TAYLOR ENGINEERING, INC.

Long-Range Dredged Material Management Plan Update for the Intracoastal Waterway

Duval County, Florida

July 2016

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Long-Range Dredged Material Management Plan Update for the Intracoastal Waterway
Duval County, Florida

Prepared for

FLORIDA INLAND NAVIGATION DISTRICT

by

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LONG-RANGE DREDGED MATERIAL MANAGEMENT PLAN UPDATE FOR THE INTRACOASTAL WATERWAY DUVAL COUNTY, FLORIDA

EXECUTIVE SUMMARY

The 22.36-mile Duval County project area — comprising five reaches (Reaches III – VII); 50 cuts (27 – SJ-3); and portions of the AIWW, JHP, and ICWW federal navigation projects — extends from the south side of Nassau Sound to about 1.5 miles south of the Duval/St. Johns county line, including a 0.11-mile gap between the southern end of the AIWW and the northern end of the ICWW within the JHP. The 0.11-mile gap within the JHP separates the 10.44-mile AIWW and the 11.81-mile ICWW federal navigation projects in Duval County. The selected dredged material placement sites for Duval County include six upland DMMAs (DU-2, DU-3&4, DU-6A & 6B, DU-7, DU-8, and DU-9). Together, these six sites, when fully constructed, will provide sufficient storage capacity to manage the material dredged from Duval County's five defined reaches over a 50-year period.

A review of the historical maintenance dredging records and recent shoaling data provided the 50-year dredged material storage requirements for the Duval County reaches. The resulting countywide 50-year dredging and storage requirements equate to 1,815,555 cy and 3,903,443 cy. Previous physical and chemical analyses of sediments revealed no consistent pattern of significant contamination and particularly do not indicate that dredging would result in any significant degradation of ambient water quality. Only two areas — located immediately south of Nassau Sound (Reach III, Cut 27) and south of Atlantic Boulevard bridge (Reaches VI and VII) — may require special handling due to their pronounced fine-grained characteristics. Historical maintenance dredging records indicate median dredging frequencies of 6 – 7 years for the AIWW reaches (Reach III and IV), 10 years for ICWW Reach V, and 3 – 5 years for ICWW Reaches VI and VII. The status of the dredged material management sites follow below.

The combined capacity of the 49.91-acre DMMA DU-2 and 122.66-acre DMMA DU-3&4 — both located west of the AIWW and on Black Hammock Island — will handle sediments dredged from the AIWW Duval County Reach III. The FIND acquired the DMMA DU-2 site in 1990 and USACE completed the DMMA construction in 1995. The USACE built a diked containment basin on DU-3&4 to receive the greater portion of the 298,000 cy of dredged material produced by the 1982 Reach III channel maintenance operations. However, the long-term DU-3&4 containment facility has not been built. Numerous conservation lands located in the vicinity of the sites include the Nassau River-St. Johns River Marshes State Aquatic Preserve, Timucuan National Ecological and Historic Preserve, Pumpkin Hill Creek State Buffer Preserve, and the City of Jacksonville's Cedar Point Park.

The 82.15-acre DMMA DU-6A & 6B property — located 0.6-mile east of the confluence of the AIWW (Sisters Creek) with the St. Johns River, 400 ft north of the river's northern shoreline, and immediately north of the right-of-way for Heckscher Drive (S.R. 105) — will handle sediments dredged from the AIWW Duval County Reach IV. DMMA DU-6A&6B comprises two separate parcels. The FIND acquired the eastern 71.54-acre parcel (DU-6A), also known as "Fanning Island," in 1989 and the USACE constructed the existing DMMA in 1993. To date, the FIND has not acquired an operational permit necessary to receive and dewater dredged sediment at DMMA DU-6A. When built on the 10.91-acre DU-

6B parcel immediately adjacent to the DMMA DU-6A site, the second DMMA will receive and dewater relatively small volumes of dredged material that for reasons of its physical or chemical characteristics (e.g., excessive silt or clay content, elevated concentrations of contaminants) may not be appropriate for placement in DMMA DU-6A.

The 32.0-acre DMMA DU-7 site — located west of the ICWW, north of Wonderwood Drive, and on the northeast portion of Greenfield Peninsula — will handle sediments dredged from the ICWW Duval County Reach V. The FIND acquired the DMMA DU-7 site (formerly known as the "Bullard Property") in 1988 and cleared and grubbed the site in 2001. Before site construction and operation, FIND must resolve issues regarding supply and return pipeline routes (due to anticipated temporary wetland impacts) and site access issues from Wonderwood Drive.

The 36.23-acre DMMA DU-8 site, also known as the "Moody Marine Disposal Area," is located just south of Atlantic Boulevard and abuts the Mira Vista at Harbortown condominiums (Mira Vista) to the east. This site will handle sediments from ICWW Duval County Reach VI. The FIND acquired this site in 1991. The USACE built the DMMA in 1993. A pipeline easement extends from the eastern site boundary to the ICWW. The 60-ft wide, 1,100-ft long easement comprises a total area of 2.4 acres and the upland portion of the easement lies within property owned by the Mira Vista at Harbortown Condominium Association, Inc. In 2014, FIND installed a permanent pipeline sleeve extending the entire upland length, approximately 400 ft, of this easement. The 36-in. high-density polyethylene (HDPE) underground sleeve enables a dredging contractor to insert its supply and return pipes during maintenance dredging operations. Finally, depending on the on-site presence of gopher tortoises at the time of use, the previously issued tortoise relocation permit (WR94057) requires renewal.

Finally, the 179.9-acre DMMA DU-9 site, also known as the "Pablo Creek" site is located approximately 0.50-mile west of the ICWW, south of Pablo Creek, approximately 1.5 miles south of the Duval/St Johns County line, and lies within an extensive private landholding known as Dee Dot Ranch. This site will handle sediments dredged from the ICWW Duval County Reach VII. The FIND acquired the DMMA DU-9 site in 1995 and obtained construction permits in 2000. Due to contamination found within the center of the site during preliminary construction activities in 2001, the FIND modified the permit in 2004 and redesigned and constructed a smaller basin north of the contaminated area in 2006. At present, FIND is moving forward with the permitting and construction of the originally planned, large DMMA necessary to meet the capacity requirements of the projected 50-year storage volume for Reach VII.

While the immediate dredged material storage needs of the Duval County DMMP have largely been addressed, several outstanding requirements remain to meet the full potential of the outlined plan. With only four of the recommended sites constructed, the combined and current design storage capacity (1,756,427 cy) meets only a portion of the 50-year storage capacity requirement (3,903,443 cy). Recommendations, in order of priority, include (1) determine operational permit requirements for constructed DMMAs; (2) permit, design and construct the permanent, expanded DMMA DU-9 containment basin; (3) develop a market analysis for the DMMA DU-2 sediment; (4) permit, design, and construct the DMMA DU-3&4 facility; (5) acquire remaining pipeline easement segment for the DMMA DU-6A & 6B facility; and (6) permit, design, and construct the DMMA DU-7 facility.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Since its formation in 1927, the Florida Inland Navigation District (FIND) has served as the local sponsor for the ±410-mile long federal Atlantic Intracoastal Waterway (AIWW) and Intracoastal Waterway (ICWW) channels. Collectively known as the "Waterway", the federal channels extend along Florida's east coast from the Florida-Georgia state line south to Biscayne Bay in Miami-Dade County. The Waterway comprises two authorized project depths: (1) 12 ft below mean lower low water (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 segment of the Waterway, 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 ±384-mile IWW extends southward from the JHP to the MHP. Together, the AIWW and ICWW intersect each of Florida's 12 east coast counties. As the projects' local sponsor, the FIND provides the U.S. Army Corps of Engineers (USACE) with sites suitable for placing material dredged from the authorized navigation channels.

1.1 Background

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. To this end, 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 Waterway. A majority 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 Waterway 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.

Because of society's increased environmental awareness and scientific knowledge, the unconfined placement of dredged material within wetland areas no longer represents a responsible approach to the long-term and continued maintenance of the Waterway. Present-day legislation and regulatory constraints have also rendered this approach unrealistic. Dredging and dredged material management must comply with state and federal legislation dealing with water quality, wetland filling, habitat protection, and threatened and endangered species. In addition, county and municipal governments typically address dredge-and-fill issues in local comprehensive planning documents within state-established guidelines. The long-range limitations

[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.

on dredged material management imposed by these constraints have become more apparent as existing dredged material sites reach capacity and as the identification and permitting of new dredged material management sites become increasingly difficult. Moreover, the intensive development pressure currently experienced throughout coastal Florida has made the acquisition of additional dredged material management sites an increasingly expensive proposition.

To secure its ability to maintain the Waterway 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 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. Phase I focused on the development of basic plan concepts, the definition of long-term dredging requirements, and the identification of suitable management alternatives which satisfy, to the extent practicable, the identified considerations. Phase I resulted in the identification of a bank of primary and secondary sites potentially suitable for long-term dredged material management. Phase II focused on obtaining and documenting detailed site-specific information required for the preparation and submission of permit applications for the primary sites identified in Phase I. In addition, Phase II addressed site acquisition, design of site facilities, and the construction and continuing operation and maintenance of these sites as permanent dredged material management facilities.

1.2 Project Overview

In general accordance with the USACE Engineer Regulation 1105-2-100 guidance document, the FIND originally completed the *Long-Range Dredged Material Management Plan for the Intracoastal Waterway in Northeast Florida* — inclusive of both Nassau and Duval counties — in September 1986. The development of the original Duval County Phase I report 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 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

With the completion of the Phase I report(s), the FIND moved into Phase II of the DMMP, which included three primary components:

(1) Collection of public record information (e.g., land use, zoning restrictions, taxes and assessed values, easements, and property ownership) to assist in the further development (and final site selection and acquisition) of the primary and secondary sites;
(2) Collection of site-specific information for primary sites (and secondary sites if the primary sites were deemed unfit)
    a. Boundary survey
    b. Topographic survey
    c. Subsurface and soils survey
    d. Environmental resource survey; and
(3) Preliminary design and analysis of dredged material management facilities.

Because of the preceding efforts, the FIND developed four site-specific reports (i.e., Environmental Site Documentation, Management Plan, Engineering Narrative, and Cost Report) for each primary site. Combined, these collective Phase I and II documents, authored between 1986 and 2002, compose the original DMMP for Duval County. This document updates the DMMP, succinctly incorporating recently collected data with previously published information, to guide immediate and future dredged material planning efforts in Duval County. Executed in close cooperation with the FIND and the USACE Jacksonville District, this document will

(1) Summarize the key and established foundation of the DMMP;
(2) Establish, define, and update the 50-year maintenance dredging and storage requirements;
(3) Provide the current status and evaluate the remaining or potential storage capacities of the FIND-owned and designated DMMAs; and,
(4) Recommend a long-range dredging and DMMA construction schedule.

This report makes no attempt to recount all of the information previously developed for Duval County during the original DMMP's two-phased implementation. Rather, the report summarizes relevant portions of this information and presents additional information developed to support the update of the long-range DMMP for Duval County.

1.3 Established DMMP Features

As summarized above and detailed in the previously developed Phase I and II reports, the Duval County DMMP included the establishment of multiple permanent dredged material management sites to receive, dewater, and temporarily store materials dredged from an adjacent segment (i.e., reach) of the Waterway. Previously defined reach delineation reflects the detailed review and consideration of historical shoaling patterns, sediment quality, projected material transfer and storage requirements, area demographics, and site availability. Each reach comprises several straight-line segments (i.e., cuts). A change in orientation (i.e., direction) of the Waterway provides the end of one cut and the beginning of the next.

Thus, the Duval County project area — comprising five reaches (Reaches III – VII)[2] and 50 cuts (27 – SJ-3) — extends from the south side of Nassau Sound southward to approximately 1.5 miles south of the Duval/St. Johns county line. The selected dredged material placement sites for Duval County comprise six upland areas (DMMA DU-2, DU-3&4, DU-6A & 6B, DU-7, DU-8, and DU-9). Together, the six sites, when fully constructed, should provide sufficient storage capacity to manage the amount of material dredged from Reaches III – VII over a 50-year period.

Table 1.1, Figure 1.1, and **Figure 1.2** present the reach delineation and accompanying dredged material management sites. Description of the channel geometry, specifically the detailed longitudinal stationing information included with the more recent dredging plans, was used to establish a system for cross-referencing a particular location along the Waterway to both cut and station, and channel mileage. As revised in Brownell et al. (2016), the Florida segment of the AIWW begins about 2,000 ft south of the Florida/Georgia state line (at Cut 2, Station 0+00 of the federal Fernandina Harbor Project (FHP)). The AIWW segment ends at the centerline of the JHP in the St. Johns River. After a 0.11-mile gap within the JHP, the ICWW segment begins at the south side of the JHP. Due to resolution of inconsistencies between the older plan documents (stemming from modifications in the channel geometry over the project lifetime) and the 2016 revisions, the channel mileages applied in this updated report vary from those in the original DMMP.

Table 1.1 Reach Limits and Designated Dredged Material Management Sites

Reach		Cut	End Station (ft)	Length (mi)	AIWW[1]/ICWW[2] Mileage	Management Site
Atlantic Intracoastal Waterway						
III	Nassau Sound at Sawpit Cut-off to Fort George River	27	70+55.89	1.34	16.98	DMMA DU-2 DMMA DU-3&4
		26A	6+22.84	0.12	17.10	
		26	5+05.18	0.10	17.20	
		25	11+43.72	0.22	17.41	
		24	15+27.21	0.29	17.70	
		23	31+51.63	0.60	18.30	
		22	10+36.22	0.20	18.49	
		21	10+59.39	0.20	18.70	
		20	12+29.11	0.23	18.93	
		19	28+89.92	0.55	19.48	
		18	10+00.14	0.19	19.67	
		17	24+37.88	0.46	20.13	
		16	17+13.47	0.32	20.45	
		15	7+99.57	0.15	20.60	
		14	7+20.85	0.14	20.74	
		13	7+97.92	0.15	20.89	
		12	26+53.96	0.50	21.39	
		11	23+64.03	0.45	21.84	

[2] Reaches I and II are in Nassau County as described in the Long-Range Dredged Material Management Plan Update for Nassau County (Brownell et. al, 2016).

Table 1.1 Reach Limits and Designated Dredged Material Management Sites Continued

Reach		Cut	End Station (ft)	Length (mi)	AIWW[1]/ICWW[2] Mileage	Management Site
IV	Fort George River to Jacksonville Harbor	10	21+13.43	0.40	22.24	DMMA DU-6A & 6B
		9	22+87.96	0.43	22.67	
		8	23+95.89	0.45	23.13	
		7	19+70.52	0.37	23.50	
		6	52+22.35	0.99	24.49	
		5	21+26.54	0.40	24.89	
		4	11+90.53	0.23	25.12	
		3	10+45.47	0.20	25.32	
		2	18+55.45	0.35	25.67	
		1	21+76.67	0.41	26.08	
Intracoastal Waterway						
V	Jacksonville Harbor To Pine Island	DU-1	27+00.04	0.51	0.51	DMMA DU-7
		DU-2	10+50.79	0.20	0.71	
		DU-3	21+75.35	0.41	1.12	
		DU-4	25+29.47	0.48	1.60	
		DU-5	47+33.60	0.90	2.50	
		DU-6	75+61.80	1.43	3.93	
VI	Pine Island to Beach Blvd	DU-7	31+61.10	0.60	4.53	DMMA DU-8
		DU-8	16+49.70	0.31	4.84	
		DU-9	29+48.19	0.56	5.40	
		DU-10	18+30.57	0.35	5.75	
		DU-11	10+05.02	0.19	5.94	
		DU-12	23+80.06	0.45	6.39	
		DU-13	39+24.98	0.74	7.13	
		DU-14	13+60.99	0.26	7.39	
		DU-15	22+23.40	0.42	7.81	
VII	Beach Blvd to DMMA DU-9	DU-16	22+15.55	0.42	8.23	DMMA DU-9
		DU-17	37+34.74	0.71	8.94	
		DU-18	37+00.08	0.70	9.64	
		DU-19	28+10.81	0.53	10.17	
		SJ-1	21+65.82	0.41	10.58	
		SJ-2	27+48.65	0.52	11.10	
		SJ-3	37+26.84	0.71	11.81	

[1]AIWW begins at Cut N-FHP-10, Station 0+00 (coincident with Cut 2, Station 0+00 of the FHP). Mileage column value is the southerly end mileage of the cut; [2]ICWW begins at Cut DU-1, Station 0+00 at the south side of the JHP. Mileage column value is the southerly end mileage of the cut.

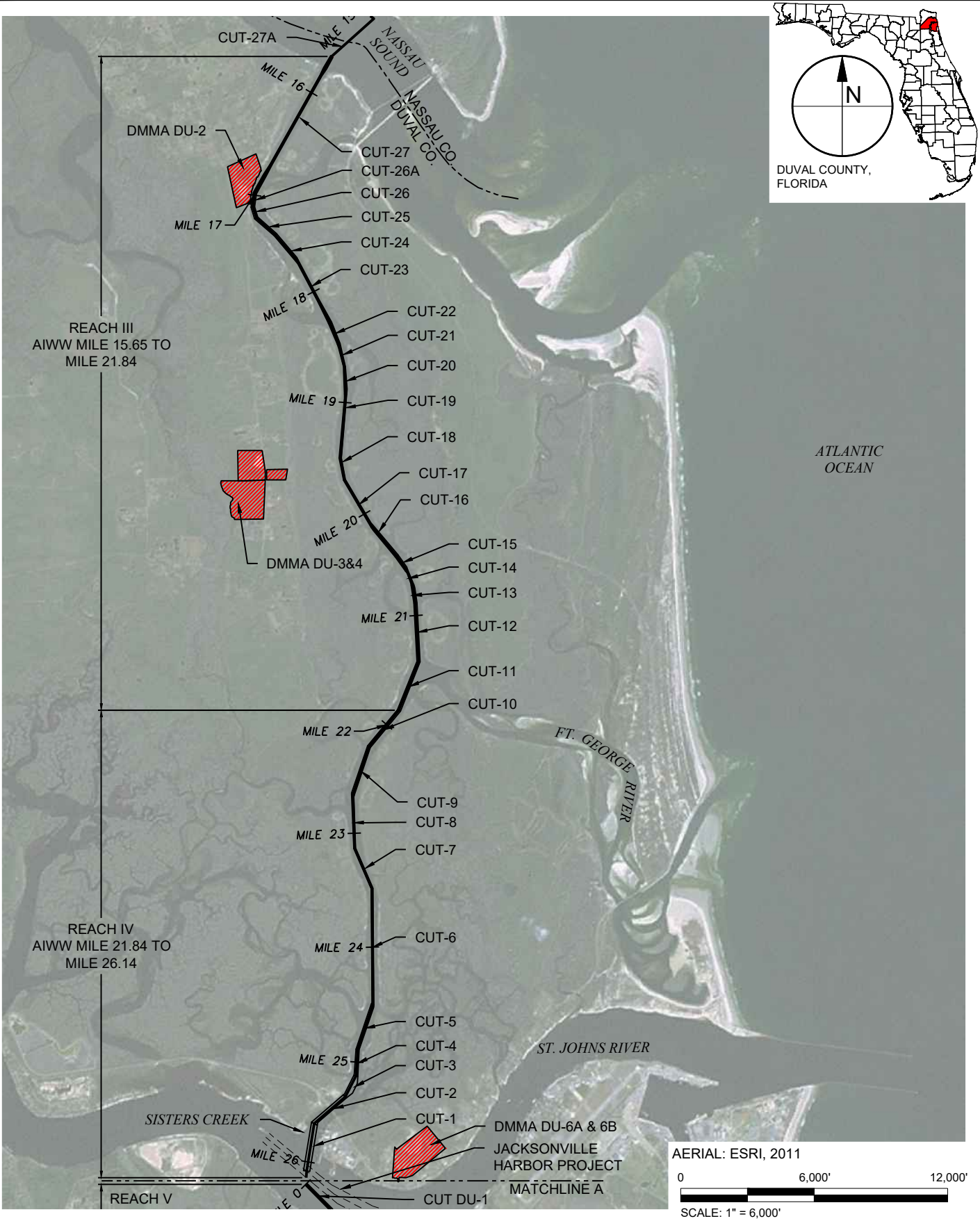

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FIGURE 1.1
REACH LIMITS AND DESIGNATED DREDGED MATERIAL MANAGEMENT SITES
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	1 of 17
DATE	JULY 2016

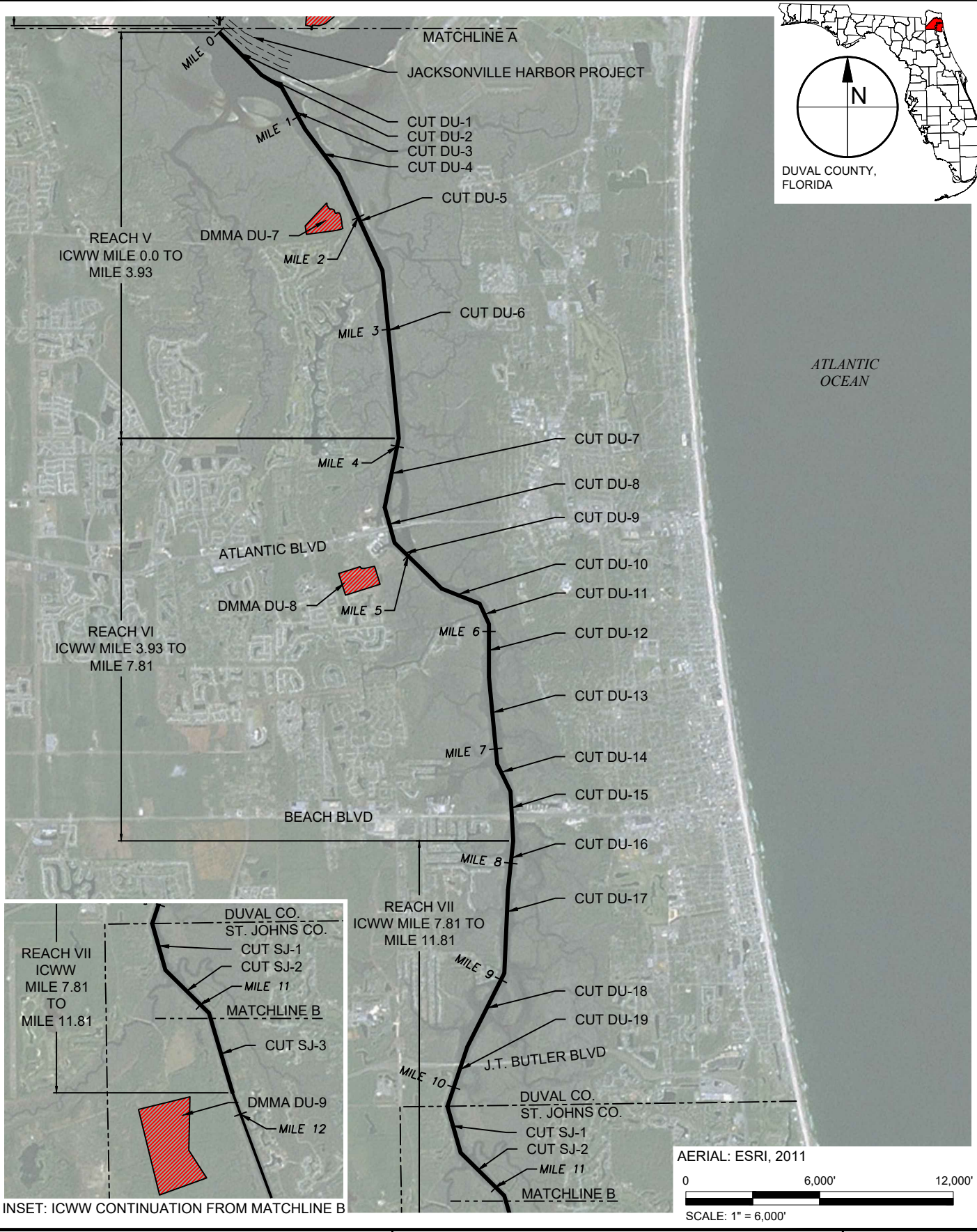

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FIGURE 1.2
REACH LIMITS AND DESIGNATED DREDGED MATERIAL MANAGEMENT SITES
INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	2 of 17
DATE	JULY 2016

1.4 Report Organization

The methods reported herein closely follow the methods of the original Phase I and subsequent Phase II DMMP reports. The organization of this report generally reflects those methods. **Chapter 2.0**, *DMMP Development*, summarizes the primary components of the original DMMP development including the selected dredged material management concept(s) and summarizes the evaluation criteria for selection of the upland DMMA sites. **Chapter 3.0**, *50-Year Material Storage Requirement*, provides a revised projection of the 50-year material management requirements based on an update of the historic channel maintenance records and evaluation of the most recent bathymetric surveys and channel sediment data, and discusses the implications of the revised projections. **Chapter 4.0**, *DMMA Design and Construction*, addresses the overall dredged material management strategy for Duval County along with the current status, design, operation, management, and mitigation, as applicable, of the selected dredged material placement areas. **Chapter 5.0**, *DMMA Operational Considerations,* provides a summary of the three phases (pre-, during-, and post-dredging) of DMMA operations. Finally, **Chapter 6.0**, *Conclusions and Recommendations*, summarizes the updated findings.

2.0 DMMP DEVELOPMENT

The underlying foundation for the reach delineation and ultimate dredged material placement site selection — summarized herein and extensively detailed in the original DMMP reports — included selection of a dredged material management concept(s) and identification, evaluation, and eventual selection of six DMMAs (DU-2, DU-3&4, DU-6A & 6B, DU-7, DU-8, DU-9) for the management of dredged material from the Waterway. The following paragraphs summarize the development of the Duval County DMMP.

2.1 Dredged Material Management Concept

The central issue guiding the development of a management concept — i.e., a guiding set of principles that reflects the attitudes and considerations of the project's local sponsor — for the Waterway in Duval County was the selection of the most appropriate material management strategy. Based on previous experience and DMMP reports, four basic alternatives are available for consideration: (1) ocean disposal, (2) open water placement, (3) beach placement, and (4) centralized upland storage. The following paragraphs discuss each of these alternatives with respect to its applicability to Duval County management requirements.

(1) *Ocean Disposal.* While considered a favorable management strategy typically reserved for large volume areas (e.g., entrance channels, inlets, deepening projects), ocean disposal requires the transport of dredged material from the dredging site to an authorized offshore disposal area. For the Duval County project area, this condition would result in a very inefficient and costly operation for the following reasons. The dredge (hydraulic or mechanical) must first load the material into a hopper barge capable of transiting the relatively shallow depths of the Waterway. Within Duval County, the channel's -12 ft (MLLW) controlling depth would place severe limits on the barge's draft and thereby on its capacity. Regulatory restriction on overflowing the barge during filling would likely limit its effective capacity even further. Once a barge is filled to its (draft-limited) capacity, the barge must then transit to an appropriate point at which to transfer the material to a deep-draft seagoing barge for transport to an authorized offshore placement site. A review of offshore disposal areas currently authorized by the U.S. Environmental Protection Agency (EPA) to receive dredged material did not identify any reasonably close (i.e., less than 10 miles) approved offshore placement sites. Given the depth-limited restrictions on barges in the waterway and lack of a close EPA-approved Ocean Dredged Material Disposal Site (ODMDS), the ocean disposal management strategy was not considered a viable option.

(2) *Open Water Placement.* This particular method, as noted in **Chapter 1.0**, was perhaps the most widely used approach before the growth of today's environmental regulatory programs that address wetland and benthic habitat protection. Today, under the guise of wetland or habitat creation, open water placement has found favor in areas (coastal Louisiana, Chesapeake Bay, etc.) that have experienced severe losses of similar wetland habitats. However, in Florida, open water placement as a dredged material management strategy has generally not gained regulatory support. Discussions with representatives of the relevant regulatory agencies have

repeatedly confirmed that they consider open water placement within Florida's estuaries to carry unacceptable environmental impacts in terms of the destruction or degradation of shallow-water or benthic habitat. *Open water placement or island creation also remains inconsistent with a basic principle of the FIND's dredged material management program: to provide permanent infrastructure of material management facilities that can support the long-term maintenance of the Waterway without relying on changeable regulatory attitudes.* Even if the initial placement operation would receive the necessary permits, the creation or expansion of open water placement represents an unacceptable and short-term dredged material management strategy for Duval County.

(3) *Beach Placement.* The State of Florida and the USACE (via its Regional Sediment Management program) encourages placement of beach-quality dredged material on the beach as a beneficial use of dredged material. The FIND also includes this approach as an essential part of the dredged material management for channel reaches which, based on the historic data, are likely to contain beach-quality sediments. These conditions are most typically encountered in the immediate area of tidal inlets where Waterway shoals are formed primarily by sand driven through the inlet by waves and tides. Within Duval County, such conditions are not present within the Waterway channel except within the 1,920-ft wide by 40-ft deep overlapping segment of the federally authorized JHP channel. The FIND does not anticipate dredging that area as part of the Waterway maintenance program and, therefore does not include those sediments in the Waterway management strategy for Duval County.

(4) *Centralized Upland Storage*. Centralized upland storage relies on the use of diked containment areas with appropriate outlet flow control structures. The dredged material is pumped in a sediment-slurry to one end of the containment basin opposite the outlet structure. Sediment settles in the basin while the residual water returns to the Waterway via the basin outlet structure and return pipeline. Upland storage sites offer a number of significant advantages over other available methods: (1) they provide an efficient means of dredged material management without excessive costs of transportation and material re-handling involved with the use of ocean disposal; (2) given identification of suitable sites, they avoid most wetland impact issues inherent in the use of open water disposal; (3) they are conducive to reconfiguration and reconditioning for subsequent disposal events; and (4) unlike beach disposal, they do not demand particular physical characteristics of dredged material.

The use of a limited number of centralized upland storage sites has additional economic, operational, and environmental advantages over the use of a greater number of smaller sites: (1) fewer, larger sites reduce the total acreage required and thereby reduce the total cost of site acquisition; (2) developing and constructing fewer, larger sites is more cost-effective than developing and constructing a number of small sites; (3) the use of centralized sites allows for improved site security and requires the allocation of fewer operating personnel; and (4) the use of fewer, larger sites reduces the total impact to upland habitat and allows for improved effluent and stormwater control, as well more efficient and comprehensive monitoring procedures. Considering all of the above factors, the DMMP relies solely on centralized upland storage for the Duval County Waterway reaches.

2.2 Evaluation Criteria

With the management concept in-hand, the final site evaluation and selection process for the overall site bank employed a standard set of criteria. Developed as part of the original 1986 Phase I report, these criteria remain consistent with the dredged material management strategy designated most appropriate for future Duval County requirements. Taylor Engineering evaluated each centralized upland storage candidate site based on its ability to satisfy criteria in three broad areas:

(1) *Engineering/operational.* Engineering/operational considerations take into account the mechanics behind the construction of an upland DMMA and maintenance dredging of the Waterway. Selection of the optimal site will have a long-term and compounding economic impact on the construction, operation, and maintenance of a particular site. Specific considerations within this broad-based criterion include ability of the site to meet the required storage capacity, adequate and appropriate dike material for site construction, minimization of pumping distance, and availability of pipeline and upland access.

(2) *Environmental.* By minimizing adverse impacts to sensitive habitats, the environmental site evaluation criteria guided the selection of sites that carried minimal environmental permitting constraints. Reflecting the FIND's established principle of restricting the placement and storage of dredged material to upland areas, the resulting criteria fell under two categories: (1) criteria for the avoidance of wetland areas to the greatest extent possible, and (2) criteria for minimizing unavoidable impacts to sensitive upland habitats. Other environmental considerations included maximization of buffer area (to limit view and lessen sound intrusion of the DMMA from adjacent properties), identification of potential archeological sites, and protection of groundwater.

(3) *Socioeconomic/cultural.* The third major category of site evaluation criteria considers the socioeconomic issues of on-site or adjacent land use, current comprehensive plan and zoning designations, local governmental jurisdictions, and site ownership. Typically, the initial site selection process seeks areas of suitable existing on-site land use with areas of minimal development receiving preference. Given their reduced environmental value, areas previously disturbed by clearing, excavation, timber harvesting, or drainage also received preference. To the maximum extent possible, a buffer zone was considered to reduce potential conflicts by separating the site's active storage from adjacent residential or commercial development.

2.3 Site Identification

Given the established dredged material management strategy of centralized upland storage for each of Duval County's five reaches, the FIND evaluated sites throughout the county to identify those potentially useful as permanent dredged material management and storage facilities for the Waterway. For the 1986 Phase I report, the site identification process began with an office review of LABINS (Land Boundary Information System, FDEP Bureau of Survey and Mapping) visible/infrared aerial photography supplemented with aerial photography and other information from the Duval County Property Appraiser's office. Other resource materials included U.S. Geological Survey 7.5-minute topographic quadrangle maps, City of Jacksonville Comprehensive Plan future land use and zoning maps, U.S. Fish and Wildlife Service

wetland inventory maps and U.S. Soil Conservation Service maps. Through this review, Taylor Engineering identified potentially suitable sites for development as DMMAs. Consistent with the FIND's established program standards, the selection of the identified sites reflects each site's potential to satisfy a range of engineering/operational, environmental, and socioeconomic/cultural criteria.

Through the general process outlined above, the FIND 1986 report originally identified the following primary and secondary sites (**Table 2.1**) to serve the projected future Waterway dredged material management requirements in Duval County. The "Current Status" column in the table identifies the construction status of the site and the rationale, if applicable, behind the secondary site selection over the originally identified primary site. Moving forward, the remainder of this report discusses only those sites selected for ultimate centralized upland storage (i.e., DMMA).

Table 2.1 Summary of Alternative Centralized Upland Storage Sites

REACH		DREDGED MATERIAL MANAGEMENT SITE		CURRENT STATUS
		SITE NAME/ ALTERNATIVE SITE NAME(S)	1986 DESIGNATION	
ATLANTIC INTRACOASTAL WATERWAY				
III	Nassau Sound at Sawpit Cut-off to Fort George River	**DMMA DU-2** N.E. Black Hammock Island	Primary	Constructed.
		DMMA DU-3&4 MSA 300E: Central Black Hammock Island DU-3&4: W. Central Black Hammock Island	Primary	MSA 300E: The USACE used this area for DMMA construction, material handling, and pipeline routing for its 1982 maintenance operation. The area, separated into two parcels and segmented by Sawpit Road, will be developed into a larger capacity DMMA (i.e., DMMA DU-3&4) with the adjoining southern parcel. DU-3&4: Southern site portion purchased for expansion of MSA 300E. Archaeological issues identified in the southwest site corner. Not constructed.
IV	Fort George River to Jacksonville Harbor	Cedar Point	Secondary	Secondary site (DMMA DU-6A & 6B) acquired. No further action expected.
		West of Sisters Creek	Primary	Site abandoned due to significant on-site environmental resources/wetland areas identified during the site reconnaissance.
		DMMA DU-6A & 6B W. Fanning Island	Secondary	DMMA DU-6A is constructed. DMMA DU-6B is not constructed.
		400E N. Heckscher Drive	Primary	Site was removed from consideration due to City of Jacksonville plans to develop it as a public marina (Sisters Creek Marina), The site was later exchanged for the DU-6B parcel adjoining DU-6A.

Table 2.1 Summary of Alternative Centralized Upland Storage Sites Continued

REACH		DREDGED MATERIAL MANAGEMENT SITE		CURRENT STATUS
		SITE NAME/ ALTERNATIVE SITE NAME(S)	1986 DESIGNATION	
INTRACOASTAL WATERWAY				
V	Jacksonville Harbor to Pine Island	**DMMA DU-7** Bullard Property	Primary	Acquired; not constructed.
		DeBlieu Creek	Secondary	Primary site acquired. No further action expected.
VI	Pine Island to Beach Blvd	**DMMA DU-8** Moody Marine	Primary	Constructed.
		Hogpen Creek	Secondary	Primary site acquired. No further action expected.
VII	Beach Blvd to DMMA DU-9	**DMMA DU-9** Pablo Creek	Primary	Smaller containment area on the northern site portion is constructed. Pending the conditional closure of the Dee Dot Sludge Disposal Area No. 2 (located on the southern site portion), the FIND will construct the larger, permanent DMMA.
		Cabbage Creek	Secondary	Primary site acquired. No further action expected.

2.4 Public Involvement

Lastly, the implementation of the DMMP, by design, included a four-tiered involvement of outside reviewers and interested members of the public who commented on the long-range DMMP during development. These four sources of input consisted of: (1) a technical advisory committee comprising representatives from the FIND staff, the USACE Jacksonville District, the Florida Department of Environmental Regulation (DER) and the Florida Department of Natural Resources (now combined as the FDEP), and the Florida Department of Community Affairs; (2) a citizens advisory committee comprising community representatives appointed by the Jacksonville City Council; (3) the FIND Board of Commissioners; and (4) the general public. Outreach activities included initial telephone and letter contacts followed by short presentations in the Tallahassee DER office and presentations within the local community. The constructive and valuable input received from each of the above-described sources contributed greatly to the successful completion of the original long-range DMMP for Duval County.

3.0 50-YEAR MATERIAL STORAGE REQUIREMENT

The first step in reestablishing, defining, and updating the 50-year maintenance dredging and material storage requirement requires updating and reassessing the projected future dredging and material storage requirements of the project area. These projected requirements will determine the volume of dredged material that each established placement area must accommodate. The projected dredging and dredged material storage requirements, in turn, reflect two quantities:

(1) the estimated volume of material removed from the Waterway channel in all maintenance dredging operations since construction of the channel to its present project depth, and
(2) the estimated volume of shoaling presently within the authorized channel based on recent surveys of the project area.

The latter quantity represents the volume of shoaling since the last maintenance operation or, in non-maintained areas, the volume of shoaling since the channel's original construction to its present dimensions. By accounting for channel maintenance operations performed within the project area since the original 1986 study as well as more accurate and comprehensive survey data unavailable at the time of the original study, this reassessment provides a more accurate, updated projection for the volume of dredged material that each DMMA must accommodate. The following sections provide a breakdown of both the historical maintenance and recent shoaling volumes, a summary of the resulting projection of the 50-year dredging and material storage requirements, and a review of the material quality (physical and sediment chemistry characteristics) of previously collected geotechnical borings.

3.1 Historic Channel Maintenance

The volume of historic maintenance dredging was derived from an analysis of the USACE Jacksonville District archival records — specifically, analysis of all engineering plans and supporting documents for channel maintenance performed in the Duval County segment of the Waterway since the USACE deepened the channel to its authorized project depth of 12 ft below Mean Low Water (-12 ft MLW[3]) in 1941 – 1942 for the AIWW, and in 1951 for the ICWW segments of the Waterway. Of those maintenance dredging events referenced (**Table 3.1**), only the plans for the 1943 and 1945 channel maintenance within the AIWW were unavailable. To ensure accuracy, consistency, and completeness, the original 1986 report (as well as the records since received for this updated report) review included all available sources of dredging information held by USACE Jacksonville District. Relevant sources included the annual Office of the Chief of Engineers (OCE) reports, previous USACE summaries of maintenance dredging within the project area, and interviews with USACE personnel. The primary sources of information, however, remained USACE archival maintenance plan documents and examination surveys.

The archival records express the estimated volume of material dredged in previous channel maintenance operations in two forms. The first estimate — the pre-dredging estimate, or the design volume of required dredging — reflects the comparison of the results of a detailed pre-dredging examination survey of the authorized channel to the project design depth. The plan for the dredging operation and the bids of the dredging contractors reflect this estimate. The second estimate represents the pay volume. This estimate

[3]The current design depth is defined as 12 ft below MLLW. Prior to 2008, the USACE referenced the design depth to MLW.

determines the dollar amount the dredging contractor receives for the work and reflects the comparison of detailed pre- and post-dredging examination surveys. Therefore, the pay volume closely corresponds to the actual volume of material removed from the channel and accounts for allowable overdepth dredging. Because of past contracting and recording procedures, pay volumes do not always link dredging quantities to specific dredging locations. In those maintenance operations for which the pay volume was unavailable, multiplying the design volume by a correction factor provides an estimate of the pay volume. Derived from all dredging records evaluated thus far in the FIND's long-range program (and consistent with all other Waterway DMMP efforts), the correction factor of 1.19 represents the ratio of pay volume to design volume in those channel maintenance operations for which both quantities are known.

The updated analysis of historic dredging records (**Table 3.1**) established that the USACE performed 10 separate channel maintenance operations totaling a pay volume of 1,372,799 cy for AIWW Reaches III and IV between 1943 and 2015. Similarly, since 1956 the USACE has also performed 11 separate channel maintenance operations totaling a pay volume of 930,371 cy for ICWW Reaches V – VII. As itemized, consistent maintenance operations occurring approximately every 4 – 6 years took place in both the AIWW and ICWW up until the mid-1980s. A ±20-year gap in channel maintenance followed; however, the lack of maintenance dredging during the gap does not necessarily prove the absence of shoaling. Needed dredging may have been curtailed due to various factors including environmental regulation, contracting procedures, lack of funding and equipment, and lack of useable material management sites.

Table 3.1 Historic Maintenance Dredging, 1943 — 2015

REACH	AIWW/ICWW MILEAGE		CUT/STATION		LENGTH (FT)	YEAR	DESIGN VOLUME (CY)	PAY VOLUME (CY)[1]
	FROM	TO	FROM	TO				
ATLANTIC INTRACOASTAL WATERWAY[2]								
III	--	--	--	--	--	1943	***33,250***	39,568
	--	--	--	--	--	1945	***58,381***	69,473
	15.84	16.00	27/60+50	27/52+00	845	1952	9,000	***10,710***
	16.64	16.76	27/18+00	27/11+50	634		16,000	***19,040***
	16.99	17.16	26A/6+00	26/2+00	898		6,000	***7,140***
	18.20	18.70	23/5+00	21/0+00	2,640		32,000	***38,080***
	20.89	21.12	13/0+00	12/14+50	1,214		4,000	***4,760***
	15.75	15.89	27/65+00	27/57+50	739	1957	15,000	15,829
	17.02	17.12	26A/4+00	26/4+00	528		6,500	7,417
	15.67	16.11	27/69+00	27/46+00	2,323	1962	23,900	52,006
	17.25	17.55	25/8+60	24/8+00	1,584		5,300	9,530
	15.68	15.89	27/68+66	27/57+66	1,109	1968	8,600	***10,234***
	17.26	17.43	25/8+00	24/14+50	898		5,200	***6,188***
	21.43	21.53	11/21+50	11/16+50	528		4,000	***4,760***
	21.76	21.99	11/4+00	10/13+00	1,214		12,200	***14,518***
	15.65	16.83	27/70+55	27/8+00	6,230	1982	121,000	***143,990***

Table 3.1 Historic Maintenance Dredging, 1943 — 2015 Continued

REACH	AIWW/ICWW MILEAGE		CUT/STATION		LENGTH (FT)	YEAR	DESIGN VOLUME (CY)	PAY VOLUME (CY)[1]
	FROM	TO	FROM	TO				
III	17.02	17.04	26A/4+00	26/8+00	106	1982	73,500	***87,465***
	17.96	18.91	23/18+00	20/1+00	5,016		43,500	***51,765***
	19.13	21.67	19/18+00	11/9+00	13,411		139,000	***165,410***
	21.76	22.26	11/4+00	9/22+00	2,640		34,000	***40,460***
	16.72	16.89	27/14+00	27/5+00	898	2006	3,795	3,789
	15.71	15.83	27/67+00	27/61+00	634		1,647	837
	17.06	17.10	26A/2+00	26A/0+00	211		167	167
	17.10	17.20	26/5+00	26/0+00	528		10,476	10,455
	17.20	17.41	25/11+43	25/0+00	1,109		47,876	44,843
	17.61	17.70	24/5+00	24/0+00	475		1,187	909
	17.41	17.61	24/15+27	24/5+00	1,056		9,150	9,097
	17.70	17.79	23/31+50	23/27+00	475		182	-
	18.36	18.49	22/7+00	22/0+00	686		2,357	1,871
	18.49	18.52	21/10+59	21/9+00	158		350	-
	18.76	18.93	20/9+00	20/0+00	898		6,603	6,389
	18.93	18.96	19/28+89.85	19/27+00	158		437	170
	19.44	19.48	19/2+00	19/0+00	211		170	170
	19.48	19.67	18/10+00.12	18/0+00	1,003		7,508	7,456
	19.66	20.13	17/24+37.83	17/0+00	2,482		21,394	21,362
	20.13	20.45	16/17+13.44	16/0+00	1,690		17,858	17,858
	20.45	20.60	15/7+99.55	15/0+00	792		3,243	3,138
	20.60	20.74	14/7+20.83	14/0+00	739		1,008	1,006
	20.74	20.89	13/7+97.90	13/0+00	792		3,310	3,184
	20.89	20.98	12/26+53.90	12/22+00	475		651	605
	21.26	21.39	12/7+00	12/0+00	686		8,607	8,247
	21.39	21.84	11/23+61	11/0+00	2,376		56,252	55,883
	17.04	17.64	26A/3+00	24/3+00	3,168	2013	97,192	94,536
	16.72	16.89	27/14+00	27/5+00	898		6,855	5,360
	15.71	15.86	27/67+00	27/59+00	792		11,471	11,368
	REACH III TOTAL						**970,077**	**1,107,043**
IV	--	--	--	--	--	1943	***15,272***	18,174
	25.28	25.58	3/1+65	2/4+70	1,584		***16,932***	20,149
	--	--	--	--	--	1945	***28,816***	31,911
	22.65	23.31	9/1+00	7/10+30	3,485	1952	13,000	***15,470***
	23.60	23.71	6/47+00	6/41+00	581		3,000	***3,570***
	25.28	25.58	3/1+65	2/4+70	1,584		34,000	***40,460***
	25.28	25.58	3/1+65	2/4+70	1,584	1954	***29,023***	34,537

Table 3.1 Historic Maintenance Dredging, 1943 — 2015 Continued

Reach	AIWW/ICWW Mileage		Cut/Station		Length (ft)	Year	Design Volume (cy)	Pay Volume (cy)[1]
	From	to	from	to				
Atlantic Intracoastal Waterway[2]								
IV	22.60	22.69	9/4+00	8/23+00	475	1962	7,000	9,260
	22.28	23.39	9/21+00	7/6+00	5,861	1982	72,500	***86,275***
	23.46	23.75	7/2+00	6/39+00	1,531		5,000	***5,950***
	Reach IV Total						**224,543**	**265,756**
Reach III and IV Total							**1,194,620**	**1,372,799**
Intracoastal Waterway[3]								
V	0.67	0.87	DU-2/8+50	DU-3/8+50	1,056	1956	15,000	**17,850**
	2.45	2.64	DU-5/44+75	DU-6/7+75	1,003		12,000	**14,280**
	2.44	2.53	DU-5/44+50	DU-6/1+50	475	1966	3,100	2,399
	Reach V Total						**30,100**	**34,529**
VI	4.79	4.89	DU-8/14+00	DU-9/2+50	528	1956	3,000	***3,570***
	4.78	4.90	DU-8/13+00	DU-9/3+00	634	1960	4,000	9,133
	4.76	5.03	DU-8/12+00	DU-9/10+00	1,426	1962	13,100	24,415
	4.78	4.98	DU-8/13+30	DU-9/7+50	1,056	1964	2,700	2,203
	4.78	5.01	DU-8/13+39	DU-9/9+00	1,214	1965	4,600	7,634
	4.78	5.03	DU-8/13+29	DU-9/10+00	1,320	1970	13,700	13,374
	4.79	4.95	DU-8/14+00	DU-9/6+00	845	1973	9,000	9,224
	4.78	4.97	DU-8/13+00	DU-9/7+00	1,003	1986	10,000	***11,900***
	4.33	4.92	DU-7/21+00	DU-9/4+00	3,115	2005	25,490	24,377
	Reach VI Total						**85,590**	**105,830**
VII	10.11	10.28	DU-19/24+83	SJ-1/6+00	898	1956	60,000	***71,400***
	10.77	11.29	SJ-2/10+00	SJ-3/10+00	2,746			
	9.59	11.36	DU-18/34+35	SJ-3/13+60	9,346	1958	77,000	98,630
	10.53	11.81	SJ-1/19+00	SJ-4/0+00	6,758	1960	100,000	114,508
	8.94	12.00	DU-18/0+00	SJ-4/10+00	16,157	1962	151,400	218,636
	10.11	10.26	DU-19/24+85	SJ-1/5+00	792	1964	99,300	***118,617***
	10.56	12.00	SJ-1/20+50	SJ-4/10+00	7,603			
	10.55	12.47	SJ-1/20+00	SJ-4/35+00	10,138	1965	71,000	101,500
	10.58	11.71	SJ-2/0+00	SJ-3/32+00	5,966	1970	42,000	47,912
	10.11	10.28	DU-19/25+00	SJ-1/6+00	898	1986	4,000	***4,760***
	11.02	11.10	SJ-2/23+00	SJ-2/27+47.35	422	2009	1,381	1,381
	11.10	11.81	SJ-3/00+00	SJ-3/37+26.7	3,749		12,892	12,668
	Reach VII Total						**618,973**	**790,012**
Reach V – VII Total							**734,663**	**930,371**
Reach III – VII Total							**1,929,283**	**2,303,170**

[1]Numbers in ***bold italic*** are based on the relationship: Pay Volume = 1.19 x Design Volume; [2]AIWW begins at Cut N-FHP-10, Station 0+00 of the FHP; [3]ICWW begins at Cut DU-1, Station 0+00

3.2 Recent Shoaling

As discussed in the introductory paragraph of **Section 3.0**, the volume of recent shoaling represents the second component that determines the projected future dredging and dredged material storage requirements for the Duval County segment of the AIWW. A FIND bathymetric survey of the AIWW and ICWW in 2014 provides the most recent shoal information.

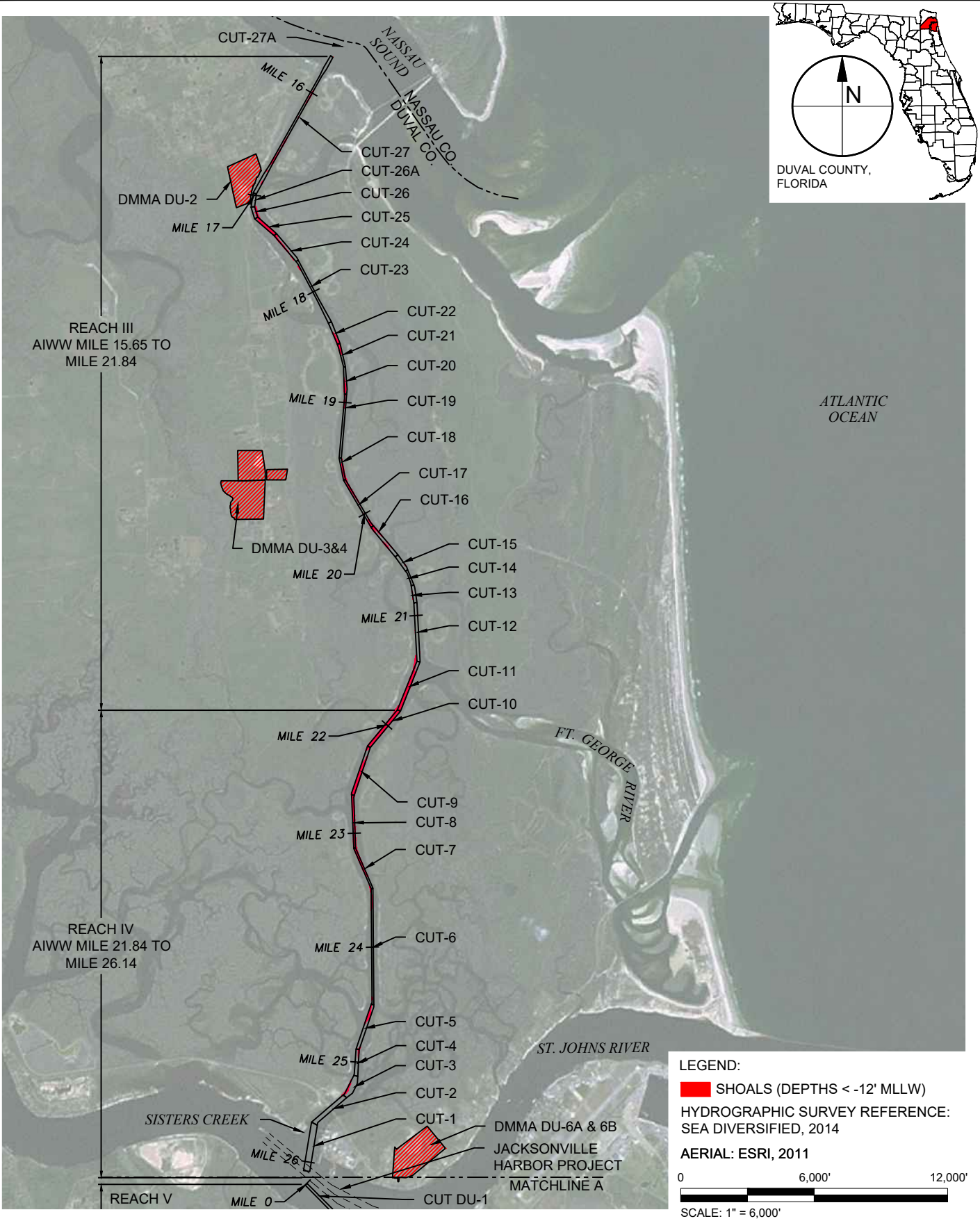
From the 2014 survey results, Taylor Engineering identified the shoal locations and calculated the shoal volumes listed in **Table 3.2.** Shoal volumes calculated from the surveys correspond to the design volume (i.e., the amount of material removed to achieve project design depth). The application of the correction factor (i.e., 1.19) as described in the previous section then derived the corresponding pay volume which accounts for typical allowable overdepth dredging.

Table 3.2 Summary of Recent Shoals, 2014

Reach	AIWW/ICWW Mileage		Cut/Station		Length (ft)	Year	Design Volume (cy)	Pay Volume (cy)[1]
	From	To	From	To				
Atlantic Intracoastal Waterway[2]								
III	15.72	16.88	27/66+42	27/5+35	6,107	2014	980	1,167
	17.07	17.78	26A/1+65	23/27+18	3,775	2014	8,351	9,938
	18.41	19.02	22/4+51	19/23+94	3,235	2014	5,384	6,407
	19.49	20.17	18/9+54	16/15+05	3,586	2014	5,531	6,582
	21.35	21.84	12/1+99	11/0+00	2,563	2014	17,856	21,248
	Reach III Total						**38,102**	**45,342**
IV	21.84	23.69	10/21+13	6/42+27	9,764	2014	55,942	66,571
	24.41	25.36	6/3+98	2/16+47	4,969	2014	9,552	11,367
	Reach IV Total						**65,494**	**77,938**
Reach III - IV Total							**103,596**	**123,279**
Intracoastal Waterway[3]								
V	0.59	0.97	DU-2/4+35	DU-3/13+72	1,988	2014	11,405	13,571
	Reach V Total						**11,405**	**13,571**
VI	4.39	4.89	DU-7/24+29	DU-9/2+82	2,663	2014	4,497	5,351
	Reach VI Total						**4,497**	**5,351**
VII	10.16	10.60	DU-19/27+70	SJ-2/1+05	2,311	2014	2,472	2,942
	10.69	11.81	SJ-2/5+64	SJ-3/37+26	5,911	2014	22,097	26,295
	Reach VII Total						**24,569**	**29,237**
Reach V — VII Total							**40,470**	**48,160**
Reach III — VII Total							**144,067**	**171,439**

[1]Pay Volume = 1.19 x Design Volume; [2]AIWW Mile zero occurs at Cut N-FHP-10, Station 0+00 (coincident with Cut 2, Station 0+00 of the FHP); [3]ICWW Mile zero occurs at Cut DU-1, Station 0+00 at the south side of the JHP.

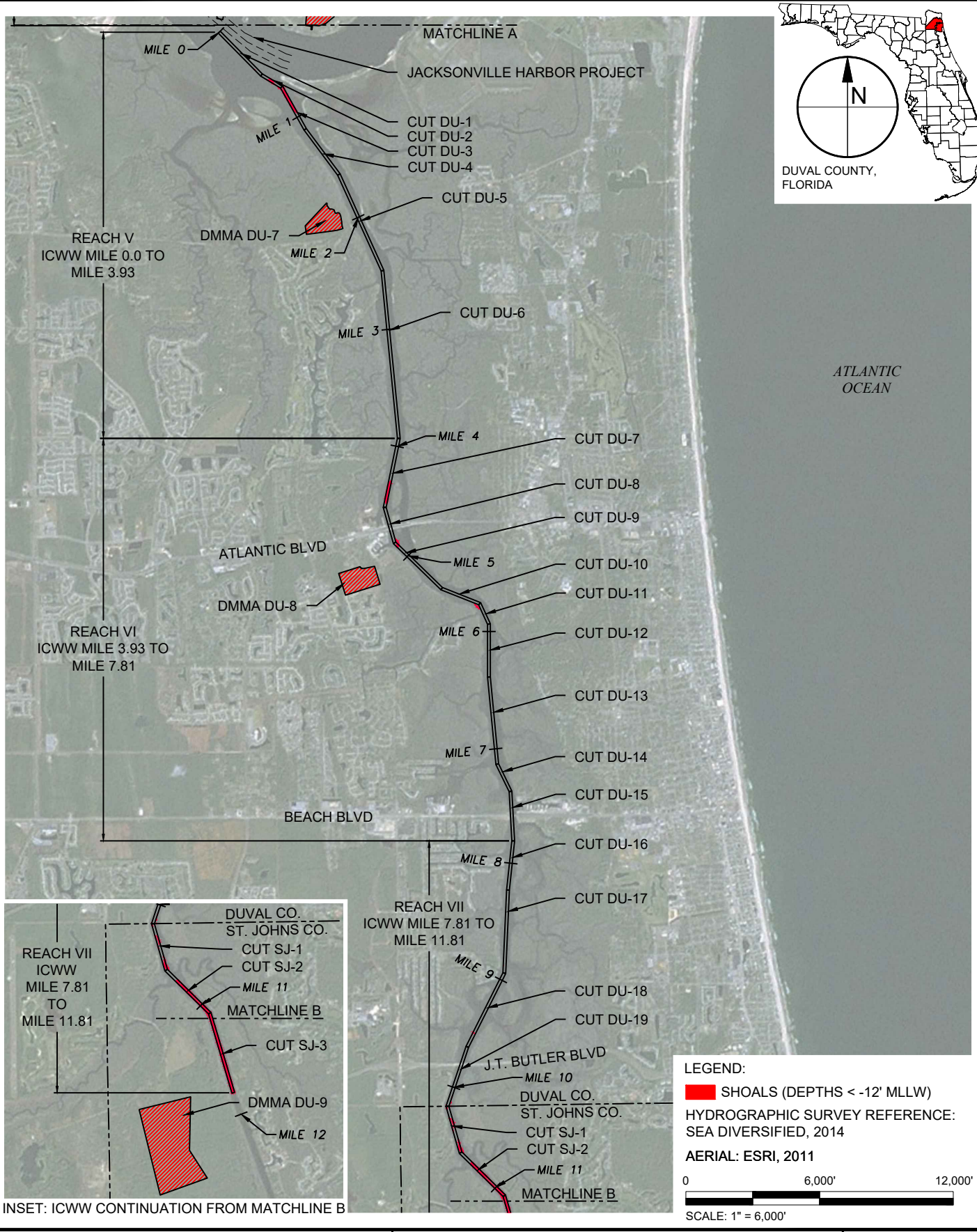
As summarized, the estimated design and pay volumes of shoals within the Duval County project area total 144,067 cy and 171,439 cy, respectively. The estimated shoaling volume (pay volume) in the AIWW (123,279 cy) is roughly two and a half times that in the ICWW (48,160 cy). This difference in shoaling volume and thus, historic maintenance volume, between the AIWW and ICWW can likely be attributed to the tidal influences and subsequent deposition of material in vicinity of Sawpit Cut-off and Fort George River. **Figures 3.1** and **3.2** depict the shoal locations listed in **Table 3.2**.



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 3.1
RECENT SHOALS
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	3 of 17
DATE	JULY 2016



TAYLOR ENGINEERING INC.
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BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 3.2
RECENT SHOALS
INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	4 of 17
DATE	JULY 2016

3.3 Projected 50-Year Dredging and Material Storage Requirements

Sections 3.1 and **3.2** provide information to develop the projected 50-year dredging and material storage requirements for the Duval County reaches (**Table 3.3**). These projections were derived as follows. To project the corresponding 50-year maintenance requirement for the Duval County project area, the volumes of shoaling (that is, the pay volume of historic maintenance dredging and recently documented shoaling) over the 72-year period of record (1943 – 2014) were summed, converted to an annual shoaling rate, and then interpolated to 50 years. The resulting project dredging volumes of 1,038,943 cy for AIWW Reaches III and IV and 776,612 cy for ICWW Reaches V – VII correspond to the in situ or unbulked volume of dredging anticipated over the next 50 years. Translating the projected 50-year in situ dredging volume into the storage volume required to handle the dredged material requires application of a bulking factor.

Table 3.3 Projected 50-Year Dredging and Material Storage Requirements

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 Require-ment (cy)	50-Year Storage Require-ment (cy)
Atlantic Intracoastal Waterway								
III	6.21	1,107,043	45,342	1,152,385	16,005	2,577	800,267	1,720,575
IV	4.23	265,756	77,938	343,694	4,774	1,128	238,676	513,154
III - IV	**10.44**	**1,372,799**	**123,279**	**1,496,078**	**20,779**	**--**	**1,038,943**	**2,233,728**
Intracoastal Waterway								
V	3.93	34,529	13,571	48,100	763	194	38,175	82,076
VI	3.88	105,830	5,351	111,181	1,765	455	88,239	189,714
VII	4.00	790,012	29,237	819,249	13,004	3,251	650,198	1,397,926
V-VII	**11.81**	**930,371**	**48,160**	**978,531**	**15,532**	**--**	**776,612**	**1,669,715**
III - VII	**22.25**[2]	**2,303,170**	**171,439**	**2,474,609**	**36,311**	**--**	**1,815,555**	**3,903,443**

[1]Based on 1942 - 2014 for AIWW and 1951 - 2014 for ICWW; [2] 0.11-mile gap within the JHP separates the 10.44-mile AIWW and the 11.81-mile ICWW federal navigation projects.

Bulking refers to the expansion of consolidated sediment that occurs as a result of dredging. Hydraulic dredging leads to material bulking by increasing the water content of the dredged material compared to its in situ consolidated state. After dredging and placement for long-term storage, the dredged material will begin to consolidate under its own weight. Given the appropriate conditions and sufficient time, the material may approach its original pre-dredging volume. The degree to which the material expands (bulks) depends on the physical characteristics of the sediment, as well as its relative consolidation before dredging. The present study (as well as the original 1986 report) applies a conservative factor of 2.0 to account for the increase in volume of the dredged material compared to its in situ volume. Consistent with USACE Jacksonville District experience and recommendations, an additional allowance of 15% of the original in situ volume accounts for non-pay volume (i.e., unauthorized) overdredging. Thus, multiplying the projected 50-year volume of required dredging by the effective bulking factor of 2.15 yields a projected 50-year material storage requirement of 3,903,443 cy for the Duval County AIWW and ICWW project

area. Broken down, the volume/year/mile equates to ±2,600 and ±1,100 cy/year/mile for AIWW Reaches III and IV and between ±200 and ±3,250 cy/year/mile for the ICWW Reaches V – VII.

As summarized in **Section 3.2**, the projected 50-year material storage requirements for Reaches III – VII are based, in part, 2014 survey data. In 1996, 2000, and 2004 — to provide improved data on recent shoaling within the Waterway under its sponsorship — the FIND or USACE completed comprehensive bathymetric surveys of the AIWW and ICWW. **Table 3.4** provides a comparison of the material storage requirements between those surveys and the original 1986 report. Given that the Waterway channel geometry (e.g., centerline location, longitudinal stationing, and reach definition) has adjusted over the previous 30-years, the updated material storage requirements for each individual reach (**Table 3.3**) are not directly comparable to **Table 3.4**. As summarized, the total for the AIWW and ICWW indicates an approximate 11% decrease (from 4,401,865 cy to 3,903,443 cy) in material storage requirements for the Duval County project area between 1986 and 2014. Reach III, including the Sawpit Cut-off area, experienced the only substantial increase (roughly 11%) in storage capacity requirements.

Table 3.4 Previously Reported 50-Year Dredging and Material Storage Requirements

REACH	LENGTH (MI)	50-YEAR STORAGE REQUIREMENT (CY)				
		2014	2004	2000	1996	1986
III	6.21	1,720,575	2,107,185	2,054,852	2,026,340	1,553,852
IV	4.23	513,154	749,162	803,219	835,936	713,677
III – IV	**10.44**	**2,233,728**	**2,856,347**	**2,858,071**	**2,862,276**	**2,267,529**
V	3.93	82,076	69,113	65,800	82,375	92,450
VI	3.88	189,714	163,539	184,027	246,297	184,593
VII	4.00	1,397,926	1,415,486	1,550,328	2,053,902	1,857,293
V – VII	**11.81**	**1,669,715**	**1,648,138**	**1,800,155**	**2,382,574**	**2,134,336**
III - VII	**22.25**	**3,903,443**	**4,504,485**	**4,658,226**	**5,244,850**	**4,401,865**

3.4 Material Quality

In addition to projected material quantities, the long-range DMMP must also consider the physical and chemical properties of channel sediments. Techniques employed to maintain water quality during dredging and dewatering operations depend on the material's physical (i.e., particle size, specific gravity, etc.) and chemical characteristics. In addition, physical and chemical properties determine the dredged material's potential for reuse (e.g., construction fill, landfill cover, etc.) and therefore, influence a dredged material management site's effective service life.

3.4.1 Sediment Physical Characteristics

Historically, USACE Jacksonville District only obtained channel sediment data as part of the planning process for scheduled channel maintenance operations and then only within the proposed dredging template as required to obtain the state water quality certification (WQC). The following paragraphs detail three known geotechnical sampling events occurring in 1979/1980, 1985, and 2009 within the Duval County Waterway.

At the time of the 1986 Phase I *Long-Range Dredged Material Management Plan for the Intracoastal Waterway in Northeast Florida* study, physical data for the Duval County Waterway were limited to the results of single sets of core borings. Each set of borings was taken by the USACE prior to the most recent maintenance dredging activities in the respective segments of the Waterway; 1982 for the AIWW (borings collected in 1979/1980) and 1986 for the ICWW (borings collected in 1985). Per the 1986 Phase I report, the data consisted of individual core boring logs, with qualitative characterizations of the sediment at elevations referenced to MLW, as well as gradation or sieve analysis results and suspended sediment-time curves from composite samples representing the entire depth of each boring. For present purposes, only information contained in the boring logs was used to characterize the sediment, and only to a depth of -14 ft MLW (i.e., 12-ft project depth, plus 2-ft overdredging). Given the total boring depth was typically -17 to -20.5 ft MLW while Waterway maintenance dredging extends down to only -14 ft MLW, the results of the composite sample analyses did not accurately represent the anticipated dredged material.

Sediments within the AIWW are described by the results of 55 core borings taken inside the dredged channel, well-distributed longitudinally from Cut-30 (Duval County) to Cut-6 (Nassau County). From qualitative descriptions contained in the 1979/1980 boring logs, the sediment within this segment of the waterway may be characterized as predominantly fine to medium quartz sand, slightly silty, with fine to coarse shell fragments. The most extensive deposition of fine silty materials within the Duval County portion of the AIWW is documented within Cut 27. This artificial cut, also known as the "Sawpit Cut-off," has historically been a high-maintenance area as a result of the natural channel of Sawpit Creek retaining the greater proportion of tidal flushing. In 2009, in conjunction with the aforementioned 2010 bathymetric survey and anticipation of 2013 channel maintenance, the USACE, through its subcontractor (Challenge Engineering & Testing, Inc.), obtained 27 vibracores in Duval County. As summarized in **Table 3.5**, the 2009 borings yielded results similar to the original 1979/1980 boring logs. Results of these sampling efforts indicate that within the AIWW, only the maintenance material from Reach III, Cut 27, located immediate south of Nassau Sound, may require specialized handling procedures because of its pronounced silty character and above-average organic content. **Figure 3.3** provides the location of the 2009 geotechnical borings as they relate to the AIWW shoals identified in recent USACE surveys.

Within the ICWW, borings documented only the two shoaling areas scheduled for maintenance in 1986 — the area immediately south of the Atlantic Boulevard bridge (Cut DU-8/Station 13+00/ ICWW mile 4.77 to Cut DU-9/Station 7+00/ICWW mile 4.97) and the Palm Valley area astride the Duval/St. Johns County line (Cut DU-19, Station 25+00, ICWW mile 10.11 to Cut SJ-1/Station 6+00/ ICWW mile 10.30). **Table 3.1** indicates that these two shoals correspond closely to the primary maintenance areas within the study area of the ICWW over the project history. Again, the table only references qualitative descriptions of the sediment to -14.0 ft MLW contained in the boring logs. South of the Atlantic Boulevard bridge (Reaches VI and VII), sediments are characterized as fine quartz sand, while sediments from the high-maintenance Palm Valley area are described as fine, brown to dark brown silty sand, with some clay and organic content, indicating that dredged material from this area may also require more careful handling.

Table 3.5 Sediment Sampling Locations and Physical Characteristics

Reach	AIWW Mileage	Year	Boring ID	Northing	Easting	Datum	Top of Boring Elevation (ft)	Bottom of Boring (ft)	Soil Description (Depth, ft: Description)[1]
				NAD83 FL State Plane, East Zone, ft					
III	11.86	2009	VB-AIWW08M-DU27-2	2,250,359	510,924	MLLW	-12.0	-22.0	12.0-17.2: SAND, Silt, mostly fine-grained sand-sized quartz (SM); 17.2-21.4: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, some sub angular sand to gravel-sized shell up to ½´´ (SP-SM); 21.4-22.0: No Recovery
	12.95	2009	VB-AIWW08M-DU27-1	2,245,278	508,164	MLLW	-11.7	-21.7	11.7-15.5: SAND, poorly graded, mostly fine-grained sand-sized quartz (SP); 15.5-19.2: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to ¼´´; 19.2-21.7: No Recovery
	13.26	2009	VB-AIWW08M-DU26-1	2,243,843	507,827	MLLW	-8.4	-18.4	8.4-15.2: SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to $^{1}/_{8}$´´ (SP); 15.2-16.4: SAND, silt, mostly fine-grained quartz (SM); 16.4-18.4: No Recovery
	13.38	2009	VB-AIWW08M-DU25-2	2,243,272	508,103	MLLW	-7.4	-17.4	7.4-14.5: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 14.5-17.4: No Recovery
	13.5	2009	VB-AIWW08M-DU25-1	2,242,852	508,537	MLLW	-8.3	-18.3	8.3-15.5: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 15.5-15.8: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, trace sub angular fine to coarse gravel-sized shell up to 2´´; 15.8-18.3: No Recovery
	13.64	2009	VB-AIWW08M-DU24-1	2,242,322	509,023	MLLW	-9.6	-19.6	9.6-18.6: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 18.6-19.6: No Recovery
	13.84	2009	VB-AIWW08M-DU23-1	2,241,489	509,639	MLLW	-13.8	-21.8	13.8-16.3: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 16.3-17.2: CLAY, lean, medium plasticity, firm, mostly clay (CL); 17.2-20.3: SAND, silty, poorly-graded, mostly fine-grained sand-sized quartz (SM); 20.3-21.8: No Recovery
	14.56	2009	VB-AIWW08M-DU22-1	2,238,106	511,389	MLLW	-13.7	-23.7	13.7-18.0: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 18.0-20.7: SAND, clayey low plasticity, soft, mostly fine-grained sand-sized quartz, little clay, trace sub angular shell up to 1/8´´ (SC); 20.7-23.7: No Recovery
	11.86	2009	VB-AIWW08M-DU27-2	2,250,359	510,924	MLLW	-12.0	-22.0	12.0-17.2: SAND, Silt, mostly fine-grained sand-sized quartz (SM); 17.2-21.4: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, some sub angular sand to gravel-sized shell up to ½´´ (SP-SM); 21.4-22.0: No Recovery

Table 3.5 Sediment Sampling Locations and Physical Characteristics Continued

REACH	AIWW MILEAGE	YEAR	BORING ID	NORTHING	EASTING	DATUM	TOP OF BORING ELEVATION (FT)	BOTTOM OF BORING (FT)	SOIL DESCRIPTION (DEPTH, FT: DESCRIPTION)[1]
				NAD83 FL STATE PLANE, EAST ZONE, FT					
III	14.72	2009	VB-AIWW08M-DU21-1	2,237,286	511,658	MLLW	-13.8	-23.3	13.8-16.2: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 16.2-21.0: SAND, silty, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to $^{1}/_{8}$´´; 21.0-23.3: No Recovery
	14.97	2009	VB-AIWW08M-DU20-1	2,235,989	511,795	MLLW	-13.0	-23.0	13.0-15.5: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 15.5-17.0: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, trace sub angular san to gravel-sized shell up to ¼´´ (SP-SM); 17.0-22.2: SAND, silty, mostly fine-grained sand-sized quartz (SM); 22.2-23.0: No Recovery
	15.32	2009	VB-AIWW08M-DU19-1	2,234,176	511,709	MLLW	-12.1	-22.1	12.1-14.0: SAND, poorly-graded, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to $^{1}/_{8}$´´ (SP); 14.0-15.9: SAND, silty, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to ¼´´ (SM); 15.9-21.8: CLAY, lean, medium plasticity, firm, mostly clay (CL); 21.8-22.1: No Recovery
	15.69	2009	VB-AIWW08M-DU18-1	2,232,213	511,690	MLLW	-13.4	-23.4	13.4-16.5: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 16.5-17.2: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to 1´´ (SP-SM); 17.2-18.7: SAND, silty, mostly fine-grained sand-sized quartz, trace clay (SM); 18.7-19.0: SHELL, mostly sub angular sand to gravel-sized shell up to ½´´, some sub-rounded fine-grained sand-sized quartz; 19.0-21.4: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz (SP-SM); 21.4-23.4: No Recovery
	15.83	2009	VB-AIWW08M-DU17-3	2,231,514	511,950	MLLW	-13.2	-23.2	13.2-15.2: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 15.2-21.5: SAND, silty, mostly fine-grained sand-sized quartz, few sub angular fined to coarse gravel-sized shell up to 1- ½´´ (SM); 21.5-23.2: No Recovery
	16.02	2009	VB-AIWW08M-DU17-2	2,230,658	512,450	MLLW	-14.7	-24.7	14.7-17.5: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz (SP-SM); 17.5-19.0: SAND, silty, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to ½´´, trace clay (SM); 19.0-20.2: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz (SP-SM); 20.2-24.7: No Recovery

Table 3.5 Sediment Sampling Locations and Physical Characteristics Continued

Reach	AIWW Mileage	Year	Boring ID	Northing	Easting	Datum	Top of Boring Elevation (FT)	Bottom of Boring (FT)	Soil Description (Depth, FT: Description)[1]
				NAD83 FL State Plane, East Zone, FT					
III	16.21	2009	VB-AIWW08M-DU17-1	2,229,801	512,956	MLLW	-12.6	-22.6	12.6-15.6: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz (SP-SM); 15.6-16.1: SAND, clayey low plasticity, soft, mostly fine-grained sand-sized quartz, little clay, trace organic matter (SC); 16.1-16.8: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few sub angular sand to gravel-sized shell up to ¼´´ (SP-SM); 16.8-17.9: SAND, clayey low plasticity, soft, mostly fine-grained sand-sized quartz, little clay (SC); 17.9-22.6: No Recovery
	16.4	2009	VB-AIWW08M-DU16-1	2,228,968	513,557	MLLW	-13.5	-23.5	13.5-16.9: SAND, silty, mostly fine-grained sand-sized quartz (SM); 16.9-17.1: CLAY, fat, medium plasticity, soft, moist (CH); 17.1-17.5: SAND, silty, mostly fine-grained sand-sized quartz, few sub angular sand to gravel-sized shell up to $^{1}/_{8}$´´ (SM); 17.5-18.4: SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized quarts, some sub angular sand to gravel-sized shell up to ½´´; 18.4-19.5: CLAY, lean, low plasticity, soft (CL); 19.5-23.5: No Recovery
	16.61	2009	VB-AIWW08M-DU15-1	2,228,117	514,236	MLLW	-13.2	-23.2	13.2-18.5: SAND, silty, mostly fine-grained sand-sized quartz (SM); 18.5-19.1: SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized quartz (SP-SM); 19.1-23.2: No Recovery
	16.73	2009	VB-AIWW08M-DU14-1	2,227,618	514,581	MLLW	-13.9	-23.9	13.9-17.9: SAND, silty, mostly fine-grained sand-sized quartz (SM); 17.9-19.4: SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized quartz (SP-SM); 19.4-21.1: SAND, silty, mostly fine-grained sand-sized quartz (SM); 21.1-23.9: No Recovery
	16.94	2009	VB-AIWW08M-DU13-1	2,226,575	514,865	MLLW	-12.5	-22.5	12.5-15.7: SAND, silty, mostly fine-grained sand-sized quartz (SM); 15.7-20.6: SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized quartz (SP-SM); 20.6-22.5: No Recovery
	17.53	2009	VB-AIWW08M-DU11-3	2,223,495	515,016	MLLW	-14.6	-24.6	14.6-22.7: SAND, silty, mostly fine-grained sand-sized quartz (SM); 22.7-24.6: SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized quartz (SP-SM)

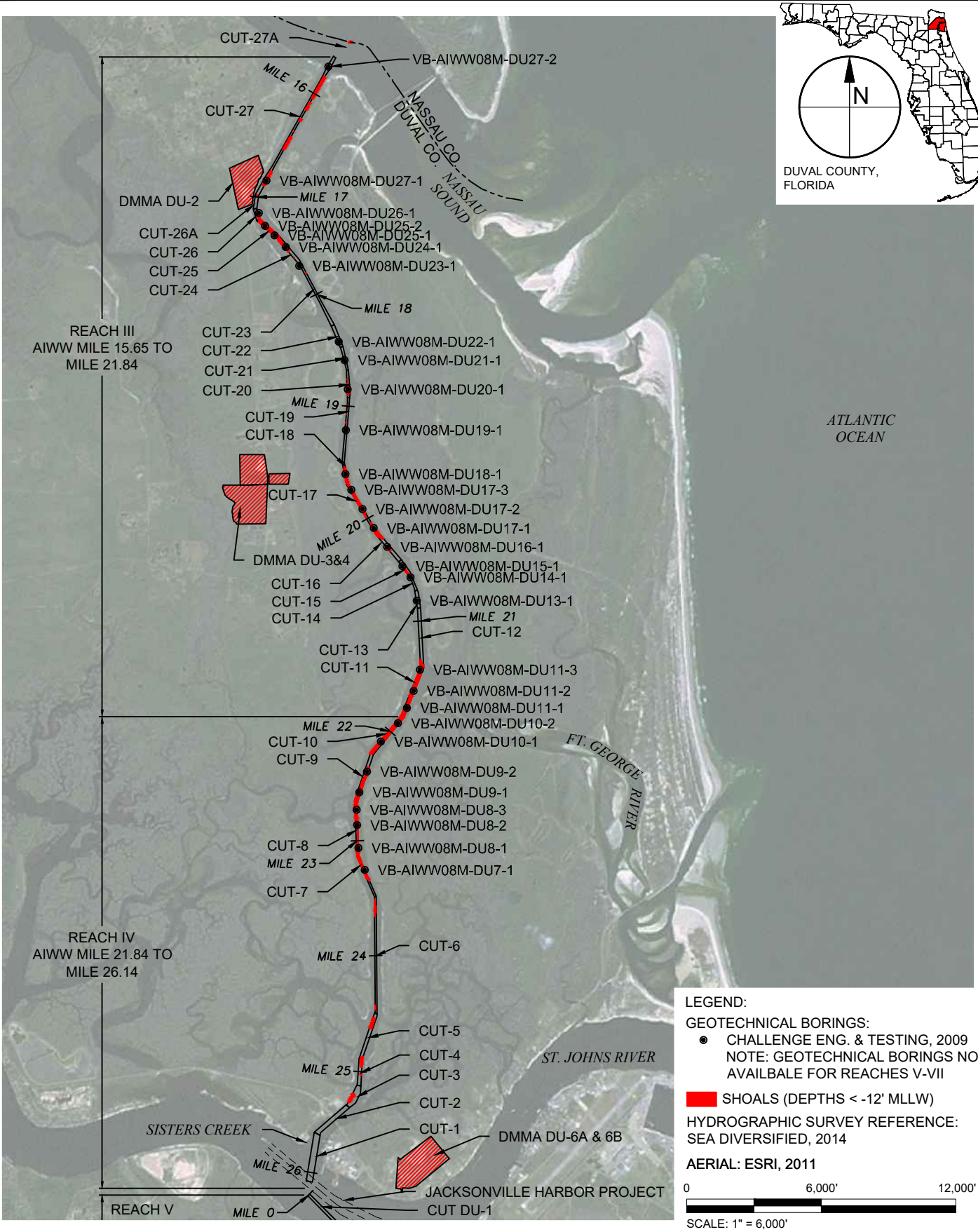
Table 3.5 Sediment Sampling Locations and Physical Characteristics Continued

Reach	AIWW Mileage	Year	Boring ID	Northing	Easting	Datum	Top of Boring Elevation (ft)	Bottom of Boring (ft)	Soil Description (Depth, ft: Description)[1]
				NAD83 FL State Plane, East Zone, FT					
IV	17.72	2009	VB-AIWW08M-DU11-2	2,222,562	514,723	MLLW	-13.2	-23.2	13.2-13.9: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 13.9-20.1: SAND, poorly-graded with silt, fine -grained sand-sized quartz, (SP-SM); 20.1-20.2: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 20.2-20.9: SAND, clayey, low plasticity, soft, mostly fine-grained sand-sized quartz, little clay (SC); 20.9-23.2: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP)
	17.87	2009	VB-AIWW08M-DU11-1	2,221,800	514,436	MLLW	-13.1	-23.1	13.1-19.0: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 19.0-19.6: SAND, clayey, low plasticity, soft, mostly fine-grained sand-sized quartz, little clay (SC); 19.6-20.2: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz (SP-SM); 20.2-23.1: No Recovery
	18.02	2009	VB-AIWW08M-DU10-2	2,221,110	514,029	MLLW	-8.0	-18.0	8.0-11.4: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 11.4-12.9: SAND, silty, mostly fine-grained sand-sized quartz (SM); 12.9-13.9: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 13.9-16.1: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz (SP-SM); 16.1-18.0: No Recovery
	18.23	2009	VB-AIWW08M-DU10-1	2,220,295	513,280	MLLW	-10.6	-20.6	10.6-15.1: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 15.1-16.5: SAND, silty, mostly fine-grained sand-sized quartz (SM); 16.5-17.6: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 17.6-17.9: SAND, clayey, low plasticity, soft, mostly fine-grained sand-sized quartz, some clay (SC); 17.9-18.2: SAND, poorly-graded with silt, mostly fine-grained sand-sized quarts, trace clay (SP-SM); 18.2-20.6: No Recovery
	18.52	2009	VB-AIWW08M-DU9-2	2,218,958	512,650	MLLW	-11.2	-21.2	11.2-14.6: SAND, poorly-graded mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to ¼´´ (SP); 14.6-17.2: SAND, silty, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to ½´´ (SM); 17.2-18.9: SILT, inorganic-L, non-plastic, very soft, mostly silt, discontinue quartz (ML); 18.9-19.4: SAND, silty, mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to ½´´ (SM); 19.4-21.2: No Recovery

Table 3.5 Sediment Sampling Locations and Physical Characteristics Continued

Reach	AIWW Mileage	Year	Boring ID	Northing	Easting	Datum	Top of Boring Elevation (ft)	Bottom of Boring (ft)	Soil Description (Depth, ft: Description)[1]
				NAD83 FL State Plane, East Zone, ft					
IV	18.7	2009	VB-AIWW08M-DU9-1	2,218,038	512,315	MLLW	-9.9	-19.9	9.9-15.9: SAND, poorly-graded, mostly fine-grained sand-sized quartz (SP); 15.9-16.5: SAND, silty, mostly fine-grained sand-sized quartz (SM), 16.5-17.9: SILT. inorganic-L, non-plastic, very soft, mostly silt, discontinue quartz (ML); 17.9-19.9: No Recovery
	18.85	2009	VB-AIWW08M-DU8-3	2,217,256	512,197	MLLW	-9.1	-19.1	9.1-16.3: SAND, poorly-graded mostly fine-grained sand-sized quartz, trace sub angular sand to gravel-sized shell up to $^{3}/_{8}$´´ (SP); 16.3-17.1: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few sub angular sand to gravel-sized shell up to 1´´ (SP-SM); 17.1-17.4: SILT, inorganic-L, non-plastic, very soft, mostly silt, few fine-grained sand-sized quart, trace sub angular shell up to ¼´´ (ML); 17.4-19.1: No Recovery
	18.98	2009	VB-AIWW08M-DU8-2	2,216,565	512,215	MLLW	-10.2	-20.2	10.2-12.7: SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz (SP-SM); 12.7-14.7: SAND, poorly-graded mostly fine-grained sand-sized quartz (SP); 14.7-15.5: SAND, silty, mostly fine-grained sand-sized quartz, few sub angular sand to gravel-sized shell up to $^{1}/_{8}$´´ (SM); 15.5-19.8: SILT, inorganic-L, non-plastic, very soft, mostly silt, trace fine-grained sand-sized quartz, trace sub angular shell up to $^{1}/_{8}$´´ (ML); 19.8-20.2: No Recovery
	19.18	2009	VB-AIWW08M-DU8-1	2,215,552	512,263	MLLW	-10.9	-20.9	10.9-15.7: SAND, poorly graded, mostly fine-grained sand-sized quartz (SP); 15.7-18.8: SILT, inorganic-L, non-plastic, very soft, mostly silt, trace fine-grained sand-sized quartz (ML); 18.8-20.9: No Recovery
	19.37	2009	VB-AIWW08M-DU7-1	2,214,569	512,543	MLLW	-8.4	-18.4	8.4-13.4: SAND, poorly graded, mostly fine-grained sand-sized quartz (SP); 13.4-16.7: SILT, inorganic-L, non-plastic, very soft, mostly silt, few fine-grained sand-sized quartz (ML); 16.7-17.8: SAND, silty, mostly quartz (SM); 17.8-18.4: SAND, poorly-graded mostly fine-grained sand-sized quartz (SP)

[1] Refer to referenced geotechnical report(s) for complete description of the collected borings.



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 3.3
GEOTECHNICAL BORING LOCATIONS
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	5 of 17
DATE	JULY 2016

3.4.2 Sediment Chemistry

This section focuses on the chemical characteristics of Duval County Waterway sediments. Chemical contaminants enter Duval County coastal waters from non-point (agricultural and urban storm water runoff, atmospheric pollutant deposition, marine craft operations, etc.) and point (industrial and municipal wastewater effluent, etc.) sources. Contaminants, over time, may accumulate in the underlying sediments. Sediment-associated contaminants prevalent in urbanized areas include metals (e.g., arsenic, cadmium, chromium, copper, lead, nickel, zinc, and mercury), pesticides, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Some natural sediment constituents, such as metals, should only qualify as contaminants when their concentrations exceed natural levels. PAHs may have natural or human origins. Other constituents, such as pesticides and PCBs that do not occur naturally, qualify as contaminants when present at any concentration. However, the presence of a contaminant does not necessarily indicate that it will cause adverse effects during dredging or dredged material placement. Expression of contaminant effects depends on a variety of factors including the contaminant concentration and chemical properties and other sediment characteristics (e.g., type of sediment, grain size, and organic content). In particular, fine-grained sediments tend to adsorb hydrophobic contaminants and therefore may likely contain potentially toxic concentrations.

As an initial screening — to determine whether Waterway sediments within Duval County contain contaminants at levels that would require additional investigation or might necessitate special dredging and sediment sampling procedures — Taylor et. al. (1986) evaluated available data for Waterway sediments collected by USACE and DER for studies in 1979 and 1981. The DER summarized the data in two separate guidance documents: "*Guide to the Interpretation of Reported Metal Concentrations in Estuarine Sediments*" (DER, 1986) and "*Deepwater Ports Manual*" (Ryan et. al, 1984). The majority of the sediment chemistry data resulted from four locations within the project area, with two additional sampling locations (IWW-1 and IWW-2) in the FHP. The four locations (IWW-3 – IWW-6) within the Duval County project area were located south of the St. Johns River located immediately north and south of the Atlantic Boulevard bridge (IWW-3 [historic entrance to the Bellinger Shipyards] and IWW-4 [Moody Marine entrance]), north of Beach Boulevard (IWW-5), and the last sample immediately south of the Duval/St. Johns County line (IWW-6 [at the confluence of the ICWW and Cabbage Creek]). All sampling locations were in zones of industrial or construction activity and were selected on the high probability of worst-case contamination. Two sites (IWW-4 and IWW-6) occur in areas requiring frequent maintenance dredging. Sediments from these four locations would most likely exhibit the highest level of pollutants within the Duval County section of the Waterway.

3.4.2.1 Sediment Analytical Results

Analysis based on DER guidelines (DER, 1986) for the interpretation of metal contamination indicated the possibility of metals being present at higher than natural levels at two sampling locations (mercury at IWW-4 and arsenic at IWW-6). Additional studies, primarily on ambient and elutriate water quality at four locations within the AIWW segment of the project area, were performed in 1979 and 1981 by the USACE Jacksonville District. Four locations were sampled.

In the 1979 study, ambient water and elutriate water were analyzed for ammonia nitrogen, orthophosphate, oil and grease, lead, zinc, iron, nickel, copper, manganese, silver, mercury, PCBs, and selenium. FDEP Class III water quality criteria for marine waters provide guidance for interpretation of the analytical results. Mercury exceeded the Class III criterion in both ambient and elutriate waters at one location and in ambient waters at a second location. Oil and grease and silver exceeded their Class III criteria in elutriate water at the second location. Additionally, all other mercury and silver analyses fell below the 0.5 µg/L detection limit. All PCB results fell below the 2 µg/L detection limit. Because the detection limits for these three analyses were above the DER Class III criteria, it is unknown whether these samples met state standards. No Class III ambient water quality criteria for marine waters exist for ammonia nitrogen, orthophosphate, or manganese.

In the April 1981 study, ambient water and elutriate water analyses were conducted for aluminum, manganese, mercury, oil and grease, selenium, silver, PCBs, and zinc. Mercury in all samples exceeded the FDEP Class III ambient water quality criterion for marine waters (0.025 µg/L). At the four sampling locations, the mercury concentrations for ambient water samples ranged from 0.06 to 1.81 µg/L and the mercury concentrations for elutriate water samples ranged from 0.5 to 1.81 µg/L. Additionally, all PCB results fell below the 0.1 µg/L detection limit. Because the PCB detection limit was greater than the Class III PCB criterion (0.03 µg/L), it is unknown whether the samples met the state standard.

These historical results indicate no consistent pattern of significant contamination and particularly do not indicate that dredging would result in any significant degradation of ambient water quality. To our knowledge, no other entity (i.e., FIND, USACE, FDEP, etc.) has collected sediment chemistry data from the Duval County Waterway since the 1979 and 1981 investigations. To date, Waterway maintenance dredging has occurred without regulatory agencies requiring collection and evaluation of additional sediment quality data.

4.0 DMMA DESIGN AND CONSTRUCTION

With the foundation of the DMMP established (**Chapter 2.0**) and the update of the 50-year maintenance dredging and storage requirements complete (**Chapter 3.0**), this section of the report focuses on a design and operational overview of the six upland dredged material placement sites — DMMA DU-2, DU-3&4, DU-6A & 6B, DU-7, DU-8, and DU-9. The selection of these sites was based on the sites' ability to best satisfy three primary categories of consideration — engineering/operational, environmental, and socioeconomic/cultural. The following section, presenting the DMMAs in order from north to south, details these considerations and how they factored into the design life cycle of the DMMA (i.e., preliminary design, permitting, and final design and construction). This section also includes a location map, plan view, and representative cross-sectional drawings depicting the as-built or preliminary design site condition and a tabular summary of site characteristics (i.e., location, reach, DMMA design, and access). To date, the FIND and the USACE have constructed four of the six DMMAs.

4.1 DMMA DU-2

The 49.91-acre DMMA DU-2 — located west of the AIWW, east of Sawpit Road, and on the northeast portion of Black Hammock Island — will handle sediments dredged from the AIWW Duval County Reach III. This site, along with DMMA DU-3&4 (**Section 4.2**), is one of two DMMA sites located on Black Hammock Island that will serve this reach. The FIND acquired the DMMA DU-2 site in 1990 and USACE completed the DMMA construction in 1995.

4.1.1 Preliminary Design

Engineering/Operational. The preliminary engineering design (Taylor and McFetridge, 1988) provided a design capacity of 394,972 cy. This capacity, in combination with the anticipated capacity of the unconstructed DMMA DU-3&4 site (1,342,310 cy) was adequate for the projected Reach III disposal requirement of 1,553,852 cy (as projected in 1986) and remains adequate for the 2014 updated requirement of 1,720,575 cy (**Table 3.4**). The original management strategy for DMMA DU-2 remains valid today (with construction of DMMA DU-3&4). DMMA DU-2 is designated to strictly handle the material from the artificial Sawpit Cut-off (Cut 27) while DMMA DU-3&4 will handle the material from the remaining cuts. While this strategy offers the operational advantage of minimizing pumping distance, it carries the disadvantage of requiring movement of the supply pipeline between two DMMAs during each maintenance event. Moreover, this apportionment will result in a more rapid of filling of the DMMA DU-2 site because the Sawpit Cut-off cut is projected to produce approximately 35% of the maintenance material from Reach III (i.e., Nassau Sound to Ft. George River), while DMMA DU-2 will hold only 21% of the combined volume of the two sites designed to serve this reach. Given the projected maintenance requirements, DMMA DU-2 will require offloading more frequently than once every 50 years. Given this known constraint, the FIND must identify marketing strategies for dredged material removal and re-use, outlined in **Section 5.3.3**, before the site reaches capacity if DMMA DU-2 is to continue in an operational capacity. With respect to other engineering/operational issues of pumping distance and road and pipeline access issues, the DMMA DU-2 site at AIWW Mile 17.0 lies in the northern one-third of the 6.21-mile reach (from AIWW Mile 15.65 to Mile 21.84). Thus, the maximum pumping distance expected (from the southern end

of the reach) is approximately 5 miles. With the DMMA located between Sawpit Road and the AIWW, road and pipeline access is considered a non-issue and no other access easements are required.

Environmental. Prior to site construction in 1995, the vegetated site included pine flatwoods, palmetto prairie, mixed oak/pine, maritime hammock, and wetland communities. Salient on-site features included an area of salt marsh that extended into the east buffer from the AIWW/Sawpit Creek marsh system. Two other wetland communities — a maritime hammock wetland located in the southwest corner of the site and a mixed wetland hardwood area lying along the eastern site boundary — were also located within the buffer area. Taylor Engineering identified one other isolated wetland feature within the DMMA footprint; however, the overall impact fell below the St. Johns River Water Management District jurisdictional threshold.

Socioeconomic/Cultural. The containment basin's placement within the site had to allow adequate separation from adjacent properties. The capacity requirement, outlined above, allowed placement of DMMA DU-2 within the central 22.76 acres of the site, leaving buffer areas of undisturbed vegetation 300 ft in width to the north, west, and south. An additional irregular buffer area, varying 80 – 120 ft wide, separates the containment area from the AIWW to the east. The State Historic Preservation Officer (SHPO), via a December 7, 1992 letter, concurred with the USACE determination that the DMMA would not affect cultural resources and stated that no further cultural resource investigation was necessary.

4.1.2 Easements and Permits

At the time of construction, the DER did not require a WQC for the upland DMMA. Between 1996 and 2006, facility operation occurred under the authorization of FDEP Permit No. 16, 45-2464629 for ICWW dredging. Subsequently, FDEP determined that future Waterway maintenance operations involving use of the site are exempt from state permitting.

4.1.3 Final Design and Construction

Carrying forward the preliminary design and permitting features that inherently include the original engineering/operational, environmental, and socioeconomic/cultural criteria, USACE designed and constructed the site. Therefore, to the extent known, the following sections detail the earthwork and weir design features of the constructed DMMA DU-2 facility.

4.1.3.1 Earthwork

Considering the subsurface conditions and the maximum basin footprint, the final dike specifications included a minimum crest elevation of 24.0 ft NGVD, or 15.0 ft above the existing mean site elevation of 9.0 ft NGVD, a dike crest width of 12 ft, 3H:1V side slopes, and a bottom basin elevation of 2.4 ft NGVD. Excavating the basin interior to a mean elevation of 2.4 ft NGVD — 9.6 ft below the existing mean grade elevation of the basin footprint — provided the material necessary for dike and ramp construction. With the containment basin filled to capacity, the surface of the deposition layer will lie a minimum 4 ft below the dike crest, allowing a minimum 2 ft of freeboard and 2 ft of ponding. A perimeter ditch, of varying depth and width, was designed to collect and treat stormwater runoff from the north, south,

and west site portions. The containment dike also includes a ramp providing ingress and egress to and from the interior of the containment area. The outside slope of the ramp and the slope of the supporting toe maintain the same 3H:1V slope as the main dike. The ascending/descending grade is 20H:1V. These ramps allow removal of the dewatered dredged material from the DMMA without disturbing the overall structural integrity of the system. A stabilized access road, extending in a northeast direction from Sawpit Road, provides direct access to the dike ramp.

4.1.3.2 Weir

The efficiency of solids retention and quality of effluent released from the DMMA DU-2 are strongly influenced by several aspects of weir design. These include weir type, weir crest length, and the location of the weirs within the containment area. The type of weir structure employed at the DMMA DU-2 site, as with all the DMMAs, represents a compromise between considerations of performance, adjustability, maintenance, and economy. The installed structure comprises four 9-ft diameter corrugated metal half-pipe risers, each with a sharp-crested, 9-ft length weir section. Each of the four risers connects via a 36-in diameter pipe to a common 42-in manifold such that the effluent exits the containment area via a single pipe under the dike at the site's northeast corner. Collectively, the four risers provide for the release of effluent over a 36-ft length, sharp-crested weir. The weir crest elevation is adjustable by means of removable boards up to an elevation of 13.0 ft NGVD (2 ft below the top of dike crest). The timber boards, 6-in. by 6-in. stock, provide the ability to control the ponding depth and thus, the retention time, within the containment basin.

The specification of a minimum weir crest length of 36 ft is based on USACE guidelines related to the dredging equipment. Weir crest length, and all project calculations, assume use of a 24-in. O.D. dredge (discharge velocity of 16 ft/sec, volumetric discharge of 6,430 cy/hr, and a 20/80 solids/liquid slurry mix) for future channel maintenance. However, the physical constraints of the channel will most likely dictate the use of a 16 – 18-in. O.D. dredge. Therefore, the assumption of a 24-in. dredge ensured a conservative disposal site design. Analysis of weir performance based on nomograms developed at the USACE Waterways Experiment Station (WES) under the Dredged Material Research Program (DMRP) (Walski and Schroeder, 1978), indicated that the weir design parameters described above will produce an effluent suspended sediment concentration of 0.63 g/L, assuming an average ponding depth of 2 ft. Relating suspended solids concentration to the State of Florida turbidity-based effluent water quality standard is problematic because turbidity depends highly on the physical characteristics and concentration of the suspended material. However, WES guidelines (Palermo, 1978) indicate that 0.63 g/L should result in turbidity values well below the Florida standard.

The final weir design parameter considered was the location of the weirs within the DMMA to maximize the distance from the dredge pipe inlet and minimize the return distance to the AIWW. The latter requirement allows the effluent to discharge from the containment area by gravity flow. As designed, distance between the weir and the inlet provides for a maximum ±1,200-ft separation. Given the previously collected boring logs and suspended sediment settling time curves, the containment area provides adequate retention time to allow the sediment to settle out of the average minimum ponding depth of 2 ft (8.59 hours maximum retention time vs. 1.72 hours required settling time multiplied by a safety factor of 3, or 5.51 hours). This indicates that a basin efficiency of 60% is required to provide adequate retention time, greater

than the reported mean efficiency of similar containment basins (44%), but well within the reported range of basin efficiencies under similar conditions (Shields, Thackston and Schroeder, 1987). The WES-DRMP guidelines also indicated that for the minimum design weir loading (i.e., liquid discharge/weir crest length) of 1.07 cfs/ft, the withdrawal depths range from 0.67 ft based on empirical results to 2.11 ft based on the WES Selective Withdrawal Model.

The primary goal of the upland DMMA is to provide sufficient capacity to receive, dewater, and temporarily store sediments dredged from an adjacent reach; **Table 4.1** provides a quantitative summary of the design and current storage capacity. This table also provides a summary of the location, reach, and DMMA features along with a narrative of unique site features. **Figure 4.1** and **Figure 4.2** provide an as-built plan and cross-sectional detail, including the site security features, of the DMMA DU-2 facility.

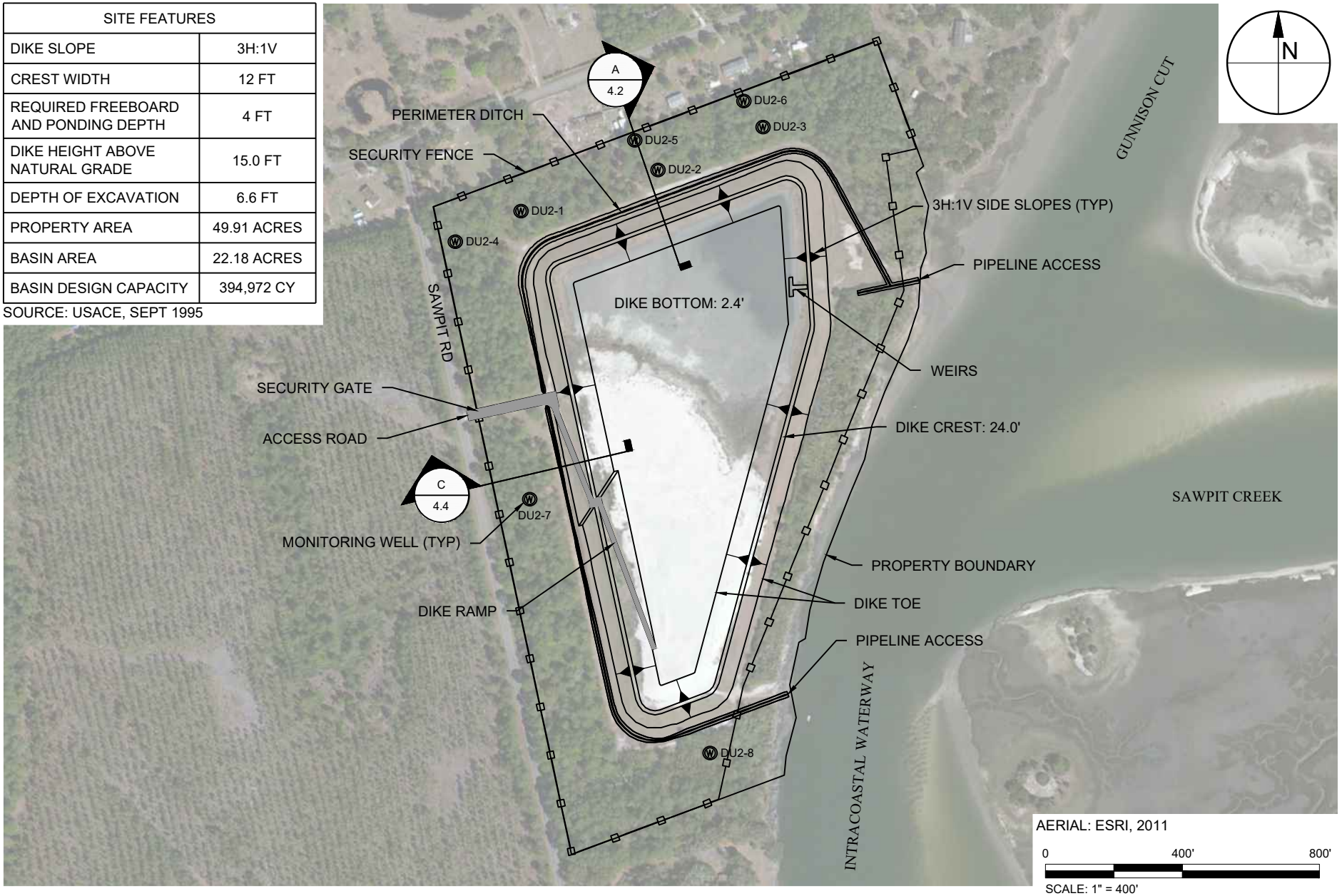
Table 4.1 DMMA DU-2 Site Data Summary Sheet

LOCATION			
Also Known As	**NE Black Hammock Island**		
Section/Township/Range	**15/1N/28E**	East/West of Waterway	**West**
County	**Duval**	Municipality	**Jacksonville**
REACH			
Designation	**III**	Projected Dredging Frequency	**5 - 10 Years**
Length (mi)	**6.21**	50-Year Dredging Requirement (cy)	**800,267**
Mileage	**15.65 – 21.84**	50-Year Storage Requirement (cy)	**1,720,575**
Cut/Station	**Cut 27C / 0+00 to 11 / 23+64.03**		
Geographic	**Nassau Sound at Sawpit Cut-off to Fort George River**		
DREDGED MATERIAL MANAGEMENT AREA			
Property Area (ac)	**49.91**	Design Basin Capacity (cy)	**394,972**
Basin Area (ac)	**22.76**	Available Basin Capacity (cy)	**Limited**
Buffer Width (ft)	**N = 300**	Dike Slope	**3H:1V**
	S = 300	Crest Width (ft)	**12**
	E = 80 – 120	Natural Grade Elevation (ft NGVD)	**9**
	W = 300	Depth of Excavation (ft)	**6.6**
Waterway Mileage	**17.0**	Dike Height Above Natural Grade (ft)	**15**
Max. Pumping Distance (mi)	**±5**	Required Ponding & Freeboard (ft)	**4**
Distance from Waterway (ft)	**Adjacent**	Type of Weir System	**4-Corrugated Metal Half-Pipes**
Impacted Wetlands (ac)	**NA[1]**	Weir Crest Length (ft)	**36**
Mitigation	**NA**	Entity and Year Constructed	**USACE 1995**
Regulatory Permits	**Construction: Not Required**		
	Operation: 16-452464629, expired		
ACCESS			
Public Access	**Sawpit Rd**	Pipeline Easement	**Not Required**
Road Easement	**Not Required**	Deep Draft Access	**Yes**
NARRATIVE			
The FIND acquired DMMA DU-2 in 1990 and the USACE constructed the site in 1993. Based on documentation from the USACE, the DER did not require a WQC for construction of the upland DMMA. Between 1996 and 2006, facility operation occurred under the authorization of FDEP Permit No. 16, 45-2464629; however, future operations (involving use of the site) were determined exempt by FDEP from further permitting requirements. Engineering/operational issues include, but are not limited to: (1) increased offloading frequency and subsequent need to offload site and restore site capacity for future maintenance operations and (2) ongoing site security issues and related maintenance (e.g., fence, erosion) repairs and debris/trash removal.			

[1]Not applicable

SITE FEATURES	
DIKE SLOPE	3H:1V
CREST WIDTH	12 FT
REQUIRED FREEBOARD AND PONDING DEPTH	4 FT
DIKE HEIGHT ABOVE NATURAL GRADE	15.0 FT
DEPTH OF EXCAVATION	6.6 FT
PROPERTY AREA	49.91 ACRES
BASIN AREA	22.18 ACRES
BASIN DESIGN CAPACITY	394,972 CY

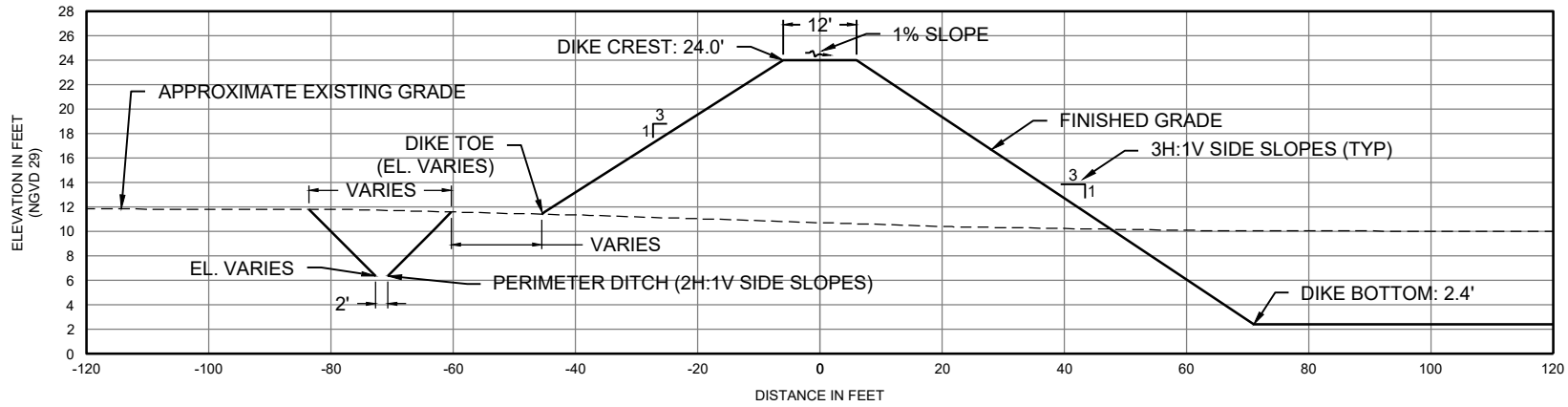
SOURCE: USACE, SEPT 1995



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

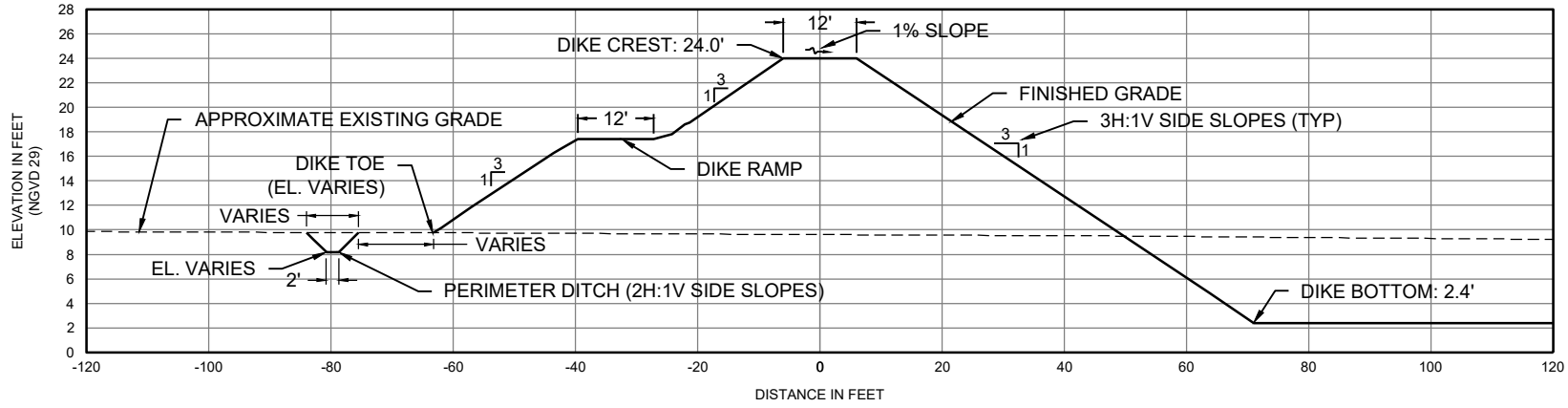
FIGURE 4.1
DMMA DU-2 PLAN VIEW
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	6 of 17
DATE	JULY 2016



A 4.1 DU-2 CROSS-SECTION A

SCALE: 1" = 30' 0 30'



B 4.1 DU-2 CROSS-SECTION B

SCALE: 1" = 30' 0 30'

TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 4.2
DMMA DU-2 SECTION VIEW
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	7 of 17
DATE	JULY 2016

4.2 DMMA DU-3&4

DMMA DU-3&4 — located west of the AIWW and lying within the central portion of Black Hammock Island — will handle sediments dredged from the AIWW Duval County Reach III. This site, along with DMMA DU-2 (**Section 4.1**), is one of two DMMA sites located on Black Hammock Island that will serve this reach. Numerous conservation lands are located in the immediate vicinity of the site including Nassau River-St. Johns River Marshes State Aquatic Preserve, Timucuan National Ecological and Historic Preserve, Pumpkin Hill Creek State Buffer Preserve, and the City of Jacksonville's Cedar Point Park. While the FIND has yet to construct the site, the following paragraphs detail its history, specifically related to acquisition, previous site use, and future development plans.

The 122.66-acre site comprises three separate parcels. The FIND obtained the northernmost 56.14-acre parcel in anticipation of the 1982 maintenance of adjacent segments of the AIWW. Formerly designated as MSA 300E, this parcel is divided into eastern and western sections by Sawpit Road. The 38.36-acre western section was used for construction of a diked containment basin that received the greater portion of the 489,000 cy of dredged material produced by the 1982 Reach III channel maintenance operations. Of this material, approximately 356,000 cy presently remains stored within the basin. As constructed, the containment basin encompasses essentially the entire western section of MSA 300E and, with the exception of the right-of-way along Sawpit Road, provides little or no separation between the containment dike and adjacent properties. For the 1982 maintenance operation, MSA 300E's 19.68-acre eastern section provided the supply and return water pipeline route to the parcel's mean high water (MHW) line.

The second parcel, a 4.60-acre, 60-ft wide drainage easement, adjoins the southern edge of the original MSA 300E western parcel and extends from Sawpit Road westward 1,980 ft to the apparent MHW shoreline of the Pumpkin Hill Creek saltmarsh, then continues westward an additional 1,357 ft to the approximate location of Pumpkin Hill Creek's main channel. The FIND acquired this easement to alleviate drainage problems associated with construction and operation of the MSA 300E containment basin to the north.

The third parcel, designated DU-3&4, also adjoins MSA 300E's southern boundary and overlaps 2.74 acres of the drainage easement. Sawpit Road forms the parcel's eastern boundary, with the apparent MHW shoreline of the saltwater marsh system associated with Pumpkin Hill Creek forming its western boundary. A commercial landscaping and nursery operation lies immediately to the south. First identified and evaluated with respect to other candidate sites in the development of a long-range DMMP for the AIWW in northeast Florida (Taylor and McFetridge, 1986), the 60.03-acre parcel was subsequently acquired by the FIND in 1988 for the construction of an independent containment facility, separate from the preexisting MSA 300E basin. A site-specific management plan (Taylor and McFetridge, 1988a) and other supporting documents describe the preliminary design for the parcel's independent containment facility.

Based on discovery of an archaeological site (further discussed in **Section 4.2.1**) in the southwest corner of the DU-3&4 parcel, the SHPO recommended redesign of the site to avoid cultural resources impacts. Site redesign would, however, inevitably result in a smaller containment facility on DU-3&4.

Combining MSA 300E and DU3&4 parcels would allow construction of a single containment facility across the two sites to realize greater operational efficiency and storage capacity than retaining the existing MSA 300E basin and constructing an independent facility within the remaining available area of the DU-3&4 parcel. Thus, the remainder of this section documents the preliminary design efforts for a future single containment facility (designated DMMA DU-3&4) across the two properties.

4.2.1 Preliminary Design

Engineering/Operational. The preliminary engineering design, completed in 2002, provided a design capacity of 1,342,310 cy. This capacity, in combination with the design capacity of the DMMA DU-2 site (394,372 cy), was adequate for the projected Reach III disposal requirement of 1,553,852 cy (as projected in 1988) and remains adequate for the updated requirement of 1,720,575 cy (**Table 3.4**). **Section 4.1.1** details the management strategy for this reach, with regard to the projected division of storage requirements between DMMA DU-3&4 and DMMA DU-2. However, given the negligible remaining storage capacity of DMMA DU-2, no useable capacity at DU-3&4, and a current shoal volume of 38,102 cy (**Table 3.2**), the FIND should construct DMMA DU-3&4 site in the near future to relieve capacity issues in Reach III. With respect to other engineering/operational issues of pumping distance and road and pipeline access issues, the DMMA DU-3&4 site at AIWW Mile 19.5 lies in the southern one-third of the 6.21-mile reach (from AIWW Mile 15.65 to Mile 21.84). Including the 0.65-mile (3,400 ft) distance from the Waterway, the maximum pumping distance expected (from the northern end of the reach) is approximately 5 miles. Due to the site's position — segmented by Sawpit Road and lying adjacent to the AIWW — and existing easements, road and pipeline access is considered a non-issue and no other access easements are required.

To achieve the desired capacity, the preliminary design included a minimum dike crest elevation of 31.85 ft NGVD, or 18.85 ft above the existing mean site elevation of 13.0 ft NGVD, a dike crest width of 12 ft, 3H:1V side slopes, and a bottom basin elevation of 6.95 ft NGVD. Excavating the basin interior to a mean elevation of 6.95 ft NGVD — 6.0 ft below the existing mean grade elevation of the basin footprint — will provide the material necessary for dike and ramp construction. With the containment basin filled to capacity, the surface of the deposition layer will lie a minimum 4 ft below the dike crest, allowing a minimum 2 ft of freeboard and 2 ft of ponding. A 20-ft wide stabilized road, positioned between the exterior dike toe and a perimeter ditch designed to collect and treat stormwater runoff, will provide access to the DMMA's perimeter features. A 20H:1V dike ramp, providing ingress and egress to and from the interior of the DMMA, will allow removal of the dewatered dredged material from the DMMA without disturbing the overall structural integrity of the system. A stabilized access road, extending from Sawpit Road, will provide direct access to the dike ramp.

The preliminary design also included a weir structure comprising four corrugated metal half-pipes, each with a 9-ft weir section, to release the clarified effluent from the containment basin. While the corrugated weir structure has mostly been replaced with a steel box-type weir in recently constructed DMMAs, the overall weir design parameters will likely remain consistent in the development of the final design of the site. The location of the weir in the site's northeast corner and directly west of the proposed pipeline route provides a 2,500-ft separation between the opposite side of the basin and likely location of the dredge pipe inlet. Removable 5.5-in. by 5.5-in. (finished dimension) flashboards will provide the 36-ft

total crest length and allow adjustment of weir height over a 25.40 ft range — from the excavated grade at the weirs (4.45 ft NGVD) to a maximum elevation of 29.85 ft NGVD. When moving to the DMMA DU-3&4 final design and construction phase, the designer should review the weir design considerations discussed by Taylor and McFetridge (2009a).

Environmental. While meeting minimum engineering/operational requirements, the basin's preliminary design configuration also minimized the environmental impacts. An environmental site documentation report (Water & Air Research, 2002) documented the vegetation and wildlife conditions within the property footprint (west of Sawpit Road) and pipeline easement (east of Sawpit Road). Although the report and associated wetland boundaries are outdated, freshwater wetland communities (resulting in an approximate impact of 8.41 acres) were identified within the preliminary DMMA DU-3&4 footprint. Predominant vegetation types at the time of the 2002 survey included relatively undisturbed pine flatwoods, scrub, temperate hardwoods, digressional wetland communities and a dredged material containment basin with numerous successional vegetation communities. Nevertheless, given the time lapse since the 2002 report, the environmental resources survey will require updating before permitting, final design, and construction activities commence.

Socioeconomic/Cultural. The containment basin's placement within the site should provide adequate separation from adjacent properties. As currently planned, the containment basin configuration provides a separation between the dike's outside toe and adjacent properties that varies between 100 ft to more than 825 ft. On the basin's northern side where the site adjoins a rural residential lot, on its eastern side bordering Sawpit Road, and on its southern side where the site adjoins a commercial nursery, the containment dike's outside toe lies 150 ft inside the site boundaries. On the basin's western side, the containment basin sits back 100 ft along the western edge of parcel MSA 300E. While less than the FIND's 350-ft optimum, given that the existing MSA 300E basin provides essentially no buffer between adjacent properties, these expanded setbacks appear both reasonable and adequate. Within parcel DU-3&4, where the site's western boundaries extend to the MHW shoreline of the Pumpkin Hill Creek saltmarsh, the presence of the archeological site imposes a setback of up to 825 ft from the site's boundary. Together, these setbacks yield a basin footprint of 58.04 acres.

Finally, an archaeological site in the southwest corner of the DU-3&4 parcel led to the planned configuration of the DMMA DU-3&4 site. Earlier reconnaissance (Russo et al., 1992) had identified an archaeological site in parcel DU-3&4's western portion and led to its registration with the Florida Division of Historical Resources Master Site File as Site 8DU7495. A subsequent Phase II archaeological investigation (Ellis, 1995) performed under contract to the USACE, documented the site's character and extents. The investigation identified 20 discrete areas containing concentrations of cultural material within a 2.71-acre region. In April 2001, to ensure that the archaeologically significant area remains undisturbed, members of the Gulf Archaeology Research Institute flagged the archaeological site boundary. A registered land surveyor then surveyed the flagged boundaries. All site construction documents will incorporate this surveyed location with specific instruction that construction activities cannot disturb this area. To ensure that the selected contractor is fully aware of this requirement, an archeologist familiar with the DU-3&4 archeological resources should participate in the pre-construction conference. Periodic inspection and archeological monitoring of the site during construction will verify and document the contractor's compliance with this requirement.

4.2.2 Easements and Permits

To construct the permanent DMMA DU-3&4 site, the FIND must apply for a joint Environmental Resource Permit (ERP). Notably, in anticipation of site construction, the USACE issued a Public Notice (PN-CO-IWW-273) dated September 10, 2004. The public notice indicated disturbance of 7.86 acres of a "poorly drained area" within the remnant MSA 300E basin and 0.36-acre impact of an isolated wetland prairie. Due to lack of funding, a site permit was never acquired from FDEP for construction.

For operation of the facility, the planned supply and return pipeline routes will follow the established pipeline route last used in the 1982 AIWW maintenance operation. That is, the supply pipeline coming from the dredge will exit the AIWW then continue across the saltmarsh system associated with the AIWW until it reaches the portion of MSA 300E east of Sawpit Road. The pipeline will then cross the eastern section of MSA 300E, pass under Sawpit Road via culvert and continue along the site boundary to the basin's perimeter service road. The pipeline will then follow the road to the basin's southwestern corner and enter the basin by passing over the dike crest. The return water pipeline will attach to the weir-manifold system near the basin's northeastern corner and follow the perimeter service road and route described above to the AIWW shoreline. The return pipeline will extend beyond the AIWW shoreline a sufficient distance to minimize any possible adverse impacts from the discharge. As both the supply and return pipeline will cross approximately 3,500 ft of intertidal saltmarsh, the FIND's operational permit should address temporary impacts to these wetlands during the active dredging period.

Finally, as noted in **Section 4.2**, a 60-ft wide drainage easement extends from the DMMA DU-3&4 site boundary to the Pumpkin Hill Creek's main channel. The FIND originally acquired this easement to alleviate drainage problems associated with the construction and operation of the MSA 300E containment basin to the north.

4.2.3 Final Design and Construction

Though the site has not yet been through the final design process, the preliminary design features should largely remain consistent in the ultimate construction of the DMMA DU-3&4 facility. In 2004, MACTEC Engineering and Consulting, under contract to Taylor Engineering, completed an exploratory boring analysis that included collection of 8 Standard Penetration Test (SPT) borings drilled between 10 and 30 ft and 26 grain size distribution tests of the MSA 300E (remnant dredged material) site portion. In 2006, the USACE performed a limited geotechnical investigation that involved collection of eight SPT borings equally spaced around the planned DMMA DU-3&4 dike perimeter. Along with conducting a detailed seepage and slope stability analysis to ensure the minimum standards of safety are met or exceeded, these geotechnical reports should be thoroughly reviewed and incorporated into the final construction documents. Other outstanding items required for final design include

(1) Site Investigation: environmental resources survey (including identification of on-site gopher tortoises)
(2) Earthwork Design and Analysis: dike, ramps, perimeter road, and ditch
(3) Structural Design and Analysis: weir and timber deck structure
(4) Erosion Control: stormwater treatment and landscaping

Finally, construction of the DMMA DU-3&4 facility will occur in two phases. The first phase will include clearing and grubbing of vegetation remaining within the planned basin footprint (including the footprint of the existing MSA 300E basin) and installing groundwater monitoring wells. The second phase will include removing all existing MSA 300E dike structures (i.e., weir, outlet pipes) and deconstructing the existing MSA 300E dike system, constructing the redesigned containment basin, installing the basin's outlet structures, and handling and redistributing sediment from the 1982 AIWW maintenance operation presently stored within the MSA 300E containment basin. This second phase, subject to the scheduling and budgets of the FIND and USACE Jacksonville District, is currently not scheduled to commence within the next five years.

The primary goal of the upland DMMA is to provide sufficient capacity to receive, dewater, and temporarily store sediments dredged from an adjacent reach; **Table 4.2** provides a quantitative summary of the preliminary design facility along with a summary of the location, reach, and DMMA features along with a narrative of unique site features. **Figure 4.3** and **Figure 4.4** provide a conceptual design (as detailed above) plan and cross-sectional detail of the DMMA DU-3&4 facility.

Table 4.2 DMMA DU-3&4 Site Data Summary Sheet

LOCATION			
Also Known A	**MSA 300E: Central Black Hammock Island DU 3&4: West Central Black Hammock Island**		
Section/Township/Range	**26, 35/1N/28E**	East/West of Waterway	**West**
County	**Duval**	Municipality	**Jacksonville**
REACH			
Designation	**III**	Projected Dredging Frequency	**5 - 10 Years**
Length (mi)	**6.21**	50-Year Dredging Requirement (cy)	**800,267**
Mileage	**15.65 – 21.84**	50-Year Storage Requirement (cy)	**1,720,575**
Cut/Station	**Cut 27C / 0+00 to 11 / 23+64.03**		
Geographic	**Nassau Sound to Sawpit Cut-off to Fort George River**		
DREDGED MATERIAL MANAGEMENT AREA			
Property Area (ac)	**122.66**	Design Basin Capacity (cy)	**1,342,310**
Basin Area (ac)	**58.04**	Available Basin Capacity (cy)	**0**
Buffer Width (ft))	**N = 150**	Dike Slope	**3H:1V**
	S = 150	Crest Width (ft)	**12**
	E = 150	Natural Grade Elevation (ft NGVD)	**13**
	W = 100 – 825	Depth of Excavation (ft)	**6.0**
AIWW Mileage	**19.5**	Dike Height Above Natural Grade (ft)	**18.85**
Max. Pumping Distance (mi)	**±5**	Required Ponding & Freeboard (ft)	**4**
Distance from Waterway (ft)	**3,400**	Type of Weir System	**TBD**
Impacted Wetlands (ac)	**TBD**[1]	Weir Crest Length (ft)	**36**
Mitigation	**TBD**	Entity and Year Constructed	**Not constructed**
Regulatory Permits	**Construction: FIND to acquire**		
	Operation: FIND to acquire		
ACCESS			
Public Access	**Sawpit Rd**	Pipeline Easement	**NA**
Road Easement	**Not Required**	Deep Draft Access	**No**
NARRATIVE			
In 1988, the FIND acquired the last of three parcels that compose the DMMA DU-3&4 site. While the site remains unconstructed, preliminary design activities were completed in 2002 and USACE issued a public notice for planned site construction in 2004. FIND has not yet applied for permits to construct and operate the site. Engineering/operational issues include, but are not limited to: (1) archeological Site 8DU7495 lies in the site's southwest corner and (2) removal of remnant MSA 300E earthen dike, 1982 maintenance material (approximately 356,000 cy), and structural components (weir, outlet pipes) are required.			

[1]To be determined

SITE FEATURES	
DIKE SLOPE	3H:1V
CREST WIDTH	12 FT
REQUIRED FREEBOARD AND PONDING DEPTH	4 FT
DIKE HEIGHT ABOVE NATURAL GRADE	18.85 FT
DEPTH OF EXCAVATION	6.0 FT
PROPERTY AREA	122.66 AC
BASIN AREA	58.04 AC
BASIN CAPACITY	1,342,310 CY

SOURCE: CONCEPTUAL DESIGN BASED ON MARCH 2002 MANAGEMENT PLAN. SITE IS NOT CONSTRUCTED.

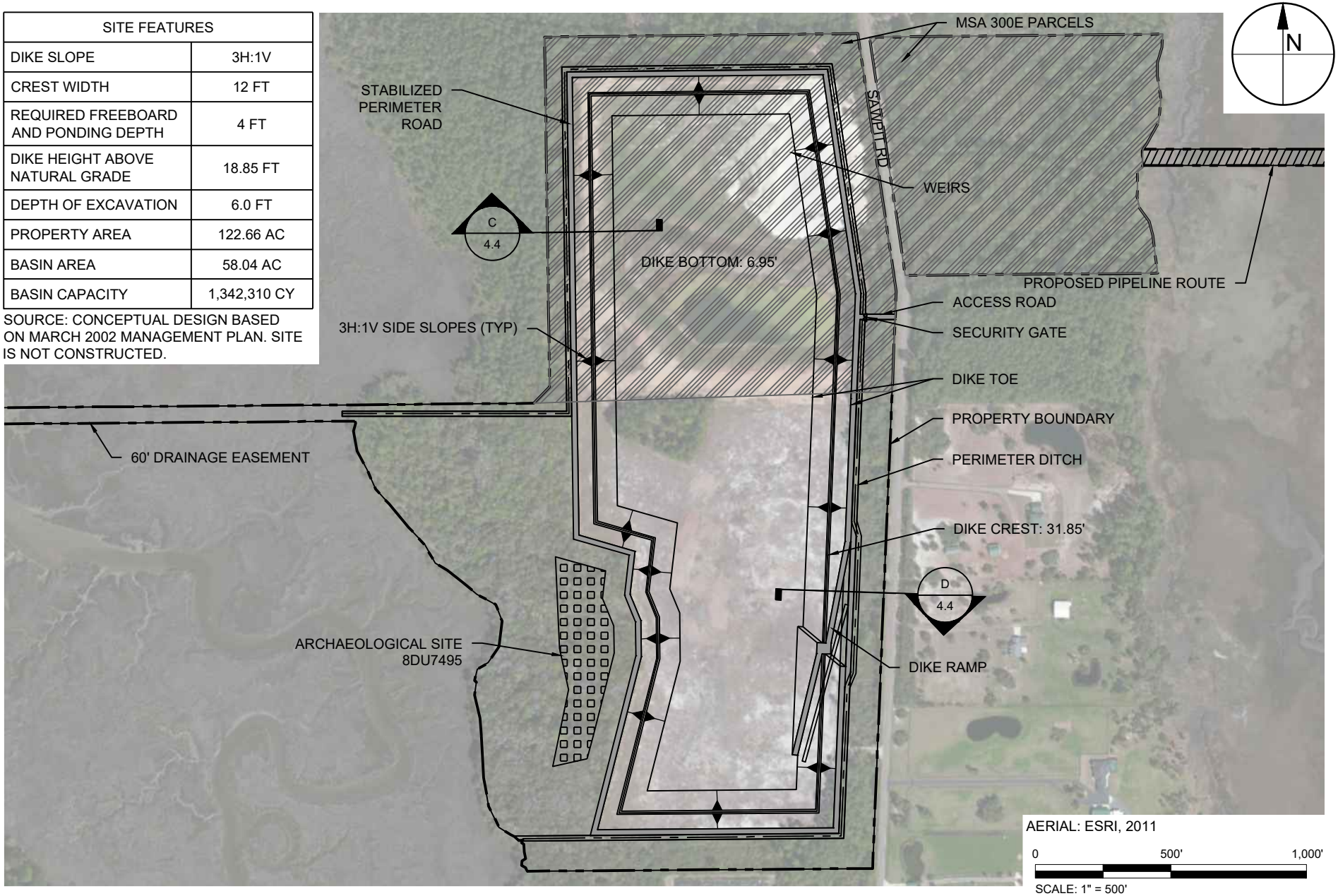


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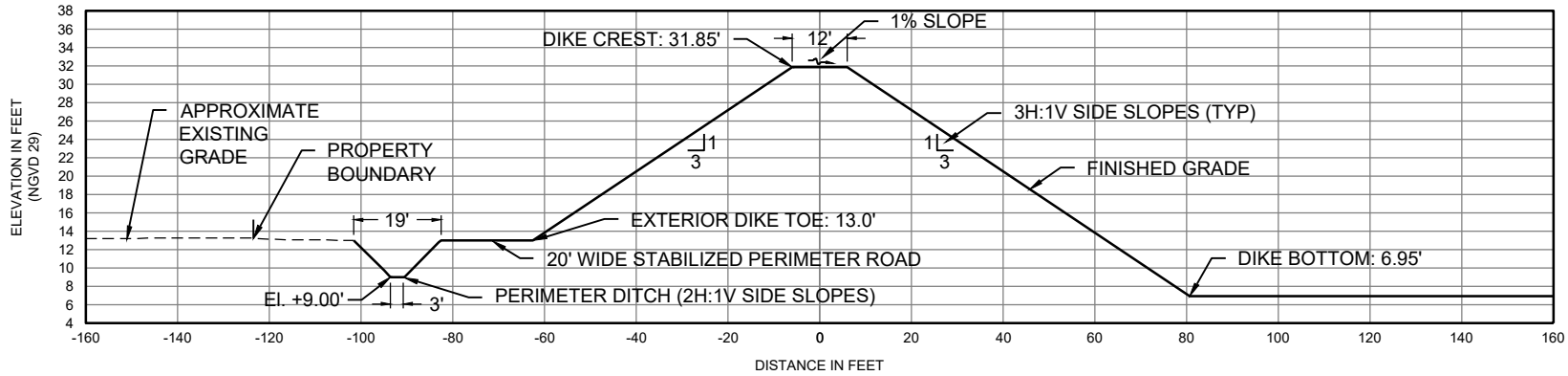
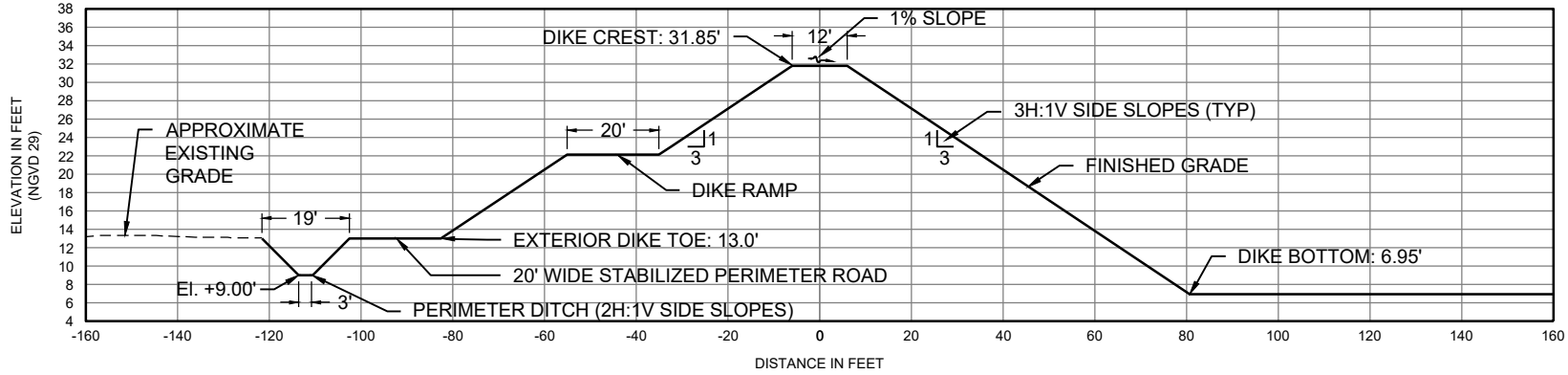
FIGURE 4.3
DMMA DU-3&4 PLAN VIEW
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	8 of 17
DATE	JULY 2016



C 4.3 DU-3 CROSS-SECTION C

SCALE: 1" = 40' 0 40'



D 4.3 DU-3 CROSS-SECTION D

SCALE: 1" = 40' 0 40'

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FIGURE 4.4
DMMA DU-3&4 SECTION VIEW
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
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DATE	JULY 2016

4.3 DMMA DU-6A & 6B

The 82.15-acre DMMA DU-6A & 6B property — located 0.6-mile east of the confluence of the AIWW (Sisters Creek) with the St. Johns River, 400 ft north of the river's northern shoreline, and immediately north of the right-of-way for Heckscher Drive (S.R. 105) — will handle sediments dredged from the AIWW Duval County Reach IV. The FIND acquired the eastern 71.54-acre property (DU-6A), also known as "Fanning Island," in 1989. After completing the necessary environmental documentation and providing a Finding of No Significant Impact (FONSI) dated July 15, 1991, the USACE constructed the existing DMMA in 1993. To date, the FIND has not acquired an operational permit necessary to receive and dewater dredged sediment at DMMA DU-6A. As discussed below, the FIND acquired the 10.91-acre DU-6B property in 2006. The following paragraphs detail the site history and future development plans.

As noted in **Table 2.1**, the Duval County Phase I DMMP report designated a second site (MSA 400E) within Reach IV to serve a specialized supplementary function in support of DMMA DU-6A's primary role. MSA 400E (also designated DU-19) was a 16.4-acre FIND-held easement located north of Heckscher Drive, immediately east of Sisters Creek. The Phase I report (Taylor et. al., 1988), as well as subsequent documentation, identified this site's role as receiving and dewatering relatively small volumes of dredged material that for reasons of its physical or chemical characteristics (e.g., excessive silt or clay content, elevated concentrations of contaminants) may not be appropriate for placement in DMMA DU-6A. With this strategy, the uncontaminated predominantly sand material dredged from Reach IV and placed in the DMMA DU-6A site will remain more suitable for offloading and beneficial reuse without further separation or processing.

Because DMMA DU-6A was constructed to provide the full projected storage requirement for Reach IV, in 1999, Atlantic Marine (under the name Atlantic Drydock) purchased DU-19 from its former owners, the North Shore Corporation, and constructed an employee parking lot on the site's uplands. To ensure its continued use of the DU-19 property, Atlantic Marine approached the FIND with the offer of an equivalent upland acreage adjacent to the FIND's DMMA DU-6A for the release of the easement on DU-19. Given that the site exchange appeared to be to the FIND's advantage, the exchange took place in 2006 and the FIND acquired the 10.91-acre property and designated it DU-6B. This smaller site, when constructed, will serve the function originally intended for DU-19. Collectively, the combined DU-6A and DU-6B parcels are now known as DMMA DU-6A & 6B.

4.3.1 Preliminary Design

DMMA DU-6A & 6B is intended to have two separate containment basins; the preliminary design for each, as well as the resulting combined 50-year material storage capacities, is detailed below. As designed, the planned construction of the DMMA DU-6B site extends into the western buffer area of the adjacent DU-6A site, but retains a minimum 100-ft separation necessary to preserve the perimeter ditch and road system that surrounds the existing containment facility. This layout allows independent use of the two containment basins with Site DU-6B receiving only that material that may require specialized dewatering and material handling techniques. If pre-dredging sediment testing determines that the material does not require special handling, the DU-6A facility will likely receive all material, with DU-6B receiving such material only if the DU-6A basin is filled to capacity.

Engineering/Operational. The preliminary engineering design for DMMA DU-6A, completed in 1988, provided a design capacity of 730,219 cy. This capacity was adequate for the projected Reach IV disposal requirement of 713,677cy (as projected in 1988) and surpasses the updated requirement of 513,154 cy (**Table 3.4**). **Section 4.3.3** provides the final design details of this site. In contrast, the preliminary design for the DMMA DU-6B site, completed in 2005, provided for a design capacity of 109,450 cy. To achieve this capacity, the dike specifications included a crest of 20.3 NGVD, or 11.5 ft above the existing mean site elevation of 8.8 ft NGVD. The dike design, including side slopes of 3H:1V and a dike crest of 12 ft, will require approximately 48,000 cy of material for construction. Ramps to provide equipment access to the interior of the containment basin for material dewatering and transfer will require an additional 1,400 cy of material. Excavating the basin interior to a mean elevation of 1.6 ft NGVD — 7.2 ft below the existing mean grade elevation of the basin footprint — will provide material for dike and ramp construction. To ensure dike stability, excavation of the basin interior will maintain the 3H:1V side slope of the interior dike. With the containment basin filled to capacity, the surface of the deposition layer will lie a minimum 4 ft below the dike crest, comprising a minimum 2 ft of freeboard and 2 ft of ponding. Combined, DMMA DU-6B and DMMA DU-6A will have a total capacity of 839,669 cy, which provides more than sufficient capacity (roughly 50% above that required), of the projected 50-year storage requirement for Reach IV. This will allow the use of the individual containment areas, as detailed above, to continue as planned.

The DMMA DU-6B preliminary design also included a weir structure comprising three corrugated metal half-pipes, each with an 8-ft weir section, to release the clarified effluent from the containment basin. While the corrugated weir structure has mostly been replaced with a steel box-type weir in recently constructed DMMAs, the overall weir design parameters will likely remain consistent in the development of the final design of the site. The location of the weir in the site's southeast corner provides 500-ft separation between the opposite side of the basin and likely location of the dredge pipe inlet. Removable 5.5-in. by 5.5-in. (finished dimension) flashboards will provide the 24-ft total crest length and allow adjustment of weir height over a 17.2-ft range — from the excavated grade at the weirs (1.1 ft NGVD) to a maximum elevation of 18.3 ft NGVD. When preparing the final design, the designer should review the weir design considerations discussed by Taylor and McFetridge (2005).

With respect to other engineering/operational issues of pumping distance and road and pipeline access issues, the DMMA DU-6A & 6-B site at AIWW Mile 26.0 lies at the southern end of the 4.23-mile reach (from AIWW Mile 21.84 to 26.14). Including the 0.66-mile (3,500-ft) distance from the Waterway, the maximum pumping distance expected (from the northern end of the reach) is approximately 4.5 miles. Due to the site location along the right-of-way of Heckscher Drive, road access is considered a non-issue. The supply and return pipeline routes and associated easements are discussed in further detail in **Section 4.3.2**.

Environmental. While meeting minimum engineering/operational requirements, the basin's configuration minimized the environmental liabilities and associated permitting constraints. As documented by previous environmental survey reports (Mosura, 1988; Environmental Sciences, 2001), the entire site comprises relic coastal habitat that has been extensively altered by human activities. Inspection of historical aerial photographs suggests that much, if not all, of this habitat was created by the unconfined placement of dredged material associated with the early construction of the JHP's approach channels. Thus,

construction of the remaining DU-6B containment basin will encounter few, if any environmental constraints.

Socioeconomic/Cultural. A primary consideration in determining the geometry (and associated buffers) as well as the configuration of the containment basins for the site was the presence of easements, detailed in the next section, dedicated to servicing the maintenance dredging and disposal requirements of the Jacksonville Port Authority (JPA). As such, the layout of both containment basins provides for a minimum 300-ft buffer to the east and south with reduced 100-ft buffers to the north and west. These reduced buffers will prevent encroachment onto the adjacent disposal easement of construction or operation activity related to DMMA DU-6A & 6B. Finally, previous inquiry to the Florida Division of Historical Resources, as well as a preliminary archeological survey of site DU-6B and its parent tract (SouthArc, 1998) confirms that the Florida Master Site File records showed no archeological sites near or within the boundaries of the DMMA DU-6A & 6B site. Furthermore, significant on-site historic or cultural resources appear unlikely, given the area's previous disturbance and history of dredged material placement.

4.3.2 Easements and Permits

Every effort was made to ensure that construction, operation, and management of the DMMA DU-6A & 6B facility do not unduly restrict the utilization of pre-existing disposal and pipeline easements designated to serve the JPA. The pre-existing disposal easement (MSA M-4, Tract No. 206E-2, USACE) adjoins the DMMA site to the north. The pipeline easement (designated PL-4A-3, USACE) dedicated to serving the needs of JPA extends southward from the disposal easement to the MWH shoreline of the St. Johns River to pass beneath Heckscher Drive through a culvert or sleeve via existing easements (Tracts 206E-8 and 206E-9). The site would require an additional easement to allow the return pipeline to continue south of the Heckscher Drive right-of-way to the MHW shoreline of the St. Johns River. The USACE DMMA DU-6A final design deviated from this plan by routing the effluent to the site's northeast corner via the perimeter ditch and releasing it to the adjacent salt marsh and tidal creeks. Due to the previous operational difficulties and permit violations brought about by this discharge strategy during Atlantic Marine's use of the facility in 1999, the present design for the DU-6B facility assumes that the FIND/USACE will route the effluent through a return pipeline as originally recommended.

As noted above, the USACE issued a FONSI in 1991. Based on this determination, the DER did not require a WQC for the upland DMMA DU-6A construction. To our knowledge, an operational permit for the site has not been acquired for DMMA DU-6A. To construct the permanent DMMA DU-6B site, the FIND must apply for a joint ERP.

4.3.3 Final Design and Construction

Because the ultimate intent for the site is to have two constructed containment basins, DMMA DU-6A and DMMA DU-6B, this section is divided to detail the as-built features of the DU-6A site and then those steps necessary to complete the design and construction of the DU-6B site.

4.3.3.1 DMMA DU-6A

Carrying forward the preliminary design and permitting features that inherently include the original engineering/operational, environmental, and socioeconomic/cultural criteria, USACE designed and constructed the site. Therefore, to the extent known, the following sections detail the earthwork and weir design features of the constructed DMMA DU-6A facility.

Earthwork

Considering the subsurface conditions and the maximum basin footprint, the final dike specifications included a minimum crest elevation of 29.0 ft NGVD, or 16.78 ft above the existing mean site elevation of 12.22 ft NGVD, a dike crest width of 12 ft, 3H:1V side slopes, and a bottom basin elevation of 6.5 ft NGVD. Excavating the basin interior to a mean elevation of 6.5 ft NGVD — 5.7 ft below the existing mean grade elevation of the basin footprint — provided the material necessary for dike and ramp construction. With the containment basin filled to capacity, the surface of the deposition layer will lie a minimum 4 ft below the dike crest, allowing a minimum 2 ft of freeboard and 2 ft of ponding. A perimeter ditch, of varying depth and width, was designed to collect and treat stormwater runoff from the containment basin perimeter. The containment dike also includes a ramp to provide ingress and egress to and from the interior of the containment area. The outside slope of the ramp and the slope of the supporting toe maintain the same 3H:1V slope as the main dike. The ascending/descending grade is 20H:1V. These ramps allow removal of the dewatered dredged material from the DMMA without disturbing the overall structural integrity of the system. A stabilized access road, extending in a north-northeast direction from Heckscher Drive, provides direct access to the dike ramp.

Weir

The type of weir structure employed at the DMMA DU-6A site represents a compromise between considerations of performance, adjustability, maintenance, and economy. The installed structure comprises four 9-ft diameter corrugated metal half-pipes, each with a sharp-crested, 9-ft length weir section. Each of the four risers connects via a 36-in diameter pipe to a common 42-in. manifold such that the effluent will exit the containment area via a single pipe under the dike at the site's southwest corner. Collectively, the four risers provide for the release of effluent over a 36-ft length, sharp-crested weir. The weir crest elevation is adjustable by means of removable boards up to an elevation of 27.0-ft NGVD (2 ft below the top of the dike crest). The timber boards, 6 in. by 6 in. stock, provide the ability to control the ponding depth and thus, the retention time, within the containment basin.

The specification of a minimum weir crest length of 36 ft is based on the USACE guidelines related to the dredging equipment. Weir crest length, and all project calculations, assume use of a 24-in O.D. dredge (discharge velocity of 16 ft/sec, volumetric discharge of 6,430 cy/hr, and a 20/80 solids/liquid slurry mix) for future channel maintenance. However, the physical constraints of the channel will most likely dictate the use of a 16 – 18-in O.D. dredge; therefore, the assumption of a 24-in. dredge ensured a conservative disposal site design. Analysis of weir performance based on nomograms developed at the USACE WES under the DMRP (Walski and Schroeder, 1978) indicated that the weir design parameters described above will produce an effluent suspended sediment concentration of 0.63 g/L, assuming an average ponding depth

of 2 ft. Relating suspended solids concentration to the State of Florida turbidity-based effluent water quality standard is problematic because turbidity depends highly on the physical characteristics and concentration of the suspended material. However, WES guidelines (Palermo, 1978) indicate that 0.63 g/L should result in turbidity values well below the Florida standard.

The final weir design parameter considered was the location of the weirs within the DMMA to maximize the distance from the dredge pipe inlet and minimize the return distance to the AIWW. The latter requirement allows the effluent to discharge from the containment area by gravity flow. As designed, distance between the weir and the inlet provides for a maximum ±1,450-ft separation. Given the previously collected boring logs and suspended sediment-settling time curves, the containment area provides adequate retention time to allow the sediment to settle out of the average minimum ponding depth of 2 ft (14.78 hours maximum retention time vs. 0.6 hours required settling time multiplied by a safety factor of 3, or 1.8 hours). This indicates that a basin efficiency of 12% is required to provide adequate retention time, less than the reported mean efficiency of similar containment basins (44%), but well within the reported range of basin efficiencies under similar conditions (Shields, Thackston and Schroeder, 1987). The WES-DRMP guidelines also indicated that for the minimum design weir loading (i.e., liquid discharge/weir crest length) of 1.07 cfs/ft, the withdrawal depth ranges from 0.67 ft based on empirical results to 2.11 ft based on the WES Selective Withdrawal Model.

4.3.2.2 DMMA DU-6B

Though the DMMA DU-6B site has not yet been through the final design process, the preliminary design features should largely remain consistent in the ultimate construction of the facility. Along with conducting a detailed seepage and slope stability analysis to ensure the minimum standards of safety are met or exceeded, the following outstanding items required for final design include

(1) Site Investigation: environmental resources survey (including identification of on-site gopher tortoises), geotechnical investigation, and topographic survey
(2) Earthwork Design and Analysis: dike, ramps, perimeter road, and ditch
(3) Structural Design and Analysis: weir and timber deck structure
(4) Erosion Control: stormwater treatment and landscaping

Construction of the DMMA DU-6B facility will occur in two phases. The first phase — to be completed as soon as practical — will include installing groundwater monitoring wells (such that they can be monitored along with the DU-6A site), clearing and grubbing all vegetation from within the planned basin footprint, constructing access roads, and installing security fencing around the site's perimeter. The second phase will include containment basin construction and related earthmoving operations and the installation of outlet structures (i.e., weir) and other design features. This second phase, subject to the scheduling and budgets of the FIND and USACE Jacksonville District, is currently not scheduled to commence within the next five years.

The primary goal of the upland DMMA is to provide sufficient capacity to receive, dewater, and temporarily store sediments dredged from an adjacent reach; **Table 4.3** provides a quantitative summary of the design and current storage capacity along with a summary of the location, reach, and DMMA features

along with a narrative of unique site features. In 1999, as previously mentioned in **Section 4.3.2**, the FIND allowed Atlantic Marine use of the site for dewatering of dredged sediment from its facility. We understand that the FIND required Atlantic Marine to remove the material from the containment basin after dewatering. This one-time event did increase chloride concentrations within some of the on-site groundwater monitoring wells; however, we understand that continued monitoring indicated dissipation of these elevated values. **Figure 4.5** and **Figure 4.6** provide an as-built plan and cross-sectional detail, including the site security features, of the DMMA DU-6A & 6B facility.

Table 4.3 DMMA DU-6A & 6B Site Data Summary Sheet

LOCATION			
Also Known As	**Fanning Island**		
Section/Township/Range	**25/1S/28E**	East/West of Waterway	**East**
County	**Duval**	Municipality	**Jacksonville**
REACH			
Designation	**IV**	Projected Dredging Frequency	**5 - 10 years**
Length (mi)	**4.23**	50-Year Dredging Requirement (cy)	**238,676**
Mileage	**21.84 – 26.14**	50-Year Storage Requirement (cy)	**513,154**
Cut/Station	**Cut 10 / 0+00 to 1 / 21+76.67**		
Geographic	**Fort George River to Jacksonville Harbor**		
DREDGED MATERIAL MANAGEMENT AREA[1]			
Property Area (ac)	**82.15**	Design Basin Capacity (cy)	**730,219 (109,450)**
Basin Area (ac)	**33.8 (9.6)**	Available Basin Capacity (cy)	**730,219**
Buffer Width (ft))	**N = 100**	Dike Slope	**3H:1V**
	S = 300	Crest Width (ft)	**12.0**
	E = 300	Natural Grade Elevation (ft)	**12.22 (8.8)**
	W = 100	Depth of Excavation (ft)	**5.7 (7.2)**
AIWW Mileage	**26.0**	Dike Height above Natural Grade (ft)	**16.78 (11.5)**
Max. Pumping Distance (mi)	**±4.5**	Required Ponding & Freeboard (ft)	**4**
Distance from Waterway (ft)	**3,500**	Type of Weir System	**Four corrugated metal half-pipes (Three corrugated metal half-pipes)**
Impacted Wetlands (ac)	**Unknown**	Weir Crest Length (ft)	**36 (24)**
Mitigation	**Unknown**	Entity and Year Constructed	**USACE 1993 (not constructed)**
Regulatory Permits	**Construction: Not required (FIND to acquire)**		
	Operation: FIND to acquire		
ACCESS			
Public Access	**Heckscher Drive**	Pipeline Easement	**Yes**
Road Easement	**Not required**	Deep Draft Access	**No**
NARRATIVE			
The FIND acquired DMMA DU-6A in 1989 and USACE constructed the site in 1993. The remaining site portion, DMMA DU-6B, was obtained by the FIND in 2006 through a parcel exchange for the MSA 400/DU-19 easement. This smaller containment basin, not yet constructed, will be used to handle material that may require special handling (i.e., fine grained or contaminated sediment). Engineering/operational issues include, but are not limited to: (1) easement needed to cross Heckscher Drive to the Waterway, and (2) overlapping USACE easement that is used by the JPA.			

[1]Where applicable, the table lists site parameters for both DU-6A and DU-6B. DU-6B parameters are given in parentheses.

SITE FEATURES		
	DU-6A	DU-6B
DIKE SLOPE	3H:1V	3H:1V
CREST WIDTH	12 FT	12 FT
REQUIRED FREEBOARD AND PONDING DEPTH	4 FT	4 FT
DIKE HEIGHT ABOVE NATURAL GRADE	16.78 FT	11.5 FT
DIKE BOTTOM ELEVATION	5.72 FT	1.6 FT
PROPERTY AREA	71.54 AC	10.61 AC
BASIN AREA	33.8 AC	9.6 AC
BASIN CAPACITY	730,219 CY	109,450 CY

SOURCE: DMMA DU-6A -- USACE, 1993
DMMA DU-6B -- CONCEPTUAL DESIGN BASED ON SEPTEMBER 2005 MANAGEMENT PLAN. SITE IS NOT CONSTRUCTED

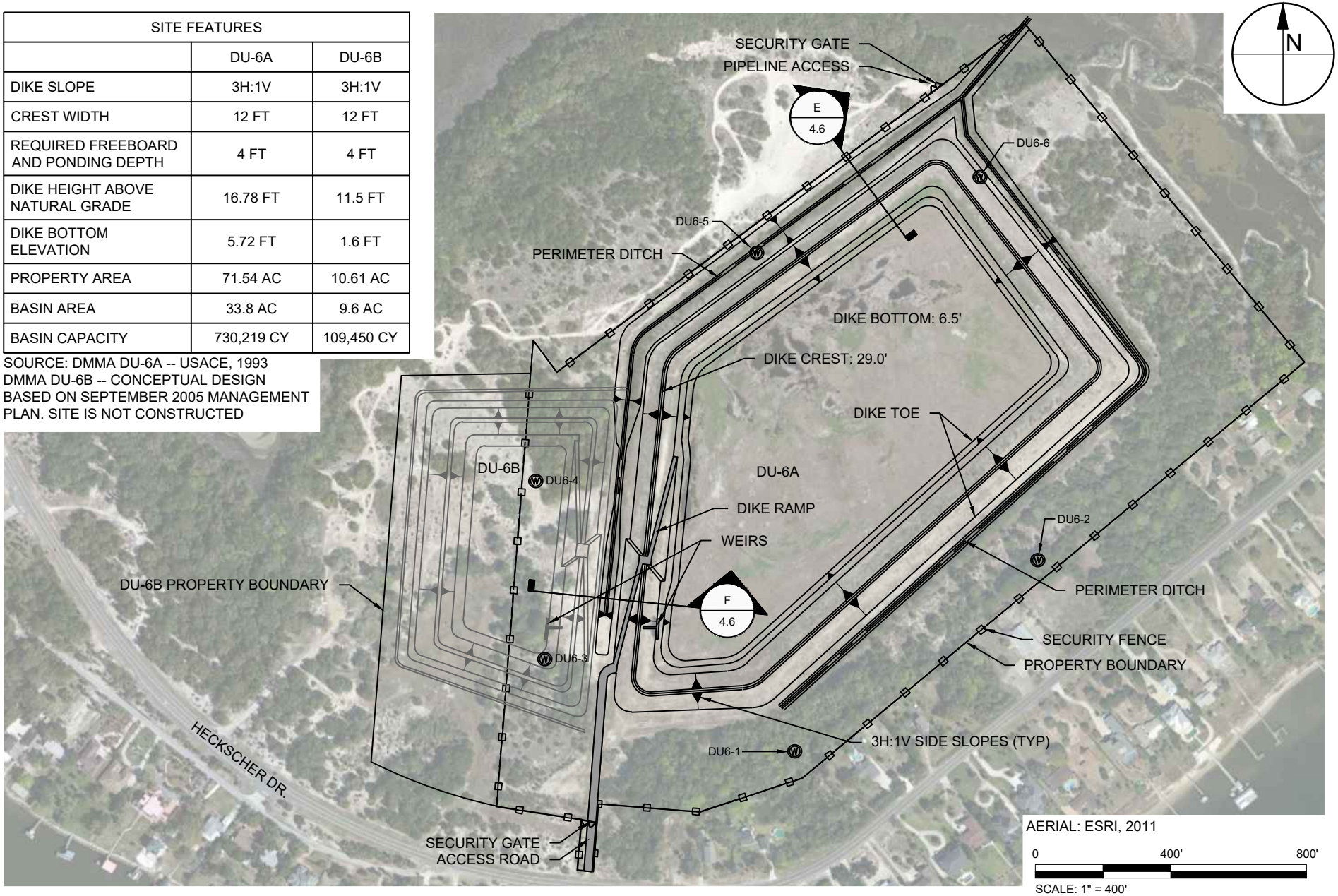

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FIGURE 4.5
DMMA DU-6A & 6B PLAN VIEW
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

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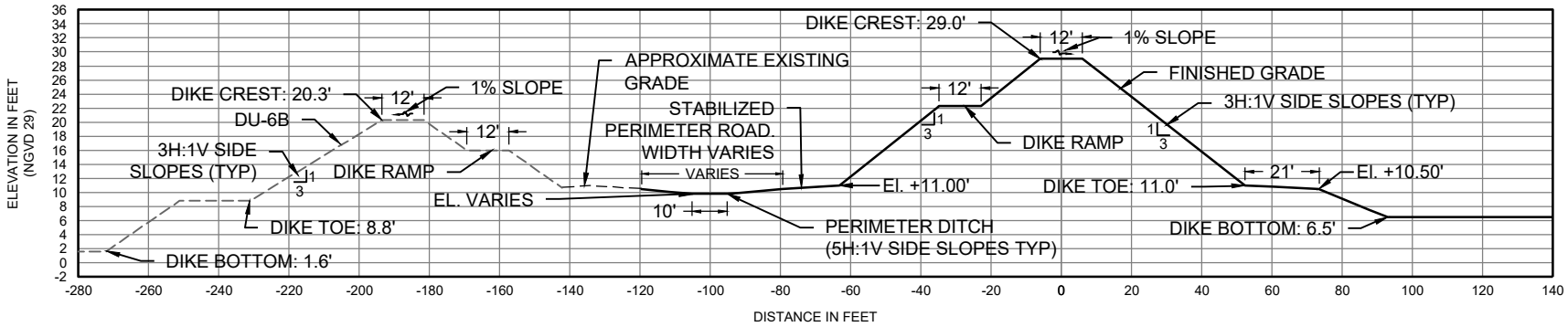
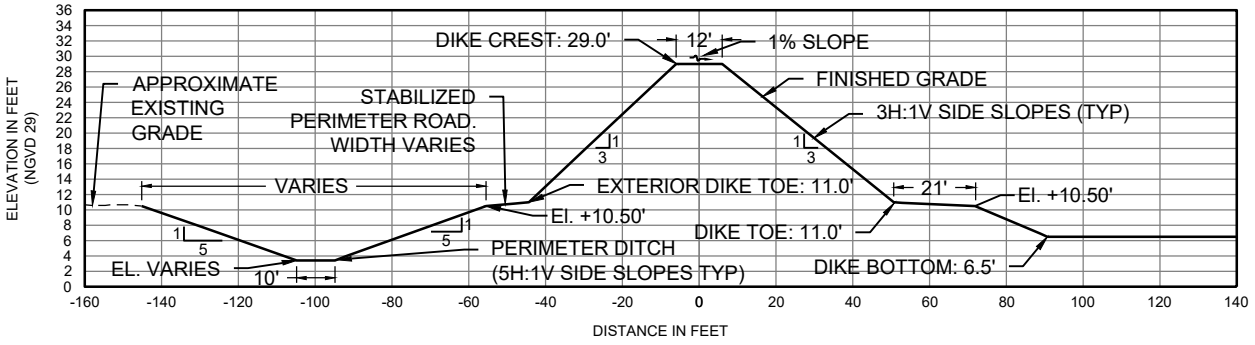
SHEET	10 of 17
DATE	JULY 2016



E 4.5 DU-6 CROSS-SECTION E

SCALE: 1" = 40' 0 40'



F 4.5 DU-6 CROSS-SECTION F

SCALE: 1" = 40' 0 40'

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FIGURE 4.6
DMMA DU-6A & 6B SECTION VIEW
ATLANTIC INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	11 of 17
DATE	JULY 2016

4.4 DMMA DU-7

The 32.0-acre DMMA DU-7 site — located west of the ICWW, north of Wonderwood Drive, and on the northeast portion of Greenfield Peninsula — will handle sediments dredged from the ICWW Duval County Reach V. Based on recommendations from the 1986 Phase I report, the FIND acquired the DMMA DU-7 site (formerly known as the "Bullard Property") in 1988 and cleared and grubbed the site in 2001. While the FIND has yet to construct the site, the following sections detail, to the extent possible, the site-specific preliminary design criteria, easements and permitting concerns, and outstanding final design and construction requirements.

4.4.1 Preliminary Design

Engineering/Operational. The preliminary engineering design, completed in 1999, provided a design capacity of 99,400 cy. This capacity was adequate for the projected Reach V disposal requirement of 92,450 cy (as projected in 1986) and surpasses the updated requirement of 82,076 cy (**Table 3.4**). With respect to other engineering/operational issues of pumping distance and road and pipeline access issues, DMMA DU-7 at ICWW Mile 1.9 lies in the central portion of the 3.93-mile reach (from ICWW Mile 0.00 – 3.93). Including the 0.05-mile (250 ft) distance to the Waterway, the maximum pumping distance expected is approximately 2 miles. Due to the site's position — bordered by Wonderwood Drive to the south and estuarine wetlands of the ICWW to the east — and existing easements, road and pipeline access is considered a non-issue and no other access easements are required.

To achieve the desired capacity, the preliminary design included a minimum dike crest elevation of 20.0 ft NGVD, or 11.0 ft above the existing mean site elevation of 9.0 ft NGVD, a dike crest width of 12 ft, 3H:1V side slopes, and a bottom basin elevation of 6.5 ft NGVD. Excavating the basin interior to this depth, roughly 2.5 ft below the existing mean grade elevation of the basin footprint, will provide the material necessary for dike and ramp construction. With the containment basin filled to capacity, the surface of the deposition layer will lie a minimum 4 ft below the dike crest, allowing a minimum 2 ft of freeboard and 2 ft of ponding. A 20-ft wide stabilized road, positioned between the exterior dike toe and a perimeter ditch designed to collect and treat stormwater runoff, will provide access to the DMMA's perimeter features. A 20H:1V dike ramp, providing ingress and egress to and from the interior of the DMMA, will allow the removal of the dewatered dredged material from the DMMA without disturbing the overall structural integrity of the system. A stabilized access road, extending from Wonderwood Drive, will provide direct access to the dike ramp.

The preliminary design also included a weir structure comprising three corrugated metal half-pipes, each with an 8-ft weir section, to release the clarified effluent from the containment basin. While the corrugated weir structure has mostly been replaced with a steel box-type configuration, the overall design parameters will likely remain consistent in the development of the final design of the site. The location of the weir in the site's southeast corner provides an approximate 600-ft separation between the opposite side of the basin and likely location of the dredge pipe inlet. Removable 5.5-in by 5.5-in (finished dimension) flashboards will provide the 32-ft total crest length and allow adjustment of weir height over a 12.1-ft range — from the excavated grade at the weirs (5.9 ft NGVD) to a maximum elevation of 18.0 ft NGVD. When

preparing the final design, the designer should review the weir design considerations discussed by Taylor and McFetridge (1999).

Environmental. While meeting minimum engineering/operational requirements, the basin's preliminary design configuration also minimized the environmental impacts. An environmental site documentation report (Mosura, 1988) documented the vegetation and wildlife conditions within the property boundary of the DMMA DU-7 site. Although the report and associated wetland boundaries are outdated, they identified the predominant vegetation of the 32.0-acre site as temperate hammock (31.1 acres). The remaining site portions include two separate areas of disturbed land (totaling 0.5 acre) and a 0.4-acre mixed wetland hardwood along the south-central boundary (and likely vegetative buffer) of the site. Nevertheless, given the time lapse since the 1988 report, the environmental resources survey will require updating before permitting, final design, and construction activities commence.

Socioeconomic/Cultural. The containment basin's placement within the site should provide adequate separation from adjacent properties. Located approximately one mile south of the St. Johns River, the 32.0-acre parcel is bounded on the north and northwest by an undeveloped outparcel of the Naval Station Mayport, on the northeast and east by the marshes of Pablo Creek, and on the south by the right-of-way of Wonderwood Drive. Immediately south of Wonderwood Drive is Queen's Harbor, an upscale residential subdivision built since the site's initial identification, documentation, and acquisition. The basin's placement also avoids documented on-site archeological resources. A Phase II archeological survey (Johnson, et al., 1988) identified four regions within the DU-7 site boundary as "Areas Recommended for Phase III Archaeological Mitigation." These regions (**Figure 4.7**) comprise the on-site portions of Florida Master Site File Sites 8DU5541 and 8DU5545, both eligible for listing on the National Register of Historic Places. The report further recommends that Phase III mitigation for these areas should consist of preservation rather than archeological data recovery. This approach, as well as the preliminary containment facility site plan, which includes a 25-ft setback from the identified areas, has the endorsement of SHPO (letter to D. K. Roach, Assistant Executive Director, FIND, dated February 4, 1999).

4.4.2 Easements and Permits

To construct the permanent DMMA DU-7 site, the FIND must apply for a joint ERP. To operate the facility, the planned supply and return pipeline routes will fall within the established pipeline easement; however, as the route crosses approximately 250 ft of intertidal saltmarsh, the FIND's operational permit must address temporary impacts to these wetland features during the active dredging period.

Wonderwood Drive was built after FIND acquired DU-7. Wonderwood Drive along the east half of DU-7's southern boundary is a bridge from which site access appears impractical. West of the bridge, a guardrail and a paved bike and pedestrian path lie between Wonderwood Drive and DU-7. We were unable to locate any agreement allowing FIND to access DU-7 from Wonderwood Drive.

4.4.3 Final Design and Construction

Though the site has not yet been through the final design process, the preliminary design features should largely remain consistent in the ultimate construction of the DMMA DU-7. Because the storage

capacity requirement has largely been reduced from 66,910 cy to 34,529 cy, the FIND could consider a reduction in the overall basin footprint or dike height. Along with conducting a detailed seepage and slope stability analysis to ensure the minimum standards of safety are met or exceeded, other outstanding items required for final design include

(1) Site Investigation: environmental resources survey (including identification of on-site gopher tortoises) and geotechnical investigation
(2) Executing (or confirming) an agreement with Florida DOT allowing access to the site from Wonderwood Drive
(3) Earthwork Design and Analysis: dike, ramps, perimeter road, and ditch
(4) Structural Design and Analysis: weir and timber deck structure
(5) Erosion Control: stormwater treatment and landscaping

Construction of the DMMA DU-7 facility will occur in two phases. The first phase — completed in 2001 — included clearing and grubbing all vegetation from within the planned basin footprint and installing security fencing around the site's upland perimeter. The second phase will include containment basin construction and related earthmoving operations and the installation of outlet structures and other design features. This second phase, subject to the scheduling and budgets of the FIND and USACE Jacksonville District, is currently not scheduled to commence within the next five years.

The primary goal of the upland DMMA is to provide sufficient capacity to receive, dewater, and temporarily store sediments dredged from an adjacent reach; **Table 4.4** provides a quantitative summary of the preliminary design facility along with a summary of the location, reach, and DMMA features along with a narrative of unique site features. **Figure 4.7** and **Figure 4.8** provide a conceptual design (as detailed above) plan and cross-sectional detail, including the site security features, of the DMMA DU-7 facility.

Table 4.4 DMMA DU-7 Site Data Summary Sheet

LOCATION			
Also Known As	**Bullard Property**		
Section/Township/Range	**37/2S/28E**	East/West of Waterway	**West**
County	**Duval**	Municipality	**Jacksonville**
REACH			
Designation	**V**	Projected Dredging Frequency	**20-30 years**
Length (mi)	**3.93**	50-Year Dredging Requirement (cy)	**38,175**
Mileage	**0.00 – 3.93**	50-Year Storage Requirement (cy)	**82,076**
Cut/Station	**Cut DU-1 / 0+00 to DU-6 / 75+61.80**		
Geographic	**Jacksonville Harbor to Pine Island**		
DREDGED MATERIAL MANAGEMENT AREA			
Property Area (ac)	**32.0**	Design Basin Capacity (cy)	**99,400**
Basin Area (ac)	**10.7**	Available Basin Capacity (cy)	**0**
Buffer Width (ft))	**N = 50**	Dike Slope	**3H:1V**
	S = 50	Crest Width (ft)	**12.0**
	E = 125	Natural Grade Elevation (ft)	**9.0**
	W = 50 - 750	Depth of Excavation (ft)	**2.5**
ICWW Mileage	**1.9**	Dike Height Above Natural Grade (ft)	**11.0**
Max. Pumping Distance (mi)	**2**	Required Ponding & Freeboard (ft)	**4.0**
Distance from Waterway (ft)	**250**	Type of Weir System	**TBD**
Impacted Wetlands (ac)	**TBD**[1]	Weir Crest Length (ft)	**32.0**
Mitigation	**TBD**	Entity and Year Constructed	**Not constructed**
Regulatory Permits	**Construction: FIND to acquire**		
	Operation: FIND to acquire		
ACCESS			
Public Access	**Wonderwood Drive**	Pipeline Easement	**Yes**
Road Easement	**Not required**	Deep Draft Access	**No**
NARRATIVE			
The FIND acquired DMMA DU-7 (also known as the Bullard Property) in 1988. While the site remains unconstructed, preliminary design activities were completed in 1999 and the site was cleared, grubbed, and fenced in 2001. FIND has not yet applied for permits to construct and operate the site. Engineering/operational issues include, but are not limited to: (1) archeological sites (8DU5541 and 8DU5545) exist on-site and these areas need to be avoided during construction and maintenance related activities, and (2) road access.			

[1]To be determined

SITE FEATURES	
DIKE SLOPE	3H:1V
CREST WIDTH	12 FT
REQUIRED FREEBOARD AND PONDING DEPTH	4 FT
DIKE HEIGHT ABOVE NATURAL GRADE	11 FT
DEPTH OF EXCAVATION	2.5 FT
PROPERTY AREA	32.0 AC
BASIN AREA	10.68 AC
BASIN CAPACITY	99,400 CY

SOURCE: CONCEPTUAL DESIGN BASED ON MAY 1999 MANAGEMENT PLAN. SITE IS NOT CONSTRUCTED.

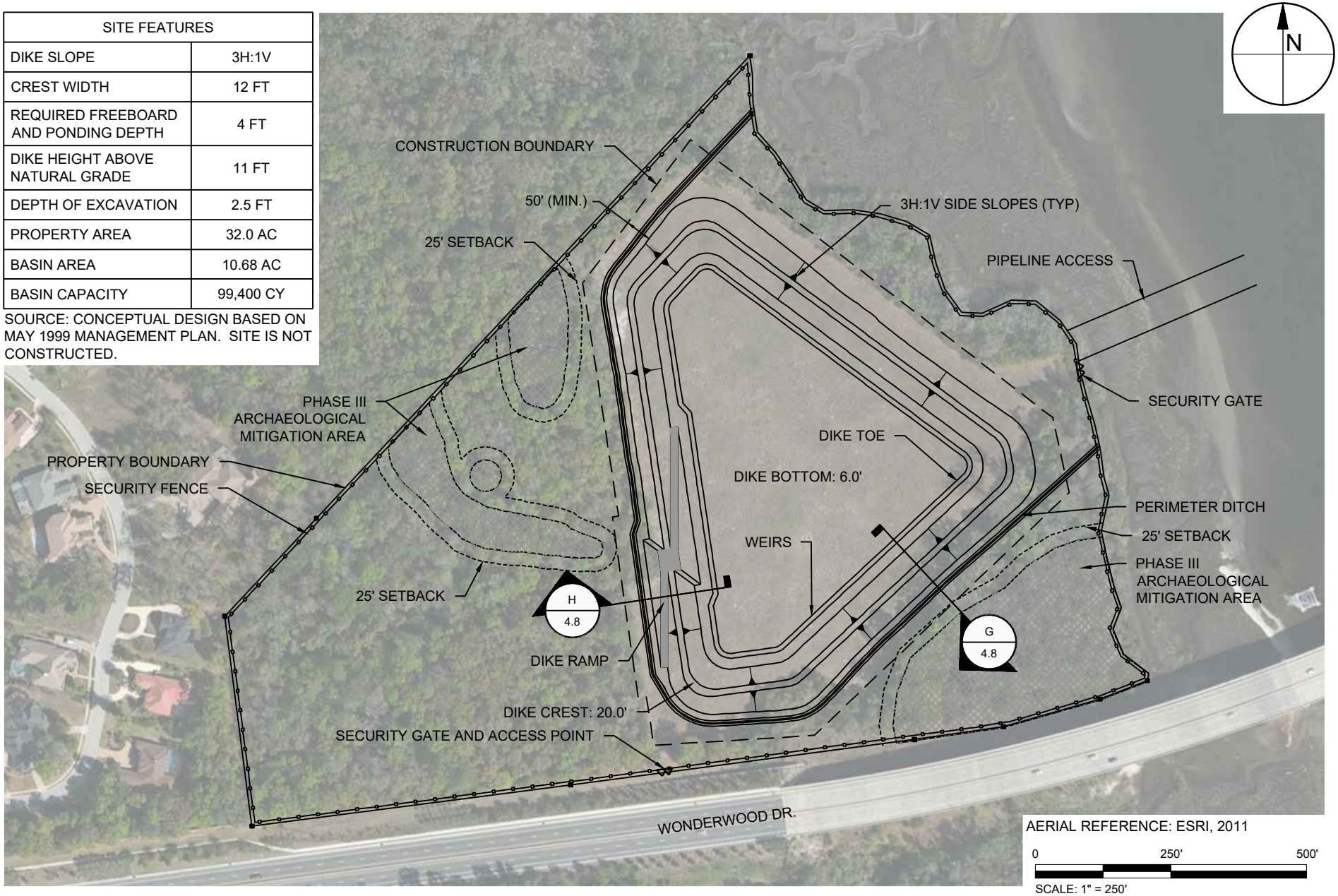

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FIGURE 4.7
DMMA DU-7 PLAN VIEW
INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
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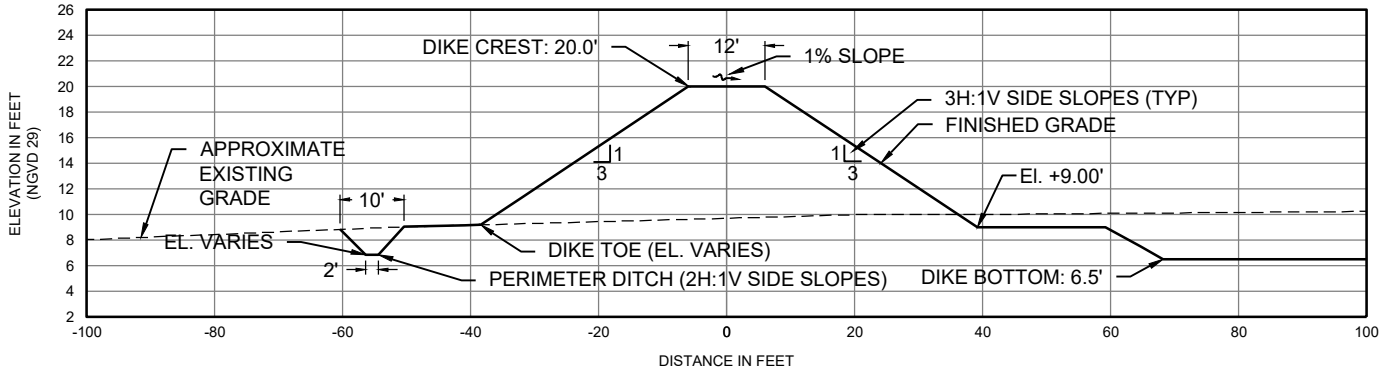
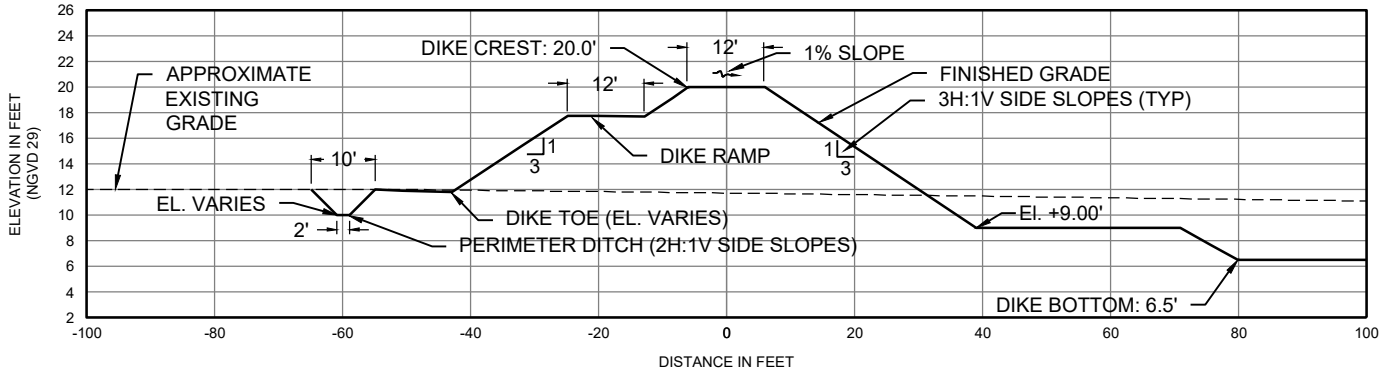
SHEET	12 of 17
DATE	JULY 2016



G 4.7 DU-7 CROSS-SECTION G

SCALE: 1" = 30' 0 30'



H 4.7 DU-7 CROSS-SECTION H

SCALE: 1" = 30' 0 30'

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FIGURE 4.8
DMMA DU-7 SECTION VIEW
INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	13 of 17
DATE	JULY 2016

4.5 DMMA DU-8

The 36.23-acre DMMA DU-8 site, also known as the "Moody Marine Disposal Area," is located just south of Atlantic Boulevard and abuts the Mira Vista at Harbortown condominiums (Mira Vista) to the east. This site handles sediments from ICWW Duval County Reach VI. The FIND acquired this site in 1991. The USACE built the DMMA in 1993.

4.5.1 Preliminary Design

Engineering/Operational. The preliminary engineering design, completed in 1994, provided a design capacity of 208,236 cy. This capacity was adequate for the projected Reach VI disposal requirement of 184,593 cy (as projected in 1986) and surpasses the updated requirement of 189,714 cy (**Table 3.4**). With respect to other engineering/operational issues of pumping distance and road and pipeline access issues, site DMMA DU-8 lies at ICWW Mile 4.9 in the north-central portion of the 3.88-mile reach (from ICWW Mile 3.93 to 7.81). Including the 0.6-mile (1,100 ft) distance from the Waterway, the maximum pumping distance expected is approximately 3.6 miles. Vehicular access is achieved via a residential road (Bermuda Drive). A pipeline easement, necessary for the intake and return pipelines, extends from the eastern site boundary (abutting the southern boundary of Mira Vista) to the ICWW.

Environmental. While meeting minimum engineering/operational requirements, the basin's configuration also minimized environmental impacts. Based on a 1987 environmental site documentation report (Mosura, 1987b), the pre-construction condition of the site predominantly included a combination of palmetto prairie, pine flatwoods, and temperate hardwood communities. The report also identified three wetland communities within the property boundary, including (1) a north-south oriented band (0.87-acre) of cypress-pine-cabbage palm along the western site boundary; (2) a north-south oriented band (0.10-acre) of wet prairie that extended south from the northeast site corner; and (3) a circular area (0.26-acre) of freshwater marsh located in the site's southeast corner.

The initial ecological survey (Mosura, 1987b) of the site also confirmed the presence of gopher tortoises (*Gopherus polyphemus*). As a state-listed threatened species, gopher tortoises are subject to regulations designed to protect the species. A follow up ecological survey, performed before commencement of site construction activities, confirmed that the tortoise burrows were of sufficient number to require the relocation of tortoises. Thus, gopher tortoise management (via relocation permit no. WR94057) for this site includes relocating these tortoises and managing a portion of the site buffer, approximately 7.3 acres, as tortoise habitat (**Figure 4.9**). As a condition of this relocation permit, the FIND agreed to construct fences to allow the movement of tortoises on and off site, manage the tortoise habitat to sustain resident tortoises by using regular underbrush control, and conduct no other activities in the tortoise habitat area that are inconsistent with the long-term tortoise preservation.

Socioeconomic/Cultural. The containment basin's placement within the site also provides adequate separation from adjacent properties and previously identified wetland features. All three wetland areas were preserved within the buffer zone that surrounds the containment areas and accounts for 56% of the total area of the site. Also preserved within the buffer zone are 7.76 acres of mesic hammock (temperate hardwood) in the eastern site portion, representing 94% of this vegetation community that occurs on-site.

In this area, the buffer width is approximately 400 ft. To the north, separating the containment area from the Atlantic Highlands trailer park, the buffer zone is a minimum of 200 ft wide. To the west — where wetlands limit development and thereby the potential for adjacent land use conflicts — the buffer is a minimum of 100 ft wide. A 200-ft buffer separates the containment basin from a residential development to the south of the site. The remainder of the site, and that portion directly impacted by construction of the containment area, is characterized as pine flatwoods, grading into palmetto prairie. Finally, we were unable to locate any correspondence from Florida Division of Historical Resources for this site.

4.5.2 Easements and Permits

As noted previously, a pipeline easement extends from the eastern site boundary to the ICWW. Sunshine State Surveyors surveyed the easement (O.R. Book 7137, PG. 1770) in June 1990. The 60-ft wide, 1,100-ft long easement comprises a total area of approximately 2.4 acres. The upland portion of the easement lies within property owned by the Mira Vista at Harbortown Condominium Association, Inc. In 2014, FIND installed a 400-ft long permanent pipeline sleeve that extends the entire upland length of this easement. The 36-in. high-density polyethylene (HDPE) underground sleeve enables a dredging contractor to insert its supply and return pipes during maintenance dredging operations.

At the time of construction, the DER did not require a WQC for the upland DMMA. On April 20, 2005, FDEP issued an exemption (File No. 16-246683-001-EE) for the maintenance dredging of the ICWW and subsequent operation of the DMMA DU-8 facility. The authority granted under the State Programmatic General Permit (SPGP) expired June 17, 2005; therefore, continued use of the facility will require re-application for an operational permit or exemption. Finally, depending on the on-site presence of gopher tortoises at the time of use, the previously issued tortoise relocation permit (WR94057) may require renewal.

4.5.3 Final Design and Construction

Carrying forward the preliminary design and permitting features that inherently include the original engineering/operational, environmental, and socioeconomic/cultural criteria, USACE designed and constructed the site. Therefore, to the extent known, the following sections detail the earthwork and weir design features of the constructed DMMA DU-8 facility.

4.5.3.1 Earthwork

To achieve the desired capacity, the final dike specifications included a minimum dike crest elevation of 24.2 ft NGVD, or 12.0 ft above the existing mean site elevation of 12.2 ft NGVD, a dike crest width of 12 ft, 3H:1V side slopes, and a bottom basin elevation of 7.4 ft NGVD. Excavating the basin interior to this depth, roughly 4.8 ft below the existing mean grade elevation of the basin footprint, provided the material necessary for site construction. The containment dike also includes a ramp to provide ingress and egress to and from the interior of the containment area. The outside slope of the ramp and the slope of the supporting toe maintain the same 3H:1V slope as the main dike. The ascending/descending grade is 20 H:1V. These ramps allow removal of the dewatered dredged material from the DMMA without disturbing the overall structural integrity of the system. With the containment basin filled to capacity, the surface of

the deposition layer will lie a minimum 4 ft below the dike crest, allowing a minimum 2 ft of freeboard and 2 ft of ponding. A varying-width stabilized road, positioned between the exterior dike toe and a perimeter ditch designed to collect and treat stormwater runoff, provides access to the DMMA's perimeter features.

4.5.3.2 Weir

The DMMA DU-8 installed structure comprises four 9-ft diameter corrugated metal half-pipe risers, each with a sharp-crested, 9-ft length weir section. Each of the four risers connects via a 36-in diameter pipe to a common 42-in manifold such that the effluent exits the containment area via a single pipe under the dike at the site's northeast corner. Collectively, the four risers provide for the release of effluent over a 36-ft length, sharp-crested weir. The weir crest height is adjusted by means of removable flashboards. The range of possible adjustment extends from a maximum elevation of 10 ft above grade down to the site's excavated grade. The timber boards, 6-in. by 6-in. stock, provide the ability to control the ponding depth and thus, the retention time, within the containment basin.

The specification of a minimum weir crest length of 36 ft is based on the USACE guidelines related to the dredging equipment. Weir crest length, and all project calculations, assume use of a 24-in O.D. dredge (discharge velocity of 16 ft/sec, volumetric discharge of 6,430 cy/hr, and a 20/80 solids/liquid slurry mix) for future channel maintenance. However, the physical constraints of the channel will most likely dictate the use of a 16 to 18-in. O.D. dredge. Therefore, the assumption of a 24-in. dredge ensured a conservative disposal site design. Analysis of weir performance based on nomograms developed at the USACE WES under the DMRP (Walski and Schroeder, 1978) indicated that the weir design parameters described above will produce an effluent suspended sediment concentration of 0.63 g/L, assuming an average ponding depth of 2 ft. Relating suspended solids concentration to the State of Florida turbidity-based effluent water quality standard is problematic because turbidity depends highly on the physical characteristics and concentration of the suspended material. However, WES guidelines (Palermo, 1978) indicate that 0.63 g/L should result in turbidity values well below the Florida standard.

The final weir design parameter considered was the location of the weir within the DMMA such that the distance from the dredge pipe inlet is maximized and the return distance to the AIWW is minimized. The latter requirement allows the effluent to discharge from the containment area by gravity flow. As designed, distance between the weir and the inlet provides for a maximum ±850-ft separation. Based on the weir location and review of available data characterizing the dredged sediments to be placed into the DMMA, an analysis of containment area and efficiency was performed. Analyses of these data indicate that the containment area provides adequate retention time to allow the sediment to settle out of the average minimum ponding depth of 2 ft (6.29 hours maximum retention time vs. about 0.75 hour required settling time multiplied by a safety factor of 3, or 2.25 hours). The basin retention time therefore exceeds the required retention time by a factor of 2.8. If effluent quality deteriorates below the ambient conditions of receiving waters, steps shall be taken to decrease effluent turbidity. These include intermittent dredge operation, increased ponding depth, or the use of turbidity curtains surrounding the site outlet weirs.

The primary goal of the upland DMMA is to provide sufficient capacity to receive, dewater, and temporarily store sediments dredged from an adjacent reach; **Table 4.5** provides a quantitative summary of the preliminary design facility along with a summary of the location, reach, and DMMA features along

with a narrative of unique site features. As part of a planned maintenance dredging project, this site was used by USACE in 2005 to receive approximately 25,000 cy of material from Cuts DU-7, DU-8, and DU-9. **Figure 4.9** and **Figure 4.10** provide an as-built plan and cross-sectional detail, including the site security features, of the DMMA DU-8 facility.

Table 4.5 DMMA DU-8 Site Data Summary Sheet

LOCATION			
Also Known As	**Moody Marine**		
Section/Township/Range	**25/1S/28E**	East/West of Waterway	**West**
County	**Duval**	Municipality	**Jacksonville**
REACH			
Designation	**VI**	Projected Dredging Frequency	**1-5 Years**
Length (mi)	**3.88**	50-Year Dredging Requirement (cy)	**88,239**
Mileage	**3.93 – 7.81**	50-Year Storage Requirement (cy)	**189,714**
Cut/Station	**Cut DU-7 / 0+00 to DU-15 / 22+23.40**		
Geographic	**Pine Island to Beach Boulevard**		
DREDGED MATERIAL MANAGEMENT AREA			
Property Area (ac)	**36.23**	Design Basin Capacity (cy)	**208,236**
Basin Area (ac)	**17.04**	Available Basin Capacity (cy)	**183,236**
Buffer Width (ft))	**N = 200**	Dike Slope	**3H:1V**
	S = 200	Crest Width (ft)	**12**
	E = 400	Natural Grade Elevation (ft)	**12.2**
	W = 100	Depth of Excavation (ft)	**4.8**
ICWW Mileage	**4.9**	Dike Height Above Natural Grade (ft)	**12.0**
Max. Pumping Distance (mi)	**3.6**	Required Ponding & Freeboard (ft)	**4**
Distance from Waterway (ft)	**1,100**	Type of Weir System	**Four corrugated metal half-pipes**
Impacted Wetlands (ac)	**NA[1]**	Weir Crest Length (ft)	**36**
Mitigation	**NA**	Entity and Year Constructed	**USACE, 1993**
Regulatory Permits	**Construction: NA**		
	Operation: 16-246683-001-EE, expired		
ACCESS			
Public Access	**Bermuda Dr.**	Pipeline Easement	**Yes**
Road Easement	**Not required**	Deep Draft Access	**No**
NARRATIVE			
The FIND acquired DMMA DU-8 in 1991 and the USACE constructed the site in 1993. A construction permit was not required by the DER and a 2005 FDEP permit determined that the site was exempt from an operational permit requirement; however, future use of the site may require one. In 2014 FIND installed a permanent 36-in diameter HDPE pipe sleeve along the entire upland length (400 ft) of the 1,100 ft pipeline easement. Engineering/operational issues include, but are not limited to: (1) the 7.3-acre gopher tortoise habitat area to the north, south and east sides of the site; (2) the FIND's requirement to maintain the habitat area as favorable gopher tortoise habitat area; and (3) likelihood of gopher tortoise occurrence due to the protected habitat area, being an issue during any construction activity.			

[1]Not applicable

SITE FEATURES	
DIKE SLOPE	3H:1V
CREST WIDTH	12 FT
REQUIRED FREEBOARD AND PONDING DEPTH	4 FT
DIKE HEIGHT ABOVE NATURAL GRADE	12.0 FT
DEPTH OF EXCAVATION	4.8 FT
PROPERTY AREA	36.23 AC
BASIN AREA	17.04 AC
BASIN CAPACITY	208,236 CY

SOURCE: USACE, 1993

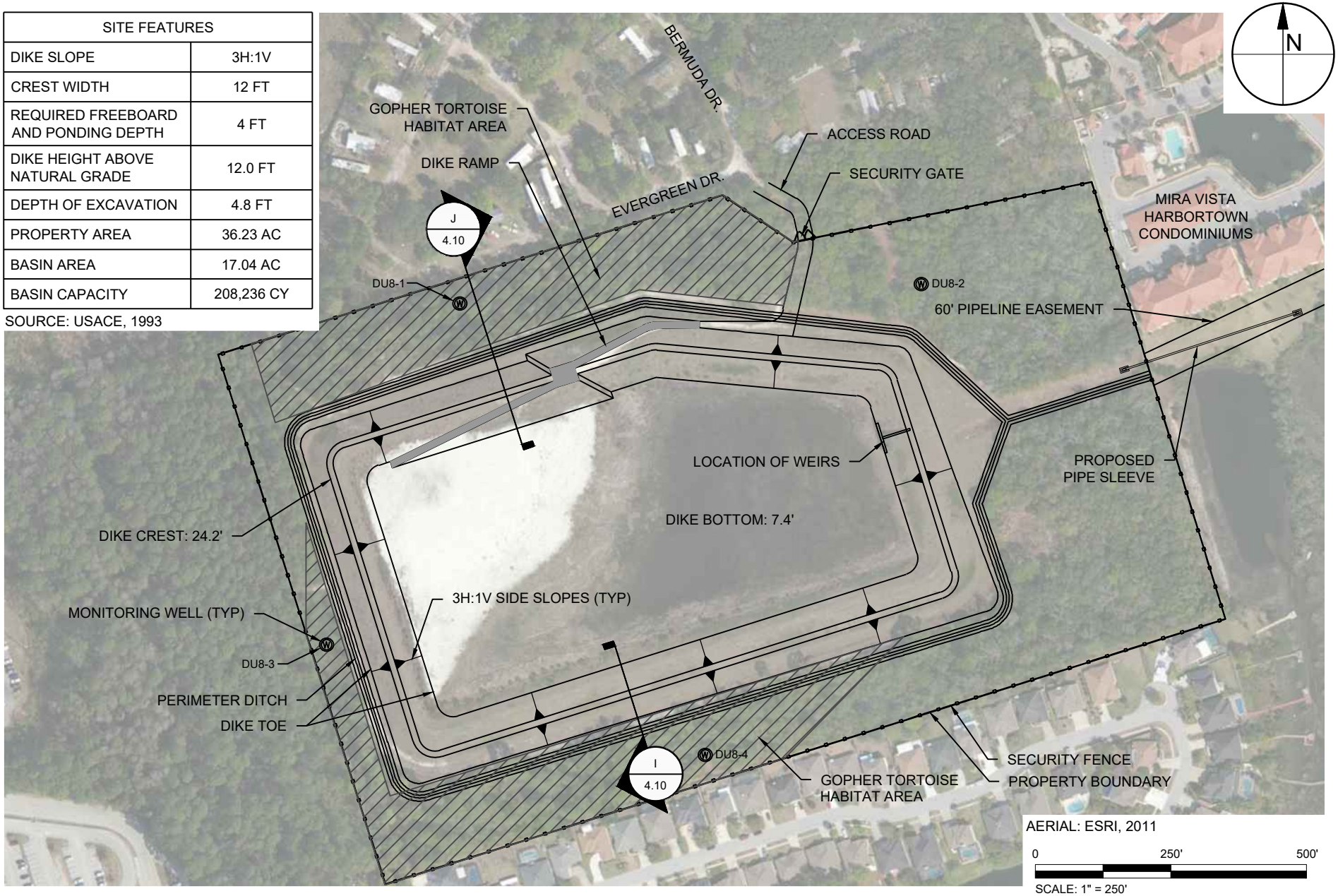

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FIGURE 4.9
DMMA DU-8 PLAN VIEW
INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
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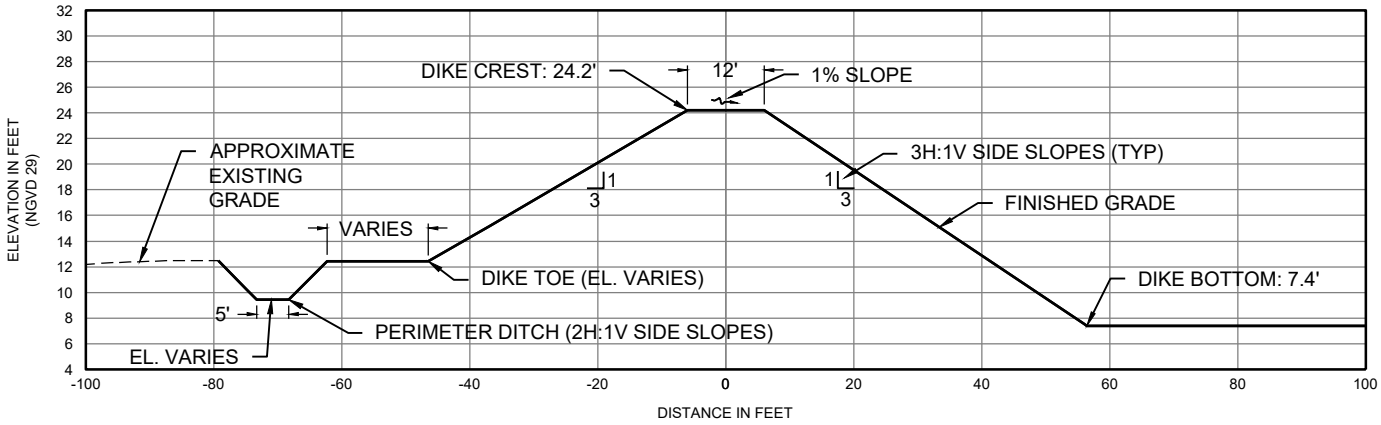
SHEET	14 of 17
DATE	JULY 2016



I / 4.9 DU-8 CROSS-SECTION I

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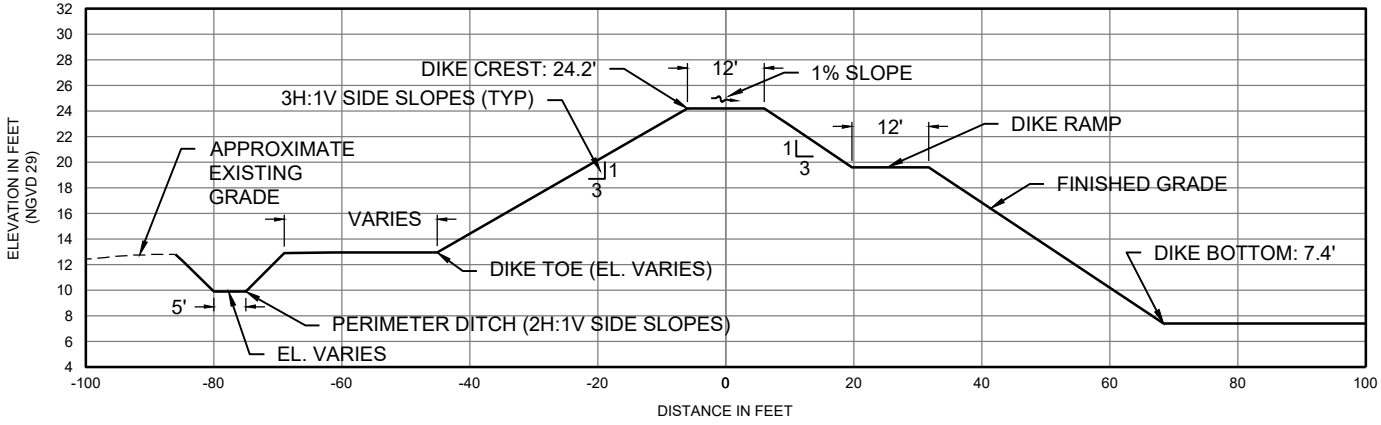

J / 4.9 DU-8 CROSS-SECTION J

SCALE: 1" = 30' 0 30'

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FIGURE 4.10
DMMA DU-8 SECTION VIEW
INTRACOASTAL WATERWAY
DUVAL COUNTY, FLORIDA

PROJECT	C2013-031
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SHEET	15 of 17
DATE	JULY 2016

4.6 DMMA DU-9

The 179.9-acre DMMA DU-9 site, also known as the "Pablo Creek" site is located approximately 0.50-mile west of the ICWW, south of Pablo Creek, approximately 1.5 miles south of the Duval/St Johns County line, and lies within an extensive private landholding known as Dee Dot Ranch. This site will handle sediments dredged from the ICWW Duval County Reach VII. The FIND acquired the DMMA DU-9 site in 1995 and obtained construction permits in 2000. Due to contamination found within the center of the site during preliminary construction activities (e.g., relocation of gopher tortoises) in 2001, the FIND modified the permit in 2004 and redesigned and constructed a smaller basin north of the contaminated area in 2006.

Since the contaminated area (approximately 400-ft wide by 1,100-ft long) was first identified, the owner of the Dee Dot Ranch (i.e., Estuary Corporation) and its engineering consultant, CH2MHILL, have worked to successfully remediate the area. While the details of the soil and groundwater contamination and subsequent remediation are not detailed herein, the area, previously known as Dee Dot Sludge Disposal Area No. 2, was permitted to receive domestic sewage sludge via DER Permit No. S016-23054 between May 1980 and June 1983. At some point during this time frame, Duval Septic Company disposed of industrial sludge onto the site. The EPA summarized the expected contamination in a 1992 site inspection prioritization report; however, this report was not shared with the FIND nor was a Phase I environmental site assessment performed before the 1995 purchase. In March 2014 FDEP granted conditional closure (i.e., no further cleanup required) with specific institutional controls that include, but are not limited to, restrictions that prohibit the withdrawal and use of surficial groundwater (less than or equal to 60 ft below land surface).

At present, FIND is moving forward with the permitting and construction of a shortened version (due to reduced capacity requirements) of the originally planned, larger DMMA necessary to meet the capacity requirements of the projected 50-year storage volume for Reach VII. As this is the case, the preliminary design features of this larger site are primarily discussed in **Section 4.6.1**; however, the remaining two sections (i.e., easement/permits and final design and construction) include those features of both the currently constructed site (i.e., as-built) and summarizes those steps necessary to complete the design and construction of the larger, permanent site (i.e., build-out).

4.6.1 Preliminary Design

Engineering/Operational. The preliminary engineering design, completed in 1993 and updated in 2000, provided a design capacity of 2,050,825 cy. This capacity fell slightly short of the projected Reach VII disposal requirement of 2,053,902 cy (as projected in 1996), but surpasses the updated requirement of 1,397,926 cy (**Table 3.4**). Should the FIND not construct the build-out design in the near-term, the as-built site currently provides for a capacity of approximately 423,000 cy. Because the USACE used the site in 2009 to receive, dewater, and store approximately 258,000 cy of material from the Palm Valley North project (i.e., Cuts SJ-2 – SJ-5), the site has reached approximately 60% of its capacity. Given that the current shoal volume is approximately 29,000 cy (**Table 3.3**), there is not an urgent need to immediately offload the current site or construct the expanded facility. With respect to other engineering/operational issues of pumping distance and road and pipeline access issues, DMMA DU-9 lies at ICWW Mile 12.0, just south of the Reach VII termination point at AIWW Mile 11.81. Including the distance the site lies from the

Waterway (0.5-mile), the maximum pumping distance from the northern end of the reach (ICWW Mile 7.81) is approximately 8.3 miles. As detailed below in **Section 4.6.2**, the FIND secured both road access and pipeline easements from the previous property owner during site acquisition.

To achieve DU-9's design capacity, the dike specifications included a crest of 33.0 ft NGVD, or 18.13 ft above the existing mean site elevation of 14.87 ft NGVD. The dike design, including side slopes of 3H:1V and a dike crest of 15 ft, required approximately 452,522 cy of material for construction. Two sets of ramps, located on the north and northwestern site corners, provide equipment access to the interior of the containment basin for material dewatering and transfer and required an additional 7,290 cy. Excavating the basin interior to an elevation of 11.0 ft NGVD, or approximately 3.9 ft below the existing grade, will provide the required 459,812 cy of dike/ramp construction material. The preliminary design also included a weir structure comprising four corrugated metal half-pipes, each with a 9-ft weir section, to release the clarified effluent from the containment basin. Timber flashboards of 6-in. by 6-in. stock will provide the 36-ft total crest length and allow adjustment of weir height over a 21.5-ft range — from the excavated grade at the weirs (10.5 ft NGVD) to a maximum elevation of 32.0 ft NGVD (1 ft below the elevation of the dike crest). The weir and accompanying weir deck (bottom elevation at 35.4 ft NGVD) in the as-built DMMA were designed in such a way that they could remain unaltered in the future expansion of the site. **Section 4.6.3** details the final design and construction of the installed weir.

Environmental. While meeting minimum engineering/operational requirements, the basin's configuration minimized environmental impacts. The pre-construction condition of the site predominantly included vegetated pasture in various stages of succession, pine flatwoods, planted pine, and various wetland communities. Of the 8.46 acres of wetlands on-site, construction of the smaller containment facility impacted 2.27 acres. Facility construction did not directly impact the remaining 6.19 acres, or 73% of the total acreage of on-site wetlands. In addition to exotic vegetation removal within the DMMA DU-9 property boundary, the FIND constructed an on-site 4.8-acre mitigation area located in the northwest site corner to offset the impact to these wetlands.

Socioeconomic/cultural. The containment basin's placement within the site had to meet the requirement of the 1995 FIND-Estuary Corporation use agreement. The dike's outside toe lies a minimum of 300 ft from the site boundaries. A perimeter service road and ditch surrounding the containment basin lies a minimum of 270 ft from the site boundaries, with the limits of construction (i.e., clearing and grubbing) a minimum of 250 ft from the site boundaries. Inquiry to the Florida Division of Historical Resources confirmed that the Florida Master Site File records did not reflect any archaeological sites near or within the boundaries of DMMA DU-9.

4.6.2 Easements and Permits

The DMMA DU-9 road access occurs via San Pablo Road through the gated and private lands of Dee Dot Ranch. The FIND secured permanent access to the site when it acquired the land from Dee Dot in 1995. Through conversations with the previous landowner (during design) and in an effort to facilitate two-way traffic for Dee-Dot staff and visitors to the ranch, a 40-ft wide two-way access road around the northern and eastern sides of the site, allows for continued access to the ranch property that lies south of the DMMA DU-9 property boundary. The 1995 purchase agreement also provided for a 60-ft wide pipeline easement that extends from the eastern side of the property boundary approximately 2,500 ft to the MHW line of the ICWW. The purchase agreement lists other stipulations, related to the property, road access, and pipeline easement, that are not specified herein.

The FIND originally acquired the FDEP permit to construct the 93.83-acre DMMA in April 2000 (FDEP Permit No. 0129250-001-EI). As cited above, the permit was modified in 2004 (FDEP Permit No. 0129250-002-EM) to allow for construction of a smaller containment basin located north of the contaminated area (USACE, 2006). In 2008, the FIND acquired another modification of this permit (FDEP Permit No. 0129250-003-EG) to allow for permanent installation of approximately 3,800 ft of 36-in diameter buried return line from the DMMA weir outlet to just west of the ICWW. Installation was successfully completed in 2011. In June 2016, FIND submitted an ERP application for the expanded containment basin.

4.6.3 Final Design and Construction

Because the ultimate intention is to construct the larger capacity, permanent site, this section is divided to include the construction detail of the as-built site and summarizes those steps necessary to complete the construction of the build-out site. Additional site-specific features, not detailed below, include installation of a discharge shut-off valve (requiring a generator to open and close) and buried return pipeline that provides a permanent underground conduit for decanting effluent from maintenance dredging operations and stormwater to the ICWW. During construction of the site in 2006, the USACE had the contractor install a permanent deep well located on the west-central site portion. During upcoming maintenance and construction activities, this artesian well should provide a good source of water, if needed.

4.6.3.1 As-built

In an effort to minimize the build-out construction effort, the preliminary design and permitting features were considered, and to the extent possible, incorporated into the final design and construction of the smaller, as-built site. Similar to the larger containment area, the smaller site design included analysis of earthwork (i.e., dike, ramps, perimeter ditch), stormwater control, dike erosion, and vegetation. The general placement of the DMMA footprint and mitigation area was mostly duplicated from previous design efforts. The weir design will remain unaltered moving from the as-built to build-out site. To prevent exacerbation of the pre-existing contaminant plume by subsequent dredging operations, the FIND installed an east-west oriented 3-ft wide by 30-ft deep bentonite slurry wall. This wall will require excavation to the depth of the containment basin (i.e., 11.0 ft NGVD) during the future construction of the expanded, permanent site. Taylor Engineering designed and the USACE constructed the as-built site. The safety factors for both as-

built and build-out site designs met or exceeded those listed in the USACE EM 1110-2-1901. The following sections detail the earthwork and weir design features of the as-built DMMA DU-9 facility.

Earthwork

Given the subsurface conditions (detailed in several site-specific geotechnical reports) and the maximum basin footprint, the final dike specifications included a minimum crest elevation of 26.5 ft NGVD, or 11.63 ft above the existing mean site elevation of 14.87 ft NGVD, a dike crest width of 12 ft, 3H:1V side slopes, and a bottom basin elevation of 12.5 ft NGVD. A single dike ramp located on the north side of the site provides ingress and egress to and from the interior of the containment area. A stabilized access road provides vehicular access to the site's perimeter and wetland mitigation area.

Weir

The installed structure comprises four 9-ft diameter corrugated metal half-pipe risers, each with a sharp-crested, 9-ft length weir section. Each of the four risers connects via a 30-in diameter pipe to a common 30-in. manifold such that the effluent will exit the containment area via a single pipe under the dike at the site's northeast corner. Collectively, the four risers provide for the release of effluent over a 36-ft length, sharp-crested weir. Removable flashboards allow adjustment of weir height over a 13.5-ft range — from 11.5 ft NGVD to a maximum 25 ft NGVD, 1.5 ft below the dike crest elevation of 26.5 ft. However, the in-place structure allows for additional weir boards to a maximum elevation of 32 ft NGVD (required for the build-out facility).

The specification of a minimum weir crest length of 36 ft is based on the USACE guidelines related to the dredging equipment. Weir crest length, and all project calculations, assume use of a 24-in O.D. dredge (discharge velocity of 16 ft/sec, volumetric discharge of 6,430 cy/hr, and a 20/80 solids/liquid slurry mix) for future channel maintenance. However, the physical constraints of the channel will most likely dictate the use of a 16 – 18-in O.D. dredge. Therefore, the assumption of a 24-in dredge ensured a conservative disposal site design. Analysis of weir performance based on nomograms developed at the USACE WES under the DMRP (Walski and Schroeder, 1978) indicated that the weir design parameters described above will produce an effluent suspended sediment concentration of 0.63 g/L, assuming an average ponding depth of 2 ft. Relating suspended solids concentration to the State of Florida turbidity-based effluent water quality standard is problematic because turbidity depends highly on the physical characteristics and concentration of the suspended material. However, WES guidelines (Palermo, 1978) indicate that 0.63 g/L should result in turbidity values well below the Florida standard.

The final weir design parameter considered was the location of the weirs within the DMMA to maximize the distance from the dredge pipe inlet and minimize the return distance to the ICWW. The latter requirement allows the effluent to discharge from the containment area by gravity flow. As designed, distance between the weir and the inlet provides for a maximum ±3,000-ft separation. Based on the weir location and review of available data characterizing the dredged sediments to be placed into the DMMA, an analysis of containment area and efficiency was performed. Analyses of these data indicate that the containment area provides adequate retention time to allow the sediment to settle out of the average minimum ponding depth of 2 ft (3.41 hours required settling time). Based on a 70% basin efficiency and the discharge characteristics of 24-in dredge, a 2.0-ft ponding depth will provide an effective retention of

time of 30.11 hours while the flow over the weir balances the liquid discharge of the dredge. However, the WES DMRP indicates that the predicted settlement time of the dredged material should be multiplied by a correction factor of 2.25 to account for field conditions. This yields an adjusted settlement time of 7.67 hours. Thus, the DMMA DU-9 build-out basin provides a retention time 3.9 times that required to maintain adequate sedimentation and effluent quality. Similar analyses, performed for the as-built basin (providing a maximum separation distance of 1,500 ft) also yield sufficient and expected sedimentation and effluent quality results. If effluent quality deteriorates below the ambient conditions of receiving waters, steps shall be taken to decrease effluent turbidity. These include intermittent dredge operation, increased ponding depth, or the use of turbidity curtains surrounding the site outlet weirs.

4.6.3.2 Build-out

The larger capacity, build-out DMMA had already been through the final design process when pre-construction activities commenced in 2001. However, due to the reduced capacity requirements, FIND modified the build-out design to match the elevation (26.5 ft NAVD) of the existing basin. The revised DU-9 expansion design, combined with the full capacity of the existing northern cell with a bottom basin elevation of 11 ft NAVD, provides material storage capacity slightly lower (1,121,820 cy) than the 50-yr storage requirement (1,397,926 cy). Aside from the slight reduction in the storage capacity requirement, the site features remain largely unchanged, including the constructed weir, from the original design; however, the permit has since expired and will require the resubmittal of an ERP application. Given this and the probable conditional closure requirements, the likely items that remain outstanding for permitting, design, and bid preparation include

(1) Permitting: updated environmental resources survey (including identification of on-site gopher tortoises)
(2) Design: removal of slurry wall, incorporation or removal of on-site dredged material in the northern cell, conditional closure requirement review and incorporation into plans and specifications, elevation and compaction of dike in vicinity of installed weir structure
(3) Bid Preparation: final bid quantities

Finally, construction of the build-out facility is subject to the scheduling and budgets of the FIND and USACE Jacksonville District and is currently scheduled to commence within the next 5 years. Currently, no urgent need for the full-capacity site is evident within the next five years; however, the use of the site for other portions of the Waterway (e.g., segments of St. Johns County) combined with FIND's desire to permit and construct the site following receipt of the conditional closure may elevate this need.

Table 4.6 provides a quantitative summary of the design and current storage capacity for the as-built site, as well as the projected capacity for the build-out site. This table also provides a summary of the location, reach, and DMMA features along with a narrative of unique site features. **Figure 4.11** and **Figure 4.12** provide an as-built and build-out plan and cross-sectional detail, including the site security features, of the DMMA DU-9 facility.

Table 4.6 DMMA DU-9 Site Data Summary Sheet

LOCATION			
Also Known As	**Pablo Creek**		
Section/Township/Range	**19, 30, 39, 40/3S/29E**	East/West of Waterway	**West**
County	**St. Johns**	Municipality	**Ponte Vedra Beach**
REACH			
Designation	**VII**	Projected Dredging Frequency	**1-5 years**
Length (mi)	**4.00**	50-Year Dredging Requirement (cy)	**650,198**
Mileage	**7.81 – 11.81**	50-Year Storage Requirement (cy)	**1,397,926**
Cut/Station	**Cut DU-16 / 0+00 to SJ-3 / 37+26.84**		
Geographic	**Beach Boulevard to DMMA DU-9**		
DREDGED MATERIAL MANAGEMENT AREA			
Property Area (ac)	**179.9**	Design Basin Capacity (cy)	**423,000 (1,121,820)**
Basin Area (ac)	**33.71 (93.83)[1]**	Available Basin Capacity (cy)	**165,000**
Buffer Width (ft))	**N = 300**	Dike Slope	**3H:1V**
	S = 300	Crest Width (ft)	**12**
	E = 300	Natural Grade Elevation (ft)	**14.87**
	W = 300	Depth of Excavation (ft)	**2.37**
ICWW Mileage	**12.0**	Dike Height Above Natural Grade (ft)	**11.63**
Max. Pumping Distance (mi)	**8.3**	Required Ponding & Freeboard (ft)	**4**
Distance from Waterway (ft)	**2,600**	Type of Weir System	**Four corrugated metal half-pipes**
Impacted Wetlands (ac)	**3.13**	Weir Crest Length (ft)	**36**
Mitigation	**On-site**	Entity and Year Constructed	**USACE, 2006**
Regulatory Permits	**Construction: 55-129250-001-EI, -002-EM, -003-EG, -004-EM; USACE SAJ-2008-4116 (buried pipeline)**		
	Operation: 55-129250-005-EM		
ACCESS			
Public Access	**Dee Dot Ranch access road via San Pablo Road**	Pipeline Easement	**Yes**
Road Easement		Deep Draft Access	**No**
NARRATIVE			
The FIND acquired DMMA DU-9 in 1995. Due to contamination found within the center of the site in 2001, the FIND modified the permit in 2004 and redesigned and constructed a smaller basin north of the contaminated area in 2006. As of June 2016, FDEP is reviewing FIND's permit application for the expanded site. Engineering/operational issues include, but are not limited to: (1) increased offloading frequency of the smaller containment area (until the build-out site is constructed), (2) FDEP institutional controls, and (3) maintenance of the shut-off valve and buried pipeline.			

[1]Where applicable, site parameters are indicated for both the temporary (as-built) and permanent (build-out) containment areas. The build-out is indicated in parentheses.

SITE FEATURES		
	AS-BUILT	BUILD-OUT
DIKE SLOPE	3H:1V	3H:1V
CREST WIDTH	12 FT	12 FT
REQUIRED FREEBOARD AND PONDING DEPTH	4 FT	4 FT
DIKE HEIGHT ABOVE NATURAL GRADE	11.63 FT	11.63 FT

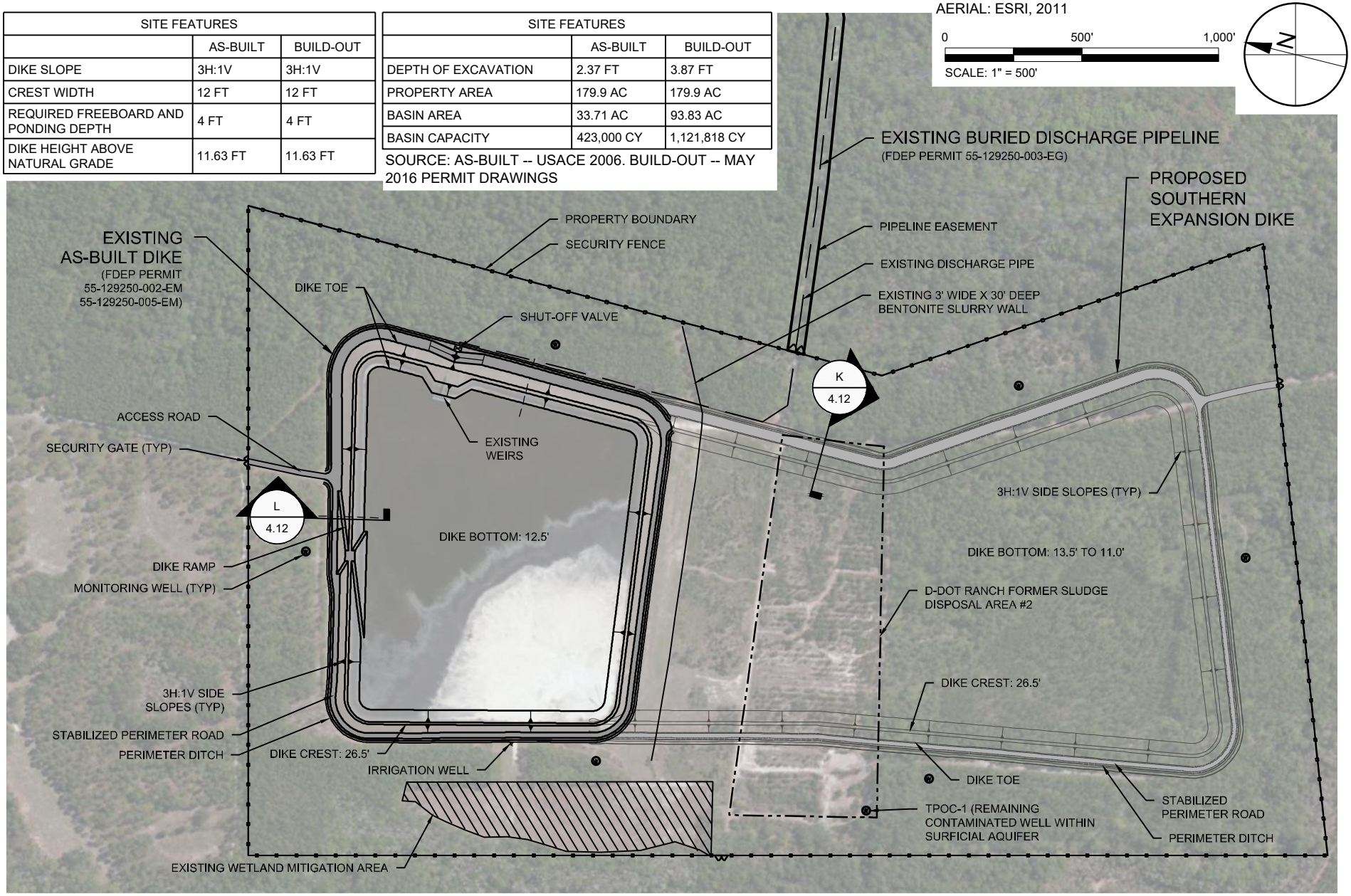
SITE FEATURES		
	AS-BUILT	BUILD-OUT
DEPTH OF EXCAVATION	2.37 FT	3.87 FT
PROPERTY AREA	179.9 AC	179.9 AC
BASIN AREA	33.71 AC	93.83 AC
BASIN CAPACITY	423,000 CY	1,121,818 CY

SOURCE: AS-BUILT -- USACE 2006. BUILD-OUT -- MAY 2016 PERMIT DRAWINGS

AERIAL: ESRI, 2011

0 500' 1,000'

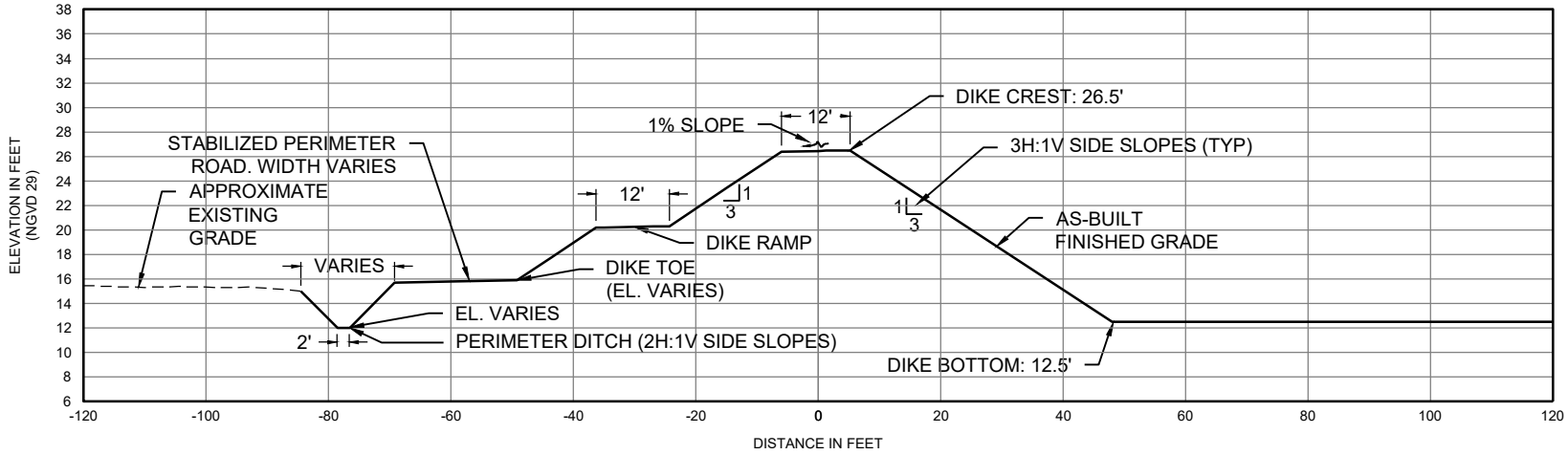
SCALE: 1" = 500'



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

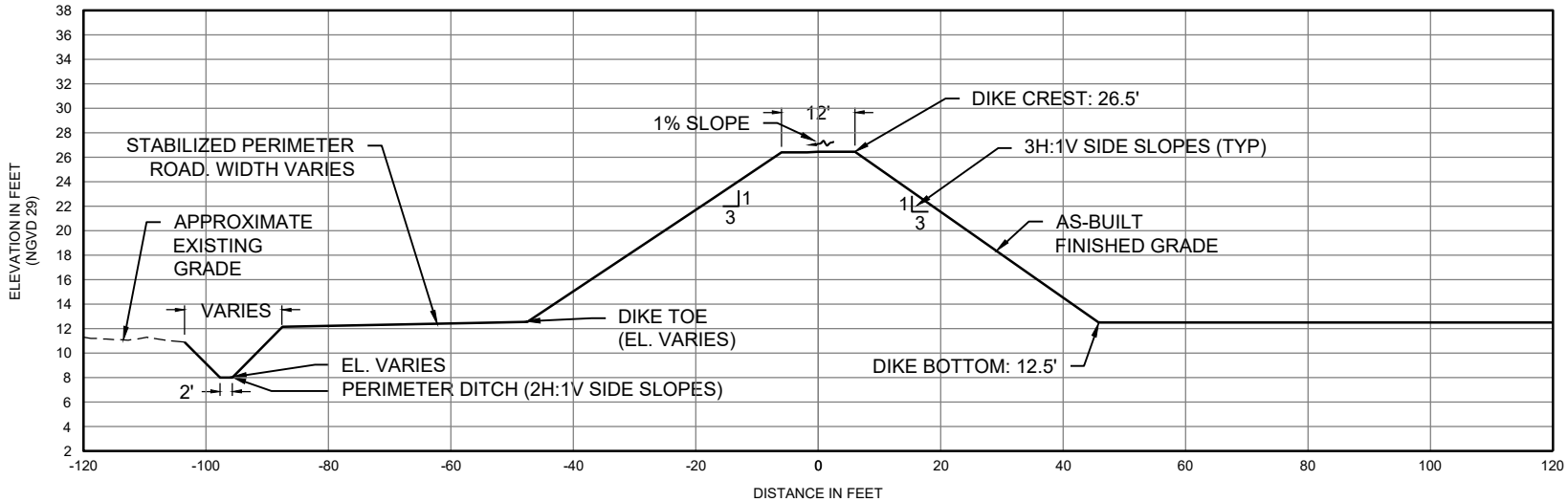
FIGURE 4.11
DMMA DU-9 PLAN VIEW
INTRACOASTAL WATERWAY
ST. JOHNS COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	16 of 17
DATE	JULY 2016



K / 4.11 DU-9 CROSS-SECTION K

SCALE: 1" = 30' 0 30'



L / 4.11 DU-9 CROSS-SECTION L

SCALE: 1" = 30' 0 30'

TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD.
BLDG. 300, SUITE 300
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 4.12
DMMA DU-9 SECTION VIEW
INTRACOASTAL WATERWAY
ST. JOHNS COUNTY, FLORIDA

PROJECT	C2013-031
DRAWN BY	AF
SHEET	17 of 17
DATE	JULY 2016

5.0 DMMA OPERATIONAL CONSIDERATIONS

This section provides guidance for the operation of DMMAs to achieve optimum efficiency in both effluent quality and management area service life. This section addresses site-specific design and operational elements, as well as those facets of design and operation that directly influence site efficiency or reduce off-site conflicts. The three phases of operational considerations include (1) elements of site preparation prior to the initial dredging and disposal of dredged material; (2) techniques of decanting and dewatering the dredged material during and immediately following a disposal event; and (3) criteria for post-dredging site operation and maintenance. Throughout the operations, each aspect of site management seeks to ensure that the site not only achieves its minimum design service life, but also serves as a permanent operating facility for the intermediate storage and re-handling of maintenance material dredged from the Waterway.

Both state and federal regulatory requirements are subject to change. Currently, maintenance dredging events with upland disposal may qualify for a state permit exemption and federal authorization under a regional general permit. If the FIND acts as the permittee for a dredging project, the FIND may request that the FDEP approve a maintenance dredging exemption from state permitting and that USACE verify federal authorization under the Department of the Army Regional General Permit SAJ-93 for Waterway maintenance dredging.

5.1 Pre-Dredging Site Preparation

5.1.1 Earthwork

Site preparation will include clearing and grubbing vegetation that has grown since site construction or last use of the facility and altering existing topography within the DMMA. Historically, containment area construction has often been accomplished without any interior site preparation. Documentation (Haliburton, 1978; Gallagher, 1978) has established that a limited amount of herbaceous vegetation or native grasses in the basin can improve sedimentation by filtration. However, large woody vegetation (brush, trees) can constrict or channelize the flow through the containment area, resulting in short-circuiting of flow, reduced retention times, resuspension of sediment, and the deterioration of effluent quality. Additionally, failure to clear existing vegetation will increase the organic content of the fill, rendering it less suitable for removal and re-use as construction material

Similarly, the existing topography (resulting from previous dredging events) within the containment area, if allowed to remain undulating and non-uniform, may cause the flow from the inlet to the weir to channelize, thereby reducing the effective sedimentation area, increasing flow velocities, and decreasing the efficiency of solids removal. Moreover, irregular topography will produce irregular deposition, which, in turn, will result in the ponding of surface water, thereby inhibiting the drying of the deposition layer and making initial attempts at surface trenching more difficult. Therefore, providing a uniform grade with a slope on the order of 0.2% from the inlet to the weir becomes very important. In addition, given an initially level surface, differential settling of varying grain size fractions will quickly establish a deposition surface sloping downward from the inlet to the weir as coarse sediment deposits near the inflow and fine sediments deposit near the weirs.

5.1.2 Migratory Bird Protection

Should construction activities at any of the DMMAs take place during the migratory bird-nesting season (March 15 – September 1), the FIND or the USACE must coordinate with the USFWS to establish site-specific migratory bird protection activities.

5.1.3 Gopher Tortoise Protection

Gopher tortoises occur on several of the Duval County DMMAs. Where permits require ongoing tortoise management practices, the FIND must ensure compliance with the permit requirements. Prior to each site use, the FIND or the USACE should survey the containment basin, dikes, and any ground areas potentially impacted by the project for tortoises. If the surveys find tortoises or burrows potentially affected by site operation, consultation with FWC must occur.

5.1.4 Groundwater Monitoring

In general, material dredged from the Waterway and pumped into each DMMA will contain approximately 20% marine sediments and 80% saline water. This slurry will remain ponded within the containment basin only during actual dredging operations and for a short period immediately following dredging as the clarified effluent is released back to the Waterway. Such periods are expected to last approximately 6 – 8 weeks, once every 5 – 10 years. Despite the infrequency of operation, hydrostatic pressure could potentially force saline water from the basin into the local surficial aquifer. Guarding against this occurrence dictates an on-site groundwater monitoring program to detect any changes in local groundwater conditions due to site operations.

Implementation of a groundwater monitoring program requires installing and monitoring shallow test wells before site construction activities commence. Each site's geotechnical characteristics and site-specific concerns (e.g., vicinity of public wells for water supply, local area contamination, etc.) will dictate the placement and depth of the installed wells. Samples from the test wells will be analyzed to document pre-operational groundwater elevations and chloride concentrations. Analysis of the groundwater samples may also include additional chemical constituents if present in the sediment to be dredged. Well monitoring data will be/have been used to establish baseline groundwater conditions before site development and to identify changes in groundwater elevation due to site development or to changes in off-site groundwater demand. Though little change in groundwater conditions is anticipated before the first dredging operation, groundwater monitoring should continue on a regular schedule. Samples should be taken monthly for the first year after the wells are installed and quarterly thereafter until the containment facility's first use.

Each site's first use as a containment facility will likely prove the most crucial period for monitoring the potential seepage of saline water through the dike's foundation and side slopes. During this time, soils forming the dike will be most porous due to their disturbance during site construction. Thus, the initial period of each dredging operation requires frequent sampling and analysis of groundwater. During the site's initial use, groundwater samples should be taken twice every 24 hours. This sampling regimen should begin at the start of dredging and continue for a period equivalent to the theoretical transit time of saline water from the basin to the furthermost sampling well. Maximum transit time should be estimated during the final

site design process, given adequate data to define soil permeability, stratification, and the governing groundwater flow gradient. Such data should be obtained from core borings taken in association with monitoring well installation. Following the estimated maximum transit time through the remainder of the decanting process, sampling should occur at least every 24 hours. If at any time elevated chloride levels are detected in the monitoring wells, dredging will be stopped and ponding depth reduced until additional corrective measures can be taken. These may include the installation of a system of well points around the dike to reverse groundwater flow. Operational experience has shown that dike permeability decreases as the dike material filters and traps the finer fraction of dredged sediments. Thus, saline seepage from the containment basin should become increasingly reduced with each successive dredging operation.

To date, and as shown in **Figures 4.1, 4.5, 4.9, and 4.11**, monitoring wells have been installed at DMMA DU-2, DU-6A & 6B, DU-8, and DU-9. Groundwater sampling for each of these sites continues as recommended.

5.2 Operational Considerations During Dredging

The primary objectives of site management during dredging operations are to maintain acceptable effluent quality during the decanting process, and maximizing the potential for dewatering the deposited material by controlling the pattern of deposition. To these ends, the following paragraphs discuss eight unique aspects of site management:

(1) Placement and handling of the supply and return water pipelines
(2) Operation and monitoring of the dredged slurry inlet
(3) Operation and adjustment of the weirs
(4) Monitoring of the released effluent
(5) Inspection of the dike
(6) Continued monitoring of local groundwater
(7) Migratory bird protection
(8) Gopher tortoise protection

5.2.1 Pipeline Placement

Each maintenance and disposal operation over the design life of each DMMA will require the temporary placement of both supply and return pipelines. Given the historical dredging frequency of each Duval County reach, typically spanning between 5 and 10 years, allowing either the supply or return pipelines to remain permanently in place is not economically feasible. Supply and return pipeline access routes and easements for each site, if required, are itemized in **Section 4.1** within each DMMA description. In general, the supply pipeline will traverse the most direct and least environmentally impactful route, between the Waterway and the containment basin property boundary. Once entering the site, the supply pipe will be routed along the outside toe of the dike, entering the basin from the opposite side of the weir and passing over the dike crest. The dredging contractor will install a single return pipeline, via a water-tight connection to the weir discharge pipe such that the decanted water is returned to the Waterway via the identical route, in most cases, as the supply line. Following completion of dredging, the dredging contractor

will remove the supply pipeline. The return pipeline will remain in place until all ponded water is removed and the decanting process is completed.

Stormwater runoff, expected to collect in the containment area, will be treated and decanted via the weir system such that they system will retain any suspended sediment from deposited material and minor dike erosion. The runoff will route, via the manifold system, to the exterior perimeter ditch and either evaporate or seep into the ground. Also, due to the relatively high water table at most Duval County DMMA sites, operation of the DMMA could result in the perimeter ditch overflowing during dredging operations. If necessary, the dredging contractor must pump water from the ditch back into the DMMA to provide adequate stormwater and seepage storage capacity and ensure compliance with water quality discharge criteria.

5.2.2 Inlet Operation

The quality of the dredged sediment, specifically, the settling characteristics of the different grain-size fractions, govern the operation of the inlet (i.e., the point at which the supply pipe discharges the dredged material slurry into the containment basin. The coarsest fraction of material will settle out of suspension very rapidly and form a mound near the inlet. Successively finer fractions, characterized by lower settling velocities, will deposit closer to the outlet weir. Absent an inlet operation strategy, the dominant grain-size fraction will determine the distribution of sediment within the basin. For example, if fine-grained sediments dominate, a relatively large volume of material will concentrate near the weirs. As discussed below, an extensive concentration of fine-grained sediment may require specialized dewatering procedures to speed drying.

As discussed in **Section 3.4** and **Table 3.5**, sediment within the Duval County portions of the Waterway are characterized as predominantly fine to medium quartz sand, slightly silty, with fine to coarse shell fragments. The most extensive deposition of fine silty materials within the Duval County portion of the AIWW are documented within Reach III, Cut 27. Based on the sediment characterizations, two basic strategies of inlet operation and control of sediment deposition within the containment area could occur.

Most of the Duval DMMAs will likely receive sediments characterized primarily as fine to medium sand, with minor silt and clay components. For these DMMAs, the primary strategy makes no attempt to segregate material grain size fractions; however, the position of the inlet will move during disposal operations to minimize mounding of the coarser fraction of sediment and to achieve more uniform deposition. This operational strategy will generally entail a progressive extension of the supply pipe from the point where it enters the containment area, resting each extension on the sediment mound formed by deposition at previous inlet position. A minimum distance of 100 ft must be maintained between the inlet and the inside toe of the dike to prevent erosion or undercutting the interior dike slope. The resulting deposition pattern should maintain a consistent slope from inlet to weir and should minimize dead zones and channelization.

An additional, although secondary, advantage gained through extending the inlet pipeline results from shutting down the dredge plant to allow the addition of each extension. These operational intermissions, together with temporary shutdowns to move the dredge, effectively increase the retention

time of the containment area, thereby increasing the solids retention efficiency of the basin. However, preliminary analysis of containment area performance indicates that attaining adequate effluent quality will not require intermittent dredge operation.

Within areas of discrete shoals or significant depositional strata characterized as predominantly fine-grained materials (e.g. Reach III, Cut 27), such as organic silts or clays, the contractor may be required to employ an alternate strategy of inlet operation to segregate fine sediments. Segregation of the fine-grained fraction to optimize the engineering properties of the remaining sediment can occur by moving the inlet pipe to deposit silts and clays nearer the weirs, thereby keeping the fine material spatially concentrated on one side of the basin. The coarser fraction of material dredged during the same operation can then be deposited along the opposite side of the containment area. This alternate strategy would necessitate additional operating precautions. Given the reduced distance between the area of fine material deposition and the weirs, retention times adequate to allow precipitation of the fine sediment and maintain acceptable effluent quality must occur via additional ponding depth, intermittent dredge operation, or the use of turbidity control devices. Preliminary analysis of the channel sediment core borings indicated that each preliminary designed and constructed DMMA provides adequate solids retention. Combined with the expected shutdowns in pumping operations to relocate the dredge plant and inlet pipe, this strategy would allow for the maintenance of acceptable effluent quality. However, to achieve the desired segregation of fine-grained material, this strategy must also include the removal of a substantial portion, if not all, of the segregated material following dewatering and prior to succeeding placement operations. Design of each Duval DMMA site specifically excludes interior dikes and compartmentalization for segregation of fine sediments.

5.2.2.1 Monitoring Related to Inlet Operation

Dredging operations will require several monitoring procedures related to inlet operations. Ponding depth is a critical parameter for maintaining acceptable containment basin performance. Increased ponding depth improves solids retention performance of the basin by increasing retention time. However, under saturated foundation conditions, unbalanced hydrostatic forces resulting from too great a ponding depth could create the potential for dike failure. Indications of impending dike instability include foundation saturation at the outer dike toe and excessive seepage through the dike's outer slope, followed by piping and small-scale slumping. Obviously, such conditions must not occur. Therefore, the ponded water surface should be allowed to rise above the 2-ft minimum depth only under close monitoring by visual inspection of dike integrity. Experience has shown that as the ponded water percolates into the interior dike slope, the coarser dike material filters the fine suspended sediment. This filtering reduces the dike permeability and thus decreases the dike's susceptibility to excessive saturation and seepage.

Optimal operating efficiency requires that flow through the containment basin approaches plug flow (i.e., flow without any mixing) to the greatest degree possible. Uneven flow distribution — evidenced by irregular sediment deposition, channelization, and short-circuiting — increases flow velocities, reduces retention time, and promotes sediment resuspension. If inspection reveals an irregular deposition pattern, the inlet pipe should be repositioned to produce a more uniform depositional surface.

Lastly, the incoming slurry should be periodically monitored at the containment basin inlet to confirm or refine dredge output specifications, including volumetric output and slurry solids content. These parameters, in combination with the actual duration of dredging, can serve as an independent measure of deposition volume to determine remaining site capacity. Additionally, the computed deposition volume can be used with pre- and post-dredging bathymetric surveys of the channel and, following placement and dewatering of the deposition layer, topographic surveys within the containment basin to refine the bulking factor employed to translate in situ dredging volumes to required storage volumes. Also, within the same monitoring program, the quality of dredged sediment should be established by laboratory analysis of grain size distributions, settling velocities, specific gravity, and Atterberg limits, if appropriate. The results of this monitoring and analysis will provide a basis for the operational management of containment area performance and efficiency.

5.2.3 Weir Operation

Weir operation — that is, controlling the ponding depth and flow rate over the weirs by adjusting the weir crest elevation — is the procedure most critical to maintaining effluent quality during dredging and decanting operations. Operational requirements begin during containment basin construction and continue thereafter. Prior to dredging commencement, the weir crest elevation should be set as high as possible to prevent the early release of effluent. The minimum initial elevation above the mean interior site grade should be equal to the maximum anticipated ponding depth (noted for each constructed DMMA in **Chapter 4.0**).

Once dredging begins, the weir crest elevation should be maintained at its initial elevation until the ponded water surface approaches the weir crest. As ponding depth increases above the 2-ft minimum design depth, the decision must be made to initiate release of the supernatant. Notably, a flow control structure such as a weir cannot improve effluent quality beyond that of the surface water immediately interior to the weir crests. The decision to release effluent over the weirs should be based on the results of turbidity testing or suspended concentration analysis conducted on surface waters inside the weirs. These tests must reflect conditions at the maximum withdrawal depth. If adequate water quality is not achieved prior to the ponded water surface reaching the initial weir crest elevation, the dredge plant must shut down until the surface water turbidity reaches acceptable limits, or until alternative measures such as the installation of turbidity screens or floating baffles are implemented. If the desired water quality is achieved at a ponding depth less than the initial weir crest elevation, the water surface should still be permitted to rise to the weir crest if dike integrity is not threatened.

Once flow over the weirs has begun and effluent of acceptable quality is being produced, as indicated by the effluent sample analysis, the hydraulic head over the weir becomes the most readily used criterion for weir operation. Actual operating head over the weir can be measured on site by two methods. First, it can be determined by using a stage gage, located in the basin where velocities caused by the weir are small (at least 10 – 20 ft from the weir), to read the elevation of water surface and subtracting from it the elevation of the weir crest. The static head can also be determined indirectly by measuring the depth of flow over the weir. If the head over the weir, as measured by either method, falls below the site-specific weir design loading, because of unsteady dredge output or intermittent operation, effluent quality should

increase. However, if the head exceeds these values, the ponding depth should be increased by adding flashboards or temporarily halting dredging to prevent a decrease in effluent quality.

At all times, each of the weirs must be maintained at the same elevation to prevent flow concentration and a decrease in effluent quality related to an increase in weir loading. Preventing floating debris from collecting in front of the weir sections is also important. An accumulation of debris at the weirs will reduce the effective weir crest length and thereby increase the withdrawal depth. This may increase the effluent suspended solids concentration.

5.2.4 Effluent Monitoring

As discussed in the preceding section, effluent monitoring is an integral part of facility operation. Each preliminary designed and constructed Duval DMMA is designed to produce effluent that meets or exceeds water quality standards for Class III waters as set forth in Chapter 62-302, *Florida Administrative Code*. The monitoring program, generally dictated by permit conditions, must therefore continue throughout dredging and decanting operations. Effluent samples should be taken and analyzed as often as practical. The minimum recommended sampling frequency is twice per 8-hour daylight shift. Unless specifically required by permit conditions, no nighttime monitoring of turbidity will occur at the weir discharge pipe, due to safety issues.

5.2.5 Dike Inspection Requirements

Throughout all phases of dredging and dewatering, the contractor shall be responsible for additional inspections of the containment facility related to ensuring the integrity and stability of the containment dikes and related structures. The following paragraphs summarize the required critical and supplemental inspections required to monitor dike condition.

5.2.5.1 Critical Inspections

The contractor shall perform periodic inspections of the containment dikes to check for certain critical conditions that may require implementation of remedial measures. A qualified geotechnical engineer or engineering technician with specific training and experience in performing inspections of earthen dams, earthen reservoirs, or earthen dredged material containment facilities will conduct all inspections. As part of the required pre-construction submittals, the contractor must submit the qualifications of the designated dike inspector for review and approval of the FIND or its authorized representative.

The contractor shall conduct inspections for the items listed below during each day of operation. Any of these conditions could indicate a critical condition that requires immediate investigation and may require emergency remedial action. Immediately upon confirming the existence of a critical condition, the contractor must inform the FIND and its authorized representative and increase the inspection frequency. The FIND will then immediately notify the FDEP. Within 24 hours of confirming a critical condition, the contractor must submit to the FIND and its authorized representative documentation of the inspections and implemented remedial actions. The FIND will then submit to the FDEP a written report detailing the

condition and the implemented remedial actions within 7 days of the confirmation of the critical condition. The following items could indicate a critical condition:

(1) Seepage with boils, sand cones, or deltas on outer face of the dike or downstream from the dike's outer toe
(2) Silt accumulations, boils, deltas, or cones in the drainage ditches at the dike's base
(3) Cracking of soil surface on the dike's crest or on either face of the dike
(4) Bulging of the downstream face of the dike
(5) Seepage, damp area, or boils in vicinity of or erosion around a conduit through the dike
(6) Any subsidence of the crest or faces
(7) Any failure of the weir structure or its operation
(8) Any leaks or seepage of the supply or return pipelines

5.2.5.2 Supplemental Inspections

During the critical inspections described above, the items listed below could indicate potential areas of concern that the contractor must then continue to monitor closely during subsequent inspections and perform repairs as necessary. Within 24 hours of confirming the presence of an indicator of a potential area of concern, the contractor must also inform the FIND and its authorized representative of the item and any required repairs undertaken. Indicators of potential areas of concern include the following:

(1) Overgrown patches of vegetation on the inside and outside portions of the dike
(2) Surface erosion, gullying, or wave erosion on the inside portion of the dike
(3) Surface erosion, gullying, or damp areas on the outside face of the dike, including the berm and the area immediately adjacent to the outside toe
(4) Erosion below any conduit exiting the dike
(5) Wet areas or soggy soil on the outside face of the dike or in the natural soil below dike
(6) Failure of the weir boards, their containing structure, or any blockage or interference of weir operations

5.2.6 Groundwater Monitoring

Per the groundwater monitoring program (**Section 5.1.4**), groundwater monitoring shall continue throughout the duration of DMMA operation.

5.2.7 Migratory Bird Protection

Should dredging become necessary during the migratory bird-nesting season (March 15 – September 1), the FIND or the USACE must coordinate with the USFWS to establish site-specific migratory bird protection activities. Expected activities include education of contractor personnel, daily monitoring for nesting activity, steps to deter nesting activity within the active construction area, avoidance of nests and, if necessary, to protect nesting birds, cessation of construction activities. Alternatives that may be considered to prevent impacts to nesting birds include creation of undesirable habitat (e.g., flagging construction area, placement of ground cover, seeding or sodding exposed areas), dissuasion through noise

or activity, or creation of alternative nesting sites. A final, undesirable alternative — incidental take — should only be considered during a documented emergency.

5.2.8 Gopher Tortoise Protection

Prior to construction, gopher tortoises must be relocated from work areas in accordance with any FWC relocation permit. Relocation permits or the results of consultation with FWC, could require protective measures such as marking buffers (generally 25-ft diameter) around tortoise burrows remaining near the work area or erecting barriers (e.g., silt fence) to exclude tortoises from the work area. Observations of gopher tortoise in the work area during construction will trigger consultation with FWC to determine protective actions.

5.3 Post-Dredging Site Management

Following the completion of each dredging event, the post-dredging phase of disposal site operation occurs. This phase continues until the next maintenance dredging event begins. During the post-dredging phase, dredged material deposited within the containment area is managed to maximize the rate at which its moisture content is reduced. In so doing, the material is made suitable for handling and removal from the site, the primary objective of the DMMA management plan. However, given the permanent nature of each DMMA, other management procedures between active dredging operations must occur. These include a comprehensive monitoring and data collection effort to guide the efficient use and environmental compliance of the disposal area, the handling of stormwater runoff, vegetation control and maintenance, the monitoring and maintenance of site habitat, mosquito control measures, and the provision for adequate ongoing site security. These are discussed in the following sections.

5.3.1 Dewatering Operations

Following the completion of dredging operations, the contractor must continue to operate the weir system and slowly release the clarified surface water that remains ponded within the basin over the weir crest by incrementally removing weir boards. The process, known as decanting, continues until all residual ponded water within the basin at the completion of dredging is released over the weirs. To maintain effluent quality throughout the decanting process, the contractor should allow the flow over the weir to drop essentially to zero before removing another set of weir boards. If at any time during the decanting process monitoring shows effluent turbidity to exceed permitted standards, the contractor must again add weir boards until testing of the ponded water that remains within the basin confirms that turbidity has returned to acceptable limits.

The fine sediment predominant in Reach III is unlikely to dry through natural evaporation and percolation alone. Therefore, the dredging contractor will likely employ supplementary dewatering techniques. The most appropriate dewatering techniques for this purpose include surface water removal, progressive trenching to promote continued drainage, and progressive reworking or removal of the dried surface layer. The following paragraphs discuss each technique and its specific application to the present situation.

Decanting all ponded surface water is necessary before significant evaporative drying of the deposited material can occur. Simply continuing to lower the weir crest will remove most of the ponded water following the completion of dredging operations. However, the anticipated topography of the deposition layer makes draining all ponded water in this manner unlikely. As discussed, differential settling of the various size fractions of the sediment results in partial segregation of the dredged material within the containment basin. Coarser sand- and gravel-sized particles settle nearer the inlet, while finer particles concentrate near the weir. The sand-sized fraction should experience relatively little consolidation because of its low initial water content. However, the fine material's greater consolidation will likely form one or more depressions near the weirs. To remove the ponded water that remains in these areas, a drainage trench may be needed to connect each depression to a sump excavated adjacent to one or more weirs. During this phase of operations, the weir crests may be raised to prevent the premature release of the ponded water which, as a result of the excavation, will likely contain a high concentration of suspended solids. Clarified water can then be released over the weirs as soon as effluent turbidity standards are met.

Following the removal of all remaining ponded water, evaporative drying will eventually form a crust over the deposition layer. This crust will trap water beneath its surface and retard continued evaporation. In addition, the desiccation cracks that quickly form in the crust will hold rainwater and limit further drying. Therefore, complete drying may require additional trenching. Initially, a dragline or clamshell operating from the crest of the containment dike can excavate a perimeter trench. More intensive trenching must wait until a crust of significant thickness (greater than 1 – 2 in.) has developed on the deposition surface. The crusted surface will eventually allow the use of conventional low ground pressure equipment. A network of radial or parallel trenches should then be constructed throughout the area of fine sediment deposition. The slumping resistance of the semiliquid layer beneath the crust will determine the appropriate depth of each trenching operation. The thickness of the fine-grained deposition layer will dictate the number of trenching operations required. After initial construction of the trenches, the DMMA should require grading no more than once to provide sufficient drainage for the relatively thin fine sediment deposition layer. Given a sufficient volume of coarser sediments, the dried surface crust can also be transferred to a more well-drained area of sandier material nearer the inlet. This would expose the wetter under layers and restore a relatively high rate of evaporative drying.

The dewatering process will continue until the moisture content of the deposition layer has lowered to a level necessary for efficient handling and removal. The time required to complete this phase of site operation will depend on the physical characteristics of the sediment, as well as climatic conditions (e.g., rainfall, relative humidity, season, etc.). During the entire dewatering phase, the weirs must be operated to control the release of residual water and impounded stormwater. The clarified effluent will be routed to the perimeter ditch and drained off site.

5.3.2 Grading the Deposition Material

To prepare for the next dredging operation, grading the dried sediment will follow dewatering. Grading will distribute the mounded sand, shell, and gravel over the remainder of the containment area and serve a number of necessary functions. These functions include reestablishing the initial uniform slope from the inlet down to the weirs, restoring the effective plan area of the containment basin, and improving subsequent dewatering of the fine-grained material by separating successive deposition layers with a free-

draining substrate. As discussed in the next section, grading also provides for stormwater runoff control. Finally, a series of post-grading topographic surveys will assess material consolidation and refine estimates of remaining storage capacity.

5.3.2.1 Control of Stormwater Runoff

Grading the dewatered deposition layer provides the additional benefit of allowing the control and release of stormwater that drains from the interior slopes of the containment dike as well as the dewatered sediment. In compliance with regulatory policy, a sump or retention area of adequate capacity should be constructed adjacent to the weirs (with the weir flashboards in place) to retain the runoff from the first 1 in. of rainfall. A site operator would then gradually release the ponded runoff at intervals determined by local weather conditions. Before the dredging contractor demobilizes from the site, the FIND and its authorized representative will determine the weir crest height required to ensure that no uncontrolled release of stormwater occurs following project close-out. This determination will reflect information specific to each placement operation at a specific DMMA site including the bulked volume of the dredged material, the geometry of the deposition, and the specific permit requirements imposed to govern the control and release of stormwater from the DMMA facility. The contractor must then reinstall the weir boards in all weirs at or above this elevation.

After the dredging contractor completes demobilization from the DMMA, responsibility for continued management of stormwater within the basin, as well as all other continuing site maintenance activities between successive dredging operations, resides with the FIND. To this end, the FIND's designated site operator will periodically return to the site to release stormwater as well as the accumulated drainage from the dredged material as it continues to consolidate under its own weight. To release this water, the site operator will remove one or more weir boards from a single stack as necessary to release the surface layer of the ponded water. To minimize the work required, the operator need only open one side of a single weir stack and only to the level to start water flowing over the lowered weir crest. Only when the flow over the lowered weir crest approaches zero should the operator remove another board. This process should continue one board at a time, until all ponded water drains from the site. The operator should then replace the weir boards to the required elevation to prevent uncontrolled stormwater releases.

5.3.3 Material Rehandling/Reuse

As discussed previously, Duval County has six DMMAs to serve the long-term maintenance requirements of the Waterway. This report, as well as the original 1986 report, has emphasized that although each site has been designed for a specific service life, they must also operate as permanent facilities for the intermediate storage and rehandling of dredged material. To fulfill this intended use, at some point the dewatered material will require removal. The following paragraphs discuss the ultimate use of this material.

Based on a comprehensive analysis of dredging records and recent survey data, the bulked material volume projected for placement and temporary storage over the 50-year design service life of the six facilities serving the Duval County segment of the Waterway exceeds 3.9 million cy (**Table 3.3**), by any standards a significant volume of potentially valuable material. Even if the possible return on the sale of this material were disregarded, the cost savings of permanent storage alone would justify an effort to

determine, through a formal market analysis, the potential demand for dewatered dredged material. If such a determination shows that material resale and/or reuse is practical, the properties of the dredged material must satisfy the requirements of commercial interests. The coarsest fraction of material (sand and gravel) can likely be used as fill or construction material. The predominantly fine-grained material, containing large percentages of organic silt or clay, may prove suitable for municipal composting or agricultural amendments once rainfall and percolation have reduced its chloride content. Elevated concentrations of contaminants that remain below the threshold for environmental hazard could further limit the material to ornamental horticulture (e.g., sod farms) or landfill capping.

A determination by the FIND that resale, or reuse is unfeasible will dictate locating and developing one or more permanent storage site(s). The appropriate location for such sites would appear to be inland where lower real estate values and development potential make permanent storage more economically feasible. The optimal distance from the initial containment area(s) to the permanent storage site would represent a compromise between lower land costs and higher transportation costs.

5.3.4 Maintenance of Vegetative Cover

Following construction of the containment facility, and again following each use of the facility to receive and dewater dredged material, the FIND will remain responsible for establishing and maintaining a vegetative cover on all exposed surfaces of the dike. To prevent the establishment of shrubs, trees, or other woody vegetation, the dike's slopes and crest will be regularly mowed. Mowing will maintain vegetation sufficiently short to allow visual inspection of the soil surfaces in critical areas such as

(1) The condition of vegetation and soil surface on the dike and in areas up to 50 ft from the outside toe;
(2) The condition of drainage ditches in the area of the base of the dike;
(3) The freeboard surface above liquid surface elevation; and
(4) The condition of spillways and water level control structures, including all conduits exiting the dikes.

The FIND should conduct periodic inspections of both the interior and exterior of the dike berm for herbaceous vegetation potentially damaging to the berm integrity. Removal of this vegetation, by hand or mechanically, shall occur regularly and in a manner that maintains berm integrity. Regular spot treatment (with proper herbicides) for herbaceous vegetation should occur as needed.

5.3.5 Additional Environmental Considerations

5.3.5.1 Migratory Bird Protection

Available sediment data suggest that the deposition layer will present very little sandy substrate, and thus should prove poorly suited for migratory bird nesting. However, given sufficient sandy material, migratory birds may nest in portions of the containment basin following dewatering and grading as well as on the containment dike. Should post-dredging site management activities be required during the March 15

– September 1 nesting season, they will be carried out in accordance with site-specific migratory bird protection activities developed in consultation with USFWS.

5.3.5.2 Gopher Tortoise Protection

Gopher tortoise management will continue as a post-construction activity in accordance with any tortoise relocation permit conditions.

5.3.5.3 Groundwater Monitoring

After the release of all ponded water remaining from the previous dredging operation, post-dredging groundwater sample collection will begin. During this period, groundwater samples will be collected and analyzed monthly for the first year following completion of decanting and quarterly thereafter unless otherwise needed. Conditions may warrant more frequent sampling intervals. Should elevated chloride levels be detected at any time, corrective actions will be taken.

5.3.5.4 Mosquito Control

The basic approach of the mosquito control program for each DMMA in Duval County will emphasize physical rather than chemical control. The time during which standing water remains inside the containment area will be kept to a minimum to reduce the potential for mosquito breeding. The operational phase most favorable for mosquito breeding follows decanting when desiccation cracks form in the crust. Trenching procedures will accelerate the dewatering process. However, given the anticipated thickness of the deposition layer and the nature of the dredged material, the dewatering phase could extend long enough to result in mosquito breeding within the desiccation cracks and residual ponds. This situation could require a short-term spray program coordinated through the Mosquito Control Division of the Environmental Resource Management Department, City of Jacksonville.

5.3.5.5 Site Security

Providing adequate security will remain a key element in the proper management of each DMMA. Unsecured dredged material containment areas typically host a variety of unauthorized activities including illegal dumping, vandalism, hunting, and dike destruction by off-road vehicles. With exception of the DU-6B portion of DMMA DU-6A & 6B, permanent security fencing, erected around the site's perimeter, and locked gates control access at each Duval County DMMA site.

Authorized access to the DMMAs is restricted to agents and representatives of the FIND, USACE Jacksonville District, and, when required, contractor personnel. Access gates will remain locked at all times except during dredging and maintenance operations. The presence of an on-site operator during such operations should further discourage unauthorized entry to the site and the occurrence of unsanctioned activities. Between dredging operations, the site operator will be responsible for carrying out regularly scheduled security inspections. These inspections, which may occur in conjunction with routine operational functions, intend to ensure that facility security is maintained. Breaches in site security will be identified and appropriate actions will be taken as quickly as possible to restore the security measures.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The 22.36-mile Duval County project area — comprising five reaches (Reaches III – VII), 50 cuts (27 – SJ-3), and portions of the AIWW, JHP, and ICWW federal navigation projects — extends from the centerline of Nassau Sound to just north of the DU-9 dredged material management placement site in St. Johns County. The dredged material placement sites for Duval County — established through a detailed evaluation and selection of a dredged material management concept, consistent evaluation criteria, and public involvement — comprise six upland DMMAs (DU-2, DU-3&4, DU-6A & 6B, DU-7, DU-8, and DU-9). Together, these sites, when fully constructed, will provide sufficient storage capacity to manage the amount of material dredged from the five reaches over a 50-year period.

A review of the historical maintenance dredging record and recent shoaling data provided the 50-year dredging and material storage requirements. The resulting volumes equate to approximately 1,815,555 cy and 3,903,443 cy, respectively. Previous physical analyses indicate sediments characterized as fine to medium quartz sand, slightly silty, with fine to coarse shell fragments with the most extensive deposition of fine silt materials occurring in Cut 27 (in vicinity of Sawpit Cut-off). Chemical analyses of samples collected in 1979 and 1981 indicate no consistent pattern of significant contamination and particularly do not indicate that dredging would result in any significant degradation of ambient water quality. To date, Waterway maintenance dredging has occurred without regulatory agencies requiring collection and evaluation of additional sediment quality data. Historical maintenance dredging records indicate median dredging frequencies of 6 – 7 years for the AIWW reaches (Reach III and IV), 10 years for ICWW Reach V, and 3 – 5 years for ICWW Reaches VI and VII.

The design and operation overview of the six upland DMMAs revealed a few considerations for future use (including both maintenance and construction activities) of each site. As noted previously, four of the six DMMAs are constructed, to some degree, in Duval County. With only four of the recommended sites constructed (i.e., DMMA DU-2, DU-6A, DU-8, and the smaller containment area for DU-9), the combined and current design storage capacity (1,756,427 cy) meets only a portion of the 50-year storage capacity requirement (3,903,443 cy) DMMA DU-3&4, DU-6B, DU-7, and the larger, permanent containment area for DU-9 all require construction to fully realize the potential of the Duval County DMMP. **Table 6.1** provides a tabular summary of the primary DMMA features.

Table 6.1 DMMA Summary

Reach	DMMA	Status			50-Year Material Storage Requirement (cy)	DMMA As-Built/Design Capacity (cy)	Engineering/ Operational Issues
		Constructed	Operation Permit	Cultural Resources			
III	DU-2	Y	N	N	1,720,575	394,972	• Site nearing capacity • Deficient reach storage capacity • Continued maintenance issues related to fencing and debris/trash removal
	DU-3&4	N	N	Y		1,342,310	• Site needs to be constructed to help resolve deficient reach storage capacity • Archaeological site in SW site corner. Must coordinate and involve archaeological staff at pre-construction conference. • MSA 300E remnant dike, disposal material, and weir needs to be removed off-site
IV	DU-6A	Y	N	N	513,154	730,219	• Pipeline easement required to cross Heckscher Drive • USACE easement bisects DU-6A & DU-6B site
	DU-6B	N	N	N		109,450	
V	DU-7	N	N	Y	82,076	99,400	• Four separate archaeological sites within project buffer need to be avoided during construction and operation of the DMMA • Road access
VI	DU-8	Y	N	N	189,714	208,236	• Required gopher tortoise habitat area in the buffer area to be maintained and preserved
VII	DU-9 (as-built)	Y	Y	N	1,397,926	423,000[1]	• Deficient reach (and overall ICWW) storage capacity without construction of permanent site • FDEP institutional controls related to conditional closure of Dee Dot Sludge Disposal Area No. 2 • Continued maintenance of shut-off valve and submerged pipeline
	DU-9 (expanded)	N	N	N		1,121,820[2]	
III – VII		–	–	–	3,903,443	3,307,587[1] 4,006,407[2]	• With the four constructed sites, total design capacity sums to 1.8 million cy leaving a 50-year storage capacity deficit of 2.1 million cy.

[1]Capacity with current (as-built) DU-9 containment area; [2]Capacity with permanent, expanded (build-out) DU-9 containment area

6.2 Recommendations

While the immediate dredged material storage needs of the Duval County DMMP have largely been addressed, several outstanding requirements remain to meet the full potential of the outlined plan. With only a portion of the recommended sites constructed, the combined and current design storage capacity meets only a portion (1,756,427 cy) of the 50-year storage capacity requirement (3,903,443 cy). Recommendations, in order of priority, are outlined as follows.

(1) Determine operational permit requirements for constructed DMMAs
(2) Permit, design, and construct the permanent, expanded DMMA DU-9 containment basin
(3) Develop a market analysis for the DMMA DU-2 sediment and offload facility
(4) Permit, design, and construct the DMMA DU-3&4 facility
(5) Acquire remaining pipeline easement segment for the DMMA DU-6A & 6B facility
(6) Permit, design, and construct the DMMA DU-7 facility

7.0 REFERENCES

Deeds / Easements

1988. Order of Taking. Case No. 88-7473-CA. DMMA DU-3&4. Duval County, Florida.

1988. Quit-Claim Deed. Vol. 6620. Pages 1762 – 1768. DMMA DU-7. Duval County, Florida.

1989. Warranty Deed. Vol. 6753. Pages 1503 – 1504. DMMA DU-6A. Duval County, Florida.

1990. Warranty Deed. Vol. 6962. Pages 0139 – 0141. DMMA DU-2. Duval County, Florida.

1991. Special Warranty Deed. Vol. 7137. Pages 2021 – 2022. DMMA DU-8. Duval County, Florida.

1994. Certificate of Lands for Project Title and Attorney's Title Certificate. DMMA DU-3&4. Duval County, Florida.

1994. Certificate of Lands for Project Title and Attorney's Title Certificate. DMMA DU-7. Duval County, Florida.

1995. Purchase Agreement. O.R. 1097. Pages 1039 – 1068. DMMA DU-9. St. Johns County, Florida.

1996. Certificate of Lands for Project Title and Attorney's Title Certificate. DMMA DU-9. Duval County, Florida.

2002. Quit-Claim Deed. Book 10780. Pages 183 – 185. MSA-FIND 109-A, MSA-FIND-109-B. Duval County, Florida.

Environmental Reports

Ellis, G.D. 1995. *Phase II Investigation at 8DU7495, West Central Black Hammock Island, Duval County, Florida.* Ellis Archeology. Lecanto, FL.

Environmental Sciences. 2001. Environmental Site Documentation for DMMA DU-6B, Duval County, Florida.

Johnson, R.E., Basinet, B.A., Dickel, D.N. and Fradkin, A. 1998. *A Phase II Archeological Investigation of Florida Inland Navigation District Tract DU-7, Greenfield Peninsula, Duval County, Florida.* Florida Archeological Services, Inc. Jacksonville, Florida.

Mosura, E. L. 1987. *Environmental Site Documentation for Proposed Dredged Material Management Disposal Areas in Northeast Florida; Volume V – West Central Black Hammock Island.* Water & Air Research, Inc. Gainesville, FL.

Mosura, E. L. 1987. *Environmental Site Documentation for Proposed Dredged Material Management Disposal Areas in Northeast Florida; Volume IV – Moody Marine*. Water & Air Research, Inc. Gainesville, FL.

Mosura, E. L. 1988. *Environmental Site Documentation for Proposed Dredged Material Management Disposal Areas in Northeast Florida; Volume VIII – Fanning Island*. Water & Air Research, Inc. Gainesville, FL.

Mosura, E. L. 1992. *Environmental Site Documentation for Proposed Dredged Material Management Disposal Areas in St. Johns County; Pablo Creek Alternative 2 Site (extended southerly)*. Water & Air Research, Inc. Gainesville, FL.

Mosura, E. L. 2002. *Environmental Site Documentation for Site DU 3 & 4 / MSA 300E; Proposed Dredged Material Management Disposal Areas in Duval County, Florida*. Water & Air Research, Inc. Gainesville, FL.

Russo, M., Cordell, A.S., and Ruhl, D.L. 1992, The Timucuan Ecological and Historic Preserve Phase III Final Report (Draft). National Park Service. Southeast Archaeological Center, Tallahassee, FL.

SouthArc, Inc. 1998. *Atlantic Marine Navy Dry Dock Project Archaeological Evaluation.* Gainesville, FL.

Stem, L.T., Dollar, H.D., Howell, D.A., Lewis, D.L., Wettstein, C.A., and Yamataki, H. 1978. *Soil Survey of City of Jacksonville, Duval County, Florida.* Soil Conservation Service, U.S. Department of Agriculture, Washington, D.C.

Taylor Engineering. 1995. *Preliminary Environmental Assessment for the Construction of Dredged Material Management Area DU-9 (Pablo Creek Alternative 2 Southern Extension); Intracoastal Waterway, St. Johns County, Florida.* Jacksonville, Florida.

USEPA. 1989. *Final Screening Site Inspection Report; Dee Dot's Ranch Sludge Farm; City of Jacksonville, Duval and St. Johns Counties, Florida.* EPA ID#FLD981026420. USEPA Waste Management Division.

USEPA. 1992. *Site Inspection Prioritization; Dee Dot Ranch Sludge Landfarm; Jacksonville, Duval and St. Johns Counties, Florida*. Document Control No. C04119-SIPS-LC-050. USEPA, Region IV.

Watts, F. C. 1998. *Soil Survey of Coty of Jacksonville, Duval County, Florida Natural Resources Conservation Service.* U.S. Department of Agriculture. Washington, D. C.

Geotechnical Data / Reports

Challenge Engineering & Testing, Inc. 2009. *Final Report Vibracore Sampling and Laboratory Testing; Atlantic Intracoastal Waterway Nassau Sound to Sawpit Creek; Jacksonville to Miami, Florida.* Contract # W912EP-05-D-0010. Delivery Order # 0018. U.S. Army Corps of Engineers – Jacksonville District, Geotechnical Branch.

Ellis & Associates, Inc. 1999. *Report of Geotechnical Exploration, DMMA DU-9, Dee Dot Ranch Property, St. Johns County, Florida.* E&A Project NO. 99-1018. Jacksonville, FL.

MACTEC Engineering and Consulting, Inc. 2003. *Preliminary Report of Geotechnical Exploration. DU-9 Dredged Material Management Area, Florida Inland Navigation District, St. Johns County, Florida.* MACTEC Project No. 6734-03-8695. Jacksonville, FL.

MACTEC Engineering and Consulting, Inc. 2003. *Groundwater Modeling Evaluation. Proposed DU-9 Dredged Material Management Area, St. Johns County, Florida*. MACTEC Project No. 6734-03-8695. Jacksonville, FL.

MACTEC Engineering and Consulting, Inc. 2004. *Report of Exploratory Borings, FIND Site DU-3&4 / MSA 300E, Sawpit Road, Jacksonville, FL.* Project No. 6734-04-8800. Jacksonville, FL.

Thompson Engineering Testing, Inc. 1987. Core Boring Logs and Results of Laboratory Testing; Disposal Areas – IWW & AIWW Nassau/Duval Counties, Florida. Mobile, AL.

USACE. 2008. *Grain Size Analysis of Dredged Material Placed in Dredged Material Management Area DU-2 between 1995 and 2006*. Department of the Army, Jacksonville District, Corps of Engineers, Jacksonville, FL.

Regulatory

FIND Maintenance Dredging of Cuts DU-7, DU-8, and DU-9. Florida Department of Environmental Protection File No. 16-246683-001-EE.

FIND DMMA DU-9 Florida Department of Environmental Protection Environmental Resources Permit (55-129250-001-E1, 55-129250-002-EM, 55-129250-003-EG, 55-129250-005-EM). Issued 4/27/2000, 4/1/2004, 11/12/2008, 9/15/2010.

USACE. DMMA DU-9 Department of the Army Nationwide Permit (SAJ-2008-4116).

USACE. 2004. Public Notice. *Construction of Dredged Material Management Area (DMMA) DU-2. Notice Number PN-CO-IWW-273.* Department of the Army, Jacksonville District, Corps of Engineers, Jacksonville, FL.

USACE. 1994. *Memorandum for Record. Statement of Finding (SOF) for Proposed Dike Construction for the Atlantic Intracoastal Waterway (AIWW), Fernandina to St. Johns River (F-SJ) Disposal Area (D/A) DU-2 and Intracoastal Waterway, Jacksonville to Miami (J-M), Disposal Area (D/A) DU-8, Duval County, Florida.* Department of the Army, Jacksonville District, Corps of Engineers, Jacksonville, FL.

USACE. 1991. Diked Disposal Area Construction Fanning Island; Jacksonville Harbor, Florida; Finding of No Significant Impact. Department of the Army, Jacksonville District, Corps of Engineers, Jacksonville, FL.

Planning and Design Documents

Brownell, L. S., Schropp, S. J., Adams, J., and Taylor, B. 2016. *Long-Range Dredged Material Management Plan Update for the Intracoastal Waterway Nassau County, Florida*. Taylor Engineering, Inc., Jacksonville, FL.

Carvalho, A. 2006. SURVEY 2004. Taylor Engineering, Inc. Jacksonville, FL.

Craig, K.R. and Brownell, L.S. 2000. SURVEY 2000. Taylor Engineering, Inc. Jacksonville, FL.

Craig, K.R, Dompe, P.E., and Schropp, S.J. 1996. SURVEY 1996. Taylor Engineering, Inc. Jacksonville, FL.

DER. 1986. *Guide to the Interpretation of Reported Metal Concentrations in Estuarine Sediments*" (DER, 1986). Tallahassee, FL.

Gallagher, B. J. and Company. 1978. *Investigation of Containment Area Design to Maximize Hydraulic Efficiency*. Technical Report D-78-12. U. S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Haliburton, T. A. 1978. *Guidelines for Dewatering/Densifying Confined Dredged Material.* Technical Report DS-78-11. U. S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Palermo, M. R., Montgomery, R. L. and Poindexter, M. E., 1978. *Guidelines for Designing, Operating, and Managing Dredged Material Containment Areas.* Technical Report DS-78-10. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

Ryan, J.D., Calder, F.D., Burney, L.C. 1984. *Deepwater Ports Maintenance Dredging and Disposal Manual. A Guide to Planning and Estuari*ne Chemical Data Collection, Analysis and Interpretation. U.S. Department of Commerce. NOAA Coastal Services Center Library. Charleston, SC.

Setser, D. M., Brownell, L. S., Armbruster, J. A., Taylor, R. B. 2003. *Florida Inland Navigation District Seepage Control Feasibility Study.* Taylor Engineering, Inc., Jacksonville, FL.

Shields, F. D., Thackston, Jr. E.L., and Schroeder, P.R. 1987. *Design and Management of Dredged Material Containment Areas to Improve Hydraulic Performance, Technical Report D-87-2*. U.S. Army Waterways Experiment Station, CE, Vicksburg, MS.

Taylor, R. B., McFetridge, W.F. 2009. *Technical Addendum; Weir Design Modifications and Operational Guideline, Site DU-3&4/MSA-300E, Duval County.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F. 2009. *Technical Addendum; Weir Design Modifications and Operational Guideline, Site DU-6A, Duval County.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F. 2008. *Technical Addendum; Weir Design Modifications and Operational Guideline*, Site DU-8, Duval County. Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F. 2008. *Technical Addendum; Weir Design Modifications and Operational Guideline*, Site DU-2, Duval County. Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F., Wagner, R.J., 2005. *Management Plan; DU-6B Dredged Material Management Area.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F., Wagner, R.J., 2002. *Management Plan; DU-3&4/MSA 300E Dredged Material Management Area, Duval County, Florida.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F., Wagner, R.J., 2000 (Revised from 1993). *Management Plan; DU-9 (Pablo Creek) Dredged Material Management Area.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F., 1999. *Management Plan; DU-7 Dredged Material Management Area, Duval County, Florida.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F., 1994. *Management Plan; Moody Marine Disposal Area.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W. F. 1989. *Engineering Evaluation of Proposed Dredged Material Transfer and Handling Operation.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W. F. 1988. *Management Plan, Fanning Island Disposal Area.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W.F. 1988. *Management Plan; Northeast Black Hammock Island Disposal Area (Phase I Designator A-12.4 W-27.3).* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W. F. 1988a. *Management Plan, West Central Black Hammock Island Disposal Area.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W. F. 1988b. *Management Plan, Central Black Hammock Island Disposal Area.* Taylor Engineering, Inc., Jacksonville, FL.

Taylor, R. B., McFetridge, W. F. 1986. *Long-Range Dredged Material Management Plan for the Intracoastal Waterway in Northeast Florida.* Taylor Engineering, Inc., Jacksonville, FL.

USACE. 1993. *Engineering and Design Seepage Analysis and Control for Dams.* Engineering Manual 1110-2-1901. Washington, DC.

USACE. 2000. Planning Guidance Notebook. Engineering Regulation 1105-2-100.

Walski, T. M. and Schroeder, P. R. 1978. *Weir Design to Maintain Effluent Quality from Dredged Material Containment Areas.* Technical Report D-78-18. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS.

Surveys

Cody's Professional Surveying & Mapping, Inc. 2010. *As-Built of DU-9 Permanent Discharge Pipeline for TB Landmark, Inc.* Project No. 11710. Jacksonville, FL.

DeGrove Surveyors, Inc. 2005. Map Showing Topographic Survey of the IWW Disposal Area DU-9 Lying in Township 3 South, Range 29 East, St. Johns County, FL. Jacksonville, FL.

Sea Diversified, Inc. 2014. *Hydrographic Survey of the Intracoastal Waterway, Duval County, Florida.* Project Number 13-2078. Sea Diversified, Inc. Delray Beach, FL.

Sea Diversified, Inc. 2015. *Hydrographic Survey of the Intracoastal Waterway Nassau County, Florida*. Project Number 13-2078. Delray Beach, FL

USACE. 1993. Atlantic Intracoastal Waterway, Norfolk, VA to St. Johns River, FL and Intracoastal Waterway, Jacksonville, FL to Miami, FL, Plans for D/A Construction, DU-2 & DU-8. Department of the Army, Jacksonville District, Corps of Engineers, Jacksonville, FL.

USACE 1993. *Dike Construction D/A-D3 As-Built.* (AKA DMMA DU-6A). D.O. File No. 6-36, 504. Atlantic Intracoastal Waterway Norfolk, VA. to St. Johns River, Florida between Fernandina to St. Johns River.

USACE Hydrographic Survey No. 04-021. 2004. *Intracoastal Waterway, Jacksonville to Miami, Project Condition Survey.*

USACE Hydrographic Survey No. 10-039. 2010. *Atlantic Intracoastal Waterway, Fernandina to St. Johns River, Nassau County, Fla. (Cuts 7 thru 24).*

USACE Hydrographic Survey No. 11-062. 2011. *Intracoastal Waterway, Duval County, Fla (Cut DU-1 thru DU-8).*

USACE Hydrographic Survey No. 11-063. 2011. *Atlantic Intracoastal Waterway, Fernandina to St. Johns River, Nassau County, Fla. (Cuts 1 thru 8).*

USACE Hydrographic Survey No. 12-117. 2012. *Atlantic Intracoastal Waterway, Fernandina to St. Johns River, Nassau County, Fla. (Cuts 24 thru 27C).*