BENTHIC HABITAT ASSESSMENT REPORT

St. Lucie ICWW Reach 1 Pre-Construction Survey
Benthic Habitat Assessments
St. Lucie County

Prepared for:

Florida Inland Navigation District
1314 Marcinski Road
Jupiter, Florida 33477

Prepared by:

SCHEDA ECOLOGICAL ASSOCIATES
204 Dixie Blvd., Delray Beach, FL 33444

September 1, 2016

1.0 BACKGROUND

The Florida Inland Navigation District (FIND) is proposing to conduct maintenance dredging at five (5) locations along the Intracoastal Waterway (ICWW) channel near Ft. Pierce, St. Lucie County, Florida. The project will pump dredged material through a pipeline that will pass from the ICWW to the shoreline near the existing Dredged Material Management Area (DMMA) SL-2 Easement (Pipeline corridor). FIND contracted Scheda Ecological Associates, Inc. (Scheda) to conduct a pre-dredging seagrass and benthic habitat survey assessment to map and characterize the submerged natural resources occurring in the pipeline corridor and the five (5) proposed dredge areas. The data collected during this survey/mapping effort will be used to assess potential natural resource impacts, complete an impact UMAM assessment, and draft a potential Essential Fish Habitat Assessment during the project's permitting phase. This report summarizes the pre-construction presence, coverage, and conditions of natural resources occurring within the project areas.

2.0 SITE DESCRIPTION

The survey areas encompassed approximately 61.16 acres of lagoon bottom which include the pipeline corridor (12.68 acres) and the five (5) ICWW survey areas (48.48 acres) (**FIGURES 1 & 7**). All of the survey areas are within the known range of the federally endangered Johnson's seagrass (*Halophila johnsonii*) as well as other protected seagrass species. The five ICWW survey areas listed below (**TABLE 1**) spanned the width of the ICWW channel (typically 125 ft.) plus an additional 75 ft. on either side of the channel (**FIGURES 7 & 8**).

TABLE 1.

Survey Areas		
Cut	**Station(s)**	**Acres**
SL-2	11+00 THRU 16+00	2.30
SL-2	25+00 THRU 53+00	12.86
SL-3N	8+50 THRU 12+00	1.61
SL-3S	2+50 THRU 4+50	0.92
SL-5	7+00 THRU 74+00	30.79
Pipeline Corridor	NA	12.68

The pipeline corridor survey area encompassed approximately 12.68 acres of lagoon bottom, which included a 1.8 acre interior basin surrounded by mangroves that also required survey (**FIGURES 2-4**). Water depths in the pipeline corridor survey area averaged approximately 4 to 5 feet, with depths generally increased from 1 to 2.5 feet within the interior basin to 10 feet abutting the ICWW channel. Water depths in the five ICWW

survey areas typically ranged from 8-14 ft. Depths in the cargo ship turning basin located within and adjacent to the Cut SL-2 survey area exceeded 30 ft. and maximum water depths in the SL-3 survey area approached 20 ft.

3.0 METHODOLOGY

A Scheda team of three (3) certified scientific divers experienced in conducting estuarine benthic resource assessments in St. Lucie County and the Indian River Lagoon performed the assessment between July 26 and July 28, 2016. Weather conditions ranged from clear skies to partly cloudy with moderate winds (10-15 mph). The weather conditions were sufficient to properly conduct the underwater surveys. Underwater visibility ranged from one foot (typically during low tide) to a maximum of 15 ft. (typically at high tide) near the western limit of the Fort Pierce Inlet.

The seagrass mapping event was conducted in two phases in accordance with the "Recommendations for Sampling *Halophila johnsonii* at a Project Site" in the Final Recovery Plan for Johnson's Seagrass prepared by the Johnson's Seagrass Recovery Team, for the National Marine Fisheries Service (NMFS) and National Oceanic and Atmospheric Administration (NOAA) (NMFS 2002). The hardbottom habitat mapping was conducted in two phases in accordance with Florida Keys National Marine Sanctuary, 2008. Coral Rescue & Relocation Protocols.

SEAGRASS HABITAT

PHASE 1

The first phase consisted of an initial reconnaissance of the survey areas to delineate and identify existing seagrass beds. Phase 1 included a series of north to south perpendicular tow-behind transects with 100-ft spacing that spanned the width of the pipeline corridor (**FIGURE 3 & 4**). Similarly, the five (5) ICWW survey areas were surveyed utilizing a series of east to west perpendicular transects and a 75-ft wide buffer on each side of the 125-ft wide (typical) ICWW channel (**FIGURE 9-12)**. Perpendicular tow-behind transects were conducted in order to more accurately determine the extent of seagrass coverage.

Scheda divers were towed behind the work vessel along each perpendicular transect. Tow speeds were constant and slow, not exceeding two knots. Using SCUBA outfitted with communications, the scientific diver delineated the boundaries of seagrass beds and other benthic habitat types along each perpendicular transect by communicating with on-vessel staff who recorded a georeferenced navigational target associated with the edge of each seagrass bed and/or benthic habitat boundary observed. The perpendicular transects were traversed during the incoming tide, whenever possible, when visibility was the greatest. Divers carefully delineated bottom habitat types (e.g. seagrass and hardbottom) in a minimum 12-20ft swath around each perpendicular transect. These areas were located and mapped using a Trimble DGPS receiver and investigated more thoroughly in Phase 2. Scheda used the geolocated data collected during the tow surveys to plot the observed and located seagrass beds on georectified aerial photographs.

Qualitative video and still photographic data was also collected for identification verification of seagrasses and biota observed during the survey. In the pipeline corridor, divers visually identified relatively less dense "pockets' in the seagrass that could reduce the impact of installing a potential pipeline anchor. All areas measuring a minimum of 100 sq. ft. that contained no seagrass to very sparse seagrass coverage (0-5%) were identified along each perpendicular transect. Divers located the center points of these relatively sparse "pockets", and by communicating with on-vessel staff, were georeferenced using DGPS.

PHASE 2

Seagrass densities were quantitatively estimated during the second phase of sampling in the pipeline corridor and the five (5) ICWW survey areas. Seagrass densities were measured using a one-meter by one-meter (one square meter) quadrat along 100-ft long modified belt transects which were distributed across seagrass beds identified during Phase I. Belt transect locations were determined using a stratified random sampling design (**FIGURES 3-4 & FIGURES 9-12).** Divers incorporated point-intercept methodology to document seagrass distribution and occurrence at ten (10) locations along each modified belt transect. (Virnstein 1995; Fonseca et al. 1998; Braun-Blanquet 1965).The modified belt transect parameters were measured *in situ* by a diver who recorded species composition, percent cover, abundance, shoot density, and blade length data, using multiple 10 x 10-cm cells. Seagrass cover abundance was determined using the following modified Braun-Blanquet coverage classifications (Braun-Blanquet, 1965; Kirsch et al., 2005):

TABLE 2.

Braun-Blanquet (BB) Cover-Abundance Scale with Range Mid-Point Values

BB Score		Cover	Range Mid-Point
0	=	Not Present	0
0.1	=	Solitary individual	1% *
0.5	=	Few, with small cover	1% *
1	=	Numerous, <5%	2.5%
2	=	5% to 25%	15%
3	=	25% to 50%	37.5%
4	=	50% to 75%	62.5%
5	=	75% to 100%	87.5%

* Mid-point was assigned the value of 1%. Whereas the higher BB scores reference specific ranges in percent cover, the lower scores are primarily estimates of abundance (i.e. the number of individuals).

Braun-Blanquet scores for each quadrat were converted to range midpoint values, and then averaged over the total number of quadrats assessed. From the quadrat data collected along each transect, seagrass percent cover, cover abundance, and densities were calculated as follows:

- **Percent cover** = (Number of occupied sub-units/total number of sub-units) x100
- **Cover Abundance** = Sum of modified BB cover scale values/number of occupied quadrats
- **Density** = Sum of modified BB cover scale values/total number of quadrats

The transect and quadrat data provided sufficient information to adequately describe the distribution and abundance of seagrass in the survey area.

In addition to seagrass data, the divers recorded the biota observed during the survey, which included macroalgae, sponges, sessile invertebrates, and fishes. These biota were field-identified to the lowest practical taxonomic level. Occurrences of protected wildlife (i.e. manatee, sea turtles and smalltooth sawfish) were also noted during the mapping event.

HARDBOTTOM HABITAT

The hardbottom habitat areas identified during Phase 1 were investigated in more detail using a combination of *in situ* and video survey techniques. A total of five (5) belt transects spaced 50-ft apart were established parallel to the channel (north to south) in the hardbottom habitat located on the east side of the SL-3S survey area. The survey area width of this hardbottom assessment area was approximately 200 ft. from the edge of the channel. For the hardbottom habitat located on the west edge of the SL-3S survey area, an additional six (6) belt transects with 50-ft spacing were established perpendicular to the channel (east to west) spanning a distance of approximately 100 ft. from the channel edge (**FIGURE 10**). One (1) diver traversed each belt transect documenting all benthic species (including stony corals, soft corals (octocorals), macroalgae, sponges, tunicates, hydroids, and other invertebrates) that occurred within one (1) meter on each side of the belt transect. A second diver traversed each belt transect approximately one (1) meter above the bottom, obtaining qualitative video and still photographic data with a GoPro 4 camera to determine benthic percent coverage.

4.0 RESULTS

This section summarizes the results of the benthic habitat assessment conducted in the pipeline corridor and ICWW project areas. The results include all seagrass habitat cover types, percent cover, abundance, and density values calculated from the field data, and maps showing the approximate limits of each identified seagrass bed. Seagrass habitats were located throughout the pipeline corridor and in the southern portion of Cut SL-5. Results of the hardbottom habitat characterization and maps showing the approximate limits of each identified hardbottom habitat are also included in this section.

4.1 SEAGRASS HABITATS

PIPELINE CORRIDOR

Seagrasses were found in 10.45 acres of the pipeline corridor survey area. The majority of the pipeline corridor survey area contained sparse seagrass coverage (typically 5-10% coverage; **FIGURE 5 & 6**) and consisted of a sand/shell hash substrate. Approximately 1.26 acres of very dense (75-100% cover) mixed seagrass beds were delineated in the eastern portions of the survey area. Approximately 7.89 acres of sparse (typically less than 10% cover) mixed seagrass beds were delineated along the western extent of the

survey area. The mixed beds contained various combinations and coverages of manatee grass (*Syringodium filiforme*), Cuban shoal grass (*Halodule wrightii*), and turtle grass (*Thalassia testudinum*), which tended to dominate the shallow areas. *Thalassia testudinum* and *H. wrightii* dominated areas that appeared to be disturbed by previous anchoring or spudding (i.e. prop scars). Moderate macroalgae coverage dominated by *Laurencia* sp., *Chondria* sp, and *Caulerpa* sp. and occasional encrusting sponges also occurred in this habitat. Among belt transects, *H.* wrightii had a percent cover range of <5%-10%, with an overall average of 5%; *S. filiforme* had a percent cover range of 0%-10%, with an overall average of 5%; *T. testudinum* had a percent cover range of 0%-10%, with an overall average of 6%. Photos (**APPENDIX PAGE 1)** depict the variable coverage of seagrass habitats that occur in the pipeline corridor survey area.

The majority of benthic habitat in the pipeline corridor that was void of seagrasses existed near the eastern and western extents of the survey area (**FIGURES 5 & 6**). This habitat consisted of a sand/shell hash substrate containing sparse macroalgae coverage dominated by *Laurencia* sp., *Chondria* sp, and *Caulerpa* sp. and occasional encrusting sponges (*Cliona delitrix* and *Tedania ignis*). A typical view is provided in **APPENDIX PAGE 1**. A moderate film of epiphytic algae typically covered the observed seagrass.

The average percent cover for seagrass, macroalgae, and other invertebrates identified in the pipeline corridor survey area can be examined in **TABLE 3.** Additionally, the average shoot counts and blade heights for seagrasses recorded can be referenced in **TABLE 4.**

"Bare pockets", represented by blue areas in **FIGURES 5 & 6** were located throughout the pipeline corridor survey area. These pockets varied in size and consisted of a sand/shell hash substrate typically containing to no seagrass to very sparse coverage (maximum of <5% cover) with reduced blade lengths. A typical view of a 'bare pocket' is provided in **APPENDIX PAGE 2**. Sparse drift macroalgae (such as *Laurencia* sp.) was typically the only other benthic resource occurring in the "bare pockets". **TABLE 8** provides a complete list of seagrass, macroalgae, and invertebrates observed in the pipeline corridor survey areas.

INTRACOASTAL WATERWAY

The Cut SL-2 North survey area (**FIGURE 13**) contained no seagrasses. It can be characterized as mixed sand/shell hash bottom with sparse macroalgae coverage and the occasional presence of branching hydroids (*Sertularella speciosa*) and red boring sponges (*C. delitrix*). Red macroalgae were dominant including: *Acanthophora* sp., *Chondria* sp., *Gracilaria* sp., and *Laurencia* sp. Photos in **APPENDIX PAGE 2** provide typical views of this survey area's benthic habitat. The Cut SL-2 South survey area (**FIGURE 13**) also contained no seagrasses or other protected marine resources. Observed resources occurring on the survey area bottom were similar to those observed in the Cut SL-2 North survey area, however no sponges were documented. *Laurencia* sp. was the dominant macroalgae species. Water depths in the eastern portion of the Cut SL-2 South survey area exceeded 35 ft. Visibility in this portion of the survey area was typically less than one foot and there was minimal light penetration to the bottom. The benthic habitat in the deep water portion was typically silt and sand bottom devoid of any sessile resources (**APPENDIX PAGE 3**). The Cut SL-3N and

Cut SL-3S survey areas are directly adjacent to the Fort Pierce Inlet (**FIGURE 13**). Tidal currents are very strong resulting in a sand bottom void of any seagrasses or other protected resources (**FIGURE 14**). No sessile resources were observed; only drift algae such as *Laurencia* sp. and *Chondria* sp. The navigation channel in the SL-3S survey area contained no seagrasses or other protected marine sources. Its benthic habitat was similar to the shallow water portion of Cut SL-2 South survey area (**APPENDIX PAGE 3**).

Cut SL-5 survey area had a total of 5.65 acres of seagrass habitat which were identified and delineated in the southern half of the Cut SL-5 survey area (**FIGURE 15 & 16**). This area was characterized as having a very sparse coverage (less than 5%), and contained a mixed bed of paddle grass (*Halophila decipiens*) with mostly Johnson's seagrass (*Halophila johnsonii*; less than 5% coverage). Johnson's seagrass was observed in nine (9) of the ten (10) belt transects. Therefore, it is likely that the Johnson's seagrass was spread throughout the entire bed. Among belt transects, *H. johnsonii* had a percent cover range of 0%-20%, with an overall average of <5%, and *H.* decipiens had a percent cover range of <1%-20%, with an overall average of <5%. Photos **(APPENDIX PAGE 4)** depict typical views of the benthic habitat in the Cut SL-5 survey area. **TABLE 5** lists the seagrass coverage, recorded as an average per each 100-ft belt transect, in the Cut SL-5 survey area. **TABLE 6** lists average shoot count and blade heights recorded along each seagrass transect. In addition to seagrass, red algae (including *Acanthophora* sp., *Chondria* sp., *Gracilaria* sp., and *Laurencia* sp.) and green algae (including *Caulerpa Mexicana*, *Caulerpa prolifera*, *Penicillus* sp., and *Halimeda* sp.) occurred in the Cut SL-5 survey area with coverage ranging from very sparse to sparse (typically less than 5% to 15%). A moderate film of epiphytic algae typically covered the observed seagrass.

TABLE 7 provides a complete list of seagrass, macroalgae, and invertebrates observed in the pipeline corridor and ICWW survey areas.

4.2 HARDBOTTOM HABITAT

Divers delineated and surveyed a total of 1.28 acres of hardbottom habitat adjacent to the SL-3S survey area (**FIGURE 18**). No hardbottom habitats were observed elsewhere within the survey limits. Approximately 0.8 acres of low-relief hardbottom habitat dominated by macroalgae was surveyed on the east side of the SL-3S survey area. This hardbottom habitat had a maximum length of approximately 250 ft. (north to south) and expanded further east of the 200-ft survey area, with water depths that ranged from 9-11 ft. The divers characterized the habitat as exposed limerock which typically extended 6-12 inches above the surrounding sand/shell hash substrate. The limerock was encrusted with macroalgae and occasional sponges and hydroids (**APPENDIX PAGES 4 & 5**). Dominant algal species included *Acanthophora* sp., *Chondria* sp., *Gracilaria* sp., *Laurencia* sp., and *Sargassum* sp. Occasional algal species included *Hypnea musciformis*, *Cualerpa mexicana*, *Caulerpa prolifera, and Ulva* sp. *Sertularella speciosa,* red boring sponge, and fire sponge (*Tedania ignis)* represent the only hydroid and sponge species observed. Coverage by all macroalgae and invertebrates was less than 10% across the entire hardbottom habitat survey area.

Approximately 0.48 acres of hardbottom habitat were surveyed on the west side of the SL-3S survey area (**FIGURE 18**). This hardbottom habitat had a maximum length of approximately 250 ft. (north to south). Its eastern limit marked the edge of the navigation channel, which was a 6-8 ft. tall ledge likely formed during creation of the channel. The hardbottom habitat is bound to the south by a smaller navigation channel and to the north by erosion/scour protection measures associated with the South Causeway Bridge. Water depths at the top of the ledge were 8-9 ft.; depths at the base of the ledge were 14-17 ft. The hardbottom habitat spanned further west of the 100-ft survey width, however resource coverage became increasingly more sparse further to the west.

The SL-3S hardbottom area can be categorized into two separate habitats: 1) Algal encrusted limerock interspersed in a sand/shell hash substrate with low relief on top of the ledge; and 2) Algal and sponge dominated vertical limerock wall that was much more densely colonized than the surrounding hardbottom habitat of the SL-3S survey area.

Habitat 1 was quite similar to the hardbottom habitat described on the east side of the SL-3S survey area. No stony corals were observed in this area; however, it consisted of exposed limerock encrusted with macroalgae and occasional sponges, hydroids, tunicates, and gorgonians that are separated by unvegetated sand/shell hash bottom (**APPENDIX PAGE 5**). A layer of silt covered most of the resources observed in this area. Coverage by macroalgae species ranged between 30% and 55% and was dominated by the same species listed for the east hardbottom area, such as *Sargassum* sp., which was relatively more abundant in this area. Coverages by sponges, hydroids, and gorgonians did not exceed 10%. Dominant sponges in this area included: red boring sponge, fire sponge, and brown carpet sponge (*Anthosigmella* sp.). Feather hydroid (*Gymnangium* sp.) was the dominant hydroid species. Regal sea fan (*Leptogorgia hebes*) was the dominant gorgonian.

Habitat 2 (the vertical limerock wall) contained very dense coverage (typically 75-90% cover) from an assortment of macroalgae, sponges, hydroids, tunicates, and octocorals (**APPENDIX PAGE 5**). The pre-construction survey did not locate any stony corals. **TABLE 8** provides a complete list of the plant and animal species observed in the vicinity of the ledge. Macroalgae was the dominant resource on the vertical wall, with an estimated coverage range of 55-85%. Total resource coverage was estimated at 75-90%. Numerous small (less than 5 cm) ivory brush corals (*Oculina diffusa*) and lesser starlet corals (*Siderastrea radians*) were identified as “dead”; and observed to be completely encrusted with encrusting/boring sponges (such as *Cliona* sp.). Size measurements were not recorded on any dead corals that were less than 5 cm in diameter.

5.0 DISCUSSION

This report summarizes the pre-construction presence, coverage, and conditions of seagrass and hardbottom resources occurring within the project areas. Seagrasses were located and delineated in 26.1% of the entire 61.16 acres during this pre-construction survey event. The pipeline corridor made up 17.08% of

the total seagrass beds identified, while the ICWW survey area (SL-5) made up the remaining 9.07%. Mixed, sparse seagrass beds consisting of *H. wrightii, S. filiforme* and *T. testudinum* made up 82.4% of the total pipeline corridor. Approximately 17.6% of the remaining pipeline corridor area consisted of no seagrass ("barespots") and oysters. Sparse, mixed beds of *H. johnsoni* and *H. decipiens* in the SL-5 portion made up 11.65% of the total 48.48 acres of the ICWW survey area. The remaining 88.3% of the ICWW survey area contained no seagrasses. The seagrass data documented in the pipeline corridor survey area should be used as a guide to select potential pipeline anchor installation locations. The sampling areas surveyed around the modified belt transects in both the ICWW and pipeline corridor covered over two (2) percent of the total seagrass area observed during Phase I (exceeding the minimum one percent coverage requirement established in the NMFS/NOAA Johnson's Seagrass protocol for large area projects). The low percent cover data illustrates the low density of seagrass beds throughout the pre-construction survey areas. Generally, B-B scores for all species (*H. wrightii, S. filiforme and T. testudinum H. decipiens and H. johnsonii*) were quite low, illustrating a very sparse to sparse coverage in the identified seagrass beds. Areas of *H. wrightii, S. filiforme* and *T. testudinum* in the pipeline corridor were documented as mixed beds, as well as *H. decipiens* and *H. johnsonii* in the ICWW.

A total of 1.28 acres of hardbottom habitat was identified adjacent to the SL-3S survey area, while no other hardbottom habitats were located throughout the remainder of the survey limits. While no stony corals were located during the pre-construction survey, the hardbottom habitats consisted of algal encrusted limerock and a vertical limerock ledge dominated by algae, sponges, hydroids, tunicates and octocorals. Some small corals (less than 5cm) were identified as "dead" and were completely encrusted with encrusting/boring sponges. This hardbottom habitat had a maximum length of approximately 250 ft. (north to south), and extended further east of the 200-ft survey width and further west of the 100-ft survey width.

Two bottlenose dolphins (*Tursiops truncatus*), protected under the Federal Marine Mammal Protection Act, were observed in the ICWW near the pipeline corridor survey area. No other federal or state-listed species were observed.

6.0 LITERATURE CITED

Braun-Blanquet, J. 1965. Plant sociology: the study of plant communities. Hafner Publications, London. 439p.

Fonseca, M.S., J.W. Kenworthy, and G.W. Thayer. 1998. Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters. NOAA Coastal Ocean Program Decision Analysis Series, No. 12. NOAA Coastal Ocean Office, Silver Springs, MD.

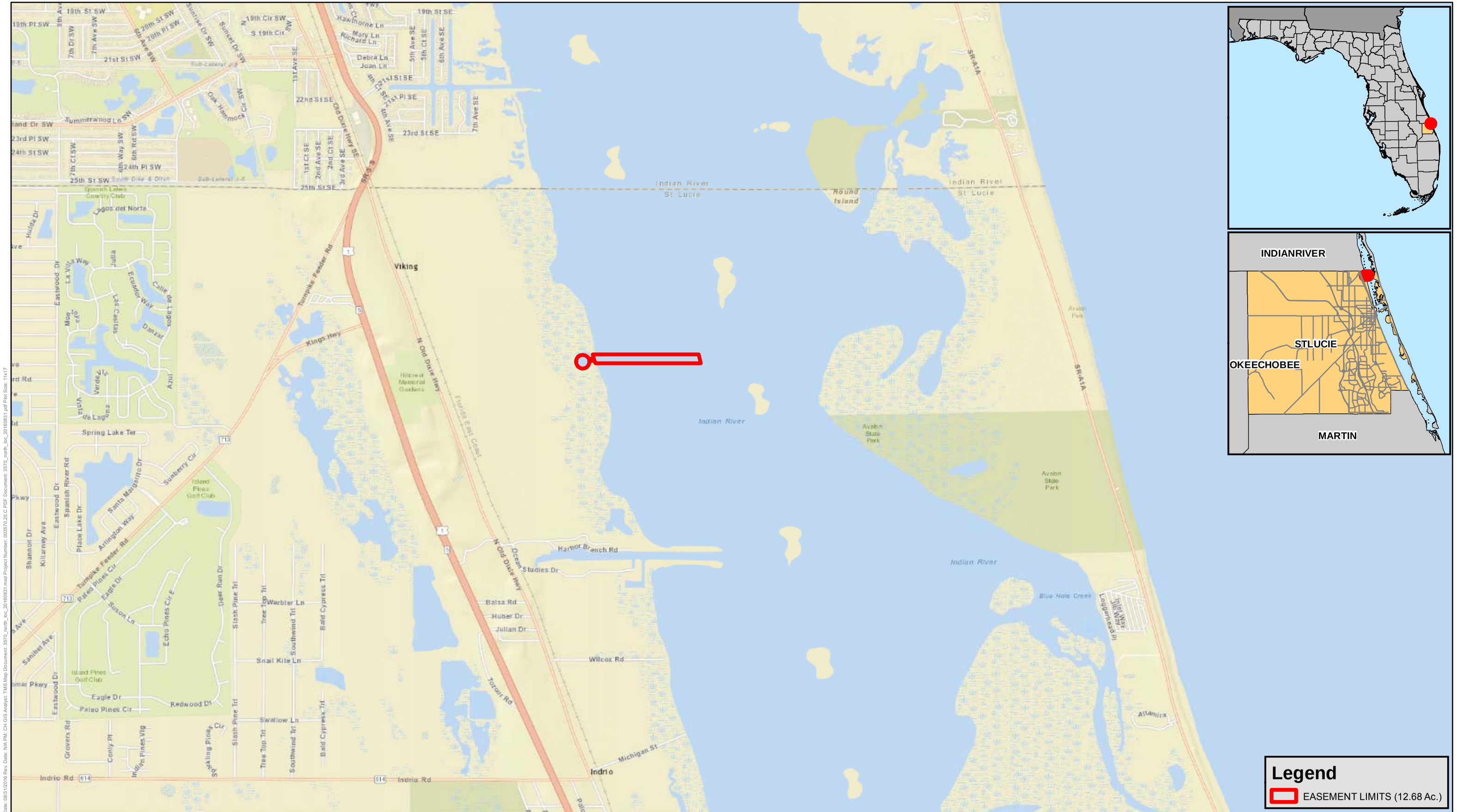
Kirsch K.D., K.A. Barry, M.S. Fonseca, P.E. Whitfield, S.R. Meehan, W.J. Kenworthy and B.E. Julius. 2005. The Mini-312 Program – An Expedited Damage Assessment and Restoration Process for Seagrasses in the Florida Keys National Marine Sanctuary. Journal of Coastal Research. 40:109-119.

National Marine Fisheries Service (NMFS) 2002. Final Recovery Plan for Johnson's Seagrass (http://www.nmfs.noaa.gov/ pr/pdfs/recovery/johnsonsseagrass.pdf). Accessed July 25, 2014.

National Oceanic and Atmospheric Administration (NOAA) Office of Protected Resources website 2015. http://www.nmfs.noaa.gov/pr/species/plants/johnsonsseagrass.htm. Accessed April 22, 2016.

Virnstein, R. 1995. Seagrass Landscape Diversity in the Indian River Lagoon, Florida: the Importance of Geographic Scale and Pattern. Bulletin of Marine Science 57: 67-74.

FIGURES



SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 1 - Pipeline Corridor Project Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

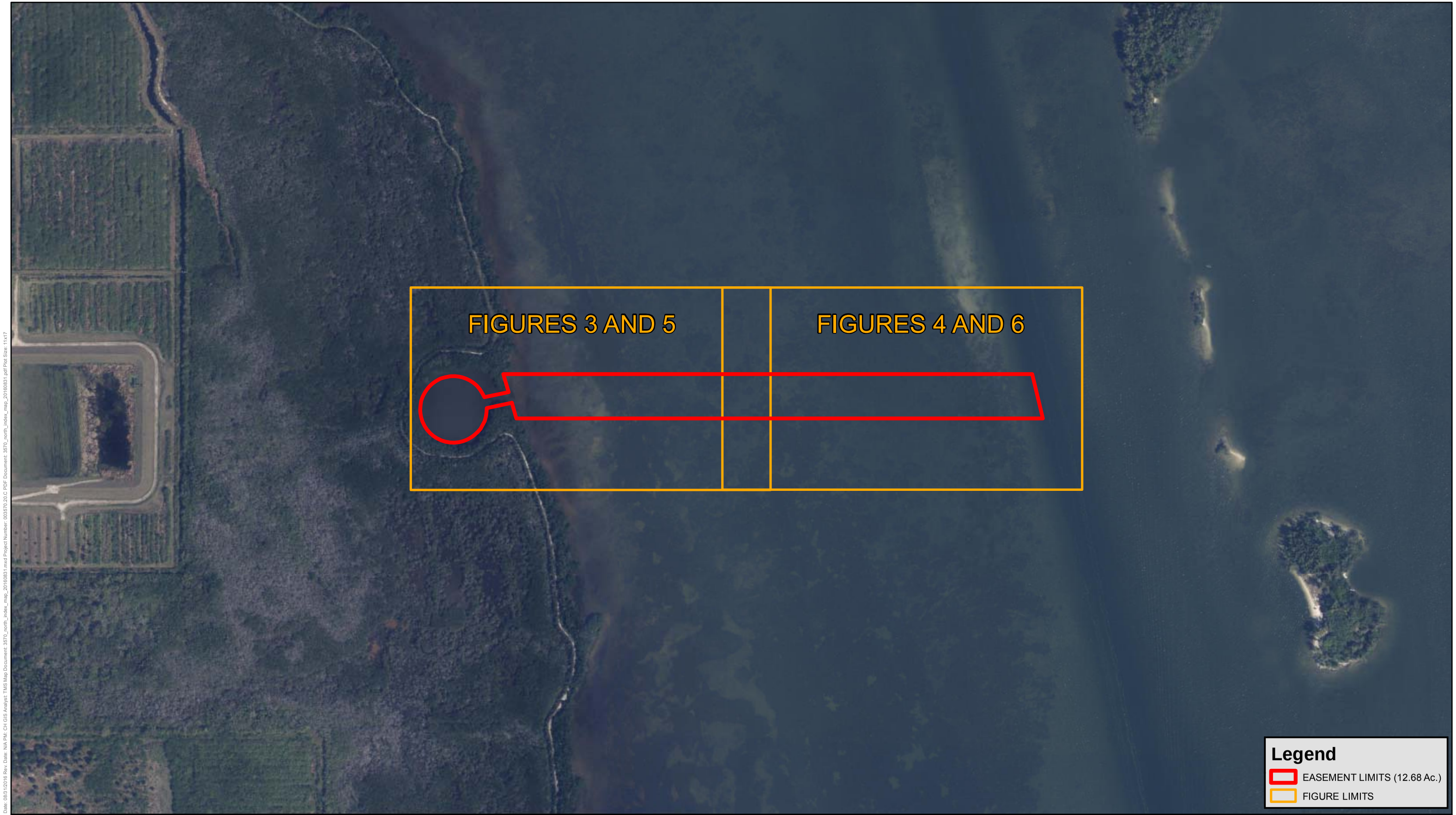
0 2,000 4,000 6,000 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_north_loc_20160831.mxd Project Number: 003570.20 C PDF Document: 3570_north_loc_20160831.pdf Plot Size: 11x17



Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_north_index_map_20160831.mxd Project Number: 003570.20 C PDF Document: 3570_north_index_map_20160831.pdf Plot Size: 11x17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 2 - Pipeline Corridor Index Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 400 800 1,200 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

1

2

3

4

5

Legend

- EASEMENT LIMITS (12.68 Ac.)
- TRANSECTS

SCHEDA ECOLOGICAL ASSOCIATES

www.scheda.com

Figure 3 - Pipeline Corridor Transect Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 100 200 300 Feet

Data Source:
- Scheda Ecological Associates, Inc.

Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

6

7

8

9

10

Legend

- EASEMENT LIMITS (12.68 Ac.)
- TRANSECTS

SCHEDA ECOLOGICAL ASSOCIATES

www.scheda.com

Figure 4 - Pipeline Corridor Transect Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

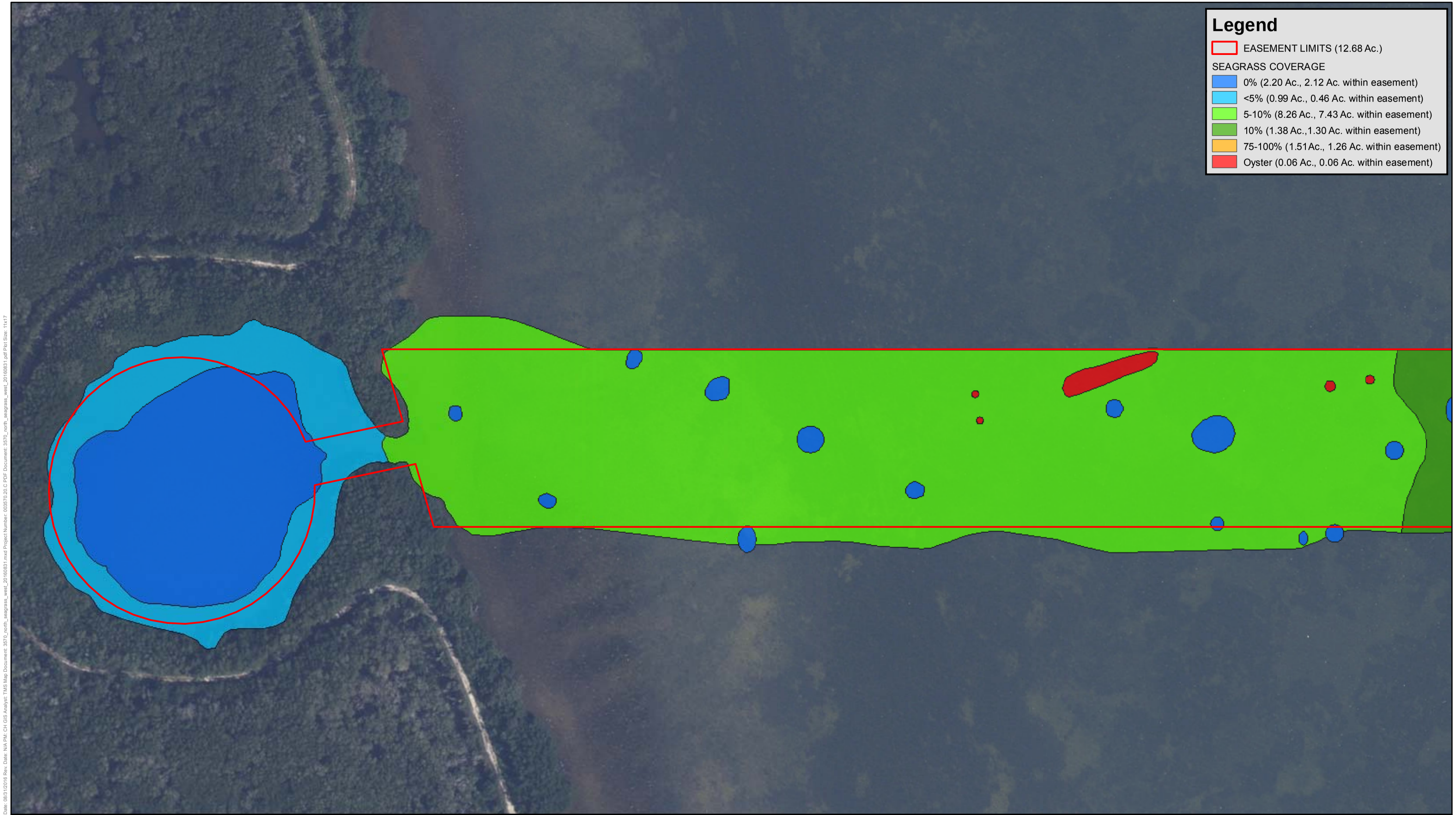
0 100 200 300 Feet

Data Source:
- Scheda Ecological Associates, Inc.

Imagery Source:
- ESRI Streets

N

Coordinate System:
NAD 1983 Florida
State Plane East



SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 5 - Pipeline Corridor Seagrass Coverage Map

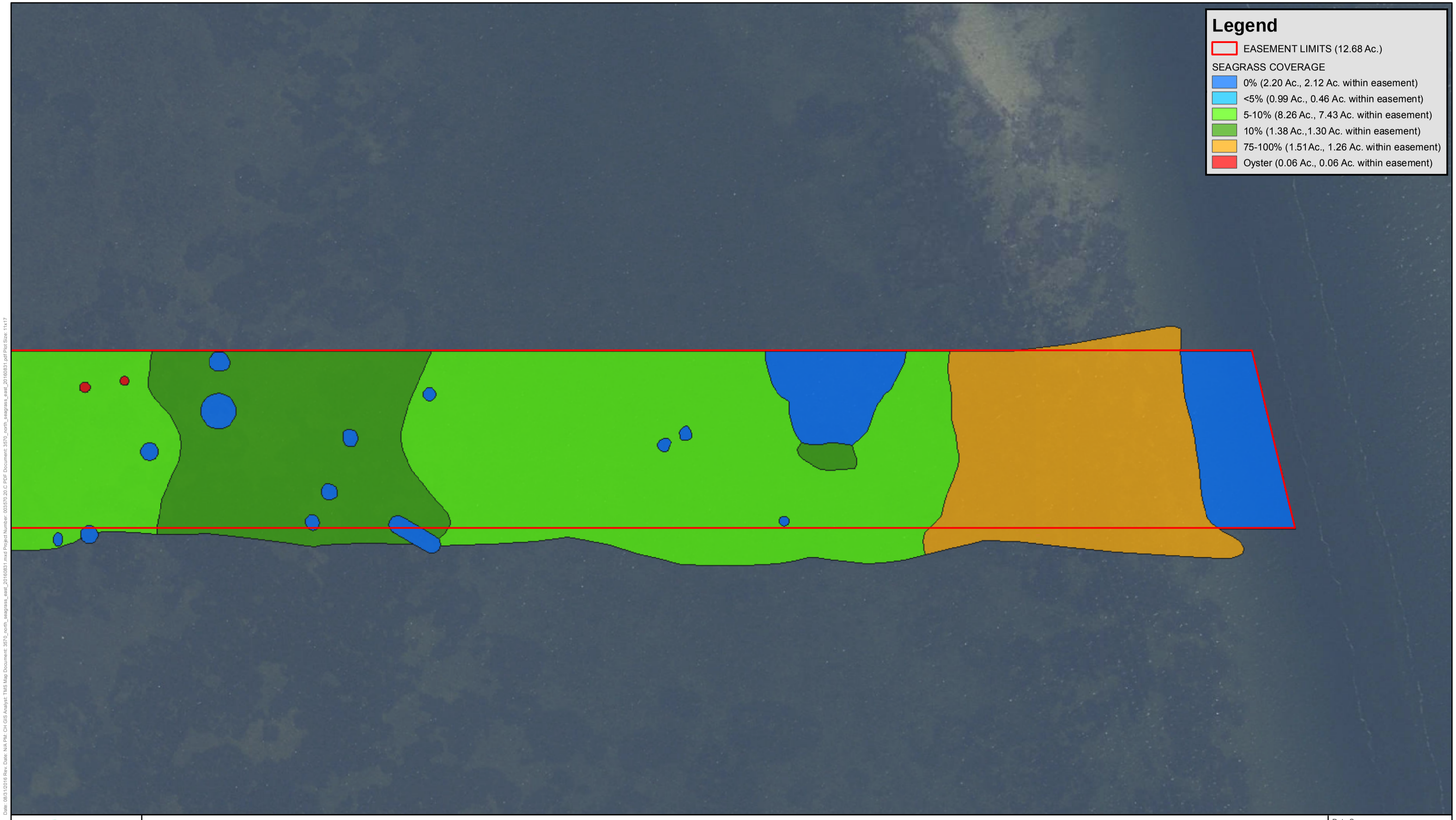
FIND - St. Lucie Reach
Pre-construction
St. Lucie County, Florida

0 100 200 300 Feet

Data Source:
- Scheda Ecological Associates
Imagery Source:
- ESRI

N

Coordinate System:
NAD 1983 Florida
State Plane East



Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_north_seagrass_east_20160831.mxd Project Number: 003570.20 C PDF Document: 3570_north_seagrass_east_20160831.pdf Plot Size: 11x17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 6 - Pipeline Corridor Seagrass Coverage Map

FIND - St. Lucie Reach
Pre-construction
St. Lucie County, Florida

0 100 200 300 Feet

Data Source:
- Scheda Ecological Associates
Imagery Source:
- ESRI

N

Coordinate System:
NAD 1983 Florida
State Plane East

Legend

SURVEY AREA BOUNDARY (48.48 Ac.)

STLUCIE

MARTIN

Figure 7 - Intracoastal Waterway Project Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 2,000 4,000 6,000 Feet

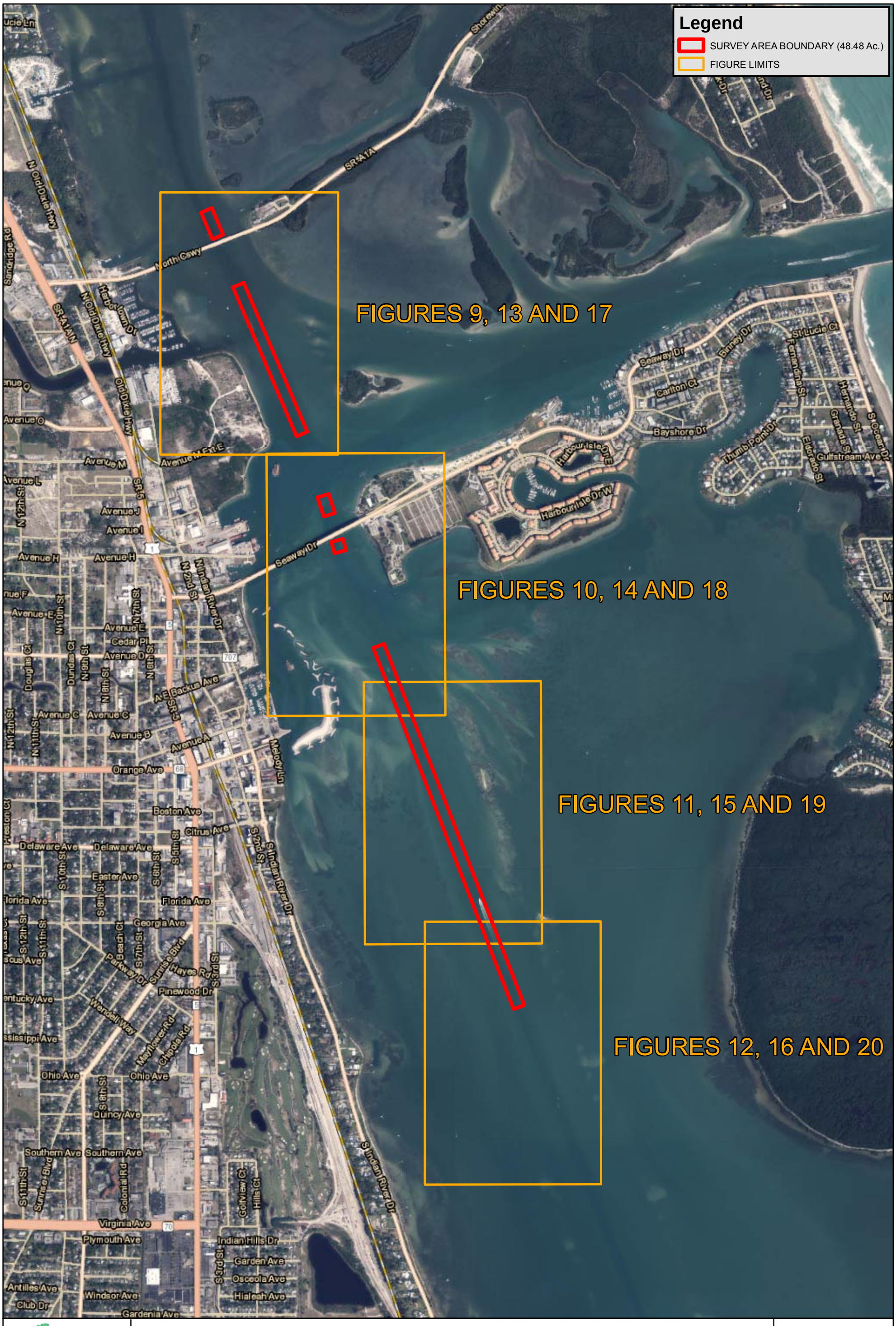
SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_loc_20160831.mxd Project Number: 003570.20 C PDF Document: 3570_south_loc_20160831.pdf Plot Size: 11x17



SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 8 - Intracoastal Waterway Index Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 1,500 3,000 4,500 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- 2013 ESRI

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_index_map_20160831.mxd Project Number: 003670.20 C PDF Document: 3570_south_index_map_20160831.pdf Plot Size: 11x17

Legend
SURVEY AREA BOUNDARY (48.48 Ac.)
MODIFEID BELT TRANSECTS
TOW-BEHIND TRANSECTS
Cut SL-2
SR-A1A
CSWY
Cut SL-2
Cut SL-2

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_transect_map_1of4_20160831.mxd Project Number: 003570.20.C PDF Document: 3570_south_transect_map_1of4_20160831.pdf Plot Size: 11x17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com
All data within this map are supplied as is, without warranty. This product has not been prepared for legal, engineering, or survey purposes. Users of this information should review or consult the primary data sources to ascertain the usability of the information.

Figure 9 - Intracoastal Waterway Transect Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- 2013 ESRI

Coordinate System:
NAD 1983 Florida
State Plane East

N

Figure 10 - Intracoastal Waterway Transect Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- 2013 ESRI

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_transect_map_2of4_20160831.mxd Project Number: 003570.20 C PDF Document: 3570_south_transect_map_2of4_20160831.pdf Plot Size: 11x17

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_transect_map_3of4_20160831.mxd Project Number: 003570.20.C PDF Document: 3570_south_transect_map_3of4_20160831.pdf Plot Size: 11x17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 11 - Intracoastal Waterway Transect Location Map

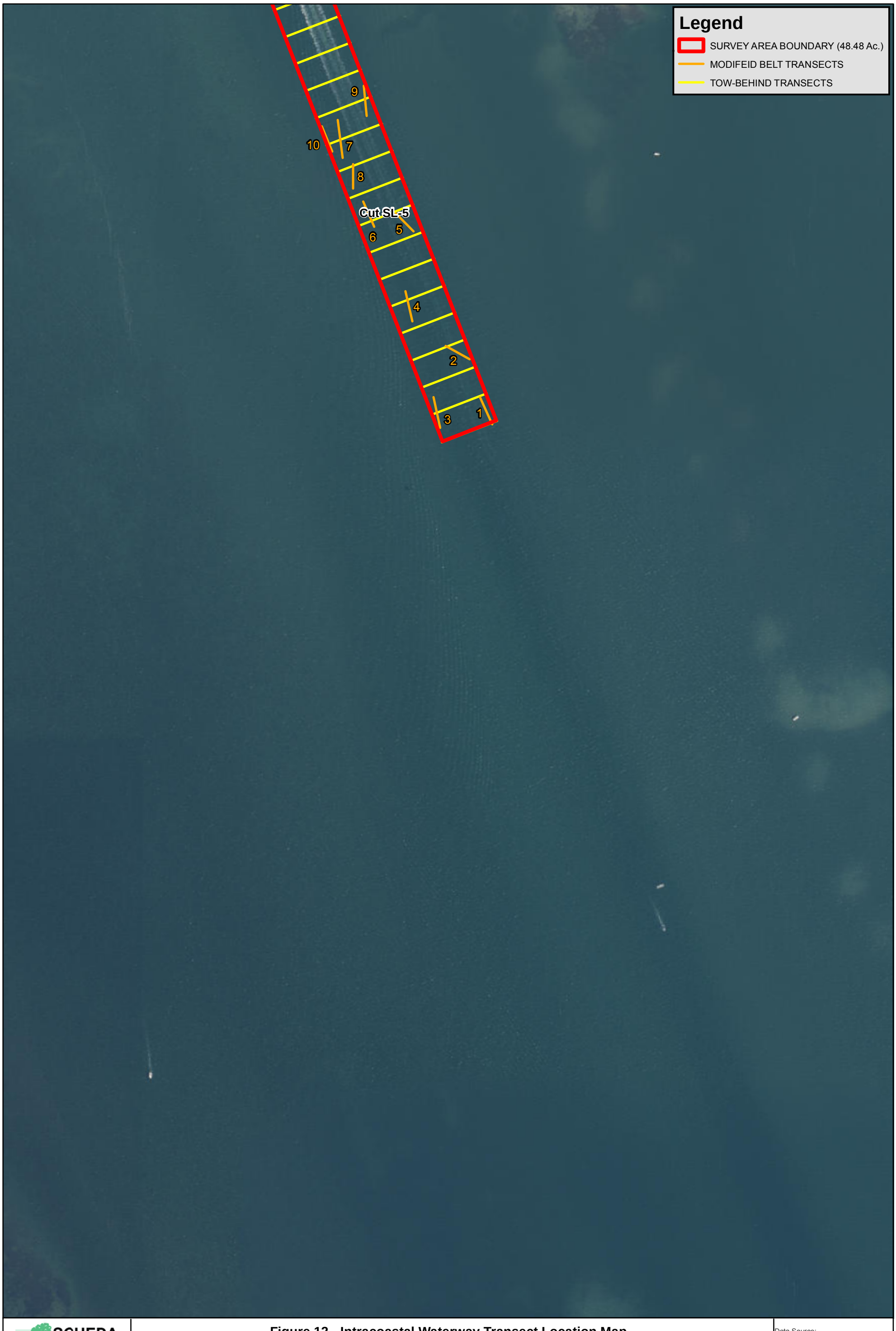
FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- 2013 ESRI

Coordinate System:
NAD 1983 Florida
State Plane East

N



SCHEDA ECOLOGICAL ASSOCIATES

www.scheda.com

Figure 12 - Intracoastal Waterway Transect Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.

Imagery Source:
- 2013 ESRI

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_transect_map_4of4_20160831.mxd Project Number: 003570.20.C PDF Document: 3570_south_transect_map_4of4_20160831.pdf Plot Size: 11x17

Legend

- SURVEY AREA BOUNDARY (48.48 Ac.)

SEAGRASS COVERAGE

- 0% (42.83 Ac.)
- <5% (4.19 Ac.)
- 5% (0.80 Ac.)
- 10% (0.29 Ac.)
- 25% (0.37 Ac.)

Cut SL-3N

Cut SL-3S

Cut SL-5

Seaway Dr

Seaway Dr

Seaway Dr

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_seagrass_map_1of4_20160831.mxd Project Number: 003570.20.C PDF Document: 3570_south_seagrass_map_1of4_20160831.pdf Plot Size: 11 x 17

SCHEDA ECOLOGICAL ASSOCIATES

www.scheda.com

Figure 13 - Intracoastal Waterway Seagrass Coverage Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.

Imagery Source:
- 2013 ESRI

N

Coordinate System:
NAD 1983 Florida
State Plane East

Figure 14 - Intracoastal Waterway Seagrass Coverage Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- 2013 ESRI

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_seagrass_map_2of4_20160831.mxd Project Number: 003570.20.C PDF Document: 3570_south_seagrass_map_2of4_20160831.pdf Plot Size: 11 x 17

SCHEDA ECOLOGICAL ASSOCIATES

www.scheda.com

Figure 15 - Intracoastal Waterway Seagrass Coverage Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- 2013 ESRI

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/31/2016 Rev. Date: N/A PM: CH GIS Analyst: TMS Map Document: 3570_south_seagrass_map_3of4_20160831.mxd Project Number: 003570.20 C PDF Document: 3570_south_seagrass_map_3of4_20160831.pdf Plot Size: 11 x 17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 16 - Intracoastal Waterway Seagrass Coverage Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- 2013 ESRI

N

Coordinate System:
NAD 1983 Florida
State Plane East

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 17 - Intracoastal Waterway Hardbottom Habitat Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.

Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/15/16 Rev. Date: xx/xx/xx PM: CH GIS Analyst: TMS Map Document: 3570_south_hardbottom_map_1of4_20160831.mxd Project Number: 003570.20.C PDF Document: 3570_south_hardbottom_map_1of4_20160831.pdf Plot Size: 11 x 17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 18 - Intracoastal Waterway Hardbottom Habitat Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.
Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/15/16 Rev. Date: xx/xx/xx PM: CH GIS Analyst: TMS Map Document: 3570_south_hardbottom_map_2of4_20160831.mxd Project Number: 003570.20.C PDF Document: 3570_south_hardbottom_map_2of4_20160831.pdf Plot Size: 11 x 17

Date: 08/15/16 Rev. Date: xx/xx/xx PM: CH GIS Analyst: TMS Map Document: 3570_south_hardbottom_map_3of4_20160831.mxd Project Number: 030570.20.C PDF Document: 3570_south_hardbottom_map_3of4_20160831.pdf Plot Size: 11 x 17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 19 - Intracoastal Waterway Hardbottom Habitat Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.

Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

Date: 08/15/16 Rev. Date: xx/xx/xx PM: CH GIS Analyst: TMS Map Document: 3570_south_hardbottom_map_4of4_20160831.mxd Project Number: 030570.20.C PDF Document: 3570_south_hardbottom_map_4of4_20160831.pdf Plot Size: 11 x 17

SCHEDA ECOLOGICAL ASSOCIATES
www.scheda.com

Figure 20 - Intracoastal Waterway Hardbottom Habitat Location Map

FIND St. Lucie Reach 1
Pre-construction
St. Lucie County, Florida

0 300 600 900 Feet

Data Source:
- Scheda Ecological Associates, Inc.

Imagery Source:
- ESRI Streets

Coordinate System:
NAD 1983 Florida
State Plane East

N

TABLES

TABLE 3. AVERAGE PERCENT COVER FOR SEAGRASS, MACROALGAE AND OTHER INVERTEBRATES IDENTIFIED IN THE PIPELINE CORRIDOR.

Transect	Seagrasses				Macroalgae	Invertebrates	Dominant Substrate	Average Water Depth (ft)
	Halodule wrightii	*Ruppia Maritima*	*Syringodium filiforme*	*Thalassia Testudinum*				
1	<5	0	0	0	<5	0	Thick Silt	2
2	10	<5	0	0	10	0	Sand/Silt Bottom	2
3	5	0	5	10	10	0	Sand Bottom with Some Shell Hash	3
4	5	0	0	5	10	< 1	Sand Bottom	3
5	10	0	5	5	10	< 1	Sand Bottom	3
6	5	0	5	10	5	< 1	Sand Bottom	3.5
7	<1	0	10	5	5	0	Sand Bottom	4
8	<5	0	5	5	10	0	Sand Bottom	4.5
9	5	0	10	10	5	< 1	Sand Bottom with Some Shell Hash	5
10	5	0	10	10	10	< 1	Sand Bottom with Some Shell Hash	5.5

TABLE 4. AVERAGE SEAGRASS SHOOT COUNTS AND BLADE HEIGHTS RECORDED IN THE PIPELINE CORRIDOR SURVEY AREA.								
Transect	*Halodule wrightii*		*Ruppia maritima*		*Syringodium Filiforme*		*Thalassia testudinum*	
	Shoot Count	Blade Height	Shoot Count	Blade Height	Shoot Count	Blade Height	Shoot Count	Blade Height
	#/0.1m²	cm	#/0.1m²	cm	#/0.1m²	cm	#/0.1m²	cm
1	0.2	5.5	0	0	0	0	0	0
2	1.2	7.5	0	0	0	0	0	0
3	1.3	17.4	0	0	0	0	0.8	15.6
4	0.6	16.7	0	0	0	0	1.2	16.5
5	0.9	11.6	0	0	1.6	27.6	0.3	14.0
6	0.8	16.6	0	0	0	0	1.0	16.8
7	0.2	15.0	0	0	1.6	28.3	0.3	19.7
8	0.6	17.0	0	0	1.6	29.0	0.2	18.9
9	0.7	16.0	0	0	1.6	29.4	0.1	17.0
10	0	0	0	0	1.4	29.3	0.3	17.2

TABLE 5. AVERAGE PERCENT COVER FOR SEAGRASS, MACROALGAE AND OTHER INVERTEBRATES IDENTIFIED IN THE CUT SL-5 SURVEY AREA.

Transect	Seagrasses		Macroalgae	Invertebrates	Dominant Substrate	Average Water Depth (ft)
	Halophila johnsonii	*Halophila decipiens*				
1	<5	<5	10	< 1	Sand Bottom with Shell Hash	9
2	20	20	15	<1	Sand Bottom with Shell Hash	8
3	<5	<5	<5	<1	Sand Bottom	9
4	<5	<5	< 5	< 1	Sand Bottom	8
5	<5	< 5	5	< 1	Sand Bottom	8
6	5	<5	5	0	Sand Bottom	9
7	<1	<1	<5	1	Sand Bottom	9
8	< 1	<5	10	0	Sand Bottom	9
9	< 1	<1	5	< 1	Sand Bottom with Shell Hash	8
10	0	< 5	10	0	Sand Bottom	9

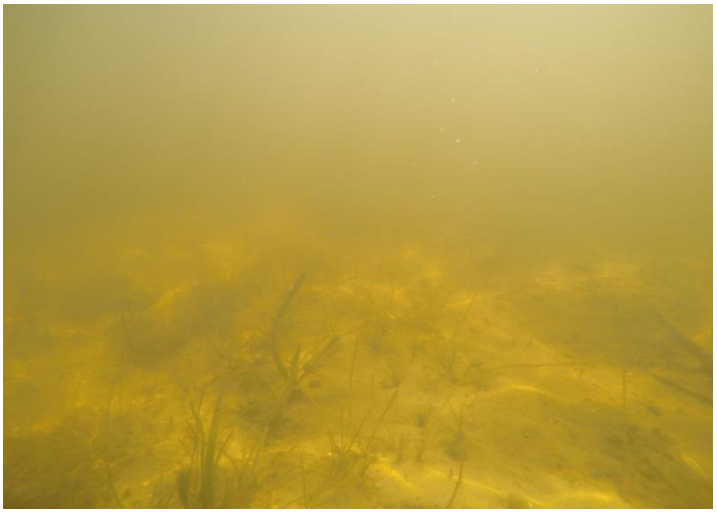
TABLE 6. AVERAGE SEAGRASS SHOOT COUNTS AND BLADE HEIGHTS RECORDED IN THE CUT SL-5 SURVEY AREA.				
Transect	*Halophila johnsonii*		*Halophila Decipiens*	
	Shoot Count (#/0.1m²)	Blade Height(cm)	Shoot Count (#/0.1m²)	Blade Height(cm)
1	0.16	1.09	2.0	1.9
2	0.27	1.10	1.5	2.17
3	0.20	1.12	2.02	2.0
4	0.10	1.10	0.45	1.45
5	0.12	1.12	0.98	1.3
6	0.10	0.99	1.05	1.87
7	0.10	1.28	2.76	1.68
8	0	0	1	1.75
9	0	0	1.9	1.8
10	0	0	1.54	2.25

TABLE 7. LIST OF BIOTA OBSERVED IN THE FIVE (5) ICWW AREAS AND PIPELINE CORRIDOR.	
SEAGRASS	
Scientific Name	**Common Name**
Halodule wrightii	Cuban shoal grass
Halopihila decipiens	Paddle grass
Halophila johnsonii	Johnson's seagrass
Syringodium filiforme	Manatee grass
Thalassia testudinum	Turtle grass
MACROALGAE	
Scientific Name	**Common Name**
Acanthophora sp.	Rhodomelaceous red algae
Caulerpa prolifera	Calcareous green algae
Caulerpa Mexicana	Calcareous green algae
Caulerpa sp.	Calcareous green algae
Chondria sp.	Rhodomelaceous red algae
Derbesia sp.	Green turf algae
Gracilaria sp.	Gracilariaceous red algae
Halimeda sp.	Halimaceous green algae
Laurencia sp.	Rhodomelaceous red algae
Penicillus sp.	Mermaids shaving brush
Sargassum sp.	Sargassaceous brown algae
Udotea sp.	Calcareous green algae
SPONGES	
Scientific Name	**Common Name**
Cliona sp.	Red boring sponge/encrusting sponge
Tedania ignis	Fire sponge
HYDROIDS	
Scientific Name	**Common Name**
Gymnangium sp.	Feather hydroid
Sertularella speciosa	Branching hydroid
OTHER INVERTEBRATES	
Scientific Name	**Common Name**
Coenobita clypeatus	Caribbean hermit crab
Echinometra lucunter	Rock-boring urchin
Hermodice carunculata	Bearded fireworm
Holothuria sp.	Sea cucumber
Ophioderma sp.	Brittle star
Pleuroploca gigantea	Horse conch
	Unknown tubeworm
FISH	
Scientific Name	**Common Name**
Abudefduf saxatilis	Sergeant major
Dasyatis americana	Southern stingray
Diplectrum formosum	Sand perch
Lutjanus apodus	Schoolmaster
Lutjanus griseus	Mangrove snapper
Menidia sp.	Silverside
Sphoeroides greeleyi	Caribbean puffer
Syngnathinae sp.	Pipefish
Tylosurus crocodilus	Needlefish
Unidentified Gobiidae	
MAMMALS	
Scientific Name	**Common Name**
Tursiops truncatus	Bottlenose dolphin

TABLE 8. LIST OF BIOTA OBSERVED IN THE HARDBOTTOM HABITAT EAST OF THE CUT SL-3S SURVEY AREA.	
STONY CORALS	
Scientific Name	**Common Name**
N/A	N/A
OCTOCORALS	
Scientific Name	**Common Name**
Carijoa riisei	White telesto
Leptogoria hebes	Regal sea fan
MACROALGAE	
Scientific Name	**Common Name**
Acanthophora sp.	Rhodomelaceous red algae
Acetabularia sp.	Calcareous green algae
Batophora oerstedii	Calcareous green algae
Caulerpa prolifera	Calcareous green algae
Caulerpa Mexicana	Calcareous green algae
Caulerpa sp.	Calcareous green algae
Chondria sp.	Rhodomelaceous red algae
Dasya sp.	Dasyaceous red algae
Derbesia sp.	Green turf algae
Dictyopteris sp.	Dictyotaceous brown algae
Gracilaria sp.	Gracilariaceous red algae
Halimeda sp.	Halimaceous green algae
Heterosiphonia sp.	Dasyaceous red algae
Hypnea musciformis	Hypneaceous red algae
Laurencia sp.	Rhodomelaceous red algae
Penicillus sp.	Mermaids shaving brush
Sargassum sp.	Sargassaceous brown algae
Udotea sp.	Calcareous green algae
Ulva sp.	Ulvaceous green algae
Wrangelia sp.	Ceramiaceous red algae
	Red turf algae
SPONGES	
Scientific Name	**Common Name**
Amphimedon compressa	Erect rope sponge
Callyspongia plicifera	Azure vase sponge
Cinachyrella alloclada	Ball sponge
Cliona sp.	Red boring sponge/encrusting sponge
Desmapsamma sp.	Lumpy overgrowing sponge
Siphonodictyon coralliphagum	Variable boring sponge
Spheciospongia vesparium	Loggerhead sponge
Spirastrealla coccinea	Pink and red encrusting sponge
Tedania ignis	Fire sponge
Xestospongia muta	Giant barrel sponge

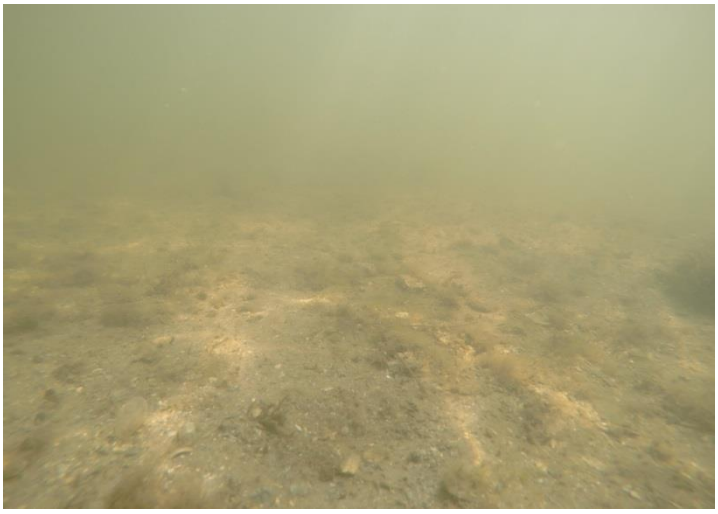
TABLE 8. LIST OF BIOTA OBSERVED IN THE HARDBOTTOM HABITAT EAST OF THE CUT SL-3S SURVEY AREA.	
TABLE 8 Con't.	TUNICATES
Scientific Name	**Common Name**
Clavelina sp.	Bulb tunicate
Eudistoma obscuratum	Black condominium tunicate
Eudistoma sp.	White condominum tunicate
	HYDROIDS
Scientific Name	**Common Name**
Gymnangium sp.	Feather hydroid
Sertularella speciosa	Branching hydroid
Thyroscyphus sp.	Algae hydroid
	OTHER INVERTEBRATES
Scientific Name	**Common Name**
Echinometra lucunter	Rock-boring urchin
Holothuria sp.	Sea cucumber
Spirobranchus giganteus	Christmas tree worm
	Unknown cyanobacteria
	FISH
Scientific Name	**Common Name**
Abudefduf saxatilis	Sergeant major
Acanthostracion quadricornis	Scrawled cowfish
Acanthurus tractus	Ocean surgeonfish
Acanthurus coeruleus	Blue tang
Anisotremus virginicus	Porkfish
Balistes capriscus	Gray triggerfish
Chaetodon sedentarius	Reef butterflyfish
Gymnothorax funebris	Green moray eel
Lutjanus apodus	Schoolmaster
Pomacanthus paru	French angelfish
Pomacanthus arcuatus	Queen anglefish
Sparisoma sp.	Parrotfish
Sphoeroides greeleyi	Caribbean puffer
Urobatis jamaicensis	Yellow stingray
	Unidentified goby
	CRUSTACEANS
Scientific Name	**Common Name**
Callinectus sapidus	Blue crab
Cronius ruber	Blackpoint sculling crab
Panulirus argus	Caribbean spiny lobster

APPENDIX: PHOTOPAGES

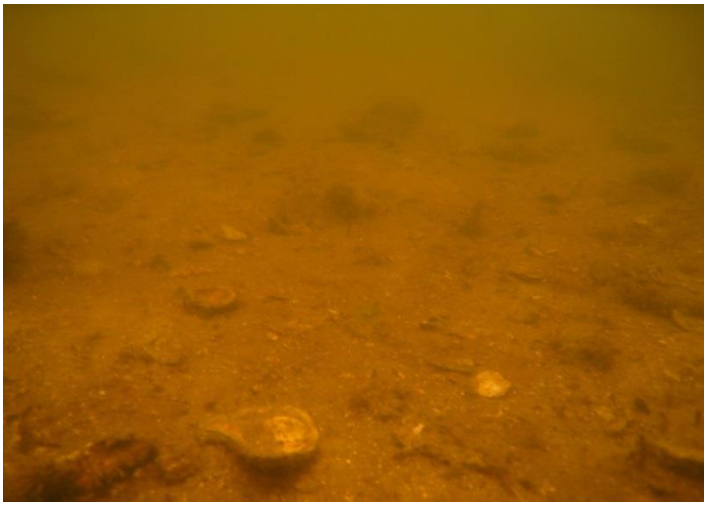


Typical view of seagrass coverage in Pipeline Corridor.

Typical view of the 2.12 acres near the eastern extent Pipeline Corridor.

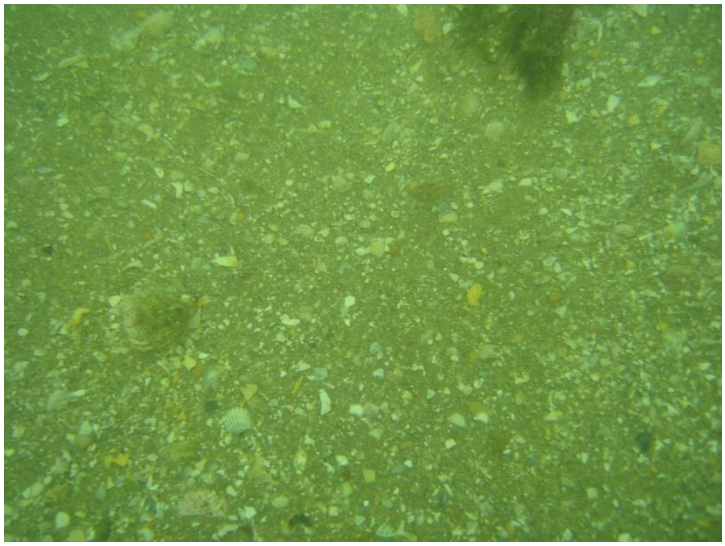


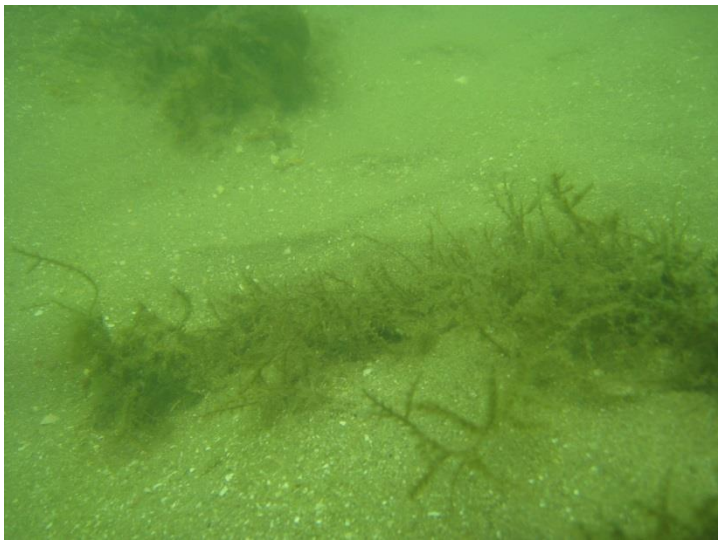
Typical view of a ‘bare pocket’ identified in the Pipeline Corridor .



Typical views of ICWW survey areas benthic habitat

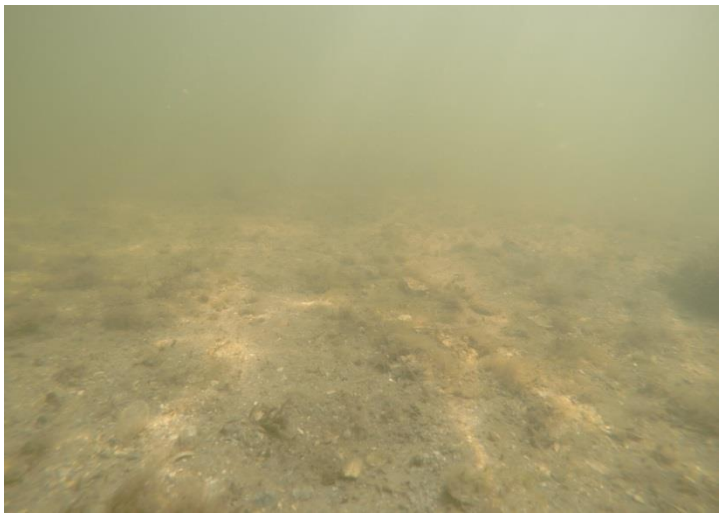
.

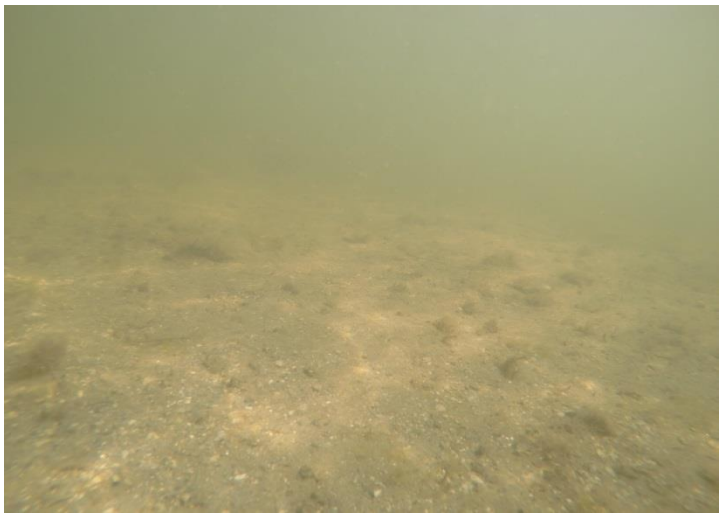




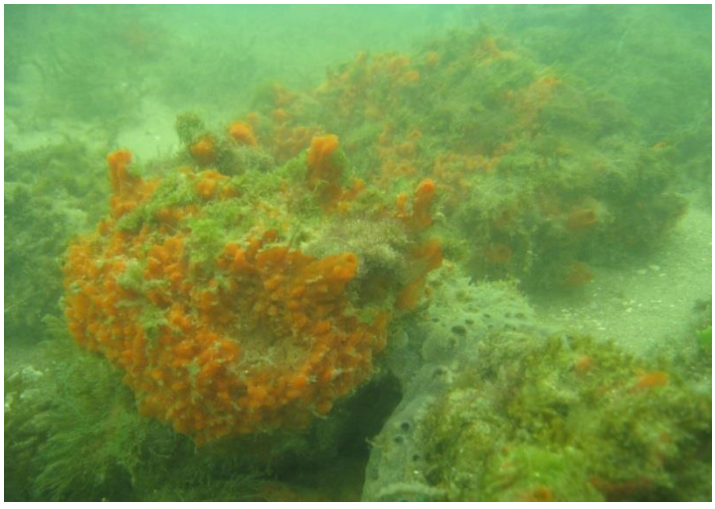
Typical view of habitat in deep water portions of Cut SL-2 South

Typical view of survey area adjacent to Ft. Pierce Inlet

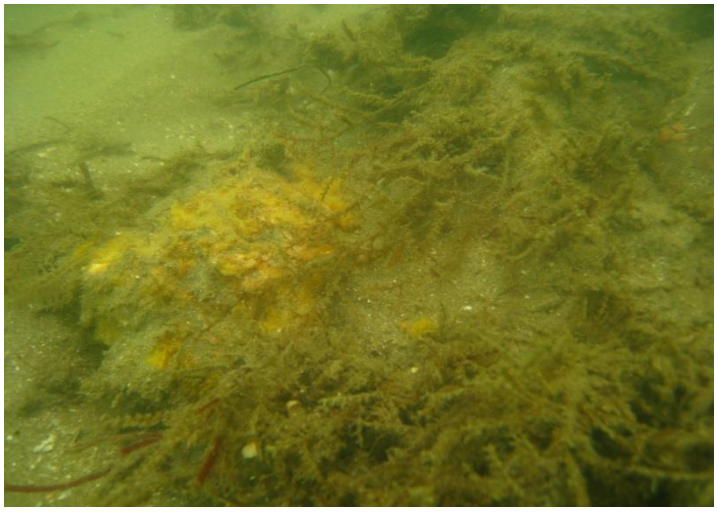




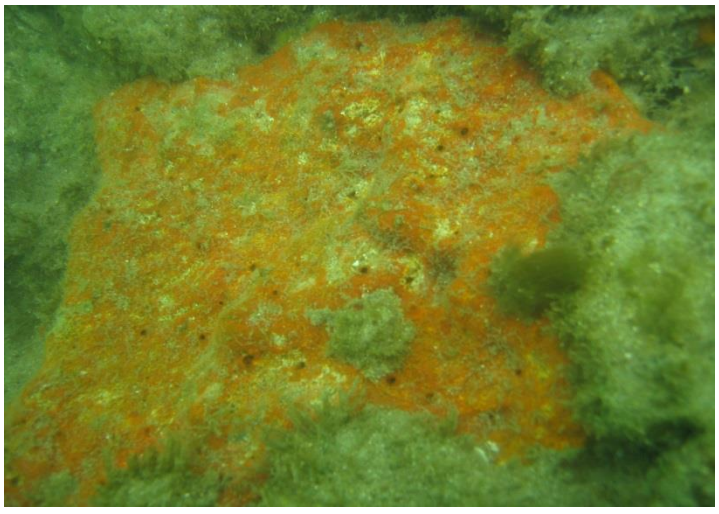
Typical view of benthic habitat in Cut SL-5 survey area.



Typical view of the hardbottom habitat survey areas.



Typical view of hardbottom habitat survey areas.



Typical view of hardbottom habitat survey areas.