TOWN OF LONGBOAT KEY CANAL DREDGING

FEASIBILITY STUDY

Prepared For:

Town of Longboat Key

February 1996

COASTAL PLANNING & ENGINEERING, INC.

TOWN OF LONGBOAT KEY CANAL DREDGING FEASIBILITY STUDY

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TOWN OF LONGBOAT KEY CANAL DREDGING FEASIBILITY STUDY

A. Authorization and Scope

On June 14, 1995 the Town of Longboat Key authorized Coastal Planning & Engineering, Inc. to perform a feasibility study of the dredging of the canals in Longboat Key. The feasibility study included the following:

1. A reconnaissance level bathymetric survey of 53 residential canals.
2. Collection of sediment samples.
3. Engineering observations of the canals and seawalls.
4. A preliminary analysis of the effect of dredging on the stability of the seawalls.
5. An engineering analysis of dredging the canals.
6. A discussion of possible dredge spoil disposal options.
7. A discussion of regulatory constraints.
8. Development of a project cost estimate.

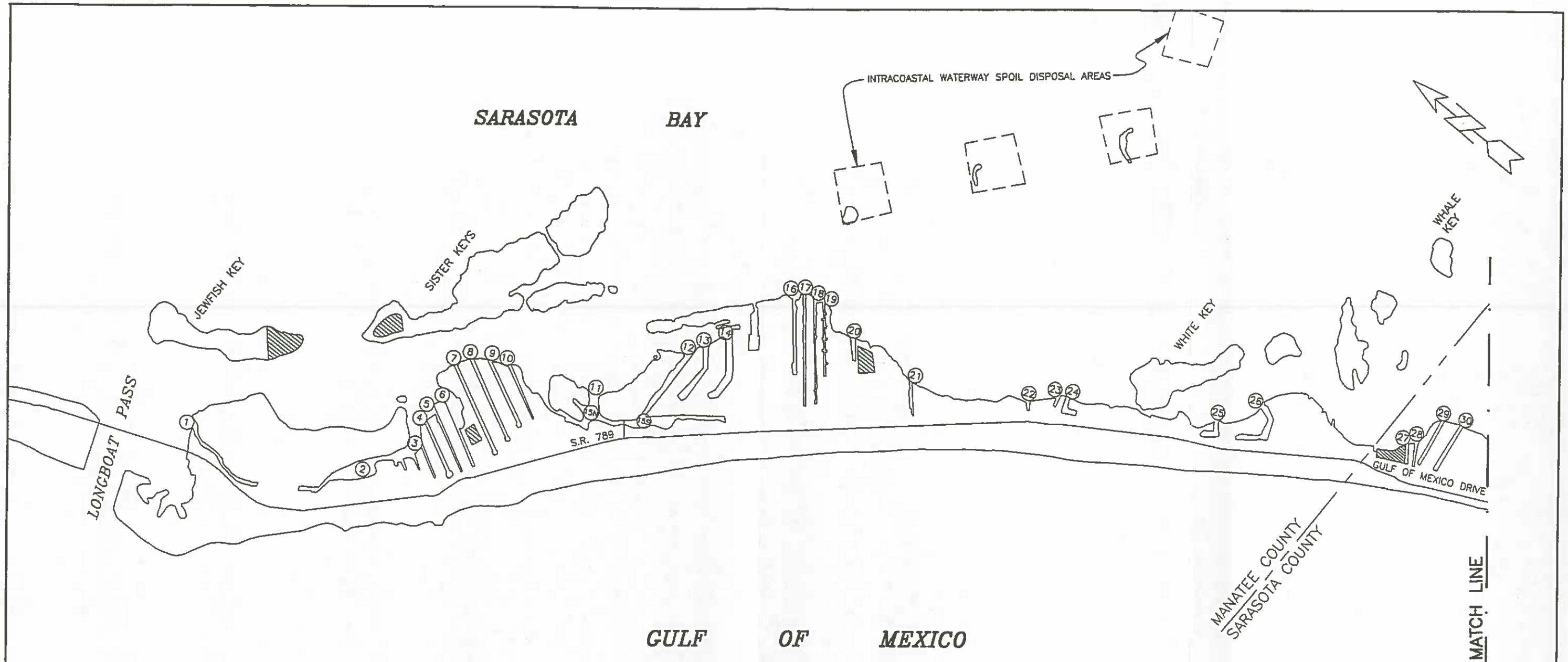
B. Bathymetry

The Town of Longboat Key identified 53 canals within the Town that are included in the feasibility study. The canals were numbered consecutively north to south and are shown in Figure 1. Streets and landmarks adjacent to each canal are cross referenced in the inspection field notes contained in Appendix A.

The reconnaissance level survey consisted of surveying two longitudinal tracklines in each canal as the survey boat entered and exited the canal. In some of the narrow canals it was not possible to survey two different tracklines. A few of the canals contained obstructions which prevented complete surveying of the canals. These obstructions included anchored boats, shoals, overhanging mangroves and trees, and mangroves encroaching laterally into the canal. The surveys were terminated at the eastern ends of the canals in the adjacent north-south canals or seagrass beds located east of some of the canal entrances.

The canal surveys were performed on August 24, 1995 and September 26, 1995 and the bathymetric data is shown on Sheets 1 through 16. The surveys indicated that the majority of the canals require some maintenance dredging in order to re-establish a -5 foot MLW (-5.4 ft. NGVD) channel depth. The surveys covered 12.2 miles of canals and indicate that approximately 40 percent of the total surveyed length requires dredging.

This reconnaissance level survey was used to estimate dredge volumes as discussed in a later section of this report. Due to the scope of these surveys it should be recognized that the length of canals that requires dredging is an approximate amount. Additional detailed surveying and



LEGEND

④ CANAL REFERENCE NUMBER

POTENTIAL UPLAND DISPOSAL SITE
DISPOSAL SITE LIMITS NOT TO SCALE

2000 0 2000 4000

SCALE IN FEET

LONGBOAT KEY CANALS
LOCATION MAP

COASTAL PLANNING & ENGINEERING, INC.
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431

FIGURE 1A

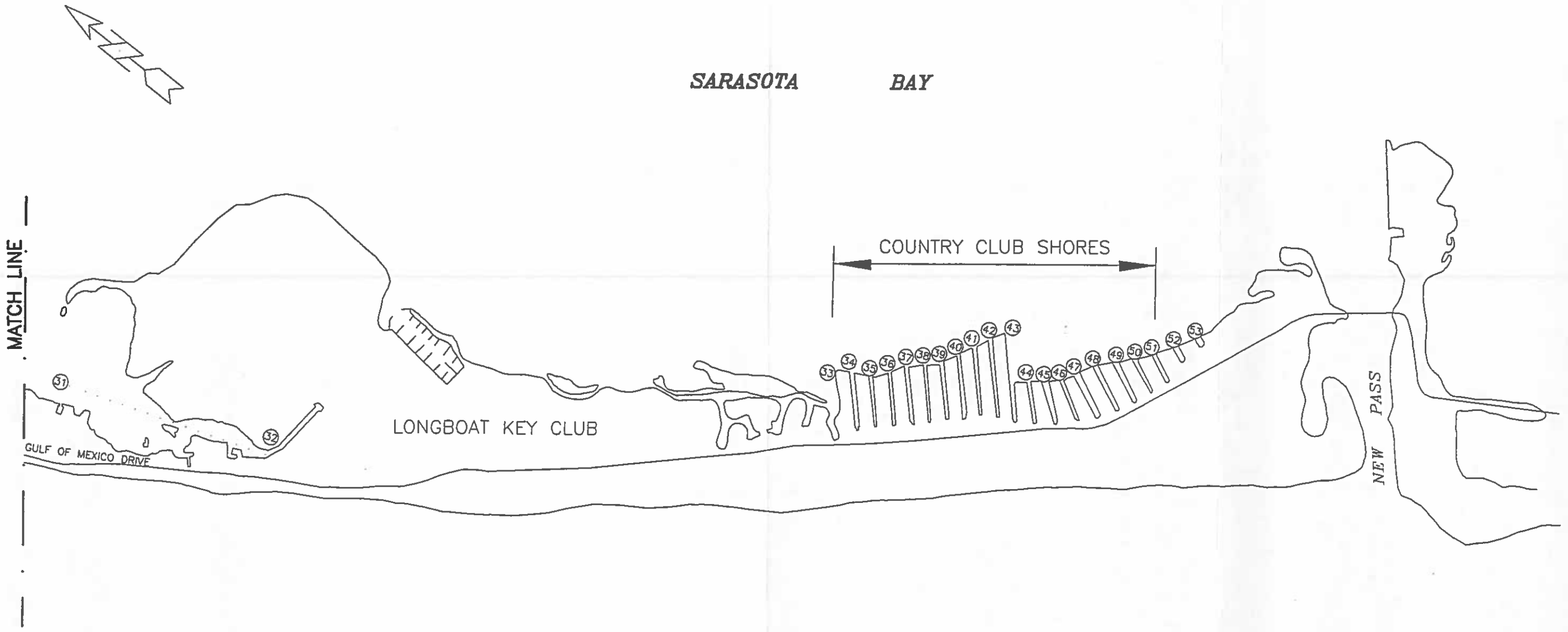


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FIGURE 1B

decisions by the Town to re-open the blocked canals (Numbers 3, 10, 16, 20 and 27) could increase the length and volume of dredging.

Shoaling in the canals appears at the most common locations (the entrance and the end of the canal) and also intermediate locations. Shoaling in the end of the canal can be associated with the deposition of fine material and the effects of stormwater discharges. Shoaling in the entrance is often associated with deposition of sand transported by waves in Sarasota Bay. Shoaling in intermediate areas can occur as a result of storm water transport. Other factors, including prop dredging by boaters, incomplete initial dredging, and leaking seawalls, may also affect shoaling patterns.

Depths within the canals were observed to range from 2 feet to 10 feet, depending on the original design of the canals and the extent of shoaling. It appears that some of the canals were dredged deeper to provide sufficient fill material to provide dry buildable land.

C. Sediment Sampling

During the bathymetric surveys, five sediment samples were collected from shallow areas within selected canals. Bottom grab samples were obtained using a Ponar sampler. The samples were analyzed by placing the samples in glass jars, adding water to cover the sample, shaking the sample, and allowing the sample to settle. The percentages of sand and silt were then estimated visually by comparing the resulting layer thickness. This approximate method can be used to characterize the sand and silt/clay components. The results of this approximate analysis are shown in Table 1.

The samples collected contained significant amounts of silt which will create significant turbidity during construction. During the observations of the canals in Country Club Shores, the majority of the canal bottom material was observed to be sand with shell and limestone rubble (< 1 inch). This sediment was observed to be sufficiently stable to support algae. No sediment samples were collected; nevertheless, the Country Club Shores area (canals 33-51) appears to be distinctly different in sediment composition than the northern canals (1-32).

The sediment samples collected contained significant fine organic material and mangrove detritus. The organics will add to the turbidity created by the silt during dredging. All of the samples were aromatic which may be offensive to residents if placed in an upland disposal area adjacent to residential developments.

Table 1

Town of Longboat Key Canals
Sediment Analysis

Canal No.	Location	Depth of Sample	Description	Est. Silt Content	Presence of Visible Organics
3	Mid Canal	4 ft.	Silty, fine sand	25%	Yes, a few unidentified organics
6	Interior Shoal	2.5 ft.	Fine, sandy silt	>90%	Yes, some mangrove detritus
16	Entrance	2.8 ft.	Fine, sandy silt	>90%	Yes, some mangrove detritus
25	Entrance	5.7 ft.	Silty, fine sand	25%	Yes, some mangrove detritus
30	Interior Shoal	5.5 ft.	Fine, sandy silt	>90%	No

D. Canal and Seawall Observation

The canals and seawalls were observed on September 26 and 27, 1995. Canals 1 through 32 were observed by boat coincident with the bathymetric survey. Canals 33 to 53 (Country Club Shores) were observed from adjacent upland properties. The Town has a wide range of canal conditions ranging from wide deep canals which will not require any maintenance to narrow canals which are shallow and in need of maintenance dredging but whose seawalls may become unstable if dredging occurs.

Much of the development of waterfront properties in Longboat Key occurred by dredging the canals to create the waterfront and to provide fill to raise the adjacent properties. This procedure is typical of much of the waterfront development in Florida and is not unique to the Town of Longboat Key. It was apparent in the observation that the houses which were not raised significantly were typically found on shallow or narrow canals, while the condominiums were often raised several feet and were on wider and deeper canals. One exception to this general trend was observed in southern Country Club Shores where several of the canals are relatively shallow when compared to the elevations of the upland properties.

During the observations, conditions of the canal and adjacent seawalls were noted. The observations are summarized in Appendix A. Photographs were taken of all the canals to document existing and unique conditions. The following photographs were selected to describe the many canal/seawall configurations within the Town. The following are not meant to provide an exhaustive description of all situations. All canals are referenced by number and are identified on Figure 1.

Canal 5 (between DeNarvaez Drive and Bayview Drive) is of average width and contains seawalls on both sides intermittently. Some areas contain mangrove shorelines with the mangroves encroaching into the canal.

Canal 8 (between Norton Street and Marbury Lane) has greater development than Canal 5, with nearly continuous seawalls on the north and south sides. Docks have been built out from the seawalls to moor boats.

Canal 10 (South of Penfield Street) is unique to the Town because it is developed only on the north side and the limited development has installed revetments to protect some of the upland property. The south side and the western end of the north side contain mature mangroves which grow into and over the canal. The canal is utilized by only a few small boats.

Canal 13 (between Emerald Harbor Drive and Old Compass Road) is typical of the Canals 12 through 14. The canals are generally wide and deep. The canals are continuously lined with concrete seawalls.

Canal 15 (north) is located west of the Buccaneer Inn. The canal is deep and has large boats moored at the Buccaneer Inn Marina. The south end of the canal has mangroves on the west side.

Canal 17 (between Jungle Queen Way and Tarawitt Drive) is typical of Canals 17 through 19. The canals are narrow (less than 40 feet between the seawalls) and are shallow. The canal contains several seawalls that have failed due to lack of sufficient toe penetration. Canal 18 also contains one stand of mangroves which is encroaching into the canal. The narrow width of these canals may preclude further dredging.

Canal 22 (between 5050 and 5056 Gulf of Mexico Drive) is a short canal which provides water access to only three upland residential properties.

Canal 24 is a short canal to the northern boat basin at the Longboat Harbor development. The basin is constructed of concrete seawalls on three sides with mangroves on the fourth side. Canal 25 is similar.

Canal 31 is the entrance channel into Buttonwood Harbor. The channel is marked with navigational buoys.

Canal 36 (between Chipping Lane and Wedge Lane) is typical of the canals in Country Club Shores. The canals are wide with concrete seawalls. Most of the homes along the canal have marginal docks, many with boat lifts. The seawall in the photograph shows evidence of tieback replacement which is common in Country Club shores.

Canal 38 (between Birdie Lane and Putting Green Lane) shows evidence of seawall failure with the installation of wood piles at the face of the wall to prevent toe or tieback failure.

Canal 47 (between Outrigger Lane and Cutter Lane) is unique in the Town since it contained an algae bloom on the day it was inspected. This suggests that this canal does not flush well with Sarasota Bay. The seawall shows evidence that the joints were externally patched which is common on the seawalls in Country Club Shores.

Canal 49 (between Yawl Lane and Schooner Lane) contains a sandy, shell, and limestone rubble (<1 inch) bottom which supports brown and green algae. Note the external patches on the seawall.

Canal 52 is a canal into the common areas of the Bay Harbor Apartments. A marginal dock lines the north and west sides of the canal.

Canal 53 is a short entrance canal to the Marina Boat House.

E. Seawall Stability

A potential impact of dredging the canals is the destabilization of the adjacent seawalls. If more sediment is removed from the face of the wall than originally designed for, or the wall components have deteriorated, failure could occur as a result of the additional stresses placed on the wall. There are two primary modes of failure: tie back failure, and toe failure. Both modes were observed to be occurring on a few seawalls during the observations (Appendix A).

Tieback failure occurs when the tieback system (deadmen and tierod) fails to prevent the top of the seawall from overturning. Figure 2 shows a schematic representation of a tieback seawall. A typical tieback seawall design for sandy soil will consist of a sheet pile penetration, D, equal to the free face, H. Many times tieback systems are designed with no safety factor. Therefore, a change in the soil forces (heavy rain, dredging, surcharge load, etc) and corrosion of the tieback rod can often lead to failure of the seawall.

Toe failure occurs when the passive resistance offered by the soil in front of the seawall is less than active soil forces. In this failure mode, the seawall rotates (counterclockwise in the left seawall in Figure 2) about the tieback rod and a loss of soil occurs behind the seawall. For sandy soil (angle of repose equal to 30 degrees), the width of soil required to prevent toe failure is 1.7 times the penetration depth, D. As with the tiebacks, the seawalls are often designed with no safety factor on the seawall penetration. Therefore, a change in the soil forces in front of the seawall can lead to toe failure.

Based on the limited soil samples collected from the Longboat Key Canals, the preceding assumption of sandy soils is optimistic in many areas but is probably appropriate for the Country Club Shores area. The soil samples collected are weaker and less dense than sand; therefore, the required width of soil to prevent toe failure would be greater and the required seawall penetration, D, to prevent tieback failure would increase.

The Town supplied subdivision plans for the four units of the Country Club Shores subdivision. No plans were available for other areas. These plans were reviewed to determine the typical seawall free face heights and penetration depths used in the development of the Country Club Shores. Results are shown in Table 2.

Table 2 shows that the seawalls were designed with greater free faces than penetration depths. Therefore, they are susceptible to toe failure and overturning failure. During the observations a repair indicative of toe failure was observed and many of the seawalls showed evidence of tieback replacement.

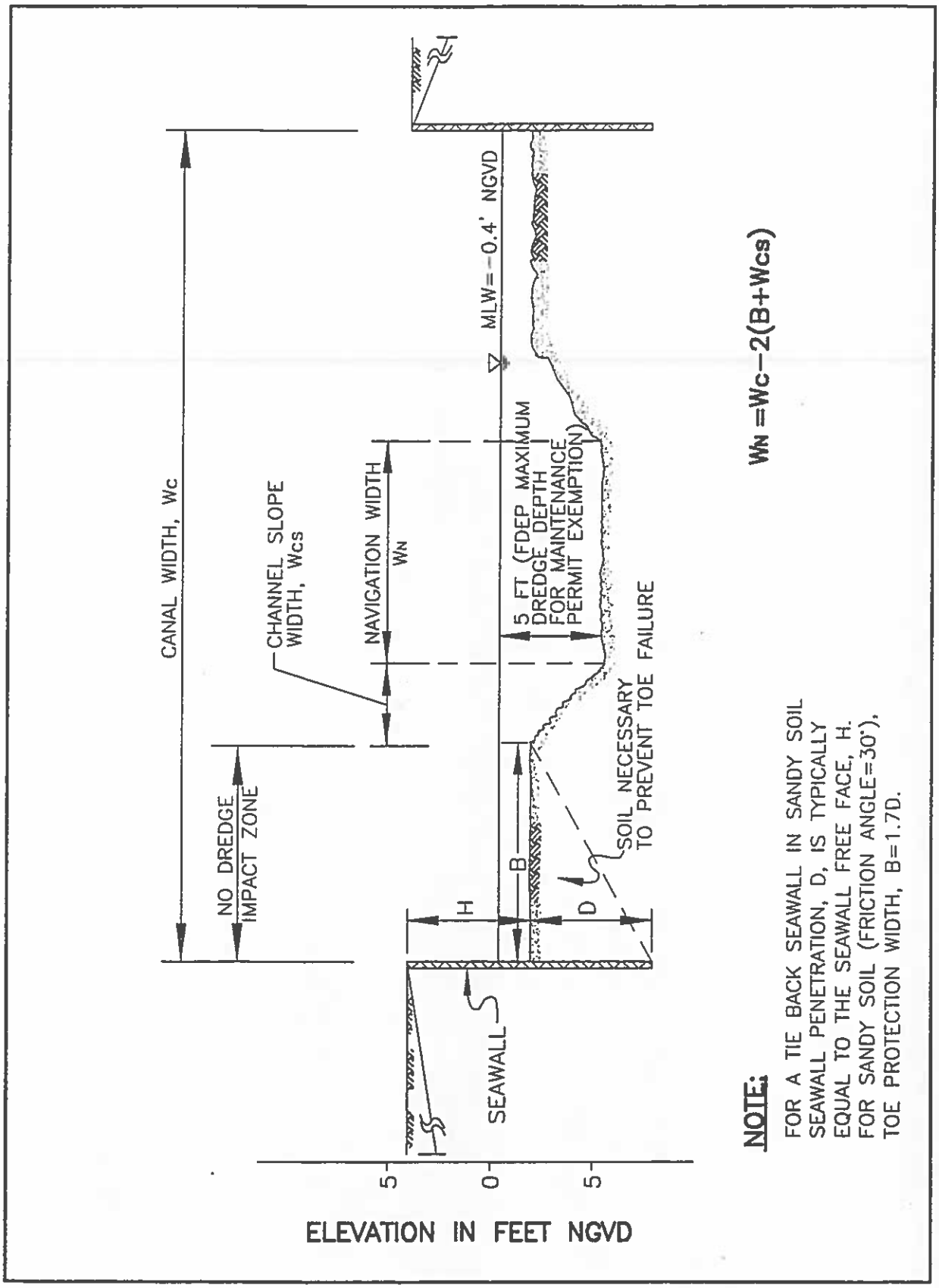

FIGURE 2

LONGBOAT KEY CANALS TYPICAL CANAL AND SEAWALL CROSS SECTION

Table 2

Seawall Parameters in Country Club Shores

Country Club Shores Unit	Free Face Height (Ft.)	Penetration Depth (Ft.)	Engineer
1	5	3	Murphy
2	5	3	Murphy
3	4.5	4	Geoffrion
4	4.5	4	Geoffrion

With the exception of the widest canals, dredging any canals in Longboat Key could potentially result in seawall failure. Additional seawall analyses should be performed for each canal during the final design to better understand the potential for seawall failure as a result of dredging the canals. This analysis will provide data to evaluate the appropriate distance from the walls to the dredged channel. Depending on the channel width selected by the Town it may be prudent to inform the residents and consider obtaining waivers from the upland owners.

F. Navigational Width

The preceding seawall analysis defined the soil width necessary to support the toe of the seawall (Figure 2). Figure 2 also defines the navigation width and the channel slope width in relation to the canal width. For a given canal width, and seawall condition, the width of the navigation channel can be estimated. Table 3 is an estimate of the maximum width of the navigation channel for combinations of seawall free face and canal width which will not destabilize the seawalls. Table 3 is based on sandy soil conditions and a channel slope width of six feet.

The canal widths shown in Table 3 cover the range of canal widths observed in the Town. While 10 and 20 foot canal widths do not actually exist within the Town, several canals are encroached by mangroves which limit the useable width of the canal. Table 3 shows that for canal widths less than 40 feet and seawall free face heights similar to those observed within the Town, a channel is not feasible. Based on this limitation analysis, canals 17 through 19 (between Jungle Queen Way and St. Judes South) could not be dredged without impacting the existing walls. Twenty to forty foot channel widths may be feasible in the remainder of the canals.

TABLE 3
ESTIMATE OF FEASIBLE CHANNEL WIDTHS

FREE FACE HEIGHT FEET	TOE SUPPORT WIDTH, B, FEET	WIDTH OF NAVIGATION CHANNEL(FEET), Wn									
		CANAL WIDTH(FEET), Wc									
		10	20	30	40	50	60	70	80	90	100
1	1.7	0	5	15	25	35	45	55	65	75	85
2	3.4	0	1	11	21	31	41	51	61	71	81
3	5.1	0	0	8	18	28	38	48	58	68	78
4	6.8	0	0	4	14	24	34	44	54	64	74
5	8.5	0	0	1	11	21	31	41	51	61	71
6	10.2	0	0	0	8	18	28	38	48	58	68
7	11.9	0	0	0	4	14	24	34	44	54	64
8	13.6	0	0	0	1	11	21	31	41	51	61
9	15.3	0	0	0	0	7	17	27	37	47	57
10	17	0	0	0	0	4	14	24	34	44	54

NOTES:
1. SANDY SOIL ASSUMED IN SEAWALL STABILITY ANALYSIS. $Wn = Wc - 2 (B + Wcs)$
2. CHANNEL SLOPE WIDTH (FEET), Wcs,= 6

G. Level of Service

If the channel width is of insufficient size to meet the requirements of all users at all times, the channel can be described in terms of its level of service. The need for improvements can be determined by assessing the acceptability of the level of service the canal provides. For example, the minimum width of channel necessary to easily turn a boat around is approximately 1.5 times the length of the longest boat in the canal (California Department of Boating & Waterways, 1980). For example, a 25 foot boat would require 38 feet of channel width (without obstructions). For many of the canals in Longboat Key, this width is not possible and a level of service for this parameter will necessarily be less than the optimum.

Most of the canals in Longboat Key serve only 20 to 30 upland residences. The occurrence of two boats traveling in opposite directions in any one canal at the same time is low; therefore, a channel width for one directional travel should be sufficient to provide an acceptable level of service for this parameter. Based on Dunham and Finn (1974), boats of the sizes observed in the Longboat Key canals (less than 40 feet) will have a beam of 14 feet or less. Therefore a minimum channel width of 15 to 20 feet may be suggested for a minimal level of service in terms of directional travel. By comparing the recommended channel width for a 25 foot boat (38 feet) to the minimum width of 15 to 20 feet, there can be a wide range of channel widths and the resulting levels of service. Navigation channel widths of less than 15 feet are not recommended. In addition, construction of a channel width of less than 22.5 feet may not be possible because of the width of construction barges.

While the navigable width of a canal will affect its level of service, the depth of the canal will also affect the ability to utilize the canal. By comparing the depth of water (at mean low water) to the depth requirements of classes of vessels, the level of service can be estimated. For example, a power boat less than 30 feet in length will have a draft of up to 3 feet (Dunham and Finn, 1974). Allowing for one foot of under keel clearance, the power boat should be able to utilize a -5 foot MLW canal at all times. A 30 foot sailboat may have a draft of up to 7 feet (Dunham and Finn, 1974) which may not be able to utilize a -5 foot MLW canal at any time. Based on the preceding example, a canal of a certain depth can have a wide range of levels of service. In the Longboat Key canals, it may not be possible to provide full access to all boat owners at all times. Some sailboats may be restricted to utilizing the canals at times of high tide only. To accurately determine the level of service a particular canal depth will provide, a detailed inventory of boat drafts is required.

H. Regulatory Constraints

The waters within Sarasota Bay are designated as an Outstanding Florida Water (OFW) and those waters west of the Intracoastal Waterway are classified as Class II Waters (Chapter 17-302, F.A.C.). The canals of Longboat Key that were created by dredge and fill activities are exempt from the OFW designation (Chapter 17-302.700(9)(i), F.A.C.). Without the OFW designation, the Town will not have to justify that the project is clearly in the public interest. FDEP will probably consider part or all of canals 2, 6, and 31 (Bishop Bayou, Gull Bayou and Buttonwood Harbor) as natural and require public interest criteria to be met.

When dredging occurs, the canals will have to be isolated from the adjacent OFW through the use of silt curtains which will prevent turbidity from reaching the OFW. This would greatly simplify the permitting process, but will prohibit the use of the canals by boaters. The Town should notify the upland owners prior to dredging so the owners can move their boats if they choose to.

As a cursory look at potential permitting concerns, we selected one soil sample to be analyzed for metals listed in Class II surface water requirements. The sample from Canal 30, a typical residential canal with silty bottom material, was tested using EPA standard test 6010 for all the metals except mercury and standard test 7470 for mercury. These tests determine the quantity of metal that is in, and bound to, the sample. These are not elutriate or wash tests. The results are shown in Table 4.

Table 4 shows that if the sample from Canal 30 were dredged (mixed), a violation of Class II waters may occur if there was little dilution of material and if the metals were not chemically bonded to the soil. Chemical analyses indicate that the sample contained concentrations of copper, iron, and silver equal to or above the Class II waters limits. Further analysis of samples, specific to the shoals to be dredged, may be needed for permitting purposes. If the sample tested is representative of all the canals, the Town would need to apply for a mixing zone variance the length of each canal. Otherwise, frequent shutdown of the dredging would be needed to comply with water quality standards.

The measured values of the Class II metals were also compared against the Toxicity Characteristic Leaching Procedure (TCLP) limit to determine if the material would be considered toxic. The measured values from this sample are below the TCLP limits. Since the material may be placed in upland disposal areas that are on private or municipal property, additional testing should be performed to provide reasonable assurances that the spoil material is non-toxic.

The Florida Department of Environmental Protection (FDEP) and the U.S. Army Corps of Engineers (USACE) will require that there is no submerged aquatic vegetation (SAV) in the areas that are to be dredged. The limited inspection of the canals indicated only one localized incidence of SAV in the canals (Appendix A). Several of the northern canals 1 through 12, had SAV at the entrances to the canals. This will limit dredging in these areas. A detailed inspection of the shoal areas should be performed to document existing SAV in the project area.

The Town should consider obtaining a FDEP permit exemption for the proposed dredging. This will simplify the permitting process and can be done if the Town can agree to certain conditions. Chapter 17-312.050 (e), F.A.C. allows the maintenance dredging of canals under the following conditions:

1. Dredging restores the canal to its original design.
2. Spoil is placed in a self contained upland spoil site.

Condition 1 can be satisfied with the documentation from previous permits, asbuilt surveys, or design plans. Soil borings, showing a layer of silt over sand may also satisfy this condition.

TABLE 4
LONGBOAT KEY SEDIMENT ANALYSIS

METAL	MEASURED VALUE ug/L	CLASS II WATER LIMIT ug/L	TCLP LIMIT ug/L
ALUMINUM	904	1500	
ANTIMONY	0.03	4300	
ARSENIC	2.61	36	5000
BARIUM	4.26	N/A	100000
BERYLLIUM	0.14	0.13	
CADMIUM	0.10	9.3	1000
CHROMIUM	8.61	50	5000
COPPER	15.1	2.9	
IRON	1289	300	
LEAD	2.89	5.6	5000
MANGENESE	5.80	100	
MERCURY	0.04	0.025	200
NICKEL	1.97	8.3	
SELENIUM	4.04	71	1000
SILVER	0.05	0.05	5000
THALLIUM	0.08	48	
ZINC	11.6	86	

CLASS II LIMITS ARE FROM F.A.C. 17-302.500.
TCLP LIMITS ARE FROM 40 CFR 261.24.
TCLP IS THE TOXICITY CHARACTERISTIC LEACHING PROCEDURE.

If no permits were previously issued by FDEP or the Corps of Engineers, the maximum allowable dredge depth is -5 ft. MLW (-5.4 ft. NGVD) to obtain the exemption. The Town was able to provide the design plans for the Country Club Shores canals. Therefore, the -5 ft. limit may not be applicable in these canals.

Condition 2 requires that the spoil be disposed of in a upland site so that surface waters of the State are not polluted. FDEP requires that the spoil area dewater through percolation and evaporation. No return flow pipes will be permitted. This essentially restricts the method of dredging to mechanical methods (clamshell) where the ratio of water to solids is low or possibly hydraulic cutterhead dredging if large enough spoil sites can be found. Potential spoil disposal areas are discussed in the following section.

FDEP indicated that they do not have any specific criteria for dredge spoil testing if the project qualifies for an exemption. FDEP indicated that the burden of proof for proving the project would cause pollution is on the State not the applicant.

The Corps of Engineers will process the permit application as an individual permit and will be looking primarily for impacts to seagrasses. They have no particular dredge depth restrictions. They recommend that an upland disposal site be considered to simplify the processing of the application.

The Division of State Lands will primarily focus on SAV and other environmental resources on submerged lands of the State. If SAV is impacted on State owned submerged lands, mitigation will be required. A determination of which canals are on State lands and which ones are private or municipal will be required.

Several of the canals contain mangroves which encroach into the canal and restrict navigation. Chapter 62-321.060 provides for trimming of mangroves in manmade canals. The Town may want to consider including the trimming of any mangroves which qualify for the permit exemption as part of the proposed canal dredging project.

I. Spoil Disposal Options

Since the project area is located in an environmentally sensitive area (OFW), the disposal of dredge material is as important as the design of the navigational channel dredging. Several potential methods of spoil disposal are discussed in the following paragraphs.

1. Open Water Disposal in Sarasota Bay

Open water disposal in Sarasota Bay would be an economical method of disposing of the material. Logical disposal sites would be the existing Intracoastal Waterway spoil areas which are under the jurisdiction of the West Coast Inland Navigation District (WCIND). We contacted the WCIND and requested that they assist the Town in identifying WCIND disposal areas that could be used. No response was received.

A second open water site is the mangrove berm around the Longboat Key Club property along the perimeter canal. On the east side, the berm is eroding and could benefit from additional clean, sandy dredge spoil (Dr. Clifford Truitt, personal communication). A significant problem with open water disposal is the difficulty in permitting the disposal through FDEP. FDEP indicated that they have not permitted open water disposals recently due to the concern over the long term movement of the sediments. A recent FDEP application to fill an old dredge hole in Anna Maria Sound has met with resistance over the perceived reliability of sand capping technology (placing a clean sand layer over dredge spoil). Due to the difficulty in obtaining a permit (probable permit denial), this option is not recommended for further evaluation.

2. Open Water Disposal Gulfward of Longboat Key

There is an offshore disposal site which has received EPA approval to accept clean dredge spoil. The site is located in the Gulf of Mexico, 25 miles northwest of Longboat Key, in 60 feet of water. The spoil area has been utilized for disposal of dredge spoil from the Port of Tampa. The spoil area has the advantage of being already permitted for clean dredge spoil. According to the USACE, extensive testing of the sediments within the Longboat canals would be required prior to EPA approval. There is no guarantee that the sediments would be approved for disposal in this area.

The second drawback to this site is the cost to transport the material from Longboat Key to the offshore site. An ocean going tug and scow would be required. This scow would have too large a draft to be directly loaded. Dredge spoil would have to be excavated from the canals and placed in a shallow scow or barge. The material would have to be reloaded into the oceangoing scow. This double handling of the material will significantly increase the cost of disposing of the material when compared to upland disposal. This option is not recommended for further evaluation.

3. Upland Disposal

The third alternative to dispose of the dredge spoil is to use an upland disposal area. Dredge spoil would be offloaded from a barge or scow onto upland areas where short berms or dikes would control the spoil. This alternative has the additional advantage of meeting the requirements of containing the spoil which is part of the FDEP permit exemption criteria.

During the survey and a review of the aerial photographs, potential upland disposal sites were identified. The upland disposal areas are in both residential and nonresidential areas and are discussed below.

a. Residential

During the surveying of the canals, three empty lots were identified along Canals 7 and 18. One empty lot was identified along both Canal 15 and Canal 16. An empty lot also exists north of the telephone company building. Aside from the lot north of the telephone company building, most of the properties are small. This will limit the volume of material that can be placed on

each lot. The proximity of private residences may preclude the placement of spoil due to its aromatic nature.

b. Non-residential areas

Within the Town we identified five non-residential sites which have the potential for use as upland disposal areas. They are the Canal 20 site, Jewfish Key, Sister Keys, Town property between Bayview Drive and Lyons Lane, and Bayfront Park. They are discussed in the following paragraphs:

The aerials of Longboat Key that were obtained by Coastal Planning & Engineering for the Town's beach engineering studies show a large lot south of Canal 20 (Gulf Bay Road) which appears to be presently dry; no mangroves are present. This may serve as a potential disposal area. A drawback to this site is that Canal 20 is presently unnavigable with little development along its shores. Therefore, the Town would have to dredge the canal in order to get the spoil to the spoil site.

Review of the aerial photographs revealed locations on Jewfish Key and northern Sister Keys which could be utilized. Jewfish Key has only limited development with only one development per 5 acres of land. The island is primarily covered with Australian pines with limited mangroves around parts of the island. No seagrass immediately offshore of Jewfish Key was observed in the photographs. Sister Keys has no development and is also zoned for only one development per 5 acres of land. The northern end of the Sister Keys is covered by Australian pines with a narrow mangrove fringe. There appears to be a narrow bed of seagrasses immediately offshore of the northern end of Sister Keys.

Disposal on either Jewfish Key or northern Sister Keys has the advantage of placing the aromatic spoil material where few people will complain of the smell. The distance from the canals to the islands is short relative to the offshore disposal option, which should keep disposal costs low. A drawback to the Sister Key site is that Sister Key was purchased as an environmental mitigation or conservation area. It may not be possible to use this area as a spoil area.

A fourth site identified from the aerial photographs and the zoning maps is the Town owned property between Bayview Drive and Lyons Lane. The area upland of the mangroves may be covered by Australian pines and could possibly serve as a disposal site with access via Canal 6 (Gull Bayou). This site could provide an economical disposal site.

Bayfront Park, located immediately adjacent to the telephone company building, could serve as a disposal area if the Town were willing to destroy and rebuild the playing fields. The total cost of using this site should be evaluated in the final design phase.

The volume of dredge material determined in the next section, indicates that more than one of the upland disposal sites will probably be required. There appears to be sufficient space to contain all the spoil; offsite trucking of the dredge spoil is not expected to be necessary.

4. Beach Disposal of Compatible Sediments

Sediments within the County Club Shores canals appeared to be sand, shell, and limestone rubble. Unlike the muddy sediments found elsewhere in Longboat Key, these materials may be beach compatible. If future sampling confirms the sediment composition, beach disposal of this portion of the dredge spoil may be the best option. The primary advantage to this method is that dredging costs for the Country Club Shores volume (approximately 5100 cubic yards) would be significantly reduced (50-75%) over a mechanical excavation project.

Shoal areas could be dredged hydraulically with a discharge pipe exiting canal number 40 (between Yardarm Lane and Bowsprit Lane). A pipeline would be constructed under Bogey Lane and Gulf of Mexico Drive and along the emergency easement between the Beach Place and Privateer condominiums to the beach.

Drawbacks to this system include acquiring construction easements from the private residents at the end of Canal 40 and the installation of the discharge pipe. The Town indicates a flexible disposal pipe could be placed through the storm drains under Gulf of Mexico Drive. This would be the best solution if the installation logistics can be worked out.

A second discharge pipe route may be around the southern end of Longboat Key. The distance from the center of Country Club Shores to the beach is approximately 2.5 miles. Contractors confirmed that their small dredges (12 inch) could achieve this pumping distance. This method would not require obtaining private easements to cross property. The pipeline would have to be floated over seagrass beds or sunk outside areas of seagrass beds. Disposal of material on Lighthouse Point could be accomplished if there was a need for additional beach quality materials at that location. A FDEP Bureau of Beaches and Coastal Systems permit would be required for sand disposal seaward of the Coastal Construction Control Line.

5. Filling of Blocked Canals

As previously identified in section B, several of the canals are blocked by debris, vegetation, or shallow depths and are not now navigable. These canals could serve as disposal areas of dredge material by filling in the blocked segments of the canals.

The advantage to this proposal is that the partial filling of the canals could be done to create wetlands which could serve as mitigation in permitting for the dredging of the other canals. It was estimated that canals 3, 20, 27 and 28 could contain approximately 400 c.y., 200 c.y., 800 c.y., and 800 c.y., respectively. However, more detailed surveys would be needed to confirm this volume.

The volume estimates were calculated by assuming one to two feet of sediment could be placed in the portion of the canal that was blocked. The spoil could be used to either fill in a previously dredged canal to create dry land, or the canal could be filled to create shallow water wetlands. With proper containment, hydraulic dredging and filling may be possible.

Drawbacks to this spoil disposal option are the limited volume of spoil disposal and FDEP approval. Adjacent owners may also object to the canals being filled. Nevertheless, this alternative could be used for mitigation for the dredging of the remaining canals.

6. Spoil Disposal Summary

In summary, upland disposal is the most cost effective and easiest disposal method to permit for the silty dredge material. There appears to be 5 potential large sites which could be used for upland disposal that should be further evaluated. More than one of these sites may be required. These sites are not directly adjacent to residential areas so the aroma of the spoil should not affect many residents. These sites may require mitigation for damage to mangroves or seagrasses in order to access the site. Site restoration may also be necessary. All five sites should be evaluated in the next phase of the work in the following areas:

a. Owner approval.
b. Environmental impact assessment.
c. Feasibility of spoil delivery.
d. Additional upland requirements (tree removal, etc.).
e. Spoil area and volume limits.
f. Environmental mitigation.
g. Spoil revegetation and habitat enhancement.
h. Site restoration

Further evaluation of the sediments in Country Club Shores is recommended to determine if the material is beach compatible. Beach compatible material could be dredged hydraulically and disposed of on the beach. Cost and feasibility evaluations should be performed to determine if crossing the island is more advantageous than pumping around the south end.

In addition, the filling of existing non-navigable canals should also be further considered. This method has the advantage of providing mitigation which may be required by FDEP as a permit condition. Further investigation of the site is needed to determine the containment volume available. Discussions with FDEP should be had to determine their opinion on this method of spoil disposal.

J. Dredge Volumes

The results of the bathymetric survey and engineering analyses were combined to develop an estimate of the required dredge volume. Table 2 and the seawall free face (Appendix A) were used to determine a channel width for the Country Club Shores canals, since these canals are wide (Table 5). The remaining canals were assigned a channel width of 22.5 feet which is the minimum width that can be constructed.

All of the canals were assumed to be dredged to -5.4 feet NGVD (-5 ft. MLW) which would allow FDEP to grant a permit exemption. This depth will also provide the residents with a depth that provides an acceptable level of service under most tidal fluctuations. The dredge

TABLE 5
LONGBOAT KEY CANALS PROPOSED CHANNEL WIDTHS

CPE CANAL NO.	BETWEEN (STREET)	AND (STREET)	PROPOSED CHANNEL WIDTH(FT)
1	GULF OF MEXICO DRIVE	LONGBOAT DRIVE NORTH	22.5
2	LONGBOAT DRIVE SOUTH	PALM DRIVE	22.5
3	SHINBONE ALLEY	JUAN ANASCO DRIVE	22.5
4	JUAN ANASCO DRIVE	DE NARVAEZ DRIVE	22.5
5	DE NARVAEZ DRIVE	BAYVIEW DRIVE	22.5
6	BAYVIEW DRIVE	LYONS LANE	22.5
7	LYONS LANE	NORTON STREET	22.5
8	NORTON STREET	MARBURY LANE	22.5
9	MARBURY LANE	PENFIELD STREET	22.5
10	PENFIELD STREET	MANGROVES(WAKE ISL.)	22.5
11	HIDEAWAY BAY	BUCCANEER INN	22.5
12	DREAM ISLAND ROAD	EMERALD HARBOR DRIVE	22.5
13	EMERALD HARBOR DRIVE	OLD COMPASS ROAD	22.5
14	OLD COMPASS ROAD	BINNACLE POINT DRIVE	22.5
15 N	BUCCANEER INN	GULF OF MEXICO DRIVE	22.5
15 S	EMERALD HARBOR DRIVE	GULF OF MEXICO DRIVE	22.5
16	EVERGREEN WAY	JUNGLE QUEEN WAY	22.5
17	JUNGLE QUEEN WAY	TARAWITT DRIVE	22.5
18	TARAWITT DRIVE	ST JUDES NORTH	22.5
19	ST JUDES NORTH	ST JUDES SOUTH	22.5
20	GULF BAY ROAD(END OF)	N/A	22.5
21	SANDHAMN PLACE	N/A	22.5
22	5056 GULF OF MEXICO DR	5050 GULF OF MEXICO DR	22.5
23	5000 GULF OF MEXICO DR	LONGBOAT HARBOR NOR	22.5
24	LONGBOAT HARBOR NOR	NORTH BOAT BASIN	22.5
25	LONGBOAT HARBOR NOR	SOUTH BOAT BASIN	22.5
26	EXETER DRIVE	CHATHAM & FALMOUTH DI	22.5
26 A	SUTTON PLACE	N/A	22.5
27	LBK RECREATION CENTEF	JESSMYTH WAY	22.5
28	JESSMYTH WAY	JESSMYTH DRIVE	22.5
29	JESSMYTH DRIVE	ROUNDTREE DRIVE	22.5
30	ROUNDTREE DRIVE	KINGFISHER LANE	22.5
31	GULF OF MEXICO DRIVE	BUTTONWOOD HARBOR	300
32	BUTTONWOOD DRIVE	LONGVIEW DRIVE	22.5
33	HARBOR COVE CIRCLE	PUTTER LANE	40
34	PUTTER LANE	GOLF LINKS LANE	30
35	GOLF LINKS LANE	CHIPPING LANE	30
36	CHIPPING LANE	WEDGE LANE	30
37	WEDGE LANE	BIRDIE LANE	30
38	BIRDIE LANE	PUTTING GREEN LANE	30
39	PUTTING GREEN LANE	YARDARM LANE	30
40	YARDARM LANE	BOWSPRIT LANE	30
41	BOWSPRIT LANE	RANGER LANE	30
42	RANGER LANE	HALYARD LANE	30
43	HALYARD LANE	SPINAKER LANE	40
44	SPINAKER LANE	HORNBLOWER LANE	40
45	HORNBLOWER LANE	GUNWALE LANE	40
46	GUNWALE LANE	OUTRIGGER LANE	40
47	OUTRIGGER LANE	CUTTER LANE	40
48	CUTTER LANE	YAWL LANE	40
49	YAWL LANE	SCHOONER LANE	40
50	SCHOONER LANE	KETCH LANE	40
51	KETCH LANE	SLOOP LANE	40
52	SLOOP LANE	BAY HARBOR APTS.	35
53	MARINA BOATHOUSE	N/A	22.5

cross-section consisted of a box cut to -5.4 feet NGVD with side slopes of 1V:3H (Figure 2). This cross-section was compared to the average elevation of each shoal area and the volume computed. The dredge volumes are summarized in Table 6.

Table 6

Dredge Volume Summary

Dredge Volume (all canals)	44,500 c.y.
Dredge Volume (canals 17-19)	13,700 c.y.
Dredge Volume (without canals 17-19)	30,800 c.y.
Volume Contingency (25%)	7,700 c.y.
Estimated Project Volume	38,500 c.y.

Based on the above analysis, approximately 44,500 cubic yards is required to be dredged. This volume does not include dredging in blocked canals (No. 3, 10, 16, 20 and 27). Since canals 17-19 (Jungle Queen Way to St. Judes South) cannot be dredged without risking seawall failure, the canal 17 to 19 dredge volume of 13,700 cubic yards was deducted. Due to the preliminary nature of the study we propose a dredge volume contingency of 25 percent; therefore, the estimated project volume is 38,500 cubic yards.

Further evaluation of the sediments and seawalls in each canal is required to refine the channel width estimate. Additional analyses may indicate that an increase the channel width is allowable or indicate dredging is not feasible without risk to the seawalls. If the Town selects a deeper channel, volumes would be considerably higher.

K. Cost Estimate

After consultation with dredge and marine contractors capable of performing this work, the following preliminary cost estimate was developed. It is based on upland disposal of all material.

Mobilization/Demobilization	$30,000
Dredge and Dispose of Spoil	$25/c.y.
Disposal Area Site Restoration	$75,000

For a 38,500 cubic yard project, a construction cost of $1.2 million could be used for planning purposes. This cost includes a 10% contingency.

If the Country Club Shores canals could be dredged hydraulically with beach disposal at $30,000 for mobilization and $6.00 per cubic yard, the cost of the hydraulic dredging 6375 cubic yards would be $75,000 including a 10% contingency. The reduction of mechanical dredging cost would be $159,000. A net savings of $84,000 may be realized.

The cost estimate is preliminary. As recommended in section I, a detailed assessment of spoil area cost is needed to refine the above cost estimate.

L. Project Schedule

This feasibility study has indicated that the maintenance of these canals is possible, though there are still many unknowns associated with this project which cannot be determined within the scope of this study. Therefore, a phased approach to the development of the project design would be best. The time to complete the design, resolve regulatory requirements and prepare construction documents is estimated to be 18 months. Initially, a more detailed analysis of seawalls and canal sediments (for wall stability analysis) would take 3 to 5 months. Concurrently, the Town Attorney could investigate ownership questions and the Town could address the needed level of services. Subsequently, more detailed engineering, design, and surveying would be carried out utilizing the information obtained in the previous phase. Cost estimates would be refined. The permitting process would also be carried out during this phase. This phase will take about 8 to 10 months. Finally, the Town would proceed to preparation of plans, bidding and construction. Plans and specifications preparation will take about 2 months and bidding about 2 to 3 months. The construction of the project will then take an additional 2 to 3 months.

M. Conclusions

The survey and analyses performed during this study indicate the following:

1. A -5.4 NGVD (5.0 ft. MLW) channel depth was selected in our analysis since it will allow an exemption from the permit process for the majority of the canals. Deeper channels might be achieved, but the permitting process is more rigorous. The Town must determine a level of service for channel depth and width.

2. A majority of the canals require some dredging to restore a -5.4 feet NGVD channel. Approximately 38,500 cubic yards should be removed from the canals to achieve this depth.

3. Mechanical dredging of the silty dredge material with self contained upland disposals is the most feasible method of shoal removal. Hydraulic dredging may be possible in Country Club Shores with beach disposal.

4. Upland disposal sites are exempt from permitting and there are several sites available. More investigation is needed to confirm these sites. Filling of non-navigable canals

could also serve as disposal sites and provide an opportunity for mitigation, if required by the permits.

5. A preliminary construction cost estimate of $1.2 million can be used for future planning.

6. Dredging the canals may destabilize the adjacent seawalls. Detailed surveying, geotechnical investigations, and engineering analyses are required to determine site specific seawall stability or risk to the seawalls.

7. Canals 17 through 19 (Jungle Queen Way to St. Judes South) are too narrow to dredge a channel without impact to the seawalls. A reduced level of service must be accepted.

8. The dredging of the canals is feasible but many factors identified in this study may significantly modify the scope and cost of the work prior to construction.

9. A phased approach to the further development of this project is the best way to proceed. The construction of the project is about 18 months away from the authorization to proceed.

N. Recommendations

1. Proceed with the next phase of project development which would include:

   a. Collect additional sediment samples (surface grabs and cores) to analyze the sediment in front of the seawalls and determine if Country Club Shores' materials are beach compatible.

   b. Analyze the seawalls for each area to be dredged to determine the most feasible channel width.

   c. Evaluate the acceptability of the level of service for the proposed 22.5 ft. wide, -5.4 feet NGVD channel in most canals and the no dredge scenario for the narrow canals in northern Longboat Key (Canals 17 to 19).

   d. Evaluate on a case by case basis, the trimming of mangroves to improve the level of service in some of the (narrow) canals.

   e. Evaluate the potential dredge spoil locations identified for their ownership, access, permittability and mitigation requirements.

References

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Dunham, J. and A. Finn, "Small-Craft Harbors: Design, Construction and Operation," *Special Report No. 2*, U. S. Army Corps of Engineers, Coastal Engineering Research Center, December 1974.

LBK02:CANALDRG

APPENDIX A

LONGBOAT KEY CANALS SURVEY FIELD NOTES

LONGBOAT KEY CANAL SURVEY FIELD NOTES

CPE CANAL NO.	BETWEEN (STREET)	AND (STREET)	NORTH BANK PROTECTION	SOUTH BANK PROTECTION	GENERAL SEAWALL CONDITION	NO. OF OBSERVED OUTFALLS	FREE FACE ON WALL (EST IN FT)	NOTES
1	GULF OF MEXICO DRIVE	LONGBOAT DRIVE NORTH	MANGROVE	SEAWALL	GOOD	2		SHALLOW BAR WITH SEAGRASSES NORTH OF ENTRANCE.
2	LONGBOAT DRIVE SOUTH	PALM DRIVE	MANGROVE/WALL	MANGROVE/WALL	GOOD	1	4 TO 5	SHALLOW ADJACENT TO SHOPPING CENTER
								CANAL NARROWS TO 8 FEET WIDE DUE TO MANGROVES.
3	SHINBONE ALLEY	JUAN ANASCO DRIVE	MANGROVE	MANGROVE/WALL	GOOD	0		SURVEY TERMINATED DUE TO BOATS IN CANAL.
4	JUAN ANASCO DRIVE	DE NARVAEZ DRIVE	SEAWALL	SEAWALL	GOOD	2	5	WALLS ARE CONCRETE EXCEPT 1 ALU MINUM WALL.
5	DE NARVAEZ DRIVE	BAYVIEW DRIVE	MANGROVE/WALL	SEAWALL	GOOD	0	5	SURVEY TERMINATED DUE TO BOATS IN CANAL.
								ONE CONCRETE BAG SEAWALL
6	BAYVIEW DRIVE	LYONS LANE	SEAWALL	MANGROVE	GOOD	0	4 TO 5	GULL BAYOU SHALLOW WITH SEAGRASS.
								CHANNEL ADJACENT TO NORTH SEAWALL.
7	LYONS LANE	NORTON STREET	SEAWALL	SEAWALL	GOOD	1		1 EMPTY LOT NORTH SIDE. TWO EMPTY LOTS SOUTH SIDE.
8	NORTON STREET	MARBURY LANE	SEAWALL	SEAWALL	GOOD	0	4 TO 5	2 EMPTY LOTS NORTH SIDE. 1 EMPTY LOT SOUTH SIDE.
								SOME WALLS ARE OLDER THAN REMAINDER OF WALLS.
9	MARBURY LANE	PENFIELD STREET	MANGROVE/WALL	MANGROVE/WALL	GOOD	0	5 TO 6	
10	PENFIELD STREET	MANGROVES(WAKE ISL.)	REVETMENT	MANGROVES	N/A	0	N/A	NARROW CANAL WITH ENCROACHING MANGROVES.
11	HIDEAWAY BAY	BUCCANEER INN	MANGROVE/WALL	MANGROVE/WALL	GOOD	0		LARGE YACHTS AT BUCCANEER INN MARINA.
12	DREAM ISLAND ROAD	EMERALD HARBOR DRIVE	MANGROVE/WALL	SEAWALL	GOOD	0		A.K.A. CANNON'S MARINNA CHANNEL.
13	EMERALD HARBOR DRIVE	OLD COMPASS ROAD	SEAWALL	SEAWALL	GOOD	0		DEEP WIDE CANAL.
14	OLD COMPASS ROAD	BINNACLE POINT DRIVE	SEAWALL	SEAWALL	GOOD	1		DEEP WIDE CANNAL.
15 N	BUCCANEER INN	GULF OF MEXICO DRIVE	MANGROVE	MANGROVE/DOCK	N/A	0	N/A	DEEP WIDE CANAL.
15 S	EMERALD HARBOR DRIVE	GULF OF MEXICO DRIVE	SEAWALL	SEAWALL	GOOD	1	4 TO 5	ONE EMPTY LOT.
16	EVERGREEN WAY	JUNGLE QUEEN WAY	MANGROVE	MANGROVE	N/A	0	N/A	SURVEY TERMINATED DUE TO SHALLOW BAR AT MOUTH.
17	JUNGLE QUEEN WAY	TARAWITT DRIVE	SEAWALL	SEAWALL	FAILURES(4)	0	4 TO 5	4 WALLS FAILED AT TOE OF WALL. NARROW CANAL.
								WALLS AT ENTRANCE FAILED BY TIEROD AND PANEL FAILURE.
18	TARAWITT DRIVE	ST JUDES NORTH	SEAWALL	MANGROVE/WALL	GOOD	1	4 TO 5	3 VACANT LOTS. NARROW CANAL.
								MANGROVE ENCROACHES ON WEST END OF CANAL.
19	ST JUDES NORTH	ST JUDES SOUTH	SEAWALL	SEAWALL	FAILURE(1)	1	4 TO 5	1 TIEBACK FAILURE. NARROW CANAL.
								SOUTH ENTRANCE WALL DETERIORATING.
20	GULF BAY ROAD(END OF)	N/A	MANGROVE	MANGROVE	N/A	0	N/A	SURVEY TERMINATED DUE TO SHALLOW BAR AT MOUTH.
21	SANDHAMN PLACE	N/A	MANGROVE	MANGROVE	N/A			CANAL NOT FOUND DURING SURVEY.
22	5056 GULF OF MEXICO DF	5050 GULF OF MEXICO DF	SEAWALL	SEAWALL	GOOD	0		CANAL TO 3 PRIVATE RESIDENCES.
23	5000 GULF OF MEXICO DF	LONGBOAT HARBOR NOR	SEAWALL	SEAWALL	FAILURE(1)	0		TIEBACK FAILURE ON NORTH SEAWALL.
24	LONGBOAT HARBOR NOR	NORTH BOAT BASIN	SEAWALL	MANGROVE	GOOD	0	7	ENTRANCE TO BOAT BASIN.
25	LONGBOAT HARBOR NOR	SOUTH BOAT BASIN	MANGROVE	SEAWALL	GOOD	0	7	ENTRANCE TO BOAT BASIN.
26	EXETER DRIVE	CHATHAM & FALMOUTH D	SEAWALL	SEAWALL	GOOD	2		ROCKS ALONG SOUTH ENTRANCE WALL.
26 A	SUTTON PLACE	N/A	SEAWALL	SEAWALL	GOOD	0		NO BATHYMETRY REQUIRED. DEEP WATER.
27	LBK RECREATION CENTE	JESSMYTH WAY	SEAWALL	SEAWALL	GOOD	0		NO BOATS OR DOCKS PRESENT.
								SURVEY TERMINATED DUE TO MANGROVES.
28	JESSMYTH WAY	JESSMYTH DRIVE	SEAWALL	SEAWALL	FAILURE(1)	0		WOOD WALL ON SOUTH SIDE DETERIORATED.
29	JESSMYTH DRIVE	ROUNDTREE DRIVE	SEAWALL	SEAWALL	GOOD	1	6 TO 7	SOME REPAIRS TO SEAWALLS PRESENT.
30	ROUNDTREE DRIVE	KINGFISHER LANE	SEAWALL	SEAWALL	GOOD	1	6 TO 7	MOST WALLS HAVE BEEN REPAIRED WITH NEW CAPS.
31	GULF OF MEXICO DRIVE	BUTTONWOOD HARBOR	MANGROVE/WALL	MANGROVE/WALL	GOOD	0		MARKED CHANNEL IS DEEP.
32	BUTTONWOOD DRIVE	LONGVIEW DRIVE	SEAWALL	SEAWALL	GOOD	1	6 TO 7	SOME NEW CAPS ON SEAWALLS.
33	HARBOR COVE CIRCLE	PUTTER LANE	SEAWALL	SEAWALL	GOOD	0	7 TO 8	
34	PUTTER LANE	GOLF LINKS LANE	SEAWALL	SEAWALL	GOOD	0	8	
35	GOLF LINKS LANE	CHIPPING LANE	SEAWALL	SEAWALL	GOOD	1	8	EXTERNAL PATCHES ON SOME JOINTS.
36	CHIPPING LANE	WEDGE LANE	SEAWALL	SEAWALL	GOOD	1	8	SOME NEW CAPS AND TIEROD BOLTS EXPOSED.
37	WEDGE LANE	BIRDIE LANE	SEAWALL	SEAWALL	GOOD	2	8	
38	BIRDIE LANE	PUTTING GREEN LANE	SEAWALL	SEAWALL	GOOD	2	8	
39	PUTTING GREEN LANE	YARDARM LANE	SEAWALL	SEAWALL	GOOD	0	8	
40	YARDARM LANE	BOWSPRIT LANE	SEAWALL	SEAWALL	GOOD	1	8	EXTERNAL PATCHES ON SOME JOINTS.
41	BOWSPRIT LANE	RANGER LANE	SEAWALL	SEAWALL	GOOD	1	7	SOME NEW CAPS. SOME CORROSION ON PANELS.
42	RANGER LANE	HALYARD LANE	SEAWALL	SEAWALL	GOOD	2	8	BREAKWATER AT ENTRANCE TO CANAL.
								EXTERNAL PATCHES ON SOME JOINTS.

43	HALYARD LANE	SPINAKER LANE	SEAWALL	SEAWALL	GOOD	0	7 TO 8	SOME CORROSION ON PANELS. SOME NEW TIERODS. SOME NEW TIERODS. SOME NEW CAPS. EXTERNAL PATCHES ON SOME JOINTS.
44	SPINAKER LANE	HORNBLOWER LANE	SEAWALL	SEAWALL	GOOD	0	7.5 TO 8	MANY EXTERNAL JOINT REPAIRS. SMALL AREA OF SEAGRASS OBSERVED.
45	HORNBLOWER LANE	GUNWALE LANE	SEAWALL	SEAWALL	GOOD	1	6	SOME NEW TIEBACK RODS. SOME EXTERNAL JOINT REPAIRS.
46	GUNWALE LANE	OUTRIGGER LANE	SEAWALL	SEAWALL	GOOD	0	7	MANY EXTERNAL JOINT REPAIRS. SOME NEW TIERODS. ALGAE OBSERVED ON BOTTOM.
47	OUTRIGGER LANE	CUTTER LANE	SEAWALL	SEAWALL	GOOD	0	6	ALGAE OBSERVED ON BOTTOM. MOST JOINTS HAVE BEEN PATCHED EXTERNALLY. WATER COLOR IS TURBID AND LIGHT GREEN.
48	CUTTER LANE	YAWL LANE	SEAWALL	SEAWALL	GOOD	1	6.5 TO 7	ALGAE OBSERVED ON BOTTOM. MOST JOINTS HAVE BEEN PATCHED EXTERNALLY. SOME NEW CAPS. ONE WALL HAS TOE PILE DRIVEN.
49	YAWL LANE	SCHOONER LANE	SEAWALL	SEAWALL	GOOD	1	6	MOST JOINTS HAVE BEEN PATCHED EXTERNALLY. ALGAE OBSERVED ON BOTTOM. CANAL IS SHALLOW. ONE WALL HAS TOE PILE DRIVEN. BOTTOM IS SAND, SHELL, AND SMALL ROCK.
50	SCHOONER LANE	KETCH LANE	SEAWALL	SEAWALL	GOOD	1	7	MOST JOINTS HAVE BEEN PATCHED EXTERNALLY. SOME NEW TIEBACK RODS. ALGAE OBSERVED ON BOTTOM. BOTTOM IS SAND,SHELL, AND SMALL ROCK. ALGAE PRESENT.
51	KETCH LANE	SLOOP LANE	SEAWALL	SEAWALL	GOOD	2	5.5	MOST JOINTS HAVE BEEN PATCHED EXTERNALLY. ONE WALL HAS NEW TIEBACK RODS. ONE WALL HAS TWO ACTIVE SOIL LOSSES.
52	SLOOP LANE	BAY HARBOR APTS.	SEAWALL	SEAWALL	GOOD	0	8	BOTTOM IS SAND,SHELL, AND SMALL ROCK. ALGAE PRESENT. MOST JOINTS HAVE BEEN EXTERNALLY PATCHED. NORTH SIDE CAP IS SPALLED ON BOTTOM EDGE.
53	MARINA BOATHOUSE	N/A	SEAWALL	SEAWALL	GOOD	0	7	ACCESS TO DRY STORAGE UNIT ONLY.

NOTES SEAWALL CONDITION IDENTIFIED AS GOOD IS AN INDICATION OF NO OBSERVABLE FAILURES.
IT DOES NOT REPRESENT THE STABILITY OR ADEQUACY OF THE WALL UNDER EXISTING OR PROPOSED CONDITIONS.