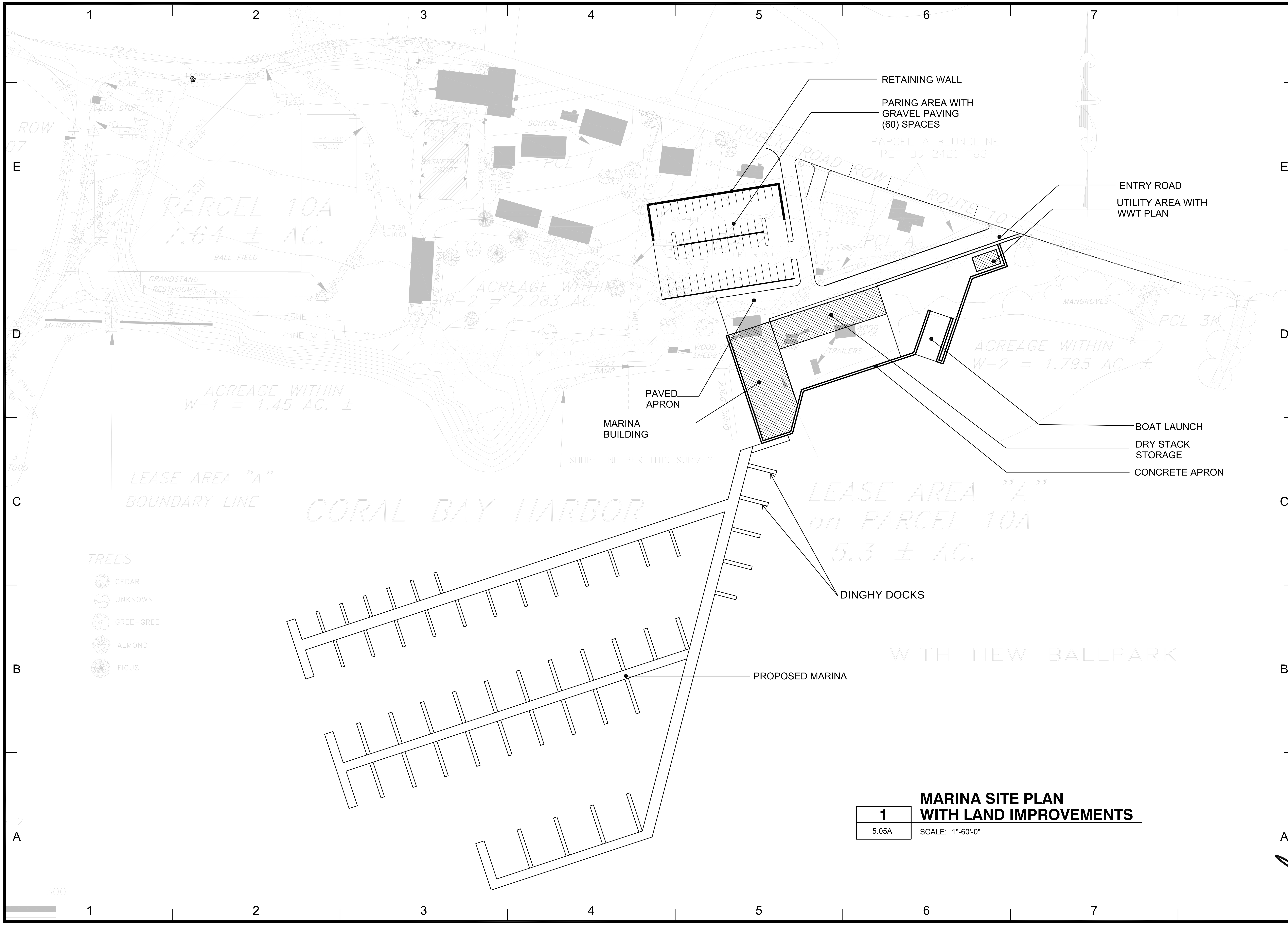

MARINA SITE PLAN WITH LAND IMPROVEMENTS

1 — 5.05A

SCALE: 1"-60'-0"

REVISIONS

NO:	DATE:	REMARKS

CONSULTANTS

Jaredian Design Group
Architects, Engineers and Construction Managers
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Post Office Box 6218
St. Thomas, U.S. Virgin Islands 00804
telephone: 340.777.1600 fax: 340.777.1601
e-mail: jaredian2@vipowernet.net

SIRIUS RESORT & MARINA
PARCEL 10A-1REM
ESTATE EMMAUS
NO. CORAL BAY QUARTER
ST JOHN U.S.V.I

DATE: 6-2-15
DRAWN BY: K.R.B.
CHECKED BY: K.R.B.
APPROVED BY: J.P.W.

PROJECT NO.: 07-019
CONTRACT NO.:

SHEET NO.:
5.05A

PERMIT SUBMITTAL
NOT TO BE USED FOR CONSTRUCTION

SIRIUS RESORT AND MARINA

CORAL BAY, ST. JOHN, U.S.V.I.

SHEET	SHEET TITLE	2015-06-03 ISSUE					
SHT-01	COVER SHEET AND DRAWING INDEX	■					
SHT-02	VICINITY AND LOCATION MAPS	■					
SHT-03	GENERAL NOTES	■					
SHT-04	EXISTING CONDITIONS AND DEMO PLAN	■					
SHT-05	GENERAL ARRANGEMENT PLAN	■					
SHT-06	BOATYARD PLAN	■					
SHT-07	MARINA PLAN	■					
SHT-08	DREDGING & BOAT RAMP SECTIONS	■					
SHT-09	TYPICAL BULKHEAD SECTION	■					
SHT-10	TYPICAL DOCK SECTION	■					
SHT-11	WAVE ATTENUATOR DOCK SECTION	■					
SHT-12	AIDS TO NAVIGATION PLAN	■					

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3 JUNE 2015
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LEGEND:

■ INDICATES DRAWINGS ISSUED

☒ INDICATES DRAWINGS MODIFIED FROM PREVIOUS SUBMITTAL

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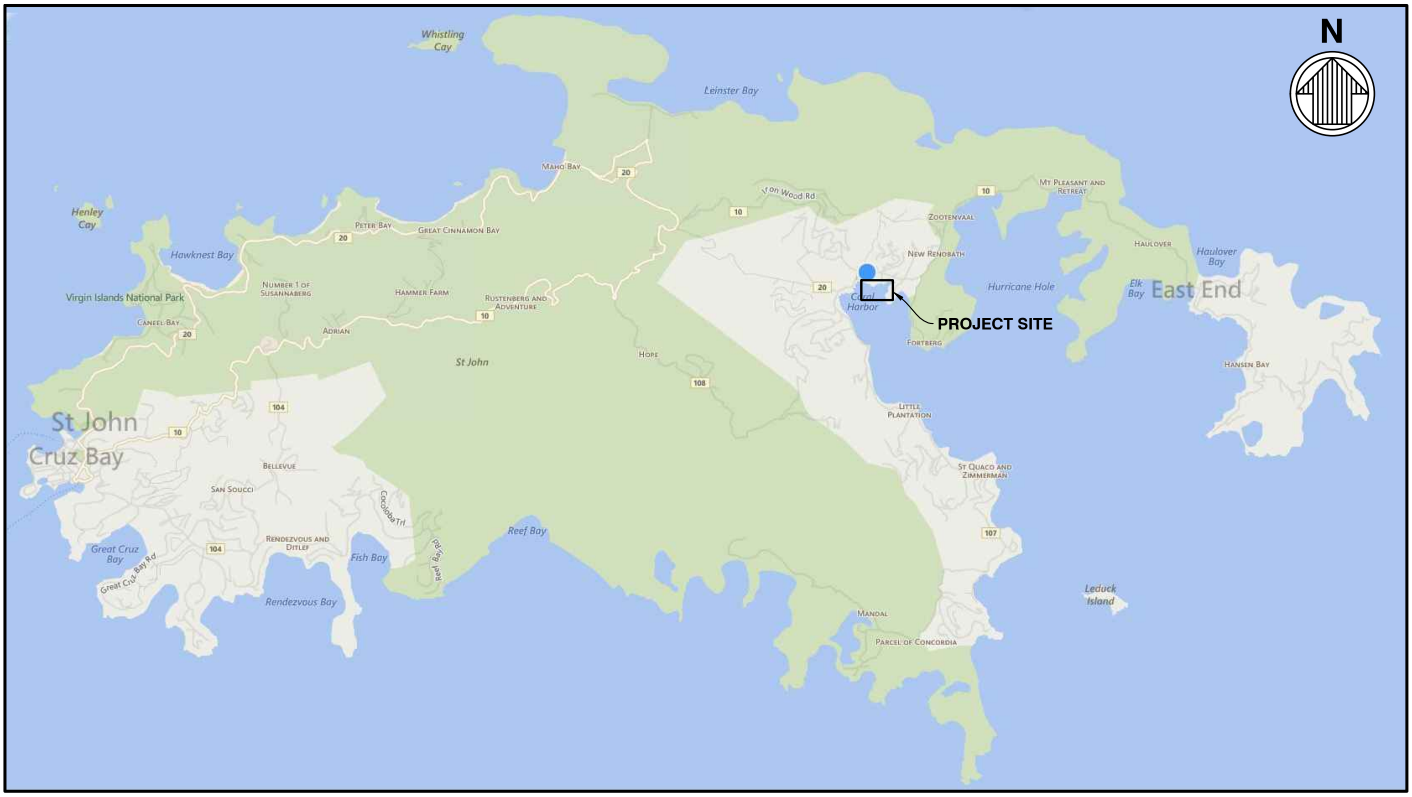
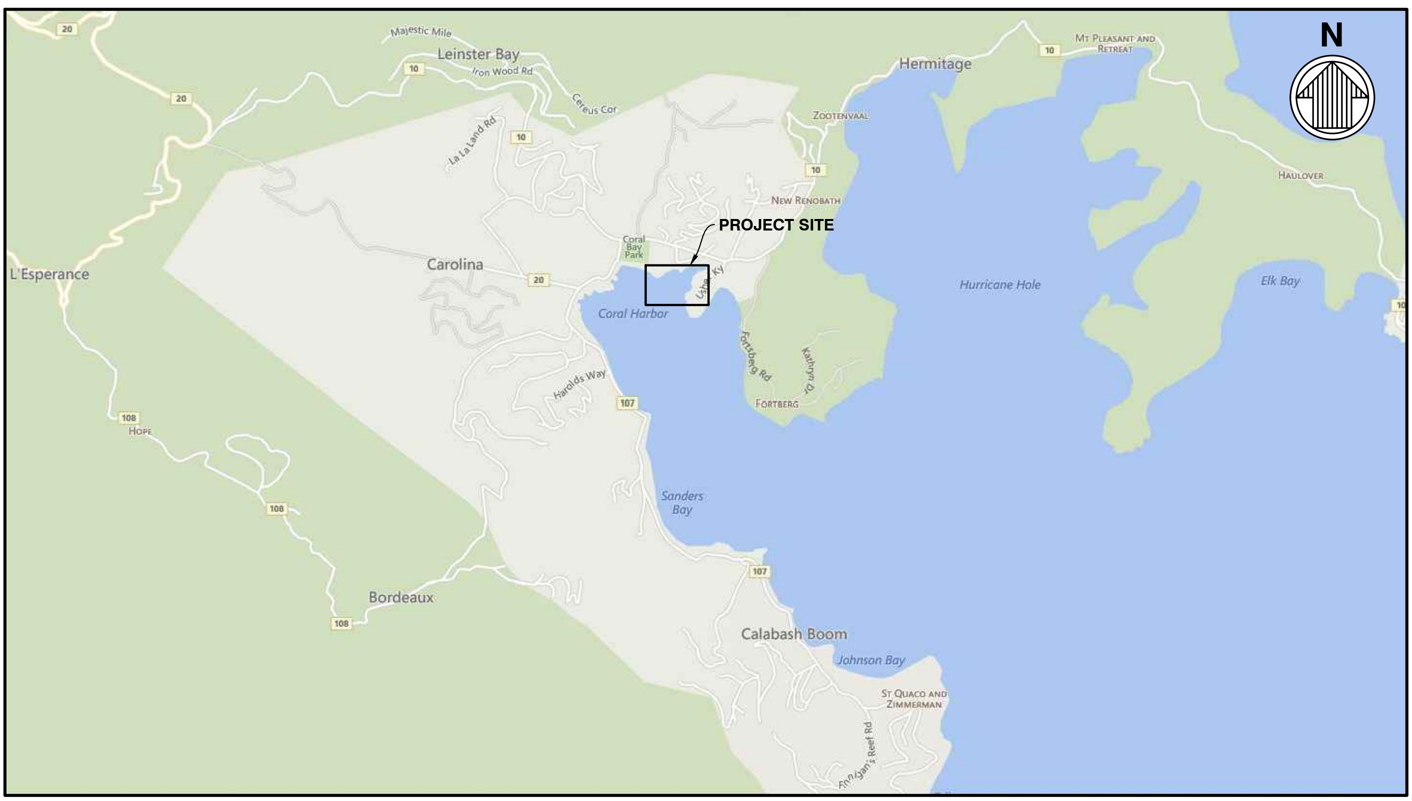


VICINITY MAP
SCALE: NTS



LOCATION MAP
SCALE: NTS

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GENERAL NOTES
ALL ELEVATIONS SHOWN ON DRAWINGS REFERENCED TO MEAN SEA LEVEL (MSL).

1. THE TOPOGRAPHIC AND BATHYMETRIC INFORMATION DEPICTED REPRESENTS THE SURVEY MADE BY MARVIN BERNING AND ASSOCIATES ON MAY 10, 2007 AND NOVEMBER 2014, AND CAN ONLY INDICATE THE GENERAL CONDITIONS EXISTING ON SAID DATES.

2. TIDAL DATUM RELATIONSHIP AS FOLLOWS:

MEAN HIGHER HIGH WATER	0.46 FEET
MEAN HIGH WATER	0.37 FEET
MEAN SEA LEVEL	0.00 FEET
MEAN LOW WATER	−0.35 FEET
MEAN LOWER LOW WATER	−0.43 FEET

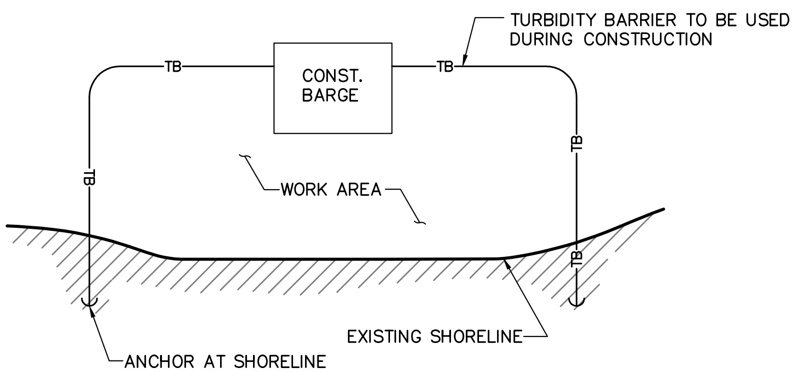
GENERAL CONSTRUCTION – BEST MANAGEMENT PRACTICES
1. ALL WORK WILL ADHERE TO PERFORMANCE REQUIREMENTS OF THE CLEAN WATER ACT, SECTION 404 PERMIT AND SECTION 401 WATER QUALITY CERTIFICATION. NO IN–WATER WORK WILL BEGIN UNTIL AFTER ISSUANCE OF REGULATORY AUTHORIZATIONS.

2. THE CONSTRUCTION CONTRACTOR IS RESPONSIBLE FOR PREPARATION OF AN ENVIRONMENTAL PROTECTION PLAN. THE PLAN WILL BE SUBMITTED AND IMPLEMENTED PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES. THE PLAN WILL IDENTIFY CONSTRUCTION ELEMENTS AND RECOGNIZE SPILL SOURCES AT THE SITE. THE PLAN WILL OUTLINE BMPS, RESPONSIVE ACTIONS IN THE EVENT OF A SPILL OR RELEASE, AND NOTIFICATION AND REPORTING PROCEDURES. THE PLAN WILL ALSO OUTLINE CONTRACTOR MANAGEMENT ELEMENTS SUCH AS PERSONNEL RESPONSIBILITIES, ACTION AREA SECURITY, SITE INSPECTIONS, AND TRAINING.

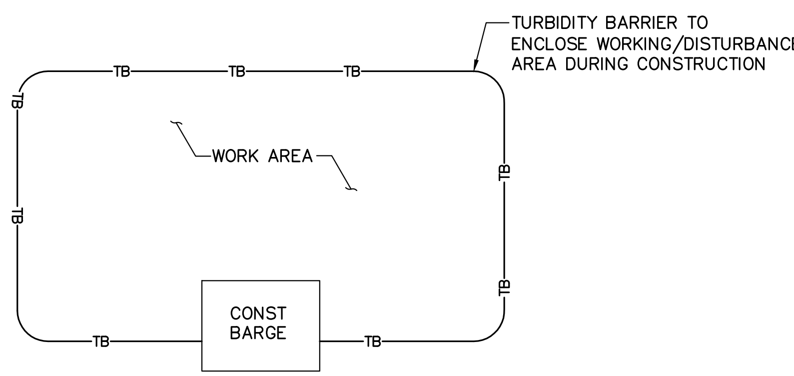
3. BARGE OPERATIONS WILL BE RESTRICTED TO TIDAL ELEVATIONS ADEQUATE TO PREVENT GROUNDING OF A BARGE.

TURBIDITY BARRIER NOTES
1. THE CONTRACTOR SHALL FURNISH, INSTALL AND MAINTAIN TURBIDITY CONTROL BARRIERS AROUND THE WORK AREA AS NECESSARY. THE PURPOSE OF THE BARRIER IS TO AVOID ANY DEBRIS FROM GOING INTO THE MAIN WATERS. THE CONTRACTOR HAS THE OPTION TO ENCLOSE THE ENTIRE WATERSIDE OF THE SITE, WITHIN THE LIMITS OF DISTURBANCE, OR TO INSTALL AND MOVE THE BARRIER IN STAGES. THE CONTRACTOR SHALL MAINTAIN SUCH BARRIERS AT ALL TIMES IN THE AREAS WHERE WORK IS IN PROGRESS.

2. DURING DREDGING, THE CONTRACTOR SHALL MONITOR THE TURBIDITY LEVELS TO ENSURE THAT TERRITORIAL WATER QUALITY STANDARDS ARE MAINTAINED AND CONSTRUCTION METHODS ARE IN ACCORDANCE WITH THE PERMITS.



ALONG SHORE
PLAN



OFF SHORE
PLAN

DETAIL – TURBIDITY CONTROL BARRIER

SHT-03
GENERAL NOTES

DATE: 2015–06–03

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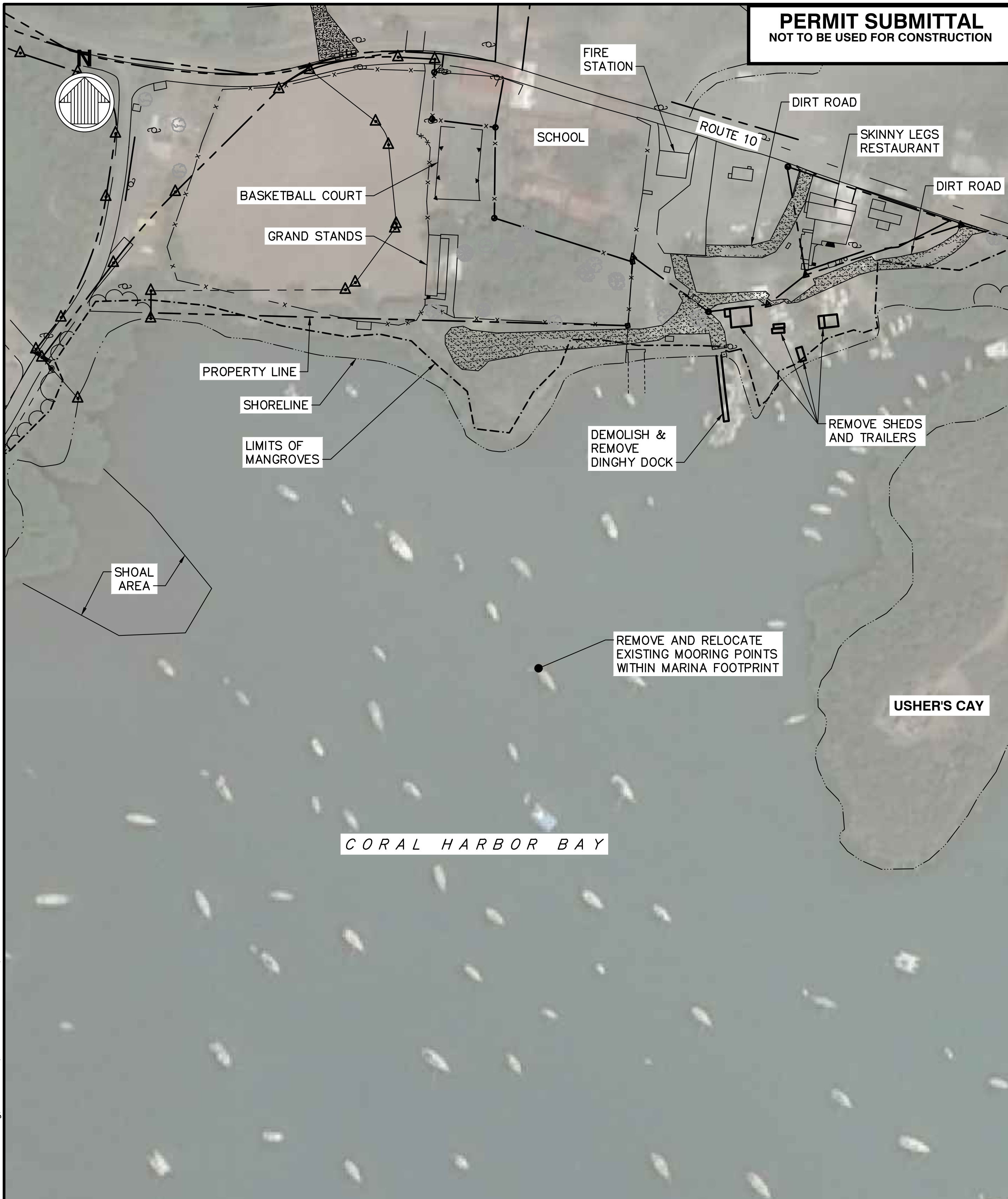

NOTES
1. ALL PRIVATE MOORING SYSTEMS SHALL BE RELOCATED IN ACCORDANCE WITH OWNER.

100' 0' 100' 200'
SCALE: 1"=200'

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SHT-04
EXISTING CONDITIONS AND DEMO PLAN

DATE: 2015-06-03

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SHT-05
GENERAL ARRANGEMENT PLAN

DATE: 2015-06-03

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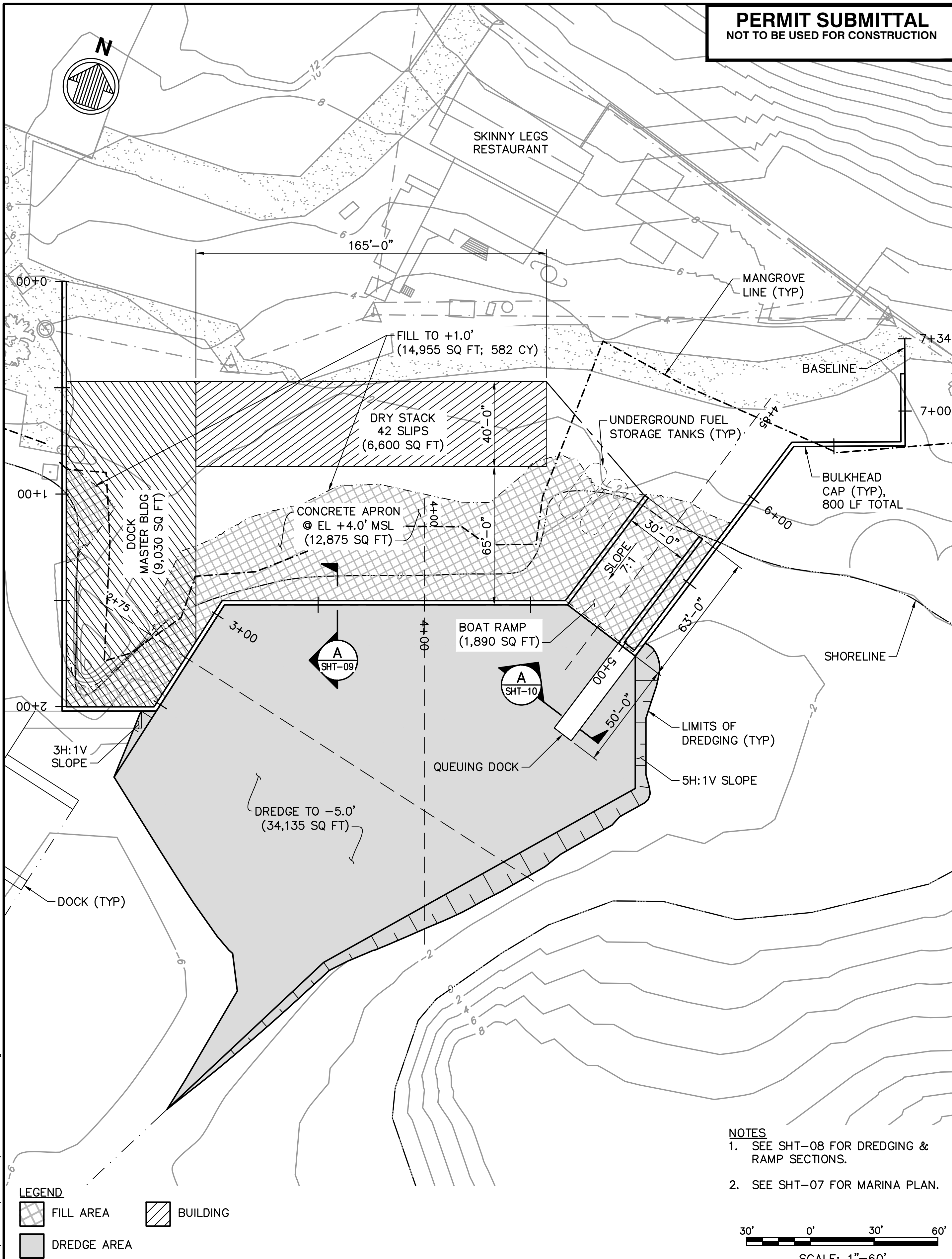

SHT-06
BOATYARD PLAN

DATE: 2015–06–03

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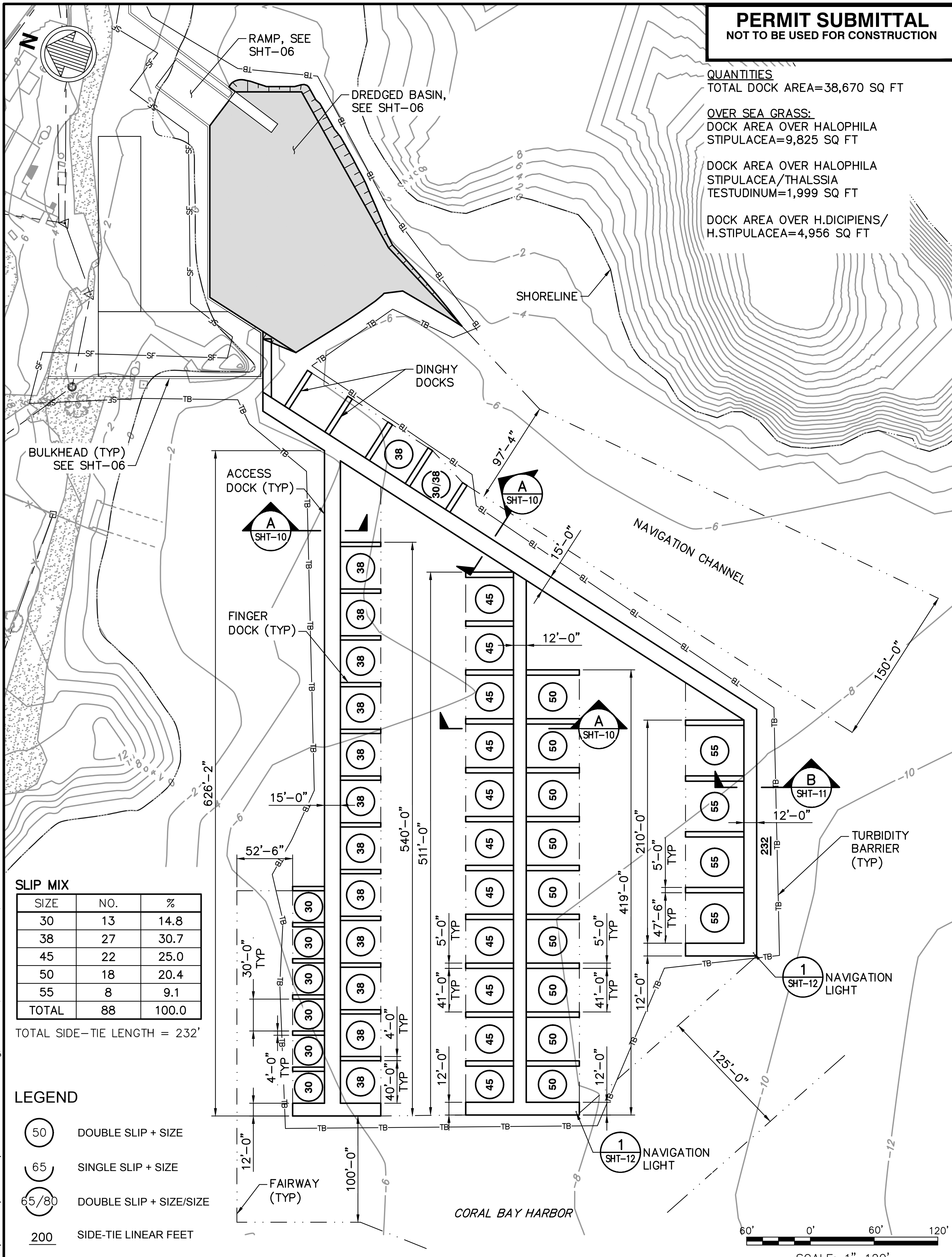
QUANTITIES
TOTAL DOCK AREA=38,670 SQ FT

OVER SEA GRASS:
DOCK AREA OVER HALOPHILA STIPULACEA=9,825 SQ FT

DOCK AREA OVER HALOPHILA STIPULACEA/THALSSIA TESTUDINUM=1,999 SQ FT

DOCK AREA OVER H.DICIPIENS/ H.STIPULACEA=4,956 SQ FT



SLIP MIX

SIZE	NO.	%
30	13	14.8
38	27	30.7
45	22	25.0
50	18	20.4
55	8	9.1
TOTAL	88	100.0

TOTAL SIDE-TIE LENGTH = 232'

LEGEND

- (50) DOUBLE SLIP + SIZE
- (65) SINGLE SLIP + SIZE
- (65/80) DOUBLE SLIP + SIZE/SIZE
- 200 SIDE-TIE LINEAR FEET

SCALE: 1"=120'

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SHT-07
MARINA PLAN

DATE: 2015-06-03

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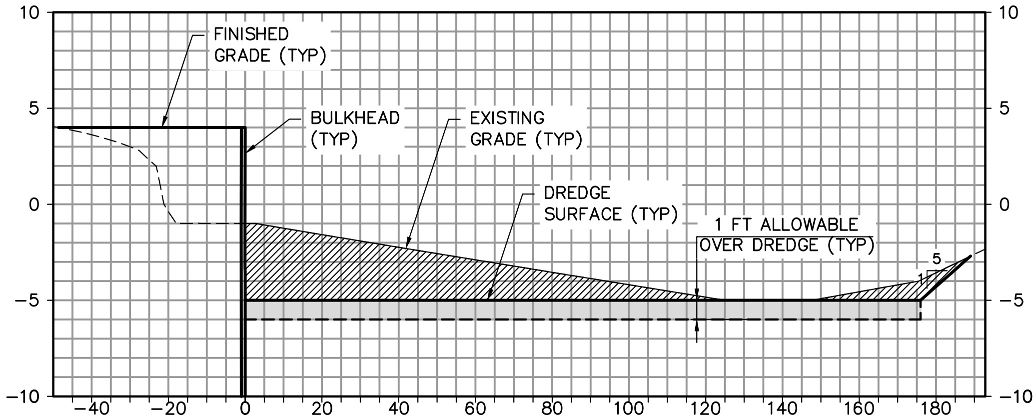
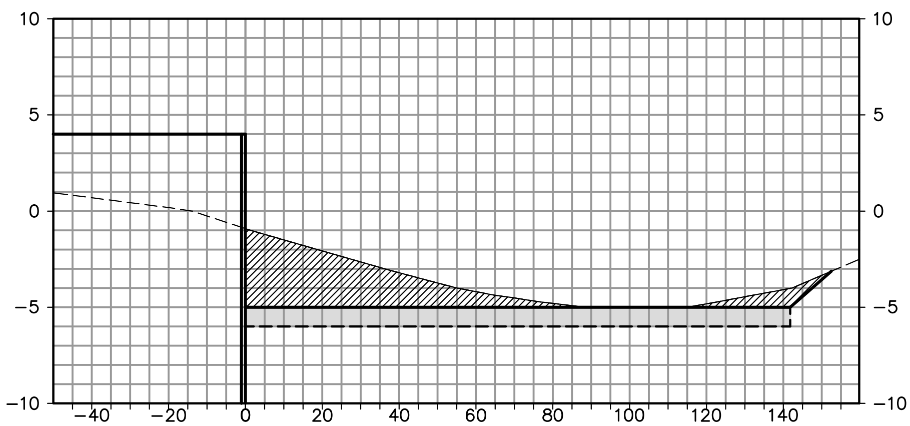
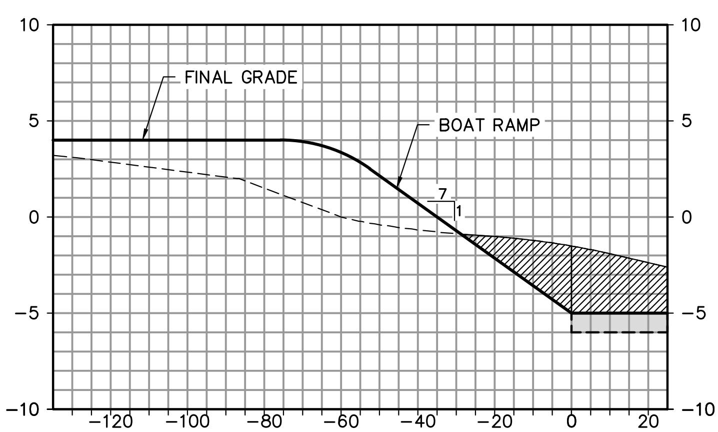


2+75



4+00



4+85

NOTES
1. SEE SHT–06 FOR PLAN.
2. VERTICAL EXAGGERATION 5:1

QUANTITIES
DREDGE VOLUME=1,781 CY
1 FT OVER DREDGE VOL=1,264 CY

25' 0' 25' 50'
HORIZONTAL SCALE: 1"=50'

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SHT-08
DREDGING & BOAT RAMP SECTIONS

DATE: 2015–06–03

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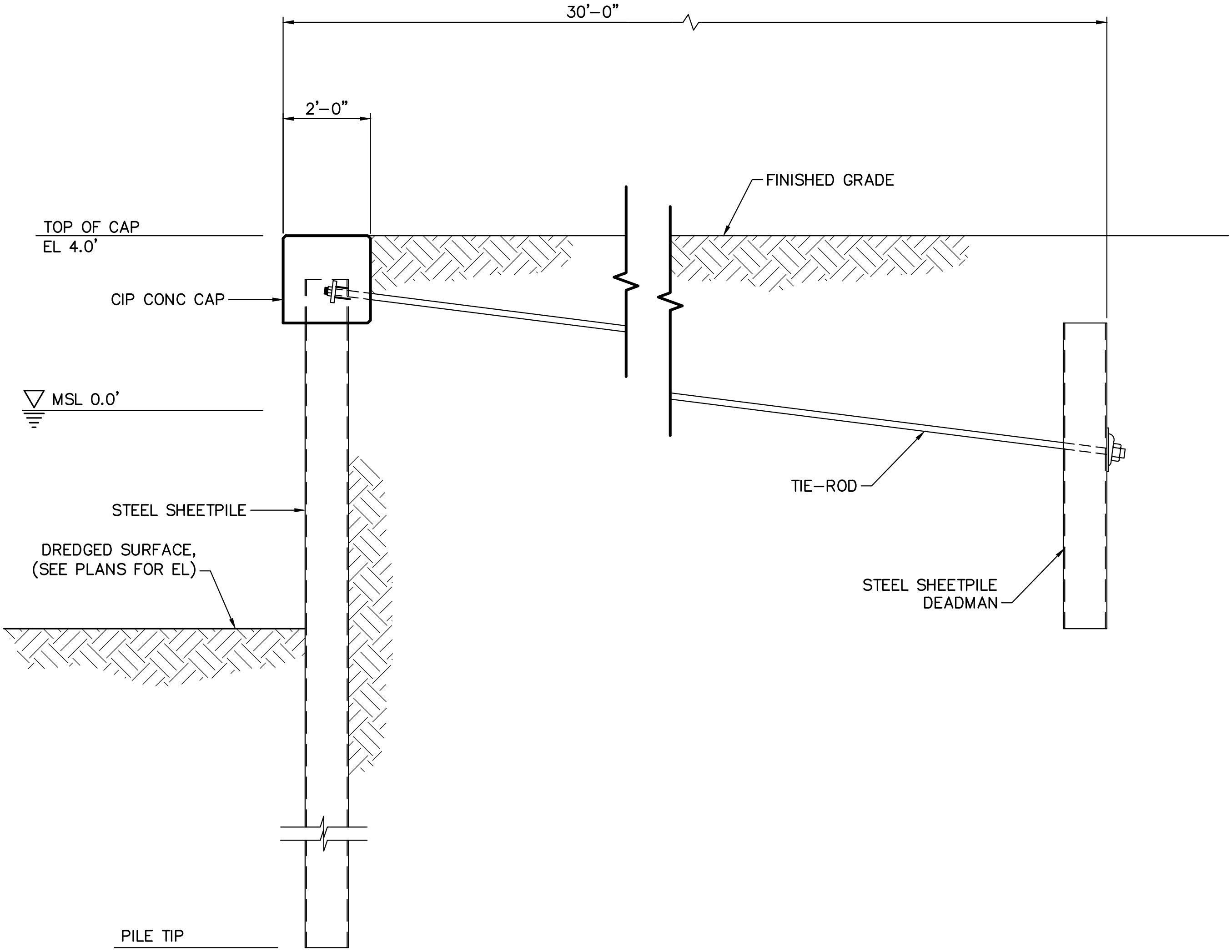

A SHT–06 SECTION
SCALE: 1/4"=1'–0"

2'–0" 0'–0" 2'–0" 4'–0"
SCALE: 1/4"=1'–0"

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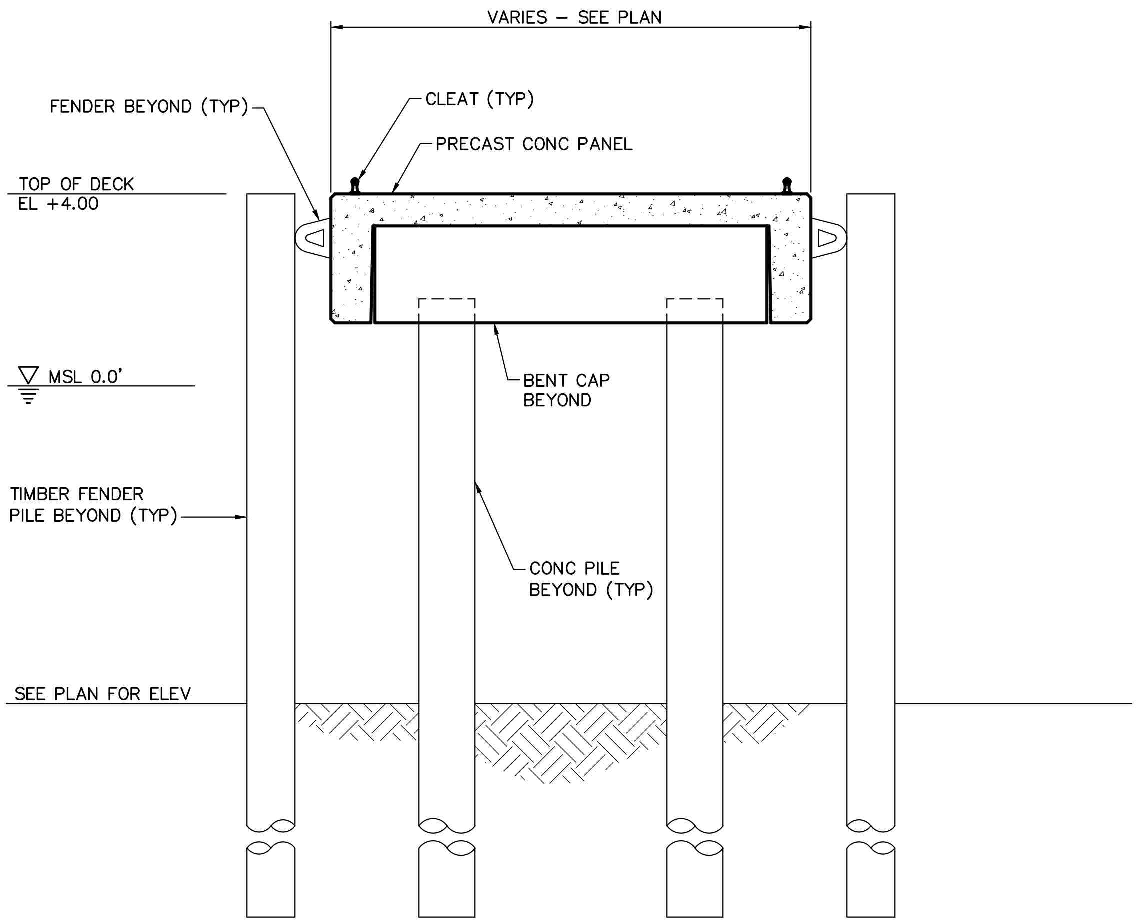
SHT-09 **TYPICAL BULKHEAD SECTION**	DATE: 2015–06–03 moffatt & nichol	**SIRIUS RESORT & MARINA**

PERMIT SUBMITTAL
NOT TO BE USED FOR CONSTRUCTION



A / SHT-07 SECTION
SCALE: 1/4"=1'-0"

2'-0" 0'-0" 2'-0" 4'-0"
SCALE: 1/4"=1'-0"

SHT-10
TYPICAL DOCK SECTION

DATE: 2015-06-03

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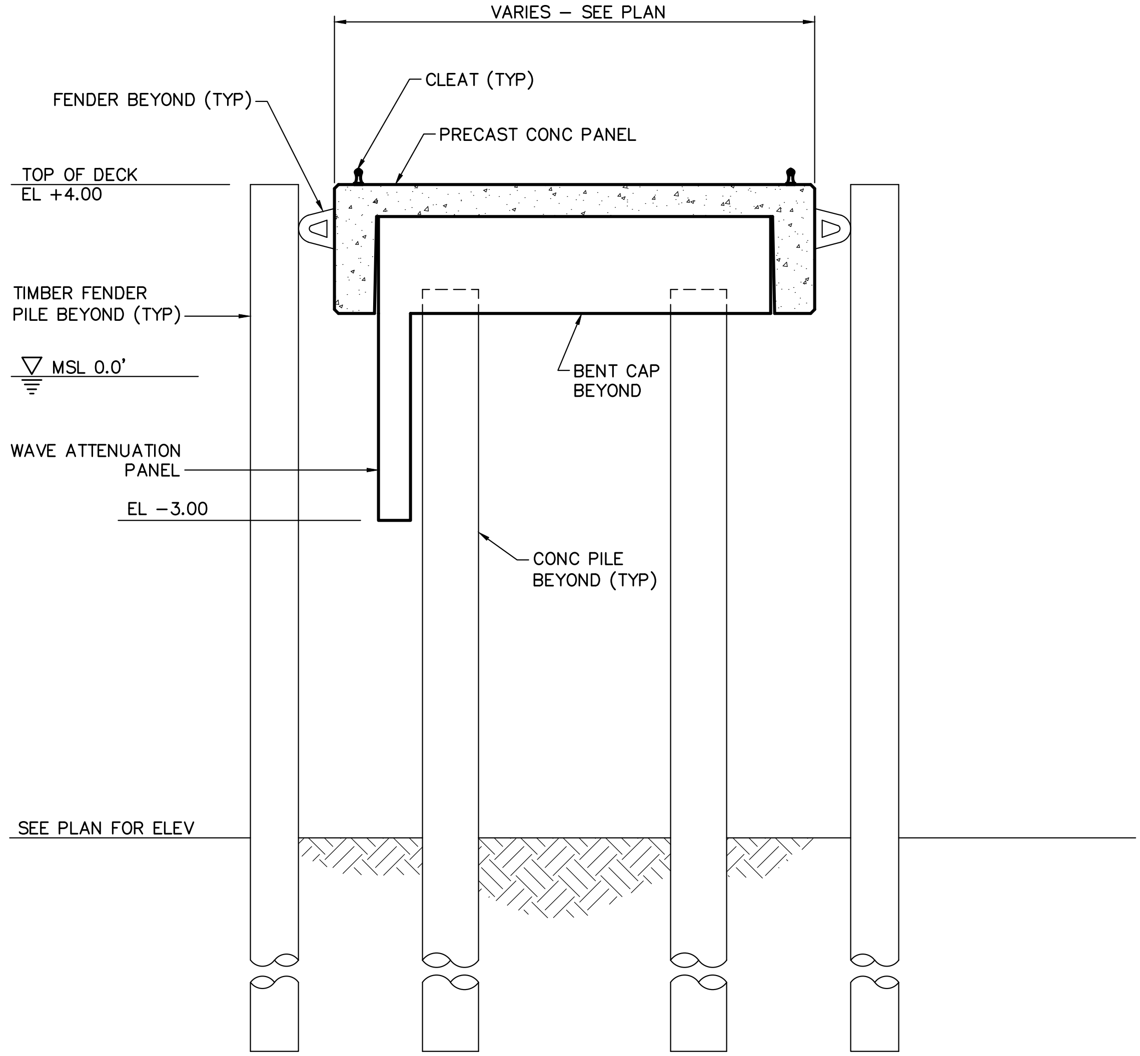

B
SHT-07
SECTION
SCALE: 1/4"=1'–0"

2'–0" 0'–0" 2'–0" 4'–0"
SCALE: 1/4"=1'–0"

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SHT-11
WAVE ATTENUATOR DOCK SECTION

DATE: 2015–06–03

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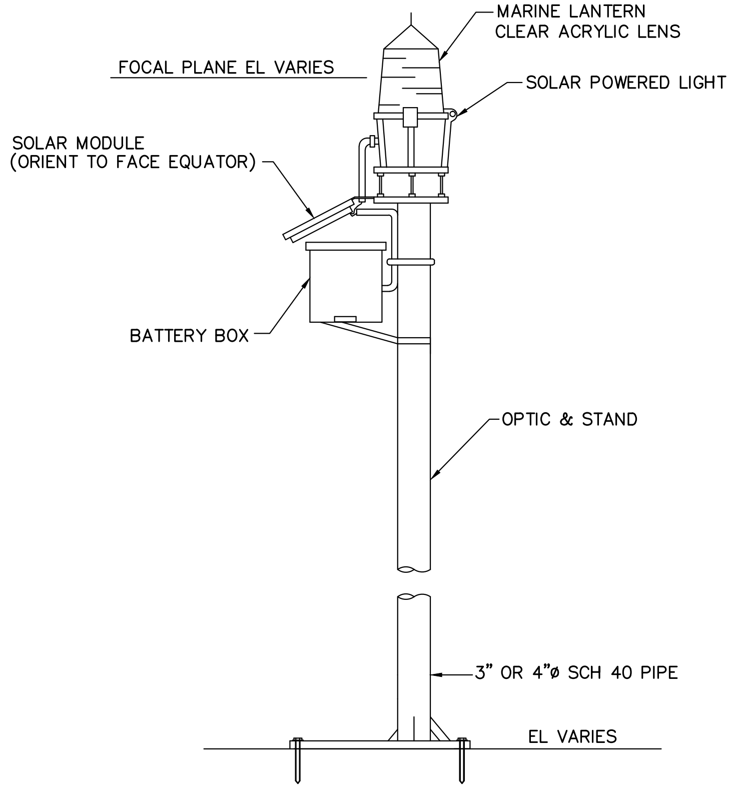

1 SHT-07 DETAIL
SCALE: 1/2"=1'-0"

1'-0" 0'-0" 1'-0" 2'-0"
SCALE: 1/2"=1'-0"

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SHT-12 AIDS TO NAVIGATION PLAN	DATE: 2015-06-03 moffatt & nichol	SIRIUS RESORT & MARINA

CORAL BAY
SEDIMENT QUALITY ASSESSMENT
JUNE 2007

Prepared for:

moffatt & nichol

Mr. Mark Pirrello
Moffatt & Nichol
1509 West Swann Avenue
Suite 225
Tampa, FL 33606

Prepared by:

Biological Research Associates
A Division of ENTRIX, Inc.

August 2007

Daniel G. Hammond
Water Resource Analyst

Douglas J. Durbin, Ph.D.
Technical Director and Vice President

1.0 INTRODUCTION

Coral Bay is located along the southeastern portion of the island of St. John in the US Virgin Islands. Much of Coral Bay is located within the St. John National Park, however, the northern portion of Coral Bay, also known as Coral Harbor, is outside the National Park boundary. The uplands surrounding the project site have undergone significant human development and land alteration. Similarly, the waters of Coral Bay are heavily used by recreational boaters, with more than 100 sailboats and yachts permanently moored there (Figure 1).

Figure 1. Sailboats permanently moored in Coral Bay, St. John, US Virgin Islands.

Biological Research Associates (BRA) conducted a sediment quality assessment within Coral Bay as part of a larger process to evaluate, design, and obtain regulatory approval for a proposed commercial marina in a portion of the Coral Harbor area. This report provides the results and interpretation of sediment quality data from the area proposed for marina development.

2.0 METHODS

The sampling design was developed by BRA based upon our knowledge of estuarine systems and our experience with typical resource management and regulatory agency requirements. Sampling was conducted on 21 June 2007.

2.1 SAMPLING STATIONS

Ten sampling stations were used to characterize sediment quality at the project site (Figure 2). Eight stations were sampled within the project footprint and two were chosen outside the footprint of the project, but near the project area. This sampling regime was chosen to generally characterize the bottom sediments in and around the proposed project site.

2.2 PARAMETERS

To characterize sediment quality, one sediment sample was collected from the top five centimeters of the substrate, with an Ekman dredge, at each station and analyzed for the following heavy metals:

aluminum	arsenic	cadmium	chromium
copper	lead	nickel	zinc

Each sample was also analyzed for the determination of sediment grain size.

All field sampling was conducted according to governmental Standard Operating Procedures (SOPs) for field sampling. A laboratory that is Florida certified and National Environmental Laboratory Accreditation Program (NELAP) accredited conducted the laboratory analyses.

Figure 2
Sediment Sampling Location Map
Coral Bay, USVI

Map Scale: 1:4,800

Biological Research Associates
3905 Cresent Park Drive
Riverview, Florida 33578
ph 813.664.4500 fx 813.664.0440
www.biologicalresearch.com

3.0 RESULTS AND DISCUSSION

This section provides the results of the laboratory analysis, as well as discussion of the findings as related to the proposed Coral Bay marina project.

3.1 SEDIMENT QUALITY

The sediment evaluation focused upon heavy metals, which are commonly constituents of concern in waterside developments. The analytical approach used to characterize sediment quality in this assessment was modeled after the Florida Department of Environmental Protection's (FDEP) "Deepwater Ports Maintenance Dredging and Disposal Manual" (1984), and includes additional interpretive tools as cited below. Sediment quality results are presented in Tables 1 and 2 and laboratory results sheets are attached as Appendix A.

The sediment samples showed substantial heterogeneity in their appearance among the stations. This was primarily attributable to the biological characteristics in the location of each sample. In some cases, the dredge fell in an area of clean sand or silt (Figure 3). Other areas had substantial cover by various macroalgae and/or seagrasses (Figure 4). In certain instances, the prevalence of such material made it necessary to drop the dredge more than once to obtain sufficient sediment material for analysis. The most commonly encountered macroalgal taxon was *Halimeda*. This is not surprising since this species is one of the principal sources of carbonate sand in the Caribbean, through the accumulation of calcium carbonate in its cell walls. Many of the sediment samples contained fragments of dead *Halimeda*, indicative of the constant transition from biological to mineral material in such systems.

Figure 3. Clean sand and silt sample collected from Coral Bay, St. John, US Virgin Islands on 21 June 2007.

Figure 4. Sediment with rock fragments, algal detritus and seagrass material from Coral Bay, St. John, US Virgin Islands.

3.1.1 Sediment Grain Size Assessment

The distribution of grain size fractions can be a primary determinant of the occurrence of heavy metals in sediments. Sediments comprised mainly of sand grain-size or larger particles are less likely to accumulate heavy metals than are sediments with a substantial fraction (i.e., more than 10 percent) of fines (silt and clay components). Table 1 provides the results of the sediment grain size analysis.

Table 1. Sediment Grain Size Results, Coral Bay, St. John, U.S. Virgin Islands, 21 June 2007.

Station	Gravel and Larger (%)	Sand (%)	Silt (%)	Clay (%)
CB-1	0	19	67	14
CB-2	0	31	57	12
CB-3	0	39	43	18
CB-4	0	36	55	9
CB-5	0	42	46	12
CB-6	0	63	20	17
CB-7	7	65	14	14
CB-8	3	57	23	17
CB-9	0	19	71	10
CB-10	0	70	14	16

All ten stations contained sediments with a substantial fraction (more than 10 percent) of fines. Sediments from six of the ten stations contained fractions of fines over 50 percent. The relatively high fraction of fines found at all ten stations suggests the area is subject to limited flushing and wave action allowing for the deposition of finer sediments, which is not surprising given the protected configuration of the Coral Bay embayment. Additionally, stormwater runoff from the mountains surrounding Coral Bay may contribute finer sediments to the Bay.

3.1.2 Sediment Metals Evaluation

Table 2 provides the results of the heavy metals analyses. There are no federal sediment standards for metals and sediment data interpretation is hampered by a variety of factors including mineralogy, grain size, organic content, spatial heterogeneity, and anthropogenic factors. The development, use, and accuracy of sediment quality guidelines (SQG) to assist in determining the ecological affect of heavy metals in sediments has been well documented (Long and Morgan 1990, MacDonald 1994, Long et al. 1998, Buchman 1999, Wenning and Ingersoll 2002, Hinkey and Zaidi 2007). BRA contacted the Virgin Islands Coastal Zone Management Program (VICZMP) to determine if any SQGs had been developed for use in the Virgin Islands. The VICZMP was unable to provide reference to any SQGs. This assessment compares observed metals concentrations to SQGs developed by Long and Morgan (1990) and MacDonald (1994) relating metals concentrations to known toxicological levels of metals through the use of several threshold levels, as determined from a variety of toxicological studies. These thresholds are listed below the sampling data in Table 2 to allow for comparisons between measured metals levels and the levels where ecological effects may be expected. The Threshold Effects Level (TEL) is the concentration of a metal below which adverse biological effects are never observed (MacDonald 1994). The Effects Range Low (ERL) is similar to the TEL and is the concentration below which the likelihood of biological effects is low (Long and Morgan, 1990). The Predicted Effects Level (PEL) is the concentration above which adverse biological effects are likely (MacDonald 1994). The Effects Range Median (ERM) is a value above which there is a high probability of biological effects (Long and Morgan, 1990) and is similar in concept to the PEL value.

Table 2. Sediment Quality Results, Coral Bay, St. John, U.S. Virgin Islands, 21 June 2007.

Station	Arsenic (mg/Kg)	Cadmium (mg/Kg)	Chromium (mg/Kg)	Copper (mg/Kg)	Lead (mg/Kg)	Nickel (mg/Kg)	Zinc (mg/Kg)	Aluminum (mg/Kg)
CB-1	5.6	0.27	9.4	100	19.2	4	57.1	8490
CB-2	4	0.14	7	27.5	5.4	2.7	27.4	5450
CB-3	6	0.14	9.2	31.6	5.9	3.1	28.6	6020
CB-4	3.1	0.08	5.7	16.1	3	2	18.9	3770
CB-5	3.9	0.15	6.9	30.3	6.2	2.8	31	6160
CB-6	3.7	0.2	9.6	42.8	8.8	3.9	43.4	8820
CB-7	2	0.09	6.6	23.6	5.6	2.5	25.4	5220
CB-8	2.9	0.12	8.7	28.7	5.3	3	30.2	6060
CB-9	2.3	U (0.04)	6.8	12.4	1.9	1.9	11.9	2560
CB-10	U (0.4)	0.07	6.4	19.7	3.3	2.2	20.3	4260
TEL[1]	**7.2**	**0.7**	**52.3**	**18.7**	**30.2**	**15.9**	**124**	**----**
ERL[2]	**33**	**5**	**80**	**70**	**35**	**30**	**120**	**----**
PEL[3]	**41.6**	**4.2**	**160**	**108**	**112**	**42.8**	**271**	**----**
ERM[4]	**85**	**9**	**145**	**390**	**110**	**50**	**270**	**----**

U - Undetected - value listed is the method detection limit (MDL)

[1] Threshold Effects Level

[2] Effects Range Low

[3] Predicted Effects Level

[4] Effects Range Median

As indicated in Table 2, only copper exceeded any of the thresholds listed. Copper concentrations at eight of the ten stations exceeded the TEL, which is the most conservative of the threshold levels, and one station exceeded the ERL. All other metals remained well below all of the thresholds reported indicating the risk of ecological impacts from the observed concentrations is negligible.

It is important to understand that the TEL, ERL, PEL, and ERM numerical values are based simply upon a statistical evaluation of an array of toxicological studies conducted by various researchers under a variety of laboratory and field conditions. While these values are useful in providing a general comparison to ecotoxicological findings, they do not represent criteria or clean-up levels.

Schroop and Windom (1988) provided guidance on interpreting sediment data based upon the use of aluminum as a reference element and provided a series of aluminum-to-metal ratios expected for relatively unaltered estuarine systems in Florida. Aluminum occurs naturally in most soils and sediments at high levels and is not of toxicological concern. For each of these metals, Schroop and Windom (1988) produced a plot indicating the expected concentrations range for a given metal as a function of aluminum in the same sediment. The data used to generate these plots was collected from estuaries in Florida, however they are included in this assessment for general comparative purposes in the absence of analogous data from the US Virgin Islands. They are not intended to indicate exceedance of any criteria or possible presence of elevated metals concentrations. The plots are presented in Figures 5-11.

As illustrated in Figures 8 and 11, copper and zinc concentrations in the Coral Bay sediments were slightly above expected ranges at most stations when compared to expected metals concentrations based upon their typical relationship with aluminum, as generated for Florida sediments. Lead concentrations at one station were also slightly above the expected range (Figure 9). All other metals concentrations were well within normal ranges. For most of the metals, the ratio relative to aluminum was the highest at station CB-1, which is not surprising given the location of that station at the northern terminus of the bay, and its proximity to the shoreline in an area apparently used for boat maintenance. In addition, this portion of the bay also receives direct runoff from the nearby developed land. The comparisons represented in these plots suggest the presence of slightly elevated metals concentrations when compared to normal distribution of aluminum in Florida sediments, but do not indicate the exceedance of any regulatory criteria or clean-up levels, nor do they raise concern over the proposed marina project. The abundant macroalgal vegetation and associated fauna observed during the sampling supports this conclusion. Overall, the metals levels observed are surprisingly low given the high proportion of fine-grained sediments. This implies a low input of heavy metals to the Coral Bay mooring area overall.

It is important to realize this assessment only looked at sediment quality at the very top of the substrate. The sparse development around Coral Bay, and the relatively short span of time the bay has been used for mooring significant numbers of boats, suggests that virtually all heavy metals contributed to the system are probably within the top few centimeters of the sediment. Below that veneer, sediment quality is expected to be significantly better than at the surface. This could be borne out through the use of coring to evaluate the deeper sediments.

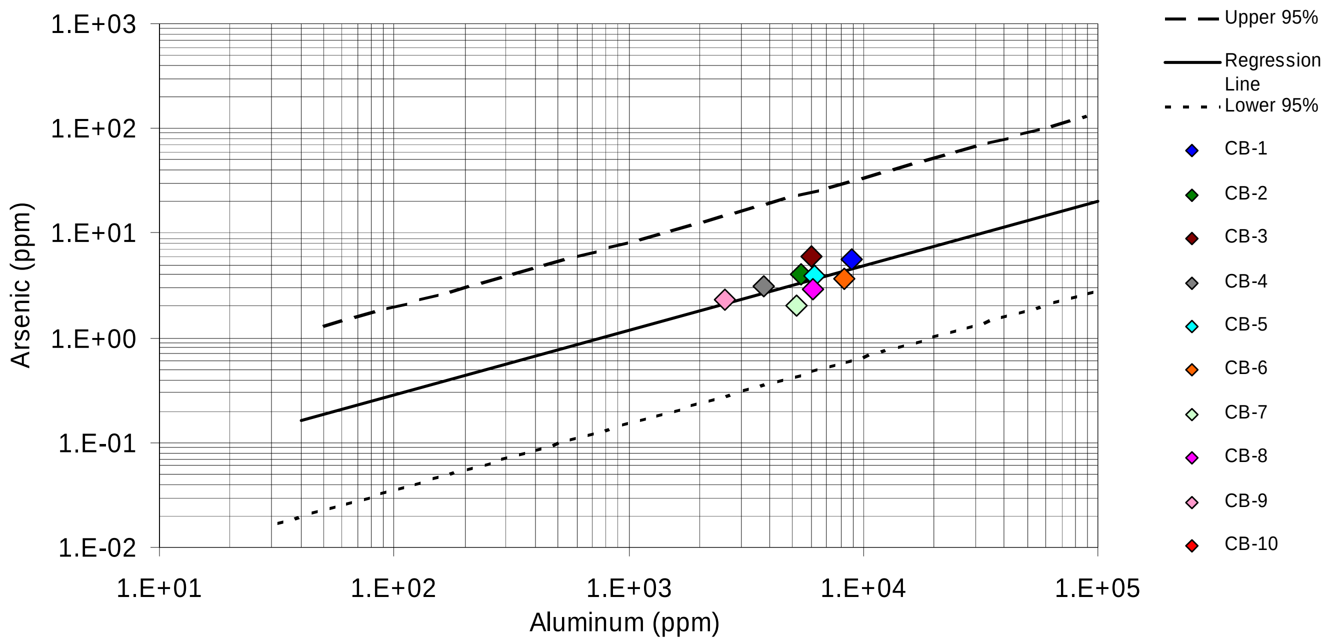

Figure 5. Observed levels of arsenic relative to aluminum levels in sediment samples collected at Coral Bay on 21 June 2007.

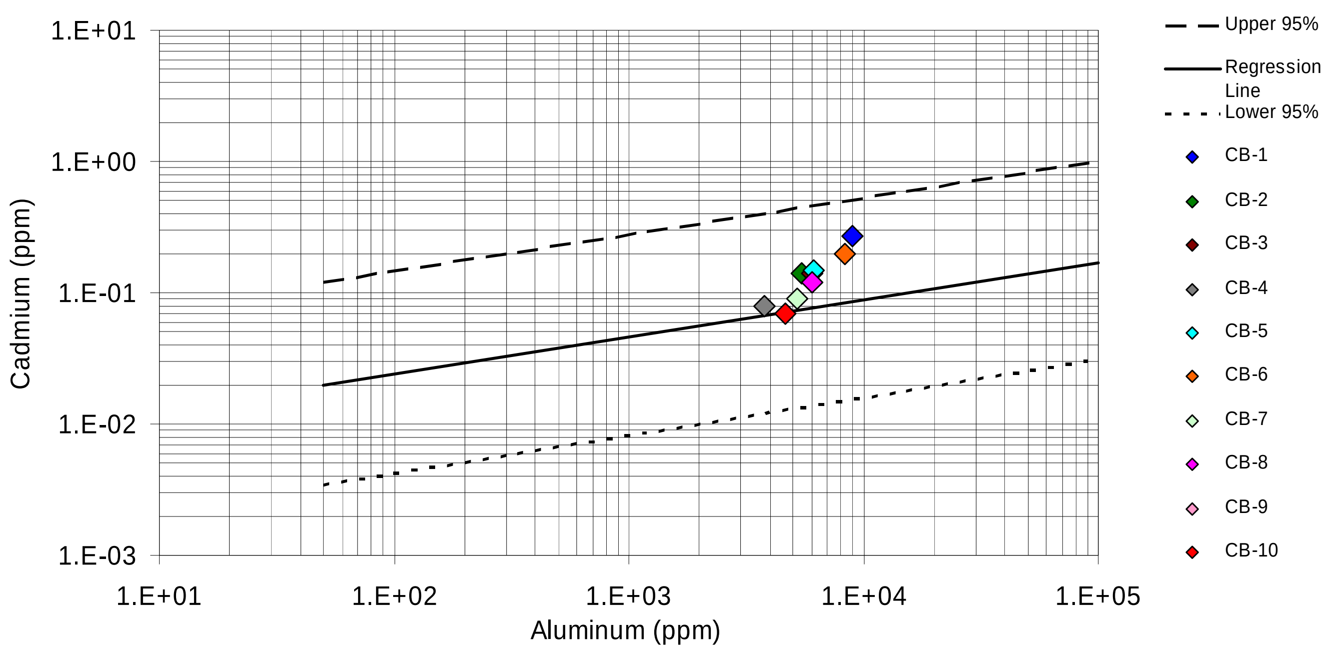

Figure 6. Observed levels of cadmium relative to aluminum levels in sediment samples collected at Coral Bay on 21 June 2007.

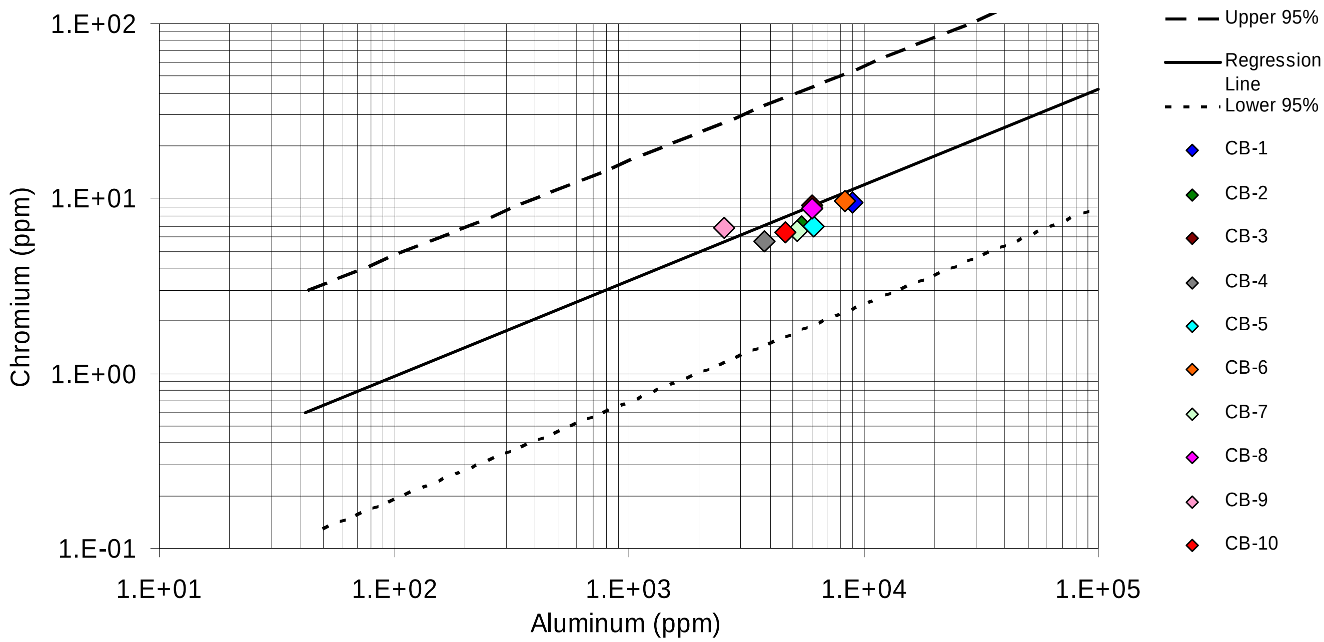

Figure 7. Observed levels of chromium relative to aluminum levels in sediment samples collected at Coral Bay on 21 June 2007.

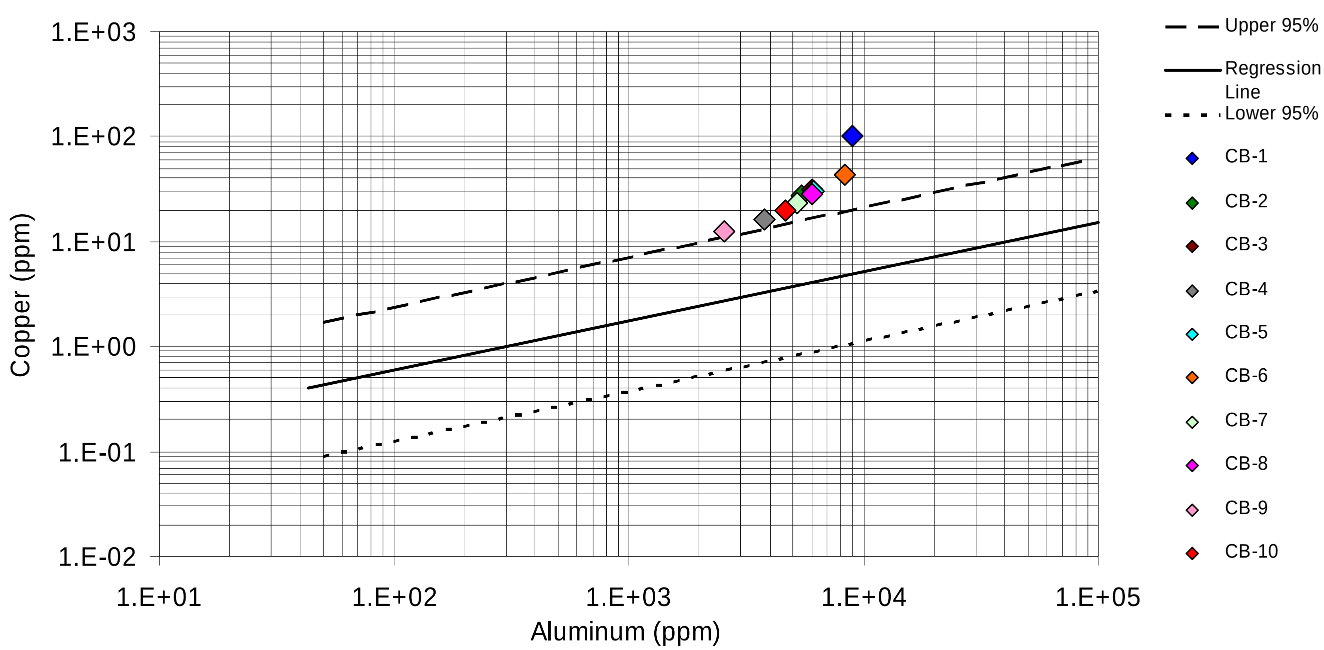

Figure 8. Observed levels of copper relative to aluminum levels in sediment samples collected at Coral Bay on 21 June 2007.

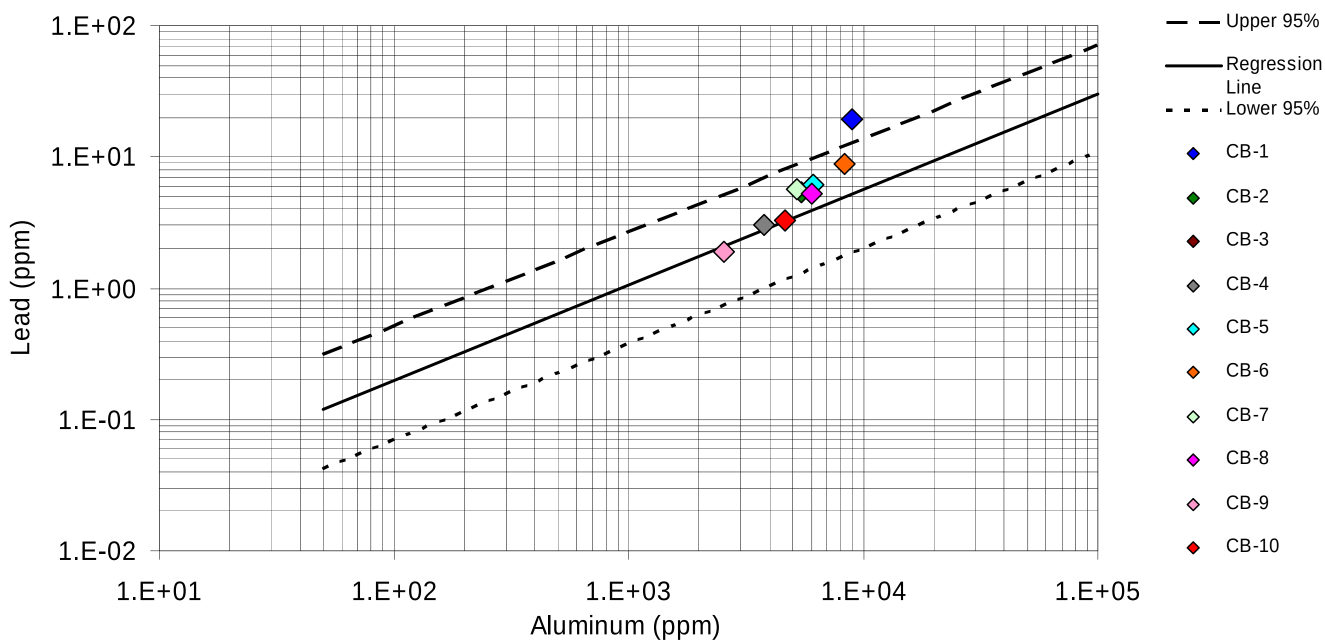

Figure 9. Observed levels of lead relative to aluminum levels in sediment samples collected at Coral Bay 21 June 2007.

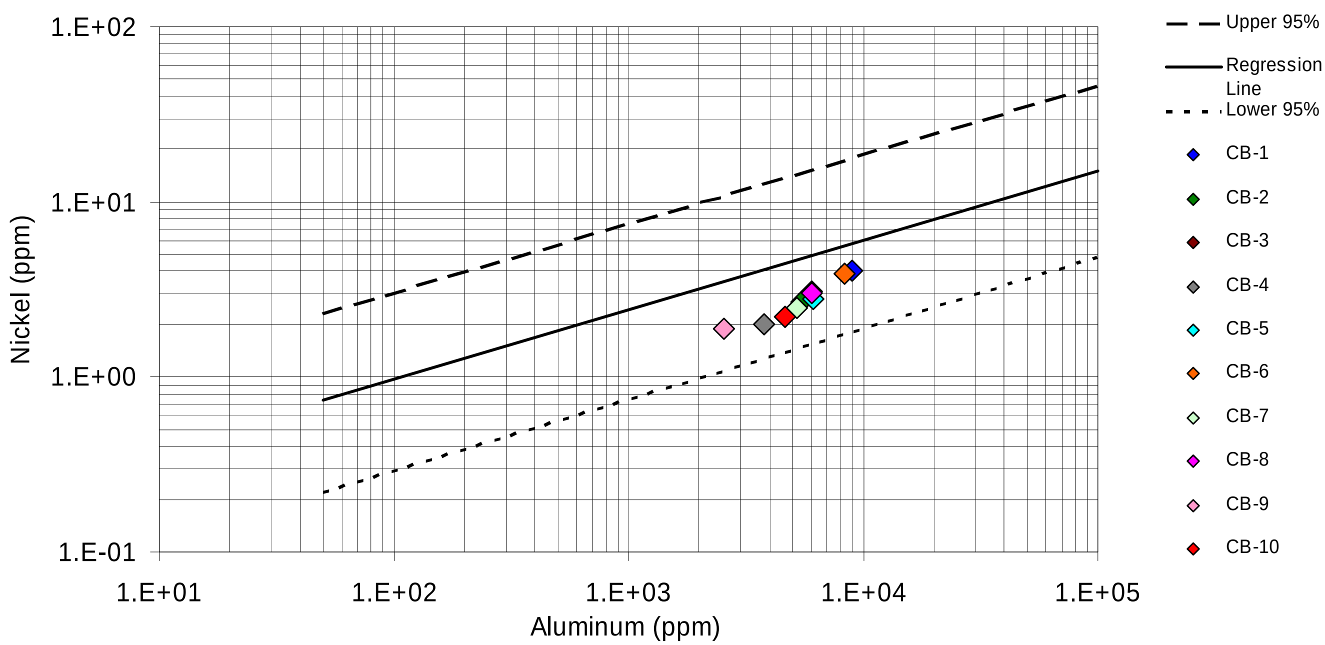

Figure 10. Observed levels of nickel relative to aluminum levels in sediment samples collected at Cora Bay on 21 June 2007.

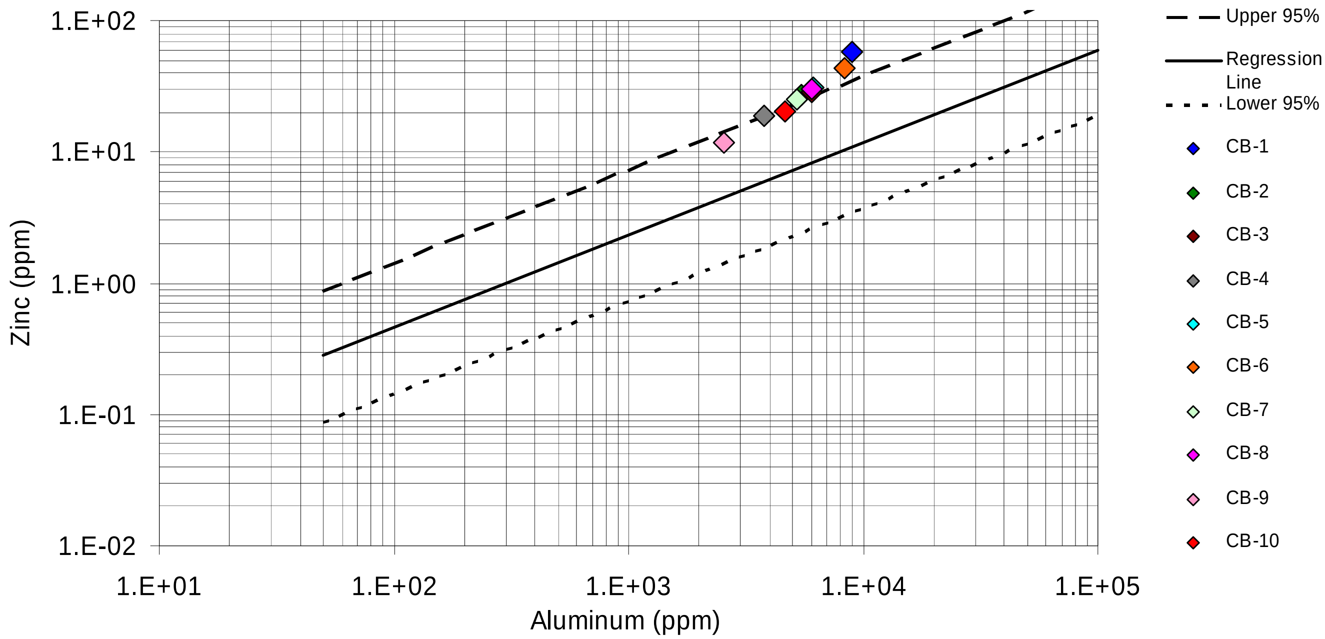

Figure 11. Observed levels of zinc relative to aluminum levels in sediment samples collected at Coral Bay on 21 June 2007.

4.0 SUMMARY AND CONCLUSIONS

Biological Research Associates (BRA) conducted a sediment quality assessment in a portion of Coral Bay on the southeastern side of the island of St. John in the U.S. Virgin Islands on 21 June 2007. Ten sampling stations were chosen both inside and outside of the proposed project boundary. One sediment sample was collected at each station and sent to a certified laboratory for analysis of heavy metals and grain size distribution.

Results of the sediment grain size distribution indicate all ten stations had a significant fraction of fines (silt and clay), in fact, six of the ten stations had fractions of fines above 50 percent. The observed fraction of fines found at all ten stations suggests the area is subject to reduced flushing and wave action allowing for the deposition of finer sediments.

There are no federal sediment standards for metals and sediment data interpretation is hampered by a variety of factors including mineralogy, grain size, organic content, spatial heterogeneity, and anthropogenic factors. The use of sediment quality guidelines (SQGs) can assist in determining the possible ecological effect of heavy metals in sediments, but do not indicate any criteria or clean-up levels. Copper is the only metal that exceeded any of the thresholds listed in this evaluation. The TEL (the most conservative threshold) was exceeded at eight of the ten stations, and the ERL was exceeded at one station. Observations of a diverse biological community during sampling suggest no adverse ecological effects of the metals present above these thresholds.

The heavy metals concentrations observed in the Coral Bay sediments were also evaluated graphically with plots indicating the expected concentrations range for a given metal as a function of aluminum in the same sample (Schroop and Windom, 1988). While these plots were generated based upon reference data from estuaries in Florida, they are included in this assessment for general comparative purposes in lieu of site or region specific data. Copper and zinc concentrations in the Coral Bay sediments were slightly above expected ranges at most stations. Lead was also slightly above the expected range at one station.

The heavy metals concentrations observed in this assessment raise no concern with respect to the proposed marina project. The copper, zinc, and lead concentrations found in the Coral Bay sediments are not surprising given that these three metals (particularly copper) are found in many marine products and anti-fouling paints. The presence of these metals can be attributed to the more than 100 sailboats and yachts permanently moored in Coral Bay, combined with the sheltered nature of the bay allowing for deposition of finer sediments. The station with the highest heavy metals concentrations (CB-1) was located very close to shore and presumably is subject to heavy runoff from a small boat maintenance area and nearby commercial and residential development.

This evaluation focused only on the upper portion of the sediments and sediment quality can be presumed to improve with depth. This could be confirmed through analysis of sediment cores extending deeper into the substrate.

In summary, this assessment indicates no significantly prohibitive conditions related to sediment quality with respect to the proposed marina development at the Coral Bay project site.

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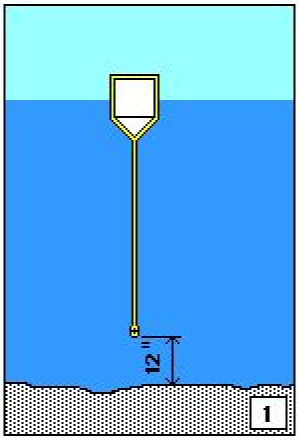
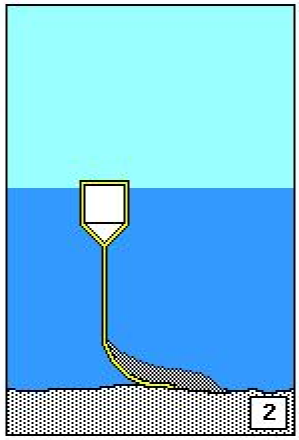
Wenning, R.J., and C.G. Ingersoll. 2002. Summary of the SETAC Pellston Workshop on Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments, Fairmont, Montana, USA, 17-22 August 2002. Society of Environmental Toxicology and Chemistry (SETAC), Pensacola, FL, USA.

PRODUCTS >> TURBITY BARRIERS >> SITES

Printer Friendly





The standard practice in installing barriers is to keep the lower edge of the barrier about 12 inches above the bottom as shown in Figure 1. When the lower edge of the barrier is long enough to drape on the bottom, silt will build up as shown in Figure 2. If the build-up is allowed to collect over a long period of time, the barrier may be pulled beneath the surface of the water. The build-up also makes it difficult to remove the barrier without stirring up the silt and sending in back in to the water course.

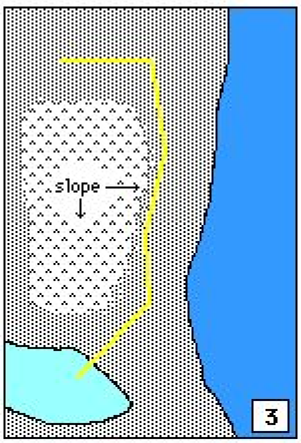


Figure 3 shows a typical staked barrier type site. The barrier is installed as shown in Staked. It is used primarily to direct the runoff into a settling pond or other collection area. Staked barriers function best in porous soils on sloping grades as shown.

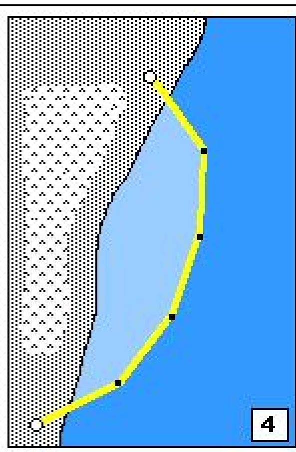
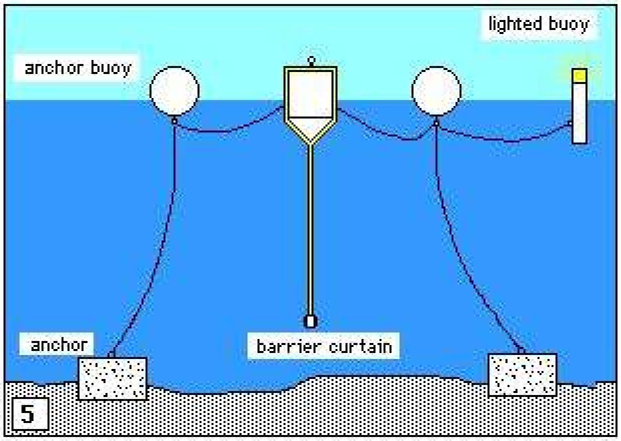
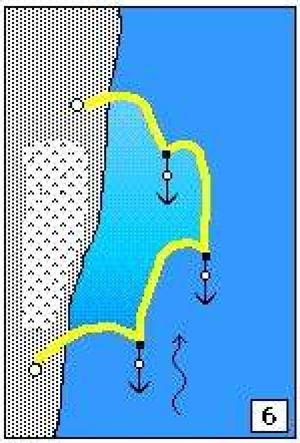
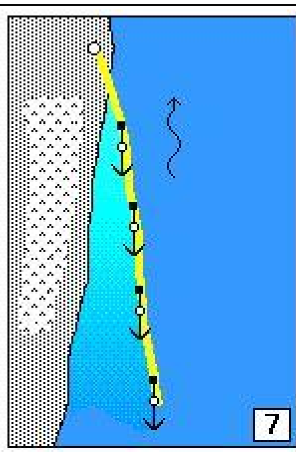
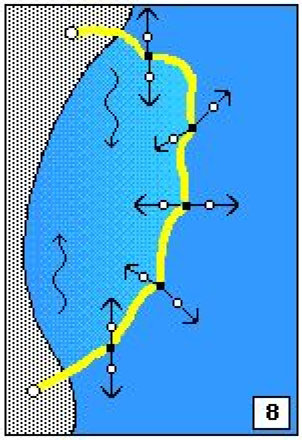
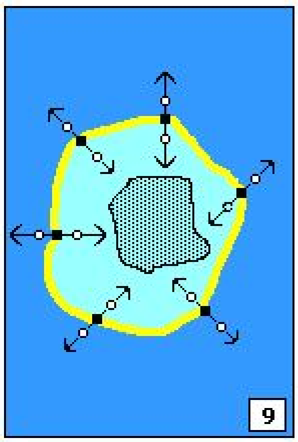
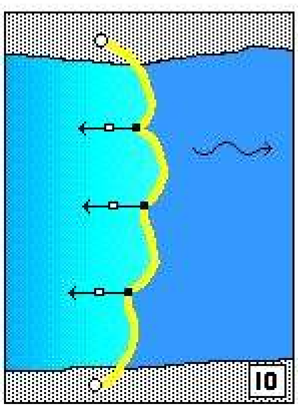


Figure 4 shows a common example of a site having low exposure to winds, water currents of less than 1 foot per second and water depths less than 15 feet. Type I barriers are designed for these applications which may include ponds, shallow lakes, bays and small streams.

Figure 5 shows a cross section of a barrier line as it would appear in a tidal zone. Anchors are placed on both sides of the curtain to hold it in place in both ebb and flow tides. Anchor buoys are attached to the anchor lines allowing the curtain to shift during tide changes without being pulled under by the anchor line. Any type of marine anchor may be used; however, concrete

	dead men are shown because they are the easiest to fabricate and the least expensive. Lighted buoys may be required when the barrier is located in navigable waters. Anchor loads must be calculated using methods described in this text.
	Figure 6 shows a site with a one directional current of 3 feet per second or less running parallel to the shore line. This site will require a Type II barrier. The anchors layout is similar to that shown in Figure 5 except that they only need to be on the upstream side of the barrier. The sag in the barrier is designed to reduce the anchor and cable loads
	When the current is greated than 3 feet per second, the barrier should be installed similar to Figure 7. Type II barriers are required and careful analysis of anchor and cable loads must be made. The effectiveness of barriers in this configuration is less than that expected from other types of sites since the water current will carry much of the sediment under the curtain.
	Figure 8 shows a typical barrier system in a tidal environment. The anchoring arragement is as shown in Figure 10. Type II barriers are required and lighted buoys may be necessary when boating activities are nearby.

	
	Figure 9 shows a barrier placed around a submerged construction site such as a bridge pier or caisson. Anchors may be necessary on both sides of the barriers to keep it in line. Some method for separating the curtain to allow ingress and egress will also be needed.
	The placement of trubidity barriers directly across streams having currents greater than 1 foot per second is never recommended. Cross currents as shown in Figure 10 place extreme loads on the barrier system.The bottom of the skirt must be kept above the stream bottom as shown in Figure 1 so that the barrier does not become an impediment to the stream flow. The determination of anchor and cable loads is critical in this application and must be carefully considered before any installation is attempted. However, short skirts can be placed across slow currents to collect loose debris, but cannot be effective for collecting sediment and silt.

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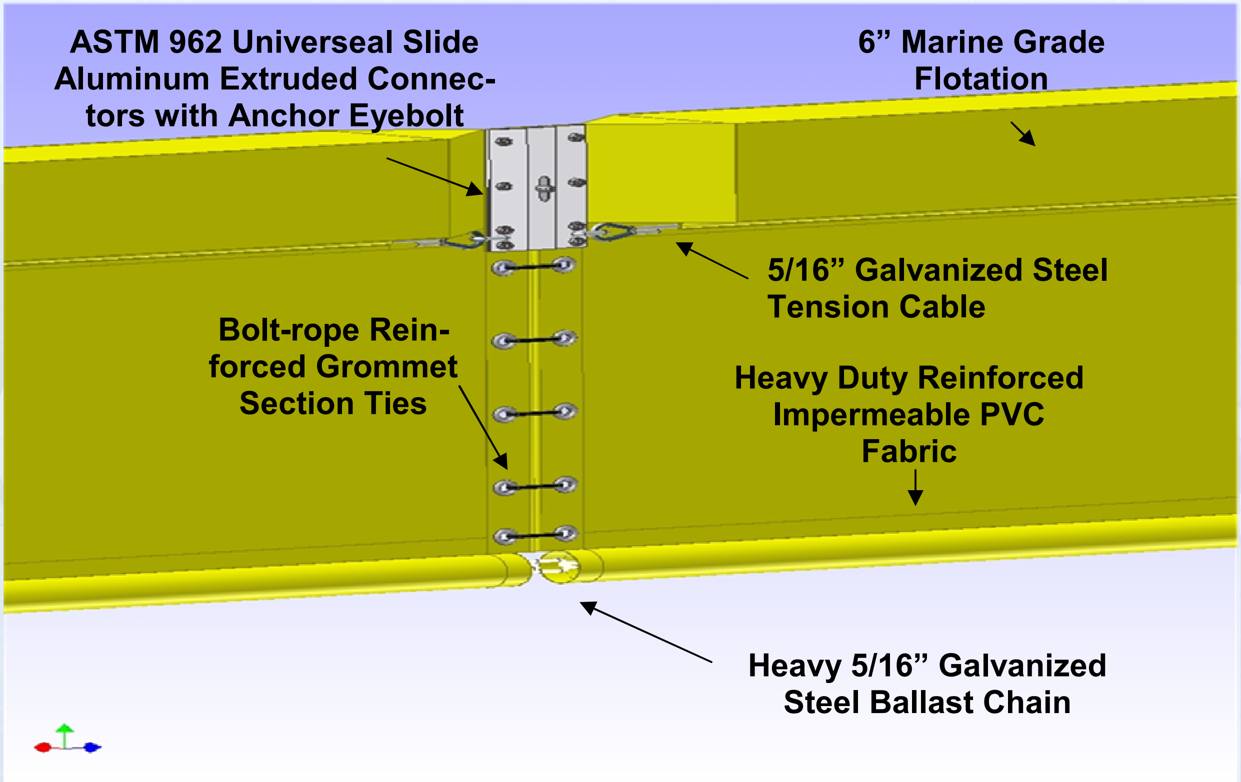

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TYPICAL LENGTH: Normally 100 feet (30 m) or 50' (15m) but adjustable by special order to any length. (additional cost applies for varied length/s)

DRAFT: Any depths from 3 feet (1 m) to 100 feet (30 m).

FREEBOARD: 8- 12 inches. (dependant on skirt depth)

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MEMBRANE: 22 ounce per square yard vinyl coated nylon or polyester or a combination with geotextile filter panel depending on application.

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500 x 550 Lbs/square inch tensile strength
(specification sheet available on request)

FILTER PANEL:
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(specification sheet available on request)

TENSION CABLE: 1 each 5/16 inch vinyl coated galvanized steel cable at the waterline. The cable is secured to each end connector of the curtain section and seamed into the PVC fabric for superior performance in current and waves.

LOWER TENSION & BALLAST: Ballast is provided by a 5/16 inch galvanized steel chain sheathed in 22 oz membrane along the bottom edge of the skirt. This acts as a lower tension member by terminating in stainless steel stress plates on each skirt corner and bolted with no fewer than 4 stainless steel bolts allowing minimum load transfer of 5000 lbs of tensile from membrane.

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ANCHOR POINTS: Anchor points are provided every 50' at the tension cable line on both side of the barrier.

Skirt Furling System: To furl/raise and lower the curtain skirt to varied operation depths (Optional at additional charge).

Accessories: *Oil Spill Equipment, Navigational Warning Lights, Marker Buoys, Anchor Systems, Geotextile Sludge Tubes, Repair Kits, Debris Boom.*

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PRELIMINARY HYDROGEOLOGIC SUMMARY

CORAL BAY – ST. JOHN, USVI

Geology

The dominant rock type surrounding the Coral Bay area is metavolcanic rocks of the Cretaceous Water Island Formation. This unit consists of lavas and flow breccias with minor amounts of bedded tuffs and volcaniclastics that have been subjected to later deformation that resulted in recrystallization and mineral alteration. An east-west trending band of pillow basalt has been mapped along the ridge just to the north of Coral Bay. These units have been intruded by near vertical Tertiary dikes, primarily diabase, in discrete areas. These dikes were also subsequently deformed and recrystallized.

This package of metavolcanic rocks was subjected to two periods of faulting within the Coral Bay Gut drainage. The northeast-trending Brown Bay Fault, which spans almost the entire island, has been mapped along the western-northwestern upgradient edge of the Coral Bay Gut drainage. At this location, the Brown Bay Fault is offset by three northwest-trending right lateral faults, which trend through the drainage towards Coral Harbor and may transect the entire island. The topography of the Coral Bay Gut drainage suggests structural control by these faults.

The upper surface of the metavolcanics weathered to produce a zone of saprolite overlying a relatively thick zone of weathered bedrock (1-15 m) containing dense fracturing. The unweathered bedrock below this zone is fractured at specific locations. This package is overlain by substantially thick alluvial deposits in the Coral Bay Gut drainage that constitute one of largest alluvial deposits on the island. The alluvial deposits are centrally located along the trend of the underlying bedrock faults, suggesting that these areas may be overdeepened.

Overall, the local bedrock should be densely fractured in specific nearby locations, hence forming a productive bedrock aquifer system. The overlying saprolite also likely forms a substantial storage reservoir from which the underlying bedrock may derive recharge to support sustained groundwater extraction.

Precipitation & Groundwater Recharge

Average annual precipitation on St. John, US Virgin Islands is approximately 35 to 40 inches/year. This is typically adequate to provide sufficient recharge to support high rates of fresh groundwater extraction from coastal areas.

Existing Wells

There are several existing wells within the Coral Bay Gut drainage and detailed information on these wells is lacking. The vast majority of these wells are completed within the alluvial deposits and were either dug by hand or utilized slotted well casing. One public supply well in this area (slotted) has a reported yield of 15 gpm. Other slotted wells within the drainage are up to 96 feet deep (Well #9). One well within the drainage was completed in the fractured bedrock aquifer and utilized telescoping casing and an open hole completion. This well (#2) has a reported yield of 20 gpm and reportedly encountered 120 feet of unconsolidated material that was cased off during well construction. The well information we have reviewed suggests that the construction specifications used are not optimal and likely limit, perhaps greatly, the rate of water production that may be available were more sophisticated well designs employed.

The well construction information also suggests that the alluvial sediments are substantially thick within the Coral Bay Gut drainage. A review of measured water levels of these wells reveals that the majority of the water levels (with the exception of Well 2 and 3) are less than 10 feet above sea level and most wells directly on the coast have water levels only a few feet above sea level. By contrast, the measured water level in Well #2 is 53 feet above sea level.

Published water quality data for the alluvial aquifers lists median dissolved solids values of 2,150 mg/l and chloride values of 261 mg/l. Groundwater derived from the fractured metavolcanic aquifer is reported by previous studies to be hard, but contain less dissolved solids and chloride than the alluvial aquifer.

Conclusions

Wells developed close to the coast will likely draw a greater proportion of sea water. However, if wells can be constructed somewhat inland from the Coral Bay property, there are multiple environments that could host ‘low’ salinity/brackish groundwater or, potentially, directly potable freshwater supplies. These include brackish wells within the alluvial aquifer, less brackish/potable freshwater wells within the alluvial aquifer at inland locations, or less brackish/potable freshwater wells within fractured bedrock associated with the fault systems within the Coral Bay Gut drainage.

In summary, the geologic setting appears conducive to development of productive well sources, as is the presumed available recharge given the annual rate of precipitation. It is conceivable, if not likely, that wells targeting fracture networks in the local bedrock could produce from a few to up to several hundred thousand gallons per day of fresh or brackish water each. Regardless of where the wells are sited, given the island setting, it will be critical to properly site, construct and operate wells to prevent excessive water level drawdown during pumping, and so that upconing and capture of highly saline water (sea water) does not occur. Possible hydraulic impact on other nearby well sources, if any exist nearby, would also need to be taken into consideration so that such instances can be appropriately avoided, where necessary.

Technical Memorandum

Regarding: **Essential Fish Habitat Assessment**
Coral Bay Harbor Marina, St. John, U.S. Virgin Islands

Prepared for: **T. Rory Calhoun, T-Rex St. John LLC, 45 Maple St., Garden City, NY 11530**

By: **Dial Cordy and Associates Inc., Jacksonville Beach, FL**

Date: **22 MAY 2015**

Table of Contents

1.0 INTRODUCTION

Dial Cordy and Associates Inc. (DC&A) was contracted by T-Rex St. John, LLC to prepare an Essential Fish Habitat (EFH) Assessment for potential impacts to nearshore and hardbottom habitat associated with proposed construction of an approximate 100-wet-slip marina at Coral Bay, St. John, U.S. Virgin Islands.

2.0 PROJECT DESCRIPTION AND POTENTIAL GENERAL EFFECTS

Avoidance and minimization of effects associated with the project have been achieved through revised design by Moffatt & Nichol. The number of wet slips has been reduced to 92, and the slip structure has been pulled back toward the north shore in order to avoid unnecessary impacts to seagrass beds. The proposed facility will incorporate the following:

- 92 wet slips for vessels from 35 to 70 feet in length
- 30 dry storage slips for vessels under 35 feet
- Septic pump-out facilities

- Fuel facilities
- Use of wave-attenuation panels
- Flexibility to accommodate a few vessels up to 150 feet
- Accommodations for transient boaters and dinghies
- Retains marine service capability
- Public boat ramp and navigational channel to the bay
- Dock master building
- Parking

Most of the land-side facilities would be constructed on previously developed terrain, but filling a small area of wetlands would also be unavoidable in order to site the facilities in an area with the least impact while maximizing the efficiency and use of the facility and available real estate. Along the shoreline, a mangrove fringe is present, which must be filled to provide access between the various sections of the facility (buildings, docks, etc.). Other impacts to EFH include direct removal of both seagrasses and unvegetated soft-bottom habitat, and indirect effects on seagrasses due to shading due to docks and vessels. Indirect effects to the water column may include temporary increases in turbidity due to dredging the small navigational channel extending from the boat ramp to the bay. The text in below sections describes the existing conditions as well as these potential impacts in greater detail.

3.0 MAGNUSON-STEVENS ACT

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) of 1976, and the amended Magnuson-Stevens Fishery Conservation and Management Act of 1996 mandates the identification and protection of essential marine and anadromous fish habitats by the NMFS, regional fishery management councils (FMC), and other federal agencies. The NMFS and FMCs delineate "essential fish habitat" for federally managed species supporting a primary goal of maintaining sustainable fisheries through implementation of fishery management plans (FMP). Achieving this goal requires appropriate fishery habitat quality and quantity. Federal permitting agencies whose actions could adversely affect managed species and their EFHs must consult with the NMFS regarding a project's potential EFH effects.

EFH is defined in the Magnuson-Stevens Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." An EFH is further clarified with the following definitions: **waters -** aquatic areas and their associated physical, chemical, and biological properties used by fish and may include aquatic areas historically used by fish; **substrate -** sediment, hardbottom, underlying structures, and associated biological communities; **necessary** - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and **spawning, breeding, feeding, or growth to maturity** - stages representing a species' full life cycle where any EFH may be a subset occupied by species during full life cycles [South Atlantic Region (SAR) 2008].

4.0 CARIBBEAN FISHERY MANAGEMENT COUNCIL

The Caribbean Fishery Management Council (CFMC) manages fishery resources' conservation in the United States' portion of the Caribbean Sea. The CFMC's jurisdiction includes waters nine nautical miles off the Puerto Rican coast and three (3) nautical miles off the USVI (St. Thomas; St. John; and St. Croix). The CFMC has implemented fishery management plans for the spiny lobster (*Panulirus argus*), shallow water reef fish, coral, and the queen conch (*Strombus gigas*) (CFMC 2010).

5.0 ESSENTIAL FISH HABITAT DESIGNATION

5.1. Introduction

The Caribbean archipelago is approximately 1,100 miles east-southeast of Miami, Florida. The USVI include the largest islands of the chain: St. Croix, St. Thomas, and St. John. The easterly trade winds are responsible for the USVI's major wind and wave patterns with rain and severe winds occurring in the winter as well as hurricanes in the summer and autumn, with average winter and summer temperatures varying little. The USVI's coastal-marine environment includes a variety of habitats; many distinct benthic nearshore habitats have been mapped aerially by the National Oceanic and Atmospheric Administration (NOAA) National Ocean Service. USVI benthic habitats aerially mapped include coral reefs, hardbottoms, mangroves, submerged vegetation, and unconsolidated sediment. Mangrove wetlands, seagrass beds/submerged aquatic vegetation (SAV), and coral reefs are the most productive marine habitat areas; however, sandy beaches, mud flats, and soft bottom lagoons are essential in overall habitat productivity [Comprehensive Amendment to the Fishery Management Plans (CAFMP) 2005].

St. John's habitats cannot be compartmentalized and discussed in isolation from each other in that mangroves, reefs, and SAV beds provide each other interactive protection. Reef systems disperse wave energy from sheltered areas allowing SAVs and mangrove wetlands to thrive. SAVs stabilize and bind fine sediments and nutrients that could affect turbidity and nutrient sensitive reef coral. Mangrove fringes act as depositional areas for heavier sediments washed from upland areas during rain events. Such habitats from upland fringes through quiescent SAVs and beyond the reef systems are shelter, foraging grounds, reproduction/nursery grounds for many fish species. St. John's coastal habitats are interconnected biologically, physically, and chemically (CAFMP 2005).

5.2. Water Column

5.2.1 Significance and Existing Conditions

Water column properties such as salinity, temperature, and nutrients are essential to a managed species' long-term survival and success. The transient boundaries of the water column EFH are maintained by wind and tide driven nearshore and offshore waters. Additional descriptors, such as adjacent structures (shoals, channels, and reefs); water depth, available wind distances or fetch, and potential turbidity sources are used to further describe this EFH. The EFH water column provides both migrating and residential species of varying life stages the opportunity to survive in an active and unpredictable environment. As the transport medium between the nearshore and offshore ocean systems for food, species migration, and life cycle stage transport; the water column is as essential a habitat as any marsh, seagrass bed, or reef [South Atlantic Fishery Management Council (SAFMC) 1998, CAFMP 2005].

ATM (2014) reported that water quality in Coral Bay fluctuates widely as turbidity (ranging 2.6 to 36.0 mg/L, sampled ten times from 2009 through 2012) and fecal coliform and enterococci bacteria levels vary, but dissolved oxygen levels appear (from samples) to be consistently near or just above 6.0 mg/L (Department of Planning and Natural Resources Division of Environmental

Protection Station STJ 53). Bacterial counts may be elevated due to vessel pump-outs of sewage, or incidental leaks of septic systems.

5.2.2. Potential Effects of Proposed Action

Construction (installation of pilings and dredging the boat channel) may temporarily elevate water column turbidity in the project area. However, best management practices (BMPs) such as the use of turbidity curtains and in situ water quality monitoring will serve to minimize and/or eliminate any significant effects. BMPs are useful for minimizing adverse water clarity effects and reducing potential photosynthetic active radiation (PAR) effects. Submerged aquatic vegetation (SAV) and corals are autotrophic species that are critically reliant on PAR. SAV require 10-20% of the PAR reaching the water surface, branching corals require 60%, and massive corals approximately 40% (CAFMP 2005).

The boat launch channel would be hydraulically dredged from the channels' seaward points landward (approximately 1,780 cubic yards). Beneficial use of these dredged materials would be incorporated in stabilizing and augmenting the shoreline adjacent to the dredged channel. Turbidity curtains and water quality monitoring would be employed around the dredge plant during operations.

5.3. Wetlands

5.3.1 Significance and Existing Conditions

Coastal emergent wetlands may be found in estuarine or marine systems with estuarine emergent wetlands considered tidal in low-energy environments with freshwater influence yet with salinity concentrations greater than 0.5 parts per thousand (ppt) (CAFMP 2005). Riparian wetlands protect shorelines from erosion, produce detritus, filter overland runoff, and function as a vital nursery area for various finfish and many other species. Estuarine wetlands are normally margins of the estuaries and sounds; including estuarine mangrove forests, estuarine mangrove shrub/scrub, and salt/brackish marsh (Street et.al. 2005, CAFMP 2005). In the USVI, predominant wetland types are mangrove wetlands (estuarine/marine intertidal forested and shrub) and intertidal flats (estuarine/marine intertidal emergent) (CAFMP 2005). The mangrove species found in the USVI are red mangrove, *Rhizophora mangle*; black mangrove, *Avicennia germinans*; white mangrove, *Laguncularia racemosa*; and the buttonwood, *Conocarpus erectus*. Such mangrove species combinations are found in regularly flooded tidal areas and in higher elevations receiving tidal waters only during storm events or seasonal high tide events. Black mangroves, white mangroves, and buttonwood grow landward of the more salt tolerant red mangroves acting as important sediment and nutrient traps from upland stormwater flows (CAFMP 2005).

In the immediate project area, red mangroves are the most common type of vegetation; some black mangroves are also present. The mangrove habitat comprises a thin strip of vegetation on a high-grade slope to the water surface.

5.3.2 Potential Effects of Proposed Action

Given that the mangrove strip is typically approximately five-feet-wide through the immediate project area, the total area of jurisdictional wetland removal comprises only approximately 90 square feet. The action will not cause any other wetland areas landward to be isolated from the bay; the inland areas are uplands and previously developed lands.

5.4. Unvegetated Bottoms

5.4.1 Significance and Existing Conditions

Sandy shorelines, nearshore bottoms, and intertidal flats are common throughout the Caribbean. Buffered by reefs and SAV beds, these dynamic and high-energy areas are essential to many sea turtles, crabs, fish, and benthos as well as salt-tolerant vegetation. Finfish life stages use these unvegetated sandy reaches for migration, foraging, and protection (vs. less protected, deeper areas outside reef and seagrass beds). Conch species including the managed species Queen conch, as described in Section 7.2, occur on sandy bottoms with coral rubble and macroalgae. Other managed species routinely found in these habitats include spiny lobsters, yellowtail snapper (*Ocyurus chrysurus*), as well as many pelagic species using waters overlying these unvegetated bottoms [Essential Fish Habitat Generic Amendment (EFHGA) 1998]. These managed species are further described in Section 7.0.

ATM (2014) conducted surveys in the harbor area, and noted that "sea cucumbers (*Holothuria mexicana*) were common as were sea stars (*Oreaster reticulatus*). Several juvenile conch were noted during all surveys.

5.4.2 Potential Effects of Proposed Action

The project's footprint includes dredging a channel from the boat launches past the marina docks to the bay. The channel will be approximately 30 feet-wide and 63 feet-long, and dredged to a -5 foot MLLW depth. The remainder of the footprint includes the combined area of disturbance from the series of piles that will be driven into the seabed for attachment of the dock for the marina. That area will cumulative comprise 34,615 square feet. The shallow areas in the footprint of the channel would be converted from a shallow habitat to a slightly deeper unvegetated bottom. Marine macroinvertebrates and infauna would recolonize that benthic habitat within a year. Therefore, this impact would be temporary in nature. The loss of the 480 square feet due to piling placement would be permanent.

5.5. Submerged Aquatic Vegetation

5.5.1 Significance and Existing Conditions

SAV beds are very important primary production areas within tropical marine ecosystems. SAV provides a food source, habitat, and nursery areas for many managed and commercially important species. Turtle grass (*Thalassia testudinum*) is an omnipresent species forming large SAV meadows. Species such as shoal grass (*Halodule wrightii*) depend on rhizome turnover and shoot longevity rather than capacity when supporting extensive areas (CAFMP 2005, EFHGA 1998). SAV trap sediment and lower the sediment re-suspension potential complementing the success of offshore reef systems. Many coral reef animals use SAV as secondary feeding grounds, shelter, and habitat migration. Spiny lobsters reside in SAV areas in the first 9 to 12 months of life before migrating to deeper waters, yet nocturnally returning to feed. The importance of SAV must be recognized not only as large continuous meadows, but as patchy beds creating habitat continuity between unvegetated substrates and the SAV. Successful SAV systems facilitate a three dimensional physical network incorporating a canopy of leaves and networks of roots and rhizomes. This complex association influences water circulation patterns, facilitates substrate attachments, provides shelter, allows sediment deposition, and nutrient recycling (EFHGA 1998).

The seagrass communities found within the project area are detailed in Section 6.06 of the EAR. As indicated there, over 11 acres of SAV are located in the project area, including such species as *Halophila decipiens*, *Syringodium filiforme*, *Thalassia testudinum*, and the recently introduced invasive exotic seagrass *Halophila stipulacea*. ATM (2014) sated that,

> *In 2009, Paul Bologna presented the "Assessing Faunal Utilization of Seagrass and Mangrove Habitats in St. John" at the annual meeting of the International Marine Conservation Congress, George Madison University, Fairfax, Virginia. He stated "Results indicate that Coral Bay Harbor, the most anthropogenically impacted site, had the highest T. testudinum biomass, but the lowest floral diversity. Its faunal community was dominated by small polychaetes with significantly lower secondary production".*

ATM (2014) further assessed the harbor area: "The area is heavily used for boat mooring and there are large scars associated with most moorings, even those with properly installed anchors. Ropes with associated chains swinging from the moorings denude large areas of seagrass."

5.5.2 Potential Effects of Proposed Action

Effects to seagrass have been minimized to the greatest extent practicable. The redesigned proposed project may permanently remove some seagrasses due to shading (approximately 1,450 square feet) and placement of piles (approximately 480 square feet). However, dredging is not anticipated to remove any seagrass habitat. Seagrass functions will be replaced through a mitigation project with multiple elements.

6.0 HABITAT AREAS OF PARTICULAR CONCERN

An additional habitat designation is authorized for consideration by the FMCs: Habitat Areas of Particular Concern (HAPC). HAPCs are EFH partitions of rare, ecologically important, highly susceptible to human degradation, or environmentally stressed areas. HAPCs frequently include habitats used for migration, spawning, and rearing of fish and shellfish; offshore areas of high habitat value or vertical relief; and high value intertidal and estuarine habitats. Additional regulatory protection is not afforded HAPCs; however, federal actions potentially affecting HAPCs are more carefully assessed and may be held to more stringent EFH protection recommendations (SAR 2008). No HAPCs are known to exist in the project area.

7.0 MANAGED SPECIES

7.1. Introduction

ATM (2014) detailed benthic surveys that included observations of fishes. It noted, "Tarpon (*Megalops atlanticus*) and yellowtail jacks (*Lutjanus chyrsurus*) were both seen, as well as juvenile black tipped shark (*Carcharhinus limbatus*). The bay is a known shark nursery and the Coral Bay Community Council funded a study of the harbor and found the harbor is heavily used by lemon, black tip and nurse sharks." Table 1 identifies those species and Table 2 identifies these and other species and their lifestage(s) that may occur in the vicinity of the proposed Coral Bay project and that are under CFMC's managerial jurisdiction. The CFMC has developed and implements fishery management plans for the spiny lobster, the queen conch, coral, and shallow water reef fish (CFMC 2010). The following sections describe the potential species found in the vicinity of the proposed Coral Bay project.

Table 1. Species managed by the Caribbean Fishery Management Council

Species	Taxa
Corals	100 species of coral (including stony corals, sea fans and gorgonians) and over 60 species of plants (including seagrasses) and invertebrates
Queen Conch	*Strombus gigas*
Reef Fish	~ 140 species
Spiny Lobster	*Panulirus argus*
Highly Migratory Species	
Tuna	
Albacore	*Thunnus alalunga*
Bigeye	*Thunnus obesus*
Swordfish	
Swordfish	*Xiphias gladius*
Billfish	
Blue Marlin	*Mokaira nigricans*
Longbill Spearfish	*Tetrapturus pfluegeri*
Roundscale Spearfish	*Tetrapturus georgii*
Sailfish	*Istiophorus platypterus*
White Marlin	*Tetrapturus albidus*
Sharks	
Bigeye Thresher	*Alopias superciliosus*
Blacktip	*Carcharinus limbatus*
Caribbean Reef	*Carcharhinus perezi*
Common Thresher	*Alopias vulpinus*
Great Hammerhead	*Sphyrna mokarran*
Lemon	*Negaprion brevirostris*
Nurse	*Gingloymostoma cirratum*
Oceanic Whitetip	*Carcharhinus longimanus*
Tiger	*Galeocerdo cuvieri*

Source: NOAAFS 2010a

Table 2. Species managed by the Caribbean Fishery Management Council that may occur in the vicinity of the proposed Coral Bay Harbor project

Species/ Management Unit	Taxa	Lifestage(s) Found at Location	Fishery Management Plan
Corals	100 species of coral (including stony corals, sea fans and gorgonians) and over 60 species of plants (including seagrasses) and invertebrates	Post-Egg/Larval, Larval	Corals
Queen Conch	*Strombus gigas*	Post-Egg/Larval, Larval	Queen Conch
Spiny Lobster	*Panulirus argus*	Post-Egg/Larval, Larval	Spiny Lobster
Reef Fish			
Groupers			
Jewfish	*Epinephelus itajara*	Post-Egg/Larval, Larval	Reef Fish
Nassau Grouper	*E. striatus*	Post-Egg/Larval, Larval	Reef Fish
Red Hind	*E. guttatus*	Post-Egg/Larval, Larval	Reef Fish
Snappers			
Yellowtail	*Ocyurus chrysurus*	Post-Egg/Larval, Larval	Reef Fish
Mutton	*Lutjanus analis*	Post-Egg/Larval, Larval	Reef Fish
Butterflyfish			
Banded butterflyfish	*Chaetodon striatus*	Post-Egg/Larval, Larval	Reef Fish
Foureye butterflyfish	*C. capistratus*	Post-Egg/Larval, Larval	Reef Fish
Spotfin butterflyfish	*C. ocellatus*	Post-Egg/Larval, Larval	Reef Fish
Longsnout butterflyfish	*C. aculeatus*	Post-Egg/Larval, Larval	Reef Fish

Table 3. (concluded)

Species/Management Unit	Taxa	Lifestage(s) Found at Location	Fishery Management Plan
Secretarial EFH			
Sharks			
Smooth Hammerhead	*Sphyrna zygaena*		Sec. FMP
Galapagos	*Carcharhinus galapagensis*		Sec. FMP
Narrowtooth	*Carcharhinus brachyurus*		Sec. FMP
Bigeye Sand Tiger	*Odontaspis noronhai*		Sec. FMP
Whale	*Rhincodon typus*		Sec. FMP
Caribbean Sharpnose	*Rhizoprionodon porosus*		Sec. FMP
Smalltail	*Carcharhinus porosus*		Sec. FMP
Bigeye Sixgill	*Hexanchus nakamurai*		Sec. FMP
Sevengill	*Notorynchus cepedianus*		Sec. FMP
Sixgill	*Hexanchus griseus*		Sec. FMP

Source: NOAAFS 2010a

7.2 Spiny Lobster (*Panulirus argus*)

7.2.1 Life History

The spiny lobster is found in the Western Central and South Atlantic Ocean, including the Caribbean Sea and the Gulf of Mexico. Brazil is the southernmost limit and North Carolina marks its northernmost limit. The spiny lobster is found in shallows and offshore; and taken commercially, for local subsistence, and recreationally. Sexes are separate and physically distinct with males having larger and heavier carapaces, but smaller tails than females. Maturity is related to length rather than age; thus, the “maturity molt”. Molting appears tied to the females’ reproductive response, where males appear capable year round. Most females reach sexual maturity between 3.1 and 3.5 inches carapace length (CL), reaching peak egg production between 4.3 and 5.0 inches CL. Fertilization is external and egg production ranges by body weight from 670 to 1,210 eggs/gram of total body weight and spawning occurs at least once a year. In Caribbean waters, egg-bearing females have been observed in all months of the year; with the greatest frequency from February to August. Fertilized eggs are carried until fully developed, approximately four (4) weeks, when an offshore movement occurs for hatching. The hatch is a planktonic larva spending up to eleven months offshore before metamorphosing into the puerulus stage and settling to the bottom. This planktonic stage attribute allows for wide dispersal. SAV and mangrove shallows provide habitat as a nursery and for pre-adult populations. Adults reaching reproductive sizes generally move offshore finding shelter by reefs, wrecks, or other structure. Spiny lobsters are benthic carnivores feeding primarily on annelids, mollusks, and crustaceans. Sub-adult and adult spiny lobsters are food sources for large benthic feeders such as sharks, dolphins, octopuses, and rays (CAFMP 2005). Table 4 describes the spiny lobsters’ life stage by EFH.

Table 3. Spiny lobster life stage EFH

SUBSTRATE	LIFESTAGES						
	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adults	Spawning Adults
Mangrove	N/A	N/A	N/A	N/A	Feeding, Growth to Maturity	N/A	N/A
Seagrasses	N/A	N/A	N/A	N/A	Feeding, Growth to Maturity	Feeding	N/A
Hard Bottoms	N/A	N/A	N/A	Feeding, Growth to Maturity	N/A	Feeding	N/A
Reef	Growth to Maturity	N/A	N/A	Feeding, Growth to Maturity	Feeding, Growth to Maturity	Feeding	Spawning

Source: EFHGA 1998, FEISGEFHA 2004a

N/A – Life stage does not occur in type habitat.

7.2.2 Potential Effects of the Proposed Project

The project would primarily affect juvenile and pre-adult individuals making use of SAV and mangroves within the proposed docking area. These habitats serve as protection, feeding, and maturation areas for spiny lobster. Indirect effects from operation of the marina include shading effects that could decrease SAV productivity and therefore decrease benthic cover. It is likely that lobsters, being a highly mobile species, could avoid direct effects of pile driving.

7.3 Queen Conch (*Strombus gigas*)

7.3.1 Life History

The queen conch is found in Atlantic semi-tropical and tropical waters from south Florida, Bermuda, and the Caribbean Sea to northern South America. The queen conch is harvested by both commercial and recreational fishers. The queen conch is generally found on sandy bottoms supporting SAV, beach hardbottoms/coral and rubble/gravel, and offshore. Adult queen conchs weigh approximately 4.4 pounds at 6 to 12 inches in length. Sexual maturation is reached at 3.5 to 4.0 years with shell growth stopping except for shell lip thickening. The queen conch has separate sexes and copulation with internal fertilization can occur several weeks before spawning. In the Caribbean, peak spawning aggregations occur from May through September. Numbers of gelatinous, egg string masses are deposited in low organic areas of clean coral sand and sometimes within SAV. Females spawn six to eight times per season producing 1 to 25 egg masses with individual strings containing up to 460,000 eggs. After five days, planktonic larvae are hatched spending 18 to 40 days within the water column before settling and metamorphosing. Developing juveniles spend much of the first year buried in shallow sub-tidal sediments. Once shell lengths reach 2 to 3.9 inches, juveniles emerge beginning an epibenthic life. Developed juvenile migrate offshore into deeper waters and return inshore as temperatures increase in the spring. Queen conch larvae feed on plankton, juvenile and adults feed on algae and SAV supported algae found in sandy flats, shallow lagoons, and hard bottoms. Mollusks, crustaceans, and fish feed on the juvenile conch; while rays, sharks, and turtles feed on adults (CAFMP 2005). Table 5 describes the queen conch's life stage by EFH.

Table 4. Queen conch life stage EFH.

SUBSTRATE	**LIFESTAGES**						
	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adults	Spawning Adults
Mangrove	N/A	N/A	N/A	N/A	Unknown	N/A	N/A
Seagrasses	Growth to Maturity	N/A	N/A	N/A	Feeding, Growth to Maturity	Feeding	Spawning
Reef	N/A	N/A	N/A	N/A	Feeding, Growth to Maturity	Feeding	N/A
Sand/Shell Bottoms	Growth to Maturity	N/A	N/A	N/A	Feeding, Growth to Maturity	Feeding	Spawning
Hard Bottoms	N/A	N/A	N/A	N/A	N/A	Feeding	N/A

Source: EFHGA 1998
N/A – Life stage does not occur in type habitat.

7.3.2 Potential Effects of the Proposed Project

The project would potentially affect the queen conch's egg, late juvenile, and adult life stages. These specific life stages may make use of SAV and sandy bottom habitats within the proposed dredging and dock zones. The SAV habitats serve as protection, feeding, and maturation areas for the queen conch. Indirect effects could occur to individuals due to construction effects such as increased turbidity/suspended, but this would be temporary. Prior to construction, any sub-adult or adult queen conch observed within the project footprint would be relocated.

7.4 Reef Fish

7.4.1 Life History

The Caribbean is home to approximately 350 species of shallow-water reef fish from which approximately 180 species are taken supporting the most important commercial/recreational fishery in the islands. Each island's reef fish populations could be supported by local fish populations or by spawns from great distances transported by ocean currents, challenging the management of the reef fish species and habitats. The CFMC's FMP for reef fish includes 140 species of which 80 are recreationally, commercially, or subsistently taken with the remaining 60 species taken for aquariums (CAFMP 2005). Specific species/life stages potentially found within the project area and managed by the CFMC are referenced in Table 2.

Most reef fish spawn offshore producing pelagic eggs drifting inshore for juvenile development within shallow waters, estuaries, and other nearshore nursery areas. Of these nearshore nursery areas, mangroves are of great ecological importance to the reef fish species. The distribution, development, or settling of reef fish larvae are not well documented. Research continues on spawning seasonality and distribution regarding temperature, depth, distance from shore, and other environmental factors. However, newly settled stages generally tend to occur in depths ranging up to 30 feet with species specific larval durations affecting local larval retention. Many reef fish juveniles utilize mangrove and SAV before moving offshore as adults. Sandy and hardbottom habitats populated by gorgonians, sea fans, and sponges also serve as refuge and cover for reef fish juveniles. Grouper and snapper species migrate to reproduce in spawning aggregations (SPAGs). Reef fish spawning sites occur near outer reefs or reef passages over hard sandy bottoms. Yet, a primary red hind (*Epinephelus guttatus*) SPAG occurs on Lang Bank St. Croix, a coral feature. SPAGs are extremely important to many reef fish in terms of direct commercial population support and indirectly in terms of marine tourism.

Among the reef fish species, many are both prey and predators within the fishery management units; as an example, Nassau groupers (*Epinephelus striatus*) feed on small grunts and spiny lobsters, while yellowtail snapper are planktonic feeders as juveniles and prey on fish eggs and larvae as adults. Most finfish have a diverse diet of cephalopods, copepods, fish, and shrimp including some diets dependent on sponges and anemones. Habitat protection supports both prey and predator reef fish in that both inhabit simultaneous areas.

Habitat use by reef fish species/life stages can be found in reference (FEISGEFHA 2004c) or on line at http://caribbeanfmc.com/SCANNED%20FMPS/FINAL%20EFH-EIS/Volume% 202%20 Tables_Figures.pdf.

7.4.2 Potential Effects of the Proposed Project

SAV and sand habitats may serve as protection, feeding, and maturation areas for the reef fish species. The proposed project could have an indirect effect on reef fish species that use inshore SAV, mangrove, and unvegetated benthic habitat. Effects to those habitats are noted above. In addition to habitat effects that may indirectly result in a slight reduction in habitat available to reef fish egg, larval, and juvenile stages, temporary construction effects such as dredging may result in direct entrainment and mortality for individuals of those life stages. Temporary impacts also include the exposure of individuals to project-related turbidity. Most species that are stronger swimmers may simply be temporarily dislocated from the immediate project area, and will return at its conclusion.

7.5 Highly Migratory Species

7.5.1 Life History

The highly migratory species (HMS) fishery has challenging management issues resulting from the species' multi-national global distribution. Many are identified as "overfished" (e.g. bluefin tuna (*Thunnus thynnus*), bigeye tuna (*Thunnus obesus*), swordfish (*Xiphias gladius*) and large coastal sharks) with enforcement and management implementation inconsistent among nations (FEISGEFHA 2004b, NOAAFS 2010b). EFH for HMS includes the marine and estuarine water column habitats offshore and adjacent to the proposed project area. Nine species of sharks, five species of billfish, the swordfish, and two tuna species may be present within the CFMC area (Table 1). Within the offshore vicinity of Coral Bay, ten shark species noted under the CFMC's Secretarial EFH (Table 2) may utilize habitats.

FINAL REPORT

Terrestrial Survey of Parcels

Parcels 10A & Lease Area A, Estate Emmaus
No. 2 Coral Bay Quarter
St. John, U.S. Virgin Islands

For

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INTRODUCTION

We were asked to survey the terrestrial ecological communities of a 5.3-acre Lease Area A (later dropped from the study), a 7.64-acre portion of Parcel 10A, a 5.071-acre Lease Area "B" from Parcel 10A, Estate Emmaus. A 3+-acre portion of Parcel 10C (09-6381-T98) Estate Carolina, 2 Coral Bay Quarter, St. John, U.S. Virgin Islands (Fig. 1), was eliminated from this particular study by the clients after the contract was awarded. It will not be included in this report.

Our survey includes a search for plant and animal species protected both under U.S. Federal statute, namely the Endangered Species Act of 1973, and local law: the Indigenous and Endangered Species Act of 1990, Title 12 VI Code, Chapter 2. Also, Lignumvitae (*Guaiacum officinale*) is protected under CITES (Convention on International Trade in Endangered Species of Fauna and Flora).

The acreage north of the Emmaus Moravian Church was covered in mostly natural secondary dry forest, with few woody exotics. Other properties and lease parcels consisted of mostly cleared vegetation or parklands, an open ball field clear of trees except along its perimeter, with several commercial buildings in various locations. Natural communities existed on the coastline, including areas of fringe mangrove lining the shoreline on the western and eastern segments of the property's southern boundary. The two-acre lease area on Parcel 10C, subsequently dropped from this study, was low-lying, highly disturbed, site consisting mostly of weedy vegetation.

Physical Site Description

Climate

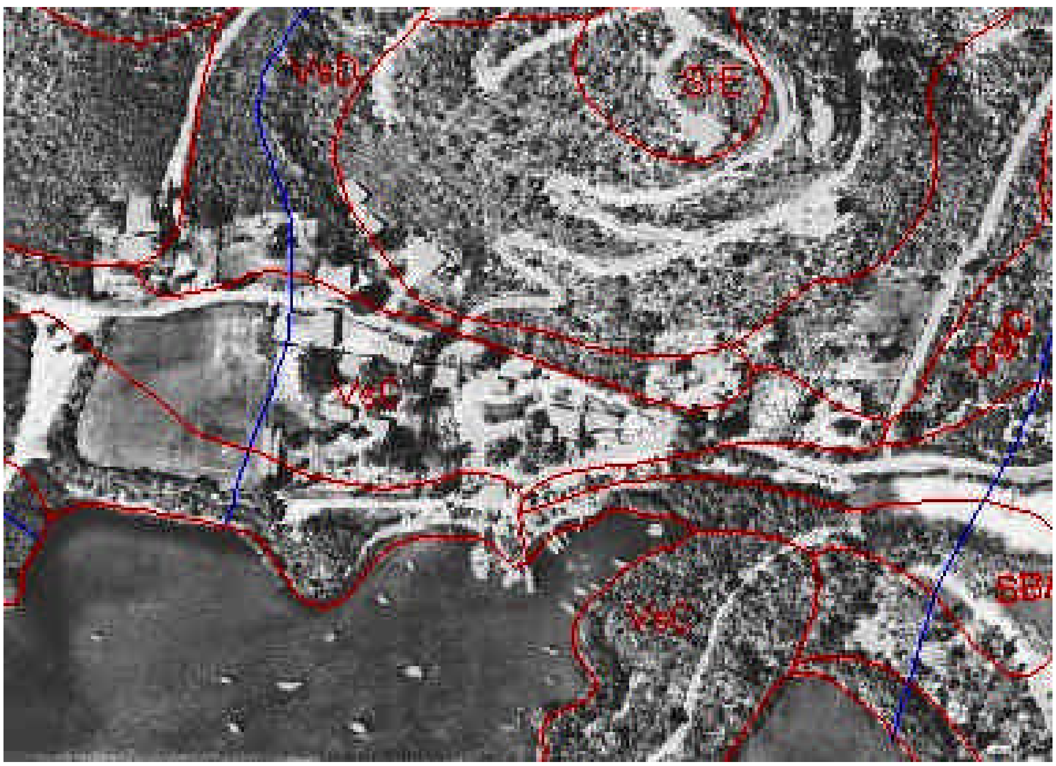
No data has been published by NOAA, National Weather Service on the rainfall of Coral Bay. Unofficial reports from local rain gauges indicate a mean of about 36-39 inches. Mean monthly maximum temperatures range from 26 to 30 degrees Celsius. Evaporation rates can be extreme during the winter dry season and during late summer.

Soils

The general soil series of the area is Southgate – Victory – Cramer. These are soils that are well-drained soils of moderate permeability, with low available water capacity. The erosion hazard is severe. Depth to bedrock is 10-40 inches. More detailed descriptions associated with map units in various section of the property are given below.

The major portion of the property on the northern half of the land area stretch west to east is classified as Victory Southgate Complex (VsC), 2-20 % slopes, very stony (Fig. xx). On the seaward edge of the VsC boundary are soils highly altered from their natural condition by human activity, such as cutting and filling, and are termed "Ustorthents". There are some very local soils in the central coastline that have not been classified. These support a small scrub thicket. The low area on the property's eastern section bears two small, but distinctive soil units: 1) Sandy Point and Sugar Beach (SBA) soils, 0-2% slope, frequently flooded, and 2) Solitude (SoA) gravelly fine sandy loam, 0-2% slope, frequently flooded. The SBA soils run along the waters edge on the eastern section, just landward of the fringe mangrove. Landward of these soils are the Solitude series. The SBA soils typically occur on nearly level salt marshes, saline flats, and salt ponds adjacent to the sea. Solitude soils occur in adjacent to salt marshes, saline flats, in this case on the landward edge of the SBA.

Fig. 1. Soil map of the property. Source: USDA, NRCS Soil Survey of the United States Virgin Islands.



Soils associated with the upland parcel were classified Southgate Rock Outcrop Complex (SrE, SrF, and SrG). These soils are essentially shallow, brown gravelly loams over weather igneous bedrock, varying from 20-90% slopes.

Objectives

We were asked to conduct a terrestrial survey of these parcels. The project included the following objectives:

1. Conduct a field survey of vertebrate animals and plants.

2. Locate, identify, and flag all rare/endangered plants.
3. Locate, identify, measure and flag all trees with a diameter of 6” or greater.
4. Locate all plants identified in items 2 & 3 above and map them in Cadd format; integrate into final report.
5. Survey for and identify all rare/endangered fauna.
6. Identify potential wetlands, if any.
7. Identify and map the various vegetation communities.
8. Prepare draft and final reports describing findings and recommendations and a map of vegetative communities.
9. Work with the design team regarding CZM submittal requirements.

Fig. 2. Aerial photograph of the proposed marina development site, showing properties (coastal area is indicated in red). An additional 3+-acre lease Parcel 10C, Estate Carolina, indicated by black arrow, is not included in this study.

Methods

The consultant surveyed all plants and vertebrate animals on the properties. We produced two separate floristic lists in tabular format for (a) a proposed 5-acre lease parcel on a slope above Emmaus Moravian Church, and (b) a list of all other vascular plant species in the coastal and near coastal areas, consisting of most of Parcel 10A and Parcel 10C associated with the proposed development. We compiled list of birds, reptiles, amphibians and small mammals observed during the survey. While conducting the bio-inventory, we searched for rare or endangered plants and animals. Rare plants encountered were tagged, measured in girth and height, flagged in pink and white ribbon, and geographic coordinates were recorded by GPS and mapped. All live trees with primary stems measuring a minimum of 15.2 cm DBH (1.3 m) were be identified, sequentially flagged, and digitally mapped. Also, plant communities of the property were mapped, including mangrove wetlands. Terrestrial vertebrate animals, including ground rodents were be trapped and their species identities recorded.

RESULTS

General Floristic Summary

A combined total of 165 plant species from 53 families were encountered on Parcel A (Coral Bay Harbor Area) and a proposed, 5-acre Lease Area B, north of Emmaus Moravian Church in Coral Bay (Appendix I).

The waterfront area south of Route 10 contained 110 of these plant species, many of the larger specimens of which were planted into the landscape. Another large portion of these species colonized on their own. A significant portion (30%) of the species encountered in the Coral Harbor area was non-native.

By contrast, the 5-acre proposed Lease Area B exhibited a near pristine floristic composition. The parcel consisted of 86 species, only five (5.8%) of which were non-natives. This plant community of the upland (proposed) lease area earned a high conservation ranking, owing to its rich array of native trees, shrubs and herbs and the near absence of introduced plant species.

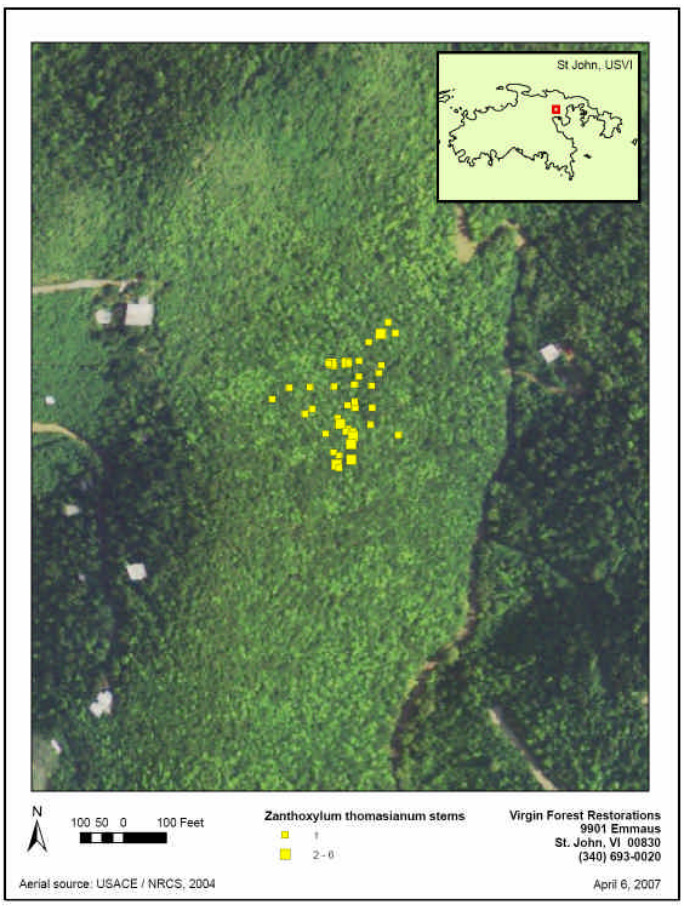
Rare Species Search

<u>Flora</u>

The proposed upland parcel, subsequently dropped from the project, contained a population of 59 individuals of St. Thomas Prickly ash (*Zanthoxylum thomasianum*), a species listed "endangered" under the Endangered Species Act of 1973 (Appendix II). This species is found only in forest tracks of the purest floristic composition – essentially dry woodlands with few to no introduced woody species. The mean canopy height of this long-lived shrub was 2.7 m. This population shows a full size-class distribution (implying a broad spectrum in age classes). Growth rates of this species are in the range of 0.5 to 0.75 mm per year. The mean diameter of stem bases was 6.6 cm, suggesting a mean age somewhere between 8 and 12 decades. The largest (oldest) individual (35 cm diameter), was likely more than 400 years old. This is the third largest population within its global distributional range, which includes St. Thomas, St. John, Virgin Gorda (British Virgin Islands), Vieques and 3 locations on the main island of Puerto Rico.

Fig. 3. Leaves of St. Thomas Prickly ash.

Fig. 4. Digital map of the locations of 59 individuals of St. Thomas Prickly ash on a proposed Lease Area B, north of Emmaus Moravian Church. It was determined by the developer prior to the completion of this study that the area should be rejected from the plan for development.



Fauna

We encountered no rare or endangered animals on the property. Our survey lists 19 birds, 5 reptiles, 3 amphibians and 9 mammals observed during our terrestrial communities survey.

Table 1. List of birds encountered across all parcels, Estate Emmaus, St. John.

Common name	Scientific name	Family	Family Relatives	Habitat
Hawk, Red-tailed	*Buteo jamaicensis*	*Accipitridae*	Hawks and Harriers	throughout
Egret, Cattle	*Bubulcus ibis*	*Ardeidae*	Herons, Egrets, Bitterns	open fields
Heron, Green-backed	*Butorides striatus*	*Ardeidae*	Herons, Egrets, Bitterns	fringe mangrove
Heron, Little Blue	*Egretta caerulea*	*Ardeidae*	Herons, Egrets, Bitterns	fringe mangrove
Pigeon, Scaly-naped	*Columba squamosa*	*Columbidae*	Pigeons & Doves	dry scrub, woodlands
Dove, Common Ground	*Columbina passerina*	*Columbidae*	Pigeons & Doves	dry scrub
White-winged dove	*Zenaida asiatica*	*Columbidae*	Pigeons & Doves	dry scrub, open sites
Dove, Zenaida	*Zenaida aurita*	*Columbidae*	Pigeons & Doves	dry scrub, woodlands
Cuckoo, Mangrove	*Coccyzus minor*	*Cuculdae*	Cuckoos & Anis	dry scrub, woodlands
Bananaquit	*Coereba flaveola*	*Emberizidae*	Wood Warblers, Blackbirds, Tanagers	dry scrub, woodlands
Bullfinch, Lesser Antillean	*Loxigilla noctis*	*Emberizidae*	Wood Warblers, Blackbirds, Tanagers	dry scrub, woodlands
Grassquit, Black-faced	*Tiarus bicolor*	*Emberizidae*	Wood Warblers, Blackbirds, Tanagers	open sites
Kestral, American	*Falco sparverius*	*Falconidae*	Falcons	open sites
Thrasher, Pearly-eyed	*Margarops fuscatus*	*Mimidae*	Mockingbirds & Thrashers	dry scrub, woodlands
Chicken or Junglefowl	*Gallus gallus*	*Phasianidae*	Junglefowl and Quail	throughout
Green-throated Carib	*Eulampis holosericeus*	*Trochilidae*	Hummingbirds	dry scrub, woodlands
Hummingbird, Antillean Crested	*Orthorhyncus cristatus*	*Trochilidae*	Hummingbirds	dry scrub, woodlands
Elaenia, Caribbean	*Elaenia martinica*	*Tyrannidae*	Tyrant Flycatchers	dry scrub, woodlands
Kingbird, Gray	Tyrannus dominicensis	*Tyrannidae*	Tyrant Flycatchers	dry scrub, woodlands

Fifteen of the 19 birds are native. Only the chicken, Pearly-eyed thrasher, the Cattle egret, and the White winged dove were introduced. All three native anoline lizards were observed. The ground lizard is also quite common. Cuban tree frogs were heard at night near the restaurant. Bats were not abundant, but two species were observed. Other birds expected, but not seen, included the Great Blue heron, and any of a few species of shorebirds, including plovers and the killdeer.

Table 2. List of reptiles and amphibians observed at Estate Emmaus, St. John, VI.

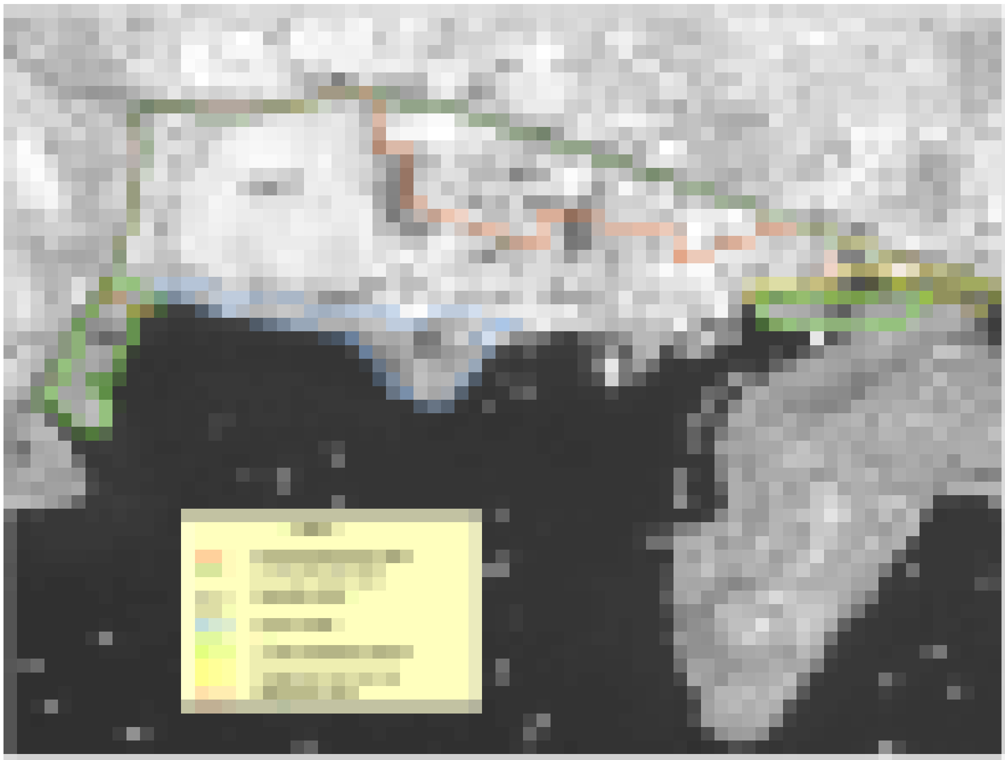
Common name	Scientific name	Family	Order	Class	VI Distribution
Ground lizard	*Ameiva exsul*	*Teiidae*	Squamata - Lacertilia	Reptilia III	PR, VI (except SX)
Crested anole	*Anolis cristatellus*	*Polychrotidae*	Squamata - Lacertilia	Reptilia V	A, T, VG, JVD, SJ, ST, C, V, PR
Grass anole	*Anolis pulchellus*	*Polychrotidae*	Squamata - Lacertilia	Reptilia V	A, VG, T, SJ, JVD, ST, V, C, PR
Barred anole	*Anolis stratulus*	*Polychrotidae*	Squamata - Lacertilia	Reptilia V	VG, T, SJ, JVD, ST, V, C, PR
Cotton ginner	*Sphaerodactylus macrolepis*	*Gekkonidae*	Squamata - Lacertilia	Reptilia IV	A, VG, T, SJ, JVD, ST, V, C, PR
Antillian tree frog	*Eleutherodactylus antillensis*	*Leptodactylidae*	Anura	Amphibia	All Major Islands
Cochrane's tree frog	*Eleutherodactylus cochranae*	*Leptodactylidae*	Anura	Amphibia	T, VG, ST, SJ, PR
Cuban tree frog	*Osteopilus septentrionalis*	*Leptodactylidae*	Anura	Amphibia	Introduced to all Major Islands

The ball field commonly included a large herd (more than 30) of sheep. Donkeys are frequently seen on the ball field and along the roadside. Stray cats are also seen here in there in the shoreline scrub thickets and around the restaurant.

Table 3. List of mammals observed at Estate Emmaus, St. John, VI

Common name	Scientific name	Family	Origin
Jamaican fruit bat	*Artibeus jamaicensis*	*Phyllostomidae*	native
Velvety free-tailed bat	*Molossus molossus*	*Molossidae*	native
Mongoose	*Herpestes auropunctatus*	*Herpestidae*	introduced
Cat	*Felis domesticus*	*Felidae*	introduced
Donkey	*Equus asinus*	*Equidae*	introduced
Goat	*Capra hircus*	*Bovidae*	introduced
Sheep	*Ovis aries*	*Bovidae*	introduced
Black rat	*Rattus rattus*	*Muridae*	introduced

Fig. 5. Plant community map of Parcel 10A, Estate Emmaus, Coral Bay, St. John.



Community Descriptions

A. Tropical dry woodland (Proposed Lease Area B – Johnny Horn Rd, Emmaus)

This community is integral to the predominant biome of the region, classified, “Tropical Dry Forest”, as are most forest communities of the Virgin Islands. Local authors have sub-classified this as “dry, semi-deciduous woodland”. The canopy height across the community varies from a range of 5-7 meters in the ravines to 2-5 meters on east- to south-facing slopes. Soils are shallow and boulder-strewn, with surface rockiness high on convex slopes; less rocky in concave topographies, except in ravine channels, which exhibit the largest exposed rocks. Duff layer is quite deep in the upper central portion of the parcel.

The most abundant woody species was Amarat (*Acacia muricata*), which dominated most of the central and northwestern section of the parcel. *A. muricata*, a tree in the legume family, is an indicator species for rare species wherever it occurs as a dominant species in older forest stands of the Virgin Islands. Duff layers are normally quite thick under *A. muricata* canopy, apparently due at least in part to the resistance to decay of the leaflets, which accumulate in very high numbers and persist for years. The rhizosphere (root zone) is typified by the presence of a dense network of fungal mycelia, perhaps associated with the species' mycorrhizal partner, which may assist in favoring this species over numerous woody competitors. This species has been encountered as a dominant in every community also harboring the endangered, St. Thomas prickly ash (*Zanthoxylum*

Fig. 6. Interior of near-pristine dry woodland

thomasianum), which is quite dense in the section dominated by *A. muricata*. Other common canopy trees of this woodland included Guama (*Reynosia guama*), Princewood (*Exostema caribbea*), Water mampoo (*Pisonia subcordata*), and Rodwood (*Eugenia biflora*). A common understorey tree across the woodland was Torchwood (*Amyris elemifera*). Bertero's barbasco (*Jacquinia berte*roi) occurred across the community, while Oysterwood (*Gymnanthes lucida*), was locally common in areas with taller canopy in association with St. Thomas Prickly ash.

Florida boxwood (*Schaefferia frutescens*), was the most common element of the shrub layer. *Oplonia microphylla* was also quite prevalent in many areas. Frequent shrubs were Birchberry (*Eugenia ligustrina*), Heart-leaved eugenia (*E. cordata*), and Inkberry (*Randia aculeata*).

Bull vine (*Stigmaphyllon emarginatum*) and Egger's morning glory (*Ipomoea eggersii*) were common woody vines (lianas) throughout the woodland. Other frequently encountered lianas included Cat-claw vine (*Macfadyena unguis-cati*), Basket wiss (*Serjania polyphylla*), and Twining soldierbush (*Tournefortia microphylla*).

B. Developed Coastal Plain

This segment of the property is the least natural. It consists mostly of grazed recreational field, a derelict park, and parking lots surrounding a boatyard, and a restaurant and gift shop complex. Many of the larger trees were planted. The grandest specimen is a picturesque Rain tree (*Samanea saman*), rooted just east of the basketball court, providing shade for the bleachers at courtside. Also, some large *Ficus* trees grow in an abandoned park seaward of the Guy Benjamin School. Seaward of the park and ball field were the scrub thicket and natural shoreline communities.

Fig. 7. Ball field below Emmaus Moravian Church (left center).

C. Scrub thicket

Approaching the shoreline, deeper soils give way to shallower, more saline soils. This zone is covered in "Scrub Thicket". This dry shrub land association was typified by two abundant shrubs, Yellow maran (*Croton rigidus*), and Pipe organ cactus (*Pilosocereus royenii*). A few trees were prevalent, including Nothing nut (*Cassine xylocarpa*), White frangipani (*Plumeria alba*), Mountain grape (*Coccoloba microstachya*), Wild tamarind (*Leucaena leucocephala*), Stink casha (*Acacia macracantha*), and Pink cedar (*Tabebuia heterophylla*). Other common shrubs were Century plant (*Agave missionum*), White maran (*Croton astroites*), Bread-and-cheese (*Pithecellobium unguis-cati*), Christmas bush (*Comocladia dodonaea*), Yellow sage (*Lantana camara*), Cankerberry (*Solanum racemosum*), and. Vines included Clashie malashie (*Jacquemontia pentanthos*), *Passiflora foetida*, and *Convolvulus nodiflorus*. Ground-layer species were Hurricane grass (*Bothriochloa pertusa*), salt grass, finger grass (*Chloris barbata*), Guinea grass (*Urochloa maxima*), and *Oplonia spinosa*.

Fig. 7. Scrub thicket south of Guy Benjamin School.

D. Mangrove communities

Mangroves of this property may be divided into two distinct sub-communities, “fringe mangroves” and “basin mangroves”. Fringe mangroves consist entirely of Red mangrove trees (*Rhizophora mangle*), which fringed the shoreline on the west and east sections of Parcel 10A. The fringe mangrove exhibited occasional inclusions of vines, which were rooted landward, growing seaward. Fringe mangroves commonly front a landward berm, on which many halophytic species thrive. The mangroves on the west section of the property contain abundant White mangrove (*Laguncularia racemosa*) trees, and the salt-loving shrub, *Bontia daphnoides*.

Fig. 8. Fringe mangrove on west section of Parcel 10A,
Estate Emmaus.

The basin mangrove grows on the perimeter of a tidal channel connecting it with a salt pond to the east of the property. Nothing nut (*Cassine xylocarpa*) was mixed with Limber caper (*Capparis flexuosa*). The introduced shrub (*Cryptostegia grandiflora*)

Fig. 9. Aerial image of eastern shoreline section of Parcel 10A, showing a fringe mangrove community (center) and a tidal flat connecting this community with a basin mangrove (right center) and salt pond on an adjacent property to the east.

E. Rocky shoreline

Much of the western and central sections of the property's coastline is rocky. This environment favors halophilic (salt-loving) herbs and shrubs, many growing in rock crevices and around small tide pools. Along this rocky shoreline, we encountered numerous dry coastal herbs, e.g. Saltgrass (*Sporobolus virginicus*), Sea purslane (*Sesuvium portulacastrum*) and Nut sedge (*Cyperus rotundus*), shrubs, e.g. Black torch (*Erythalis fruticosum*), *Chamaesyce articulata*, and lianas, e.g. Limber caper. In stony or gravelly areas, Buttonwood (*Conocarpus erectus*) and Manchineel (*Hippomane mancinella*) were found.

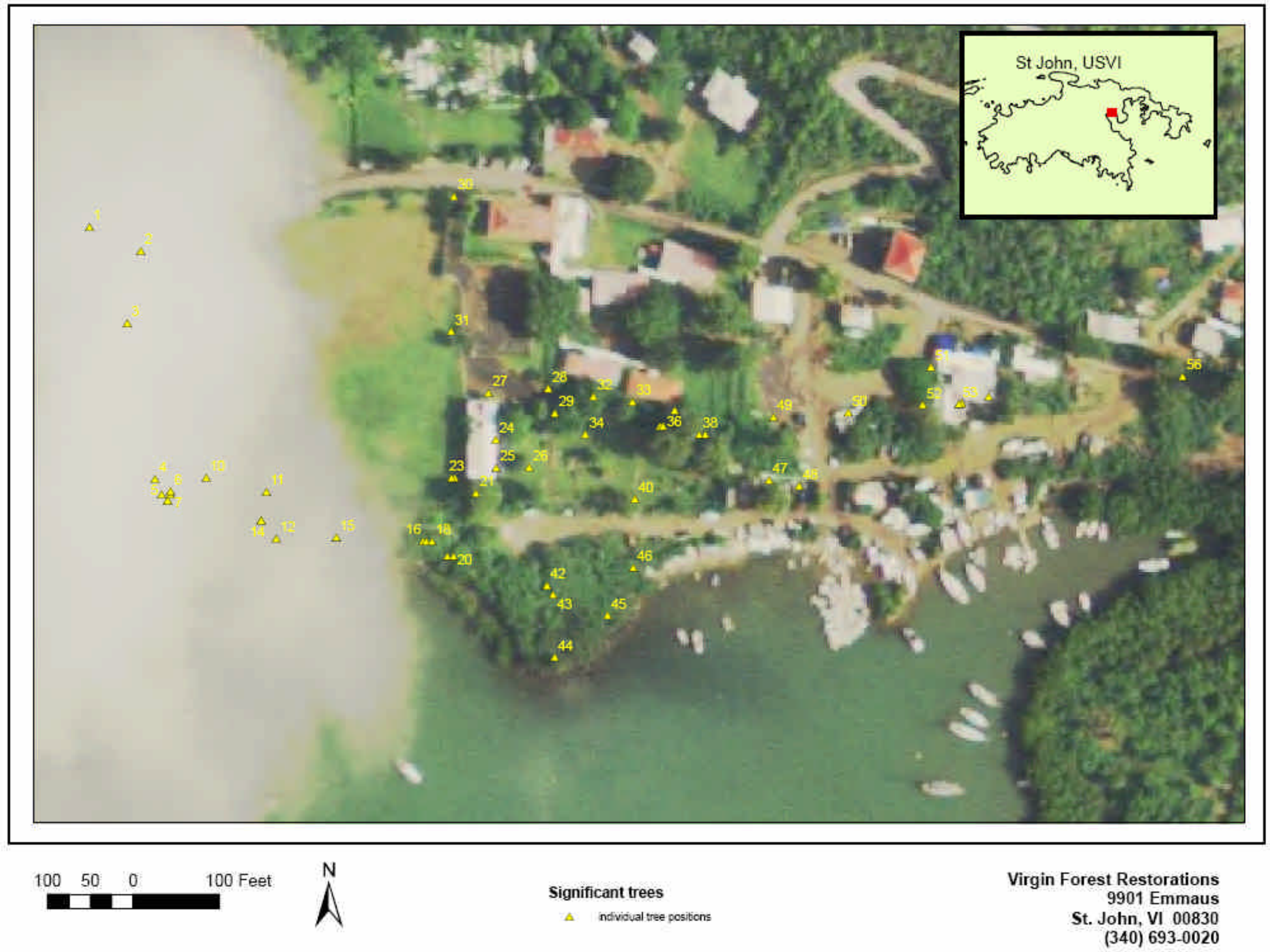
Fig. 10. Rocky shoreline interface with coastal scrub thicket, Parcel 10A, Estate Emmaus.

Significant trees of Parcel A

The lowland parcel contained 56 trees with stem diameters exceeding 6 inches (15.2 cm) at breast height (1.3 m). The group consisted of 20 species, 13 of them indigenous and seven exotics. The diameter of these trees ranged from 15.2 cm to 128 cm; the mean diameter was 42.6 cm. The largest tree was a Banyan (*Ficus benjamina*) located in the abandoned park south of the elementary school. Most of these trees are planted along the margins of various open areas intended for recreation. The grandest specimen tree in the vicinity is rooted on the lease border, apparently on the school grounds. The common name is Rain tree (*Samanea saman*). It is of considerable girth, shading the bleachers on east edge of the basketball court. Other exceptional trees grow seaward of the elementary school in a small park, which is overgrown with weeds and has been allowed to go derelict. This unused, shady area is one of the more pleasant hidden places in the Coral Bay vicinity.

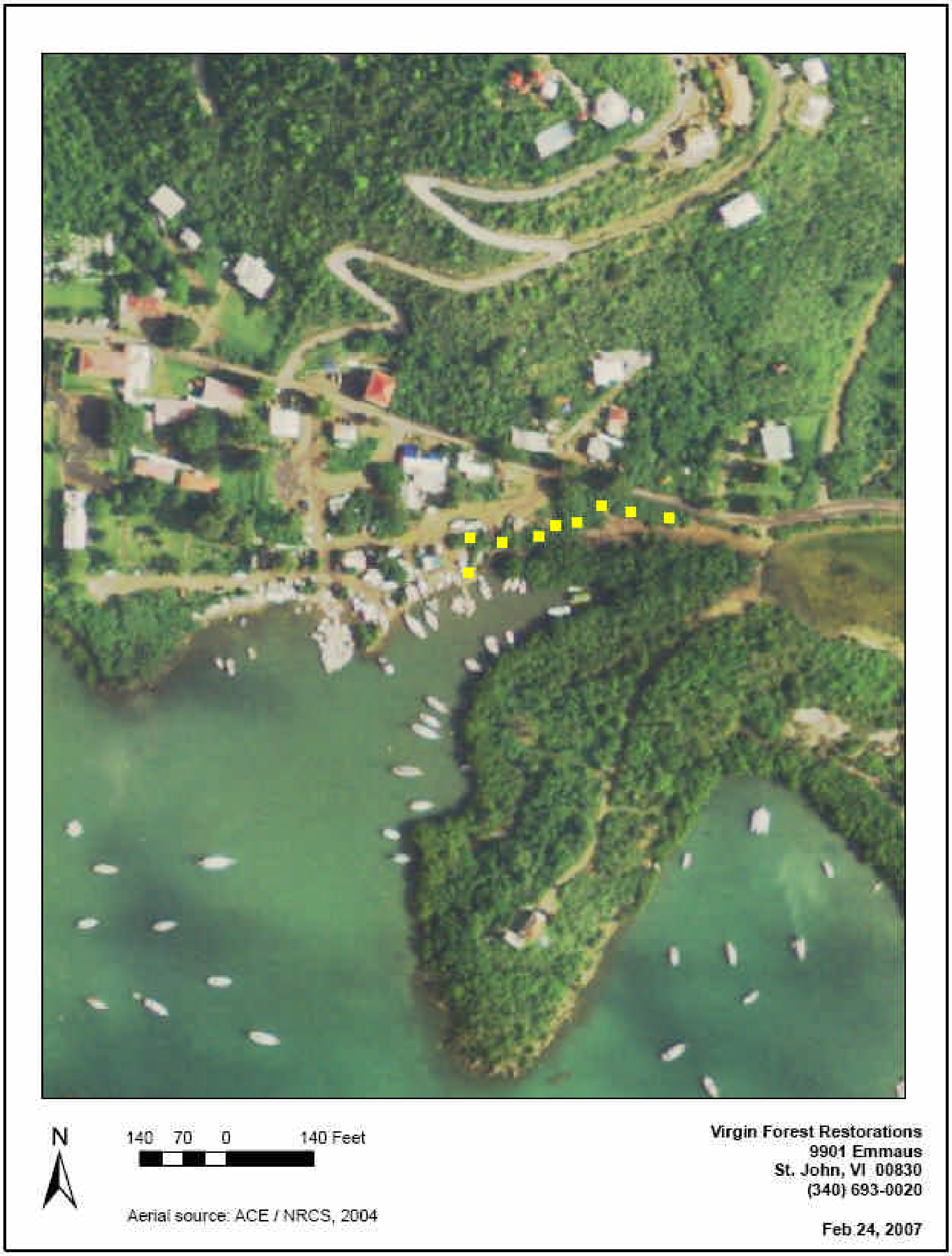
All trees have been wrapped with red flagging ribbon, the flagging being marked with numbers 1-56. GPS coordinates for the positions of Parcel A significant trees are presented in Appendix II.

Fig. 11. Map of significant tree positions from the coastal Parcel A, Estate Emmaus, St. John.



We were requested to map the landward boundary of the wetland on the eastern side of the property for planning purposes. At least partially based on this information, a request for proposal was promulgated for wetland delineations by a certified expert. Wetlands occur on both the east and west boundaries.

Fig. 12. Approximate digital tracings of the landward boundary of the east side wetland boundary. From west to east, a fringe mangrove intergrades with a basin mangrove community landward of the fringe mangrove.



RECOMMENDATIONS

The top priority for terrestrial community protection has already been accomplished. As of this writing, the developer had decided to forego the development of Lease Area B, located north of Emmaus Moravian Church west of Johnny Horn Rd. In view of the fact that the parcel contains an important population of a federally listed endangered plant species, St. Thomas Prickly ash, the protection of this property is vital to its future recovery and sustainability.

Among the significant trees in the area, certainly the Rain tree (*Samanea saman*), located on the school grounds adjacent to the basketball court, and outside the lease area, is the most spectacular. Special care should be taken during future construction to protect the canopy, trunk and roots of this tree. The grandest tree on the lease parcel that this author would deem worthy of saving would be the large (128 cm DBH) Banyan (*Ficus benjamina*) tree (#32) seaward of the school playground (see Appendix III). Another large (80 cm DBH) Banyan (#28) is nearby. There are numerous fine specimens, including large Turpentine (*Bursera simaruba*) trees, several large Gri-gri (*Bucida buceras*) trees, and Geiger (*Cordia sebestena*) trees.

An erosion hazard that is moderately acute exists in three areas: the western boundary with Route 107, the ball field, which receive runoff from Johnny Horn Road during heavy rains, and the eastern area where storm runoff empties from Route 10 into the parking lot and mangrove apron infested with rubber tree (*Cryptostegia grandiflora*). Plumes of suspended terrestrial fine sediment are a frequent site during heavy rainfall events.

The west section of the shoreline has relatively sparse ground cover protecting a 10-foot embankment sloping toward Coral Harbor. Flood waters heading seaward should be sequestered before reaching the embankment. Sea grass beds and other marine communities are nearby.

Also, Carolina valley catchments empty into lowland from which retention areas have been filled and rerouted to roadside culverts, eventually emptying directly into Coral Harbor. This erosion hazard is somewhat south of the property boundary. However, it adversely affects the proposed marina development, so cooperative actions to mitigate should be considered in the interest of the Coral Bay communities and marine ecosystem integrity.

A 10-15 foot minimum setback from wetland boundaries should be recognized to protect plant and animal life inhabiting high quality mangrove communities.

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Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
1	*Oplonia microphylla*	*Acanthaceae*	Small-leaved Oplonia	shrub	native	common	Lease Area B
2	*Oplonia spinosa*	*Acanthaceae*	Oplonia	liana	native	frequent	Parcel A, Lease B
3	*Siphonoglossa sessilis*	*Acanthaceae*	Blossum	herb	native	frequent	Parcel A
4	*Agave missionum*	*Agavaceae*	Century plant	herb	native	infrequent	Parcel A, Lease B
5	*Aloe vera*	*Aloaceae*	Aloe	herb	introduced	frequent	Parcel A
6	*Hymenocallis caribaea*	*Amarylidaceae*	White lily	herb	native	infrequent	Parcel A
7	*Comocladia dodonaea*	*Anacardiaceae*	Christmas bush	shrub	native	frequent	Parcel A, Lease B
8	*Annona muricata*	*Annonaceae*	Soursop	tree	introduced	rare	Parcel A
9	*Cryptostegia grandiflora*	*Apocynaceae*	Rubber plant	shrub	introduced	frequent	Parcel A
10	*Plumeria alba*	*Apocynaceae*	White frangipani	tree	native	infrequent	Parcel A
11	*Rauvolfia viridus*	*Apocynaceae*	Milky bush	shrub	native	infrequent	Parcel A
12	*Alocasia plumbea*	*Araceae*	Metallic taro	herb	introduced	infrequent	Parcel A
13	*Anthurium crenatum*	*Araceae*	Scrub bush:	herb	native	infrequent	Lease Area B
14	*Cocus nucifera*	*Arecaceae*	Coconut	tree	introduced	infrequent	Parcel A
15	*Chromolaena sinuata*	*Asteraceae*		shrub	native	infrequent	Lease Area B
16	*Launea intybacea*	*Asteraceae*		herb	native	infrequent	Parcel A
17	*Crescentia cujete*	*Bignoniaceae*	Calabash tree	tree	introduced	infrequent	Parcel A
18	*Macfadyena unguis-cati*	*Bignoniaceae*	Cat claw vine	liana	native	frequent	Lease Area B
19	*Tabebuia heterophylla*	*Bignoniaceae*	Pink cedar	tree	native	infrequent	Parcel A
20	*Bourreria succulenta*	*Boraginaceae*	Pigeonberry	tree	native	frequent	Parcel A, Lease B
21	*Cordia alliodora*	*Boraginaceae*		tree	native	infrequent	Lease Area B
22	*Cordia collococca*	*Boraginaceae*	White manjack	tree	native	infrequent	Parcel A
23	*Cordia rickseckeri*	*Boraginaceae*	Orange manjack	tree	native	infrequent	Lease Area B

Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
24	*Cordia sebestena*	*Boraginaceae*	Gieger tree	tree	native	frequent	Parcel A
25	*Heliotropium curassavicum*	*Boraginaceae*	Salt heliotrope; Seaside heliotrope	herb	native	infrequent	Parcel A
26	*Rochefortia acanthophora*	*Boraginaceae*	Rochefortia	shrub	native	infrequent	Lease Area B
27	*Scolosanthus versicolor*	*Boraginaceae*	Scolosanthus	shrub	native	infrequent	Lease Area B
28	*Tournefortia microphylla*	*Boraginaceae*	Twining soldier vine	liana	native	frequent	Parcel A, Lease B
29	*Bromelia pinguin*	*Bromeliaceae*	Wild pineapple	herb	introduced	occasional	Lease Area B
30	*Tillandsia recurvata*	*Bromeliaceae*	Bunch moss	epiphytic herb	native	infrequent	Parcel A
31	*Tillandsia utriculata*	*Bromeliaceae*	Spreading airplant	epiphytic herb	native	frequent	Parcel A
32	*Bursera simaruba*	*Burseraceae*	Turpentine tree	tree	native	frequent	Lease Area B
33	*Hylocereus trigonus*	*Cactaceae*	Night-blooming cereus	vine	native	infrequent	Lease Area B
34	*Opuntia repens*	*Cactaceae*	Suckers	herb	native	infrequent	Parcel A
35	*Pilosocereus royenii*	*Cactaceae*	Pipe organ cactus	tree	native	common	Parcel A
36	*Selenicereus grandiflorus*	*Cactaceae*	Cuban nightbloomer	vine	introduced	frequent	Parcel A
37	*Capparis amplissima*	*Capparaceae*		tree	native	infrequent	Lease Area B
38	*Capparis baduca*	*Capparaceae*		shrub	native	infrequent	Lease Area B
39	*Capparis cynophallophora*	*Capparaceae*	Black caper; Jamaica caper	tree	native	infrequent	Parcel A, Lease B
40	*Capparis flexuosa*	*Capparaceae*	Limber caper	liana	native	frequent	Parcel A, Lease B
41	*Capparis hastata*	*Capparaceae*	Hastate caper	liana	native	infrequent	Parcel A, Lease B
42	*Capparis indica*	*Capparaceae*	White caper	tree	native	frequent	Parcel A, Lease B

Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
43	*Morisonia americana*	*Capparaceae*	Rat apple	liana	native	frequent	Lease Area B
44	*Cassine xylocarpa*	*Celastraceae*	Nothing nut	tree	native	frequent	Parcel A
45	*Crossopetalum rhacoma*	*Celastraceae*	Crossopetalum	shrub	native	infrequent	Parcel A
46	*Maytenus laevigata*	*Celastraceae*	Maytenus	tree	native	infrequent	Lease Area B
47	*Schaefferia frutescens*	*Celastraceae*	Schaefferia	shrub	native	frequent	Parcel A, Lease B
48	*Clusia rosea*	*Clusiaceae*	Pitch apple, Strangler fig	tree	native	rare	Parcel A
49	*Conocarpus erectus*	*Combretaceae*	Buttonwood	tree	native	frequent	Parcel A
50	*Laguncularia racemosa*	*Combretaceae*	White mangrove	tree	native	common	Parcel A
51	*Callisia repens*	*Commelinaceae*		herb	introduced	occasional	Lease Area B
52	*Commelina erecta*	*Commelinaceae*	French grass	herb	introduced	frequent	Parcel A, Lease B
53	*Convolvulus nodiflorus*	*Convolvulaceae*	Clashi mulat	vine	native	frequent	Parcel A
54	*Ipomoea eggersii*	*Convolvulaceae*	Egger's morning glory vine	vine	native	frequent	Parcel A, Lease B
55	*Ipomoea nil*	*Convolvulaceae*	Mexican morning glory	vine	introduced	infrequent	Parcel A
56	*Jacquemontia pentanthos*	*Convolvulaceae*		vine	native	infrequent	Parcel A
57	*Meremia aegyptica*	*Convolvulaceae*		vine	introduced	infrequent	Parcel A
58	*Meremia quinquefolia*	*Convolvulaceae*		vine	native	infrequent	Parcel A
59	*Bryophyllum pinnatum*	*Crassulaceae*	Kalanchoe; Love plant	herb	introduced	infrequent	Lease Area B
60	*Momordica charantia*	*Cucurbitaceae*	Maiden apple; Jumbie pumpkin	vine	introduced	infrequent	Parcel A
61	*Cyperus planifolius*	*Cyperaceae*	Flatleaf flatsedge	herb	native	infrequent	Parcel A
62	*Cyperus rotundus*	*Cyperaceae*	Nut-grass	herb	introduced	infrequent	Parcel A

Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
63	*Sansevieria trifasciata*	*Dracaenaceae*	Snake plant	herb	introduced	infrequent	Parcel A
64	*Erythroxylum brevipes*	*Erythroxylaceae*	Brazilet	tree	native	frequent	Parcel A, Lease B
65	*Adelia ricinella*	*Euphorbiaceae*	Adelia	tree	native	infrequent	Parcel A, Lease B
66	*Ayenia insulaecola*	*Euphorbiaceae*	Ayenia	herb	native	infrequent	Parcel A
67	*Croton astroites*	*Euphorbiaceae*	Maran	shrub	native	frequent	Parcel A, Lease B
68	*Croton betulinus*	*Euphorbiaceae*	Birch-leaved croton	shrub	native	frequent	Lease Area B
69	*Croton flavens v. rigidus*	*Euphorbiaceae*	Yellow sage	shrub	native	frequent	Parcel A, Lease B
70	*Euphorbia lactea*	*Euphorbiaceae*	Milk bush	shrub	introduced	rare	Parcel A
71	*Euphorbia petiolaris*	*Euphorbiaceae*	White manchineel	shrub	native	infrequent	Lease Area B
72	*Euphorbia tirucalli*	*Euphorbiaceae*	Pencil cactus	shrub	introduced	rare	Parcel A
73	*Gymnanthes lucida*	*Euphorbiaceae*	Oyster tree	tree	native	frequent	Lease Area B
74	*Hippomane mancinella*	*Euphorbiaceae*	Manchineel	tree	native	frequent	Parcel A
75	*Jatropha gossypifolia*	*Euphorbiaceae*	Wild physic nut	herb	native	infrequent	Parcel A
76	*Lantana involucrata*	*Euphorbiaceae*	Sage	shrub	native	infrequent	Parcel A
77	*Ricinus communis*	*Euphorbiaceae*	Caster oil plant	herb	introduced	infrequent	Parcel A
78	*Tragia volubilis*	*Euphorbiaceae*	Stinging vine	vine	native	frequent	Parcel A, Lease B
79	*Piscidia carthagenensis*	*Fabaceae (Faboideae)*	Fish poison tree	tree	native	frequent	Lease Area B
80	*Poitea florida*	*Fabaceae (Faboideae)*	Watapama	tree	native	occasional	Lease Area B
81	*Rhynchosia reticulata*	*Fabaceae (Faboideae)*		vine	native	frequent	Lease Area B
82	*Acacia macracantha*	*Fabaceae (Mimosoideae)*	Stink casha	tree	native	frequent	Parcel A, Lease B
83	*Acacia muricata*	*Fabaceae (Mimosoideae)*	Spineless acacia, Amarat	tree	native	common	Parcel A, Lease B

Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
84	*Acacia retusa*	*Fabaceae (Mimosoideae)*	Catch-and-keep	liana	native	occasional	Lease Area B
85	*Acacia tortuosa*	*Fabaceae (Mimosoideae)*	Casha	tree	native	infrequent	Parcel A
86	*Desmanthus virgatus*	*Fabaceae (Mimosoideae)*	Bundleflower	herb	native	frequent	Parcel A
87	*Leucaena leucocephala*	*Fabaceae (Mimosoideae)*	Tan tan; Wild tamarind	tree	introduced	infrequent	Parcel A, Lease B
88	*Pithecellobium unguis-cati*	*Fabaceae (Mimosoideae)*	Cat-claw bush; Bread-and-cheese	shrub	native	frequent	Parcel A, Lease B
89	*Samanea saman*	*Fabaceae (Mimosoideae)*	Rain tree	tree	introduced	frequent	Parcel A
90	*Parkinsonia aculeata*	*Fabaceae: (Caesalpinioideae)*	Jerusalem thorn	shrub	introduced	infrequent	Parcel A
91	*Abrus precatorius*	*Fabaceae: (Faboideae)*	Crab's eye; Jumbie bead	vine	introduced	frequent	Parcel A
92	*Coursetia caribaea*	*Fabaceae: (Faboideae)*		herb	native	infrequent	Parcel A
93	*Galactia striata*	*Fabaceae: (Faboideae)*		vine	native	frequent	Parcel A
94	*Gliricidia sepium*	*Fabaceae: (Faboideae)*	Pea tree; Quick stick	tree	introduced	frequent	Parcel A
95	*Stylosanthes hamata*	*Fabaceae: (Faboideae)*		herb	native	infrequent	Parcel A
96	*Chamaecrista glandulosa*	*Fabaceae: Caesalpinioideae*		shrub	native	frequent	Parcel A
97	*Casearia guianensis*	*Flacourtiaceae*		tree	native	frequent	Parcel A
98	*Samyda dodecandra*	*Flacourtiaceae*	Samyda; Velvet goddess	shrub	native	infrequent	Lease Area B

Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
99	*Ginoria rohrii*	*Lythraceae*	Sugar ant; Wedding tree	tree	native	frequent	Parcel A, Lease Area B
100	*Dendropemon caribaeus*	*Loranthaceae*	Mistletoe; Bass an' boom	herb, parasite	native	infrequent	Parcel A, Lease B
101	*Heteropteris purpurea*	*Malpighiaceae*	Royalty vine	liana	native	infrequent	Parcel A, Lease B
102	*Stigmaphyllon emarginatum*	*Malpighiaceae*	Wiss	liana	native	frequent	Parcel A, Lease B
103	*Abutilon umbellatum*	*Malvaceae*	Abutilon	herb	native	frequent	Parcel A
104	*Bastardia viscosa var. viscosa*	*Malvaceae*		herb	native	infrequent	Parcel A
105	*Pavonia spinifex*	*Malvaceae*		shrub	native	infrequent	Lease Area B
106	*Sida ciliaris*	*Malvaceae*		herb	native	infrequent	Parcel A
107	*Sida sp.*	*Malvaceae*		herb	native	infrequent	Parcel A
108	*Thespesia populnea*	*Malvaceae*	Seaside maho	tree	introduced	frequent	Parcel A
109	*Melia azedarach*	*Meliaceae*	Chinaberry	tree	introduced	infrequent	Parcel A
110	*Sweitenia mahagoni*	*Meliaceae*	Mahogany	tree	introduced	infrequent	Parcel A
111	*Musa sp.*	*Musaceae*	Banana	herb	introduced	infrequent	Parcel A
112	*Bontia daphnoides*	*Myoporaceae*	Bontia	shrub	native	infrequent	Parcel A
113	*Eugenia biflora*	*Myrtaceae*	Rodwood	tree	native	frequent	Parcel A, Lease B
114	*Eugenia cordata*	*Myrtaceae*	Heart-leaved eugenia	shrub	native	frequent	Lease Area B
115	*Eugenia ligustrina*	*Myrtaceae*	Birchberry	shrub	native	frequent	Lease Area B
116	*Eugenia monticola*	*Myrtaceae*	Mountain eugenia	tree	native	frequent	Lease Area B
117	*Eugenia procera*	*Myrtaceae*		shrub	native	infrequent	Lease Area B
118	*Guapira fragrans*	*Nyctaginaceae*	Black mampoo	tree	native	frequent	Lease Area B
119	*Neea buxifolia*	*Nyctaginaceae*	Neea	shrub	native	occasional	Lease Area B
120	*Pisonia subcordata*	*Nyctaginaceae*	Water mampoo	tree	native	common	Lease Area B
121	*Passiflora foetida*	*Passifloraceae*	Fetid passion	vine	native	frequent	Parcel A, Lease

Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
122	*Rivina humilis*	*Phytolaccaceae*	Cat's blood	herb	native	frequent	Parcel A, Lease B
123	*Thrichostigma octandrum*	*Phytolaccaceae*	Hoop vine	liana	native	occasional	Lease Area B
124	*Bothriochloa pertusa*	*Poaceae*	Hurricane grass	herb	introduced	frequent	Parcel A
125	*Chloris barbata*	*Poaceae*	Swollen fingergrass	herb	introduced	frequent	Parcel A
126	*Cynodon dactylon*	*Poaceae*	Bermuda grass	herb	introduced	common	Parcel A
127	*Lasiacis divaricata*	*Poaceae*	Dwarf bamboo	herb	native	infrequent	Lease Area B
128	*Sporobolis indica*	*Poaceae*	Saltgrass	herb	native	common	Parcel A
129	*Urochloa fasciculatum*	*Poaceae*		herb	native	infrequent	Parcel A
130	*Urochloa maxima*	*Poaceae*	Guinea grass	herb	introduced	infrequent	Parcel A
131	*Coccoloba microstachya*	*Polygonaceae*	Mountain grape	tree	native	infrequent	Parcel A
132	*Coccoloba uvifera*	*Polygonaceae*	Seagrape	tree	native	infrequent	Parcel A
133	*Talinum fruticosum*	*Portulacaceae*		herb	native	infrequent	Parcel A
134	*Colubrina elliptica*	*Rhamnaceae*	Maubi	tree	native	infrequent	Lease Area B
135	*Gouania lupuloides*	*Rhamnaceae*		liana	native	frequent	Parcel A, Lease B
136	*Krugiodendron ferreum*	*Rhamnaceae*	Ironwood	tree	native	frequent	Lease Area B
137	*Reynosia guama*	*Rhamnaceae*	Guama	tree	native	frequent	Lease Area B
138	*Rhizophora mangle*	*Rhizophoraceae*	Red mangrove	tree	native	common	Parcel A
139	*Antirhea lucida*	*Rubiaceae*		tree	native	infrequent	Lease Area B
140	*Chiococca alba*	*Rubiaceae*		vine	native	infrequent	Lease Area B
141	*Exostema caribeum*	*Rubiaceae*	Princewood	tree	native	common	Lease Area B
142	*Guettarda odorata*	*Rubiaceae*		shrub	native	infrequent	Lease Area B
143	*Guettarda scabra*	*Rubiaceae*	Velvet seed	tree	native	infrequent	Lease Area B
144	*Psychotria microdon*	*Rubiaceae*		liana	native	occasional	Lease Area B
145	*Randia aculeata*	*Rubiaceae*	Inkberry	shrub	native	frequent	Parcel A, Lease B
146	*Rondeletia pilosa*	*Rubiaceae*	Rondeletia	shrub	native	infrequent	Lease Area B
147	*Amyris elemifera*	*Rutaceae*	Torchwood	tree	native	common	Lease Area B

Appendix I. Plant species list for combined areas of Parcel A and Proposed Lease Area B, Est. Emmaus, St. John, VI.

No.	Scientific name	Family	Common name	Habit	Origin	Abundance	Parcel
148	*Zanthoxylum monophyllum*	*Rutaceae*	Yellow prickle	tree	native	infrequent	Lease Area B
149	*Zanthoxylum thomasianum*	*Rutaceae*	St. Thomas Prickly ash	shrub	native	frequent	Lease Area B
150	*Melicoccus bijugatus*	*Sapindaceae*	Genip; Kenip	tree	introduced	infrequent	Lease Area B
151	*Serjania polyphylla*	*Sapindaceae*	Basket wiss	liana	native	frequent	Lease Area B
152	*Brunfelsia americana*	*Solanaceae*	Brunfelsia; Heart-throb	shrub	native	infrequent	Lease Area B
153	*Solanum polygamum*	*Solanaceae*	Cankerberry	shrub	native	infrequent	Lease Area B
154	*Solanum racemosum*	*Solanaceae*	Canker berry	shrub	native	frequent	Parcel A
155	*Solanum torvum*	*Solanaceae*		shrub	introduced	infrequent	Parcel A
156	*Helicteres jamaicensis*	*Sterculiaceae*	Cow bush; Cat balls	shrub	native	occasional	Lease Area B
157	*Melochia nodiflora*	*Sterculiaceae*		shrub	native	infrequent	Parcel A
158	*Melochia tomentosa*	*Sterculiaceae*	Broom weed	shrub	native	infrequent	Parcel A
159	*Waltheria indica*	*Sterculiaceae*	Marsh-mallow	shrub	native	infrequent	Parcel A
160	*Jacquinia berteroi*	*Theophrastaceae*	Bertero's barbasco	tree	native	frequent	Lease Area B
161	*Citharexylum fruticosum*	*Verbenaceae*	Fiddlewood	tree	native	frequent	Parcel A, Lease B
162	*Clerodendrum aculeatum*	*Verbenaceae*	Crabwood	shrub	native	frequent	Parcel A
163	*Lantana camara*	*Verbenaceae*	Largeleaf lantana; Red sage	shrub	introduced	frequent	Parcel A
164	*Terminalia catappa*	*Verbenaceae*	Tropical almond	tree	introduced	infrequent	Parcel A
165	*Guaiacum officinale*	*Zygophyllaceae*	Lignumvitae	tree	native	rare	Lease Area B

Appendix II. Measurement data and GPS coordinates for a population of St. Thomas Prickly ash, Estate Emmaus

Tag Code	**Scientific name**	**Basal Diameter (cm)**	**Ht (m)**	**Lat**	**Lon**	**Remarks**
EMM-01	*Zanthoxylum thomasianum*	3.1	2.2	21.193	42.762	CUT
EMM-02	*Zanthoxylum thomasianum*	16.0	3.3	21.189	42.765	4 cut stems
EMM-03	*Zanthoxylum thomasianum*	17.0	4.5	21.189	42.765	
EMM-04	*Zanthoxylum thomasianum*	0.3	0.2	21.186	42.770	
EMM-05	*Zanthoxylum thomasianum*	0.4	0.5	21.178	42.779	
EMM-06	*Zanthoxylum thomasianum*	0.9	1.3	21.178	42.779	
EMM-07	*Zanthoxylum thomasianum*	0.9	0.5	21.178	42.778	cut at 0.5 m
EMM-08	*Zanthoxylum thomasianum*	28.0	4.5	21.179	42.774	
EMM-09	*Zanthoxylum thomasianum*	6.5	4.5	21.173	42.774	
EMM-10	*Zanthoxylum thomasianum*	15.0	4.0	21.170	42.776	2 stems cut
EMM-11	*Zanthoxylum thomasianum*	20.0	3.0	21.177	42.784	
EMM-12	*Zanthoxylum thomasianum*	1.7	1.2	21.178	42.785	
EMM-13	*Zanthoxylum thomasianum*	1.0	2.5	21.178	42.785	sapling
EMM-14	*Zanthoxylum thomasianum*	15.0	4.5	21.178	42.786	v. old shrub
EMM-15	*Zanthoxylum thomasianum*	7.5	4.0	21.169	42.794	
EMM-16	*Zanthoxylum thomasianum*	3.5	3.5	21.169	42.802	
EMM-17	*Zanthoxylum thomasianum*	8.5	2.0	21.165	42.809	CUT

Appendix II. Measurement data and GPS coordinates for a population of St. Thomas Prickly ash, Estate Emmaus

Tag Code	Scientific name	Basal Diameter (cm)	Ht (m)	Lat	Lon	Remarks
EMM-18	*Zanthoxylum thomasianum*	7.5	4.5	21.154	42.783	
EMM-19	*Zanthoxylum thomasianum*	4.8	4.0	21.157	42.783	Main stem cut; 1 remains
EMM-20	*Zanthoxylum thomasianum*	1.0	0.4	21.169	42.784	seedling cut at 40 cm
EMM-21	*Zanthoxylum thomasianum*	2.9	3.5	21.151	42.788	FEMALE
EMM-22	*Zanthoxylum thomasianum*	6.0	3.0	21.143	42.783	1 stem cut; 2 remain
EMM-23	*Zanthoxylum thomasianum*	2.1	2.5	21.155	42.782	sapling
EMM-24	*Zanthoxylum thomasianum*	2.7	3.2	21.155	42.782	sapling
EMM-25	*Zanthoxylum thomasianum*	0.9	1.0	21.155	42.782	seedling
EMM-26	*Zanthoxylum thomasianum*	0.9	1.0	21.155	42.782	seedling
EMM-27	*Zanthoxylum thomasianum*	1.0	1.4	21.155	42.782	seedling
EMM-28	*Zanthoxylum thomasianum*	2.0	1.4	21.153	42.779	sapling main st cut; 0.8 cm remains
EMM-29	*Zanthoxylum thomasianum*	11.3	4.0	21.152	42.777	
EMM-30	*Zanthoxylum thomasianum*	10.0	4.0	21.152	42.780	4 stems
EMM-31	*Zanthoxylum thomasianum*	11.3	3.8	21.150	42.777	7 stems
EMM-32	*Zanthoxylum thomasianum*	16.5	3.0	21.150	42.777	4 stems
EMM-33	*Zanthoxylum thomasianum*	2.0	3.5	21.150	42.777	1 stem

Appendix II. Measurement data and GPS coordinates for a population of St. Thomas Prickly ash, Estate Emmaus

Tag Code	Scientific name	Basal Diameter (cm)	Ht (m)	Lat	Lon	Remarks
EMM-34	*Zanthoxylum thomasianum*	2.5	3.0	21.150	42.777	1 stem
EMM-35	*Zanthoxylum thomasianum*	20.5	4.3	21.150	42.777	8 stems, v. old
EMM-36	*Zanthoxylum thomasianum*	9.0	4.0	21.161	42.776	3 stems
EMM-37	*Zanthoxylum thomasianum*	0.9	0.8	21.163	42.776	seedling
EMM-38	*Zanthoxylum thomasianum*	4.2	4.3	21.162	42.779	possibly dying, older tree
EMM-39	*Zanthoxylum thomasianum*	5.0	3.5	21.189	42.759	5 of 7 stems dead
EMM-40	*Zanthoxylum thomasianum*	2.1	2.0	21.174	42.766	sapling
EMM-41	*Zanthoxylum thomasianum*	10.6	4.0	21.177	42.765	
EMM-42	*Zanthoxylum thomasianum*	35.0	4.0	21.169	42.769	vigorous old basal cluster
EMM-43	*Zanthoxylum thomasianum*	12.0	3.8	21.161	42.769	
EMM-44	*Zanthoxylum thomasianum*	9.5	4.0	21.154	42.770	5 stems, main cut
EMM-45	*Zanthoxylum thomasianum*	12.0	3.5	21.150	42.759	7 stems
EMM-46	*Zanthoxylum thomasianum*	3.2	4.0	21.147	42.778	
EMM-47	*Zanthoxylum thomasianum*	2.1	1.0	21.147	42.778	
EMM-48	*Zanthoxylum thomasianum*	9.0	3.2	21.139	42.784	just S of boundary
EMM-49	*Zanthoxylum thomasianum*	0.7	0.7	21.139	42.784	just S of boundary; seedling

Appendix II. Measurement data and GPS coordinates for a population of St. Thomas Prickly ash, Estate Emmaus

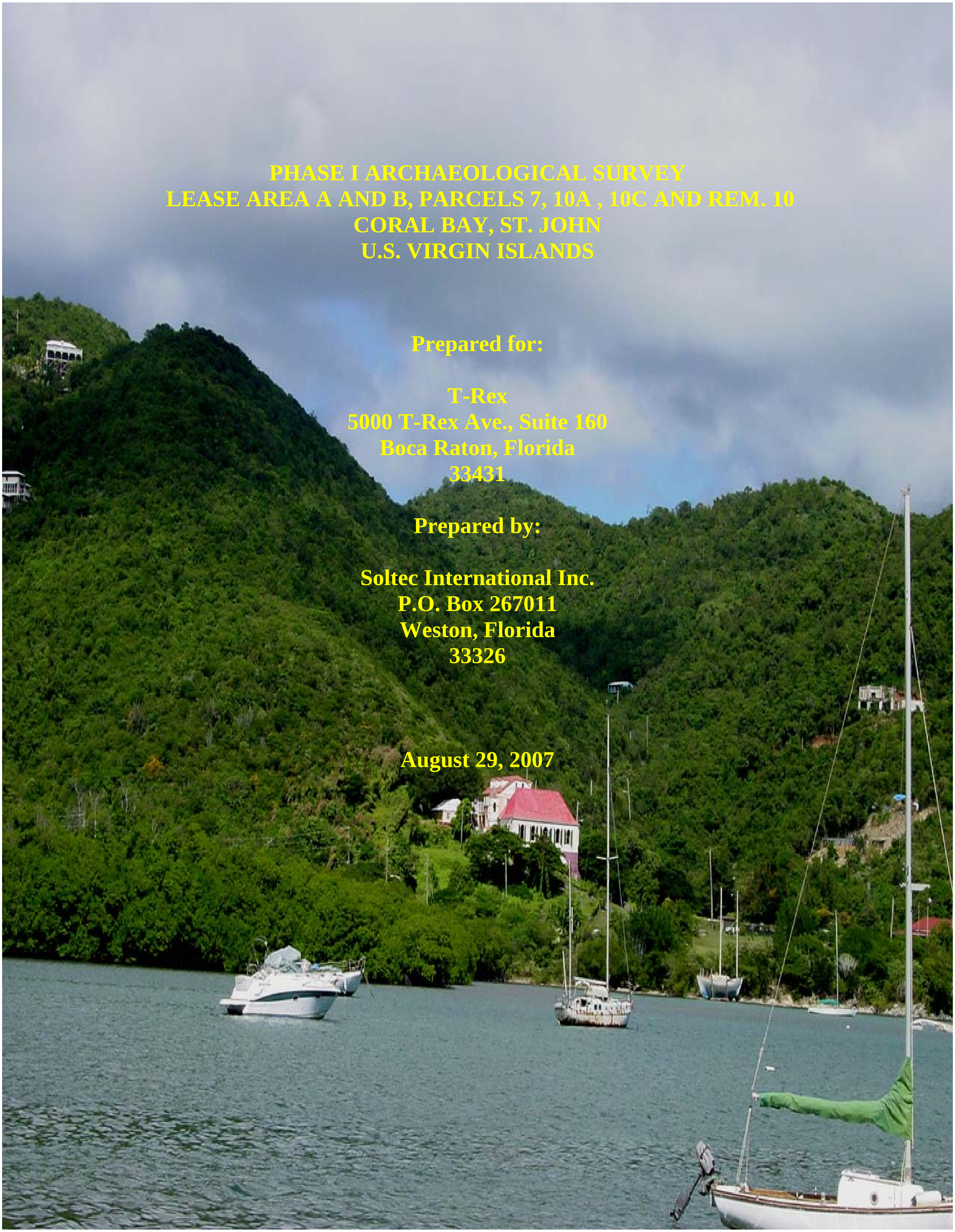
Tag Code	Scientific name	Basal Diameter (cm)	Ht (m)	Lat	Lon	Remarks
EMM-50	*Zanthoxylum thomasianum*	2.1	1.5	21.138	42.783	just S of boundary
EMM-51	*Zanthoxylum thomasianum*	1.6	1.5	21.144	42.785	just S of boundary
EMM-52	*Zanthoxylum thomasianum*	7.0	3.8	21.141	42.778	just S of boundary
EMM-53	*Zanthoxylum thomasianum*	1.1	1.4	21.141	42.778	seedling
EMM-54	*Zanthoxylum thomasianum*	1.0	1.0	21.141	42.778	seedling
EMM-55	*Zanthoxylum thomasianum*	0.8	0.7	21.141	42.778	seedling
EMM-56	*Zanthoxylum thomasianum*	0.9	1.3	21.141	42.778	seedling
EMM-57	*Zanthoxylum thomasianum*	0.7	0.6	21.141	42.778	seedling - leafless
EMM-58	*Zanthoxylum thomasianum*	2.0	2.0	21.159	42.796	
EMM-59	*Zanthoxylum thomasianum*	7.7	4.0	21.161	42.793	

Appendix III. GPS coordinates for Significant Tree Positions of Parcel A, Estate Emmaus, St. John.

No.	Species	Stem A	Basal Dia?	Lat	Lon	Comments
1	*Samanea saman*	35.5		20.879	42.844	
2	*Andira inermis*	59.0	BD	20.874	42.834	
3	*Samanea saman*	25.7		20.860	42.837	
4	*Bourreria succulenta*	34.5	BD	20.830	42.832	
5	*Cassine xylocarpa*	25.0	BD	20.827	42.831	
6	*Gliricidia sepium*	29.0	BD	20.828	42.829	
7	*Pilosocereus royenii*	27.0	BD	20.827	42.829	
8	*Pilosocereus royenii*	17.0	BD	20.826	42.830	
9	*Pilosocereus royenii*	15.2	BD	20.826	42.830	
10	*Tabebuia heterophylla*	28.9	BD	20.830	42.822	
11	*Gliricidia sepium*	36.0	BD	20.827	42.810	
12	*Pilosocereus royenii*	50.0	BD	20.818	42.808	
13	*Plumeria alba*	15.2	BD	20.822	42.811	
14	*Acacia muricata*	20.1	BD	20.822	42.811	
15	*Pilosocereus royenii*	20.0	BD	20.818	42.796	
16	*Cassine xylocarpa*	21.0	BD	20.817	42.779	
17	*Pilosocereus royenii*	21.0	BD	20.817	42.778	
18	*Pilosocereus royenii*	60.0	BD	20.817	42.777	
19	*Pilosocereus royenii*	23.0	BD	20.814	42.774	
20	*Pilosocereus royenii*	28.0	BD	20.814	42.773	
21	*Bucida buceras*	35.0		20.826	42.768	prostrate
22	*Bucida buceras*	83.5	BD	20.829	42.772	
23	*Guapira fragrans*	17.3		20.829	42.773	
24	*Cordia sebestena*	32.0	BD	20.836	42.764	
25	*Ginoria rohrii*	43.5	BD	20.831	42.764	
26	*Tabebuia heterophylla*	41.7		20.831	42.757	
27	*Terminalia catappa*	59.0		20.845	42.765	
28	*Cordia sebestena*	39.0	BD	20.846	42.753	
29	*Ficus benjamina*	80.8	BD	20.841	42.752	
30	*Cordia sebestena*	23.4		20.883	42.771	
31	*Tabebuia heterophylla*	34.8		20.857	42.772	
32	*Ficus benjamina*	128.0		20.844	42.744	
33	*Cordia sebestena*	60.5		20.843	42.736	

Appendix III. GPS coordinates for Significant Tree Positions of Parcel A, Estate Emmaus, St. John.

No.	Species	Stem A	Basal Dia?	Lat	Lon	Comments
34	*Cordia sebestena*	62.0		20.837	42.746	
35	*Bucida buceras*	54.6		20.838	42.731	
36	*Bucida buceras*	67.8		20.838	42.730	
37	*Bucida buceras*	63.7		20.841	42.728	
38	*Bucida buceras*	56.5		20.836	42.723	
39	*Bucida buceras*	52.8		20.836	42.722	
40	*Bucida buceras*	32.8		20.824	42.736	
41	*Pilosocereus royenii*	22.0	BD	20.808	42.754	
42	*Pilosocereus royenii*	25.0	BD	20.808	42.754	
43	*Pilosocereus royenii*	18.0	BD	20.806	42.753	
44	*Coccoloba microstachya*	80.0	BD	20.794	42.753	
45	*Tabebuia heterophylla*	17.5	BD	20.802	42.742	
46	*Thespesia populnea*	61.0	BD	20.811	42.737	Toppled
47	*Bucida buceras*	64.5		20.827	42.709	
48	*Bucida buceras*	72.0		20.826	42.703	
49	*Bucida buceras*	74.0		20.839	42.708	
50	*Cordia collococca*	22.0		20.840	42.693	
51	*Delonix regia*	96.5	BD	20.848	42.676	
52	*Samanea saman*	50.0		20.841	42.678	
53	*Swietenia mahagoni*	20.2		20.841	42.671	
54	*Swietenia mahagoni*	17.0		20.841	42.670	
55	*Bucida buceras*	55.0	BD	20.842	42.665	
56	*Bucida buceras*	46.3		20.845	42.626	
	Stems measured at Breast Height unless indicated (BD) -- Basal Diameter	**42.9**	Mean stem diameter (cm)			



PHASE I ARCHAEOLOGICAL SURVEY
LEASE AREA A AND B, PARCELS 7, 10A , 10C AND REM. 10
CORAL BAY, ST. JOHN
U.S. VIRGIN ISLANDS

Prepared for:

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LIST OF FIGURES

1.0 INTRODUCTION

Soltec International Inc. (Soltec) performed a Phase I archaeological survey in Lease Areas A and B located on Parcels 7, 10A, 10C and Rem. 10, Estate Emmaus (Study Area), No. 2 Coral Bay Quarter, St. John, U.S. Virgin Islands (Figures 1, 2 and 3) on behalf of T-Rex Capital (T-Rex). Since the performance of the field study, Lease Area B has been excluded in the proposed development plans. The proposed development for Lease Area A includes the relocation of existing facilities such as a fire station, elementary school and ball field to areas to the west in Parcel 10C. T-Rex proposes to construct a marina and hotel complex on Lease Area A. A small area in the northeastern part of Lease Area A that is currently occupied by Skinny Legs Restaurant will remain as an out-parcel.

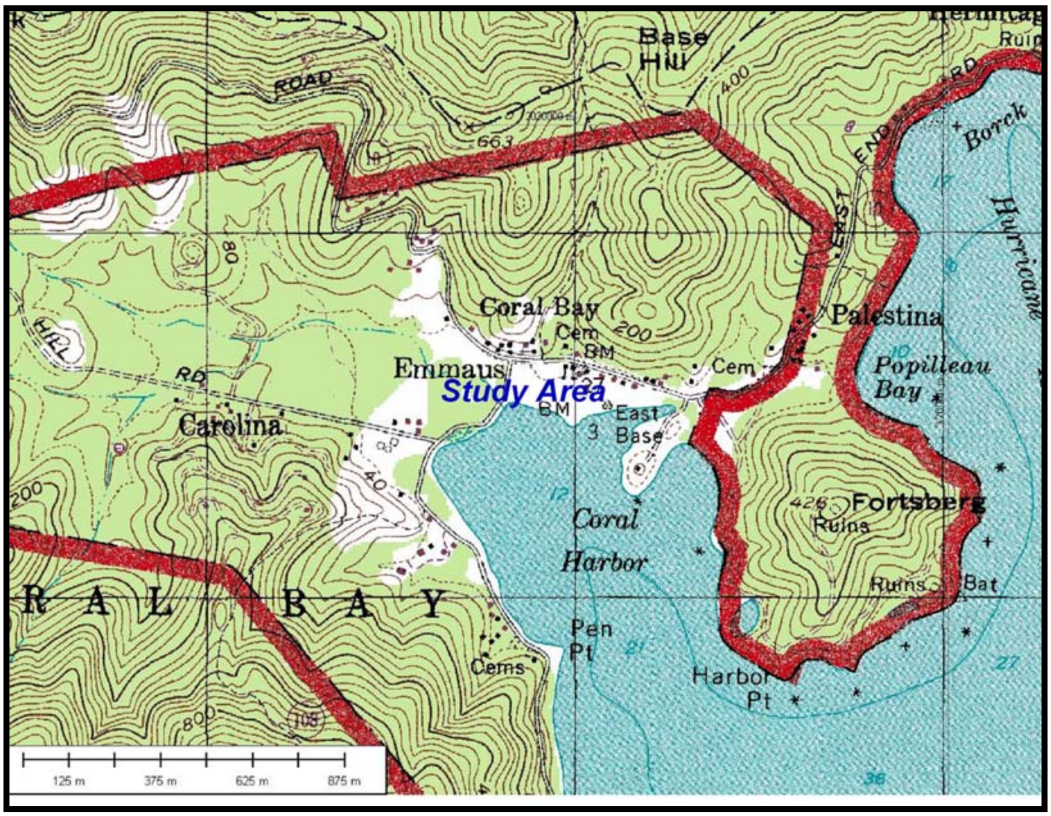

Figure 1: USGS Map (Western St. John: 1982) showing the general location of the Study Area

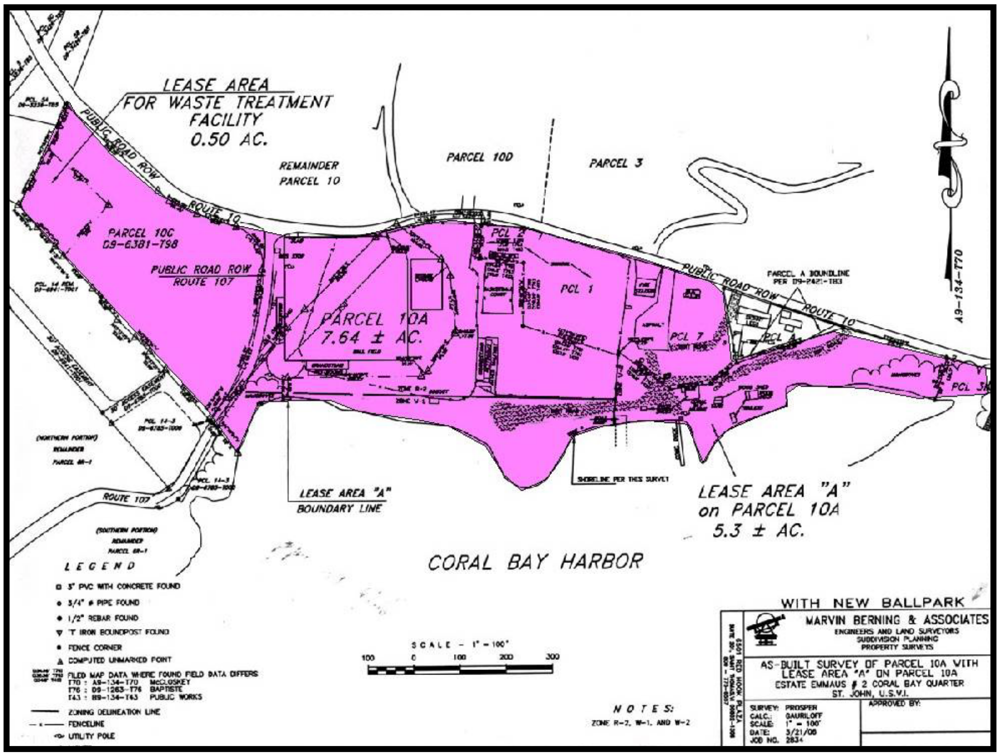

Figure 2: Plot map showing Lease Area A

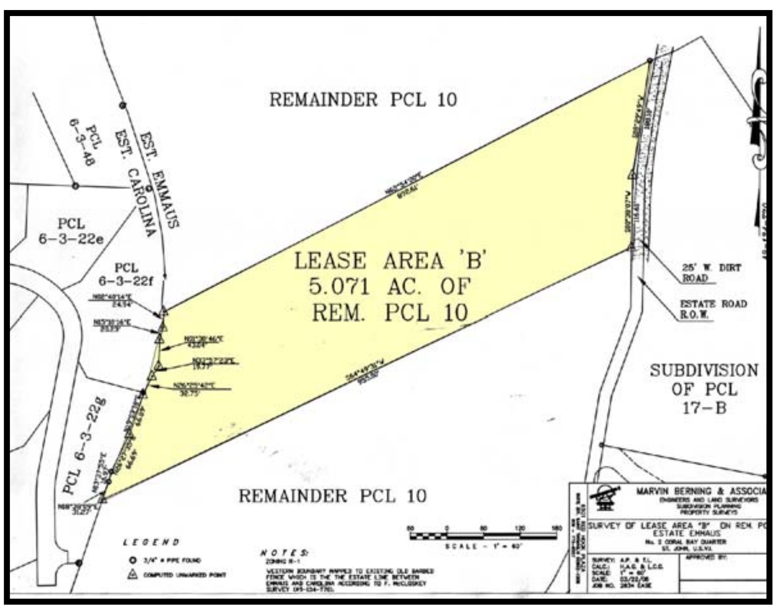

Figure 3: Plot Map showing Lease Area A

1.1 REGULATORY FRAMEWORK

The proposed development is required to comply with Section 106 of the National Historic Preservation Act of 1996, as amended and Title 29, Chapter 17, Section 959, of the Virgin Islands Code, also known as the Antiquities and Cultural Properties Act of 1998.

To comply with the above requirements, T-Rex Capital contracted a Phase I (A and B) Archaeological Survey. Phase IA was intended to review literature and records for the potential presence of significant cultural resources, the results are reported in Section 2.0. Phase IB was composed of a systematic Archaeological Survey of the Study Area in order to identify any possible cultural resources that may exist, the results are reported in Section 3.0.

1.2 ENVIRONMENTAL SETTING

The topography of Lease Area A ranges from moderately sloping foot slopes to nearly level lowlands. Lease Area B contains steeply sloping side slopes with gradients that range between approximately 40 to 80 percent.

1.2.1 Lease Area A

This portion of the property is located on the north shore of Coral Bay Harbor. The area of concern is located at the intersection of foot slopes, a narrow strip of low lying and modified land and the ocean (Figures 4 – 10). The Soil Conservation Service classifies the soils for most of Lease Area A into the mapping unit Ustorthents which are soils that have been altered from their natural state by humans, in this case cut activities to level foot slopes and infilling of low lying areas adjacent to the shore. Most of the flora has been cleared for human activity, and the flora that does exist is secondary growth. The eastern most part of the property is regularly affected by tidal influence, while the westernmost part of the property appears to contain areas that are periodically inundated. The central part of the subject property is contained on highly modified toe slopes of the hills to the north; this area contains numerous buildings (Figures 11 - 13) including a school, fire department, restaurant and shops, as well as a ball field.

Figure 4: Photograph showing lowland topography of Lease Area A; dirt road along Coral Bay Marina facing east

Figure 5: Photograph showing lowland topography of Lease Area A; Coral Bay Marina facing west

Figure 6: Photograph showing fill layers of Lease Area A

Figure 7: Photograph showing exposed bedrock in Lease Area A

Figure 8: Photograph showing Mangrove environment in eastern portion of Lease Area A

Figure 9: Photograph of characteristic vegetation in the western part of Lease Area A

Figure 10: Photograph of ground surface and crab hole in the western section of Lease Area A

Figure 11: Photograph of ball field, note the abrupt change in elevation that evidences the truncation of the upper soil horizons (Moravian Church in background)

Figure 12: Photograph of firehouse

Figure 13: Photograph of school buildings and yard

1.2.2 Lease Area B

The topography of Lease Area B is characterized by sloping side slopes with gradients that range between approximately 40 to over 60 percent (Figures 14 and 15).

Based on the Soil Survey of the United States Virgin Islands (2002), the majority of the subject property is covered by the Southgate Rock Outcrop Complex, with slopes varying from 40-60% . The ground surface is very rocky, where exposed, the surface soils consist of brown gravelly clay loam that extend to a depth of approximately 15 centimeters below surface and are underlain by brown gravelly clay, which extends to a depth of approximately 30 centimeters, the depth at which weathered igneous bedrock is encountered.

The vegetation consists primarily of pioneer species characteristic of formerly cleared lands of the xerophytic environments of the East End of St. John. A few mature interspersed deciduous trees are present throughout the property.

Figure 14: Photograph of Lease Area B from across the Bay (area above red roofed church)

Figure 15: Photograph showing rocky topography and steep slope of Lease Area B

2.0 LITERATURE AND RECORDS SEARCH SUMMARY

Mr. David Brewer, Senior Archaeologist with the Virgin Islands State Historic Preservation Office (VISHPO) informed Soltec that his search of the Archaeological Site Files indicated that no archaeological sites of record were located within the specific Lease Areas. Mr. Brewer did however, inform Soltec of significant cultural resources located within relatively close proximity to the two areas of concern. The resources in close proximity to Lease Areas A and B include the Moravian Church compound, which is listed in the National Register of Historic Places (NRHP), the Emmaus settlement to the northeast, the Carolina Plantation to the southwest and a fortification to the southeast. The closest reported prehistoric site is the Calabash Boom site located on Johnson Bay to the southeast of the subject property. All of the resources mentioned above are outside of the areas of concern (Lease Areas A and B).

Historic period ruins are located north of the study area (Lease Area B) on the Johnny Horn Trail (see also Singer 2006), and outside of the study area. As the trail forks near the top of the ridge, a spur trail to the west leads to the ruins of the Leinster Bay Estate House (also known as Windy Hil). The structure was originally built in the late 1700s as the estate house for James Murphy. Murphy owned a vast estate that was part of the Murphy Estate, including Annaberg, Mary Point, Water Bay, Leinster Bay and Brown Bay plantations. In 1843, the estate house became the property of Judge H. Berg, the vice-governor of the Danish West Indies. Berg, who lived in St. Thomas, was also the owner of the Annaberg Plantation. Before selling the remainder of his estates on St. John, Judge Berg bequeathed small plots of land east of the estate house to some of his employees. These employees and their descendants established the village of Johnny Horn, and remains of these houses are located adjacent to the Johnny Horn Trail.

The Moravian Church (Figure 17) is located at the bottom of the trail in Coral Bay near the intersection of Centerline Road (Route 10) and the Johnny Horn Trail. The Moravians came to St. John in 1741, the original church building is reported to have been built in or shortly after 1782 and destroyed by a hurricane in 1790 and its replacement destroyed by fire in 1892; the current building was constructed in 1919. The 1780 Oxholm map (Figure 16) depicts three structures at the approximate location of the existing church, one of the structures depicted is likely to represent the Manse which is reported to have been constructed at about the middle of the 18th- century, predating the first church.

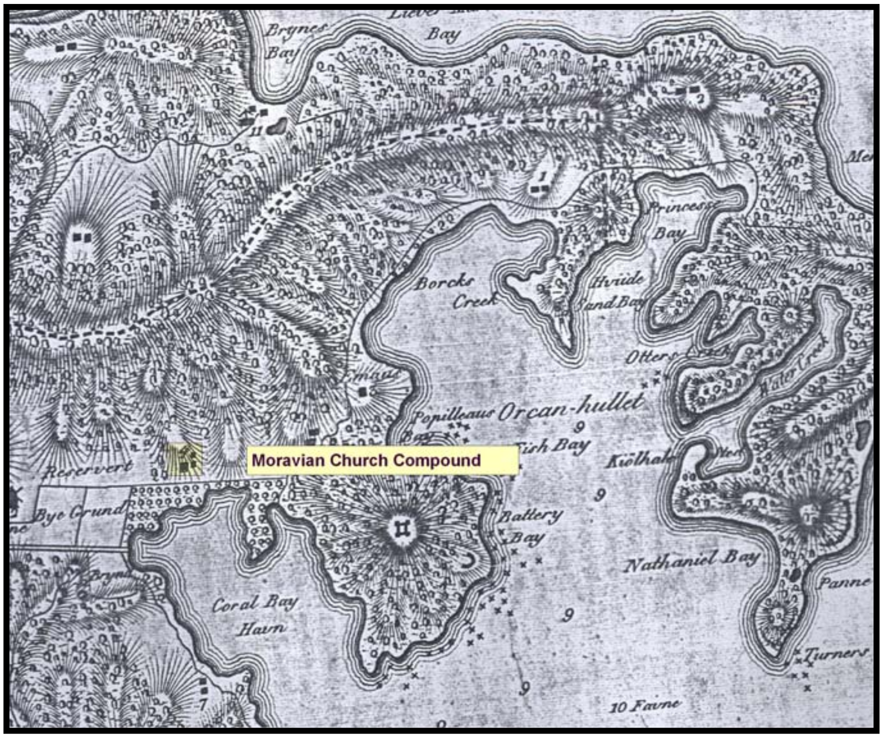

Figure 16: 1780 Oxholm map showing location of Moravian Church compound

Figure 17: Photograph showing the Moravian Church, view to the north

3.0 DESCRIPTION OF FIELD WORK

Archaeological investigations included a pedestrian reconnaissance and subsurface testing. The subsurface testing included shovel testing at 20-meter intervals and test trenching with a backhoe to assess the nature of fill materials as well as the buried natural ground surfaces.

3.1 LEASE AREA A

With the exception of Parcel 10C which remains undeveloped, Lease Area A has been extensively modified by the construction of structures and a ball field. The exposed surfaces are, for the most part, sub-soils that have been exposed and/or created by cut and fill activities. Some areas of Parcel 10A are hard surfaced. Shovel tests were performed at 20-meter intervals in those areas that appeared to retain some degree of pedon integrity, such as a trail behind the baseball field, and past the dingy dock to the mangroves, and the small peninsula near the south central part of Study Area and all of Parcel 10C (Figures 18-21).

The soil from each shovel test was passed through ¼-inch mesh hardware cloth in order to search for any artifacts or cultural remains (Figure 19). For each test, soil texture, soil color in the Munsell notation system, depth, and content were recorded. If any materials were recovered, they were bagged and labeled as to provenance. Some shovel tests could not be excavated due to the presence of modern concrete or asphalt, modern cultural features or exposed bedrock, in this situation the test area was marked, noted, and skipped. No testing was performed for the ball field as the obvious truncation of the upper soil horizons destroyed any cultural resources that may have existed at that location; however, an extensive visual examination of the currently exposed surfaces was performed.

Deep testing was performed along the south-central and eastern parts of Parcel 10A where fill deposits were encountered during the shovel testing activities. Five trenches were mechanically excavated at between 40 and 50-meter intervals in this area (Figures 22-26). These trenches were excavated to artifactually sterile soils or bedrock, the profiles of the trenches and excavated soils were inspected for artifacts. Profiles were drawn and photos taken.

The deep testing revealed a general stratigraphy consisting of a surface layer of heterogeneous clay loam underlain by clay and rubble fill layers; bedrock was encountered at a depth of approximately 1 meter below the ground surface. The water table was encountered at approximately 65 centimeters below surface in the eastern parts of Parcel 10A. In addition to the modern fill layers, other evidence of disturbance includes the exposure of the corner of a concrete septic tank.

Figure 18: Photograph showing Transect A of Lease Area A, facing east

Figure 19: Photograph showing shovel testing activities in Lease Area A

Figure 20: Photograph showing example of shovel test excavated in Parcel 10A

Figure 21: Photograph showing vertical roller, found in south- central part of Parcel 10A

Figure 22: Photograph showing Trench 1, Lease Area A

Figure 23: Photograph showing Trench 2, Lease Area A

Figure 24: Photograph showing Trench 3, Lease Area A

Figure 25: Photograph showing Trench 4, Lease Area A

Figure 26: Photograph showing Trench 5, Lease Area A

3.2 LEASE AREA B

Lease Area B was located on the slopes north of the Coral Bay Marina. The terrain is extremely rocky (Figure 27) and generally contains very steep slope grades (> 40 %). The area was investigated using pedestrian reconnaissance and subsurface testing in the form of shovel tests. Surveyor's transects were used when possible for surface survey and shovel testing. An east/west transect ran the length of the property at 78º and 8.2 meters from the northern property line. This transect was initially walked and observed for surface finds or architectural features, none were found. From the east/west transect, transects extended south every 15 meters oriented between 192 and 195º.

Shovel tests were initially placed on the east/west transect, and then continued every 20 meters along the north/south transects. Many of the shovel tests were impossible to complete because of the extreme rocky terrain and steep slope. None of the shovel tests was positive for cultural remains. If a relatively flat area was located adjacent to the transect (Figure 28), it was also walked and inspected for cultural remains, none were found.

Figure 27: Photograph showing rocky terrain of Lease Area B

Figure 28: Photograph showing visual inspection of areas adjacent to transects

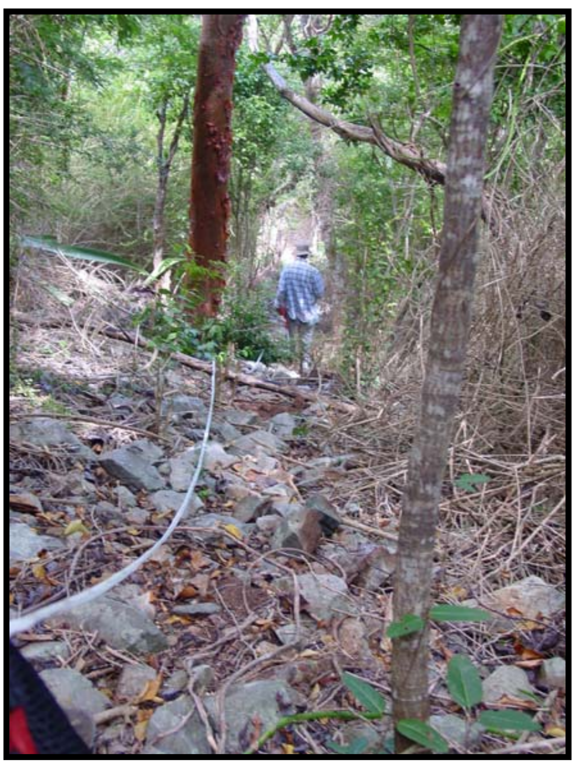

Figure 29: Photograph showing east/west transect, and rocky, steep slopes of Lease Area B

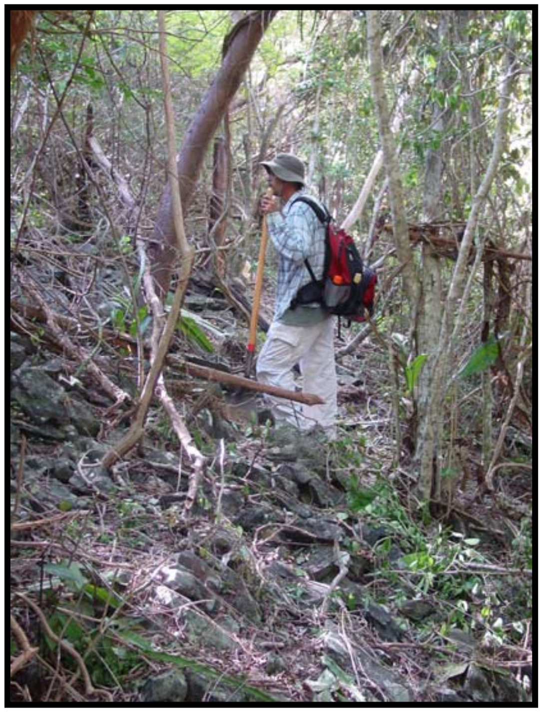

Figure 30: Photograph showing shovel testing of Lease Area B

4.0 SURVEY RESULTS

The Phase I Archaeological Survey performed for Lease Areas A and B indicates that no potentially significant archaeological contexts are present within the surveyed areas. The absence of archaeological contexts within Parcel 10A was surprising given that this location was likely an attractive location for a prehistoric settlement. Although extensively disturbed, no evidence was found to indicate that a prehistoric settlement existed at this location where sites existed. Ordinarily, materials such as shell and ceramics are found even in highly disturbed contexts. Historic and modern artifacts were recovered from the shovel tests and test trenches, but these were few in number and small in size. Four undecorated Whiteware sherds, six clear and four green glass sherds were recovered in Parcel 10A. The exterior ferrous metal sheath of a roller for crushing cane was also found in Parcel 10A. This artifact was re-utilized in more recent times by filling it with concrete and setting rebar in its center (Figure 21).

Cultural Features

A potentially significant historic building was recorded within Lease Area A The structure is what appears to be the original school house for the Guy H. Benjamin Elementary School (Formerly Benjamin Franklin School) which is reported to be approximately one hundred years old. The school's architecture appears to be an adaptation of the Caribbean cottage style (Figure 31).

Figure 31: Photograph of the Guy H. Benjamin Elementary School (north elevation)

A rock alignment was recorded in the southwestern part of the subject property. The rock alignment is most likely a historic property division marker as evidenced by its correlation to a recent survey point at the southwestern corner of the subject property (Figure 32).

Figure 32: Photograph of the southwest corner of rock alignment and subject property

The shovel and backhoe tests performed demonstrated that the south central part of the subject property has been extensively modified and the few artifacts recovered were contained in contexts that lack contextual integrity. The level of disturbance to natural soil matrices was found to be less extensive in the western parts of the property, however, these lands are periodically inundated and as such not attractive for permanent settlement.

4.0 DESCRIPTION OF LABORATORY WORK AND ARTIFACTS RECOVERED

Laboratory work was minimal, as very few artifacts were recovered. The initial processing of artifacts included washing and air-drying of the artifacts. Once dry, the artifacts were sorted into broad artifact classes (e.g. ceramics and glass), then re-bagged and labeled. Classification of artifacts was then made within a comparative framework. Existing classificatory systems were used to classify the artifacts. The artifacts recovered are described in previous sections of the report.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Our concluding remarks for Lease Areas A and B and provided below.

5.1 LEASE AREA A

No undisturbed archaeological contexts were encountered during shovel and mechanical subsurface testing. The materials recovered were both historic and modern and within disturbed contexts. The testing performed indicates that numerous cut and fill episodes have been made within Lease Area A. The stripping and/or deflation of top soil is in part, evidenced by exposed parent rock or its presence at near surface depths. The western part of the subject property is less modified, but even in that location, we encountered a number of push piles. Multiple fill episodes were also documented in Lease Area A, as evidenced by the heterogeneity of the soils and unsorted inclusions, such as rock and modern materials.

The Guy H. Benjamin School is considered to have the potential to be considered as a significant architectural resource because of the role it has played in the education of the Coral Bay community for approximately one hundred years, and because of its architectural style. T-Rex Capital proposes to preserve the building and adaptively reuse it as a Custom's House. We recommend additional studies to include the recordation of existing building conditions be made of the building and any other potentially significant associated structures be performed prior to making any modifications. The level of recordation of the building should follow Historic Architecture and Building Survey (HABS) standards and guidelines. This documentation includes measured drawings, large format photography and historical documentation.

The rock alignment considered to represent the remains of the property boundary marker is not considered to have the potential to meet criteria of eligibility to the National Register of Historic Places. However, these cultural features once ubiquitous throughout St. John, are rapidly disappearing due to development activities. Given its location in the corner of the property, we recommend that the feature be preserved in situ. In the event that preservation is not feasible, we recommend that the extent of the feature be mapped and representative cross section drawings and photographs made prior to its destruction.

There exists a potential to adversely impact the visual landscape of the Moravian Church, which is listed in the NRHP. Potential adverse visual impacts may be avoided or minimized though the design of culturally sensitive buildings and landscaping.

5.2 LEASE AREA B

The steep topography and rocky surface conditions present within Lease Area B are not considered conducive for human settlement without significant land modifications, requiring large investments of energy. These areas likely served for resource procurement during both prehistoric and historic times. As mentioned in Section 1.0, Lease Area B will not be developed.

With the exceptions noted in the preceding paragraphs, Soltec concludes that no further archaeological studies are required for Lease Area A and recommends that the VISHPO issue a finding of ***no objection*** to the proposed development of the subject property. However, we recommend that T-Rex consult with the VISHPO concerning the potential for adverse visual impacts to the landscape setting of the Moravian Church and the adaptive re-use of the Guy H. Benjamin School.

In the event that the additional lands are added to this project, we recommend to T-Rex that the VISHPO be notified of such changes. In the event that cultural resources are encountered during land clearing or construction activities, the developer should cease all earth movement activities and notify the VISHPO.

6.0 REFERENCES

Singer, Gerald
2006 *St.John, Off the Beaten Track* Sombrero Publishing Company

USDA
2002 *Soil Survey of the U.S. Virgin Islands*

REPORT OF FINDINGS

Cultural Resources Remote Sensing Survey Of The Proposed Coral Bay Marina Coral Bay, St. John, U.S. Virgin Islands

Prepared for:

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March ♦ 2007

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March ♦ 2007

ABSTRACT

In February of 2007, maritime archaeologists from Panamerican Consultants, Inc. of Memphis, Tennessee (Panamerican) conducted a Cultural Resources Remote Sensing Survey of a proposed marina development on St. John, U.S. Virgin Islands. Performed under contract to Soltec International, Inc. of Weston, Florida, the proposed project area is located on the east end of St. John in Coral Bay. Specifically, the proposed project includes an area approximately 320 feet by 250 feet located adjacent to the north-central coast of Coral Harbor, which forms the northwestern portion of Coral Bay. The remote-sensing survey consisted of a magnetometer survey to determine the presence or absence of submerged anomalies or targets within the Project Area that might represent the remains of historic shipwrecks. Results of the current remote sensing survey recorded several small magnetic anomalies. However, because of visual confirmation of the anomaly sources (i.e., vessels, moorings), as well as the over all the intensive modern use-history of the area, the anomalies are not considered to be representative of potentially significant submerged cultural resources. It is the opinion of the Principal Investigator that no potentially significant submerged cultural resources will be impacted by proposed project activities, and, therefore, the Project Area should be given clearance relative to submerged cultural resources permit issues.

ACKNOWLEDGMENTS

As with all undertakings of this nature, the successful completion is the result of the combined efforts of numerous individuals. First, the author wishes to offer his appreciation to Mr. Carlos Solis, President of Soltec International, Inc. for affording this research opportunity. Mr. David Brewer, State Archaeologist with the U.S. Virgin Island Department of Archaeology and Historic Preservation, Department of Planning and Natural Resources, must be thanked for his help with archaeological records and direction. Mr. Calvin Pressley, our boat captain, is thanked for getting us there and back and performing in a tight area. Lastly, the fine people of the Virgin Islands are thanked for their island hospitality.

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LIST OF FIGURES

I. INTRODUCTION

In February of 2007, maritime archaeologists from Panamerican Consultants, Inc. of Memphis, Tennessee (Panamerican) conducted a Cultural Resources Remote Sensing Survey of a proposed marina development on St. John, U.S. Virgin Islands. Performed under contract to Soltec International, Inc. of Weston, Florida, the proposed project area is located on the east end of St. John in Coral Bay (Figure 1). Specifically, the proposed project includes an area approximately 320 feet north/south by 250 feet east/west located adjacent to the north-central shore of Coral Harbor, which forms the northwestern portion of Coral Bay (Figures 2 and 3).

Figure 1. Aerial photograph showing the eastern end of St. John and general project area location (courtesy of NOAA's Center for Coastal Monitoring and Assessment).

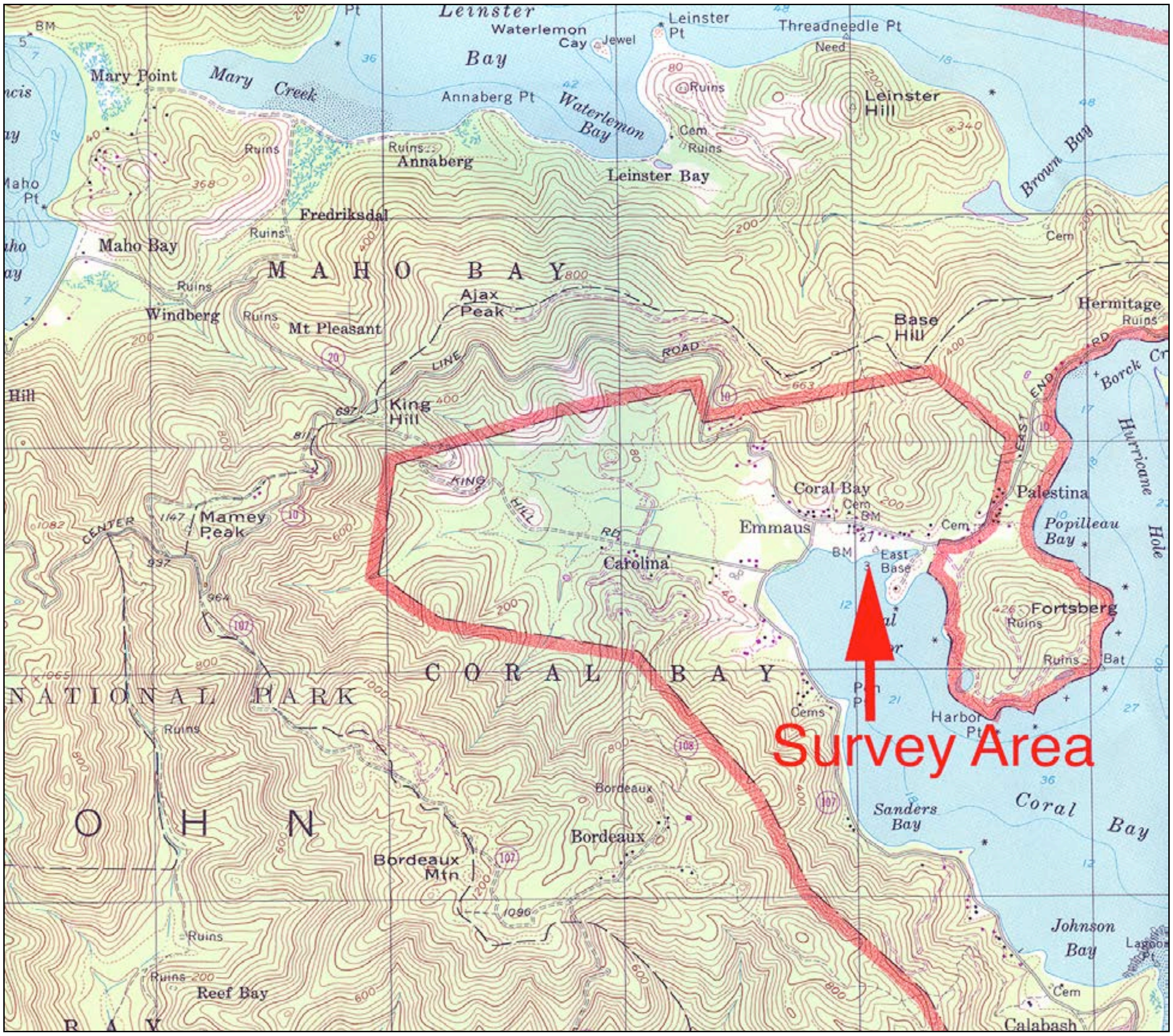

Figure 2. Project area location map (Western St. John, V., N1816.5-W6442).

Under regulations created by the Federal Water Pollution Control Act Amendments of 1972 and the attendant Clean Water Act of 1977 (FWPCA), the client is required to provide information on the effects of the proposed expansion project activities relative to potential submerged cultural resources within the project area. To comply with these federal regulations, the current investigation, which utilized a marine magnetometer in concert with differential global positioning system, was designed and implemented to identify the presence or absence of submerged historic remains within the project area. To this effect, results of the magnetometer survey documented no potentially significant magnetic anomalies within the project area. With this said, it is the opinion of the Principal Investigator that no potentially significant submerged cultural resources will be impacted by proposed project activities, and the project area should be given clearance relative to submerged cultural resources permit issues. These conclusions are presented in the following report along with chapters on the island's maritime history and the conduct and results of the field investigation.

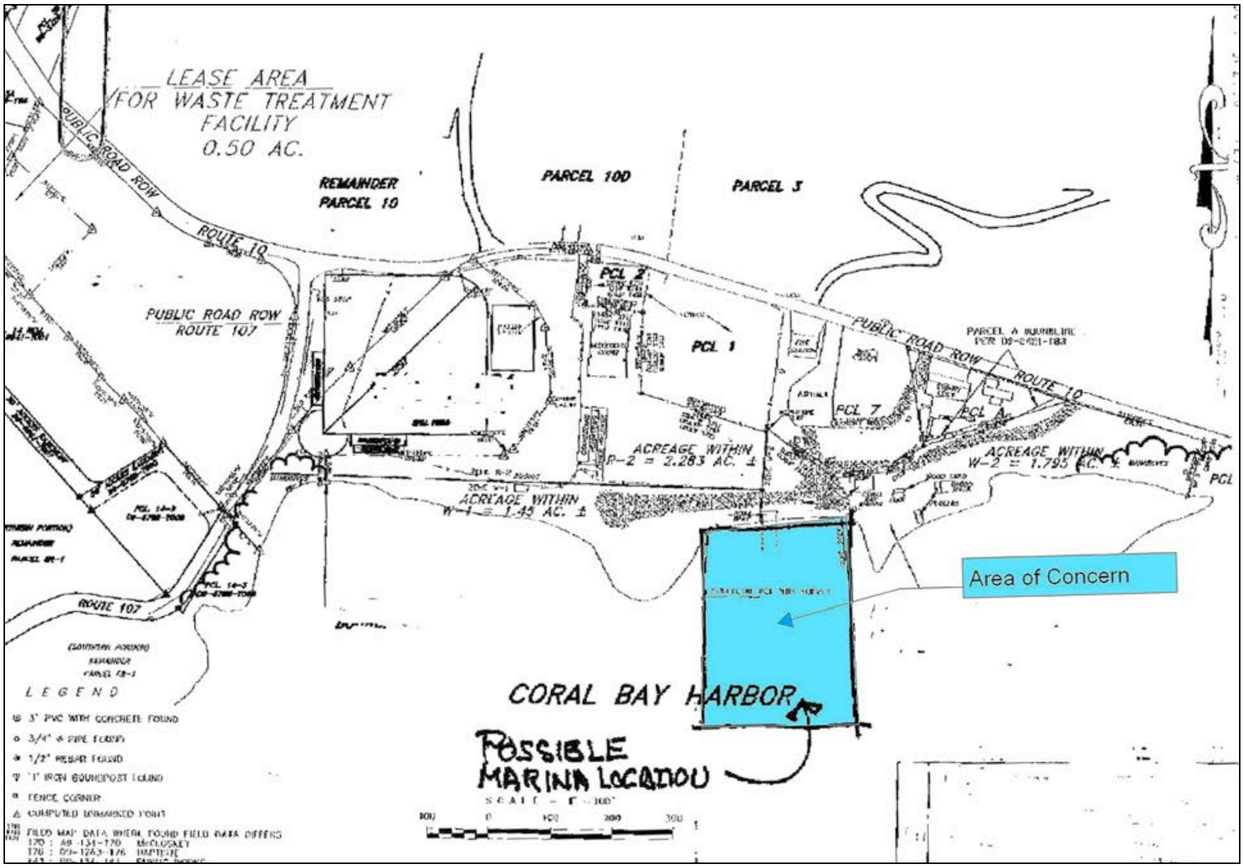

Figure 3. Current schematic of the proposed marina development project area boundaries (courtesy of Soltec International, Inc.). Project area is approximately 320 feet north/south by 250 feet east/west.

II. CULTURAL BACKGROUND

The investigation was prefaced by limited archival research and an archaeological site files check. The archival research and site files check covered this broad area in general in order to identify sites that would need to be addressed, if present, if they fell within the actual project area; however, no submerged cultural resources sites are recorded in or near the project area, and no previous investigations have been conducted in the general vicinity. With that said, the land portion of the project area has been subject to an intensive Phase 1A and 1B investigation.

The following historical overview presents a general overview of maritime history of the Virgin Islands and the island of St. John, as well as previous submerged cultural resource investigations for the area.

HISTORIC OVERVIEW

St. John was among the Caribbean Islands that Christopher Columbus encountered and claimed for Spain during his second voyage to the New World in 1493. Preoccupied with the mineral wealth of the Greater Antilles and Latin America, the Spanish made no effort to colonize this small, mountainous island. In the mid- to late 1600s, small parties of woodcutters and agriculturalists periodically inhabited St. John (Larsen 1986).

Attracted by the lucrative prospects of cultivating sugar cane, the Danes took formal possession in 1694. In March 1718, settlers from neighboring St. Thomas established the first permanent European settlement on St. John at Estate Carolina in Coral Bay. The Danish began to parcel the land for plantation development, with the intention of supplying Europe with sugar, cotton, and tobacco.

GENERAL MARITIME HISTORY OF THE VIRGIN ISLANDS AND ST. JOHN

Beginning in the late seventeenth century, the Virgin Islands, with the main focus St. Thomas, was the scene of considerable maritime activity. Besides Denmark, trade with the British American colonies in the 1700s was extremely important to the efficient operation of island plantations. Maritime activity also included trade with British, Dutch, French, and Spanish colonies in the West Indies (Dookhan 1974; Tyson 1986a, 1986b).

Most seaborne commerce, as indicated by several eighteenth- and nineteenth-century charts (i.e., Bellin 1771; Jeffreys 1775; Rohde 1822), approached the island's main harbor, Charlotte Amalie, from the south. When the Virgin Islands plantation system was flourishing during the seventeenth and eighteenth centuries, some trans-oceanic ships sailed along the coasts in order to put into protected bays, where they took on cargoes of sugar, rum, molasses, and cotton and/or engaged in illegal trade from nearby estates. Additionally, small inter-island coasters regularly transported plantation produce between the bays and St. Thomas harbor (Olsen 1988).

St. Thomas' proximity to regular trade routes used by sailing ships entering or leaving the West Indies made it an ideal site for the practice of piracy during the seventeenth and eighteenth centuries. Additionally, the attitudes of the island's earlier governments allowed piracy and smuggling to exist and even flourish. While the Virgin Islands never acquired the fame of notorious pirate havens of some islands like Jamaica, they were visited by well-known practitioners of the trade such as Le Paine, Captain Kidd, and Bartholomew Sharp (Dookhan 1974).

The Virgin Islands made the transition from an agricultural to a trade-based economy during the second half of the eighteenth century. The port of St. Thomas was opened to free trade with other European colonies in 1764, a step that was reversed about 10 years later. Free trade returned in

1782, when Danish ships trading through St. Thomas were allowed free trade with European ports. All restrictions on trade were lifted in 1815, and St. Thomas has remained a free port ever since (Westergaard 1917:250). An average of 2,809 ships called on St. Thomas during the 1821-1830 period, with 21,769 from 1841 to 1850. The amount of tonnage represented by those ships increased until 1850, when the increased number of steamships plying the Caribbean decreased the role of St. Thomas in the Caribbean trade (Westergaard 1917:252). St. Thomas' role in Caribbean shipping and trade was reduced to that of a coaling station by the second half of the nineteenth century, as the rise of steamships made possible the direct shipment of goods to markets throughout the region. A total of 682 ships larger than 25 tons visited St. Thomas in 1908, with an increase to 749 in 1910. The mixture of ship types that entered the port in 1910 underscores the nature of change in Caribbean trade by that time, with a total of "...38 war-ships, 446 merchant steamers and 265 sailing ships" (Westergaard 1917:253).

PREVIOUS INVESTIGATIONS

Due to the extensive maritime history of the Virgin Islands, there is a possibility for submerged cultural remains (i.e., shipwrecks) to be located within the project area. A number of submerged cultural resource studies have been undertaken in the Virgin Islands and the general vicinity of the project area, and all have relevance to the current investigation. In 1975, a magnetometer survey was conducted by Alan R. Albright of portions of Coral Bay (and portions of the other surrounding islands). The survey specifically focused on the wreck of the HMS *Santa Monica* and Figures 4 and 5 illustrate the location of the survey areas as well as the wreck site in relation to the project area (Albright 1975).

Originally a Spanish ship seized by the British in 1779, the HMS *Santa Monica* tore her hull open in 1782 on what is now named Santa Monica Rock, located to the southeast of her resting place. Rapidly filling with water, the vessel was beached and subsequently salvaged. The wreck site has been the recent focus of a maritime doctoral dissertation from East Carolina University, but little archaeology has been conducted at the site (David Brewer, Personal Communication 2007).

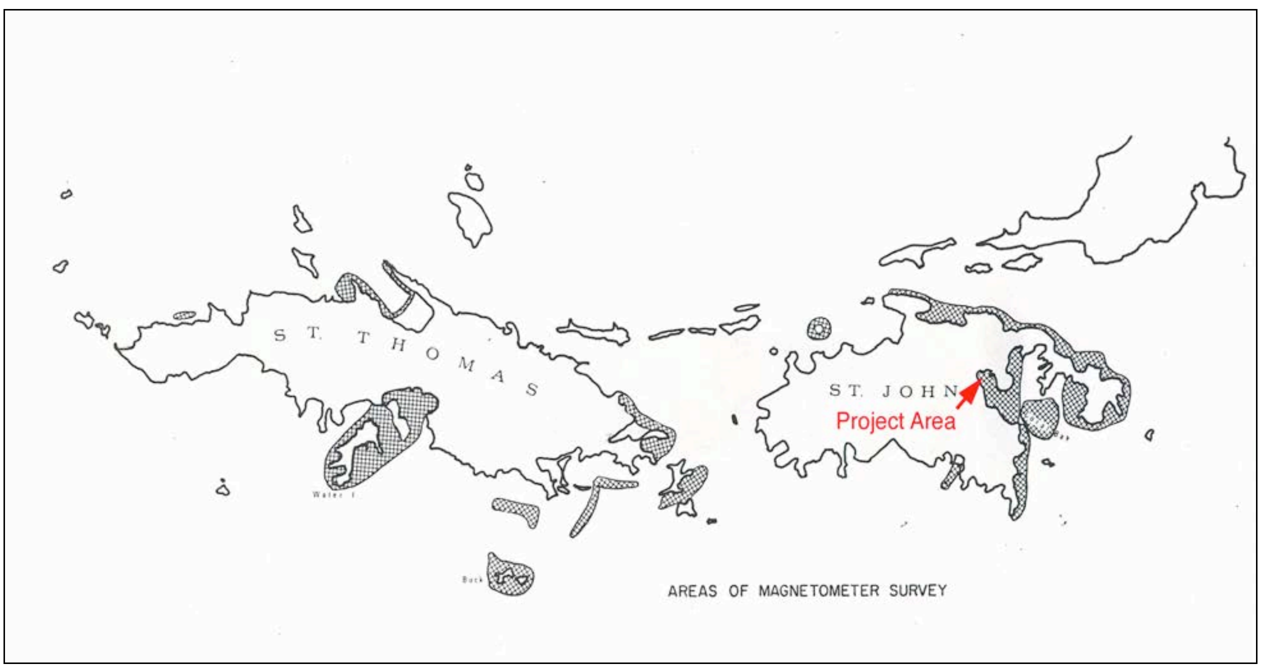

Figure 4. 1975 Magnetometer survey areas (as presented in Albright 1975).

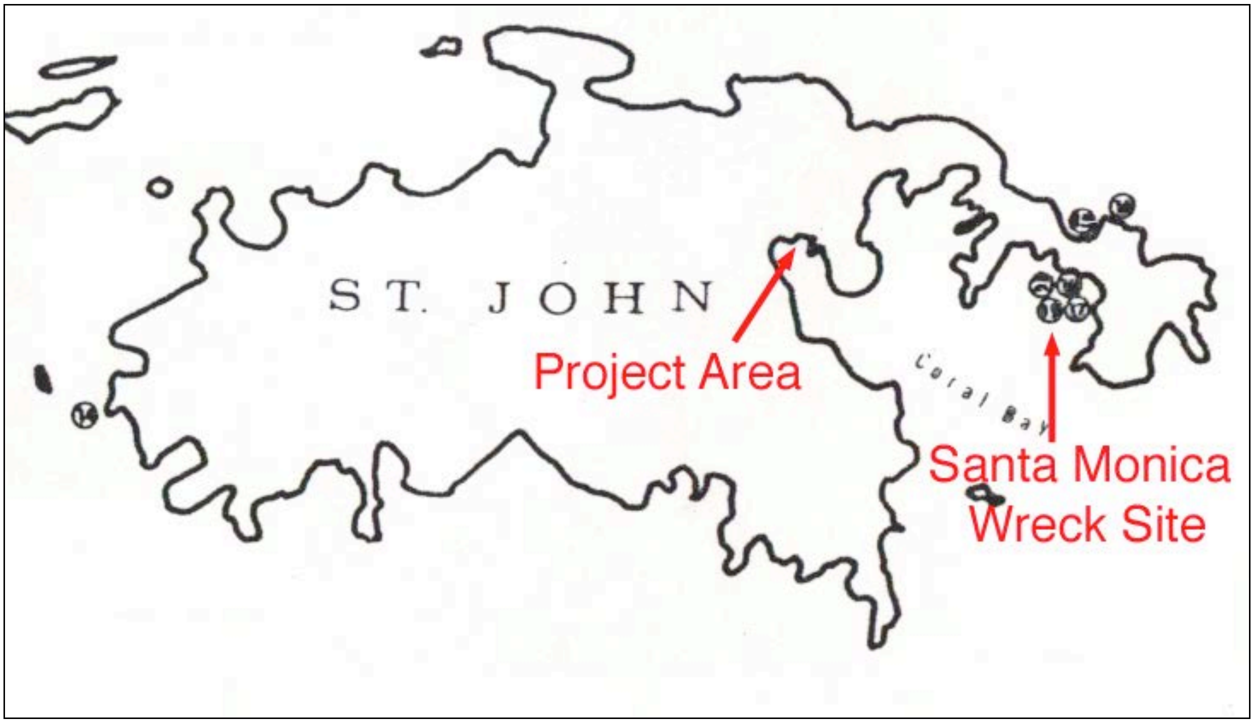

Figure 5. Location of HMS *Santa Monica* in relation to the project area (after Albright 1975).

In 1976, an inventory of shipwrecks in the Virgin Islands (1523-1825) was compiled by Edward L. Towle, Robert F. Marx, and Alan B. Albright. In addition to the HMS *Santa Monica*, review of this inventory mentions two other wrecks for St. John, the earliest being a bark burned by Spaniards "in one of St. John's harbors" (Towle et al. 1976).

To determine if any shipwrecks have been recorded as occurring in Coral Bay, the *Register of Virgin Islands Shipwrecks* (1523-1917), prepared by George Tyson (1983) for the Virgin Island Planning Office was consulted. This *Register*, which is based on extensive archival research in a variety of primary and secondary sources, identifies over 650 shipwrecks reported in waters surrounding the U.S. and British Virgin Islands. It is the most comprehensive, up-to-date listing of Virgin Islands shipwrecks, subsuming information found in earlier inventories, such as that prepared by Towle et al. (1976). Specific to St. John, Tyson states:

> Neither St. John, nor the British Virgin Islands, with their limited agricultural outputs, attracted much shipping. However, as they stood athwart the sea lanes linking St. Thomas and St. Croix with Europe and North American, most of the ships trading with the archipelago passed through their waters, and they engaged in a considerable inter-island commerce with St. Thomas (Tyson 1983:2-3).

Tyson's shipwreck inventory indicates that over 23 vessels were lost on St. John. However, all sources (i.e., Marx 1987; Towle et al. 1976; Tyson 1983; AWOIS 2007) were unaware of any significant submerged cultural resources within the general project area.

III. METHODS

PROJECT AREA ENVIRONMENT

Located in the northwestern portion of Coral Bay and along the north central shore of Coral Harbor, the project area environment had a direct impact on the survey methods and subsequent data analysis. A large rocky promontory marks the survey area's western boundary and a small rocky outcrop marks the eastern boundary. Just to the west of this latter feature is a long wooden pier that angles to the west at its end. In a location well protected from open ocean swells and lacking a large wind fetch, making for calm waters, the project area is currently employed as a boat anchorage (Figure 6). The numerous boats and moorings within the project area boundaries precluded the survey of a small area and created insignificant magnetic anomalies in other areas. The immediate shoreline area was fringed with a line of moored boats that made survey of this area problematic, as did a small wooden pier that was lined with dinghies. Out from the shore, bay waters are host to numerous permanent and temporarily moored vessels, the majority being sailboats of various types and sizes. Several vessels, possibly storm victims, lay mostly submerged outside of the survey area. These various vessels all created anomalies, as did the large concrete boat ramp that is located in the center of the northern shoreline (Figures 7 through 11).

Figure 6. Aerial overview photograph of the project area (courtesy of NOAA's Center for Coastal Monitoring and Assessment). Note the numerous moored vessels.

Figure 7. Project area, looking north towards the shoreline, the northern boundary. Note the boat dingy-covered pier to the right and the boats and moorings out from shore.

Figure 8. Eastern boundary of the project area, demarcated by mooring floats. The view is looking northeast up a small cove employed by vessels.

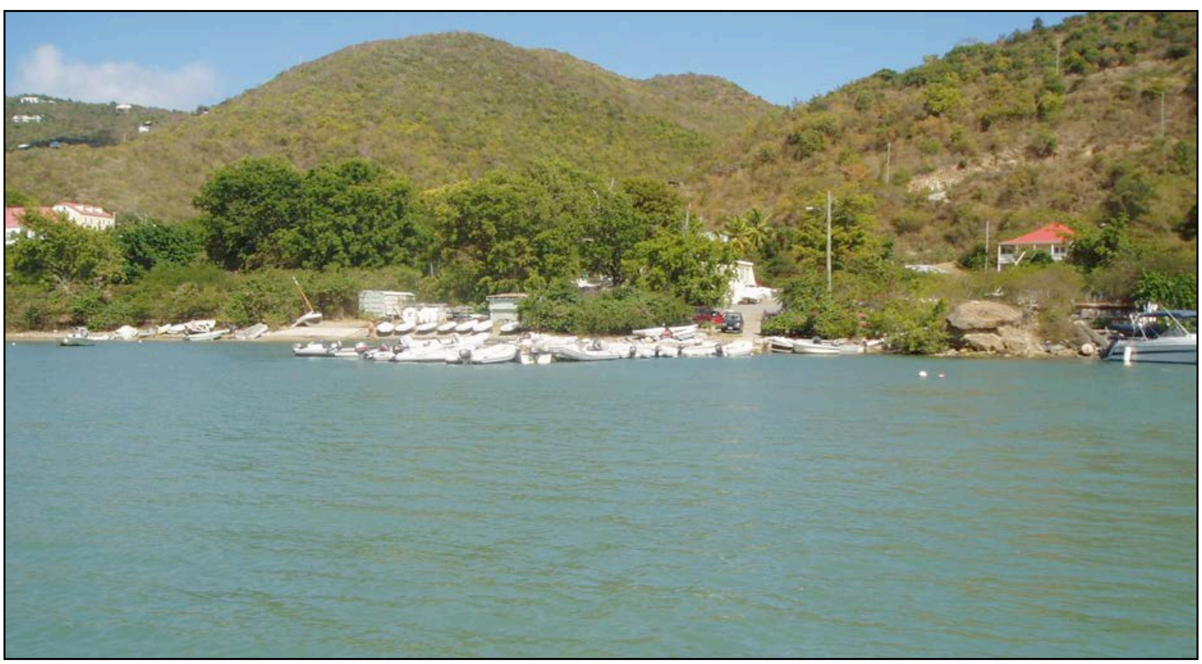

Figure 9. View opposite the rocky outcrop that forms the eastern boundary. Note dinghy-covered pier.

Figure 10. View of the rocky promontory that forms the western boundary. Note the vessels moored along the shoreline.

Figure 11. General view of the shoreline and moored vessels. Note the magnetometer and cable.

REMOTE-SENSING SURVEY METHODS

PERSONNEL

The personnel involved with this remote-sensing survey had the requisite experience to effectively and safely complete the project as proposed. Stephen R. James, Jr. served as the Principal Investigator, with Dr. Michael Faught serving as the Remote-Sensing Specialist.

REMOTE SENSING SURVEY EQUIPMENT

The remote-sensing survey was conducted with equipment and procedures intended to facilitate the effective and efficient search for magnetic anomalies and to determine their exact location. Remote-sensing instruments included a Marine Magnetics SeaSPY overhauser magnetometer, integrated with a Trimble Navigation DSM12/212, Integrated 12-channel Global Positioning System (DGPS).

DIFFERENTIAL GLOBAL POSITIONING SYSTEM

A primary consideration in the search for magnetic anomalies is positioning. Accurate positioning is essential during the running of survey tracklines, and for returning to recorded locations for supplemental remote-sensing operations or ground-truthing activities. These positioning functions were accomplished on this project through the use of a Trimble Navigation DSM12/212 global-based positioning system (Figure 12).

Figure 12. Trimble Navigation DSM 12/212 global-based positioning system used during the investigation.

The DSM12/212 is a global positioning system that attains differential capabilities by internal integration with a dual-channel MSK Beacon receiver. This electronic device interprets transmissions both from satellites in Earth's orbit and from a shore-based station, to provide accurate coordinate positioning data for offshore surveys. This Trimble system has been specifically designed for survey positioning. This positioning was provided through continuous real-time tracking of the moving survey vessel by utilizing corrected position data provided by an on-board GPS, which processed both satellite data and differential data transmitted from a shore-based GPS station utilizing Radio Technical Commission for Maritime Services (RTCM) 104 corrections. The shore-based differential station monitored the difference between the position that the shore-based receiver derived from satellite transmissions and that station's known position. Transmitting the differential that corrected the difference between received and known positions, the DGPS aboard the survey vessel constantly monitored the navigation beacon radio transmissions in order to provide a real-time correction to any variation between the satellite-derived and actual positions of the survey vessel. Puerto Rico–Virgin Islands State Plane coordinates (survey feet), based on the 1983 North American Datum (NAD 83) coordinate system were employed for this project.

Both the satellite transmissions and the differential transmissions received from the shore-based navigation beacon were entered directly into a Sony VAIO computer. The computer and associated hardware and software calculated and displayed the corrected positioning coordinates every second and stored the data. The level of precision for the system is considered by the manufacturer "…to achieve positions accurate to the sub-meter level" (Trimble Navigation Limited 1998:1-2). Computer software (Hypack Max®) used to control data acquisition was written and developed by Coastal Oceanographics, Inc. specifically for survey applications. Positioning information was stored on magnetic disk aboard the survey vessel.

All positioning coordinates are based upon the position of the antenna DGPS. The magnetometer was oriented to the antenna, and their orientation relative to the antenna (known as a layback) was noted (Figure 13). This information is critical in the accurate positioning of targets during the data analysis phase of the project, and repositioning for any subsequent archaeological activities. The layback of the magnetometer sensor was 60-feet aft and 7 foot to port.

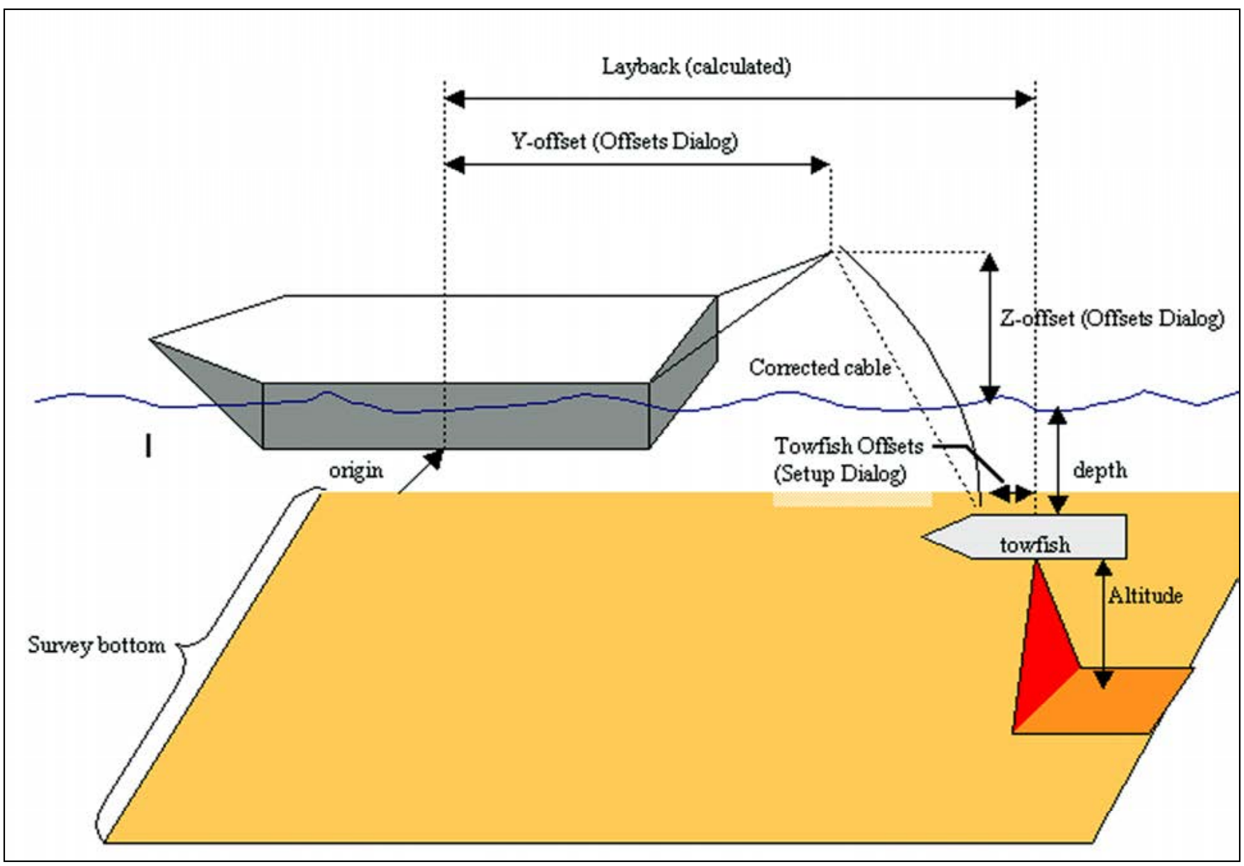

Figure 13. Equipment schematic illustrating layback (Courtesy of Coastal Oceanographics, Inc.).

MAGNETOMETER

The remote-sensing instrument used to search for ferrous objects on or below the harbor floor of the survey area was a Marine Magnetics Sea Spy overhauser magnetometer (Figure 14). The magnetometer is an instrument that measures the intensity of magnetic forces. The sensor measures and records both the Earth's ambient magnetic field and the presence of magnetic anomalies (deviations from the ambient background) generated by ferrous masses and various other sources. These measurements are recorded in gammas, the standard unit of magnetic intensity (equal to 0.00001 gauss). The Sea Spy is capable of sub-second repeatability, but data was collected at one-second intervals both digitally and graphically, providing a record of both the ambient field and the character and amplitude of anomalies encountered. This data was stored electronically in the navigation computer.

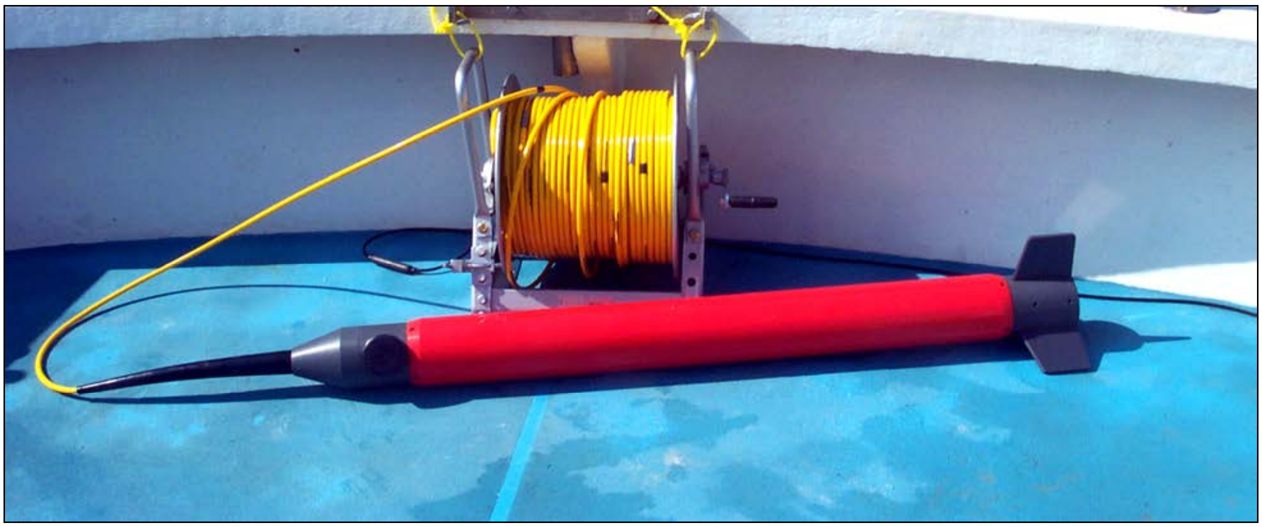

Figure 14. Marine Magnetics Sea Spy overhauser magnetometer used during the survey.

The ability of the magnetometer to detect magnetic anomalies, the sources of which may be related to submerged cultural resources such as shipwrecks, has caused the instrument to become a principal remote-sensing tool of marine archaeologists. While it is not possible to identify a specific ferrous source by its magnetic field, it is possible to predict shape, mass, and alignment characteristics of anomaly sources based on the magnetic field recorded. It should be noted that there are other sources, such as electrical magnetic fields surrounding power transmission lines, underground pipelines, navigation buoys, or metal bridges and structures, that may significantly affect magnetometer readings. Interpretation of magnetic data can provide an indication of the likelihood of the presence or absence of submerged cultural resources. Specifically, the ferrous components of submerged historic vessels tend to produce magnetic signatures that differ from those that are characteristic of isolated pieces of debris.

While it is impossible to specifically identify the source of any anomaly solely from the characteristics of its magnetic signature, this information, in conjunction with other data (historic accounts, use patterns of the area, diver inspection), other remote-sensing technologies, and prior knowledge of similar targets, can lead to an accurate estimation.

For this project the magnetometer was interfaced with a Sony VAIO laptop computer, utilizing Hypack® software applications for data storage and management. It was also interfaced with the positioning system, allowing positioning fix points to be integrated with each magnetometer data point (Figure 15).

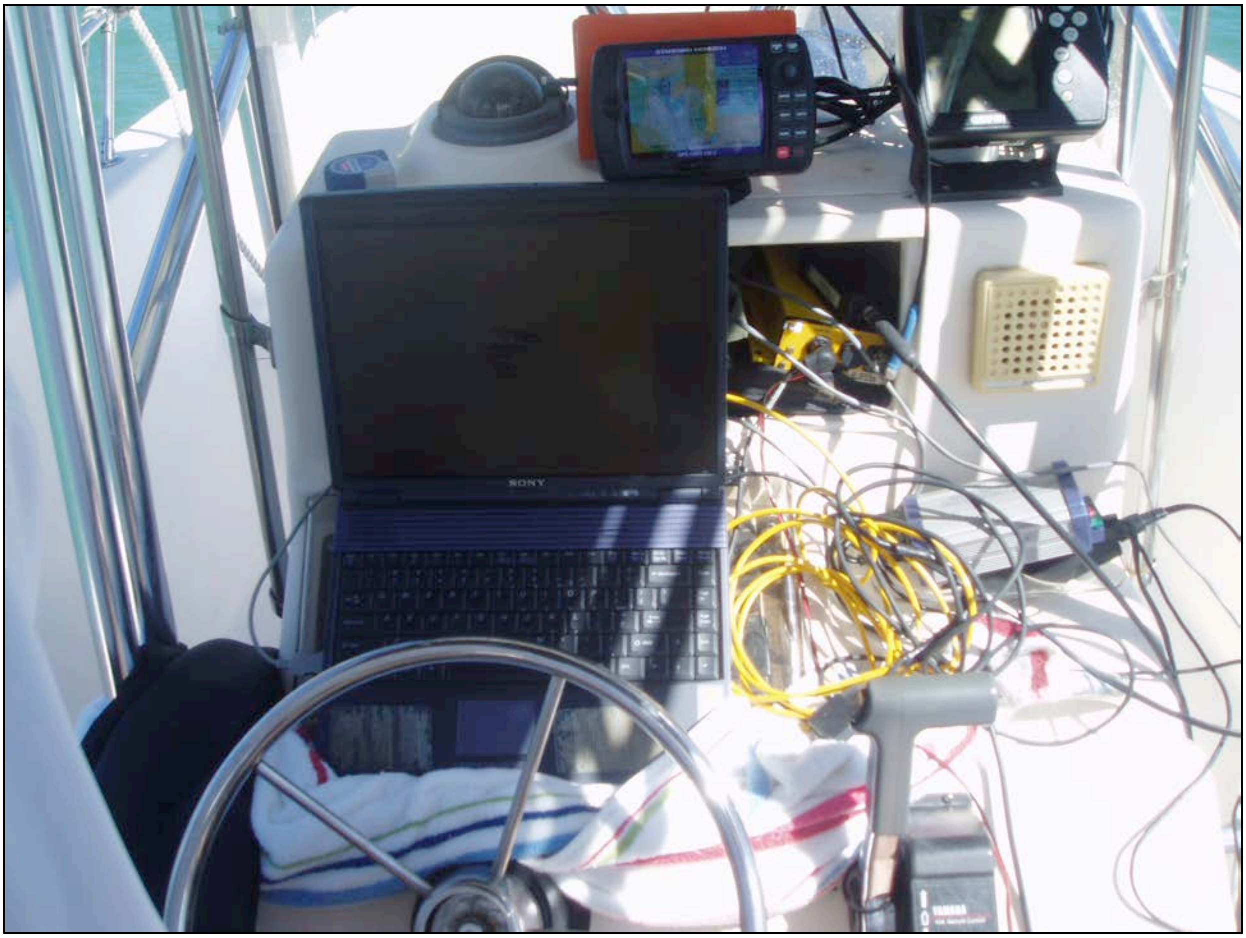

Figure 15. Navigation computer on the center console of the survey vessel.

SURVEY VESSEL

The vessel used for the remote-sensing survey was a 20-foot, shallow-draft, center-console, modified V-hull, fiberglass Grady-White with a 225-hp Evinrude outboard. Provided by St. Thomas resident Calvin Pressly, the Grady-White had a stand-up center console and ample deck area for the placement and operation of the necessary remote-sensing equipment.

The vessel conformed to all U.S. Coast Guard specifications according to class, and had a full complement of safety equipment. The vessel carried appropriate emergency supplies including lifejackets, spare parts kit, tool kit, first-aid materials, flare gun, air horns, and potable water.

SURVEY PROCEDURES

Because of the number of moored vessels within the survey area, pre-plot tracklines with 50-foot offsets were not possible. Therefore, the survey covered the project area by transiting through the vessels along the east-west axis of the survey area; with additional transects run north and south. A total of seventeen (n=17) transect lines spaced approximately no greater than 50 feet were necessary to adequately cover the proposed project area. The actual area surveyed was much greater than the project area boundaries, thus ensuring total coverage.

The magnetometer and DGPS were mobilized and tested, and the running of tracklines began. The helmsman viewed a video monitor, linked to the DGPS and navigational computer to aid in directing the course of the vessel relative to the individual survey tracklines. The monitor displayed the real-time position of the path of the survey vessel along the trackline. The speed of the survey vessel was maintained at approximately three to four knots for the uniform acquisition of data.

As the survey vessel maneuvered down each trackline, the navigation system determined vessel position along the actual line of travel every second. The computer recorded positioning and magnetometer data every second. Vessel speed was between three and four feet per second, acquiring magnetic readings every second. The positioning points along the line traveled were recorded on the computer hard drive and the magnetic data were also stored digitally.

Each of the tracklines was run until completed. Any navigation errors, problems with the remote-sensing instruments, or with the positioning system during the running of a line resulted in the termination of that run. Problems with remote-sensing instruments were resolved before repeating the run of an aborted line.

Upon completion of the magnetometer survey, the raw positioning and magnetometer data were edited within the Hypack® computer program. The edited file was input into the systems contouring program to produce magnetic contour maps. The maps, field notes, and magnetometer digital strip charts were then analyzed to create a list of any magnetic anomalies that were possibly indicative of potentially significant cultural resources.

Bathymetric Survey Procedures

In addition to the magnetometer survey, a bathymetric survey was conducted of the project area. Survey lines were run in a north-south direction perpendicular to shore. A Garmin "160" fathometer with an in-hull transducer was employed for depths with positioning data recorded by the on-board survey computer.

IV. RESULTS

The remote-sensing survey of the proposed Coral Bay marina project on St. John intended to locate and identify any potentially significant submerged cultural resources, and if present, that may be impacted by the placement of marina construction. The survey was completed in an effort to locate those anomalies that may be eligible for inclusion into the NRHP.

With respect to analysis of the recorded remote-sensing data, interpretation of the data that was obtained from both the magnetometer and the sidescan sonar is an imperfect process at best, and, as stated by Pearson et al. (1991), "relies on a combination of sound scientific knowledge and practical experience." The evaluation of remote-sensing anomalies with regard to a determination that the anomaly does or does not represent shipwreck remains depends on a variety of factors. These factors include the detected characteristics of the individual anomalies (e.g., magnetic anomaly strength and duration, sidescan image configuration), associations with other sidescan or magnetic targets on the same or adjacent lines, and also relationships to observable target sources, such as channel buoys or pipeline crossings.

Interpretation of data collected by the magnetometer, the tool of choice by the underwater archaeologist for locating shipwrecks, is perhaps the most problematic. Magnetic anomalies are evaluated and prioritized on the basis of magnetic amplitude or deflection of gamma intensity in concert with duration or spatial extent; they are also correlated with sidescan targets. Because the sonar record gives a visible indication of the target, identification or evaluation of potential significance is based upon visible target shape, size, and presence of structure, as well as association with magnetic anomalies. Targets such as isolated sections of pipe can normally be immediately discarded as non-significant, while large areas of above-sediment wreckage are generally easy to identify.

The problems of differentiating between modern debris and shipwrecks on the basis of remote-sensing data have been discussed by a number of authors. This difficulty is particularly true in the case of magnetic data, and therefore it has received the most attention in the current body of literature dealing with the subject. Pearson and Saltus (1990:32) state, "even though a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate any specific signature with a shipwreck or any other feature." There is no doubt that the only positive way to verify a magnetic source object is through physical examination. With that said, however, the size and complexity of a magnetic signature does provide a usable key for distinguishing between modern debris and shipwreck remains (see also Garrison et al. 1989; Irion and Bond 1984; Pearson et al. 1993). Specifically, the magnetic signatures of most shipwrecks tend to be large in area and display multiple magnetic peaks of differing amplitude.

While data indicate the validity of employing specific shipwreck magnetic signature characteristics when assessing magnetic anomalies, other factors must also be taken into account. Pearson and Hudson (1990) have argued that the past and recent use of a water body must be an important consideration in the interpretation of remote-sensing data, and in many cases, the most important criterion. Unless the remote-sensing data, historical record, or the specific environment (i.e., harbor entrance channel) provide compelling and overriding evidence to the contrary, it is believed that the history of the water body's use should be a primary consideration in interpretation. What constitutes "compelling evidence" is to some extent left to the discretion of the researcher; however, in settings where modern commercial traffic and historic use have been intensive, the presence of a large quantity of modern debris must be anticipated. Filled with moored modern vessels and mooring buoys marking the location of mooring anchors, this is indeed the case for the Coral Bay Marina Project survey area. Figure 16 illustrates the location of vessels and visible mooring buoys marked with the navigation program.

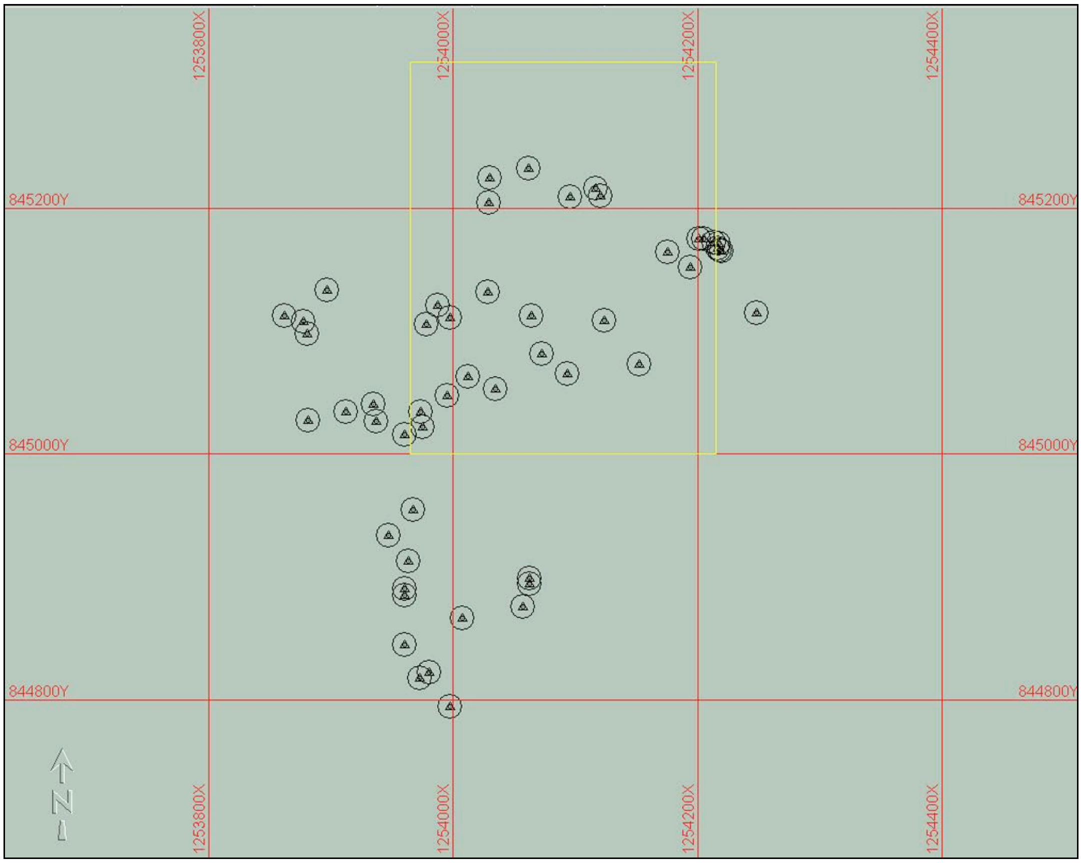

Figure 16. Plot of the location of vessels and moorings marked on the navigation program. The project area is marked in yellow. The cluster on the right side of the project area marks the general location of the end of the pier.

MAGNETOMETER SURVEY RESULTS

As illustrated in Figure 17—a post-plot of the tract of the survey vessel—100 percent survey coverage was obtained for the project area. Some minor deviations are evident in the survey lines due to the presence of anchored vessels and mooring buoys within the survey area. Figure 18 represents the magnetic contour map of the proposed project area. Employing a 20-gamma contour, the contour colors indicate the positive and/or negative poles of each magnetic anomaly. The color blue indicates the negative pole, whereas the color red indicates the positive pole. As indicated by the contour map overlain with the moored vessel plot, the majority of the anomalies are generated by moored vessels, their visible locations time-stamped on the navigation computer (Figure 19).

Further review of the contour map shows only several anomaly locations without a time-stamp mooring/vessel indicator (see Figure 19). However, when the transect lines are overlaid (Figure 20), these "anomalies," which are not representative of potentially significant submerged cultural resources, are seen to be located where tracklines cross. This is a characteristic of "false" anomalies generated by differing magnetic readings at the same location a result from differing sensor direction. Analysis of data for specific transect lines indicated that this was indeed the case, and revealed an absence of potentially significant magnetic anomalies within the project area.

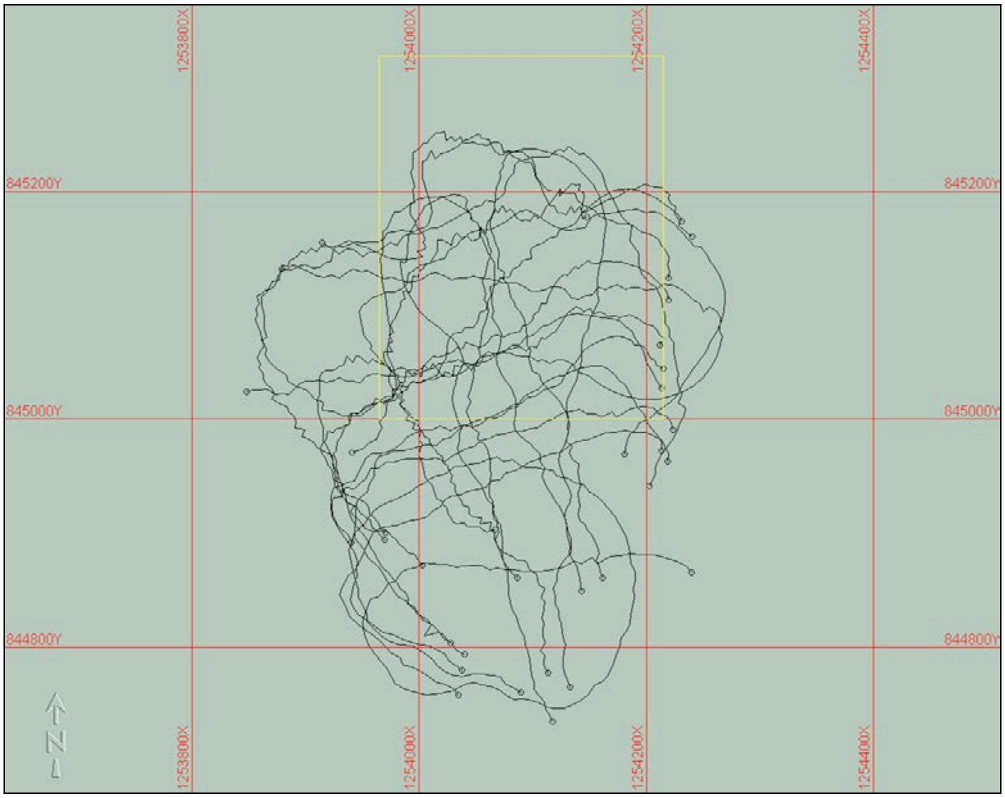

Figure 17. Post-plot of the tract of the project vessel, showing survey coverage. Project area is in yellow.

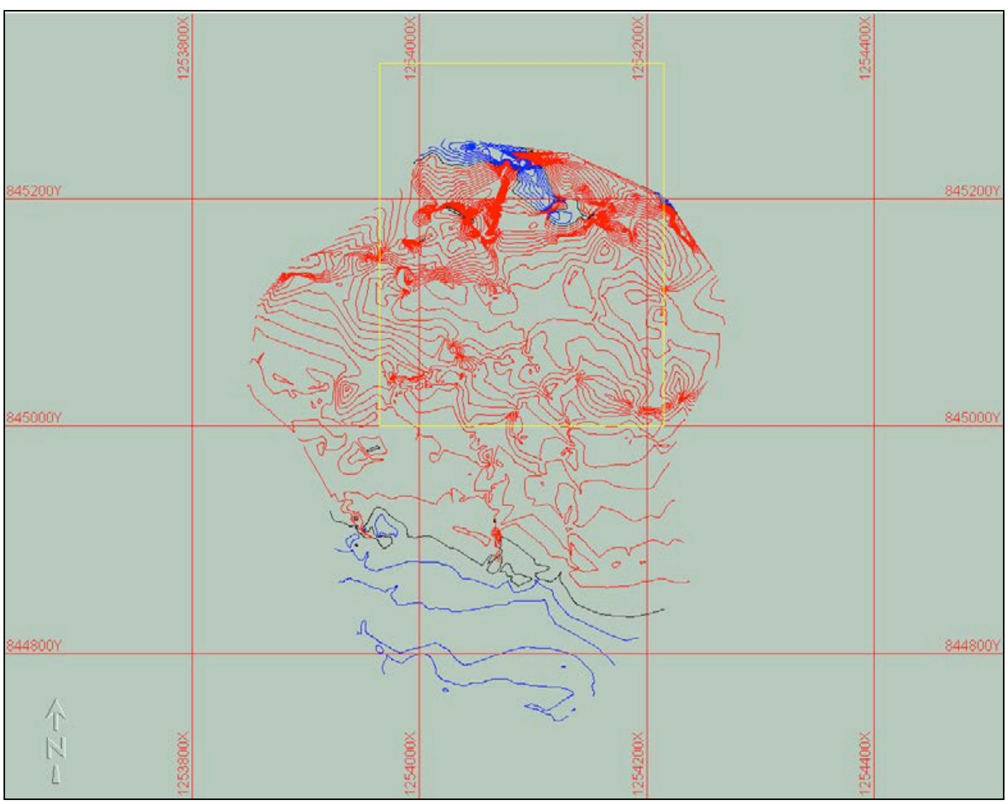

Figure 18. Magnetic contour map of the survey area.

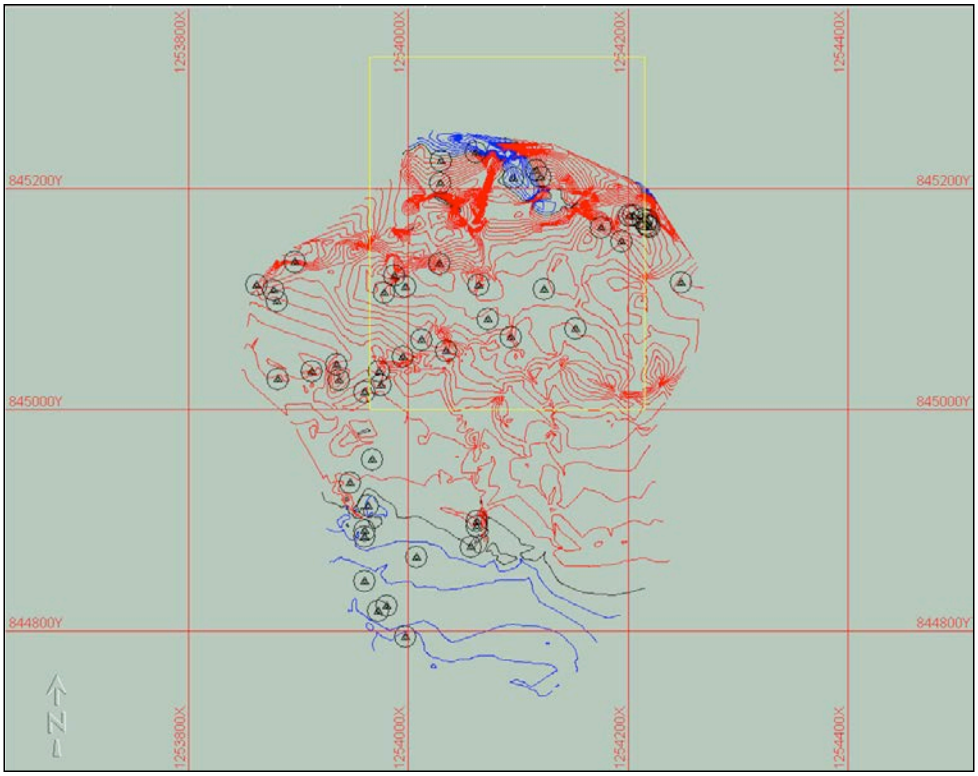

Figure 19. Magnetic contour map of the survey area with overlay of moored vessel plot.

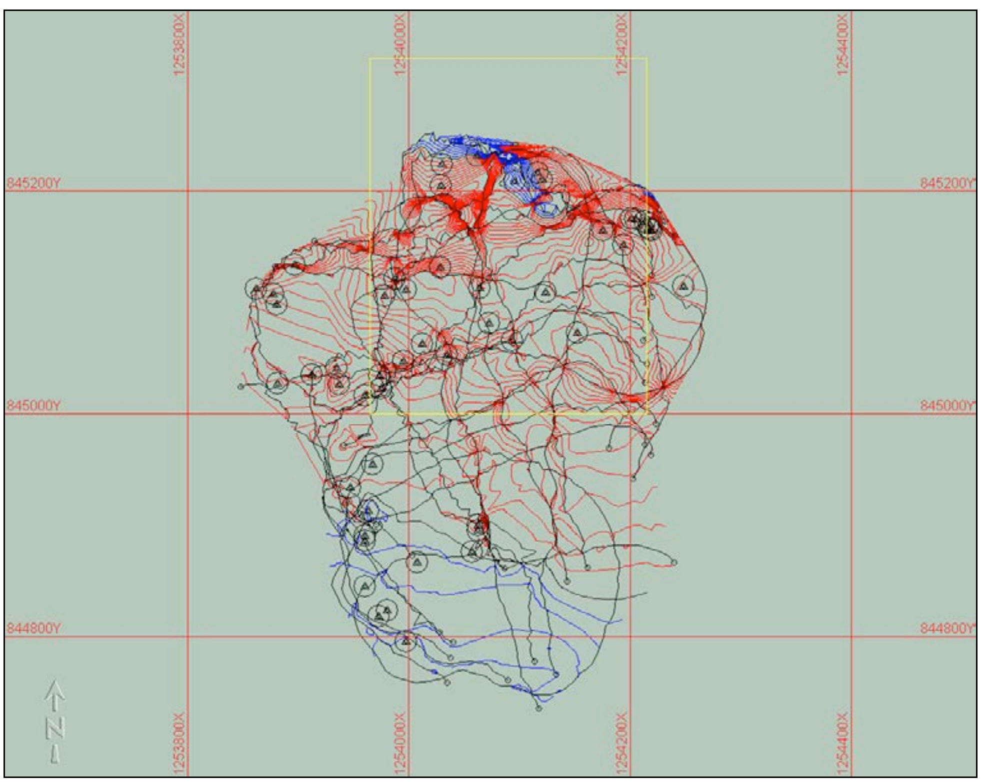

Figure 20. Magnetic contour map of the survey area with moored vessel plot lines and tracklines overlain. Note some anomalies correspond to the location of crossed transect lines, a characteristic of "false" anomalies generated by differing magnetic readings at the same location a result of differing sensor direction.

BATHYMETRIC SURVEY RESULTS

Upon completion of the magnetometer survey and in-field data analysis, a bathymetric survey was conducted. Illustrated in Figure 21, six lines were run in a north-south direction towards shore. Conducted at 1:30pm on February 13, the survey data was not corrected for tidal variation. Figure 22 indicates the depths for the project area.

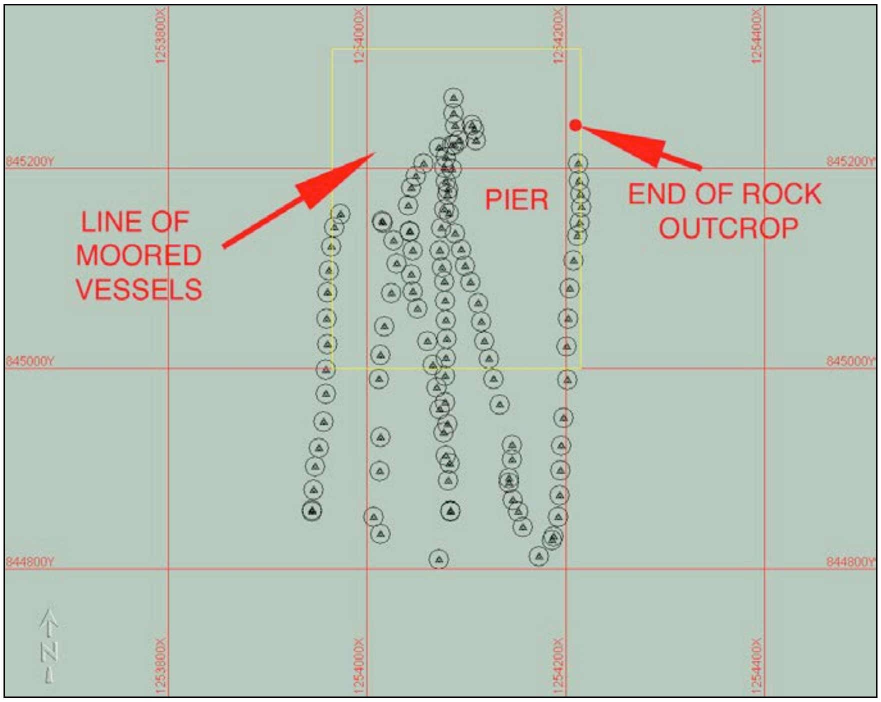

Figure 21. Bathymetric survey transect lines.

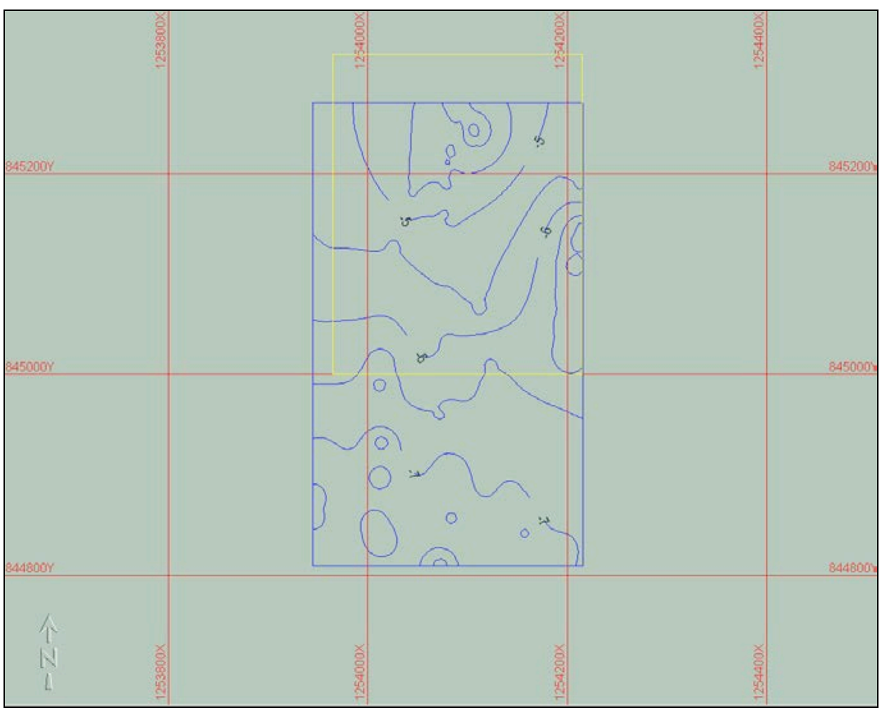

Figure 22. Bathymetric contour map of the survey area. Contours are half-foot intervals.

V. CONCLUSIONS

In February of 2007, maritime archaeologists from Panamerican conducted an intensive remote-sensing survey of a proposed marina development on St. John, U.S. Virgin Islands. Performed under contract to Soltec International, Inc., the proposed project area is located on the east end of St. John in Coral Bay. Specifically, the proposed project included an area approximately 320 feet by 250 feet located adjacent to the north-central shore of Coral Harbor, which forms the northwestern portion of Coral Bay. The remote-sensing survey consisted of a magnetometer survey to determine the presence or absence of submerged anomalies or targets within the project area that might represent the remains of historic shipwrecks. However, results of the magnetometer survey revealed an absence of potentially significant magnetic anomalies within the project area.

The present findings are similar to other areas where modern usage of a water body is heavy. Comparable to the present study, the results from other surveys in the U.S. Virgin Islands where modern commercial traffic is fairly high, especially in the form of mooring fields, is similar to our findings (James and Tyson 1990, Krivor and Tyson 1997, Krivor 2000, Krivor 2001). Remote-sensing studies conducted in these areas found that non-significant modern debris constituted all of the magnetic signatures located. Perhaps the most germane of these earlier field investigations to the current study was the 2006 magnetometer survey at Compass Point for a marina expansion. Covering a similar use area and of similar size, results of the investigation recorded numerous anomalies that were all attributable to moored vessels and observable moorings (i.e., buoys), as well abandoned moorings in the form of engine blocks, all of which were not representative of potentially significant submerged cultural resources (James and Tyson 2006). These findings are identical to the current investigation.

Results of the current remote-sensing survey recorded several small magnetic anomalies. However, because of visual confirmation of the anomaly sources (i.e., vessels, moorings), as well as the overall intensive modern use-history of the area, the anomalies are not considered to be representative of potentially significant submerged cultural resources. Therefore, it is the opinion of the Principal Investigator that no potentially significant submerged cultural resources will be impacted by proposed project activities, and that the project area should be given clearance relative to submerged cultural resources permit issues.

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Marina Market Analysis
Coral Bay, St. John, U.S. Virgin Islands

Final Report

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1. EXECUTIVE SUMMARY

T-Rex St. John, LLC is developing the Sirius Seaside Resort located in Coral Bay on St. John, U.S. Virgin Islands. T-Rex St. John retained Moffatt & Nichol (M&N) to update a previously prepared marina market assessment for the Virgin Islands with regards to the planned marina associated with the proposed resort. The project site, located as shown in Figure 1, is expected to feature a resort-style hotel catering to tourism focused on the nearby national park and world class marine habitat. The marine facilities include the marina, a boat repair yard, public boat launch facility, and point-of-sale for fuel and boat provisioning.

The objective of this assessment is to evaluate the number of boat slips supported by the market, projected slip size demand, market standard support facilities and amenities, and slip lease rates. This information is expected to be used to assist T-Rex St. John in programming the proposed marina facilities.

Existing Marina Market

The existing marina market evaluated for this study includes marinas in the U.S. and British Virgin Islands. The market is subdivided geographically by the international border, as travel between the two countries requires clearing customs each way as well as differences in laws, taxes, and requirements that influence which marina a user will choose.

The marina market is also divided demographically with marinas catering to different boater groups. These groups include marinas connected to residential developments, hotel marinas, commercial charter facilities, and marinas catering to visiting (transient) boaters.

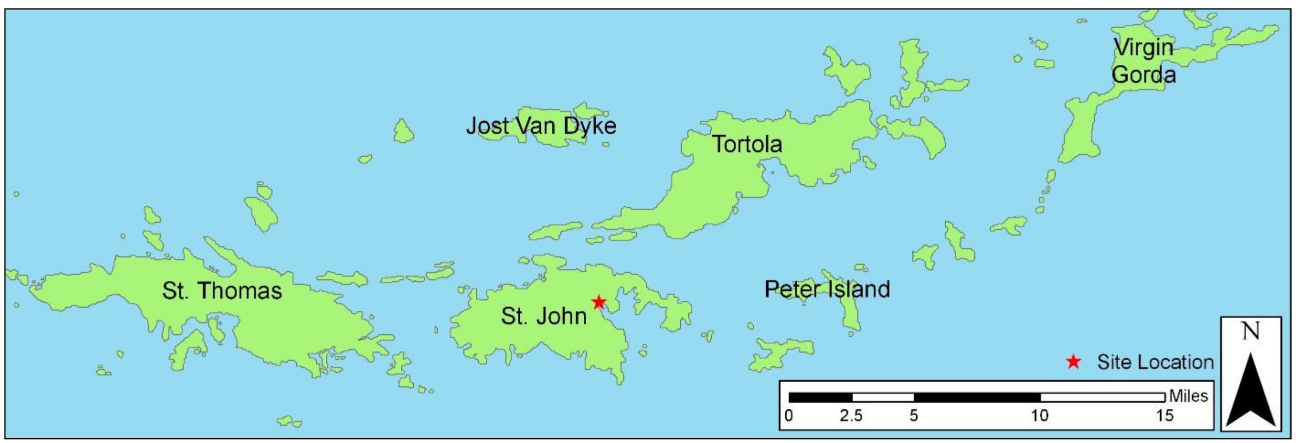


Figure 1: Virgin Islands Vicinity Map

Forty-two marinas – 18 in the U.S. Virgin Islands and 24 in the British Virgin Islands - representing approximately 2,050 boat slips were identified in the market area. Over 200 moorings were also identified throughout the U.S. National Park System. Marina facilities are mostly located on St. Thomas and Tortola coincident with the main tourism airports and destinations in the Virgin Islands.

Within the market, slip sizes are trending towards larger slips. Slips under 20 ft have mostly been converted to larger slips and slips under 30 ft are similarly diminishing. Slip mix statistics show that the median slip size is in the 40-49 ft range, with 75% of all slips between 30 and 59 feet. There are approximately 51 mega-yacht compatible slips (6% to 7% of all slips).

Amenities offered vary by the demographic served by the marina. Most marinas offer shore power and potable water while marinas catering to transient boaters and liveaboards also offer showers, laundry service, and internet service. Fuel is offered at approximately half of all marinas.

Slip Pricing Analysis

Wet slip lease prices vary by market and facility. U.S.V.I marinas on St. Thomas that are in desirable locations with good facilities charge more than $30 per ft per month with average prices ranging from $15 to $25 per ft per month. Marinas in the British Virgin Islands follow similar trends but are priced slightly below comparable U.S.V.I facilities. Daily rates generally range from $1.25 to $2.00 per ft per day with some marinas charging up to $3.00.

The dry stack marina market is limited. Dry storage appeals to local boaters using smaller boats. The combination of the existing population demographics and boating environment results in limited use of small boats. Existing dry storage facilities in the region charge $12 to $15 per ft per month.

The target marina is expected to achieve pricing on the order of $20 to $25 per lf per month or $2.00 per lf per day.

Market Trends

Boat registration trends reflect boat use trends and marina slip demand. Data from the U.S. mainland shows boat registration dropping following the 2008 recession. However, analysis of boats larger than 40 ft that are more likely to require a wet slip shows a relatively stable trend in boat registration.

Boat registration data for the Virgin Islands and Puerto Rico shows similar recent declines in boat registrations. The decreases are expected to be related to smaller boats with larger boats that tend to use marinas expected to be stable.

Market Driver Analysis

Marina market drivers identified include the underserved existing population, population growth, demographic shifts, tourism, boat yard users, and mega-yacht visits. Analysis of these market drivers suggests demand for 495 to 790 slips over the next ten years.

Market demand is summarized as follows:

Table 1: Slip Demand Summary

Underserved Existing Population	
With 6-Pax	20 – 30
Modified 6-Pax	130 – 150
Population Growth	5 - 10
Demographic Shift (by 2025)	400 - 500
Tourism	60 – 110
Boat Yard	10 – 20
Mega-yacht	Seasonal – use flex slips
Total	495 - 790

The largest contributor to slip demand is projected demand due to demographic shifts. Removing this factor results in projected slip demand ranging from 95 to 290 slips.

As some of the demand is future projection and some is site specific, the following table breaks down the projection based on present demand and demand in 10 years as well as demand with and without the project hotel and associated services.

Table 2: Slip Demand Summary

	2015 (Present)		Year 2025	
	No Hotel	With Hotel	No Hotel	With Hotel
Sirius Project	40 – 50	80 – 100	100 – 150	150 - 200
Total Coral Bay	100 – 200		150 – 300 6-Pax Mod 200 – 600	

Fuel Analysis

Fuel usage is expected to vary seasonally with peaks during fishing season. Similarly sized marinas currently have storage capacity for 10,000 gallons of gas and 30,000 gallons of diesel. The on-site storage capacity at Sirius would depend on the frequency of re-supply deliveries and should include allowance for delays due to storm events. The fuel storage should also be sized to also accommodate on-site backup-power generation and demand from retail sales to automobile customers.

Competing Facilities

Marinas expected to compete with the proposed marina based on quality of facility, amenities included, slip count/size, available cost, and expected level of service include the following 7 facilities:

- Green Cay Marina ($20-$25/ft/mo)
- Hodge's Creek Marina ($1.80/ft/day)
- Nanny Cay Marina and Hotel ($14-$24/ft/mo)
- Sapphire Beach Resort and Marina ($17.50/ft/mo)
- Scrub Island Resort and Marina (pricing not available)
- The Moorings Marina (pricing not available)
- Village Cay Marina ($28.50-$45/ft/mo)

These facilities include on-site hotels and have more than 50 wet slips with a focus on boating tourism. Multiple other large marinas are located near unaffiliated hotels and may also compete with the proposed marina.

Summary

- The market supports a 100 slip marina at the project site with hotel and associated amenities.
- Slip demand will increase if the 6 pax rule is modified.
- Slips should be sized mostly for 40-50 ft boats with limited capacity for megayachts on end-tie docks. Projected slip mix is as follows:
    - 30ft to 40 ft 25-30%
    - 40 ft to 50 ft 40-50%
    - 50 ft to 60 ft 20-25%
    - > 60 ft 5-10%
- Slip pricing is expected to be on the order of $20 to $25 per lf per month or $2.00 per lf per day.

2. MARINA MARKET AREA

A marina's "market area" is defined as the **geographic** and **demographic** boundaries within which marinas compete for boaters. Marinas outside of the market area are not expected to directly compete for boaters with marinas within the market. The proposed marina at the Sirius Seaside Resort on St. John, U.S.V.I. will compete with other resort marinas within the Virgin Islands marina market.

A map of the Virgin Islands is shown in Figure 2. Forty-two existing marina facilities have been identified in the Virgin Islands market area. These marinas are associated with resorts, residential developments, and commercial areas. Several of these marinas are expected to be in direct competition with the subject marina.

Marina users in the market include full time boating residents of the Virgin Islands, transient boaters visiting while cruising, and charter and commercial boating businesses. The target marina market area for these boater groups is based on proximity to their desired boating/fishing areas and the cost and availability of docks for berthing a boat in those areas.

2.1. Geographic Boundaries

Market areas are defined geographically by the expected distance that boaters are willing or able to travel to use the marina facilities. The U.S. and British Virgin Islands offer a variety of activities for boaters and are considered part of the Caribbean cruising markets while also offering world class sport fishing.

While the two groups of islands are physically close to each other with regular ferry service between them, the need to clear customs while traveling between the two groups of island and differences in laws create a "geographic boundary." Marinas in the B.V.I. are not expected to directly compete with marinas in the U.S.V.I. for most marina user categories with the exception of cruising transient boaters. These two sub-market areas are shown in Figure 3.

Figure 2: Virgin Islands Market Area

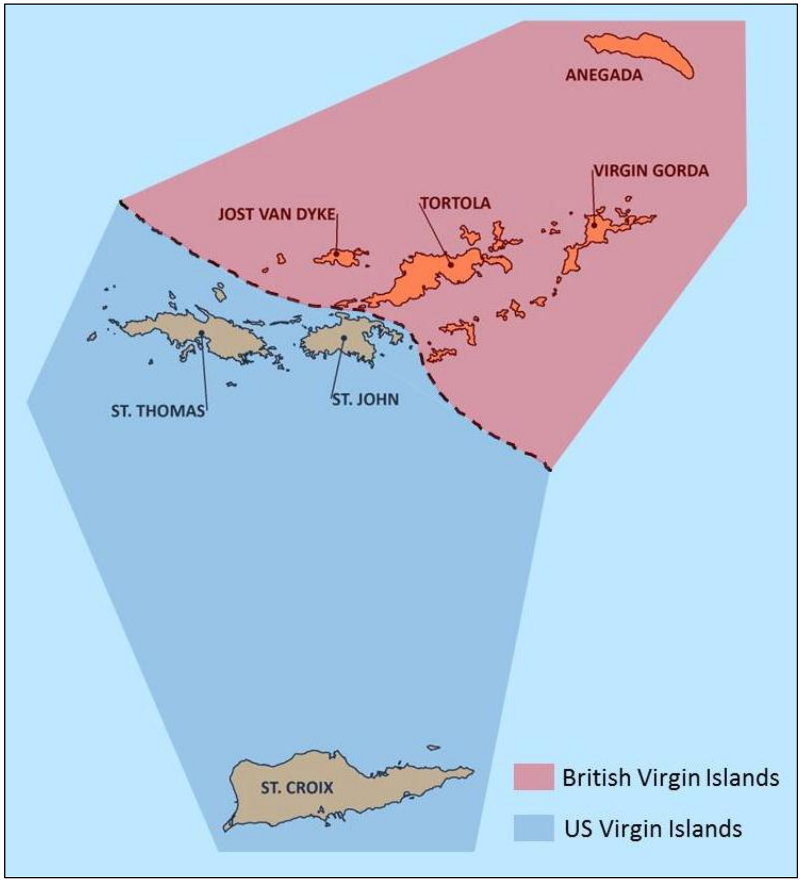


Figure 3: Virgin Islands Geographic Sub-Market Area

The following sections describe the market areas including the size of the market area; major islands, cities, and airports; and typical marina users.

2.1.1. U.S. Virgin Islands

The U.S. Virgin Islands are defined by the three major land masses of St. Thomas, St. Croix, and St. John. Major population centers in the U.S.V.I. are listed below:

- St. Thomas
  - Charlotte Amalie
    - Cyril E. King Airport
- St. Croix
  - Christiansted
    - Henry E. Rohlsen Airport
  - Fredrickstedt
- St. John
  - Cruz Bay

Boating activities in the U.S. Virgin Islands market are currently supported by 18 marinas, 2 of which are specifically on St. John, along with some private residential boat slips.

Typical U.S.V.I. Boater:

- Residents
- Sail charters
- Fishing Charters
- Cruisers

Currency is U.S. dollars, which appeals to American tourists. Fuel is taxed at U.S. tariff rates which are significantly less expensive than most other Caribbean Islands.

2.1.2. British Virgin Islands

The British Virgin Islands include numerous small islands and cays. Islands with permanent population centers and infrastructure are listed below:

- Tortolla

- Road Town
  - Terrence B. Lettsome Airport
- Parham Town

- Jost Van Dyke
- Virgin Gorda
  - Spanish Town
- Anegada
  - Auguste George Airport

Typical B.V.I. boaters

- Residents
- Sail charters
- Cruisers/Transient visitors

The B.V.I. are known for sailing. Consequently, sailing charters and sailing based tourism are major contributors to the local economy. Currency is U.S. dollars making transactions convenient for U.S. visitors.

2.2. Demographic Sub-Markets

Demographic sub-markets are defined within a geographic market based on the targeted boater demographic. Marinas are categorized based on marina type, the type of associated upland development, and the targeted owner demographic. Some marinas may fit within multiple sub-markets.

Typical demographic sub-markets include the following:

- Local Boaters – local population including attached communities
- Yacht Clubs – private residential/yacht club
- Transient (short- and long-term) – live outside the market but visit or keep a boat in the market or liveaboard
- Charters and Watersports – fishing charters and boat rentals
- Resort and Destination – marina associated with a resort or destination acting as the primary draw

Marinas within these demographic sub-markets compete with each other more directly than marinas within the geographic market that target other demographic groups.

3. EXISTING MARINA MARKET

Analysis of the existing marina market provides insight into the market demand, typical slip sizes, available amenities, and slip pricing.

3.1. Marina Facilities

Marina facilities on St. Thomas, St. Croix, Tortola, Virgin Gorda, Jost Van Dyke and Peter Island were surveyed to determine the market in this region. The majority of the slips typically range from 20 feet to 60 feet with a scattering of larger slips available at most marinas. When available, the dockmaster at each property was interviewed to determine the dock type, number and length of slips, occupancy levels, available amenities, and activities of the boaters. This information was supplemented with additional information taken from marina internet sites when available. Additional topics discussed during the informal survey included slip and utility pricing, and occupancy trends. While responsive, many dockmasters were unable or unwilling to provide specific slip and boat occupancy distributions due to the nature of their record keeping and industry competition. The survey results for each island are discussed in the following sections.

3.1.1. U.S. Virgin Islands

Eighteen marinas were identified in the U.S. Virgin Islands. Most of the marinas are located on St. Thomas, coincident with the main tourism destination. Several new marinas are planned or have recently been constructed on St. Croix to support the large local population and growing tourism market.

St. Thomas

Eleven boating facilities catering to a wide variety of boating needs were identified on St. Thomas. St. Thomas is the only location in the U.S.V.I sub-market area that has marinas specifically catering to the mega-yacht community as well as individually owned "dockominium" slips. St. Thomas also has the only dry rack facilities in the Virgin Islands. Table 3 shows the identified marinas and slip counts.

Service yards and dry storage are typically offered at the same facilities. The Independent Boat Yard offers marine service and repair and has associated dry rack storage with approximately 44 wet slips. The only facility specifically dedicated to dry rack storage is Tropical Marine with two rows of racks totaling 88 dry rack slips accommodating vessels up to 35 feet.

Crown Bay Marina and Yacht Haven Grande Marina cater to the mega-yacht clientele with specific amenities such as higher amperage power, high speed fueling and gourmet provisioning. While Crown Bay Marina has slips ranging from 30 feet to 200 feet, Yacht Haven Grande is the first marina in the Virgin Islands to cater only to mega-yachts with the smallest slips starting at 80 feet and the largest slip reaching 450 feet.

Fish Hawk Marina and Frenchtown Marina are home to charter fleets, with Fish Hawk's four slips catering to fishing charters and the CYOA fleet at Frenchtown Marina catering to bareboat charter vacations. Pirate's Cove Marina has the shallowest water depth of all the marinas on St. Thomas at 4 feet deep. This limits the vessels that can utilize this marina and the marina users are mostly long-term, local, power boaters.

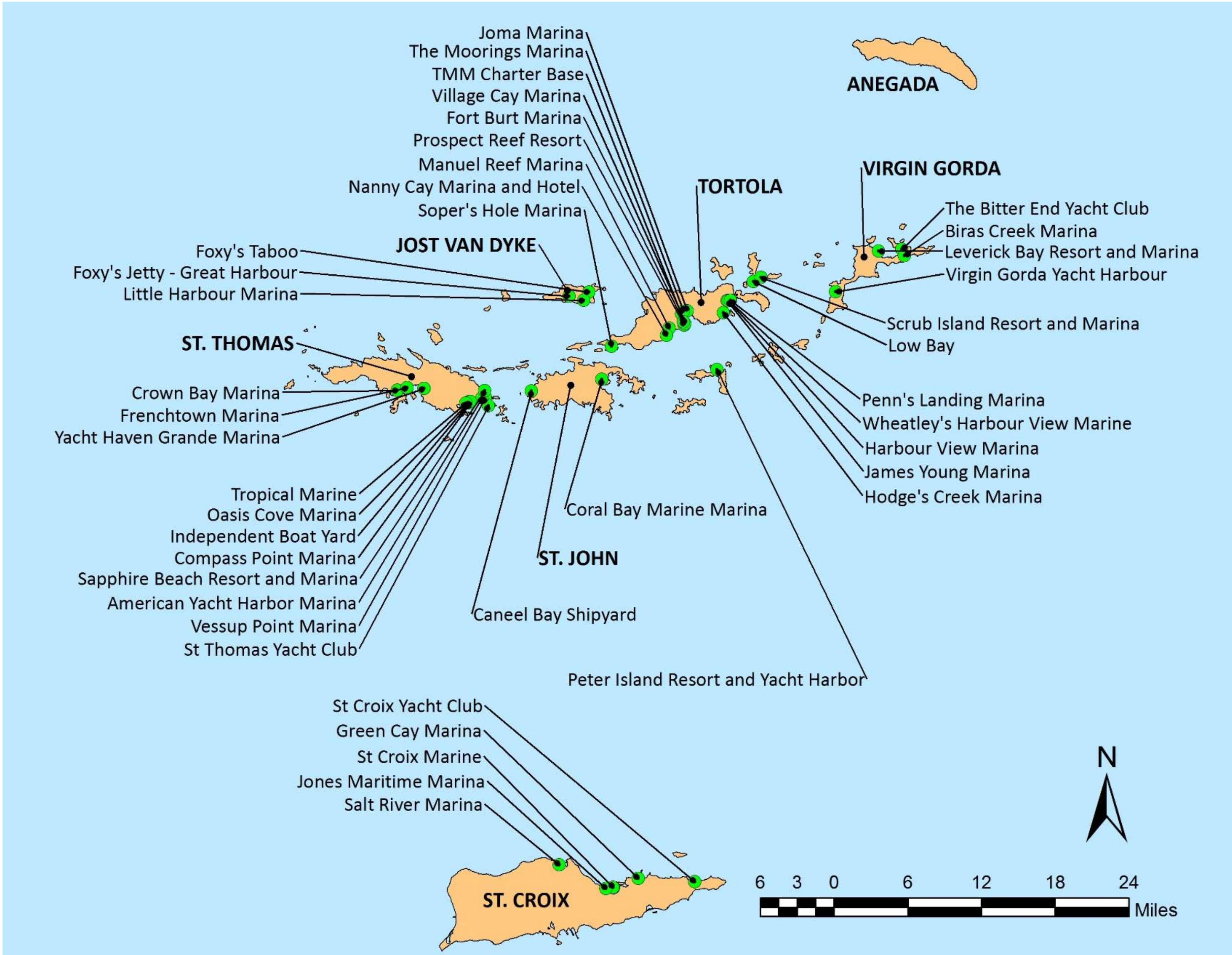


Figure 4: Virgin Islands Market Area Marinas

The sole dockominium marina (marina offering slips for sale) on St. Thomas is the Sapphire Beach Resort & Marina. The dockmaster indicated that the majority of these slips are owned by residents of Puerto Rico that will sub-lease the slip during part of the year. This marina has an associated upland resort with privately owned condos; however, only one or two of the marina slips were purchased by the condo owners.

American Yacht Harbor and Boater's Haven at Compass Pointe marinas serve charter vessels, local and transient boaters. The latter two marinas have also been ports of call for DockLift and Dockwise, two ship transport vessels.

St. Croix

The distance between St. Croix and the remaining Virgin Islands deters many boaters from including this location on their "island-hopping" cruises. The market for St. Croix does not include many of the tourism boater's that frequent the remaining Virgin Islands.

Dockmasters indicated that, in addition to the time to sail from St. Croix to the other islands, significant portions of charter boat visitors to the Virgin Islands are infrequent boater's and do not feel comfortable traveling out of sight of land to reach St. Croix.

There are five operating marinas located on St. Croix. The existing marinas mostly support the local boating market. The proposed Gallows Bay Marina (project has been on hold for several years and may no longer be pending) and the marina at the William and Punch Property will be designed to accommodate luxury yachts to establish a stronger tourism base. These facilities are expected to attract larger yachts and some mega-yachts following the traditional cruising route. While the island is hoping to attract additional off-island boaters in the future, the current marinas primarily serve the local market.

Table 3: U.S. Virgin Islands Marina by Type

Marina Name	Total Number of Wet Slips
Destination/Resort/Hotel Marina	
American Yacht Harbor Marina – **C**	128
Frenchtown Marina – **C**	27
Green Cay Marina	154
Oasis Cove Marina – **C**	26
Sapphire Beach Resort and Marina	67
Yacht Haven Grande Marina	48
Local/Residential Marina	
Compass Point Marina	112
Independent Boat Yard – **B**	80
Jones Maritime Marina	15
Salt River Marina – **C**	7
St Croix Marine – **B**	44
Tropical Marine – **B**	24
Vessup Point Marina	17
Boat Repair Yard	
Caneel Bay Shipyard – **B**	*No Leasable Slips*
Coral Bay Marine – **B**	20

Yacht Club Marina	
St Croix Yacht Club	32
St Thomas Yacht Club	16

*B denotes boat yard services; C denotes charter services

St. John

St. John is predominated by U.S. Government land that is maintained by National Park Service (NPS). St. John has no airport, meaning visitors must fly into a neighboring island and use ferry services to reach the island. The limited access has limited residential and commercial development. As such, marine services on St. John are limited to Cruz Bay and Coral Bay. Coral Bay has a large mooring field operated by the NPS

St. John is a travel and honeymoon destination with two main resorts and one of the top ten beaches in the world (Trunk Bay). St. John is also considered to be the wealthiest and most expensive of the U.S. Virgin Islands, attracting a high level of affluent tourists. The island's high level of affluence has earned it the distinction of being the "Beverly Hills of the Caribbean". Cruz Bay on the western coast of the island is St. John's principal port.

3.1.2. U.S. Moorings

Based on a registration list prepared by NPS, there are approximately 210 mooring balls designated within the National Park boundaries (see Figure 5). Other private moorings are also located throughout the bays around St. John. There are also a significant number of vessels that anchor in Coral Bay and other natural bays around St. John. Estimates provided by residents suggest that approximately 100 vessels moor year round in Coral Bay. The U.S. Park Service indicated a demand for an additional 400 mooring balls around St. John.

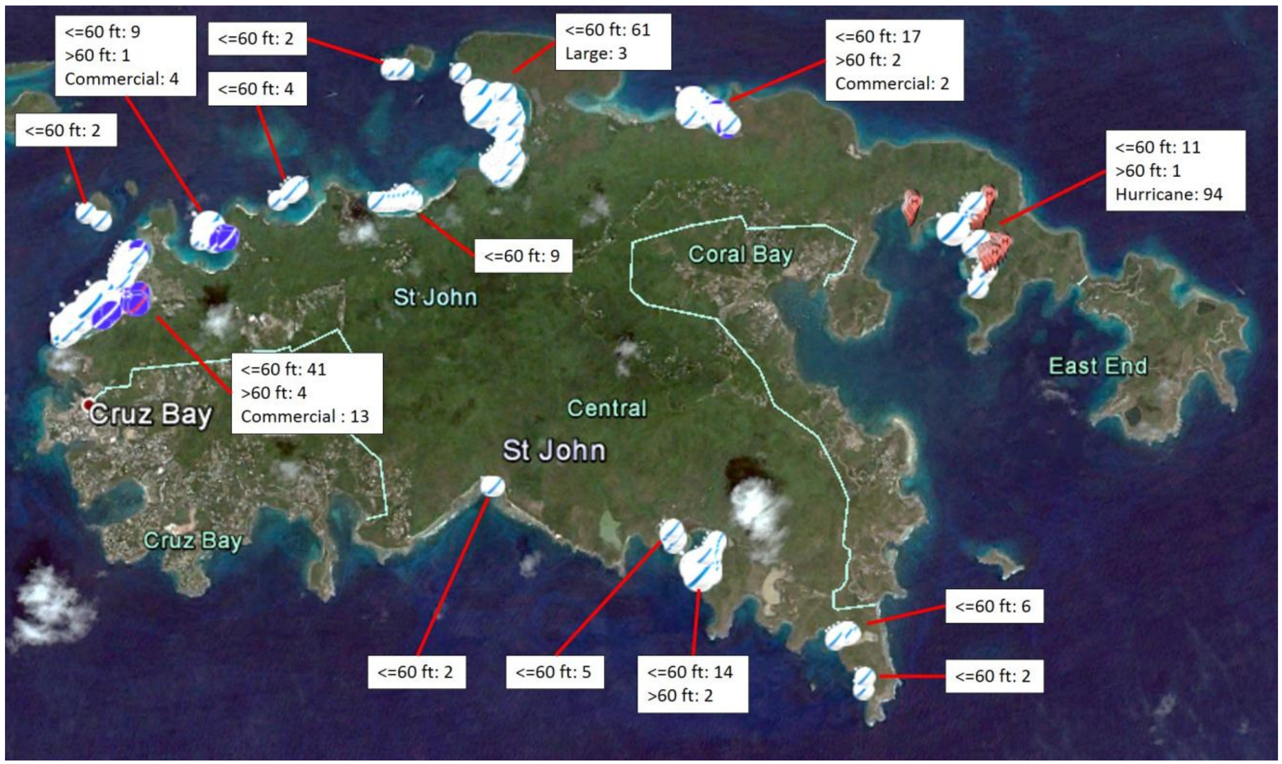


Figure 5: St. John National Park Service Mooring Locations

Most of the vessels using the single point mooring balls are mono-hull sailboats between 35 and 60 feet in length.

3.1.3. British Virgin Islands

Twenty-four marina facilities were identified in the British Virgin Islands. The majority of the marinas are located in Tortola followed by Virgin Gorda. Table 4 shows the identified marinas by type.

Tortola

The hub of the British Virgin Islands, Tortola has a prevalent charter sailing market. The route followed by most charter operators is a loop route around the main islands of the U.S. and British Virgin Islands, with overnight stops at the out islands of both chains. The prevailing winds around the Virgin Islands and favorable charter regulations have caused an increase in the number of charter sailboats in the B.V.I.'s in recent years. Tortola is served by 14 marinas.

Several marinas on Tortola are solely for charter fleet vessels, including The Moorings Marina, Fort Burt Marina, Prospect Reef Resort, Road Reef Marina and Wheatley's Harbour View Marina. Hodges Creek Marina is transitioning from a charter fleet occupied marina to a transient marina. In addition to these marinas, Nanny Cay Hotel & Marina and Soper's Hole Wharf & Marina both have a majority of their slips occupied by charter fleets. The remaining marinas serve a variety of clients including charter vessels, local and transient boaters.

Virgin Gorda

Virgin Gorda in the BVI's is only accessible by boat and has three marina facilities, two of which have associated upland developments. All three marinas have a mixed use of facilities serving local and transients, including charter vessels cruising around the Virgin Islands.

Jost Van Dyke

Jost Van Dyke is a small island, with a population less than 200, west of Tortola. The only access to this island is by boat and a majority of the visitors anchor offshore. Little Harbour Marina can accommodate approximately four boats on its single pier. The Diamond Cay Marina is associated with a phased upland development.

Peter Island

Peter Island is a private island south of Tortola in the B.V.I.'s. There is one marina on this island with 15 wet slips and an associated upland resort.

Table 4: British Virgin Islands Marina by Type

BRITISH VIRGIN ISLANDS	
Marina Name	**Total Number of Wet Slips**
Destination/Resort/Hotel Marina	
Biras Creek Marina	16
The Bitter End Yacht Club	25
Coral Bay Marine Marina	20
Foxy's Taboo	80
Harbour View Marina	10
Hodge's Creek Marina	82
Leverick Bay Resort and Marina	23
Nanny Cay Marina and Hotel	180
Penn's Landing Marina – **B**	13
Peter Island Resort and Yacht Harbor	16

Scrub Island Resort and Marine	55
Soper's Hole Marina – **C**	5
Virgin Gorda Yacht Harbor	12
Village Cay Marina – **C**	106
Charter Marinas	
Fort Burt Marina	40
Joma Marina - **C**	58
The Moorings Marina – **C**	200
Prospect Reef Resort	12
Road Reef Marina	
Wheatley's Harbour View Marina	22
Local/Residential Marina	
Foxy's Jetty – Great Harbour	19
James Young Marina – **B**,**C**	19
Little Harbour Marina	*No Leasable Slips*
Low Bay	25
Manuel Reef Marina	40

***B** denotes boat yard services; **C** denotes charter services

3.2. Market Slip Mix

Slip size mixes in existing markets are indicators of slip size demand. Existing marinas upgrade slips, either during typical repair/upgrade cycles or in direct response to market trends, to include slip sizes higher in demand.

The general trend is for slips to increase in size as many smaller boats are priced out of wet slips and are kept on trailers (marinas earn higher profits on larger boats) and larger boats increase in popularity as they become more affordable and easier to control due to advances in propulsion.

Table 6 shows the existing slip mix for the combined U.S. and British Virgin Islands. Analysis of the statistics shows that the median slip size is in the 40-49 ft range, with 75% of all slips between 30 and 59 feet. There are approximately 3 slips in the 90-99 ft range and 48 in the 100+ ft range for a total of 6% to 7% slips catering to mega-yachts. Some marinas accommodate larger yachts on smaller slips and marinas with larger slips often use the slips for smaller boats when larger boats are not present.

Slip size analysis suggests the following slip mix for new marinas:

Table 5: Marina Slip Mix

Slip Size	Percent of Slips
30ft to 40 ft	25-30%
40 ft to 50 ft	40-50%
50 ft to 60 ft	20-25%
> 60 ft	5-10%

Table 6: Virgin Islands – Overall Marina Slip Mix

U.S. & British Virgin Islands	Total Slips	<20 ft	20-29 ft	30-39 ft	40-49 ft	50-59 ft	60-69 ft	70-79 ft	80-89 ft	90-99 ft	100+ ft	Side Tie
Total Count	2048	55	165	469	625	457	139	22	23	3	75	15
Total %		2.7%	8.1%	22.9%	30.5%	22.3%	6.8%	1.1%	1.1%	0.1%	3.7%	0.7%

Table 7 shows the slip mix by marina for identified marinas in the Virgin Islands.

Table 7: Virgin Islands - Marina Slip Mix

	Marina Name	Total	<20 ft	20-29 ft	30-39 ft	40-49 ft	50-59 ft	60-69 ft	70-79 ft	80-89 ft	90-99 ft	100+ ft	Side Tie
	St. Thomas												
1	American Yacht Harbor Marina	128	0	10	48	42	24	0	0	3	0	1	0
2	Compass Point Marina	112	0	0	4	56	46	6	0	0	0	0	0
3	Crown Bay Marina	99	0	20	0	28	20	0	10	0	0	21	0
4	Frenchtown Marina	27	0	10	10	5	0	2	0	0	0	0	0
5	Independent Boat Yard	80	0	0	25	25	30	0	0	0	0	0	0
6	Oasis Cove Marina	26	0	10	8	4	4	0	0	0	0	0	0
7	Sapphire Beach Resort and Marina	67	0	0	0	27	20	20	0	0	0	0	0
8	St Thomas Yacht Club	16	10	6	0	0	0	0	0	0	0	0	0
9	Tropical Marine	24	0	0	10	10	4	0	0	0	0	0	0
10	Vessup Point Marina	17	0	0	6	6	4	0	0	1	0	0	0
11	Yacht Haven Grande Marina	48	0	0	0	0	8	10	0	10	0	20	0
	St. Thomas Total	**644**	**10**	**56**	**111**	**203**	**160**	**38**	**10**	**14**	**0**	**42**	**0**
	St. John												
1	Caneel Bay Shipyard	0	0	0	0	0	0	0	0	0	0	0	0
2	Coral Bay Marine	20	20	0	0	0	0	0	0	0	0	0	0
	St. John Total	**20**	**20**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	St. Croix												
1	Green Cay Marina	149	0	0	50	50	20	20	0	0	0	3	6
2	Jones Maritime Marina	15	0	4	5	5	0	0	1	0	0	0	0
3	Salt River Marina	7	0	0	0	0	0	0	0	0	0	0	7
4	St Croix Marine	44	0	0	12	24	6	0	0	0	0	2	0
5	St Croix Yacht Club	32	0	7	12	12	0	0	0	0	1	0	0
	St. Croix Total	**247**	**0**	**11**	**79**	**91**	**26**	**20**	**1**	**0**	**1**	**5**	**13**
	Tortola												
1	Fort Burt Marina	40	0	0	8	10	10	10	0	0	0	2	0
2	Harbour View Marina	10	0	0	0	10	0	0	0	0	0	0	0
3	Hodge's Creek Marina	82	0	0	31	25	24	0	0	0	0	2	0
4	James Young Marina	19	0	0	0	10	9	0	0	0	0	0	0
5	Joma Marina	58	0	0	16	24	16	0	0	2	0	0	0

6	Manuel Reef Marina	40	0	0	30	5	5	o	0	0	0	0	0
7	Nanny Cay Marina and Hotel	180	0	40	55	58	10	4	4	3	0	6	0
8	Penn's Landing Marina	13	0	0	3	10	0	0	0	0	0	0	0
9	Prospect Reef Resort	0	0	0	0	0	0	0	0	0	0	0	0
10	Soper's Hole Marina	50	0	0	0	24	25	0	0	0	0	1	0
11	The Moorings Marina	200	0	0	50	70	50	30	0	0	0	0	0
12	TMM Charter Base	18	0	0	8	8	0	0	0	0	2	0	0
13	Village Cay Marina	106	0	0	0	14	50	35	4	0	0	3	0
14	Wheatley's Harbour View Marine	22	0	0	8	10	0	0	0	0	0	2	2
	Tortola Total	**838**	**0**	**40**	**209**	**278**	**199**	**69**	**8**	**5**	**2**	**16**	**2**
	Virgin Gorda												
1	Biras Creek Marina	16	0	7	8	0	1	0	0	0	0	0	0
2	Leverick Bay Resort and Marina	23	0	6	6	4	3	0	0	3	0	1	0
3	The Bitter End Yacht Club	25	0	4	10	10	0	0	0	0	0	1	0
4	Virgin Gorda Yacht Harbour	120	0	16	20	32	48	0	0	0	0	4	0
	Virgin Gorda Total	**184**	**0**	**33**	**44**	**46**	**52**	**0**	**0**	**3**	**0**	**6**	**0**
	Jost Van Dyke												
1	Foxy's Jetty - Great Harbour	19	10	5	2	2	0	0	0	0	0	0	0
2	Foxy's Taboo	0	0	0	0	0	0	0	0	0	0	0	0
3	Little Harbour Marina	0	0	0	0	0	0	0	0	0	0	0	0
	Jost Van Dyke Total	**19**	**10**	**5**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Peter Island/ Scrub Island/ Great Camanoe												
1	Peter Island Resort and Yacht Harbor	16	0	0	2	5	5	2	0	1	0	1	0
2	Scrub Island Resort and Marina	55	0	10	22	0	15	0	3	0	0	5	0
3	Low Bay	25	15	10	0	0	0	0	0	0	0	0	0
	Other Total	**96**	**15**	**20**	**24**	**5**	**20**	**2**	**3**	**1**	**0**	**6**	**0**
	U.S. and British Virgin Islands Total:	**2048**	**55**	**165**	**469**	**625**	**457**	**139**	**22**	**23**	**3**	**75**	**15**
			2.7%	**8.1%**	**22.9%**	**30.5%**	**22.3%**	**6.8%**	**1.1%**	**1.1%**	**0.1%**	**3.7%**	**0.7%**

Many marinas claim to serve mega-yachts and have slips large enough to accommodate them. Field visits confirm that nineteen existing marinas have maximum slip lengths over 80 ft. These larger slips typically represent only one or two slips in most marinas.

Figure 6 shows a summary of maximum slip length for each marina in the market area.

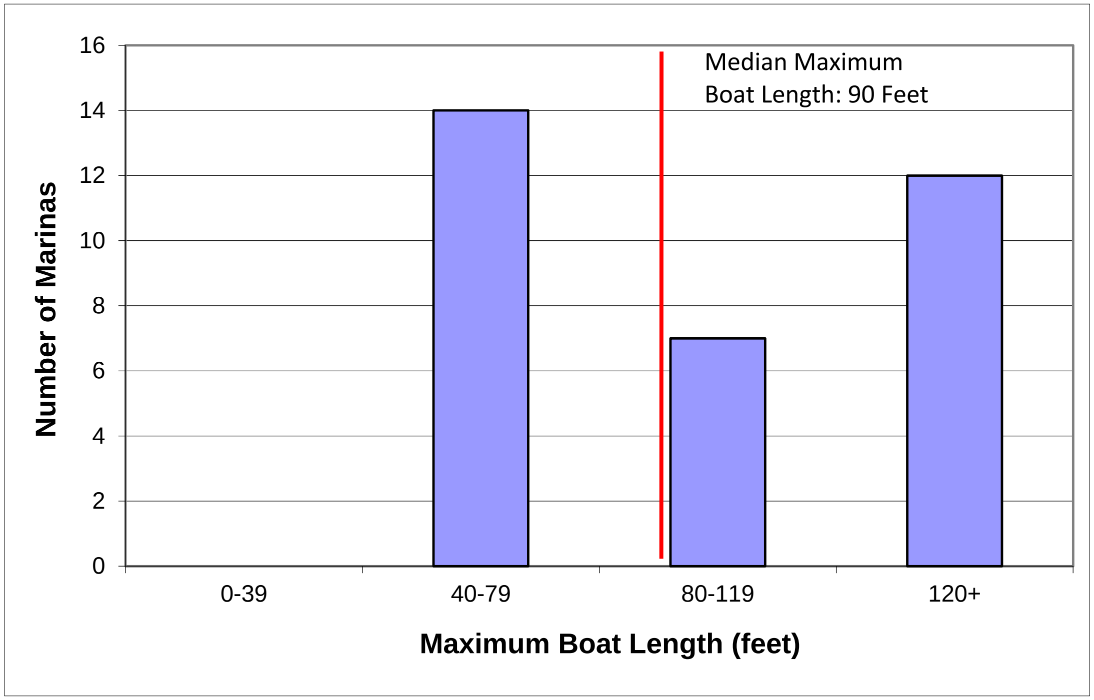


Figure 6: Maximum Slip Length in the Virgin Islands Market

3.3. Amenities

The amenities offered at marinas varies depending on the target boater demographic. shore power and potable water is expected for larger slips in all marinas, while showers, laundry service, and internet service are expected in marinas catering to transient boaters.

Amenities provided at each marina in the Virgin Islands market were identified and are shown in Table 8 while Table 9 shows a summary of the market.

Some services were universally available while others were more specific to the clientele of the marina. All marinas reported having electrical service and potable water for each boat. The electrical service ranged from 30 amp to 600 amp power with the majority of marinas having 30 and 50 amp power. There were only five marinas that had the capability for 100 amp single phase power with the two marinas that cater to mega-yachts having more than 100 amp three phase power available.

The charter industry and support for cruising routes around the islands allows many marinas to provide gas and diesel fuel. Approximately half of the existing marinas offer fuel. Figure 7 shows fuel availability relative to Coral Bay.

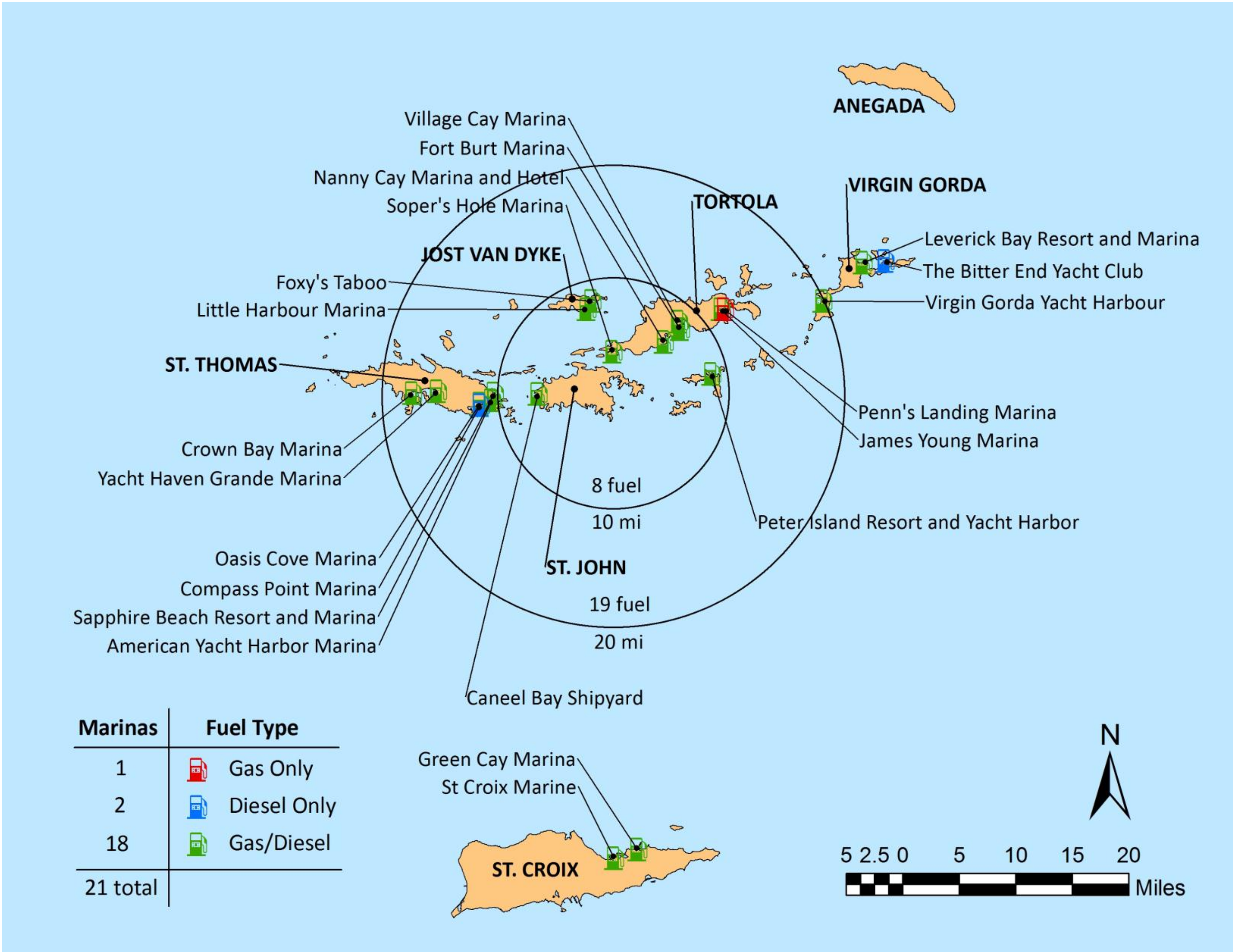


Figure 7: Fuel Facilities Relative to Coral Bay

Approximately 80% of marinas offer internet access. As cell phone coverage and reliability continues to increase in the Caribbean, fewer boaters have need for access to a telephone hookup and availability of this amenity is decreasing.

Charter fleet marinas do not require the added amenities such as telephone, TV, internet and laundry as their patrons are not staying on the boat while it is docked at the marina but merely embarking and disembarking for the charter trip. Besides power, water and fuel needed for the boat, the predominant amenities offered at these charter fleet marinas are ice and showers.

Although not apparent from prevalence in the existing market, sanitary sewer pumpout is a highly desired amenity. There are only 7 facilities that offer this service, none of them on St. John or in the B.V.I.'s.

Table 8: Virgin Islands – Available Amenities

Marina Name	Electric	Potable Water	Internet	Telephone	TV	Gas	Diesel	Pumpout	Restaurant	Bar	Hotel	Shopping	Pool	Water Sports	Ice	Showers	Laundry	Three Phase
St. Thomas																		
American Yacht Harbor Marina	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y
Compass Point Marina	Y	Y	Y	N	N	N	Y	Y	Y	N	N	N	N	Y	Y	N	N	N
Crown Bay Marina	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y
Frenchtown Marina	Y	Y	N	N	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N
Independent Boat Yard	Y	Y	N	Y	Y	N	N	N	N	N	N	N	N	N	Y	Y	N	N
Oasis Cove Marina	Y	Y	Y	N	N	Y	Y	N	N	N	Y	Y	N	Y	N	N	N	N
Sapphire Beach Resort and Marina	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	N
St Thomas Yacht Club	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	N	Y	N	N
Tropical Marine	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Vessup Point Marina	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	Y	N	N	N
Yacht Haven Grande Marina	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
St. John																		
Caneel Bay Shipyard	Y	Y	Y	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
Coral Bay Marine Marina	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
St. Croix																		
Green Cay Marina	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Jones Maritime Marina	Y	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y	N

Salt River Marina	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	N
St Croix Marine	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	Y
St Croix Yacht Club	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	N	N

Marina Name	**Electric**	**Potable Water**	**Internet**	**Telephone**	**TV**	**Gas**	**Diesel**	**Pumpout**	**Restaurant**	**Bar**	**Hotel**	**Shopping**	**Pool**	**Water Sports**	**Ice**	**Showers**	**Laundry**	**Three Phase**
Tortola																		
Fort Burt Marina	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	N
Harbour View Marina	Y	Y	Y	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	Y	N
Hodge's Creek Marina	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
James Young Marina	Y	Y	N	N	N	Y	Y	N	Y	N	Y	Y	N	Y	Y	N	Y	N
Joma Marina	Y	Y	N	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N
Manuel Reef Marina	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	Y	Y	N	N
Nanny Cay Marina and Hotel	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Penn's Landing Marina	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	N	Y	Y	Y	N
Prospect Reef Resort	Y	Y	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	N	N	N
Soper's Hole Marina	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	Y	Y	Y	N
The Moorings Marina	Y	N	Y	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N
TMM Charter Base	Y	Y	Y	N	N	N	N	N	Y	N	Y	Y	N	Y	Y	N	N	N
Village Cay Marina	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wheatley's Harbour View Marine	Y	Y	Y	N	N	N	N	N	Y	Y	Y	N	Y	N	Y	Y	N	N
Virgin Gorda																		
Biras Creek Marina	N	Y	Y	N	N	N	N	N	Y	N	Y	N	N	N	Y	N	Y	N
Leverick Bay Resort and Marina	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
The Bitter End Yacht Club	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Virgin Gorda Yacht Harbour	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y
Jost Van Dyke																		
Foxy's Jetty - Great Harbour	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	Y	Y	N	N
Foxy's Taboo	Y	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	N	N	N
Little Harbour Marina	N	Y	N	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	N	N	N
Peter Island/ Scrub Island/ Great Camanoe																		

Peter Island Resort and Yacht Harbor	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Scrub Island Resort and Marina	N	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Low Bay	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Table 9: Virgin Islands – Available Amenities Summary

Market Area	Total Marinas	Electric	Potable Water	Internet	TV	Gas	Diesel	Restaurant	Bar	Hotel	Shopping	Pool	Water Sports	Ice	Showers	Laundry
U.S. Virgin Islands	18	100%	100%	73%	43%	47%	53%	83%	73%	40%	50%	23%	85%	82%	75%	60%
British Virgin Islands	24	95%	91%	67%	40%	50%	50%	96%	74%	68%	86%	52%	71%	95%	76%	57%

3.4. Fuel Analysis

Marinas that provide fuel should have enough on-site storage capacity to prevent running out of fuel between deliveries. Marinas determine on-site fuel storage capacity by balancing expected fuel demand with available space for storage tanks, the cost of stored product, and keeping the stored fuel fresh.

Marinas in the market with fueling facilities were contacted to request information on fuel storage capacity. These requests went mostly unanswered with marinas claiming security concerns and trade secrets preventing them from disclosing their on-site fuel capacity. One respondent, Crown Bay Marina, indicates 150,000 gallons of diesel and 40,000 gallons of gasoline onsite. This amount of fuel is higher than typical marinas store due to the proximity of the marina to the commercial port and the demand for fuel by large boats and megayachts at this location.

American Yacht Harbour stocks up to 30,000 gallons of diesel fuel and 10,000 gallons of gas. Fuel is delivered via in slip fueling as well as a dedicated fuel dock. The marina indicates that this amount allows them to fully meet customer needs, even during the fuel-intensive peak fishing season.

Boat fuel consumption is directly related to the type and use of the boat – fishing, sailing, cruising, etc. – and the frequency of use. Boat fuel consumption is primarily due to the operation of propulsion engines but fuel is also consumed by electric generators used to power on-board equipment. Some sailboats now use wind and solar devises to generate power, reducing gas and diesel consumption by these vessels.

Table 10 shows projected fuel consumption by boat type per week for typical 40 ft boats in the market area. The projected consumption per hour is averaged over a typical 24 hour day. Consumption for power boats would likely be higher during peak travel and lower at night. Consumption also varies by season.

Table 10: Fuel Consumption Analysis

Boat Type	Avg Gallons per Wk	
Charter power boat	5dy x 24hr x 5gal/hr =	600 gal/wk
Charter sail boat	5dy x 24hr x 0.5gal/hr =	60 gal/wk
Fishing charter	5dy x 8hr x 15gal/hr =	600 gal/wk
Residential power boat	1dy x 4hr x 15gal/hr =	60 gal/wk
Transient boat	=	500 gal/wk

For a 100 slip marina in the market, the following example shows possible fuel consumption by boats for one week:

Power Charter	15	9,000 gal
Sail Charter	30	1,800 gal
Fish Charter	15	9,000 gal
Residential	30	1,800 gal
Transient	10	5,000 gal
Total	100	26,600 gal

Larger vessels typically use diesel fuel while conversely smaller vessels use gasoline. Marinas in this market are expected to consume more diesel fuel than gasoline. A marina of this size typically has at least one 10,000 gallon tank for gasoline. A site specific fuel study may be required to more accurately estimate projected fuel consumption.

3.5. Dock Style

The small tidal range and potential exposure to tropical storm events makes fixed docks the preferred system in the market area. Only one marina currently has floating docks.

Although the preferred style of dock system is fixed, the construction material varies and includes concrete, wood and synthetic wood products.

Slip layouts tend to be “double loaded” meaning two boats berth between each set of finger piers. Each boat has access to one finger pier on one side of the boat that is shared with the boat on the opposite side of the finger pier.

4. SLIP LEASE PRICING

Slip lease rates vary throughout the Caribbean based on location (proximity to cruising routes), amenities, and marina quality. Many marinas have daily slip lease rates that apply regardless of the length of stay.

Lease rates are computed based on the length of boat or dock (whichever is longer) and the length of stay. Rates are up to three times higher for catamarans or multi-hull vessels.

Cruising blogs list the following Caribbean lease rates based on 30 ft boat (most rates exclude utilities):

- Bahamas: $0.45 to $2.45 pf … ~ $21,000 per year
- British Virgin Islands: $0.40 to $1.30 pf … ~ $12,000.00 per year
- Curacao: $0.15 to $0.18 pf … ~$21,000.00 per year
- Grenada: $0.31 to $0.51 pf … ~$4,500.00 per year
- Puerto Rico: $0.42 to $0.75 pf … ~$6,000.00 per year; dry storage for a 30’ or smaller boat is approximately $3,400.00 per year
- St. Kitts: $0.42 to $0.50 pf … ~ $6,500.00 per year
- St. Maarten: $0.45 to $2.80 pf … ~ $6,500.00 per year
- St. Vincent: $0.55 to $1.00 pf … ~ $8,000.00 per year
- Trinidad: $0.40 to $0.57 pf … ~ $5,800.00 per year
- Turks & Caicos: $0.55 to $0.95 pf – about $8,000.00 per year
- U.S. Virgin Islands: $0.50 to $1.20 pf … ~ $9,000.00 per year in a marina; to rack a 30’ boat is about $3,600.00 per year; a mooring from DPNR, including permits, runs about $450.00 per year

This comparison shows that Virgin Islands marinas are among the most expensive in the Caribbean.

The following slip pricing assessment was based on the pricing of comparable facilities in the existing Virgin Islands marina market and trends in the boating industry.

4.1. Wet Slip Rates

Factors affecting the Virgin Island marina slip rates include the type of berth, the length of stay, the vessel size, and the available amenities.

Table 11 shows the wet slips prices are similar at most marinas throughout the Virgin Islands. The exception to this slip pricing is Yacht Haven Grande which caters exclusively to mega-yachts and is not judged to be a comparable facility.

Table 11: Virgin Islands Marina Lease Rates by Submarket

		Daily	Monthly
U.S. Virgin Islands	Minimum	$ 1.25	$ 11.50
	Maximum	$ 1.85	$ 30.00
	Median	$ 1.50	$ 15.50
British Virgin Islands	Minimum	$ 1.00	$ 10.00
	Maximum	$ 2.00	$ 75.00
	Median	$ 1.50	$ 15.00

The significant presence of catamarans and their wider beams require additional berthing space at a marina. Marina operators charge a premium for these vessels and have introduced a separate lease category for these vessels.

Table 12: Marina Wet Slip Pricing Rates for St. Thomas

Marina	Daily Per Foot	Monthly Per Foot
American Yacht Harbor Marina	$1.25	$30
Boater's Haven at Compass Point Marina	NA	$15.50-$27
Crown Bay Marina	$1.25	$24
Independent Boat Yard	NA	$11.50-$13.50
Sapphire Beach Resort & Marina	$1.50	$17.50
Yacht Haven Grande Marina	$3-$4.75	NA
Pirate's Cove Marina	$1	$18
Tropical Marine	NA	$450/month*
Range	**$1-$4.75**	**$11.50-$30**
St. Thomas Average	**$2.15**	**$19.65**

*Not included in Range and Average

Table 13: Marina Wet Slip Pricing Rates for St. Croix

Marina	Daily Per Foot	Monthly Per Foot
Green Cay Marina	$1.25	$20-$25
Salt River Marina	NA	$10-$13
Range	**NA**	**$10-$20**
St. Croix Average	**$1.25**	**$14.50**

Table 14: Marina Wet Slip Pricing Rates for Tortola

Marina	Daily Per Foot	Monthly Per Foot
Nanny Cay Marina & Hotel	$1.10-$2	$14-$24
Soper's Hole Wharf & Marina	$1-$2	$13-$14
Sheppard's Marina	$1.25	NR
Hodges Creek Marina Hotel	$1.35-$1.80	NA
Penn's Landing Marina	$1.45	$14.50
Manuel Reef Marina	$1.20-$1.50	$12-$15
Village Cay Marina	$1.15-$1.55	$28.50-$45
James Young Marina	$1-$1.50	$10-$12
Range	**$1-$2**	**$10-$45**
Tortola Average	**$1.40**	**$18.35**

Table 15: Marina Wet Slip Pricing Rates for Virgin Gorda

Marina	Daily Per Foot	Monthly Per Foot
Virgin Gorda Yacht Harbour	$1.25-$2.50	$27-$75
The Bitter End Yacht Club	$1.50-$2	NR
Leverick Bay Resort & Marina	$1	$15
Range	**$1-$2.50**	**$15-$75**
Virgin Gorda Average	**$1.65**	**$39**

Table 16: Marina Wet Slip Pricing Rates for Peter Island

Marina	Daily Per Foot	Monthly Per Foot
Peter Island Resort & Yacht Harbor	$2-$4.25	NA

4.1.1. Wet Slip Price Analysis

The anticipated appeal of the landside development at Coral Bay, in conjunction with the planned amenities and services at the proposed marina, suggest that slip lease prices on the order of $1.5 to $2.00 per linear foot per day and $20 to $25 per linear foot per month may be obtained.

4.2. Dry Storage Rates

Demand for dry storage is typically limited to local residents with smaller boats and, as such, dry storage is not popular in the Virgin Islands. Long term dry storage leasing is available at one location in the Virgin Islands on St. Thomas. Tropical Marine offers dry stack leasing for $12 per foot. Independent Boatyard has a dry stack facility in conjunction with its vessel maintenance and repair work; however, this facility does not lease slips for storage.

4.2.1. Dry Storage Price Analysis

A dry storage facility at the proposed resort would be able to command a similar price structure, with rates up to $15 per foot per month if services and amenities are included with the basic storage fee. Because of the price sensitive nature of the local market in this vessel class, the price structure may need to be adjusted to maintain absorption.

4.3. Slip Sale

The purchase of wet slips is growing in popularity throughout Florida and the Caribbean. Many prospective buyers view slip purchases the same as real estate purchases, location and availability determine the purchase and sale prices. The scarcity of available slips for lease or purchase in some markets, such as Key West, have driven slip prices to over $12,000 per linear foot. Slip ownership may be in many forms from a fee simple deed to an equity club membership with an exclusive license to utilize the slip. Pricing for these "dockominium slips" does not appear to be affected by the form of ownership.

Sales in the Caribbean range from $1,500 to $3,000 per linear foot. Generally, higher prices corresponded to longer, deeper, and more amenity laden slips. Sapphire Beach Club is the only facility to date in the USVI that offers slips for purchase. Official pricing structure was not available at this facility but the dockmaster indicated that purchase price was on the order of $1,500 per linear foot. This lower price may reflect the age of the facility and the amenities offered. To

date, at least five facilities in the Caribbean, which include resort, residential, and retail developments in addition to the marina offer wet slips for sale with four offering presales while still under construction. These offerings have been met with some interest and success in sales and reservations to date.

4.3.1. Slip Sale Price Analysis

Rates on the order of $1,500 to $2,000 per linear foot are considered indicative of what may be achieved at the proposed marina.

4.4. Amenity Pricing

Amenity pricing is driven by availability, type, and location within the marina. The two primary utilities that boat owners require are electrical hookups and potable water.

Electrical hookups and potable water can be assigned a flat rate, to be included in the slip price or the utilities can be metered and billed by kilowatt/hour for electric or by gallon for water. The majority of marinas in the Virgin Islands meter their electric and water.

Most marinas offer water in the range of 10 to 25 cents per gallon. The exception is the Peter Island Resort & Yacht Harbor which charges 60 cents a gallon. The electric charge per kilowatt hour is in the range of 40 to 50 cents for the marinas that meter this amenity. Independent Boatyard is an exception charging only 28 cents a kilowatt hour; however, they also have an additional monthly charge of $10.

For marinas that offer a flat daily rate for electric, the range is widespread from $10 per day to $125 per day. The majority of the marinas are within a $10 to $40 range with Peter Island Resort & Yacht Harbor increasing the range by charging $70 to $125 per day. If metered water and electric are desired at the proposed marina a range of 13 to 17 cents per gallon should be supported for water and 45 to 50 cents per kilowatt hour for electric.

Additional amenities are often charged on a flat fee basis or are the responsibility of the vessel. Television hookups are offered through cable or satellite options while internet availability is shifting more towards wireless access. Telephone hookup is usually the vessel owner's responsibility at the marinas and due to the increasing reliability of cell phone service is not a widely available amenity.

5. BOAT USE AND REGISTRATION TRENDS

Estimating marina demand requires an understanding of trends in the local, regional, and global boating markets. This section describes trends in boat use and registration statistics for all vessels less than 80 feet. Due to U.S. luxury taxes in conjunction with owner demographics, many larger yachts are registered to countries in the Caribbean and do not show up in the U.S. DMV vehicle registration statistics.

5.1. Boat Use Trends

In 2002, the U.S. Coast Guard (USCG) Office of Boating Safety commissioned a detailed report on boating use and safety throughout the United States and its territories. This report provides a distribution of boat use subdivided by categories for each State, Territory, and the U.S. as a whole. These boat use trends are judged to be indicative of ownership trends.

Respondents of this study were asked to categorize the activities they engage in while utilizing their vessel. As shown in Figure 8 almost 70% of boaters in the U.S.V.I.'s use their vessels for cruising, either mechanically powered or under sail. The second and third most popular activities were fishing and swimming and/or diving.

There are several popular locations for fishing around the Virgin Islands, including the North Drop and the South Drop. These popular fishing areas are located north and south of St. Thomas, respectively, where the water depth drops rapidly, and have produced several world record fishing titles which continue to draw fishermen to the region all year. All three of the top boat use activities draw tourists to the islands all year long supporting a well-established charter industry around the islands.

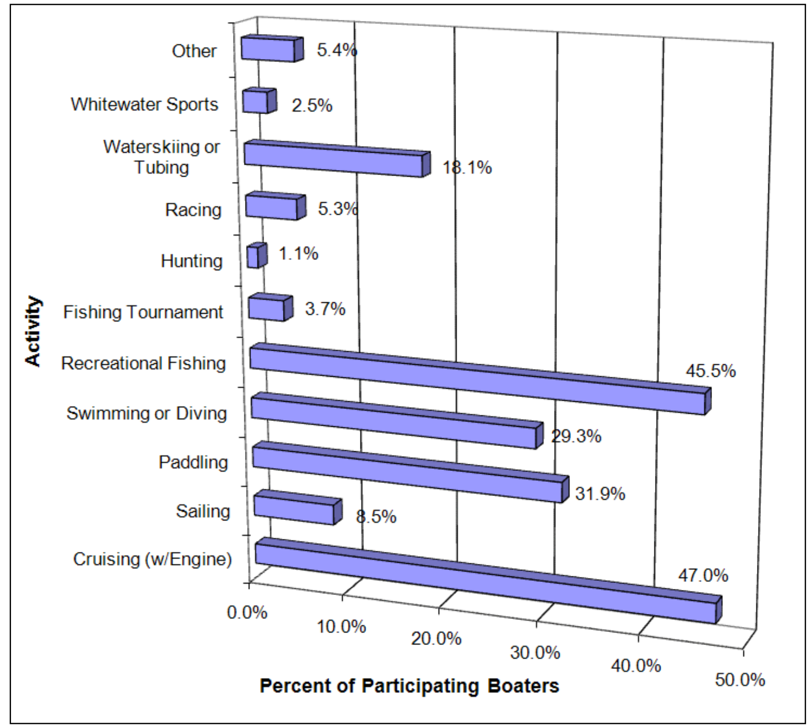


Figure 8: U.S.V.I. Boater Activity Participation

5.2. U.S. Market Registration Trends

While the total number of boats in the world market is difficult to track due to inconsistencies in registration procedures, in the United States the Coast Guard and state governments track the registration of vessels and this information is made publicly available.

The National Marine Manufacturers Association (NMMA), a marine industry advocacy group, annually collects and summarizes boat registration records for each state in an annual U.S. Boat Registration Statistics report.

Analysis of the U.S. boat registration statistics shows that on a nationwide basis boat ownership was significantly impacted by the 2008 recession. As Figure 9 indicates the total number of registered boats declined dramatically after 2008.

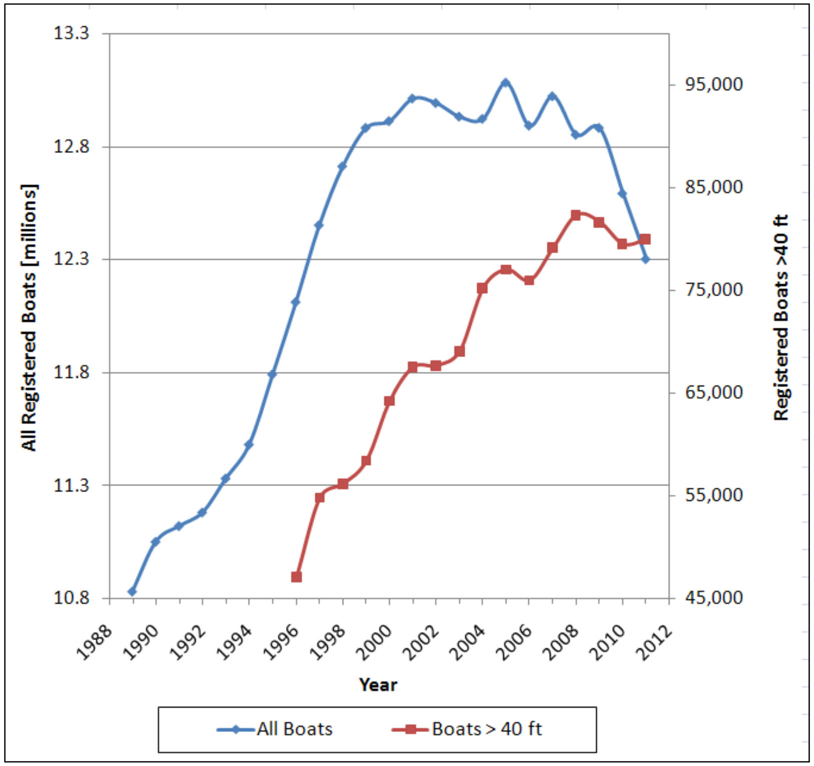


Figure 9: U.S. Boat Registration Trends
(Source: USCG/NMMA)

Contrary to the overall trends, ownership trends for boats greater than 40 feet in length are less volatile as evidenced by the nationwide registration trends shown in Figure 9. Trends in boats larger than 40 ft are indicative of marina demand as smaller slips are phased out and larger boats are the primary slip takers in marinas.

In 2011 there were over 75,000 vessels over 40 feet long registered in the U.S, from 47,000 vessels in 1996, with only slight dips in registration trends. The growth in the registration of vessels over 40 ft long can be attributed somewhat to the demographics of the owners, which tends to higher wealth individuals, improvements in the operability of these boats making them more accessible to amateur boaters, and improved efficiency in manufacturing lowering purchase costs.

5.3. Virgin Islands Market Boat Ownership Trends

The year-round boating climate and favorable winds in the U.S. and British Virgin Islands region is conducive to a strong boating industry. Registration data shown in Figure 10 show that boat registrations increased starting in 2006 and grew every year through 2011. In 2011, registrations declined to pre-2000 levels. Detailed data on boat registration per size is not available but economic trends and anecdotal information suggest that most boats removed from U.S.V.I registration rolls correspond to smaller boats less than 20 ft that do not significantly affect the marina market.

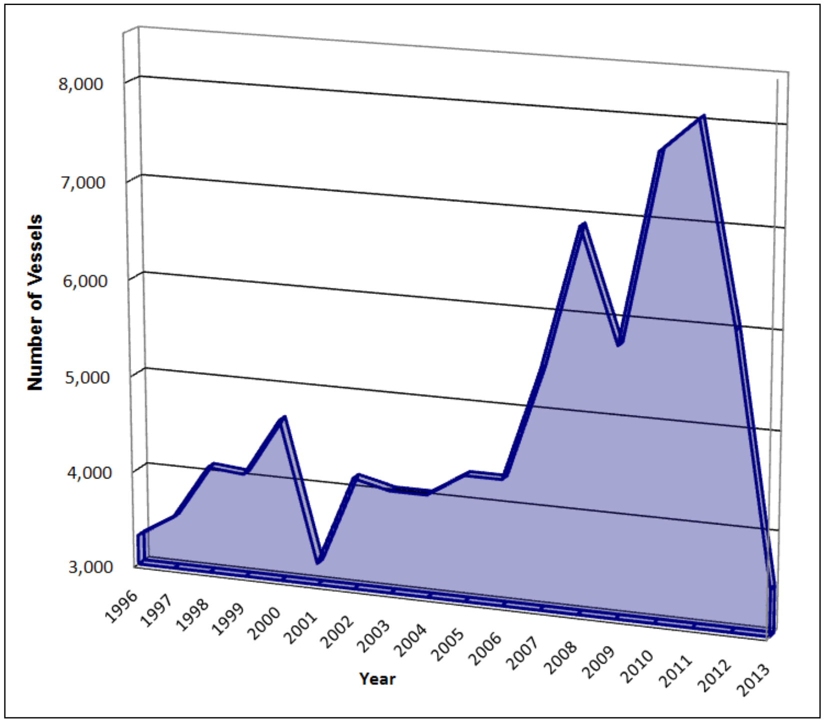


Figure 10: U.S.V.I Registered Boats Total

Some decrease in the total number of boats in the U.S.V.I.'s may be due in part to the USCG Uninspected Passenger Vessel Regulation, commonly known as the "6-Pax" rule, and the Jones Act, a U.S. law governing transport of passengers and good between U.S. ports.

The current "6-Pax" regulation restricts any chartered vessel under 100 gross tons not inspected by the USCG to carrying no more than six paying passengers in U.S. waters. Passing the inspection requires boats meet stringent criteria which most of the existing fleet do not meet. For example, no forward facing porthole openings are permitting to prevent flooding during wave overtopping – many boats include forward facing hatches to promote sea breezes into the cabins. This has had a significant impact on the charter industry in the U.S.V.I.'s as many of the vessels accommodate eight to ten passengers. As a result some charter companies have relocated to the B.V.I.'s where this rule does not impede the charter business, resulting in a decrease in the number of registered boats in the U.S.V.I.'s. This rule is currently in discussions for modification to allow up to 12 passengers on charter boats without requiring a USCG inspection. An alternative to relocating to the B.V.I.'s has been for charter boats to be home-ported in the U.S.V.I.'s but pick up charter passengers in the B.V.I.'s.

Vessels registered in the U.S.V.I. are not excluded from the requirements of the Jones Act. The Jones Act states that foreign vessels cannot disembark passengers or unload cargo at more than one U.S. port without visiting a foreign port in the interim. The goal of the Jones Act was to protect U.S. shipping interests by banning foreign flagged ships transporting cargo between U.S. ports. The downside is that foreign flagged charter vessels departing from the U.S.V.I. cannot visit more than one Puerto Rican harbor or port.

In addition to the "6-Pax" and Jones Act regulations affecting cruising between the island groups, the foreign garbage law prohibits anything purchased on the B.V.I.'s from being disposed of in the U.S.V.I.'s and vice versa. This includes all garbage ranging from food scraps to plastic bags from gift shops. This is problematic in that once a vessel travels from the B.V.I.'s to the U.S.V.I.'s any garbage on the boat, regardless of whether it originated in the B.V.I.'s, is now considered foreign trash once the vessel enters back into the B.V.I.'s. Many vessels have avoided the issue by evacuating garbage into the waters more than three miles off the coasts of the islands (limit of territorial waters) if they are traveling between the U.S.V.I.'s and the B.V.I.'s.

5.4. Facility Trends

The marinas in the U.S. Virgin Islands predominantly cater to local (long term residents and seasonal second home buyers) and Puerto Rican owners in the 40-foot to 60-foot range with some transient and charter slips. The majority of marinas in the B.V.I. have 40-foot to 60-foot slips that are leased to charter companies.

Yacht Haven Grande was built specifically to cater to mega-yachts and there are several other facilities that have additional amenities to serve this clientele; however, the main focus in U.S. and British Virgin Island is on the sailboat and charter market in the 40-foot to 60-foot range. The 40-foot to 60-foot slip size accommodates the sailboats during the peak cruising season and regional power boats during the off-peak season.

Marinas are elevating the level of service and amenities offered to their guests including utilities that meet or exceed marina benchmarks, concierge attendants and exclusive features such as spas and boutique shops. The role of amenities in the yachting market has grown as yachters have more choices of where to berth their vessels. Industry experts indicate that boat owners and captains prefer marinas that offer quality and service over price. Marinas have recognized the need for upscale amenities and have been adding new features to meet the need of modern yachts. Some specific trends include the following:

- higher amperage (up to 600 amps for mega-yachts) electrical service in multiple phases and frequencies available at mega-yacht slips
- high speed refueling with increased fuel storage capacity
- In-slip or convenient disposal operations for reclaimed water (gray water) and sanitary sewer (black water)
- wider berths to accommodate trends in yacht and catamaran construction
- expanded crew services and entertainment options

Increased power supply and reclaimed or sanitary sewer disposal have been difficult amenities for the Virgin Islands to accommodate. Limited power supply on the islands makes higher amperage power at slips more difficult to obtain. The lack of capacity or distribution lines at the regional wastewater treatment plants has resulted in moratoriums on the permitting of new facilities that would offer such services.

As a majority of the boating market in the Virgin Islands is charters, upland amenities are desirable to patrons booking a charter. One dockmaster in the BVI's indicated that having comfortable shower facilities has been a draw for the marina as vacationers want to be pampered after having spent a week on a boat.

6. THE VIRGIN ISLANDS MARINA MARKET

Successful marina development requires an understanding of the existing and projected slip demand. Slip demand is determined by analyzing marina market drivers.

Market drivers are the market forces that cause boaters to populate slips. Typical market drivers include existing underserved population, local population growth and demographic changes, residential development associated with a marina, the charter boat industry, and local tourism. The following sections describe these market drivers.

6.1. Existing Underserved Population

The population of the Virgin Islands has remained relatively constant over the past decades. However, demographic shifts and increased prevalence of second homes in the Virgin Islands has increased the demand for boat slips.

Population distribution in St. John shows significant population in the Central and Coral Bay districts.

2010 St. John Population by District:

- Total Population: 4,197
- Central: 779
- Coral Bay: 634
- Cruz Bay: 2,706
- East End: 51

The limited boating facilities to serve the Central and Coral Bay districts suggest that these populations are underserved. Table 17 and Table 18 show the number of slips and population by Island.

Table 17: U.S.V.I Slips per Capita

	Population	Slips*	Slips per 1,000
St. Thomas	51, 634	644	12.5
St. Croix	50,601	247	4.9
St. John	4, 170	20	4.8
U.S.V.I. Total	**105,275**	**911**	**8.7**

Analysis shows that the number of slips per capita on St. John is significantly lower than the average for St. Thomas and the U.S.V.I. in general. Based on population and regional average slips per capita, St. John is projected to need 16 to 20 additional slips.

The number of slips per capita for the British Virgin Islands is significantly higher than the U.S. Virgin Islands due to the charter industry and 6-pax law described above.

Table 18: B.V.I Slips per Capita

	Population	Slips*	Slips per 1,000
Tortolla	23,000	838	36.4
Virgin Gorda	4,000	184	46.0
Jost van Dyke	300	19	63.3
Other	500	96	192.0
B.V.I Total	**27,800**	**1,137**	**40.9**

* Does not include moorings

Should the rules inhibiting the charter market change, the number of needed slips on St. John might more closely resemble the number in the B.V.I. Based on B.V.I. slips per capita, St. John would support approximately 150 additional slips.

6.1.1. Existing Underserved Population Analysis

Analysis of the existing population and slip distribution suggests the need for 20 up to 150 additional slips on St. John to support the existing population.

6.2. Population Growth

Trends in the Virgin Islands and Puerto Rico's population growth and demographics can serve as an indicator of potential demand for boating facilities within the Virgin Islands market. As the population grows and new boaters enter the market, demand for boat slips is expected to similarly increase.

6.2.1. Virgin Islands Population

According to the U.S. Census Bureau, the population of the Virgin Islands is expected to show an average annual increase due to the "baby boomer" population of 0.2 percent until 2037 when there will be slight annual decreases of the same magnitude until 2050.

6.2.2. Puerto Rico Population

Puerto Rico is easily within cruising distance for yachts and mega-yachts. Boaters residing in Puerto Rico often visit the U.S.V.I. and are locally referred to as the "Puerto Rican Navy" due to the large number of vessels sailing together. However, the number of vessels registered in Puerto Rico declined significantly from 2010 to 2011. The reason for this decline, shown in Figure 11, may be attributed to several factors.

1) Recent economic downturns in Puerto Rico have resulted in declining population and lower per capita income. In 2011 and 2012, Puerto Rico's population fell by nearly 1 percent, according to census figures. From July 2012 to July 2013, population declined again by 1 percent, or about 36,000 people.

2) Increased taxes on boat registrations, combined with economic pressures, have led to boaters not reporting their boats or allowing their registration to expire.

3) Prior to 2010, boats staying in Puerto Rico for more than 60 days were required to register in Puerto Rico. That rule changed and vessels may now stay several months up to a year without registering in Puerto Rico.

These factors, combined with a suspected clearing of the boater registration rosters of boats with expired registrations, contributed to the reduction in registered boats.

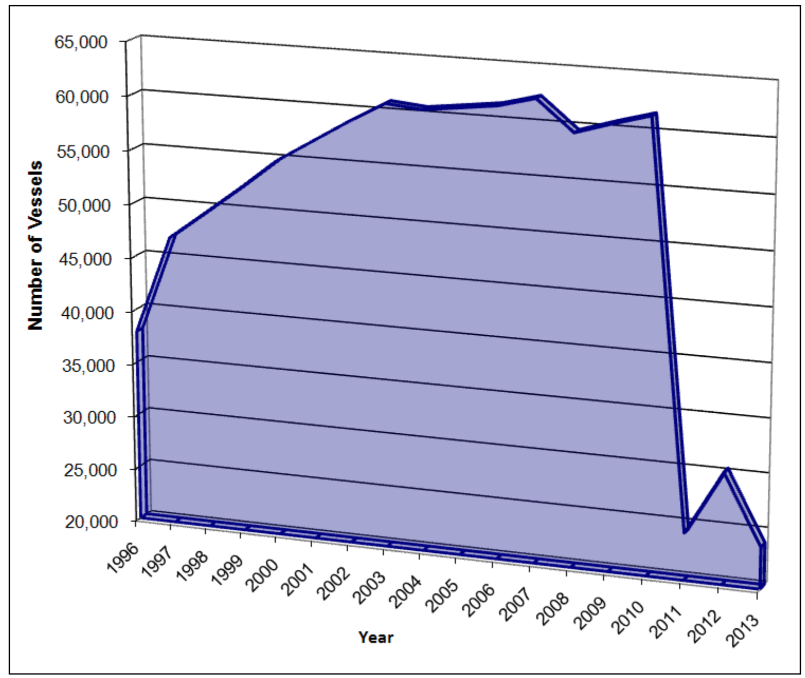


Figure 11: Puerto Rico Boats

Some boat owners from Puerto Rico homeport their vessels in the Virgin Islands. There were approximately 30 vessels with Puerto Rico registration decals observed during the site visits of marinas in St. Thomas and Tortola.

6.2.3. Population Growth Projection

The demand for slips in Coral Bay is projected to increase by 5 to 10 slips over the next 10 years based on population growth.

6.3. Demographic Shift

Demographic shifts affecting boating demand include change in population age and change in wealth.

6.3.1. Age

Population growth projections based on age show that a higher percentage of the anticipated population growth may be persons 55 years and older as shown in Figure 12. The population in this age range is expected to increase by approximately 85 percent between 2007 and 2050 with annual increases of 1.5 percent to 3 percent over the next 10 to 15 years as the “baby boom” generation enters retirement age. Generally, a higher percentage of the retirement age demographics are yacht owners. These population demographic trends suggest that an increase in this age group may lead to an increase in the number of boaters.

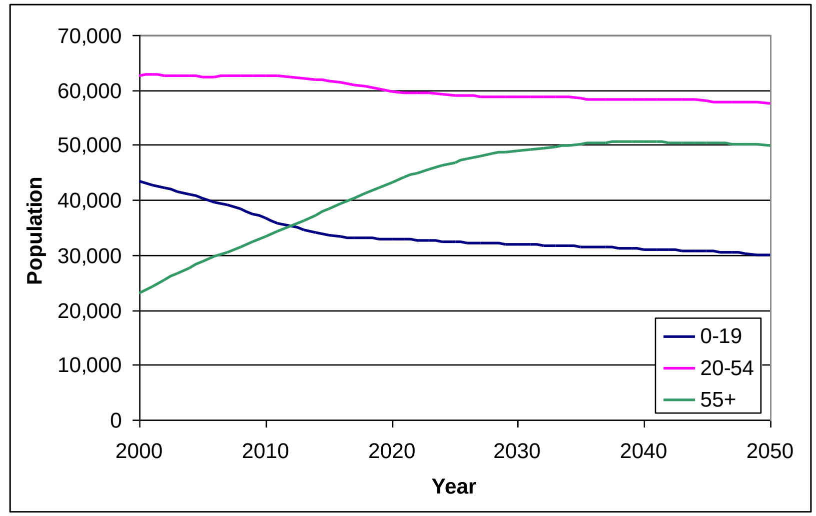


Figure 12: Census and Projected Population Growth

6.3.2. Wealth

Recent real estate data illustrates that the trend in home sale value is trending strongly upward. The sudden decrease of nearly 30% in value in 2008, as shown in Figure 13, corresponds to conditions related to the economic recession. By 2011 values had recovered to 12.6% below record highs, compared to 28.5% below just 3 years earlier.

These trends suggest higher wealth individuals buying second homes or moving to St. Thomas and St. John. These individuals are more likely to purchase larger boats these demographic trends suggest that an increase in wealth may lead to an increase in the number of boaters.

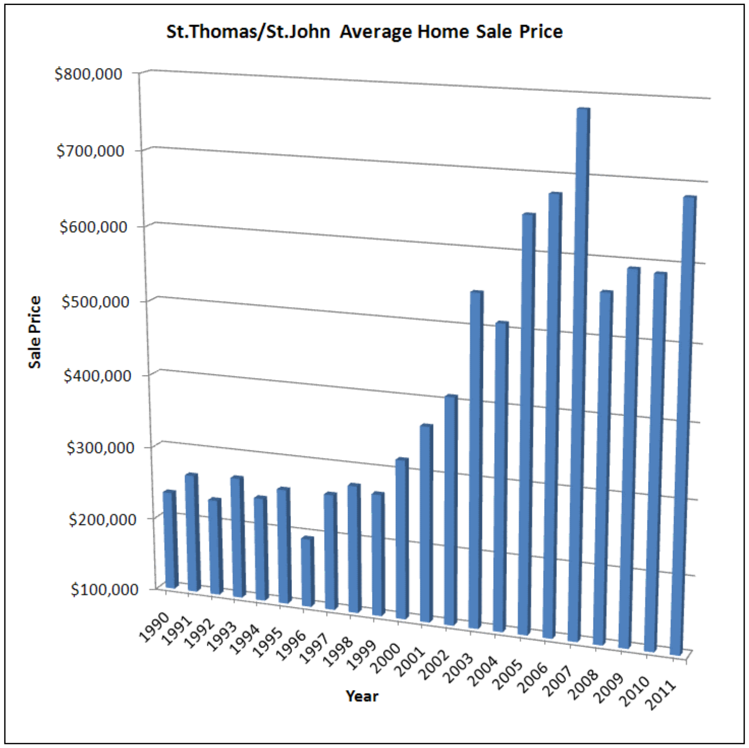


Figure 8: U.S.V.I Average Home Sale Price Trend

6.3.3. Demographic Shift Projection

Applying the percentage of registered boat owners in U.S.V.I. today with future projections for the 55 and older demographic, an additional 1,000 boats may be registered in the U.S.V.I. within the next 10 years. Approximately 15% to 20% of the boats (150-200) would be power boats greater than 30-feet in length based on the current distribution of registered boats. Similarly, 25% to 30% of boats (250-300) would be sailboats larger than 25 or 30 feet (sail with auxiliary power). In summary, 400 to 500 vessels would need a wet slip or mooring ball to berth within the next decade.

6.4. Tourism

Tourism, as a market driver for marinas, is considered both regionally and locally. The regional considerations include trends in transient boat visits to the Virgin Islands. Local considerations focus on the proposed hotel development at Coral Bay and associated boating activities.

The Virgin Islands are a popular tourist destination and the tourism industry creates the economic base for the region. The environment provides access to a variety of activities which attract a steady flow of visitors to this area year-round.

Figure 10 shows that the number of visitors U.S. Virgin Islands. The number of visitors to the US Virgin Islands reached a record high in 2011, and the number of visitors to St. Thomas/St. John in 2011 was less than 3% below its record high reached in 2004.

The busiest time of year for the islands is during the winter season. Marinas during this time are able to maintain close to full occupancy. While the summer months that coincide with the peak hurricane season are the slowest time of year for the tourism industry. The popularity of blue marlin and other game fish draws avid fishermen to the area for the various tournaments, helping to support occupancy in marinas during these slower periods.

6.4.1. Visiting Transient Boaters

Transient boating for this analysis is defined as boaters passing through or visiting the region temporarily. Transient boating is directly affected by economy as boat owners stay closer to home to reduce operating costs during economic difficulties. Analysis of overall tourism trends shows that visits to the Virgin Islands continues to grow.

Sponsored fishing tournaments draw additional boaters to marinas throughout the Virgin Islands. During fishing tournaments and sailing regattas, marinas in the B.V.I. have indicated that they have to turn vessels away. The centrality of St. John to the Virgin Islands makes Coral Bay an ideal location for the overflow vessels to dock.

Surveyed dockmasters indicated that they maintain up to 15 wet slips during the season to attract transients to the facility during the cruising season. The latter number can expand upwards of 25 slips during fishing tournaments.

6.4.2. Hotel Development

The proposed 110+ room hotel in Coral Bay is expected to have an eco-tourism theme that focuses on observing and participating in activities/ programs within the National Park boundaries. Regardless of the hotel theme, the proximity to world class diving, snorkeling, and fishing will result in a demand for commercial boat operators at the marina to serve the hotel patrons.

Hotel marketing efforts and pricing will heavily influence the demand for these services by hotel guests. The range of expected boat users from the hotel population that did not arrive by private boat is expected to be on the order of 25% to 45%

6.4.3. Charter Boats

The charter boat market is directly related to the tourism market. The Virgin Islands attract a large number of visitors for charter boat rentals (mainly mono-hull sailboats and catamarans) for a variety of activities and this industry is a mainstay at marinas throughout the

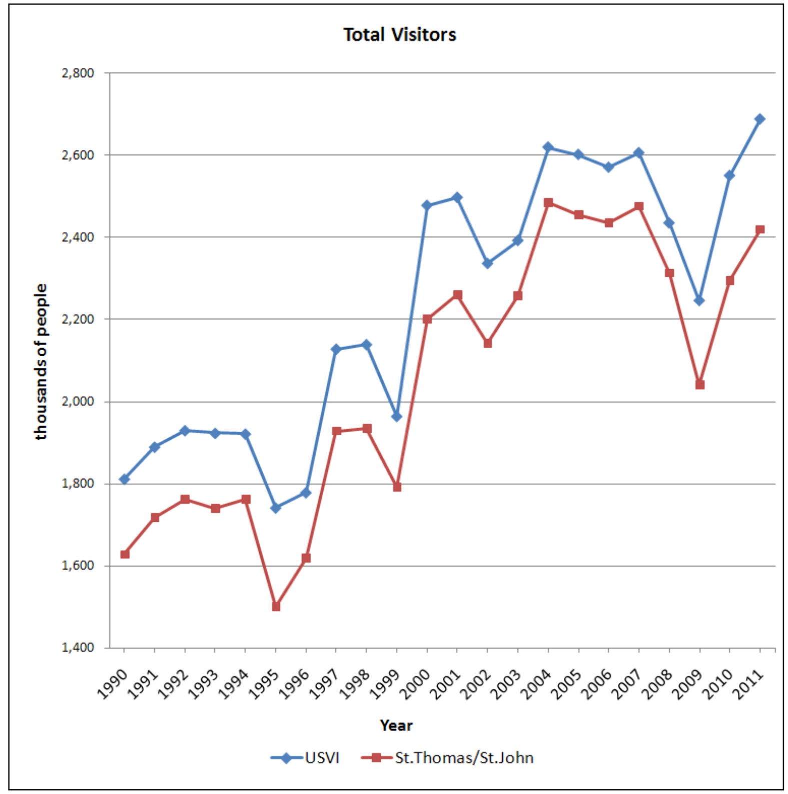


Figure 10: Total U.S.V.I Visitors

region. The Moorings, a marina in downtown Road Harbour, is solely dedicated to the charter market.

Charter boats homeport in locations with convenient access to open water and water related activities while having sufficient public access. The construction of the marina and upland residential development may attract existing and new charter vessels that desire to homeport in the Coral Bay area. The proximity of recognized fishing areas suggest that charters dedicated to fishing use may find

Coral Bay a convenient homeport as well. Fishing charters also may generate additional traffic by hosting fishing tournaments. Meeting and catering facilities and available dockage will help to draw tournaments to a location.

The number of charter vessels that berth at the marina may be influenced by the “6 pax” and foreign garbage regulations. As described above, the 6-pax rule requires charter boats berthed in the U.S.V.I.s that host more than 6 passengers comply with tougher coast guard regulations that most existing charter vessels do not meet. The 6-pax rules are being discussed for modifications in Congress to relax these requirements to allow up to 12 passengers without requiring a USCG inspection.

Pending the law being modified, charters that cater to small groups (six or less people) and limit their cruise destinations to the U.S.V.I. and Puerto Rico are possible tenants in the proposed marina. There is expected to be less demand for wet slip space due to the regulatory constraints that affect charters departing from the U.S.V.I. The percentage of charter vessels berthed at marinas in St. Thomas may be more representative of what would occur at the proposed marina.

The number of charters seeking berths in the U.S.V.I. is expected to increase if the 6-pax rule is modified to allow more passengers and Tortola may be more representative of the expected demand.

At present, between 10 to 15 percent of the wet slips in St. Thomas were observed to cater to the charter vessels while the number of wet slips in Tortola for charters may be closer to 40%.

6.4.4. Tourism Analysis

Tourism is the main economic driver for marinas in the Virgin Islands. Tourism is site specific and a marina location and associated amenities will influence the marina slip demand.

The proposed Coral Bay facility is expected to have demand from tourism ranging from 60 to 85 slips (15 + 35+ 10 = 60 slips to 25 + 45 + 40 = 110 slips).

6.5. Commercial Boat Yard Services

The Virgin Islands have limited boat repair yards. A full service yards with engine repair, fiberglass, canvas, and electronics shops will likely require 10 to 20 dedicated wet slips for staging and in-water work on boats that can’t be hauled out onto the yard.

6.6. Mega-yachts

Mega-yachts are typically defined as yachts larger than 80 ft long. These yachts are used by the yacht owners or are often made available for charter. The owners or charter users of these vessels typically look for unique destinations and expect high levels of marina service. Consequently, mega-yachts often spend significant amounts of money at ports they visit and are highly desired by marina operators.

Mega-yachts are not confined to a regional cruising range as the amenities and equipment on most vessels of this size allow ocean crossings. There are two widely recognized mega-yacht cruising areas-the Caribbean Sea and the Mediterranean Sea. The Caribbean Sea is the favored cruising grounds during the months from November to May. During hurricane season, June 1 to November 30, many mega-yachts relocate to the Mediterranean Sea for cruising.

The demand in the global mega-yacht market has continued to increase over the past several years as mega-yachts continue to increase in size and popularity. The Virgin Islands are located on the active mega-yacht cruising route as shown in Figure 13.

Currently the focus for mega-yachts in the Virgin Islands is on facilities in St. Thomas. The two marinas that cater to the mega-yacht class of vessels are Yacht Haven Grande adjacent to the West Indian Company Dock in downtown Charlotte Amalie and Crown Bay Marina locate west of downtown adjacent the Crown Bay port facility. Upland amenities such as high end shops, restaurants, and provisioning facilities that are prevalent on the island of St. Thomas have been able to attract the mega-yacht community. Many mega-yacht users look for dockage with high visibility to the public and the location of the existing facilities allows for high visibility.

Although a majority of the marinas surveyed in the U.S. and British Virgin Island have the ability to accommodate a few of these vessels, mostly on the end of "T-head" piers, most dockmasters indicate that low demand and the seasonal nature of the mega-yacht does not justify the infrastructure investment or the level of staffing required to cater to these vessels. Some dockmasters in the B.V.I. indicate that they accommodate mega-yachts for a few weeks at the end of the season as these vessels await transfer to the Mediterranean via shipboard transport departing from Road Harbour, Tortola in early May.

Mega-yachts owners in almost all cases carry boat insurance to protect their investment. Boat insurance often requires that the yacht be removed from hurricane prone areas during the hurricane season. In addition to very high premium costs in the Virgin Islands, typical policies require a storm plan that includes the owner or their representative staying in close proximity to the yacht at all times to respond to emergencies, including while berthed at the yacht's homeport.

Due to limited direct access to the project site, with the closest airport being off-island, mega-yachts yachts are not expected make the proposed marina a homeport unless the yacht owner has a residence on St. John.

6.6.1. Mega-yacht Analysis

The project marina may attract a few mega-yachts during the cruising season who wish to stay at the resort. The marina will offer easy access to explore the national park on St. John as well as close proximity to popular fishing areas. Industry guidelines suggest 5 to 10 percent of the total slips in the marina (approximately 5 to 10 slips) should be able to accommodate mega-yachts. Due to the seasonality of the mega-yacht market, these slips should be able to also accommodate smaller vessels.

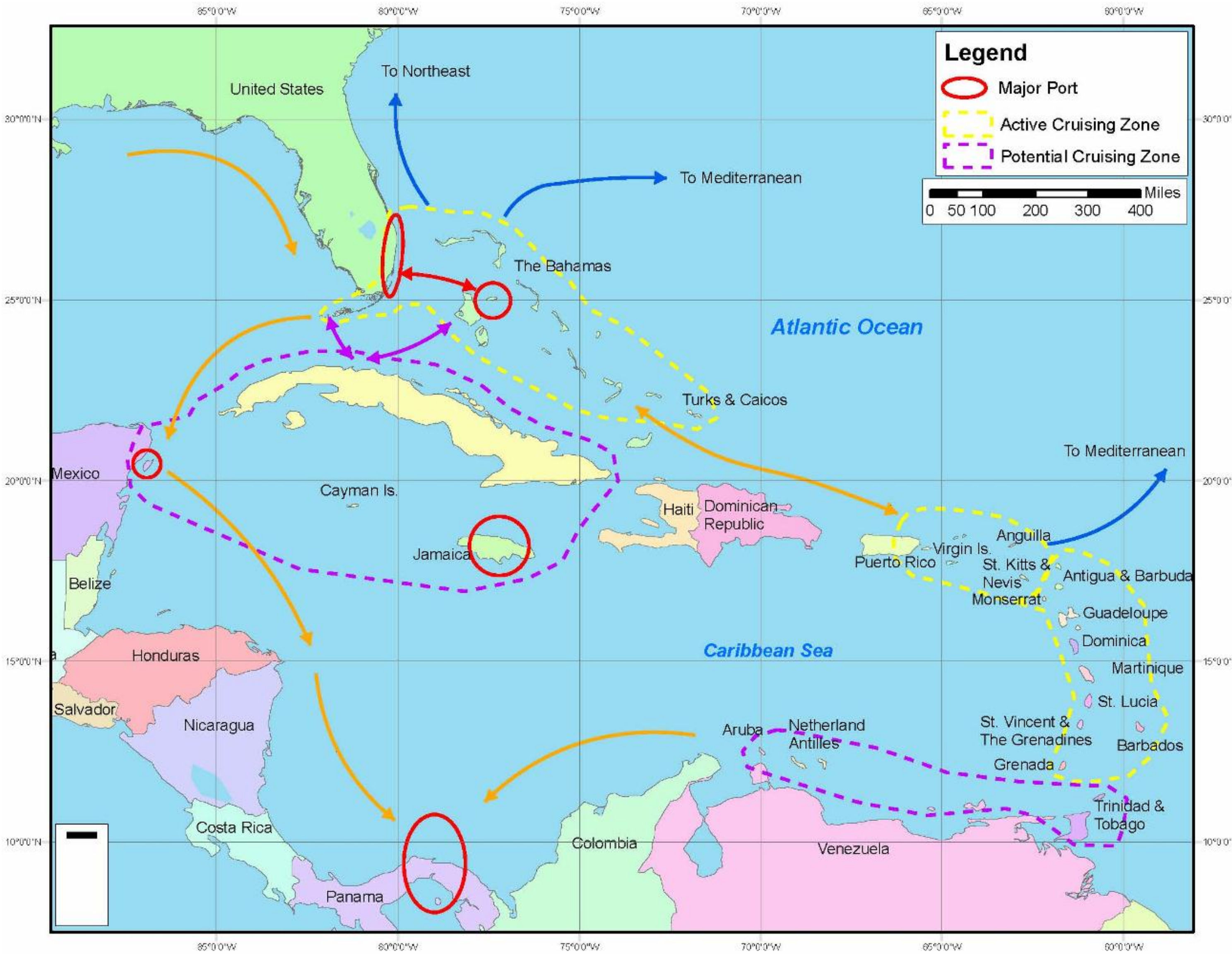


Figure 13: Mega-Yacht Cruising Routes

6.7. Summary

Market demand is summarized as follows:

Table 19: Slip Demand Summary

Underserved Existing Population With 6-Pax Modified 6-Pax	 20 – 30 130 – 150
Population Growth	5 - 10
Demographic Shift (by 2025)	400 - 500
Tourism	60 – 110
Boat Yard	10 – 20
Mega-yacht	Seasonal – use flex slips
Total	495 - 790

The largest contributor to slip demand is projected demand due to demographic shifts. Removing this factor results in projected slip demand ranging from 95 to 290 slips.

As some of the demand is future projection and some is site specific, the following table breaks down the projection based on present demand and demand in 10 years as well as demand with and without the project hotel and associated services.

Table 20: Slip Demand Summary

	2015		2025	
	No Hotel	With Hotel	No Hotel	With Hotel
Sirius Project	40 – 50	80 – 100	100 – 150	150 - 200
Total Coral Bay	100 – 200		150 – 300 6-Pax Mod 200 – 600	

7. COMPETING FACILITIES

The following marinas are expected to compete with the proposed marina based on quality of facility, amenities included, slip count/size, available cost, and expected level of service. The following 7 marinas were determined to be "competing" because they include hotel services and had more than 50 wet slips. Multiple other large marinas are located near unaffiliated hotels and may compete with the Sirius Seaside Resort Marina.

Table 21: Competing Marinas

	Marina Name	Wet Slips
1	Green Cay Marina	154
2	Hodge's Creek Marina	82
3	Nanny Cay Marina and Hotel	180
4	Sapphire Beach Resort and Marina	67
5	Scrub Island Resort and Marina	55
6	The Moorings Marina	200
7	Village Cay Marina	106
	Total:	**844**

Key features and highlights of each marina facility is summarized in the following section.

7.1. Green Cay Marina (St. Croix, U.S.V.I.)

Green Cay marina is part of the Tamarind Reef Resort and is a Blue Flag-recognized ecologically-friendly marina.

Location — The Buck Island National Park.

Notable Amenities — The resort includes a hotel, spa, club lounge, fitness center, 4 tennis courts, and more, all available to visiting yachts. Pool and beach access, kayaks, and snorkels are also available to visitors at no additional charge. Three charters operate out of Green Cay Marina: Buck Island Charters, Lightheart Charters, and Iditarum Sailing Charters.

Number of Wet Slips — 154

Maximum Slip Size — 105 ft

 # Hotel Rooms — 40

7.2. Hodge's Creek Marina (Tortola, B.V.I.)

Hodge's Creek Marina is associated with the Treasure Isle Hotel (a Penn Hotel).

Location — Road Town, the capital of the British Virgin Islands, on Tortola Island. The marina's location is significant because it is close to the British Virgin Islands' commercial, government, and population center.

Notable Amenities — Accommodates guests in rooms ranging from "Standard" to "Executive Harbour View Suites." The hotel also has a number of spaces dedicated to events such as corporate meetings and weddings.

Number of Wet Slips — 82

Maximum Slip Size — 120 ft

 # Hotel Rooms — 65

7.3. Nanny Cay Marina and Hotel (Tortola, B.V.I.)

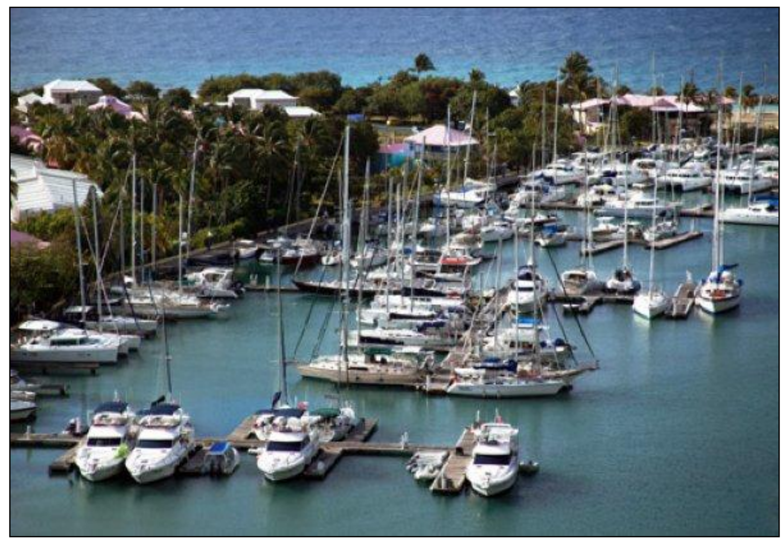
Location — Centrally located on the south side of Tortola between the capital, Road Town, and West End.

Notable Amenities — The site has a full service boatyard to address vessel maintenance issues. A variety of amenities are provided to visitors, including a library, free high-speed internet, 4 separate shower facilities, a café, a bar, a restaurant, and deluxe hotel suites overlooking the marina. The marina contains 5 mega-yacht slips.

Number of Wet Slips — 180

Maximum Slip Size — 125 ft

 # Hotel Rooms — 38



7.4. Sapphire Beach Resort and Marina (St. Thomas, U.S.V.I.)

Sapphire Beach Resort and Marina is one of Antilles Resorts' 8 resorts in the Virgin Islands.

Location — 1 mile from the town of Red Hook on the eastern end of St. Thomas.

Notable Amenities — Sapphire Beach Resort offers beachfront suites and villas, and includes amenities including a multi-level cascading pool overlooking the Caribbean Sea. The water sports center provides equipment for aquatic activities, and visitors can choose between numerous water excursions

Number of Wet Slips — 67

Maximum Slip Size — 65 ft

 # Hotel Rooms — 171

7.5. Scrub Island Resort and Marina (Scrub Island, B.V.I.)

Scrub Island Resort and Marina is the newest private island luxury resort in the British Virgin Islands.

Location — Adjacent to Great Camanoe Island off the northeastern end of Tortola.

Notable Amenities — The resort consists of 52 ocean view hotel rooms, a 55 deep-water slip marina, and a variety of amenities including a spa, 24-hour fitness center, 3 bars, 2 restaurants, and a café. Business and group-oriented amenities include a business center with computer work stations, banquet and meeting facilities for up to 150 guests, and an award-winning convention services team. The marina offers mega-yacht slips and charters for snorkeling, diving, eco-exploring and more.

Number of Wet Slips — 55

Maximum Slip Size — 160 ft

 # Hotel Rooms — 52

7.6. The Moorings Marina (Tortola, B.V.I.)

The Moorings Marina has been re-named the Mariner Inn and Marina following a $15 million renovation completed on January 29, 2009.

Location — Tortola.

Notable Amenities — A variety of charter services are offered to visitors. The Mariner Inn and Marina prides itself in its high quality food/beverage options and environmentally-conscious chartering and utilities practices exemplified by the on-site desalination plant. Amenities include a spa, business center, free wifi, a dockside market, retail shops, and a gourmet café.

Number of Wet Slips — 200

Maximum Slip Size — 62 ft

 # Hotel Rooms — 39

7.7. Village Cay Marina (Tortola, B.V.I.)

Location — Adjacent to The Moorings Marina in the Inner Harbour of Tortola. Village Cay is a popular destination for businesses due to its central location and on-site business center.

Notable Amenities — Visitors will feel more secure with the full security patrol and camera system. An array of amenities are offered, including three-phase electricity in each berth. The marina is located in the heart of the Capital, Road Town, just a short walk away from markets, shops, banks, and government offices.

Number of Wet Slips — 106

Maximum Slip Size — 190 ft

 # Hotel Rooms — 23

8. SUMMARY

Moffatt & Nichol analyzed the existing marina market for the U.S. and British Virgin Islands. The Virgin Islands market shows continued growth and market trends indicate that Coral Bay will support the construction of a marina facility. The planned upland development will attract both long-term slip leasers as well as transient leasers throughout the year. The marina can expect to attract more sailboats during the winter and spring season (December to May) and a higher percentage of power boats during the summer season.

The following summarizes finding from the inventory.

- The Virgin Islands marina market is defined geographically into two sub-areas by the international boarder.
    - Within these two areas are demographic sub-markets for different types of marinas.
    - St. Thomas and Tortola are the primary boating centers for the two markets.
- 42 marina and boating facilities were identified.
    - Most have more than 20 slips.
    - In the regional market, all marinas evaluated were able to accommodate boats greater than 40 feet.
    - The docks in the Virgin Islands are predominantly fixed with a mix of wood and concrete.
    - Common "must-have" amenities include potable water and electrical service
- Existing marinas are recovering from the economic downturn.
- Peak season for the Virgin Islands is November through April with occupancy above 80 percent at most marinas.
    - Most marinas are full during holidays and the peak winter season but have periods of lower occupancy during the summer/hurricane season.
    - Off-peak occupancy may fall to 50 to 70 percent with intermittent periods of almost complete occupancy coinciding with holidays and fishing tournaments.
- Bigger slips are in higher demand due to relatively lower supply and owners of smaller boats experiencing more impact from the economy.
    - Smaller boats can easily be pulled from the water and stored.

M&N analyzed the Virgin Islands market for market drivers and marina demand.

- Boat registrations in the Virgin Islands and Puerto Rico have dropped during the economic downturn.
    - Registrations for boats >40 ft. continued to increase throughout the economic downturn.
- Existing demand is generally satisfied – wait lists are limited to special events and larger slips in high demand marinas.
- Most marinas cater to charter and watersport boats to supplement transient boat slip demand and to increase tourism traffic at the marina.
- Virgin Island market analysis suggests that the market needs 95 to 790 additional wet-slips for vessels 40 feet and greater in length may.

Slip size analysis suggests the following slip mix for new marinas:

- 30ft to 40 ft 25-30%
- 40 ft to 50 ft 40-50%
- 50 ft to 60 ft 20-25%
- > 60 ft 5-10%

M&N analyzed potential revenue for existing and new marinas.

- Existing marinas range from $15 to $30 per ft per month.
- The project site should support a rate of $1.50 to $2.00 per foot per day and $15 to $25 per foot per month.
- The market in the Virgin Islands area should support a rate of $12 to $15 per foot per month for the dry stack storage slips.

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