (420 kW)	575 HP (430 kW)
Cutter Power	40 HP (30 kW)	100 HP (75 kW)	100 HP (75 kW)

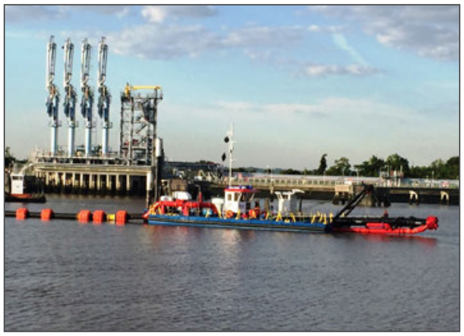
1270 Dragon® Dredge



- High production with dedicated engine for pumping system
- Separate engine for hydraulic system
- Used in a variety of applications including coastal, river dredging, and sand and gravel mining

Dredge Model	1270	2070
Discharge Diameter	18” (450 mm)	20” (500 mm)
Max. Digging Depth	50’ (15.2 m)	50’ (15.2 m)
Total Power	1350 HP (1010 kW)	1740 HP (1300 kW)
Pump Power	1000 HP (750 kW)	1200 HP (895 kW)
Cutter Power	155 HP (115 kW)	250 HP (190 kW)

2070 Dragon® Dredge


- Optional spud carriage and anchor booms
- Separate engines for dredge pump and hydraulic system and generator
- Ideal for river dredging, port applications and land reclamation

3870 Super-Dragon® Dredge



- Innovative catamaran hull design
- Ladder pump driven directly by diesel engine via pivoting gearbox
- High production rates from submerged dredge pump
- Standard spud carriage

Dredge Model	3870	4170
Discharge Diameter	26” (650 mm)	24” (600 mm)
Max. Digging Depth	60’ (18 m)	60’ (18 m)
Total Power	3750 HP (2800 kW)	4070 HP (3040 kW)
Pump Power	2450 HP (1825 kW)	2560 HP (1910 kW)
Cutter Power	600 HP (450 kW)	750 HP (560 kW)

4170 Super-Dragon® Dredge



- Heavy-duty, long life design
- Available as single welded monohull design or 6 piece dismountable hull
- Optional spud carriage and anchor booms

Custom Dredges and Special Features

Large Custom Dredges

Greater than 24" discharge

- For major capital dredging projects
- Up to 15,000 HP (11,250 kW)
- For very high output - up to 82' (25 m) digging depth

Wheel Dragon® Dredges

Dual Wheel Excavators

- Excellent excavation device for hard materials
- Extremely high recovery rates make it standard excavator for many mining applications

Coastal Dragon® Dredges

Hulls with additional freeboard

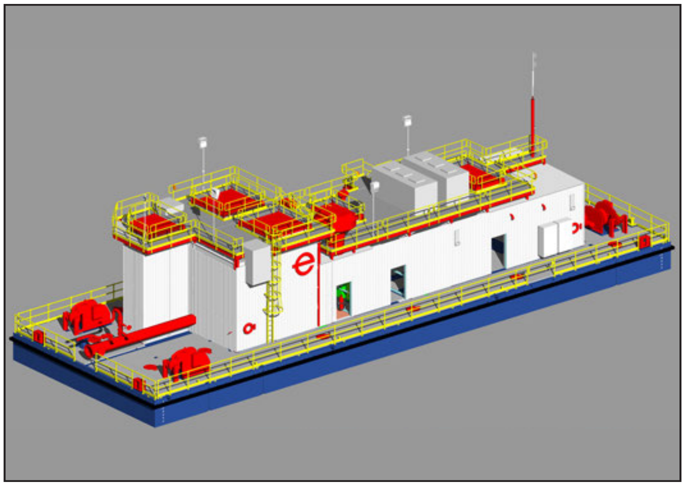
- Suitable for coastal service

Electric Dredges

Available in all sizes

- Built to meet any customer or Ellicott specifications

Pump Barges



Ellicott offers custom pumping solutions and operating platforms for dredges, barges, boosters, e-houses and substations configured to client's requirements. We offer various products and services.

Pumps
- Vertical Cantilever
- Submerged
- Dredge

Power Delivery Options
- Electric
- Diesel
- Combination Drives

Turn-Key Integration
- Automation Controls
- Custom Manufacturing and Delivery Solutions

Engineering Services
- Professional Engineers
- Naval Architects
- Weight/Stability
- Electrical
- Mechanical
- I & C
- Process

Materials Handled
- Water
- Recycled Water (RCW)
- Mature Fine Tailings (MFT)
- Thin Fine Tailings (TFT)

Quality Assurance
- Code Compliance (CSA, CEC, ABC, TC, etc.)
- Manufacturing Controls (WPS, MTR, Witnessed Testing, etc.)

Custom Auxillary Systems
- Hydraulics
- HVAC
- Cooling Systems
- Heat Trace and De-Icing Systems
- Marine Cranes

Booster Pumps

Ellicott's heavy-duty booster pump stations are designed and built for high efficiency in a wide range of dredging conditions. Each booster station adds head to the pumping system so the dredge can maintain optimum production at longer pipeline distances.

- 325 HP - 2,000 HP
- Standard units available in 10-20" (250 - 600mm)
- Skid mounted or floating
- Electric or diesel

About the Company

Purchasing a dredge is a major decision. Choosing the right size and model is important, but so is selecting the company who builds it. The supplier should support you with service, parts, training, and upgrades, all necessary to keep the dredge operating efficiently for 25 years or more. Ellicott has a long history of living up to these expectations, and its dredges have proven to be sound investments.

This tradition started in 1885 when Charles Ellicott started a machine shop in the growing city of Baltimore, Maryland. Business thrived, and in 1888 he was approached by a local contractor and asked to design and build new machinery for a dredge that was struggling in nearby Washington, DC. At that time, hydraulic dredging was still in its infancy and effective designs were still being explored.

Combining his engineering knowledge and manufacturing expertise, Mr. Ellicott supplied one of the first true dredge pumps and other specialized components. This retrofitted dredge was productive, reliable and well suited to its task. Word got around and soon others started coming to Mr. Ellicott for complete dredges.

By 1907 the U.S. Corps of Engineers took notice and purchased four dredges for the largest construction project ever undertaken—the Panama Canal. The successful performance of these machines led to "Ellicott" becoming a name known all over the world for strong, capable, and versatile dredges.

Ellicott has grown to become one of the world's largest dredge manufacturers, and while its products incorporate the best available technology, they are sold under the basic principles established by Mr. Ellicott over a century ago:

- Supply dredges designed to meet the customer's requirements and build them to the highest standards
- Provide training and continuous service for every dredge

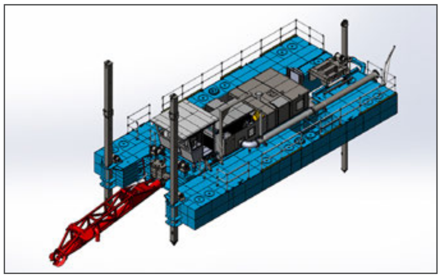
This tradition of offering modern, efficient, and well-built dredges continues today as Ellicott dredges find their way to all corners of the world.

Ellicott plant in Baltimore, MD

Ellicott's other facility in New Richmond, WI

Inside New Richmond, WI factory

State-of-the-art dredge simulator



3D CAD engineering model

Dredge operator control systems

Ellicott Dredges
1611 Bush Street
Baltimore, MD 21230
www.dredge.com

Contact Us
Ph: 1-410-545-0232
Fax: 1-410-545-0293
Email: sales@dredge.com

ELLICOTT DREDGES LLC   EST. 1885

1611 Bush Street • Baltimore, Maryland 21230 • Ph 410-625-0808

www.dredge.com
smiller@dredge.com

Current Contracts for New Dredging Equipment in Process

Ellicott Dredges is the supplier of choice for any size Government contract. Our equipment is designed to navigational dredging applications and knows to provide many years of trouble free operation backed by established professional company.   Here is example of contracts from Government entities which are currently in process.

- Barnstable County MA – Custom 850S dredge   (Delivered November 2017)
County waterways and shoreline replenishment
Repeat client since 1980's

-Suffolk County NY – 460SL   (Delivered December 2017)
County waterways and beach fill
Repeat client since 1990's

-Edgartown Mass – 370HP   (Delivered November 2017)
County waterway's and beach fill
Repeat customer since 2000

-State of Ohio – Two custom booster pumps   (Delivered December 2017)
State owned lakes and flood control pools
Repeat customer since 1960's

-Federal Department of Interior -Custom 860SL dredge and support boat
Colorado River Dredging
Repeat client since 1950's   (Delivery January 2018)

-State of New York Custom 1270 Dredge
Erie Canal Maintenance
Repeat client since 1930's   (Delivery June 2018)

Above contracts were competitive bid and based on value added to government entity

Ellicott Dredges LLC
Demonstration of Firm's Experience

Customer: **The State of Ohio, Division of Parks and Recreation**
Contact: Tom Grabow, Dredging Superintendent
Tel. 419-394-3611, Tom.grabow@dnr.state.oh.us
2045 Morse Road, Columbus, OH 43229

Dredge Models: **Two (2) 460SL 12" Discharge Combination Conventional and Swinging Ladder Dredges**
Contract# DNR01-26444 Date: November 2013 Type: State open bid RFP firm fixed contract
Initial Contract Amount: $1,790,000.00 Final Contract Amount $1,790,000.00
Scope of Work: Design, Build, Delivery & Onsite Commissioning
Project Schedule: Date of Contract: 11/06/13 Delivery Required: Early July 2014
Date of Completion: July 9, 2014

460SL 10" Combination Conventional / Swinging Ladder Dredge

Ellicott's relationship with **State of Ohio** dates back to the early '60s, with over 12 dredges to date delivered to the State's **Ohio Department Natural Resources (ODNR)** program. Ellicott has been successful in recent supply of the State competitive bid contracts totaling four (4) modern 460 series dredges. Ellicott continuously supports the ODNR dredging program with service and parts to maintain the equipment. Ellicott has taken oldest state owned dredges in trade for new equipment providing consideration and handling all aspects of the removal old dredge and delivery of its replacement. Ellicott maintain close working relationship and supports the State annual Dredging Days event as a guest speaker. The State of Ohio's (ODNR) dedicated dredging program annually maintains Lakes located within states park system, dredging operations improve waterway navigation at marina's , entrance channels, and remove phosphate laden sediments to help improve lake water quality and reduce harmful algae blooms. Aside from statewide dredging program the state is actively involved dredge material beneficial reuse programs.

Ellicott Dredges LLC
Demonstration of Firm's Experience

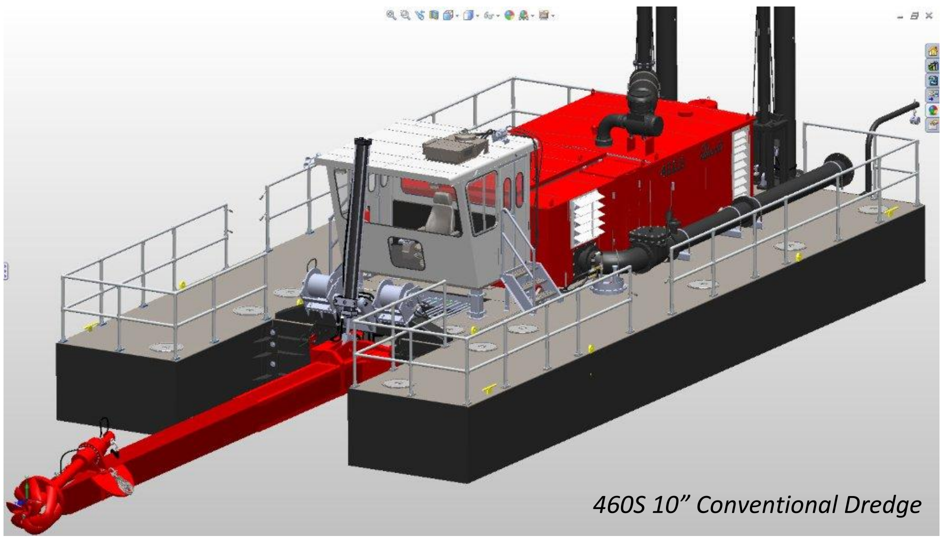
Customer: **The State of Ohio, Division of Parks and Recreation (continued)**

Contact: Tom Grabow, Dredging Superintendent
Tel. 419-394-3611, Tom.grabow@dnr.state.oh.us
2045 Morse Road, Columbus, OH 43229

Other Dredges Supplied to the State of Ohio:

Dredge Model: **460S 10" Discharge Conventional Dredge, Features Extra high Freeboard (loaded min. 24")**

Contract : 501800 Date : March 2012 Type: State Open Bid RFP Firm Fixed Contract
Initial Contract Amount: $668,229.00 Final Contract Amount $668,229.00
Scope of Work : Design , Build, Delivery & Onsite Commissioning
Project Schedule : Date of Contract: 5/11/11 Delivery Required: January 9, 2011
Date of Completion : January 9, 2011 (Client postponed delivery until early spring project start)



460S 10" Conventional Dredge

Dredge Model: **460SL 10" Discharge Combination Conventional and Swinging Ladder Dredge**

Contract# 500625 Date: June 2005 Type: State open bid RFP firm fixed contract
Initial Contract Amount $ 587,000.00 Final Contract Amount: $587,000.00
Scope of Work: Design, Build, Delivery & Onsite Commissioning
Project Schedule: Date of Contract: 6/15/05 Delivery Required: December 2005
Date of Completion: May 5, 2006 (As agreed ODNR staff to support dredging season start)

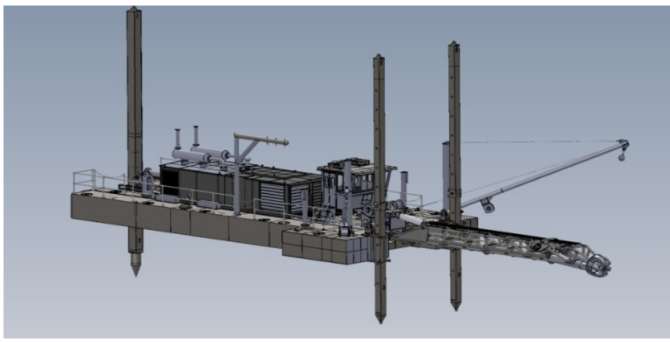
460SL 10" Conventional and Swinging Ladder Dredge

460SL Operator Control Console

Ellicott Dredges LLC
Demonstration of Firm's Experience

Customer: **The Bureau of Reclamation of the US Department of Interior**
Contact: Jim Tate, Dredging Program Mgr., USBR Lower Colorado Region
Tel. 928-343-8555 JTATE@USBR.GOV

Dredge Model: **860SL 12" Discharge Combination Conventional and Swinging Ladder Dredge**
Contract # R10PC34R10 Date: June 2010 Type: Federal Open Bid RFP Firm Fixed Contract
Initial Contract Amount : $3,247,000.00
Final Contract Amount: $4,094,000.00 Client Added Scope
Scope of Work: Design, Build, Delivery, Onsite Commissioning (Dredge, Boosters, Pipe)
Project Schedule: Date of Contract: 6/29/10



Design 860 SL

860 SL in Operation

In 2010, The Bureau of Reclamation of the US Department of Interior selected the newest and most versatile dredge, the 860SL, to maintain settling basins on the lower Colorado River near Yuma, Arizona. The dredge uses biodegradable oil, an engine certified by the US Environmental Protection Agency (EPA) and a fully self-contained system environmentally sound for water, air, and noise pollution. This dredge is operable in a wide range of conditions from cold to hot climates, narrow creeks or channels, as a swinging ladder dredge, or in open water in conventional swing mode. Along with the dredge, Ellicott supplied two boosters, 20,000 ft. of pipeline, and a dredge tender.

Ellicott Dredges has previously supplied dredges to **The Bureau of Reclamation of the US Department of Interior**. Over the years Ellicott has been awarded dredge supply contracts because of quality products, long lasting service, and ease of operation, safety, and service that stays with the dredge owner throughout its life cycle. Dredge "Cibola "10 inch discharge design was supplied in 1997. Since that time, the dredge is still in perfect operating condition and is now owned by private contractor in California.

Original Dredge "Cibola" Series 370SL

Ellicott Dredges LLC
Demonstration of Firm's Experience

Customer: **The State of Delaware**
Contact: Charles (Chuck) Williams, Program Manager, DNREC 302-739-9921
Charles.Williams@state.de.us

Dredge Model: 300SL 8" "Swinging Ladder" Dredge
Contract# 501390 Date: January 2009 Type: Neg. Bid
Initial Contract Amount: $460,000.00 Final Contract Amount $460,000.00
Scope of Work: Supply, Delivery in stock dredge, Onsite Commissioning
Project Schedule: Date of Contract: 1/16/09 Delivery Required: April 2009
Date of Completion: April 2009

Photo of 300 SL in Marina

Photo of DNR 300 SL in Operation

Ellicott Dredges has routinely provided the **State of Delaware** with new equipment to meet its program requirements and has accepted older equipment in trade or exchange.

The **State of Delaware** has owned and solely operated Ellicott dredges for over 40 years to accomplish several critical needs. The State's **Department Natural Resources and Environmental Control (DNREC)** maintains state waterways for navigational safety and restoration of inner bay marsh lands. Together, **The State Delaware** and **DNREC** have successfully owned and operated **six (6) Ellicott** dredges throughout the lifespan of the program:

1. Two 370 Series 10" Cutter Suction Dredges
2. One 970 16" Cutter Suction Dredge
3. One 670 series 12" Cutter Suction Dredge
4. One MC-2000 10" Auger Dredge
5. One 300SL 8" Swinging Ladder Dredge

ELLICOTT DREDGES LLC
GOVERNMENT CUSTOMERS
FEDERAL, STATE, MUNICIPAL, COUNTY & LOCAL

U.S. Federal Government:
U.S. Army, Corps of Engineers
U.S. Dept. of Interior, Bureau of Reclamation
U.S. Agency for International Development (AID)
U.S. International Boundary & Water Commission
U.S. Dept. of Commerce (Baltimore Dredges was a customer of DOC thru its Gold Key Service)
TVA Tennessee Valley Authority, TN

Port Authorities:
Port of Houston Authority, TX

States:
State of Ohio, Dept. of Natural Resources & Dept. of State Parks
State of Delaware
State of Washington
State of Oregon
State of New York, Canal Authority
State of Illinois, Fox Waterway Agency
State of Maryland, Dept. of National Parks & Planning
State of South Dakota, Dept. of Lakes & Parks
State of Texas
Gulf Coast Authority
Parks & Recreation Department

Municipalities/Cities
City of Baltimore, MD
City of Chicago, IL
City of Colorado Springs, CO
City of Pocatello, ID
City of San Jose, CA
City of Grants Pass, OR
City of Mandan, ND
City of Muscatine, IA
City of Beaumont, TX
City of Decatur, IL
City of Muscle Shoals, PA
Town of Hempstead NY

Municipalities/Cities (Cont.)
City of Pittsburgh, PA
City of Virginia Beach, VA
City of Borrough/Belmar, NJ
City of Goleta, Sanitary District, CA
City of Palmer, AK
City of Eugene, OR
City of Stockton, CA
City of Bellevue, NE
City of Birmingham, AL
City of Columbia, MO
City of Franklin, IN
City of Hart, MI
City of Memphis, TN
City of Sioux Falls, SD
City of Denton, TX
City of St. Peters, MO
City of Cape Coral, FL
City of Cocoa Beach, FL
City of Ellenburg, WA
City of Mexico Beach, FL
City of Philadelphia

Counties & Local:
County of Barnstable, MA
County of Sacramento, CA
County of Suffolk, NY
Warren County Soil & Water, NY
Town of Edgartown, MA
Orange County Water District, CA
Newberry County Water & Sewage, SC
Jackson County, MO
Jarratt Waste Water Treatment Plant, VA
Palisades Interstate Park, NJ
Foothills Waste Water Treatment Plant, CA
Township of Howell NJ
Hillsboro FL. Inlet District

This is a representative sample – not complete

Thinking About Starting Your Own Dredging Program?

The recent uncertainties in Federal funds for dredging leave municipalities with the critical challenge of how they will handle their erosion problems. Many counties and states now have their own in-house dredging programs which have proven successful – yours can be too. Here are some benefits:

- Project planning within your control on a quarterly, annual, or 5-year plan.
- Tailor projects more to your own needs, since you own the equipment and can plan on annual operative funds.
- Dredges can be used for multiple purposes—shore protection, waterway depth control, marina dredging.
- Be self-reliant with a program that is controlled at the local level and is cost efficient.
- Start up operations when needed, and quicker response to emergencies.

Virginia Beach DPW

Delaware DNR

State/County/Municipality Owned Dredging Programs

Hillsboro Inlet Commission, Florida

Barnstable County, Massachusetts

Ohio DNR

New York State

Other Government Entities Not Shown:

Boro of Belmar, New Jersey • City of Cape Coral, Florida • City of Boca Raton, Florida • Maryland National Capital Park and Planning Commission • New Castle County, Delaware • North Carolina Department of Transportation • State of North Carolina • Suffolk County, New York • Town of Edgartown, Massachusetts • U.S. Bureau of Reclamation, Arizona

Ellicott DREDGES

ELLICOTT HAS THE ANSWER

USA – Ellicott Dredges is pleased to announce that they were recently awarded three significant contracts with the U.S. government.

The first contract is for a customized Ellicott 860SL Swinging Dragon® dredge and support boat for the U.S. Bureau of Reclamation (USBR). This dredge will be used to increase depth and restore water flow in the Colorado River, and to create wetland habitats. One of the primary objectives of this program is multi-species conservation, including birds, fish, turtles, insects, and plants.

Ellicott 860SL Swinging Ladder Dredge

860SL Swinging Ladder Specs	
Total Installed Power	800 HP (600 kW)
Cutter Power	80 HP (60 kW)
Pump Power	625 HP (470 kW)
Discharge Diameter	14” (355 mm)
Max. Digging Depth	30 ft. (9 m)

Ellicott has already supplied multiple dredges to the USBR for the Colorado River management project.

Barnstable County

Ellicott designed a new dredge – **the 14” Bay Dragon** – for Barnstable County, Massachusetts. The Bay Dragon® series is a modernized line of Ellicott’s 10-20” portable cutter suction dredges.

This dredge will be used to maintain small harbors and inlets with beneficial reuse of the sand for beach restoration. It is a step up from their smaller Ellicott dredge, a Series 670 model named the "COD FISH," which Barnstable has reliably operated for over 20 years.

Ellicott's new Bay Dragon Series

Barnstable requested several customized features, including an integrated spud carriage, which allows for better positioning and therefore more precise and efficient cutting. Additionally, the dredge has a raked bow and tow points, which allow for convenient low-drag towing. The dredge is capable of being lifted once fully assembled, and was customized for Barnstable's crane to allow the dredge to be launched by crane rather than a slipway.

14" Bay Dragon Series Specs	
Total Installed Power	850 HP (640 kW)
Cutter Power	100 HP (75 kW)
Pump Power	700 HP (520 kW)
Pump Diameter	14" x 14" (355 mm x 355 mm)
Max. Digging Depth	40 ft. (12 m)

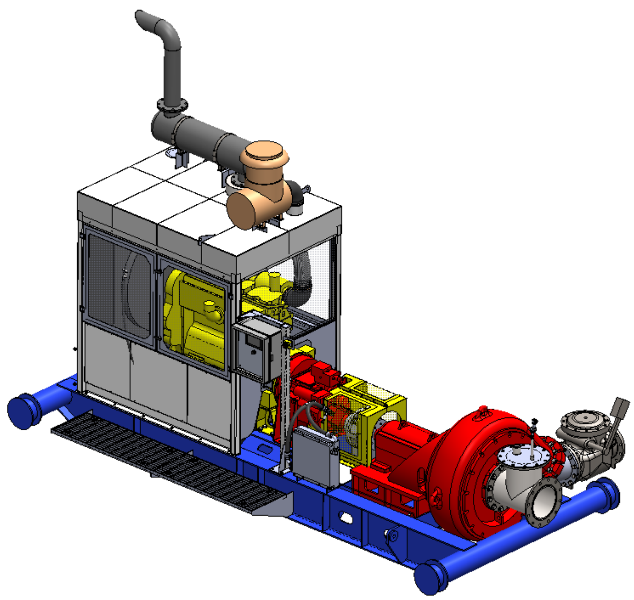
Other new features of the Bay Dragon Series include:

- Tier 3 compliant marine engine
- Inline drive train with a marine transmission
- A new hydraulic system, designed in-house, that reduces power and fuel consumption by approximately 10% and increases operating efficiency by 20%.

- Modern electric over hydraulic control system using Parker IQAN for increased reliability.
- Easy-to-use joystick controls mounted in the operator's control chair

State of Ohio

Ellicott will supply two fully customized booster pump stations for the State of Ohio. These boosters will be used to support the multiple state-owned Ellicott 460SL swinging ladder dredges. They are equipped with remote wireless automation and a monitoring station for use on the dredges.



An Ellicott Booster Pump Station

Features of the booster pumps include:

- 12" L-36 hard iron dredge pump with adjustable liner
- Caterpillar Engine – 540 HP (400 kW), bio-diesel compatible
- Inline marine gear transmission
- Double-walled fuel tank
- Local analog gauges and controls
- Advanced controls and vibration monitoring system

Ellicott is the leading provider of innovative dredging systems and solutions to meet their customers' needs. For more information, please contact sales@dredge.com.

Ellicott® Announces Two New Dredge Simulators

After two years of development, Ellicott Dredges is pleased to announce the start-up of two new dredging simulators, one for cutter dredges and one for auger dredges. Both are available for immediate use. These simulators are the most modern dredge simulator systems in North America, and will be used in conjunction with Ellicott's existing dredge training program. Auger dredge training is available at Ellicott's Wisconsin USA factory.

The simulators are equipped with three large panoramic screens to replicate the actual view from the operator's control room, a control center replicating actual interactive dredge controls along with gauges, and an operator chair. This system provides a realistic experience for the operator to familiarize himself with the equipment and to learn how to operate the dredge properly for maximum production. For training at Ellicott's headquarters in Baltimore, MD, cutter dredge operators will use a simulator that is based on the physical dimensions of an Ellicott 1270 Dragon® Dredge. Although it depicts the control cab of a 16-18" dredge, the simulator is appropriate for all portable cutter dredge operators. This will be a valuable tool in training users how to operate their dredge safely and more efficiently.

Cutter dredge simulator with three 42" (107 cm) screens

One of the most significant benefits of the simulator is that with advance planning operators will be able to begin training before a dredge is fully built and delivered. Generally it can take weeks for operator training in the field, which ties up the entire dredging system. However, a few days of training with this simulator will enable the operator to use his or her dredge immediately after delivery, improving productivity and reducing down time.

Additionally, proper training on how dredges work will lead to fewer problems and therefore less unscheduled maintenance during operation. The simulator will show how the various gauges such as suction and discharge pressure affect production. This knowledge is crucial in achieving the highest possible output.

Ellicott portable cutter dredge simulator control stand

Mark Heimberger, Ellicott's Senior Field Service Engineer, adds, "We see this as a benefit not only in training dredge operators, but also in offering hands-on experience for plant superintendents, company owners, and municipalities wanting to gain a better understanding of variables that impact production and bottom line operations of their dredging projects."

Ellicott offers this training not only to new Ellicott dredge owners, but to all cutter dredge operators. Brief simulator tours are also available for group and individual visits by appointment.

A full list of simulator features and specifications is attached.

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT B
INTERNATIONAL DREDGE FLEET

			Trailing Suction Hopper	Trailing Suction Hopper - Mining	Suction Hopper	Cutter Suction	Cutter Suction/ Auger	Cutter Suction/ Auger - Mining	Cutter Suction/ Suction Hopper	Airlift	Suction, Plain	Suction, Plain - Mining	Suction Dustpan	Water Injection	Bucket Wheel Suction	Bucket Wheel Suction - Mining	Bucket Ladder	Bucket Ladder - Mining	Bucket Ladder - with Hopper	Bucket Clamshell - Hopper	Bucket Clamshell - Floating Grab	Floating Grab/ Clamshell	Floating Grab/ Clamshell with Hopper	Plough	Hydraulic Offloader	Bucket Dipper/ Dragline	Bucket Backhoe	Bucket Backhoe/Floating Clamshell
Region	Nation	No. of Dredges	TH	TH/M	SH	CS	CS/A	CS/A/M	CH/SH	SA	S	S/M	SD	SJ	BWS	BWS/M	BL	BL/M	BL/H	BC/H	BC/G	BG/C	BG/H	Plough	HO	BD	BB	BB/BC
Africa-Middle East	Bahrain	3	1	2																								
	Egypt	35	3		1	23					1				4							3						
	Gambia	1																				1						
	Iran	10	6			3																	1					
	Israel	9	1			1	2								3							1					1	
	Jordan	1						1																				
	Kuwait	3				2																				1		
	Morocco	6	3			2																1						
	Mozambique	4	2																								1	1
	Namibia	2				1										1												
	Nigeria	1	1																									
	Saudi Arabia	12	3			7										1											1	
	South Africa	6																										
	United Arab Emirates	16				14					2																	
Asia-SE Asia	Australia	21	1			13				1						4						1					1	
	Bangladesh	2			1																		1					
	China	92	45			31	1						1			1	3					5	3			1	1	
	India	60	19		3	17		3	1										1			11	3				2	
	Indonesia	63	2			24					1							32									1	3
	Japan	53	4			27					13											5					1	3
	Korea (South)	33	1			11									4							6					2	9
	Malaysia	46	9			11					2							5		2	1	7		1			4	4
	Maldives	1				1															0							
	Myanmar	7	1												1						5							
	New Zealand	7	2			2																2						1
	Pakistan	5	1			2											2											
	Philippines	27	4			20																	2			1		
	Sri Lanka	6	1			3																	2					
	Taiwan	17	2			12																	3					
	Thailand	8	3			2												1				1					1	
Europe	Belgium	65	24			21								3			5										7	
	Denmark	34	17		2						1						2			6					1		5	
	Finland	7				2					1						1					1					2	
	France	26	12		2	4					1						1						4				1	
	Germany	28	8			3				4							4						1			3	5	
	Greece	5				2																3						
	Iceland	2	2																									
	Ireland	12									6												6					
	Italy	6			2	2											1						1					
	Luxemburg	89	29			15																					6	
	Netherlands	170	34			22					16		1	9			2					3	2				8	
	Portugal	1																					1					
	Russia	11	2		9																							
	Spain	17	1		1	3											2				1	4	3				2	
	Turkey	18				5											5										8	
	Ukraine	22	1	8	1												6					6						
	United Kingdom / Englan	58	7	21	4	1			3		1						3				1	2	11				4	
	Scotland / UK	6	1																			1				1		
North America	Canada	92	4			39			1	2											32	5				6	3	
	Mexico	5				4									1													

Region	Nation	Dredge No.	Trailing Suction Hopper TH	Trailing Suction Hopper - Mining TH/M	Suction Hopper SH	Cutter Suction CS	Cutter Suction/ Auger CS/A	Cutter Suction/ Auger - Mining CS/A/M	Cutter Suction/ Suction Hopper CH/SH	Airlift SA	Suction, Plain S	Suction, Plain - Mining S/M	Suction Dustpan SD	Water Injection SJ	Bucket Wheel Suction BWS	Bucket Wheel Suction - Mining BWS/M	Bucket Ladder BL	Bucket Ladder - Mining BL/M	Bucket Ladder - with Hopper BL/H	Bucket Clamshell - Hopper BC/H	Bucket Clamshell - Floating Grab BC/G	Floating Grab/ Clamshell BG/C	Floating Grab/ Clamshell with Hopper BG/H	Plough Plough	Hydraulic Offloader HO	Bucket Dipper/ Draglline BD	Bucket Backhoe BB	Bucket Backhoe/Floating Clamshell BB/BC
North America	United States																											
	Alabama	1				1																						
	Arizona	3				3																						
	Arkansas	11						6				3	1														1	
	California	15	1								1				1			1				11						
	Colorado	2										2																
	Connecticut	6																				3	1				2	
	Delaware	2				2																						
	Florida	44				31	7					2										4						
	Georgia	1						1																				
	Idaho	9				2	5	1				1																
	Illinois	34	7			17		2				3										4					1	
	Indiana	10				5	2					3																
	Iowa	13				4	2	2				3										2						
	Kansas	3						3																				
	Louisiana	21				10																8				2	1	
	Massachusetts	13	1			1																6			1		4	
	Michigan	35				7	1															25					2	
	Minnesota	4					2															1					1	
	Mississippi	2										2																
	Missouri	11				3	2	6																				
	Nebraska	3						3																				
	New Jersey	28	2			10	2					1		1								12						
	New York	46				15															9	3				1	4	
	North Carolina	10						6				4																
	Ohio	29				16		2										1		1		4				1	4	
	Oregon	14				14																						
	Pennsylvania	6		2		1												1		2								
	South Carolina	17				12																5						
	South Dakota	4				4																						
	Tennessee	8				8																						
	Texas	47				23		8			1											11						
	Virginia	16	2			11															3							
	Washington	29				4															21	4						
	Wisconsin	34				10															7	7					5	
	USACE	11	4		2	1					1		3															
	Puerto Rico	3				2	1																					
South & Central America - Caribbean	Argentina	19			9	10																						
	Brazil	28				24										4												
	Colombia	23	1			15										2		4									1	
	Guyana	2	1																			1						
	Panama	5				2															1					1	1	
	Trinidad	3				2																1						
	Uruguay	6	2			2											2											
	Venezuela	12	4			8																						
INTERNATIONAL TOTAL		1874	282	33	37	632	27	44	5	7	48	24	6	13	14	13	39	45	1	11	81	181	45	1	2	18	94	21
PERCENT OF INTERNATIONAL TOTAL			16%	2%	2%	37%	2%	3%	0%	0%	3%	1%	0%	1%	1%	1%	2%	3%	0%	1%	5%	10%	3%	0%	0%	1%	5%	1%
NATIONAL (U.S.) TOTAL		545	17	2	2	217	24	40	0	0	3	24	4	1	1	0	0	3	0	3	40	110	1	0	1	4	25	0
PERCENT OF NATIONAL (U.S.) TOTAL			3%	0%	0%	42%	5%	8%	0%	0%	1%	5%	1%	0%	0%	0%	0%	1%	0%	1%	8%	21%	0%	0%	0%	1%	5%	0%

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT C
AIWW/ICWW MAINTENANCE DREDGING HISTORY

AIWW/ICWW HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans and USACE Dredging Records

REACH	REACH LENGTH (Miles)	CUT/STATION		DREDGED MATERIAL MANAGEMENT AREA		HISTORICAL MAINTENANCE VOLUME (cy)	RECENT SURVEY SHOAL VOUME (cy)	TOTAL CY (HISTORICAL + 2014 SURVEY)	VOLUME (cy/ year)	VOLUME (cy/ year/mile)	50-YEAR DREDGING REQUIREMENT (cy)	50-YEAR STORAGE REQUIREMENT (cy)	NUMBER OF DREDGING EVENTS BY REACH	HIGH SHOALING RATE REACHES
		From	To	Site Name	Constructed									
KINGS BAY ENTRANCE CHANNEL & FERNANDINA HARBOR														
N-FHP	3.74	N-FHP-10/STA 27+87.546	N-FHP-1/STA 0+00.0	Undefined		18,392	11,354	29,746	407	109	20,374	43,804	1	
NA-1	10.20	C/STA 18+19.188	27D/STA 0+00.0	NA-1	X	377,580	23,763	401,343	5,498	539	274,892	591,019	5	
NA-II	1.65	27C/STA 26+95.94	27A/STA 0+00.0	Amelia Island State Park	BEACH	812,588	2,619	815,207	11,167	6,768	558,361	1,200,476	7	
NASSAU TOTAL	**15.59**	**N-FHP-10/STA 27+87.546**	**27A/STA 0+00.0**	**DMMA: 1 ; BEACH: 1**		**1,208,560**	**37,736**	**1,246,296**	**17,073**	**1,095**	**853,627**	**1,835,299**	**13**	Sawpit
DU-III	6.19	27/STA 70+55.894	11/STA 0+00.0	DU-2	X	1,107,043	45,342	1,152,385	16,005	2,577	800,267	1,720,575	9	
				DU-3&4 (AKA MSA 300E/DU-20)										
DU-IV	4.24	10/STA 21+13.432	1/STA 0+00.0	DU-6A & 6B	X	265,756	77,938	343,694	4,774	1,128	238,676	513,154	6	
MAYPORT, MARINE CORPS TERMINAL - BLOUNT, JACKSONVILLE HARBOR														
DU-V	3.93	DU-1/STA 0+00.0	DU-6/STA 75+61.795	DU-7		34,529	13,571	48,100	763	194	38,175	82,076	2	
DU-VI	3.88	DU-7/STA 0+00.0	DU-15/STA 22+23.404	DU-8	X	105,830	5,351	111,181	1,765	455	88,239	189,714	9	
DU-VII	4.00	DU-16/STA 0+00.0	SJ-3/STA 37+26.837	DU-9	X	790,012	29,237	819,249	13,004	3,251	650,198	1,397,926	9	
DUVAL TOTAL	**22.24**	**27/STA 70+55.894**	**SJ-3/STA 37+26.837**	**DMMA: 6 ; BEACH: 0**		**2,303,170**	**171,439**	**2,474,609**	**36,311**	**1,633**	**1,815,555**	**3,903,443**	**35**	
SJ-I	6.29	SJ-4/STA 0+00.0	SJ-7/STA 32+44.738	SJ-14	X	1,149,140	79,144	1,228,284	19,811	3,155	990,552	2,129,686	4	
SJ-II	7.86	SJ-8/STA 0+00.0	SJ-15/STA 26+38.373			507,089	61,518	568,607	9,171	1,167	458,554	985,891	3	
SJ-III	11.86	SJ-16/STA 0+00.0	SJ-32/STA 10+95.253	SJ-29		123,345	6,223	129,568	1,993	168	99,667	214,285	1	
				St. Augustine Inlet Beach Placement Area (SJ-SAI)	BEACH									
ST. AUGUSTINE INLET & ST. AUGUSTINE, PORT, WATERWAY, & BEACH DISTRICT														
SJ-IV	10.90	SJ-33/STA 0+00.0	SJ-49A/STA 33+44.637	SJ-20A		-	18,600	18,600	300	28	15,000	32,251	0	
SJ-V	7.81	SJ-51/STA 0+00.0	F-1/STA 15+07.447	SJ-1	X	3,963,829	55,418	4,019,247	61,835	7,917	3,091,728	6,647,216	21	Matanzas
				Matanzas Inlet Beach Placement Area (SJ-MB)	BEACH									
ST JOHNS TOTAL	**44.72**	**SJ-4/STA 0+00.0**	**F-1/STA 15+07.447**	**DMMA: 4 ; BEACH: 2**		**5,743,403**	**220,902**	**5,964,305**	**93,110**	**2,082**	**4,655,501**	**10,009,328**	**29**	
FL-I	4.44	F-2/STA 0+00.0	F-10/STA 12+52.502	FL-3	X	262,390	47,491	309,881	4,998	1,131	249,904	537,293	4	
FL-II	3.80	F-11/STA 0+00.0	F-19/STA 12+87.847	FL-8		588,120	14,185	602,305	9,715	2,563	485,730	1,044,320	3	
FL-III	5.84	F-20/STA 0+00.0	F-26A/STA 8+00.005	FL-12		-	23,936	23,936	386	66	19,303	41,502	0	
FL-IV	4.06	F-27/STA 0+00.0	F-32/STA 50+02.694			-	20,947	20,947	338	83	16,892	36,319	0	
FLAGLER TOTAL	**18.14**	**F-2/STA 0+00.0**	**F-32/STA 50+02.694**	**DMMA: 3 ; BEACH: 0**		**850,510**	**106,559**	**957,069**	**15,437**	**851**	**771,830**	**1,659,434**	**7**	
V-I	10.16	V-1/STA 0+00.0	V-9/STA 11+00.0	MSA 410		57,406	195,902	253,308	4,691	462	234,544	504,270	1	
				V-6 (MSA 426/428)										
V-II	5.82	V-9/STA 11+00.0	V-13/STA 14+00.0	V-25		-	14,435	14,435	267	46	13,366	28,736	0	
V-III	4.85	V-13/STA 14+00.0	V-19/STA 58+50.0	V-29	X	60,835	11,351	72,186	1,337	276	66,838	143,703	1	
V-IV	10.98	V-19/STA 58+50.0	V-36/STA 12+00.0	MSA 434/434N		5,442,527	64,320	5,506,847	101,979	9,288	5,098,933	10,962,706	16	Ponce de Leon Inlet
				MSA 434/434S	X									
				Volusia Ponce deLeon Inlet Beach Placement Area (V-PDI)	BEACH									
PONCE DE LEON INLET & VOLUSIA COUNTY PONCE DE LEON INLET PORT AUTHORITY														
V-V	10.58	V-36/STA 12+00.0	V-43/STA 96+85.28	V-26	X	523,876	61,286	585,162	10,836	1,024	541,817	1,164,906	5	
				V-21										
V-VI	10.09	V-44/STA 0+00.0	V-46/STA 268+97.811	V-22A		-	115,666	115,666	2,142	212	107,098	230,261	0	
VOLUSIA TOTAL	**52.48**	**V-1/STA 0+00.0**	**V-46/STA 268+97.811**	**DMMA: 9 ; BEACH: 1**		**6,084,644**	**462,960**	**6,547,604**	**121,252**	**2,310**	**6,062,596**	**13,034,582**	**23**	
BV-I	7.74	BV-1/STA 0+00.0	BV-6/STA 37+74.333	BV-2C	X	1,483,778	152,640	1,636,418	30,304	3,915	1,515,202	3,257,684	5	
BV-II	11.94	BV-7/STA 0+00.0	BV-14/STA 88+79.768	BV-4B		101,111	127,578	228,689	4,235	355	211,749	455,261	1	
				BV-NASA	X									
BV-III	11.06	BV-15/STA 0+00.0	BV-19/STA 75+00.0	BV-11		42,980	55,008	97,988	1,815	164	90,730	195,069	1	
BV-IV	11.11	BV-19/STA 75+00.0	BV-24/STA 44+00.0	BV-R		-	24,250	24,250	449	40	22,454	48,275	0	
BV-V	12.69	BV-24/STA 44+00.0	BV-26/STA 392+55.337	BV-40		-	6,498	6,498	120	9	6,017	12,936	0	
				BV-52	X									
BV-VI	13.47	BV-27/STA 0+00.0	BV-37/STA 36+72.479	BV-24A		-	128,816	128,816	2,385	177	119,274	256,439	0	
BREVARD TOTAL	**68.01**	**BV-1/STA 0+00.0**	**BV-37/STA 36+72.479**	**DMMA: 8 ; BEACH: 0**		**1,627,869**	**494,790**	**2,122,659**	**39,309**	**578**	**1,965,425**	**4,225,664**	**7**	

						SEBASTIAN INLET & SEBASTIAN INLET DISTRICT								
IR-I	8.09	IR-1/STA 0+00.0	IR-6/STA 20+00.0	IR-2	X	276,311	-	276,311	4,848	599	242,378	521,113	1	
IR-II	6.96	IR-6/STA 20+00.0	IR-24/STA 28+00.0	IR-7A		-	10,845	10,845	190	27	9,513	20,453	0	
						CANAVERAL HARBOR								
IR-III	8.27	IR-24/STA 28+00.0	IR-35/STA 31+50.0	IR-14		-	22,956	22,956	403	49	20,137	43,294	0	
INDIAN RIVER TOTAL	**23.32**	**IR-1/STA 0+00.0**	**IR-35/STA 31+50.0**	**DMMA: 3 ; BEACH: 0**		**276,311**	**33,801**	**310,112**	**5,441**	**233**	**272,028**	**584,860**	**1**	
SL-I	8.81	IR-35/STA 31+50.0	SL-5/STA 77+60.0	SL-2	X	2,381	6,259	8,640	157	18	7,855	16,887	1	
						FT PIERCE HARBOR								
SL-II	12.91	SL-5/STA 77+60.0	SL-6/STA 373+50.0	M-8		73,777	8,878	82,655	1,425	110	71,254	153,197	3	
ST LUCIE TOTAL	**21.72**	**IR-35/STA 31+50.0**	**SL-6/STA 373+50.0**	**DMMA: 2 ; BEACH: 0**		**76,158**	**15,137**	**91,295**	**1,582**	**73**	**79,109**	**170,084**	**4**	
M-I	4.34	SL-6/STA 373+50.0	M-1/STA 190+00.0	M-12		-	1,727	1,727	34	8	1,693	3,640	0	
M-II	4.07	M-1/STA 190+00.0	M-7/STA 17+48.951	M-5 St. Lucie Inlet Beach Placement (M-SLI)	X BEACH	615,183	28,428	643,611	12,620	3,101	630,991	1,356,631	10	Crossroads
						ST. LUCIE INLET								
M-III	6.00	M-8/STA 0+00.0	M-16/STA 32+93.638	MSA 504B/E		19,286	15,039	34,325	673	112	33,652	72,352	1	
M-IV	7.84	M-17/STA 0+00.0	P-1/STA 31+20.0	MSA 524B		-	3,426	3,426	67	9	3,359	7,221	0	
MARTIN TOTAL	**22.25**	**SL-6/STA 373+50.0**	**P-1/STA 31+20.0**	**DMMA: 4 ; BEACH: 1**		**634,469**	**48,620**	**683,089**	**12,650**	**569**	**669,695**	**1,439,844**	**11**	
						JUPITER INLET & JUPITER INLET DISTRICT								
PB-I	3.65	P-1/STA 31+20.0	P-13/STA 34+44.42	Jupiter Inlet Beach Disposal Area (PB-JB)	BEACH	1,428,972	6,752	1,435,724	27,089	7,422	1,354,457	2,912,082	17	Jupiter
PB-II	7.52	P-15/STA 0+00.0	P-31/STA 35+51.484	MSA 610/611 MSA FO-617C		847,756	13,237	860,993	16,245	2,160	812,258	1,746,354	2	
PB-III	17.12	P-32/STA 0+00.0	P-46/STA 9+96.441	Peanut Island	X	233,277	14,886	248,163	4,682	274	234,116	503,349	4	
						PALM BEACH HARBOR								
PB-IV	18.50	P-47/STA 0+00.0	P-91/STA 17+15.198	Boynton Inlet Beach Disposal Area (PB-BB) MSA 640/640A MSA 641 MSA 684A	BEACH X 	687,582	13,759	701,341	13,233	715	661,642	1,422,531	2	
PALM BEACH TOTAL	**46.79**	**P-1/STA 31+20.0**	**P-91/STA 17+15.198**	**DMMA: 6 ; BEACH: 2**		**3,197,587**	**48,634**	**3,246,221**	**61,249**	**1,309**	**3,062,473**	**6,584,316**	**25**	
						HILLSBORO INLET & HILLSBORO INLET DISTRICT								
BW-I	4.74	BW-1/STA 0+00.0	BW-22/STA 29+75.238	MSA 726, 726B, 726C Hillsoboro Inlet Beach Placement Area (B-HI)	 BEACH	-	9,781	9,781	192	40	9,589	20,617	0	
BW-II	7.05	BW-23/STA 0+00.0	BW-32/STA 15+25.218	MSA FO-727B		-	2,119	2,119	42	6	2,077	4,467	0	
						PORT EVERGLADES								
BW-III	13.20	BW-33/STA 0+00.0	BW-63/STA 58+15.579	Port Everglades (MSA 783)		179,743	197	179,940	3,528	267	176,412	379,285	1	
BROWARD TOTAL	**24.99**	**BW-1/STA 0+00.0**	**BW-63/STA 58+15.579**	**DMMA: 3 ; BEACH: 1**		**179,743**	**12,097**	**191,840**	**3,762**	**151**	**188,078**	**404,369**	**1**	
DA-I	3.99	DA-1/STA 0+00.0	DA-7/STA 20+86.105	D-29		-	13	13	0	0	14	31	0	
DA-II	3.99	DA-8/STA 0+00.0	DA-9/STA 178+50.0	Bakes Haulover Inlet Beach Placement Area (D-BHI)	BEACH	418,102	108	418,210	9,294	2,329	464,678	999,057	7	Bakers Haulover
DA-III to END of FEDERAL PROJECT	8.89	DA-9/STA 178+50.0	D-3/STA 57+80.0	D-29		-	26	26	1	0	29	62	0	
DA-I to END of FEDERAL PROJECT	16.87	DA-1/STA 0+00.0	D-3/STA 57+80.0	DMMA: 2 ; BEACH: 1		418,102	147	418,249	9,294	286	464,721	999,150	7	
						END OF FEDERAL PROJECT - MIAMI HARBOR AND RIVER								
DA-IV	15.75	--	--	D-45		-	-	-	-	-	-	-	0	
DA-V	15.29	--	--	D-45		-	1,574	1,574	35	2	1,749	3,760	0	
MIAMI-DADE TOTAL	**47.91**	**--**	**--**	**DMMA: 1 ; BEACH: 0**		**418,102**	**1,721**	**419,823**	**9,329**	**288**	**466,470**	**1,002,911**	**7**	
						KEY WEST HARBOR								
NASSAU-MIAMI-DADE TOTAL	**408.16 377.12**	**N-FHP-10/STA 27+87.546**	**D-3/STA 57+80.0**	**DMMA: 52 ; BEACH: 9**		**22,600,526**	**1,654,396**	**24,254,923**	**416,504**	**1,020**	**20,862,388**	**44,854,134**	**163**	

NOTE: 377.12 MILES FROM FL-GA BORDER TO END OF FEDERAL PROJECT AT MIAMI HARBOR

OWW HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans and USACE Dredging Records

REACH	REACH LENGTH (Miles)	CUT/STATION		DREDGED MATERIAL MANAGEMENT AREA		HISTORICAL MAINTENANCE VOLUME (cy)	1996 SHOAL VOUME (cy)	TOTAL CY (HISTORICAL + 2014 SURVEY)	VOLUME (cy/ year)	VOLUME (cy/ year/mile)	50-YEAR DREDGING REQUIREMENT (cy)	50-YEAR STORAGE REQUIREMENT (cy)	NUMBER OF DREDGING EVENTS BY REACH	HIGH SHOALING RATE REACHES
		From	To	Site Name	Constructed									
OWW-I	0.99	1/STA 0+00	3/STA 0+00	M-5	X	241,901	20,062	261,963	4,294	4,338	214,724	461,656	13	Crossroads
OWW-II	4.35	3/STA 0+00	9/STA 44+35	O-23		109,766	28,681	138,447	2,270	522	113,481	243,984	8	
OWW-III	4.65	9/STA 44+35	19/STA 19+00	O-35		497,156	73,624	570,780	9,357	2,012	467,852	1,005,883	13	
OWW-IV	5.12	19/STA 19+00	AF/STA 8+08	O-7	X	292,157	22,634	314,791	5,161	1,008	258,025	554,755	13	
CROSSROADS TO ST. LUCIE LOCK TOTAL	**15.11**	**1/STA 0+00**	**AF/STA 8+08**	**DMMA: 3; BEACH: 0 (M-5 accounted for in Martin Reach M-II)**		**1,140,980**	**145,001**	**1,285,981**	**21,082**	**7,880**	**1,054,083**	**2,266,278**	**47**	
St. Lucie Canal	24.02	SLC-1/STA 0+00	SLC-58/1268+23.42	O-7	X	0	40,776	583	583		29,126	48,057		
Route 1	23.13	R1-1/0+00	R1-6/1221+00.94	**EASTERN PORTIONS OF ROUTE 1 & 2:** HD-1 & HD-3 (lakefront offloading sites); LT-4A (long-term storage);		0	410,489	5,864	5,864		293,207	483,791		
Route 2 (Rim Canal)	35.20	RC-1/0+00	RC-74/1858+69.03	**WESTERN PORTIONS OF ROUTE 1 & 2:** HD-4 & HD-6 (lakefront offloading sites); LT-13 (long-term storage)		0	198,205	2,832	2,832		141,575	141,575		
ST. LUCIE LOCK TO PALM BEACH/HENDRY COUNTY LINE TOTAL	**82.35**	**SLC-1/STA 0+00**	**RC-74/1858+69.03**	**DMMA: 2; BEACH: 0 (O-7 accounted for in OWW Reach I-V)**		**0**	**649,471**	**9,278**	**9,278**	**0**	**463,908**	**673,424**	**0**	
OWW TOTAL	**97.46**	**1/STA 0+00**	**RC-74/1858+69.03**	**DMMA: 5; Beach: 0**		**1,140,980**	**794,472**	**1,295,259**	**30,360**	**7,880**	**1,517,990**	**2,939,702**	**47**	

NASSAU COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1986, 2017 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
N-FHP	**3.74**	**11,354**	N-FHP-1/4+89	N-FHP-2/4+00	0.54	2017	30,000	18,392	34,059	1
				N-FHP Total	**0.54**	**2017**	**30,000**	**18,392**	**34,059**	
NA-I	**10.20**	**23,763**	--	--	0.00	1943	***9,179***	10,923	--	5
			--	--	0.00	1945	***16,116***	19,178	--	
			NA-28/72+50	NA-28/53+00	0.37	1952	11,000	***13,096***	35,387	
			NA-30/10+00	NA-29/5+00	0.28	1982	10,500	***12,500***	44,655	
			NA-28/4+00	NA-27Q/9+00	1.32		51,500	***61,311***	46,445	
			NA-27K/21+00	NA-27G/14+00	0.73		68,500	***81,549***	111,723	
			NA-A/11+91	NA-B/11+51	0.44	2017	6,000	36,221	82,320	
			NA-27M/4+16	NA-27G/7+87	1.22		140,000	142,802	117,280	
				Reach NA-I Total	**2.78**	**1943-2017**	**312,795**	**377,580**	**--**	
NA-II	**1.65**	**2,619**	NA-27B/3+00	NA-27A/12+00	0.17	1943	5,480	***6,521***	38,257	7
			NA-27B/3+00	NA-27A/12+00	0.17	1945	9,621	***11,449***	67,167	
			NA-27B/3+00	NA-27A/12+00	0.17	1982	71,000	***84,490***	495,675	
			NA-27C/18+00	NA-27C/0+00	0.34	1997	39,882	47,459	139,213	
			NA-27C/18+00	NA-27C/0+00	0.34	2001	19,033	22,649	66,437	
			NA-27A/20+00	NA-27A/8+00	0.23	2006	238,413	231,728	1,019,603	
			NA-27C/25+50	NA-27C/0+00	0.48	2013	111,173	96,616	200,052	
			NA-AMA-A/5+50	NA-AMA-A/20+00	0.27		237,779	228,977	833,792	
			NA-SB, AMA-B/7+00	NA-SB, AMA-B/20+00	0.25		90,254	82,699	335,885	
			NA-27A/10+00	NA-27A/20+00	0.19				-	
				Reach NA-II Total	**2.61**	**1943-2013**	**822,635**	**812,588**	**--**	**13**
				Reach N-FHP - NA-II Total	**5.93**	**1943-2017**	**1,165,430**	**1,208,560**	**--**	

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2015 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/ year)	Volume (cy/ year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
N-FHP	3.74	18,392	11,354	29,746	407	**109**	20,373.97	43,804	1
NA-1	10.20	377,580	23,763	401,343	5,498	**539**	274,892.47	591,019	5
NA-II	1.65	812,588	2,619	815,207	11,167	**6,768**	558,360.96	1,200,476	7
N-FHP-NA-II	15.59	1,208,560	37,736	1,246,296	17,073	**1,095**	853,627	1,835,299	13

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2015	**2004**	**2000**	**1996**	**1986**
N-FHP	3.74	43,804	--	--	--	--
NA-1	10.20	591,019	796,003	653,228	819,399	429,003
NA-II	1.65	1,200,476	464,717	612,976	266,957	215,215
N-FHP-NA-II	15.59	1,835,299	1,260,720	1,266,204	1,086,356	644,218

DUVAL COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1986, 2018 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
DU-III	6.19	45,342	--	--	0.00	1943	***33,250***	39,568	--	8
			--	--	0.00	1945	***58,381***	69,473	--	
			DU-27/60+50	DU-27/52+00	0.16	1952	9,000	***10,710***	66,937	
			DU-27/18+00	DU-27/11+50	0.12		16,000	***19,040***	158,667	
			DU-26A/6+00	DU-26/2+00	0.17		6,000	***7,140***	42,000	
			DU-23/5+00	DU-21/0+00	0.50		32,000	***38,080***	76,160	
			DU-13/0+00	DU-12/14+50	0.23		4,000	***4,760***	20,696	
			DU-27/65+00	DU-27/57+50	0.14	1957	15,000	15,829	113,064	
			DU-26A/4+00	DU-26/4+00	0.10		6,500	7,417	74,170	
			DU-27/69+00	DU-27/46+00	0.44	1962	23,900	52,006	118,195	
			DU-25/8+60	DU-24/8+00	0.30		5,300	9,530	31,767	
			DU-27/68+66	DU-27/57+66	0.21	1968	8,600	***10,234***	48,733	
			DU-25/8+00	DU-24/14+50	0.17		5,200	***6,188***	36,400	
			DU-11/21+50	DU-11/16+50	0.10		4,000	***4,760***	47,600	
			DU-11/4+00	DU-10/13+00	0.23		12,200	***14,518***	63,122	
			DU-27/70+55	DU-27/8+00	1.18	1982	121,000	***143,990***	122,025	
			DU-26A/4+00	DU-26/8+00	0.02		73,500	***87,465***	4,373,250	
			DU-23/18+00	DU-20/1+00	0.95		43,500	***51,765***	54,489	
			DU-19/18+00	DU-11/9+00	2.54		139,000	***165,410***	65,122	
			DU-11/4+00	DU-9/22+00	0.50		34,000	***40,460***	80,920	
			DU-27/14+00	DU-27/5+00	0.17	2006	3,795	3,789	22,288	
			DU-27/67+00	DU-27/61+00	0.12		1,647	837	6,975	
			DU-26A/2+00	DU-26A/0+00	0.04		167	167	4,175	
			DU-26/5+00	DU-26/0+00	0.10		10,476	10,455	104,550	
			DU-25/11+43	DU-25/0+00	0.21		47,876	44,843	213,538	
			DU-24/5+00	DU-24/0+00	0.09		1,187	909	10,100	
			DU-24/15+27	DU-24/5+00	0.20		9,150	9,097	45,485	
			DU-23/31+50	DU-23/27+00	0.09		182	-	-	

DU-III	**6.19**	**45,342**	DU-22/7+00	DU-22/0+00	0.13	2006	2,357	1,871		1
			DU-21/10+59	DU-21/9+00	0.03		350	-	-	
			DU-20/9+00	DU-20/0+00	0.17		6,603	6,389	37,582	
			DU-19/28+89.85	DU-19/27+00	0.03		437	170	5,667	
			DU-19/2+00	DU-19/0+00	0.04		170	170	4,250	
			DU-18/10+00.12	DU-18/0+00	0.19		7,508	7,456	39,242	
			DU-17/24+37.83	DU-17/0+00	0.47		21,394	21,362	45,451	
			DU-16/17+13.44	DU-16/0+00	0.32		17,858	17,858	55,806	
			DU-15/7+99.55	DU-15/0+00	0.15		3,243	3,138	20,920	
			DU-14/7+20.83	DU-14/0+00	0.14		1,008	1,006	7,186	
			DU-13/7+97.90	DU-13/0+00	0.15		3,310	3,184	21,227	
			DU-12/26+53.90	DU-12/22+00	0.09		651	605	6,722	
			DU-12/7+00	DU-12/0+00	0.13		8,607	8,247	63,438	
			DU-11/23+61	DU-11/0+00	0.45		56,252	55,883	124,184	
			DU-26A/3+00	DU-24/3+00	0.60	2013	97,192	94,536	157,560	
			DU-27/14+00	DU-27/5+00	0.17		6,855	5,360	31,529	
			DU-27/67+00	DU-27/59+00	0.15		11,471	11,368	75,787	
				Reach DU-III Total	**12.49**	**1943-2013**	**970,077**	**1,107,043**	**--**	
DU-IV	**4.24**	**77,938**	--	--	0.00	1943	***15,272***	18,174	-	6
			DU-3/1+65	DU-2/4+70	0.30		***16,932***	20,149	67,163	
			--	--	0.00	1945	***28,816***	31,911	#DIV/0!	
			DU-9/1+00	DU-7/10+30	0.66	1952	13,000	***15,470***	23,439	
			DU-6/47+00	DU-6/41+00	0.11		3,000	***3,570***	32,455	
			DU-3/1+65	DU-2/4+70	0.30		34,000	***40,460***	134,867	
			DU-3/1+65	DU-2/4+70	0.30	1954	***29,023***	34,537	115,123	
			DU-9/4+00	DU-8/23+00	0.09	1962	7,000	9,260	102,889	
			DU-9/21+00	DU-7/6+00	1.11	1982	72,500	***86,275***	77,725	
			DU-7/2+00	DU-6/39+00	0.29		5,000	***5,950***	20,517	
				Reach DU-IV Total	**3.16**	**1943-1982**	**224,543**	**265,756**	**--**	
DU-V	**3.93**	**13,571**	DU-2/8+50	DU-3/8+50	0.20	1956	15,000	**17,850**	89,250	2
			DU-5/44+75	DU-6/7+75	0.19		12,000	**14,280**	75,158	
			DU-5/44+50	DU-6/1+50	0.09	1966	3,100	2,399	26,656	
				Reach DU-V Total	**0.48**	**1956-1966**	**30,100**	**34,529**	**--**	

DU-VI	**3.88**	**5,351**	DU-8/14+00	DU-9/2+50	0.10	1956	3,000	***3,570***	35,700	9
			DU-8/13+00	DU-9/3+00	0.12	1960	4,000	9,133	76,108	
			DU-8/12+00	DU-9/10+00	0.27	1962	13,100	24,415	90,426	
			DU-8/13+30	DU-9/7+50	0.20	1964	2,700	2,203	11,015	
			DU-8/13+39	DU-9/9+00	0.23	1965	4,600	7,634	33,191	
			DU-8/13+29	DU-9/10+00	0.25	1970	13,700	13,374	53,496	
			DU-8/14+00	DU-9/6+00	0.16	1973	9,000	9,224	57,650	
			DU-8/13+00	DU-9/7+00	0.19	1986	10,000	***11,900***	62,632	
			DU-7/21+00	DU-9/4+00	0.59	2005	25,490	24,377	41,317	
			Reach DU-VI Total		**2.11**	**1956-2005**	**85,590**	**105,830**	--	
DU-VII	**4.00**	**29,237**	DU-19/24+83	SJ-1/6+00	0.17	1956	60,000	***71,400***	420,000	9
			SJ-2/10+00	SJ-3/10+00	0.52				-	
			DU-18/34+35	SJ-3/13+60	1.77	1958	77,000	98,630	55,723	
			SJ-1/19+00	SJ-4/0+00	1.28	1960	100,000	114,508	89,459	
			DU-18/0+00	SJ-4/10+00	3.06	1962	151,400	218,636	71,450	
			DU-19/24+85	SJ-1/5+00	0.15	1964	99,300	***118,617***	74,602	
			SJ-1/20+50	SJ-4/10+00	1.44					
			SJ-1/20+00	SJ-4/35+00	1.92	1965	71,000	101,500	52,865	
			SJ-2/0+00	SJ-3/32+00	1.13	1970	42,000	47,912	42,400	
			DU-19/25+00	SJ-1/6+00	0.17	1986	4,000	***4,760***	28,000	
			SJ-2/23+00	SJ-2/27+47.35	0.08	2009	1,381	1,381	17,263	
			SJ-3/00+00	SJ-3/37+26.7	0.71		12,892	12,668	17,842	
			Reach DU-VII Total		**12.40**	**1956-2009**	**618,973**	**790,012**	--	**35**
Reach DU-III – DU-VII Total					**31**	**1943-2013**	**1,929,283**	**2,303,170**	--	

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/ mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
Atlantic Intracoastal Waterway									
DU-III	6.19	1,107,043	45,342	1,152,385	16,005	**2,577**	800,267	1,720,575	9
DU-IV	4.24	265,756	77,938	343,694	4,774	**1,128**	238,676	513,154	6
DU-III – DU-IV	**10.43**	**1,372,799**	**123,279**	**1,496,078**	**20,779**	**1,992**	**1,038,943**	**2,233,728**	**15**
Intracoastal Waterway									
DU-V	3.93	34,529	13,571	48,100	763	**194**	38,175	82,076	2
DU-VI	3.88	105,830	5,351	111,181	1,765	**455**	88,239	189,714	9
DU-VII	4.00	790,012	29,237	819,249	13,004	**3,251**	650,198	1,397,926	9
DU-V – DU_VII	**11.81**	**930,371**	**48,160**	**978,531**	**15,532**	**1,315**	**776,612**	**1,669,715**	**20**
DU-III – DU-VII	**22.24**	**2,303,170**	**171,439**	**2,474,609**	**36,311**	**1,633**	**1,815,555**	**3,903,443**	**35**

Based on 1942 - 2014 for AIWW and 1951 - 2014 for ICWW

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	2004	2000	1996	1986
DU-III	6.19	1,720,575	2,107,185	2,054,852	2,026,340	1,553,852
DU-IV	4.24	513,154	749,162	803,219	835,936	713,677
DU-III – DU-IV	**10.43**	**2,233,728**	**2,856,347**	**2,858,071**	**2,862,276**	**2,267,529**
DU-V	3.93	82,076	69,113	65,800	82,375	92,450
DU-VI	3.88	189,714	163,539	184,027	246,297	184,593
DU-VII	4.00	1,397,926	1,415,486	1,550,328	2,053,902	1,857,293
DU-V – DU-VII	**11.81**	**1,669,715**	**1,648,138**	**1,800,155**	**2,382,574**	**2,134,336**
DU-III – DU-VII	**22.24**	**3,903,443**	**4,504,485**	**4,658,226**	**5,244,850**	**4,401,865**

ST. JOHNS COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1989, 2017 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
SJ-I	**6.29**	**79,144**	SJ-6/30+50	SJ-6/43+50	0.25	1967	14,100	*16,920*	67,680	4
			SJ-7/32+00	SJ-7/32+44.7	0.01	1973	652	1,261	126,100	
			SJ-5/80+00	SJ-5/100+00	0.38	2005	87,585	84,497	222,361	
			SJ-5/100+00	SJ-5/120+00	0.38		90,271	90,223	237,429	
			SJ-5/120+00	SJ-5/140+00	0.38		98,248	98,153	258,297	
			SJ-5/140+00	SJ-6/20+00	0.42		114,579	114,359	272,283	
			SJ-6/20+00	SJ-6/38+00	0.34		91,864	91,570	269,324	
			SJ-6/38+00	SJ-6/58+00	0.37		101,815	101,804	275,146	
			SJ-6/58+00	SJ-6/79+00	0.40		119,247	108,185	270,463	
			SJ-6/79+00	SJ-7/9+00	0.40		104,251	99,953	249,883	
			SJ-7/9+00	SJ-7/32+44.7	0.44		101,965	98,411	223,661	
			SJ-4/0+00	SJ-4/40+00	0.75	2009	34,089	32,087	42,783	
			SJ-4/40+00	SJ-4/66+62.60	0.51		27,200	25,160	49,333	
			SJ-5/0+00	SJ-5/10+00	0.19		19,925	14,736	77,558	
			SJ-5/10+00	SJ-5/45+00	0.66		76,659	74,880	113,455	
			SJ-5/45+00	SJ-5/80+00	0.66		97,653	96,941	146,880	
				Reach SJ-I Total	**6.54**	**1967-2009**	**1,180,103**	**1,149,140**	--	
SJ-II	**7.86**	**61,518**	SJ-8/0+00	SJ-8/32+00	0.61	1973	46,348	89,644	146,957	3
			SJ-8/0+00	SJ-8/25+00	0.48	2005	98,742	104,258	217,204	
			SJ-8/25+00	SJ-8/56+00	0.58		92,410	103,784	178,938	
			SJ-8/56+00	SJ-9/36+00	0.75		105,280	106,724	142,299	
			SJ-9/36+00	SJ-9/84+46.7	0.92		52,336	73,618	80,020	
			SJ-12/33+00	SJ-13/5+00	0.46	1960	22,000	29,061	63,176	
				Reach SJ-II Total	**3.80**	**1960-1973**	**417,116**	**507,089**	--	
SJ-III	**11.86**	**6,223**	SJ-28/15+50	SJ-28/31+50	0.31	2017	*12,810*	15,245	49,177	1
			SJ-28/31+50	SJ-28A/00+50	0.04		*1,988*	2,366	59,150	
			SJ-28A/0+50	SJ-28A/6+50	0.12		*4,532*	5,393	44,942	
			SJ-29/6+00	SJ-29A/13+00	0.35		*84,320*	100,341	286,689	
				Reach SJ-III Total	**0.82**	**2017**	**103,650**	**123,345**	--	
SJ-IV	**10.90**	**18,600**	No Historical Maintenance Dredging							0
				Reach SJ-IV Total	**0.00**	**--**	**-**	**-**	--	

SJ-V	**7.81**	**55,418**	SJ-60/6+00	SJ-61/7+00	0.52	1958	*53,372*	63,538	122,188	18
			SJ-61/45+00	SJ-61/58+00	0.25		*20,849*	24,820	99,280	
			SJ-62/25+00	SJ-62/32+00	0.13		*10,841*	12,906	99,277	
			SJ-63/2+00	SJ-63/28+00	0.49		*40,863*	48,647	99,280	
			SJ-60/7+00	SJ-61/5+00	0.48	1960	102,000	87,727	182,765	
			SJ-61/44+00	SJ-61/57+00	0.25		16,000	46,664	186,656	
			SJ-63/4+00	SJ-63/31+00	0.52		19,000	18,967	36,475	
			SJ-63/39+00	SJ-64/6+00	0.15		4,000	5,950	39,667	
			SJ-60/6+00	SJ-61/5+00	0.49	1962	105,000	103,504	211,233	
			SJ-61/47+00	SJ-61/56+00	0.17		14,000	35,909	211,229	
			SJ-60/10+50	SJ-61/36+50	1.00	1963	*99,010*	117,869	117,869	
			SJ-60/0+00	SJ-60/60+00	1.14	1964	66,900	*80,280*	70,421	
			SJ-61/36+50	--	0.00	1966	*5,974*	7,112	-	
			SJ-62/45+50	--	0.00		*21,717*	25,853	-	
			SJ-60/9+50	SJ-60/15+00	0.11	1967	15,700	20,240	184,000	
			SJ-64/34+50	F-1/8+00	0.19		14,000	9,441	49,689	
			SJ-60/18+50	SJ-60/25+75	0.14	1968	21,400	59,542	425,300	
			SJ-61/40+00	SJ-61/61+00	0.40	1970	52,500	56,668	141,670	
			SJ-61/64+50	SJ-62/7+00	0.24		31,500	34,000	141,667	
			SJ-63/3+80	SJ-63/26+00	0.42		39,700	59,501	141,669	
			SJ-60/10+50	SJ-61/10+50	0.51	1973	86,000	112,447	220,484	
			SJ-61/40+50	SJ-62/2+50	0.61		46,000	76,266	125,026	
			SJ-59/23+00	SJ-61/11+00	0.73	1978	260,000	312,776	428,460	
			SJ-61/40+00	SJ-62/35+00	1.23		174,000	185,632	150,920	
			SJ-63/8+00	SJ-63/31+00	0.44		52,000	*62,207*	141,380	
			SJ-63/31+00	F-1/6+00	1.00		31,000	*37,200*	37,200	
			SJ-59/19+00	SJ-61/14+00	0.87	1983	288,000	287,560	330,529	
			SJ-60/6+00	SJ-61/58+00	1.50	1987	188,000	*225,600*	150,400	
			SJ-60/8+50	SJ-61/16+00	0.65	1990	170,000	191,502	294,618	
			SJ-60/4+00	SJ-61/15+00	0.72	1994	180,000	197,370	274,125	
			SJ-59/20+00	SJ-61/22+00	1.00	1999	222,000	211,615	211,615	
			SJ-60/5+00	SJ60/12+00	0.13	2003	15,013	24,732	190,246	
			SJ-60/12+00	SJ-60/17+00	0.09		36,536	48,787	542,078	
			SJ-60/17+00	SJ-60/24+00	0.14		45,224	65,838	470,271	
			SJ-60/24+00	SJ-60/26+83	0.05		28,386	37,703	754,060	
			SJ-61/0+00	SJ-61/5+00	0.10		37,035	52,360	523,600	
			SJ-61/5+00	SJ-61/13+00	0.15		23,808	44,837	298,913	
			SJ-61/46+00	SJ-61/55+00	0.17		1,737	9,029	53,112	
			SJ-61/55+00	SJ-61/65+00	0.19		355	3,243	17,068	
			SJ-60/0+00	SJ-61/70+07.03	1.33	2004	214,475	286,529	215,908	

SJ-V	**7.81**	**55,418**	SJ-60/8+00	SJ-60/26+83	0.36	2007	81,434	124,064	344,622	3
			SJ-61/0+00	SJ-61/13+00	0.25		37,026	62,460	249,840	
			SJ-60/5+00	SJ-60/23+90	0.36	2011	85,396	123,990	344,417	
			SJ-60/23+90	SJ-61/13+00	0.68		79,950	114,163	167,887	
			SJ-60/25+50	SJ-61/0+50	0.03		127	824	27,467	
			SJ-59/20+00	SJ-60/1+56	0.10	2017	*6,436*	7,659	76,590	
			SJ-60/1+56	SJ-60/26+86.34	0.48		*223,164*	265,565	553,260	
			SJ-61/0+00	SJ-61/18+00	0.34		*133,834*	159,262	468,418	
				Reach SJ-V Total	**19.97**	**1958-2017**	**3,501,262**	**4,250,358**	--	**29**
				Reach SJ-I – SJ-V Total	**31.13**	**1958-2017**	**5,202,131**	**6,029,932**	--	

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
SJ-I	6.29	1,149,140	79,144	1,228,284	19,811	3,155	990,552	2,129,686	4
SJ-II	7.86	507,089	61,518	568,607	9,171	1,167	458,554	985,891	3
SJ-III	11.86	123,345	6,223	129,568	1,993	168	99,667	214,285	1
SJ-IV	10.90	0	18,600	18,600	300	28	15,000	32,251	0
SJ-V	7.81	3,963,829	55,418	4,019,247	61,835	7,917	3,091,728	6,647,216	21
SJ-I - SJ-V	**44.72**	**5,743,403**	**220,902**	**5,964,305**	**93,110**	**2,082**	**4,655,501**	**10,009,328**	**29**

Current and Previously Reported 50-Year Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)					
		2017	2014	2004	2000	1996	1989
SJ-I	6.29	2,129,686	2,129,686	2,182,790	2,339,492	2,396,623	1,822,613
SJ-II	7.86	985,891	985,891	671,513	570,818	390,430	124,064
SJ-III	11.86	214,285	57,089	156,784	140,970	114,412	8,769
SJ-IV	10.90	32,251	32,251	97,461	91,317	86,107	--
SJ-V	7.81	6,647,216	6,374,154	6,201,637	6,228,418	6,828,799	7,034,370
SJ-I - SJ-V	**44.72**	**10,009,328**	**9,579,070**	**9,310,185**	**9,371,015**	**9,816,371**	**8,989,816**

FLAGLER COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1994, 2016 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
FL-I	4.44	47,491	F-2/10+50	F-2/33+50	0.43	1967	23,100	27,500	63,953	4
			F-2/34+50	F-3/19+00	0.41		7,000	8,334	20,327	
			F-3/19+00	F-4/32+00	0.67		22,800	27,143	40,512	
			F-2/15+00	F-2/32+50	0.33	1976	42,000	50,000	151,515	
			F-2/26+00	F-5/55+00	2.28	1986	97,000	115,475	50,647	
			F-2/5+00	F-2/32+00	0.51	2011	15,479	33,938	66,545	
			Reach FL-I Total		**4.63**	**1967-2011**	**207,379**	**262,390**	**--**	
FL-II	3.80	14,185	F-16/20+00	F-17/3+00	0.21	1960	17,000	20,239	96,376	3
			F-16/0+00	F-20/0+00	1.62	1979	342,000	407,151	251,328	
			F-11/25+00	F-16/1+00	1.73	1986	135,000	160,730	92,908	
			Reach FL-II Total		**3.56**	**1960-1986**	**494,000**	**588,120**	**-**	
FL-III	5.84	23,936	No Historical Maintenance Dredging							0
			Reach FL-III Total		**--**	-	-	-	**-**	
FL-IV	4.06	20,947	No Historical Maintenance Dredging							0
			Reach FL-IV Total		**--**	**--**	-	-	**-**	**7**
Reach I – IV Total					**8.19**	**1960-2011**	**701,379**	**850,510**	--	

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year) 1952-2014	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
FL-I	4.44	262,390	47,491	309,881	4,998	1,131	249,904	537,293	4
FL-II	3.80	588,120	14,185	602,305	9,715	2,563	485,730	1,044,320	3
FL-III	5.84	0	23,936	23,936	386	66	19,303	41,502	-
FL-IV	4.06	0	20,947	20,947	338	83	16,892	36,319	-
FL-I - FL-IV	**18.14**	**850,510**	**106,559**	**957,069**	**15,437**	**851**	**771,830**	**1,659,434**	**7**

Current and Previously Reported 50-Year Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	**2004**	**2000**	**1996**	**1993**
FL-I	4.44	537,293	619,394	666,845	696,031	756,630
FL-II	3.80	1,044,320	1,188,556	1,342,443	1,441,526	1,756,192
FL-III	5.84	41,502	78,906	80,299	282,279	-
FL-IV	4.06	36,319	241,162	249,914		11,849
FL-I - FL-IV	**18.14**	**1,659,434**	**2,128,018**	**2,339,501**	**2,419,836**	**2,524,671**

VOLUSIA COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plan 1993 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station From	Cut/Station To	Drege Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
V-I	**10.16**	**195,902**	V-5/38+00	V-6/61+00	0.68	1960	35,000	***39,036***	57,406	1
				REACH V-I TOTAL	**0.68**	**1960**	**35,000**	***39,036***	**57,406**	
V-II	**5.82**	**14,435**	No Historical Maintenance Dredging							0
				REACH V-II TOTAL	**0.00**	**-**	**-**	**-**		
V-III	**4.85**	**11,351**	V-13/30+00	V-13/59+00	0.55	1960	30,000	***33,459***	60,835	1
				REACH V-III TOTAL	**0.55**	**1960**	**30,000**	***33,459***	**60,835**	
V-IV	**10.98**	**64,320**	V-24/31+00	V-24/44+50	0.26	1958	28,735	32,048	125,343	9
			V-26/21+00	V-27/18+00	0.23		83,982	93,666	407,243	
			V-27/18+00	V-27/30+00	0.43		6,811	7,596	17,665	
			V-23/66+50	V-23/23+00	0.25		13,854	15,451	61,804	
			V-22/58+00	V-23/23+00	0.62	1960	22,000	26,646	42,977	
			V-24/103+50	V-26/15+00	0.51		59,000	76,504	150,008	
			V-27/18+00	V-27/30+00	0.23		11,000	16,367	71,161	
			V-20/6+0	V-20/18+00	0.23	1962	12,000	***13,384***	58,191	
			V-22/66+50	V-23/12+00	0.25		10,000	***10,048***	40,192	
			V-24/104+18	V-26/13+00	0.47		36,000	52,133	110,921	
			V-26/21+00	V-27/15+00	0.48		19,000	13,948	29,058	
			V-27/29+00	V-27/34+00	0.09		2,000	12,250	136,111	
			V-23/66+50	V-23/12+00	0.25	1963	5,606	6,255	25,020	
			V-26/21+00	V-27/18+00	0.23		13,000	27,404	119,148	
			V-27/6+00	V-27/15+00	0.17		2,700	4,123	24,253	
			V-24/97+00	V-26/6+50	0.47	1964	65,000	80,739	171,785	
			V-24/104+18	V-26/11+50	0.44	1966	29,000	65,877	149,720	
			V-24/105+00	V-26/1+00	0.54	1967	37,400	33,033	61,172	
			V-27/11+00	V-27/5+30	0.56		38,500	44,559	79,570	
			V-28/8+00	V-29/18+00	0.55		29,200	32,575	59,227	
			V-22/56+50	V-24/1+50	0.77	1968	46,800	43,080	55,948	
			V-24/31+00	V-24/44+50	0.25		42,400	56,124	224,496	
			V-24/47+50	V-27/6+50	2.01		92,400	111,043	55,245	
			V-27/28+50	V-28/3+50	0.20		8,200	14,710	73,550	
			V-32/7+25	V-34/1+50	0.51		26,000	28,490	55,863	
			V-36/8+00	V-36/10+50	0.05		1,600	***1,784***	35,680	
			V-22/0+00	V-23/3+00	1.34	1970	14,500	9,302	6,942	
			V-24/104+18	V-26/16+00	0.54		83,700	62,716	116,141	

V-IV	10.98	**64,320**	V-27/29+00	V-28/4+00	0.20	1970	9,700	7,268	36,340	6
			V-29/19+36	V-31/18+00	0.72		51,000	38,214	53,075	
			V-31/19+60	V-32/5+20	0.38		17,000	20,893	54,982	
			V-20/11+40	V-20/18+00	0.12	1972	11,000	***12,268***	102,233	
			V-28/0+00	V-33/14+50	1.86	1973	119,000	98,423	52,916	
			V-22/55+00	V-24/12+00	1.00	1979	213,000	***237,559***	237,559	
			V-24/87+50	V-28/3+00	1.86		405,000	***451,697***	242,848	
			V-33/0+00	V-36/5+20	0.91	1986	64,000	***71,379***	78,438	
			V-24/86+00	V-26/22+00	0.98		162,000	***180,679***	184,366	
			V-36/17+00	V-36/29+24	0.23	2005	9,899	9,745	42,037	
			V-37/0+00	V-37/04+00	0.08		273	231	3,049	
			V-37/16+00	V-37/19+32	0.06		893	881	14,011	
			V-38/0+00	V-38/25+00	0.47		28,250	26,582	56,141	
			V-38/38+00	V-38/43+00	0.09		40	23	243	
			V-38/55+00	V-38/60+00	0.09		44	29	306	
			V-38/74+00	V-38/111+00	0.70		38,434	37,828	53,982	
			V-39/0+00	V-39/124+47	2.36		79,605	72,914	30,930	
			V-40/0+00	V-40/31+88	0.60		37,126	34,892	57,789	
			V-22/0+00	V-22/67+70	1.28	2008	83,645	***77,378***	60,348	
			V-23/0+00	V-23/28+16	0.53		134,713	131,145	245,897	
			V-23 - Settling Basin	V-23 - Settling Basin	0.00		73,146	71,801	-	
			V-24/0+00	V-24/94+00	1.78		176,885	172,948	97,145	
			V-25/0+00	V-25/06+44	0.12		26,590	26,561	217,767	
			V-26/0+00	V-26/31+27	0.59		43,924	42,807	72,280	
			V-26 - Settling Basin	V-26 - Settling Basin	0.00		44,604	41,649	-	
			V-27/0+00	V-27/10+00	0.19		4,185	***3,996***	21,099	
			V-27/2400	V-27/35+43	0.22		17,318	***16,620***	76,775	
			V-28/0+00	V-28/19+18	0.36		28,085	***27,100***	74,603	
			V-29/0+00	V-29/03+00	0.06		23	***23***	405	
			V-29/19+00	V-29/24+52	0.10		2,042	***1,952***	18,671	
			V-30/0+00	V-30/15+00	0.28		1,893	***1,892***	6,660	
			V-31/0+00	V-31/2+00	0.04		203	***203***	5,359	
			V-31/9+00	V-31/17+00	0.23		1,009	***763***	3,357	
			V-31/29+00	V-29/34+00	0.09		316	***130***	1,373	
			V-32/0+00	V-32/05+00	0.09		1,264	***1,151***	12,155	
			V-32/7+00	V-32/10+00	0.06		1,229	***1,204***	21,190	
			V-33/0+00	V-33/22+45	0.43		74,170	***73,414***	172,662	
			V-35/0+00	V-35/10+00	0.19		18,613	***18,428***	97,300	

V-IV	**10.98**	**64,320**	V-22/64+00	V-22/67+69.6	0.07	2013	2,347	2,091	29,871	1
			V-23/0+00	V-23/28+15.0	0.53		85,454	82,324	154,412	
			V-24/0+00	V-24/109+33.4	2.07		68,770	64,819	31,303	
			V-25/0+00	V-25/06+43.9	0.12		10,399	8,295	68,019	
			V-26/0+00	V-26/31+26.9	0.59		13,035	9,449	15,955	
			V-27/0+00	V-27/35+47.20	0.67		15,010	11,898	17,710	
			V-28/0+00	V-28/19+17.6	0.36		20,576	19,804	54,529	
				REACH V-IV TOTAL	**36.72**	**1958-2013**	**3,036,100**	**3,203,205**	**5,442,527**	
V-V	**10.58**	**61,286**	V-38/8+00	V-38/28+00	0.38	1960	22,000	***24,537***	64,571	5
			V-38/89+00	V-38/110+00	0.39		8,000	***8,922***	22,877	
			V-38/10+00	V-38/26+00	0.30	1962	11,000	***12,268***	40,893	
			V-38/12+50	V-38/26+00	0.25	1970	19,700	***21,971***	87,884	
			V-38/83+00	V-38/107+50	0.47	1972	17,600	***19,629***	41,764	
			V-39/39+50	V-39/50+50	0.20		10,000	***11,153***	55,765	
			V-42/0+00	V-42/15+00	0.28		10,300	***11,488***	41,029	
			V-38/6+00	V-38/22+00	0.31	1979	47,000	***52,419***	169,094	
				REACH V TOTAL	**2.58**	**1960-1979**	**145,600**	**162,387**	**523,876**	
V-VI	**10.09**	**115,666**	No Historical Maintenance Dredging							0
				REACH V-VI TOTAL	**0.00**	-	-	-	-	**23**
						REACH I – VI TOTAL	**3,246,700**	**3,438,087**	**6,084,644**	

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
V-I	10.16	57,406	195,902	253,308	4,691	462	234,544	504,270	1
V-II	5.82	0	14,435	14,435	267	46	13,366	28,736	-
V-III	4.85	60,835	11,351	72,186	1,337	276	66,838	143,703	1
V-IV	10.98	5,442,527	64,320	5,506,847	101,979	9,288	5,098,933	10,962,706	16
V-V	10.58	523,876	61,286	585,162	10,836	1,024	541,817	1,164,906	5
V-VI	10.09	0	115,666	115,666	2,142	212	107,098	230,261	-
V-I - V-VI	**52.48**	**6,084,644**	**462,960**	**6,547,604**	**121,252**	**2,310**	**6,062,596**	**13,034,582**	**23**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	2005	2000	1996	1993
V-I	10.16	504,270	1,240,459	1,526,456	1,626,694	862,270
V-II	5.82	28,736	122,357	202,827	139,140	52,572
V-III	4.85	143,703	296,719	343,898	333,271	291,478
V-IV	10.98	10,962,706	5,720,398	6,309,995	6,441,214	6,622,730
V-V	10.58	1,164,906	859,851	1,043,125	1,045,088	836,106
V-VI	10.09	230,261	716,013	902,553	814,812	479,518
V-I - V-VI	**52.48**	**13,034,582**	**8,957,802**	**10,330,854**	**10,402,215**	**9,146,667**

BREVARD COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1989 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	**To**						
BV-I	**7.74**	**152,640**	BV-5/160+00	BV-6/5+80	0.82	1960	67,000	58,717	71,606	5
			BV-5/5+00	BV-5/58+50	1.02		70,000	92,282	90,473	
			BV-4/32+00			1966	***1,950***	2,161	--	
			BV-4/90+00	BV-5/7+00	0.34	1967	25,100	30,012	88,271	
			BV-4/9+00	BV-6/7+00	5.61	1978	275,000	***305,556***	54,466	
			BV-1/0+00	BV-7/0+00	21.49	2002	900,000	744,388	34,639	
			BV-7/0+00	BV-9/43+00	3.84		300,000	250,662	65,277	
				Reach BV-I TOTAL	**33.12**	**1960-2002**	**1,639,050**	**1,483,778**	**404,731**	
BV-II	**11.94**	**127,578**	BV-12/62+00	BV-14/62+00	2.91	1978	91,000	***101,111***	34,746	1
				Reach BV-II TOTAL	**2.91**	**1978**	**91,000**	**101,111**	**34,746**	
BV-III	**11.06**	**55,008**	BV-17/171+00	--	--	1963	***38,700***	42,980	--	1
				Reach BV-III TOTAL		**1963**	**38,700**	**42,980**	-	
BV-IV	**11.11**	**24,250**	No Historical Maintenance Dredging							0
				Reach BV-IV TOTAL						
BV-V	**12.69**	**6,498**	No Historical Maintenance Dredging							0
				Reach BV-V TOTAL						
BV-VI	**13.47**	**128,816**	No Historical Maintenance Dredging							0
				Reach BV-I TOTAL						7
				Reach BV-I – BV-VI Total	**36.03**	**1960-2002**	**1,768,750**	**1,627,869**		

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)[1]	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
BV-I	7.74	1,483,778	152,640	1,636,418	30,304	3,915	1,515,202	3,257,684	5
BV-II	11.94	101,111	127,578	228,689	4,235	355	211,749	455,261	1
BV-III	11.06	42,980	55,008	97,988	1,815	164	90,730	195,069	1
BV-IV	11.11	0	24,250	24,250	449	40	22,454	48,275	-
BV-V	12.69	0	6,498	6,498	120	9	6,017	12,936	-
BV-VI	13.47	0	128,816	128,816	2,385	177	119,274	256,439	-
BV-I - BV-VI	**68.01**	**1,627,869**	**494,790**	**2,122,659**	**39,309**	**578**	**1,965,425**	**4,225,664**	**7**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	**2,005**	**2000**	**1996**	**1989**
BV-I	7.74	3,257,684	2,427,650	2,488,516	2,623,966	3,659,623
BV-II	11.94	455,261	1,744,984	1,696,901	1,870,448	1,415,219
BV-III	11.06	195,069	640,898	887,111	1,007,361	496,618
BV-IV	11.11	48,275	548,055	548,996	622,868	541,237
BV-V	12.69	12,936	670,584	670,487	652,006	417,417
BV-VI	13.47	256,439	919,509	1,320,897	1,508,457	1,053,044
BV-I - BV-VI	**68.01**	**4,225,664**	**6,953,685**	**7,614,908**	**8,287,102**	**7,585,147**

INDIAN RIVER COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1997 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
IR-I	8.09	98,785 (Assumed removed by 2015 Dredging Project)	IR-1/0+00	IR-1/48+00	0.91	2015	80,168	79,684	87,652	1
			IR-1/48+00	IR-1/54+00	0.11		2,965	2,545	22,396	
			IR-1/54+00	IR-1/56+00	0.04		1,651	1,587	41,897	
			IR-1/56+00	IR-2/22+00	0.49		10,475	11,109	22,473	
			IR-2/22+00	IR-2/90+00	1.29		98,034	95,693	74,303	
			IR-2/90+00	IR-2/117+00	0.51		29,109	27,147	53,087	
			IR-2/117+00	IR-2/130+21	0.25		3,961	4,305	17,207	
			IR-3/7+00	IR-3/40+00	0.63		9,486	8,723	13,957	
			IR-4/5+00	IR-4/18+00	0.25		18,415	16,622	67,511	
			IR-4/89+00	IR-5/5+00	0.15		7,403	6,398	43,034	
			IR-5/9+00	IR-5/21+00	0.23		11,542	11,367	50,015	
			IR-5/21+00	IR-5/28+00	0.13		2,834	2,761	20,826	
			IR-5/31+00	IR-6/4+00	0.16		3,751	3,564	22,139	
			IR-6/5+00	IR-6/14+00	0.17		4,960	4,806	28,195	
			Reach IR-I TOTAL		**5.32**	**1957-2015**	**284,754**	**276,311**		
IR-II	6.96	10,845	No Historical Maintenance Dredging							0
			Reach IR-II TOTAL							
IR-III	8.27	22,956	No Historical Maintenance Dredging							0
			Reach IR-III TOTAL							**1**
Reach IR-I - IR-III TOTAL					**5.32**	**1957-2015**	**284,754**	**276,311**		

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
IR-I	8.09	276,311	-	276,311	4,848	599	242,378	521,113	1
IR-II	6.96	0	10,845	10,845	190	27	9,513	20,453	0
IR-III	8.27	0	22,956	22,956	403	49	20,137	43,294	0
IR-I - IR-III	**23.32**	**276,311**	**33,801**	**310,112**	**5,441**	**233**	**272,028**	**584,860**	**1**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	2005	2000	1997	1996
IR-I	8.09	521,113	496,514	601,229	427,862	427,862
IR-II	6.96	20,453	45,998	13,258	12,021	12,021
IR-III	8.27	43,294	174,811	141,329	162,658	162,658
IR-I - IR-III	**23.32**	**584,860**	**717,323**	**755,816**	**602,541**	**602,541**

ST. LUCIE COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1997 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
SL-I	8.81	**6,259**	SL-3N/9+50	SL-3N/11+50	0.91	1972	2,000	2,381	2,619	1
			Reach SL-I TOTAL		**0.91**	**1972**	**2,000**	**2,381**		
SL-II	12.91	**8,878** **(Assumed removed during the 2017 Dredging Project)**	SL-5/10+00	SL-5/34+00	0.45	2017	46,994	41,307	90,875	3
			SL-5/34+00	SL- 5/54+00	0.38	2017	26,043	16,029	42,317	
			SL-5/54+00	SL-5/72+00	0.34	2017	28,539	16,441	48,227	
			Reach SL-II TOTAL		**1.17**	**2017**	**101,576**	**73,777**		**4**
Reach SL-I - SL-III TOTAL					**2.08**	**1972-2017**	**103,576**	**76,158**	-	

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
SL-I	8.81	2,381	6,259	8,640	157	18	7,855	16,887	1
SL-II	12.91	73,777	8,878	82,655	1,425	110	71,254	153,197	3
SL-I - SL-III	**21.72**	**76,158**	**15,137**	**91,295**	**1,582**	**73**	**79,109**	**170,084**	**4**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	**1997**	**2005**	**2000**	**1996**
SL-I	8.81	16,887	65,358	75,560	80,327	99,516
SL-II	12.91	153,197	89,882	122,299	75,997	55,724
SL-I - SL-III	**21.72**	**170,084**	**155,240**	**197,859**	**156,324**	**155,240**

MARTIN COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1993 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station From	Cut/Station To	Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
M-I	**4.34**	**1,727**	No Historical Maintenance Dredging							0
			Reach M-I Total				-	-		
M-II	**4.07**	**28,428**	M-5/37+00	M-5/52+00	0.28	1963	21,500	***25,596***	91,414	10
			M-5/35+50	M-5/55+00	0.37	1964	25,700	***30,596***	82,692	
			M-5/39+50	M-5/51+00	0.22	1966	8,700	***10,357***	47,077	
			M-3/5+50	M-6/1+00	2.09	1970	60,000	***71,430***	34,177	
			M-5/41+50	M-5/57+00	0.29	1972	27,500	***32,739***	112,893	
			M-5/30+00	M-7/2+00	1.02	1975	125,000	***148,813***	145,895	
			M-5/39+00	M-5/54+00	0.28	1984	35,100	***41,787***	149,239	
			M-1/197+00	M-2/60+00	1.58		49,200	***58,573***	37,072	
			M-2/32+00	M-7/9+00	2.23	1991	164,000	195,292	87,575	
			M-4/0+00	*M-6/19+91.58*	*5.35*	2003	46,300	***53,245***	9,952	
			M-4/0+00	*M-6/19+91.58*	*5.35*	2009	51,900	41,461	7,750	
			Reach M-II Total		**19.06**	**1963-2009**	**516,700**	**615,183**	-	
M-III	**6.00**	**15,039**	M-11/55+50	M-11/55+50	0.33	1963	16,200	***19,286***	58,442	1
			Reach M-III Total		**0.33**	**1963**	**16,200**	**19,286**	-	
M-IV	**7.84**	**3,426**	No Historical Maintenance Dredging							0
			Reach M-IV Total				-	-	-	
Reach M-I - M-IV Total					**19.39**	**1963-2009**	**532,900**	**634,469**	-	**11**

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
M-I	4.34	0	1,727	1,727	34	8	1,693	3,640	0
M-II	4.07	615,183	28,428	643,611	12,620	3,101	630,991	1,356,631	10
M-III	6.00	19,286	15,039	34,325	673	112	33,652	72,352	1
M-IV	7.84	0	3,426	3,426	67	9	3,359	7,221	0
M-I - M-IV	**22.25**	**634,469**	**48,620**	**683,089**	**12,650**	**569**	**669,695**	**1,439,844**	**11**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	2,005	2000	1996	1993
M-I	4.34	3,640	108,559	23,033	195,681	164,909
M-II	4.07	1,356,631	1,943,931	1,974,501	2,313,988	2,391,058
M-III	6.00	72,352	188,104	131,132	225,168	89,515
M-IV	7.84	7,221	87,756	30,389	13,453	47,895
M-I - M-IV	**22.25**	**1,439,844**	**2,328,350**	**2,159,055**	**2,748,290**	**2,693,377**

PALM BEACH COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1989 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station From	Cut/Station To	Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
PB-I	**3.65**	**6,752**	P-3/3+00	P-4/10+00	0.30	1988	87,000	***103,530***	345,100	17
			P-1/67+00	P-1/78+00	0.20	1987	***15,546***	18,500	92,500	
			P-3/3+00	P-4/10+00	0.40		***109,496***	130,300	325,750	
			P-1/67+00	P-1/78+00	0.20	1986	13,000	19,360	96,800	
			P-3/3+00	P-4/10+00	0.30		106,000	130,300	434,333	
			P-1/66+00	P-1/80+00	0.20	1983	***26,303***	31,300	156,500	
			P-3/1+00	P-4/10+00	0.40		***92,857***	110,500	276,250	
			P-3/3+50	P-4/10+00	0.40	1979	***99,832***	118,800	297,000	
			P-2/25+50	P-4/11+00	0.50	1975	***129,412***	154,000	308,000	
			P-1/64+00	P-1/77+00	0.30	1972	40,500	***48,195***	160,650	
			P-2/23+00	P-3/2+00	0.10		3,300	***3,927***	39,270	
			P-3/8+50	P-4/11+00	0.30		33,000	***39,270***	130,900	
			P-4/21+20	P-6/2+50	0.10		12,000	***14,280***	142,800	
			P-3/3+50	P-4/11+00	0.40	1970	85,000	93,500	233,750	
			P-3/3+50	P-4/11+00	0.40	1969	***42,437***	50,500	126,250	
			P-3/4+00	P-4/5+00	0.30	1968	28,000	***33,320***	111,067	
			P-3/10+00	P-4/3+00	0.10	1967	31,500	***37,485***	374,850	
			P-3/2+00	P-4/16+20	0.50	1965	24,000	***28,560***	57,120	
			P-3/3+00	P-4/7+00	0.30	1964	21,800	***25,942***	86,473	
			P-3/6+00	P-4/4+00	0.10	1963	46,000	***54,740***	547,400	
			P-2/16+90	P-11/0+00	0.30	1961	134,000	***159,460***	531,533	
			P-1/0+00	P-1/81+20.77	1.54	2004	141,000	23,203	15,086	
			P-2/0+00	P-2/26+12.60	0.49			1,624	3,282	
			P-3/0+00	P-3/11+51.91	0.22			74,358	340,834	
			P-4/0+00	P-4/24+83.54	0.47			14,930	31,741	
			P-1/0+00	P-4/24+83.54	2.72	2013	64,000	85,986	31,613	
				Reach PB-I TOTAL	**6.10**	**1961-1988**	**1,321,982**	**1,428,972**		

PB-II	**7.52**	**13,237**	P-31/12+25	P-31/23+50	0.30	1972	4,400	***5,236***	17,453	2
			P-11/0+00	P-18/0+00	0.50	1961	103,000	***122,570***	245,140	
			P-18/0+00	P-22/0+00	1.00		102,000	***121,380***	121,380	
			P-22/0+00	P-25/23+80	1.00		95,000	***113,050***	113,050	
			P-25/23+80	P-26/10+00	1.10		139,000	***165,410***	150,373	
			P-26/10+00	P-28/0+00	1.00		122,000	***145,180***	145,180	
			P-28/0+00	P-31/16+20	1.60		147,000	***174,930***	109,331	
			Reach PB-II TOTAL		**6.50**	**1961-1972**	**712,400**	**847,756**		
PB-III	**17.12**	**14,886**	P-37/0+00	P-37/7+00	0.13	2016	18,000	17,414	131,351	4
			P-36/28+79	P-36/20+00	0.17		25,000	23,123	138,896	
			P-36/0+00	P-36/20+00	0.38		50,000	62,316	164,514	
			P-36/3+00	P-36/8+00	0.10	1968	4,600	***5,474***	54,740	
			P-36/27+80	P-37/37+50	0.20	1962	-	-	-	
			P-37/47+00	P-39/6+50	1.20		-	-	-	
			P-41/29+00	P-44/83+00	5.10		-	-	-	
			P-44/93+00	P-48/13+25	3.70		-	-	-	
			P-49/11+50	P-59/24+00	0.90		-	-	-	
			P-52/10+00	P-63/26+62	6.20		-	-	-	
			P-31/16+20	P-36/15+50	4.70	1961	105,000	***124,950***	26,585	
			Reach PB-III TOTAL		**22.78**	**1961-1972**	**202,600**	**233,277**		
PB-IV	**18.50**	**13,759**	P-74/6+00	P-76/11+00	0.60	1971	-	-	-	2
			P-63/26+62	P-67/0+00	1.60	1966	103,000	***122,570***	76,606	
			P-67/0+00	P-71/0+00	0.30		100,000	***119,000***	396,667	
			P-71/0+00	P-80/0+00	3.30		93,000	***110,670***	33,536	
			P-80/0+00	P-88/26+32	2.50		118,800	***141,372***	56,549	
			P-88/26+32	P-91/0+00	1.10		100,000	***119,000***	108,182	
			P-91/0+00	BW-2/8+97	0.65		63,000	***74,970***	115,338	
			Reach PB-IV TOTAL		**10.05**	**1966-1972**	**577,800**	**687,582**	-	
Reach PB-I - PB-IV Total					**45.43**		**2,814,782**	**3,197,587**	-	**25**

NOTE: 2016 REACH PB-III project was a deepening project.

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)[1]	Volume (cy)/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
PB-I	3.65	1,428,972	6,752	1,435,724	27,089	7,422	1,354,457	2,912,082	**17**
PB-II	7.52	847,756	13,237	860,993	16,245	2,160	812,258	1,746,354	2
PB-III	17.12	233,277	14,886	248,163	4,682	274	234,116	503,349	4
PB-IV	18.50	687,582	13,759	701,341	13,233	715	661,642	1,422,531	2
PB-I - PB-IV	**46.79**	**3,197,587**	**48,634**	**3,246,221**	**61,249**	**1,309**	**3,062,473**	**6,584,316**	**25**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	**2005**	**2000**	**1996**	**1989**
PB-I	3.65	2,912,082	3,571,896	3,875,259	4,207,684	10,000,000
PB-II	7.52	1,746,354	412,476	447,377	499,430	230,000
PB-III	17.12	503,349	128,753	191,323	198,909	116,000
PB-IV	18.50	1,422,531	357,123	231,449	283,854	28,000
PB-I - PB-IV	**46.79**	**6,584,316**	**4,470,248**	**4,745,408**	**5,189,877**	**10,374,000**

BROWARD COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 2003 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
BW-I	4.74	9,781	No Historical Maintenance Dredging							0
			Reach BW-I TOTAL							
BW-II	7.05	2,119	No Historical Maintenance Dredging							0
			Reach BW-II TOTAL							
BW-III	13.20	197	BW-38/12+50	BW-38/14+55	0.04	2016	2,374	1,798	46,309	1
			BW-39/0+00	BW-39/31+86	0.60		65,315	55,121	91,349	
			BW-40/0+00	BW-40/4+00	0.08		12,109	11,928	157,450	
			BW-41/0+00	BW-41/5+30	0.10		14,434	14,163	141,096	
			BW-42/0+00	BW-42/4+00	0.08		9,998	9,806	129,439	
			BW-43/0+00	BW-43/17+89	0.34		23,927	23,275	68,693	
			BW-44/0+00	BW-44/4+56	0.09		8,892	8,784	101,709	
			BW-45/0+00	BW-41/3+60	0.07		7,071	7,026	103,048	
			BW-46/0+00	BW-41/3+60	0.07		7,150	7,110	104,280	
			BW-47/0+00	BW-41/3+60	0.07		7,340	7,281	106,788	
			BW-48/0+00	BW-41/4+56	0.09		8,778	8,668	100,366	
			BW-49/0+00	BW-41/13+95	0.26		1,426	1,260	4,769	
			BW-49/24+95	BW-41/27+95	0.06		24,259	23,523	414,005	
			Reach BW-III TOTAL		**1.93**	**2016**	**193,073**	**179,743**	**-**	
Reach BW-I - BW-III TOTAL					**1.93**	**2016**	**193,073**	**179,743**	**-**	**1**

NOTE: 2016 REACH BW-III project was a deepening project.

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)[1]	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
BW-I	4.74	0	9,781	9,781	192	40	9,589	20,617	-
BW-II	7.05	0	2,119	2,119	42	6	2,077	4,467	-
BW-III	13.20	179,743	197	179,940	3,528	267	176,412	379,285	1
BW-I - BW-III	**24.99**	**179,743**	**12,097**	**191,840**	**3,762**	**151**	**188,078**	**404,369**	**1**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)				
		2014	2,005	2003	2000	1996
BW-I	4.74	20,617	62,596	58,092	70,362	105,565
BW-II	7.05	4,467	1,103	12,262	1,722	5,421
BW-III	13.20	379,285	1,952	1,980	260	742
BW-I - BW-III	**24.99**	**404,369**	**65,651**	**72,334**	**72,344**	**111,728**

MIAMI-DADE COUNTY HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 2002 and USACE Dredging Records

Reach	Reach Length (mi)	2014 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
DA-I	**3.99**	**13**	No Historical Maintenance Dredging							0
			REACH DA-I TOTAL							
DA-II	**3.99**	**108**	DA-9/30+00	DA-9/47+00	0.32	1969	30,000	25,990	81,219	7
			DA-9/26+00	DA-9/48+00	0.42	1975	69,404	69,404	165,248	
			DA-9/24+00	DA-9/45+00	0.4	1980	52,000	43,163	107,908	
			DA-9/30+00	DA-9/39+00	0.17	1985	34,400	34,407	202,394	
			DA-9/24+00	DA-9/48+00	0.46	1988	59,234	59,324	128,965	
			DA-9/22+00	DA-9/48+00	0.49	1994	52,000	24,560	50,122	
			DA-9/23+50	DA-9/48+00	0.47	1998	36,000	34,882	74,217	
			DA-9/0+00	*DA-9/178+50*	*3.38*	2010	38,000	33,080	9,785	
			DA-9/0+00	*DA-9/178+50*	*3.38*	2013	44,000	49,592	14,669	
			DA-9/0+00	*DA-9/178+50*	*3.38*	2017	38,000	43,700	12,926	
			REACH DA-I TOTAL		**12.87**	**1969-2017**	**453,038**	**418,102**	-	
DA-III	**8.89**	**26**	No Historical Maintenance Dredging							0
			REACH DA-I TOTAL					**-**	-	
DA-IV	**15.75**	**-**	No Historical Maintenance Dredging							0
			REACH DA-I TOTAL					**-**	-	
DA-V	**15.29**	**1,574**	No Historical Maintenance Dredging							0
			REACH DA-I TOTAL					**-**	-	**7**
REACH DA-I - DA-V TOTAL					**12.87**	**1969-2017**	**453,038**	**418,102**		

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	2014 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
DA-I	3.99	0	13	13	0	0	14	31	**0**
DA-II	3.99	418,102	108	418,210	9,294	2,329	464,678	999,057	7
DA-III	8.89	0	26	26	1	0	29	62	0
DA-IV	15.75	0	-	0	0	0	0	0	0
DA-V	15.29	-	1,574	1,574	35	2	1,749	3,760	0
DA-I - DA-V	**32.62**	**418,102**	**1,721**	**419,823**	**9,329**	**286**	**466,470**	**1,002,911**	**7**

Previously Reported 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	50-Year Storage Requirement (cy)			
		2014	**2,005**	**2000**	**1996**
DA-I	3.99	31	1,573	33,972	--
DA-II	3.99	999,057	933,835	1,044,978	--
DA-III	8.89	62	4,122	2,493	--
DA-IV	15.75	0	891	0	--
DA-V	15.29	3,760	184,478	153,284	--
DA-I - DA-V	**32.62**	**1,002,911**	**1,124,899**	**1,234,727**	**--**

OKEECHOBEE WATERWAY (Crossroads to St. Lucie Lock) HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 1998 and USACE Dredging Records

Reach	Reach Length (mi)	1996 Shoal Volume (cy)	Cut/Station		Dredge Length (mi)	Year	Design Volume (cy)	Pay Volume (cy)	Pay Volume/ Length (cy/mi)	No. of Historical Dredging Events
			From	To						
I	0.99	--	1/0+00	3/0+00	5,227	1937	3,445	4,099	0.78	13
			1/0+00	3/0+00	5,227	1942	249	296	0.06	
			1/0+00	3/0+00	5,227	1947	5,359	6,378	1.22	
			1/0+00	1/6+20	620	1950	5,862	6,979	11.26	
			1/0+00	1/4+80	480	1954	4,408	5,248	10.93	
			1/0+00	3/0+00	5,227	1955	1,818	2,164	0.41	
			1/0+00	3/0+00	5,227	1959	2,636	3,137	0.60	
			1/0+00	3/0+00	5,227		1,262	1,501	0.29	
			1/0+00	3/0+00	5,227	1963	1,311	1,560	0.30	
			1/4+50	1/9+50	500	1967	4,796	5,710	11.42	
			1/23+50	2/1+00	1,288		4,796	5,710	4.43	
			2/4+00	2/13+50	950		4,796	5,710	6.01	
			1/8+00	3/0+00	4,435	1970	14,749	17,559	3.96	
			1/11+50	2/14+00	3,802	1972	37,400	30,636	8.06	
			1/12+00	3/0+00	4,013	1980	64,977	77,355	19.28	
			1/0+00	2/13+00	4,858	1992	57,000	67,859	13.97	
		20,062	1/4+20	1/14+80	1,040	1996**	9,259	11,023	10.60	
			1/25+30	1/33+80	803		4,596	5,472	6.81	
			2/3+70	2/10+60	644		2,996	3,567	5.54	
					60,022	**1937-1996**	**231,715**	**261,963**		

II	**4.35**	--	3/0+00	9/44+35	22,968	1937	15,136	18,012	0.78	8
			3/0+00	9/44+35	22,968	1942	1,095	1,303	0.06	
			3/0+00	9/44+35	22,968	1947	23,549	28,023	1.22	
			3/0+00	9/44+35	22,968	1955	7,989	9,506	0.41	
			3/0+00	9/44+35	22,968	1959	11,584	13,785	0.60	
			3/0+00	9/44+35	22,968		5,546	6,600	0.29	
			3/0+00	9/44+35	22,968	1963	5,759	6,853	0.30	
			3/0+00	3/3+00	317	1970	1,054	1,255	3.96	
			3/0+00	4/3+00	1,267	1980	20,520	24,429	19.28	
		28,681	8/95+60	9/1+60	438	1996**	650	774	1.77	
			9/5+80	9/44+35	3,854		23,451	27,907	7.24	
					166,652	**1937-1996**	**116,333**	**138,447**		
III	**4.65**	--	9/44+35	19/19+00	24,552	1937	16180	19,254	0.78	12
			9/44+35	19/19+00	24,552	1938	96821	115,217	4.69	
			9/44+35	19/19+00	24,552	1942	1,170	1,392	0.06	
			9/44+35	19/19+00	24,552	1947	25,173	29,956	1.22	
			16A/3+00	19/19+00	9,346	1950	116,819	139,073	14.88	
			16A/3+10	17/0+12	4,066	1952	11,149	13,273	3.26	
			19/0+50	19/13+50	1,300		3,565	4,224	3.25	
			17/0+90	19/8+50	4,066	1953	18,523	22,052	5.42	
			16A/2+90	17/1+10	4,224	1954	38,793	46,183	10.93	
			17/4+80	17/6+60	180		1,653	1,968	10.93	
			17/14+60	18/0+40	264		2,425	2,886	10.93	
			18/2+80	19/9+75	2,323		21,336	25,400	10.93	
			19/16+00	19/19+00	300		2,378	2,830	9.43	
			9/44+35	19/19+00	24,552	1955	8,687	10,337	0.42	
			9/44+35	19/19+00	24,552	1959	12,383	14,735	0.60	
			9/44+35	19/19+00	24,552		5,928	7,055	0.29	
			9/44+35	19/19+00	24,552	1963	6,156	7,325	0.30	
			16/9+50	16/30+50	2,100	1967	4,796	5,710	2.72	
			16/32+50	18/7+00	3,522		4,796	5,710	1.62	
			16B/15+00	19/7+00	5,702	1970	18,953	22,576	3.96	

III	**4.65**	73,624	19/4+20	19/6+90	238	1996**	572	681	2.86	1
			19/18+00	19/19+00	940		492	585	0.62	
			9/44+35	9/85+50	4,115		25058	29,819	7.25	
			10/3+70	10/43+30	3,960		24,269	28,892	7.30	
			17/1+60	18/10+00	2,540		11,463	13,647	5.37	
					245,602	**1937-1996**	**479,538**	**570,780**		
IV	**5.12**	--	19/19+00	LOCK/0+00	27034.00	1937	17,816	21,201	0.78	13
			19/19+00	LOCK/0+00	27034.00	1938	106,607	126,862	4.69	
			19/19+00	LOCK/0+00	27034.00	1942	1,288	1,533	0.06	
			19/19+00	LOCK/0+00	27034.00	1947	27,717	32,984	1.22	
			X/13+32	Y/7+73	898	1950	8,487	10,104	11.25	
			Y/12+09	Z/5+67	634		5,991	7,132	11.25	
			AE/0+00	AE/6+09	609		5,758	6,855	11.26	
			AE/10+94	AF/8+08	845		7,988	9,509	11.25	
			20/3+00	A/1+58	1056.00	1952	3,016	3,591	3.40	
			19/20+50	19/30+00	950.00	1953	4,330	5,155	5.43	
			Y/4+24	Y/7+24	300		1,367	1,627	5.42	
			AF/5+12	AF/8+08	296		1,349	1,605	5.42	
			P/1+59	P/4+49	290		1,321	1,573	5.42	
			19/19+00	19/30+50	1150.00	1954	10,939	13,017	11.32	
			19/19+00	LOCK/0+00	27034.00	1955	9,403	11,189	0.41	
			19/19+00	LOCK/0+00	27034.00	1959	13,634	16,225	0.60	
			19/19+00	LOCK/0+00	27034.00		6,528	7,738	0.29	
			19/19+00	LOCK/0+00	27034.00	1963	6,778	8,065	0.30	
			B/0+00	LOCK/0+00	23971.00	1969	2,567	3,056	0.13	
			19/20+00	19/28+00	792.00	1970	2,634	3,136	3.96	
		22,634	D/2+60	D/7+40	480.00	1996**	3,537	4,211	8.77	
			E/2+60	E/5+80	301.00		1,977	2,354	7.82	
			L/1+60	M/4+20	597.00		2,173	2,587	4.33	
			N/0+60	N/5+30	465		3,791	4,513	9.71	
			W/1+60	W/7+40	597		3,749	4,463	7.48	
			AD/4+20	AD/5+30	100		205	244	2.44	
			19/19+00	19/27+50	850.00		3,851	4,262	5.01	
						1937-1996	**264,801**	**314,791**		**47**

Projected 50-Year Dredging and Material Storage Requirements

Reach	Reach Length (mi)	Historical Maintenance Pay Volume (cy)	1996 Shoal Volume (cy)	Total Volume (cy)	Volume (cy/year)	Volume (cy/year/ mile)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy)	No. of Historical Dredging Events
OWW-I	0.99	241,901	20,062	261,963	4,294	4,338	214,724	461,656	13
OWW-II	4.35	109,766	28,681	138,447	2,270	522	113,481	243,984	8
OWW-III	4.65	497,156	73,624	570,780	9,357	2,012	467,852	1,005,883	12
OWW-IV	5.12	292,157	22,634	314,791	5,161	1,008	258,025	554,755	13
OWW-I - OWW-IV	**15.11**	**1,140,980**	**145,001**	**1,285,981**	**85,108**	**5632.5574**	**1,054,083**	**2,266,278**	**46**

OKEECHOBEE WATERWAY (St. Lucie Lock to Palm Beach/Hendry County Line) HISTORICAL MAINTENANCE DREDGING RECORDS

SOURCE: Dredged Material Management Plans 2007 and USACE Dredging Records

PROJECT DEPTH

Reach	Project Depth[1]	Maintenance Depth[1]	Shoal Volume[2] (cy)	Project Volume[3] (cy)	Dredging Volume[4] (cy)	Vol/Year 1936-2006 (cy)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy) (BF=1.65)[5]
St. Lucie Canal	8.0 ft	8.0 ft	393	1,102	1,311	19	937	1,546
Route 1	8.0 ft	8.0 ft	4,871	16,432	19,554	279	13,967	23,046
Route 2 (Rim Canal)	6.0 ft	6.0 ft	4,557	16,050	19,100	273	13,643	22,510
TOTAL			9,821	33,584	39,965	571	28,546	47,102

PROJECT DEPTH + 1 FT

Reach	Project Depth[1]	Maintenance Depth[1]	Shoal Volume[2] (cy)	Project Volume[3] (cy)	Dredging Volume[4] (cy)	Vol/Year 1936-2006 (cy)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy) (BF=1.65)[5]
St. Lucie Canal	8.0 ft	9.0 ft	2,267	5,326	6,338	91	4,527	7,470
Route 1	8.0 ft	9.0 ft	48,052	140,640	167,362	2,391	119,544	197,248
Route 2 (Rim Canal)	6.0 ft	7.0 ft	26,821	59,176	70,419	1,006	50,300	82,994
TOTAL			77,140	205,142	244,119	3,487	174,371	287,712

PROJECT DEPTH + 2 FT

Reach	Project Depth[1]	Maintenance Depth[1]	Shoal Volume[2] (cy)	Project Volume[3] (cy)	Dredging Volume[4] (cy)	Vol/Year 1936-2006 (cy)	50-Year Dredging Requirement (cy)	50-Year Storage Requirement (cy) (BF=1.65)[5]
St. Lucie Canal	8.0 ft	10.0 ft	13,006	34,266	40,776	583	29,126	48,057
Route 1	8.0 ft	10.0 ft	183,213	344,949	410,489	5,864	293,207	483,791
Route 2 (Rim Canal)	6.0 ft	8.0 ft	77,585	166,559	198,205	2,832	141,575	233,599
TOTAL			273,804	545,774	649,471	9,278	463,908	765,447

[1]Below Lake Okeechobee Datum (+12.56 ft NGVD 1929)

[2]Volume of material above the reference elevation

[3]Shoal Volume plus 1ft of advanced maintenance/overdepth dredging within the horizontal limits of the shoal

[4]Project volume x 1.19 [accounts for increase in the post-construction measured dredging volume compared to the pre-construction estimate)

[5]50-Year Dredging Requirement x (Bulking + Overdredging factor of 1.65)

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT D
USACE ADVANCED MAINTENANCE AREA DOCUMENTATION

CESAD-CM-O (CESAJ-CO-OM/4 Dec 00) (11-2-240a) 1st End Ms. Susan S. Whittington/dsm/(404) 562-5133
SUBJECT: Advanced Maintenance Dredging of the Atlantic Intracoastal Waterway (AIWW) Norfolk to St. Johns River, in the Vicinity of Nassau Sound, Nassau County, Florida

Commander, South Atlantic Division, U.S. Army Corps of Engineers, 60 Forsyth Street, S.W., Room 9M15, Atlanta, Georgia 30303-8801
12 December 2000

FOR COMMANDER, JACKSONVILLE DISTRICT, ATTN: CESAJ-CO-M

1. Your request to perform advanced maintenance in subject channels is approved subject to completing all appropriate environmental documentation, coordination, and clearance.

2. As all costs involved with this advanced maintenance dredging will be paid by the Florida Inland Navigation District (FIND) under an existing Memorandum of Agreement, we are not requiring the standard cost savings analysis. Therefore, all advanced maintenance dredging performed under this approval must be funded by FIND. Advanced maintenance approval must be requested separately for any work in this area for which Federal funds will be utilized.

FOR THE DIRECTOR OF CIVIL WORKS AND MANAGEMENT:

Susan S. Whittington

SUSAN S. WHITTINGTON
Acting Chief, Operations Division
Directorate of Civil Works and
Management

Encl
nc

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

CESAJ-CO-OM (11-2-240a) December 4, 2000

MEMORANDUM FOR CDR, USAED (CESAD-ET-CO-M), ATLANTA, GA 30335

SUBJECT: Advance Maintenance Dredging of the Atlantic Intracoastal Waterway (AIWW) Norfolk to St. Johns River, in the Vicinity of Nassau Sound, Nassau County, Florida

1. Reference ER 1130-2-520.

2. Advance maintenance dredging is proposed for the AIWW at the junction of Cut-27A & Cut-27B in the vicinity of Nassau Sound where the Nassau River intersects the South Amelia River. We will perform advance maintenance in effort to:

a. Reduce the frequency of dredging required for this reach of the AIWW.

b. Reduce hazardous shoaling that is limiting the draft of vessels along this reach of waterway. The advance maintenance will provide the most efficient and cost effective solution for long term maintenance of the channel.

3. This is an extremely fast shoaling area. The confluence of the Nassau River and South Amelia River form a shoal that extends from the northwest to the southeast through Cut-27A. The advance maintenance will remove portions of the sand shoal on both sides of Cut-27A. The controlling channel depth in this reach is -4.3 feet mllw. The water depth in the proposed advance maintenance areas is as little as -2.3 feet mllw. It is obvious from the enclosed survey that the shoaling within the channel is a direct result of the formation of this sand shoal. We are proposing to dredge an additional 300,000 cubic yards to project depth (-12' mllw) from the two advance maintenance areas which are adjacent to the authorized channel. This work will allow the channel to remain at authorized depths for a longer period of time, thus reducing the required dredging frequency.

4. The Florida Inland Navigation District (FIND) is the sponsor for the project. FIND and the Corps of Engineers has a Memorandum of Agreement allowing FIND to contribute funds for the operation and maintenance of the AIWW. FIND requested that

CESAJ-CO-OM (11-2-240a)
SUBJECT: Advance Maintenance Dredging of the Atlantic Intracoastal Waterway (AIWW) Norfolk to St. Johns River, in the Vicinity of Nassau Sound, Nassau County, Florida

we perform this advance maintenance dredging in conjunction with the on-going maintenance dredging contract [DACW17-00-C-0037 (8a)]. FIND has agreed to pay 100 percent of the cost to perform the proposed advance maintenance dredging. Accordingly, no economical analysis has been incorporated into this memorandum.

5. We are in the process of acquiring the environmental and cultural clearances for performing the additional dredging. Geotechnical data has been collected and evaluated.

6. The advance maintenance dredging areas are shown on the attached maps.

7. In accordance with the referenced ER, we request that your office approve this advance maintenance request for the subject project. Point of contact for this memorandum is Al Fletcher at (904) 232-2530.

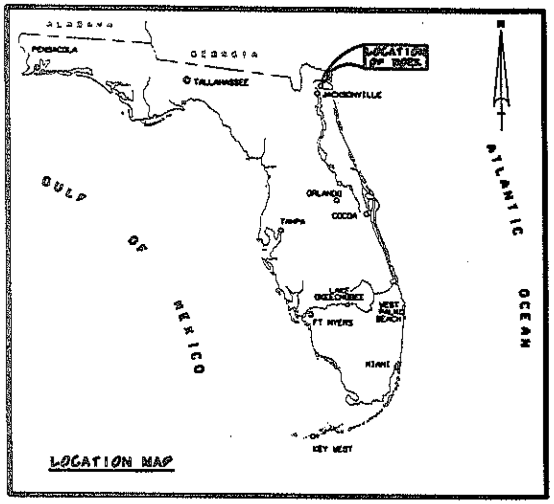
Gordon M. Butler Jr.

Encls

GORDON M. BUTLER, JR.
Chief, Construction-Operations Division

CF:
CESAJ-DP-I (Fore)

ATLANTIC INTRACOASTAL WATERWAY
FERNANDINA TO ST. JOHNS RIVER, FLORIDA
PROJECT CONDITION SURVEY



LOCATION MAP

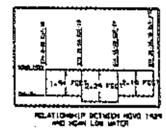
SURVEY NOTES:

1. REFER TO SURVEY NO. [illegible].
2. ELEVATIONS ARE IN FEET AND TENTHS AND REFER TO MEAN LOW WATER (MLW). REFER TO DATUM TABLES ON THIS SHEET FOR DIFFERENCES FROM NGVD 1929.
3. ALL ELEVATIONS ARE BELOW THE CHART DATUM UNLESS PRECEDED BY A (+) SIGN.
4. TIDAL REDUCTIONS WERE MADE FROM MULTIPLE BENCHMARKS. REFER TO SURVEY TABULATION SHOWN ON THIS SHEET.
5. PLANE COORDINATES ARE BASED ON THE TRANSVERSE MERCATOR PROJECTION FOR THE EAST ZONE OF FLORIDA AND REFERENCED TO NORTH AMERICAN DATUM OF 1927 (NAD27).
6. ALL AZIMUTHS ARE GRID: RECKONED CLOCKWISE FROM SOUTH.
7. ALL STATIONING REFERS TO THE CENTERLINE OF THE CHANNEL.
8. SURVEY WAS PERFORMED USING DIFFERENTIAL GPS FOR POSITIONING AND UTILIZING THE USCG NAVBEACON SYSTEM AS THE REFERENCE SITE. VERTICAL MEASUREMENTS WERE MADE USING A ROSS SMART SOUNDER DEPTH RECORDER WITH A 200KHZ (HIGH FREQUENCY) TRANSDUCER.
9. AIDS TO NAVIGATION WERE LOCATED DURING THIS SURVEY.
10. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS AT THAT TIME.
11. SURVEY QUALITY CONTROL STANDARDS AND FIELD EQUIPMENT CALIBRATIONS WERE FOLLOWED DURING THIS SURVEY IN ACCORDANCE WITH EM 1110-2-1003 FOR CLASS 1 HYDROGRAPHIC SURVEYS.

SURVEY TABULATION

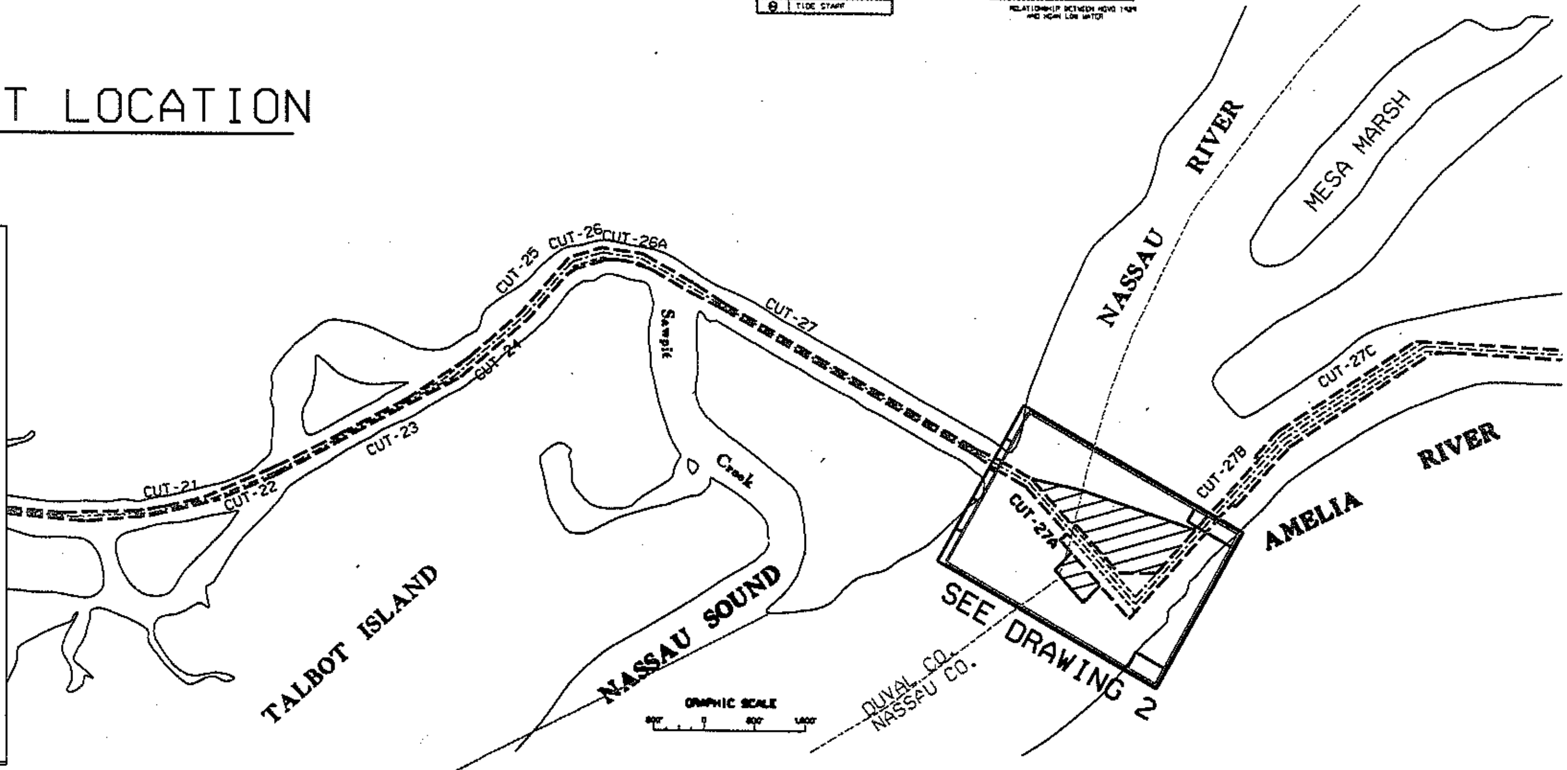
SURVEY NO	VESSEL	AREA SURVEYED	DATE SURVEYED	STAFF LOCATION	BENCHMARK
98-201	V8-32	CUT-21 THRU 26A	11 AUG 98	ON WOODEN RED DBN-50	IVOU-156
98-201	V8-32	CUT-27A THRU 27C	12 AUG 98	ON PILING OF RED LT-44	IVN-082
99-350	V8-34	CUT-21 THRU 26A	07 OCT 99	ON WOODEN RED DBN-50	IVOU-156
99-350	V8-34	CUT-27 THRU 27C	19-20 OCT 99	ON PILING OF RED LT-44	IVN-082

LEGEND	
+BM	BENCHMARK
	LIGHTED BEACON
	GREEN DAYBEACON
	RED DAYBEACON
	RED LIGHTED BUOY
	GREEN LIGHTED BUOY
	CAN BUOY
	NUN BUOY
	TIDE STAFF



RELATIONSHIP BETWEEN NGVD 1929 AND MEAN LOW WATER

SHEET LOCATION



**AIWW, SAWPIT CREEK
ADVANCE MAINTENANCE
REQUEST
NOVEMBER 2000**

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

ATLANTIC INTRACOASTAL WATERWAY
FERNANDINA TO ST. JOHNS RIVER, FLORIDA
PROJECT CONDITION SURVEY
12-FOOT PROJECT
CUT-21 THROUGH CUT-27C
PLANS

D.O.FILE NO. 6-37,948

DRAWING NO. 1/2

SHEET 1 OF 2

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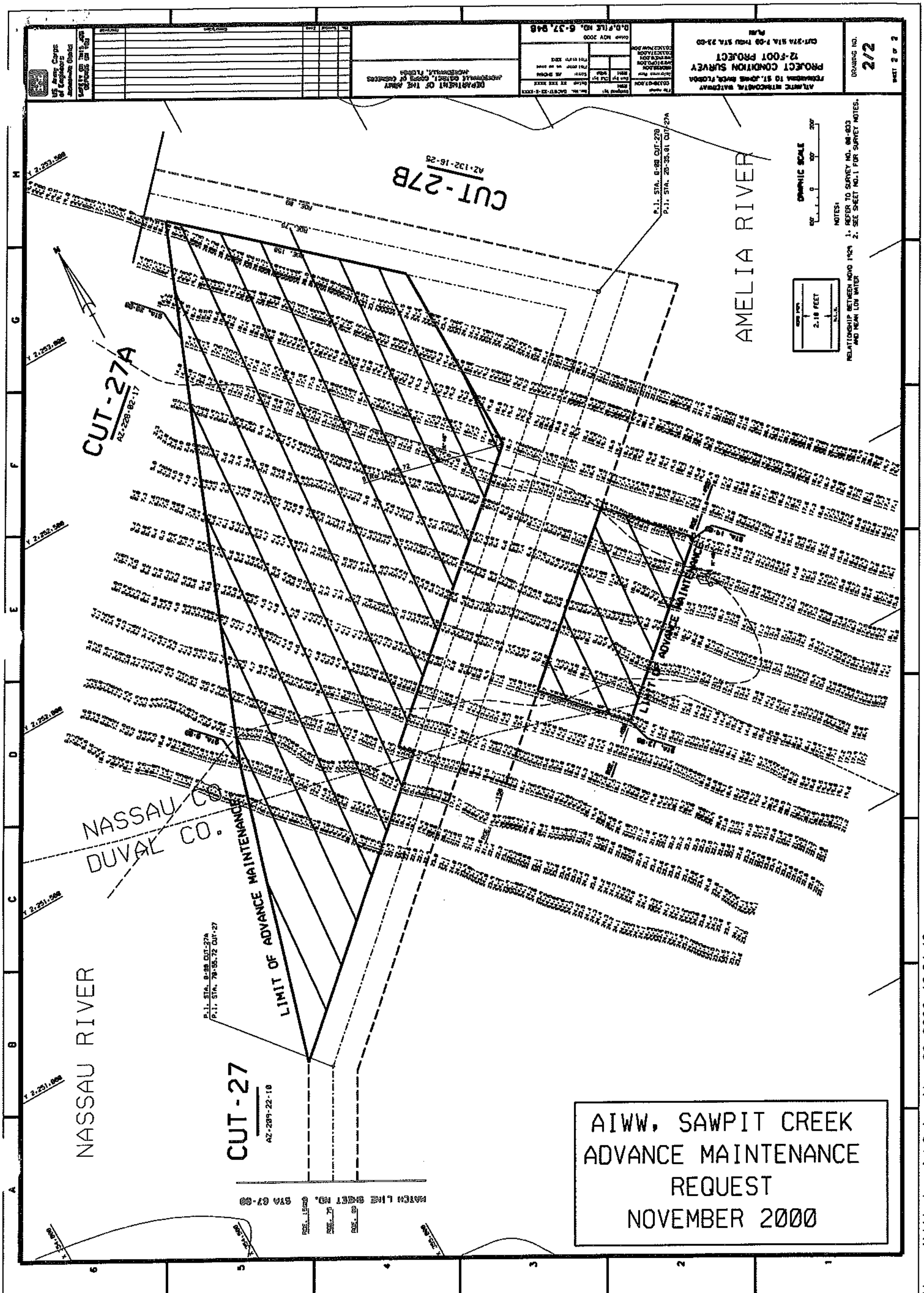

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9/8
Don FV

FLORIDA INLAND NAVIGATION DISTRICT

October 15, 1999

Mr. Don Fore, Project Manager
Project Management
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Fore:

RE: ICW Maintenance Dredging in the Vicinity of Matanzas Inlet

I am in receipt of the after dredging survey of the referenced area. This survey shows significant out channel shoaling to the west of the channel. Deep water appears again west of the shoal along the shoreline of SJ-1.

As the contractor is coming back to this area to offload SJ-1, do you think that it would be prudent to dredge this out channel shoal to lengthen the interval between dredging events. It appears that there will be capacity on the beach for this material. It appears that there is ample time to modify the permits for this additional work since the contractor will not be offloading SJ-1 until next fall. Additionally, the District has funds on account with the Corps for this project that are not currently encumbered and could be utilized for this additional work.

Please review this matter and advise me of your thoughts.

Sincerely,

David K. Roach
Executive Director

Cc: Commissioner Faulkner

ADMINISTRATIVE OFFICE ON THE INTRACOASTAL WATERWAY IN PALM BEACH COUNTY
1314 MARCINSKI ROAD, JUPITER, FLORIDA 33477 TELEPHONE 561-627-3386 FAX No. 561-824-6480
www.flinet.com/~flnavdist

CESAD-ET-CO (CESAJ-CO-OM/1 Feb 00) (11-2-240a) 1st End Ms. Susan Whittington/jag/404-562-5133
SUBJECT: Advanced Maintenance Dredging of the Atlantic Intracoastal Waterway (IWW) Jacksonville to Miami, in the Vicinity of Matanzas Inlet, St. Johns County, Florida

Commander, South Atlantic Division, U.S. Army Corps of Engineers, Room 9M15, 60 Forsyth Street, SW., Atlanta, GA 30335-6801
13 September 2000

FOR COMMANDER, JACKSONVILLE DISTRICT, ATTN: CESAJ-CO-~~M~~ OM

1. Your request to perform advanced maintenance in subject channels is approved subject to completing all appropriate environmental documentation, coordination, and clearance.

2. As all costs involved with this advanced maintenance dredging will be paid by the Florida Inland Navigation District (FIND) under an existing Memorandum of Agreement, we are not requiring the standard cost savings analysis. Therefore, all advanced maintenance dredging performed under this approval must be funded by FIND. Advanced maintenance approval must be requested separately for any work in this area for which Federal funds will be utilized.

FOR THE DIRECTOR OF ENGINEERING AND TECHNICAL SERVICES:

Susan S. Whittington

SUSAN S. WHITTINGTON
Acting Chief, Operations Division
Directorate of Engineering
and Technical Services

Encl
nc

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

01 February 2000

REPLY TO
ATTENTION OF

CESAJ-CO-OM (11-2-240a)

MEMORANDUM FOR CDR, USAED (CESAD-ET-CO-M), ATLANTA, GA 30335

SUBJECT: Advanced Maintenance Dredging of the Atlantic Intracoastal Waterway (IWW) Jacksonville to Miami, in the Vicinity of Matanzas Inlet, St. Johns County, Florida

1. Reference ER 1130-2-520.

2. Advanced maintenance dredging is proposed for the IWW in the vicinity of Matanzas Inlet to:

a. Reduce the frequency of dredging required for this reach of the IWW.

b. Reduce hazardous shoaling that is limiting the draft of vessels along this reach of waterway. The advanced maintenance will provide the most efficient and cost effective solution for maintaining the channel at project depths.

3. This is an extremely fast shoaling area. Six months after the area was last dredged, the channel width was reduced to less than half the authorized channel due to shoaling. It is difficult to maintain channel depths because of its proximity to Matanzas Inlet. The authorized depth is 12 feet MLW. Water depth adjacent to the channel is shallow. We are proposing to perform advance maintenance to project depth adjacent to the authorized channel during the current dredging project. This will allow the channel to remain at authorized depths for a longer period of time, thus reducing the required dredging frequency.

4. The Florida Inland Navigation District (FIND) is the sponsor for the project. FIND and the Corps of Engineers have a Memorandum of Agreement for FIND to contribute funds for the operation and maintenance of the IWW. FIND requested that we perform this advanced maintenance dredging in conjunction with the on-going maintenance dredging in the vicinity, and that they are agreeable to paying 100% of the cost to perform this advance maintenance. Accordingly, no economical analysis is needed.

CESAJ-CO-OM (11-2-240a)
SUBJECT: Advanced Maintenance Dredging of the Atlantic Intracoastal Waterway (IWW) Jacksonville to Miami, in the Vicinity of Matanzas Inlet, St. Johns County, Florida

This advance maintenance request is to dredge the areas shown on the attached map. The verbal description of the area to be dredged is as follows:

a. Cut SJ-60 (Range 0 to -250) from Station 10+00 to 26+86.3

b. Cut SJ-61 (Range 0 to -250) from Station 0+00 to 13+00

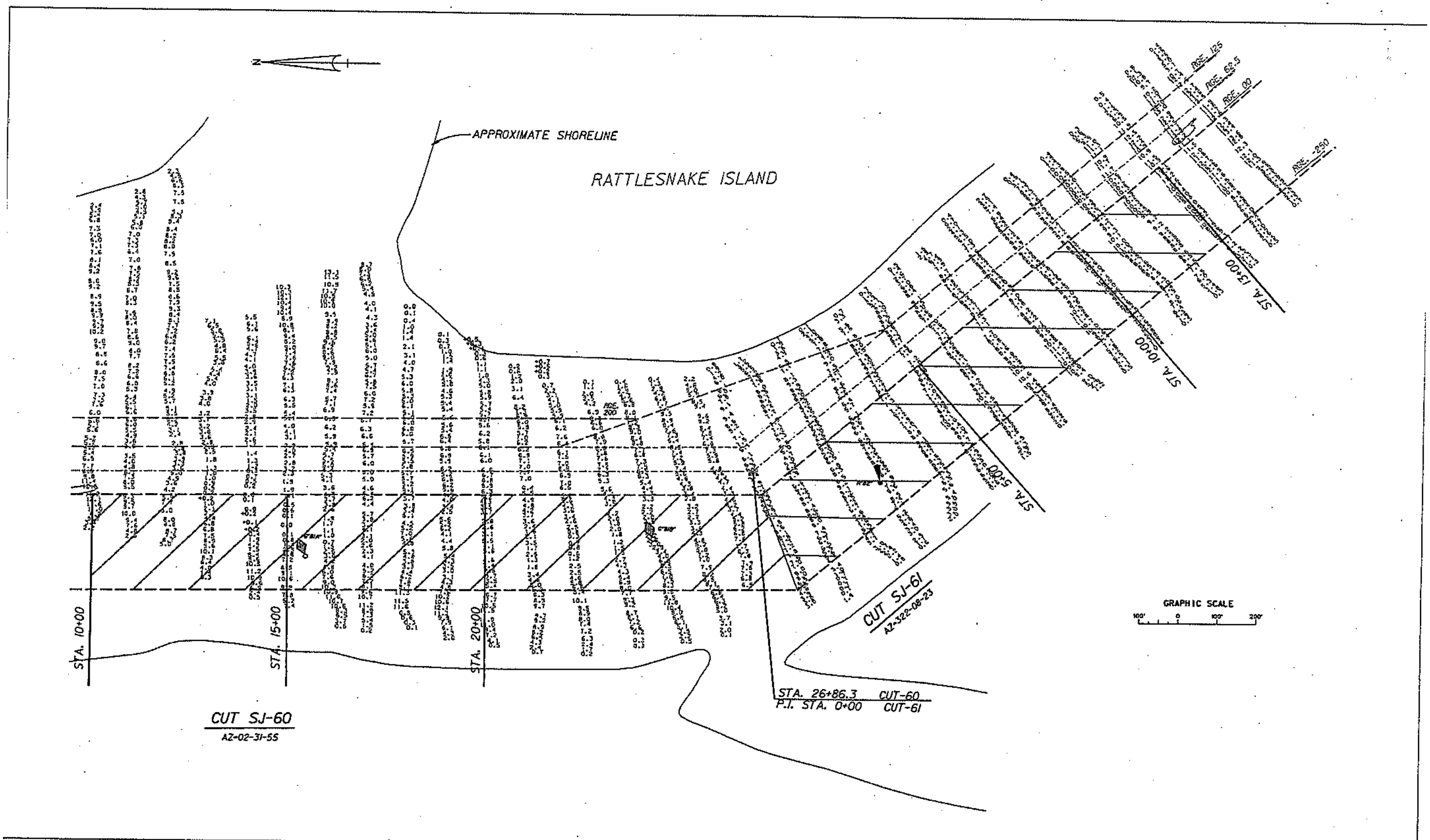
5. We are in the process of acquiring the environmental and cultural clearances for performing this advanced maintenance dredging. If advanced maintenance dredging is performed in this area, we will closely monitor the effectiveness of the dredging. If federal funding were available, it would certainly be beneficial to dredge the areas listed above.

6. Point of Contact for this memorandum is Al Fletcher at (904) 232-2530.

Encl

GORDON M. BUTLER, JR.
Chief, Construction-Operations Division

CF:
DP-I/Fore



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DEPARTMENT OF THE ARMY
SOUTH ATLANTIC DIVISION, CORPS OF ENGINEERS
ROOM 9M15, 60 FORSYTH ST., S.W.
ATLANTA GA 30303-8801

REPLY TO
ATTENTION OF

CESAD-PDO

29 AUG 2013

MEMORANDUM FOR Commander, Jacksonville District

SUBJECT: Advanced Maintenance Dredging for the Intracoastal Waterway (IWW) in the Vicinity of Jupiter Inlet, Palm Beach County, Florida

1. Reference Memorandum, CESAJ-PM-W, 29 July 2013, subject as above (enclosed).

2. In accordance with ER 1130-2-520, your request to perform advanced maintenance dredging for the IWW, Vicinity of Jupiter Inlet is approved.

3. The point of contact for this action is John Ferguson, (404) 562-5111.

Encl

DONALD E. JACKSON, JR.
Brigadier General, U.S. Army
Commanding

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

29 JUL 2013

CESAJ-PM-W

MEMORANDUM FOR Commander, South Atlantic Division, (CESAD-PD-O, Mr. Dylan Davis) 60 Forsyth Street, SW, Room 10M15, Atlanta, Georgia 30303

SUBJECT: Advanced Maintenance Dredging for the Intracoastal Waterway (IWW) in the Vicinity of Jupiter Inlet, Palm Beach County, Florida

1. References:

   a. ER 1130-2-520, Chapter 8

   b. National O&M Programmatic Review Plan (checklist attached)

2. The current authorized depth of Cut P-4 of the IWW project in the vicinity of Jupiter Inlet is 10-ft plus 2-ft of allowable overdepth. The Jacksonville District requests that advanced maintenance dredging be performed to a maximum depth of 15-ft plus 1-ft of allowable overdepth, as shown on the attached drawings.

3. In an effort to demonstrate cost savings that would be realized with implementation of this advanced maintenance, historical records were analyzed to establish an average annual shoaling rate. It has been determined that this portion of the channel shoals at a rate of approximately 5,000 cubic yards per year. Advanced maintenance has been ongoing within this reach since 1971; however, the formal documentation for this cannot be located either within SAJ or SAD. In 1971, with the first advanced maintenance, we were able to stretch the dredge cycle out from 1 year to every 4 years. In 2008, further advanced maintenance was implemented which increased the dredge cycle by an additional year out to every 5 years. If you evaluate advanced maintenance over 50 years it is estimated that 10 dredging events will take place at the current cycle of every 5 years and 13 dredging events when you utilize the previous cycle of every 4 years, thus reducing the number of dredging events by 3 over a 50 year cycle. To establish a monetary value for cost savings, we evaluated the cost of additional mobilizations. It is estimated that mobilization for this project is approximately $1,000,000 (typically combined with another reach of the IWW) which would equate to a minimum $3,000,000 savings over a 50 year project life.

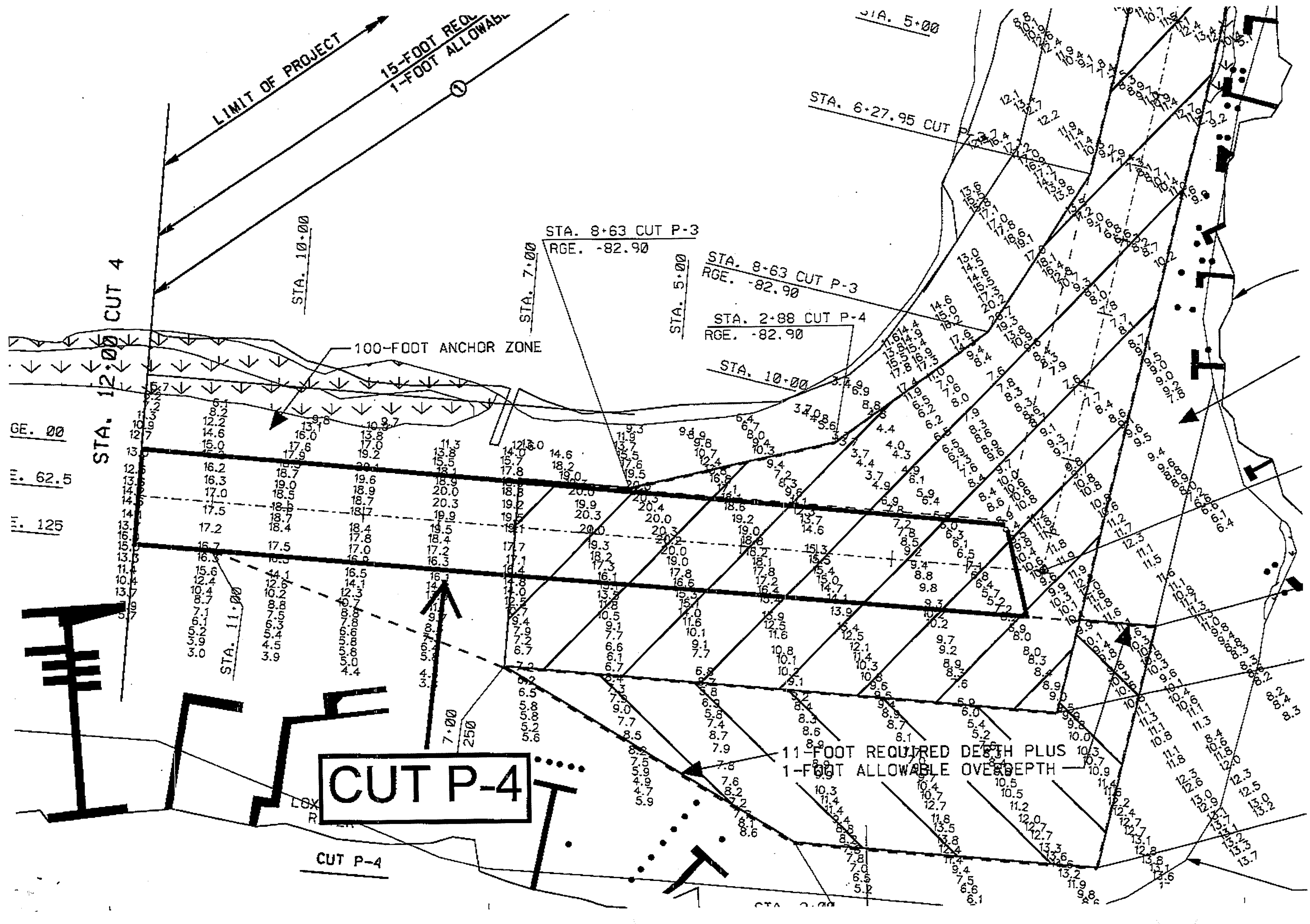
4. Per paragraph 3 above, advanced maintenance of this area has been approved in the past. However, documentation regarding that previous request could not be located either within SAJ or SAD. During the 2008 event the area was dredged to 15+1 and no rock was encountered. Because the dredge prism matches the 2008 prism, it is anticipated that rock would not be found during this next event, currently scheduled to advertise 1 Aug 2013. Additionally, there are no surrounding structures that would be impacted by this proposal.

5. The advanced maintenance area being proposed is a small section of the overall project and will not result in a change to the design vessel that utilizes this channel. The advanced maintenance will solely provide for the more efficient maintenance of the project.

6. All environmental documentation is current on this project to include the advanced maintenance depth. No additional environmental coordination will be required.

7. In accordance with ER 1130-2-520, we request that your office approve this advance maintenance request for the subject project. POC for this memorandum is Bob Riddell at 904-232-2451.

ALAN M. DODD
Colonel, Corps of Engineers
Commanding



LIMIT OF PROJECT
STA. 12+00 CUT 4
STA. 10+00
STA. 7+00
STA. 8+63 CUT P-3
RGE. -82.90
STA. 5+00
STA. 8+63 CUT P-3
RGE. -82.90
STA. 2+88 CUT P-4
RGE. -82.90
STA. 10+00
STA. 6+27.95 CUT
100-FOOT ANCHOR ZONE
STA. 11+00
7+00
250
CUT P-4
11-FOOT REQUIRED DEPTH PLUS
1-FOOT ALLOWABLE OVERDEPTH
CUT P-4

Routine O&M

Work Product Determination Form

Work Product Description: Advanced Maintenance Dredging for the Intracoastal(IWW) for the vicinity of Jupiter Inlet, Palm Beach County Florida

Facility: USACE-SAJ

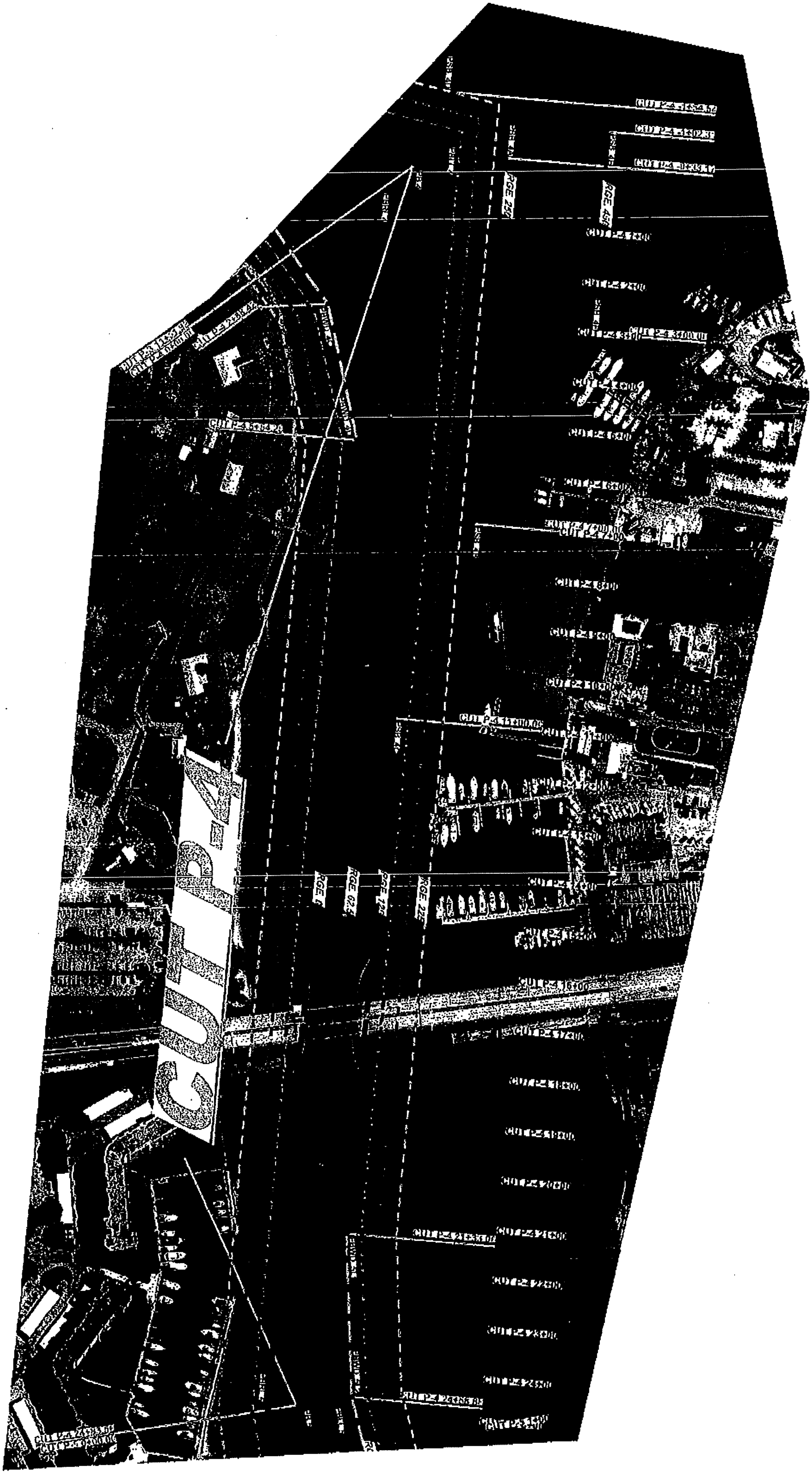
This work product is an Other Work Product per EC1165-2-214	**Y**
This work product is Routine O&M	**Y**
Does not require an ATR per EC 1165-2-214 paragraph 15	**Y**

Justification: Advanced maintenance of this area has been approved in the past(since 1971); however, documentation regarding those previous requests could not be located. The most recent dredging down to this proposed depth was performed in 2008.

7/29/13

Jerry W. Scarborough, P.E. — **Date**

Chief, Water Resources Branch



CUT P-4
CUT P-4 1+00
CUT P-4 2+00
CUT P-4 6+00
CUT P-4 8+00
CUT P-4 9+00
CUT P-4 10+00
CUT P-4 16+00
CUT P-4 17+00
CUT P-4 18+00
CUT P-4 19+00
CUT P-4 20+00
CUT P-4 21+00
CUT P-4 22+00
CUT P-4 23+00
CUT P-4 24+00

CESAJ-CO-ON (1130)

2 October 1990

MEMORANDUM FOR RECORD

SUBJECT: Request for Additional Foot of Advance Maintenance, Bakers Haulover, Florida

1. Reference telephone conversation between Gail Gren, CESAJ-CO, Jim Kelly and Tucker Russel, CESAD, 28 September, 1990, subject as above.

2. This memorandum records the verbal approval of our request for one additional foot of overdepth dredging in the Intracoastal Waterway, cut DA-9, between stations 21+00 and 48+00. This additional foot increases required dredging depth to 13 feet, 10-foot project with 2 feet of overdepth and 1-foot of advance maintenance.

GAIL G. GREN
Chief, Construction-Operations Division

IWW J to M Dade County Project Authorization

CESAJ-CO-ON (113Ø)

2 October 199Ø

MEMORANDUM FOR CESAJ-EN-DL

SUBJECT: Maintenance Dredging Vicinity of Bakers Haulover with Sunny Isles Beach D/A

1. Reference CESAJ-EN-DL memorandum dated 24 September 199Ø, subject as above, and CESAJ-CO-ON memorandum for the record dated 1 October 199Ø, copies enclosed.

2. Verbal acceptance of 3 feet of advance maintenance dredging in cut DA-9 between stations 21+ØØ and 43+ØØ, including the settling basin, has been recieved from CESAD. Enclosed are exam surveys showing the areas that have been authorized for dredging to 13 feet.

3. Please compute the additional quantities and proceed with preparation of the Plans and Specifications.

4. Point of contact is Mr. Mark Skarbek at extension 1131.

Encls

Girlamo DiChiara

GIRLAMO DiCHIARA
Acting Chief
Construction-Operations Division

Mark's Copy

IWW Jx to M Dade County Project Authorization

Dist 04-10-90

CESAJ-CO-ON (1130) 9 October 1990

MEMORANDUM FOR CESAJ-EN-DL

SUBJECT: Maintenance Dredging, IWW, J-M, Vicinity of Bakers Haulover Inlet, Florida

1. Reference telephone conversation between Bob Schmitt, CESAJ-EN-DL and Mark Skarbek, CESAJ-CO-ON, 3 October, 1990, subject as above.

2. This memorandum records the verbal approval given to Engineering's suggestion to extend the one additional foot of over-depth dredging in the Intracoastal Waterway, cut DA-9, to station 48+00 instead of 43+00.

3. Point of Contact for this project is Mark Skarbek, extension 1131.

Gail G. Gren

GAIL G. GREN
Chief, Construction-Operations Division

Mark S' Copy

IWW J to M Dade County Project Authorization

CESAJ-CO-ON (1130)

2 October 1990

MEMORANDUM FOR RECORD

SUBJECT: Request for Additional Foot of Advance Maintenance~~, Bakers Haulover, Florida~~

1. Reference telephone conversation between Gail Gren, CESAJ-CO, Jim Kelly and Tucker Russel, CESAD, 28 September, 1990, subject as above.

2. This memorandum records the verbal approval of our request for one additional foot of overdepth dredging in the Intracoastal Waterway, cut DA-9, between stations 21+00 and 48+00. This additional foot increases required dredging depth to 13 feet, 10 foot project with 2 feet of overdepth and 1 foot of advance maintenance.

GAIL G. GREN
Chief Construction-Operations Division

CESAJ-CO-ON/Skarbek
bkj/2539 02-10-90
CESAJ-CO-ON/Beasley
CESAJ-CO-O/Adams
CESAJ-CO-A/DiChiara
CESAJ-CO/Gren

IWW

VIC. BAKERS HAULOVER

CESAD-CO-ON (CESAJ-CO-ON/9 August 1993) (1110-2-1150a) 1st End
Mr. Russell/dsm/(404) 331-6745
SUBJECT: IWW J to M - Advance Maintenance, Cut DA-9

Commander, South Atlantic Division, U.S. Army Corps of Engineers,
77 Forsyth Street, SW, Room 313, Atlanta, Georgia 30335-6801
13 August 1993

FOR COMMANDER, JACKSONVILLE DISTRICT, ATTN: CESAJ-CO-ON

1. Your request to perform advanced maintenance dredging in Cut DA-9 is approved.

2. You should continue to monitor the cost of maintenance to assure that the advanced dredging results in the least costly method for maintaining the channel.

FOR THE COMMANDER:

John J. Blake

JOHN J. BLAKE, P.E.
Director of Construction-Operations

IWW J to M Dade County Project Authorization

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

CESAJ-CO-ON (1130)

9 August 1993

MEMORANDUM FOR Commander, South Atlantic Division, 77 Forsyth Street, S.W., Atlanta, Georgia 30335

SUBJECT: IWW J to M - Advance Maintenance, Cut DA-9

1. Sand material moves through Bakers Haulover Inlet and is deposited in Cut DA-9 over a half mile reach of channel. The quantity of material in the channel is usually around 30,000 to 40,000 cubic yards. Material in the setting basin is usually another 10,000 yards. The shoal becomes highly restrictive as you can see from our enclosed May 1993 survey.

2. In past years we have performed advance dredging with 13 feet required in the channel and 11 feet in the basin. We cannot go beyond these depths due to hard rock in the area. This past practice has resulted in dredging the area every two years. The small quantities involved however, result in a high cost to remove a small shoal.

3. We request approval to issue future IFB with the following additions:

a. Extend the 13-foot required depth in the channel to Sta 20.

b. Extend the 11 feet required depth in the basin to Sta 20.

c. Widened the basin 25 feet to range 175, Sta 41 to 20 and dredge to 11 feet or rock whichever is higher.

4. The contractor will be alerted to the fact that he may hit rock, but he will not be required to dredge rock.

5. We believe the wider basin along with the overdepth dredging should result in the channel staying open longer than 2 years. If we can achieve a 3-year maintenance cycle the savings will be significant. Accordingly dredging of the advanced maintenance material is the most economical method of maintaining the channel.

6. Plans and specification are now being prepared and are to be advertised 20 September 1993. We would appreciate your early reply.

IWW J to M Dade County Project Authorization

CESAJ-CO-ON
SUBJECT: IWW J to M - Advance Maintenance, Cut DA-9

7. Request your concurrence to perform advance maintenance.

FOR THE COMMANDER:

Enclosures

GIRLAMO DiCHIARA
Chief Constructions-Operation
Division

CF:
CESAJ-EN-DL (w/encls)

IWW J to M Dade County Project Authorization

CESAD-ET-CO-M (CESAJ-CO/21 Jun 97) (11-2-240a) 1st End Mr. DeVeaux/
dsm/(404) 331-6742
SUBJECT: Advanced Maintenance Dredging of the Atlantic Intracoastal Waterway (IWW) Jacksonville to Miami, in the Vicinity of Bakers Haulover Inlet, Dade County, Florida

Commander, South Atlantic Division, U.S. Army Corps of Engineers, 77 Forsyth Street, S.W., Room 322, Atlanta, Georgia 30303-3490
10 July 1997

FOR THE COMMANDER, JACKSONVILLE DISTRICT, ATTN: CESAJ-CO

1. Your request to perform advanced maintenance in subject channel is approved subject to completing all appropriate environmental documentation, coordination, and clearance. Approval of the Memorandum of Agreement with the Florida Inland Navigation District is also required.

2. You should continue to monitor the cost of maintenance to assure that the proposed advanced maintenance dredging results in the least costly method of maintaining the channel.

FOR THE DIRECTOR OF ENGINEERING AND TECHNICAL SERVICES:

GEORGE R. PRINCE, JR., PE, CPE
Chief, Construction-Operations Division
Directorate of Engineering and Technical Services

Rcvd: 7 Jul 97

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

CESAJ-CO (11-2-240a)

21 June 1997

MEMORANDUM FOR CDR, USAED (CESAD-ET-CO-M), ATLANTA, GA 30335

SUBJECT: Advanced Maintenance Dredging of the Atlantic Intracoastal Waterway (IWW) Jacksonville to Miami, in the Vicinity of Bakers Haulover Inlet, Dade County, Florida

1. Reference ER 1130-2-520.

2. Advanced maintenance dredging is proposed for the IWW in the vicinity of Bakers Haulover Inlet to reduce the frequency of dredging required for this reach of the IWW. The advanced maintenance will provide the most efficient and cost effective solution for maintaining the channel at project depths. The authorized project is 125 feet wide with a depth of 10 feet mean low water. Overdepth dredging is not an option because existing project depth was attained by excavating through rock. Recent dredging contracts in this portion of the IWW provided a safe navigation channel for less than a year. Within a year after dredging, complaints from the Coast Guard and users of this reach of the IWW have been received. The channel is presently reported to be 50 feet wide and 6 feet deep, and is able to serve only navigation interests with very shallow drafts.

3. Enclosure 1 is an Area Map which shows the location of the project. Bakers Haulover Inlet is a man-made inlet, with a relatively high top of rock elevation throughout its flood tide shoal. Enclosure 2 provides a hydrographic survey overlayed onto the Federal inlet channel and IWW channel. Please note the area for which we are requesting advanced maintenance coincides with the flood tide shoal. Enclosure 3 shows the top of rock elevations in the area. We intend to dredge the flood tide

shoal down to two feet above rock, which will create a settling basin. In the past when the IWW channel was dredged, the dredging effectively just cut off the western edge of this flood tide shoal, and as the inlet processes continued, the flood tide shoal simply extended back into the IWW channel. A Water Quality Certificate for doing this work has been submitted to the Florida Department of Environmental Protection. All dredged material will be placed on Bal Harbour Beach.

4. According to the project cost estimate, the total cost to dredge the 22,000 cubic yards of material in the IWW would be $661,900. Alternatively, the total cost to dredge the 142,000 cubic yards in the flood tide shoal (including the IWW portion) would be $1,359,525. Since all the material to be dredged is beach quality, it would be placed on Bal Harbour Beach, located immediately south of Bakers Haulover Inlet. Enclosure 4 compares the dredging costs for the with and without advanced maintenance alternative. We anticipate that the frequency of dredging is a non-linear function proportional to the quantities dredged. We predict that by dredging this settling basin, the dredging frequency would be reduced from the annual requirement to a four-year period. This would result in a project savings of over $1,288,000 every four years, and at the same time producing a channel that would be truly navigable for four years or possibly more.

5. ER 1130-2-520 allows the District to perform advanced maintenance dredging with your permission. Without your approval, the District will have to dredge the channel every year to every other year. Consequently, the district will fail to maintain the project at authorized dimensions during portions of the interval and maintenance of the channel will cost more. Prior to future advanced maintenance for this location of the IWW, the District will evaluate and affirm the effectiveness of advanced maintenance.

CESAJ-CO
SUBJECT: Advanced Maintenance of the Atlantic Intracoastal Waterway (IWW) Jacksonville to Miami, in the Vicinity of Bakers Haulover Inlet, Dade County, Florida

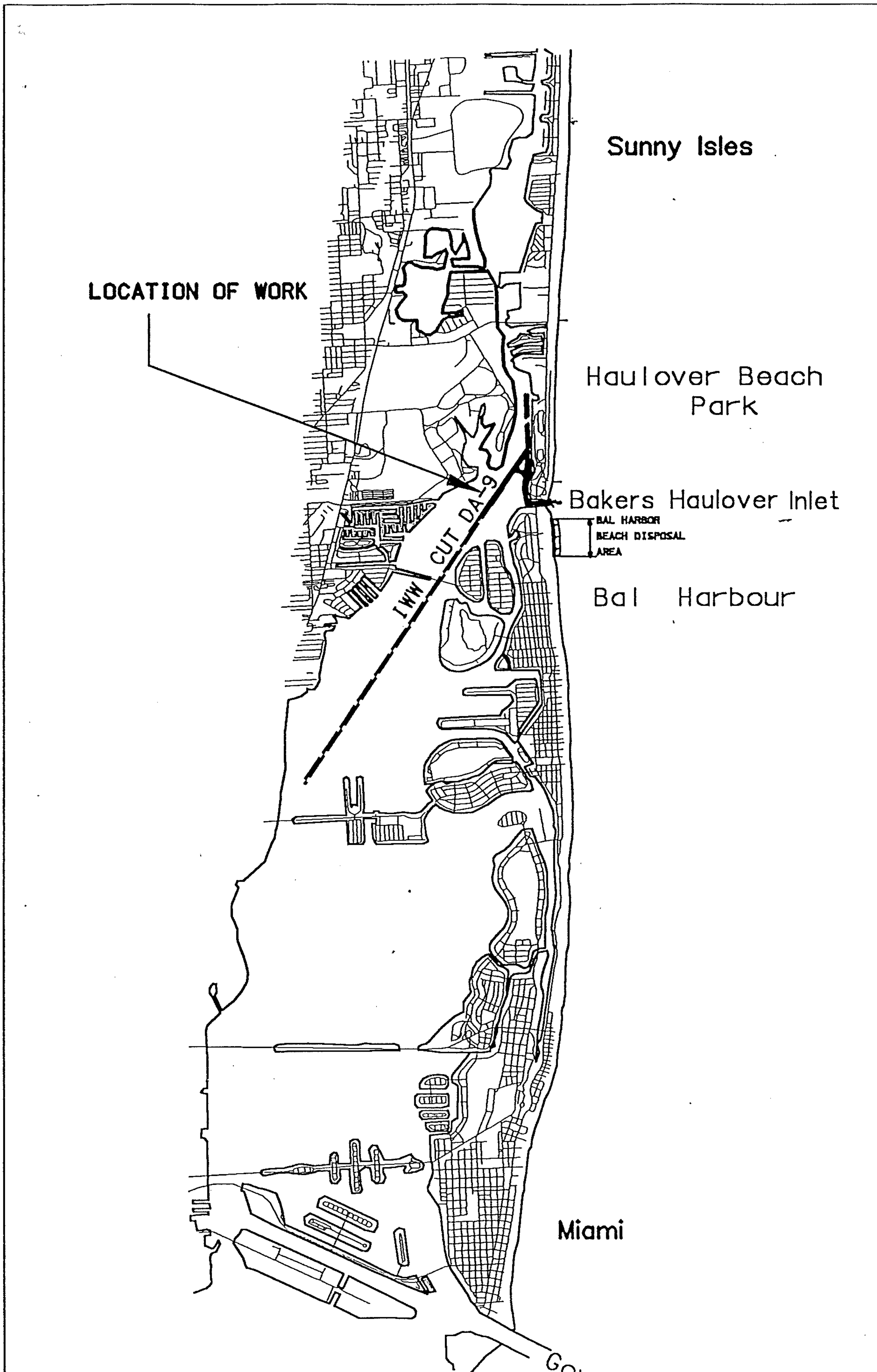
6. Request approval of subject advanced maintenance for the area shown at Enclosure 2. The Florida Inland Navigation District (as local sponsor), is willing to pay for the additional cost of the first advanced maintenance activity. A Memorandum of Agreement to accept their funds is being processed.

FOR THE COMMANDER:

Sirlamo DiChiara

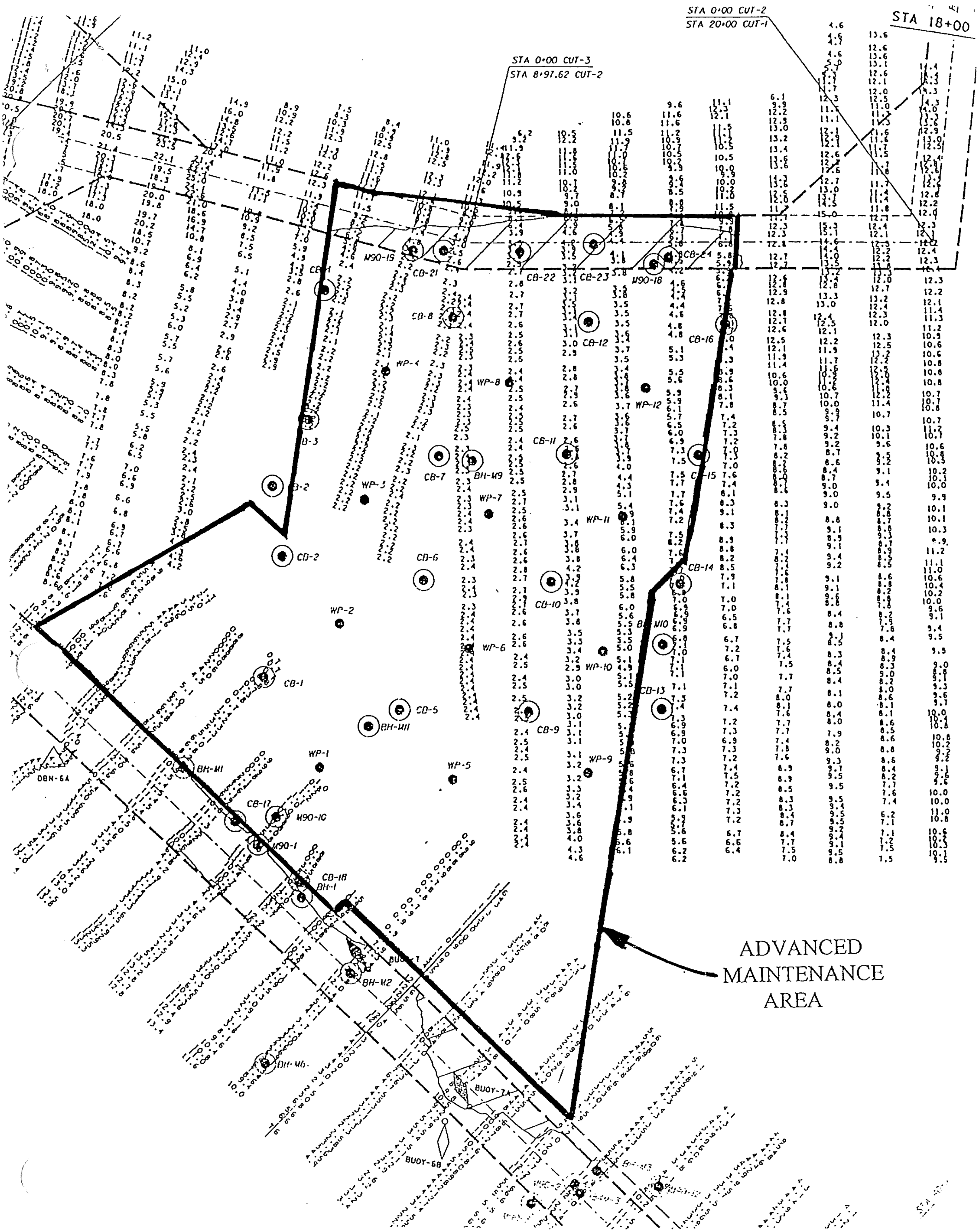
Encls

GIRLAMO DiCHIARA
Chief, Construction-Operations
Division

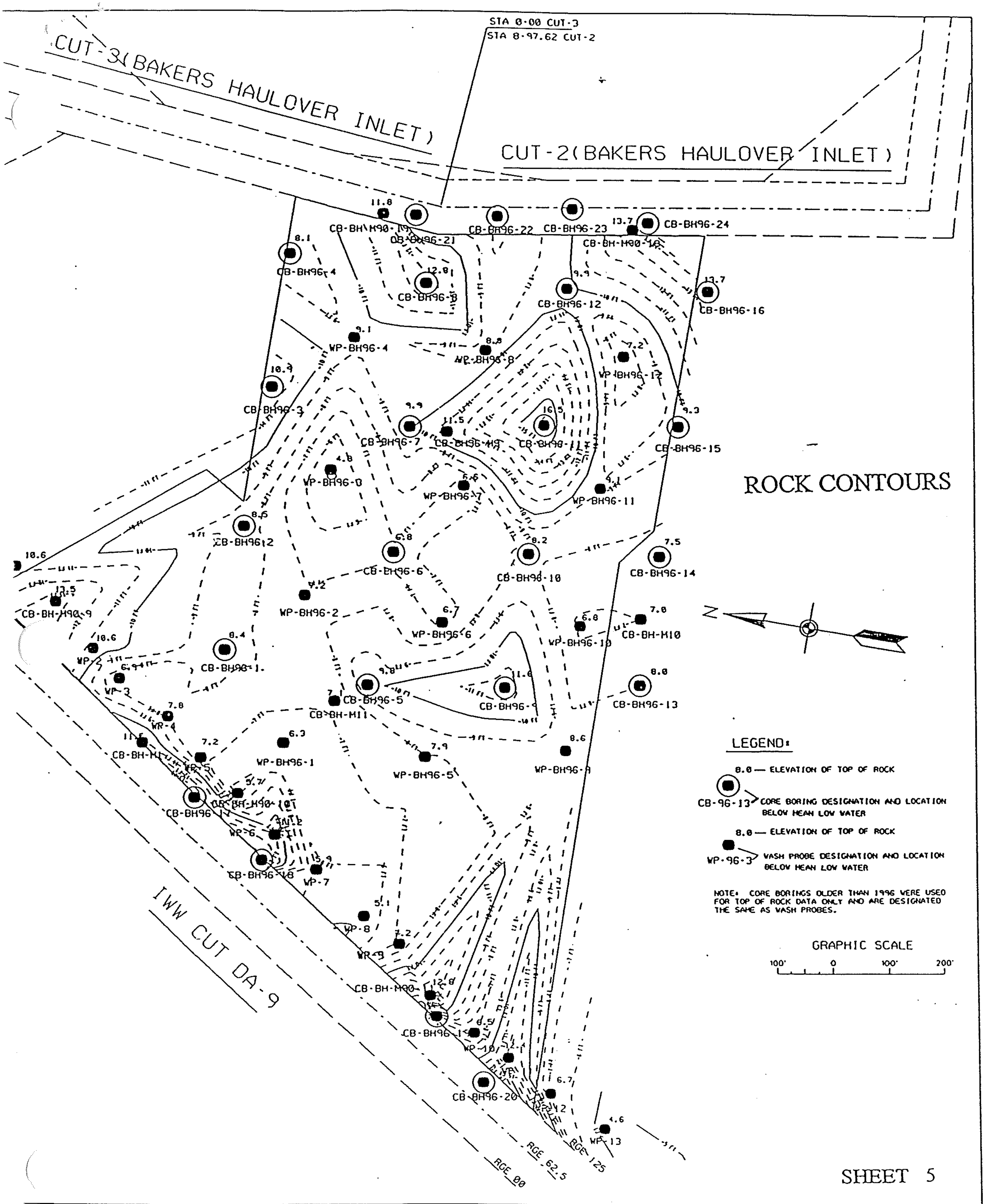


VICINITY MAP

ENCLOSURE 1


STA 0+00 CUT-2
STA 20+00 CUT-1
STA 18+00
STA 0+00 CUT-3
STA 8+97.62 CUT-2
ADVANCED MAINTENANCE AREA

ENCLOSURE 2


STA 0·00 CUT-3
STA 8·97.62 CUT-2
CUT-3(BAKERS HAULOVER INLET)
CUT-2(BAKERS HAULOVER INLET)
ROCK CONTOURS
CB-BH96-22
CB-BH96-23
CB-BH96-24
CB-BH96-21
CB-BH96-4
CB-BH96-8
CB-BH96-12
CB-BH96-16
WP-BH96-4
WP-BH96-8
WP-BH96-12
CB-BH96-3
CB-BH96-7
CB-BH96-15
WP-BH96-0
WP-BH96-7
WP-BH96-11
CB-BH96-2
CB-BH96-6
CB-BH96-10
CB-BH96-14
WP-BH96-2
WP-BH96-6
CB-BH-M10
CB-BH96-1
CB-BH96-5
CB-BH96-9
CB-BH96-13
CB-BH-M11
WP-BH96-1
WP-BH96-5
CB-BH96-17
CB-BH96-18
CB-BH96-19
CB-BH96-20
IWW CUT DA-9
RGE 00
RGE 62.5
RGE 125
LEGEND:
8.0 — ELEVATION OF TOP OF ROCK
CB-96-13 CORE BORING DESIGNATION AND LOCATION BELOW MEAN LOW WATER
8.0 — ELEVATION OF TOP OF ROCK
WP-96-3 WASH PROBE DESIGNATION AND LOCATION BELOW MEAN LOW WATER
NOTE: CORE BORINGS OLDER THAN 1996 WERE USED FOR TOP OF ROCK DATA ONLY AND ARE DESIGNATED THE SAME AS WASH PROBES.
GRAPHIC SCALE
100' 0 100' 200'
SHEET 5

ENCLOSURE 3

DREDGING COST FOR IWW - VICINITY OF BAKERS HAULOVER INLET WITH AND WITHOUT ADVANCE MAINTENANCE					
Estimated shoaling rate = 22,000 cubic yards per year in the IWW - vicinity of Bakers Haulover Inlet.					
Mobilization and Demobilization cost are slightly higher for advanced maintenance for extra pipeline.					
E&D costs are slightly higher for Adv Maint due to additional surveying and material sampling costs.					
Estimates assume a 20 percent contingency factor.					
Existing Condition-No Advance Maintenance - Annual Requirement					
item	quantity	unit	unit cost		cost
Mobilization and Demobilization	1 job	job	LS		$ 400,000
Dredging	22,000	cu. yds	$ 6.00		$ 132,000
Subtotal					$ 532,000
E&D					$ 90,000
S&A	0.075				$ 39,900
Total Cost of Operation					$ 661,900
Dredging Operation - Advanced Maintenance (assume 4 year dredging period)					
item	quantity	unit	unit cost		cost
Mobilization and Demobilization	1	job	LS		$ 435,000
Dredging	22,000	cu. yds	$ 6.00		$ 132,000
Advanced Dredging	120,000	cu. yds	$ 5.00		$ 600,000
Subtotal					$ 1,167,000
E&D					$ 105,000
S&A	0.075				$ 87,525
Total Cost of Operation					$ 1,359,525
Cost over a 4 year dredging period	without Adv Maint	with Adv Maint			
Year 1	$661,900	$1,359,525			
Year 2	$661,900				
Year 3	$661,900				
Year 4	$661,900				
4-year total	$2,647,600	$1,359,525			
Annual Cost	$661,900	$ 339,881			
Potential Savings over 4 year dredging period		$1,288,075			
Potential Annual Savings		$322,019			
L:\COPM\EXCEL\BH-ADVMN.XLS					

ENCLOSURE 4

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program Efficiencies

ATTACHMENT E
FLORIDA EAST COAST HARBOR MAINTENANCE DREDGING HISTORY

DESIGN DEPTH	FY	JOBKEY	NICKNAME	CONTRACT NAME	DMMA No.	DMMA NAME	QUANTITY (CY)	COST	UNIT COST ($/CY)	BENUSECD	DISPOSAL TYPE	DREDGE TYPE	DREDGE NAME	CONTRACTOR	CONTRACT TYPE	CONTRACT NUMBER	SOLICITATION TYPE	DREDGE START DATE	DREDGE END DATE	DURATION	PRODUCTION RATE
	KINGS BAY ENTRANCE CHANNEL																				
	FY02	02SAJ002	KBEC	KINGS BAY ENTRANCE CHANNEL O&M	SAJ208	AMELIA ISLAND NORTH BEACH	265,182	$ 1,080,979.88	$ 4.08	BN	beach	hopper	Stuyvesant	Bean Stuyvesant	Unit-price	02-C-0005	IFB	22-Jan-02	29-Mar-02	66	4018
	FY02	02SAJ002	KBEC	KINGS BAY ENTRANCE CHANNEL O&M	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	12,117	$ 49,393.37	$ 4.08	BN	nearshore	hopper	Stuyvesant	Bean Stuyvesant	Unit-price	02-C-0005	IFB	22-Jan-02	29-Mar-02	66	184
	FY02	02SAJ002	KBEC	KINGS BAY ENTRANCE CHANNEL O&M	SAJ019	FERNANDINA ODMDS	761,486	$ 3,104,098.49	$ 4.08	NO	ODMDS	hopper	Stuyvesant	Bean Stuyvesant	Unit-price	02-C-0005	IFB	22-Jan-02	29-Mar-02	66	11538
	FY03	03SAJ001	KBEC	KINGS BAY ENTRANCE CHANNEL O&M	SAJ208	AMELIA ISLAND NORTH BEACH	38,298	$ 176,471.84	$ 4.61	BN	beach	hopper	Bayport	Manson	Unit-price	03-C-0002	IFB	7-Jan-03	13-Mar-03	65	589
	FY03	03SAJ001	KBEC	KINGS BAY ENTRANCE CHANNEL O&M	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	17,555	$ 80,890.99	$ 4.61	BN	nearshore	hopper	Bayport	Manson	Unit-price	03-C-0002	IFB	7-Jan-03	13-Mar-03	65	270
	FY03	03SAJ001	KBEC	KINGS BAY ENTRANCE CHANNEL O&M	SAJ019	FERNANDINA ODMDS	751,635	$ 3,463,429.17	$ 4.61	NO	ODMDS	hopper	Bayport	Manson	Unit-price	03-C-0002	IFB	7-Jan-03	13-Mar-03	65	11564
	FY05	05SAJ020	KBEC	KINGS BAY EC	SAJ019	FERNANDINA ODMDS	500,566	$ 2,209,984.58	$ 4.41	NO	ODMDS	hopper	Stuyvesant	Bean Stuyvesant	Unit-price	05-C-0004	IFB				
	FY05	05SAJ020	KBEC	KINGS BAY EC	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	9,608	$ 42,419.05	$ 4.41	BN	nearshore	hopper	Stuyvesant	Bean Stuyvesant	Unit-price	05-C-0004	IFB				
	FY05	05SAJ020	KBEC	KINGS BAY EC	SAJ208	AMELIA ISLAND NORTH BEACH	42,092	$ 185,834.98	$ 4.41	BN	beach	hopper	Stuyvesant	Bean Stuyvesant	Unit-price	05-C-0004	IFB				
	FY06	06SAJ004	KBEC	Kings Bay Entrance Channel O&M C-S Dredge Rental	SAJ019	FERNANDINA ODMDS	122,736	$ 830,201.53	$ 6.76	NO	ODMDS	hopper	Stuyvesant	Bean Stuyvesant	Rental	06-C-0005	IFB				
	FY06	06SAJ004	KBEC	Kings Bay Entrance Channel O&M C-S Dredge Rental	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	122,736	$ 830,201.53	$ 6.76	BN	nearshore	hopper	Stuyvesant	Bean Stuyvesant	Rental	06-C-0005	IFB				
	FY06	06SAJ004	KBEC	Kings Bay Entrance Channel O&M C-S Dredge Rental	SAJ240	KBEC IN CHANNEL PLACEMENT	122,736	$ 830,201.53	$ 6.76	NO	in channel	hopper	Stuyvesant	Bean Stuyvesant	Rental	06-C-0005	IFB				
	FY07	07SAJ012	KBEC	Kings Bay Entrance Channel O&M	SAJ100	KBEC FT CLINCH	71,312	$ 291,736.77	$ 4.09	BN	beach	hopper	Newport	Manson	Unit-price	07-C-0005	IFB				
	FY07	07SAJ012	KBEC	Kings Bay Entrance Channel O&M	SAJ019	FERNANDINA ODMDS	578,311	$ 2,365,865.23	$ 4.09	NO	ODMDS	hopper	Newport	Manson	Unit-price	07-C-0005	IFB				
	FY07	07saj025	KBEC	Kings Bay Entrance Channel O&M (c-s dredge rental)	SAJ208	AMELIA ISLAND NORTH BEACH	243,000	$ 11,080,409.94	$ 45.60	BN	beach	cutter-suction	Illinois	GLDD	Rental	07-C-0019	IFB				
	FY08	08SAJ002	KBEC	Kings Bay Entrance Channel O&M	SAJ019	FERNANDINA ODMDS	806,473	$ 4,020,700.84	$ 4.99	NO	ODMDS	hopper	RN Weeks	Weeks	Unit-price	08-C-0002	RFP				
	FY08	08SAJ002	KBEC	Kings Bay Entrance Channel O&M	SAJ233	AMELIA ISLAND SOUTH JETTY BCH	60,170	$ 299,979.75	$ 4.99	BN	beach	hopper	RN Weeks	Weeks	Unit-price	08-C-0002	RFP				
	FY09	09SAJ007	KBEC	Kings Bay EC-CUT1N (1)	SAJ019	FERNANDINA ODMDS	264,477	$ 1,895,717.41	$ 7.17	NO	ODMDS	hopper	Liberty Island	GLDD	Unit-price	09-C-0011	IFB				
	FY09	09SAJ023	KBEC	Kings Bay EC-CUT1N (2)	SAJ019	FERNANDINA ODMDS	1,052,386	$ 6,783,722.98	$ 6.45	NO	ODMDS	hopper	Liberty Island & Terrapin Island	GLDD	Unit-price	09-C-0052	IFB				
	FY09	09SAJ023	KBEC	Kings Bay EC-CUT1N (2)	SAJ100	KBEC FT CLINCH	246,733	$ 1,590,450.96	$ 6.45	BN	beach	hopper	Liberty Island & Terrapin Island	GLDD	Unit-price	09-C-0052	IFB				
	FY09	09SAJ023	KBEC	Kings Bay EC-CUT1N (2)	SAJ233	AMELIA ISLAND SOUTH JETTY BCH	49,128	$ 316,681.09	$ 6.45	BN	beach	hopper	Liberty Island & Terrapin Island	GLDD	Unit-price	09-C-0052	IFB				
	FY11	11SAJ001	KBEC	MATOC KBEC O&M	SAJ019	FERNANDINA ODMDS	764,906	$ 5,512,892.50	$ 7.21	NO	ODMDS	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0001	MATOC				
	FY11	11SAJ001	KBEC	MATOC KBEC O&M	SAJ208	AMELIA ISLAND NORTH BEACH	89,988	$ 648,568.80	$ 7.21	BN	beach	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0001	MATOC				
	FY12	12SAJ004	KBEC	MATOC Kings Bay Entrance Channel O&M	SAJ100	KBEC FT CLINCH	123,653	$ 1,576,603.28	$ 12.75	BN	beach	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0004	MATOC				
	FY12	12SAJ004	KBEC	MATOC Kings Bay Entrance Channel O&M	SAJ019	FERNANDINA ODMDS	537,987	$ 6,859,454.01	$ 12.75	NO	ODMDS	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0004	MATOC				
	FY13	13SAJ004	KBEC	MATOC Kings Bay EC	SAJ019	FERNANDINA ODMDS	678,885	$ 3,257,512.00	$ 4.80	NO	ODMDS	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0006	MATOC	1-Feb-13	13-Mar-13	40	16972
	FY13	13SAJ010	KBEC	Kings Bay EC	SAJ208	AMELIA ISLAND NORTH BEACH	121,046	$ 8,030,480.00	$ 66.34	BN	beach	cutter-suction	Alaska	GLDD	Unit-price	13-C-0023	IFB	7-Oct-13	18-Oct-13	11	11004
	FY14	14SAJ001	KBEC	MATOC Kings Bay EC O&M	SAJ208	AMELIA ISLAND NORTH BEACH	107,634	$ 873,191.24	$ 8.11	BN	beach	hopper	Terrapin Island & Liberty Island	GLDD	Unit-price	11-D-0004-0007	MATOC	8-Mar-14	27-Mar-14	19	5665
-50 FT MLLW	**FY14**	14SAJ001	KBEC	MATOC Kings Bay EC O&M	SAJ019	FERNANDINA ODMDS	643,567	$ 5,220,999.59	$ 8.11	NO	ODMDS	hopper	Terrapin Island & Liberty Island	GLDD	Unit-price	11-D-0004-0007	MATOC	8-Mar-14	27-Mar-14	19	33872
	FY15	15SAJ004	KBEC	MATOC NAVY KBEC	SAJ019	FERNANDINA ODMDS	605,081	$ 8,706,442.35	$ 14.39	NO	ODMDS	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0008	MATOC	8-Feb-15	8-Apr-15	59	10256
	FY15	15SAJ004	KBEC	MATOC NAVY KBEC	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	336,992	$ 4,848,939.93	$ 14.39	BN	nearshore	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0008	MATOC	8-Feb-15	8-Apr-15	59	5712
	FY15	15SAJ004	KBEC	MATOC NAVY KBEC	SAJ100	KBEC FT CLINCH	33,480	$ 481,739.95	$ 14.39	BN	beach	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0008	MATOC	8-Feb-15	8-Apr-15	59	567
	FY15	15SAJ004	KBEC	MATOC NAVY KBEC	SAJ208	AMELIA ISLAND NORTH BEACH	400,704	$ 5,765,684.72	$ 14.39	BN	beach	hopper	Terrapin Island	GLDD	Unit-price	11-D-0004-0008	MATOC	8-Feb-15	8-Apr-15	59	6792
	FY16	16SAJ001	KBEC	MATOC KINGS BAY ENT CHAN O&M	SAJ019	FERNANDINA ODMDS	730,678	$ 9,578,211.98	$ 13.11	NO	ODMDS	hopper	Terrapin Island & Liberty Island	GLDD	Unit-price	11-D-0004-0009	MATOC	10-Feb-16	21-Mar-16	40	18267
	FY16	16SAJ001	KBEC	MATOC KINGS BAY ENT CHAN O&M	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	190,750	$ 2,500,477.55	$ 13.11	BN	nearshore	hopper	Terrapin Island & Liberty Island	GLDD	Unit-price	11-D-0004-0009	MATOC	10-Feb-16	21-Mar-16	40	4769
	FY16	16SAJ001	KBEC	MATOC KINGS BAY ENT CHAN O&M	SAJ208	AMELIA ISLAND NORTH BEACH	302,695	$ 3,967,926.88	$ 13.11	BN	beach	hopper	Terrapin Island & Liberty Island	GLDD	Unit-price	11-D-0004-0009	MATOC	10-Feb-16	21-Mar-16	40	7567
	FY17	17SAJ002	KBEC	Kings Bay Entrance Channel O&M	SAJ019	FERNANDINA ODMDS	700,284	$ 10,832,278.82	$ 15.47	NO	ODMDS	hopper	Bayport & Newport	Manson	Unit-price	17-C-0007	RFP	27-Jan-17	29-Mar-17	61	11480
	FY17	17SAJ002	KBEC	Kings Bay Entrance Channel O&M	SAJ100	KBEC FT CLINCH	123,828	$ 1,915,416.90	$ 15.47	BN	beach	hopper	Bayport & Newport	Manson	Unit-price	17-C-0007	RFP	27-Jan-17	29-Mar-17	61	2030
	FY17	17SAJ002	KBEC	Kings Bay Entrance Channel O&M	SAJ208	AMELIA ISLAND NORTH BEACH	231,652	$ 3,583,287.71	$ 15.47	BN	beach	hopper	Bayport & Newport	Manson	Unit-price	17-C-0007	RFP	27-Jan-17	29-Mar-17	61	3798
	FY17	17SAJ002	KBEC	Kings Bay Entrance Channel O&M	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	164,303	$ 2,541,511.04	$ 15.47	BN	nearshore	hopper	Bayport & Newport	Manson	Unit-price	17-C-0007	RFP	27-Jan-17	29-Mar-17	61	2693
	FY17	17SAJ011	KBEC	MATOC NAVY KBEC																	
	KINGS BAY INNER CHANNEL																				
	FY07	07SAJ004	KBIC	Kings Bay Inner Channel O&M	SAJ205	KBIC UPLAND DMMAS	548,094	$ 2,583,479.55	$ 4.71	NO	upland	cutter-suction	Cherokee	Marinex	Unit-price	07-C-0013	IFB				
	FY08	08SAJ010	KBIC	Kings Bay Inner Channel	SAJ205	KBIC UPLAND DMMAS	523,087	$ 2,481,720.70	$ 4.74	NO	upland	cutter-suction	Cherokee	Southern	Unit-price	08-C-0010	IFB				
	FY09	09SAJ008	KBIC	Kings Bay NSB	SAJ205	KBIC UPLAND DMMAS	986,768	$ 4,653,764.70	$ 4.72	NO	upland	cutter-suction	Cherokee	Southern	Unit-price	09-C-0030	IFB				
	FY10	10SAJ020	KBIC	KBIC O&M	SAJ205	KBIC UPLAND DMMAS	314,887	$ 2,913,904.50	$ 9.25	NO	upland	cutter-suction	Cherokee	Southern	Unit-price	10-C-0018	IFB				
	FY15	15SAJ001	KBIC	MATOC Kings Bay EHW O&M	SAJ205	KBIC UPLAND DMMAS	129,445	$ 2,381,687.80	$ 18.40	NO	upland	cutter-suction	Brunswick	Southern	Unit-price	11-D-0012-0003	MATOC	2-Jan-15	13-Jan-15	11	11768
	FY06	06SAJ009	KBIC & MCT	Kings Bay Inner Channel & USMC BIC	SAJ205	KBIC UPLAND DMMAS	1,013,062	$ 4,364,924.50	$ 4.31	NO	upland	cutter-suction	Cherokee	Southern	Unit-price	06-C-0008	IFB				
	FY06	06SAJ009	KBIC & MCT	Kings Bay Inner Channel & USMC BIC	SAJ206	DAYSON ISLAND (USMC)	39,637	$ 170,781.76	$ 4.31	NO	upland	cutter-suction	Cherokee	Southern	Unit-price	06-C-0008	IFB				
	FY11	11SAJ007	KBIC & MCT	MATOC KBIC & MCT O&M	SAJ206	DAYSON ISLAND (USMC)	104,185	$ 410,762.92	$ 3.94	NO	upland	cutter-suction	Lexington	Cottrell	Unit-price	11-D-0011-0002	MATOC				
	FY11	11SAJ007	KBIC & MCT	MATOC KBIC & MCT O&M	SAJ205	KBIC UPLAND DMMAS	1,184,849	$ 4,671,421.34	$ 3.94	NO	upland	cutter-suction	Lexington	Cottrell	Unit-price	11-D-0011-0002	MATOC				
	FY13	13SAJ006	KBIC & MCT	MATOC KBIC and USMC	SAJ205	KBIC UPLAND DMMAS	1,994,942	$ 6,313,218.40	$ 3.16	NO	upland	cutter-suction	Cherokee	Southern	Unit-price	11-D-0012-0002	MATOC	2-Aug-13	10-Jun-14	312	6394
	FY13	13SAJ006	KBIC & MCT	MATOC KBIC and USMC	SAJ206	DAYSON ISLAND (USMC)	95,774	$ 303,087.60	$ 3.16	NO	upland	cutter-suction	Cherokee	southern	Unit-price	11-D-0012-0002	MATOC	2-Aug-13	10-Jun-14	312	307
	FY15	15SAJ003	KBIC & MCT	MATOC KINGSBAY IN CH & USMC	SAJ206	DAYSON ISLAND (USMC)	149,159	$ 941,406.41	$ 6.31	NO	upland	cutter-suction	Brunswick	Southern	Unit-price	11-D-0012-0004	MATOC	24-Mar-15	3-Oct-15	193	773
	FY15	15SAJ003	KBIC & MCT	MATOC KINGSBAY IN CH & USMC	SAJ205	KBIC UPLAND DMMAS	1,168,023	$ 7,371,893.87	$ 6.31	NO	upland	cutter-suction	Brunswick	Southern	Unit-price	11-D-0012-0004	MATOC	24-Mar-15	3-Oct-15	193	6052
	FY16	16SAJ009	KBIC & MCT	MATOC KINGS BAY IC & MCT O&M	SAJ223	KBIC UPLAND DMMAS	1,347,303	$ 11,244,427.51	$ 8.35	NO	upland	cutter-suction	Brunswick	Southern	Unit-price	11-D-0012-0005	MATOC	9-May-16	15-Sep-16	129	10444
	FY16	16SAJ009	KBIC & MCT	MATOC KINGS BAY IC & MCT O&M	SAJ206	DAYSON ISLAND (USMC)	85,846	$ 716,460.31	$ 8.35	NO	upland	cutter-suction	Brunswick	Southern	Unit-price	11-D-0012-0005	MATOC	9-May-16	15-Sep-16	129	665
	FY17	17SAJ003	KBIC & MCT	MATOC KINGS BAY IC & MCT O&M																	
							22,711,912	**$ 179,753,933.05**	**$ 6.45**												
	FERNANDINA HARBOR																				
	FY04	04SAJ040	KBEC	FERNANDINA HBR MD	SAJ208	AMELIA ISLAND NORTH BEACH	352,160	$ 1,179,723.90	$ 3.35	BN	beach	hopper	Liberty Island, Manhattan Island	GLDD	Unit-price	04-C-0004	IFB				
-29 ft MLLW	**FY04**	04SAJ040	KBEC	FERNANDINA HBR MD	SAJ223	AMELIA ISLAND NEARSHORE (KBEC)	22,402	$ 75,045.93	$ 3.35	BN	beach	hopper	Liberty Island, Manhattan Island	GLDD	Unit-price	04-C-0004	IFB				
	FY04	04SAJ040	KBEC	FERNANDINA HBR MD	SAJ019	FERNANDINA ODMDS	850,792	$ 2,850,123.96	$ 3.35	NO	ODMDS	hopper	Liberty Island, Manhattan Island	GLDD	Unit-price	04-C-0004	IFB				
							1,225,354	**$ 4,104,893.79**	**$ 3.35**												
	MAYPORT																				
	FY02	02SAJ013	Mayport	MAYPORT HARBOR MD	SAJ021	MAYPORT D/A O	158,610	$ 547,177.05	$ 3.45	NO	upland	cutter-suction & bucket	Charleston, Virginian	Norfolk	Unit-price	02-C-0002	IFB	31-Oct-02	16-May-03	197	805
	FY02	02SAJ013	Mayport	MAYPORT HARBOR MD	SAJ201	JACKSONVILLE ODMDS Zone-A	1,130,528	$ 3,900,125.95	$ 3.45	NO	ODMDS	cutter-suction & bucket	Charleston, Virginian	Norfolk	Unit-price	02-C-0002	IFB	31-Oct-02	16-May-03	197	5739
	FY05	05SAJ250	Mayport	MAYPORT NAVAL BASE	SAJ021	MAYPORT D/A O	121,953	$ 671,554.68	$ 5.51	NO	upland	hopper & bucket	Northerly Island, Stuyvesant, Ba	Lake Michigan	Unit-price	05-C-0037	IFB				
	FY05	05SAJ250	Mayport	MAYPORT NAVAL BASE	SAJ201	JACKSONVILLE ODMDS Zone-A	947,801	$ 5,219,225.46	$ 5.51	NO	ODMDS	hopper & bucket	Northerly Island, Stuyvesant, Ba	Lake Michigan	Unit-price	05-C-0037	IFB				
	FY08	08SAJ009	Mayport	Mayport O&M	SAJ021	MAYPORT D/A O	49,373	$ 450,314.14	$ 9.12	NO	upland	cutter-suction & bucket	Hampton Roads & Atlantic	Norfolk	Unit-price	08-C-0004	IFB				
-50 FT MLLW	**FY08**	08SAJ009	Mayport	Mayport O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	579,661	$ 5,286,888.43	$ 9.12	NO	ODMDS	cutter-suction & bucket	Hampton Roads & Atlantic	Norfolk	Unit-price	08-C-0004	IFB				
	FY10	10SAJ017	Mayport	Mayport O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	174,941	$ 2,738,367.85	$ 15.65	NO	ODMDS	bucket	Virginian	Norfolk	Unit-price	10-C-0009	IFB				
	FY13	13SAJ012	Mayport	MATOC Mayport Naval Base O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	296,161	$ 3,292,854.65	$ 11.12	NO	ODMDS	bucket	Dredge 55	GLDD	Unit-price	13-D-0007-0003	MATOC	23-Jan-14	21-Feb-14	29	10212
	FY14	14SAJ007	Mayport	MATOC Mayport Naval Base O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	1,537,768	$ 11,116,504.75	$ 7.23	NO	ODMDS	hopper & bucket	BE Lindholm & Weeks 551	Weeks	Unit-price	13-D-0012-0003	MATOC	6-Jan-15	21-Apr-15	105	14645
	FY17	17SAJ001	Mayport	MATOC Mayport O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	1,621,550	$ 11,167,830.06	$ 6.89	NO	ODMDS	hopper & bucket	Dodge Island & Dredge 55	GLDD	Unit-price	13-D-0007-0014	MATOC	27-Jan-17	17-Aug-17	202	8027
	FY10	10SAJ002	Mayport Deepening	Mayport Deepening	SAJ201	JACKSONVILLE ODMDS Zone-A	4,713,974	$ 42,784,341.80	$ 9.08	NO	ODMDS	hopper & bucket	Liberty Island, Terrapin Island, D	GLDD	Unit-price	10-C-0038	RFP				
							11,332,320	**87,175,185**	**$ 7.23**												
	MARINE CORPS TERMINAL - BLOUNT ISLAND																				
	FY05	05SAJ291	MCT	MARINE CORPS TERMINAL	SAJ206	DAYSON ISLAND (USMC)	263,415	$ 1,772,096.82	$ 6.73	NO	upland	cutter-suction	Jeri B	Lake Michigan	Unit-price	05-C-0026	RFP				
	FY07	07SAJ006	MCT	Marine Corps Terminal O&M	SAJ206	DAYSON ISLAND (USMC)	197,366	$ 1,750,634.00	$ 8.87	NO	upland	cutter-suction	Lexington	Cottrell	Unit-price	07-C-0006	IFB				
-40 FT MLLW	**FY09**	09SAJ014	MCT	USMC Blount Island-MD	SAJ206	DAYSON ISLAND (USMC)	141,506	$ 1,299,412.00	$ 9.18	NO	upland	cutter-suction	Lexington	Cottrell	Unit-price	09-C-0009	IFB				
	FY09	09SAJ019	MCT	USMC BLOUNT ISLAND-EMERG	SAJ206	DAYSON ISLAND (USMC)	20,263	$ 365,094.14	$ 18.02	NO	upland	cutter-suction	Jeri B	Subaqueous	Unit-price	09-C-0012	RFP				
	FY10	10SAJ019	MCT	Marine Corps Terminal O&M	SAJ206	DAYSON ISLAND (USMC)	66,031	$ 497,058.43	$ 7.53	NO	upland	cutter-suction	Cherokee	Southern	Unit-price	10-C-0036	IFB				
							688,581	**5,684,295**	**$ 8.87**												
	JACKSONVILLE HARBOR																				
	FY02	02SAJ010	Jax Harbor	JACKSONVILLE HBR TERM C MD	SAJ039	JAX HRBR BARTRAM ISLAND (A)	259,362	$ 1,638,945.71	$ 6.32	NO	upland	bucket	Sea Tech Bucket Dredge	Sea Tech	Unit-price	02-C-0030	IFB	9-Nov-02	5-Mar-03	116	2236
	FY04	04SAJ130	Jax Harbor	Jacksonville Harbor - MD	SAJ039	JAX HRBR BARTRAM ISLAND (A)	239,838	$ 2,391,984.14	$ 9.97	NO	upland	hopper	Columbia	B+B	Unit-price	04-C-0029	RFP				
	FY05	05SAJ150	Jax Harbor	JACKSONVILLE HARBOR-O&M	SAJ039	JAX HRBR BARTRAM ISLAND (A)	125,038	$ 1,903,882.33	$ 15.23	NO	upland	hopper	Newport	Chibbco/Lake Michigan	Rental	05-C-0031	RFP				
	FY06	06SAJ003	Jax Harbor	Jacksonville Harbor O&M Hopper Dredge Rental	SAJ044	JAX HRBR BUCK ISLAND SITE B	136,500	$ 2,995,913.75	$ 21.95	NO	upland	hopper	Columbia	B+B	Rental	06-C-0012	RFP				
	FY07	07SAJ005	Jax Harbor	Jacksonville Harbor O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	853,051	$ 7,839,179.29	$ 9.19	NO	ODMDS	hopper & bucket	Atlantic, Virginian, RN Weeks	Norfolk	Unit-price	07-C-0015	IFB				
	FY10	10SAJ003	Jax Harbor	Jax Harbor O&M	SAJ043	JAX HRBR BUCK ISLAND SITE A	97,669	$ 6,163,328.15	$ 63.10	AG	upland	cutter-suction & hopper	Texas & Liberty Island	GLDD	Unit-price	10-C-0016	IFB				
-40 FT MLLW: CONSTRUCTED; -47 FT MLLW: AUTHORIZED	**FY11**	11SAJ006	Jax Harbor	Jax Harbor O&M	SAJ043	JAX HRBR BUCK ISLAND SITE A	152,746	$ 1,385,244.98	$ 9.07	NO	upland	hopper	Newport	Manson	Unit-price	11-C-0030	IFB				
	FY11	11SAJ006	Jax Harbor	Jax Harbor O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	352,756	$ 3,199,078.37	$ 9.07	NO	ODMDS	hopper	Newport	Manson	Unit-price	11-C-0030	IFB				
	FY12	12SAJ008	Jax Harbor	Jacksonville Harbor/US Navy Fuel Pier O&M	SAJ201	JACKSONVILLE ODMDS Zone-A	57,621	$ 787,692.25	$ 13.67	NO	ODMDS	bucket	Dredge 506 & Dredge 551	Weeks	Unit-price	12-C-0021	IFB				
	FY12	12SAJ008	Jax Harbor	Jacksonville Harbor/US Navy Fuel Pier O&M	SAJ222	MAYPORT BEACH	354,393	$ 4,844,633.35	$ 13.67	BN	beach	bucket	Dredge 506 & Dredge 551	Weeks	Unit-price	12-C-0021	IFB				
	FY12	12SAJ008	Jax Harbor	Jacksonville Harbor/US Navy Fuel Pier O&M	SAJ041	JAX HBR BARTRAM ISLAND CELL F	30,714	$ 419,867.40	$ 13.67	NO	upland	bucket	Dredge 506 & Dredge 551	Weeks	Unit-price	12-C-0021	IFB				
	FY13	13SAJ013	Jax Harbor	MATOC Jax Harbor O&M	SAJ041	JAX HBR BARTRAM ISLAND CELL F	541,369	$ 7,029,322.90	$ 12.98	NO	upland	hopper	Terrapin Island	GLDD	Unit-price	13-D-0007-0004	MATOC	13-Oct-13	13-Nov-13	31	17464
	FY14	14SAJ006	Jax Harbor	MATOC Jax Harbor O&M	SAJ222	MAYPORT BEACH	210,090	$ 5,017,865.55	$ 23.88	BN	beach	hopper	Terrapin Island	GLDD	Unit-price	13-D-0007-0009	MATOC	29-Jan-15	6-May-15	97	2166
	FY14	14SAJ006	Jax Harbor	MATOC Jax Harbor O&M	SAJ043	JAX HRBR BUCK ISLAND SITE A	151,735	$ 3,624,093.63	$ 23.88	AG	upland	hopper	Terrapin Island	GLDD	Unit-price	13-D-0007-0009	MATOC	29-Jan-15	6-May-15	97	1564
	FY15	15SAJ005	Jax Harbor	MATOC Jacksonville Hbr O&M	SAJ039	JAX HRBR BARTRAM ISLAND (A)	292,627	$ 3,885,779.15	$ 13.28	NO	upland	hopper	Terrapin Island	GLDD	Unit-price	13-D-0007-0011	MATOC	15-Dec-15	25-Dec-15	10	29263
	FY16	16SAJ005	Jax Harbor	MATOC JAX HARBOR O&M	SAJ205	JAX HRBR BARTRAM ISLAND (A)	243,720	$ 2,683,480.00	$ 11.01	NO	upland	bucket	Vasa	Manson	Unit-price	13-D-0014-0003	MATOC	22-Dec-16	27-Jan-17	36	6770
	FY17	17SAJ009	Jax Harbor	MATOC Jacksonville Hbr O&M	SAJ043	JAX HRBR BUCK ISLAND SITE A	303,645	$ 5,143,162.50	$ 16.94	AG	upland	hopper	Atchafalaya	Cashman	Unit-price	13-D-0005-0007	MATOC	2-Feb-17	3-Apr-17	60	5061
	FY02	02SAJ007	Jax Harbor Deepening	JACKSONVILLE HBR CT#2 NW	SAJ039	JAX HRBR BARTRAM ISLAND (A)	728,919	$ 8,030,866.15	$ 11.02	NO	upland	hopper & cutter-suction	Texas, Alaska, California, and fiv	GLDD	Unit-price	02-C-0013	RFP	30-Apr-02	17-Aug-03	474	1538

DESIGN DEPTH	FY	JOBKEY	NICKNAME	CONTRACT NAME	DMMA No.	DMMA NAME	QUANTITY (CY)	COST	UNIT COST ($/CY)	BENUSECD	DISPOSAL TYPE	DREDGE TYPE	DREDGE NAME	CONTRACTOR	CONTRACT TYPE	CONTRACT NUMBER	SOLICITATION TYPE	DREDGE START DATE	DREDGE END DATE	DURATION	PRODUCTION RATE
	JACKSONVILLE HARBOR (CONTINUED)																				
-40 FT MLLW: CONSTRUCTED; -47 FT MLLW: AUTHORIZED	**FY02**	02SAJ007	Jax Harbor Deepening	JACKSONVILLE HBR CT#2 NW	SAJ043	JAX HRBR BUCK ISLAND SITE A	411,803	$ 4,537,040.15	$ 11.02	NO	upland	hopper & cutter-suction	Texas, Alaska, California, and fiv	GLDD	Unit-price	02-C-0013	RFP	30-Apr-02	17-Aug-03	474	869
	FY02	02SAJ007	Jax Harbor Deepening	JACKSONVILLE HBR CT#2 NW	SAJ201	JACKSONVILLE ODMDS Zone-A	560,466	$ 6,174,934.97	$ 11.02	NO	ODMDS	hopper & cutter-suction	Texas, Alaska, California, and fiv	GLDD	Unit-price	02-C-0013	RFP	30-Apr-02	17-Aug-03	474	1182
	FY02	02SAJ007	Jax Harbor Deepening	JACKSONVILLE HBR CT#2 NW	SAJ225	DUVAL CO SPP	193,666	$ 2,133,715.44	$ 11.02	BN	beach	hopper & cutter-suction	Texas, Alaska, California, and fiv	GLDD	Unit-price	02-C-0013	RFP	30-Apr-02	17-Aug-03	474	409
	FY02	02SAJ007	Jax Harbor Deepening	JACKSONVILLE HBR CT#2 NW	SAJ260	JAX ARTIFICIAL REEF AREA	1,405,169	$ 15,481,451.51	$ 11.02	HD	habitat dev	hopper & cutter-suction	Texas, Alaska, California, and fiv	GLDD	Unit-price	02-C-0013	RFP	30-Apr-02	17-Aug-03	474	2964
	FY02	02SAJ007	Jax Harbor Deepening	JACKSONVILLE HBR CT#2 NW	SAJ261	MILEPOINT RIVERBANK	96,551	$ 1,063,750.78	$ 11.02	SH	shore protection	hopper & cutter-suction	Texas, Alaska, California, and fiv	GLDD	Unit-price	02-C-0013	RFP	30-Apr-02	17-Aug-03	474	204
	FY09	09SAJ005	Jax Harbor Deepening	Jacksonville Hbr Deepening	SAJ039	JAX HRBR BARTRAM ISLAND (A)	2,144,947	$ 62,321,175.08	$ 29.05	NO	upland	cutter-suction	Texas	GLDD	Unit-price	09-C-0031	RFP				
	FY17	17SAJ007	Jax Harbor Deepening	Jacksonville Harbor Deepening - Contract A																	
	FY15	15SAJ002	Jax Harbor Milepoint	Jax Hbr Milepoint NW	SAJ224	JAX HBR GREAT MARSH ISL DMMA	pending	pending	pending	HD	habitat dev	cutter-suction	Bechtolt	Manson	Unit-price	15-C-0006	RFP	5-Mar-16	24-Oct-16	233	#VALUE!
	FY02	02SAJ001	MILL COVE	MILL COVE CONSTRUCTION DREDGING	SAJ041	JAX HRBR BARTRAM ISLAND CELL F	391,095	$ 1,755,390.00	$ 4.49	NO	upland	cutter-suction	Marion	Cottrell	Unit-price	02-C-0002	IFB	2-Feb-02	11-Apr-02	68	5751
							10,335,490	**$ 162,451,777.53**	**$ 11.02**												
	ST. AUGUSTINE INLET																				
-12 FT MLLW	**FY13**	13SAJ015	St Augustine Inlet	MATOC St Augustine O&M - Sandy	SAJ099	ST AUGUSTINE BEACH	182,998	$ 2,439,010.40	$ 13.33	BN	beach	cutter-suction	Savannah	Marinex	Unit-price	13-D-0009-0002	MATOC	29-Sep-13	27-Oct-13	28	6536
							182,998	**$ 2,439,010.40**	**$ 13.33**												
	PONCE DE LEON INLET																				
RUCTED; -47 FT	**FY05**	05SAJ290	Ponce Inlet	PONCE DE LEON INLET	SAJ229	PONCE INLET BEACH	115,339	$ 1,079,749.40	$ 9.36	BN	beach	cutter-suction	Wilko	Govcon	Unit-price	05-C-0027	IFB				
	FY09	09SAJ001	Ponce Inlet	Ponce de Leon Inlet	SAJ229	PONCE INLET BEACH	134,490	$ 1,506,263.40	$ 11.20	BN	beach	cutter-suction	Wilko	Govcon	Unit-price	09-C-0040	IFB				
							249,829	**2,586,013**	**$ 10.28**												
	CANAVERAL HARBOR																				
	FY02	02SAJ008	Canaveral Harbor	Canaveral Harbor O&M - Multi-year	SAJ006	CANAVERAL HRBR D/A A (EAST)	25,481	$ 180,350.00	$ 7.08	NO	upland	bucket	Atlantic	Norfolk	Unit-price	02-C-0021	IFB	30-Jun-02	30-Sep-05	1188	21
	FY02	02SAJ008	Canaveral Harbor	Canaveral Harbor O&M - Multi-year	SAJ203	CANAVERAL ODMDS	1,036,337	$ 7,335,009.69	$ 7.08	NO	ODMDS	bucket	Atlantic	Norfolk	Unit-price	02-C-0021	IFB	30-Jun-02	30-Sep-05	1188	872
	FY02	02SAJ008	Canaveral Harbor	Canaveral Harbor O&M - Multi-year	SAJ234	CANAVERAL NEARSHORE	208,064	$ 1,472,640.13	$ 7.08	BN	nearshore	bucket	Atlantic	Norfolk	Unit-price	02-C-0021	IFB	30-Jun-02	30-Sep-05	1188	175
	FY04	04SAJ142	Canaveral Harbor	CANAVERAL HBR EMER MD	SAJ203	CANAVERAL ODMDS	146,095	$ 945,553.75	$ 6.47	NO	ODMDS	hopper	Padre Island	GLDD	Rental	04-C-0035	EMERGENCY				
	FY05	05SAJ085	Canaveral Harbor	CAN HBR MULTI-YEAR MD YEAR 1	SAJ007	CANAVERAL HRBR D/A C (WEST)	1,738	$ 10,549.23	$ 6.07	NO	upland	bucket	506 & 551	Weeks	Unit-price	05-C-0021	IFB-MULTI-YEAR				
	FY05	05SAJ085	Canaveral Harbor	CAN HBR MULTI-YEAR MD YEAR 1	SAJ234	CANAVERAL NEARSHORE	221,498	$ 1,344,434.62	$ 6.07	BN	nearshore	bucket	506 & 551	Weeks	Unit-price	05-C-0021	IFB-MULTI-YEAR				
	FY05	05SAJ085	Canaveral Harbor	CAN HBR MULTI-YEAR MD YEAR 1	SAJ203	CANAVERAL ODMDS	221,498	$ 1,344,434.62	$ 6.07	NO	ODMDS	bucket	506 & 551	Weeks	Unit-price	05-C-0021	IFB-MULTI-YEAR				
	FY05	05SAJ295	Canaveral Harbor	CANAVERAL HBR EMER O&M	SAJ203	CANAVERAL ODMDS	57,118	$ 938,532.50	$ 16.43	NO	ODMDS	bucket	Atlantic	Norfolk	Rental	05-C-0003	RFP				
	FY05	05SAJ295	Canaveral Harbor	CANAVERAL HBR EMER O&M	SAJ234	CANAVERAL NEARSHORE	57,118	$ 938,532.50	$ 16.43	BN	nearshore	bucket	Atlantic	Norfolk	Rental	05-C-0003	RFP				
-46 FT MLLW	**FY06**	06SAJ001	Canaveral Harbor	Canaveral Harbor O&M - Multi-year	SAJ203	CANAVERAL ODMDS	378,060	$ 2,080,221.50	$ 5.50	NO	ODMDS	bucket	506 & 551	Weeks	Unit-price	05-C-0021	IFB-MULTI-YEAR				
	FY07	07SAJ002	Canaveral Harbor	Canaveral Harbor O&M - Multi-year	SAJ203	CANAVERAL ODMDS	439,116	$ 2,560,667.15	$ 5.83	NO	ODMDS	bucket	506 & 551	Weeks	Unit-price	05-C-0021	IFB-MULTI-YEAR				
	FY08	08SAJ004	Canaveral Harbor	Canaveral Harbor O&M	SAJ007	CANAVERAL HARBOR D/A C (WEST)	5,306	$ 87,633.04	$ 16.52	NO	upland	bucket	Dredge 53	GLDD	Unit-price	08-C-0015	IFB				
	FY08	08SAJ004	Canaveral Harbor	Canaveral Harbor O&M	SAJ203	CANAVERAL ODMDS	135,996	$ 2,246,079.79	$ 16.52	NO	ODMDS	bucket	Dredge 53	GLDD	Unit-price	08-C-0015	IFB				
	FY08	08SAJ004	Canaveral Harbor	Canaveral Harbor O&M	SAJ234	CANAVERAL NEARSHORE	55,996	$ 924,812.67	$ 16.52	BN	nearshore	bucket	Dredge 53	GLDD	Unit-price	08-C-0015	IFB				
	FY10	10SAJ005	Canaveral Harbor	Canaveral Harbor O&M	SAJ203	CANAVERAL ODMDS	821,320	$ 6,227,068.43	$ 7.58	NO	ODMDS	bucket	Atlantic	Norfolk	Unit-price	10-C-0026	IFB				
	FY12	12SAJ005	Canaveral Harbor	Canaveral Harbor O&M	SAJ203	CANAVERAL ODMDS	1,158,289	$ 8,882,090.46	$ 7.67	NO	ODMDS	bucket	Atlantic & Virginian	Norfolk	Unit-price	12-C-0017	IFB				
	FY15	15SAJ008	Canaveral Harbor	MATOC Canaveral Harbor O&M	SAJ203	CANAVERAL ODMDS	pending	pending	pending	NO	ODMDS	bucket	Paula Lee	Dutra	Unit-price	13-D-0008-0002	MATOC	2-May-16	23-Jun-16	52	PENDING
	FY07	07SAJ013	Canaveral Sand Bypass	Canaveral Sand Bypass	SAJ227	CANAVERAL BEACH	760,986	$ 7,903,557.28	$ 10.39	BN	beach	cutter-suction & bucket	Illinois & Dredge 54	GLDD	Unit-price	07-C-0023	IFB				
	FY10	10SAJ013	Canaveral Sand Bypass	Canaveral Harbor Sand Bypass	SAJ227	CANAVERAL BEACH	646,781	$ 7,920,164.80	$ 12.25	BN	beach	cutter-suction	Texas	GLDD	Unit-price	10-C-0008	IFB				
							6,376,796	**$ 53,342,332.17**	**$ 7.33**												
	FT PIERCE HARBOR																				
	FY02	02SAJ009	Ft Pierce Harbor	Ft Pierce Harbor O&M	SAJ023	FORT PIERCE ODMDS	93,524	$ 653,091.40	$ 6.98	NO	ODMDS	bucket	Dredge 53	GLDD	Unit-price	02-C-0026	IFB	16-Aug-02	3-Sep-02	18	5196
-28 FT MLLW	**FY14**	14SAJ003	Ft Pierce Harbor	MATOC Ft Pierce O&M to ODMDS (Sandy Supplemen	SAJ023	FORT PIERCE ODMDS	141,494	$ 2,843,634.00	$ 20.10	NO	ODMDS	hopper	Padre Island	GLDD	Unit-price	13-D-0007-0007	MATOC	2-Oct-14	21-Oct-14	19	7447
	FY13	13SAJ021	Ft Pierce SPP	MATOC Ft Pierce Inlet O&M - Sandy	SAJ024	FORT PIERCE BEACH SPP	164,100	$ 3,074,727.00	$ 18.74	BN	beach	cutter-suction	Savannah	Marinex	Unit-price	13-D-0009-0003	MATOC	2-May-14	26-May-14	24	6838
							399,118	**$ 6,571,452.40**	**$ 18.74**												
	ST LUCIE INLET																				
	FY02	02SAJ006	St Lucie Inlet	ST LUCIE INLET IMPOUNDMENT BASIN CG	SAJ258	JUPITER ISLAND NEARSHORE	319,621	$ 6,501,231.68	$ 20.34	BN	beach	cutter-suction	Texas	GLDD	Unit-price	02-C-0012	RFP	4-Sep-02	27-Sep-02	23	13897
	FY02	02SAJ006	St Lucie Inlet	ST LUCIE INLET IMPOUNDMENT BASIN CG	SAJ259	DONALDSON ARTIFICIAL REEF AREA	329,016	$ 6,692,330.12	$ 20.34	HD	habitat dev	cutter-suction	Texas	GLDD	Unit-price	02-C-0012	RFP	4-Sep-02	27-Sep-02	23	14305
	FY06	06SAJ016	St Lucie Inlet	St Lucie Inlet O&M	SAJ063	ST LUCIE INLET BEACH	560,052	$ 10,625,152.57	$ 18.97	BN	beach	cutter-suction	Illinois	GLDD	Unit-price	06-C-0018	IFB				
-10 FT MLLW	**FY13**	13SAJ009	St Lucie Inlet	MATOC St Lucie Inlet O&M - Sandy	SAJ063	ST LUCIE INLET BEACH	196,000	$ 6,410,200.00	$ 32.71	BN	beach	bucket	AJ Fournier	Cashman	Unit-price	13-D-0005-0002	MATOC	18-Nov-13	20-Feb-14	94	2085
	FY17	17SAJ015	St Lucie Inlet	MATOC St Lucie Inlet O&M																	
	FY17	17SAJ014	Tampa & Manatee	Tampa & Manatee Harbor O&M																	
	FY17	17SAJ010	Tampa & St Pete	MATOC Tampa & St Pete Harbor O&M																	
							1,404,689	**30,228,914**	**$ 20.34**												
	PALM BEACH HARBOR																				
	FY02	02SAJ003	PBH	PALM BEACH HARBOR O&M	SAJ101	PALM BCH HBR BEACH	152,860	$ 2,443,139.78	$ 15.98	BN	beach	hopper	Atchafalaya	B+B	Unit-price	02-C-0006	IFB	12-Jan-02	19-Mar-02	66	2316
	FY03	03SAJ002	PBH	PALM BEACH HARBOR O&M	SAJ101	PALM BCH HBR BEACH	97,874	$ 1,473,628.25	$ 15.06	BN	beach	hopper	Northerly Island	GLDD	Unit-price	03-C-0006	IFB	7-Apr-03	19-Apr-03	12	8156
	FY04	04SAJ050	PBH	PALM BEACH HARBOR	SAJ249	PBH IN CHANNEL PLACEMENT	41,783	$ 302,184.09	$ 7.23	NO	in channel	hopper	Atchafalaya	B+B	Rental	04-C-0026	RFP				
	FY04	04SAJ141	PBH	PALM BEACH HURRICANE EMER MD	SAJ055	PALM BEACH HBR NEAR SHORE	214,200	$ 875,107.00	$ 4.09	BN	nearshore	hopper	Bayport	Manson	Rental	04-C-0037	EMERGENCY				
	FY05	05SAJ292	PBH	PALM BEACH HARBOR O&M	SAJ101	PALM BCH HBR BEACH	74,193	$ 907,261.33	$ 12.23	BN	beach	hopper	Atchafalaya	B+B	Unit-price	05-C-0012	RFP				
	FY05	05SAJ292	PBH	PALM BEACH HARBOR O&M	SAJ055	PALM BEACH HBR NEAR SHORE	170,861	$ 2,089,355.83	$ 12.23	BN	nearshore	hopper	Atchafalaya	B+B	Unit-price	05-C-0012	RFP				
	FY06	06SAJ005	PBH	Palm Beach Harbor O&M Hopper Dredge Rental	SAJ055	PALM BEACH HBR NEAR SHORE	70,689	$ 440,675.00	$ 6.23	BN	nearshore	hopper	Atchafalaya	B+B	Rental	06-C-0003	IFB				
-33 FT MLLW: CONSTRUCTED; -39 FT MLLW: AUTHORIZED	**FY06**	06SAJ017	PBH	Palm Beach Harbor Emergency O&M	SAJ055	PALM BEACH HBR NEAR SHORE	2,312	$ 182,546.40	$ 78.96	BN	nearshore	bucket	unknown	Murphy Construction	Unit-price	06-C-0020	RFP				
	FY07	07SAJ003	PBH	Palm Beach Harbor O&M (hopper dredge rental)	SAJ055	PALM BEACH HBR NEAR SHORE	185,000	$ 2,637,853.25	$ 14.26	BN	nearshore	hopper	Atchafalaya	B+B	Rental	07-C-0003	IFB				
	FY08	08SAJ005	PBH	Palm Beach Harbor O&M	SAJ055	PALM BEACH HBR NEAR SHORE	100,000	$ 2,154,995.84	$ 21.55	BN	nearshore	hopper	Atchafalaya	B+B	Rental	08-C-0006	IFB				
	FY09	09SAJ009	PBH	Palm Beach Harbor	SAJ055	PALM BEACH HBR NEAR SHORE	64,068	$ 2,034,239.36	$ 31.75	BN	nearshore	hopper	Padre Island	GLDD	Unit-price	09-C-0042	IFB				
	FY10	10SAJ007	PBH	Palm Beach Harbor O&M	SAJ055	PALM BEACH HBR NEAR SHORE	100,145	$ 2,723,657.80	$ 27.20	BN	nearshore	hopper	Newport	Manson	Unit-price	10-C-0040	IFB				
	FY10	10SAJ007	PBH	Palm Beach Harbor O&M	SAJ101	PALM BCH HBR BEACH	44,195	$ 1,201,977.70	$ 27.20	BN	beach	hopper	Newport	Manson	Unit-price	10-C-0040	IFB				
	FY12	12SAJ003	PBH	MATOC Palm Beach Harbor O&M	SAJ055	PALM BEACH HBR NEAR SHORE	69,275	$ 1,299,650.00	$ 18.76	BN	nearshore	hopper	Atchafalaya	Cashman	Unit-price	12-D-0003-0001	MATOC				
	FY12	12SAJ009	PBH	Palm Beach Harbor O&M	SAJ101	PALM BCH HBR BEACH	145,885	$ 2,169,398.77	$ 14.87	BN	beach	cutter-suction & bucket	Dredge Texas & Dredge 54	GLDD	Unit-price	12-C-0029	IFB				
	FY12	12SAJ009	PBH	Palm Beach Harbor O&M	SAJ055	PALM BEACH HBR NEAR SHORE	272,731	$ 4,055,676.03	$ 14.87	BN	nearshore	cutter-suction & bucket	Dredge Texas & Dredge 54	GLDD	Unit-price	12-C-0029	IFB				
	FY15	15SAJ007	PBH	MATOC PALM BEACH HBR O&M	SAJ055	PALM BEACH HBR NEAR SHORE	88,725	$ 1,690,887.50	$ 19.06	BN	nearshore	hopper	Atchafalaya	Cashman	Unit-price	12-D-0003-0003	MATOC	2-Mar-15	20-Mar-15	18	4929
	FY16	16SAJ002	PBH	MATOC PALM BEACH HARBOR O&M	SAJ224	PALM BCH HBR BEACH	164,815	$ 5,384,990.00	$ 32.67	BN	beach	cutter-suction	Alaska	GLDD	Unit-price	13-D-0007-0012	MATOC	7-Mar-16	4-Apr-16	28	5886
	FY17	17SAJ008	PBH	MATOC Palm Beach Harbor O&M																	
							2,059,611	**34,067,224**	**$ 15.52**												
-47 FT MLLW: AUTHORIZED; -42 FT MLLW: CONSTRUCTED	**PORT EVERGLADES**																				
	FY05	05SAJ050	PEH	PORT EVERGLADES N TNG BASIN	SAJ060	PORT EVERGLADES ODMDS	46,686	$ 481,989.58	$ 10.32	NO	ODMDS	hopper	Dodge Island	GLDD	Unit-price	05-C-0030	IFB				
	FY13	13SAJ002	PEH	Port Everglades O&M	SAJ059	PORT EVERGLADES BEACH	96,126	$ 1,963,245.10	$ 20.42	BN	beach	hopper & bucket	Terrapin Island & Dredge 54	GLDD	Unit-price	13-C-0001	IFB	26-Feb-13	15-Apr-13	48	2003
	FY13	13SAJ002	PEH	Port Everglades O&M	SAJ060	PORT EVERGLADES ODMDS	322,548	$ 6,587,611.90	$ 20.42	NO	ODMDS	hopper & bucket	Terrapin Island & Dredge 54	GLDD	Unit-price	13-C-0001	IFB	26-Feb-13	15-Apr-13	48	6720
							465,360	**$ 9,032,846.58**	**$ 20.42**												
	MIAMI HARBOR AND RIVER																				
-50 FT MLLW	**FY04**	04SAJ120	Miami Harbor Deepening	MIAMI HARBOR CHANNEL, FL NW	SAJ050	MIAMI ODMDS	1,438,469	$ 36,804,565.05	$ 25.59	NO	ODMDS	cutter-suction	Texas	GLDD	Unit-price	04-C-0024	RFP				
	FY13	13SAJ005	Miami Harbor Deepening	Miami Harbor Deepening	SAJ050	MIAMI ODMDS	5,189,529	$ 215,820,210.32	$ 41.59	NO	ODMDS	hopper & cutter-suction &	Texas, Dredge 55, New York, Lib	GLDD	Unit-price	13-C-0015	RFP	20-Nov-13	16-Jun-15	573	9057
-15 FT MLLW	**FY04**	04SAJ020	Miami River	MIAMI RIVER, MD	SAJ246	LOCAL LANDFILL	541,250	$ 69,933,275.36	$ 129.21	NO	upland	bucket	Barredor del Rio	Weston-Bean JV	Unit-price	04-C-0021	RFP				
							7,169,248	**$ 322,558,050.73**	**$ 41.59**												
-30 FT MLLW: AUTHORIZED; -50 FT MLLW: CONSTRUCTED	**KEY WEST HARBOR**																				
	FY03	03SAJ006	Key West Harbor	Key West Harbor Dredging	SAJ046	KEY WEST SINGLE USE ODMDS	366,025	$ 15,680,483.74	$ 42.84	NO	ODMDS	hopper & bucket	Eagle 1 & Maricavor	Bean Stuyvesant	Unit-price	03-C-0001	RFP	12-Jul-04	25-Mar-06	621	589
	FY03	03SAJ006	Key West Harbor	Key West Harbor Dredging	SAJ256	FLEMING KEY	578,765	$ 24,794,261.94	$ 42.84	NO	upland	hopper & bucket	Eagle 1 & Maricavor	Bean Stuyvesant	Unit-price	03-C-0001	RFP	12-Jul-04	25-Mar-06	621	932
	FY06	06SAJ020	Key West Harbor	Key West Harbor O&M	SAJ046	KEY WEST SINGLE USE ODMDS	92,102	$ 2,521,877.53	$ 27.38	NO	ODMDS	hopper	Atchafalaya	B+B	Unit-price	06-C-0023	IFB				
							1,036,891	**$ 42,996,623.21**	**$ 42.84**												
							65,638,197	942,992,551													

Florida Inland Navigation District
Intracoastal Waterway
Review of Dredging Program
Efficiencies

ATTACHMENT F
MAINTENANCE DREDGING PERMITTING

CHAPTER 403.813, FLORIDA STATUTES
REGIONAL GENERAL PERMIT SAJ-93

Chapter 403.813 Permits issued at district centers; exceptions —

(3) A permit is not required under this chapter, chapter 373, chapter 61-691, Laws of Florida, or chapter 25214 or chapter 25270, 1949, Laws of Florida, for maintenance dredging conducted under this section by the seaports of Jacksonville, Port Canaveral, Fort Pierce, Palm Beach, Port Everglades, Miami, Port Manatee, St. Petersburg, Tampa, Port St. Joe, Panama City, Pensacola, Key West, and Fernandina or by inland navigation districts if the dredging to be performed is no more than is necessary to restore previously dredged areas to original design specifications or configurations, previously undisturbed natural areas are not significantly impacted, and the work conducted does not violate the protections for manatees under s. 379.2431(2)(d). In addition:

(a) A mixing zone for turbidity is granted within a 150-meter radius from the point of dredging while dredging is ongoing, except that the mixing zone may not extend into areas supporting wetland communities, submerged aquatic vegetation, or hardbottom communities.

(b) The discharge of the return water from the site used for the disposal of dredged material shall be allowed only if such discharge does not result in a violation of water quality standards in the receiving waters. The return-water discharge into receiving waters shall be granted a mixing zone for turbidity within a 150-meter radius from the point of discharge into the receiving waters during and immediately after the dredging, except that the mixing zone may not extend into areas supporting wetland communities, submerged aquatic vegetation, or hardbottom communities. Ditches, pipes, and similar types of linear conveyances may not be considered receiving waters
for the purposes of this paragraph.

(c) The state may not exact a charge for material that this subsection allows a public port or an inland navigation district to remove. In addition, consent to use any sovereignty submerged lands pursuant to this section is hereby granted.

(d) The use of flocculants at the site used for disposal of the dredged material is allowed if the use, including supporting documentation, is coordinated in advance with the department and the department has determined that the use is not harmful to water resources.

(e) The spoil material from maintenance dredging may be deposited in a self-contained, upland disposal site. The site is not required to be permitted if:

1. The site exists as of January 1, 2011;
2. A professional engineer certifies that the site has been designed in accordance with generally accepted engineering standards for such disposal sites;
3. The site has adequate capacity to receive and retain the dredged material; and
4. The site has operating and maintenance procedures established that allow for discharge of return flow of water and to prevent the escape of the spoil material into the waters of the state.

(f) The department must be notified at least 30 days before the commencement of maintenance dredging. The notice shall include, if applicable, the professional engineer certification required by paragraph (e).

(g) This subsection does not prohibit maintenance dredging of areas where the loss of original design function and constructed configuration has been caused by a storm event, provided that the dredging is performed as soon as practical after the storm event. Maintenance dredging that commences within 3 years after the storm event shall be presumed to satisfy this provision. If more than 3 years are needed to commence the maintenance dredging after the storm event, a request for a specific time extension to perform the maintenance dredging shall be submitted to the department, prior to the end of the 3-year period, accompanied by a statement, including supporting documentation, demonstrating that contractors are not available or that additional time is needed to obtain authorization for the maintenance dredging from the United States Army Corps of Engineers.

DEPARTMENT OF THE ARMY PERMIT
REGIONAL GENERAL PERMIT SAJ-93

<u>Permittee</u>: **Florida Inland Navigation District**
1314 Marcinski Road
Jupiter FL 33477-9498

<u>Effective Date</u>: April 26, 2016
<u>Expiration Date</u>: April 26, 2021

<u>Issuing Office: U.S. Army Engineer District, Jacksonville</u>

NOTE: The term "you" and its derivatives, as used in this permit, means the Permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the U.S. Army Corps of Engineers (Corps) having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

After you receive written verification for your project under this Regional General Permit (RGP) from the Corps, you are authorized to perform work in accordance with the terms and conditions specified below.

<u>Work Authorized</u>: The work authorized includes maintenance dredging of the Atlantic Intracoastal Waterway (AIWW), Intracoastal Waterway (IWW), and Okeechobee Waterway (OWW) federal navigation channels, including wideners, along the east coast of Florida which includes the following counties: Nassau, Duval, St. Johns, Flagler, Volusia, Brevard, Indian River, St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade. The federal navigation projects are described in Table 1 below and shown in Attachment 1 and encompass the channel area as defined as the 12-foot deep, 150-foot wide to 125-foot wide federal AIWW channel extending from the Georgia/Florida line in Nassau County to the St. Johns River in Jacksonville; the 12-foot deep, 125-foot wide federal IWW channel extending from the St. Johns River in Jacksonville to the Fort Pierce Harbor Project in St. Lucie County; the 10-foot deep, 125-foot wide federal IWW channel from the Fort Pierce Harbor Project in St. Lucie County to the Miami Harbor in Miami-Dade County; the 8-foot deep, 80-foot wide channel originating at the confluence of the Indian River Lagoon/IWW and the St. Lucie River in Martin County (“Crossroads”) to the St. Lucie Lock and Dam/eastern limit of St. Lucie Canal; the 8-foot deep, 100-foot wide channel originating from the St. Lucie Lock and Dam/eastern limit of St. Lucie Canal to the western Palm Beach County line across the middle of Lake Okeechobee (Route 1); and the 6-foot deep, 80-foot channel originating from the Port Mayaca Lock/western limit of St. Lucie Canal to the western Palm Beach County line along the southern shore of Lake Okeechobee (Route 2/Rim canal). This permit authorizes maintenance dredging of any of the aforementioned federal navigation projects in accordance with the Congressional authorization or as deepened or widened under a Department of the Army permit. Maintenance dredging of residential canals and/or flood control projects; “new” dredging to widen or deepen an existing federal navigation project, new access channels, and channel realignments; and removal of channel/canal plugs or connection of any canal or other waterway to navigable waters of the United States are not authorized herein. This permit includes no limitation on volume. Maintenance dredging is restricted to the amount necessary to restore the congressionally authorized or permitted dimensions of the federal navigation channel allowing for a two-foot over-dredge.

Table 1. Federal Navigation Channels Within the Scope of RGP SAJ-93.

Federal Channel	Limits	Depth (feet)	Width (feet)[1]	Approximate Side Slopes (DepthX3) (feet)[2]
Atlantic Intracoastal Waterway	Florida State line to St. Johns River	12	150-125	36
Intracoastal Waterway	St. Johns River to Ft. Pierce.	12	125	36
Intracoastal Waterway	Ft. Pierce to Miami	10	125	30
Okeechobee Waterway	IWW (at St. Lucie Inlet) to St. Lucie Lock and Dam	8	80	24
Okeechobee Waterway	St. Lucie Lock and Dam to Clewiston (Route 1)	8	100	24
Okeechobee Waterway	St. Lucie Lock and Dam to Clewiston (Route 2)	6	80	18
[1]Channel wideners are not shown in this table.				
[2]Actual horizontal width depends on bathymetry outside the federal project limits.				

Maintenance dredging within the AIWW, IWW, and OWW would be performed using a hydraulic pipeline cutterhead suction dredge or mechanical clamshell dredge. Hopper dredges are excluded under this permit. Since dredging does not always result in a smooth and even channel bottom, a drag bar or chain may be dragged along the bottom or agitation or injection dredging used to smooth down high spots and fill in low areas. The authorized work includes activities associated with maintenance dredging including transportation methodology and use of pipelines, booster pumps, and associated dredged material transfer mechanisms. Pipelines may be submerged or floating, typically constructed of steel or high-density polyethylene (HDPE) with connecting steel collars. Authorized pipeline sizes range from 12-inch to 24-inch in diameter. Dredging may require strategically locating booster pumps to facilitate pipeline disposal of the dredged material. Work vessels and activities typically include: the dredge vessel; booster pumps/small barges; push boats; scows/barges; crew transport/work vessels; spudding, anchoring, staging, and stockpile areas; loading/unloading areas; and associated vessel movements.

Dredged material shall be deposited in operational Dredged Material Management Areas (DMMAs), upland areas where the dredged material is self-contained, or placed on certain beaches when dredging beach-compatible material. Operational DMMAs at the time of this authorization are shown in Attachment 2. Decanted return water is allowed and must meet State Water Quality Standards as established by the Florida Department of Environmental Protection (FDEP). The use of an upland disposal area that is not a standard DMMA shall be constructed with consideration of the existing onsite drainage patterns, and the Permittee shall provide verification no onsite or offsite adverse flooding conditions will result from the placement of dredged material. Beneficial reuse of dredged material is allowed through the placement of dredged material at the eight beach sites shown in Table 2 below where the characteristics of the dredged material are consistent with that of the beach placement site and this authorization. This authorization also includes offload of dredged material from operational DMMAs, specifically from DMMA SJ-1 to Summer Haven Beach and from MSA 434 to New Smyrna Beach. Offload of DMMA M-5 to Hobe Sound National Wildlife Refuge (NWR) is covered under SAJ-2009-03015 which expires October 24, 2021.

Table 2. Beach Placement Sites within the Scope of RGP SAJ-93

DREDGE REACH	LOCATION	COUNTY	BEACH	FDEP RANGE MONUMENTS	LINEAR FT OF SHORELINE
N-II	Sawpit	Nassau Co.	Amelia Island	R-75 to R-78	3,000
SJ-III	St Augustine Inlet Intersection	St. Johns Co.	Anastasia State Park	R-84 to R-122 R-123 to R-152	38,000 29,000

SJ-V	Matanzas	St. Johns Co.	Summer Haven	R-205 to R-208	3,000
V-IV	Volusia/Ponce	Volusia Co.	New Smyrna	R-161 to R-189.5	28,500
M-II	Crossroads	Martin Co.	Hobe Sound NWR	R-59 to R-80	21,000
P-I	Jupiter	Palm Beach Co.	Jupiter	R-13 to R-19	4,000
P-IV	Ocean Ridge/South Lake Worth Inlet	Palm Beach Co.	Ocean Hammock Park	R-155 to R-122 R-123 to R-152	2,050
MD-II	Baker's Haulover	Miami-Dade Co.	Bal Harbor	R-28 to R-32	4,000

Special Conditions Related to Water Quality:

1. Where disposal of dredged material includes beach placement, prior to the initiation of construction, the project must be authorized by the applicable permit required under Part IV of Chapter 373, F.S., by the FDEP and receive Water Quality Certification (WQC) and applicable Coastal Zone Consistency Concurrence (CZCC) or waiver thereto, as well as any authorizations required for the use of state-owned submerged lands under Chapter 253, F.S., and, as applicable, Chapter 258, F.S. The Permittee shall comply with state standards as approved by FDEP and included as special conditions in the Corps' authorization.

2. Turbidity control measures will be used to minimize turbidity impacts from dredging to the maximum extent practicable to control water quality and the work must be in accordance with State Surface Water Quality Standards as outlined in Chapter 62.302, Florida Administrative Code (F.A.C.). Turbidity control measures may include, but are not limited to, turbidity control curtains, the exclusive use of suction dredging, and the exclusive use of closed "clam shell" dredging, or any other technique necessary to reduce turbidity to meet State Surface Water Quality Standards. The FDEP may require the applicant to submit a turbidity report within seven (7) days of sample collection, which may be verified by federal, state, or local government inspectors. More frequent report submissions, such as daily, may be requested or required by FDEP. If turbidity generated from the project exceeds acceptable levels as defined in Chapter 62-302.530, F.A.C. during normal work hours, i.e., 8:00 am to 5:00 pm, the Permittee shall immediately notify the Corps. If the exceedance occurs after normal work hours, the Permittee shall notify the Corps on the morning of the following workday. All dredging or disposal shall cease until corrective measures have been taken and turbidity has returned to acceptable levels.

3. The Permittee is prohibited from dumping oil, fuel, or hazardous wastes in the work area, and will adopt safe and sanitary measures for the disposal of solid wastes in accordance with federal, state, and local requirements. The Permittee shall develop an environmental protection plan to address concerns regarding monitoring of equipment,

maintenance and security of fuels, lubricants, and spill prevention. The plan shall be submitted to the Corps for review and approval at least 30 days prior to commencement of work under this permit. Subsequent environmental protection plans for individual verifications are not required unless provided there are no major changes to the plan.

Special Conditions Related to Seagrass and other Aquatic Resources:

4. This permit authorizes direct impacts to seagrass within the design limits of the federal navigation channel as described in Table 1. The Corps has identified seagrass potentially impacted as a result of maintenance dredging of the AIWW, IWW, and OWW based on two sources: the "Corps' 2015 Side-Scan Sonar and Aquatic Resource Mapping of the AIWW, IWW, and OWW" (referred to below as "side-scan sonar data") and the compilation of existing GIS data from the Fish and Wildlife Research Institute (referred to below as "GIS data"). Where side scan sonar data or the GIS data show seagrass within the design limits of the federal channel, the Permittee shall provide a pre-construction notification to include information on whether the navigation channel has continued to be maintained at or near authorized dimensions and a pre-construction seagrass survey performed in accordance with the requirements of special condition number 5.a and 5.b below. The Corps will evaluate whether there are substantially changed physical conditions that support and sustain significant ecological resources and will address, on a case-by-case, basis whether compensatory mitigation is required. If compensatory mitigation is required, the Corps will debit the appropriate acreage of credits from the Snook Island Natural Area unless the Permittee provides an alternate in-kind compensatory mitigation plan to the Corps for review and approval.

5. For maintenance dredging of the IWW from Dunlawton Bridge in Volusia County to Miami-Dade County, pre-construction seagrass surveys are required for all projects where the side-scan sonar data, GIS data, or other data source indicates seagrass is present within 100 feet from the near bottom edge of the federal navigation channel, within the anchor drop zones (typically within 100 feet of the near bottom edge of the channel), and/or pipeline corridors (typically a 50-feet corridor). Post-construction seagrass surveys are required for all projects where the pre-construction survey identifies seagrass within the survey area.

a. The pre-construction survey will clearly identify the limits of all seagrass beds in their entirety and the seagrass polygons will be illustrated on the project construction plans (plan view and cross-sections). The Permittee must also provide a GIS data set for seagrass and construction plan view. The size, species identified, estimate of percent coverage, and estimate of percent species abundance shall be provided. The pre-construction survey shall be conducted during the period from June 1 through September 30. All surveys within the range of Johnson's Seagrass shall fully adhere to the *Recommendations for Sampling Halophila johnsonii at a Project Site* as provided in Appendix III of the Johnson's Seagrass Recovery Plan available at: http://sero.nmfs.noaa.gov/protected_resources/johnsons_seagrass/documents/recoveryplan.pdf .

b. The pre-construction survey shall involve a visual inspection of the proposed pipeline route(s), the anchor zone adjacent to the dredge areas, and all vessel operation areas. The pre-construction survey shall indicate water depths and bottom contours and shall identify and define existing seagrass beds and other aquatic resources within the anchor and pipeline zone on a map at a resolution sufficient to avoid impacts. Patches of Johnson's seagrass within the anchor zone, pipeline routes, and vessel operation areas shall be delineated with GPS and areas of coverage shall be quantified. Anchor drop points and identified pipeline corridor (within 5 meters from the centerline) shall be free of seagrass resources. Coordinates of all dredge anchor drop points shall be recorded using GPS technology, accurate to one (1) meter.

c. Within 30 days following completion of construction, or after June 1 (whichever is later), a post-construction seagrass survey shall be conducted in the same manner and following the same transect locations and methods that were established during the pre-construction survey and as described in special condition number 5.a and 5.b above. The Permittee must provide the GIS data set for seagrass and construction plan view for the post-construction survey. If construction is completed prior to June 1, the post-construction survey shall be completed between June 1 and July 30.

6. If the pre-construction survey identifies seagrass adjacent to the federal channel, the project may proceed under this permit when the project includes hydraulic dredging of sandy or coarse sediments (no more than 10% of the material passing a #230 sieve for no more than 10% of the total dredged material composition) and seagrass can be avoided with a minimum 25-foot buffer between seagrass and all dredging activities or when the project includes mechanical dredging of fine sediments (material passing a #230 sieve) and seagrass can be avoided with a minimum 100-foot buffer between seagrass and all dredging activities.

7. If the pre-construction survey identifies seagrass adjacent to the federal channel, the Corps will coordinate with NMFS HCD for a 10-day review period prior to verification of a project under this permit when the activity includes hydraulic dredging of sandy or coarse sediments (no more than 10% of the material passing a #230 sieve for no more than 10% of the total dredged material composition) and there is less than a 25-foot buffer between seagrass and all dredging activities or when the activity includes mechanical dredging of fine sediments (material passing a #230 sieve) and there is less than a 100-foot buffer between seagrass and all dredging activities.

8. Work vessels crossing seagrass beds shall have a minimum of eighteen inches of clearance below their operational draft (i.e. lowest point in the water).

9. Direct impacts to seagrass located outside of the federal channel are not authorized by this permit. The Permittee shall not anchor, place pipeline, or stage equipment in a manner that will cause any damage to seagrass. Divers shall survey all anchor and pipeline locations and will document any alterations to the seagrass, changes in bottom contours, and any changes to the extent of the seagrass (e.g., altered bottom strata including coverage by fill, furrowing from pipelines, or anchoring from dredge equipment/work boats). Unauthorized impacts to seagrass shall require remediation and may be subject to compensatory mitigation requirements.

10. Impacts to natural hardbottom (including corals and worm rock) and wetlands are not authorized by this permit. This permit recognizes that the construction of the IWW in certain areas resulted in ledges that provide habitat for a variety of fish and other marine organisms including sessile invertebrates such as corals and sponges. These ledges are part of the federal navigation project as they form the edge of channel and as such this permit recognizes there may be temporary impacts to these resources during dredging. The Permittee shall not anchor, place pipeline, or stage equipment in a manner that will cause any permanent damage to hardbottom or wetlands; these areas shall be avoided to the maximum extent practicable. If the side-scan sonar data or GIS data identifies the presence of hardbottom, a detailed benthic resource survey will be required (date of survey, species type, coverage, quantity, resource characteristics, etc.) prior to commencement of work. If high-functioning benthic groups are present, such as stony corals, and the resources are candidates for relocation, the Permittee may avoid impacts by implementing an approved relocation plan prior to construction. All hardbottom relocation plans for federally-listed coral species shall be provided to the Corps for review and coordination for a 10-day period with NMFS HCD and NMFS Protected Resources Division (PRD) prior to verification under this permit. If impacts to wetland resources cannot be avoided, the Permittee shall develop a compensatory mitigation plan in accordance with 33 C.F.R. Part 332 to be reviewed and approved by the Corps following a 10-day coordination period with NMFS HCD.

11. Anchor or pipeline damage to seagrass, hardbottom (other than the ledges identified in special condition number 10 above), or wetlands outside the federal channel limits shall be reported to the Corps within 48 hours of discovery of impact. If the post-construction survey or project monitoring reveals that unintentional impacts to seagrass, hardbottom, or wetlands have occurred outside the federal channel as described in Table 1 as a result of project-related activities (e.g., anchoring impacts, pipeline impacts, sedimentation and/or burial impacts, side slope sloughing, propeller wash, etc.), the Permittee shall immediately coordinate with the Corps to quantify the

impact, assess the ecological functional loss, and provide an in-kind compensatory mitigation plan in accordance with 33 C.F.R. Part 332. Within 30 days of discovery of the impact, the Corps shall coordinate with NMFS for review and approval of the recommended remediation.

Special Conditions Related to Federally Listed Species:

12. Manatee Conditions:

a. The Permittee shall comply with the "Standard Manatee Conditions for In-Water Work - 2011" available at: http://www.saj.usace.army.mil/Portals/44/docs/regulatory/sourcebook/endangered_species/Manatee/2011_StandardConditionsForIn-waterWork.pdf .

b. For any proposed project located within 500-feet of a Warm Water Aggregation Area (WWAA) or Important Manatee Area (IMA) (identified on the Manatee Key maps available at http://www.saj.usace.army.mil/Portals/44/docs/regulatory/sourcebook/endangered_species/Manatee/County_Maps_2013.pdf , the Permittee shall comply with the listed restricted dredging protocols. If a proposed project is within 500-feet of a WWAA or IMA and the Permittee is unable to implement the specified dredging protocols, the Corps will coordinate with the Florida Fish and Wildlife Conservation Commission and the U.S. Fish and Wildlife Service. Upon completion of coordination, the Corps may elect to verify the project under this permit with the inclusion of any additional applicable special conditions. The Manatee Key 2013, or any future revised keys, is available at: http://www.saj.usace.army.mil/Missions/Regulatory/SourceBook.aspx.
(*Note: The manatee key may be subject to revision at any time. It is our intention that the most recent version of this technical tool will be utilized during the verification of any dredging activity under this permit).*

c. During clamshell dredging operations, a dedicated observer shall monitor for the presence of manatees. The dedicated observer shall have experience in manatee observation and be equipped with polarized sunglasses to aid in observing. Nighttime lighting of waters within and adjacent to the work area shall be illuminated using shielded or low-pressure sodium-type lights, to a degree that allows the dedicated observer to sight any manatee on the surface within 200 feet of the dredging operation. The dredge operator shall gravity-release the clamshell bucket only at the water surface, and only after confirmation that there are no manatees within the safety distance identified in the standard construction conditions.

d. Barges shall install mooring bumpers that provide a minimum 4-foot standoff distance under maximum compression between other moored barges and large vessels.

f. Pipelines may be weighted or floated and shall be positioned such that they do not restrict manatee movement to the maximum extent possible. Pipelines transporting dredged material shall be weighted or secured to the bottom substrate as necessary to prevent movement of the pipeline and to prevent manatee entrapment or crushing.

g. In the event that such pipeline positioning has the potential to impact seagrass or nearshore hardbottom, the pipeline may be elevated or secured to the bottom substrate to minimize impacts.

13. Sea Turtle and Smalltooth Sawfish Conditions:

a. The Permittee shall comply with National Marine Fisheries Service's "Sea Turtle and Smalltooth Sawfish Construction Conditions" dated March 23, 2006 and available at http://www.saj.usace.army.mil/Portals/44/docs/regulatory/sourcebook/endangered_species/sea_turtles/inwaterWorkSeaTurtle032306.pdf .

b. Sand placement projects in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties shall occur between November 1 and April 30. During the period May 1 through October 31, no construction equipment or pipes may be operated, placed, and/or stored on the beach.

14. Biological Opinion: This permit does not authorize the Permittee to take an endangered species, in particular sea turtles, shortnose sturgeon, piping plovers, red knots, southeastern beach mice, Anastasia Island beach mice, or Johnson's seagrass. In order to legally take a listed species, the Permittee must have separate authorization under the Endangered Species Act (ESA) (e.g., an ESA Section 10 permit, or a Biological Opinion (BO) under ESA Section 7, with "incidental take" provisions with which you must comply). The following BOs provide incidental take provisions for the above federally listed species: 1) *NMFS Regional Biological Opinion on Hopper Dredging Along the South Atlantic Coast* (SARBO) dated October 29, 1997, including all addendums; 2) *NMFS Maintenance Dredging of the Ports and Intracoastal Waterway within the Range of Johnson's Seagrass Regional Biological Opinion* dated June 4, 2001; 3) *U.S. Fish and Wildlife Service* (*FWS) Statewide Programmatic Biological Opinion (SPBO) for the U.S. Army Corps of Engineers Civil Works and Regulatory sand placement activities updated March 13, 2015;* 4) *FWS Programmatic Piping Plover Biological Opinion (P3BO) for the effects of U.S. Army Corps of Engineers planning and regulatory shore protection activities dated May 22, 2013; and 5) FWS BO for Regional*

General Permit SAJ-93 dated January 29, 2016. The aforementioned referenced BOs contains mandatory terms and conditions to implement the reasonable and prudent measures that are associated with “incidental take” that is also specified in the BO. Authorization under this permit is conditional upon compliance with all of the mandatory terms and conditions associated with incidental take of the referenced BOs, which terms and conditions are incorporated by reference in this permit. Failure to comply with the terms and conditions associated with incidental take of the BOs, where a take of the listed species occurs, would constitute an unauthorized take, and it would also constitute noncompliance with this permit. The USFWS or NMFS is the appropriate authority to determine compliance with the terms and conditions of its BO, and with the ESA. Mandatory terms and conditions required for projects verified under this permit are described below.

a. Terms and conditions A1-A23 on pages 122-143 of the *SPBO* apply to the following sites: St. Johns County, St. Augustine Inlet Intersection; Volusia County, Volusia/Ponce and MSA 434 offload; and Martin County, Crossroads and M-5 offload. Terms and conditions for beach mouse protection, A18 through A21 apply to St. Johns County, St. Augustine Inlet Intersection, R-132 to R-152.

b. Terms and conditions B1-B23 on pages 143-154 of the *SPBO* apply to the following sites: Nassau County, Sawpit; St. Johns County, Matanzas; Palm Beach County, Jupiter; Palm Beach County, Ocean Ridge; and Miami-Dade County, Baker’s Haulover. Terms and conditions for beach mouse protection, B15 through B18 apply to St. Johns County, St. Augustine Inlet Intersection, R-132 to R-152.

c. The 10 terms and conditions on pages 29-32 of the *P3BO* apply to the following sites: Nassau County, Sawpit; St. Johns County, St. Augustine Inlet Intersection R-123 to R-152; Volusia County, Volusia/Ponce and MSA 434 offload; and Martin County, Crossroads and M-5 offload.

d. The 10 terms and conditions on pages 51-53 of the RGP SAJ-93 BO apply to the following sites: Nassau County, Sawpit; St. Johns County, St. Augustine Inlet Intersection R-123 to R-152; Volusia County, Volusia/Ponce and MSA 434 offload; and Martin County, Crossroads and M-5 offload.

15. This permit acknowledges the federal navigation channel is excluded from Johnson’s seagrass designated critical habitat; however, in the event that dredging related activities such as pipeline placement are proposed within Johnson’s seagrass designated critical habitat, consultation with the NMFS PRD may be required. Upon completion of consultation, the Corps may elect to verify the project under this permit with the inclusion of any additional applicable special conditions.

16. Where beach placement is proposed, the Permittee shall submit to the Corps for review plans and specifications for beach placement and a monitoring plan for sand compaction, scarp formation and leveling, lighting, beach profile surveys, sea turtle surveys and shorebird surveys. The beach profile template for the sand placement projects shall be designed to mimic the native beach berm elevation and beach slopes landward and seaward of the equilibrated berm crest. Prior to verification of a project with beach placement under this permit, the Corps will provide FWS with the pre-construction notification including any required information listed above for a 30-day period of review, including a request for a waiver if any of the terms and conditions of the BOs cannot be met.

17. Any take of, or sighting of, an injured or incapacitated federally listed species shall be reported immediately to the Corps and U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or in Vero Beach (1-772-562-3909) for south Florida.
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Special Conditions Related to Historic Properties:

18. If, during the initial ground disturbing activities and construction work, there are archaeological/cultural materials unearthed (which shall include, but not be limited to: pottery, modified shell, flora, fauna, human remains, ceramics, stone tools or metal implements, dugout canoes or any other physical remains that could be associated with Native American cultures or early colonial or American settlement), the Permittee shall immediately stop all work in the vicinity and notify the Compliance and Review staff of the State Historic Preservation Office (850-245-6333) and the Corps (904-232-1658) to assess the significance of the discovery and devise appropriate actions, including salvage operations. Based on the circumstances of the discovery, equity to all parties, and considerations of the public interest, the Corps may modify, suspend or revoke the permit in accordance with 33 CFR Part 325.7.

19. In the unlikely event that human remains are identified, they will be treated in accordance with Section 872.05, Florida Statutes; all work in the vicinity shall immediately cease and the local law authority, the State Archaeologist (850-245-6444) and the Corps (904-232-1658) shall immediately be notified. Such activity shall not resume unless specifically authorized by the State Archaeologist and the Corps.

Special Conditions for Notification and Reporting:

20. No work shall be performed until the Permittee submits satisfactory plans for the proposed activity and receives written verification from the District Engineer that the proposed project is in accordance with the general and specific conditions of this permit.

The pre-construction notification (PCN) shall include: the proposed date of construction; the total quantity and type of material to be dredged; type of dredged equipment; anticipated duration of dredging; the location and areal extent of the cut or shoals to be dredged; information on when the area was last dredged and the dredging frequency; the designated disposal sites, including miles of shoreline for beach placement; and any required pre-construction surveys for the areas to be dredged and the disposal site. The PCN shall also identify any terms and conditions that cannot be met and include a rationale for why a waiver may be needed.

21. Within 60 days of completion of the authorized work, the Permittee shall furnish the Corps an "As built Drawing" of the completed project, including a certified/sealed drawing which includes elevations and stations illustrating the total area, including depths. The Permittee shall also provide the Geographic Information Systems (GIS) data set for the area dredged. The information shall be submitted to: CESAJ-ComplyDocs@usace.army.mil and nmfs.ser.monitoringreportshc@noaa.gov

Hardcopies may be sent to:

> Jacksonville District, Regulatory Division
> South Permits Branch, Enforcement Section
> Post Office Box 4970, Jacksonville, Florida 32232

22. The Permittee shall provide an annual report to the Corps by 31 March of each year that includes: a list of all verifications under this permit; total quantity of material dredged; GIS coverage of all cuts/shoals dredged; construction schedule; the results of all required mitigation and monitoring, including pre and post seagrass surveys with supporting GIS data set; and miles of shoreline where dredged material was placed on the beach for the prior year.

Special Conditions Related to the Activity Authorized:

23. This permit will not obviate the necessity to obtain any other permits, which may be required.

24. The District Engineer reserves the right to require that any request for authorization under this RGP be evaluated as a Standard Individual Permit or Letter of Permission.

25. This permit shall be valid for a period of 5 years from the above date of issuance, unless suspended or revoked by issuance of a public notice by the District Engineer. If SAJ-93 expires or is revoked prior to completion of the authorized work, authorization of activities that have commenced or are under contract (including if plans and

specifications have commenced for contract) under reliance on SAJ-93 will remain in effect, provided the activity is completed within 12 months of the date the SAJ-93 expired or was revoked.

26. The Permittee shall perform all work in accordance with the general conditions for permits. The general conditions attached hereto are made a part of this permit.

27. Assurance of Navigation: The Permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration of the structures or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the Permittee will be required, upon due notice from the U.S. Army Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

General Conditions:

1. The time limit for completing the work authorized ends on **April 26, 2021**.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature and mailing address of the new owner in the space provided below and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

(X) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)

(X) Section 404 of the Clean Water Act (33 U.S.C. 1344)

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413)

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, State, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal projects.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or Construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (see 3 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

6. Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7, or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CER 209.170) accomplish the corrective measures by contract, or otherwise, and bill you for the cost.

7. When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

____________________________________ ________________________
(TRANSFEREE-SIGNATURE) (DATE)

____
(NAME-PRINTED)

____
(ADDRESS)

8. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

Tori K White
for 26 April 2016
(DISTRICT ENGINEER) (DATE)
Jason A. Kirk, P.E.
Colonel, U.S. Army
District Commander

Attachments to Department of the Army Regional General Permit SAJ-93

1. LOCATION MAPS FOR FEDERAL NAVIGATION CHANNELS: 7 pages

2. FIND/USACE INTRACOASTAL WATERWAY DREDGED MATERIAL MANAGEMENT AREAS, 1 page, dated April 2015.

3. AS-BUILT CERTIFICATION FORM: 2 pages

4. BIOLOGICAL OPINIONS TERMS AND CONDITION: A1-A23 and B1-B23 of SPBO, pages 122-154; 10 terms and conditions of P3BO, pages 29-32*;* and 10 terms and conditions on RGP SAJ-93 BO, pages 51-53.

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
PO BOX 4970
JACKSONVILLE, FLORIDA 32232-8176

REPLY TO
ATTENTION OF

May 3, 2018

Regulatory Division
Regional General Permit SAJ-93
Modification #1

Mr. Mark Crosley, Executive Director
Florida Inland Navigation District
1314 Marcinski Road
Jupiter, Florida 33477

Dear Mr. Crosley:

The U.S. Army Corps of Engineers (Corps) hereby modifies the Florida Inland Navigation District's Regional General Permit (RGP), SAJ-93, issued on April 26, 2016. The RGP authorizes the Florida Inland Navigation District to maintenance dredge the Atlantic Intracoastal Waterway, Intracoastal Waterway, and Okeechobee Waterway federal navigation channels, including wideners, along the east coast of Florida. The aforementioned channels are located in the following counties: Nassau, Duval, St. Johns, Flagler, Volusia, Brevard, Indian River, St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade. This is the first modification.

In an effort to minimize impacts to swimming sea turtles the following is added to the RGP as special condition number 13.c: *Where buoys are used to mark pipelines, the Permittee shall use light weight chain, non-looping wire rope, or plastic sheathing around nylon rope to secure the buoy line to the pipeline to prevent looping*.

This modification is effective on the date of this letter. Authorization of projects that have commenced or are under contract to commence in reliance on SAJ-93 prior to the date of this letter are not affected. If you have any questions concerning this letter, please contact me by email at tori.white@usace.army.mil or by telephone at (904) 232-1658.

Sincerely,

Tori K White

Tori K. White
Deputy, Regulatory Division