

LONG-RANGE DREDGED MATERIAL  
MANAGEMENT PLAN FOR THE  
INTRACOASTAL WATERWAY  
IN BREVARD COUNTY,  
FLORIDA

Final Report  
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Prepared for:  
FLORIDA INLAND NAVIGATION DISTRICT

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## EXECUTIVE SUMMARY

The identification and permitting of suitable dredged material disposal sites for the Intracoastal Waterway in Florida has become increasingly difficult because of the nature of dredging and disposal operations and the environmentally sensitive areas in which they occur. In response to this situation the Florida Inland Navigation District has initiated a program of long term dredged material management. It is intended that this program, the FIND's Fifteen Year Atlantic Intracoastal Waterway Maintenance and Management Plan, will provide a permanent infrastructure for accommodating all maintenance material dredged from Waterway channels. The pilot study which addressed the needs of the Waterway within Nassau and Duval Counties is now nearing completion with the acquisition of seven upland sites upon which permanent dredged material management facilities will be constructed. The remainder of the Waterway south to Miami is being treated on a prioritized county-by-county basis with St. Johns, Brevard, and Palm Beach Counties constituting the second group of counties to be addressed. This report documents Phase I of a two-phased effort to develop the dredged material management plan for the Intracoastal Waterway in Brevard County.

### Work Performed

The methods used in the development of the long-range dredged material management plan for the Intracoastal Waterway in Brevard County are based on the previous pilot study addressing similar needs within Nassau and Duval Counties. Elements of the plan development were as follows: (1) Establishment of the 50-year disposal requirement within the Brevard County project area based on historical maintenance dredging volumes and subsequent examination surveys; (2) Evaluation of existing easements and/or disposal areas within the project area to determine the disposal capacity deficit; (3) Development of a disposal concept or strategy appropriate to specific engineering and operational requirements, and environmental and land-use constraints; (4) Identification of candidate disposal sites consistent with the disposal concept; and (5) Evaluation of all candidate sites based on a standard set of evaluation criteria developed within the framework of the disposal concept, and reflecting engineering, operational, environmental and land-use considerations.

To begin this process, engineering records at the Jacksonville District Office of the Army Corps of Engineers were reviewed and analyzed to develop estimates for the fifty-year maintenance dredging and disposal requirements of the 71 miles of channel within the study area. The analysis showed a projected total disposal requirement of 7,583,155 cubic yards of bulked material distributed over six channel reaches. Preliminary assessment of the 11 tracts involving over 10,000 acres to which the FIND currently holds a disposal easement revealed that almost all of these easements are submerged lands, with only isolated spoil islands of inadequate size for disposal site development. Only one existing easement was retained for further consideration.

Having established the maintenance characteristics of the Waterway and the projected fifty-year disposal requirement, a disposal concept was then developed to focus the selection of disposal alternatives in a manner consistent with the unique characteristics of the study area and the projected channel maintenance requirements. In this manner, unrealistic and impractical disposal alternatives were eliminated and the identification of more reasonable alternatives could proceed in a logical manner. In addition, as will be seen shortly, the disposal concept embodies principles which have long term implications regarding the management of material dredged from the Waterway. The concept adopted for Brevard County is stated as follows:

- (1) All future dredged material disposal will be confined to upland areas to the maximum extent possible as determined by site availability.
- (2) Sites will be established to provide centralized disposal in a minimum number of locations per operating reach of Waterway as determined by the analysis of historical data.
- (3) Disposal sites will be operated and maintained as permanent facilities.

Within this framework a total of 25 candidate sites were identified for further consideration. Each site was then field inspected and evaluated under a standard set of criteria addressing engineering, operational, environmental and land use considerations. By this process, 14 sites were selected to form a site bank of 7 primary or first choice disposal options and 7 secondary or alternative sites. Included among the primary disposal options is a site in the vicinity of Rockledge,

Florida presently being acquired by the FIND.

Experience gained from the earlier Nassau-Duval project has demonstrated the importance of the systematic documentation of disposal alternatives and the basis upon which these alternatives are evaluated. This Phase I report provides such information for the long-range dredged material management plan for the Intracoastal Waterway in Brevard County. All work performed under this contract is documented in this report and a companion set of 101 photobase engineering plans which summarize pertinent channel and disposal site information. Phase II of this project will develop all of the detailed engineering, environmental, and survey information necessary to design, permit, and construct permanent dredged material disposal facilities on each of the sites selected. Cost considerations associated with these actions, as well as the development of detailed site operation and management plans, will also be addressed. A detailed scope of work for Phase II of the project is presented in Section 5.0 of this report.



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## 1.0 INTRODUCTION

This report documents work performed during the first phase of a two-phased effort to develop a fifty year plan for the management of maintenance material dredged from Intracoastal Waterway channels in Brevard County, Florida (Figure 1-1). The initial phase of the project focuses on the development of basic plan concepts, the definition of short and long-term dredging requirements, and the identification of suitable disposal alternatives which satisfy these requirements based on preliminary environmental, engineering, and operational criteria. During Phase II of the project, detailed site-specific information required for the preparation and submission of permit applications for the primary or first-choice disposal sites identified in Phase I will be obtained and documented. In addition, the design of disposal site facilities, and the construction and continuing operation and maintenance of these sites as permanent dredged material management facilities will be addressed.

The methods used in the performance of the work reported herein are based on a previous study which addressed similar needs of the Waterway within Nassau and Duval Counties, Florida (Taylor and McPetridge, 1986). This earlier effort was performed under the sponsorship of the Florida Inland Navigation District (FIND) and was intended to serve as a pilot study for the FIND's Fifteen Year Atlantic Intracoastal Waterway Maintenance and Management Plan. Phase II of the Nassau-Duval study is now nearing completion with the acquisition of seven upland sites upon which permanent dredged material management facilities will be constructed. It is intended that these facilities serve the needs of the Waterway within Nassau and Duval Counties for a minimum period of 50 years.

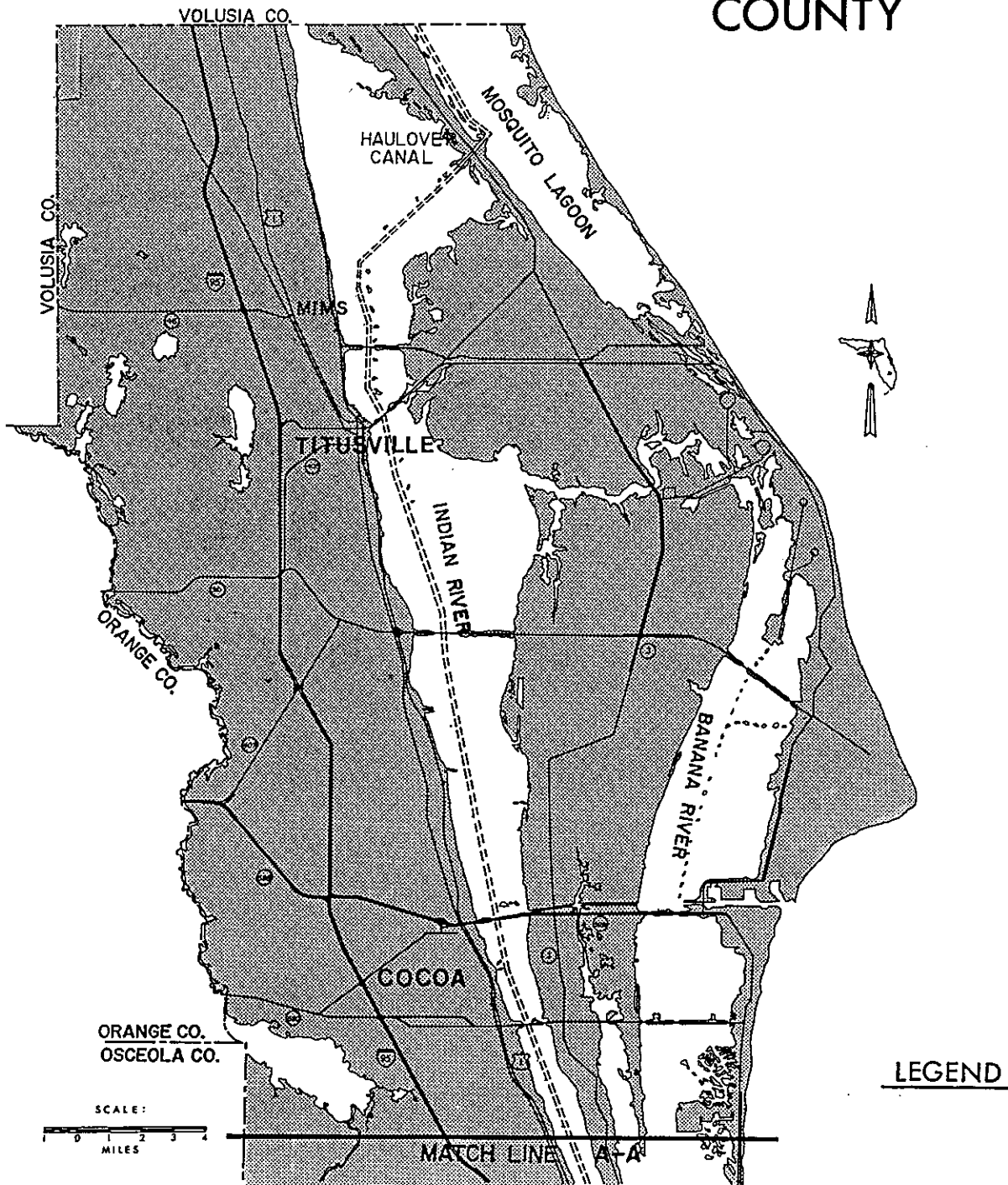
Experience gained from this earlier project has demonstrated the importance of the systematic documentation of disposal alternatives and the basis upon which these alternatives are evaluated. This report provides such information for the long range dredged material management plan for the Intracoastal Waterway in Brevard County.

### 1.1 Background

Since its formation in 1927 the Florida Navigation District (FIND) has served as the state governmental body responsible for maintaining Intracoastal Waterway (ICWW) channels along the east coast of Florida between Fernandina Harbor and Miami.



# BREVARD COUNTY



SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



**TAYLOR ENGINEERING INC**

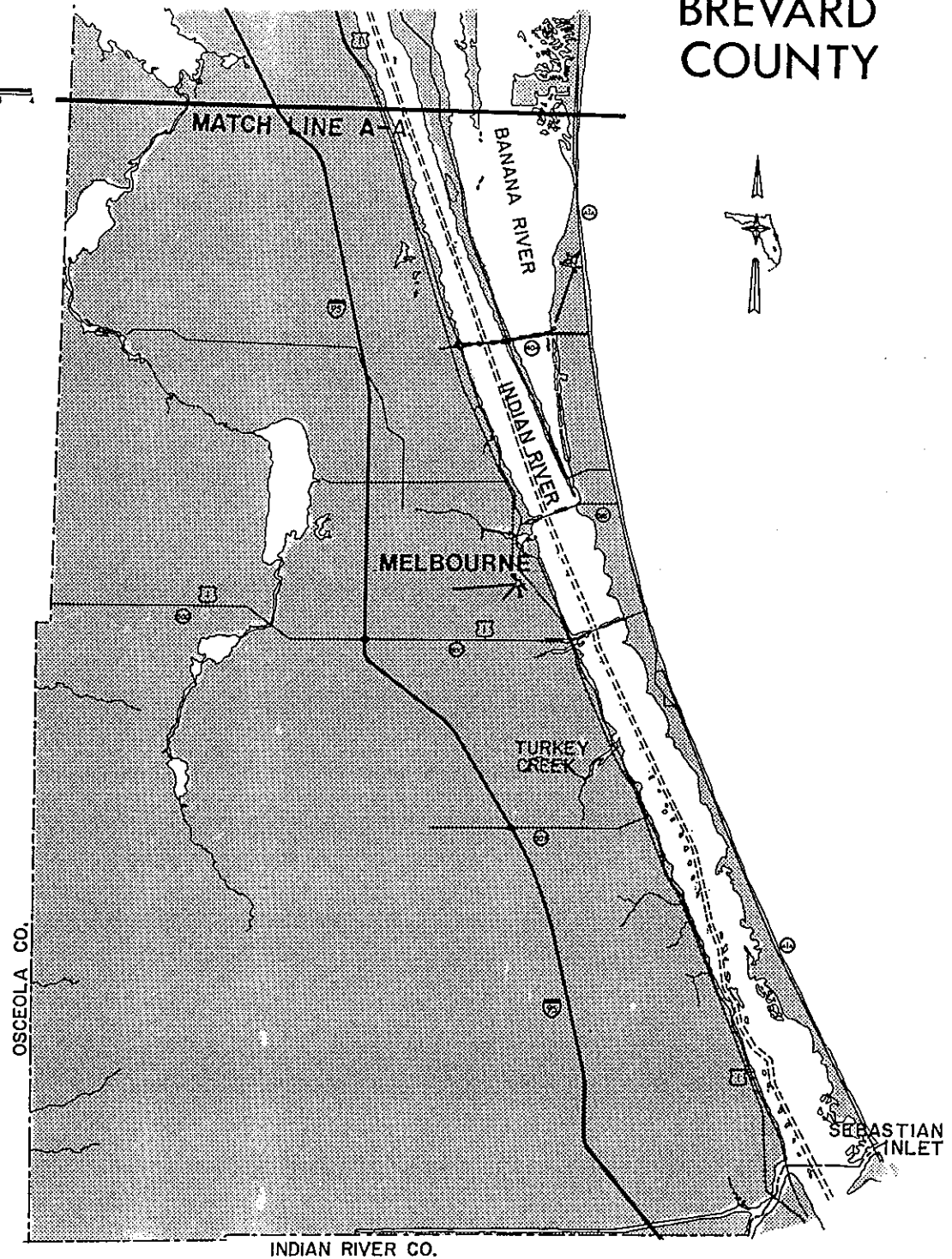
9086 CYPRESS GREEN DRIVE  
JACKSONVILLE FLORIDA 32216

**Figure 1-1a: Study Area, Dredged  
Material Management Plan,  
Intracoastal Waterway, Brevard  
County, Florida**

PROJECT	C8906
REVISION	
SHEET	
DATE	9/30/89

# BREVARD COUNTY

SCALE:  
0 1 2 3  
MILES



## LEGEND

SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



**TAYLOR ENGINEERING INC**  
9086 CYPRESS GREEN DRIVE  
JACKSONVILLE FLORIDA 32216

**Figure 1-1b: Study Area, Dredged  
Material Management Plan,  
Intracoastal Waterway, Brevard  
County, Florida**

PROJECT	C8906
REVISION	
SHEET	
DATE	9/30/89

As such, the FIND must provide to the U.S. Army Corps of Engineers disposal sites suitable for the placement of material dredged from the authorized federal navigation channel.

Prior to the increased environmental awareness of the 1970's, and the recognition by various federal and state regulatory agencies of the value of estuarine wetlands, the disposal of dredged material was guided by an approach which emphasized short-term economy. Engineering, cost, and operational considerations were of primary importance in the design and execution of channel maintenance projects. To this end, an abundant number of perpetual easements had been granted to the FIND by the Trustees of the Internal Improvement Trust Fund (hereafter referred to as Trustees). The majority of these were located entirely within the sovereign waters of the State and included both open water areas and expanses of pristine salt marsh. 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 the dredging contractor to maximize operational efficiency, resulted in the proliferation of numerous spoil mounds and islands lining the waterway.

As a result of society's increased environmental awareness and the scientific knowledge upon which it is based, the unconfined disposal of dredged material within wetland areas is no longer a responsible approach to the maintenance of the Waterway. Neither is it a realistic approach given present day agency reviews and permitting constraints. Current State and federal legislation mandates that all dredging and dredged material disposal activities satisfy a spectrum of environmental requirements dealing with water quality, habitat protection, threatened and endangered species, and the filling of wetlands. The long range implications of these constraints become more apparent as existing sites reach capacity, and the identification and permitting of dredged material disposal sites becomes increasingly difficult. Moreover, the intensive development pressure being experienced throughout coastal Florida has made the acquisition of additional disposal areas an ever more expensive proposition.

In order to secure its ability to maintain the Waterway within the existing framework of engineering, operational and environmental constraints, the FIND initiated a fifteen year program of long-term planning and site acquisition to

provide a means for accommodating all maintenance material dredged from the Intracoastal Waterway during the next fifty years and beyond. The first program element, addressing the needs of the Waterway within Nassau and Duval counties, was briefly described in Section 1.0. The continuation of the program, is now guided by a prioritization of waterway segments, county by county, based on the immediate need for channel maintenance and the relative difficulty of providing appropriate disposal areas. This prioritization, jointly decided upon by the FIND and the Jacksonville District, U.S. Army Corps of Engineers, identified three counties, St. Johns, Brevard, and Palm Beach, as the second group of counties for which long range dredged material management plans were needed.

## 1.2 Project Overview

The Phase I development of the long-range dredged material management plan for the Intracoastal Waterway (ICWW) in Brevard County consists of four basic components: (1) the determination of projected 50 year channel maintenance and dredged material disposal requirements; (2) the formation of an appropriate disposal strategy or concept for satisfying these requirements; (3) the identification of candidate disposal sites designed to meet the projected disposal requirements within the framework of the disposal concept; and (4) the evaluation of each site based on a set of criteria consistent with the disposal concept. Each of these plan components is documented in this report.

A vital element in the plan development process was the participation of cognizant federal and state agency representatives. At key points during the project period of performance an advisory committee consisting of representatives from the FIND, the Florida Department of Environmental Regulation (DER), and the Jacksonville District, Army Corps of Engineers met with the contractor to monitor work in progress, review technical decisions, and establish project policy for the execution of future tasks. These meetings were supplemented with continuing dialogue with key agency personnel. Input and guidance received from this group of individuals proved invaluable to the successful completion of the project.

The entire process is documented in the remaining sections of this report beginning with Section 2.0 which describes the establishment of fifty year disposal needs for various reaches of the Waterway. This was accomplished by the use of

historical data, and the comparison of projected disposal quantities and dredging locations with the capacities of existing sites and easement areas. Section 3.0 discusses the disposal concept, the initial selection of alternative disposal sites, and the re-evaluation of all existing and alternative sites based upon field observations. The final site evaluation process is described in Section 4.0 including the evaluation criteria used and the formation of the site bank. Finally, Section 5.0 summarizes the results of this Phase I effort and presents a specific scope of work for its implementation in Phase II.

## 2.0 50-YEAR DISPOSAL REQUIREMENT

### 2.1 Historical Analysis

#### 2.1.1 Methodology

The establishment of a baseline rate of shoaling from which to project fifty year dredging and disposal volumes for the Brevard County segment of the ICWW required a detailed examination of Jacksonville District, U.S. Army Corps of Engineers (COE) archival records, engineering plans, and survey data related to channel maintenance. These records represent the best available information on patterns of sedimentation within the project area.

Dredging volumes, as estimated in pre-dredging plan documents or as determined by post-dredging examination, are obtained from comprehensive bathymetric surveys of the Waterway channel. Over an adequate period of record during which maintenance dredging is regularly performed, these volumes provide a reasonable and reliable indication of sedimentation patterns. However, dredging frequency is often dependent on factors unrelated to rates of shoaling. These factors include the availability of funding and equipment, contracting procedures, and most relevant to the present study, the non-availability of suitable dredged material disposal sites. The lack of appropriate disposal sites has resulted in no channel maintenance of the Brevard County segment of the Waterway since 1978, and only one maintenance event since 1967 despite the presence of documented and extensive shoals. For these reasons, it was decided to include in the calculation of future dredging and disposal requirements estimates of current shoaling volumes based on the most recent COE channel centerline survey performed in October of 1987.

Experience gained in the previous Nassau-Duval study demonstrated that a necessary first step in the analysis of dredging records and survey data is the establishment of an accurate and consistent system for cross-referencing a particular location along the Waterway to both cut and station, and channel mile. Moreover, such a system must resolve inconsistencies between project descriptions found in older engineering records and those of more recent origin. This was achieved here by adopting currently used designations of channel cut and station and referencing

these to ICWW channel mile. The system is therefore derived from the original navigation project record documents which accompanied the establishment of the 12 ft. ICWW project depth. Moreover, it also includes modifications to the original documents which appeared in succeeding maintenance plans. Consistency with the previous Nassau-Duval study was maintained by measuring channel mileage from the southern boundary of the Jacksonville Harbor Project (ICWW mile 0.0). The accuracy of channel mileage was maintained by continuing the system of cross-referencing the authorized longitudinal channel stationing from the southern boundary of the original Nassau-Duval study southward through St. Johns, Flagler and Volusia Counties to Brevard County. The resulting system, presented in Table 2-1, was used throughout the remainder of the study.

Within this framework, a comprehensive analysis was then conducted of all maintenance dredging occurring in the ICWW in Brevard County since the establishment of the 12ft project depth. Within Brevard County the channel was deepened to 12 ft MLW in three stages: (1) to Haulover Canal in 1952; (2) Haulover Canal to Eau Gallie in 1953; and, (3) Eau Gallie southward in 1958. All available sources of dredging information within the Jacksonville District, Corps of Engineers were consulted to insure accuracy, consistency and completeness. Secondary sources included the annual Office of the Chief of Engineers (OCE) Reports, previous COE summaries of maintenance dredging within the project area, and interviews with COE personnel. The primary source of information, however, was direct reference to archival maintenance plan documents and examination surveys.

The compilation and reduction of historical dredging information from the various secondary sources was a difficult task. No single source had complete information, and the resolution of inconsistencies among sources was necessary prior to the location of specific dredging plans. This task accomplished, the records then had to be physically located under several filing systems within the district office archives, and missing plans recalled from inter-division loan or from alternate storage at the Jacksonville District Dredge Depot. Of those maintenance dredging events referenced in the OCE reports or other secondary sources, only the plans for the 1963 and 1966 channel maintenance were unavailable. For these events the only data available were total pay volumes for project channel reaches given in summaries compiled by the Navigation Branch, Planning Division, Jacksonville District COE. All other relevant dredging information was verified by reference to the original

TABLE 2-1: INTRACOASTAL WATERWAY

## BREVARD COUNTY, FLORIDA

		MILEAGE		
END STATION		0.0 @ Cut BV-1 STA 0+00	0.0 @ ICWW 0.0 DU-1 STA 0+00	0.0 @ FHP CUT 34
Cut V-45	152 + 61.5	--	121.24	143.62
46	268 + 97.4	--	126.33	148.71
Volusia/Brevard Co. Line at Cut V-46 STA 132+47.4, or ICWW Mile 123.75				
Cut BV-1	38 + 13.6	0.72	127.05	149.43
2	32 + 25.4	1.33	127.66	150.04
3	2 + 64.4	1.38	127.71	150.09
4	100 + 84.61	3.29	129.62	152.00
5	197 + 30.57	7.03	133.36	155.74
6	37 + 74.32	7.74	134.07	156.45
7	60 + 04.11	8.88	135.21	157.59
8	99 + 90.85	10.77	137.10	159.48
9	69 + 43.51	12.09	138.42	160.80
10	41 + 11.12	12.87	139.20	161.58
11	55 + 67.68	13.92	140.25	162.63
12	181 + 11.32	17.35	143.68	166.06
13	34 + 08.44	18.00	144.33	166.71
14	88 + 79.74	19.68	146.01	168.39
15	123 + 25.69	22.01	148.34	170.72
16	81 + 04.51	23.55	149.88	172.26
17	221 + 28.04	27.74	154.07	176.45
18	83 + 14.55	29.31	155.64	178.02
19	130 + 70.2	31.79	158.12	180.50
20	110 + 28.9	33.88	160.21	182.59
21	51 + 91.3	34.86	161.19	183.57
22	150 + 60.1	37.71	164.04	186.42
23	174 + 33.0	41.02	167.35	189.73
24	190 + 00.0	44.61	170.94	193.32
25	131 + 32.99	47.10	173.43	195.81
26	392 + 55.38	54.54	180.87	203.25
27	191 + 51.61	58.17	184.50	206.88
28	117 + 27.32	60.39	186.72	209.10
29	54 + 64.53	61.42	187.75	210.13
30	64 + 95.11	62.65	188.98	211.36
31	29 + 06.29	63.20	189.53	211.91
32	33 + 21.34	63.83	190.16	212.54
33	38 + 59.68	64.56	190.89	213.27
34	25 + 34.68	65.04	191.37	213.75
35	47 + 65.0	65.95	192.28	214.66
36	71 + 99.54	67.31	193.64	216.02
37	36 + 72.48	68.01	194.34	216.72
Cut 1R-1	60 + 10.02	69.15	195.48	217.86
2	130 + 20.8	71.62	197.95	220.33

Source: U.S. Army Corps of Engineers, Jacksonville, District, D.O. File #8A-30, 014,  
Dated May 1967



plan sheets or microfiche versions of the original engineering drawings. Through this procedure, it was determined that maintenance within the study area since the establishment of the present -12.0 ft. MLW project depth consisted of five separate events.

Additional information contained in the dredging plans included shoaling areas and limits of planned dredging (referenced to the existing longitudinal stationing), the estimated dredging volume for each shoal, and in many cases, the location of planned disposal. Pay volumes (i.e., volumes actually dredged as determined by post-project bathymetric surveys) were obtained from secondary sources previously discussed or directly from after-dredging examination survey documents. From the dredging events in which both design (pre-project estimates) and pay dredging volumes were documented, a mean ratio of design to pay volume of 0.84 was calculated. This ratio was applied to those maintenance events for which only the design or pay volume was given to obtain the missing quantity. For those events for which only total or combined dredging volume was documented, the total quantity was apportioned to specified shoaling areas based on the relative length of each individual shoal. The results of this analysis are summarized in Table 2-2.

In addition to historical maintenance dredging activity within the Brevard County segment of the ICWW, Table 2-2 also includes estimates of shoaling which has occurred since the last channel maintenance based on the results of the most recent channel centerline survey. For consistency, corresponding pay volumes for each area of shoaling are projected from the same design volume to pay volume ratio used in the analysis of historical dredging. This measure of recent shoaling was combined with historical dredging volumes to determine projected dredging and disposal requirements. As discussed previously, this was done for purposes of completeness, and to extend the period of record since the lack of available disposal sites has precluded dredging in recent years. Reaches of the Waterway within Brevard County which have historically required maintenance, or have recently documented shoals are identified in Figure 2-1.

#### 2.1.2 Material Quantities and Locations

Examination of Table 2-2 amply shows the relatively small amount of maintenance dredging performed in the ICWW channels of Brevard County since the establishment

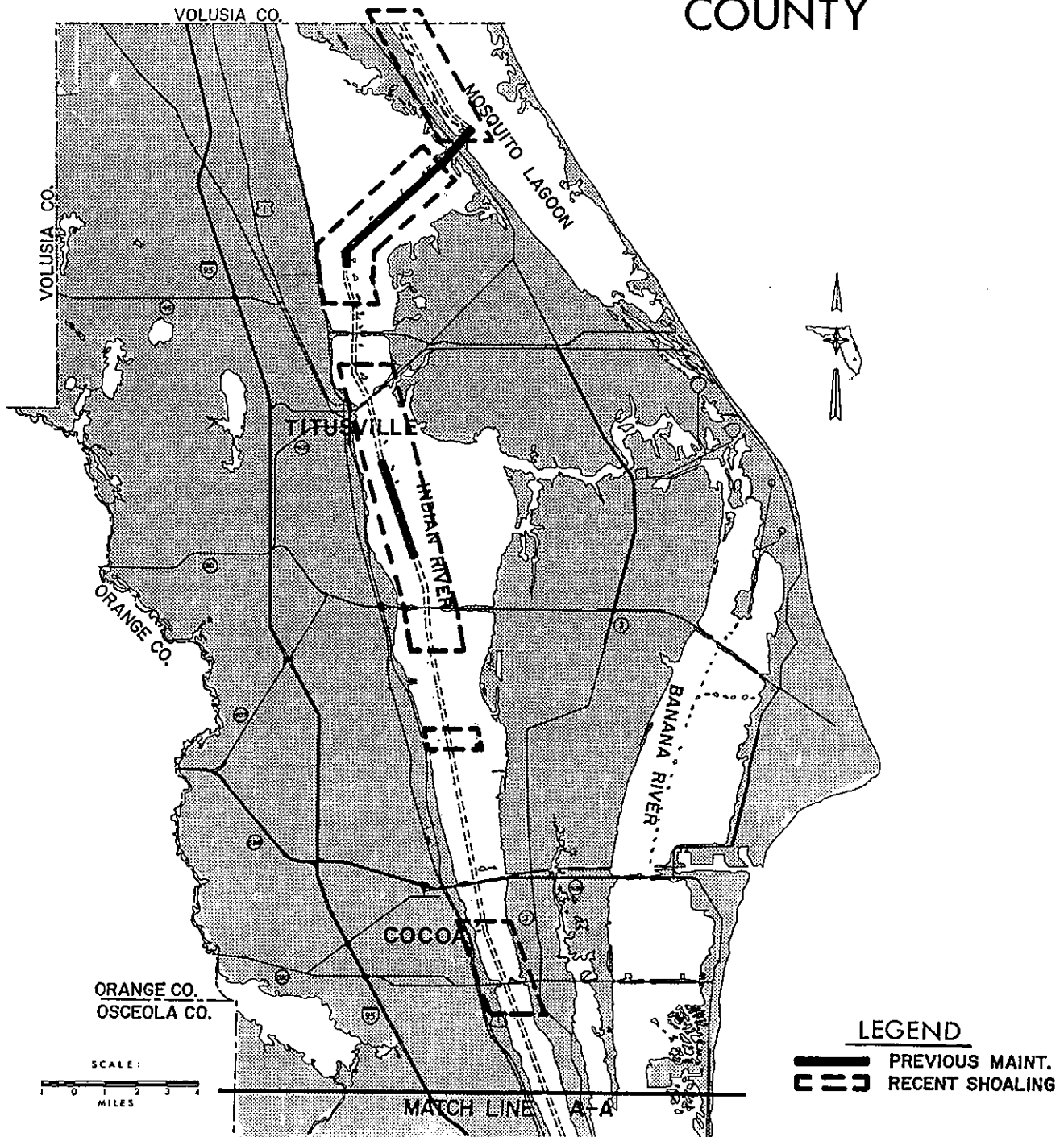
TABLE 2-2: SUMMARY OF HISTORICAL  
MAINTENANCE DREDGING/RECENT SHOALING - BREVARD COUNTY  
1953 - 1987

PREVIOUS MAINTENANCE/RECENT SHOALING									
TO ICWW	FROM MILEAGE	FROM CUT STA	TO CUT STA	LENGTH	YEAR	DESIGN VOL. (C.Y.)	PAY VOL (C.Y.)		
123.25 - 123.97		V-46 106+00	46 144+00	0.72	1987 <sup>+</sup>	55,104	(61,227)		
124.10 - 124.35		46 151+00	46 164+00	0.25	1987 <sup>+</sup>	4,494	(4,993)		
125.07 - 126.24		46 202+00	46 264+00	1.17	1987 <sup>+</sup>	82,000	(91,111)		
126.76 - 126.92		BV-1 23+00	1 31+00	0.16	1987 <sup>+</sup>	11,698	(12,998)		
127.88 - 133.49		4 9+00	6 7+00	5.61	1978	275,000	(305,556)		
128.29 - 128.32		4 29+50	4 32+00	0.03	1987 <sup>+</sup>	2,938	(3,264)		
128.32		4 32+00			1966	(1,950)	2,161		
129.02 - 130.95		4 69+00	5 70+00	1.93	1987 <sup>+</sup>	191,743	(213,048)		
129.41 - 129.75		4 90+00	5 7+00	0.34	1967	25,100	30,012		
129.71 - 130.73		5 5+00	5 58+50	1.01	1960	70,000	92,282		
131.04 - 134.07		5 75+00	7 0+00	3.03	1987 <sup>+</sup>	253,884	(282,093)		
132.65 - 133.47		5 160+00	6 5+80	0.82	1960	67,000	58,717		
134.07 - 135.17		7 0+00	7 58+00	1.10	1987 <sup>+</sup>	78,253	(86,948)		
137.50 - 137.69		9 21+00	9 31+00	0.19	1987 <sup>+</sup>	17,756	(19,729)		
138.99 - 139.05		10 30+00	10 33+00	0.06	1987 <sup>+</sup>	2,808	(3,120)		
139.73 - 142.81		11 28+00	12 135+00	3.08	1987 <sup>+</sup>	120,282	(133,647)		
141.42 - 144.33		12 62+00	14 62+00	2.90	1978	91,000	(101,111)		
143.00 - 143.56		12 145+00	12 175+00	0.56	1987 <sup>+</sup>	25,326	(28,140)		
143.79 - 144.17		13 6+00	13 26+00	0.38	1987 <sup>+</sup>	20,287	(22,541)		
145.33 - 146.01		14 53+00	15 0+00	0.68	1987 <sup>+</sup>	47,131	(52,368)		
146.01 - 147.18		15 0+00	15 62+00	1.17	1987 <sup>+</sup>	67,993	(75,548)		
147.56 - 147.66		15 82+00	15 87+00	0.10	1987 <sup>+</sup>	5,618	(6,242)		
150.15 - 150.71		17 14+00	17 44+00	0.56	1987 <sup>+</sup>	29,070	(32,300)		
153.12		17 171+00			1963	(38,700)	42,980		
158.25 - 158.63		20 7+00	20 27+00	0.38	1987 <sup>+</sup>	40,192	(44,658)		
159.86 - 160.17		20 92+00	20 108+00	0.31	1987 <sup>+</sup>	6,434	(7,148)		
161.44 - 162.91		22 13+00	22 91+00	0.46	1987 <sup>+</sup>	71,926	(79,918)		
166.10 - 166.67		23 109+00	23 139+00	0.57	1987 <sup>+</sup>	35,512	(39,458)		
174.44 - 174.76		26 65+00	26 70+00	0.32	1987 <sup>+</sup>	5,361	(5,957)		
175.23 - 175.48		26 95+00	26 108+00	0.25	1987 <sup>+</sup>	13,404	(14,893)		
177.99 - 178.15		26 241+00	26 249+00	0.16	1987 <sup>+</sup>	7,750	(8,611)		
179.47 - 180.87		26 319+00	27 0+00	1.40	1987 <sup>+</sup>	78,729	(87,477)		
180.87 - 182.40		27 0+00	27 81+00	1.53	1987 <sup>+</sup>	87,409	(97,121)		
182.59 - 183.48		27 91+00	27 138+00	0.89	1987 <sup>+</sup>	39,703	(44,114)		
183.60 - 184.35		27 144+00	27 184+00	0.75	1987 <sup>+</sup>	26,797	(29,774)		
184.77 - 185.39		28 14+00	28 47+00	0.62	1987 <sup>+</sup>	14,929	(16,588)		
191.56 - 191.84		35 10+00	35 25+00	0.28	1987 <sup>+</sup>	5,422	(6,024)		
192.41 - 193.13		36 7+00	36 45+00	0.72	1987 <sup>+</sup>	50,305	(55,894)		
193.64 - 194.02		37 0+00	37 20+00	0.38	1987 <sup>+</sup>	31,105	(34,561)		

NOTE: Parenthetical values based on derived relationship: Pre-dredging estimate or design volume = 0.90 (pay volume)

+ : Estimated shoaling volumes based on center line survey, dated 10/87

# BREVARD COUNTY



SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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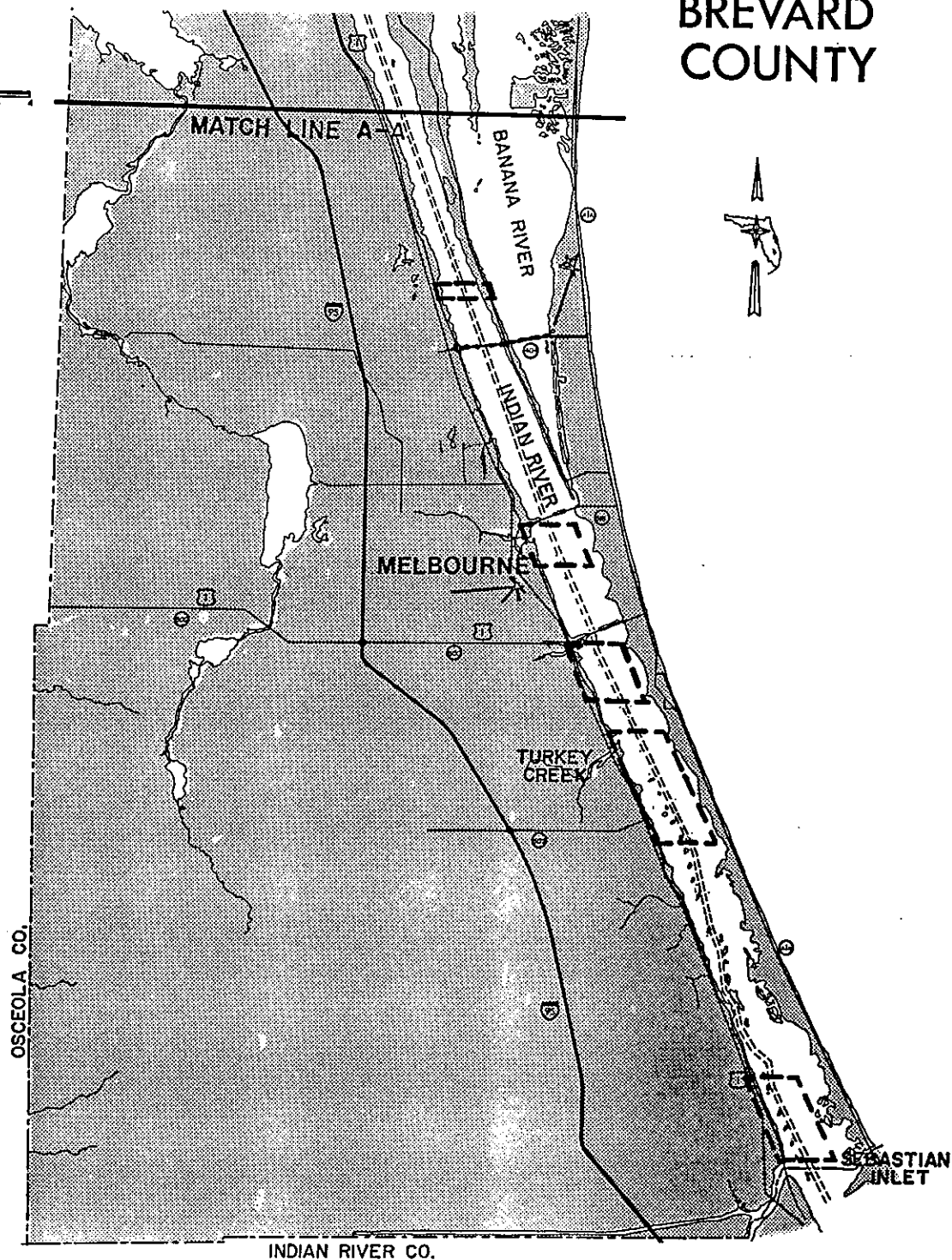
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**Figure 2-1a: Areas of Previous Maintenance Dredging or Recent Shoaling, Intracoastal Waterway, Brevard County, Florida**

PROJECT	C8906
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SHEET	
DATE	9/30/89

## BREVARD COUNTY

SCALE:  
0 1 2 3 4  
MILES



## LEGEND

PREVIOUS MAINTENANCE  
 RECENT SHOALING

SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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**Figure 2-1b:** Areas of Previous Maintenance Dredging or Recent Shoaling, Intracoastal Waterway, Brevard County, Florida

PROJECT	C8906
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of the 12 ft project depth. The quantity of material removed from the 70.61 miles of Waterway channels with the project area has totalled only 632,819 cubic yards (c.y.) over five separate maintenance operations. Moreover, the dredging which has occurred has been quite localized. The 5.76 channel miles extending southwest from the vicinity of Haulover Canal (ICWW mile 127.71 to ICWW mile 133.47) account for over 77 per cent (488,728 c.y.) of the total historical maintenance volume. A second shoal north of the NASA Parkway (ICWW mile 141.42 to ICWW mile 144.33) represents an additional 16 per cent of the total quantity dredged. No channel maintenance has been performed in the southern 41 miles of Brevard County since initial construction of the 12ft project channel. The last maintenance operation within the northern portion of the county took place in 1978. Prior to that event, the channel in this area was last dredged in 1967. Thus, within the Brevard County project area, only one channel maintenance operation has been performed in the last 22 years.

As confirmed by discussions with representatives of the Jacksonville District COE, this situation has resulted not from the absence of shoaling, but rather from a lack of available disposal sites. As will be discussed in Section 2.1.3, it is believed that the Waterway remains passable throughout much of the County only as a result of the repeated resuspension of sediments by boat traffic. In fact, the critical need to perform channel maintenance in the vicinity of Rockledge necessitated the ad hoc selection of an upland disposal site which is now being acquired by the FIND. This site will be discussed further in Section 2.2.

The critical need for maintenance of Waterway channels within significant reaches of the ICWW in Brevard County was confirmed by the analysis of the most recent channel centerline survey conducted in October 1987. Channel centerline soundings were used to obtain estimates of the volume of shoal material which existed at the time of the survey. In this manner, it was determined that approximately 1.7 million cubic yards of material would have to be removed from the Waterway in Brevard County to re-establish project depths. This result indicates that of the total volume of documented shoaling which has occurred over the history of the 12 ft project, over 72 per cent currently remains within the Waterway.

The analysis of the most recent channel centerline survey provides two additional insights into the characteristics of sedimentations within Brevard County beyond those apparent from historical dredging records. First, the 1987 survey

indicates a recurrence of shoaling in areas previously dredged. Significant quantities of shoal material are evident south of Haulover Canal (ICWW mile 128.29 to mile 134.07, 498,405 c.y.) and in the vicinity of Titusville south to the NASA Parkway (ICWW mile 139.73 to mile 146.01; 236,696 c.y.). Second, the recent survey also demonstrates that shoaling is more evenly distributed throughout the County than would be expected from prior channel maintenance (Figure 2-1). Extensive shoals are now evident in a number of channel reaches which have never been previously maintained. These include: (1) the area south of the NASA Parkway (ICWW mile 146.01 to mile 150.71; 114,090 c.y.); (2) several discrete areas of shoaling south of the S.R. 520 bridge (ICWW mile 158.25 to mile 166.67; 171,182 c.y.); (3) a major shoal extending both north and south of the mouth of Turkey Creek (ICWW mile 179.47 to mile 185.39; 275,074 c.y.); and, (4) three discontinuous areas immediately north of Sebastian Inlet (ICWW mile 191.56 to mile 194.02; 96,479 c.y.). Only two significant discontinuities in shoaling are evident. The first of these extends from north of the Canaveral Barge Canal 7.5 miles southward to a point approximately 1 mile south of the S.R. 520 bridge (ICWW mile 150.71 to mile 158.25). The second is an eight mile reach which extends both north and south of the Pineda Causeway, south of the vicinity of Cocoa-Rockledge (ICWW mile 166.67 to mile 174.44).

Combining the maintenance dredging quantities and existing shoal volumes for the various reaches of the Waterway yields a total County-wide maintenance volume of 2,334,333 c.y. Because the Waterway within the County was deepened to 12 ft in segments (Section 2.1.1), the period of record corresponding to this maintenance volume is 34 years (1953-1987) for the reach extending from the north County line south to the vicinity of Melbourne (ICWW mile 123.75 to mile 179.00). Southward from Melbourne to the south County line (ICWW mile 179.00 to mile 194.36) the period of record is 29 years (1958-1987). To project 50-year maintenance requirements, the County-wide volume was apportioned into two component volumes representing the shoaling which has occurred within each of the two 12 ft. project history channel segments. Each of these values was then adjusted upward by linear extrapolation to obtain the corresponding 50-year component volumes. North of ICWW mile 179.00 the appropriate volume component was multiplied by a factor of 1.47 or  $50/34$ . South of ICWW mile 179.00 the multiplication factor was 1.72 or  $50/29$ . The resulting projected dredging volume of 3,527,049 c.y. corresponds to the in-situ or unbulked volume of shoaling anticipated throughout the County over the next 50 years. This quantity was then multiplied by an effective bulking factor of 2.15 to obtain a 50-

year projected disposal volume of 7,583,155 c.y. The factor of 2.15 is based on Corps of Engineers' standard practice and recommendation, and represents a material bulking of 2.0, plus an additional 15 percent of non-pay volume, or unauthorized overdredging.

### 2.1.3 Material Quality

In addition to projected material quantities, a dredged material management plan must also consider the physical and chemical properties of the sediment to be dredged. Techniques employed to maintain water quality during dredging and dewatering are highly dependent on sediment chemistry and the physical characteristics of the dredged material (i.e., particle size, specific gravity, etc.). Also, both the physical and chemical properties of the dredged material determine its potential for reuse, and therefore, the effective site lifetime. Similar to the procedure used to establish historical dredging volumes, a complete review was made of all available physical and chemical sediment data.

Two sources of data characterize the physical properties of the sediment deposited within the Waterway channels of Brevard County. The first of these is the Jacksonville District, COE. Minimal sediment data were obtained by the Corps in 1977 in association with the last maintenance operation performed within the project area in 1978. These data consist of qualitative descriptions of channel sediments based on centerline probings of documented shoals. Only areas scheduled for maintenance during the 1978 operation were investigated. These included the vicinity of Haulover Canal (ICWW mile 127.88 to mile 133.49), and the vicinity of Titusville (ICWW mile 141.42 to mile 144.33). The sediments sampled were described as fine silty sand, with a significant organic component, dark brown to black in color. The predominance of this type of sediment within Brevard County Waterway channels was later confirmed by grab samples taken by the Corps for visual inspection in several unspecified areas of shoaling. This was done in connection with the most recent channel centerline survey performed in October of 1987.

The second source of data characterizing channel sediments within the Brevard County project area was a limited sampling and sediment analysis project (Trefry and Stauble, 1987) performed in 1986 under contract to the Florida Sea Grant College and the Florida DER. This effort constituted the first phase of a comprehensive

examination of Indian River sediments. The final results of the program are expected in early 1990. However, the first phase effort did address sediment characteristics in two locations of the Indian River; specifically, the Melbourne area, south of the Melbourne Causeway (S.R. 516); and the vicinity of Sebastian Creek and Sebastian Inlet. One objective of this program was to determine the distribution of muck-like sediments within the Indian River estuary. The operational definition used to describe muck was "fine-grained, paste-like, black ooze... composed of biological material such as algae remains and [also containing] silt and clay from soil runoff." Sediments of this type were documented at each of four sampling locations within the dredged ICWW channel: station 7 (ICWW mile 179.10) and station 20 (ICWW mile 181.15) in the vicinity of Melbourne; and station 25 (ICWW mile 193.36) and station 28 (ICWW mile 194.00) in the Sebastian area. Each of the four sampling stations were within or immediately adjacent to areas of documented shoaling. Depths of the muck deposition ranged from 6 cm (2.4 inches) at station 20, to 42 cm (16.5 inches) at both stations 7 and 28. Indeed, the muck deposits appear to be concentrated within the Waterway channel with only minimal deposits (0-6cm) in the shallower lagoon areas. Moreover, the depth of muck deposition within the channel was found to decrease with increasing distance from major sediment sources, such as Crane Creek. This relationship was less clear for Turkey and Sebastian Creeks.

The distribution of fine-grained sediments within the Indian River is consistent with the sediment transport mechanisms implied by the estuary's confined geometry and minimal tidal communication with the open ocean (Trefry and Stauble, 1987). The lack of significant tidal currents results in the estuary being dominated by wind driven currents and upland run-off. Soil minerals, primarily aluminosilicates, as well as nutrient enriched municipal and domestic sewage and upland run-off are introduced to the margins of the estuary. Once introduced, they are easily and continuously resuspended by wind and wave action across the broad shallow lagoon shelf until they are deposited in the dredged Waterway channel or other deep areas. Trefry and Stauble concluded that carefully controlled dredging of shoals within the Waterway channels therefore represents an opportunity to remove from the estuary significant portions of this fine-grained material. These sediments would otherwise continue to be resuspended by large boat traffic, with attendant implications of increased turbidity and decreased water quality. Based on the very limited data available, it is anticipated that a significant portion of the material dredged within the Brevard County project area will require specialized handling and de-



watering procedures because of its pronounced silty character and organic content.

The chemical composition and possible contamination of channel sediments also has implications for determining the appropriate procedures to be followed during dredging and disposal operations. Fine-grained sediments have been shown to provide a good medium for the adsorption of pollutants. Many contaminants, most notably heavy metals show a marked affinity for fine particles. Within the same study cited earlier (Trefry and Stauble, 1987) Indian River muck sediments were analyzed for the presence of mercury, lead and copper as indicators of the level of estuarine contamination. The level of mercury present in Melbourne area sediments was found to be at least 3 times higher than anticipated uncontaminated conditions based on aluminum/mercury ratios. Increasingly elevated levels of mercury were identified in the more recent deposits. However, interpretation of this same data using DER guidelines for the determination of metal concentrations in estuarine sediments (Ryan et al, 1984; DER, 1986) indicates that the level of mercury in Melbourne area sediments is below the mean value to be in uncontaminated estuarine conditions, again based on aluminum/mercury ratios. No anomalous levels of mercury were identified in Sebastian area sediments under either interpretive methodology.

Trefry and Stauble also determined lead to be present in both the Melbourne and Sebastian area sediments at levels more than 2 standard deviations above the mean values expected for uncontaminated conditions, suggesting that the sediments are unnaturally enriched or polluted. However, specific sampling locations were not identified. Therefore, it is not known to what extent this applies to Waterway channel sediments. Copper levels in Indian River sediments were found to be within normal uncontaminated limits.

Additional sediment chemistry data for the Brevard County project area was obtained in a Florida DER sediment sampling program. Sediments from within or immediately adjacent to the ICWW channel were sampled in 1984 at four locations within a six-mile reach extending both north and south of Haulover Canal. Analysis of the resulting data using DER guidelines indicates the presence of arsenic and mercury at one location and cadmium at two locations at marginally elevated levels (i.e., 1-2 standard deviations above mean uncontaminated conditions).

The results discussed above do not necessarily indicate significant and pervasive metals contamination of Waterway channel shoals. Rather, they indicate that some contamination exists and a more comprehensive sampling effort should be conducted prior to dredging. If subsequent analysis then documents significant sediment contamination, close monitoring of ambient and effluent water quality, combined with increased efforts to control the release of fine particles for which metal contaminants show a marked affinity, may be required during dredging and disposal operations.

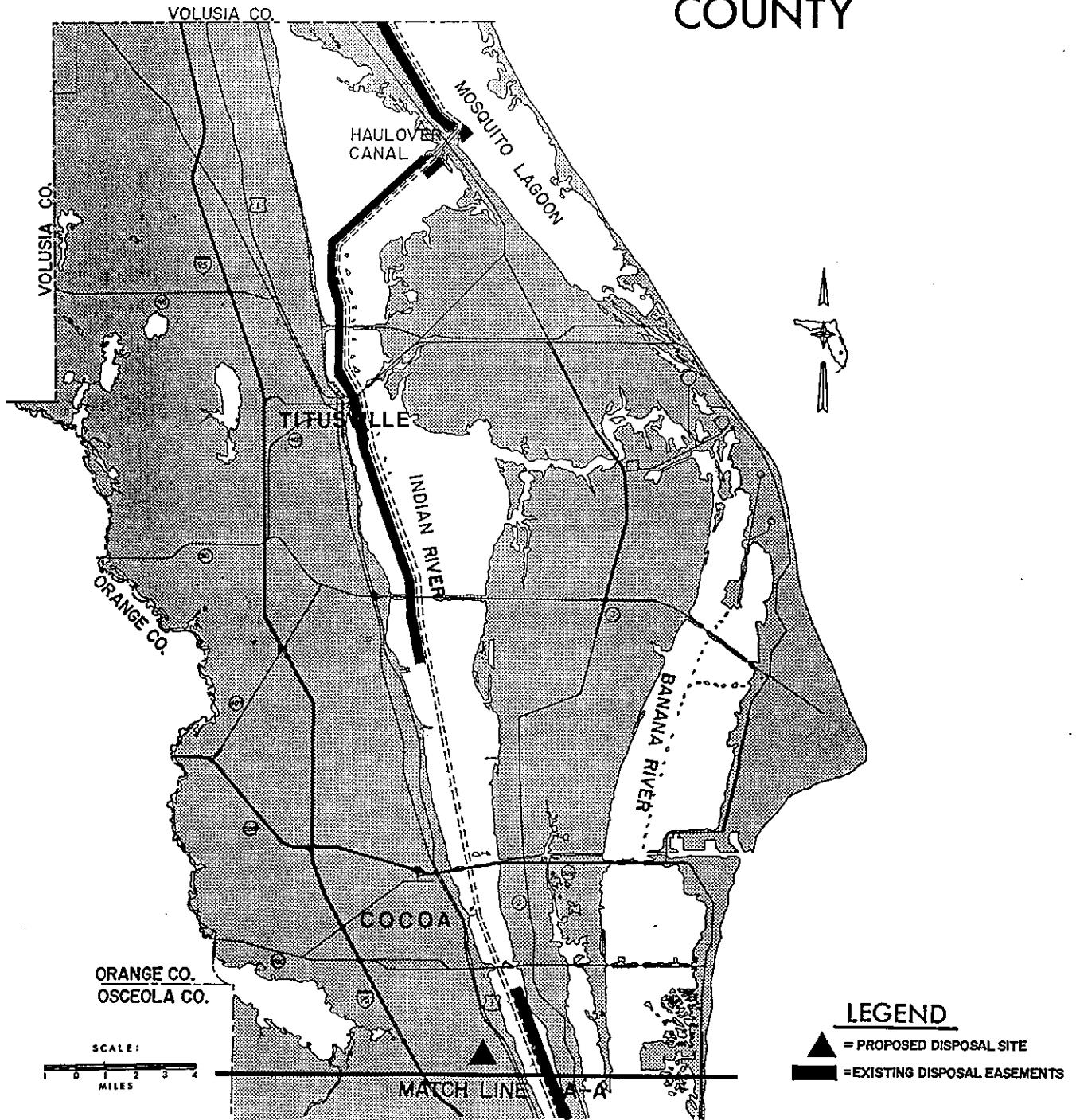
The same DER program discussed above also analyzed the sediment samples for nutrient enrichment using as an indicator TKN:TOC ratios. None of the samples analyzed were found to exceed DER criterion. However, the potential for nutrient enrichment of sediments is present within all areas of the Indian River. Therefore, elutriate testing would still be appropriate to guard against the possibility of excessive release of nutrients during dredging or dewatering operations.

## 2.2 Existing Sites

A review of Corps of Engineers real estate maps yielded a total of 11 tracts representing 10,784.32 acres, to which the FIND holds temporary or permanent disposal easements (Figure 2-2, Table 2-3). With the exception of three small tracts located immediately south of Haulover Canal within the Merritt Island National Wildlife Refuge (total area: 14.20 acres), all easements are presently under State ownership (Trustees of the Internal Improvement Fund, T.I.I.F.). A preliminary evaluation of each site was then performed using three resources: (1) black and white aerial photography of nominal 1" - 800' scale, flown January-December, 1985 for the Corps of Engineers, Jacksonville District; (2) 1:24,000 scale (1" = 2,000') color-infrared aerial photography, flown February-March 1984 and February 1985, from the National High Altitude Photography Program of the U.S. Geological Survey; and (3) 1:24,000 scale (1" = 2,000') National Wetlands Inventory maps from the U.S. Fish and Wildlife Service. Preliminary evaluation of these easements eliminated all but one tract (Tract No. E500-E, 7.40 acres) from further consideration.

As will be discussed in detail in Section 3.0, the disposal strategy developed for the ICWW in Brevard County requires material disposal to be confined to upland areas, and that each disposal site be developed and managed as a permanent operating

# BREVARD COUNTY



SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



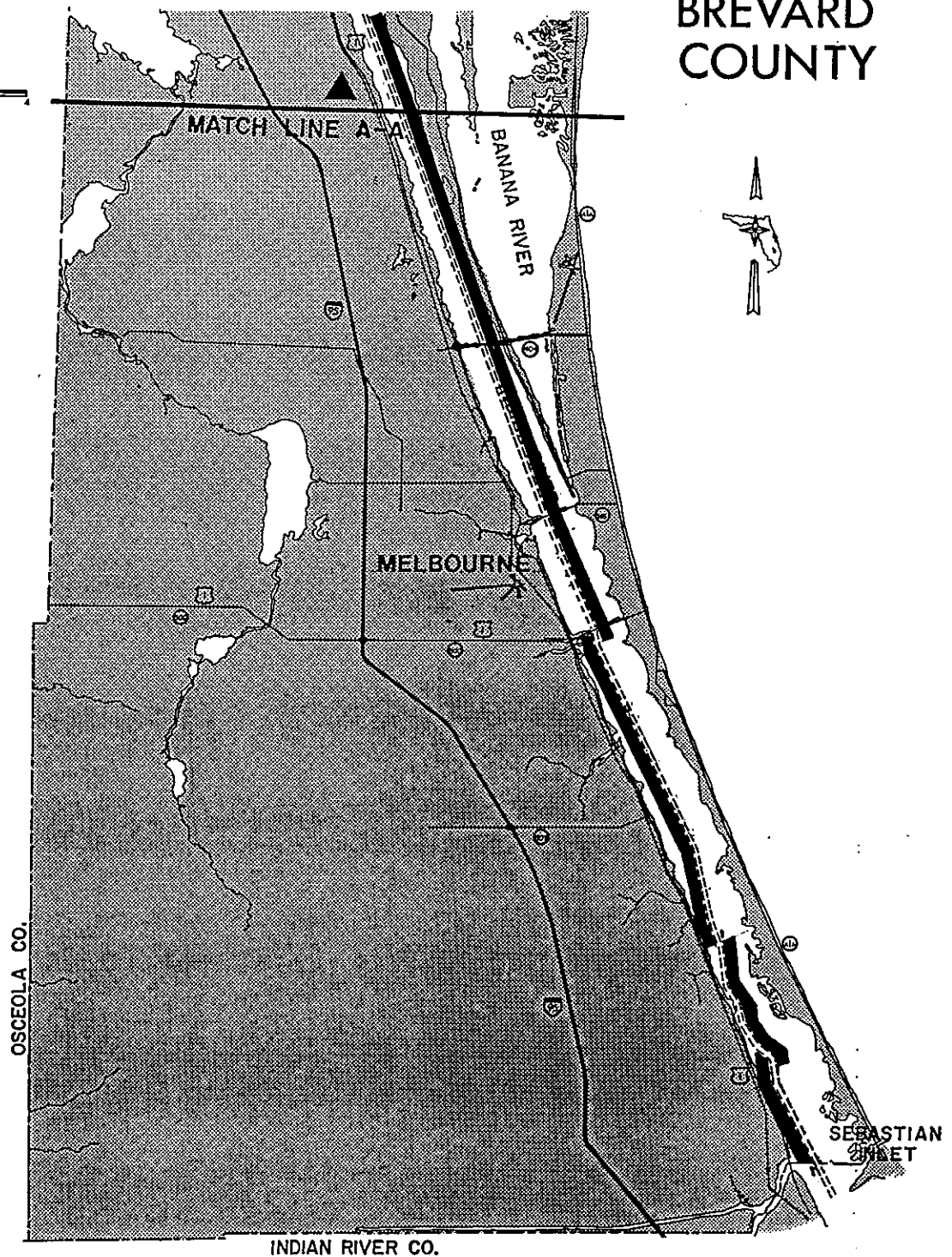
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**Figure 2-2a: Existing Disposal Easements and Disposal Site, Intracosastal Waterway, Brevard County, Florida**

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# BREVARD COUNTY



## LEGEND

- = PROPOSED DISPOSAL SITE
- = EXISTING DISPOSAL EASEMENTS

SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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**Figure 2-2b:** Existing Disposal Easements/and Disposal Site, Intracoastal Waterway, Brevard County, Florida

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TABLE 2-3: INVENTORY OF EXISTING DISPOSAL EASEMENTS

## INTRACOASTAL WATERWAY, BREVARD COUNTY, FLORIDA

F.I.N.D. Designation	C.O.E. Tract No.	ICWW* Mile	Comments
MSA B-1	351	123.75	Spoil islands totaling 75.5 acres as only upland present, not of sufficient size for efficient use, inaccessible by road.
MSA B-1-A	E500E	127.77	Spoil area adjacent to Haulover Canal, total area 7.40 acres, expansion of site to adjacent upland possible, accessible by road.
MSA B-1-A	E501E1	127.77	Primarily submerged, with spoil mounds as only upland, not of sufficient size for efficient use, accessible by road.
MSA B-3	356	128.83	Primarily submerged, with spoil islands as only upland, not of sufficient size for efficient use, inaccessible by road.
MSA B-2	352	128.85	Primarily submerged, with spoil islands as only upland, not of sufficient size for efficient use, inaccessible by road.
MSA B-4	357	157.85	Totally submerged, lies adjacent to ICWW right of way.
MSA B-4A	359	161.07	Totally submerged, lies adjacent to ICWW right of way.
MSA B-5	361	177.42	Primarily submerged, with spoil islands as only upland, not of sufficient size for efficient use, no road access.
MSA B-5-A	E508E	177.42	Totally submerged.
MSA B-6	363	187.13	Primarily submerged, with spoil islands as only upland, not of sufficient size for efficient use, no road access.
MSA B-7	364	190.82	Primarily submerged, with spoil islands as only upland, not of sufficient size for efficient use, no road access.

\* Measured to northern boundary of easement

facility. The 10 existing disposal easements eliminated from further consideration are clearly not consistent with these requirements. All of these tracts are located in predominantly open water areas, generally paralleling the dredged channel in a band 1250' wide throughout most of the Brevard County project area. The only upland contained within these easements consists of isolated spoil islands associated with the initial channel construction or early channel maintenance. However, not all of the spoil islands in Brevard County actually lie within existing disposal easements. Those that do are predominantly located in the Mosquito Lagoon reach of the project area (MSA B-1), south of Haulover Canal (MSA B-2, B-3), and south of the Melbourne (S.R. 216) Causeway (MSA B-5, B-6, B-7).

Continued use of these spoil islands for the disposal of dredged material is neither feasible nor consistent with the disposal concept developed for Brevard County (Section 3.0). The small size (typically less than 5 acres) and minimal elevation, and insular character with no potential for upland road access, render them impractical for the purposes of this program. Moreover, their use in connection with alternative disposal strategies, such as open water disposal, would probably not be permitted by the relevant regulatory agencies. Such use would clearly be incompatible with the location of almost all of the islands within either the Mosquito Lagoon or Indian River Lagoon Aquatic Preserves as well as within designated DER class II waters (Section 3.1). As evidence of the perceived value of these islands, the Florida Department of Natural Resources (DNR), Bureau of Aquatic Preserves, supported by a grant from the FIND, recently completed a spoil island management plan for the Indian River in Brevard County (Peterson and Eames, 1989). Under this plan the major spoil islands within the Indian River are divided into four appropriate use or management classifications based on physiography, ecological importance, and historical use. The four appropriate uses include recreation (active or passive), education, and conservation. Included among the 41 islands thus addressed are all significant islands located within existing disposal easements in Brevard County. Their continued use for the disposal of dredged material is obviously not compatible with this management plan.

The single existing disposal easement retained for further evaluation (Tract No. E 500-E) is located on Merritt Island immediately south of Haulover Canal within the Merritt Island National Wildlife Refuge. The acreage of this tract (7.40 acres) is not adequate in itself to allow efficient disposal site development. However,

expansion of this site to adjacent uplands appears feasible and is addressed in Section 3.4.

The FIND has also initiated proceedings to acquire a 79.97 acre site south of the town of Rockledge. The acquisition of this site was at the request of the Jacksonville District, Corps of Engineers, based on a critical need to perform channel maintenance in this area. The site is intended to be capable of receiving 500,000 c.y. of material in each of two disposal operations over the next 50 years. This requirement was considered by the Corps to be conservative. However, it apparently was not based on any rigorous analysis. Candidate sites were identified and evaluated by the Bussen Engineering Group (1986) in a study performed under contract to the FIND. However, none of the sites examined by Bussen were selected for acquisition. The final site selection made by the FIND and the Corps was based on engineering, operational, economic land-use, and zoning considerations. The use of this site for dredged material disposal will be included in the long-range plan for the ICWW in Brevard County. Specific characteristics of the Rockledge site will be further addressed in Section 4.0 and Appendix B.

### 3.0 DISPOSAL ALTERNATIVES

#### 3.1 Environmental Constraints

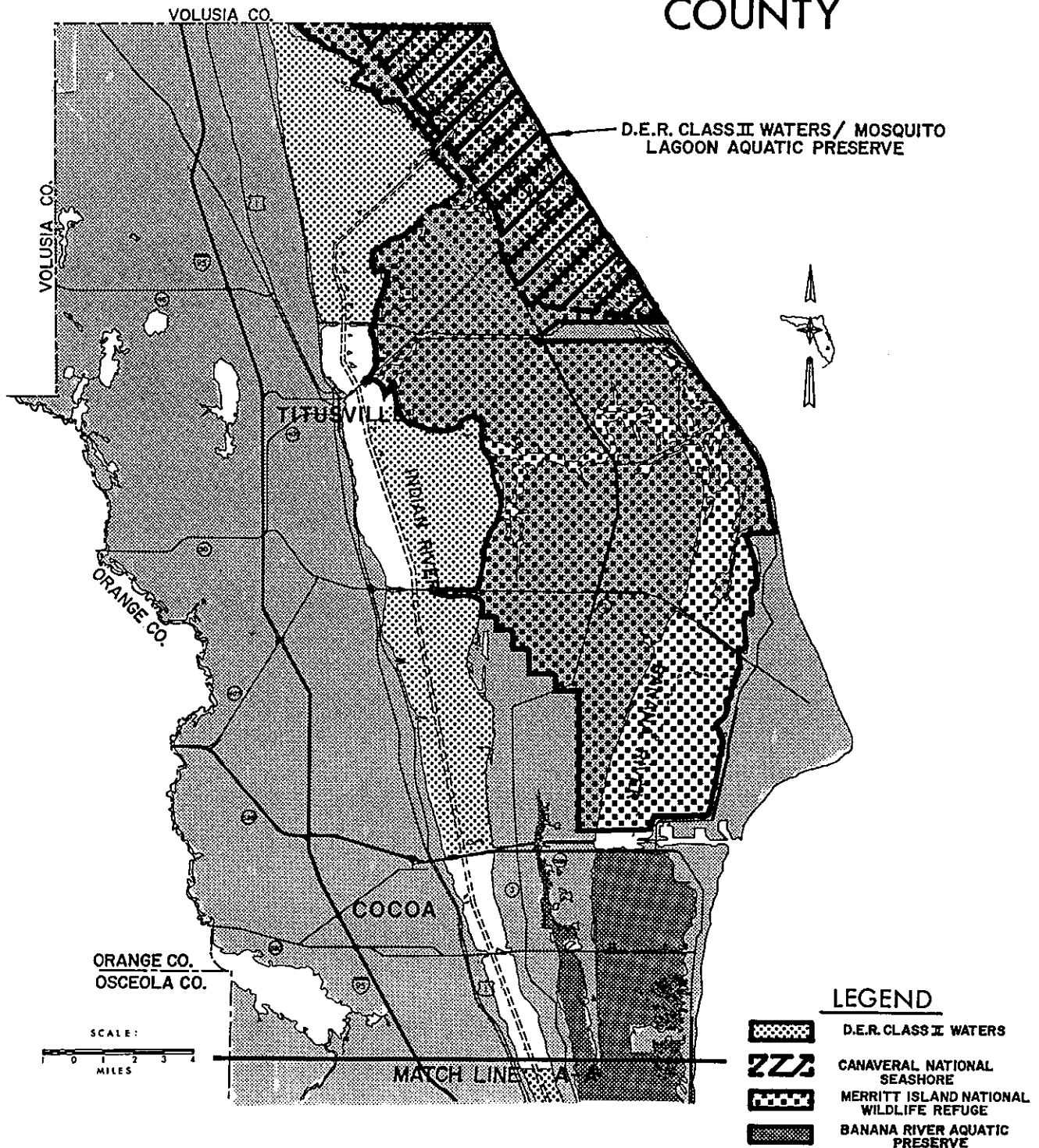
Inherent in every dredged material disposal operation is a set of guiding principles which reflect the attitudes and constraints of the project sponsor, the project engineer, and the contractor. Historically, these principles (i.e., the "Disposal Concept") have not been explicitly stated, and have evolved primarily through the desire to maximize operational efficiency and short-term economy. Thus, minimal consideration was given to environmental issues or indeed any long-term goals. Within the broad expanses of Mosquito Lagoon and the Indian River through which the Intracoastal Waterway passes, this concept led to the unconfined disposal of dredged material in open water areas. These actions resulted in the numerous small submerged mounds and spoil islands which line the Waterway as the dredging contractor sought to place the material as close as possible to the area being dredged.

With increased environmental awareness this approach is no longer desirable; nor is it possible, given present day environmental constraints, agency reviews and permitting requirements. The relatively pristine quality of significant portions of Mosquito Lagoon and the Indian River offers a unique set of challenges to the development of a suitable disposal strategy. These major estuaries of East Central Florida are being increasingly recognized as a regional resource, the benefits of which extend far beyond their geographical limits. The growing awareness of the scientific community, the regulatory agencies, and the general public of the biological productivity and hydrologic significance of this estuarine community, and its sensitivity to cultural disturbance, has led to a range of programs and guidelines designed to protect this irreplaceable resource. To appropriately address the needs of the Waterway within Brevard County, a realistic disposal strategy must recognize and abide by these necessary environmental constraints.

In addition to the regulatory protection afforded sea grass beds and mangrove habitats, selected reaches of the Waterway and adjacent areas within Brevard County have been classified as areas of particular environmental concern, and therefore have been granted additional layers of regulatory constraint (Figure 3-1). At the Federal



# BREVARD COUNTY



SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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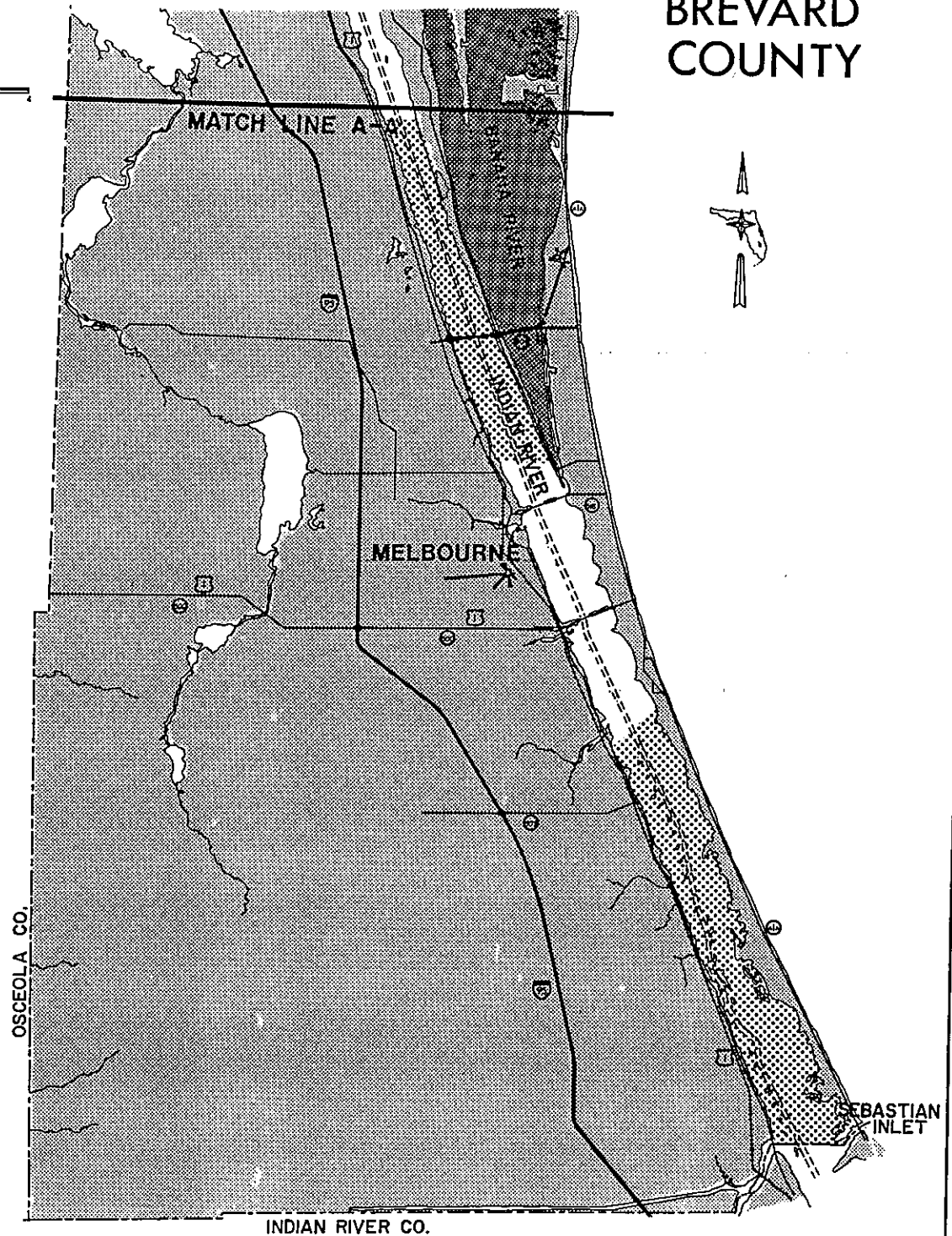
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**Figure 3-1a: Environmentally Sensitive  
Areas, Intracoastal Waterway,  
Brevard County, Florida**

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# BREVARD COUNTY

SCALE:  
0 1 2 3 4  
MILES



## LEGEND

- DER CLASS II WATERS
- BANANA R. AQUATIC PRESERVE

SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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**Figure 3-1b:** Environmentally Sensitive  
Areas, Intracoastal Waterway,  
Brevard County, Florida

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level, the Canaveral National Seashore, administered by the National Park Service, encompasses Mosquito Lagoon and adjacent lands within Brevard County. The Merritt Island National Wildlife Refuge, under the U.S. Fish and Wildlife Service, includes the Brevard County portion of the Canaveral National Seashore, as well as roughly two-thirds of Merritt Island, the majority of the NASA reservation, and significant portions of the Indian and Banana Rivers.

To these are added several layers of State regulatory authority which overlap Federal jurisdictions. Within Brevard County, the ICWW passes through two State Aquatic Preserves administered by the Florida Department of Natural Resources (DNR): the Mosquito Lagoon State Aquatic Preserve at the northern end of the study area; and the Indian River, Cape Malabar to Sebastian, Aquatic Preserve at the southern end. The southern two-thirds of the Banana River also have been designated as a State Aquatic Preserve, and although the Banana River is not an actual link in the Waterway, its proximity makes this a consideration. Additionally, all waters within the above described State and Federal jurisdictional areas have received designation as Outstanding Florida Waters. This program, administered by the Florida Department of Environmental Regulation (DER), rightfully places severe constraints on the placement of dredged material within OFW boundaries.

The pristine quality of much of the estuaries through which the ICWW passes within Brevard County is also demonstrated by DER's designation of the majority of Mosquito Lagoon and the Indian River within the County as Class II waters; that is, waters which are suitable for the propagation and harvesting of shellfish. The Class II designation applies to five areas within the County, all of which possess active shellfish lease areas.

From the preceding discussion it is apparent that the unique character of the Mosquito Lagoon/Indian River estuarine system has received special consideration to preserve its biological productivity and environmental quality. A disposal concept appropriate to the requirements of the Intracoastal Waterway in Brevard County must reconcile these environmental constraints with more traditional engineering, operational and land-use considerations. The balancing of these concerns is addressed in the following section.

### 3.2 Disposal Concept

The disposal concept developed for the Intracoastal Waterway in Brevard County was intended to resolve the apparent conflict between the engineering and operational requirements of channel maintenance and the environmental and land-use constraints imposed on site selection. The concept is based on the set of principles originally developed as part of the pilot study addressing the needs of the Waterway in Nassau and Duval Counties. The ICWW in Northeast Florida shares with Brevard County requirements imposed by significant expanses of pristine estuarine wetlands combined with rapid development. Although the character of the Brevard County segment of the ICWW is clearly unique, the comprehensive environmental protection afforded the Mosquito Lagoon/Indian River estuarine system, and the even more urbanized waterfront, suggested that a similar disposal strategy be employed. The three fundamental principles which constitute the disposal concept adopted for Brevard County are as follows:

- (1) All future dredged material disposal will be confined to upland areas to the maximum extent possible as determined by site availability.
- (2) Sites will be established to provide centralized disposal in a minimum number of locations per operating reach of Waterway as determined by the analysis of historical data.
- (3) Disposal sites will be operated and maintained as permanent facilities in which dredged material will be actively managed.

These principles provided the basic framework within which various disposal alternatives and candidate disposal sites were identified and subsequently evaluated. In so doing, minimum acceptance standards were established and a focus was given to the planning process. Moreover, the early establishment of the disposal concept facilitated the specification of a meaningful set of individual site evaluation criteria later in the project. The utility of the above set of principles is demonstrated by the successful implementation of a workable dredged material management plan in Nassau and Duval Counties based on essentially the same principles.

The first principle of the disposal concept as adapted to the specific requirements of Brevard County were that future disposal be restricted to upland areas to the maximum extent allowed by the availability of appropriate upland sites. The difficulty of identifying adequate upland sites in Brevard County was recognized prior to the beginning of the study. This initial expectation resulted from the recognition of the level of waterfront development throughout much of the project area and its high degree of environmental sensitivity. Also anticipated were severe restrictions on the disposal of dredged material within Federal lands (i.e., Canaveral National Seashore, Merritt Island National Wildlife Refuge) which encompass much of the undeveloped areas in the northern portion of the County. However, it was also recognized that alternatives to confined upland disposal of dredged material might not prove to be feasible as a result of operational or environmental liabilities. Alternative disposal methods which were preliminarily evaluated and judged inappropriate for further consideration included ocean disposal and beach disposal. The difficulties associated with these are discussed in the following paragraphs.

Ocean disposal of dredged material requires the use of deep draft ocean barges or hopper dredges. These types of vessels have frequently been used in conjunction with the maintenance dredging of deepwater ports. However, because of their size they cannot operate in the relatively shallow depths of the ICWW. Therefore, the utilization of ocean disposal for the Waterway would require multiple handling of the material, using shallow draft vessels and/or pumping in combination with sea-going barges. The cost of such an operation would be exorbitant. Moreover, limited ocean access within the project area (i.e., the Canaveral Barge Canal and Sebastian Inlet) also would introduce significant increases in transport or pumping distances with associated operational costs increases. This approach was therefore not considered further.

Beach disposal of suitable dredged material would appear to be operationally feasible only in the vicinity of Sebastian Inlet where direct hydraulic placement is possible, and where channel sediments may prove to be predominantly littoral material introduced through the Inlet. However, as discussed in Section 2.1.3, the limited sediment data available to characterize channel sediments adjacent to Sebastian Inlet indicate that a significant component of the shoal material is fine-grained, highly organic silt (Trefry and Stauble, 1987). This sediment is derived

not from material entering the Inlet but from upland sources through agricultural and urban runoff, augmented by the decomposition of organic material. Indeed, in no portion of the project area for which data is available do channel sediments appear suited to beach disposal. Therefore, this alternative method of disposal was also abandoned from further consideration.

One other alternative method to confined upland disposal, the disposal of maintenance material in open water areas of the estuary, does offer several advantages. These include the elimination of direct site acquisition costs, and the utilization of open water disposal easements held by the FIND. Cost savings realized from the use of this disposal method have been documented in limited demonstration projects sponsored by the Corps' Waterway Experiment Station. However, these advantages are accompanied by significant environmental liabilities. The predominant disposal technique employed in earlier channel construction and maintenance operations, that is, unconfined placement of dredged material in open water areas, is no longer feasible or acceptable. Moreover, confined open water disposal, even when conducted in areas devoid of submerged aquatic vegetation, is likely to be viewed as inappropriate for an environmentally sensitive and biologically productive area such as the Indian River. The attendant problems of habitat destruction and effluent water quality are neither compatible nor permissible within the designated areas of Class II waters and Aquatic Preserves which comprise the majority of the project area (Figure 3-1).

The only method of open water disposal which shows some promise of satisfying the unique requirements of Brevard County is the disposal of dredged material within artificial dikes in combination with habitat restoration. This approach may be appropriate for those areas adjacent to the more highly developed reaches of the Waterway where cultural influences have removed pre-existing sea grass beds. Mitigation, in the form of the re-establishment of submerged aquatic vegetation, would be required to offset the adverse impacts of benthic habitat destruction and temporary water quality degradation associated with this disposal method. However, this too carries its own operational disadvantage in that it limits the site to a single disposal operation. Succeeding operations would require the dedication of additional areas of submerged lands. As will be seen shortly, this approach is not consistent with the concept that each site be operated as a permanent facility.

The inclusion of innovative techniques of open water disposal such as these within a comprehensive long-term dredged material management plan carries inherent liabilities which could threaten the success of the program. First, techniques of confined open water disposal combined with habitat recreation are unproven. Although some success has been achieved in limited and site specific test applications, the viability of these methods has yet to be demonstrated in sedimentary, hydrological, and biological conditions similar to those of the Mosquito Lagoon/Indian River estuarine system. Second, the acceptance of the use of submerged state lands for the disposal of dredged material by all of the pertinent regulatory agencies is not a fait accompli. For these reasons it was decided that the strategy of confined open water disposal would merit further consideration only if the identification and development of appropriate upland sites proved not to be feasible.

It is recognized that the use of upland sites for the disposal of dredged material has its own set of operational and environmental liabilities. Operationally, the exclusive use of upland sites in a urbanized, rapidly developing region where upland alternatives are few may force the contracting agent (COE) to accept increased pumping distances, more difficult pipeline access, and associated increased operational costs. These considerations are discussed later in this section.

The use of upland sites carries environmental liabilities as well, the most significant of which is the unavoidable destruction of upland habitat. In addition, within Brevard County the total avoidance of all wetland impacts as part of the disposal site selection process is virtually impossible. Examples of minor wetland impacts associated with site development or operation which are typically very difficult to avoid include pipeline crossings, and minimal encroachment on isolated wetland areas to provide realistic site geometries for dike construction. The use of disturbed areas may also involve the alteration or relocation of channelized drainage. However, by limiting future disposal to predominantly upland areas the majority of the adverse wetland impacts associated with past dredged material disposal operations can be prevented. Therefore, the use of upland disposal areas remains a fundamental principle of the disposal concept.

The second principle of the disposal concept developed for Brevard County has both operational and environmental advantages. The centralization of disposal

operations within fewer sites has the operational advantage of locating these sites in a logical manner to more efficiently serve individual reaches of the Waterway. Moreover, the use of fewer, larger sites reduces the total acreage required through economies in dike area requirements. It also eliminates the proliferation of smaller sites each with their own outlet works and attendant water quality considerations. Thus, the use of centralized disposal sites is considered to be an important element of the disposal concept.

Active management of disposal sites as permanent operating facilities complements the two preceding principles. It also represents a significant departure from historical practice in which upland sites were more or less abandoned following limited usage. By operating the sites as permanent facilities a suite of management procedures and techniques can be implemented, all of which have long term operational and environmental benefits. Example management measures include improved detention area design; material handling and processing to increase dewatering efficiency (e.g., mechanical grading, trenching, storm water control); and the use of natural buffer areas and the vegetation of dikes to reduce the visual impact of the site. Most importantly, the permanency of the sites encourage the removal of the dewatered material from the site to be used as construction material, or simply to be stored in less ecologically sensitive upland areas further inland. Road access, existing or potential, is therefore essential. By not regarding the sites as one-time holding facilities, as in the past, but as intermediate processing areas, it is hoped that they will serve the needs of the Waterway in perpetuity. This type of activity in combination with effective site management measures will establish the long term material handling facilities required.

### 3.3 Delineation of Channel Reaches

With the disposal concept thus defined, logical channel reaches were then established. In performing this task, it was assumed that one, or at most, two sites would be required to serve each reach. This of course has significant operational implications. Within a relatively developed, rapidly urbanizing area such as is found in coastal Brevard County, the availability of appropriate upland sites is limited. Thus, it became necessary to accept longer operational reaches and therefore, greater maximum pumping distances than would be considered acceptable for less developed conditions. It was determined that a maximum of six operational



channel reaches could be used to define the Brevard County project area, based on a preliminary assessment of the availability of appropriate upland sites. This determination resulted in a mean reach length of 12+ channel miles. It should be noted that a centrally located disposal site within a particular reach, or the use of two sites within a reach, results in a maximum pumping distance which is significantly less than the total length of the reach.

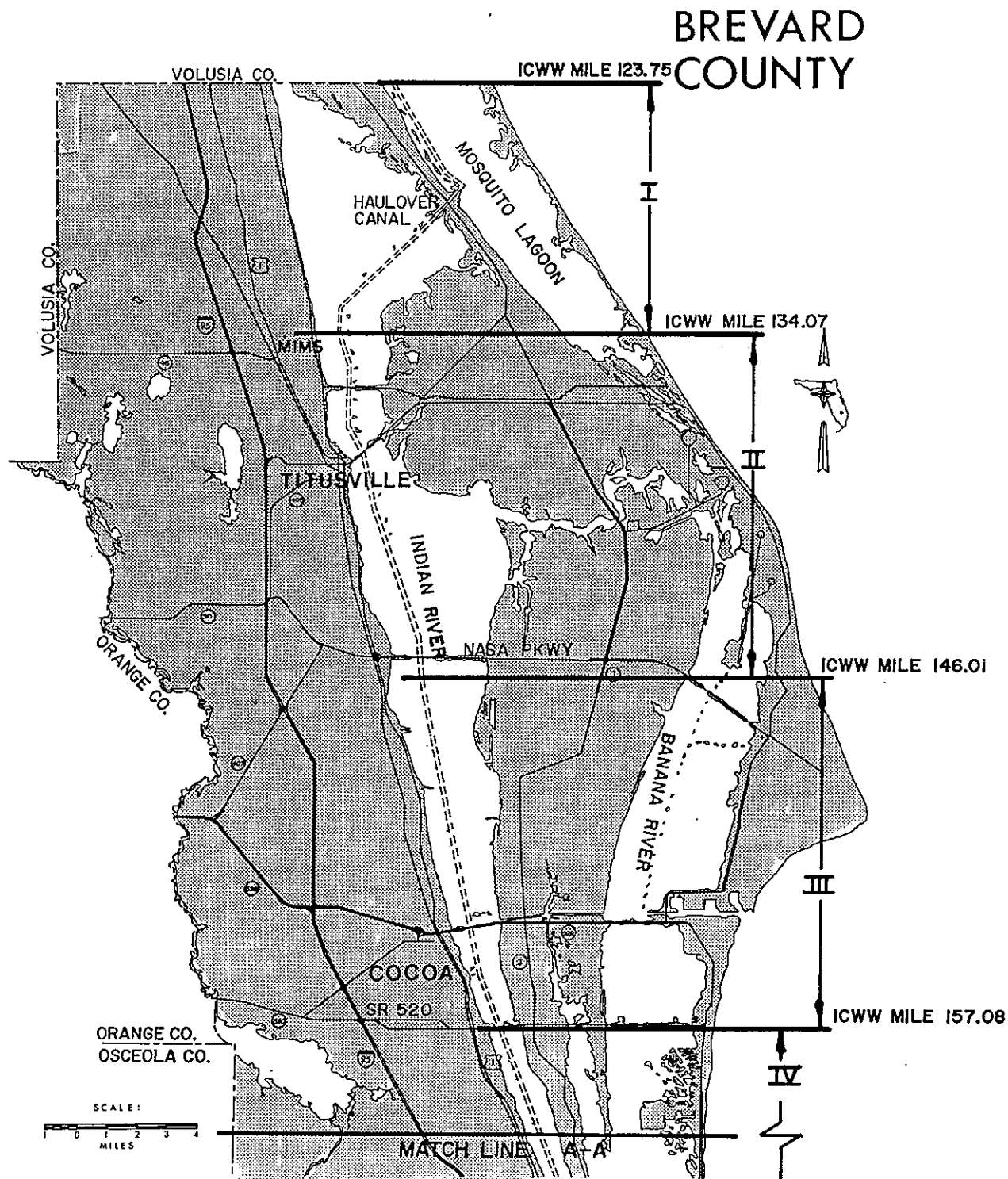
The resulting delineation of channel reaches is summarized in Table 3-1, and is illustrated in Figure 3-2. Table 3-2 organizes, by channel reach, the previous summary of historical dredging/recent shoaling as presented in Table 2-2. Also presented in Table 3-2 for each reach are the total dredging or shoaling volumes and 50-year disposal requirements. As an indication of the relative shoaling rate within each reach, the mean annual volume of required maintenance dredging or shoaling per channel mile is also included.

The northernmost reach of the Brevard County project area, Reach I, extends from the north County line (ICWW mile 123.75, cut V-46 Sta 132+47) in the Mosquito Lagoon, southward through the Haulover Canal to the beginning of cut BV-7 (ICWW mile 134.07), a distance of 10.32 miles. Although recent shoaling appears to extend across the Brevard County line, this is not confirmed by historical maintenance requirements. Therefore, the north County line was chosen to delineate the northern project boundary as well as the northern limit of Reach I. Similarly, the southern limit of Reach I corresponds to a discontinuity in historical dredging activity, but not in recent shoaling. As a result, this reach covers all of the area of historical dredging activity within the northern portion of the County. This dredging was performed in four separate events during the period 1960-1978. Moreover, it contains the most extensive of the existing shoals within northern Brevard County. Combining areas of both historical dredging and recently documented shoaling indicates essentially continuous shoals throughout the length of this reach. The resulting disposal requirement of 3.66 m.c.y. is second only to the corresponding requirement for the Waterway in the vicinity of Matanzas Inlet in St. Johns County (Reach V, 7.03 m.c.y.), and the unit shoaling rate of 3,299 c.y./yr/mi is three times that of the second-ranked reach (Reach II) within the Brevard County project area.

Reach II continues southward another 11.94 miles to a point approximately one mile south of the NASA Parkway (ICWW mile 134.07 to mile 146.01). The projected

TABLE 3-1: DEFINITION OF CHANNEL REACHES,  
INTRACOASTAL WATERWAY, BREVARD COUNTY

Reach	ICWW Mileage	From Cut	Sta	To Cut	Sta	Length
(I) County Line to Mims	123.75 - 134.07	V-46	132+47	BV-7	0+00	10.32
(II) Mims to NASA Prkwy	134.07 - 146.01	BV-7	0+00	BV-15	0+00	11.94
(III) NASA Prkwy to S.R. 520 Br.	146.01 - 157.08	BV-15	0+00	BV-19	75+85	11.07
(IV) S.R. 520 Br. to Pineda Cswy	157.08 - 168.18	BV-19	75+85	BV-23	44+00	11.10
(V) Pineda Cswy to Turkey Creek	168.18 - 180.87	BV-24	44+00	BV-27	0+00	12.69
(VI) Turkey Creek to Sebastian Inlet	180.87 - 194.36	BV-27	0+00	IR-1	0+00	13.49
Total Project Length ----->						70.61



SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS

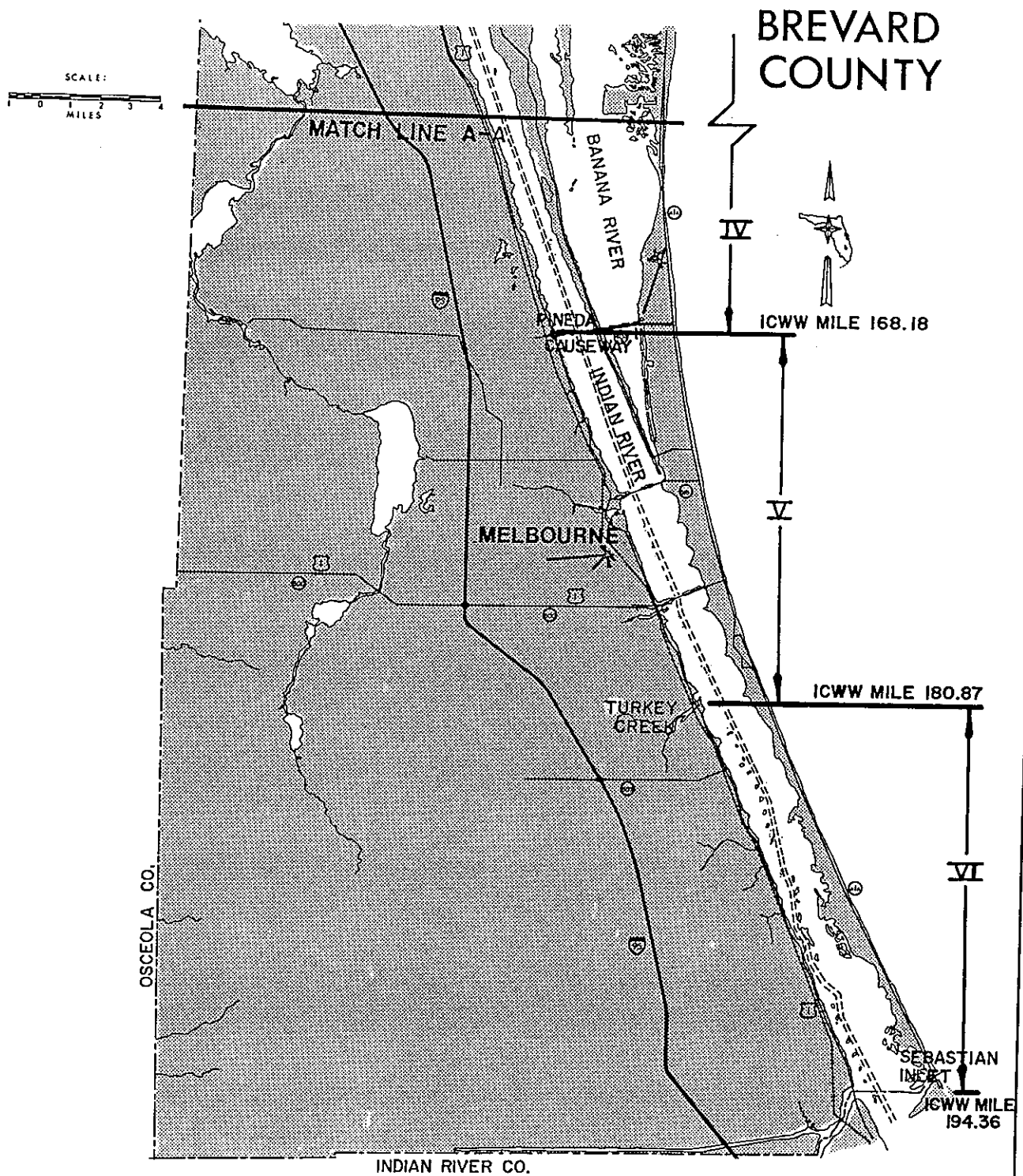


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**Figure 3-2a:** Delineation of  
Operational Channel Reaches, Intra-  
coastal Waterway, Brevard County,  
Florida

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SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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**Figure 3-2b: Delineation of  
Operational Channel Reaches, Intra-  
coastal Waterway, Brevard County,  
Florida**

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TABLE 3-2: SUMMARY BY CHANNEL REACH OF HISTORICAL  
MAINTENANCE DREDGING/RECENT SHOALING - BREVARD COUNTY  
1953 - 1987\*

PREVIOUS MAINTENANCE/RECENT SHOALING										REACH SUMMARY					
Reach	To ICWW	From Mileage	From Cut Sta	To Cut Sta	Length	Year	Design Vol. (c.y.)	Pay Vol (c.y.)	Total Vol. (c.y.)	Vol/Yr* (c.y.)	Vol/Yr/Mi (c.y.)	50yr Unbulked Vol (c.y.)	50yr Disposal Vol (c.y.)		
I: County Line to Mims; ICWW Mile 123.75 to 134.07	123.25	- 123.97	V-46	106+00	46	144+00	0.72	1987 <sup>+</sup>	55,104	(61,227)					
	124.10	- 124.35	46	151+00	46	164+00	0.25	1987 <sup>+</sup>	4,494	(4,993)					
	125.07	- 126.24	46	202+00	46	264+00	1.17	1987 <sup>+</sup>	82,000	(91,111)					
	126.76	- 126.92	BV-1	23+00	1	31+00	0.16	1987 <sup>+</sup>	11,698	(12,998)					
	127.88	- 133.49	4	9+00	6	7+00	5.61	1978	275,000	(305,556)					
	128.29	- 128.32	4	29+50	4	32+00	0.03	1987 <sup>+</sup>	2,938	(3,264)					
10.32	128.32		4	32+00				1966	(1,950)	2,161					
	129.02	- 130.95	4	69+00	5	70+00	1.93	1987 <sup>+</sup>	191,743	(213,048)					
	129.41	- 129.75	4	90+00	5	7+00	0.34	1967	25,100	30,012					
	129.71	- 130.73	5	5+00	5	58+50	1.01	1960	70,000	92,282					
	131.04	- 134.07	5	75+00	7	0+00	3.03	1987 <sup>+</sup>	253,884	(282,093)					
	132.65	- 133.47	5	160+00	6	5+80	0.82	1960	67,000	58,717	1,157,462	34,043	3,299	1,702,150	3,659,623
II: Mims to NASA Parkway; ICWW Mile 134.07 to 146.01	134.07	- 135.17	7	0+00	7	58+00	1.10	1987 <sup>+</sup>	78,253	(86,948)					
	137.50	- 137.69	9	21+00	9	31+00	0.19	1987 <sup>+</sup>	17,756	(19,729)					
	138.99	- 139.05	10	30+00	10	33+00	0.06	1987 <sup>+</sup>	2,808	(3,120)					
	139.73	- 142.81	11	28+00	12	135+00	3.08	1987 <sup>+</sup>	120,282	(133,647)					
	141.42	- 144.33	12	62+00	14	62+00	2.90	1978	91,000	(101,111)					
11.94	143.00	- 143.56	12	145+00	12	175+00	0.56	1987 <sup>+</sup>	25,326	(28,140)					
	143.79	- 144.17	13	6+00	13	26+00	0.38	1987 <sup>+</sup>	20,287	(22,541)					
	145.33	- 146.01	14	53+00	15	0+00	0.68	1987 <sup>+</sup>	47,131	(52,368)	447,604	13,165	1,103	658,241	1,415,219
III: NASA Parkway to S.R. 520; ICWW Mile 146.01 to 157.08	146.01	- 147.18	15	0+00	15	62+00	1.17	1987 <sup>+</sup>	67,993	(75,548)					
	147.56	- 147.66	15	82+00	15	87+00	0.10	1987 <sup>+</sup>	5,618	(6,242)					
	150.15	- 150.71	17	14+00	17	44+00	0.56	1987 <sup>+</sup>	29,070	(32,300)					
	153.12		17	171+00				1963	(38,700)	42,980	157,070	4,620	417	230,985	496,618

PREVIOUS MAINTENANCE/RECENT SHOALING								REACH SUMMARY								
Reach	To ICWW	From Mileage	From Cut Sta	To Cut Sta	Length	Year	Design Vol. (c.y.)	Pay Vol. (c.y.)	Total Vol. (c.y.)	Vol/Yr (c.y.)	Vol/Yr/Mi (c.y.)	50yr Unbulked Vol (c.y.)	50yr Disposal Vol(c.y.)			
IV: S.R. 520 to Pineda Cause- way; ICWW Mile 157.08 to 168.18	158.25 - 159.86 - 161.44 - 166.10 -	158.63 160.17 162.91 166.67	20 20 22 23	7+00 92+00 13+00 109+00	20 20 22 23	27+00 108+00 91+00 139+00	0.38 0.31 1.46 0.57	1987+ 1987+ 1987+ 1987+	40,192 6,434 71,926 35,512	(44,658) (7,148) (79,918) (39,458)		171,182	5,035	454	251,738	541,237
V: Pineda Cswy to Turkey Creek; ICWW Mile 168.18 to 180.87	174.44 - 175.23 - 177.99 - 179.47 -	174.76 175.48 178.15 180.87	26 26 26 26	65+00 95+00 241+00 319+00	26 26 26 27	70+00 108+00 249+00 0+00	0.32 0.25 0.16 1.40	1987+ 1987+ 1987+ 1987+	5,361 13,404 7,750 78,729	(5,957) (14,893) (8,611) (87,477)		116,938	3,883	306	194,147	417,417
VI: Turkey Creek to Sebastian Inlet; ICWW Mile 180.87 to 194.36	180.87 - 182.59 - 183.60 - 184.77 - 191.56 - 192.41 - 193.64 -	182.40 183.48 184.35 185.39 191.84 193.13 194.02	27 27 27 28 35 36 37	0+00 91+00 144+00 14+00 10+00 7+00 0+00	27 27 27 28 35 36 37	81+00 138+00 184+00 47+00 25+00 45+00 20+00	1.53 0.89 0.75 0.62 0.28 0.72 0.38	1987+ 1987+ 1987+ 1987+ 1987+ 1987+ 1987+	87,409 39,703 26,797 14,929 5,422 50,305 31,105	(97,121) (44,114) (29,774) (16,588) (6,024) (55,894) (34,561)		284,077	9,796	772	489,788	1,053,044

\* : Period of record north of ICWW mile 179.0 is 34 years (1953-1987); period of record south of ICWW mile 179.0 is 29 years (1958-1987); refer text

+ : Estimated shoaling volumes based on centerline survey, dated 10/87

NOTE: Parenthetical values based on derived relationship: Pre-dredging estimate or design volume = 0.90 (pay volume)

50-year disposal requirement for this reach is 1.42 m.c.y. The relatively large magnitude of this figure is a result of the extensive shoaling indicated in this area by the 1987 centerline survey. With the exception of a 2.33 mile channel segment in the northern portion of Reach II, this shoaling is well-distributed throughout the entire reach.

Reach III extends from south of the NASA Parkway to the S.R. 520 bridge in the vicinity of Cocoa-Rockledge (ICWW mile 146.01 to mile 157.08), a distance of 11.07 miles. A single maintenance operation performed in 1963 removed a shoal of unspecified length in the central portion of this reach (ICWW mile 153.12). Shoaling recently documented within the reach, north of the area of previous dredging, contributed to the projected disposal requirement of approximately 496,000 c.y. Within Reach III, no shoaling has been documented within an almost four mile stretch of the channel in the vicinity of the S.R. 528 Causeway and the Canaveral Barge Canal (i.e., ICWW mile 153.12 to mile 157.08). Moreover, no channel maintenance has been performed from the central portion of Reach III, south to the Brevard - Indian River County line. As a result, the projected disposal requirements for Reaches IV, V, and VI are based entirely on shoal volumes documented by the October 1987 centerline survey.

Reach IV continues southward from the S.R. 520 bridge to the Pineda Causeway (ICWW mile 157.08 to mile 168.18 ), a distance of 11.10 miles. The boundaries of this reach correspond to clear discontinuities in shoaling. Within the reach four discrete areas of shoaling are reported, yielding a projected 50-year disposal requirement of over 541,000 c.y. Almost 50 per cent of the shoaling within this reach has occurred in the central 1.46 miles (ICWW mile 161.44 to mile 162.91).

Reach V is bounded by the Pineda Causeway to the north and, to the south, the confluence of the Indian River (ICWW) and Turkey Creek in the vicinity of Melbourne - Palm Bay (ICWW mile 168.18 to mile 180.87), a distance of 12.69 channel miles. The shoaling within this reach is heavily weighted towards the south, with no shoaling in its northernmost 3.26 miles, and approximately 75 per cent of the total located within its southernmost 1.40 miles. This latter area corresponds to the northern portion of an extensive shoal which extends for almost three miles north and south of Turkey Creek. The contribution of this shoal results in a projected disposal requirement for this reach of 417,000 c.y.

Lastly, Reach VI continues from the vicinity of Turkey Creek southward to the Brevard - Indian River County line (ICWW mile 180.87 to mile 194.36), a distance of 13.49 miles. Here shoaling extends southward almost continuously over 4.5 miles from Turkey Creek. Immediately south of this shoal is a six mile stretch of channel which remains shoal free. The southernmost three miles of the reach contain three discrete shoals. The projected disposal requirement for Reach VI is 1.05 m.c.y.

### 3.4 Identification of Candidate Sites

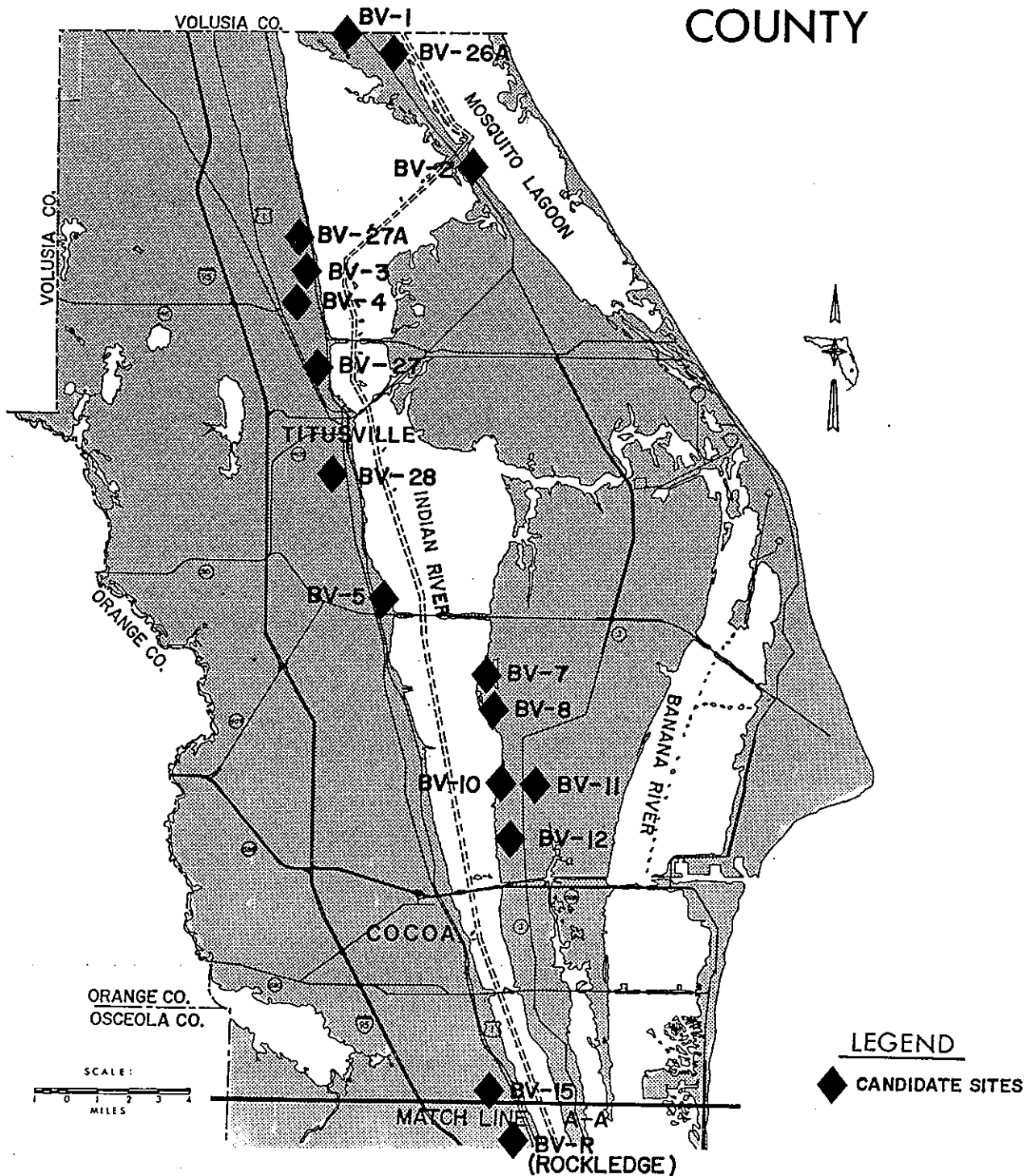
The definition of the disposal concept and the delineation of logical channel reaches provided a necessary focus to the selection of candidate disposal sites. Preliminary identification and evaluation of the sites was accomplished through the use of the black and white aerial photographs (1" = 800' nominal scale), color infrared photography, and USFWS Wetlands Inventory maps previously described in Section 2.2.

The process began with the identification of all sites within reasonable distance of the Waterway which had the potential to satisfy the basic requirement of centralized disposal in an upland area, with existing or potential road access to meet the demands of on-going disposal site management. Additional environmental considerations, such as the quality of existing habitat, the diversity of vegetation, or the degree to which the area had been previously disturbed were not included in this initial evaluation. However, these factors were considered in the final site evaluation and are discussed in Section 4.1. In some instances adjacent land-use conflicts such as adjoining high-density residential development, or operational limitations such as excessive overland pipeline access, did eliminate sites from further consideration. A total of 25 candidate sites, or two to six sites within each reach, were selected. These are shown in Figure 3-3.

Of concern during this process was the availability of suitable upland sites within Reach I because of the extensive Federal landholding in this area. Although this matter remains a concern, steps have been taken to explore the possibility of using Federal lands for permanent upland dredged material disposal. To date, the results of these efforts have been encouraging. On June 19, 1989 representatives of the U.S. Fish and Wildlife Service (USFWS), Florida Department of Natural Resources (DNR), FIND, and Taylor Engineering, Inc. met at the Merritt Island



# BREVARD COUNTY



SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS

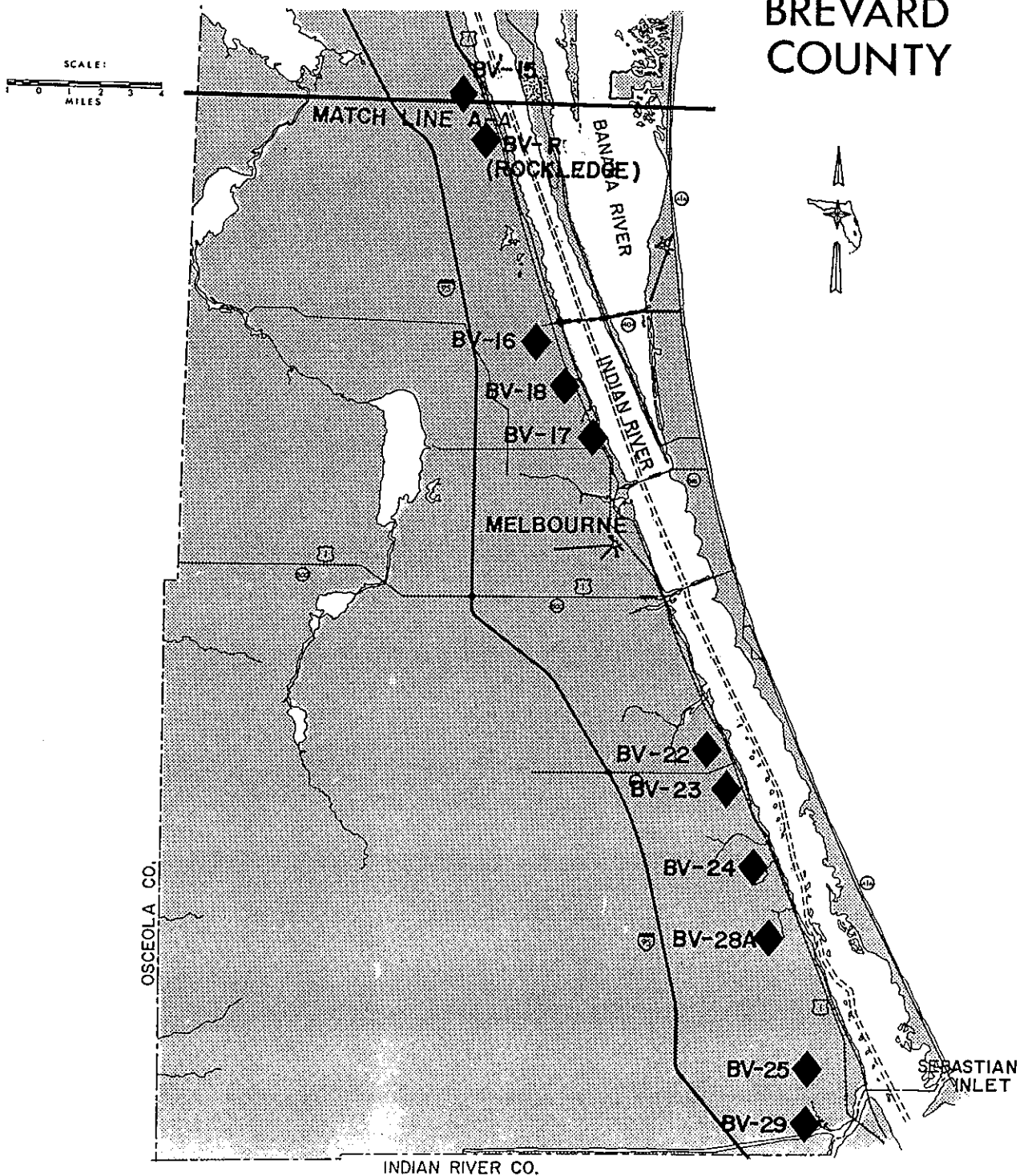


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**Figure 3-3a: Candidate Sites,**  
Intracoastal Waterway, Brevard  
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## BREVARD COUNTY



## LEGEND

◆ CANDIDATE SITES

SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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**Figure 3-3b:** Candidate Sites,  
Intracoastal Waterway, Brevard  
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Wildlife Refuge visitors center to discuss the FIND dredged material management program for the ICWW and its relation to other Federal and State interests in the area. All parties present recognized the mutual benefits of comprehensive management of the natural resources and environment of the Mosquito Lagoon, the Indian River, the Merritt Island Wildlife Refuge, and the Canaveral National Seashore. They also recognized that the Intracoastal Waterway in this area constitutes an important component of these resources. Based upon these discussions it was then mutually acknowledged that the FIND study, which is documented by this report, would include Federally owned and managed lands in the Cape area as part of the site selection process for the ICWW in Brevard County. Final approval of the use of these lands for dredged material disposal would of course reside with the Federal government, specifically the USFWS and NASA. The inclusion of these properties in the site selection process greatly facilitated the performance of this study.

Preliminary estimates were also made of the maximum disposal capacity of the candidate sites identified. Tracings of the initial delineation of useable upland area of each site were made using the 1" = 800' black and white aerials. A capacity analysis was then performed, based on the most realistic dike configuration attainable within the delineated upland. This was accomplished using a set of relationships (APPENDIX A) which expressed the required volume of dike material, the volume of dike material available on-site, and the resulting disposal capacity as functions of the dike crest elevation above grade, mean site elevation, depth of excavation, dike side slope, width of dike crest, and required minimum freeboard. During Phase II of the project, dike geometry will be specific to each site. However, for the purposes of this preliminary evaluation, a standard dike geometry was applied to all sites. Selected parameter values are within the range of standard practice for similar sites used for previous maintenance events. These included a 15.0 ft. crest elevation above grade, a 1V:3H side slope, a 12.0 ft. crest width, an excavated grade elevation of +4.0 ft. NGVD., and a minimum freeboard plus ponding allowance of 4.0 ft. Calculations were based on a realistic dike configuration (i.e., a 3 to 5 sided polygon), specific to each site, which utilizes the maximum available upland area as delineated by photo-interpretation. The mean grade elevation for each site was estimated from survey transects, if available, or from U.S. Geological Survey Quadrangle maps.

This preliminary disposal capacity analysis was done to insure that each site possessed sufficient capacity to satisfy the requirements of the reach it was intended to serve. Thus, within each reach the total capacity of the candidate sites greatly exceeded the corresponding disposal requirement. These overages in capacity were retained to provide the greatest flexibility prior to final site selection. Also, it was expected that subsequent field inspection of the sites would result in the total elimination of some sites, and a reduction in the usable acreage of others. The site inspection procedure is discussed in the following section.

### 3.5 Site Inspections

Field inspections of all candidate sites were performed to document site environmental characteristics, as well to assess their general suitability for disposal site development. Specific objectives included preliminary delineation of wetlands, and the initial assessment of vegetation communities, habitat, and environmental constraints including the presence of protected wildlife. Also noted during the site inspections were surrounding land uses, topography, general soil conditions, existing or potential road access, and possible pipeline routes. Twenty-four of the 25 candidate sites were visited by a team consisting of a biologist and an engineer during the period July to September, 1989. The Rockledge Site now being acquired by the FIND (Section 2.2) was not visited.

Within each site, ecological conditions were assessed by combined photographic aerial interpretation and ground-truthing as necessary to identify and map vegetation communities. Aerial coverage included 1985 1" = 800' black and white photography, 1983-84 1" = 2000' color infrared photography, and in some cases, 1986 blueline aeriels at a scale of 1" = 400'. Ground-truthing was carried out using 4-wheel-drive vehicles accessing adjacent roads or on-site dirt roads and trails, combined with pedestrian surveys. Dominant or significant photographic signatures were identified on aeriels and visited by truck or on foot. Within Reach III, candidate sites BV-7 and BV-8 were approached by boat, then covered on foot. Maps were prepared in the field by drawing on acetate overlays on the 1" = 800' black and white aerial photographs. Other sources of information, such as USGS 7.5' quadrangles and U.S. Fish and Wildlife Service Wetland Inventory Maps and soil surveys, were checked to aid in the interpretation of site conditions. Observations of significant

wildlife species were also noted when encountered on-site. This included the presence or sign of State or Federally protected wildlife species.

Following each site inspection, the original site tracings were modified to exclude sensitive areas. The most common modification was to withdraw from areas possessing wetland or transitional vegetation. Specifically excluded were those wetland and transitional areas contiguous with the Waterway or its tributaries. Because of this latter consideration which establishes the jurisdiction of DER permitting authority, all drainage features were examined for evidence of this contiguity. Isolated wetlands or drainage features, which still fell within the permitting jurisdictional authority of the St. Johns River Water Management District (SJRWMD), were excluded where feasible, but not if their exclusion made an otherwise viable site unusable.

A second analysis of maximum potential disposal capacity was then performed for each site based on its field-verified configuration. Results of this analysis are presented in Table 3-3. Again, the total potential capacities of the candidate sites exceed the disposal requirement for each reach. During the final site evaluation, described in the following section, these parameters were brought into agreement.

TABLE 3-3: CANDIDATE SITES  
BREVARD COUNTY

Reach	Site	Location ICWW Mileage	Total Acreage	Disposal Acreage	Disposal Capacity (c.y.)	Depth of Excavation (ft)	Dike Material Shortfall (c.y.)
I	BV-1	123.04	220.8	152.4	2,660,800	2.1	-----
	2	127.98	394.5	243.1	4,239,300	2.4	-----
	3	132.80	187.6	90.1	1,571,100	2.2	-----
	26A	123.85	81.4	40.9	713,532	1.6	-----
	27A	130.50	237.8	120.0	2,093,100	2.2	-----
II	4	135.16	96.6	65.3	1,138,100	2.2	-----
	5	143.63	336.6	228.9	4,014,600	1.4	-----
	27	136.63	120.0	33.6	583,500	2.6	-----
	28	140.07	126.4	114.2	1,996,400	1.7	-----
III	7	146.65	100.5	29.6	449,400	3.0	57,800
	8	147.34	69.7	27.3	419,900	3.0	48,000
	10	149.93	59.2	38.5	662,100	4.5	-----
	11	149.88	76.5	53.4	924,200	3.3	-----
	12	151.94	80.8	52.1	904,500	2.9	-----

Reach	Site	Location ICWW Mileage	Total Acreage	Disposal Acreage	Disposal Capacity (c.y.)	Depth of Excavation (ft)	Dike Material Shortfall (c.y.)
IV	R	162.08	79.97	20.7	761,191	---	-----
	15	161.04	212.1	101.9	1,780,600	1.9	-----
V	16	167.66	213.2	120.0	2,094,800	2.1	-----
	17	169.66	91.0	71.1	1,234,100	2.8	-----
	18	171.78	107.1	69.4	1,200,000	3.7	-----
VI	22	182.84	84.9	62.9	1,092,100	2.8	-----
	23	183.96	216.9	134.9	2,360,700	1.7	-----
	24	187.60	225.8	108.4	2,105,900	1.6	-----
	25	192.79	154.0	120.3	2,104,700	1.7	-----
	28A	188.58	144.2	80.8	1,408,135	2.3	-----
	29	194.88	223.6	63.7	1,107,897	1.9	-----

#### 4.0 ESTABLISHMENT OF SITE BANK

The final evaluation of the 25 candidate sites was accomplished by assessing the ability of each site to satisfy a standard set of evaluation criteria, and by the consideration of comments and suggestions provided by the project sponsor and advisory committee members throughout the course of the study. Through this process a group of 14 sites was selected to form a site bank serving the six channel reaches comprising the Intracoastal Waterway within the study area. The site bank consists of 7 primary and 7 secondary sites which, as their names imply, represent first and second choice options for the long term disposal and management of dredged material removed from ICWW channels.

A standard set of criteria were used to perform the final site evaluation. However, no attempt was made to quantify the relative merits of each evaluation criterion, using what is sometimes referred to as matrix analysis. Although such an approach is sometimes very useful it was not felt to be necessary in this particular case. Therefore, the decision was made to evaluate the sites using the criteria as a wholistic standard and to take into consideration specific information pertinent to a particular criterion when it was available.

The remaining portions of Section 4.0 describe the evaluation procedure and the results obtained from it, including the criteria used, the agency input considered, and the primary and secondary sites comprising the site bank.

##### 4.1 Evaluation Criteria

Each site was evaluated by its ability to satisfy criteria in three broad areas:

- o Engineering/Operational Considerations
- o Environmental Considerations
- o Socioeconomic or Cultural Considerations

Individual criteria considered in each of these areas are described below.



#### 4.1.1 Engineering/Operational Considerations

A primary objective of this study was to identify suitable sites of adequate capacity to meet the projected fifty-year disposal requirements of the Waterway in the study area. Therefore, the potential disposal capacity of a site was included as an evaluation criterion. In keeping with the concept of centralized disposal, all alternative sites were selected and existing sites were retained based on their ability to provide adequate capacity with a minimum number of sites. Typically, a single site within each reach is required. However, within Reach II, two sites have been designated to serve jointly as primary sites. Similarly, two sites have been designated to jointly function as secondary sites within both Reaches I and IV. As will be discussed later, these decisions were primarily based on considerations of pumping distance and operational efficiency.

Closely related to site capacity is the availability of adequate dike material on-site to construct the containment basin employed in the disposal capacity analysis (APPENDIX A). It is possible to circumvent an insufficient on-site supply by trucking in additional material, or by using dewatered material from a previous disposal operation to incrementally build the dikes to design elevation. However, the expense of transporting material from off-site sources, the uncertainties of dredging and disposal frequency, and the possible unsuitability of the dewatered dredged material for dike construction, make an adequate on-site supply of material preferable.

Pumping distance from the area to be dredged to the disposal site is also a criterion affecting site selection. The availability of add-on boosters can extend pumping distances as needed. However, this increased distance is achieved through a reduction in dredging efficiency and a significant increase in the cost of operation. Therefore, it is desirable to choose a site which is either centrally located within the reach it is to serve, or one that is located adjacent to the area requiring the highest maintenance. However, the lengths of the channel reaches and the limited availability of centrally located sites necessitated the designation of two primary sites located near the ends of Reach II, and two secondary sites within Reaches I and VI.

A site which affords the greatest ease of pipeline access from the Waterway to the disposal area, as well as the return of effluent to the Waterway, is also preferred. Apart from the environmental concerns which will be discussed later, problems related to difficult pipeline access, such as convoluted routes, significant elevation changes, or the crossing of road or railroad right-of-ways add to mobilization-demobilization costs, and decreased operating efficiency. Moreover, the need to acquire additional pipeline easements increases the cost of site development.

Upland access, with existing or potential road service, is desirable for initial site construction, and is required if the site is to be managed as a permanent operating disposal facility. It should be noted that this criterion was a condition for the selection of candidate sites.

Soil properties (e.g. foundation loading, resistance to piping, etc.), as well as the depth of the water table below grade, are additional factors which should be included as criteria for site evaluation. However, these determinations require field testing not included in the initial phase of the project. Data supporting site soil properties and geohydrology will be obtained during Phase II. Visual observations made during the field inspections revealed no obvious areas of concern.

#### 4.1.2 Environmental Considerations

The environmental criteria used for site evaluation are intended to minimize adverse impacts to sensitive estuarine and upland areas, within the constraint of providing adequate disposal capacity to serve the needs of the Waterway. The resulting criteria may be organized under two categories reflecting the desire to restrict disposal to upland sites only: (1) criteria for the avoidance of wetland areas to the greatest extent possible; and (2) criteria for minimizing the unavoidable impacts to upland areas.

Avoidance of wetlands was a primary consideration throughout the site selection process, and by use of the USFWS Wetlands Inventory maps and the color-infrared photography this has largely been achieved. However, where a question remained, or where avoidance of isolated or transitional wetland areas would have precluded the use of a site, several specific criteria were used to weigh the relative success in

minimizing wetland impacts.

All estuarine wetland areas exhibiting salt or brackish water characteristics, particularly those judged to be contiguous with State waters, are recognized by all state and federal agencies to be an extremely valuable resource. Therefore, the degree to which a site succeeds in eliminating the impacts to estuarine wetlands is obviously a crucial criterion in site selection. However, within significantly disturbed areas, such as abandoned citrus groves, which contain channelized drainage with hydrologic or vegetative connection to State waters, the relocation of drainage ditches was considered an acceptable impact if the existing ditch would preclude the use of a site. It is anticipated that the various regulatory agencies concerned with this project would also be amenable to such action.

Isolated freshwater wetlands are also a valuable biological community, and in addition can afford a system of filtering run-off and recharging groundwater supplies. However, such wetlands are not given the same degree of protection under joint Corps of Engineers and DER permitting criteria although they may fall under the jurisdiction of the SJRWMD. The presence of these isolated wetlands was considered in the evaluation of a particular site, and their disruption was avoided wherever possible. However, agency comments received during the previous Nassau-Duval study tend to support the position that the sacrifice of small isolated areas possessing wetland vegetation may be acceptable if required to provide an adequate disposal area. Somewhat independent of the areal extent of an interior wetland is the quality of the habitat which it may afford, or the unusual vegetation assemblages it may support. Thus, the quality of impacted wetlands was also a criterion of site selection.

The use of upland disposal areas minimizes the impact to wetlands; however, restricting disposal site development to upland areas requires the removal of existing upland biota within the diked area. Again, the quality of the impacted upland communities can vary widely, and therefore considerations which reflect the existing ecological value of a potential disposal area are useful site evaluation criteria. Specifically, these include the quality of habitat afforded by a particular site as determined by field inspection and ecological categorization; the value, uniqueness, maturity, and aesthetic quality of the existing vegetation (e.g., mature hardwood canopy vs. second-growth scrub); and the extent to which a

site was disturbed by previous activities.

Also considered as a criterion was the ability of a site to provide a buffer zone of undisturbed vegetation outside of the containment area while still maintaining adequate disposal capacity. The potential benefits of such a buffer, beyond its primary function as a visual barrier, can include the preservation of areas of particular environmental value such as maritime hammock or transitional wetlands. Moreover, the preservation of a buffer region within a dedicated conservation easement may mitigate the impact of containment basin construction, as well as the assessment of the impact during the permitting process.

The final environmental evaluation criterion addresses potential groundwater impacts; specifically the possibility of residential well contamination. The confined upland disposal of dredged material should have no impact on the geologically isolated Floridan Aquifer from which private residential wells may obtain potable water. However, the possibility exists that within residential areas adjacent to a disposal site, private irrigation wells tapping the shallow aquifer may experience elevated chloride levels or saltwater intrusion as a result of disposal and dewatering operations. Nutrient enrichment or other contamination is less likely to occur. To minimize the possibility of such occurrences, the sediment to be dredged will undergo analysis including elutriate testing prior to the commencement of dredging and disposal operations. Moreover, the quality of local groundwater will be monitored before, during, and after disposal. Nevertheless, the potential for residential well contamination as measured by the proximity of residential development was a criterion in site evaluation. As such, this criterion is closely related to the issue of adjacent land use, to be addressed in the following section.

#### 4.1.3 Socioeconomic or Cultural Considerations

The third major category of site evaluation criteria considers the socioeconomic or cultural issues of on-site or adjacent land use, site ownership, and the presence of archeological or historical resources. Every effort was made during the initial identification of candidate sites to select areas of minimal existing development. Agricultural areas, however, were not excluded from consideration and twelve candidate sites containing areas of fallow, marginal, or active citrus groves were

chosen. Moreover, areas having evidence of previous disturbance (e.g., earth-moving operations, artificial or channelized drainage) were given priority because of their reduced environmental value. Subsequent discovery of existing on-site residential or commercial development resulted in modifying the configuration of the site if possible, or eliminating the site from further consideration if insufficient acreage remained. Adjacent land use conflicts were not so easily resolved, and in areas in which upland acreage was limited, such conflicts remain. To the maximum extent possible, these conflicts were mitigated by the recommendation of a buffer zone to separate the disposal area from residential or commercial development.

Site ownership was investigated and established for all but three candidate sites so that authorized access for the purpose of site inspection could be obtained where necessary. As an evaluation criterion, site ownership was only considered peripherally in those cases in which slight modification of the site boundaries significantly reduced the number of individual property owners involved. No consideration was given to the identities of the property owners.

The presence of a documented archeological site, common to upland regions within the study area, was an additional evaluation criteria. To apply this to the disposal sites under consideration, a request for a records search was forwarded to the Division of Historical Resources, Florida Department of State, so that potential conflicts with documented archeological or historical sites listed in the National Register of Historical Places or the Florida Master site file could be identified. This search has not yet been completed. The presence of a verified archeological or historical site may necessitate a site survey or documentation effort prior to containment area construction, or it may require the limitation of excavation during construction activities. However, it should not preclude the use of an otherwise viable site for dredged material disposal.

#### 4.2 Site Bank

Following the final evaluation of all candidate sites, a total of 14 sites were selected to form a site bank. Of these, seven sites represent primary or first choice disposal options. The remaining seven were included to provide backup secondary disposal options in the event utilization of one or more of the primary sites proved not to be feasible. As their names imply, these 14 sites represent the

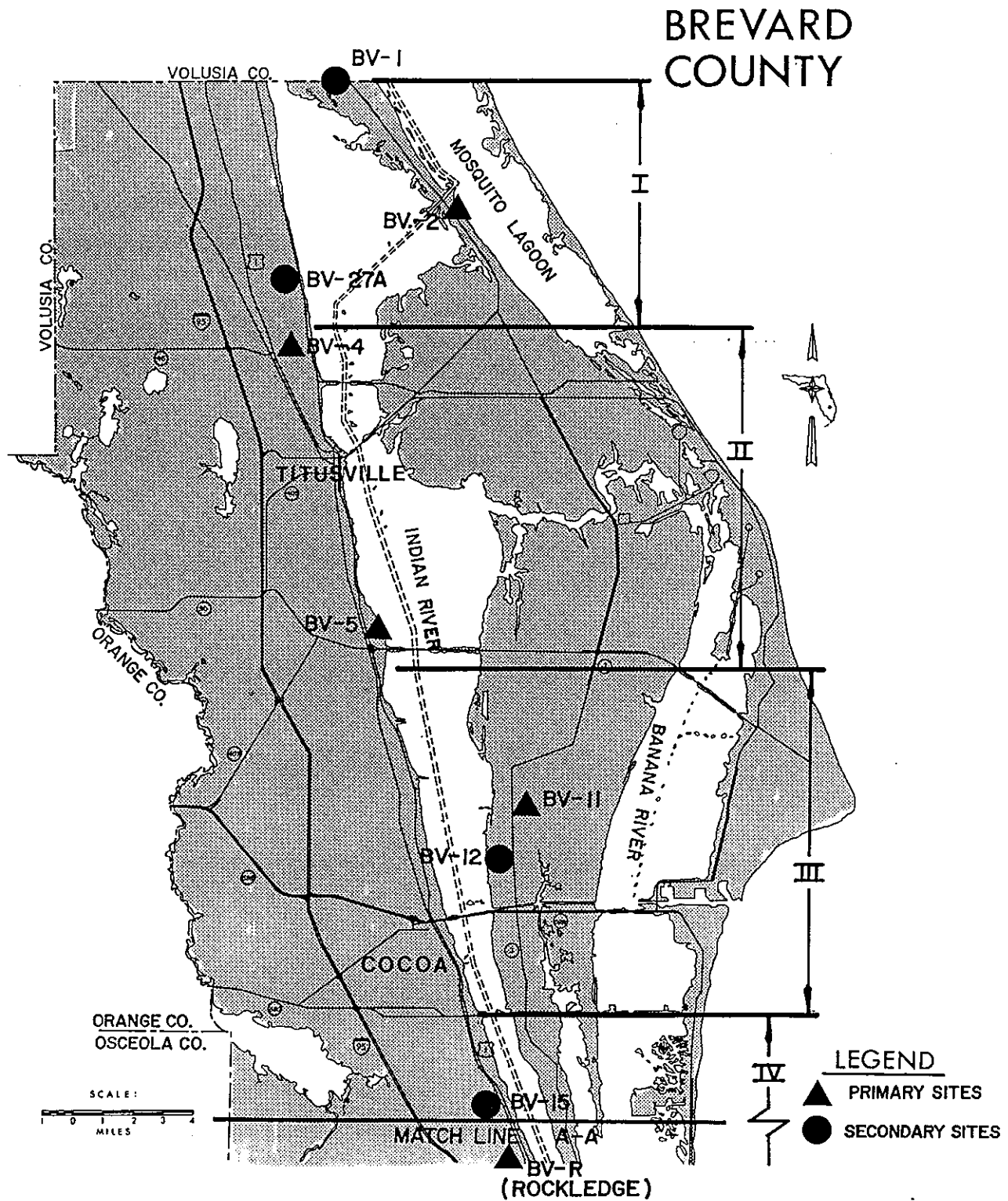
seven best and seven second best disposal options to serve the Intracoastal Waterway channels in the Brevard County area after the consideration of all engineering, operational, environmental, socioeconomic, and cultural factors influencing site selection. These sites are identified in Figure 4-1.

Each of the six channel reaches has been assigned at least one primary and one secondary site. As discussed previously, within three project reaches considerations of operational efficiency, primarily pumping distance and to a lesser extent site capacity, dictated the designation of two sites to serve in combination as either primary sites (Reach II) or secondary sites (Reaches I and VI). All remaining reaches each have a single primary and secondary site.

Site BV-2 has been designated to serve as the primary site for Reach I, with Sites BV-1 and BV-27A to serve as joint secondary sites. This decision was based on several considerations. First, BV-2 is the most centrally located site within a reach possessing very limited upland within its central portion. Second, BV-2 contains adequate capacity to receive the entire projected 50-year disposal requirement of the reach (3.66 m.c.y.). Third, the site is a highly disturbed area, and has on it a series of dead end finger canals connected at their seaward end to Mosquito Lagoon. The acceptance of the permitting agencies of the filling of these canals has yet to be determined. The filling of these canal would be required for efficient site development. However, this action is viewed as a potential environmental benefit of the project.

Should the use of Site BV-2 not prove to be feasible, Sites BV-1 and BV-27A have been designated as the secondary, or second choice option for Reach I. Located at opposite ends of the reach, these sites together provide adequate capacity for the reach's disposal requirement. Site capacities are based on the maximum utilization of the available upland in Site BV-27A, with the remainder of the reach requirement allocated to Site BV-1.

Within Reach II, both Sites BV-4 and BV-5 have been designated as primary choices based on considerations of operational efficiency and capacity. Site BV-5 has more than enough capacity to serve the entire reach. However, its location at the extreme southern end of the reach suggests a modified approach using Site BV-4, which is located at the northern end of the reach, as a part of the primary site



SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS

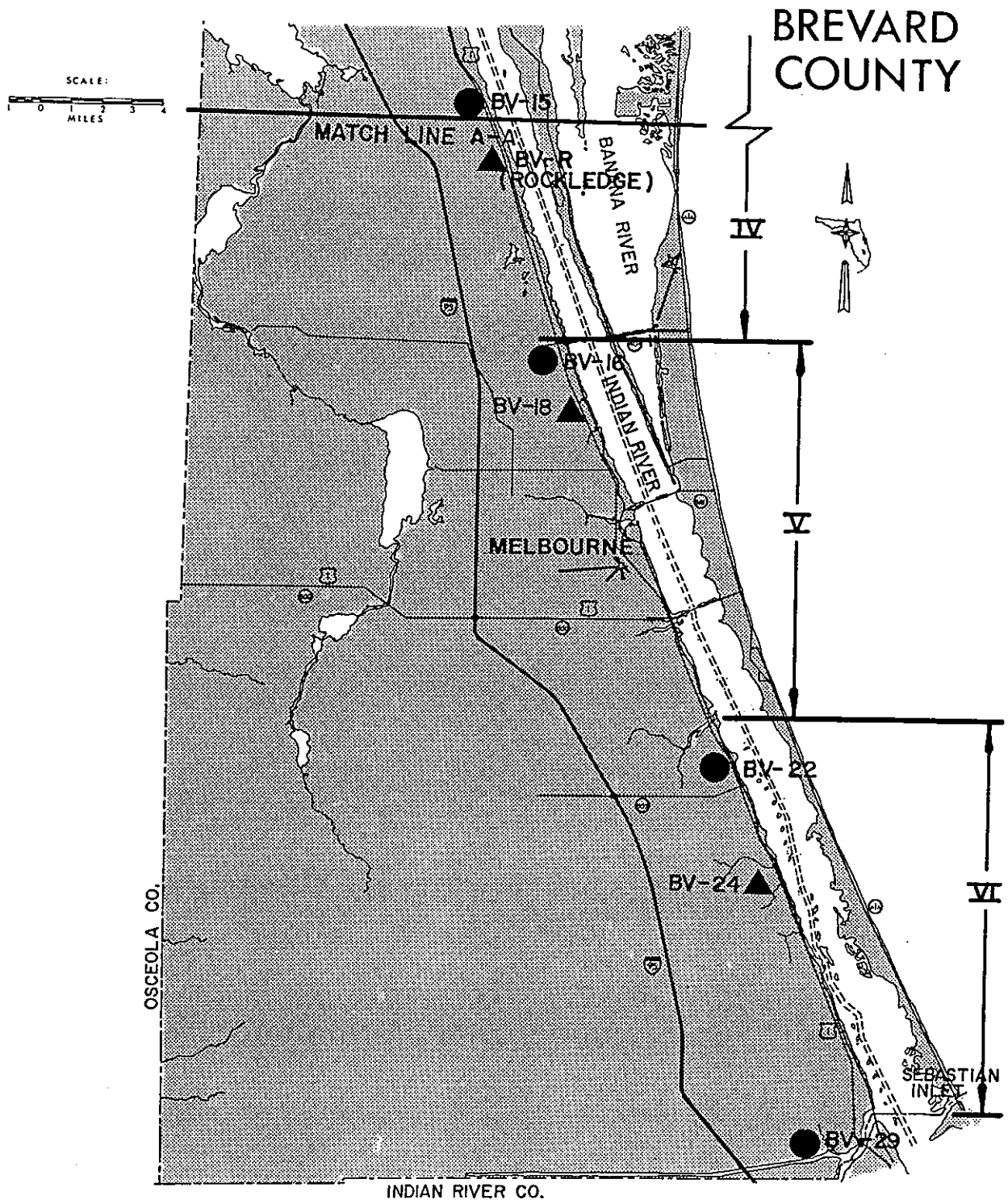


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**Figure 4-1a: Site Bank, Dredged Management Plan, Intracoastal Waterway, Brevard County, Florida**

PROJECT	C8906
REVISION	
DATE	9/30/89



### LEGEND

- ▲ PRIMARY SITES
- SECONDARY SITES

SOURCE: JACKSONVILLE DISTRICT, U.S. ARMY CORPS OF ENGINEERS



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JACKSONVILLE FLORIDA 32216

**Figure 4-1b: Site Bank, Dredged Management Plan, Intracoastal Waterway, Brevard County, Florida**

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REVISION	
SHEET	
DATE	9/30/89



selection. This combination significantly reduces reach pumping distances. The sole use of Site BV-5 represents the secondary, or second-best disposal option.

Sites BV-12 and BV-11 were selected to serve as the primary and secondary sites, respectively, for Reach III. Both sites contain adequate capacity for the requirements of the reach. Site BV-12 is preferred because of its more central location within the reach, and its potential for providing a more appropriate buffer area.

Within Reach IV, the Rockledge site presently being acquired by the FIND (Section 2.2) has been designated as the reach primary site. Although the configuration of this site limits the efficiency of its use, it still retains more than adequate capacity for the reach (Appendix B). Therefore, it was retained as the primary site for Reach IV, with Site BV-15 as a secondary disposal option.

Site BV-18 was designated as the primary disposal site for Reach V, a choice which was largely dictated by the rapid encroachment of development and competing land use. This site was selected over the secondary site, BV-16, based on its more central location and greater potential for an ample buffer area to separate the containment basin from adjacent residential development.

The southernmost reach, Reach VI, is the longest reach within the project area. Site BV-24 was chosen to be the primary site for this reach based on its central location, and its ability to provide adequate capacity within a single site. Two sites, BV-22 and BV-29, were designated to serve as secondary sites. Although Site BV-29 provides sufficient capacity in itself, its location at the extreme southern end of the reach and distance from the Waterway would result in unacceptably long pumping distances. Therefore, Site BV-22, located near the opposite end of the reach, was selected to function jointly with Site BV-29. Capacities of these secondary sites were based on the maximum utilization of Site BV-22, with Site BV-29 fulfilling the remaining disposal requirement as needed.

Additional site specific information for each primary and secondary site is presented in Appendix B. A map of each site is included showing the initial site boundaries, and major vegetation communities and land use categories as verified by field inspection under the FLUCFCS (Florida Land Use, Cover and Forms Classification

System, Florida Department of Transportation, 1985). Approximate acreages of each vegetation and land use category are presented in tabular form. Accompanying site narratives summarize pertinent characteristics of each site including general physiographic and environmental conditions, vegetative communities, and observed plant species which typify these communities. Also discussed are considerations relevant to specific evaluation criteria such as adjacent land use, possible buffer area configurations, potential or existing road access, and pipeline access routes.

Preliminary acreage requirements, disposal capacities, and operational factors for each site in the site bank are summarized in Table 4-1. The final determination of these parameter values will be made during Phase II of the project. However, the preliminary estimates presented here are felt to be both realistic and conservative. In all cases, site disposal capacities are sufficient to meet the projected disposal requirements of the reach to be served. Referring to Table 4-1, the required disposal acreage for each site represents the area within a realistic dike configuration necessary to contain the stated disposal capacity for that site. For all sites the required dike configuration lies wholly within the delineation of useable upland (i.e., the initial site acreage). The total required acreage corresponds to the required disposal acreage plus an appropriate buffer surrounding the diked containment basin. Where possible, an upland buffer of 300 foot minimum width is provided. However, in several cases as will be discussed in Appendix B, it was necessary to slightly reduce the buffer area width, or utilize adjacent confining wetland areas to serve as buffer.

The total required primary site acreage for the 70.61 miles of channel within the Brevard County study area is approximately 799 acres. This includes 439 acres of active disposal area and 360 acres of buffer region. The corresponding required secondary site area is 854 acres, of which 478 acres are active disposal area and 376 acres are buffer.

TABLE 4-1: SITE BANK, INTRACOASTAL WATERWAY,  
BREVARD COUNTY, FLORIDA

DISPOSAL SITES									
Reach	Site Designator Location	Initial Acreage	Total Required Acreage	Required Disposal Acreage	Disposal Capacity (c.y.)	Length of Road Easement (mi)	Maximum Pumping Distance (mi)	Pipeline Easement Length (mi)	Comments
I: County Line to Mims; ICWW Mile 123.75 to 134.07	BV-2 (P) ICWW Mile 127.98	394.5	345.8	211.1	3,670,500	0.0	6.09	0.0	Sized to provide capacity for entire reach
	BV-1 (S) ICWW Mile 123.04	220.8	207.5	119.1	2,068,142	0.0	11.03	1.42	Combined capacities of both secondary sites meet reach requirements
	BV-27A (S) ICWW Mile 130.50	237.8	130.5	95.7	1,666,000	0.0	10.75	0.53	
II: Mims to NASA Parkway; ICWW Mile 134.07 to 146.01	BV-4 (P) ICWW Mile 135.16	96.6	80.4	31.2	538,693	0.0	12.21	0.36	Site capacity based on efficient use of available area
	BV-5 (P) ICWW Mile 143.63	336.6	145.7	87.5	1,528,329	0.0	11.04	0.0	Serves as a primary site in combination with BV-4, as a secondary site alone
III: NASA Parkway to S.R. 520 ICWW Mile 146.01 to 159.08	BV-12 (P) ICWW Mile 151.94	80.8	62.4	29.2	499,969	0.0	7.43	0.36	Adequate capacity to meet reach requirement
	BV-11 (S) ICWW Mile 149.88	76.5	59.4	29.2	499,969	0.0	9.14	0.25	Adequate capacity to meet reach requirement

P - Primary site choice for reach

S - Secondary site choice for reach

## DISPOSAL SITES

Reach	Site Designator Location	Initial Acreage	Total Required Acreage	Required Disposal Acreage	Disposal Capacity (c.y.)	Length of Road Easement (mi)	Maximum Pumping Distance (mi)	Pipeline Easement Length (mi)	Comments
IV: S.R. 520 to Pineda Cswy; ICWW Mile 157.08 to 168.18	Rockledge Site (P) ICWW Mile 162.08	79.97	79.97	20.67	761,191	0.0	6.95	0.47	Presently being acquired by F.I.N.D. Provides adequate capacity for entire reach
	BV-15 (S) ICWW Mile 161.04	212.1	71.4	32.7	563,655	0.09	8.66	0.85	Provides adequate capacity for entire reach
V: Pineda Cswy to Turkey Creek; ICWW Mile 168.18 to 180.87	BV-18 (P) ICWW Mile 171.78	107.1	61.5	25.0	428,372	0.0	9.58	1.06	Sized to meet disposal req't for entire reach
	BV-16 (S) ICWW Mile 167.66	213.2	58.8	25.1	430,170	0.0	13.92	2.39	Provides adequate capacity for entire reach
VI: Turkey Creek to Sebastian Inlet; ICWW Mile 180.87 to 194.36	BV-24 (P) ICWW Mile 187.60	225.8	103.5	65.4	1,138,127	0.61	7.27	0.51	Provides adequate capacity for entire reach
	BV-22 (S) ICWW Mile 182.84	84.9	69.5	24.8	423,289	0.0	12.85	0.47	Combined capacities of secondary sites meet req't for entire reach
	BV-29 (S) ICWW Mile 194.88	223.6	110.7	63.7	1,107,899	0.34	16.03	0.04	

P - Primary site choice for reach

S - Secondary site choice for reach

## 5.0 RECOMMENDED SCOPE OF WORK

### Task I: Preparatory Documentation

The purpose of this task is to obtain all of the information and authorizations necessary to facilitate the detailed documentation of site conditions and facilities design in Task II; and to document public record information concerning land use and zoning restrictions, taxes and assessed values, easements, and property ownership. This will be done for all primary and secondary sites subject to property acquisition proceedings. Specific sub-tasks are outlined below.

- A. Public Information - From County tax rolls and related public records, verify and update, as necessary, site ownership and tax information including parcel size, boundaries, and assessed value. This information will be provided to the FIND at the earliest possible date to facilitate the FIND obtaining from all relevant property owners appropriate written permission as required for site access, survey work, field testing, and data collection.
- B. Zoning - Determine existing zoning classification and permitted uses under that classification.
- C. Other Site Encumbrances - Identify other restrictions which may limit the use of the site such as local or regional planning constraints, right-of-ways, easements, adjacent property constraints, or potential damages to adjacent properties.
- D. Site Reconfiguration - Modify site boundaries, as necessary. Eliminate unusable or unnecessary acreage and finalize site configuration for performance of boundary survey.

### Task II: Site Conditions

Obtain necessary engineering and environmental site information required for preliminary engineering design and permitting of primary sites only as modified by results of Task I.

A. Engineering Topographic Survey - Provide site topographic information necessary for site planning, permitting, and design purposes. Horizontal and vertical control of data should include reference to established bench marks and all elevations should be referenced to NGVD. This task will be performed by the Jacksonville District, Corps of Engineers.

B. Subsurface and Soils Survey - This task will be performed by the Jacksonville District, Corps of Engineers.

1. Soils Survey - By means of core borings and analysis, document site soil characteristics including boring logs, grain size distributions, specific gravity, organic content, Atterberg limits (where appropriate), shear strength, compaction, and consolidation.
2. Groundwater - Obtain groundwater table elevations at a sufficient number of locations to provide estimates of water table potential surface elevations on-site referenced to NGVD.

C. Environmental Survey - Perform field survey and data collection efforts to provide the following:

1. Detailed documentation of site vegetation communities, including species frequencies of occurrence, and the delineation of wetlands and transitional areas using state approved methods.
2. Detailed documentation of on-site animal species, including endangered or threatened species, and pertinent habitat information.
3. Documentation of existing vegetation communities and species habitats along proposed pipeline access and return drainage routes.

### **Task III: Preliminary Design and Analysis**

Using data obtained from Task II, develop site documentation, and complete preliminary design necessary to prepare permit drawings.

A. Environmental - Using information obtained from Task II-C prepare the following:

1. Detailed site maps showing vegetation communities, species locations and habitats, revised usable boundaries, and wetland areas.
2. Detailed written text supporting 1. above.
3. Specific mitigation measures as required.
4. Archeological site locations as recorded in published records available from the Division of Historic Resources, Florida Department of State.
5. Recommend pipeline access and return water routes.

B. Engineering - Using information obtained in Task II prepare the following:

1. Site Capacity Analysis - Recalculate estimated site capacity and dike material requirements.
2. Site Topographic Map - Prepared by Jacksonville District, Corps of Engineers.
3. Engineering Report on Subsurface and Soils Conditions - Prepared by Jacksonville District, Corps of Engineers.
4. Preliminary design calculations and permit drawings of:
  - o Location Map
  - o Site Plan
  - o Pipeline Access and Return Routes
  - o Inlet Works
  - o Outlet Works
  - o Dike Section
  - o Internal Structures
  - o Equipment Ingress and Egress Features
  - o Vegetation and Buffer Area Plan
  - o Site Drainage Plans
5. Detailed written text supporting (1) - (4) above.

C. Agency Co-ordination - Obtain from the Florida Department of Environmental Regulation (DER) the following:

1. A binding statement defining the on-site extent of DER jurisdiction, based on site inspection by agency representatives as needed to delineate jurisdictional areas, as well as additional environmental

information provided to the agency by Taylor Engineering, Inc.

2. A preliminary statement on the acceptability of the proposed site plans, based on the site engineering narrative, permit drawings, and environmental report, as well as the above statement of agency jurisdiction.

#### **Task IV: Site Management Plans**

Prepare a site management plan for each primary site in the Site Bank as modified by the results of Task I. Each plan will address the following:

- A. Design Features - Brief description of all site design features as they relate to the long term operation of the site and the management of dredged material.
- B. During-Dredging Procedures
  1. Outlet Operations
  2. Inlet Operations
  3. Ponding Depth
  4. Material Distribution
  5. Monitoring
- C. Post-Dredging Procedures
  1. Dewatering
  2. Surface Water Management
  3. Material Handling/Reuse
  4. Monitoring

#### **Task V: Cost Considerations**

For all primary sites, the following cost considerations will be evaluated:

- A. Site Improvement Costs
- B. Site Operation Costs
- C. Site Maintenance Costs



#### Task VI: Documents and Deliverables

The following project documents will be prepared and submitted for each primary site:

- A. Permit drawings and accompanying engineering narrative
- B. Subsurface and soils report, prepared by Jacksonville District, Corps of Engineers.
- C. Environmental Report
- D. Site Management Plan
- E. Cost Report

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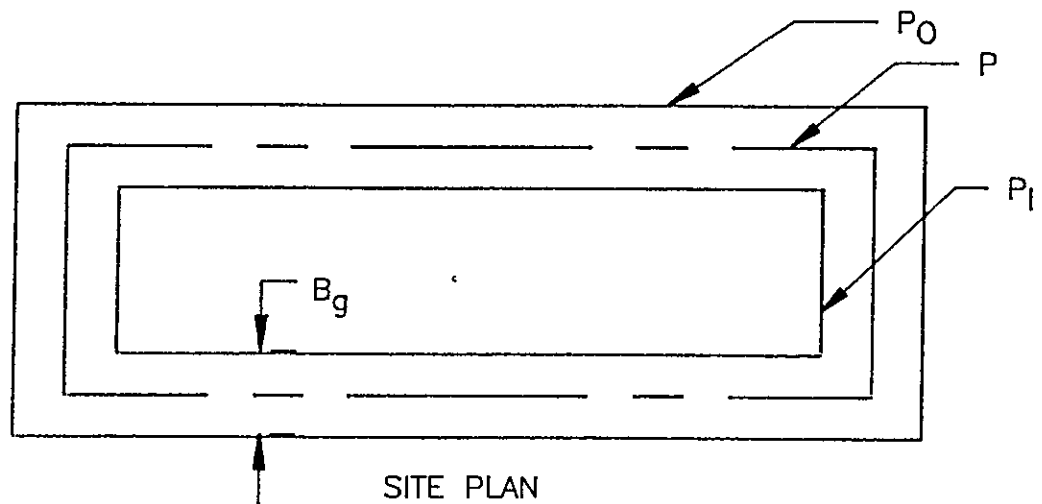
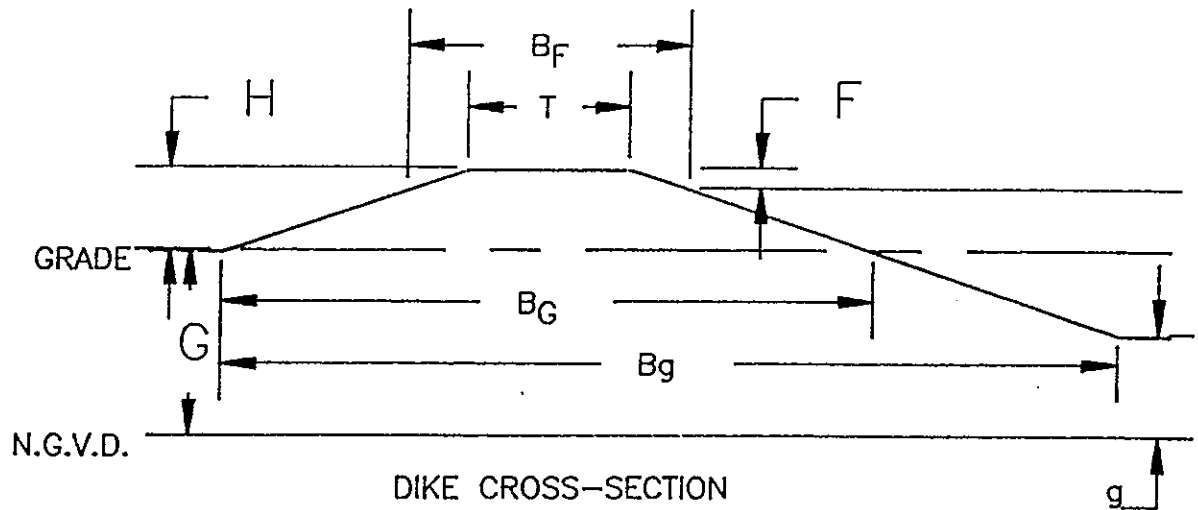
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A P P E N D I X    A

DIKE REQUIREMENTS  
AND  
DISPOSAL CAPACITY ANALYSIS

# Appendix A: Dike Requirements and Disposal Capacity Analysis



$P_0$	OUTER PERIMETER OF DIKE FOOTPRINT	SITE SPECIFIC
$P$	DIKE PERIMETER @ CENTERLINE OF DIKE CREST	SITE SPECIFIC
$P_1$	PERIMETER OF DIKE AT INTERIOR DIKE TOE	SITE SPECIFIC
$A$	REQUIRED DISPOSAL AREA, BOUNDED BY $P_0$	SITE SPECIFIC
$A_1$	AREA WITHIN $P_1$	SITE SPECIFIC
$G$	SITE GRADE (+ NGVD)	SITE SPECIFIC
$g$	EXCAVATED GRADE (+ NGVD)	SITE SPECIFIC
$H$	DIKE HEIGHT ABOVE GRADE	15 ft.
$S$	DIKE SIDE SLOPE	3 (1V:3H)
$T$	DIKE CREST WIDTH	12 ft.
$F$	FREEBOARD AND PONDING	4 ft.

APPENDIX A: (continued)

Width of Dike at Grade,  $B_G$

$$B_G = 2HS + T \quad (1)$$

Width of Dike at Excavated Grade,  $B_g$

$$B_g = 2HS + T + (G - g) S \quad (2)$$

Width of Dike at Depth of Freeboard and Ponding,  $B_F$

$$B_F = 2FS + T \quad (3)$$

Volume of Dike Material Required,  $V_{MR}$

$$V_{MR} = \frac{1}{2}H (T + B_G) P \quad (4)$$

Volume of Dike Material Available on Site,  $V_{MA}$

$$V_{MA} = (G - g)[A - \frac{1}{2}P_I (B_g - B_G)] \quad (5)$$

Volume of Disposal Capacity,  $V_D$

$$V_D = V_{MA} + (H - F) \left\{ A + \frac{1}{2}P_I [B_G - (H - F) S - B_F] \right\} \quad (6)$$

Depth of Excavation,  $(G - g)$

$$(G - g) = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (7)$$

where:  $a = \frac{1}{2}P_I S$

$$b = P_I HS + \frac{1}{2}P_I T - A - \frac{1}{2}P_I B_G$$

$$c = \frac{1}{2}H (T + B_G) P$$

**A P P E N D I X   B**

**SITE BANK**

## PRIMARY SITES

Site: BV-2

Reach I: Northern County Line to Mims; ICWW mile 123.75 to mile 134.07

Site Location: ICWW mile 127.98

Site BV-2 is a 394.5 acre parcel located within the Merritt Island National Wildlife Refuge. The site lies along the western shore of Mosquito Lagoon, bounded on the north by Haulover Canal and on the west by S.R. 3 (A1A) (Figure 4-1). The soil adjacent to State Road 3 consists of well-drained sands (Cocoa sand) that are nearly level to gently sloping. This soil type typically lies over a bed of coquina rock. A band of Myakka sand, a poorly drained soil type, occurs to the east of the Cocoa sand. This soil type is usually found between sand ridges and lower elevations. Toward Mosquito Lagoon two additional bands of Canaveral-Urban land complex and Tavares fine sand are located. The predominant land use on the site seems to originally have been a combination of citrus and ground crop production (Table B-1).

The character of this site has been significantly altered in the recent past, however. Numerous alterations in the site's surface structure are present in the form of spoil deposits, ditches, borrow pits, and canals (Figure B-1). The most prominent of these are dead-end or finger canals. The northern half of the site contains a series of these canals that were excavated to serve a waterfront residential community. Plans for development of the area were abandoned before any homes were constructed, however, and the canals are presently in a state of advanced deterioration. Canals of this type are prone to be environmental liabilities as a result of inadequate tidal flushing. The filling of these canals as a part of disposal site development, as would be required for efficient utilization of the site, could prove to be an environmental benefit. The permitability of such action will be examined in greater detail in Phase II.

The banks of the finger canals are vegetated with wax myrtle (Myrica cerifera), sand cordgrass (Spartina bakeri), southern red cedar (Juniperus silicicola), and cabbage palm (Sabal palmetto). The upland forest surrounding the canals is a mixture of hardwoods and conifers. This community contains live oak (Quercus virginiana),



Table B-1: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-2, Brevard County, Florida, July 11, 1989

Map ID No.*	Name	Approximate Acreage
221	Citrus Groves	28.5
434	Hardwood-Conifer Mixed	333.7
541	Embayment	0.2
630	Wetland Forested Mixed	16.2
642	Saltwater Marshes	1.3
742	Borrow Areas	3.2
743	Spoil Areas	11.4
Total		394.5

\*Florida Department of Transportation 1985.

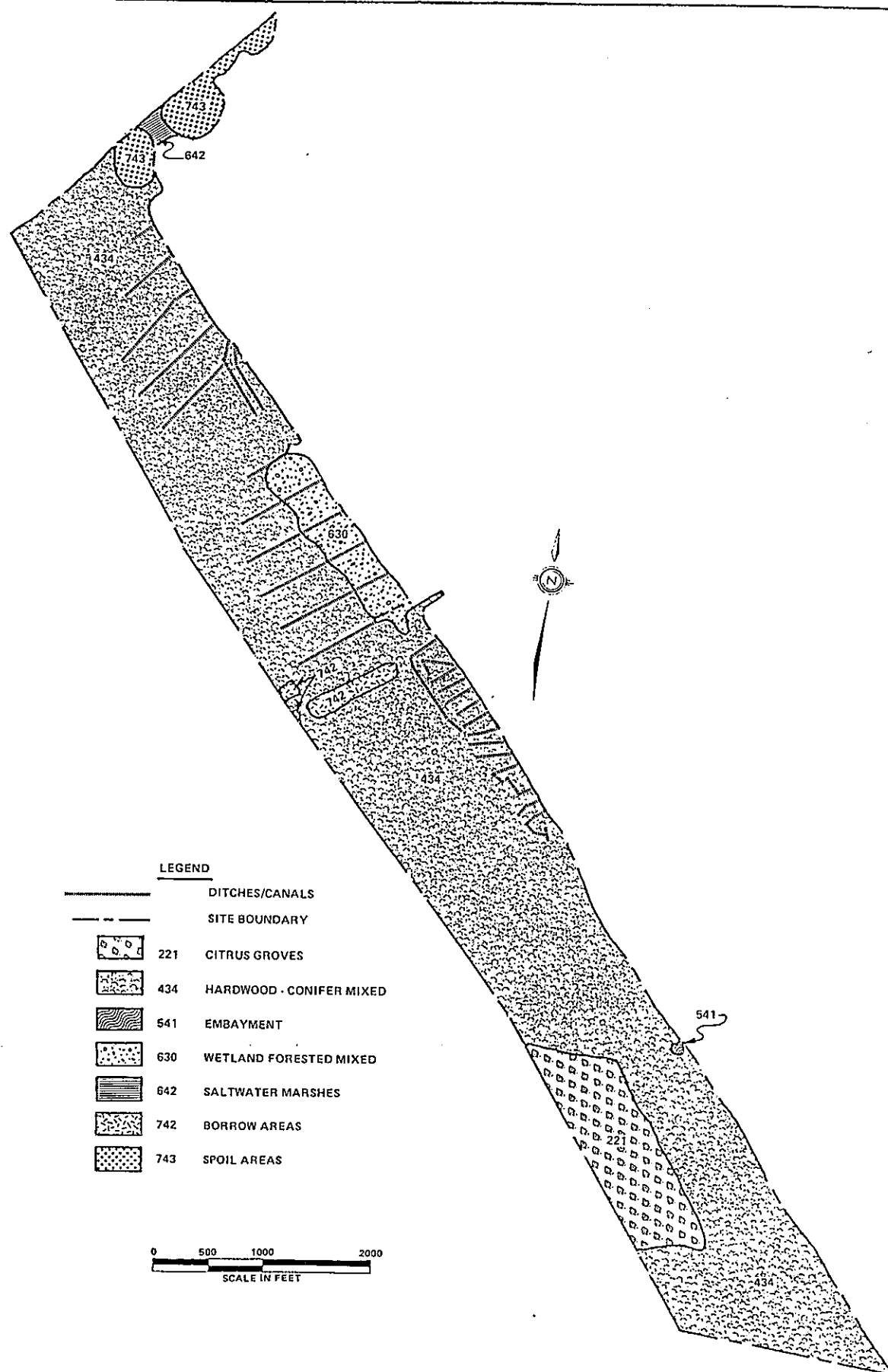


FIGURE B-1: Vegetation Communities and Land Use Types on Site 2, Brevard County, Florida, as of July 11, 1989

slash pine (Pinus elliottii), southern red cedar, and cabbage palm in varying abundances.

Elsewhere other artificial site alterations have become focal points for variations in vegetation communities. A series of irregular ditches occur in the east-central portion of the property. The banks are lined with Brazilian pepper (Schinus terebinthi-folius). Standing, dead Australian pines (Casuarina equisetifolia) were noted between these ditches. Three borrow pits which occur near the center of the site are characterized by vegetation types similar to those found in the vicinity of the finger canals. A forested wetland consisting of a mixture of species occurs in the central portion of the site. This low hammock contains southern red cedar, Brazilian pepper, and cabbage palm.

Site BV-2 is considered to be the ideal primary site for Reach I. This conclusion is based on several important factors. First, Site BV-2 is located near the center of Reach I. Pumping distance is therefore limited to a distance equal to one half of reach length, about 6 miles. Second Site BV-2 is of adequate size to provide disposal capacity for the entire reach, thereby eliminating the costs of acquiring, developing and maintaining additional sites. Third, Site BV-2 is located in an isolated region where the operation of a dredged material disposal site would have minimal negative impact on adjacent land use. And finally, Site BV-2 was suggested as potentially suitable for disposal site development by representatives of the USFWS charged with managing the Merritt Island National Wildlife Refuge within which the site is located.

#### Site: BV-4

Reach II: Mims to NASA Parkway; ICWW mile 134.07 to mile 146.01

Site Location: ICWW mile 135.16

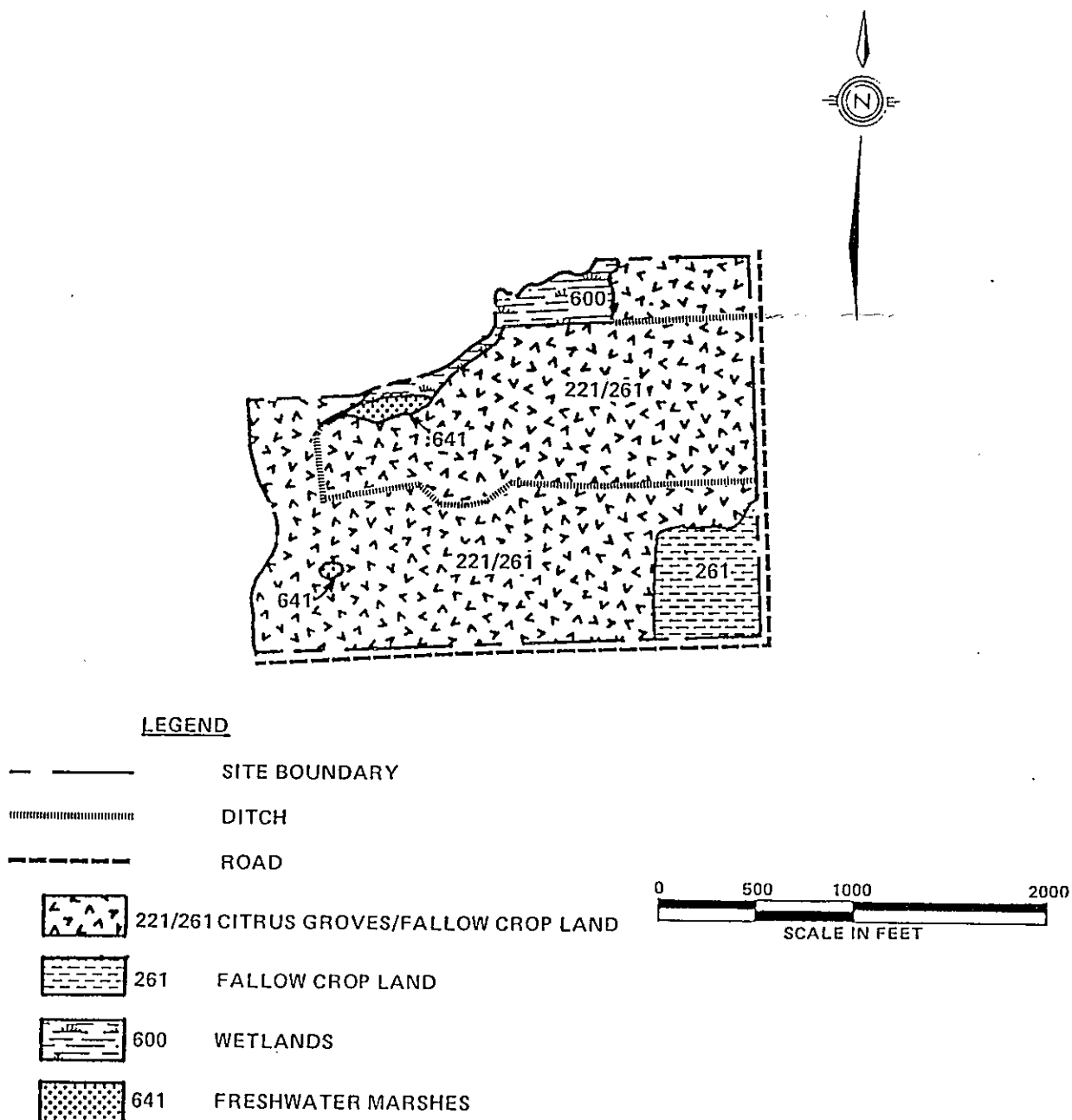
Site BV-4 lies east of Mims, bounded on the east and south by Hammock Trail and Cuyler Road respectively (Figure 4-1). The 96.6 acre site lies approximately 1500 feet west of the Indian River and consists primarily of active and cleared citrus groves (Table B-2). Surface elevation ranges from +5 to +15 feet NGVD.

A major feature of this site is the forested wetland located along the northern site boundary (Figure B-2). This wetland appears to be connected to other wetlands

Table B-2: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-4, Brevard County, Florida, July 12, 1989

Map ID No.*	Name	Approximate Acreage
221/261	Citrus Groves/Fallow Crop Land	84.2
261	Fallow Crop Land	6.8
600	Wetlands	4.7
641	Freshwater Marshes	0.9
Total		96.6

\*Florida Department of Transportation 1985.



**FIGURE B-2:** Vegetation Communities and Land Use Types on Site 4, Brevard County, Florida, as of July 11, 1989

to the east via two ditches. The ditches are dominated by sugarberry (Celtis laevigata) and southern elderberry (Sambucus simpsonii). Also on site is a small, apparently isolated wetland located in the southwest corner of the property. The preliminary configuration of the site places all of these wetlands within the 300 foot wide buffer.

BV-4 was selected as a primary site for Reach II based on several considerations. First, the site is located in a relatively isolated area at the northern boundary of the reach. When used in conjunction with Site BV-5 which is located at the southern reach boundary, maximum pumping distance is reduced to approximately 6 miles. Secondly, old citrus grove areas typically contain very few wetland areas or viable wildlife habitat. Finally, the shape of the site allows for highly efficient use of available area.

The site is located adjacent to public roads; therefore, no road easement must be acquired. Undeveloped land lies east of the site, thereby facilitating pipeline access. However, to reach the Indian River it will be necessary to cross a railroad right of way via an existing culvert located directly east of the northern site boundary.

Site: BV-5

Reach II: Mims to NASA Parkway; ICWW mile 134.07 to mile 146.01

Site Location: ICWW Mile 143.63

Site BV-5 lies on the western shore of the Indian River adjacent to the U.S. 1 - NASA Parkway interchange just south of Indian River City (Figure 4-1). The 336.6 acre tract is bounded on the west by U.S. 1 and on the south by NASA Parkway (S.R. 405). The site is bounded on the east by the abandoned right-of-way of U.S. 1. Though this asphalt-paved roadway is no longer maintained, it is presently in very good condition. Immediately to the west of the roadway is a railroad grade. This has also been abandoned and all rails and crossties have been removed. The railroad grade is elevated on average 6 feet above the natural grade which ranges in elevation from +5 feet to +15 feet NGVD. Soils on the site are a mixture of well drained to poorly drained sands.

Ground cover consists of upland scrub and flatwoods (Table B-3). The scrub, found for the most part on the western half of the site is made up of a dense cover of myrtle oak (Quercus myrtifolia), sand live oak (Quercus geminata), and saw palmetto (Serenoa repens) (Figure B-3). The flatwoods areas were vegetated by slash pine (Pinus elliottii), saw palmetto (Serenoa repens), and fetterbush (Lyonia lucida). Many areas contained a mixture of scrub and flatwoods species.

Access into the site was somewhat limited due to the thick scrub vegetation; therefore, the two isolated wetlands noted on aerial photos of the site were not visited. They appear to be wet prairies vegetated by grasses. One wetland is located north of the creek which flows northeast into the Indian River near the northern site boundary. The second wetland is located in the southwest portion of the site. A narrow band of forested wetland consisting of red maple (Acer rubrum), southern willow (Salix caroliniana), and cabbage palm (Sabal palmetto), was located along the northeast-flowing creek.

One noteworthy wildlife observation made on site was a family of scrub jays. The scrub jay is a protected species (threatened, U.S. Fish and Wildlife Service and Florida Game and Fresh Water Fish Commission), whose population decline is linked to loss of suitable habitat. The 300 foot buffer zone proposed for this site would provide an area of undisturbed vegetation, thereby preserving upland scrub habitat that would otherwise be eventually cleared for industrial development.

Site BV-5 was selected to serve as a primary site for Reach II along with Site BV-4. Since BV-4 is located at the northern end of the reach and BV-5 is at the southern end, pumping distance to both sites would be limited to one half of the length of the reach. In the event that Site BV-4 could not be used, Site BV-5 is of adequate size to provide the entire disposal capacity and still provide the proposed buffer zone. The location of Site BV-5 on the shore of the Indian River and the presence of a surfaced roadway into the site provide complete access without requiring procurement of additional road or pipeline easements.

Table B-3: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-5, Brevard County, Florida, July 1989

Map ID No.*	Name	Approximate Acreage
194	Other Open Land	1.0
322	Coastal Scrub	213.6
411	Pine Flatwoods	120.8
643	Wet Prairies	1.6
Total		336.6

\*Florida Department of Transportation 1985.



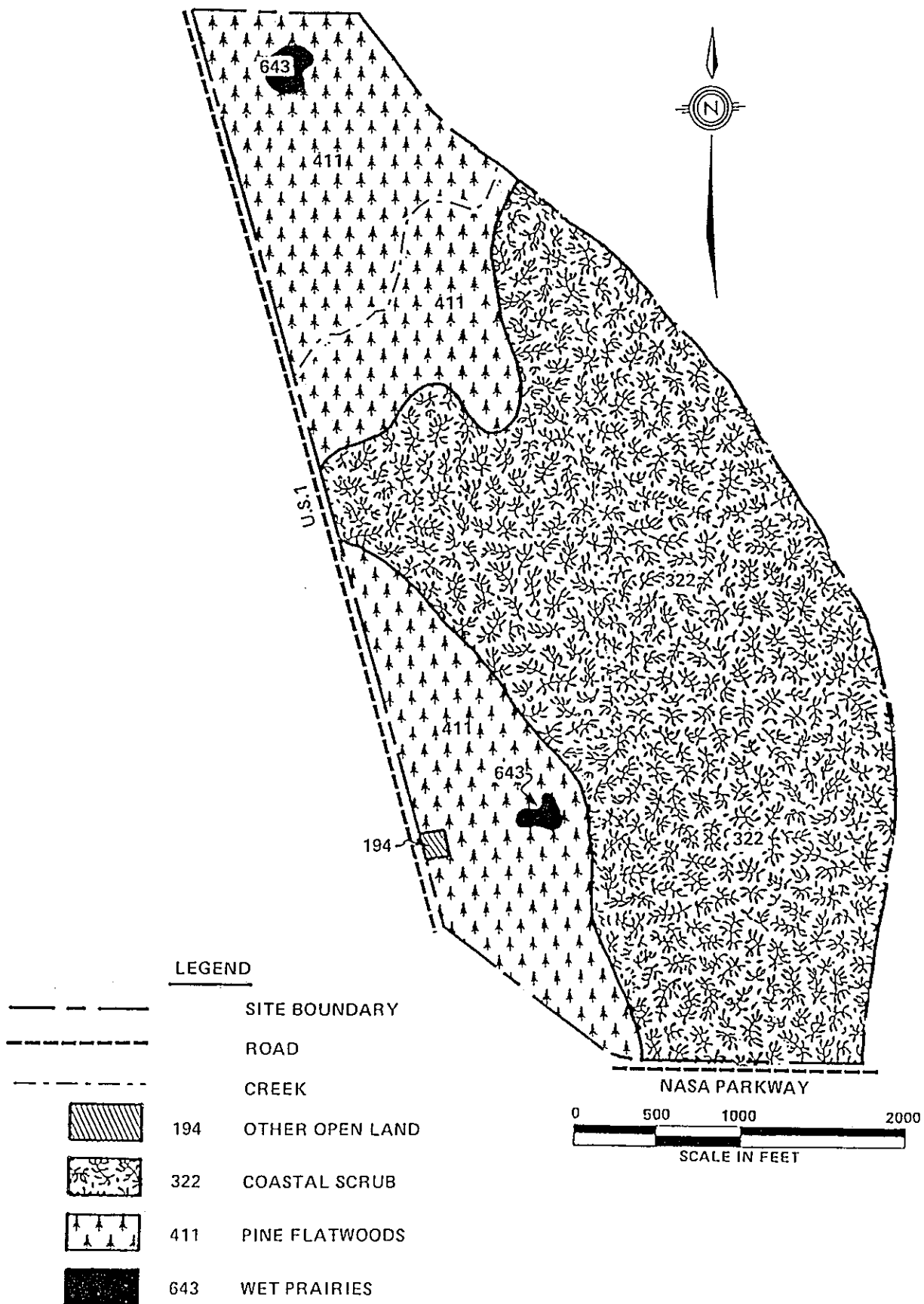


FIGURE B-3: Vegetation Communities and Land Use Types on Site 5, Brevard County, Florida, as of July 1989

WAR 1989.

Site: BV-12

Reach III: NASA Parkway to S.R. 520; ICWW mile 146.01 to 157.08

Site Location: ICWW mile 151.94

Site BV-12 is a 80.8 acre citrus grove (Table B-4) located on Merritt Island approximately 1 mile north of State Road 528 (Figure 4-1). The site is bordered on the west by a paved county road (North Tropical Trail) and is otherwise surrounded by a mixture of grove areas and tree-lined drainage ditches. The surrounding area contains sparse residential development, the most concentrated of which is a mobile home community located just west of North Tropical Trail near the southwest corner of the site.

The soils on the site are mainly well-drained sands with some poorly drained fine sands occurring in the northwest corner. The site is generally level, with elevations ranging from +5 and +10 feet NGVD.

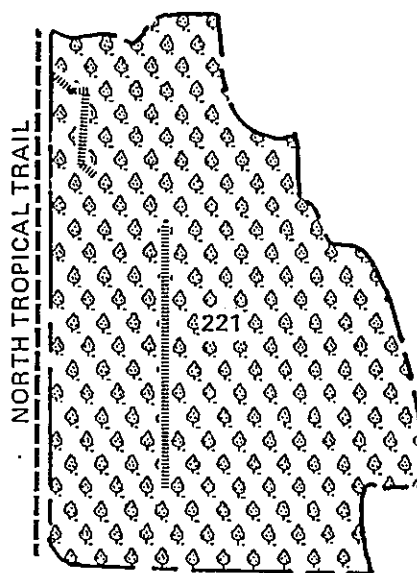
Vegetation on-site consists of regularly spaced citrus trees with a ground cover composed mainly of pigweed (Amaranthus sp.), ironweed (Sida rhombifolia), and fingergrass (Chloris sp) (Figure B-4). Two drainage ditches were observed on the property. One of the ditches is isolated and oriented in a north-south direction near the center of the site. It is approximately 10 feet wide and at the time of the site visit contained no water, but water tolerant grasses were found growing in the bottom. The second ditch, oriented east-west in the northwest corner of the site, passes under North Tropical Trail by way of a 12 inch diameter culvert and continues for 1900 feet through citrus groves, finally draining into the Indian River. This ditch offers practical pipeline access to the site, although the culvert would need to be upgraded.

Site BV-12 is considered to be the best primary site to serve Reach III because it is centrally located, contains very little wetland, and can provide adequate storage capacity and ample buffer area.

Table B-4: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-12, Brevard County, Florida, August 1989

Map ID No.*	Name	Approximate Acreage
221	Citrus Groves	80.8
	Total	80.8

\*Florida Department of Transportation 1985.



# LEGEND

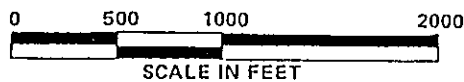
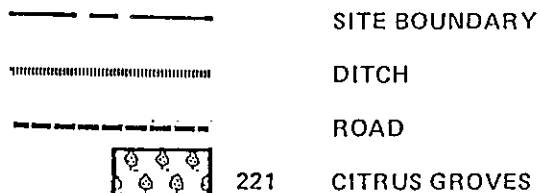


FIGURE B-4: Vegetation Communities and Land Use Types on Site 12, Brevard County, Florida, as of July, 1989

Site: BV-R (Rockledge Site)

Reach IV: S.R. 520 to Pineda Causeway; ICWW mile 157.08 to mile 168.18

Site Location: ICWW mile 162.08

Site BV-R or Rockledge site is composed of two adjoining parcels of land totalling 79.97 acres. Parcel no. 1 lies just south of the town of Rockledge in the northwest corner of Section 26 (Figure 4-1). It is bordered on the east by a Florida Power and Light powerline easement. The northwest corner of Parcel no. 2 adjoins the southeast corner of Parcel no. 1 and lies to the east of the Florida Power and Light easement, extending to the Florida East Coast Railroad right of way.

This site is presently being acquired by the Florida Inland Navigation District (FIND) for use as a dredged material disposal site. As of the time of submission of this report, this site has not been visited by Taylor Engineering, Inc. staff. Based on information supplied by F.I.N.D. in the form of a boundary survey, Parcel no. 1 appears to be an undeveloped tract while Parcel no. 2, is the site of an active borrow pit. A topographic survey of Parcel no. 2, also supplied by F.I.N.D., indicates that as of the time of the survey (dated May 17, 1988) 505,000 cubic yards of material would be required to restore the borrow pit to the pre-existing grade. This quantity nearly equals the 50-year reach disposal requirement of 541,237 cubic yards. This existing capacity coupled with the additional storage capacity provided by diked areas constructed on natural grade of both parcels would yield a total storage capacity of one and a half times the 50-year disposal requirement for the entire reach.

Other advantages of this site are its central location within Reach IV and the existing access provided by public roads. A potential disadvantage of the site is that it is located approximately one half mile west of the Indian River. Within this distance lies dense residential development, U.S. Highway 1 and the Florida East Coast Railroad right of way. However, a pipeline easement has been obtained to enable crossing of these obstacles during dredging and disposal operations. Since no site inspection was conducted, detailed vegetation studies will also be carried out during Phase II.

IDENTIFIED

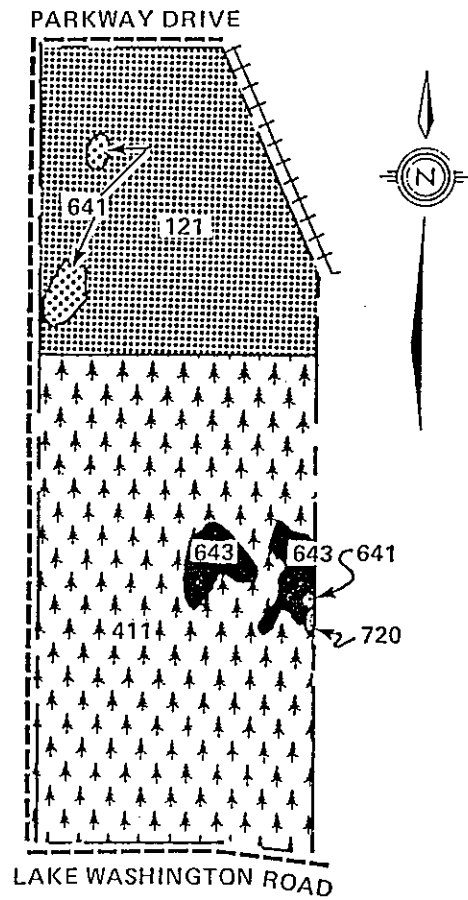
Site: BV-18

Reach V: Pineda Causeway to Turkey Creek; ICWW mile 168.18 to mile 180.87

Site Location: ICWW mile 171.78

Site BV-18 is located in a developing area of northern Eau Gallie. It is bordered on the west by a paved street, on the south by Lake Washington Road and on the east by industrial and commercial development (Figure 4-1). Upon examination of the site it was found that a single family residential community occupied the northern one third of the proposed 107.1 acre tract (Figure B-5). There was, however, no evidence of southerly expansion of development into the remainder of the site. Elevation in the undeveloped portion of the site ranged from +20 and +25 feet NGVD. Longleaf pine flatwoods dominate this area, with some palmetto prairies and wet prairies present (Table B-5). A recent fire has allowed expansion of the palmetto prairies. The wet prairies are vegetated by a variety of grasses, including sand cordgrass (Spartina bakeri), beak rush (Rhynchospora sp.), maidencane (Panicum hemitomom), and little blue maidencane (Amphicarpum muhlenbergianum), and are surrounded by a fringe of cabbage palm (Sabal palmetto). Prevalent soils occurring on the site are Satellite sand, a somewhat poorly drained soil found on low ridges in the flatwoods and Pomello sand, a moderately well-drained soil usually associated with longleaf pine flatwoods.

The uplands adjacent to the reach served by Site BV-18 is an area of increasingly high-density development, both residential and commercial. Very little undeveloped acreage meeting site selection criteria remains in this region of Brevard County. All tracts initially identified as candidate sites have been developed to varying degrees, with only sites BV-16 and BV-18 remaining suitable for disposal site development. Although the northern portion of Site BV-18 has recently been developed, the remainder of the site provides sufficient capacity for the 50-year disposal requirement of Reach V (417,417 c.y.), as well as adequate buffer area. The added advantage of centralized location, makes BV-18 the primary disposal site choice for Reach V, with BV-16 as the secondary site. As with most sites west of the Indian River, pipeline access to site BV-18 is somewhat encumbered, but not precluded, by existing development. Final pipeline routes will be addressed in Phase II.



# **LEGEND**

- SITE BOUNDARY
- ROAD
- + + + + + RAILROAD RIGHT-OF-WAY
- 121 FIXED SINGLE FAMILY UNITS
- 411 PINE FLATWOODS
- 641 FRESHWATER MARSHES
- 643 WET PRAIRIES
- 720 SAND OTHER THAN BEACHES

0 500 1000 2000  
SCALE IN FEET

**FIGURE B-5: Vegetation Communities and Land Use Types on Site 18, Brevard County, Florida as of July, 1989**

Table B-5: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-18, Brevard County, Florida

<u>Map ID No.*</u>	<u>Name</u>	<u>Approximate Acreage</u>
121	Fixed Single Family Units	36.2
411	Pine Flatwoods	66.0
641	Freshwater Marshes	1.4
643	Wet Prairies	3.4
720	Sand Other Than Beaches	0.1
Total		107.1

\*Florida Department of Transportation 1985.



Site: BV-24

Reach VI: Turkey Creek to Sebastian Inlet; ICWW mile 180.87 to mile 194.36

Site Location: ICWW mile 187.60




Site BV-24 lies midway between the townships of Valkaria (to the north) and Grant (to the south), close to the southeast wing of the Valkaria Airfield Missile Tracking Annex (Figure 4-1). The 225.8 acre site is bordered on the west by a drainage ditch which flows north into Kid Creek, while the northern site boundary lies approximately 800 feet south of the creek itself (Figure B-6). The site is nearly level with an average elevation of +21 feet NGVD. Site vegetation is predominantly pine flatwoods interspersed with wet prairies (Table B-6). The flatwoods contain slash pine (Pinus elliottii) with a saw palmetto (Serenoa repens) under-story. The wet prairies are intermittent ponds vegetated with sandweed (Hypericum fasciculatum), bachelor's button (Polygala sp.), and meadowbeauty (Rhexia mariana). The ditch bounding the west edge of the site is lined with cabbage palm (Sabal palmetto). Scrub uplands east of the site have been cleared and seeded with grass. This may be part of an expansion of the golf course adjacent to the southern boundary of the site.

Major soil types present on the site are Immokalee and Pomello sands. Immokalee sand is a poorly drained soil often associated with flatwoods vegetation. The Pomello sand, a moderately well-drained type, forms broad low ridges. The site itself and surrounding areas remain largely undeveloped, making expansion feasible. The preliminary configuration of the site would require an road easement of approximately 0.6 mile from Old Dixie Highway. Alternatively, the site could be expanded eastward to the right of way of Old Dixie Highway, in which case no road easement would be needed.

Two natural drainages connect site BV-24 to the Indian River. The first, Kid Creek, is a fairly large drainage and as described previously lies north of the site. The second is a smaller unnamed drainage which flows from the midsection of the property's eastern boundary. Both drainages pass under Old Dixie Highway, the Florida East Coast Railroad right of way, and U.S. Highway 1 before entering the Indian River. These drainages have potential as pipeline access routes. Specific pipeline routes will be addressed during Phase II.



# **LEGEND**

- SITE BOUNDARY
- ||||| DITCH
-  411 PINE FLATWOODS
-  630 WETLAND FORESTED MIXED
-  643 WET PRAIRIES

0 500 1000 2000  
SCALE IN FEET

**FIGURE B-6:** Vegetation Communities and Land Use Types on Site 24, Brevard County, Florida, as of July 12, 1989

Table B-6: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-24, Brevard County, Florida, July 12, 1989

Map ID No.*	Name	Approximate Acreage
411	Pine Flatwoods	191.0
630	Wetland Forested Mixed	13.9
643	Wet Prairies	20.9
Total		225.8

\*Florida Department of Transportation 1985.

Site BV-24 was selected as the primary site for Reach VI based on three considerations. First, the region in which the site is located lacks high-density development; therefore, adequate capacity is available on-site. Expansion of the site is also possible, and conflicts with surrounding land use are minimized. Secondly, efficient pipeline and road access appears feasible, but will require that additional easements be acquired. Finally, the site is located near the center of Reach VI, thereby minimizing pumping distances.

## SECONDARY SITES

Site: BV-1

Reach I: Northern County Line to Mims; ICWW mile 123.75 to mile 134.07

Site Location: ICWW mile 123.04

Site BV-1 is a 220.8 acre tract located within the Merritt Island National Wildlife Refuge. It lies just west of State Road 3 (A1A), centered on the Brevard-Volusia county line (Figure 4-1). The property, once part of a large citrus grove, is now mostly clear of trees (Table B-7). The site surface slopes downward from east to west with elevations ranging from +25 to +5 feet NGVD. Astatula fine sand is the predominant soil on site with some Cocoa sand also present. Both of these sands are well-drained types.

The uplands are currently vegetated with herbaceous species indicative of disturbed conditions, such as camphorweed (Heterotheca subaxillaris) and ragweed (Ambrosia artemisiifolia). Scattered clusters of live oak (Quercus virginiana) and slash pine (Pinus elliottii) occur on the site. The only substantial area of this habitat (3.8 acres) is located in the southeast corner of the property (Figure B-7). A drainage ditch linking two off-site forested wetlands is located in the northeast corner of the property. The ditch is approximately 20 feet wide and 5 feet deep. Cattails (Typha sp.) and duckweed (Lemna minor) occur in the ditch and the banks are vegetated with wax myrtle (Myrica cerifera), primrose willow (Ludwigia peruviana), and southern elderberry (Sambucus simpsonii). The ditch flows to a large forested wetland system that is dominated by American elm (Ulmus americana) and water hickory (Carya aquatica). The northern leg of the ditch is connected to a small red maple (Acer rubrum) swamp located adjacent to the property. Also of note was the presence of three active Osprey nests located in dead trees on the site.

Site BV-1 was selected as a secondary site to serve in conjunction with an additional site located near the southern limit of Reach I. Site BV-1, having a disposal capacity of two million cubic yards, would serve only the northern portion of the reach. This would substantially reduce pumping distances, thereby helping to offset the costs of developing and operating two sites. The site has existing road access (A1A); however, additional pipeline easement of up to 2 miles may have to be acquired.

Table B-7: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-1, Brevard County, Florida, July 11, 1989

<u>Map ID No.*</u>	<u>Name</u>	<u>Approximate Acreage</u>
261	Fallow Crop Land	217.0
434	Hardwood-Conifer Mixed	3.8
Total		220.8

\*Florida Department of Transportation 1985.

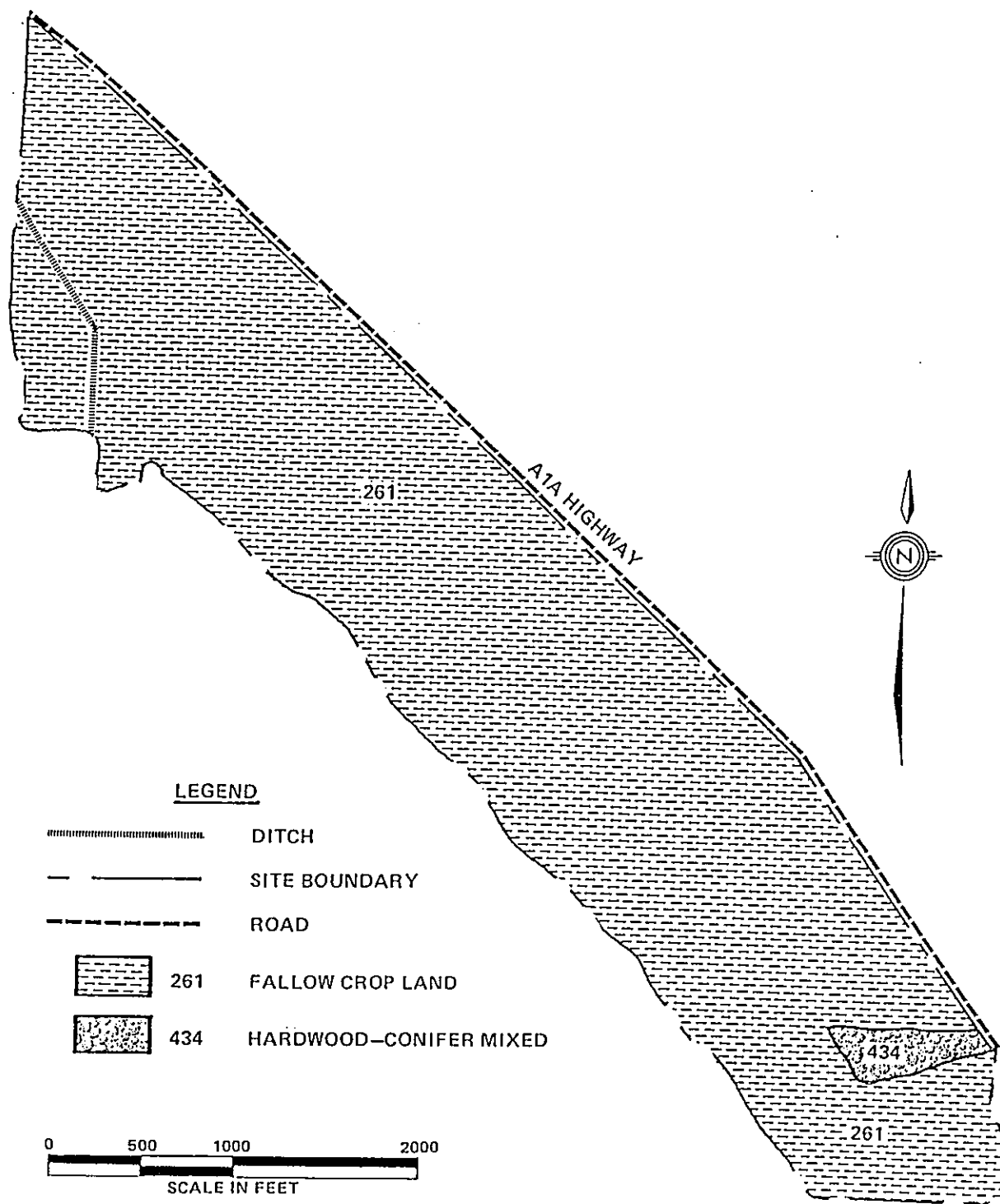


FIGURE B-7: Vegetation Communities and Land Use Types on Site 1, Brevard County, Florida, as of July 11, 1989

Site: BV-27A

Reach I: Northern County Line to Mims; ICWW mile 123.75 to mile 134.07

Site Location: ICWW mile 130.50

Site BV-27A is located approximately 2.5 miles north of Mims (Figure 4-1). The 237.8 acre site contains a combination of active and fallow citrus groves. The site can be accessed from U.S. Highway 1 via Lionel Road and Grantline Roads which form the south and north site boundaries, respectively. Hammock Road forms the western site border. The eastern site boundary lies approximately 2000 feet from the shore of the Indian River. Elevations in the area of the site range between +5 and +10 feet NGVD.

The site contains a few active citrus groves; however, most of the groves have been cleared. The old groves have been colonized by *Paspalum* sp. and silverling (*Baccharis halimifolia*). Several small wetlands occur in the northern half of the property. Vegetation in the wetlands is weedy, with primrose willow (*Ludwigia peruviana*), southern willow (*Salix caroliniana*), silverling (*Baccharis halimifolia*), and southern elderberry (*Sambucus simpsonii*) being the predominant species. Several east-west ditches occur on the property. The ditches are vegetated with golden canna (*Canna flaccida*) and cattails (*Typha* sp.) (Table B-8).

Site BV-27A was selected to serve as a secondary site for Reach I in conjunction with Site BV-1, and would thereby provide disposal capacity for the southern half of this reach. The site is ideally located to serve this purpose. Its location also affords ready and road access; however, additional pipeline easement of approximately 0.5 mile will be required. The F.E.C. railroad right-of-way can be crossed via existing drainage culverts.

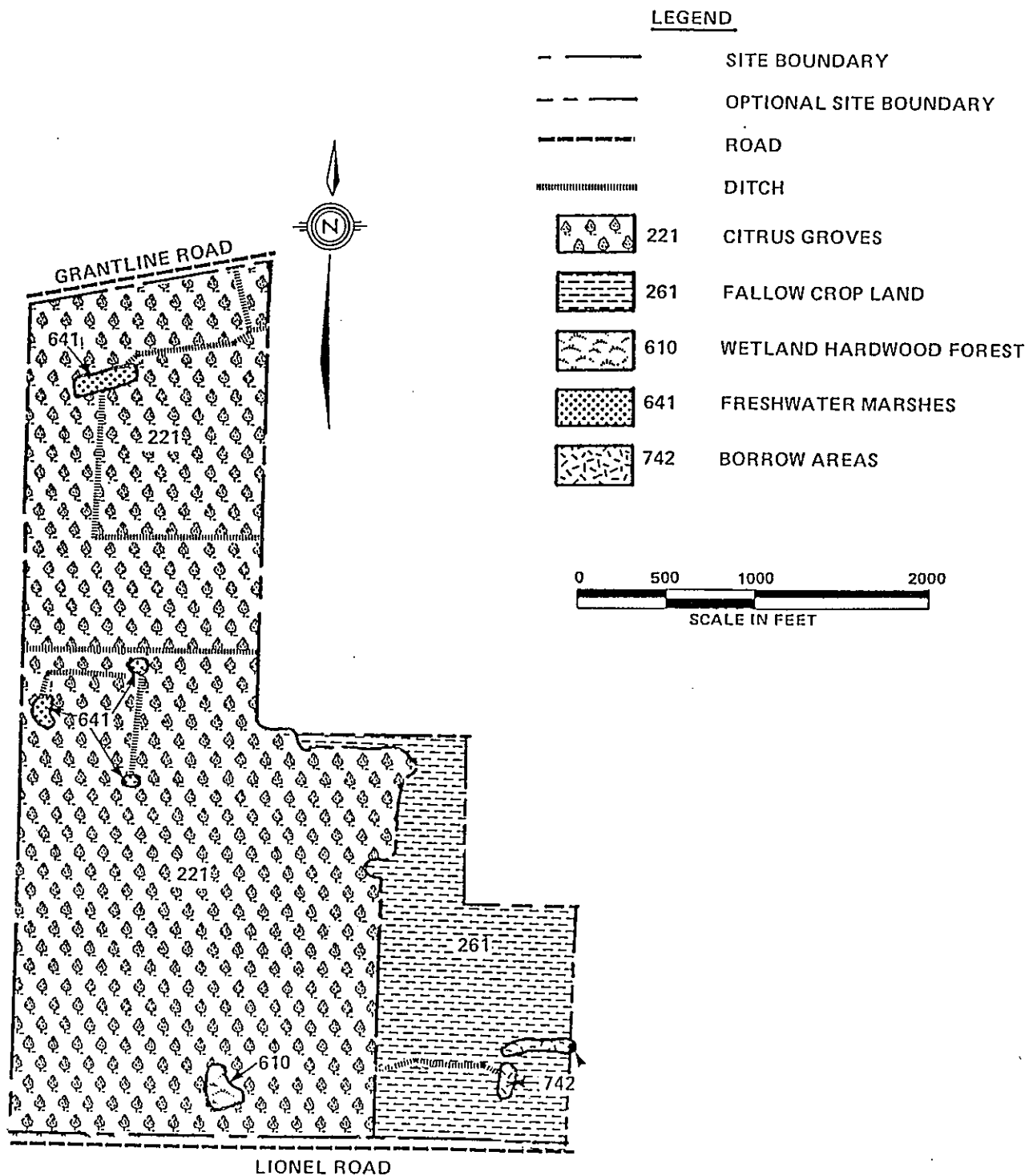
The site has been configured to provide a disposal capacity of 1.6 million cubic yards. A 300 foot buffer zone will surround the site and extends east into an area of fallow crop land (Figure B-8). This will allow the most efficient use of the grove areas while providing maximum isolation of the containment basin.



Table B-8: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-27A, Brevard County, Florida, July 12, 1989

Map ID No.*	Name	Approximate Acreage
221	Citrus Groves	190.7
261	Fallow Crop Land	44.1
610	Wetland Hardwood Forest	0.8
641	Freshwater Marshes	1.3
742	Borrow Areas	0.9
Total		237.8

\*Florida Department of Transportation 1985.



**FIGURE B-8:** Vegetation Communities and Land Use Types on Site 27A, Brevard County, Florida, as of July 12, 1989

Site: BV-11

Reach III: NASA Parkway to S.R. 520; ICWW mile 146.01 to mile 157.08

Site Location: ICWW mile 149.88

Site BV-11 is a 76.5 acre citrus grove located on Merritt Island (Figure 4-1). The property lies approximately 3 miles north of S.R. 520, and is bounded on the west by North Tropical Trail Road and on the east by wetlands (Figure B-9). Site elevation ranges from +10 feet NGVD on the western boundary to +5 feet and below along the wetlands. Soils on the property are typically moderately well-drained sand with bands of poorly drained Myakka fine sand occurring near the eastern border and in the site center.

The site is an active, managed citrus grove dominated by orange trees. A ground cover consisting mainly of cogon grass (Imperata cylindrica) is apparently mowed at regular intervals. A depressional area in the northeast part of the property is classified as a wet prairie and is vegetated with a variety of hydric grasses and herbs. A north-south oriented ditch cuts through this wetland. A small man-made pond is located in the northern portion of the site. Although the pond contained standing water at the time of the site visit, little emergent vegetation grew in the depression.

Site BV-11 is a near match for site BV-12 in size, present land use, and accessibility. The two differ mainly in location, BV-12 being more central to the reach. Site BV-11 is therefore considered a viable secondary site for Reach III.

Site: BV-15

Reach IV: S.R. 520 to Pineda Causeway; ICWW mile 157.08 to mile 168.18

Site Location: ICWW mile 161.04

Site BV-15 is a 212.1 acre parcel which lies just south of Rockledge (Figure 4-1). The area in which the site is located contains commercial and industrial development. The site is bounded on the north by a large drainage canal, on the northeast by a Florida Power and Light line easement, and by a private airstrip to the west. A paved county road bounds a portion of the site to the south while an

Table B-9: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-11, Brevard County, Florida, July 1989

Map ID No.*	Name	Approximate Acreage
221	Citrus Groves	75.1
643	Wet Prairies	1.2
653/742	Intermittent Ponds/ Borrow Areas	1.0
Total		76.5

\*Florida Department of Transportation 1985.

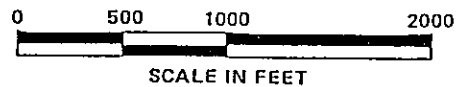
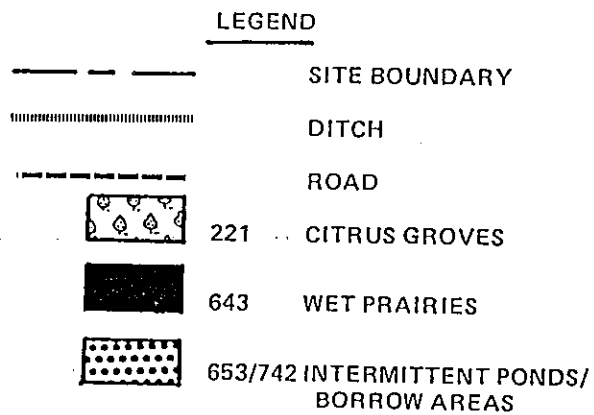
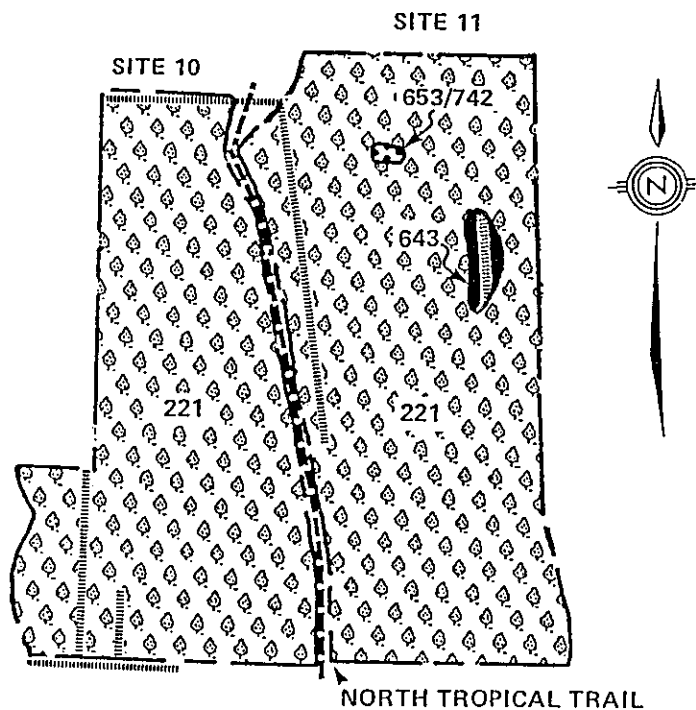


FIGURE B-9: Vegetation Communities and Land Use Types on Site 11, Brevard County, Florida, as of July, 1989

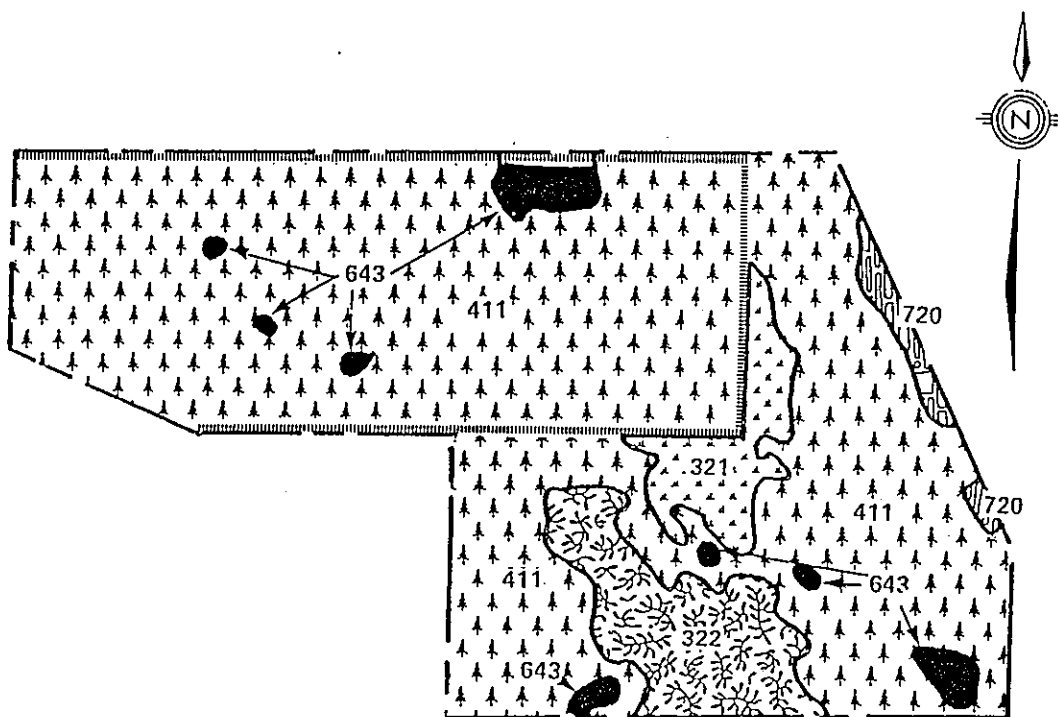
abandoned drive-in theater forms an out parcel at the southwest corner of the property. Elevations of the site typically range from +20 to +25 feet NGVD; however, some spots in the northwest corner lies between +25 and +30 feet NGVD.

Soils found on the property are classified as somewhat poorly drained to poorly drained sands typical of flatwoods sites. One area in the northeast is excessively well-drained Paola fine sand. This is an area that has recently been used as a borrow area and is currently barren land.

The vegetation on-site is quite variable (Figure B-10). As the soil types would indicate, much of the site is flatwoods; however, the cover and type of pine vary. In some areas, canopy cover is less than 10 percent. These locations are classified as palmetto prairie. Other areas are dominated by longleaf pine (Pinus palustris) or slash pine (Pinus elliotii) with a typical flatwoods understory of saw palmetto (Serenoa repens), gallberry (Ilex glabra), and fetterbush (Lyonia lucida). In the south-central portion of the site, the cover is mostly myrtle oak (Quercus myrtifolia). Some pine is present, including sand pine (Pinus clausa), but not in abundance. These areas are classified as coastal scrub (Table B-10).

There are numerous small wetlands on the property. Those visited consisted of wet prairies. It is probable that most of the wetlands on-site are also wet prairies. Eight wetlands were mapped, but a more complete field effort would be required to investigate some questionable signatures identified on the aerial photographs. All of the wetlands, except perhaps the largest which is located along the northern boundary, appear to be isolated from waters of the State. Large ditches occur along the northern site boundary, and an "L"-shaped ditch effectively splits the parcel into two pieces. This ditch empties into the large ditch along the northern portion of the site. These ditches apparently drain into the Indian River, connecting them to State waters, and thereby making their alteration subject to DER jurisdiction. For this reason, the site was configured to place the containment basin in the northwest arm of the property (Figure B-10). This area offers adequate disposal capacity to serve the entire reach and also allows a substantial buffer zone with minimal overall impact to the site.

The site would be accessible by road via an easement of approximately .10 mile. As is the case with most sites in Reaches II, III, IV, and V pipeline access could



# **LEGEND**

—	SITE BOUNDARY
	DITCH
	321 PALMETTO PRAIRIES
	322 COASTAL SCRUB
	411 PINE FLATWOODS
	643 WET PRAIRIES
	720 SAND OTHER THAN BEACHES

**FIGURE B-10:** Vegetation Communities and Land Use Types on Site 15, Brevard County, Florida, as of July, 1989

Table B-10: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-15, Brevard County, Florida, July 1989

Map ID No.*	Name	Approximate Acreage
321	Palmetto Prairies	9.5
322	Coastal Scrub	17.1
411	Pine Flatwoods	117.4
643	Wet Prairies	5.2
720	Sand Other Than Beaches	2.9
Total		212.1

\*Florida Department of Transportation 1985.



possibly be a problem for this site. Although BV-15 lies in close proximity to the Indian River, dense waterfront development presents an obstacle to the placement of pipelines between the site and open water.

Site: BV-16

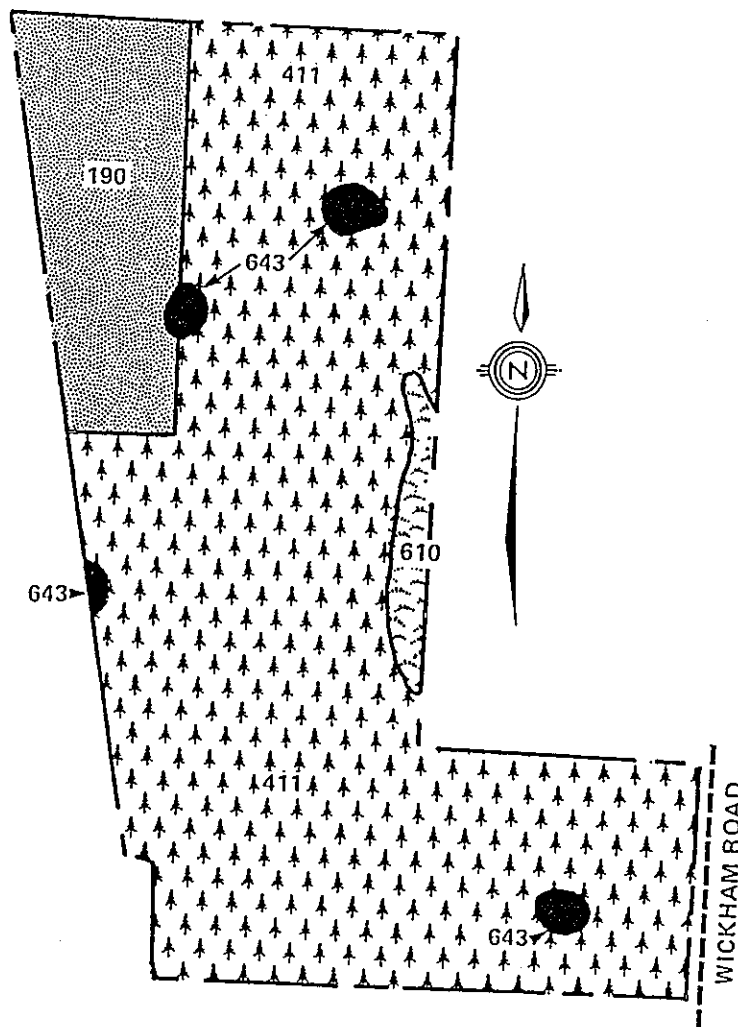
Reach V: Pineda Causeway to Turkey Creek; ICWW mile 168.18 to mile 180.87  
Site Location: ICWW mile 167.66

Site BV-16 is a 213.2 acre tract located approximately 2 miles northwest of the city of Palm Shores (Figure 4-1). The southernmost portion of this "L"-shaped parcel extends east to Wickham Road (S.R. 509) in the vicinity of the Wickham Road - S.R. 404 intersection (Figure B-11). Elevations on site typically range from +30 to +35 feet NGVD, with some areas slightly higher than 35 feet.

The site is vegetated mainly by pine flatwoods with an interspersed of citrus groves and wetlands (Table B-11). Most soils present on site are poorly drained sands typically found in flatwood communities. The flatwoods consist of longleaf and slash pine (Pinus palustris and Pinus elliottii, respectively) with an understory of saw palmetto (Serenoa repens), gallberry (Ilex glabra), and wiregrass (Aristida stricta). Wetlands on the site include four isolated wet prairies. The edge of a larger forested wetland system encroaches on the site along the eastern side of the property (Figure B-11). This large wetland may be connected to State waters by way of ditches that drain east, presumably into the Indian River.

While much of the surrounding area is currently being developed, only fringe areas of site BV-16 have been affected. The proposed site configuration places the disposal containment dike within the south-central portion of the property. A 300 foot wide buffer zone will encircle the diked containment basin.

Presently no improved roads exist on-site but several jeep trails access the site interior directly from public roads. Since a portion of the site lies adjacent to S.R. 509, acquisition of additional road easement will not be necessary. Options for the routing of pipeline between the site and open water are somewhat limited due to dense development west of U.S. Highway 1, but several alternatives appear feasible.



# **LEGEND**

- SITE BOUNDARY
- - - ROAD
- 190 OPEN LAND
- 411 PINE FLATWOODS
- 610 WETLAND HARDWOOD FORESTS
- 643 WET PRAIRIES

0 500 1000 2000  
SCALE IN FEET

**FIGURE B - 11:** Vegetation Communities and Land Use Types on Site 16, Brevard County, Florida as of July, 1989

Table B-11: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-16, Brevard County, Florida, July 1989

Map ID No.*	Name	Approximate Acreage
190	Open Land	31.5
411	Pine Flatwoods	174.0
610	Wetland Hardwood Forests	4.8
643	Wet Prairies	2.9
Total		213.2

\*Florida Department of Transportation 1985.

The major disadvantage associated with site BV-16 is its location near the northern boundary of Reach V. Servicing the southern portion of the reach could therefore require pumping a maximum distance of approximately 14 miles.

Site: BV-22

Reach VI: Turkey Creek to Sebastian Inlet; ICWW mile 180.87 to mile 194.36  
Site Location: ICWW mile 182.84

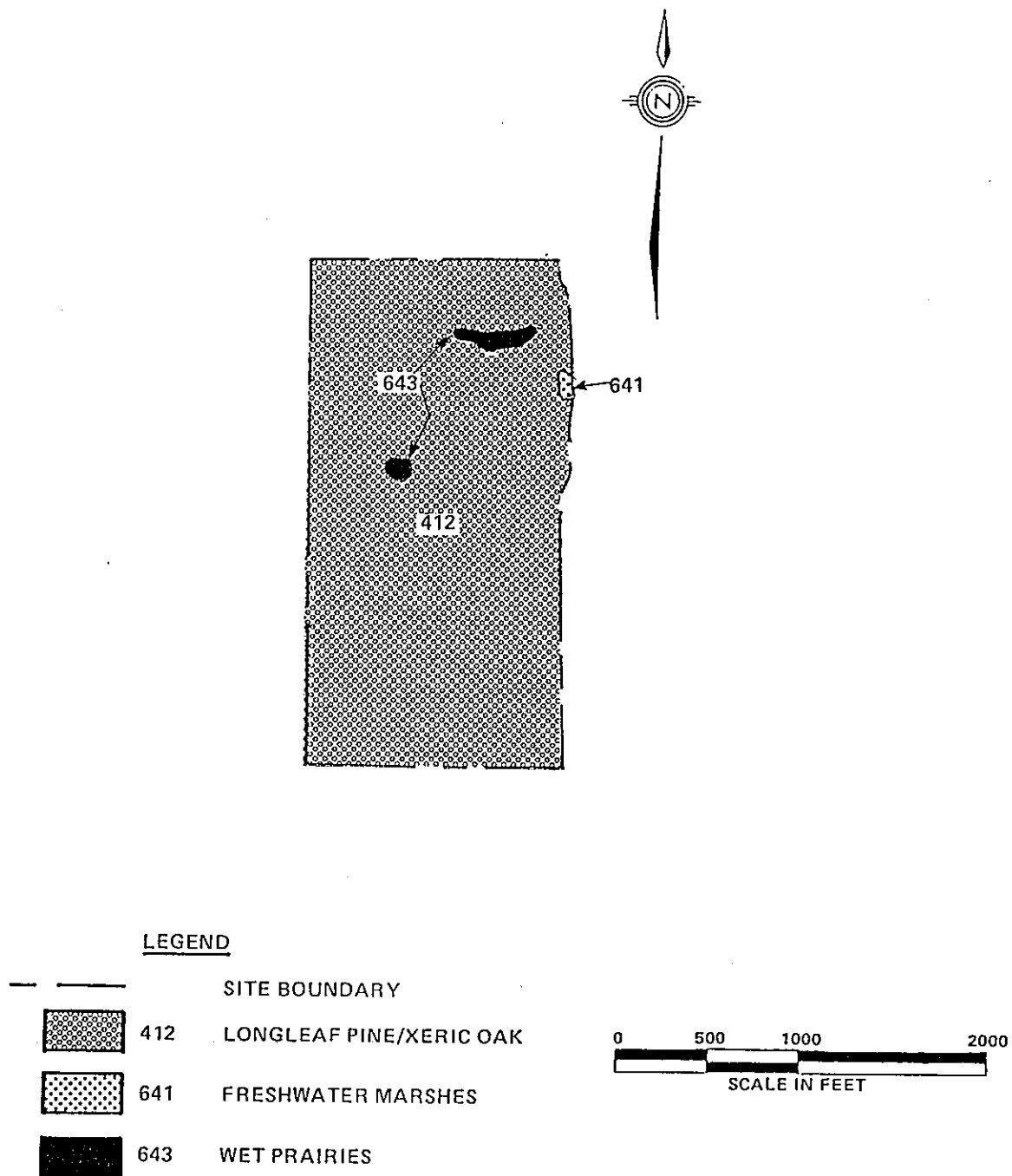
Site BV-22 is located in the northwest quadrant of Malabar (Figure 4-1). The 84.9 acre site can be accessed from State Road 514 via an unsurfaced public road. This road forms the east boundary of the site as well as providing access to several private residences in the vicinity. The site is relatively level with an average elevation of +22 feet NGVD. The primary soil type on site is St. Lucie fine sand. This is an excessively well-drained soil found on high dune-like ridges and isolated knolls. The site consists primarily of upland dominated by xeric species such as longleaf pine (Pinus palustris), sand pine (Pinus clausa), and sand live oak (Quercus geminata) (Figure B-12). Two small, isolated wet prairies occur on the site. These are vegetated with sand cordgrass (Spartina bakeri), sandweed (Hypericum fasciculatum), and yellow-eyed grass (Xyris sp.). A small marsh is located at the east edge of the site (Table B-12). Historically, this marsh was probably connected to a large marsh off-site to the east. However, a filled road presently runs between the two marshes.

Site BV-22 was selected as a secondary disposal site to serve Reach VI in conjunction with site BV-29. Site BV-22 would thereby provide storage capacity for approximately 40% (423,289 c.y.) of the projected 50-year requirement of Reach VI. The site, located 1.5 miles south of Turkey Creek, is ideally situated to service the northern portion of the reach.

Site: BV-29

Reach VI: Turkey Creek to Sebastian Inlet; ICWW mile 180.87 to 194.36  
Site Location: ICWW mile 194.88

Site BV-29, 223.6 acre tract, is located near the southern Brevard County line (Figure 4-1). The site is bordered on the east by the north prong of Sebastian Creek



**FIGURE B-12:** Vegetation Communities and Land Use Types on Site 22, Brevard County, Florida, as of July 12, 1989

Table B-12: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-22, Brevard County, Florida, July 12, 1989

<u>Map ID No.*</u>	<u>Name</u>	<u>Approximate Acreage</u>
412	Longleaf Pine/Xeric Oak	83.7
641	Freshwater Marshes	0.2
643	Wet Prairies	1.0
Total		84.9

\*Florida Department of Transportation 1985.

and on the south by St. Johns Water Management District Canal C-54. Elevations on site range from +5 feet NGVD (in the southeast corner) to +19 feet NGVD.

The soils in the eastern portion of the site consist of Pomello sand, a well-drained soil type. The vegetation on this soil type reflects the nature of the soil, with xeric species such as sand live oak (Quercus geminata), longleaf pine (Pinus palustris), and myrtle oak (Quercus myrtifolia). Soils in the western two-thirds of the site (Immokalee and Oldsmar sands) are typical of pine flatwoods communities (Figure B-13). This section of the site contains flatwoods dominated by slash pine (Pinus elliottii). Also present in the pine flatwoods community are saw palmetto (Serenoa repens) and sand live oak (Quercus geminata). All the wetlands identified on-site appear to be isolated. The wetlands are classified as wet prairies and consist of sedges (Cyperus spp.), beak rushes (Rhynchospora spp.), and sandwood (Hypericum fasciculatum). During the field visit, a Bald eagle was observed in flight over the property. The eagle may have been foraging in the C-54 canal or the Intracoastal Waterway.

Site BV-29 was designated as a secondary site to be operated in conjunction with Site BV-22. Under this arrangement only material from the southern portion of Reach VI will be stored at BV-29. In the event that development of Site BV-22 was not feasible, sufficient acreage is available at site BV-29 to provide disposal capacity for the entire projected reach requirement.

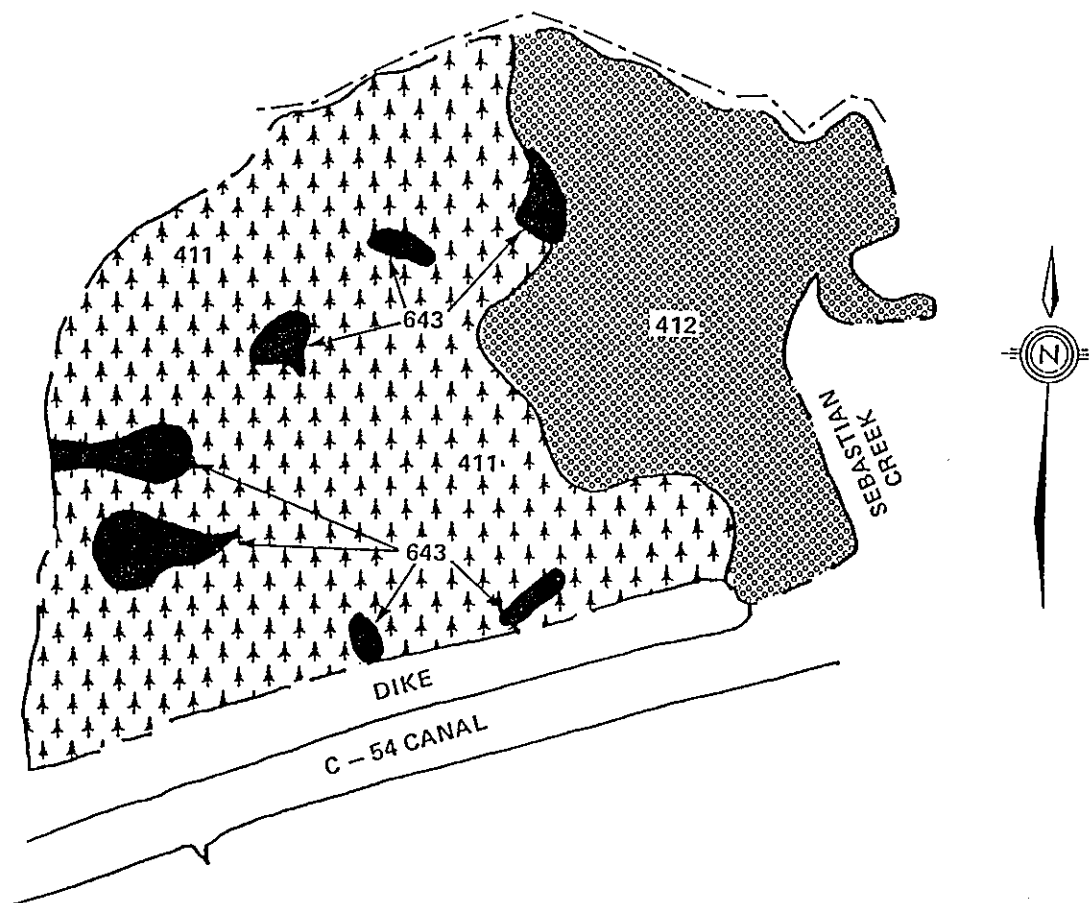
Site BV-29 lies in a remote area and is not directly accessible by public road. However, several unimproved private roads do provide possible sources of access. Additional road easement of length 0.34 miles would be required. The site is located adjacent to C-54 which is a deep canal, approximately 75 yards in width. The canal in turn empties into Sebastian Creek, providing deepwater access from the Intracoastal Waterway.

Table B-13: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-29, Brevard County, Florida, September 7, 1989




Map ID No.*	Name	Approximately Acreage
411	Pine Flatwoods	140.90
412	Longleaf Pine/Xeric Oak	72.47
643	Wet Prairie	10.26
Total		223.63

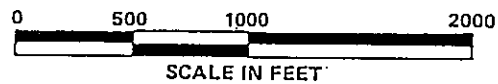
\*Florida Department of Transportation 1985.





**LEGEND**

- SITE BOUNDARY
- CREEK
-  411 PINE FLATWOODS
-  412 LONGLEAF PINE/  
XERIC OAK
-  643 WET PRAIRIE



**FIGURE B - 13:** Vegetation Communities and Land Use Types on Site 29, Brevard County, Florida as of September 7, 1989

**A P P E N D I X   C**

**CANDIDATE SITES**

### Site BV-3

Site BV-3 is located north of Mims on the west side of the Indian River. This site consists of active and abandoned citrus groves with several small freshwater marshes. It is 188 acres in size (Table C-1). The soils on Site BV-3 range from excessively well-drained sands in the northern half of the property (Paola fine sand and Astatula fine sand) and moderately well-drained Orsino fine sand in the south. The northern half of the site is characterized by undulating ridges, while the southern portion is nearly level. A series of drainage ditches traverse the property, linking the marshes (Figure C-1). The largest wetland lies in the southeast corner of the site. This wetland surrounds a shallow ditch, and is vegetated with a dense stand of silverling (Baccharis halimifolia) and southern willow (Salix caroliniana). The understory of the ditch contains cattails (Typha sp.) and golden canna (Canna flaccida). These species also occur in the surrounding wetland, but with less frequency. All three ditches drain off-site to the east.

Table C-1: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-3, Brevard County, Florida, July 11, 1989

Map ID No.*	Name	Approximate Acreage
221/261	Citrus Groves/Fallow Crop Land	179.8
600	Wetlands	6.0
641	Freshwater Marshes	1.8
Total		187.6

\*Florida Department of Transportation 1985.

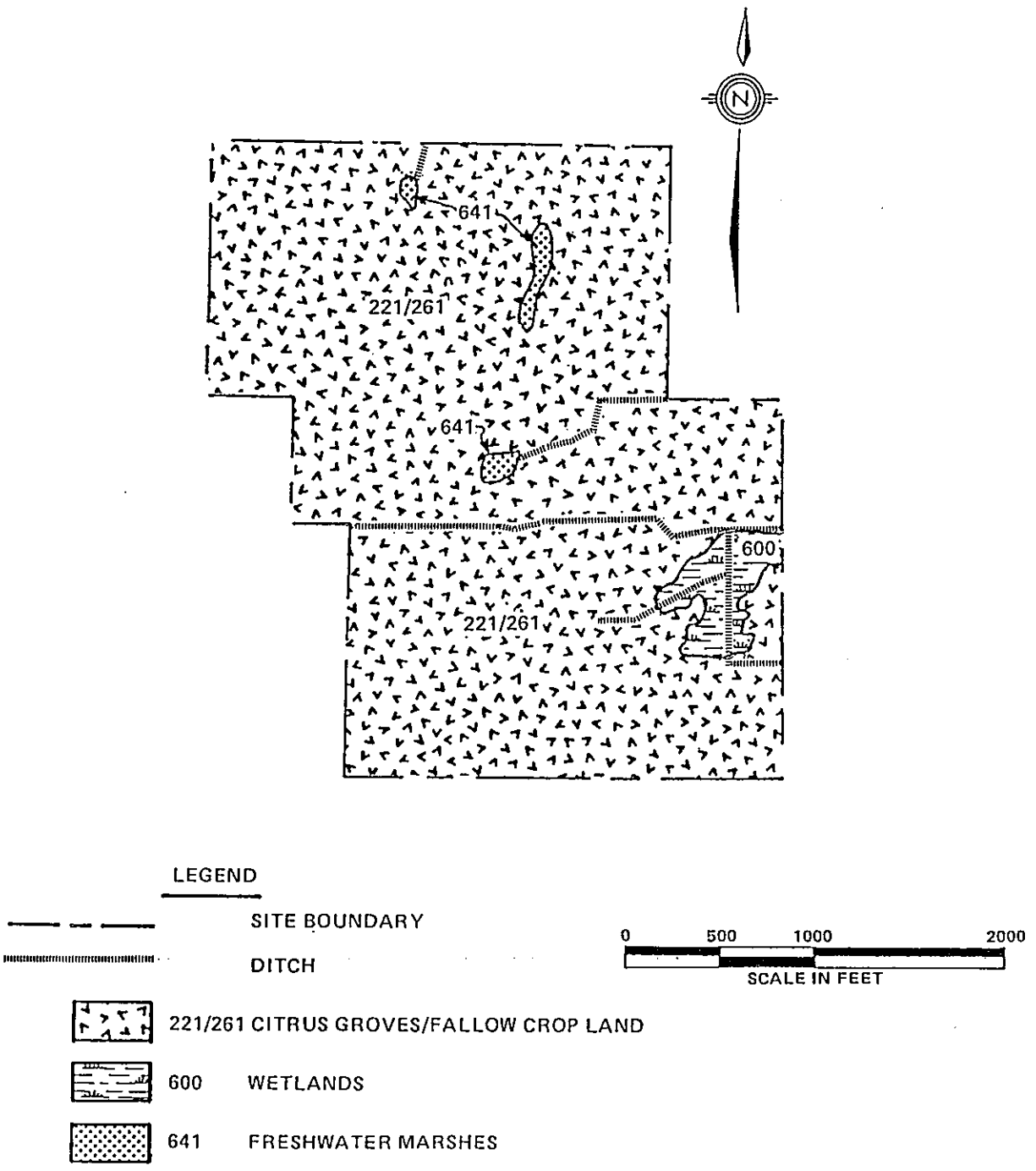


FIGURE C-1: Vegetation Communities and Land Use Types on Site 3, Brevard County, Florida, as of July 11, 1989

## Site BV-7

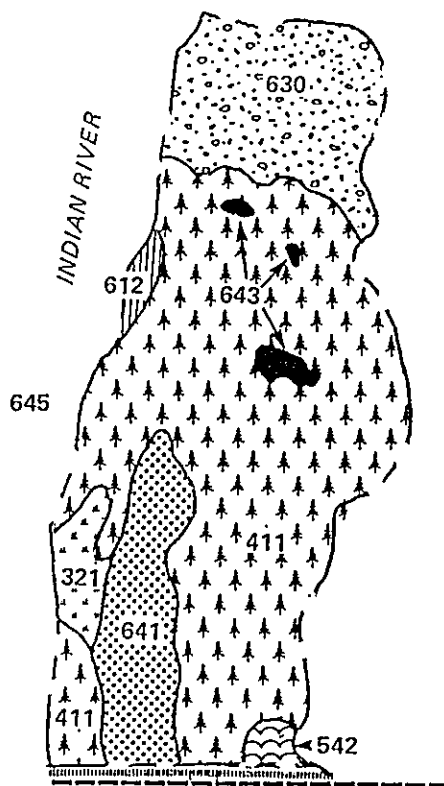
Site BV-7 is located on the western shore of Merritt Island approximately 1.5 miles south of the NASA Parkway on a small island known as Pine Island. This island is connected to Merritt Island by a filled dirt road crossing an area of marsh. Site 7, a 100-acre site (Table C-2), is located north of the filled road and is a low, flat, mostly forested area below the 5-foot NGVD contour. The site has poorly drained flatwoods sands, including Immokalee, St. Johns, and Basinger, with some areas of Anclote sand and Tidal swamp soils in wetlands.

The flatwoods area consists of slash pine (Pinus elliottii) with an understory of saw palmetto (Serenoa repens) and gallberry (Ilex glabra) (Figure C-2). Occasional hardwoods and cabbage palm (Sabal palmetto) are interspersed within the flatwoods community, indicating a low flatwoods community that infrequently burns. The north end of the site is a pine forest with a wetland understory of swamp fern (Blechnum serrulatum), Virginia chain fern (Woodwardia virginica), and needle rush (Juncus roemerianus). In addition to the slash pine, cabbage palm, sabal palmetto, and dahoon holly (Ilex cassine) were common to occasional. Within the flatwoods, three wet prairies were identified and dominated mostly by sand cordgrass (Spartina bakeri). A large, slightly brackish marsh is located in the southwest part of the site and was vegetated by sand cordgrass, leather fern (Acrostichum sp.), and scattered shrubs, including Brazilian pepper (Schinus terebinthifolius), white mangrove (Languncularia racemosa), and buttonbush (Cephalanthus occidentalis). Along the southern end of the site, a deep canal (approximately 25 feet wide) leads to a pond or embayment on the southeastern corner of the site.

Table C-2: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-7, Brevard County, Florida, August 1989

Map ID No.*	Name	Approximate Acreage
321	Palmetto Prairies	3.3
411	Pine Flatwoods	64.2
542	Embayments	1.8
612	Mangrove Swamps	1.2
630	Wetland Coniferous Forest	17.5
641	Freshwater Marshes	11.5
643	Wet Prairies	1.0
Total		100.5

\*Florida Department of Transportation 1985.



# LEGEND

- SITE BOUNDARY
- DITCH
- ROAD
- 321 PALMETTO PRAIRIES
- 411 PINE FLATWOODS
- 542 EMBAYMENTS
- 612 MANGROVE SWAMPS
- 630 WETLAND FORESTED MIXED
- 641 FRESHWATER MARSHES
- 643 WET PRAIRIES
- 645 SUBMERGENT AQUATIC VEGETATION

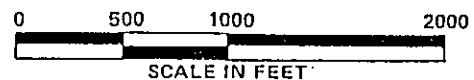


FIGURE C-2: Vegetation Communities and Land Use Types on Site 7, Brevard County, Florida, as of August, 1989

## Site BV-8

Site BV-8 adjoins Site BV-7 and consists of most of the southern end of Pine Island. The site consists of a 70-acre flatwoods site with scattered wetlands (Table C-3). The topography is level and low, not rising above the 5-foot NGVD contour. Soils on the site are similar to those found on Site BV-7.

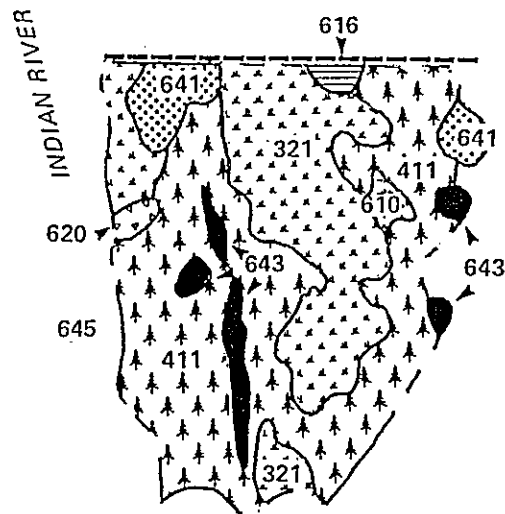
The vegetation on Site BV-8 consists of pine flatwoods or palmetto prairies in the uplands (Figure C-3). These communities contain slash pine (Pinus elliottii) with varying canopy closures, and saw palmetto (Serenoa repens), with other shrubs including gallberry (Ilex glabra), fetterbush (Lyonia lucida), and staggerbush (Lyonia fruticosa). A sand cordgrass marsh (Spartina bakeri) is located in the northwest corner of the site. Three wet prairies are located on the western side of the site and two on the eastern side. Other wetlands include a willow swamp on the north boundary (616), and two forested wetlands. The forested wetland on the western side of the property (620) is connected to the Indian River through a culvert. Other wetlands, except the freshwater marsh and wet prairies along the eastern edge of the site, appear to be isolated.

Table C-3: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-8, Brevard County, Florida, August 1989

Map ID No.*	Name	Approximate Acreage
321	Palmetto Prairies	22.4
411	Pine Flatwoods	38.1
610	Wetland Hardwood Forests	1.0
616	Inland Ponds & Sloughs	1.0
620	Wetland Coniferous Forests	1.0
641	Freshwater Marshes	4.0
643	Wet Prairies	4.0
Total		69.7

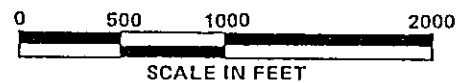
\*Florida Department of Transportation 1985.





# **LEGEND**

---	SITE BOUNDARY
---	ROAD
321	PALMETTO PRAIRIES
411	PINE FLATWOODS
610	WETLAND HARDWOOD FORESTS
616	INLAND PONDS AND SLOUGHS
620	WETLAND CONIFEROUS FORESTS
641	FRESHWATER MARSHES
643	WET PRAIRIES
645	SUBMERGENT AQUATIC VEGETATION



**FIGURE C-3:** Vegetation Communities and Land Use Types on Site 8, Brevard County, Florida, as of August, 1989

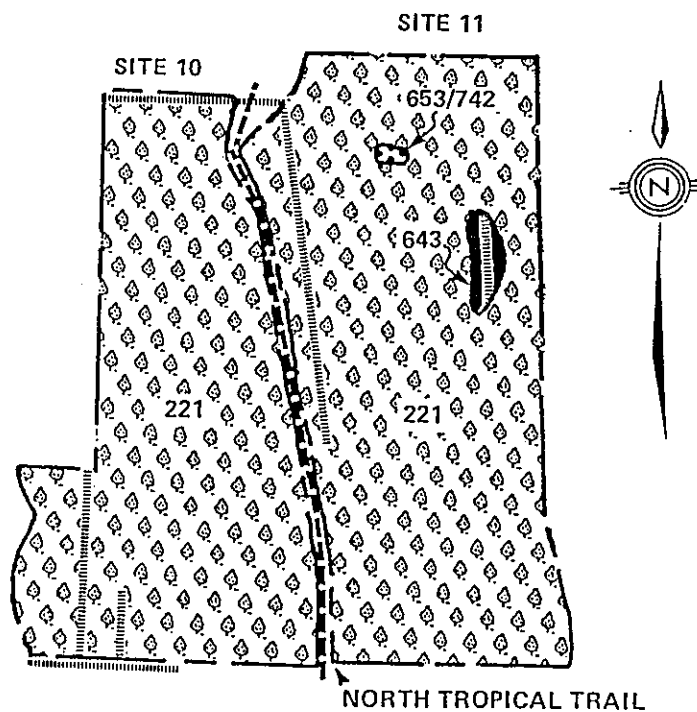
## Site BV-10

Site BV-10 within central Merritt Island is an area of citrus groves bounded by North Tropical Trail to the east and wetlands to the west. Site BV-10 is quite similar to the adjacent Site BV-11. The site is generally level, between 5 to 10 NGVD and sloping gradually to the west toward the fringing wetlands, where the elevation drops below the 5-foot contour. Site BV-10 is approximately 59 acres in size (Table C-4). Like Site 11, the vegetation of this parcel is citrus with a ground cover of cogon grass (Imperata cylindrica) (Figure C-4). Several ditches were observed on the property. One ditch along the northern boundary also drains part of Site BV-11. At the time of the site visit, this approximately 20-foot wide ditch was vegetated with cattail and other grasses. This ditch discharges into a canal leading to the Indian River. Ditches in the southern part of the site drain to a wetland to the west that is vegetated with Australian pine (Casuarina equisetifolia) and leather fern (Acrostichum sp.).

Table C-4: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-10, Brevard County, Florida, July 1989

Map ID No.*	Name	Approximate Acreage
221	Citrus Groves	59.2
Total		59.2

\*Florida Department of Transportation 1985.



#### LEGEND

- — — — — SITE BOUNDARY
- ===== DITCH
- — — — — ROAD
- 221 CITRUS GROVES
- 643 WET PRAIRIES
- 653/742 INTERMITTENT PONDS/  
BORROW AREAS

0 500 1000 2000  
SCALE IN FEET

FIGURE C-4: Vegetation Communities and Land Use Types on Site 10, Brevard County, Florida, as of July, 1989

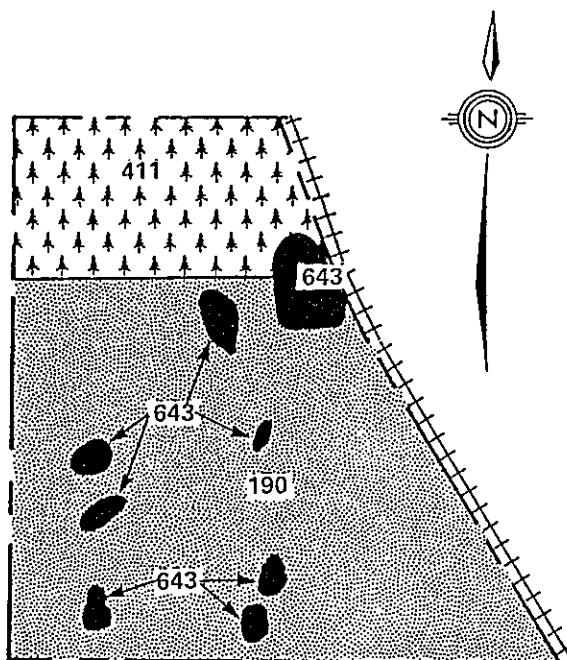
## Site BV-17

Site BV-17 is located approximately 0.5 mile east of the Indian River in the vicinity of Palm Shores. The 91-acre site consists of the northeast quarter of the section west of the railroad right-of-way (Table C-5). The property is generally level, with elevations ranging from just above the 30-foot contour line to below the 25-foot line on the east. Soils on the site are poorly drained sandy soils (Myakka sand) to moderately well-drained sandy soils (Pomello sand) except near wetland depressions, where poorly drained Tomoka muck is found. Vegetation on the property is pine flatwoods interspersed with isolated wet prairie depressions (Figure C-5). At the time of the site visit, most of the southern two-thirds of the property was under construction. Significant areas were being cleared and roads constructed. It appeared that most of the parcel would be developed in the near future. The portion of the site under construction was classified as open urban land. The area had a mixture of pines including longleaf, slash, and sand pine (Pinus palustris, Pinus elliotii, and Pinus clausa, respectively) with an understory dominated by either saw palmetto (Serenoa repens) or gallberry (Ilex glabra). The wet prairies were vegetated by little blue maidencane (Amphicarpum muhlenbergianum), redroot (Lachnanthes caroliniana), and Virginia chain fern (Woodwardia virginica) with a few scattered shrubs such as buttonbush (Cephalanthus occidentalis).

Table C-5: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-17, Brevard County, Florida

Map ID No.*	Name	Approximate Acreage
190	Open Land	68.0
411	Pine Flatwoods	20.0
643	Wet Prairies	3.0
Total		91.0

\*Florida Department of Transportation 1985.



# **LEGEND**

---	SITE BOUNDARY
- - -	ROAD
+ + + + +	RAILROAD
[Stippled Box] 190	OPEN LAND
[Tree Pattern Box] 411	PINE FLATWOODS
[Dark Box] 643	WET PRAIRIES



**FIGURE C-5:** Vegetation Communities and Land Use Types on Site 17, Brevard County, Florida, as of July, 1989

## Site BV-23

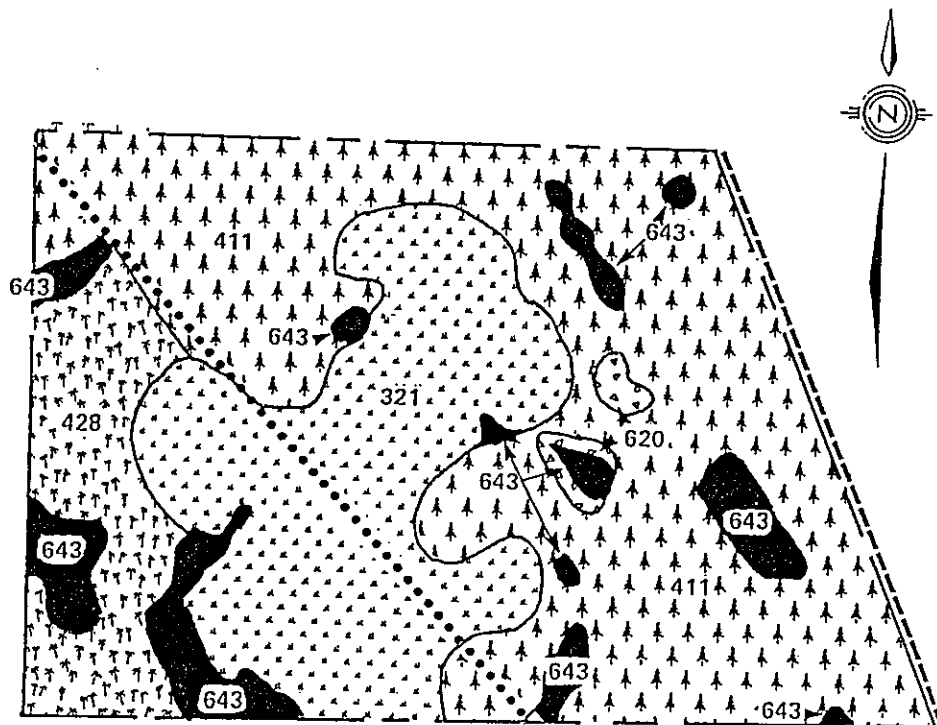
Site BV-23 is 217 acres (Table C-6) in size and is located south of Highway 514. A powerline easement transects the site (see Figure C-6). The topography of this site is nearly level and the soils can be characterized as poorly drained. The northwest half of the site consists of Myakka sand, a poorly drained sandy soil typical of flatwoods communities. The soil type in the southwest portion of the site is Immokalee sand, also characteristic of flatwoods.

As would be expected, based on existing soil types, the majority of the site is in pine flatwoods. The pine flatwoods contain slash pine (Pinus eliottii) and a saw palmetto (Serenoa repens) understory. A number of wet prairies are dominated by herbaceous cover including maidencane (Panicum hemitomon), redroot (Lachnanthes caroliniana), and saw grass (Cladium jamaicense). A large (61 acres) palmetto prairie is located in the center of the site. This is similar to the flatwoods, but the pines have a canopy closure of less than 10 percent. The third largest community on the site is a cabbage palm (Sabal palmetto) dominated habitat. In this community, cabbage palm is dominant in the overstory, and saw palmetto and gallberry (Ilex glabra) are prevalent in the understory.

Table C-6: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-23, Brevard County, Florida, July 12, 1989

Map ID No.*	Name	Approximate Acreage
321	Palmetto Prairies	61.4
411	Pine Flatwoods	113.1
428	Cabbage Palm	22.6
620	Wetland Coniferous Forests	2.2
643	Wet Prairies	17.6
Total		216.9

\*Florida Department of Transportation 1985.



#### LEGEND

- SITE BOUNDARY
- ..... POWERLINE RIGHT-OF-WAY
- ROAD
- 321 PALMETTO PRAIRIES
- 411 PINE FLATWOODS
- 428 CABBAGE PALM
- 620 WETLAND CONIFEROUS FORESTS
- 643 WET PRAIRIES

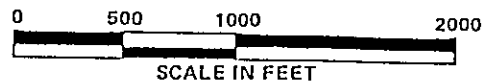


FIGURE C-6: Vegetation Communities and Land Use Types on Site 23, Brevard County, Florida, as of July 12, 1989

## Site BV-25

Site BV-25 is a 154-acre parcel (Table C-7) of young citrus trees located north of the North Prong of the Sebastian Creek. The site is bordered on the east by a paved county road, a canal and residential area on the north, and additional citrus land on the south and west. The elevation of the site ranges from 15 to 25 feet NGVD. Soils include Eau Gallie and Felda sand, poorly drained soils that have been bedded to drain the soil for citrus production.

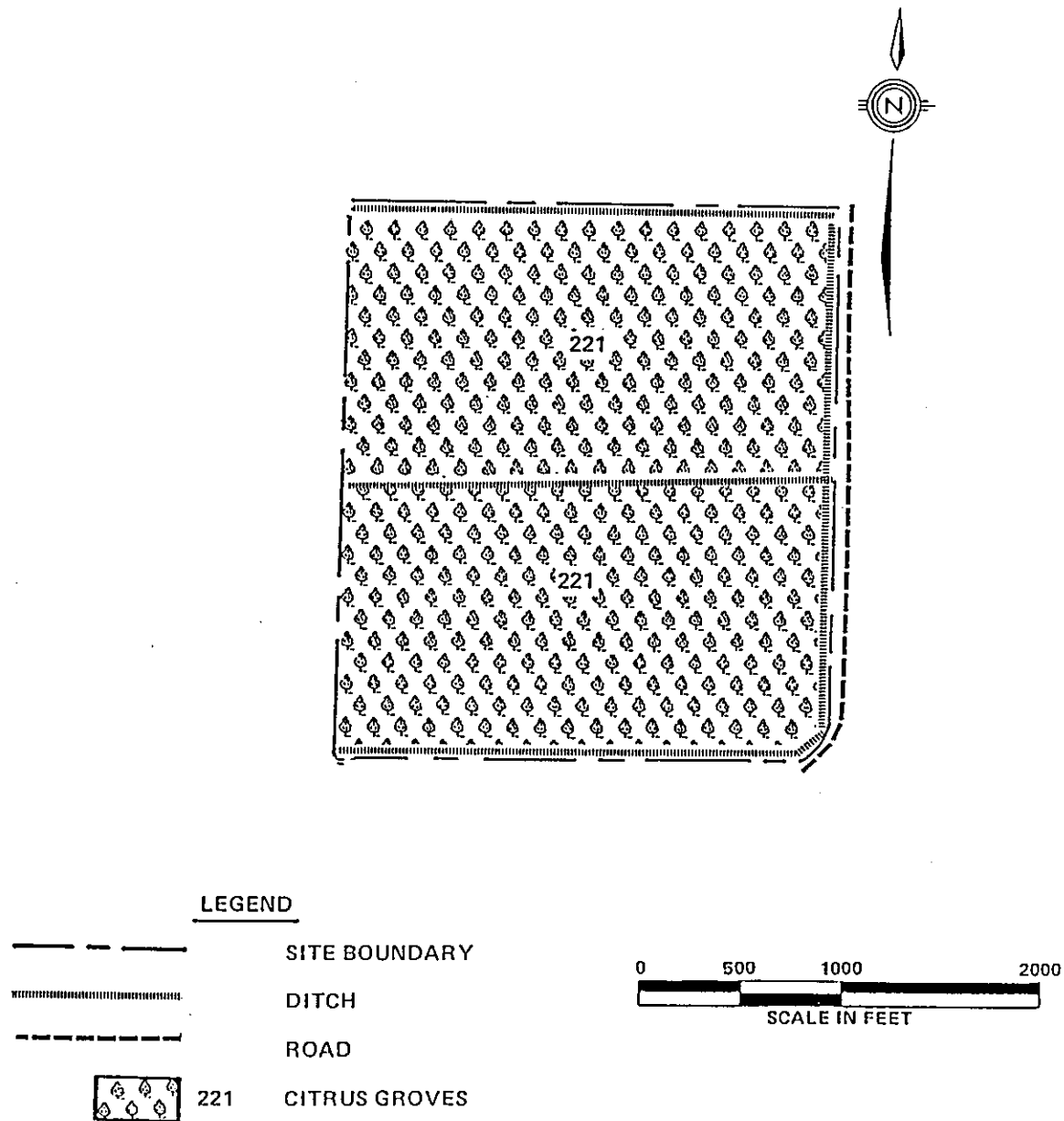
No native vegetation communities remain on-site (Figure C-7). The site is circumscribed by canals to promote drainage. There is one large drainage canal bisecting the site, as well as rows of shallow furrows throughout the grove to facilitate soil drainage. Some emergent wetland vegetation occurs in the deep ditches, including cattail (Typha sp.) and sedges (Cyperus spp.). Duckweed (Lemna sp.) covers the water surface.

Table C-7: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-25, Brevard County, Florida

Map ID No.*	Name	Approximate Acreage
221	Citrus Groves	154.0
	Total	154.0

\*Florida Department of Transportation 1985.





**FIGURE C-7:** Vegetation Communities and Land Use Types on Site 25, Brevard County, Florida, as of July, 1989

## Site BV-26A

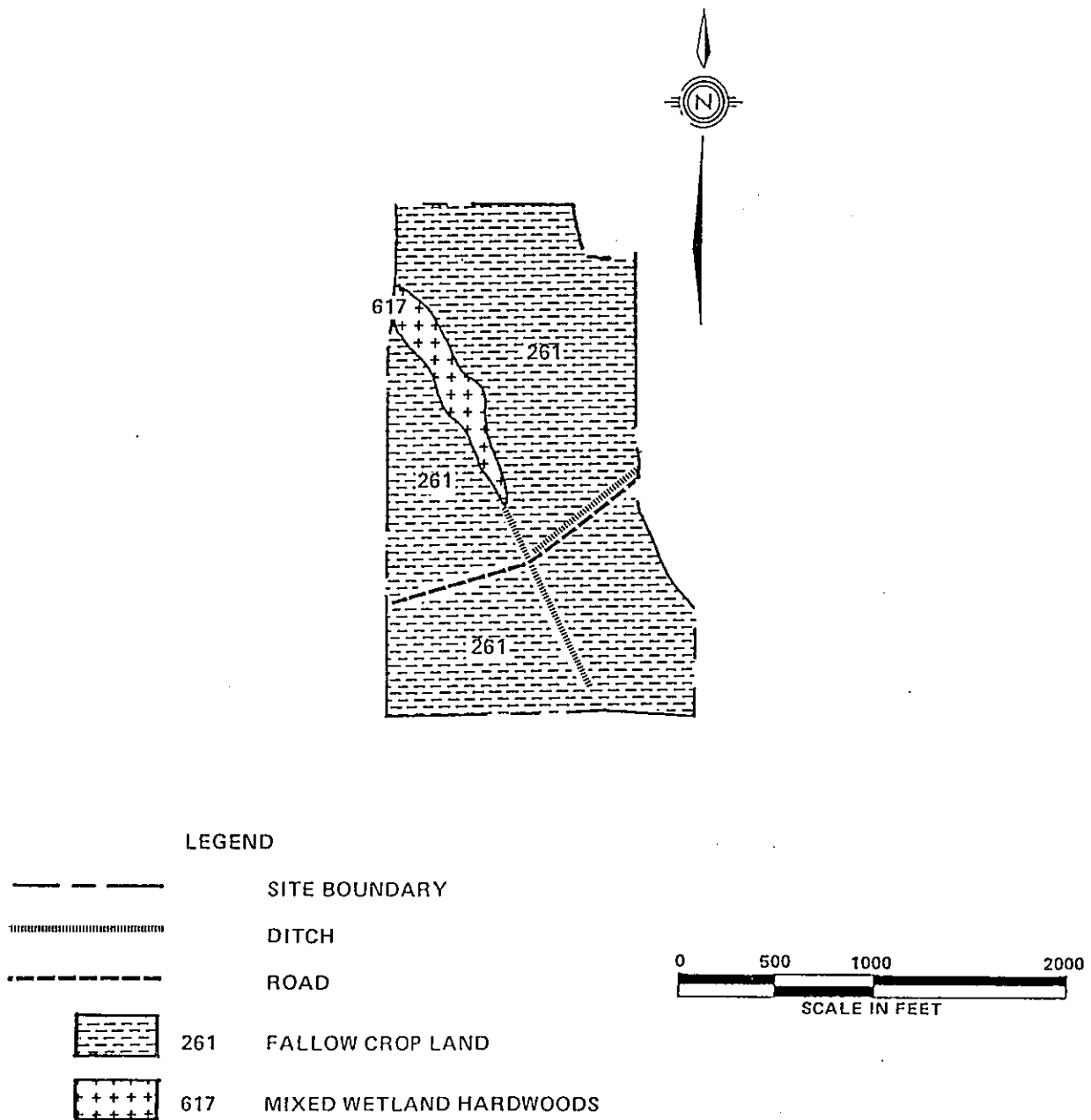
This 81-acre site is located within the Merritt Island National Wildlife Refuge, north of Haulover Canal. The site (Table C-8) consists of land which was previously planted in citrus groves and has been cleared (Figure C-8). The predominant soil types are Astatula fine sand and Paola fine sand. Both of these soils are considered excessively well-drained and occur on high ridges (0-5 percent slope). A narrow band of poorly drained sandy soil (Basinger sand) runs diagonally through the site.

The site has become overgrown with invader species such as camphorweed (Heterotheca subaxillaris), dog fennel (Eupatorium sp.), and ragweed (Ambrosia artemisiifolia). Cabbage palm (Sabal palmetto) is also common in the uplands on the site. A forested wetland lies in the northwest portion of the property, corresponding with the Basinger soil type. This wetland is isolated to the north, but drains southeast through a shallow ditch system. The south leg of the ditch widens to a shallow swale and then ends; however, the wetland may be connected to waters of the State via an east-west ditch that parallels the road through the center of the site. Vegetation in the forested wetland consists of sweetgum (Liquidambar styraciflua), American elm (Ulmus americana), red maple (Acer rubrum), and southern willow (Salix caroliniana). Emergent vegetation present in the ditches includes arrowhead (Sagittaria sp.) and pickerelweed (Pontederia cordata). Southern willow and wax myrtle (Myrica cerifera) line the banks of the ditches.

Table C-8: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-26A, Brevard County, Florida, July 11, 1989

Map ID No.*	Name	Approximate Acreage
261	Fallow Crop Land	77.6
617	Mixed Wetland Hardwoods	3.8
Total		81.4

\*Florida Department of Transportation 1985.



**FIGURE C-8:** Vegetation Communities and Land Use Types on Site 26A, Brevard County, Florida, as of July 11, 1989

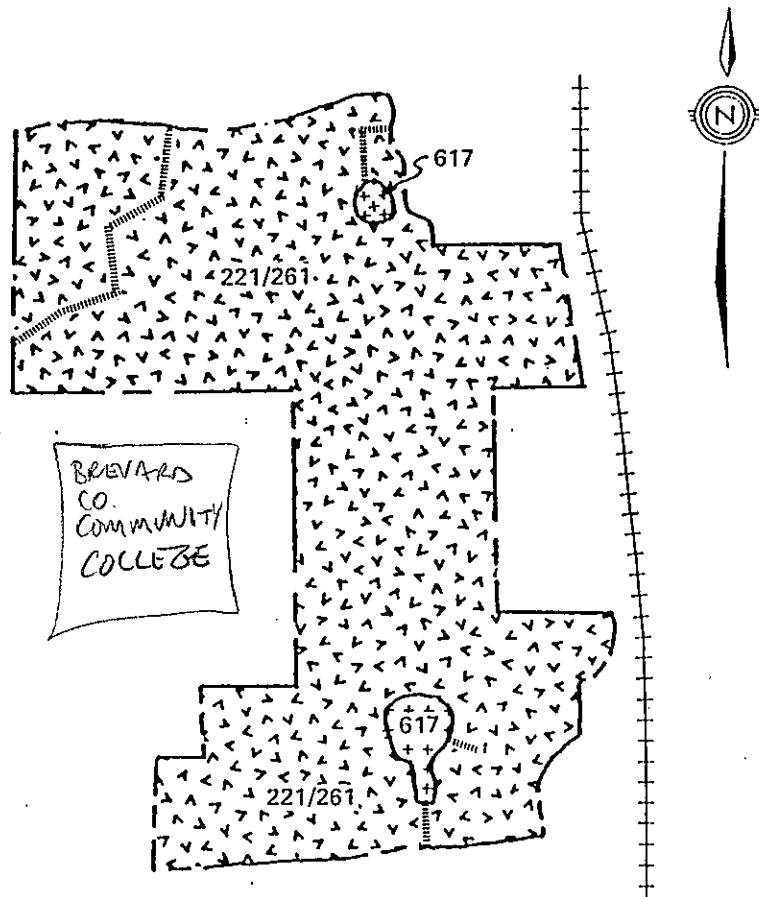
## Site BV-27

Site BV-27 is located north of the vicinity of Titusville. The site is 120 acres (Table C-9) in size and lies east of U.S. 1, bordering Brevard Community College. The site consists of active and old groves (Figure C-9). A shallow drainage ditch is located in the northwest corner of the site. The ditch is vegetated with sweetgum (Liquidambar styraciflua) and southern elderberry (Sambucus simpsonii). An isolated wetland is located at the south-central site boundary. This wetland contains red maple (Acer rubrum), American elm (Ulmus americana), and sweetgum (Liquidambar styraciflua). Although this wetland probably historically drained to the south, there is no longer a connection across the existing road. There is a small wetland in the northeast corner of the site which appears to drain off-site to the east.

Table C-9: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-27, Brevard County, Florida, July 12, 1989

Map ID No.*	Name	Approximate Acreage
221/261	Citrus Groves/Fallow Crop Land	117.6
617	Mixed Wetland Hardwoods	2.4
Total		120.0

\*Florida Department of Transportation 1985.



# LEGEND

- SITE BOUNDARY
- ||||| DITCH
- + + + + + RAILROAD
- 221/261 CITRUS GROVES/FALLOW CROPLAND
- 617 MIXED WETLAND HARDWOODS

0 500 1000 2000  
SCALE IN FEET

FIGURE C-9: Vegetation Communities and Land Use Types on Site 27, Brevard County, Florida, as of July 12, 1989

## Site BV-28

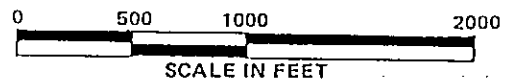
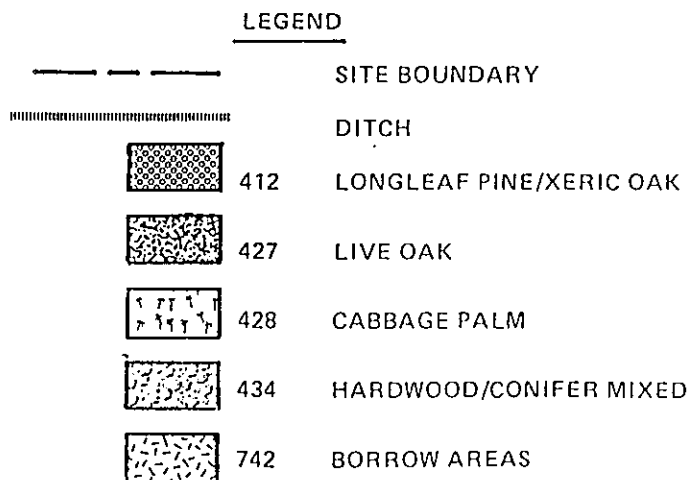
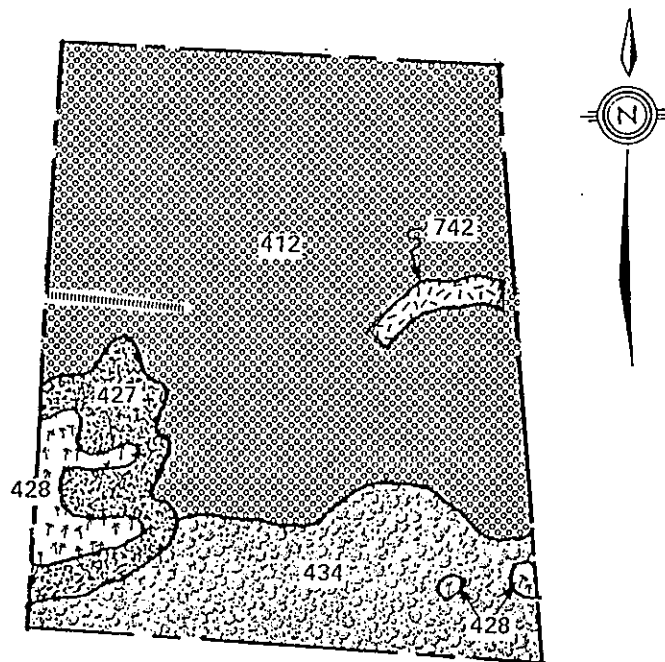
This 126-acre site (Table C-10) is located south of Titusville, between DeLeon Avenue and the F.E.C. rail-road. The major feature of this property site is the large man-made pond (Figure C-10). Soil from the excavated pond was piled along the southern edge, creating a dike. Large pines are now growing on the dike. The banks of the pond are lined with wax myrtle (Myrica cerifera) and southern willow (Salix caroliniana). Cattails (Typha sp.) are also present.

The northern half of the site consists of a xeric community containing slash pine (Pinus elliottii), myrtle oak (Quercus myrtifolia), sand live oak (Quercus geminata), and saw palmetto (Serenoa repens). The southern portion of the site has a more mesic cover, containing live oak (Quercus virginiana) and slash pine (Pinus elliottii). Several cabbage palm-dominated communities occur within the southern half of the site.

Table C-10: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-28, Brevard County, Florida, July 12, 1989

Map ID No.*	Name	Approximate Acreage
412	Longleaf Pine/Xeric Oak	86.4
427	Live Oak	8.9
428	Cabbage Palm	3.9
434	Hardwood/Conifer Mixed	25.4
742	Borrow Areas	1.8
Total		126.4

\*Florida Department of Transportation 1985.



**FIGURE C-10:** Vegetation Communities and Land Use Types on Site 28, Brevard County, Florida, as of July 12, 1989

## Site BV-28A

This 144-acre site (Table C-11) is located approximately 0.5 mile west of the Indian River in the vicinity of Grant. Its boundaries are delineated on the north by a creek/canal system, on the east by Trout Creek, a drainage ditch on the south, and a large wetland system on the west. The topography of the property is nearly level, ranging from 20 to 25 feet NGVD. Most of the site consists of poorly drained flatwoods soils along the creeks and western half of the parcel. The northern half is moderately well-drained Pomello sand.

The vegetation cover on the site includes a variety of communities (Figure C-11). The western and northwestern portions are pine flatwoods dominated by slash pine (Pinus elliottii) with a saw palmetto (Serenoa repens) and fetterbush (Lyonia lucida) understory. The northeast portion has well-drained soils and is mostly vegetated with sand pine (Pinus clausa) and myrtle oak (Quercus myrtifolia). The south-central and southeast portions of the site are in improved pasture, mostly Bahia grass (Paspalum notatum), but also contain a variety of herbs and other grasses. The area is crossed by a series of shallow ditches and a deeper central ditch presumably used to drain the soils.

Despite the drainage improvements, wetland species dominate in some locations in the pasture. Species found there include rushes (Juncus sp.), beakrushes (Rhynchospora sp.), sand cordgrass (Spartina bakeri), and pennywort (Hydrocotyle sp.). Detailed ground-truthing would be required to delineate upland and wetland boundaries in this low pasture.

Three small isolated wetlands are located within the pasture. One is an excavated pond in the center of the pasture, containing open water. A second area along the southern boundary is a pond with emergent vegetation, mostly cattails (Typha sp.) and maidencane (Panicum hemitomom). Although a berm exists around the pond, an opening to the adjacent ditch allows water to discharge from the pond to the drainage ditch. The third area is a low, grassy wet prairie area in the pasture. In addition, some of the large ditches on-site are vegetated by wax myrtle (Myrica cerifera); others are open and vegetated by water-tolerant grasses and herbs. Some of the shallow ditches found throughout the field were vegetated by wetland species



while others were not. A band of wetland forest occurred along the creeks and included red maple (Acer rubrum), Southern willow (Salix caroliniana), sweetgum (Liquidambar styraciflua), laurel oak (Quercus laurifolia), and wax myrtle (Myrica cerifera).

Notable wildlife on the site include the gopher tortoise (Gopherus polyphemus) observed in an ecotone between the sand pine community and the pasture.

Table C-11: Approximate Acreage of the Florida Land Use Cover and Forms Classification System\* Types Found on Site BV-28A, Brevard County, Florida

Map ID No.*	Name	Approximate Acreage
110	Residential, Low Density	1.0
211	Improved Pastures	65.9
411	Pine Flatwoods	43.8
413	Sand Pine	26.2
534	Reservoirs, less than 10 acres	1.0
610	Wetland Hardwood Forests	6.5
641	Freshwater Marshes	1.0
643	Wet Prairies	1.0
Total		144.2

\*Florida Department of Transportation 1985.

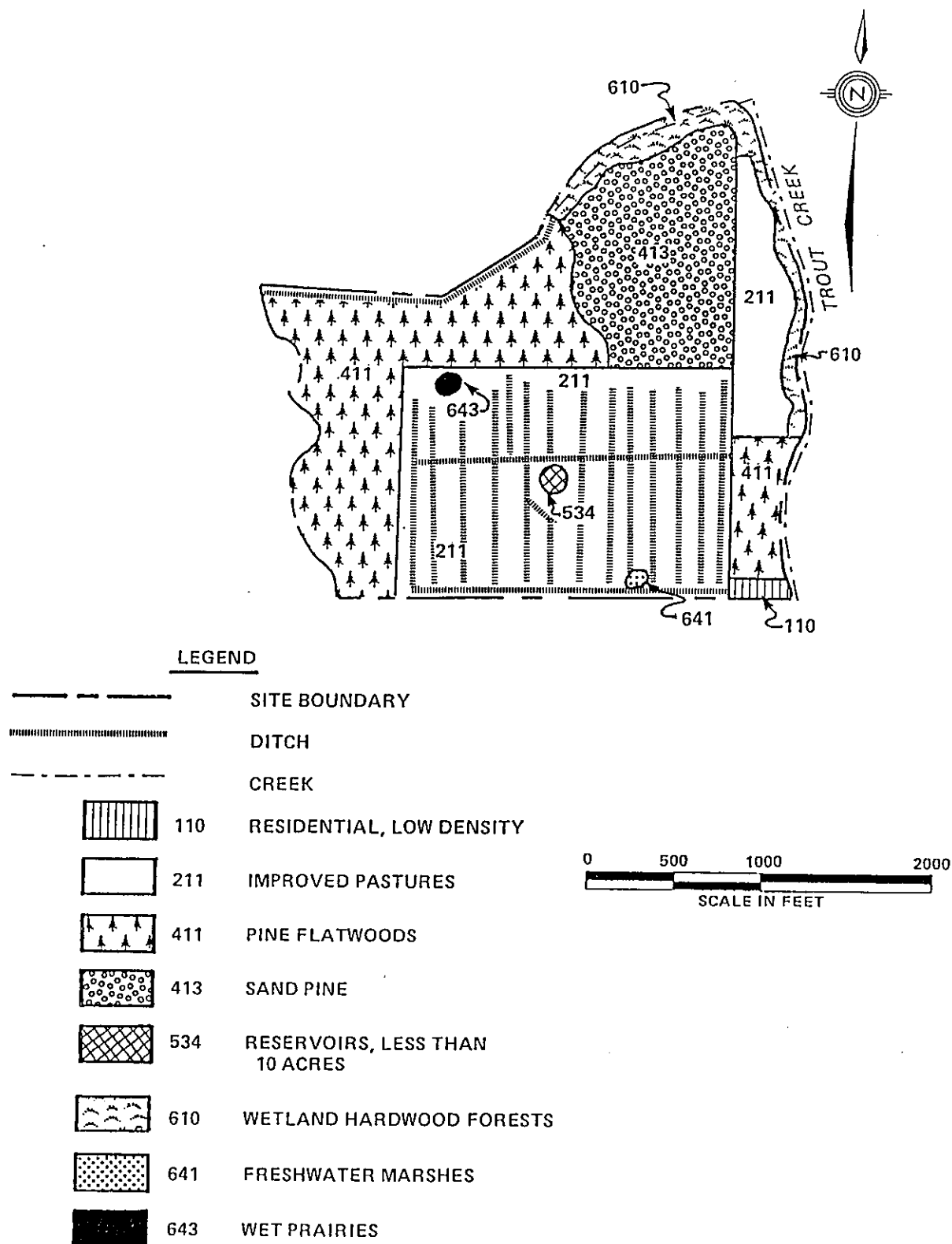


FIGURE C-11: Vegetation Communities and Land Use Types on Site 28A, Brevard County, Florida, as of July 1989

A P P E N D I X   D

SITE BANK OWNERSHIP

TABLE D-1: SITE BANK OWNERSHIP

Site #	Section/ Township/Range	Property Record No. or Recording Information	Parcel Size (Acres)	Assessed Value (Taxed Value)	Owner
BV-1	33, 34/19S/ 35E	N/A	N/A	N/A	NASA (National Aeronautics and Space Administration)
BV-2	19, 20, 29, 30, 33/ 20S/35E	N/A	N/A	N/A	NASA (National Aeronautics and Space Administration)
BV-4	16/21S/35E	Hawthorn Re-S/D D.B. EE-597 #25 (1) Lots 1 - 6	93.80	\$194,140.	Michael L. Whitman et al G. Zagoren Etc P.O. Box 8036 Madiera Beach, FL 33738
	16/21S/35E	(2) Exc. Lots 2 - 5, W 839.52 ft.	20.0	28,190.	J.J. Parrish, Jr. Trustee East of Barn P.O. Drawer L Titusville, FL 32780
	16/21S/35E	Hawthorn S/D P.B. 1 - 5 #26 Lot 22	10.0	18,220.	Same as above.
	17/21S/35E	00 783	14.0	25,750.	Same as above.
	17/21S/35E	00 784	6.0	8,700.	Nathanial Pilate et ux Bernice Cuyler 2316 S. Palmetto Ave. Mims, FL 32754
	17/21S/35E	00 785	9.63	15,900.	Same as above.
	17/21S/35E	00 786	9.61	13,700.	J.J. Parrish Jr. Trustee West of Barn P.O. Drawer L Titusville, FL 32780

Site #	Section/ Township/Range	Property Record No. or Recording Information	Parcel Size (Acres)	Assessed Value (Taxed Value)	Owner
BV-11	27/23S/36E	00 750	221.0	380,880.	A. Brooks Humphrey et ux Lavian H. P.O. Box 307 Cocoa, FL 32923-0307
	34/23S/36E	00 1	9.75	11,290.	Same as above.
	34/23S/36E	00 250 (incl. 00 3)	20.0	24,220.	Same as above.
BV-12	34/24S/36E	00 750	160.0± (1/2 Sec)	-----	(Not Recorded)
	3/24S/36E	00 5	16.95±	-----	B.E. Wiggins et ux 658 Orange Court Rockledge, FL 32955
	3/24S/36E	00 6 (Church)	1.01±	-----	(Not Recorded)
BV-5	35/22S/35E	00 1	310.0	-----	Hughes Aircraft Co. P.O. Box 45066 Bldg. C1/B116 Los Angeles, CA 90045-0066
	35/22S/35E	00 501	0.81	-----	FL Nat Bank, Trustee Greyhound Line Inc. - Lessee Hughes Aircraft Co. Attn. Tax Dept. P.O. Box 45066 Bldg. C1/B116 Los Angeles, CA 90045-0066

Site #	Section/ Township/Range	Property Record No. or Recording Information	Parcel Size (Acres)	Assessed Value (Taxed Value)	Owner
BV-5 (cont.)	35/22S/35E	00 752	15.56	-----	Hughes Aircraft Co. P.O. Box 45066 Bldg. C1/B116 Los Angeles, CA 90045-0066
	35/22S/35E	00 753	-----	-----	(Not Recorded)
	35/22S/35E	00 754	7.46	-----	(Not Recorded)
BV-15	22/35S/36E	00 1	80.0	227,500.	TCM Investments Inc. c/o Eurys Corp. 700 S. Johns Rodes Blvd. Suite C-2 Melbourne, FL 32904
	22/35S/36E	00 2	40.0	-----	Same as above.
	22/35S/36E	00 3	40.0	95,000.	Same as above.
	22/35S/36E	00 250	60.1	1200,000.	Jack Langer, Trustee 3310 Granada Blvd. Coral Gables, FL 33134
BV-16	24/26S/36E	00 3	40.08	N/A	School Board of Brevard Co. FL 1260 S. Florida Ave. Rockledge, FL 32955
	24/26S/36E	00 4	40.90	-----	Sara Bartholomae c/o Mickey Hartling 2501 Seaview Ave. Corona Del Mar, CA 92625
	24/26S/36E	00 750	80.0	680,000.	Gus Poulos 515 East 89th St., Apt. 4A New York, NY 10028

Site #	Section/ Township/Range	Property Record No. or Recording Information	Parcel Size (Acres)	Assessed Value (Taxed Value)	Owner
BV-16 (Cont.)	24/26S/36E	00 758 (Inc. 00 759)	14.5	85,760.	Presbytery of St. Johns Inc. 1221 Lee Road, Suite 202 Orlando, FL 32810
	24/26S/36E	00 760	4.63	-----	Elio Zeppieri et al G. Zeppieri etc. 2500 S. Diplomat Drive Melbourne, FL 32901
BV-17	31/26/37	00 1	109.89	1,598,890.	Brevard - Florida Properties c/o Stone & Clements Inc. 9555 N. Kendall Dr. Suite 103 Miami, FL 33176
	31/26/37	00 2	19.32	228,900.	Same as above.
BV-22	36/28/37	00 1	20.0	70,000.	Tommy R. Smiley, Trustee 1980 Roc Rosa Dr. NE Palm Bay, FL 32905
	36/28/37	00 3	10.0	-----	Same as above.
	36/28/37	00 4	10.0	35,000.	Homer R. Dennis Trustee et al Grace E. 1600 Sarno Rd. Suite 214 Melbourne, FL 32935
	36/28/37	00 9	40.0	140,000.	Same as above.
	36/28/37				