

2021 ANNUAL PHYSICAL MONITORING REPORT – BOCA RATON INLET SAND BYPASSING



Prepared by Applied Technology and Management



Prepared for the City of Boca Raton

January 2022

*FDEP Permit No.: 0208818-003-JN
USACE Permit No.: SAJ-2002-08890 (IP-LCK)*

1. Introduction

This physical monitoring report is provided to the Florida Department of Environmental Protection (FDEP) in fulfillment of Specific Condition 4 of Permit No. 0208818-003-JN and Physical Monitoring Plan (Approved 11/2/2009) and to U.S. Army Corps of Engineers (USACE) in fulfillment of Special Conditions 1 and 12 of Permit No.: SAJ-2002-08890. This monitoring report provides the following information.

- Overview: A brief overview of the project and bypassing requirements is provided.
- Dredge Volumes: Dredge records are maintained, and bypassed volumes are summarized. The dredged material is placed on the downdrift beach using a fixed-discharge pipe.
- Hydrographic Survey: The annual hydrographic survey was conducted in June 2021. The survey area is the inlet channel (seaward of the A1A bridge) and a portion of the ebb shoal. This report provides the hydrographic conditions and changes since the July 2019 hydrographic survey of the inlet.
- Aerial Photography: The most recent aerial photography available for the monitoring area is dated January 2021. The City of Boca Raton (City) uses the aerial photography acquired and provided by Palm Beach County.

- Sea Turtle Nesting: A summary of the required sea turtle nesting data is included. Specific Condition 5 of the USACE permit requires that the City submit sea turtle nesting data to the U.S. Fish and Wildlife Service (FWS) and the Florida Fish and Wildlife Conservation Commission (FWC).

2. Overview

The Boca Raton Inlet Sand Bypassing project consists of the ongoing maintenance dredging of the Boca Raton Inlet Channel. The City owns and operates a 10-inch cutter suction-head dredge to bypass sand from the inlet channel to the downdrift beaches and has been performing this bypassing since 1972. The dredge removes material within the permitted area where dredging is necessary. The dredge captain takes depth soundings within the inlet channel and assesses which areas are experiencing deposition of sand and potential shoaling. The dredge discharges sand through a pipe on the dry beach landward of the mean high water (MHW) line, and the material is placed on the downdrift beach within the first 500 feet south of the south jetty. The placed sand has been consistently observed (qualitatively) to be beach compatible.

Based on the 1992 Inlet Management Plan (adopted in 1997), the City's annualized bypassing objective was 71,300 cubic yards per year (cy/yr). In 2004, the bypassing objective was increased to 83,000 cy/yr in the adopted 2008 Strategic Beach Management Plan update, based on an updated sediment budget for the inlet. This project allows the City to meet a portion of the annualized bypassing goal of 83,000 cy/yr. This bypassing objective is achieved through a combination of maintenance dredging using the City-owned dredge (this project) and periodic nourishment of the downdrift beaches (South Boca Raton Beach Maintenance Project, FDEP Permit No. 0182699-001-JC / USACE Permit No. SAJ-1994-01196), using the inlet ebb shoal.

3. Dredge Volumes

The City maintains daily records of the dredge activity. Volumes are based on Hobbs meter readings recording the hours dredged. The City uses these records to estimate the overall bypassed volume based on a production rate of 150 cubic yards per hour (cy/hr). Table 1 provides a monthly summary of bypassed volumes between July 2020 and June 2021. From July 2020 through June 2021, the City has bypassed 53,700 cy of sand from the inlet channel to the downdrift beaches. The estimated monthly inlet maintenance dredging quantities provided in Table 1 show periods of lesser dredging activity in some months and no activity in December 2020 due to maintenance and dredge repairs.

The City maintains daily records of the dredge location with respect to the City's dredge map/grid (Figure 1). Figure 1 also shows the estimated volumes dredged from each grid cell from July 2020 through June 2021. The estimates are based on the daily records of the dredge quantity and number of grid cells dredged and are calculated by equally dividing the daily dredge volume among the cells dredged for that day. Since July 2020, material has been dredged from Grid Rows 14 through 25, with approximately 45 percent of the material dredged from Grid Rows 15 through 18, which are adjacent to the inland side of the apex of the turn in the channel.

Approximately 27% of the dredged material came the area about midway between the bridge and the channels apex (Grid Rows 22 through 24).

Table 1. Monthly Inlet Maintenance Dredge Bypassing Volumes

Date	Estimated Dredged Volume (cy)
July 2020	9,300
August 2020	4,200
September 2020	3,150
October 2020	1,050
November 2020	3,450
December 2020	0
January 2021	1,950
February 2021	4,950
March 2021	10,050
April 2021	900
May 2021	3,375
June 2021	11,325
Total	53,700

Table 2 provides a summary of bypassed volumes since July 2004, when the bypassing goal was increased. The table also provides the relevant periodic dredging events of the ebb shoal. The calculations regarding the annualization of the periodic ebb shoal dredging events are detailed in the footnotes of Table 2. The planned renourishment interval for the South Boca Raton Beach Maintenance Project is 6 years. The City uses this renourishment interval to plan for future ebb shoal dredging events. The next ebb shoal dredging event is scheduled to occur during the 2022/23 dredging window (City of Boca Raton, 2020); thus, the anticipated annualized beach placement for the March 2017 project, which placed 134,100 cy, is 22,350 cy/yr (134,100 cy divided by 6 years).

The total amount of sand bypassed to the downdrift beaches is determined by adding the estimated inlet bypassing to the annualized periodic ebb shoal dredging events (Table 2). The City bypassed an annualized 76,050 cy for the time period July 2020 through June 2021, taking into account the 2017 ebb shoal dredging event. Since July 2004, the City has attained an average annualized total bypassing rate of 95,560 cy/yr and has placed a cumulative total of 1,624,600 cy of sand since July 2004. The City continues to meet the annualized bypassing objective of 83,000 cy/yr.

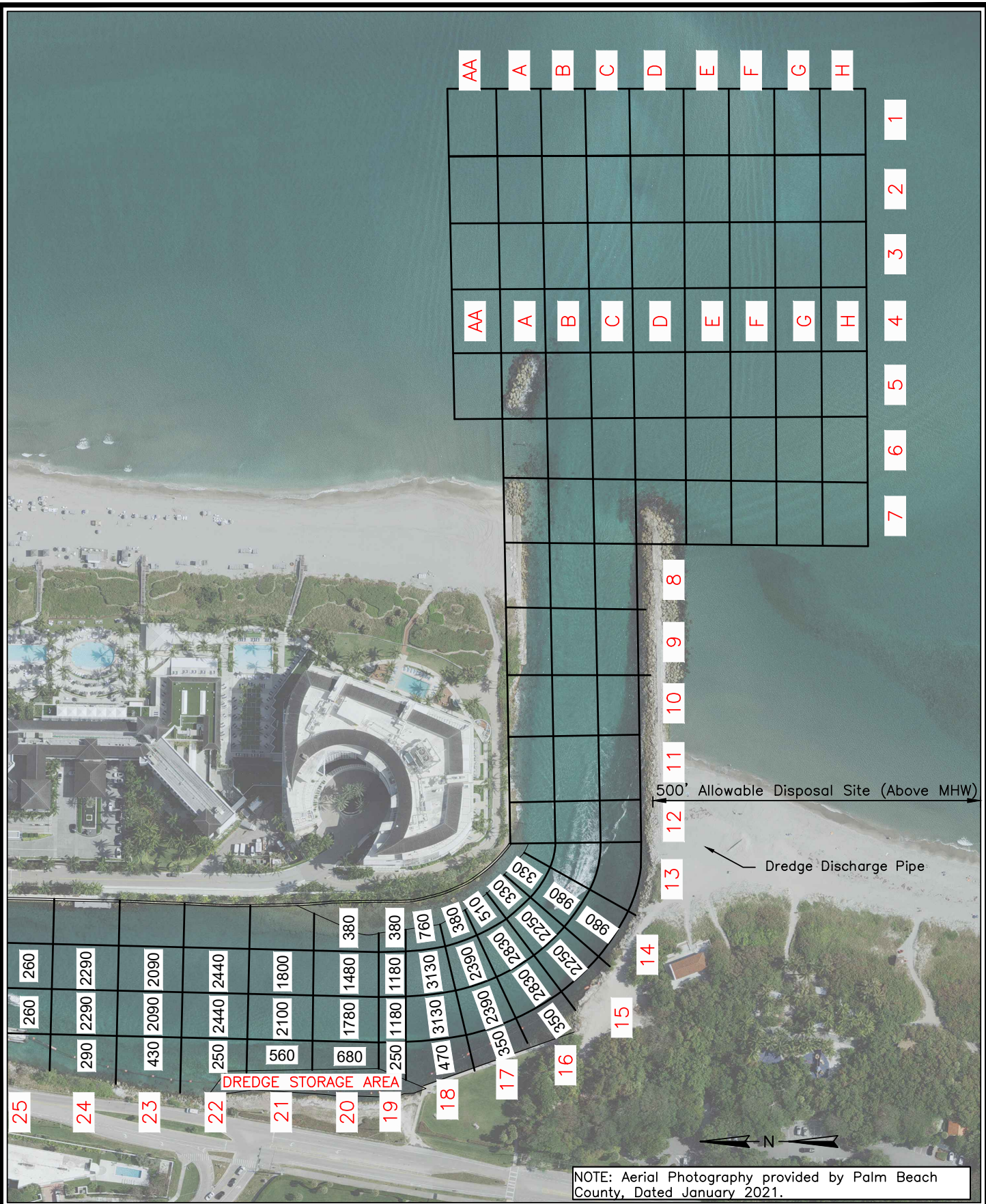


Figure 1
Estimated Dredge Volumes (July 2020 through June 2021).

Table 2. Annualized Total Bypassed Volumes.

Time Period	Estimated Inlet Maintenance Bypassed Quantity (cy/yr)	Periodic Dredging of Ebb Shoal (cy)	Annualized Periodic Dredging of Ebb Shoal (cy/yr)¹	Total Bypassed to Downdrift Beaches (cy/yr)
July 2004 to June 2005	65,090		43,810	108,900
July 2005 to June 2006	45,970		43,810	89,780
July 2006 to June 2007	59,170		43,810	102,980
July 2007 to June 2008	68,720		43,810	112,530
July 2008 to June 2009	67,740		43,810	111,550
July 2009 to June 2010	60,560	183,800	45,360	105,920
July 2010 to June 2011	52,400		49,140	101,540
July 2011 to June 2012	46,730		49,140	95,870
July 2012 to June 2013	39,150		49,140	88,290
July 2013 to June 2014	47,760	168,900	50,280	98,040
July 2014 to June 2015	30,250		51,180	81,430
July 2015 to June 2016	58,280		51,180	109,460
July 2016 to June 2017	62,250	134,100	43,830	106,080
July 2017 to June 2018	40,650		22,350	63,000
July 2018 to June 2019	52,580		22,350	74,930
July 2019 to June 2020	75,900		22,350	98,250
July 2020 to June 2021 ²	53,700		22,350	76,050
Subtotals (cy)	926,900		697,700	1,624,600
Annualized Sub-Averages (cy/yr)	54,520		41,040	
Average Annualized Bypassed ³ (cy/yr)	95,560			

Notes:

- 1) Refer to the 2017 Annual Physical Monitoring Report (ATM 2017) for details regarding calculations of the annualization of periodic dredging of ebb shoal events.
- 2) The anticipated renourishment interval for the March 2017 project is 6 years; thus, the anticipated Annualized Periodic Dredging of the Ebb Shoal for July 2020 to June 2021 is 22,350 cy/yr (134,100 cy / 6 years).
- 3) July 2004 is the basis for the average annualized bypassed rate.

The Central Boca Raton Beach Maintenance Project adjacent to the inlet and the passing of major storms and hurricanes affect the inlet and ebb shoal system. The Central Boca Raton Beach Maintenance Project places sand on the beaches adjacent to the northern jetty. The placement of sand within the Central Boca Raton Beach Maintenance Project occurred in 2004, 2006 and 2017. The 2006 project was a hurricane repair project back-passing sand from the ebb shoal onto the updrift beaches due to the impacts of Hurricanes Frances and Jeanne (2004). This project nourishment event placed on the order of 500,000 cy of sand along 7,900 feet of beach

immediately adjacent to the north side of the inlet. As a result of alongshore spreading and littoral drift, the constructed beach provides an influx of sand into the inlet channel and ebb shoal. The rate of littoral transport is variable on physical factors (beach width, jetty weir, etc.) and natural wave conditions (seasonal wave fluctuations, storms, etc.). Overall, there is anecdotal correlation to the Central Boca Raton Beach placement events to the amount of material the City dredges from the inlet channel and bypasses to the downdrift shoreline as part of this project. That is, this project continually feeds sand to the inlet channel and ebb shoal throughout the lifespan of the project, albeit at a decreasing rate. Thus, it is anticipated that, for a short time span following Central Boca Raton Beach placement events, the City's dredge is able to dredge larger volumes from the inlet channel. As the sand supply decreases from the Central Boca Raton Beach placement event, there is a reduction in material available in the inlet channel to bypass to the downdrift beaches.

In the time period since 2004, major storms and hurricanes, including but not limited to, Hurricanes Frances and Jeanne (2004), Hurricane Sandy (2012), Hurricane Matthew (2016), Hurricane Irma (2017) and Hurricane Dorian (2019), impacted the City of Boca Raton's shoreline. The variability of these storms results in impacts to the inlet and ebb shoal from elevated tides and increased wave energy. Like the Central Boca Raton Beach Project, the passing of storms and their impacts are anecdotally correlated to the City's dredge bypassing quantities.

The morphological dynamics of the inlet channel and ebb shoal system result in variability of the amount of material available for bypassing. In addition, the bypassing operations are primarily dependent on the deposition rate of material within the inlet channel. Although the City exceeded the bypassing goal during this monitoring period, this variability may impair the City's ability to meet the bypassing goal for future monitoring periods in absolute terms.

4. Hydrographic Survey

Applied Technology and Management, Inc. (ATM) conducted a survey of the inlet channel and dredge grid on June 17, 2021. The survey was conducted in accordance with the FDEP-approved Physical Monitoring Plan for this project (ATM, 2009) and FDEP's *Monitoring Standards for Beach Erosion Control Projects* (FDEP, 2014), as appropriate. Based on the bathymetric contours for the project area (Figure 2), the water depths are generally 10 to 16 feet referenced to the North American Vertical Datum of 1988 (NAVD88) in the inlet channel. Some areas in the channel inside the inlet (Figure 2a) are as deep as 24 feet NAVD88 in discrete areas; however, the controlling depth of the inlet channel inside the jetties is 10 feet NAVD88 along the northeast-eastern side of the inlet channel and in the area adjacent to the southern jetty, and 12 feet NAVD88 along northern jetty. In comparison with last year's physical monitoring report (ATM 2020), the controlling depth of the channel inside the jetties generally remains unchanged. The position of the thalweg is along the center of the channel between the entrance jetties and bend. At the bend in the channel, the thalweg is not along the center of the channel but closer to the southwest bank. Between the bend and the bridge, the thalweg is closer to the western bank. Overall, the position of the inlet channel's thalweg is generally consistent with anticipated fluvial dynamics and does not show any areas of abnormal shoaling.

LOCATION: G:\WESTPALMBEACH_SITES\DRAWINGS\PROJECTS\21-3654 BOCA RATON INLET 2021\X-REPORTS\PREP REPORT FIGURES 2020-2021\FIG-2A-B-20-21.DWG
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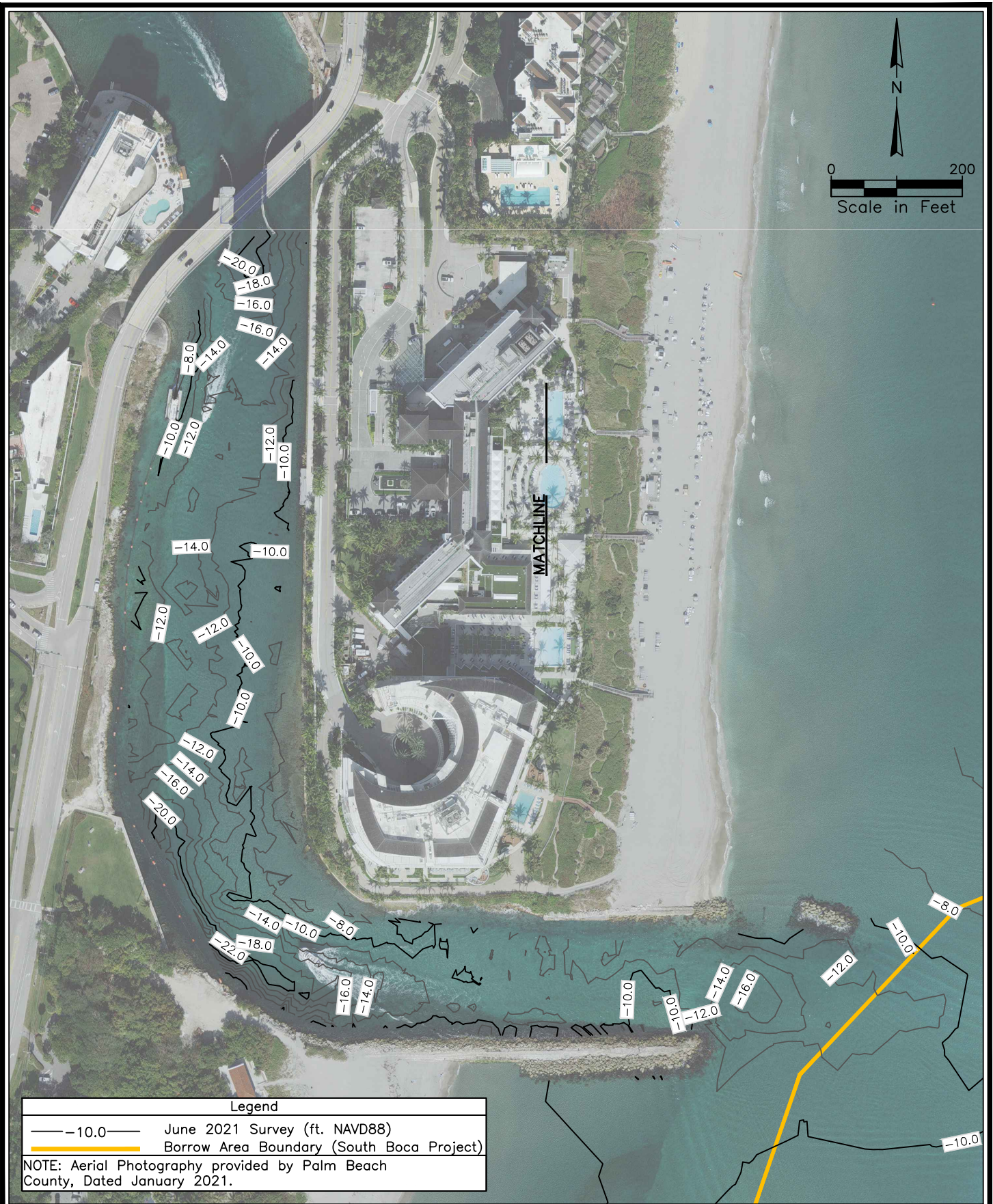


Figure 2a
Hydrographic Survey (June 2021).

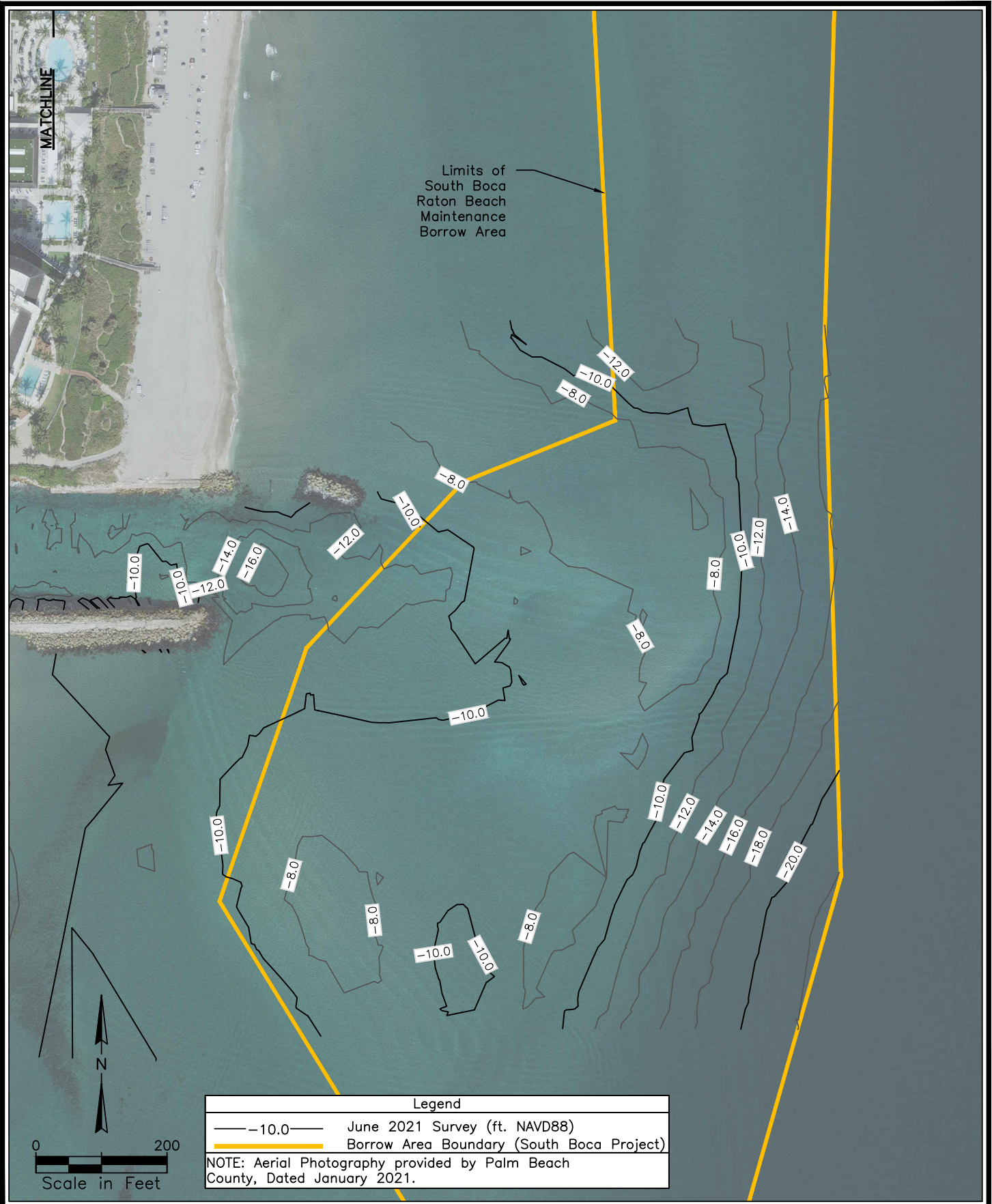


Figure 3 shows the changes in the bathymetry since the last survey (June 2020). The inlet channel has generally experienced areas of deepening with two discrete areas of material accumulation as shown below in Figure 3a. While the areas of deposition in the channel, the accumulations are generally nominal, with the most notable area at the bend in the channel, which experienced an accumulation of up to 4 feet in a single area. However, the areas of deposition in the channel to no impact or lessen the controlling depth of 10 feet NAVD88.

In Figure 3b, the area dredged as part of the South Boca Raton Project continues to experience depositions of up to approximately 3 feet along the seaward side of the ebb shoal. The ebb shoal in the area adjacent to inlet entrance the experienced deepening of up to approximately 2 to 3 feet. This is also balanced by a deposition on the southeastern portion of the survey area. These results are indicative of a portion of sand migrating off the ebb shoal and forming a bypassing bar that will attach to the shoreline in the future. The movement of sand from the ebb shoal, into a bypassing bar, and subsequently to an attachment bar along the shoreline is natural dynamic process of the ebb shoal bypassing sand to the downdrift beach south of the inlet. The formation of the bypassing bar has resulted in a controlling depth of 10 feet NAVD88 for a shore-parallel cut through the shoal, which is a typical condition for Boca Raton Inlet.

Survey data and PDF copies of the deliverables are provided as electronic attachments to this report.

5. Aerial Photography

The figures in this report use the January 2021 aerial photography acquired by Palm Beach County. The aerial images show conditions that are consistent with the survey data. These aerial images are provided as electronic attachments to this report.

6. Sea Turtle Nesting

The City performs sea turtle nesting surveys and provides the data to FWC annually. In compliance with the regulatory permits, sea turtle nesting data were collected and submitted to the regulatory agencies. Table 3 [Table 19 of the FWS Statewide Programmatic Biological Opinion (SPBO)] provides project data and nesting data that were provided to FWC on December 29, 2020 for the Statewide Nesting Beach Survey (SNBS) database.

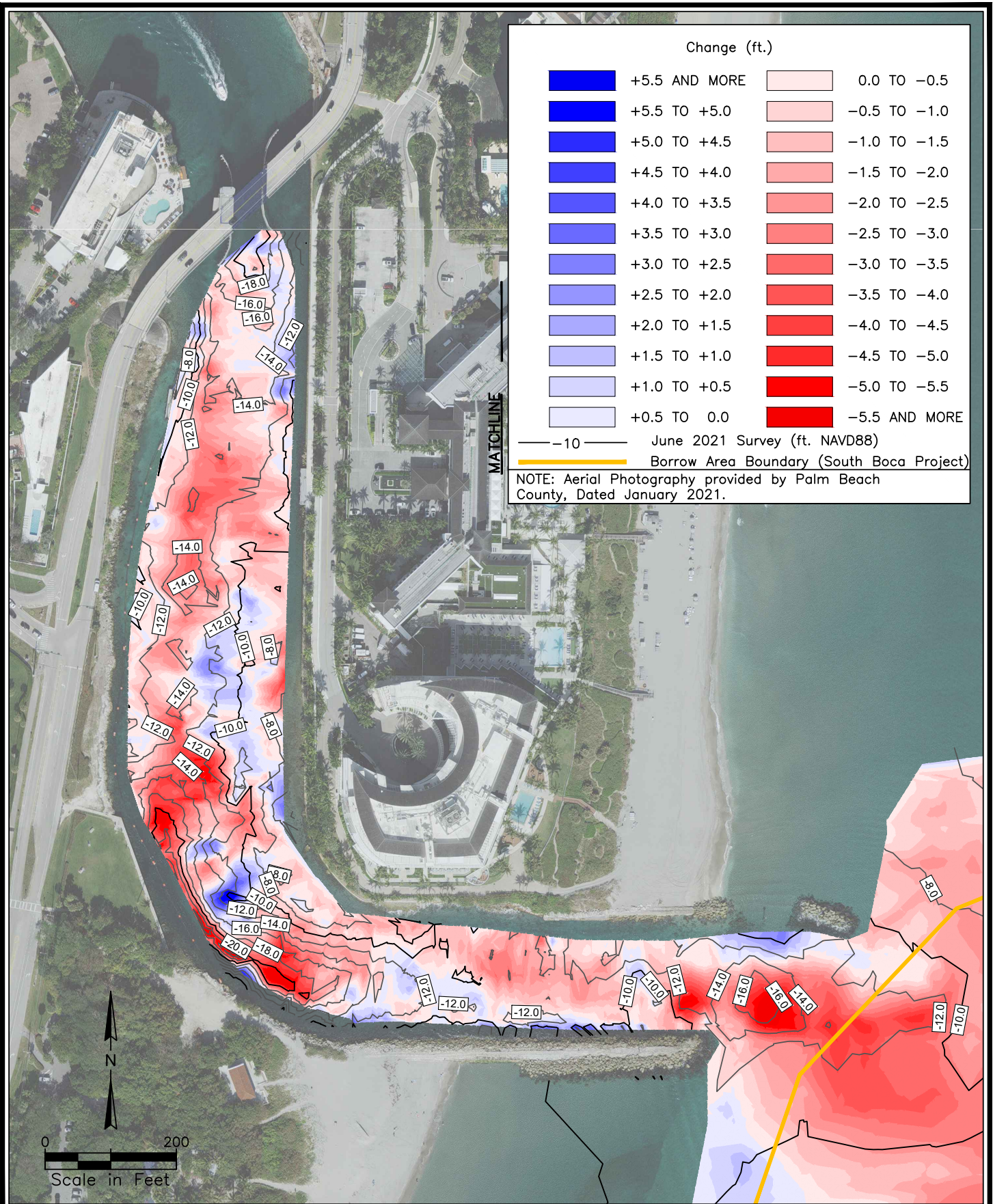


Figure 3a
 Bathymetric Changes (June 2020 to June 2021).

Table 3. Project Information (Table 19 of the U.S. FWS SPBO)

Item	Project Information
Project location (include Florida DEP R monuments and latitude and longitude coordinates)	500 feet of shoreline adjacent to the south jetty of Boca Raton Inlet (R-223, 26.338°N, 80.071°S)
Project description (include linear feet of beach, actual fill template, access points, and borrow areas)	Conduct sand bypassing operations dredging sand from Boca Raton Inlet and placing it above MHW along the beach within 500 feet of the inlet's south jetty.
Dates of actual construction activities	Between sunrise and sunset as needed, year-round.
Names and qualifications of personnel involved in sea turtle nesting surveys and relocation activities (separate the nests surveys for nourished and non-nourished areas)	Kirt Rusenko, Ph.D., Marine Conservationist, Marine Turtle Permit Holder
Descriptions and locations of self-release beach sites	Red Reef Park. This is a City of Boca Raton ocean park approximately 2 miles north of the inlet with minimal, code-compliant lighting.
Sand compaction, escarpment formation, and lighting survey results by project shall be reported as listed in the Terms and Conditions by December 31 to the FWC and appropriate Service Field Office (Table 3)	The USACE-issued permit (SAJ-2002-08890 (IP-LCK) specifies only Reasonable and Prudent Measures and Term and Conditions A1, A2, A22 and A23 apply to this project. Thus, sand compaction, escarpment formation, and lighting survey data are not required due to the nature of this project.

7. Summary

Based on the dredge records and survey data collected for this monitoring period, the following conclusions and recommendations are offered.

- The inlet maintenance dredging bypassed approximately 53,700 cy of sand to the downdrift beaches within 500 feet of the jetty from July 2020 through June 2021.
- The annualized bypassing for this monitoring period (July 2020 through June 2021) is 76,050 cy.
- Since July 2004, the City has bypassed an annualized average of 95,560 cy/yr, taking into account the South Boca Raton Beach Maintenance Project placements. The City continues to meet the bypassing goal based on long-term records.
- The bypassed material has been observed to be beach-compatible sand.
- Based on hydrographic survey data, the controlling depth of the inlet channel is generally 10 NAVD88 (approximately 12 feet MLLW), with each depth favoring one side of the inlet channel.

- In comparison with last year's physical monitoring report (ATM, 2020), the controlling depth is generally unchanged.
- It is anticipated that the ebb shoal will continue to experience deposition and should be closely monitored in the next monitoring period.

8. References

ATM, 2009. Physical Monitoring Plan, Boca Raton Inlet Sand Bypassing. West Palm Beach, FL.

ATM, 2017. 2017 Annual Physical Monitoring Report, Boca Raton Inlet, Sand Bypassing. West Palm Beach, FL.

ATM, 2020. 2020 Annual Physical Monitoring Report, Boca Raton Inlet, Sand Bypassing. West Palm Beach, FL.

City of Boca Raton, 2020. South Boca Raton Beach Maintenance Program, FY2021/22 Local Government Funding Request, Beach Projects Application. Boca Raton, FL. (In Progress)

FDEP, 2014. Monitoring Standards for Beach Erosion Control Projects. Division of Water Resource Management, Department of Environmental Protection, State of Florida. Tallahassee, FL.