Jupiter Inlet Management Plan

Office of Resilience and Coastal Protection

Florida Department of Environmental Protection

July 2025

Final Order Adopting
Jupiter Inlet Management Plan

WHEREAS, pursuant to section 161.161, Florida Statutes (F.S.), the Florida Department of Environmental Protection (department or DEP) shall "evaluate each improved, modified or altered inlet and determine whether the inlet is a significant cause of beach erosion. With respect to each inlet determined to be a significant cause of beach erosion, the plan shall include the extent to which such inlet causes beach erosion and recommendations to mitigate the erosive impact of the inlet, including, but not limited to, inlet sediment bypassing; improvement of infrastructure to facilitate sand bypassing; modifications to channel dredging, jetty design and disposal of spoil material; establishment of feeder beaches; and beach restoration and beach nourishment."

WHEREAS in 2008, the Florida Legislature amended section 161.142, F.S., finding, "The Legislature recognizes the need for maintaining navigation inlets to promote commercial and recreational uses of our coastal waters and their resources. The Legislature further recognizes that inlets interrupt or alter the natural drift of beach-quality sand resources, which often results in these sand resources being deposited in nearshore areas or in the inlet channel, or in the inland waterway adjacent to the inlet, instead of providing natural nourishment to the adjacent eroding beaches. Accordingly, the Legislature finds it is in the public interest to replicate the natural drift of sand which is interrupted or altered by inlets to be replaced and for each level of government to undertake all reasonable efforts to maximize inlet sand bypassing to ensure that beach-quality sand is placed on adjacent eroding beaches. Such activities cannot make up for the historical sand deficits caused by inlets but shall be designed to balance the sediment budget of the inlet and adjacent beaches and extend the life of proximate beach restoration projects so that periodic nourishment is needed less frequently;" and

WHEREAS in 2024, the Jupiter Inlet District sponsored an inlet management study of Jupiter Inlet, which compiled new survey data and information regarding its coastal processes and inlet and shoreline dynamics and updated its sediment budget; and

WHEREAS, in July 2025, the department finalized the development of an inlet management plan that contains corrective measures to mitigate the identified inlet erosion impacts to adjacent beaches; and

WHEREAS Jupiter Inlet District is responsible for dredging and sand bypassing at Jupiter Inlet and, therefore, responsible for implementation of the inlet management plan; and

WHEREAS this inlet management plan (attached) is consistent with the department's program objectives under Chapter 161, F.S.

THEREFORE:

The department does hereby adopt the following implementation strategies, as set forth in the attached **Jupiter Inlet Management Plan**. Future inlet management activities conducted by the Jupiter Inlet District shall be consistent with the following five strategies:

1) **A comprehensive beach and inlet hydrographic monitoring program shall be conducted** to evaluate the performance and impact of existing sand bypassing and nourishment projects and to periodically update the inlet sediment budget. Beach and nearshore surveys between DEP Range/Reference Monuments R-1 and R-28 shall be collected. Periodic inlet hydrographic surveys should be collected to include the inlet channel, the sand trap, and the ebb and flood shoals in their entirety.
2) **Sand bypassing shall be performed from the Jupiter Inlet System to the adjacent Atlantic-fronting beaches to the south of the inlet between the south jetty near DEP range/reference survey monuments R-13 and R-19.** The quantity of material to be bypassed shall be based on available navigation channel and sand trap deposition quantities documented through the monitoring protocol of Strategy #1 above and the target bypassing identified in Strategy #3 below.

3) **On an average annual basis, the initial target inlet sand bypassing quantity at Jupiter Inlet shall be 81,000 cubic yards per year to the south. This target quantity may be modified or updated based on a minimum of four years of additional monitoring data indicating a change in the sediment budget.**

4) **The source of sediment for meeting the target bypassing quantities in Strategy #3 shall be the Jupiter Inlet sand trap and adjacent interior channels, or as otherwise authorized by permit. The Jupiter Inlet flood shoal complex may be considered for further geotechnical and engineering design and permitting and implementation to develop an environmentally acceptable project as a potential sand source. Acceptable beach quality sand may also be obtained from upland sand mines or offshore sources to achieve the target sand bypassing quantities.**

5) **The north and south jetties shall be repaired and maintained as necessary to ensure their continued functioning as sediment management components of the Jupiter Inlet.**

Inlet management actions conducted by the Jupiter Inland District that implement the strategies contained in this plan are subject to further evaluation and subsequent authorization or denial, as part of the department's permitting process. Activities other than the federal navigation project that implement these adopted strategies shall be eligible for state financial participation pursuant to section 161.143, F.S., subject to department approval of a funding request and an appropriation from Florida Legislature. The level of state funding shall be determined based on the activity being conducted and the department's rules. The department may choose not to participate financially if the proposed method of implementation is not cost effective or fails to meet the intent of section 161.142, F.S. and this final order. Activities ineligible for cost sharing includes, but are not limited to navigational construction, operation, and maintenance activities, except those elements whose purpose is to place or keep sand on adjacent beaches. Nothing in this plan precludes the evaluation and potential adoption of other strategies for the effective management of Jupiter Inlet and the adjacent beaches.

Approval of Adoption

Alex Reed

Alex Reed

Director of the Office of Resilience and Coastal Protection

Florida Department of Environmental Protection

Filing and Acknowledgement

FILED, on this date with the designated Deputy Clerk, pursuant to section 120.52, F.S., receipt of which is hereby acknowledged.

IVANA KENNY CARMOLA

Deputy Clerk

July 31, 2025

Date

Electronic Copies Furnished to:

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DEP Agency Clerk

Jupiter Inlet District – Joe Chaison, P.E.
Taylor Engineering, Inc. – Ken Craig, P.E.
Taylor Engineering, Inc. - Ashley Kauppila, P.E.

Palm Beach County – Andy Studt

Notice of Rights

This action is final and effective on the date filed with the clerk of the department unless a petition for an administrative hearing is timely filed under sections 120.569 and 120.57, F.S., before the deadline for filing a petition. On the filing of a timely and sufficient petition, this action will not be final and effective until further order of the department. Because the administrative hearing process is designed to formulate final agency action, the hearing process may result in a modification of the agency action or even denial of the request for a variance or waiver.

Petition for Administrative Hearing

A person whose substantial interests are affected by the department's action may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57, F.S. Pursuant to Rule 28-106.201, Florida Administrative Code (F.A.C.), a petition for an administrative hearing must contain the following information:

(a) The name and address of each agency affected and each agency's file or identification number, if known;

(b) The name, address, telephone number and any e-mail address of the petitioner; the name, address, telephone number and any email address of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests are or will be affected by the agency determination;

(c) A statement of when and how the petitioner received notice of the agency decision.

(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;

(e) A concise statement of the ultimate facts alleged, including the specific facts that the petitioner contends warrant reversal or modification of the agency's proposed action;

(f) A statement of the specific rules or statutes that the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and

(g) A statement of relief sought by the petitioner, stating precisely the action that the petitioner wishes the agency to take with respect to the agency's proposed action.

The petition must be filed (received by the clerk) in the Office of General Counsel of the department at 3900 Commonwealth Blvd., Mail Station 35, Tallahassee, Florida 32399-3000. Also, a copy of the petition shall be mailed to the applicant at the address indicated above at the time of filing.

Time Period for Filing a Petition

In accordance with Rule 62-110.106(3), F.A.C., petitions for an administrative hearing must be filed within 21 days of receipt of this written notice. The failure to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C.

Extension of Time

Under Rule 62-110.106(4), F.A.C., a person whose substantial interests are affected by the department's action may also request an extension of time to file a petition for an administrative hearing. The department may, for good cause shown, grant the request for an extension of time. Requests for extension of time must be filed with the Office of General Counsel of the department at 3900 Commonwealth Blvd., Mail Station 35, Tallahassee, FL 32399-3000, before the applicable deadline for filing a petition for an administrative hearing. A timely request for extension of time shall toll the running of the time period for filing a petition until the request is acted upon.

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Introduction

Pursuant to subsection 161.101(2), F.S., the Florida Department of Environmental Protection (department or DEP) is the beach and shore preservation authority for the State of Florida. As part of the department's statewide beach management plan adopted pursuant to section 161.161, F.S., the department is adopting this Inlet Management Plan for Jupiter Inlet in Palm Beach County, Florida. Jupiter Inlet is in northeast Palm Beach County on the southeast Atlantic Coast of Florida connecting the Loxahatchee River to the Atlantic Ocean (**Figure 1** and **Figure 2**).

The 2025 Jupiter Inlet Management Plan updates strategies for Jupiter Inlet that were originally adopted in the 1997 Jupiter Inlet Management Implementation Plan (DEP, 1997) to be consistent with current statutes and observed erosion[1] conditions. The Strategic Beach Management Plan (DEP, 2023) called for placing all beach compatible maintenance dredging material on adjacent beaches in areas of greatest need, updating the sediment budget, and adopting an updated inlet management plan. The department and Jupiter Inlet District (JID) sponsored the Jupiter Inlet Coastal Sediment Budget Study in 2023 that was completed by Taylor Engineering, Inc. in April 2024.

[1] As used in this document, the term "erosion" means wearing away of land or the removal of consolidated or unconsolidated material from the coastal system by wind or wave action, storm surge, tidal or littoral currents or surface water runoff. As used in this document, the term "accretion" means the buildup of land or accumulation of unconsolidated material within the coastal system caused by wind and wave action, storm surge, or tidal or littoral currents. The descriptions of coastal processes in this document are not intended to affect title to real property or real property boundaries.

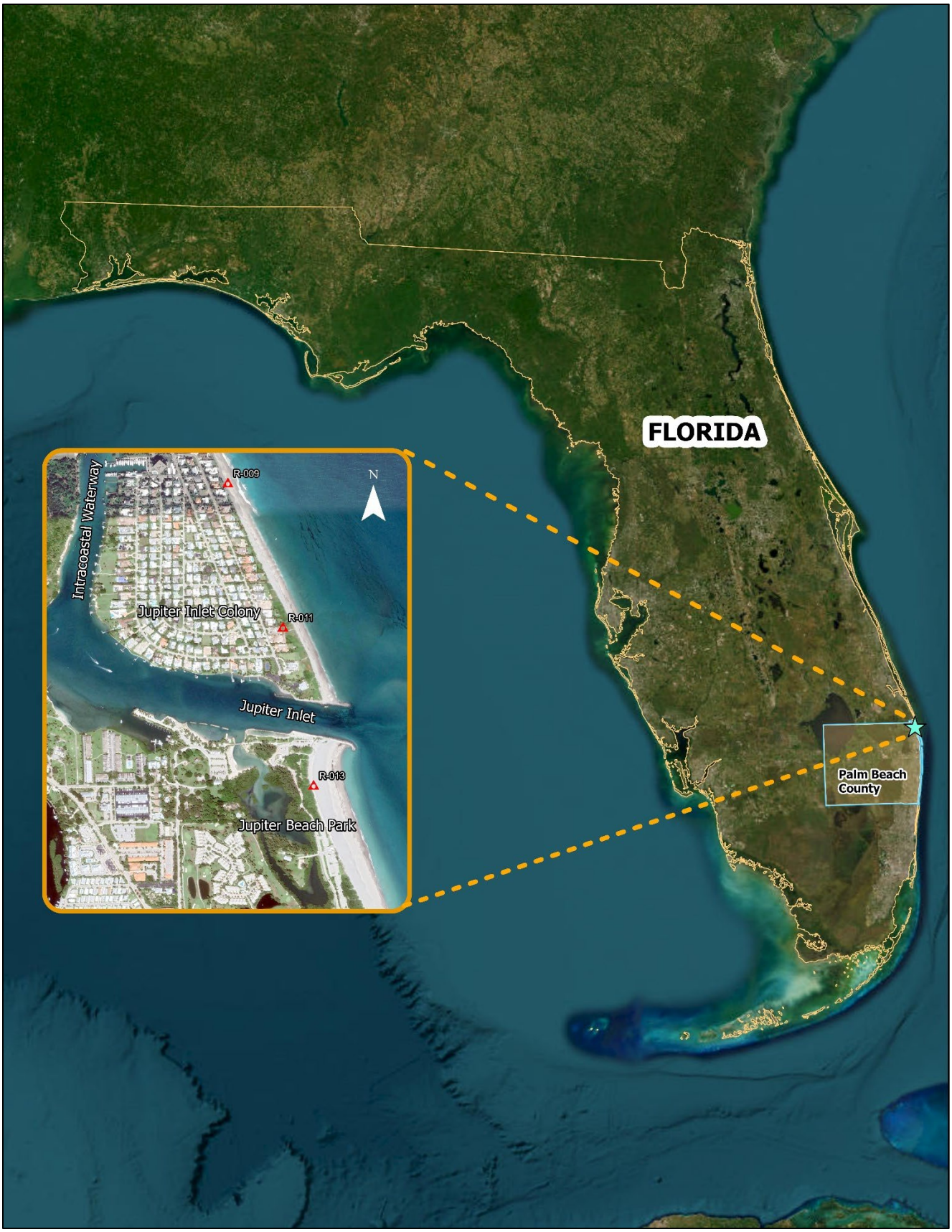

Figure 1. Jupiter Inlet along the east coast of Florida in Palm Beach County.

Program Objectives and Statutory Responsibilities for Inlet Management

In 2008, the Florida Legislature amended section 161.142, F.S., finding,

> "The Legislature recognizes the need for maintaining navigation inlets to promote commercial and recreational uses of our coastal waters and their resources. The Legislature further recognizes that inlets interrupt or alter the natural drift of beach-quality sand resources, which often results in these sand resources being deposited in nearshore areas or in the inlet channel, or in the inland waterway adjacent to the inlet, instead of providing natural nourishment to the adjacent eroding beaches. Accordingly, the Legislature finds it is in the public interest to replicate the natural drift of sand which is interrupted or altered by inlets to be replaced and for each level of government to undertake all reasonable efforts to maximize inlet sand bypassing to ensure that beach-quality sand is placed on adjacent eroding beaches. Such activities cannot make up for the historical sand deficits caused by inlets but shall be designed to balance the sediment budget of the inlet and adjacent beaches and extend the life of proximate beach restoration projects so that periodic nourishment is needed less frequently."

Pursuant to section 161.143, F.S.,

> "Studies, projects and activities for the purpose of mitigating the erosive effects of inlets and balancing the sediment budget on the inlet and adjacent beaches must be supported by separately approved inlet management plans or inlet components of the statewide comprehensive beach management plan."

The Jupiter Inlet District (JID) has been the entity responsible for dredging Jupiter Inlet and, consequently, mitigating the extent of beach erosion caused by the inlet, as specified in Subsection 161.142 (6), Florida Statutes. JID currently has an active Joint Coastal Permit (JCP) issued by the department initially in 2001 (Permit no. 0134395-001-JC) followed by multiple modifications for the purpose of maintenance dredging of the inlet channel and sand trap. The permit expires in 2026. In March 2025, JID submitted JCP application to continue maintenance dredging approximately 50,000 to 100,000 cubic yards of sand annually from the Jupiter Inlet sand trap.

History of Jupiter Inlet

Jupiter Inlet features intricate sediment transport pathways around the confluence of the Intracoastal Waterway (ICWW), Loxahatchee River, and the Atlantic Ocean, which is associated with breaking wave-induced currents, tidal flows and river discharge. The Jupiter Inlet District (JID), established in 1921 by Florida legislature, is responsible for managing the inlet channel and associated structures. The JID history link has additional information on Jupiter Inlet's history and project timelines.

Figure 2. Jupiter Inlet on the coast of Florida in Palm Beach County (Google Earth imagery, 2021).

It is important to understand the history of Jupiter Inlet, its evolution and prior inlet management activities and studies to gain a perspective on the inlet's dynamics and the need to update inlet management strategies. Efforts to stabilize the inlet began in 1922 with the construction of parallel jetties at the inlet mouth by U.S. Army Corps of Engineers (USACE) and JID. Jetty extension took place in 1929 (200 ft for the north, 74 ft for the south), and in 1931 the north jetty was recapped due to

settlement. Structural modifications and repairs to both jetties have occurred over the years, primarily for minimizing consistent settlement and channel infilling by overtopping. **Figure 3** is a historical imagery of Jupiter Inlet showing a steamboat at the inlet entrance in the 1890's. **Figure 4** is a historical image taken in the 1910's from the Jupiter Inlet Lighthouse showing the weather bureau building and Jupiter Inlet. **Figure 5** shows jetty construction taking place in the early 1920's.

Figure 3. Steamboat in Jupiter Inlet in the 1890's (State Archives of Florida).

Figure 4. Historical image from the 1910's of the weather bureau building and Jupiter Inlet (State Archives of Florida).

Figure 5. Construction of the Jupiter Inlet jetty in the 1920's (State Archives of Florida).

Figure 6 shows the north and south jetties and inlet channel during the 1920's. It was common in the 1940's to the 1970's for the U.S. Department of Agriculture to take county-wide aerial photography to show agricultural farmlands as seen in a 1953 aerial photo of northern Palm Beach County (**Figure 7**).

Two aerial images of Jupiter Inlet with one from 1968 showing the inlet shoaled and the other image from 1972 showing the inlet dredged, see **Figure 8**. An aerial image of the Jupiter Inlet Lighthouse and the Jupiter Inlet in the 1970's as seen in **Figure 9**.

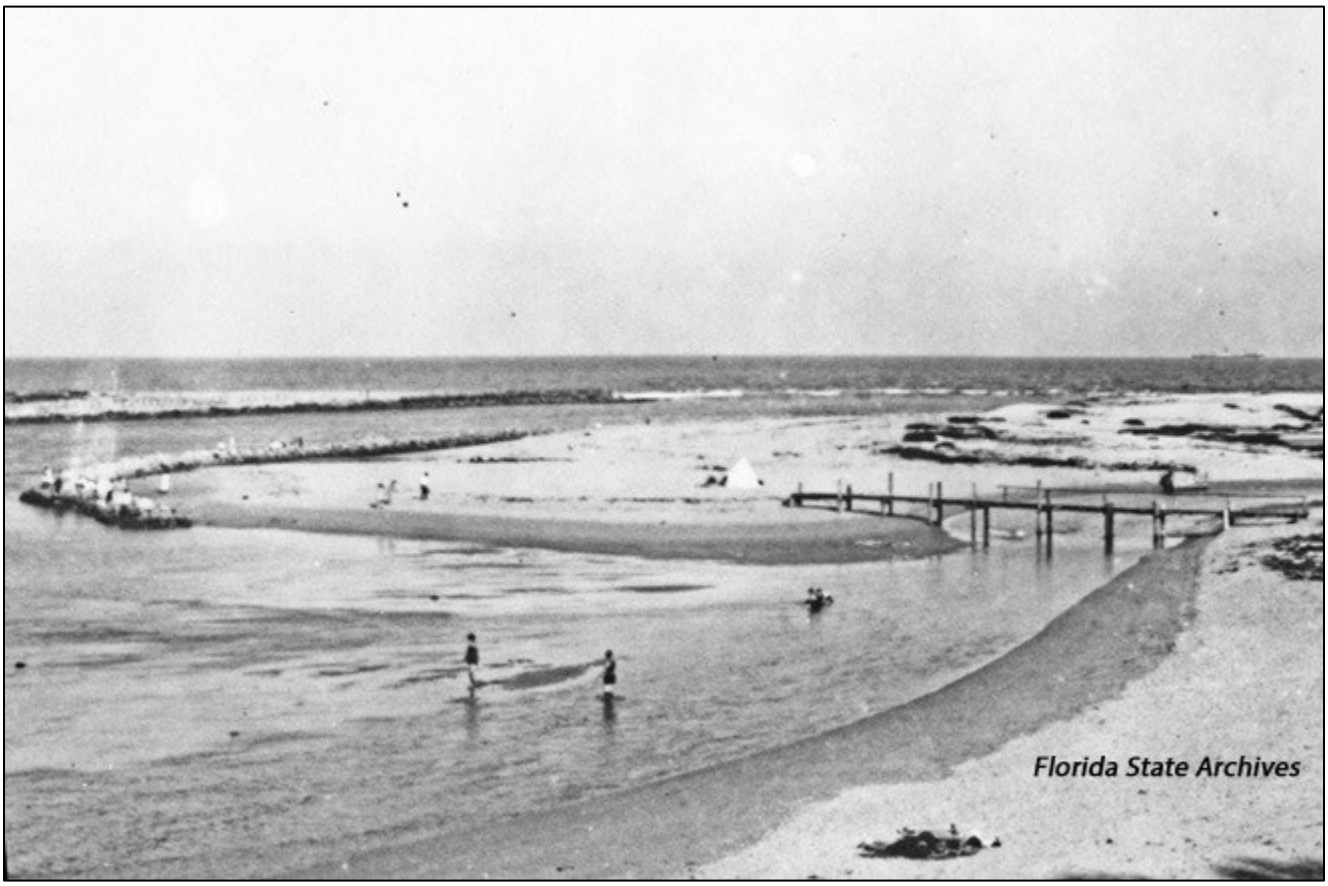

Figure 6. Jupiter Inlet alignment and jetties in the 1920's (State Archives of Florida).

Figure 7. Aerial imagery of Jupiter Inlet taken in 1953 (U.S. Department of Agriculture).

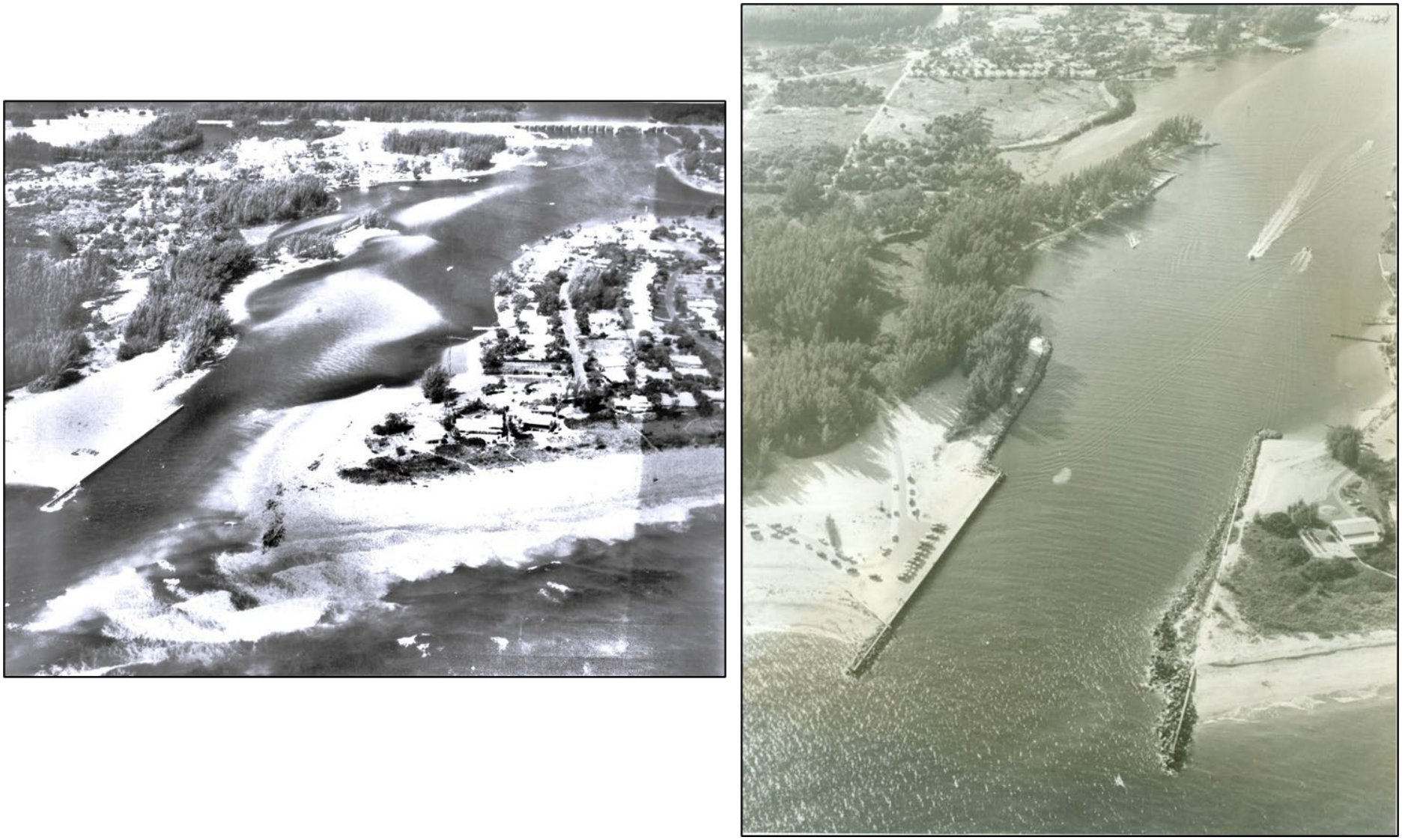

Figure 8. The aerial image on the left shows Jupiter Inlet from 1968 with extensive shoaling. The aerial image on the right shows Jupiter Inlet from 1972 that is dredged and not shoaled. Aerial images courtesy of the Jupiter Inlet District.

Figure 9. 1970 aerial view of Jupiter Inlet and lighthouse (State Archives of Florida).

A sand trap, constructed in 1966, is located approximately 1,000 feet west of the inlet's mouth. It is approximately 1,000 feet long, 300 feet wide, and has an 8-acre basin inside the inlet that collects naturally migrated sand into the inlet system. The sand trap has been dredged periodically for sand placement on downdrift beaches to minimize impacts to adjacent shorelines. The beaches located south of the inlet were restored during 1995 to mitigate erosion caused by the inlet. Maintenance dredging of the navigation channel and sand trap generally occurs on an annual basis with placement of suitable material on the downdrift beaches located south of the inlet. Similarly, USACE periodically bypasses material from the Intracoastal Waterway during maintenance dredging events.

Following a University of Florida study, JID extended and added a recurved section to the south jetty in 1997. In 1999, the crests of both north and south jetties were raised, the south jetty was extended seaward, and the sediment impoundment basin was expanded. In 2007, additional restoration works were conducted to improve the structural integrity of north jetty.

Figure 10 shows a snapshot of the jetties and downdrift beaches of Jupiter Inlet. **Figure 11** and **Figure 12** depict aerial imageries of dredging activities from the sand trap. **Table 1** lists dredged volumes from the sand trap and ICWW from 1993 to 2024.

Several prior studies were conducted to better understand the inlet dynamics and sediment pathways that include Survey Report on Jupiter Inlet, Florida (USACE 1966), Erosion, Navigation, and Sedimentation Imperatives at Jupiter Inlet, Florida (Mehta et al. 1992), Jupiter Inlet Management Implementation Plan (DEP 1997), Coastal Sediment Budget for Jupiter Inlet, Florida (Odroniec 2006), Sand Transfer Rates at Jupiter Inlet, Florida (Sharma 2007), and Sand Budget Reassessment at Jupiter Inlet, Florida (Mehta et al. 2007).

Figure 10. Snapshot in 2025 from a Jupiter Inlet webcam showing jetties and downdrift beaches (Jupiter Inlet webcam).

Figure 11. A 1997 aerial photo of Jupiter Inlet that shows a dredge pumping material from the sand trap to the beach south of the inlet (Jupiter Inlet District).

Figure 12. Jupiter Inlet sand trap dredging operation in 2024 (Ahtna Marine).

Table 1. Bypassing volumes (cy) from Jupiter Inlet sand trap and ICWW.

Year	Dredged from Sand Trap (cy)	Dredged from ICWW (cy)	Total (cy)
1960	0	0	0
1961	0	159,460	159,460
1962	0	0	0
1963	0	54,740	54,740
1964	0	25,942	25,942
1965	0	28,560	28,560
1966	0	0	0
1967	0	37,485	37,485
1968	0	33,320	33,320
1969	0	50,500	50,500
1970	0	93,500	93,500
1971	0	0	0
1972	0	105,672	105,672
1973	0	0	0
1974	0	0	0
1975	38,744	154,000	192,744
1976	0	0	0
1977	68,733	0	68,733
1978	0	0	0
1979	43,133	118,800	161,933
1980	0	0	0
1981	57,342	0	57,342
1982	0	0	0
1983	45,873	141,800	187,673
1984	0	0	0
1985	58,106	0	58,106
1986	50,078	149,660	199,738
1987	0	148,800	148,800
1988	52,984	103,530	156,514

Year	Dredged from Sand Trap (cy)	Dredged from ICWW (cy)	Total (cy)
1989	0	8,792	8,792
1990	64,987	0	64,987
1991	43,466	0	43,466
1992	0	106,273	106,273
1993	47,030	0	47,030
1994	54,681	0	54,681
1995	72,000	0	72,000
1996	0	110,500	110,500
1997	31,540	0	31,540
1998	0	0	0
1999	85,000	0	85,000
2000	56,200	100,000	156,200
2001	82,900	0	82,900
2002	44,000	120,000	164,000
2003	0	0	0
2004	58,000	114,115	172,115
2005	78,000	0	78,000
2006	65,670	0	65,670
2007	0	0	0
2008	87,837	106,934	194,771
2009	64,721	0	64,721
2010	43,391	0	43,391
2011	44,591	80,000	124,591
2012	30,805	0	30,805
2013	76,272	85,986	162,258
2014	38,284	90,000	128,284
2015	45,333	0	45,333
2016	61,699	0	61,699
2017	76,317	114,810	191,127
2018	52,751	0	52,751

Year	Dredged from Sand Trap (cy)	Dredged from ICWW (cy)	Total (cy)
2019	27,896	0	27,896
2020	0	0	0
2021	123,220	0	123,220
2022	71,330	0	71,330
2023	108,580	64,951	173,531
2024	127,780	0	127,780
Total for Sep. 2001 – Apr. 2023	**1,281,597**	**776,796**	**2,058,393**
Total for Jul. 2014 – Apr. 2023	**605,410**	**269,761**	**875,171**
Total for 1960 - 2024	**2,279,274**	**2,508,130**	**4,787,404**

Adopted Inlet Management Plan of 1997 and Subsequent Assessment

The Jupiter Inlet Management Implementation Plan (IMP) was adopted in 1997, which was based on supporting data from earlier studies of the USACE (1966) and Mehta et al. (1992 plus October 1993 addenda). The primary recommendations from the University of Florida study were the following:

1) Continue periodic maintenance dredging of the inlet channel, sand trap, and Intracoastal Waterway with sand bypassing to the beaches located south of the inlet. Dredging schedules should be optimized and the existing authorized disposal area should be modified to extend sand placement southward.
2) Continue periodic nourishment of downdrift beaches as mitigation of inlet effects.
3) Expand existing sand trap and construct an additional interior trap to increase trapping and bypassing efficiency.
4) Modify existing jetty structures. Recommended modifications include raising both the north and south jetties by 3 feet; extending the north jetty by 400 feet along a southeasterly curvature; and extending the south jetty by 175 feet along a southeasterly curvature.
5) Construct a fixed bypassing plant at the north jetty or install a sand fluidization system in conjunction with the north jetty extension.

Each of the five primary recommendations were evaluated for consistency with program objectives under Chapter 161, Florida Statues. Based on the evaluation, the department recommended the following four implementation strategies.

1) Continue effort to bypass sediment to the downdrift beaches. As a minimum, bypassing of material shall meet the average annual placement objective of 75,000 cubic yards as determined by the sediment budget.
2) Expand existing sand trap to facilitate the bypassing objectives as stated above.
3) Construct improvements to jetty structures which will reduce erosion and facilitate bypassing. Specific improvements should include raising both jetties and extending the south jetty.
4) Implement a comprehensive beach and offshore monitoring program subject to the approval of the department.

Following the IMP adoption, several reassessments were conducted in the next ten years to evaluate the effectiveness of implemented plans and further suggestions were made to improve the downdrift beach conditions. Research from the University of Florida reassessed the Jupiter Inlet sediment budget in 2006 and 2007 by reviewing the 1992 study and examining the impact of the south jetty on downdrift erosion. The study found that the beach remained stable north of the inlet, whereas the beach south of the inlet showed erosional trends likely due to variability in sand bypassing frequency and volume. The study estimated that 95% of sand that entered in the inlet complex was successfully bypassed by dredging and downdrift placement. The study report suggested increased monitoring of the inlet system and adjacent beaches; assessment of the sand trap every February or March to determine feasibility of bypassing 60,000 cy/yr; and considering an additional extension of the south jetty.

Jupiter Inlet Coastal Sediment Budget Study 2024

To update the adopted IMP and existing sediment budget of Jupiter Inlet and adjacent beaches, the Jupiter Inlet Coastal Sediment Budget Study (JICSB Study) was sponsored by JID and completed in April 2024. The study was conducted by Taylor Engineering, Inc. that involved topographic and bathymetric survey, sediment sampling and characterization, and numerical modeling of longshore transport rates.

Under separate contract to JID, from February 24 to April 3, 2024, Terraquatic collected topographic and bathymetric survey data of the inlet's area of influence and the inlet complex including ebb shoal, inlet throat, and Intracoastal Waterway north of the State Road 707 bridge (locally known as Cato's

Bridge) to Indiantown Road bridge. Taylor Engineering collected 72 grab samples of sediment from the project location on April 14 and 15, 2023, that were analyzed for sediment characteristics. These bathymetric and sediment data were incorporated into a numerical model for production runs. Model simulation required interpolation of beach transect or other survey data onto the cross-shore profile grid points. DEP surveys and locally collected beach transect surveys typically extend 3,500 to 5,500 feet offshore, but the MIKE LP model cross-shore profiles were extended approximately 8,000 feet offshore. At the grid points located offshore of the beach transect surveys, the JICSB Study interpolated bathymetric data from the digital elevation model (DEM) developed for the FEMA Coastal Flood Insurance Study (FEMA FIS) for south Florida (FEMA, 2016).

A Littoral Process (LP) model was developed using MIKE to simulate longshore transport along multiple one-dimensional (1D) cross-shore profiles extending from DEP range monument R-112 in Martin County through R-36 in Palm Beach County (total of 52 R-monuments). This range of R-monuments, considered as the inlet area of influence, spans 4.5 miles to the north and 4.5 miles to the south of the inlet. The model setup features one cross-shore profile to represent each DEP R-monument location, excluding Palm Beach County R-9 through R-19. These 11 cross-shore profiles were excluded from analyses as they represent areas close to the inlet entrance, which are subject to complex transport patterns. This condition is not consistent with the MIKE LP model assumption of a straight coastline with uniform conditions and therefore, cannot be captured by transect-based model. **Figure 13** shows the 41 cross-shore profiles in the MIKE LP Model.

The JICSB Study conducted sensitivity testing on several model parameters such as bed roughness, specific wave model, sediment characteristics and profile azimuths. These tests established changes to modeled littoral drift rates resulting from changes to various numerical parameters and input datasets. Afterwards the study selected three validation run dates for evaluating the model skill in reproducing net longshore transport rates as observed through beach volume change. Because no direct longshore transport field measurements exist for comparison to modeled results, the study validation instead compared modeled vs. observed volume change—accretion or erosion—over each run duration. Two validation runs at each modeled cross-shore profile demonstrated model skill at reproducing trends in cumulative alongshore volume change.

The validated MIKE LP model provided a range of longshore transport rates (also known as littoral drift rates) that can occur in the project area as well as the longshore transport input for the sediment budget calculations. Model production runs simulated longshore transport from 1997 through mid-2023,

incorporating more recent wave climate and water level conditions compared with the USACE (1966) estimate. The production runs reflect the existing structural configuration of the inlet following the extension and the raising of the north and south jetties in 1997. Notably, the MIKE LP model developed for the JICSB Study focused on capturing longshore transport rates updrift and downdrift of the inlet at locations outside of the inlet shadow. Locations immediately adjacent to the inlet are subjected to complex sediment transport patterns that cannot be simulated with a 1D model such as MIKE LP.

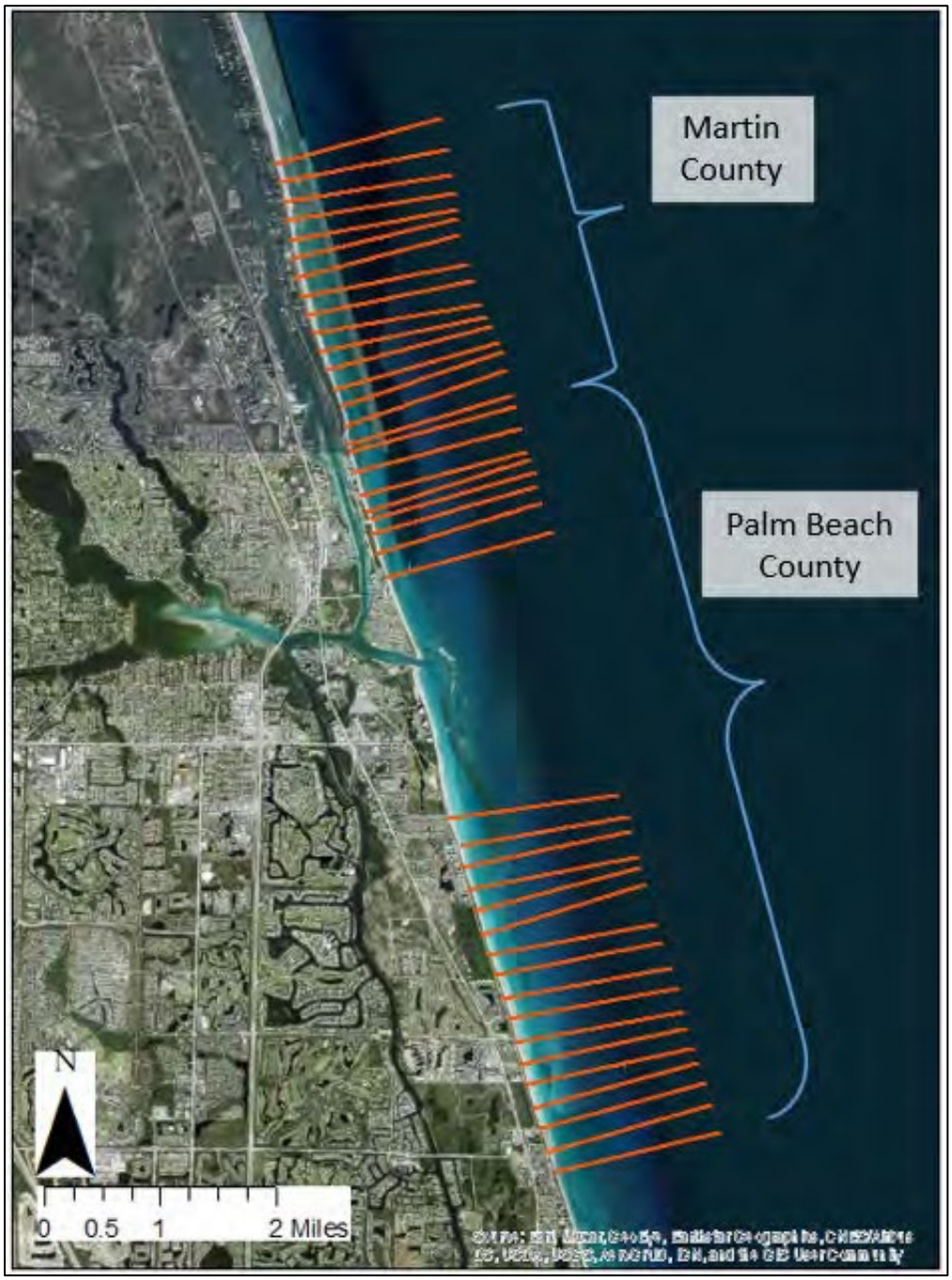

Figure 13. MIKE LP Model Cross-shore Profiles. Among the 41 profiles, approximately one-third are located in Martin County and two-thirds located in Palm Beach County (JICSB Study, 2024).

Pursuant to section 161.142, F.S., dredging within an inlet system, including its shoals, should result in the placement of all beach quality sand on adjacent eroding beaches to balance the sediment budget between the inlet and adjacent beaches. A sediment budget is a balance of the volumes (or volume rate of change) for sediments entering and leaving a tidal inlet system and its adjacent beaches. A sediment budget quantifies the natural longshore sediment transport by waves and tides to and from the inlet, the entrapment of longshore sediment by the inlet channel and the ebb and flood shoals, and the mechanical "bypassing" of sediment, typically by a hydraulic dredge, from the inlet to the adjacent eroded beaches or nearshore. Sediment transport volumes and pathways are unique to each inlet as influenced by regional geology, morphological characteristics, wave and tide conditions, and sediment characteristics and supply. A sediment budget is determined by comparing two or more surveys of an inlet system, including its channel, ebb and flood shoals and the adjacent beaches.

Several sediment budgets have been developed for Jupiter Inlet as part of the Inlet Management Studies. The 1997 adopted IMP was based on the University of Florida sediment budget of 1992 by Mehta et al. The recently concluded JICSB Study of 2024 selected two different timeframes for the sediment budget, i.e., September 2001 to April 2023 and July 2014 to April 2023. These sediment budget analyses are discussed in the following sections.

Sediment Budget of 1966 by USACE

The 1966 study adopted net drift rates from a letter from the Secretary of the Army in 1961entitled Palm Beach County, Florida, from Martin County Line to Lake Worth Inlet and from South Lake Worth Inlet to Broward County Line, Beach Erosion Control Study (USACE, 1961). The 1961 letter report notes that sediment accumulation indicates that areas north of Lake Worth Inlet experience net littoral drift of approximately 230,000 cy/yr. The letter also reported Lake Worth Inlet as the only area where an accurate estimate of littoral drift could be made and that approximately 75% of sediment is naturally bypassed with limited offshore losses. The budget applied the natural bypassing rate estimated by USACE (1966) of 73%, indicating that approximately 168,000 cy is bypassed around Jupiter Inlet. Together, these values form the primary budget of 168,000 cy/yr of natural southward transport, 60,000 cy/yr entering the inlet, and 2,000 cy/yr depositing directly onto the ebb shoal. **Figure 14** presents diagrams of net drift magnitudes and directions from USACE (1966).

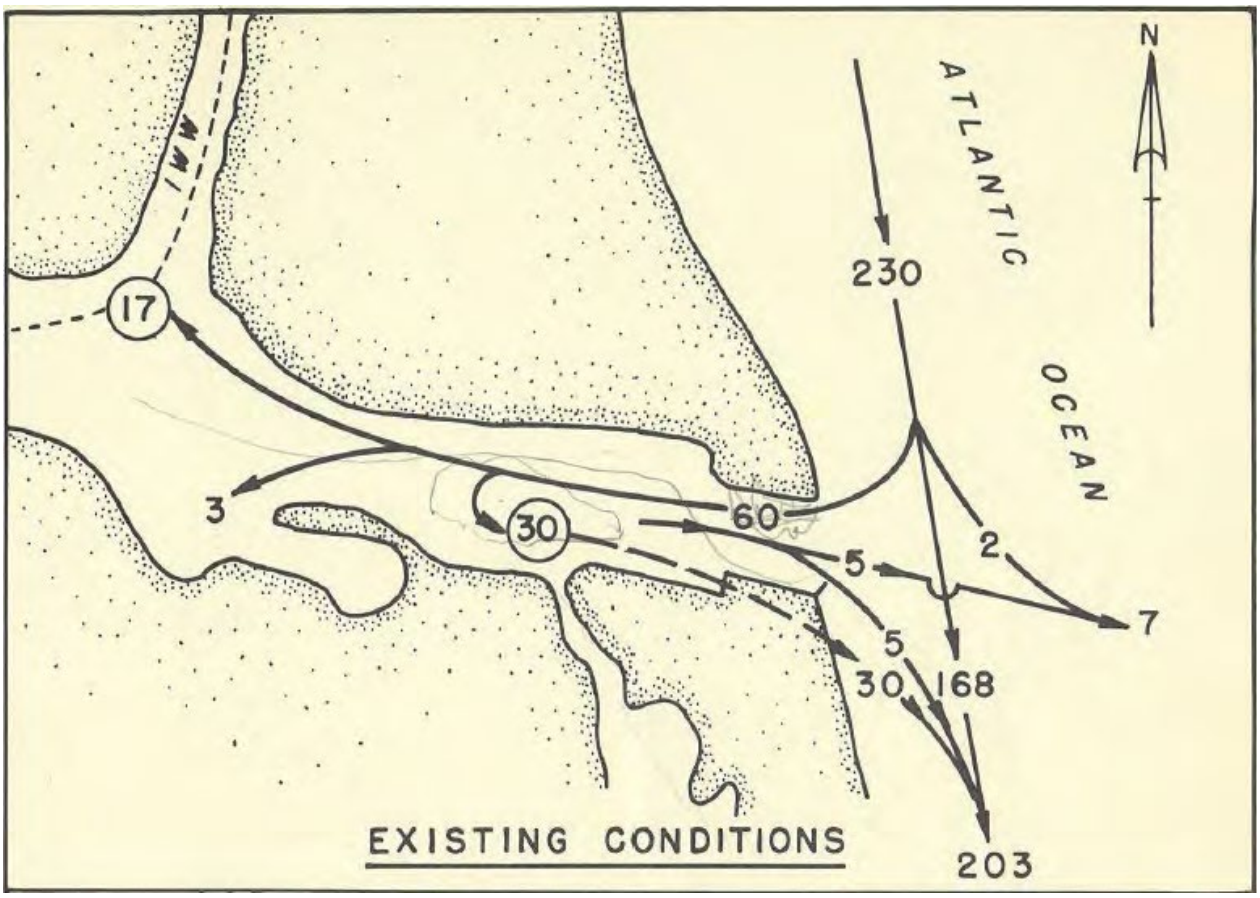

Figure 14. Distribution of 1966 Sediment Budget (USACE, 1966).

Sediment Budget of 1992 by Mehta et al.

Mehta et al. (1992) utilized the Corps' updrift longshore transport rate and developed a different sediment budget resulting in a 75,000 cy/yr inlet sediment entrapment rate. Additionally, sediment transport patterns inside the inlet were further broken down into multiple components. The budget further estimated that the 13,000 cy/yr out of dredged quantity of 17,000 cy/yr from the ICWW established by the USACE was bypassed to downdrift beaches and the remaining 4,000 cy/yr was lost to the ICWW. It was also noted that 1,000 cy/yr was lost to the central embayment that does not derive from the primary budget. **Figure 15** presents diagrams of net drift magnitudes and directions from Mehta et al (1992).

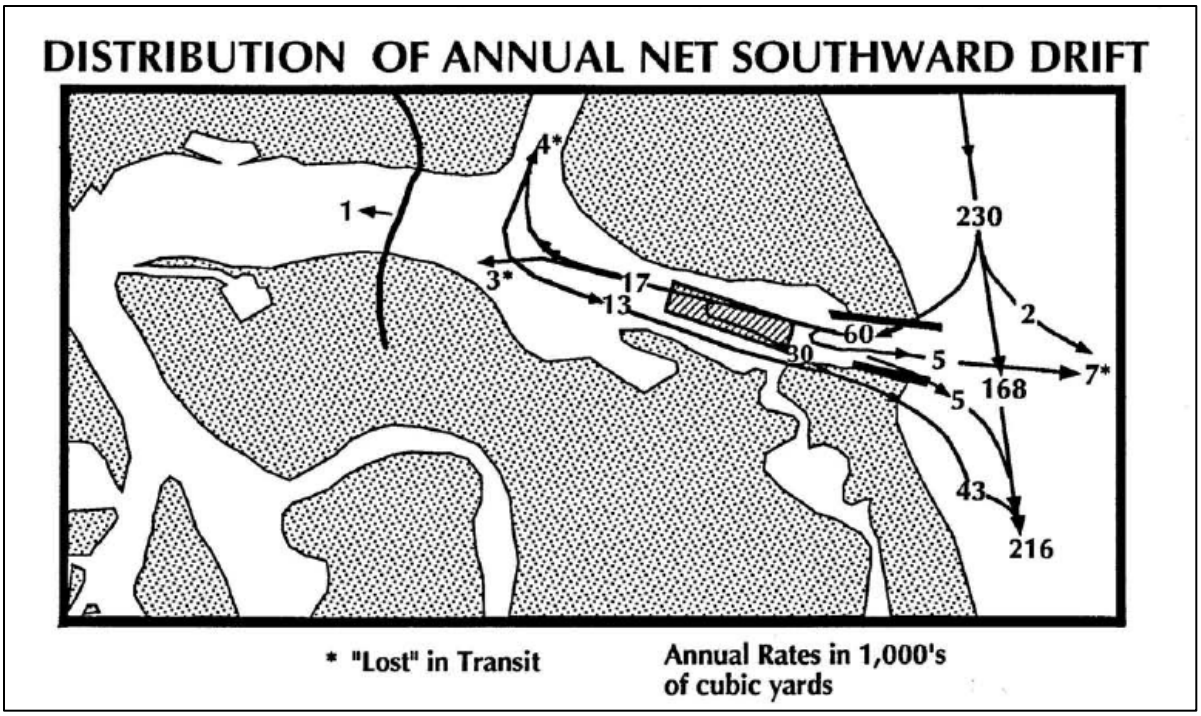

Figure 15. Distribution of 1992 Sediment Budget (Mehta et. al, 1992).

Sediment Budget of 2024 (JICSB Study, 2024)

The JICSB Study of 2024 calculated the sediment budget for two timeframes. The first timeframe was between 2001 – 2023 that best captured conditions of post-jetty expansion completion in 1997 and the present time. The second timeframe was between 2014 – 2023 that covered survey data over approximately the last decade. The recommended strategies were based upon on the sediment budget for the latter timeframe (2014 – 2023). This period included the recent trends of sediment transport in and around Jupiter Inlet and removed the influence of the immediate morphological response to the jetty extension and recovery from the significant wave events of Hurricanes Frances and Jeanne in 2004 and Hurricane Sandy in 2012.

Considering the spatial scale of available survey data, the JICSB Study delineated seven littoral cells that covered the inlet, the ebb shoal and area offshore of the ebb shoal, two beach cells north of the inlet (Martin County R-112 through R-121and R-121 through Palm Beach County R-8), and two beach cells south of the inlet (Palm Beach County R-20 through R-28 and R-28 through R-36). All littoral cells along the seaward boundary of the project domain exhibited a depth of closure of -30 or -35 ft-NAVD. The conceptual model of littoral cells for the sediment budget is shown in **Figure 16**, where R-monument names in red text show updrift and downdrift boundary locations within the beach cells. The Inlet cell includes the sand trap and immediate vicinity.

The North Beach and South Beach cells (**Figure 16**) derived measured volume change from beach transect surveys, with surveyed elevations limited to the offshore extents to depth of closures. The cross-sectional area change occurring over the timeframe computed at each R-monument, multiplied by the controlling distance for that monument, provided total volume change in cubic yards. At the updrift boundary and downdrift boundary R-monuments, the volume change calculation applied half the controlling distance, as only half of the total distance fell within the littoral cell. Summation of volume change associated with each R-monument in the littoral cell provided total volume change associated with that specific cell. Modeled littoral drift rates calculated from the MIKE LP model were used as input data for longshore transport terms for each cell. At each updrift and downdrift littoral cell boundary modeled results recorded hourly northward- and southward-directed sediment transport over the duration of the timeframe and the net southward transport was calculated (Q terms at **Figure 16**). Afterwards, beach nourishment fill quantities listed in **Table 2** were applied as placement terms within the North Beach and South Beach littoral cells as depicted by blue arrows in **Figure 16.** Notably, if fill from a particular project partially fell within a JICSB Study littoral cell, the quantity listed reflects the assumption of equal division of fill over all nourished monuments. The volumes shown in **Table 2** are only showing the beach nourishment project volumes and do not include any inlet project bypassing volumes that are shown in **Table 1**.

Sufficient point density in historical ebb shoal surveys facilitated calculation of volume change in the Nearshore and Offshore littoral cells through comparison of raster surfaces using ArcGIS Pro. For the model domain, raster surfaces were created in ArcGIS Pro version 3.2 and Cut Fill tools were used to calculate the differences of bed elevation between different years. **Figure 17** shows the differences of bed elevations for nearshore and offshore littoral cells between 2014 and 2023.

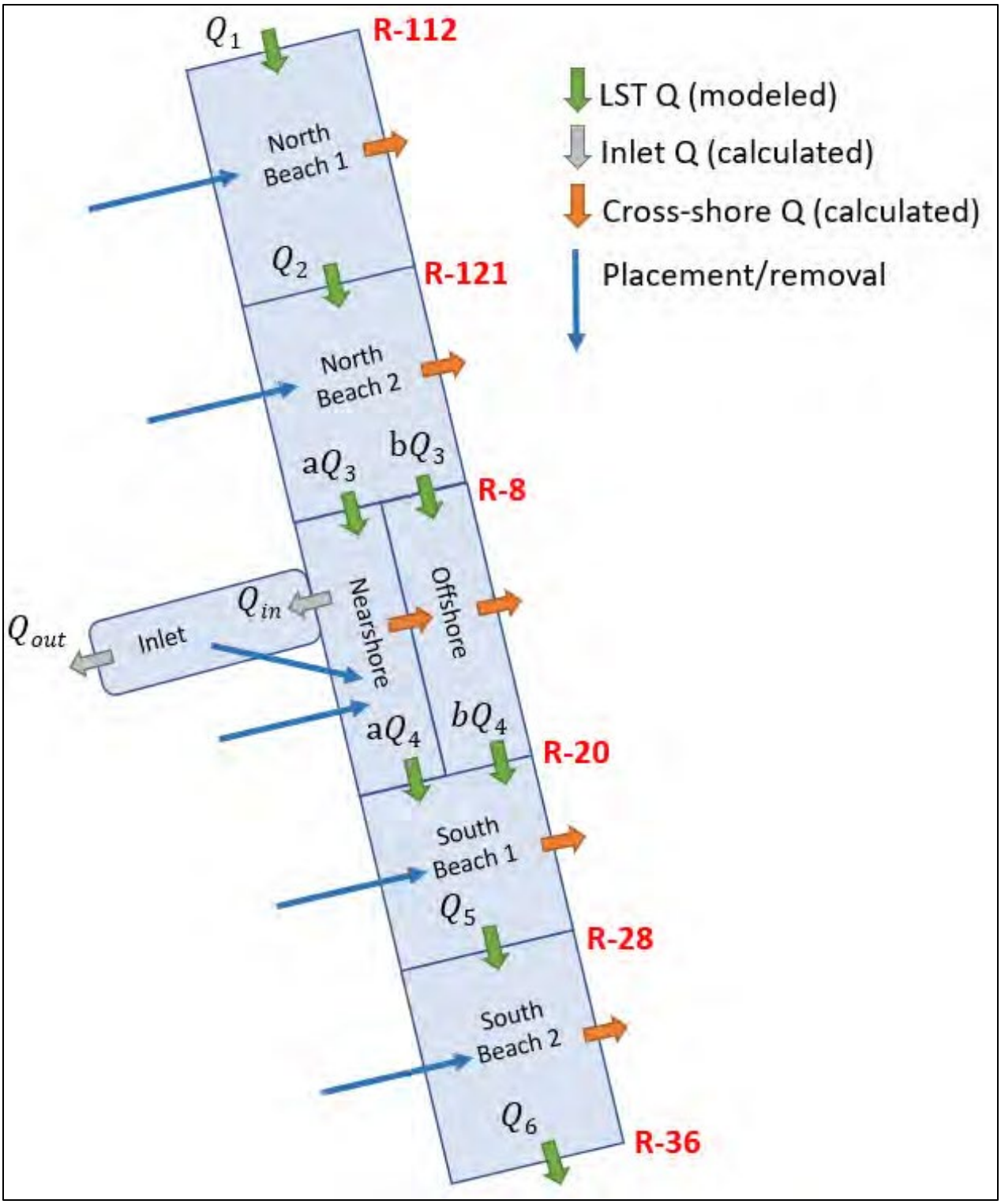

Figure 16. Conceptual model of Jupiter Inlet updated sediment budget littoral cells (JICSB Study, 2024).

Table 2. Beach nourishment project placement (in cubic yards) applied in North Beach and South Beach littoral cells as shown in **Figure 10** (JICSB Study, 2024).

Year	North Beach 1 (R-112 to R-121 in Martin County)	North Beach 2 (Martin R-121 to Palm Beach R-8)	South Beach 1 (R-20 to R-28 in Palm Beach County)	South Beach 2 (R-28 to R-36 in Palm Beach County)
2002	-	-	-	-
2003	44,693	-	-	-
2004	-	-	-	-
2005	-	-	-	-
2006	-	-	-	-
2007	-	-	-	-
2008	-	-	-	-
2009	-	-	-	-
2010	-	-	152,699	610,795
2011	-	-	-	-
2012	-	8,600	-	-
2013	-	-	-	-
2014	-	25,926	-	-
2015	-	-	-	-
2016	66,818		3,308	
2017	-	4,800	-	-
2018	-	-	-	-
2019	83,894	-	4,935	-
2020	-	6,048	-	-
2021	-	-	171,667	686,667
2022	-	47,587	23,653	-
2023	-	36,000	-	-
Total placement Sep 2001 – Apr 2023	**195,405**	**128,961**	**356,261**	**1,297,461**
Total placement Jul 2014 – Apr 2023	**150,712**	**94,435**	**203,563**	**686,667**

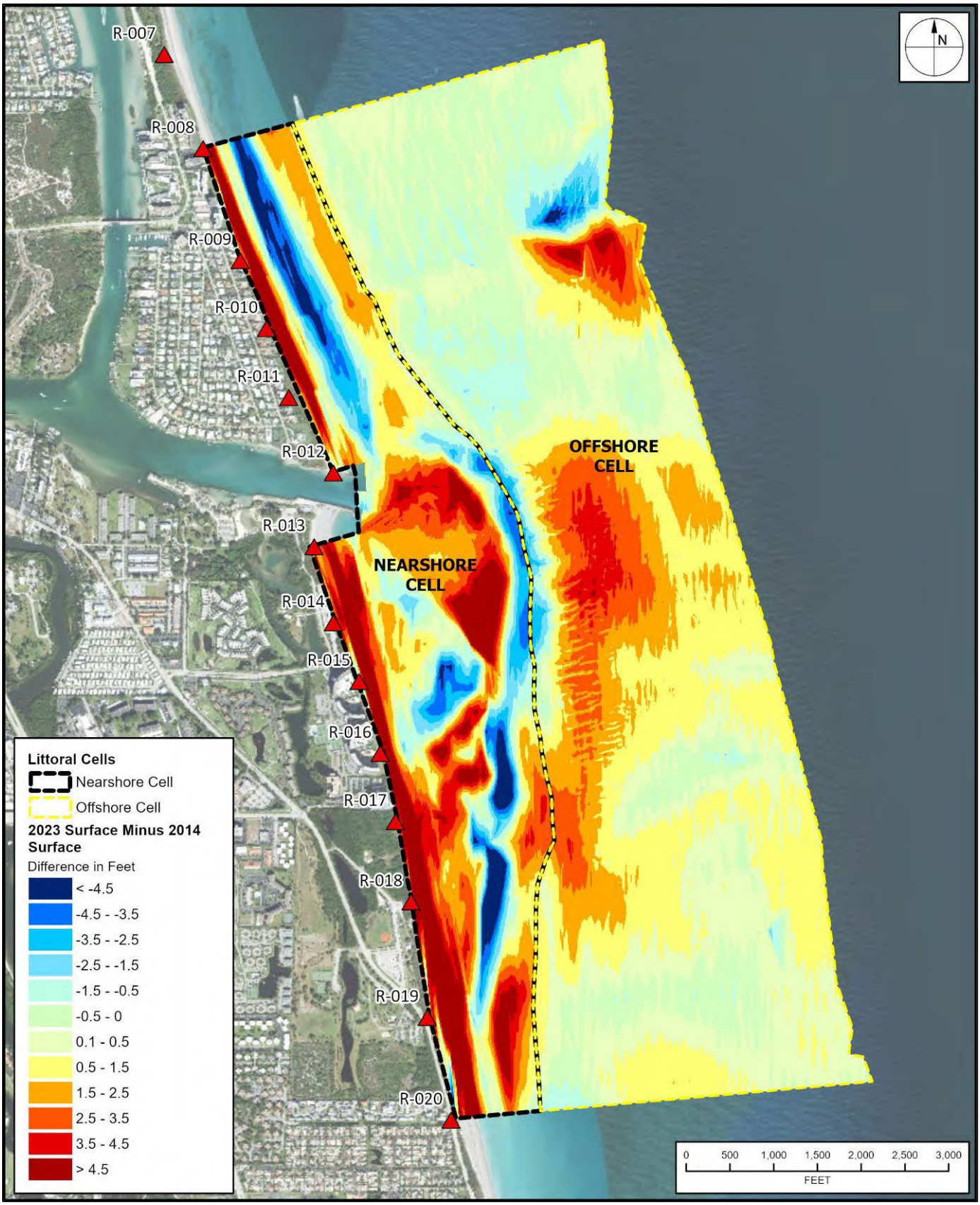

Figure 17. Nearshore/offshore cell elevation difference between 2023 and 2014. Positive and negative values indicate accretion and erosion respectively over the timeframe (JICSB Study, 2024).

Estimation of volume losses and gains across the seaward boundary of each littoral cell reveals that from July 2014 to April 2023, North Beach 1 experienced onshore directed sediment gains of +3.5 cy/ft-yr. North Beach 2 was subjected to severe offshore losses of -13.0 cy/ft-yr. South of the inlet, the downdrift beaches experienced significant offshore losses of -9.2 cy/ft-yr at South Beach 1 and -7.1 cy/ft-yr at South Beach 2. During this time period, the Nearshore cell, including the ebb shoal, gained +4.9 cy/ft-yr from the offshore cell and the offshore cell gained +13.4 cy/ft-yr across the depth of closure. **Figure 18** shows the sediment budget diagrams for Jupiter Inlet for the timeframe July 2014 – April 2023. It is evident that updrift beaches are subjected to sediment deficit. North Beach 1 and North Beach 2 cells have deficits of -18,287 cy/year and -25,557 cy/yr respectively. The littoral cell immediately downdrift of the inlet (South Beach 1) is sustaining significantly higher deficit of -52,604 cy/yr representing significant erosion. However, further downdrift at South Beach 2 cell, the inlet effect diminishes as the beach shows accretional trends. It is also evident that the ebb shoal is gaining volume within the timeframe. Overall, the July 2014 – April 2023 sediment budget found 80,924 cy/yr depositing inside of the inlet, including in the sand trap, ICWW channel, and assuming a quantity of 4,000 cy/yr "lost" to the interior. The study recommended that this quantity of approximately 81,000 cy/yr would provide an updated bypassing objective based on the available data.

In addition to examining offshore losses or gains across the depth of closure, the JICSB Study sediment calculations provided gross and net sediment transport rates entering the Inlet littoral cell. From July 2014 to April 2023, the modelled gross littoral transport rate at the updrift cross-shore profile nearest the inlet (Palm Beach County R-8) is 389, 055 cy/yr and 23% of this quantity (92,623 cy/yr) is entering the inlet. Within the same timeframe, the modelled net southward transport at Palm Beach County R-8 is 265,749 cy/year and 30% of this quantity (80,924 cy/year) is entering the inlet. Interestingly, Mehta et al. (2007) found very similar estimation of 33% entering the inlet using data from 1993 – 1998. The JICSB Study also modelled primary and secondary distribution of sediment transport at Jupiter Inlet. **Figure 19** shows sediment transport at Jupiter Inlet for the timeframe July 2014 – April 2023.

Figure 18. Sediment Budget at Jupiter Inlet, 2014 – 2023 (JICSB Study, 2024).

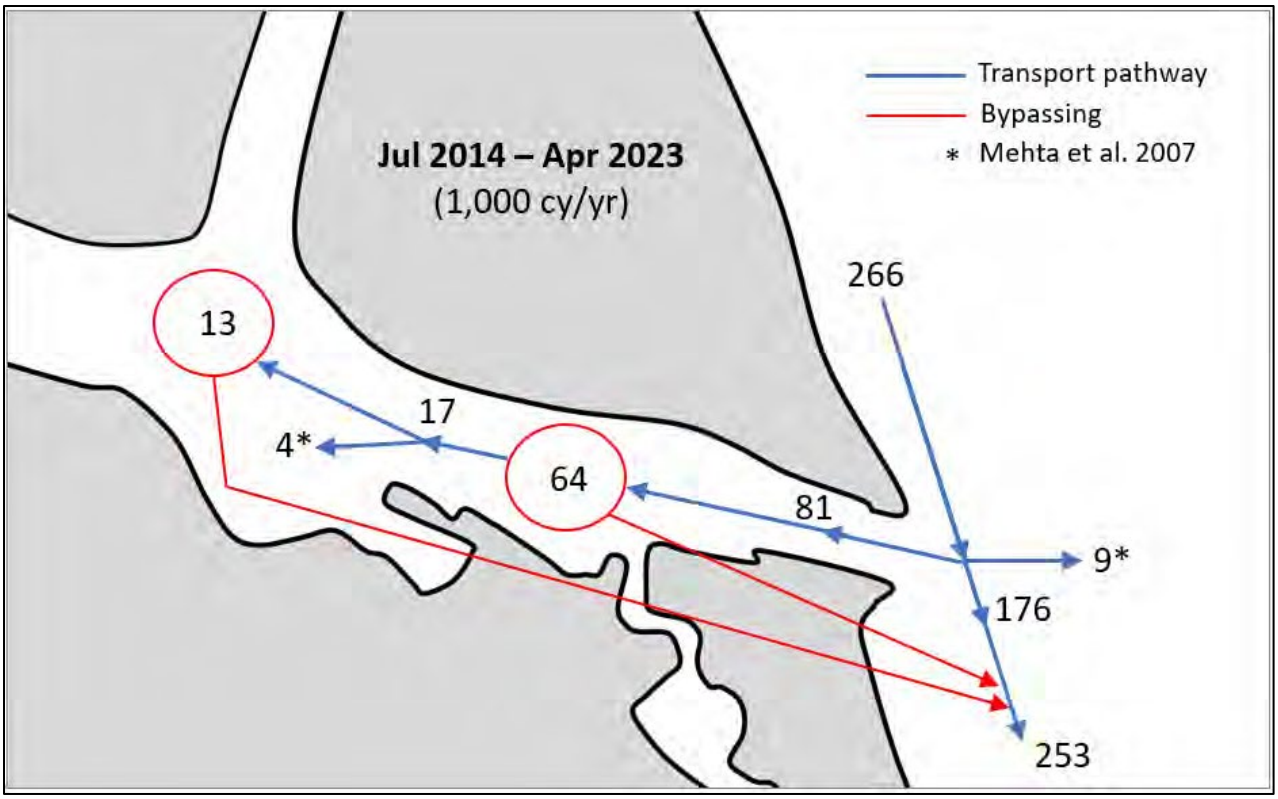

Figure 19. Average annual sediment transport at Jupiter Inlet, 2014 - 2023 (JICSB Study, 2024).

Recommended Inlet Management Plan Strategies

The department staff recommends the following inlet management strategies be adopted to meet the requirements of Chapter 161, F.S.

1) **A comprehensive beach and inlet hydrographic monitoring program shall be conducted** to evaluate the performance and impact of existing sand bypassing and nourishment projects and to periodically update the inlet sediment budget. Beach and nearshore surveys between DEP Range/Reference Monuments R-1 and R-28 shall be collected. Periodic inlet hydrographic surveys should be collected to include the inlet channel, the sand trap, and the ebb and flood shoals in their entirety.

Discussion – A comprehensive beach and inlet hydrographic monitoring program is the most important element to manage the sediment at Jupiter Inlet. Topographic and bathymetric surveys provide reliable data to estimate the volumetric impact of the inlet on adjacent beaches and to establish a sand placement protocol that complies with section 161.142, F.S. The monitoring program considers the integrity and stability of the inlet features including the inlet channel and ebb shoal features.

2) **Sand bypassing shall be performed from the Jupiter Inlet System to the adjacent Atlantic-fronting beaches to the south of the inlet between the south jetty near DEP range/reference survey monuments R-13 and R-19.** The quantity of material to be bypassed shall be based on available navigation channel and sand trap deposition quantities documented through the monitoring protocol of Strategy #1 above and the target bypassing identified in Strategy #3 below.

Discussion –The beach immediately south of Jupiter Inlet is designated as critically eroded beach that is directly impacted by the inlet system. Sediment bypassing to the beaches south of Jupiter Inlet will mitigate the inlet's downdrift impacts.

3) **On an average annual basis, the initial target inlet sand bypassing quantity at Jupiter Inlet shall be 81,000 cubic yards per year to the south. This target quantity may be modified or updated based on a minimum of four years of additional monitoring data indicating a change in the sediment budget.**

Discussion – The updated sediment budget considering data from July 2014 to April 2023 indicates a need to place an annual quantity of 81,000 cubic yards of sand on the eroded beaches south of the inlet to account for the inlet's impact.

4) **The source of sediment for meeting the target bypassing quantities in Strategy #3 shall be the Jupiter Inlet sand trap and adjacent interior channels, or as otherwise authorized by permit. The Jupiter Inlet flood shoal complex may be considered for further geotechnical and engineering design and permitting and implementation to develop an environmentally acceptable project as a potential sand source. Acceptable beach quality sand may also be obtained from upland sand mines or offshore sources to achieve the target sand bypassing quantities.**

Discussion – During the period between July 2014 and April 2023, as described in the updated sediment budget study, the annual average gross and net quantity of sand entering the inlet was 92,623 cy/yr and 80,924 cy/yr respectively. During this time frame, a total of 567,126 cy of sand was dredged from the Jupiter Inlet sand trap and additional 114,810 cy of sand was dredged from the inlet adjacent Intracoastal Waterway (ICWW). These interior maintenance dredging projects obtained beach-compatible sediment from the sand trap and ICWW, providing a viable source of material for placement on the critically eroded downdrift beaches.

5) **The north and south jetties shall be repaired and maintained as necessary to ensure their continued functioning as sediment management components of the Jupiter Inlet.**

Discussion – Since the construction of the north and south jetties, structural modifications and repairs to both jetties have occurred over the years, primarily for minimizing consistent settlement and channel infilling by overtopping. Hurricanes and northeasters are also threats to structural integrity of the jetties. Repairing of the jetties to their pre-damage dimensions is expected to prevent further structural compromise.

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